2022 Final Report

NATIONAL HIGH MAGNETIC FIELD LABORATORY

NationalMagLab.org

1800 E. Paul Dirac Dr.
Tallahassee, FL 32310

2022 Final Report

Produced by

National High Magnetic Field Laboratory

DIRECTOR

Gregory S. Boebinger

DEPUTY DIRECTOR

Eric Palm

CHIEF SCIENTIST

Laura Greene

USER PROGRAM CHIEF OF STAFF

Anke Toth

COPY EDITORS

Carolyn Bradley

FSU Office of Research

NATIONAL HIGH MAGNETIC FIELD LABORATORY

This document is available in alternative formats upon request. Contact Anke Toth for assistance via atoth@magnet.fsu.edu

Table of Content

Director's Executive Summary

2022 brought many people back to the National High Magnetic Field Laboratory (MagLab) for users to conduct in-person research and for students to experience hands-on science education.

The NSF-Funded MagLab User Program

The MagLab continued to serve scientists from across the globe in 2022, advancing society's understanding of new materials, energy solutions, the environment, and the science that underlies life. 1,958 researchers, students and technicians conducted experiments across the lab in 2022 – many returning to in-person experiments for this first time since the COVID-19 shutdown.

The National MagLab's user community continued to expand with new researchers from 326 universities, government labs or companies using the facility to investigate interdisciplinary scientific questions that span the spectrum – from physics to biology, chemistry to engineering. Of the 476 principal investigators in 2022, 21 percent were new to the MagLab user facility that they accessed to conduct their research. About 50% of the lab's 2022 user community were students and postdocs, 34% of whom identified as females and nearly 9% of whom identified as a minority. The geography of innovation around high fields also expanded in 2022 with 152 users from 35 different institutes located in 19 EPSCoR states and 125 users from 26 historically black colleges and universities, high Hispanic serving institutes, and/or women's colleges and universities.

National MagLab users remained exceptionally positive about their experience in 2022. A user survey conducted in June continues to show overwhelming satisfaction:

- 92.8% of external users are satisfied with the performance of the facilities and equipment
- 99.1% of external users are satisfied with the assistance provided by technical staff
- 95.9% of external users are satisfied with the proposal process

Across the National MagLab's seven user facilities, enhancements and upgrades were made in 2022 that improved the user experience and experimental environment. These enhancements included:

- The AMRIS 800MHz wide bore/ 63mm system was upgraded with a 1.3mm HCN probe for fast MAS biosolids.
- A 4.7T MRI scanner at AMRIS was decommissioned after over 30 years of operation to make way for a high field NMR magnet that will be installed in 2023.
- A 2H cryocoil (and related room-temperature coils) are being developed at AMRIS to enable metabolic flux measurements in tandem with proton MRI/S measurements on the 11.1T instrument through funding from a MagLab User Collaboration Grant Program (UCGP) grant.
- A new NEO console was ordered for the AMRIS 750MHz NMR/MRI instrument and will be installed in 2023.
- Chilled water pumps were upgraded in DC Field Facility with new plumbing, electrical feeders, and motor control units to serve the eight new pumps. With this increased number of pumps and optimal plumbing design, the lab has improved the operational resiliency of the magnet cooling water system.
- Following a generous $15M investment from FSU and the State of Florida, MagLab engineers and scientists began a detailed design phase to replace the 12.5kV/4000A switchgear and power factor correction/harmonic suppression circuitry that supplies power to the DC Field Facility and to the entire Tallahassee campus of the MagLab.
- A joint effort between the DC Field Facility and the High B/T Facility is underway to develop and implement cryogenic noise filters in the lab's superconducting fleet. Experimental noise reduction work is also taking place in the DC Field resistive magnet cells with new AC power conditioners.
- After completing the development of a 950GHz /36T EPR setup for use in the Series Connected Hybrid (SCH) magnet, two successful week-long runs using this instrumentation were completed during 2022, clearly demonstrating the potential of this new high-resolution EMR capability.
- Two new EMR magnets were ordered from Oxford Instruments in 2022 that will be installed in 2023.
- The third bay in the Microkelvin Building at UF was cleared and a Bluefors "dry" dilution system, which was specially designed to work with the framework of the existing welded-steel shielded room, was installed.

- High B/T also completed the analysis of clean power infrastructure in 2022 resulting in several options for modern, robust, uninterruptible and clean power.
- Two new NMR probes were commissioned, including a 1.3mm HXY MAS probe for the 36T-SCH and a 3.2mm HXY low-temperature (100K) DNP MAS probe for the 600-DNP. Currently, 1.3 and 1.9mm HXY DNP probes are both being assembled.
- New tuning configurations were added to several NMR probes, including 1H-29Si-6Li and 1H-11B-17O triple resonance (HXY) modes for 3.2mm 800MHz MAS probes; 1H-99Ru HX modes for the 5.0mm 800MHz static probe; and 1H-31P-13C HXY modes for 3.2mm 600MHz MAS probes.
- A new version of the 1.5mm 13C-optimized HTS solution NMR probe was tested. The probe has a higher Q value and 30% better sensitivity than the original version and has since been installed and to the Varian 600 system where it is operating routinely.
- A high sensitivity 13C-optimized probe for 900MHz with an innovative sample cell developed in collaboration with Bruker and U. Georgia was completed and is now operating at U. Georgia.
- The 900MHz NMR console was upgraded with a Bruker NEO console and new state-of-the-art gradient and shim systems providing shimming capabilities for in vivo MRI/S. With multiple channels and transceiver capabilities, this will offer enhanced capabilities in a new super-wide configuration to augment the existing microimaging and SSNMR applications.
- The 60T mid-pulsed magnet was launched at the Pulsed Field Facility for users in 2022 who require many tens of milliseconds at high magnetic fields for their experiments.
- In 2022, a table-top pulsed magnet for the magneto-optic lab was upgraded from 31T to 41T. The magnet was successfully tested and is now available for users.
- A new helium free 14T PPMS was purchased at Pulsed Field Facility with institutional investment from LANL to replace an aging system that was consuming significant amounts of helium. Final installation is expected in 2023, after which it will help support both in-house science and user experiments.
- The entirety of the PVC helium recovery piping at the Pulsed Field Facility (PFF) was replaced with natural gas rated piping that has a joint system designed to reduce leaks. Along with the upgraded piping, check valves were installed to further reduce pressure fluctuations and unnecessary cryogenic boil-off between interconnected systems, as well as additional gas meters to provide necessary information on the recovery rate of the entire PFF.

User Research

More than 350 articles appeared in peer-reviewed scientific and engineering journals, many in significant journals like *Science, Nature, Physical Review Letters, Energy & Fuels, Analytical Chemistry,* and the *Proceedings of the National Academy of Sciences*. A complete database of user publications can be found at https://nationalmaglab.org/research/publications-all/peer-reviewed-publications.

Important discoveries included:

- Using the 45T, MagLab users found direct evidence that the critical point in the phase diagram associated with the onset of the pseudogap phase in HTS materials is also associated with the onset of magnetism.
- Work in the EMR facility showed that vibronic coupling is strongest for vibrational modes that simultaneously distort the first coordination sphere (the atoms that coordinate directly to the ytterbium ion) and break the C3 symmetry of the molecule. With this knowledge, vibrational modes could be identified and engineered to shift their energy towards or away from particular electronic states to alter their impact. Hence, these findings provide new insights towards developing general guidelines for the control of vibronic coupling in molecules.
- Using instruments at the AMRIS facility, researchers analyzed soil samples from 125 global peatland ecosystems with solid-state nuclear magnetic resonance spectroscopy (ssNMR). This research demonstrates an explicit link between the oxygen-alkyl groups (i.e., carbohydrates) in the peat and the amount of CO_2 production, work that could improve existing climate models and better predict the impact of increasing carbon dioxide to wetland ecosystems.
- Work revealed the coexistence of ordinary electrons and novel charge-neutral quasiparticles in the Kondo insulator YbB12. By measuring the Hall effect, magnetic torque and electrical resistivity, researchers were able

to determine that the two fermion fluids exist simultaneously, resulting in a very unusual two fluid state at high fields. A further unusual feature of this state is the charge-neutral quasiparticles behave like electrons in a conventional metal but are unable to conduct electrical charge while the charge carrying electron's properties do not oscillate in magnetic field as is normally the case in metals. This discovery resolved a five-year-long paradox as to how an insulator can exhibit metallic behavior in high magnetic fields and the experimental observations support the idea that this two-fluid system constitutes a new state of matter.

- A MagLab user collaboration finds that it is the changes in glial cell volumes that cause the bright effect in the MRI signal that is observed after a stroke, uncovering the origins of the post-stroke MRI brightness that have been a long-standing and vexatious mystery for scientists. This work suggests these MRI signal changes result from fluid changes in glial cell volumes, results that could advance our ability to distinguish reversible and irreversible stroke events or provide a better understanding for other disorders such as Parkinson's, Alzheimer's, and mood or sleep disorders.
- The first ever NMR spectra from 103Rh and 99Ru nuclei were acquired on the 900MHz (results that will be published in 2023).
- The MagLab's 21 tesla FT-ICR mass spectrometer helped present the primary structures of ~30,000 unique proteoforms, nearly 10 times more than in previous studies, expressed from 1690 human genes across 21 cell types and plasma from human blood and bone marrow. The results, compiled in the Blood Proteoform Atlas (BPA), indicate that proteoforms better describe protein-level biology and are more specific indicators of differentiation than their corresponding proteins, which are more broadly expressed across cell types.
- Theory predicted that the transition between the superconducting and superfluid regimes should be continuous for electrons and holes in solid materials, but high magnetic field experiments at DC Field Facility performed by researchers from Columbia, Harvard and Brown Universities demonstrated the crossover between coupling regimes, both confirming the prior theory, but also establishing magneto-condensates as a model system to study fundamental questions of how electrons pair to form exotic quantum states.
- To meet the growing user demand for calorimetric and thermal transport measurements, particularly on milligram-sized solid samples, scalable thermometers based on quartz tuning fork resonators immersed in liquid 3He have been developed. With the calibration of a single parameter, the miniature thermometer is independent of magnetic field, even at millikelvin temperatures. This advance will facilitate thermal probes for exploring the quantum phenomena of small solid-state samples in the extreme environments accessible in the MagLab HBT Facility.
- A new ^{17}O nuclear magnetic resonance (NMR) technique at 35.2T identified water molecules in different layers of a model membrane for the first time. Typically obscured by the large signals of bulk water, here signals of chemically and dynamically distinct water molecules were identified providing new opportunities to study biologically relevant water molecules in biological systems.
- An optical spectroscopic study performed in pulsed fields focused on the interactions between electrons in the atomically thin semiconductor monolayer WSe2. The origin of an additional exciton that emerges at high electron density – often called the mysterious X-' state – is not well understood despite being known about since 2013. High field results show that the X-' state is actually a multi-particle state that occurs due to the interaction between the exciton and multiple reservoirs of distinguishable electrons; a very different scenario than the usual exciton-one electron reservoir interaction observed at lower electron density in monolayer WSe2 and other atomically-thin semiconductors.
- A collaborative team of chemists, biochemists, and structural biologists were able to attach a polymer to a protein and determine how the polymer can improve the potential to develop the protein into a therapeutic drug. Polyethylene glycol (PEG), a commonly used polymer was found to improve the stability of a protein to make it more useful as a potential therapeutic for treating cancers and inflammatory diseases. Using NMR, researchers determined a molecular model of a protein-polymer conjugate, providing new insights into how polymers can be used to make protein drugs more robust.
- In a collaboration between the NMR and EMR divisions, the first major report of 13C-enhanced Overhauser DNP NMR was made, in which J-coupling based INEPT experiments were used to obtain indirectly detected solution 1H NMR spectra with significant signal enhancements.

- Using the world's most powerful mass spectrometer, scientists have developed a new method to profile complex mixtures of the PFAS "forever" chemicals at the molecular level, facilitating future PFAS characterization in support of environmental and human health studies.
- Users investigated the nonreciprocal directional dichroism – often referred to as "one-way transparency" – in the magnetic material Ni3TeO6 using optical spectroscopy techniques in fields up to 60T, finding that one-way transparency was supported in a number of different measurements geometries, and more importantly that it persisted across the entire range of telecommunications wavelengths - findings that not only open the door to possible application for high-efficiency optical diodes, but to photonics applications as well – particularly in the area of secure fiber optic telecommunications.
- A study featured the use of 23Na and 1H MRI to monitor recovery from ischemic stroke (in rodent models) following treatment with human mesenchymal stem cell aggregates.
- Data users from Harvard and the University of Zurich accessed FAIR data from the Protein Data Bank generated by the MagLab's NMR Facility to model an RNA-binding protein in mammals dating back 160 million years and to explore how evolution and natural selection have influenced the structure of the protein. Their work suggests new strategies for improving our understanding of this protein, which could lead to improved therapies for neurodegenerative diseases like ALS.

More 2022 science highlights can be found online at https://nationalmaglab.org/research/science-highlights/?type=year&value=2022 as well as information on our in-house research efforts in condensed matter physics, cryogenics, geochemistry and biology/chemistry.

Magnet-Making Milestones

In 2022, MagLab engineers and technicians were recognized with a 2022 R&D 100 Award for the design and construction of the 32T all-superconducting magnet. The R&D 100 recognizes revolutionary ideas in science and technology, and the 32T magnet is the world's most powerful all-superconducting magnet and the first user magnet to leverage high temperature superconducting materials. This magnet now serves a worldwide community of scientists.

The MagLab continues to advance work on the preliminary and final designs of a new all superconducting 40T magnet system (NSF Mid-Scale Award number: NSF/DMR 2131790). The 40T magnet will feature a cold bore size of 34mm and will provide inhomogeneity less than 500 parts per million over a 10mm diameter spherical volume and a very low noise environment for experiments lasting days at a time, surpassing the time available from present-day powered (resistive and hybrid) magnets. Work toward the 40T in 2022 focused on mid-scale (up to 1.2km of conductor) and larger scale test coils (up to 4.6km of conductor). Two mid-scale test coils were fabricated and tested this year to probe parallel winding, quench protection, terminal design, the use of multiple grades of REBCO conductor, high operating current and high copper current density during quench. A major milestone of the 40T project was to select the insulation technology by the end of 2022 and after testing, multi-tape insulation-REBCO was chosen.

The development of capacitor-driven magnets has continued at the lab's Pulsed Field Facility in 2022. The successful 75T duplex magnet has provided more than 600 pulses to date and, in 2022, the design and construction of an 85T duplex has been completed. Due to user demand on the 75T duplex magnet, a new power transmission line will be built for the 85T to allow uninterrupted operation of the 75T while the 85T is being commissioned. The additional power infrastructure work has delayed the 85T duplex magnet testing schedule to 2023. While these duplex magnets are being finalized, work also continues to rebuild and improve the design of the 60T long pulse and 100T coils to be ready to serve users when the generator comes back online.

A special braiding machine was purchased and commissioned this year at Applied Superconductivity Center (ASC) thanks to institutional funds from FSU. This machine braids fiber around a conductor, essentially providing insulation and will enable the exploration of different materials for insulators and application procedures. Several braiding and wrapping tests have already been successfully carried out in preparation for use and further evaluation in test coils. We anticipate that it will be a critical tool to address the chemical compatibility issues that currently persist in the Bi-

2212 conductor along with a new, larger Over Pressure Heat Treatment furnace that is going through its final tests now.

Additionally, in-house work to support resistive magnet operations was performed in 2022, including the fabrication and assembly of nine resistive spare coils in addition to over a dozen maintenance actions (coil tightening, replacement or other major scheduled tasks) in the resistive magnet cells. These spare coil quantities represent 100 percent typical counts and back to “normal” maintenance volume from pre-COVID levels. The SCH magnet had its first inner coil replacement in October 2022 after more than 4,240 hours of operation. In 2022, we also explored the possibility of replacing some machining with 3D printing, using a special composite consisting of a strengthening component and a thermo-plastic matrix.

Beyond these in-house magnet projects, other magnet development work includes collaborations:

- In 2022, ASC tested a magnet design in which a CORC® cable was wound into grooved metal mandrels with insulation but with no epoxy or other filler. The coil was developed by in collaboration with the Princeton Plasma Physics Laboratory (PPPL) as a potential route to manufacture high-field Ohmic Heating coils for compact fusion reactors. The results demonstrate the feasibility of operating dry-wound CORC® cable magnets in which cable movement is allowed, which significantly facilitates manufacturing of high-field coils that operate at high current densities and high current ramp rates.
- The development of compact 25T, all superconducting, general science magnets, a project currently being worked on with Cryomagnetics Inc. and Oxford Instruments (OI). The final magnet system will consist of a 17T low temperature superconducting (LTS) outsert with an 8T Bi-2212 coil nested inside. While the Cryomagnetics project envisions the HTS insert to be powered separately from the LTS outsert, the OI project envisions the insert to be powered in series thus requiring a specific (smaller) conductor Bi-2212 diameter.
- In 2022, ASC researchers resubmitted a proposal to the National Institute of Health for a 28T magnet system. If funded, this work will be carried out in collaboration with OI, leveraging a 12T LTS magnet made by OI as an “outsert” with an HTS insert consisting of two inner coils made with Bi-2212 conductor nested inside a layer-wound coil made with Bi-2223. Models predict a field homogeneity within the target range of 1ppm which would be a significant step toward a nuclear magnetic resonance magnet at 1.1GHz and above.
- Continued efforts on Rutherford type cabled Bi-2212 round wire for high field solenoids and accelerator magnets were made this year. A MagLab-built Bi-2212 Rutherford-cable-based solenoid was tested in field and analyzed postmortem in 2022. More Rutherford cable coils will be made in 2023, particularly addressing the specifics of the TiO2 coating of cable either by establishing a dedicated coating route or by switching to a different braiding material that may eliminate the need for a TiO2 layer.
- Two medium size (containing ~200m of conductor) superconducting coils, Pup-10 and Cryo-4, have been made this year, tested in field, and a postmortem has been carried out on Pup-10.
- Project leaders for multi-billion-dollar science facilities, CEOs of companies, technology developers from aerospace, fusion, and medical sectors, raw materials suppliers, university faculty, and national laboratory program heads (including representatives from the MagLab) met in March 2022 to analyze challenges and propose solutions for the advanced superconductors supply chain. The meeting identified key elements of public-private partnerships that underpin business models for manufacturing advanced superconductors for magnet technology.

Broadening Participation & Expanding the STEM Pipeline

Work to broaden participation in and appreciation of STEM continued in 2022 at the MagLab. At the K-12 level, classroom outreach was provided in person and virtually to more than 1,700 students during the 2021-2022 school year, 72% of which were with Title I schools. Requests for virtual outreach in 2021-2022 came from seven states: Florida, Alaska, Georgia, Maryland, New York, North Carolina, and Virginia. Another 340 students came to the MagLab for an educational fieldtrip. In 2022, the Middle School Mentorship program hosted 14 students from middle schools in Leon County for a semester-long research project. Summer Camps returned in-person reaching 45 middle-school aged students, including four who participated in a special session of SciGirls Coding Camp held in partnership with Florida Agricultural and Mechanical University (FAMU) Developmental Research School. The MagLab also launched the inaugural Godby Science Scholars program, a 3-week STEM enrichment program in partnership with Godby High School, a local Title I school. Six students participated and after completion, 100% said they were interested in pursuing a career in materials science and that participation in the program increased their interest in studying materials science in college. A yearlong High School Externship program focused on students with a career interest in STEM and paired five Tallahassee high schoolers with a mentor at the MagLab to work on a STEM project virtually. After completion, 100% of externship students said they think they will pursue a career in a STEM field. In-person Science Nights events for K-12 students also resumed in 2022 and reached 145 people at the main public library and, for the first time, at a branch library in a zip code in which about 17% of the families live below the poverty line.

The summer RET program involved fourteen educators from seven states and continued to be held virtually in 2022. More than 90% of this year's participants taught in Title I schools or worked with programs that served predominately low-income youth and about 30% worked with elementary students, 20% with middle school students, and 29% with high school students (the remaining 21% worked with more than one age range). Educators learned to incorporate culturally responsive teaching strategies into their STEM lessons and developed a sample lesson for the lab.

The MagLab hosted its inaugural class of 14 undergraduate Magnetic Momentum Scholars for a 6-week program in partnership with FAMU in Spring 2022. Designed to expose a diverse student population to STEM careers at the MagLab, all participants indicated that they learned new skills that will help them to be successful in their future career path. The 2022 Research Experiences for Undergraduates program returned to a completely in-person experience for 25 students - 16% of whom came from Minority Serving Institutions or community colleges and all with majors that align with the lab's scientific disciplines - 52% physical science, 36% engineering, and 12% life sciences. A formal mentoring program - The MagLab Research Mentor Incubator (MRMI) - was piloted in 2022. Designed to give graduate students, postdocs, and faculty resources and structure to grow professionally, this program is built around the mentorship education curriculum developed by the Center for the Improvement of Mentored Experiences in Research (CIMER). The MRMI supported 5 graduate students, 3 postdocs, and 5 faculty members in a 9-week program featuring seven one-hour workshops that helped participants develop an individual mentoring philosophy statement.

In 2022, MagLab staff gave 168 lectures, talks and presentations to organizations around the country and the world both virtually and in-person. In addition, five science workshops/conferences were hosted by the lab in 2022 reaching more than 400 people, including the Theory Winter School in which more than 200 attendees focused on the topic of Non-equilibrium Quantum Matter. The MagLab Summer School resumed as a face-to-face educational experience for early career scientists to learn lab skills and techniques relevant to high magnetic field research. The Summer School was kept small in 2022, with only 11 students participating, in order to run the hands-on lab practicals that are at the core of the curriculum while implementing COVID precautions. Other events included a series of lunch & learn sessions held with the Tallahassee Senior Center, a Science & Words event featuring science-inspired literary readings and a MagLab Masterpieces science and art event for hundreds of attendees of all ages.

Securing a Healthy, Safe & Inclusive Lab Environment

The MagLab continued to work in partnership with its host institutions to protect users, employees, visitors, and the community throughout 2022. As COVID-specific precautions phased out, other strategic safety investments were made including $187,000 for safety-related equipment, supplies, security, training, and processes. Some of the key investments included personal protective equipment, equipment used to lockout/tagout and verify safe isolation of hazardous energy sources, security enhancements, monitoring devices, and COVID-related supplies. Safety highlights from 2022 included:

- A security audit was conducted by Florida State University Police Department. Specific recommendations were made to increase the safety and security of the MagLab and a work plan has been created as the recommendations continue to be implemented.

User safety also continues to remain a priority. Before coming to the lab, users are assigned online training specific to the experiment they are conducting and the hazards associated with each facility. When they arrive on-site, they receive additional hands-on training as needed and work with on-site user support staff to complete their experiments safely. In 2022, 95% of external users were satisfied or very satisfied with the lab's user training and safety procedures and 99% were satisfied or very satisfied with overall safety at the MagLab.

The Diversity Committee continued to support the work of early career scientists by reaching out to underrepresented and underserved populations in STEM, by using best practices in our hiring strategies to increase the representation of underrepresented minority groups at the lab and in the STEM workforce, and through a commitment to a climate that ensures all employees feel they have equal opportunities to career development. A draft set of new bylaws has been developed to provide more structure to the committee and will be presented for discussion, amendment, and adoption in 2023.

Looking Ahead

In December 2022, NSF announced a $195.5 million renewal grant, funding the MagLab through 2027. With a new grant period beginning in 2023, the lab remains dedicated to advancing high magnetic field research and technology.

After a successful R&D, conceptual design and now preliminary design phase, the lab expects to begin a Final Design stage for the 40T all superconducting magnet in 2023. Working with Multi Tape Insulation REBCO, this phase will feature large scale test coils in final preparation for development of a 40T magnet construction proposal to the MS-RI program in 2025. The 85T duplex magnet testing will take place in 2023 after upgrades to the power delivery system and development of the necessary control and protection infrastructure. The supporting structures and G10 blast box for this new duplex magnet are also complete, readying the entire system for commissioning once the necessary power infrastructure work is complete.

Facility and power upgrades are also planned for 2023. New variable speed drives for the magnet cooling water pumps will be installed in the DC Field Facility. When completed later in 2023, this will bring the number of magnet cooling water pumps to six, giving us a balanced capability of one 590kW + two 370kW pumps on each cooling loop. After being analyzed this past year, High B/T plans to address their facility's power infrastructure needs in 2023 with a robust, uninterruptible, and clean solution. The Pulsed Field Facility anticipates rolling out changes to their mezzanine platforms featuring a standardized configuration in 2023. This uniform set up for each user cell will enable standardized instrumentation, data acquisition, and helium management in each of the four cells, thereby facilitating quick and easy transitions between cells should an experiment have to be moved. The Pulsed Field Facility is also exploring the possibility of replacing one of the four 65T magnets with the new 75T duplex magnet in 2023 so that the 75T duplex and 60T mid-pulsed magnets could have their own cells and operate independently.

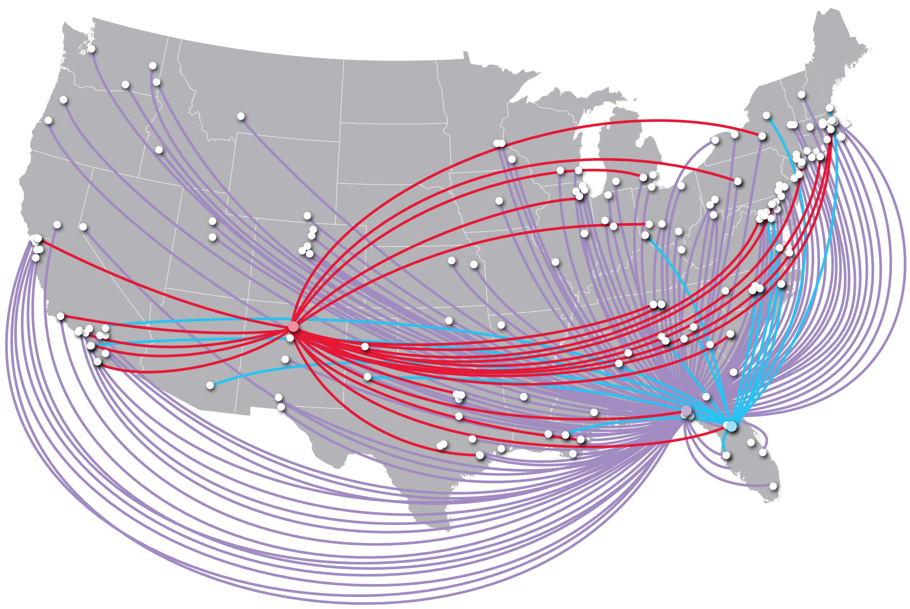
Leveraging the impact of high magnetic fields across the scientific disciplines, new proposals for expansion are also underway for 2023. The NMR Facility plans to pursue grants to the NIH RM1 to support biomedical NMR applications and awaits word on an NSF MidScale R-1 preproposal for a National Facility for High Field Dynamic Nuclear Polarization NMR, which would feature the world's first open access 18.8T/800MHz DNP NMR platform. Discussions with five other universities across the U.S. on forming a national network of ultra-high field NMR instruments will continue into 2023.

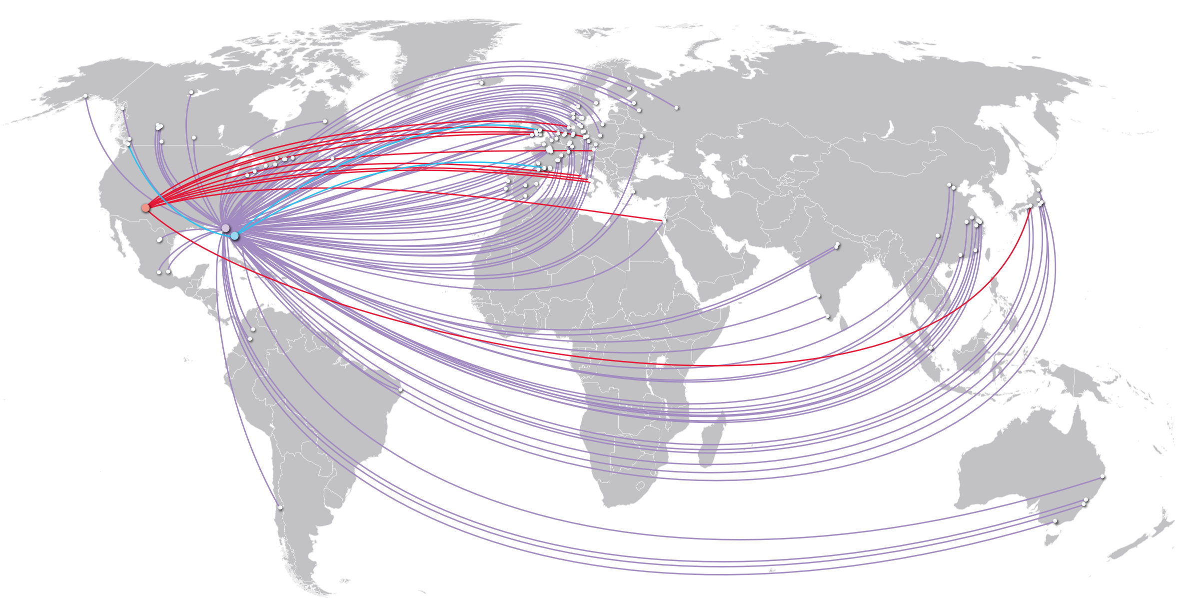
New instrumentation and training are planned for 2023 that will expand the lab's scientific capabilities. EMR plans to acquire a state-of-the-art commercial X-/Q-band pulsed EPR spectrometer with ENDOR and optical excitation capabilities. ICR will expand their MALDI imaging sampling and acquisition capabilities, Liquid Chromatography FT-ICR Mass Spectrometry for complex organic mixtures, and upgrade of the front-end of the 21T ICR magnet system. AMRIS plans new conventional and HTS NMR cryoprobes and Low-E MAS probes for their 11.1T MRI/S scanner, an 800 MHz NMR magnet, and the state-of-the-art Bruker NEO console that will soon be operational. A new NEO console and amplifiers will also be upgraded on the AMRIS 750MHz in 2023, making it compatible with other AMRIS MRI/S systems and the 900MHz system in Tallahassee. This upgrade will provide users with state-of-the-art MRI/S instrumentation at four different field strengths—7, 11.1, 17.6, and 21.1T, allowing users facile field-dependent studies. An NMR school for senior undergraduates and junior graduate students and 36T-Series Connected Hybrid workshop are being planned for late 2023. The NMR/MRI User Program plans to convert an 800MHz NMR spectrometer to a dedicated SSNMR spectrometer for 1H-indirect detection experiments on biosolids and develop DNP NMR methods at 30+ T. A 1H/19F/X fast MAS probe and low-temperature static H(F)X probe will be designed or purchased for experiments at 18.8T, which will make the MagLab's collection of 800MHz spectrometers one of the most versatile collections in the world.

SCIENCE KNOWS NO BOUNDARIES

Seeking the most powerful magnetic fields on Earth, scientists and engineers from around the world conduct their experiments at the National MagLab. In 2022, our **1,958** users represented **327** universities, government labs and private companies worldwide.

75% UNIVERSITIES **18%** GOVERNMENT LABS **8%** INDUSTRY





16

2022 LAB STATS

USERS:

1,958

PERCENTAGE OF USERS WHO WERE NEW:

25%

ARTICLES PUBLISHED IN PEER-REVIEWED JOURNALS:

352

TALKS, LECTURES AND PRESENTATIONS GIVEN TO ORGANIZATIONS AROUND THE COUNTRY & WORLD:

168

MAGLAB WORLD RECORDS:

17

PERCENTAGE OF TALKS GIVEN VIRTUALLY:

87%

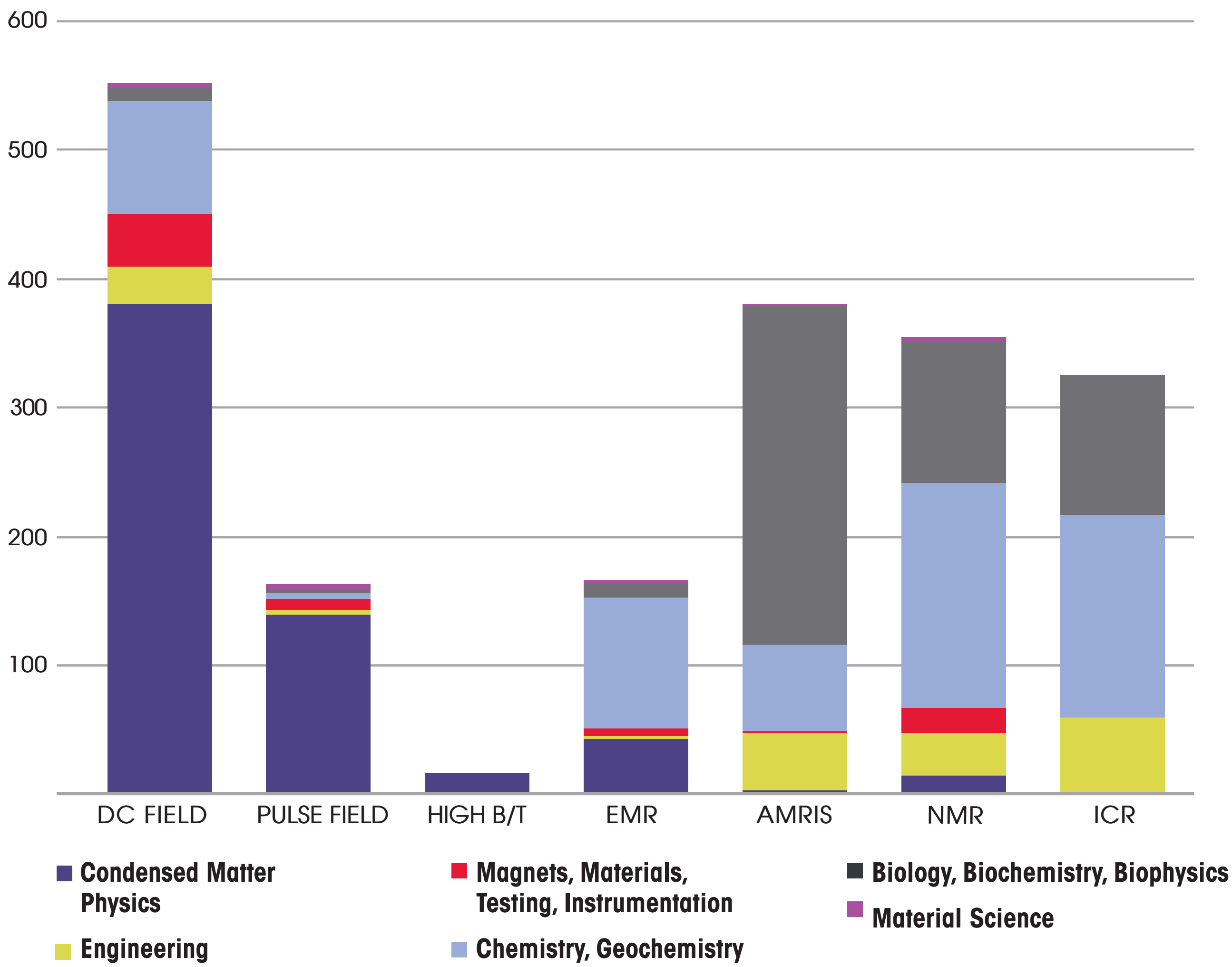
17

WHO OUR USERS ARE

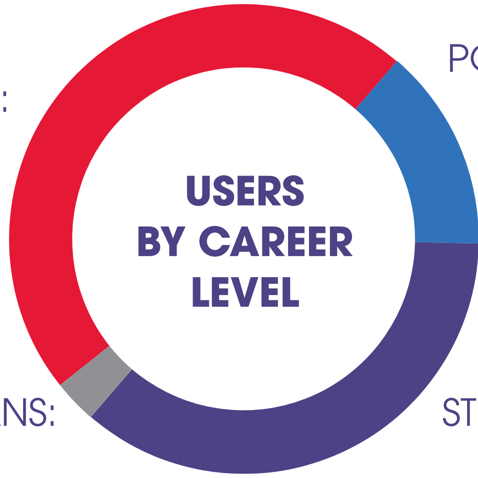
High magnetic fields are a powerful research tool across many disciplines leading to groundbreaking discoveries that impact your life. The lab comprises 7 distinct user facilities that offer our researchers a wide range of research capabilities:

- **DC Field**
  Steady, continuous magnetic fields up to 45 T
- **Pulsed Field**
  Short, ultra-powerful magnetic fields up to 100 T
- **High B/T**
  Magnetic fields up to 15 T combined with ultra-cold temperatures of 0.4 mK
- **Electron Magnetic Resonance (EMR)**
  Magnetic resonance techniques associated with the electron
- **Nuclear Magnetic Resonance (NMR)**
  Solid & solution state NMR & animal imaging
- **Advanced Magnetic Resonance Imaging & Spectroscopy (AMRIS)**
  High-resolution solution and solid-state, NMR, animal imaging & human imaging
- **Ion Cyclotron Resonance (ICR)**
  Ultra-high resolution and high mass accuracy Fourier transform ion cyclotron resonance (FT-ICR) mass spectrometry

2022 USERS BY DISCIPLINE



34% OF STUDENT USERS ARE FEMALE. & **34%** OF POSTDOC USERS ARE FEMALE.



USERS BY FACILITY

- DC FIELD - **554**
- PULSED FIELD - **163**
- HIGH B/T - **16**
- EMR - **165**
- NMR - **354**
- AMRIS - **380**
- ICR - **326**

Advancing research by expanding accessibility:

147 users from 34 different institutes located in 18 EPSCoR states

125 users from 26 historically black colleges and universities, high Hispanic serving institutes, and/or women's colleges and universities.

WHAT OUR USERS SAY

96% of users were satisfied with performance of the facilities and equipment.

99% of users were satisfied with the assistance provided by MagLab technical staff.

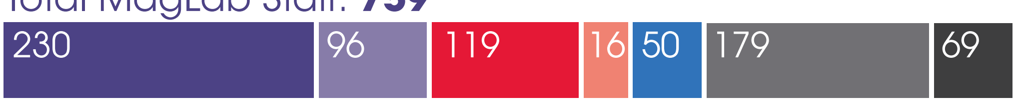
96% of users were satisfied with the proposal process.

Data reflects external users only.

MAGLAB STAFF

The MagLab employs a diverse workforce that includes scientists, machinists, engineers, administrators, writers and even artists.

Total MagLab Staff: **759**



- Senior Personnel: **230**
- Other Professional: **96**
- Support Staff - Technical: **119**
- Support Staff - Secretarial: **16**
- Postdoctoral: **50**
- Graduate Student: **179**
- Undergraduate Student: **69**

38% of MagLab students are female.

19

SPARKING CURIOSITY

Whether in a traditional classroom setting or on our website, within the walls of our lab or in universities around the globe, the National MagLab is committed to sharing our passion for science. We are growing the next generation of scientists and inspiring all individuals about the magic of discovery in high magnetic fields.

2,000+

K-12 students participated in Classroom Outreach or a field trip. **72%** of the students reached are from Title I schools.

90

scientists & staff reported conducting outreach to the community. Together, these scientists reached **5,200+** people

1.38 MILLION+

website **pageviews**

50+

Students in long-term mentorship or camp programs

35 THOUSAND+

hours of MagLab video content watched on YouTube.

20

1. Laboratory Management

1.1 Organization

The Florida State University (FSU), the University of Florida (UF) and Los Alamos National Laboratory (LANL) jointly operate the National High Magnetic Field Laboratory (NHMFL or MagLab) for the National Science Foundation (NSF) under a cooperative agreement that establishes the MagLab's goals and objectives. As the signatory of the agreement, FSU is responsible for establishing and maintaining administrative and financial oversight of the MagLab and ensuring that the operations are in line with the objectives outlined in the cooperative agreement.

The structure of the MagLab is shown in the three figures below. **Figure 1** illustrates the external oversight and advisory committees, as well as the three internal committees that provide guidance to MagLab leadership.

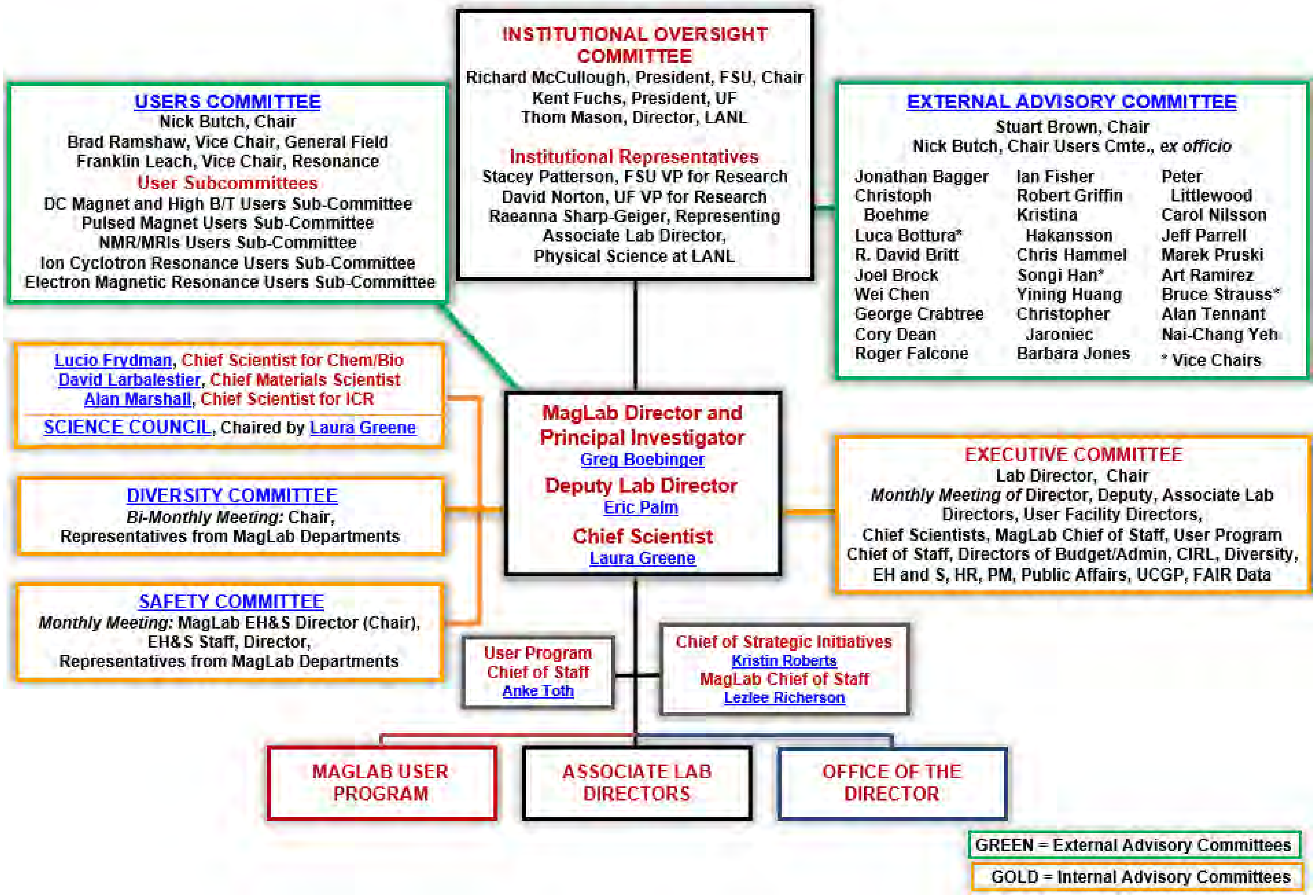


Figure 1. *Advisory Committees of the MagLab, showing internal and external advisory committees (as of December 2022).*

Greg Boebinger is the Director of the MagLab and PI of the cooperative agreement. Together, the Director, Deputy Laboratory Director, **Eric Palm,** and Chief Scientist, **Laura Greene**, function as a team to provide management oversight. **Lab Leadership** — consists of the MagLab Director, Deputy Lab Director, Chief Scientists, Associate Lab Directors and MagLab Facility Directors. Kristin Roberts has been promoted to the newly created Chief of Strategic Initiative position. She functions as a developer of and advocate at the MagLab for high-level strategic planning at the MagLab, including the MagLab's broader strategic vision for industrial partnerships and increased economic impact. Lezlee Richerson also has been promoted to the newly created MagLab Chief of Staff position in which she is the primary point-of-contact and council for the Director, providing operational management and administrative direction in support of the MagLab's leadership team. Ross McDonald became the new Director of the MagLab's

Pulsed Field Facility in Los Alamos replacing Michael Rabin. Laurel Winter has been promoted to Deputy for the MagLab's Pulsed Field Facility replacing Ross McDonald.

The **Executive Committee** meets monthly to discuss Lab-wide as well as program–specific issues. The Lab's scientific direction is overseen by the **Science Council**, a multidisciplinary "think tank" group of distinguished faculties from all three sites. Two external committees meet regularly to provide critical advice on important issues. The **External Advisory Committee**, made up of representatives from academia, government, and industry, offers advice on matters critical to the successful management of the Lab. The **User Committee**, which reflects the broad range of scientists who conduct research at the Lab, provides guidance on the development and use of facilities and services in support of the work of those scientists. These committees are further described below.

Figure 2 shows the structure of the user program with its seven user facilities – DC Field Facility, Pulsed Field Facility, High B/T Facility, Electron Magnetic Resonance Facility, Nuclear Magnetic Resonance and Magnetic Resonance Imaging at both FSU and UF, and Ion Cyclotron Resonance.

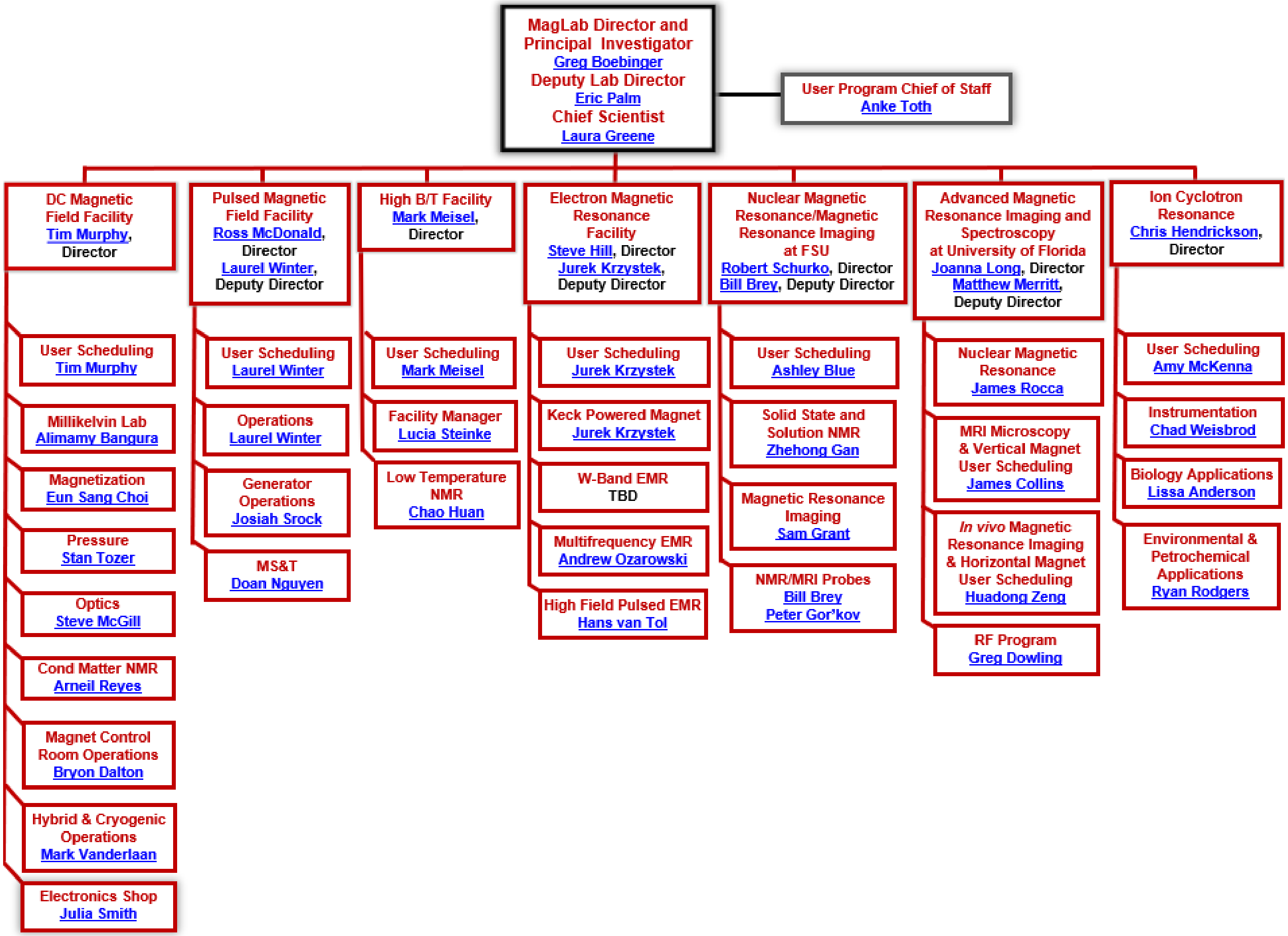


Figure 2. *MagLab User Program (as of December 2022)*

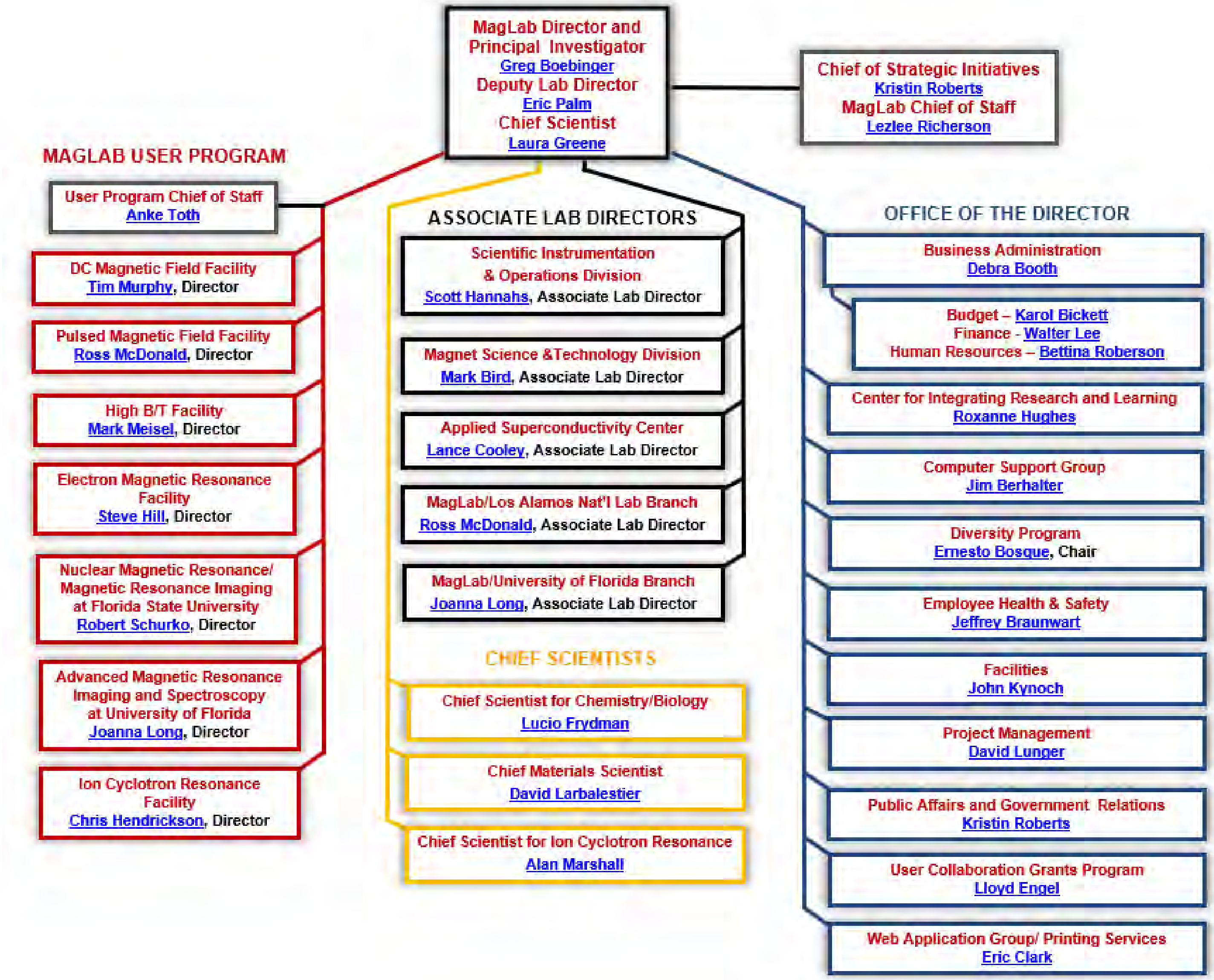


Figure 3. *MagLab Organizational Chart (as of December 2022)*

Figure 3 displays the internal operational organization of the MagLab with its seven user facilities, all Associate Lab Directors, Chief Scientists and the Office of the Director.

1.2 External Advisory Committee

The External Advisory Committee (EAC) is made up of representatives from academia, government and industry. This committee offers advice on matters critical to the successful management of the lab.

External Advisory Committee Chair

- Stuart Brown—UC-Los Angeles (Chair)

User Committee Chair (ex officio member of EAC)

- Nick Butch— NIST Center for Neutron Research

Biology and Chemistry Subcommittee

- R. David Britt—UC-Davis
- Wei Chen—University of Minnesota
- Robert Griffin—MIT
- Kristina Hakansson—University of Michigan
- Songi Han—UC-Santa Barbara (Vice Chair)

- Yining Huang—Western University
- Christopher Jaroniec—Ohio State University
- Carol Nilsson—Swedish National Infrastructure for Biological Mass Spectrometry
- Marek Pruski—Ames Lab

Condensed Matter Subcommittee

- Christoph Boehme—University of Utah
- Cory Dean—City College of New York
- Ian Fisher—Stanford University
- Chris Hammel—The Ohio State University
- Barbara A. Jones—IBM Almaden Research Center
- Art Ramirez—UC-Santa Cruz
- Nai-Chang Yeh—California Institute of Technology

Magnet Technology and Materials Subcommittee

- Luca Bottura—Magnets, Superconductors and Cryostats (Vice Chair)
- Jeff Parrell—Bruker OST LLC

Science Management

- Jonathan Bagger—American Physical Society
- Joel Brock—Cornell University
- George Crabtree—Argonne National Laboratory
- Roger Falcone—University of California, Berkeley
- Peter Littlewood—University of Chicago
- Bruce P. Strauss—U.S. Department of Energy (Vice Chair)
- Alan Tennant—University of Tennessee Knoxville

1.3 User Committee

The MagLab's User Committee represents the MagLab's broad, multidisciplinary user community and advises the Lab's leadership on all issues affecting users of our facilities. The User Committee is elected from the user base of the MagLab, and each facility has a subcommittee elected by its users to represent their interests. DC Field and High B/T facilities have a single, combined subcommittee representing the two user facilities. Likewise, the NMR facilities at UF and FSU have a single, combined subcommittee. Pulsed Field, ICR and EMR facilities have their individual subcommittees. Each subcommittee then elects members to represent it on the User Executive Committee. This User Executive Committee elects a chair and two vice chairs. The DC Field/High B/T Advisory Committee, the Pulsed Field Advisory Subcommittee, the EMR Advisory Subcommittee, the NMR/MRI Advisory Committee and the representative from the ICR Advisory Committee met in Los Alamos, NM from October 11th to 13th, 2022, to discuss the state of the MagLab and provide feedback to the NSF and MagLab management. The 2022 User Advisory Committee Report has been made available on our **website**.

Besides the fall annual meeting, MagLab leadership also met with the User Committee via Zoom on April 20th, 2022, to update the committee on a number of issues of importance to the MagLab, generally focused on the funding we anticipate receiving through 2027.

DC Field/High B/T Advisory Subcommittee

- Nat Fortune—Smith College
- Jia (Leo) Li—Brown University
- Johannes Pollanen—Michigan State University
- Sufei Shi—Rensselaer Polytechnic Institute
- Raivo Stern—National Institute of Chemical Physics & Biophysics
- Fazel Tafti—Boston College
- Jairo Velasco—University of California, Santa Cruz*
- Sanfeng Wu—Princeton University
- Matt Yankowitz—University of Washington*

EMR Advisory Sub-committee

- Rodolphe Clerac—Centre de Recherche Paul Pascal
- Carole Duboc—Université Grenoble Alpes
- Sandrine Heutz—Imperial College London
- Troy Stich—Wake Forest University*
- Joshua Telser—Roosevelt University
- Joseph Zadrozny—Colorado State University

ICR Advisory Sub-committee

- Nathalie Agar—Harvard University
- Facundo Fernández—Georgia Institute of Technology
- Franklin Leach—University of Georgia*
- Patricia Medeiros—University of Georgia
- Mike Senko—Thermo Fisher Scientific
- Paul Thomas—AbbVie, Inc.

NMR/MRI Advisory Subcommittee

- Christian Bonhomme—Laboratoire de Chimie de la Matière Condensée de Paris
- Galia Debelouchina—University of California San Diego
- Brian Hansen—Aarhus University
- Shella Keilholz—Emory University/Georgia Tech*
- Danielle Laurencin—CNRS
- Anant Paravastu—Georgia Tech
- Aaron Rossini—Iowa State University (Vice Chair) *
- Sonia Waiczies—Max Delbrück Center for Molecular Medicine in the Helmholtz Association
- Tuo Wang—Louisiana State University

Pulsed Field Advisory Subcommittee

- Nicholas P. Butch—University of Maryland (Chair)*
- Joseph G. Checkelsky—Massachusetts Institute of Technology
- Paul Goddard—University of Warwick
- Minhyea Lee—University of Colorado Boulder
- Lu Li—University of Michigan
- Brad Ramshaw—Cornell University (Vice Chair) *

*Note: * Are members of the User Executive Committee*

1.4 Personnel

As of January 3, 2023, the MagLab employs **759** individuals across its three sites. These personnel are funded by the NSF core grant, State of Florida funding, and individual investigator awards, as well as a variety of home institutions and other sources. A list of MagLab personnel by department is presented in **Appendix I**.

Principal Investigators

- Gregory Boebinger (PI)—Director/Professor
- Joanna Long (Co-PI)—Program Director, AMRIS, UF
- Alan Marshall (Co-PI)—Chief Scientist for Ion Cyclotron Resonance
- Eric Palm (Co-PI)—Deputy Lab Director
- Ross McDonald (Co-PI)—Program Director, LANL

User Facility Directors

- Advanced Magnetic Resonance Imaging and Spectroscopy Facility (UF) —Joanna Long
- DC Field Facility (FSU)—Tim Murphy
- Electron Magnetic Resonance Facility (FSU)— Stephen Hill
- High B/T Facility (UF)—Mark Meisel
- Ion Cyclotron Resonance Facility (FSU)—Chris Hendrickson
- Nuclear Magnetic Resonance (FSU)—Robert Schurko
- Pulsed Field Facility (LANL)—Ross McDonald

Of our **759** employees, senior personnel represent the largest group at 30%, followed by graduate students at 24%, technical support staff at 16%, undergraduate students at 9%, post docs at 7% and administrative support staff at 2%; all other professionals encompass 13%. The total distribution appears in **Figure 1.**

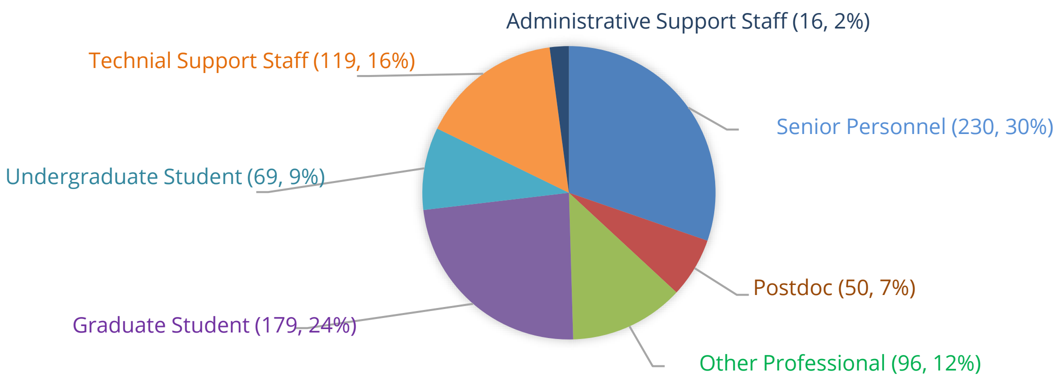


Figure 1. *MagLab Position Distribution (as of January 3, 2023).*

Overall distribution of diversity for all three sites of the MagLab includes: 48% white males, 21% Asian males and females, 16% white females, 7% black or African American males and females and 0.4% American Indian or Alaska Native males and females. The distribution by diversity appears in **Figures 2 and 3** on the following page.

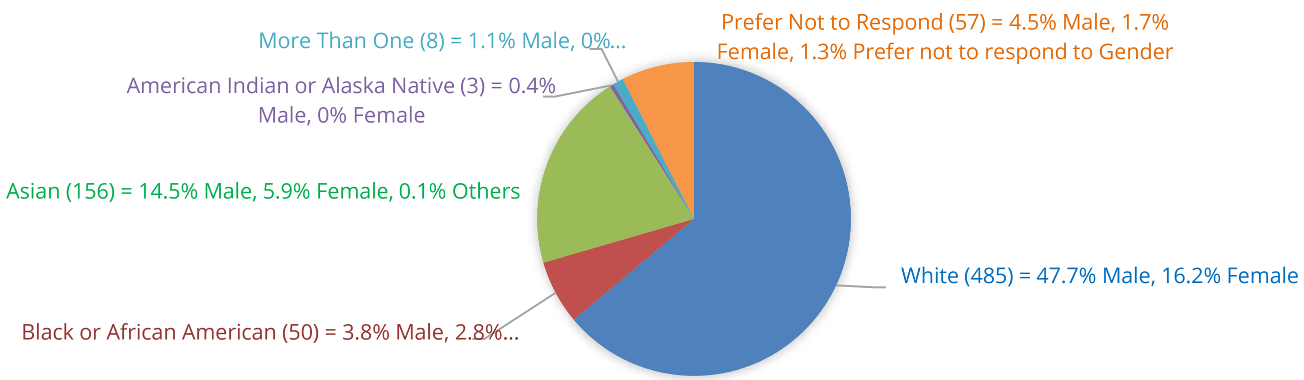


Figure 2. *MagLab Distribution by Race (as of January 3, 2023).*

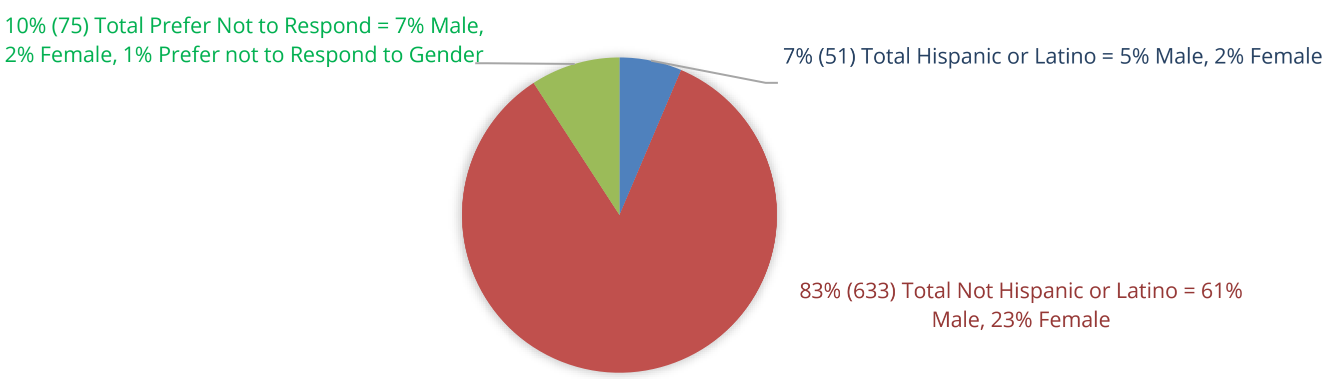


Figure 3. *MagLab Distribution by Ethnicity (as of January 3, 2023).*

1.5 Diversity Action Plan

The MagLab remains committed to diversity and inclusion in the STEM workforce within the lab as well as throughout the nation. To accomplish this goal, our efforts are focused on 1) having MagLab scientists reach out to underrepresented and underserved populations in STEM; 2) employing best practices in our hiring strategies to create an equitable starting point for all STEM candidates including those from underrepresented minority groups which includes women; and 3) improving work climate to ensure all employees feel they have equal opportunities for career development.

As part of this strategic plan, the diversity committee structures its budget and subcommittees to align with these efforts. The MagLab Diversity Committee meets periodically to discuss issues facing the lab. MAGLAB Diversity Committee members in 2022 can be found in the following **Table 1.**

***Table 1. 2022** MagLab Diversity Committee*

Greg Boebinger – Director of MagLab			
Ernesto Bosque – Diversity Committee Chair			
FSU Site		**UF Site**	**LANL Site**
Erick Arroyo	Emma Martin (Graduate Student)	Mark Meisel	John Singleton
Ryan Baumbach	Amy McKenna [1]		Amanda Valdez
Alfie Brown	Martha L. Chacon Patino		Laurel Winter
Huan Chen	Bettina Roberson		
Shalinee Chikara	Kari Roberts		
Malathy Elumalai	Kristin Roberts [1]		
Kevin Gamble	Komalavalli Thirunavukkuarasu		
Dave Graf	Anke Toth		
Elizabeth Green	Hans van Tol		
Laura Greene	Carlos Villa		
Roxanne Hughes	Kaya Wei		
Jason Kitchen [1]	Yan Xin		
Walt Lee			

[1] *Subcommittee chairs*

Our Compliance Subcommittee remains chaired by Jason Kitchen. The role of the Diversity Compliance Subcommittee is to assist in ensuring that faculty hiring committees proactively ensure that diverse candidates will see the ad for the position. The chair of every new hiring committee must meet with MagLab HR and the Compliance Subcommittee at the outset of a position search. The position advertisement is reviewed to ensure the language is positive and the search committee chair is informed of a wide array of networks that reach a wide variety of groups including those underrepresented in STEM. Additionally, the meeting provides a chance to ensure that all members of a hiring committee have been trained in best practices for successfully staging candidate searches that are fair for everyone. Before hiring committees make a final offer to a candidate, the Compliance Subcommittee is expected to review a summary of the candidate interviewing and selection process.

Within the committee, a draft of a set of bylaws has been developed to provide more structure to the committee. The draft more clearly defines basic requirements of the composition of members as well as election and rotation of leadership, as well as responsibilities and expectations within the committee. The drafted bylaws have not yet been presented to the full committee for adoption, but this process is slated for the beginning of 2023. A new strategic plan was also submitted under the MagLab's Cooperative Agreement renewal to take effect in 2023, which outlines more focused efforts to reach out into the community.

During the middle of 2022, a Morale Survey was launched with intent to provide a platform for worker engagement and climate feedback, as our workforce continued to return to work in a post-COVID world. The results of this open-ended survey provided guidance to a shorter and more focused annual climate survey launched late in the year, the results of which will inform future actions to improve morale and climate.

In 2022, the MagLab was able to hire and retain one long-time employee within EMR (the Electron Magnetic Resonance Facility) into a research faculty position. Additionally, an ASC (Applied Superconductivity Center) postdoc was also retained via a targeted hire into a visiting faculty role. Four other research faculty searches were successful in placing new hires into DC Fields, EMR, MS&T (Magnet, Science, and Technology), and NMR (Nuclear Magnetic Resonance), and one search for an assistant in research successfully placed a hire into MS&T, but these personnel additions will be reported on in the next annual report, as the employees' contracts do not begin until 2023.

Broadening Participation

Over the year, the Diversity Committee worked steadily to broaden participation in MagLab activities to all scientists, students, and staff members including those from underrepresented groups. To help retain staff, the Diversity Committee sought to improve the work climate and demonstrate appreciation for the magnet technician pool, by providing support to fund lodging for several technicians to attend a trade show to keep up to date with newest tool technology.

- The Diversity Committee granted travel funds to 7 graduate students attending the American Physical Society (APS) March Meeting. The Committee also facilitated several other travel opportunities, including enabling one female doctoral candidate to present at the International Society for Magnetic Resonance in Medicine (ISMRM), one female senior faculty member to present an invited talk at the International School & Workshop on Electronic Crystals, and
- As an outcome from Open Conversations held in 2020, Dr. Roxanne Hugues continues to assemble, with the support of Diversity Committee funds, a lunchtime summer book club for a guided reading of Disordered Cosmos by Dr. Chanda Prescod-Weinstein.
- A smaller focused workgroup continues to participate in the APS IDEA (Inclusion, Diversity, and Equity Alliance) to engage with dozens of scientific institutions to improve our organization and impact with innovative tool building. The format of this collaborative effort is expected to shift to Topical Cohorts starting in 2023.

Externally, the Diversity Committee is proud to support engaging meetings, workshops, and conference that further our diversity mission. The Committee provided support to the ELEVATE program with the Applied Superconductivity Education Foundation for their EDI efforts during the international Applied Superconductivity Conference. Additionally, our diversity chair, Dr. Bosque, served on a special plenary session discussing diversity, equity, and inclusion challenges.

1.6 Safety

A central focus of all activities conducted at the MagLab is to ensure that employees, users, visitors, and contractors are provided with a safe and educational environment. The MagLab's Environmental, Health and Safety team works collaboratively with management, researchers, staff, and users, as well as with other public and private entities, to proactively mitigate hazards in our industrial, laboratory, and office settings. The MagLab Safety Department is integrated with Florida State University's Central Environmental Health and Safety Department. This integration provides substantial support to existing safety programs at the MagLab. Areas of integration and support include Chemical Safety, Laboratory Safety, Biological Safety, Radiation Safety, Industrial Hygiene, Fire Safety, Environmental Compliance and Building Code Compliance (**Figure 1**).

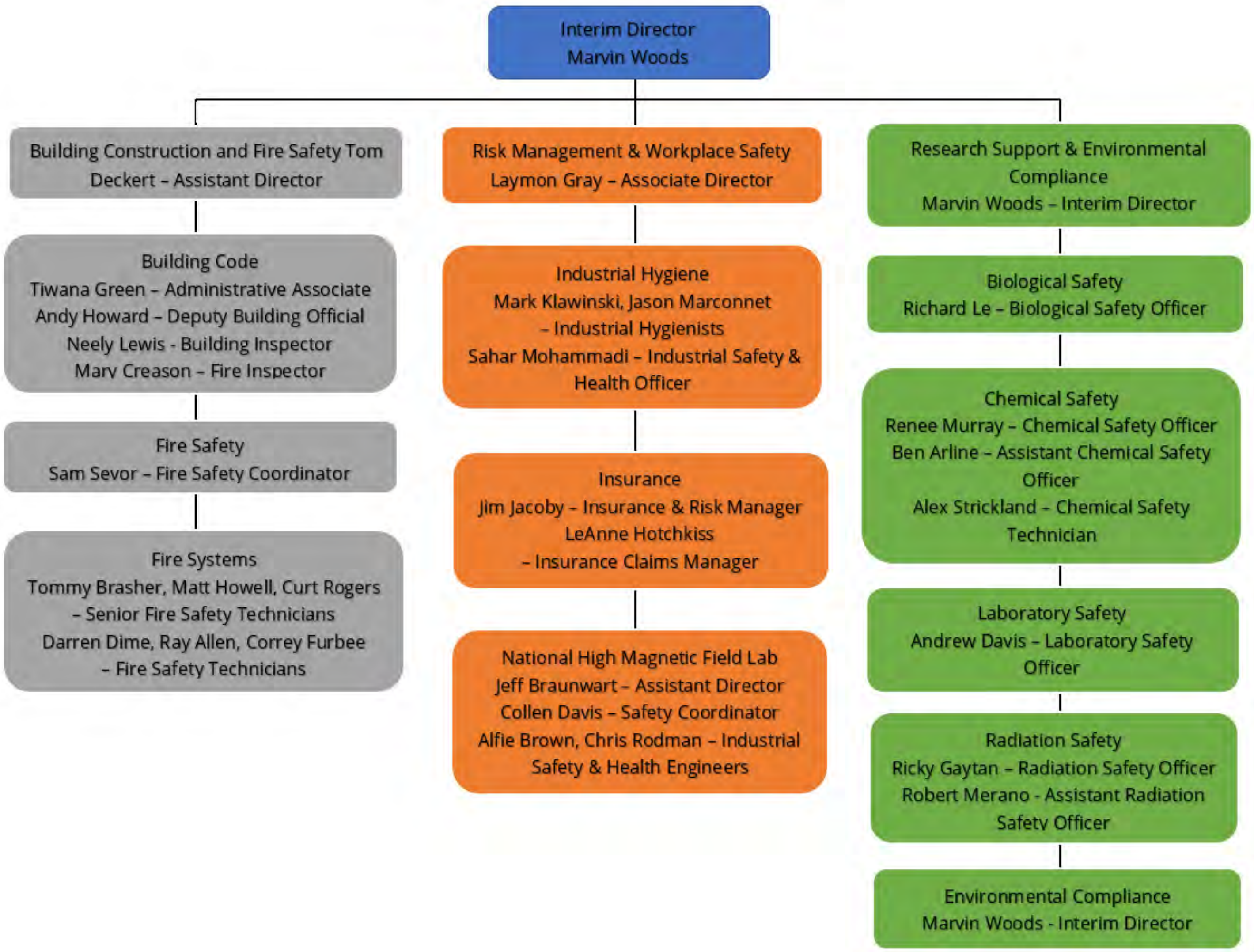


Figure 1. *Environmental Health & Safety (EHS) Organization Chart.*

The MagLab uses Integrated Safety Management (ISM) to integrate safety, health requirements and controls into daily work activities to ensure the protection of the MagLab Community. The MagLab continues to foster a sustainable and strong Safety Culture. Examples of the activities that contribute to our commitment to a strong Safety Culture at the MagLab are listed below:

a. Safety is a **core value** and is viewed as an investment, not a cost.
b. Management drives and is actively involved in promoting our Safety Culture.

c. Quarterly Safety Meetings are conducted by the Director of the MagLab to address lab-wide safety issues and initiatives.
d. The Director of the MagLab and Director of Safety routinely walk-through lab areas to engage researchers, staff, and users, and to observe ongoing work. New Employee Orientation and New Employee safety training are provided to all incoming employees with their supervisor with specific emphasis on our Integrated Safety Management (ISM) System. New employees are taught that safety is a value at the MagLab and that they are encouraged to have a questioning attitude about their safety. They are also taught about our Stop Work Policy and no-fault self-reporting near miss and accident policy.

Investments in Safety

Our investments in safety equipment and materials along with management support and employee involvement demonstrates our strong commitment to sensibly utilize resources in a manner that protect all MagLab personnel, property, and the environment. In 2022, the MagLab strategically invested $187,000 for safety-related equipment, supplies, security, training, and processes. Some of the key investments included personal protective equipment, equipment used to lockout/tagout and verify hazardous energy sources, security enhancements, monitoring devices, and COVID-related supplies.

Safety Support and Coordination with FSU Main Campus Safety Team

Safety at the MagLab is supported by a dedicated on-site team as well the Florida State University (FSU) Environmental, Health and Safety Department team. The two teams work together to provide comprehensive integrated safety support to all activities at the MagLab. Machine Shop, Biosafety, Laboratory, Laser, and Radiation inspections were completed with team members from both groups. The two teams also work together to provide safety training.

Committees

Safety committees are an integral part of the MagLab's ISM. Committees meet to discuss and address safety concerns and provide program reviews.

The following is a list of committees.

- Directors Monthly Safety Committee (includes representative from UF and LANL Facilities)
- Safety Concerns Committee
- Lock/Tag Verification Committee
- Cryogen Safety Committee
- Laser Safety Committee

Meetings in 2022 continued to take place via Zoom but more face-to-face and in-person meetings resumed. Members of these committees also form subcommittees as needed based on the need to address specific safety issues.

Safety Highlights

Security Upgrades

During a security audit conducted by Florida State University Police Department (FSU PD), recommendations were made to increase the safety and security of the MagLab. The safety department worked with FSU PD to address the recommendations, create a work plan, and implement the recommendations.

1. Install a panic alarm at the front desk in the Atrium. This will allow front desk personnel to have immediate access to an alarm in the event of an intruder or emergency.
2. Replace the 4-foot fencing with 6-foot fencing. This will serve as a more suitable deterrent for trespassers.
3. Install cylinder storage card reader access. This will add another level of security preventing non-authorized personnel entry to the gas cylinders.
4. Install additional surveillance cameras in areas where no camera coverage exists. This will increase perimeter surveillance capabilities.

5. Upgrade the MagLab fiber network. This will allow for enhanced security and camera systems in conjunction with Florida State Safety and Security.

Annual Maintenance Shutdown

In 2022, two shutdowns were performed. The first shutdown was during the summer, when a major upgrade to the DC Field User Facility was completed. The massive amount of heat generated from running the MagLab's resistive magnets was removed via a skillfully engineering cooling water system. The chilled water system received crucial upgrades with the installation and integration of four new 2,000 ton (7 Megawatt) industrial-grade chillers, electrical infrastructure, associated instrumentation, and a suite of eight chilled water circulating pumps, to ensure precise control of the magnet cooling water temperature.

The challenge of safely installing these industrial pumps, piping, and electrical gear during the shutdown required the skill and dedication of the MagLab's engineering, operations, technical staff, safety departments, and the use of outside contractors.

The project incurred over 30,000 labor hours without incident. The success of this shutdown emphasized the MagLab's commitment to treating safety as a value. This was accomplished by pre-job planning, project meetings, daily morning pre-job briefings, Integrated Safety Management (ISM) with task hazard analysis (THA), implementation of the site superintendent policy, and daily safety audits.

The second shutdown was during the winter, when the MagLab performed its annual maintenance shutdown. Extensive annual maintenance occurred including the repair of cooling tower components, regeneration of the water treatment resin, breaker testing and exercising, transformer testing, power supply, helium liquefier, capacitor yard, chiller, and pump maintenance. Project work included relocation of a 500HP pump for the upcoming install of an additional magnet cooling water pump, the replacement of four 500HP variable speed drives and the replacement of two magnet cell bridge cranes. A daily meeting was held to review the work plans, lockout reverification status, and task hazard analysis. To improve workers' engagement, meetings were conducted in person in a large open space with speakers using a microphone and audio speaker to ensure everyone in the group could hear clearly. This year's shutdown was impacted by global shipping delays and contractor shortages.

High Voltage Guarding

Because the MagLab's resistive and hybrid magnets use high-current / high-voltage DC power supplies to energize our magnets, we must ensure that personnel cannot inadvertently come into contact with energized conductors related to our user magnet systems. The MagLab conducted a hazard analysis and developed a new safety enclosure to prevent personnel and scientific users from exposure to any sort of high voltage hazard. This new safety enclosure enables work in the proximity of uninsulated conductors by making certain that personnel cannot physically touch equipment at high voltage. The customized easy-access enclosure was designed with impact-resistant and transparent material to shield the conductor while providing a visual reminder of the presence of high voltage in the area.

It is important for the MagLab to comply with safety standards from the Occupational Safety and Health Administration (OSHA). The MagLab scientific user facility combines state-of-the-art scientific instrumentation with industrial scale infrastructure to produce the highest magnetic fields in the world. This results in unique and extraordinary equipment needs, often requiring in-house technological developments due to a lack of commercial, off-the-shelf solutions**.** The skill and expertise of MagLab user facility engineers made the development of this one-of-a-kind safety enclosure possible.

Statistics

In 2022, there were 75 safety concerns entered into the SafeMag system. These entries included near misses, safety concerns, good catches/practices, and suggestions.

There were three incidents that occurred in 2022 and none resulted in lost time/days away from work or restricted work. One incident resulted in first aid, one incident resulted in medical treatment, and one required no treatment but was reported to follow protocol. None of the incidents required NSF notification.

User Facility Safety

The MagLab's User facilities (DC Field, Pulsed Field, High B/T, NMR, AMRIS, EMR and ICR) provide support to internal and external users. To facilitate their visit, users are assigned a combination of online and in-person training modules that are specific to the experiment they are conducting, and the hazards associated with each facility they will be working in. These are generally coordinated several weeks prior to the visitors' arrival if they are external users. Users complete the required training prior to receiving authorization to start work. When users arrive at the facility, they receive hands-on training that is specific to each location and discuss any potential safety concerns with user support. While at each facility, users are assigned an in-house scientist and support technician to ensure both technical and safety needs are met. Non-routine and any particularly hazardous activities are completed by trained and experienced facility technicians to minimize risks to users.

1.7 Budget

The National High Magnetic Field Laboratory, and its seven user programs, is primarily funded by the National Science Foundation. Other operating funds are provided through the participating institutions: Florida State University, University of Florida, and the Los Alamos National Laboratory. Additionally, faculty and staff have been very successful in securing individual research funding for specific areas of research from a wide variety of sources in the federal, state, and private sectors.

The National Science Foundation Division/Directorate approved the National High Magnetic Field Laboratory's facilities award for 2018-2022 on March 23, 2018.

For the Calendar Year 2022, NSF provided an operating budget of $38,910,000. On December 6, 2022, the NHMFL requested a No Cost Extension through December 31, 2023. This request was approved by NSF on December 14, 2022.

Table 1 represents the budget allocation and percentage of the total budget to each division of the National High Magnetic Field Laboratory and **Table 2** summarizes the MagLab's budget position as of December 31, 2022. The report includes our annual funding per our Cooperative Agreement.

Division/Program	CY 2022 Total Funding ($)	Budget (%)
Operations/Safety	1,704,551	4.38%
DC Field Facility	8,076,656	20.76%
Magnet Science & Technology	5,914,227	15.20%
NMR	2,268,363	5.83%
ICR	1,781,391	4.58%
EMR	1,273,191	3.27%
CIRL and REU	582,156	1.50%
ASC	2,442,441	6.28%
Electricity & Gases	4,084,063	10.50%
LANL	8,806,557	22.63%
UF High B/T	460,147	1.18%
UF - AMRIS	942,542	2.42%
Diversity	80,000	0.21%
User Collaboration Grants Program	493,715	1.27%
FAIR Data and Supplement[1]	-	0%
Total Operations	**38,910,000**	100%

[1] All FAIR Data support received and reported in Annual Report CY21.

Table 2. *NSF Budget & Expenses - Calendar Year 2022*

Expense Classification	Budget ($)	Expenses and Encumbered ($)	Balance ($)
Salaries and Fringe	8,382,748	10,492,916	(2,110,168)
Equipment	4,168,215	11,247,771	(7,079,556)
Travel	145,518	194,690	(49,173)
Participant Support	145,596	242,348	(96,752)
Direct Expense	5,821,432	6,670,587	(849,155)
Subawards	10,547,770	10,030,781	516,989
Other Direct Costs	1,304,147	2,909,822	(1,605,675)
Subtotal	30,515,426	41,788,915	(11,273,489)
Indirect Cost	8,394,574	10,163,478	(1,768,903)
Total Direct and Indirect Cost	**38,910,000**	**51,952,392**	**(13,042,392)**

Notes:

Per the Cooperative Agreement, DMR 11644799, the CY 2022 budget is $38,910,000.

Negative values are attributed to the following:

- Salaries had unspent funds from previous years.
- Equipment encumbrances include purchases that have a lengthy lead time from the time that the order is placed until the time that the goods are received.
- Travel has resumed post-COVID and travel related expenses have increased.
- Participant Support had unspent funds from previous years.
- Direct expense had unspent funds from previous years, as well as encumbrances for purchases that have a lengthy lead time from the time that the order is placed until the time that the goods are received.
- Other Direct Costs had unspent funds from previous years.
- Indirect Costs include obligations for encumbrances that have not been included in previous years.

1.8 MagLab Cost Recovery Report

Seldom does the MagLab incur costs due to resources used for companies doing proprietary research. On those occasions that companies will need access to the unique equipment at the MagLab, they will contract for the use of that equipment. The MagLab has established procedures to accumulate and report costs continuously and consistently for all such contracts based on an agreed upon schedule of fees and costs to cover the use of such equipment that involves proprietary research. During 2022, the MagLab did not receive any income for the use of NSF-funded equipment/software during the period of performance of our federal award.

1.9 Public Health Issues

For 2022, FSU and the MagLab reaffirmed our commitment to the health and wellness of the campus community and continue to closely monitor all public health issues, including COVID-19 and monkeypox. We continue to follow guidance from the Centers for Disease Control, the Florida Department of Health, and the State University System of Florida regarding COVID-19. We have encouraged everyone to get vaccinated against COVID-19 to help us mitigate the spread of the virus. We have also suggested that those who are concerned about potentially contracting or spreading coronavirus or other viruses wear mask indoors, especially in situations where there are large gatherings. Anyone who is feeling ill or has been exposed to COVID-19 should be tested and follow CDC guidance for quarantine or isolation.

As of August 2022, there is no COVID-19 testing, vaccination, social distancing, or masking requirement to visit or work at the lab. Staff are no longer required to report positive COVID-19 test results to the university or complete a wellness check.

The MagLab's top priority is always the health and safety of the workforce community. We will continue to monitor public health issues and will modify our approach if necessary. We are confident that we will be able to successfully navigate any potential challenges moving forward.

1.10 Industrial Partnership and Collaborations

The MagLab collaborated with dozens of companies, national/international labs, universities and community groups in 2022.

Industry

Advanced Conductor Technologies, Boulder, CO: The Applied Superconductivity Center and the Magnet Science and Technology Division of the MagLab are collaborating with Advanced Conductor Technologies on the development and testing of Conductor on Round Core (CORC®) cables, using multi-layer spiraling tapes around a core, for magnet applications. Danko van der Laan, the Director of the company who is also associated with NIST/University of Colorado Boulder, is developing compact cables based on REBCO coated conductors, a high temperature superconductor. The ongoing collaboration on measurements of HTS cables at low temperature and high magnetic fields (4K and 20T in Cell 4) continues to set new benchmarks for peak current, current density, bend radius and ramp rates. *(MagLab contact: Ulf Trociewitz, ASC)*

Advanced Superconducting Materials (ASM), Lexington, KY: The Applied Superconductivity Center is collaborating with ASM under a Phase-I Small Business Technology Transfer award on the development of a photo-acoustic measurement device. *(MagLab contact: Daniel Davis and Ulf Trociewitz, ASC)*

ATI Specialty Metals and Products, Albany, OR: The Applied Superconductivity Center is collaborating with ATI metals in the development of new Nb alloys for Nb_3Sn superconducting wire fabrication. The new alloys exhibit improved properties at high fields and could be used for accelerator magnets in facilities like the Future Circular Collider (FCC) under consideration by CERN. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, Peter Lee, ASC)*

Bridge12 Technologies Inc., Framingham, MA: Bridge12 is a small business specialized in the design and manufacturing of active and passive high frequency microwave components. The EMR division is collaborating with Bridge12 on novel designs of high field in-situ EPR spectrometers, as well as working together on future development of high frequency gyrotrons for DNP. *(MagLab contact: Stephen Hill and Thierry Dubroca, EMR)*

Bruker Biospin Corp., Billerica, MA: The EMR and NMR groups have entered into a collaborative effort with Bruker Biospin regarding the Dynamic Nuclear Polarization (DNP) program. In particular, the effort aims at improving Bruker's recently acquired products (395 GHz gyrotron, 600MHz/14.1T DNP probe) beyond their normal commercial uses by making technical modifications as well as developing new instrumentation. The modifications allow the DNP instruments to be more user program friendly without voiding the warranty. *(MagLab contact: Stephen Hill, EMR, Frederic Mentink, NMR, Peter Gork'ov, NMR, Thierry Dubroca EMR)*

Bruker Biospin Corp., Billerica, MA: Investigators from MagLab facilities at UF and FSU collaborate with technical staff at Agilent on two NIH-funded projects to develop improved superconductive cryogenic probes for solution NMR. *(MagLab contacts: William Brey, NMR and Matthew Merritt, AMRIS*)

Bruker OST, Carteret, NJ: Bruker OST is manufacturing accelerator quality Nb_3Sn strands based on the restacked-rod process that provide the production conductor for the High-Luminosity Upgrade of the Large Hadron Collider at CERN. The Applied Superconductivity Center oversees conductor production on behalf of the upgrade project, and ASC and the Magnet Science and Technology divisions perform quality verification utilizing the electromagnetic testing facilities at the MagLab. *(MagLab contacts: Lance Cooley, ASC; Jun Lu, MS&T)*

Bruker-OST, Carteret, NJ: Extensive collaborations exist between ASC and BOST on both Nb_3Sn and Bi-2212 conductor development, aided by direct support of R&D on these materials from DOE-High Energy Physics to ASC PIs and to BOST through the Conductor Development Program (now called Conductor Procurement and R&D Program) managed by ASC in partnership with Lawrence Berkeley National Laboratory. Through these collaborations, BOST has been able to develop the most advanced Nb_3Sn and Bi-2212 conductors produced. *(MagLab contacts: Lance Cooley, David C. Larbalestier, Eric Hellstrom, Peter J. Lee, Chiara Tarantini, Jianyi Jiang, ASC)*

Cryomagnetics Inc.: Extensive collaboration with Cryomagnetics in the area all superconducting high field hybrid magnets that make use of HTS coils made with Bi-2212 nested in the high field area of the magnet. Cryomagnetics is collaborating with the MagLab under a phase-IIa Small Business Technology Transfer award from the Department of Energy. Cryomagnetics has also obtained a license to use magnet technology based on $Bi_2Sr_2CaCu_2O_{8-x}$ superconductors developed at the MagLab. Magnets will use unique high-pressure high-temperature reaction furnaces and other techniques developed in the ASC to reach 25T in magnet systems. ASC's involvement focuses on the design, construction, and heat treatment of Bi-2212 coils to be supplied to Cryomagnetics and embedded into their LTS magnet systems. *(Maglab contact: Ulf Trociewitz, ASC)*

Cryomagnetics Inc.: Cryomagnetics is collaborating with the MagLab on development of REBCO-based magnets for commercial production under a phase-II Small Business Innovative Research award from the Department of Energy. The goal is to develop a 30 T full superconducting magnet with 18 T contributed by a REBCO coil in a 12 T LTS magnet. The MagLab is responsible to develop the HTS magnet. The phase I focused on the epoxy impregnation subscale HTS coil testing and ended in the middle of 2022. Then the Phase II got funded and started in August 2022. In phase II, the technology of epoxy impregnated REBCO coil will be explored in a relatively large-scale coil. If successful, a prototype HTS coil will be designed and fabricated at the MagLab and tested at Cryomagnetics. This project is planned to demonstrate the HTS magnet technology, power supply and manufacturing processes needed for 30 T class commercial REBCO magnets in high energy physics and condensed matter physics research. *(Maglab contact: Hongyu Bai, Mark Bird, MS&T)*

Danfoss Turbocor, Tallahassee, FL: Danfoss Turbocor Inc. is a company specializing in compressors, particularly the totally oil-free compressors. The compressors are specifically designed for the heating, ventilation, air conditioning and refrigeration (HVACR) industry and need high performance soft and hard magnet materials. The company and the laboratory have a joint research project on selection, characterization and development of permanent magnet materials and structural materials for high performance and environmentally friendly compressors. *(MagLab contact: Ke Han, MS&T)*

Engi-Mat Co., Lexington, KY: Engi-Mat is a small business specializing in manufacturing advanced nanomaterials. MagLab collaborates with Engi-Mat Co on a small business innovation research grant funded by US Department of Energy. The goal of this research is to improve the quality of $Bi_2Sr_2CaCu_2O_{8-x}$ powder for superconducting wires. *(MagLab contact: Jianyi Jiang, ASC)*

HC Starck, Newton, MA: The Applied Superconductivity Center is collaborating with HC Starck in the development of new Nb alloys for the Nb_3Sn superconducting wire fabrication to be used for accelerator magnets like the Future Circular Collider (FCC) to be built at CERN. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, Peter Lee, ASC)*

Hyper Tech Research Inc., Columbus, OH: The Applied Superconductivity Center is collaborating with HTRI on the development of a new generation of Nb_3Sn wires with high critical current density for the next generation of higher magnetic field accelerator magnets as part of the US-Magnet Development Program. *(MagLab contacts: David C. Larbalestier, Chiara Tarantini, and Peter J. Lee, ASC)*

Mevion Medical Systems, Littleton, MA: Mevion is a pioneer in the development of proton radiation therapy systems for the non-invasive treatment of cancer. The center of the systems is the proton accelerator that utilizes low temperature superconductors. The MagLab provides engineering support to Mevion by assisting in qualification testing of full-scale high current superconductors in background fields at low temperatures. The tests require the MagLab's unique test facility designed for tests of large conductors in a 12T split solenoid superconducting magnet system and the unique variable temperature – variable strain apparatus in ASC. *(MagLab contact: Todd Adkins, MS&T, ASC contact: Najib Cheggour)*

Nikon, Melville, NY: The MagLab maintains close ties with Nikon on the development of an educational and technical support microscopy website, including the latest innovations in digital-imaging technology. As part of the collaboration, the MagLab is field-testing new Nikon equipment and developing new methods of fluorescence microscopy. *(MagLab contact: Eric Clark, Optical Microscopy)*

Noveon Magnetics, San Marcos, TX: Scientists and engineers from Urban Mining Company came to the MagLab to study the complete magnetization loop of the rare-earth permanent magnet alloys which they are developing. Urban mining specializes in recovering rare-earth magnetic material from recycled electronics and processing that material into new magnets for use in industry. *(MagLab contact: Tim Murphy, DC Field)*

Olympus Corp., Tokyo, Japan: Investigators at the MagLab have been involved in collaboration with engineers at Olympus to develop and test new optical microscopy systems for education and research. In addition to pacing the microscope prototypes through basic protocols, the Optical Microscopy group is developing technical support and educational websites as part of the partnership. *(MagLab contact: Eric Clark, Optical Microscopy)*

Oxford Instruments NanoScience (OINS), UK: The ASC has a collaboration with OINS on the development of high field insert magnets made with Bi-2212 wire for use in 30+T NMR as well as 25T class compact research magnet systems. Particularly for NMR magnets, Bi-2212 conductor promises several significant advantages that will be exploited here. OINS has obtained a license to use magnet technology based on $Bi_2Sr_2CaCu_2O_{8-x}$ superconductors developed at the MagLab. Magnets will use unique high-pressure high-temperature reaction furnaces and other techniques developed in the ASC. OINS aims to produce advanced magnets for laboratory research and NMR systems. *(MagLab contact: David Larbalestier, Ulf Trociewitz, and Lance Cooley, ASC)*

Oxford Instruments, Abingdon, UK: Oxford Instruments delivered a 15T large-bore low temperature superconductor magnet to the MagLab that was combined with 17T YBCO-coated conductor coil developed by the MagLab to create the first 32T all-superconductor magnet. In case of a quench, the LTS and HTS coils interact in a complex manner. The quench protection systems for the individual coil sets are inter-dependent. This could not be handled by routine specifications in a standard vendor relationship. Therefore, Oxford Instruments and the MagLab worked closely together to develop quench protection for the combined system to ensure compatibility of the coil sets and developed a numerical code to model quench in combined YBCO-LTS magnets. Additionally, Oxford Instruments Nanoscience worked with MagLab personnel to specify, design and construct a custom top-loading dilution refrigerator for the 32T magnet system. Coupling the ultra-low temperatures of a dilution refrigerator with the 32T superconducting magnet creates a unique system for scientists to explore material properties. The 32T is now in regular service and is being employed by MagLab users for a number of scientific investigations. *(MagLab contact: Tim Murphy, DC Field)*

Phoenix NMR, LLC, Loveland, CO: Phoenix NMR used the NMR Dynamic Nuclear Resonance facility to test a commercial DNP probe. Additionally, the MagLab's NMR instrumentation program and Phoenix NMR collaborate on the development of stators for magic angle spinning NMR. *(MagLab contact: Fred Mentink, Peter Gor'kov, NMR)*

SuperPower Inc., Schenectady, NY: The Applied Superconductivity Center and the Magnet Science and Technology division of the MagLab are collaborating with SuperPower Inc. on the characterization of YBCO coated conductors. This material has the potential to transform the field of high-field superconducting magnet technology and is in an early stage of commercialization. The MagLab will work to improve our understanding of this product and provide guidance to SuperPower on enhancing the quality of their product. The MagLab has also taken the lead in encouraging a Coated Conductor Round Table of users of coated conductors at which much information about the long length performance of coated conductors has been shared. *(MagLab contacts: David C. Larbalestier, Dmytro Abraimov and Jan Jaroszynski, ASC)*

Thomas Keating LtD, UK: The EMR group has entered into a partnership with Thomas Keating (TK) LtD in the UK as part of its program aimed at developing a new characterization tool, Dynamic Nuclear Polarization Nuclear Magnetic

Resonance (DNP - NMR) at high fields (14.1T / 600MHz). TK draws on tool-making skills to design and develop quasi-optical Terahertz systems and subsystems. *(MagLab contact: Stephen Hill, EMR)*

ThermoFisher Scientific, Waltham, MA: The ICR Facility is collaborating with ThermoFisher Scientific and the University of Virginia (Charlottesville, VA) to use advanced control of proton transfer reactions to manipulate ion charge states for improved sensitivity (e.g., for proteomics and other biological applications). Further, this collaboration seeks to couple the latest Thermofisher Scientific mass spectrometry platforms with the Maglab's high field Fourier Transform ion cyclotron resonance (FT-ICR) instruments. (*MagLab contact: Chris Hendrickson, ICR)*

Virginia Diodes Inc., Charlottesville, VA: VDI is a technology company specialized in high frequency microwave sources and detectors. The EMR division collaborates with VDI on the development of microwave sources for high-sensitivity high-field EPR spectroscopy. These new sources allow the MagLab to stay at the forefront of high field EPR instrumentation. The development of high-power solid-state sources for DNP at very high magnetic fields (>30T) is also being planned. *(MagLab contact: Stephen Hill and Thierry Dubroca, EMR)*

Waters Corporation, Miford, MA: The ICR and Future Fuels Institute are a Waters Corporation, Center of Innovation and collaborate on advances in instrumentation for biological and petroleum applications. Instrument and ion source advances are provided to both facilities before their commercial release and allow for applications development well before mainstream introduction. *(MagLab Contact: Ryan Rodgers, ICR)*

National or International Laboratories and Institutes

Advanced Photon Source, Argonne National Laboratory, Lemont, IL: The Applied Superconductivity Center is collaborating APS to perform Extended X-ray absorption fine structure (EXAFS) characterization on Nb_3Sn superconducting wires in order to locate the substitution sites of the dopants and to correlate them with the superconducting performance. *(MagLab contacts: Chiara Tarantini, ASC)*

CHESS (Cornell High Energy Synchrotron Source), Cornell University, Ithaca, NY*:* MagLab scientists and engineers are collaborating with their counterparts at CHESS to support the establishment of the High Magnetic Field (HMF) X-ray beamline that is being constructed at CHESS. Once completed the HMF will greatly increase the range of DC magnetic fields available in the US for several key synchrotron techniques. *(MagLab contact: Tim Murphy DC Field)*

Dana-Farber Cancer Institute, Boston, MA: Current collaboration between Dana-Farber Cancer Institute and the Magnetic Lab is aimed at determining the molecular details of HIV envelope protein gp41 using electron paramagnetic resonance methods. Other goals include characterization of antibody-induced structural changes of gp41 and developing optimized vaccine immunogens by structural approaches. *(MagLab contact: Likai Song, EMR)*

EUCARD2 (European Collaboration for Accelerator R&D), Geneva, Switzerland: EUCARD2 is a European Framework collaboration of about 10 European labs aimed at developing kiloamp high temperature superconductor cables for future application to a high energy LHC. The European emphasis is on Roebel cables of Rare-Earth Barium Copper Oxygen (REBCO) coated conductors, but an equally attractive cable for accelerator purposes is a round wire cable made in the Rutherford style out of Bi-2212 ($Bi_2Sr_2CaCu_2O_{8-x}$). This conductor has been developed at the MagLab under Department of Energy Office of High Energy Physics (DOE-HEP) support in the context of the Bismuth Strand and Cable Collaboration (BSCCo) that unites the MagLab, Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL), Lawrence Berkeley National Laboratory (LBNL) and OST in a team developing this material for accelerator use. The MagLab is now the US point of contact for collaborations between EUCARD2 and the US program. *(MagLab contacts: David C. Larbalestier, ASC)*

Fermilab, Batavia, IL: The Applied Superconductivity Center is collaborating with Fermilab on the development of a new generation of Nb_3Sn wires with high critical current density for the next generation of higher magnetic field accelerator magnets as part of the US-Magnet Development Program. (*MagLab contacts: David C. Larbalestier, Chiara Tarantini and Peter J. Lee, ASC)*

Fermi National Accelerator Laboratory (FNAL), Batavia, IL: Applied Physics and Superconducting Technology Division, Magnet Systems Department of FNAL manages Nb_3Sn wire procurement for LHC high luminosity upgrade, MS&T physical property measurement lab is contracted by FNAL to measure critical current and residual-resistance-ratio of Nb_3Sn wires as a part of the quality verification program. This collaboration started in 2015 and will continue through the fall of 2023. *(MagLab contact: Jun Lu, MS&T)*

Fermi National Accelerator Laboratory (FNAL) Accelerator Magnet Support Division (MSD), Batavia, IL: Fermi National Lab is a partner in international collaborative project at CERN named the High-Luminosity Large Hadron Collider (LHC) Upgrade. The magnet design engineers at the FNAL-MSD rely on the Magnet Science & Technology (MS&T) group's expertise and mechanical test capabilities to qualify the reliability of critical structural welds. In support of the US-DOE funded project, MagLab scientists have measured the mechanical properties of the welded dipole superconducting support structure to confirm the acceptable weld 4 K fracture toughness values. *(MagLab contact: Bob Walsh, MS&T)*

HL-LHC Accelerator Upgrade Project (AUP), Geneva, Switzerland: The AUP is the US contribution to the High-Luminosity Upgrade of the Large Hadron Collider. All of the magnets are Nb_3Sn; there is no HTS. AUP will deliver new quadrupole magnets, 20 magnets x 4 coils = 80 coils measuring 4.2m long at 11.4T field and 1.9K, that intensify the focus of the CERN proton beams at the ATLAS and CMS intersection regions, and new crab cavities that rotate the beam slightly and ensure that collisions are head-on even when the focusing magnets are highly converging. These new elements will make physics happen 10 times faster than before (new physics being proportional to luminosity). The Hi-Lumi project in European accounting is around CHF 2.2 billion, AUP cost is $225 million, and MagLab oversees a $25 million component to procure 10 tons (7 tons have been delivered as of Feb 2021) of the highest-performing Nb_3Sn conductor ever made and verify its quality by testing critical current and other properties. The AUP is supported by the DOE Office of Science. The AUP team consists of six US laboratories and two universities: Fermilab, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, SLAC National Accelerator Laboratory, Thomas Jefferson National Accelerator Facility (all DOE national laboratories), the National High Magnetic Field Laboratory, Old Dominion University and the University of Florida. *(MagLab contacts: Lance Cooley and David C. Larbalestier, ASC)*

International Electrotechnical Commission (IEC)/ Versailles Project on Advanced Materials and Standards (VAMAS), Japan: This collaboration is a world-wide round-robin measurement of critical current of superconducting BSCCO-2223 cable. The participants are a testing lab in Japan, Korea, the US, the UK, France, and China. The materials group in the MagLab's magnet science and technology division is the US participant. The measurement at the MagLab was completed in 2022. The outcome and the final report of the world-wide round-robin effort by VAMAS is expected in 2023. *(MagLab contacts: Jun Lu MS&T)*

International Thermonuclear Experimental Reactor (ITER), US-ITER Project Office, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN: The United States is part of an exciting international collaboration to demonstrate the feasibility of an experimental fusion reactor that is under construction in France. MS&T's physical property measurement lab has been preparing Nb_3Sn wire samples as witness for heat treatment ITER central solenoid modules, coax joints and bus bars. The MagLab subsequently measures critical current of these heat treatment witness samples. *(MagLab contacts: Jun Lu MS&T)*

Japan Proton Accelerator Research Complex (J-PARC), Japan: The Applied Superconductivity Center ASC is collaborating with the Japan Proton Accelerator Research Complex J-PARC to perform neutron-diffraction experiments on RRP® Nb_3Sn wires to find the origin of the strain irreversibility cliff in these conductors and to identify the different phases present in the conductor after heat-treatments. This collaboration also includes Kozo Osamura from the Research Institute for Applied Sciences RIAS (Kyoto, Japan) and Shutaro Machiya from Daido University (Nagoya, Japan). Work from this collaboration will expand to also include other conductors currently being developed such as Nb_3Sn containing additional pinning centers. *(MagLab contact: Najib Cheggour and Peter J. Lee, ASC)*

Jefferson Lab, Newport News, VA: Recently, Nitrogen and Titanium doping have emerged as highly effective methods of improving the quality factor on Nb SRF cavities; the Applied Superconductivity Center is working with scientists at Jefferson Lab to evaluate the interaction between prior cold-work and doping treatment of Nb samples and their influence on the superconducting properties. Doping is carried out at Jefferson Lab and superconducting property measurements, including magneto optical imaging area carried out at the MagLab. *(MagLab contact: Peter J. Lee and Lance Cooley, ASC)*

Key Laboratory of Electromagnetic Processing of Materials, Northeastern University, Shenyang, China: The collaboration between the Northeastern University and the MagLab is related to the magnetic field impact on fabrication of high strength conductors and magnetic materials. Two joint papers have been published between 2019 and 2021. *(MagLab contact: Ke Han, MS&T)*

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea: Professor Hyoungsoon Choi's group at the Korea Institute of Science and Technology (KAIST) has developed a co-operative agreement with Professor Yoonseok Lee and the National High Magnetic Field Laboratory's High B/T Facility for the study and development of the design of coolant materials used in nuclear demagnetization refrigerators. The collaboration focuses on the techniques and expertise required to produce high residual resistant ratios for the metallic materials used for the coolants and the associated components. KAIST is a leading center for ultra-low temperature research in Korea. *(MagLab contacts: Yoonseok Lee, High B/T)*

Lawrence Berkeley Laboratory, Accelerator, Berkeley, CA: The Applied Superconductivity Center (ASC) is collaborating with the Lawrence Berkeley National Laboratory (LBNL) to test strain properties of high-performance RRP® Nb_3Sn wires to be used in the LBNL Test Facility Dipole Project (TFD). This collaboration will explore the strain sensitivity of a specific Nb_3Sn conductor to help LBNL researchers decide early in the project whether this conductor is suitable for TFD. *(MagLab contact: Najib Cheggour, ASC)*

Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA: Division of Accelerator Technology and Applied Physics collaborated with MS&T physical property measurement lab in critical current measurement of Nb_3Sn superconducting wires that are used in development of the accelerator magnets and the test facility dipole (TFD) magnet, which will be installed at the Fermi National Accelerator Laboratory. This Nb_3Sn wire testing collaboration consists of three projects: A) wire for canted cosine theta (CCT) dipole magnet development; B) wire for electron cyclotron resonance (ECR) source magnet at the facility for rare isotope beam (FRIB) at Michigan State University, and C) the above mentioned TFD magnet. *(MagLab contact: Jun Lu, MS&T)*

Lawrence Berkeley Laboratory, Accelerator Technology & Applied Physics Division, Berkeley, CA: MagLab - MS&T's Electro-Mechanical Properties group specializes in low temperature structural materials testing in support of DOE High-Luminosity LHC Accelerator Upgrade Project (AUP). The MagLab performs low temperature mechanical tests and microstructural evaluation of structural aluminum alloys and composites that are critical to the safe/reliable operation of large accelerator magnets being constructed for the project. *(MagLab contact: Bob Walsh, MS&T)*

Lawrence Berkeley Laboratory, Accelerator, Berkeley, CA: The Applied Superconductivity Center (ASC) is collaborating with the Lawrence Berkeley National Laboratory (LBNL) to heat-treat and test accelerator type model coils (racetrack and CCT) on the basis of Bi-2212 Rutherford cable conductor. *(MagLab contact: Daniel Davis, ASC)*

Lawrence Livermore National Laboratory, Livermore, CA: The Applied Superconductivity Center and the MS&T division of the MagLab are collaborating with researchers at Lawrence Livermore National Laboratory to develop cavity resonators and magnets for the Advanced Dark Matter Experiment. Fabrication and microstructural characterization facilities in the ASC are used to investigate Nb_3Sn and other superconducting coatings for use in cavities. MS&T consultation related to very large and high field detector magnets is ongoing. *(MagLab contacts: Lance Cooley, ASC)*

Los Alamos National Laboratory Community Programs Office, Los Alamos, NM: Center for Integrating Research and Learning (CIRL) works closely with our counterpart, the Los Alamos National Laboratory Community Programs Office. Over the last year, the MagLab has developed a partnership to share information and resources on our educational activities. The community programs office has a large staff that oversees more than 15 different educational/ community outreach programs including the Bradbury Museum. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Los Angeles County Museum of Natural History, Los Angeles, CA: The collaboration between the Integrative Vascular Physiology and Pathology (IVPP) and the MagLab is related to the investigation of Late Cenozoic Vertebrate Paleontology and Paleoenvironments of the Tibetan Plateau (China). Stable isotopic compositions of the samples collected in this project are analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

National Aeronautics and Space Administration, Washington DC: The MagLab is collaborating with a multi-university NASA University Leadership Institute to research zero-emission aviation. Collaboration members include Florida State University, Georgia Tech, University of Buffalo, University of Kentucky and industrial partners Boeing, Raytheon, and Advanced Magnet Lab. *(MagLab contacts: Wei Guo, MS&T and Lance Cooley, ASC)*

Princeton Plasma Physics Laboratory (PPPL): The Applied Superconductivity Center and PPPL are collaborating on the R&D of high-field superconducting cable coil for use nuclear fusion systems. In this context, a particular interest exists for CORC™-type cables made with ReBCO conductor as well as Rutherford-type cables made with Bi-2212 wire. *(Maglab contact: Daniel Davis, ASC)*

South Florida Water Management District (SFWMD), West Palm Beach, FL: The collaboration between the SFWMD and the MagLab is related to the investigation of land-use and change on food web structure and mercury cycling in the Everglades. Isotopic compositions of the samples collected in this project were analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

US Magnet Development Program (*MDP*), Berkeley, CA: The US Magnet Development Program aggressively pursues the development of superconducting accelerator magnets that operate as closely as possible to the fundamental limits of superconducting materials and at the same time minimize or eliminate the need to break in a magnet in a series of steps to achieve its design field strength. MDP looks forward 15-30 years at accelerators that might be built. CERN is already thinking about a Future Circular Collider at 10x the energy than the present LHC, i.e. > 100TeV, in the 2050 timeframe. An important thing about the FCC is that it is constrained by mountains, and to get to 100TeV, the envisioned Nb_3Sn technology, which as a limit at ~16T, must be replaced by or combined with HTS to get to 20T. MagLab's major developments to date include pioneering Bi-2212 magnet technology and its high-pressure, high-temperature reaction and demonstrating several Bi-2212 coils, demonstrating REBCO cables, and leading the national conductor development effort. LBNL serves as the host institution for the MDP organization. *(MagLab contacts: Lance Cooley and David C. Larbalestier, ASC)*

Woods Hole Oceanographic Institution (WHOI), Falmouth, MA: The collaboration between WHOI and the MagLab is related to ocean crust formation. WHOI is providing samples and analyses of abyssal peridotites, which are analyzed for Hf, Nd and Osisotopic composition. The MagLab also participates in seagoing expeditions. One has been to the mid-Atlantic Ridge; another is planned to the Marion Rise on the southwest Indian Ridge. Samples collected from these expeditions will be analyzed at both the MagLab and WHOI. *(MagLab contact: Vincent Salters, Geochemistry Program)*

Woods Hole Oceanographic Institution (WHOI), Falmouth, MA: The MagLab collaborates with Christopher Reddy and Robert Nelson at WHOI in characterizing petroleum oil spills at the molecular level, by gas chromatography x gas chromatography and FT-ICR mass spectrometry. Although characterization of the 2010 Macondo wellhead oil has been completed, ongoing research focuses on subsequent physical, chemical, and biological changes as the spill ages in the environment, and analysis of future spills. *(MagLab contact: Ryan Rodgers, ICR)*

Universities

Cornell University, Ithaca, New York: The Cornell High Energy Synchrotron Source (CHESS) is building a new beamline for x-ray scattering at high magnetic fields. The MagLab is a partner in this project providing advice on the design of the beamline to accommodate a future magnet using the high temperature superconductors. (*Maglab contact: Mark Bird, MS&T*)

Florida State University, College of Education, Tallahassee, FL: The Center for Integrating Research & Learning works closely with faculty from the FSU College of Education to network and strengthen programs on campus and at the lab. The MagLab utilizes the expertise of FSU faculty for research projects and recruits graduate students from FSU departments to conduct research on CIRL programs. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Michigan State University, Lansing, MI: The Applied Superconductivity Center is collaborating with Michigan State University on a DOE funded project to study the impact of grain boundaries and associated microstructural defects on the performance of superconducting cavities using the advanced microstructural, microchemical, and electromagnetic characterization techniques and expertise available in the MagLab. *(MagLab contact: Peter J. Lee, ASC)*

Nagoya University, Nagoya, Japan & Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany: The Applied Superconductivity Center is collaborating with Nagoya University and the Karlsruhe Institute of Technology in the investigation of iron-based superconducting thin films in order to establish their intrinsic properties and determine their potential for applications using electromagnetic characterization techniques also in high field and expertise available in the MagLab. *(MagLab contact: Chiara Tarantini, ASC)*

Osaka City University, Japan: The EMR group received joint funding with the University of Modena in Italy and Osaka City University in Japan through an International Program sponsored by the Air Force's Asian Office of Aerospace Research and Development (AOARD). This joint program focuses on quantum properties of molecular magnets. A cooperative agreement between Osaka City University and Florida State University has been established in order to formalize this collaboration. *(MagLab contact: Stephen Hill, EMR)*

Radboud University, Nijmegen, The Netherlands: The MagLab has partnered with the High Magnetic Field Lab in the Netherlands to develop a 45T hybrid magnet using only 24MW of power. The project was funded by the Dutch government in 2006, and in 2012 an agreement was signed for the MagLab to play a leading role in the development of the Nb_3Sn cable-in-conduit superconducting coil for this magnet system. This will be the fourth hybrid outsert to be developed at the MagLab (MagLab 45T, HZB, FSU SCH, Nijmegen), and the Dutch lab will benefit from our extensive experience. When complete, it is expected to be one of three 45T systems worldwide. The MagLab has delivered the Cable-In-Conduit-Conductor (CICC) coil to Nijmegen. The Nijmegen lab is building the cryostat and resistive coils. A final external review before commissioning is planned for April 2023 *(MagLab contact: Mark D. Bird, MS&T)*

Shanghai University, Shanghai, China: The collaboration between the Shanghai University and the MagLab is related to the solidification of metallic materials and to the application of machine learning to solidification. They have published two joint papers in 2022 *(MagLab contact: Ke Han, MS&T)*

St. Andrews University, UK: The EMR group has an ongoing partnership with St. Andrews University in the UK, involving the development of a high-power (1kW) high-frequency (94GHz) pulsed EPR spectrometer (HiPER) for its user program. *(MagLab contact: Stephen Hill, EMR)*

Tokyo University of Agriculture and Technology, Japan: The Applied Superconductivity Center is collaborating with TUAT in the investigation of iron-based superconducting bulks in order to establish their intrinsic properties and determine their potential for applications using electromagnetic characterization techniques also in high field and expertise available in the MagLab. *(MagLab contact: Chiara Tarantini, ASC)*

University of Colorado Boulder, Boulder, CO: The NIST-Boulder electromechanical testing facilities were the primary location for the determination of the strain sensitivity of a wide range of superconducting wires, and these important instruments have been transferred to the Applied Superconductivity Center so that this critical work can be continued. *(MagLab contact: Najib Cheggour, ASC)*

University of Edinburgh, UK: The EMR group received funding through a joint program between the National Science Foundation and the Engineering and Physical Sciences Research Council in the UK, enabling an International Collaboration with the Chemistry Department at the University of Edinburgh, Scotland. This joint program involved the development of high-pressure/High-field EPR techniques. *(MagLab contact: Stephen Hill, EMR*)

University of Modena, Italy: The EMR group received joint funding with the University of Modena in Italy and Osaka City University in Japan through an International Program sponsored by the Air Force's Asian Office of Aerospace Research and Development (AOARD). This joint program focuses on quantum properties of molecular magnets. *(MagLab contact: Stephen Hill, EMR)*

University of Oxford, UK: The Applied Superconductivity Center is collaborating with University of Oxford in the investigation of doped Nb_3Sn superconducting wires in order to determine by atom probe tomography the elemental distribution of dopants and their effect on the superconducting properties. *(MagLab contact: Chiara Tarantini, ASC)*

University of Texas, Arlington, TX: The Applied Superconductivity Center is working with Choong-Un Kim and his research group to understand electrochemical methods to apply refractory metals to copper and copper alloys. Kim's team has unique expertise in preparing non-aqueous methods that ensure very little oxygen is incorporated into the refractory metals, using expertise developed for semiconductor inter-connections. The MagLab's microstructural and electromagnetic characterization facilities are used to evaluate the quality of coatings and their properties, including potential use as a superconducting material in a cavity resonator. *(MagLab contact: Lance Cooley, ASC)*

University of Texas, Austin, TX: The Applied Superconductivity Center is collaborating with Prof. Eric Taleff in developing novel heat treatment strategies to improve the performance of superconducting RF cavities. *(MagLab contact: Peter J. Lee and Lance Cooley, ASC)*

Community Groups and Educational Groups

American Physical Society – Committee on the Status of Women in Physics, College Park, MD: This committee works to improve the representation and experiences of women in physics. The MagLab has engaged with this group for external reviews and advice. In addition, Dr. Hughes has served as a member of the committee and continues to help with Site Visits. *(MagLab contact: Roxanne Hughes, Educational Programs)*

American Physical Society - Forum on Outreach and Engaging the Public, College Park, MD: The Forum's goal is to increase the public's awareness of physics. CIRL works with this group to utilize best practices and engage in international discussions around physics outreach. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Applied Superconductivity Educational Foundation (ASEF), Potomac, MD: The mission of the Applied Superconductivity Educational Foundation (ASEF) is to promote exploration, learning and the exchange of scientific and technical ideas, breakthroughs and accomplishments, and to provide an array of educational and interactive experiences and events. The Applied Superconductivity Educational Foundation (ASEF) engages this vision on a variety of fronts, including the Applied Superconductivity Conference (ASC), the flagship, international conference on applied superconductivity, and ELEVATE, our integrated thrust to promote educational opportunities, professional & leadership development, and outreach between our scientific community and society. Prof. Cooley and Prof. Hellstrom are Board Officers *(MagLab contact: Lance Cooley, Eric Hellstrom, ASC)*

Big Bend/Leon Association of Science Teachers (BLAST), Tallahassee, FL: The Big Bend/Leon Association of Science Teachers (BLAST) is a group that brings together formal and informal science educators to establish lines of communication among all persons involved in science education in the North Florida community and foster life-long interest in the sciences. They do this by coordinating services most conducive to outstanding science educators, including hosting workshops and presentations that aim to increase the knowledge and skills of science teachers. Additionally, they recognize outstanding achievements in science instruction and provide monetary support for science teacher and student projects. *(MagLab contact: Carlos R. Villa, Educational Programs)*

CAISE - Center for the Advancement of Informal Science Education (CAISE), Washington, DC: CAISE works in collaboration with the National Science Foundation (NSF) Advancing Informal STEM Learning (AISL) Program to strengthen and advance the field of professional informal science education and its infrastructure by providing resources for practitioners, researchers, evaluators and STEM-based professionals. CAISE also facilitates conversation, connection and collaboration across the ISE field — including in media (TV, radio and film), science centers and museums, zoos and aquariums, botanical gardens and nature centers, cyberlearning and gaming, and youth, community, and out of school time programs. The Center for Integrating Research & Learning (CIRL) has worked with CAISE to provide advice for reaching Principal Investigators and improving the evaluation of broader impacts. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Community Classroom Consortium, Tallahassee, FL: The Community Classroom Consortium (CCC) is a coalition of more than thirty cultural, scientific, natural history and civic organizations in North Florida and South Georgia that provide educational experiences and resources to the public, especially K-12 teachers and students. Representatives from CIRL and Public Affairs represent the Lab on the board of this organization and as general members. *(MagLab contact: Kari Roberts, Director’s Office)*

Florida Afterschool Network, Tallahassee, FL: The Florida Afterschool Network (FAN) is an organization that is working toward creating and sustaining a statewide infrastructure to establish collaborative public and private partnerships that connect local, state, and national resources supporting afterschool programs that are school-based or school-linked; develop quality afterschool standards that are endorsed and promoted by statewide stakeholders and through Florida Afterschool Network; and promote public awareness and advocate for policy that expands funding, quality improvement initiatives and accessibility of afterschool programs. The Center for Integrating Research & Learning is a member of the advisory council for this organization. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Florida A&M University Developmental Research School (FAMU DRS), Tallahassee, FL: FAMU DRS is the lab school of FAMU, a historically black college and university. The mission of FAMU DRS is to conduct research, demonstrations, and evaluations of the management of teaching and learning. FAMU DRS places emphasis on mathematics, science, technology, and foreign languages. The MagLab partnered with FAMU DRS to provide a SciGirls Coding Summer Camp to their students to increase the representation of African-American women in computer science. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Florida Association of Science Teachers (FAST), Tallahassee, FL: FAST is a diverse group of teachers, scientists, science educators, science supervisors, curriculum designers, administrators and educational business partners who have a common goal of improving education for students in the state of Florida. FAST provides a way for all members to keep up with what is happening in education in Florida and across the United States. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Future Physicists of Florida, Tallahassee, FL: Future Physicists of Florida is an organization dedicated to recognizing talented middle school math and science students and providing educational guidance to these students to prepare them for careers in physics and engineering. CIRL is a partner in the organization. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Inclusive Graduate Education Network (IGEN), College Park, MD: The MagLab has worked with IGEN to beta test a mentor training for mentors at national labs. MagLab staff will be able to participate in the final curriculum to strengthen the quality of mentorship at the MagLab. *(MagLab contact: Kawana Johnson, Educational Programs)*

Institute of Electrical and Electronic Engineers (IEEE), Piscataway, NJ: The MagLab works with the IEEE Council on Superconductivity to award student fellowships for research and travel. The awards are solicited and reviewed through the council for students nearing the PhD degree. *(MagLab contacts: Eric Hellstrom and Lance Cooley, ASC)*

International Mentoring Association (IMA), Newberry, FL: This organization is a leading source for best practice solutions and support of mentoring and coaching professionals and their programs. The IMA advances individual and organizational development by promoting the use of mentoring best practices in every organizational setting. CIRL staff benefit from the professional development that this organization provides. *(MagLab contact: Kawana Johnson, Educational Programs)*

Leon County Schools, Tallahassee, FL: CIRL works closely with Leon County Schools (LCS) through our K-12 outreach and our middle school mentorship program. In 2014, CIRL staff worked with Title I elementary school teachers from LCS to develop and facilitate a year-long teacher professional development that culminated in a STEM challenge for students. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Los Angeles County Museum of Natural History, Los Angeles, CA: The collaboration between the IVPP and the MagLab is related to the investigation of Late Cenozoic Vertebrate Paleontology and Paleoenvironments of the Tibetan Plateau (China). Stable isotopic compositions of the samples collected in this project are analyzed in the Geochemistry Laboratories in the MagLab. *(MagLab contact: Yang Wang, Geochemistry Program)*

National Girls Collaborative Project, Seattle, WA: This is a national nonprofit organization that works to improve girls' interest in and access to STEM programs and careers. CIRL has utilized their publications and webinars for best practices in STEM education. CIRL's research has also informed their work. *(MagLab contact: Roxanne Hughes or Kari Roberts, Educational Programs)*

National Postdoc Association, Washington, DC: The National Postdoc Association (NPA) advocates for postdoctoral scholars at a national level and coordinates an annual meeting of postdoctoral scholars, their mentors and postdoctoral affairs staff. Florida State University is an affiliate member, so all postdocs at the FSU branch receive complementary membership to the NPA. Additionally, representatives from the lab attend the annual meeting regularly to stay up to date on the latest issues and initiatives related to postdoctoral affairs. The NPA provides direct support to postdocs through professional development and a virtual career center. (*MagLab contact: Kawana Johnson, Educational Programs*)

SciGirls National, Saint Paul, MN: This program is run by Twin Cities Public Television and provides both programming and resources for educators and girls to increase their interest and sense of belonging in STEM. CIRL utilizes these resources to train our summer camp educators and local teachers. In addition, CIRL's research has informed the SciGirls program and curriculum. *(MagLab contact: Roxanne Hughes, Educational Programs)*

Supporting Teachers to Encourage the Pursuit of Undergraduate Physics (STEP UP), Miami, FL: STEP UP is a national community of physics teachers, researchers and professional societies. They have designed high school physics lessons to empower teachers, create cultural change, and inspire young women to pursue physics in college. It is supported by NSF, APS Physics, AAPT and FIU. *(MagLab contact: Carlos R. Villa, Educational Programs)*

WFSU-TV, Tallahassee, FL: The Center for Integrating Research & Learning partners with WFSU-TV, the area's public television station, to administer SciGirls. The program includes two summer camps for middle school girls with an interest in science. The collaboration between the MagLab and WFSU-TV has resulted in a successful partnership that has lasted over a decade. *(MagLab contact: Carlos R. Villa, Educational Programs)*

Spin offs or Research Laboratories and Corporations

Black Fox LLC, Tallahassee, FL: Black Fox LLC is a spinoff company that builds custom magnetic resonance probes for research institutions. It was formed in 2016. *(MagLab contact: Peter Gor'kov)*

Center for Advanced Power Systems (CAPS), Tallahassee, FL: The Center for Advanced Power Systems (CAPS) is a multidisciplinary research center organized to perform basic and applied research to advance the field of power systems technology. CAPS emphasis is on application to electric utility, defense, and transportation, as well as developing an education program to train the next generation of power systems engineers. The research focuses on electric power systems modeling and simulation, power electronics and machines, control systems, thermal management, cyber-security for power systems, high temperature superconductor characterization and electrical insulation research*. (MagLab contact: Greg Boebinger)*

Future Fuels Institute, Tallahassee, FL: The Future Fuels Institute (FFI) was established to enhance the existing Ion Cyclotron Resonance (ICR) Program at the MagLab to deal specifically with bio- and fossil fuels, particularly for heavy oils and synthetic crudes. Supported by sponsoring companies and collaborative entities (instrument companies, universities, and research institutes), the FFI works to develop and advance novel techniques for research applications and industrial problem solving. Recent research has focused on biofuels and recycling efforts for petroleum-based materials (plastics). The institute also serves as a training center for fuel-related science and technology. It is currently part of an international joint laboratory (iC2MC), funded by TotalEnergies. (*MagLab contact/ Director: Ryan Rodgers*)

High-Performance Materials Institute (HPMI), Tallahassee, FL: The High-Performance Materials Institute (HPMI) is a multidisciplinary research institute for research and education in the field of advanced materials. Currently, HPMI is involved in four primary technology areas: High-Performance Composite and Nanomaterials, Structural Health Monitoring, Multifunctional Nanomaterials Advanced Manufacturing and Process Modeling. Over the last several years, HPMI has proven a number of technology concepts that have the potential to narrow the gap between research and practical applications of nanotube-based materials. These technologies include magnetic alignment of nanotubes, fabrication of nanotube membranes or buckypapers, production of nanotube composites, modeling of nanotube-epoxy interaction at the molecular level, and characterization of SWNT nanocomposites for mechanical properties, electrical conductivity, thermal management, radiation shielding and EMI attenuation. *(MagLab contact: Greg Boebinger)*

MagCorp, Tallahassee, FL: MagCorp is a new Tallahassee company that facilitates access to the world's leading magnetic experts to solve real world industrial problems. MagCorp was created to meet industry needs for feasibility studies, prototyping, and product development while eliminating the confusion that can come from partnering with academic institutions and research foundries. MagCorp is the world's one-stop shop for magnet science solutions and is the essential conduit between the private and government sectors and the National High Magnetic Field Lab. Leveraging completely new client and partner facing business models, MagCorp has already begun to attract industry to Tallahassee and put it on the map as the emerging magnetic capital of the world. (*MagLab contact: Greg Boebinger*)

MAXIKAT, Inc., Tallahassee, FL: Maxikat is a spinoff company that performs data analysis for petroleum industry. It was formed in 2015. *(MagLab contact: Vladislav Lobodin)*

Omics LLC, Tallahassee, FL: Omics LLC is a spinoff company that serves the data analysis and interpretation needs of the high-resolution mass spectrometry market. It was formed more than fifteen years ago and has grown over the years to address a wider analytical community. *(MagLab contact: Ryan Rodgers)*

2. User Facilities

2.1 User Program

Proposal Review Process

Across all seven facilities, proposals for magnet time are submitted online via https://users.magnet.fsu.edu and reviewed in accordance with the MagLab User Proposal Policy. In brief, each user facility has a User Proposal Review Committee (UPRC) comprised of at least seven members, with more external members than internal. UPRC memberships are treated confidentially by the laboratory but are available for review by NSF and MagLab advisory committees. Proposal reviews are conducted in strict confidence and are based on two criteria: (1) the scientific and/or technological merit of the proposed research and (2) the "broader impacts" of the proposed work. They are graded online according to a scale, ranging from "A" (Proposal is high quality and magnet time must be given a high priority) to "C" (Proposal is acceptable and magnet time should be granted at MagLab discretion) to "F" (Proposal has little/no merit and magnet time should not be granted). The Facility Directors merge the UPRC recommendations with the availability and scheduling of specific magnets, experimental instrumentation, and user support scientists and make recommendations for magnet time assignments to the MagLab Director. The MagLab Director is responsible for final decisions on scheduling of magnet time based on these recommendations. All 2022 User Proposals can be found in **Appendix V**.

User Funding Opportunities

Dependent Care Travel Grant

The MagLab recognizes the external demands of a research career placed on caregivers of children and other dependents. For caregivers, travel to the MagLab in order to conduct experiments or to conferences to disseminate research findings often incurs extra costs for dependent care. Since 2011, the MagLab's Dependent Care Travel Grant (DCTG) program offers up to $800 per year for travel expenses for MagLab scientists traveling to conferences or MagLab users traveling to any of the three MagLab facilities. In 2021, we are proud to have provided support to a married pair of postdocs at the lab, alleviating travel costs for their 13-month-old dependent to travel with them to the APS March meeting. Starting in 2023, the MagLab Dependent Care Travel Grant Program will be endowed at a level enabling $1200 in annual grants.

First Time User Support

The MagLab is charged by the National Science Foundation with developing and maintaining facilities for magnet-related research that are open to all qualified scientists and engineers through a peer-reviewed proposal process. Facilities are generally available to users without cost. In an effort to encourage new research activities, first-time users are provided financial support for travel expenses. International users are provided $1,000 of support and domestic users are provided $500 of support for their travel costs. This funding is provided by the State of Florida and is available for Tallahassee user facilities only.

Visiting Scientist Program (VSP)

The National High Magnetic Field Laboratory provides researchers from academia, industry, and national laboratories the opportunity to utilize the unique, world-class facilities of the laboratory to conduct magnet-related research. In 2022, the Visiting Scientist Program provided financial support of $8,715 for three research projects on a competitive basis.

To apply for support from the Visiting Scientist Program, interested researchers are required to submit an application and a proposal that will be reviewed by appropriate facility directors and scientists at the MagLab. All requests for support must be submitted online at https://vsp.magnet.fsu.edu/ .

User Collaboration Grants Program (UCGP)

The National Science Foundation charged the National High Magnetic Field Laboratory with developing an internal grants program that utilizes the MagLab facilities to carry out high quality research at the forefront of science and engineering and advances the facilities and their scientific and technical capabilities. User Collaboration Grants

Program (UCGP), established in 1996, stimulates magnet and facility development and provides intellectual leadership for research in magnetic materials and phenomena.

The Program strongly encourages collaboration between MagLab scientists and external users of MagLab facilities. Projects are also encouraged to drive new or unique research, i.e., serve as seed money to develop initial data leading to external funding of a larger program. In accord with NSF policies, the MagLab cannot fund clinical studies.

Twenty-two (24) UCGP solicitations have now been completed with a total of 616 pre-proposals being submitted for review. Of the 616 proposals, 326 were selected to advance to the second phase of review, and 148 were funded (24% of the total number of submissions).

2022 Solicitation and Awards

The MagLab UCGP has been highly successful as a mechanism for supporting outstanding projects in the various areas of research pursued at the laboratory. It uses a two-stage proposal review process handled by means of a web-based system. Proposal review is done be a combination of internal and external reviewers. Details of the process and review criteria are available on the website https://ucgp.magnet.fsu.edu/Guidance/ReviewCriteriaAndProcess. The most recent solicitation is complete, and its awards will be issued approximately in March 2023.

Of the 13 pre-proposals received, 6 pre-proposals advanced to the full proposal state. Of the 6 full proposals, 3 were awarded. A breakdown of the review results is presented in **Tables 1 and 2**.

Table 1. *UCGP Proposal Solicitation Results*

Research Area	Pre-Proposals Submitted	Pre-Proposals Proceeding to Full Proposal	Projects Funded
Condensed Matter Science	7	3	0
Biological & Chemical Sciences	3	2	2
Magnet & Magnet Materials Technology	3	1	1
Total	**13**	**6**	**3**

Table 2. *UCGP Funded Projects from 2022 Solicitation.*

Principal Investigator	NHMFL Institution	Project Title	Funding
Thierry Dubroca	FSU	State of the art electron spin resonance control	$225k
Martha Chacón-Patiño	FSU	Automated Analysis of Time-Dependent, Big Data for Ultrahigh Resolution Fourier Transform Ion Cyclotron Resonance Mass Spectrometry	$225k
Kwangmin Kim	FSU	HTS module performance evaluation system based on the conduction cooling method	$214k

Future Solicitations

The next solicitation announcement is planned to occur around April of 2023.

Results Reporting

To assess the success of the UCGP, reports were requested in January 2023, on 23 grants issued from the five solicitations which had start dates from 2016 through 2021. At the time of the reporting, some of these grants were in progress, and some had been completed. For this "retrospective" reporting, PIs were asked to include external grants, MagLab facilities enhancements, and publications that were generated by the UCGP. Since UCGP grants are intended to seed new research through high-risk initial study or facility enhancements, principal investigators (PIs) were allowed and encouraged to report results that their UCGP grant had made possible, even if these were obtained after the term of the UCGP grant was complete.

The PIs reported:

- Lab enhancements, which are listed in **Table 3** below.
- At least partial support for 14 undergraduate researchers, 23 grad students and 13 postdocs.

- 19 funded external grants, which were seeded by results from UCGP awards. The total dollar value of the external grants was $40M including two DOE Energy Frontier Research Centers.
- 121 publications, many in high profile journals, including 6 in *JACS*, 2 in *Nature*, 6 in *Nature Communications*, 1 in *Nature Physics,* 1 in *Nature Quantum Materials,* 1 in *Nature Chemistry,* 4 in *Physical Review Letters*, 3 in *PNAS* 1 in *Science Advances* and 1 in *Science.*

Table 3. *Facility Enhancements Reported from last five UCGP Solicitations*

Enhancement	***Date available***	***User Groups****
Magnetometer for Large Magnet Moments with Strong Magnetic Anisotropy	06/01/2021	6
Superconducting cable critical current measurement using a superconducting transformer	08/01/2021	1
Developed diamond anvil cell for pulsed fields	01/01/2022	1
Online liquid chromatography for environmental applications (metal and organic speciation)	09/01/2022	3
Low-pass filters for ultra-low electron temperatures	11/29/2021	2
Ultra-low temperature NMR spectrometers at Bay 2 of High B/T facilities	01/31/2020	1
Razorbill piezoelectric uniaxial strain/stress	05/31/2019	3
Tuning fork thermometer software	12/01/2021	2
Rapid field sweeping measurement of heat capacity, up to 5T/min	01/01/2020	5
Magneto-Raman spectroscopy down to 2K and high pressures up to 20GPa	03/01/2022	1
PEPPI-MS fractionation	06/06/2020	1
Pulsed EPR at 395GHz	01/01/2021	4
Tunnel diode oscillator (TDO) measurements	01/01/2016	3
ARS Cryocooler System for Parahydrogen Enrichment to 99%	06/01/2021	2
Ultimate3000 LC system, with low flow rate capability	09/01/2022	1
New capability for the measurement of dilation with 10x improved sensitivity	10/31/2022	1
High resolution angle dependent heat capacity	12/01/2020	5
Packed Bed Heterogeneous Catalytic Reactor for Continuous-Flow Hyperpolarization	05/01/2022	2
We now have a trace-metal free LC system that can operate at low flow rates	09/01/2022	1
In-house designed and built piezoelectric strain device for pulsed fields	08/01/2021	1
High resolution heat capacity < 0.01pJ/K^2	06/01/2020	5
Quasi-optical beam transport in the MAS-DNP 600 MHz NMR setup.	11/01/2017	10
Piston Cylinder Cell high pressure measurements	01/01/2016	2
Ultrasonic Spray Injection Reactor System	06/01/2022	2
Lowered electron temperature in dilution fridge > 300mK < 30mK	06/01/2021	5
Rapid high resolution temperature dependence of heat capacity	06/01/2020	5
Batch Catalytic Reactor System with Automated NMR Acquisition	02/01/2023	2

** Number of external users (PI's or private companies only) reported to have used the enhancement.*

Annual User Survey

The MagLab conducted its twelfth annual user survey between June 1, 2022, and June 30, 2022. This annual survey guides the MagLab in setting priorities and planning for the future, assists all seven facilities in responding to user needs and improving the facilities and services. The survey was sent to all MagLab User Principal Investigators (PI) and to their collaborators who received magnet time between June 1, 2021, and May 31, 2022, including PIs who sent samples for experiments performed by laboratory staff scientists. Out of 869 eligible users, we received feedback from 165 (19%) users. 18% of all external users responded to the survey. All user responses were treated as confidential. **Figures 1-7** exclude internal responses.

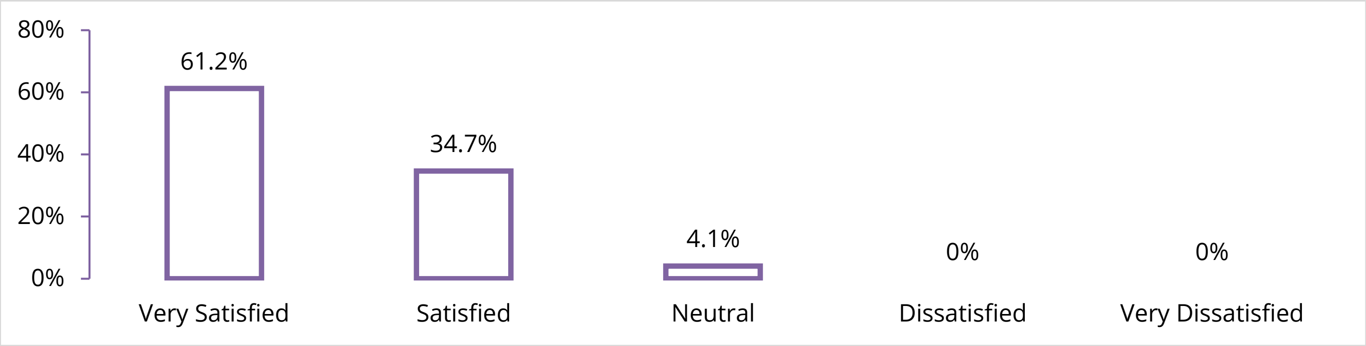


Figure 1. *95.9% of external users were satisfied or very satisfied with the proposal process (e.g., submission, review).*

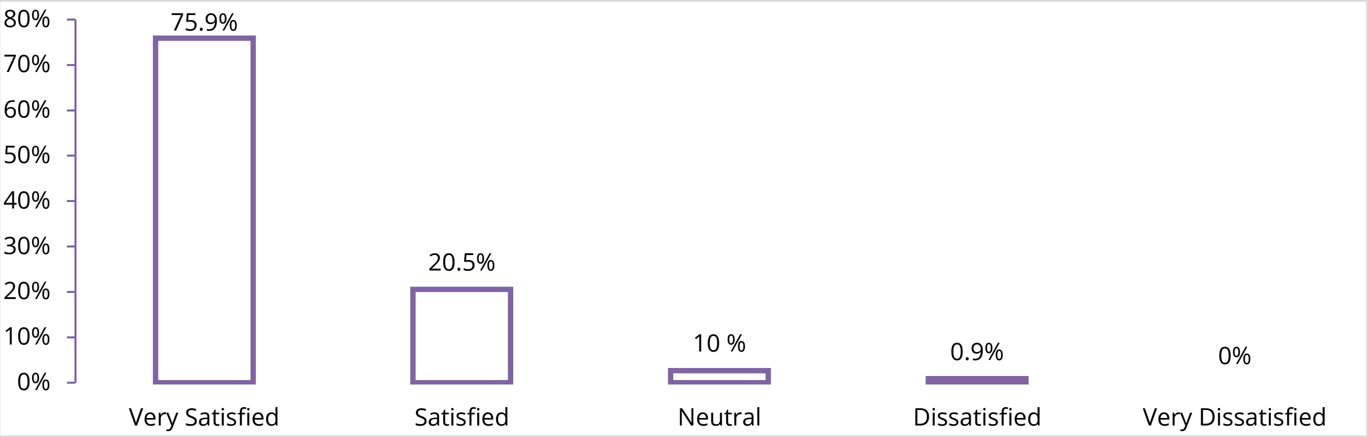


Figure 2. *96.4% of external users were satisfied or very satisfied with the availability of the facilities and equipment.*

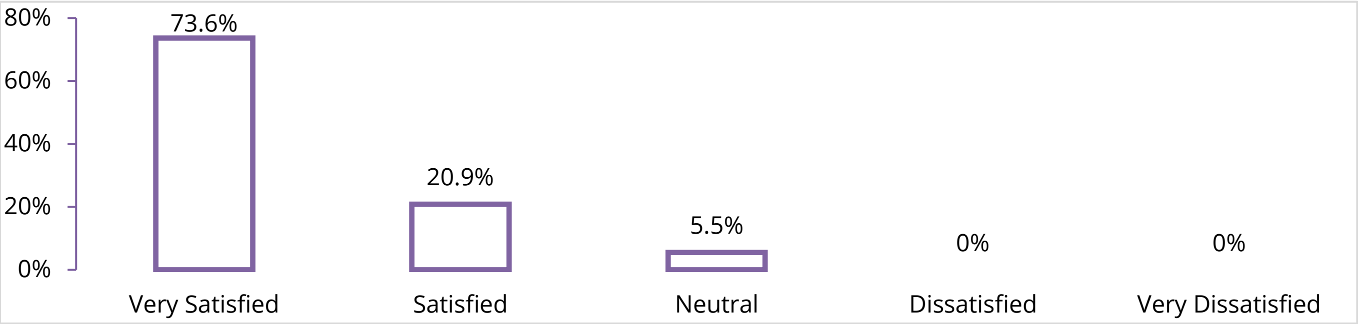


Figure 3. *94.5% of external users were satisfied or very satisfied with user friendliness of training and safety procedures.*

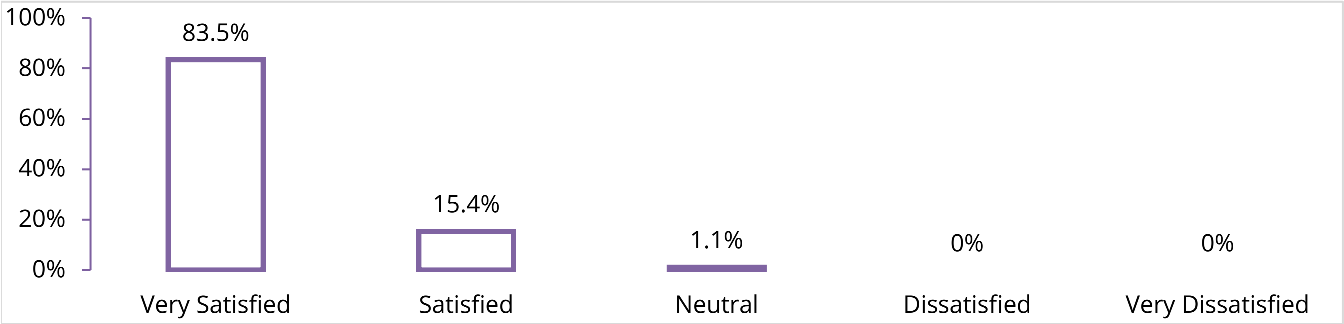


Figure 4. *98.9% of external users were satisfied or very satisfied with the overall safety at the MagLab.*

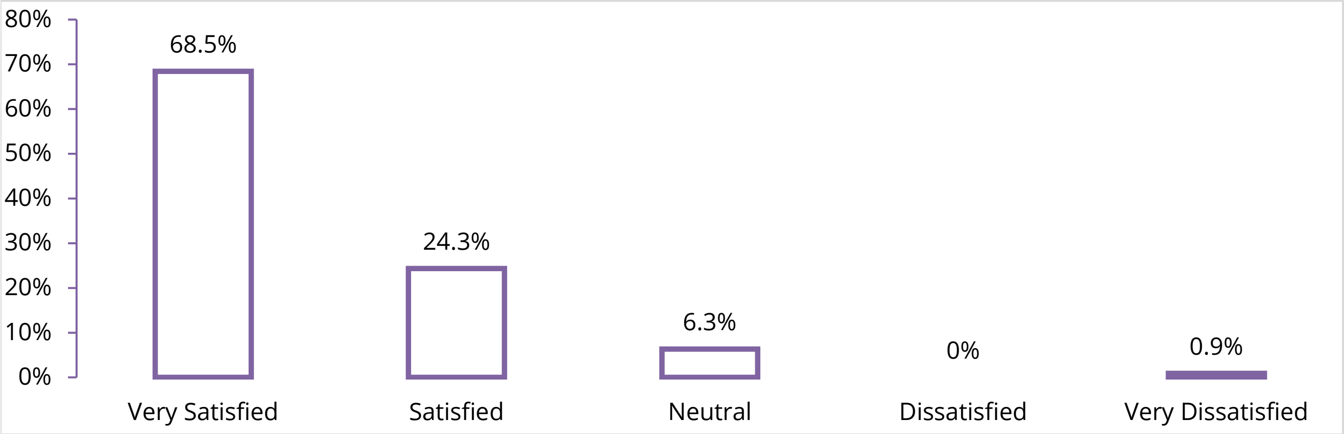


Figure 5. *92.8% of external users were satisfied or very satisfied with the performance of facilities and equipment (e.g., were they maintained to specifications for intended use, ready when scheduled, etc.).*

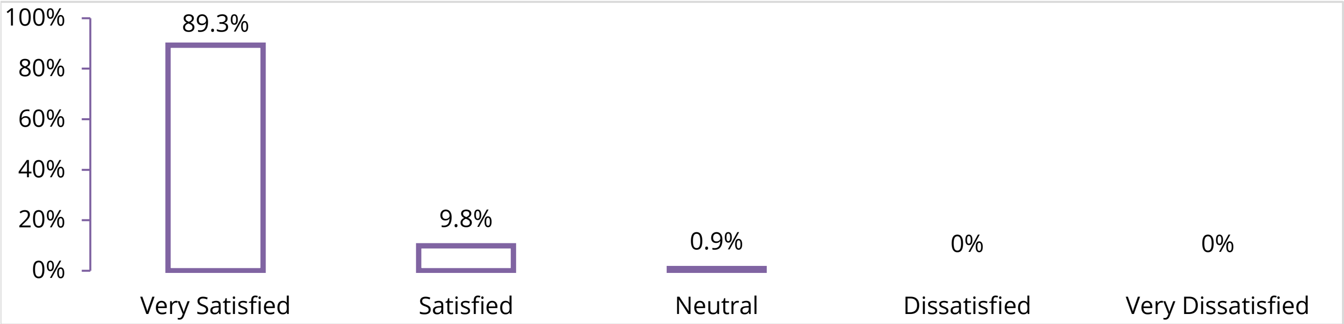


Figure 6. *99.1% of external users were satisfied or very satisfied with the assistance provided by MagLab facilities technical staff.*

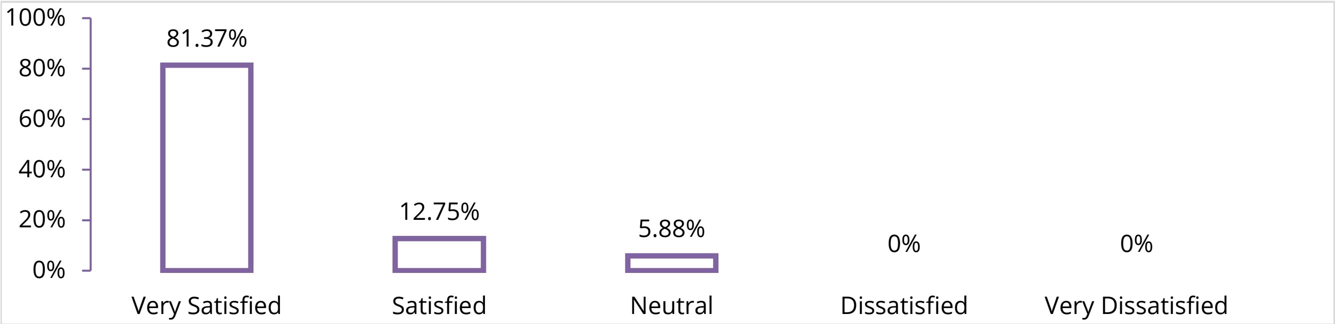


Figure 7. *94.12% of external users were satisfied or very satisfied with the assistance provided by MagLab facilities administrative staff.*

2.2 Seven User Facilities

AMRIS Facility

The AMRIS Facility at University of Florida supports nuclear magnetic resonance spectroscopy (NMR) and magnetic resonance imaging (MRI) studies of chemical compounds, biomolecular systems, tissues, small animals, large animals and humans. We offer fourteen systems with different magnetic fields and configurations to users for magnetic resonance experiments. AMRIS has fifteen professional staff members to assist users, maintain instrumentation, build new coils and probes, and help with administration.

Unique Aspects of Instrumentation Capabilities

AMRIS Magnetic Resonance instruments **(Table 1)** offer users unique capabilities particularly focused on applications in chemistry and biology: the 750MHz wide bore provides outstanding high-field imaging for excised tissues and small animals as well as diffusion measurements with gradient strengths up to 30T/m; the 11.1T horizontal MRI has a large 400mm bore size and gradient strengths up to 1.5T/m; our solution NMR instruments have state-of-the-art cryoprobes for natural products, structural biology, metabolomics, and metabolic flux measurements in perfused organs; two dissolution DNP polarizers are available for in vivo measurements of metabolic flux. Two spectrometers are now equipped with state-of-the-art Bruker NEO hardware, which support multichannel transmit and receive experiments. These systems support a broad range of science, including natural product identification, membrane protein structure determination, cardiac studies in animals and humans and correlation of neural structures with brain function and chemistry.

Table 1. *NMR & MRI Systems in the AMRIS Facility at UF in Gainesville available through the MagLab User Program*

^{1}H Frequency	Field (T), Bore (mm)	Homogeneity	Measurements
800MHz	18.8, 63	1ppb	Solution/solid-state NMR and HR-MAS
800MHz	18.8, 54	1ppb	Solution NMR (Cryoprobe)
750MHz	17.6, 89	1ppb	Solution/solid-state NMR and MRI/S
600MHz	14.1, 51	1ppb	NMR, microimaging, hyperpolarization
600MHz	14.1, 89	1ppb	NMR and hyperpolarization (10 mm Cryoprobe)
600MHz	14.1, 51	1ppb	Solution NMR (Micro Cryoprobe)
600MHz	14.1, 54	1ppb	Solution NMR (Cryoprobe)
470MHz	11.1, 400	0.1ppm	DNP, MRI and NMR of animals
212MHz	5.0, 89	1ppm	DNP polarization
143MHz	3.35, 52	1ppm	DNP polarization

Facility Developments and Enhancements

The 800MHz wide bore/ 63mm system was upgraded with a 1.3mm HCN probe for fast MAS biosolids. A ^{2}H cryocoil (and related room-temperature coils) are being developed to enable metabolic flux measurements in tandem with proton MRI/S measurements on the 11.1T instrument through funding from a UCGP grant. All of our vertical bore systems can be operated remotely with users sending samples to AMRIS staff. We note that due to decreased funding from the NSF for NMR/MRI user support, our 3.0T MRI/S scanners, a 7.0T 200mm MRI/S scanner purchased with an NIH grant in 2022, and the 500MHz NMR system no longer receive support from the MagLab user program and will no longer be included in annual reporting. These instruments are available on a fee-for-service basis and will continue to be independently administered by the AMRIS Facility. A new NEO console is on order for the 750MHz NMR/MRI instrument and will be installed in June 2023.

Major Research Activities and Discoveries/ Research Science Highlights

We note that although our facility is back to full operations for all users, many of our users continue to collect data remotely. Our staff provide on-site support for users who choose to send samples and then control the spectrometers remotely to collect data. This is working well for structural biology experiments, high resolution ex vivo MRI measurements, and diffusion studies of materials. The majority of users on site are conducting in vivo studies that require their presence. Local graduate students and postdoctoral fellows continue to develop DNP hyperpolarization and in vivo spectroscopy techniques for metabolic studies. AMRIS facility users reported 64 peer-reviewed publications and 19 theses and dissertations during 2022, despite access and personnel restrictions in place from March 2020 to summer 2022. Three highlights from the publications and graduate research projects are listed below. We note that beginning in 2023 we will be reporting only publications for instruments who receive some of their support from the NSF user program.

Atmospheric Carbon Dioxide from Peat Wetland Ecosystems (Figure 1)

Anna E. Normand[1], B.L. Turner[1,2], A.N. Smith[1], B. Baiser[1], M.W. Clark[1], J.R. Long[1,3], S.P. Grover[4], K.R. Reddy[1]

1. University of Florida; 2. Smithsonian Tropical Research Institute, Panama; 3. National MagLab - AMRIS Facility; 4. La Trobe University, Australia

Funding: *NHMFL (NSF DMR-1644779, G. Boebinger); NSF Graduate Research Fellowship (GMO2432, A. Normand)*

Citation: *Normand, A.E.; Turner, B.L.; Lamit, L.J.; Smith, A.N.; Baiser, B.; Clark, M.W.; Hazlett, C.; Kane, E.S.; Lilleskov, E.; Long, J.R.; Grover, S.P.; Reddy, K.R., Organic matter chemistry drives carbon dioxide production of peatlands, Geophysical Research Letters, 48 (18), e2021GL093392 (2021)* doi.org/10.1029/2021GL093392

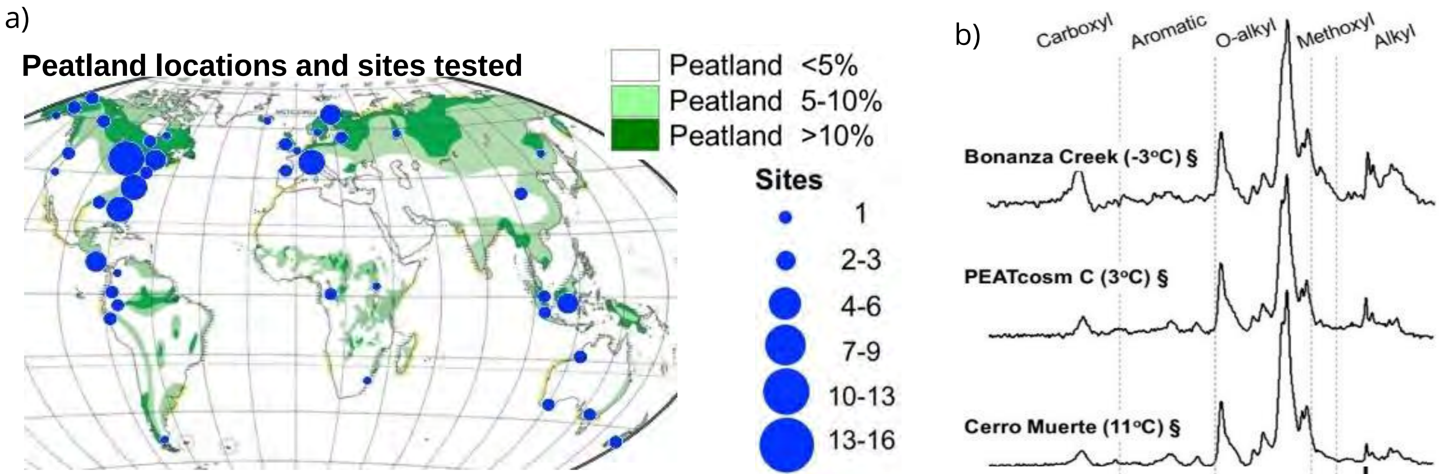


Figure 1*. (a) Peat soils vary by mean annual temperature (−3 to 26°C); vegetation (mossy §, herbaceous †, or woody ‡), and land-use by humans (nonimpacted and long-term impacted*). (b) Spectral regions correspond to carbon functional groups: alkyl (0–45ppm), methoxyl (45–60ppm), oxygen-alkyl (60–110ppm), aromatic (110–160ppm), and carboxyl (160–220ppm).*

Peat soils release carbon into the atmosphere when land is drained for use or warmed by a changing climate. The potential for carbon dioxide (CO_2) gas formation by aerobic microbial conversion depends on the soil's organic carbon source. Soil content is determined by mean annual temperature, vegetation type, and land-use conditions. In this research, soil samples were obtained from 125 global peatland ecosystems for analysis by solid-state nuclear magnetic resonance spectroscopy (ssNMR). A subset of 11 sites revealed that oxygen-alkyl chemistry (i.e., carbohydrates) is the strongest predictor of aerobic CO_2 production.

This research supports and extends previous studies of temperate and boreal peatlands that linked CO_2 production to polysaccharide or oxygen-alkyl carbon composition. This research also suggests that climate models can be improved by using oxygen-alkyl carbon content to predict risk of increased CO_2 production. Peat samples were analyzed by magic angle spinning (MAS) ^{13}C NMR spectroscopy at the MagLab's AMRIS Facility using a 3.2 mm E-free H/C/N probe built to a specialized MagLab probe design that protects the sample from chemical degradation.

On the Origin of MRI Signal In Stroke (Figure 2)

Stephen J. Blackband[1,2], JJ Flint[1], B Hansen[3] , TM Shepherd[4] , CH Lee[1,4], WJ Streit[1], JR Forder[1,2]
1. University of Florida; 2. National MagLab; 3. Aarhus University, Denmark; 4. New York University School of Medicine
Funding: *NHMFL (NSF DMR-1644779, G. Boebinger); Blackband (NIH R01EB012874)*
Citation: *Blackband, S.J.; Flint, J.J.; Hansen, B.; Shepherd, T.M.; Lee, C.H.; Streit, W.J.; Forder, J.R., On the Origins of Diffusion MRI Signal Changes in Stroke, Frontiers in Neurology, 11, 549 (2020) doi.org/10.3389/fneur.2020.00549*

Glial cells represent a major fraction of the total brain volume, and they are responsible for maintaining homeostasis to ensure accurate and consistent neuronal function. In diffusion magnetic resonance (MR) microscopy studies of tissue infarct using isolated Aplysia (sea slug) neurons, they are surrounded by satellite glial cells which appear hyperintense, as they balance water to the neuron following injury, compared to the hypointense dark interior of the neuron. Instead of a swelling in the neuronal cells, this research presents evidence that a swelling of glial cells following ischemia is the cause of the MR hyperintensity in stroke, potentially solving a 30-year-old mystery on the origin of the MRI signal in stroke victims.

A quantitative understanding of changes in glial cell volume will allow the development of working mathematical models that can be used on tissues in situ to understand signal changes in disease, like reversible and irreversible ischemia. Instrumentation is being developed to improve these measurements by moving to higher magnetic fields, including the MagLab's 35T magnet. These studies ultimately aim to improve clinical MR significantly by increasing its sensitivity and specificity.

We expect that this work will lead to improved diagnostics for other brain disorders where glial cells may play a role, including mood disorders, sleep disorders, movement disorders such as Parkinson's, and memory disorders such as Alzheimer's.

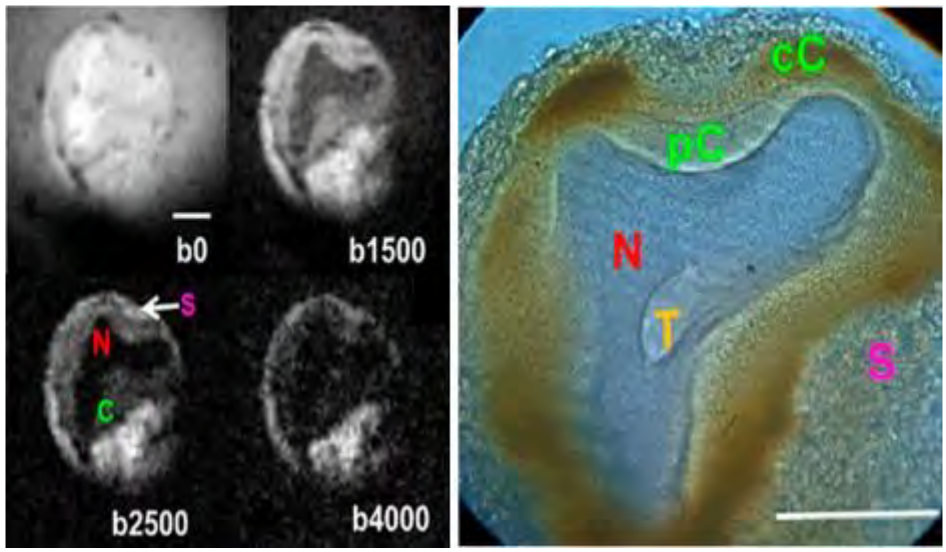


Figure 2. *(a) Diffusion MR microscopy of a sea slug neuron at 7.8 μM resolution (**left**) showing hyperintensity (brightness) due to water diffusion in glial satellite cells. (b) The cellular structures can also be identified using 40X traditional light microscopy (**right**). N = nucleus, C = cytoplasm (perinuclear and cortical), T = trophospongium (sea slug invagination), S = satellite cells. Scale bar is 100 μm.*

Atomic-Level Insights into How Polymers Improve Protein Therapeutics (Figure 3)

Amanda Pritzlaff, Guillaume Ferré, Emma Mulry, Ling Lin, Niloofar Gopal Pour, Daniel A Savin, Michael E Harris, Matthew T Eddy; University of Florida, Department of Chemistry
Funding: *NHMFL (NSF DMR-1644779, G. Boebinger); M.T. Eddy (NIH R35GM138291); E. Mulry (NIH T32 GM136583); M. Harris (NIH R35GM127100)*
Citation: *Pritzlaff, A.; Ferre, G.; Mulry, E.; Lin, L.; Gopal Pour, N.; Savin, D.; Harris, M.; Eddy, M.T., Atomic-Scale View of Protein-PEG Interactions that Redirect the Thermal Unfolding Pathway of PEGylated Human Galectin-3, Angewandte Chemie International Edition, 61, e202203784 (2022) doi.org/10.1002/anie.202203784*

Therapeutic biologics, specifically protein drugs, can be complex and unstable in the harsh environment of the human body. A promising approach to overcoming these challenges is covalent attachment of a polymer such as polyethylene glycol (PEG) to reactive groups in protein side chains. However, little structural information is available for protein-polymer conjugates that would allow one to design PEGylated proteins with predictable properties.

Prof. Matthew Eddy who was recruited to UF by the MagLab to lead the development of new capabilities in NMR and showcase their application to challenging biological problems worked with a collaborative team of polymer chemists, biochemists, and structural biologists to develop a structural model of a PEGylated human protein to visualize how the polymer and protein interact and relate this model to thermodynamic and functional properties of the PEGylated protein. This interdisciplinary team included both undergraduate and graduate students. Key to obtaining new insights into protein-polymer interactions was use of the high field NMR facilities at the MagLab's AMRIS facility, including highly sensitive NMR probes and spectrometers.

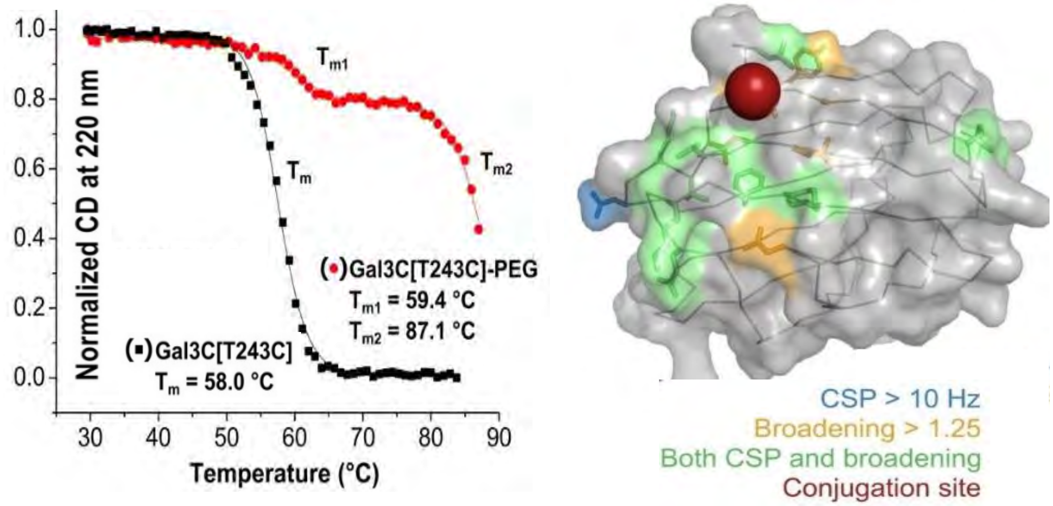


Figure 3. *Left: PEGylation of the human galectin-3C protein (Gal3C) provided a significant increase in the thermal stability of the protein without hindering its functional properties (above right, red curve). Right: High resolution NMR spectroscopy at the MagLab's AMRIS Facility provided variable temperature ^{1}H-^{15}N correlation spectra that enabled a visualization of the interactions of the polymer and the protein with amino acid specificity in order to develop a model indicating that the polymer behaved as a loosely attached "cloud" surrounding a particular region of the protein (colored areas in the schematic above).*

This work establishes a toolbox for systematically evaluating the impacts of PEGylation on protein function and stablity. Improved insights into protein-polymer interactions will allow future design of protein-polymer conjugates with predictable chemical and physical properties, enabling design of new pharmaceuticals and protein-polymer conjugates with important industrial applications.

Facility Plans and Directions

In spite of the COVID-19 pandemic and a continued challenging budgetary climate, our users have consistently and successfully pursued federal funding to support their research programs in addition to assisting the AMRIS facility in writing proposals to upgrade instrumentation. The successful partnership of the MagLab user program with individual investigator research grants provides constant scientific motivation for our technology development. One capability we are particularly focused on enhancing is our cryocooled NMR probes and MRI coils that greatly increase sensitivity. To this end, we are supporting the maintenance of conventional NMR cryoprobes as well as HTS NMR cryoprobes developed through our NIH-funded technology center for NMR probe development, the development of an ^{2}H MRI/S cryocoil for our 11.1T MRI/S scanner through a UCGP, and the initiation of a construction project of a new 3mm HTS cryoprobe for use with the state-of-the-art Bruker NEO console. We are also boosting Low-E MAS probe capabilities at 800MHz with the construction of 1.6 and 3.2mm probes for recently added NMR systems. The 750MHz console (last upgraded in 2013) is aging and will be updated with an NEO console and new amplifiers in June 2023, making it cross compatible with other AMRIS MRI/S systems and the NHMFL 900MHz system in Tallahassee. This will provide users with state-of-the-art MRI/S instrumentation at four different field strengths—7, 11.1, 17.6, and 21.1T, allowing users facile field-dependent studies. Due to decreased funding from the NSF for NMR/MRI user support, the 7.0T 200mm MRI/S scanner we are installing this year and our 500MHz NMR system will no longer be available to users free of charge through the MagLab user program. These instruments are available on a fee-for-service basis and will continue to be independently administered by the AMRIS Facility. Beginning in 2022, these instruments along with our 3T MRI/S scanners will no longer be included in annual usage statistics provided for the MagLab.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

Amy Howe coordinates the outreach efforts on behalf of both the AMRIS and High B/T MagLab facilities located at the University of Florida, in Gainesville, FL. During the 2021-2022 period, local schools had imposed restrictions permitting virtual visits only, and despite the MagLab offering to provide live video sessions with loaner kits containing interactive magnet activities, the teachers did not place any virtual outreach requests. When the in-person visits were allowed to resume in late-March 2022, there were immediate requests for magnet lessons that allowed us to reach 210 students at Title-I schools in grades K-8 before the end of that school year; however, requests remained suppressed relative to their pre-pandemic levels.

To advertise the availability of MagLab outreach beyond the local school board listings, tour request forms and links to virtual content were added to the AMRIS website and also promoted at professional conferences, including the Experimental Nuclear Magnetic Resonance Conference (ENC) in Orlando, FL, where 45 children present at the hotel participated in interactive magnet activities at the event site. The MagLab Users Program was also promoted to researchers attending the ENC event. The University of Florida also allowed the Neuroscience academic program to conduct middle school summer camp activities on campus, so members of AMRIS staff were able to interact with 30 local, middle school girls for a facility tour and hands-on electromagnet-building activities.

Following a MagLab outreach event at the Florida Association of Science Teachers Conference, October 27-29, 2022, request forms were submitted from remote/rural schools located in Perry and Interlachen, FL, each more than an hour away from Tallahassee or Gainesville. Amy was able to travel to two of these Title-I schools and conduct electromagnet-building activities with 330 fifth graders before the close of the 2022 calendar year. The MagLab Research Experiences for Teachers (RET) summer session also provided Amy with her first opportunity to mentor an 8th grade teacher from a school filled with primarily minority students, and through monthly virtual meetings they discussed inclusivity and methods to incorporate additional science content in the teacher's lesson plans.

The total number of people directly contacted through in-person outreach efforts by the AMRIS and HBT Facility personnel: 616 students and teachers in grades K-12; 66 college undergrad and graduate students and postdocs at the Gainesville facilities for a seminar, tour, or workshop; and approximately 1,300 scientists of various levels attending professional conferences where the MagLab was promoted by AMRIS or HBT staff. The values have returned to levels comparable to our pre-pandemic outreach numbers.

Facility Operations Schedule

The AMRIS facility operates all year, except during the last week of December when the University of Florida is shut down. Vertical instruments for ex vivo samples are scheduled 24/7, including holidays and weekends. Horizontal instruments operate primarily 8-10 hours/day, 5 days/week due to the difficulty in running animal or human studies overnight, with the exception of an 11.1T scanner which operates at 7 days a week due to oversubscription. During 2022 the AMRIS Facility was in full operation while continuing to follow COVID-19 safety protocols. We saw a steep rise in demand for instruments supporting in vivo experiments as users returned to normal research operations. The need to accommodate users endeavoring to make up lost momentum on their studies led to our supporting 11.1T MRI/S operations seven days a week. We anticipate demand for this instrument will return to pre-pandemic levels with the 7T MRI/S scanner coming online in May 2023, and we will return to 5 days/week operations in keeping with our scientific staffing levels.

DC Field Facility

The DC Field Facility in Tallahassee serves a large and diverse user community by providing continuously variable magnetic fields in a range and quality unmatched anywhere in the world. The DC Field user community is made up of undergraduate students, graduate students, postdocs and senior investigators from around the country and the world. State-of-the-art instrumentation is developed and coupled to these magnets through the efforts of our expert scientific and technical staff. The users of the DC Field Facility are supported throughout their visit by the scientific, technical and administrative staff to ensure that their visit is as productive as possible. The interaction between the NHMFL scientific and technical staff with the students, post docs and senior investigators who come to the DC Field Facility to perform their research results in a continuous mix of scientific ideas and advanced techniques that are passed both to and from users.

Unique Aspects of Instrumentation Capabilities

Table 1. *DC Field Magnets*

FLORIDA-BITTER and HYBRID MAGNETS		
Field, Bore, (Homogeneity)	**Power (MW)**	**Supported Research**
45T, 32mm, (25ppm/mm) **41.5T**, 32mm, (25ppm/mm) **36T**, 40mm, (1ppm/mm)[2] **35T**, 32mm (x2) **31T**, 32mm to 50mm[1] (x2) **25T**, 32mm bore (with optical access ports)[3]	30.4 32 14 19.2 18.4 27	Magneto-optics – ultra-violet through far infrared; Magnetization; Specific heat; Transport – DC to microwaves; Magnetostriction; High Pressure; Temperatures from 30mK to 1500K; Dependence of optical and transport properties on field, orientation, etc.; Materials processing; Wire, cable, and coil testing. NMR, EMR, and sub/millimeter wave spectroscopy.
SUPERCONDUCTING MAGNETS		
Field (T), Bore (mm)	**Sample Temperature**	**Supported Research**
32T, 34mm **18/20T**, 52mm **18/20T**, 52mm **17.5T**, 47mm **10T**, 34mm[3] **9T**, 25mm[4] **7T,** 7mm[4]	14mK – 300K 20mK – 1K 0.3K – 300K 4K – 300K 0.3K – 300K 2.0K – 325K 2.0K – 325K	Magneto-optics – ultra-violet through far infrared, Magnetization, Specific heat, Transport – DC to microwaves, Magnetostriction; High pressure, Temperatures from 20mK to 300K, Dependence of optical and transport properties on field, orientation, etc. Low to medium resolution NMR, EMR, and sub/millimeter wave spectroscopy.

1. A coil for modulating the magnetic field and a coil for superimposing a gradient on the center portion of the main field are wound on 32mm bore tubes.
2. Higher homogeneity magnet for magnetic resonance measurements.
3. Optical ports at field center with 4 ports each 11.4° vertical x 45° horizontal taken off of a 5mm sample space.
4. Quantum Design PPMS and MPMS user "on-ramp" magnet systems.

Table 1 lists the magnets in the DC Field Facility. The MagLab leads the world in available continuous magnetic field strength, number of high field DC magnets available to users and accessibility for scientific research. The 45T hybrid magnet is the highest field DC magnet in the world, which is reflected in the number of proposals from PIs located overseas. The 41.5T resistive magnet is the highest field resistive magnet in the world. The 36T Series Connected hybrid magnet features two configurations: a 40mm bore, with 1ppm homogeneity for chem/bio NMR experiments and a 48mm bore with 20ppm homogeneity for condensed matter physics experiments in a top-loading cryogenic system. The 35T, 32mm bore and 31T, 50mm bore resistive magnets are coupled to top loading cryogenic systems that have impressive performance, flexibility and ease of use. The 25T Split-Helix magnet is the highest field direct optical access / scattering magnet in the world. With 4 optical ports located at field center each having a 11.4° vertical x 45° horizontal taken off of a 5mm opening, the ability to perform ultrafast, time resolved and x-ray scattering experiments are now a reality at high magnetic fields. The 32T all-superconducting magnet is the highest field superconducting magnet available for users anywhere in the world.

Figure 1. *Top: One of the large plumbing headers prior to being lifted into place. Bottom: Four of the eight pumps set in place and in final stages of installation.*

Facility Developments and Enhancements

Secondary Chilled Water Pump Replacement Project

A shutdown period from mid-June to mid-August allowed the MagLab facilities group to work with a number of contractors to replace the array of six pumps that circulate chilled water through the secondary side of the magnet cooling water heat exchangers (**Figure 1**). This project required removal of the old pumps, electrical feeders, motor control units, plumbing and the pouring of an expanded concrete slab to hold the new pumps. New plumbing, electrical feeders, and motor control units were installed to serve the eight new pumps. With an increased number of pumps and a more optimal design of plumbing we have improved the operational resiliency of the magnet cooling water system against pump breakdown and maintenance needs. The new system also takes advantage of improved recycling valves and soft start motor controls to improve the temperature stability of the magnet cooling water during changes in heat load and pumps cycling on and off in response. The pumps are also equipped with on-board vibration sensors which are accessed via Bluetooth, to detect potential problems that can be addressed with maintenance before they cause failure.

Planning and Design Work for the 12.5 kV Switchgear Replacement Project

Following the generous provision of $15M by FSU and the State of Florida, MagLab engineers and scientists began the detailed design phase to replace the 12.5kV/4000A switchgear and power factor correction/harmonic suppression circuitry that supplies power to the DC Field Facility and to the entire Tallahassee site. As shown in **Figure 2**, this project is large in scope and complexity and it is expected to yield dividends in improved safety, reliability, resiliency and performance. The existing equipment is 30 years old and the industry approach to power factor correction/harmonic suppression has advanced tremendously. In 1993, the state of the art in power factor correction and harmonic suppression consisted of fixed circuit elements (capacitors, inductors, resistors) arranged in such a way a s to balance the reactive power produced by the DCFF power supplies. Since these were fixed elements, they were not effective across the entire current range of the feeder leading to harmonic generation and sub-optimal power factor values. The new power factor correction/harmonic suppression technology employs active control of IGBTs coupled to capacitors and transformers to dynamically correct the sinewave across the entire current range on the

12.5kV feeders. A direct benefit to users is decreased 60Hz harmonic noise being carried into the magnet cells and scientific instrumentation.

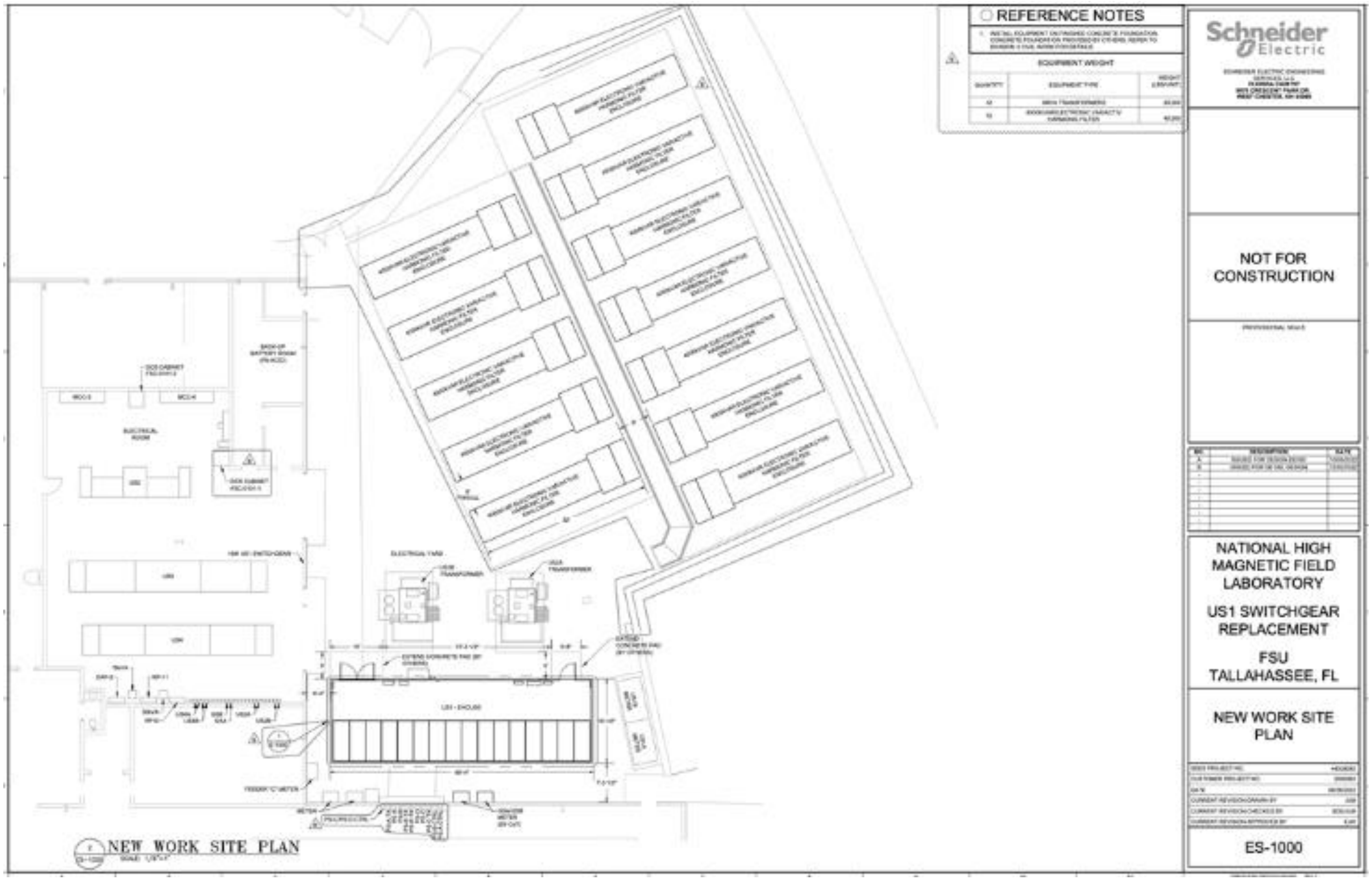


Figure 2. *Engineering site plan for the new switchgear and power factor/harmonic suppression gear.*

Development and Implementation of Cryogenic Noise Filters and Instrumentation Power Conditioning for High Field Measurements

A joint effort between the DC Field Facility (Ali Bangura, Troy Brumm and Robby Nowell) and the High B/T Facility (Lucia Steinke) to develop and implement cryogenic noise filters is underway. As shown in **Figure 3**, one approach uses RC (resistor and capacitor) filters mounted to a PCB (printed circuit board) with a roll-off frequency of 100kHz and the second approach uses filters constructed from sintered silver mounted to a PCB. A third approach employing both RC and sinter elements is in development. These filters are initially being deployed in the SCM4 (32T) and SCM1 top-loading dilution refrigerators. Both of these filters are mounted on the end of the probe at low temperatures to

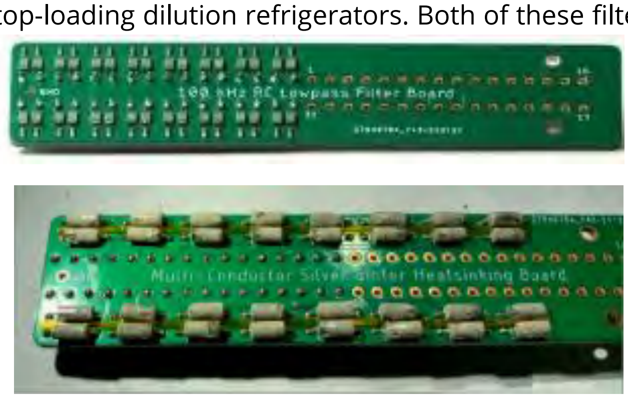


Figure 3. *Top picture showing RC filter PCB. Bottom picture showing sinter filter PCB.*

Figure 4. *Power conditioning unit for instrumentation power in a magnet cell.*

maximize noise filtration and thermalization. We are working with users to compare the noise levels and electron temperatures they achieve at the MagLab versus what they achieve at their home institutions in order to fine-tune and improve the designs.

Also in 2022, we continued our efforts to reduce experimental noise through the acquisition and installation of AC power conditioners (**Figure 4)** to supply power to instrumentation in the magnet cells. These power conditioners use the incoming 60Hz, 120V to power a precision waveform generator coupled to linear amplifiers generating a clean 60Hz, 120V sinewave without any of the accompanying harmonics produced by the 14MW power supplies. The power conditioner also contains a 1:1 transformer output which safely enables the implementation of clean, single-point grounding between the research cryostat and the instrumentation.

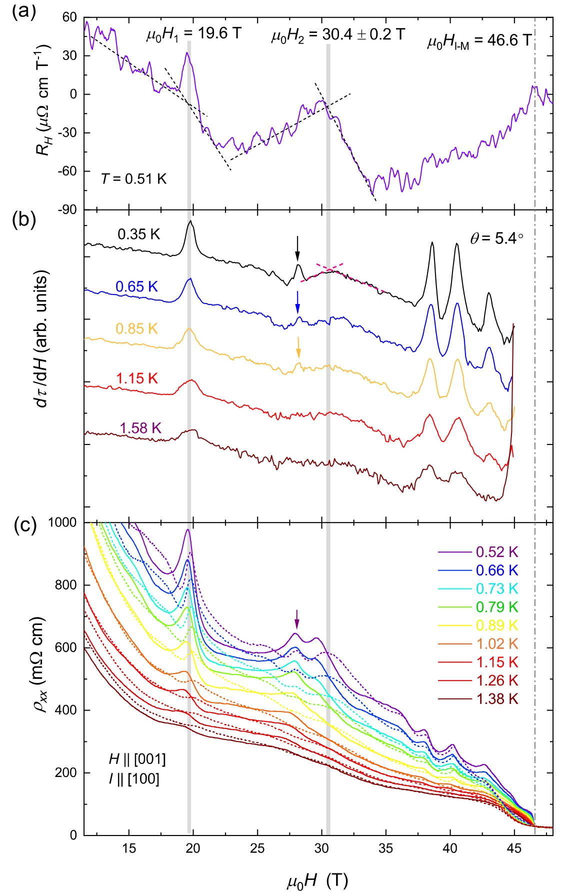


Figure 5. a) *Measurements of the Hall effect in YbB_{12}* ***b)*** *Magnetic torque in YbB_{12}* ***c)*** *Electrical resistivity in YbB_{12}. These measurements confirm that quantum oscillations and phase transitions appear in all three measured quantities at the same magnetic fields pointing to the coexistence of two very different fermion fluids.*

Major Research Activities and Discoveries/ Research Science Highlights

The research group of Lu Li from the University of Michigan used the 45T hybrid magnet in Tallahassee as well as 65T and the 73T pulsed magnets in Los Alamos to ***reveal the coexistence of ordinary electrons and novel charge-neutral quasiparticles in the Kondo insulator YbB_{12}***. By measuring the Hall effect, magnetic torque and electrical resistivity (**Figure 5**) they were able to determine that the two fermion fluids exist simultaneously, resulting in a very unusual two fluid state at high fields. A further unusual feature of this state is that the charge-neutral quasiparticles behave like electrons in a conventional metal but are unable to conduct electrical charge while the charge carrying electron's properties do not oscillate in magnetic field as is normally the case in metals. This discovery resolved a five-year-long paradox as to how an insulator can exhibit metallic behavior in high magnetic fields and the experimental observations support the idea that this two-fluid system constitutes a new state of matter. This work was published in ***Physical Review X.***

A multi-institutional research effort spearheaded by the research group of Brad Ramshaw from Cornell University and including collaborators from Université de Sherbrooke, Université Paris-Saclay, University of Texas at Austin,

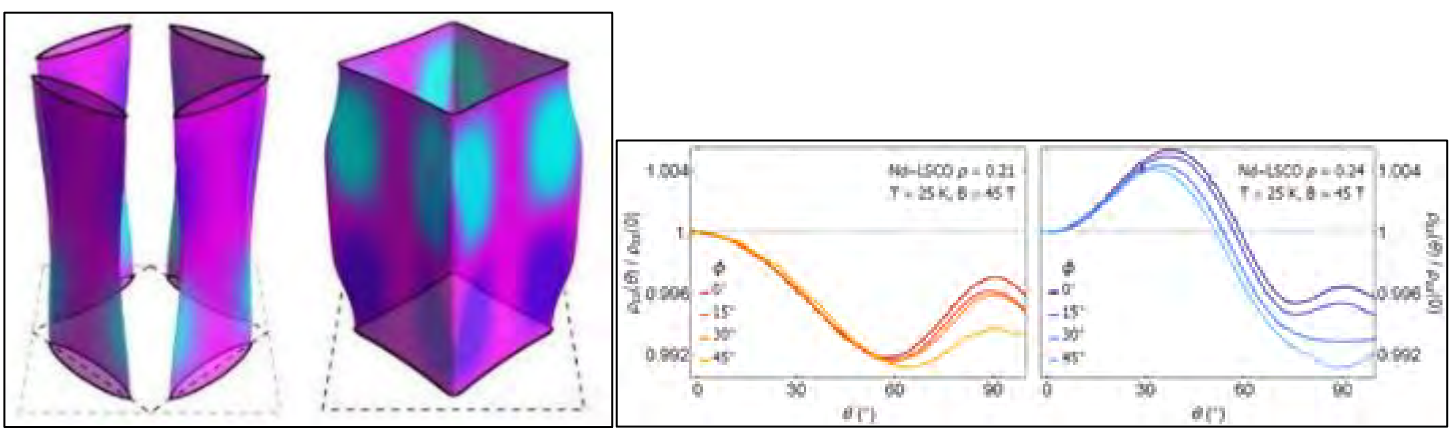


Figure 6. Left: *The Fermi surface of Nd-LSCO measured using angle-dependent magneto-resistance (ADMR) (**left**) inside the pseudogap phase and (**right**) outside the pseudogap phase.* ***Right:*** *ADMR as a function of magnetic field angle θ at a temperature of T=25K and at a magnetic field of B=45T. (**left**) Nd-LSCO p = 0.21, inside the pseudogap phase (**right**) Nd-LSCO p =0.24 outside of the pseudogap phase.*

University of Warwick, Canadian Institute for Advanced Research and the MagLab found direct evidence that the critical point in the phase diagram associated with the ***onset of the pseudogap phase in HTS materials is also associated with the onset of magnetism.*** They were able to accomplish this using the ability of 45T hybrid magnet to sit at high fields for long periods of time combined with the measurement technique of 2-axis angular dependent magnetoresistance (ADMR). The result was a detailed map of the Fermi surface in Nd-LSCO both inside and outside the pseudogap phase (**Figure 6**) revealing the participation of magnetism at the onset of the pseudogap phase. The results of this work were published in ***Nature Physics.***

Facility Plans and Directions

The installation of new variable speed drives (VSD) for the four 370kW magnet cooling water pumps will take place during a four-week shutdown period during the month of April. The existing VSDs have reached the end of their service lives and their reliability will begin to decrease if they are not replaced in a timely, planned fashion leading to interruptions in magnet operations. The new VSDs are designed with better power handling, cooling and diagnostic capabilities.

The installation of a second 590kW magnet cooling water pump is planned for November 2023. This will bring the number of magnet cooling water pumps to six giving us a balanced capability of one 590kW + two 370kW pumps on each cooling loop. The first stage of the project was accomplished in November 2022 with the relocation of one of the 370kW pumps to make room for the new 590kW pump to be installed at the optimal location on the cooling loop header. This arrangement will allow for the simultaneous operation of two high-power (33MW) magnets and resiliency for magnet operations in the event a pump is taken offline for service.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

Both the DC Field Facility and its users emerged from the shadow of the COVID-19 pandemic in 2022 with users able to travel to the MagLab in a routine fashion at numbers approaching pre-COVID levels. Due to uncertainty surrounding the format of the 2022 APS March Meeting trade show it was decided to wait until the 2023 March Meeting to host the MagLab booth at the trade show.

Appendix A, Table 10, shows that the DC Field Facility attracted ***24 new PIs in 2022*** with 21 of those new to the MagLab as a whole. This is in addition to the 19 new PIs reported last year (2021) and 20 reported in 2020.

The Annual DC Field Facility MagLab User Summer School was held on May 9-13, and we were able to return to the normal in-person format (**Figure 7**)! This marked the 15th year of the summer school, and we hosted eleven students (number kept low due to effects of COVID-19 still lingering). It is a five-day series of lectures and practical exercises in experimental condensed matter physics techniques developed and taught by members of the MagLab scientific staff as well as experts from industry. It has proven to be an excellent vehicle for communicating valuable experimental knowledge to the next generation of scientists from the enormous trove of knowledge and experience encompassed by the MagLab scientific staff. The feedback from both the students and the Users Committee is always extremely positive.

Figure 7. *2022 MagLab User Summer School students.*

Facility Operations Schedule

At the heart of the DC Field Facility are the four 14MW, low noise, DC power supplies. Each 20MW or 28MW resistive magnet requires two power supplies to run, the 45T hybrid and the 41.5T resistive magnets each require three power supplies and the 36T Series Connected Hybrid requires one power supply. Thus, the DC Field Facility operates in the following manner: in a given week there can be four resistive magnets plus six superconducting magnets operating or the 45T hybrid/41.5T resistive, series connected hybrid, two resistive magnets and five superconducting magnets.

The water-cooled DC resistive and hybrid magnets operated for 34 weeks in 2022 with 17 weeks of shutdown to allow for the installation of new secondary chilled water pumps and facility maintenance and a 1-week shutdown period for the university mandated holiday break from December 23, 2022 to January 2, 2023. The six superconducting magnets operated for 48 weeks out of the year with staggered maintenance periods as required. The daily operation schedule for the resistive and hybrid magnets is as follows: 7 hours/day on Monday and 21 hours/day Tuesday-Friday. The superconducting magnets operate 24 hours/day, 7 days/week.

EMR Facility

Electron Magnetic Resonance (EMR) covers a variety of magnetic resonance techniques associated with the electron. The most widely employed is Electron Paramagnetic/Spin Resonance (EPR/ESR), which can be performed on anything that contains unpaired electron spins. EPR/ESR has thus proven to be an indispensable tool in a large range of applications in physics, materials science, chemistry, and biology, including studies of impurity states, molecular clusters, molecular magnets; antiferromagnetic/ferromagnetic compounds in bulk, as well as thin films and nanoparticles; natural or induced radicals, optically excited paramagnetic states, electron spin-based quantum information devices; transition-metal based catalysts; and for structural and dynamical studies of metalloproteins, spin-labeled proteins, and other complex bio-molecules and their synthetic models.

Unique Aspects of Instrumentation Capabilities

The EMR facility at the MagLab offers users several home-built, high-field, and multi-high-frequency instruments covering the continuous frequency range from 9GHz to ~1THz. Several transmission probes are available for continuous-wave (CW) measurements, which are compatible with a range of magnets at the Lab, including the highest field 45T hybrid. Some of the probes can be configured with resonant cavities, providing enhanced sensitivity as well as options for in-situ rotation of single-crystal samples in the magnetic field, and the simultaneous application of pressure (up to ~3GPa). Quasi-optical (QO) reflection spectrometers are also available in combination with high-resolution 12 and 17T superconducting magnet systems; a simple QO spectrometer has also been developed for use in the resistive and hybrid magnets (up to 45T). EMR staff members can assist users in the DC field facility using broadband tunable homodyne and heterodyne spectrometers as well. Moreover, frequency coverage up to ~180 THz (6,000 cm^{-1}) is now possible through collaboration with staff in the DC field facility using broadband Fourier transform infrared spectrometers to acquire EPR spectra in the frequency domain – so-called far-infrared magneto-spectroscopy (FIRMS).

In addition to CW capabilities, the MagLab EMR group boasts the highest frequency pulsed EPR spectrometer in the world, operating at 120, 240, 336GHz, and now 316 and 395GHz with < 100ns time resolution. A high-power (1 kW) quasi-optical 94GHz spectrometer (HiPER) with 1ns time resolution (1GHz instantaneous bandwidth) is also available. Meanwhile, a commercial Bruker Elexsys 680 operating at 9/94GHz (X-/W-band) is available upon request. This unique combination of CW and pulsed instruments may be used for a large range of applications in addition to EPR, including the study of optical conductivity, electron cyclotron resonance and Dynamic Nuclear Polarization.

Finally, the EMR group collaborates with the NMR program in developing instrumentation for high-field DNP-enhanced NMR studies of solids and solution samples at fields up to 14.1T. The centerpiece of this installation is a quasioptical EPR spectrometer based on a 395GHz high-power CW gyrotron source.

Facility Developments and Enhancements

2022 has seen the most substantial changes in EMR staffing in well over a decade. The search for a new Research Faculty member concluded early in the year, and we were fortunate to receive approval to make two new hires. The first involved converting Thierry Dubroca from Visiting Scientist to Research Faculty I. Dubroca has been part of the EMR program since 2013, when he was hired as a postdoc on the original Dynamic Nuclear Polarization (DNP) development project. Meanwhile, after 12 years of service to the EMR program, our biophysics applications Research Faculty member, Likai Song, retired in July. At the postdoctoral level, Cocoa Wang started a faculty position in chemistry at Cal State University East Bay, Daphné Lubert-Perquel moved on to a 2^{nd} postdoc position at the National Renewable Energy Laboratory in Golden, Colorado, and Murari Soundararajan moved on to a 2^{nd} postdoc position at the University of Southampton, UK. Meanwhile, Jakub Hrubý joined as a postdoc having completed his PhD with Petr Neugebauer at the Central European Institute for Technology in Brno, Czech Republic. Hrubý is working on f-element qubits as part of a joint project with Lawrence Berkeley National Lab.

As reported last year, we completed development of a simple 950GHz / 36T EPR setup for use in the Series Connected Hybrid (SCH) resonance magnet within the DC-field facility. However, the first measurements had not been reported at the time of writing last year's report. We are pleased to report that two successful week-long runs were completed during 2022, clearly demonstrating the potential of this new high-resolution EMR capability. The measurements focused on two well-known radicals 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and 1,3-bis(diphenylene)-2-phenylallyl (BDPA), as well as two Gd^{III} coordination complexes of interest as potential spin labels for dipolar EPR spectroscopy at high magnetic fields. The latter were provided by the first user associated with the new capability, Mark Sherwin, from UC Santa Barbara. Measurements of the DPPH radical were employed to characterize the temporal stability of the magnet, while the measurements on BDPA and the Gd^{III} complexes demonstrated the setup's capabilities in terms of resolving and quantifying extremely weak magneto-anisotropies. At the time of writing this report, a manuscript reporting these first results has been submitted for publication in a Special Issue of the Journal of Magnetic Resonance entitled *Frontiers in EPR*.

Another important development during 2022 has been the approval by lab management to purchase two new superconducting magnets to replace the ageing ones associated with the 15/17T Transmission Spectrometer and the high-power pulsed W-band spectrometer, HiPER. Both of these magnets had developed problems that impacted scheduling and even the overall capabilities of the instruments. In the case of the transmission spectrometer, the magnet has been quenching with increasing frequency, forcing us to limit the maximum available field. In the case of HiPER, the situation is far worse, with the magnet displaying very significant hysteresis. Moreover, failure of one of the power supply modules means that the magnet currently only reaches 4.5T. Purchase orders were placed in 2022 for two new magnets from Oxford Instruments. The replacement for the Transmission Spectrometer is rated at 16T at 4.2K, with a sweep rate that is twice that of the old magnet. Since this sweep rate is the main factor limiting data acquisition times, we are hopeful that this will increase future productivity on this spectrometer, which is the most heavily used in the facility. Meanwhile, the HiPER magnet is more-or-less a like-for-like replacement, with a 9T maximum field and a 0.1T sweep coil. Both magnets are liquid helium cooled. We expect delivery of both magnets during the coming year.

Major Research Activities and Discoveries/ Research Science Highlights

28 peer-reviewed journal articles were reported by our users during the past year, as well as two PhD theses. This is slightly up from the previous year's number of 26. Most importantly, this number of publications is essentially the same as the 29 reported in 2019, the year before the pandemic. This statistic, as well as other magnet usage statistics suggest that user activity is back to pre-pandemic levels. As always, the quality of publications in 2022 was exceptionally high, including articles in the following journals: *Nature* (3); *J. Am. Chem. Soc.* (5); *Angew. Chem.* (2); *Inorg. Chem.*, *Inorg. Chem. Frontiers* and *Dalton Trans*. (8). Projects in the facility spanned a range of disciplines, from fundamental physics studies of spin liquids (*Nat. Mater.* and *Communications Phys.*), to research on molecular magnets and spin qubits (*JACS*, *Nat. Chem.* and *Nat. Comms.*), to biochemical investigations of metalloproteins using the HiPER spectrometer (*JACS*). The EMR Program continued major efforts in support of major center-type research initiatives and international collaborations involving multiple universities. First and foremost, the DOE funded Energy Frontier Research Center for Molecular Magnetic Quantum Materials (M2QM) based at the University of Florida (PI and Director – Hai-Ping Cheng; Associate Director – Stephen Hill), was up for renewal in 2022. EMR Director Hill played a major role in developing the successful renewal proposal. The Center, which has co-PIs at the University of Central Florida, Florida State University, UTEP, Caltech and Los Alamos National Laboratory, received $12M in DOE funding to continue activities through August 2026. In addition, the Hill group continued two multi-institutions collaborations: the first funded by the NSF, a trilateral international collaboration entitled “Molecular Magnetoelectric Materials” involving FSU (Stephen Hill, funded by the US NSF), University College Dublin in Ireland (Professor Grace Morgan, an EMR user, funded by the Science Foundation Ireland), and Queens University Belfast in Northern Ireland (Professor Steven Bell, funded by the Department of the Economy in Northern Ireland); the second, which involves researchers at Lawrence Berkeley National Lab and UC Berkeley, focuses on “Molecular f-Element Qubits with Controllable Quantum Coherence and Entanglement”. The latter project supports the EMR postdoc Hrubý. Finally, together with the NMR program, the NMR group also successfully renewed its NSF funding of the DNP methods development project in 2022. The highlighted work, published in *Nature Communications*, *Nature Chemistry* and *JACS*, involved users

from the following institutions: University of Copenhagen, University of Manchester, UC Irvine, and the Ohio State University.

Analysis of Vibronic Coupling in a 4f Molecular Magnet with Far-Infrared Magnetospectroscopy: Vibronic coupling, the interaction between molecular vibrations and electronic states, is a fundamental effect that profoundly influences a wide range of physical processes. In the case of molecular magnetic materials, it causes relaxation, which equates to loss of magnetic memory and loss of phase coherence in single-molecule magnets and qubits, respectively.

The study of vibronic coupling is challenging, and most experimental evidence is indirect. In this investigation, far-infrared magneto-spectroscopy (FIRMS) is used to directly probe electronic transitions coupled to vibrational excitations in an ytterbium molecule **(Figure 1, inset)** that has attracted interest as a potential spin qubit. High magnetic fields enable a deconvolution of vibronic transitions that shift in energy due to the Zeeman interaction **(Figure 1, main)** from a forest of much stronger electronic transitions that do not shift with field.

We show that vibronic coupling is strongest for vibrational modes that simultaneously distort the first coordination sphere (the atoms that coordinate directly to the ytterbium ion) and break the C_3 symmetry of the molecule. With this knowledge, vibrational modes could be identified and engineered to shift their energy towards or away from particular electronic states to alter their impact. Hence, these findings provide new insights towards developing general guidelines for the control of vibronic coupling in molecules.

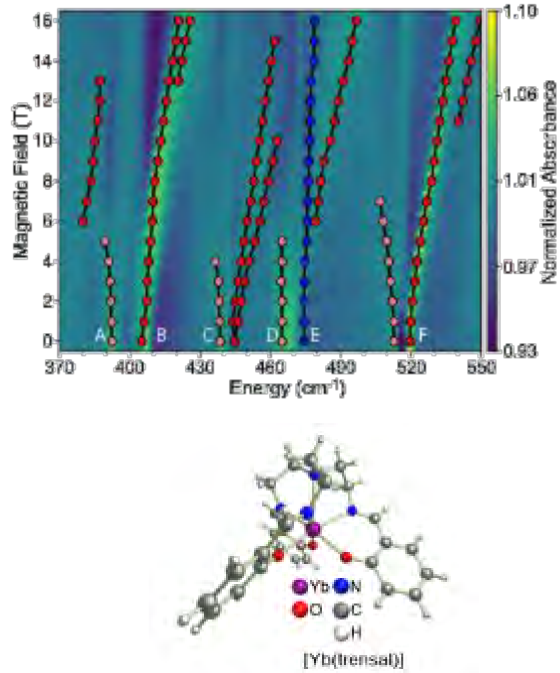


Figure 1. FIRMS map (top) of the Yb molecule (below); purely vibrational modes are suppressed via normalization to remove field-independent signals. Theoretical assignments of cold/hot vibronic transitions in red/pink; a purely electronic transition is shown in blue.

Citation: J. G. C. Kragskow, J. Marbey, C. D. Buch, J. Nehrkorn, M. Ozerov, S. Piligkos, S. Hill, N. F. Chilton, *Analysis of vibronic coupling in a 4f molecular magnet with FIRMS*, **Nat. Commun. 13**, 825 (2022). https://doi.org/10.1038/s41467-022-28352-2

Clock Transition due to Massive Hyperfine Interaction in a Lu(II) Qubit: Electron spin coherence, important in quantum information science, can be significantly enhanced at so-called clock transitions (CTs) – optimal operating points that are immune to magnetic noise. CTs can be generated via the hyperfine interaction (HFI) between electron and nuclear spins in atoms. Maximizing this interaction to achieve optimum coherence and a desirable operating frequency in the microwave regime requires enhancing electron spin density at the location of the nucleus, which can be achieved using coordination chemistry.

Chemists from UC Irvine prepared a family of molecules containing a single lanthanide (Ln = La or Lu) ion in the rare 2+ oxidation state. In each case, a single unpaired electron resides in a mixed 5d/6s orbital. The HFI can be controlled through choice of: (i) coordinating ligand, which tunes the s-orbital character and, hence, the spin density at the nucleus; and (ii) Ln ion, with increased orbital contraction for heavier Lu. As seen from the peak spacing in the high-field echo-detected ESR spectra (**Figure 2),** significant control of the 5d/6s mixing is achievable, with $[Lu^{II}(OAr^*)_3]^-$ exhibiting a massive 3.47GHz HFI (c.f. < 100MHz is typical for related molecules).

Hyperfine CTs are currently employed in more mature trapped ion quantum computers. This investigation demonstrates that the same approach is viable in molecular qubit platforms, giving rise to measurably enhanced coherence and prospects for future scalability via chemical self-assembly.

Citation: K. Kundu, J. R. K. White, S. A. Moehring, J. M. Yu, J. W. Ziller, F. Furche, W. J. Evans, S. Hill, *9.2 GHz clock transition in a Lu(II) molecular spin qubit arising from a 3467 MHz hyperfine interaction*, **Nat. Chem. 14**, 392 – 397 (2022). https://doi.org/10.1038/s41557-022-00894-4

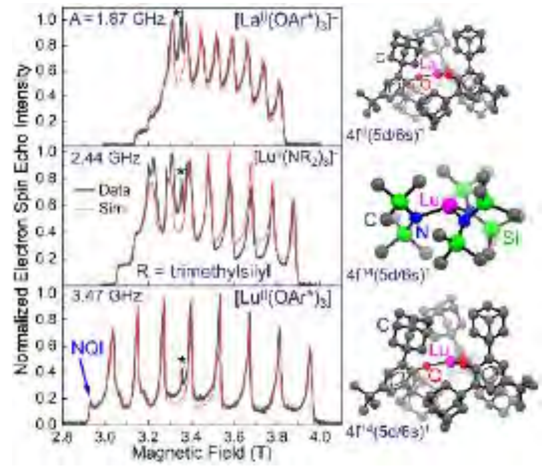


***Figure 2.** Pulsed electron spin-echo spectra recorded at 94 GHz and 5 K, for the three compounds shown. The eight (= 2I + 1) lines arise due to the HFI with the $I = {}^{7}/_{2}$ ^{175}Lu or ^{139}La nuclear spin; the spacing between peaks is a direct measure of the HFI strength, A, which increases from top to bottom. The asterisk marks an impurity and the feature labeled NQI is attributed to a strong nuclear quadrupole interaction.*

Probing the Reactivity of a New Class of Metalloproteins Using High-Field Pulsed EPR (Figure 3): Metalloproteins catalyze the most challenging chemical reactions seen in nature. R2lox metalloproteins have an unusual "mixed-metal" manganese-iron (Mn/Fe) active site and are recognized as a virulence factor in pathogens like *Mycobacterium tuberculosis (Mt)*, the causative agent of tuberculosis. While diiron (Fe/Fe) proteins are well-studied, Mn/Fe proteins represent a new class of metalloprotein for which the chemistry is largely unexplored. In this work, the reactivity of R2lox towards O_2 and the structure of a key, short-lived oxidized state have been characterized, demonstrating unusually weak electronic interactions between the Fe and Mn centers and a critical hydrogen bond within the active site that likely play an important role in determining the reactions that R2lox can perform.

Experiments at the MagLab EMR program capitalized on the sensitivity and resolution of the HiPER spectrometer to study transient biochemical species that could only be obtained at low concentrations. High-field experiments enable resolution of the spin Hamiltonian parameters of the Mn center, suggesting the presence of an open coordination site that a target molecule could subsequently use to bind to the metal(s) and undergo reaction(s). Researchers also took advantage of the high-power pulsed EPR capabilities to directly examine protons near the active site using the Electron-Detected NMR technique, which indicated a strongly coupled proton in this short-lived state that disappears as the reaction proceeds, consistent with the proton-coupled reactivity hypothesized for these proteins.

This research revealed what R2lox looks like before it reacts with a target, which will aid in identifying the role that R2lox plays in enhancing *Mt* virulence. Moreover, this study provides a roadmap for understanding electronic structure-function relationships in novel Mn/Fe metalloproteins.

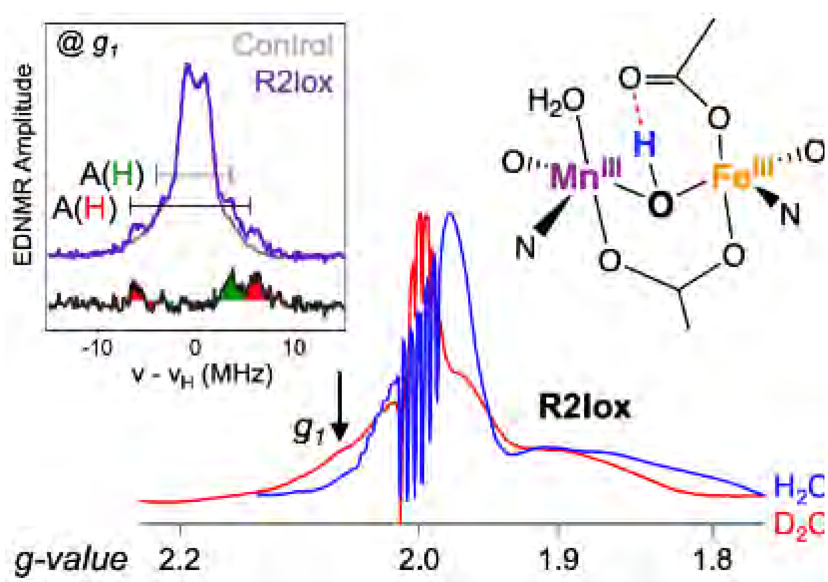


***Figure 3.** (Center) Magnetic field-swept pulsed electron echo-detected (ED) spectrum of a reactive, short-lived state of Mn/Fe R2lox after binding oxygen. (Top left) High-field ED-NMR spectrum of the same Mn/Fe R2lox state. The weak signals due to the observed protons [A(H)] are highlighted. (Top right) Structure of the trapped species proposed from EPR spectroscopy.*

Citation: E. C. Kisgeropoulos, Y. J. Gan, S. M. Greer, J. M. Hazel, H. S. Shafaat, *Pulsed Multifrequency Electron Paramagnetic Resonance Spectroscopy Reveals Key Branch Points for One- vs Two-Electron Reactivity in Mn/Fe Proteins*, **J. Am. Chem. Soc.**, 144, 11991 – 12006 (2022). https://doi.org/10.1021/jacs.1c13738

Facility Plans and Directions

The major initiative in 2023 involves the potential acquisition of a state-of-the-art commercial X-/Q-band pulsed EPR spectrometer with ENDOR and optical excitation capabilities. The workhorse ELEXYS E680 X-/W-band spectrometer that was acquired in 2001 failed towards the end of 2021. It was shipped back to Bruker in January 2022 and spent most of the year under repair in Germany. The proposed new instrument will be a major upgrade on the old system, including a full digital upgrade, with Arbitrary Waveform Generator capabilities and, for the first time in our facility, will include Q-band. At the time of writing this report, a proposal is being written to the NSF Major Research Instrumentation program to acquire this new instrument, which serves a critical role in the EMR user program, even though it is a low-field instrument. The optical excitation capability is also expected to be compatible with many of the high-field instruments within the program.

The group is also currently searching for three postdoctoral scholars to fill in for several who departed during 2022. The first will be funded via the Center for Molecular Magnetic Quantum Materials, taking over from Daphné Lubert-Perquel. With renewed NSF funding for DNP methods development, the group is also searching for a replacement for postdoc Murari Sondararajan. Finally, the EMR HiPER postdoc, Krishnendu Kundu, is expected to move on to permanent employment in India during 2023. Therefore, we are also conducting an international search for his replacement. It is hoped that all three of these postdocs will join the program during the summer.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

The highlight of 2022 was the hosting of the 50th edition of the annual Southeastern Magnetic Resonance Conference (SEMRC) in Tallahassee, over the weekend of November 4 – 6. This regional meeting has a long tradition of bringing together leading scientists to discuss the latest developments in NMR, EPR and MRI, with a focus on exchanges of ideas and recent magnetic resonance research highlights, including new applications and technique development. Particular emphasis is placed on activities in the Southeastern United States, with strong participation of young researchers. The 2022 meeting was organized jointly by the NMR and EPR groups, with respective User Program Directors Rob Schurko and Stephen Hill serving as conference co-Chairs. This continues the tradition of the MagLab hosting the meeting every two years. The conference program can be found at the following website: https://nationalmaglab.org/semrc.

With the winding down of the pandemic, the EMR user program returned to near-normal activity in 2022, including the numbers of on-site users. The total number of proposals that received magnet time during 2022 was 57, up from 48 in 2021, and just below pre-pandemic levels (~60). The number of PIs who received magnet time was 54, up from 43 in 2021, of which 19 PIs were first time users, meaning that 35% of our users were new to the program in 2022. This is a new record for the facility, suggesting that the number of returning users was back to normal in 2022, while there has been pent-up demand from new users during the pandemic. Meanwhile, the EMR program assisted 165 individual researchers in 2022, up from 121 in 2021, and slightly up from the 161 prior to the pandemic in 2019. Of these, 55 were first time users, which is again a record for the facility. 78 users were present on-site, just a little below the 88 who were on-site prior to the pandemic in 2019. In terms of diversity, 23% of EMR users were female and 8% minority. These numbers are up marginally over the 2021 numbers (18% and 5%, respectively).

With travel returning to normal in 2022, members of the EMR group ramped up their aggressive efforts to advertise the facility and recruit new users at regional, national, and international workshops and conferences, as well as via seminars at universities around the globe. As an example, the EMR Director gave eight invited presentations at conferences during 2022 and a tutorial at the MagLab Winter Theory School. The EMR program also had strong attendance at the Rocky Mountain Conference on magnetic resonance where we were able to interact with many of our existing users, as well as recruiting several new ones.

Members of the EMR group served on the organizing committees for the following events: the 2023 International Conference on Molecule-based Magnets (ICMM), organized by Nanjing University in China; the 2022 Rocky Mountain

Conferences on Magnetic Resonance, which was held in-person in July at Copper Mountain; and the 2nd Magnetism in North America (MAGNA) conference that was held in Gainesville in May 2022. The EMR Director also submitted a successful proposal to the American Physical Society to host an Invited Symposium on Molecular Spins for Next Generation Quantum Technologies, to be held at the 2023 March Meeting in Las Vegas. Finally, together with chemistry professor Mike Shatruk, the EMR Director organized a two-day Symposium focused on Quantum Science and Engineering at Florida State University in February of 2022. This event will be repeated in April 2023, also featuring several outside speakers.

Lastly, the EMR Director devoted considerable time and effort to a National Academies of Science, Engineering and Medicine (NASEM) consensus study on *Opportunities at the Interface between Chemistry and Quantum Information Science*, including making a presentation to the committee in June 2022 on Spectroscopy Methods for Molecular Quantum Spin Science. Sponsored by the Department of Energy and the National Science Foundation, the committee is expected to publish a report on its findings in 2023.

Facility Operations Schedule

As noted elsewhere in this report, operations and activities in the EMR program truly returned to pre-pandemic levels in 2022. For example, the numbers of users, PIs, on-site participation, proposals and publications were all comparable to 2019. The workhorse 15/17T Transmission Spectrometer operated for a total of 237 days during 2022, which is up slightly from 2021 (231 days). One has to go back to 2018 (255 days) to compare to pre-pandemic levels due to the construction that took place in the lab in 2019. Thus, one can see that, within year-to-year fluctuations, this workhorse magnet is back to normal operation. Meanwhile, the 12.5T heterodyne spectrometer logged 208 days of usage, well up from the 131 days in 2021 and the average of ~180 days in recent pre-pandemic years.

A total of 232 days were logged on the high-power pulsed 94GHz EPR spectrometer, HiPER, just a small decrease from the 236 days reported in 2019. It should be noted that 81 days were devoted to testing, maintenance and methods development. However, this is quite typical of a normal year due to the significant methods development associated with this unique, cutting-edge spectrometer. Significant in-house methods development was included in the plan when integrating HiPER into user operations, as much of the cost of the instrument was covered by funding separate from the MagLab core. Therefore, HiPER operated at normal capacity during 2022.

The one exception to the return to normal operations in 2022 was the commercial Bruker E680 spectrometer, which logged only 22 days. The reason for this is because the pulsed capability failed in late 2021. The instrument continued to operate in continuous-wave mode for a short time but was packed up and shipped to Bruker at the end of January 2022. It should be noted that, according to Bruker, this instrument has surpassed its serviceable lifetime. At the time of writing this report, it has still not been returned to the facility. Hence, the 22 days in 2022 reflect just 13 days of user operation and 9 days devoted to testing in a vain attempt to rectify the failure ourselves. As noted elsewhere in this report, we are about to submit a proposal to NSF to upgrade this instrument.

As a whole, the four instruments offered by the EMR User Program were oversubscribed by ~20% in 2020, i.e., 827 days were requested, and 699 total days allocated. Note that the 699 days is down from 770 in 2021, due entirely to the failure of the Bruker spectrometer.

High B/T Facility

Unique Aspects of Instrumentation Capabilities

The High B/T Facility, located on the University of Florida campus, offers users a safe, diverse, and inclusive atmosphere for performing research in high magnetic fields (up to 16T) and at ultralow temperatures (down to 0.5mK) with an ultraquiet electromagnetic interference (EMI) environment. The Microkelvin Laboratory, the core of the High B/T Facility, is a separate, specially designed and built building with Tempest-quality shielded rooms to specifically afford access to the extremes of ultralow temperatures and high magnetic fields. Two demagnetization cryostats, one employing a $PrNi_5$ + Cu refrigeration stage while the other uses a pure Cu stage, provide the main access to the unique environments by using high magnetic fields of 8T to adiabatically cool the experimental region. In other words, the high magnetic fields provide the means refrigeration for cooling quantum materials in a steady high magnetic field applied to the sample region. In 2022, a third bay was renovated and now houses an automated "dry" dilution refrigeration system operating to below 7mK. A 14T magnetic for this instrument has been ordered and is expected to be installed in 2023. The combination of high magnetic fields with samples cooled to ultralow temperatures in an electromagnetically quiet environment provides users with access to parameter space that they cannot achieve in their home institutions and is also not available in other MagLab Facilities. Briefly stated, the High B/T Facility provides users with opportunities to explore quantum matter, devices, and phenomena with unique, specialized probes, cells, and cryostats made inhouse by staff in our facility and in our cryogenics, instrument design-fabrication, and electronics shops.

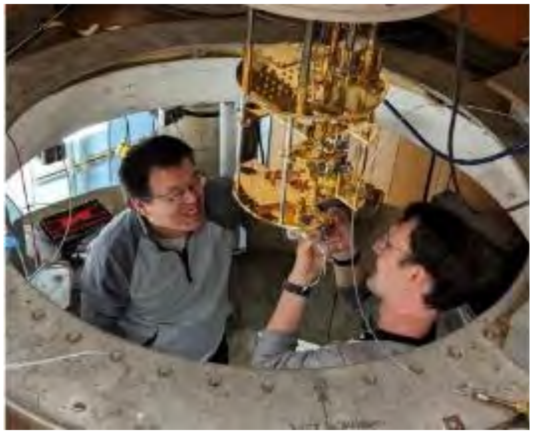


Figure 1. *Postdoctoral Researcher Zhenggauang Lu, a user from the Long Ju Group at MIT and a recipient of his PhD from FSU in 2020, and MagLab HBT Scientist Rasul Gazizulin, mount a special transport cell on the new Bluefors system, while responding to the photographer's request to look serious.*

Facility Developments and Enhancements

In 2022, the third bay in the Microkelvin Building at UF was cleared and a Bluefors "dry" dilution system, which was specially designed to work with the framework of the existing welded-steel shielded room, was installed. This instrument offers rapid cooling via the exchange of specially designed experimental cells, see **Figure 1;** the initial operational test results for temperature as a function of time are shown in **Figure 2.** In 2023, this instrument is expected to be equipped with a 14T magnet, thereby allowing novel on-chip cooling via electronic or magnetic methods that are presently being developed.

In 2023, the uninterruptible and clean power infrastructure needs to be definitively addressed. The present equipment is defunct and not suitable for repair since it is more than 25 years old, which is five years past its service time. These issues were analyzed in 2022, and several green options for modern, robust uninterruptible and clean power have been proposed.

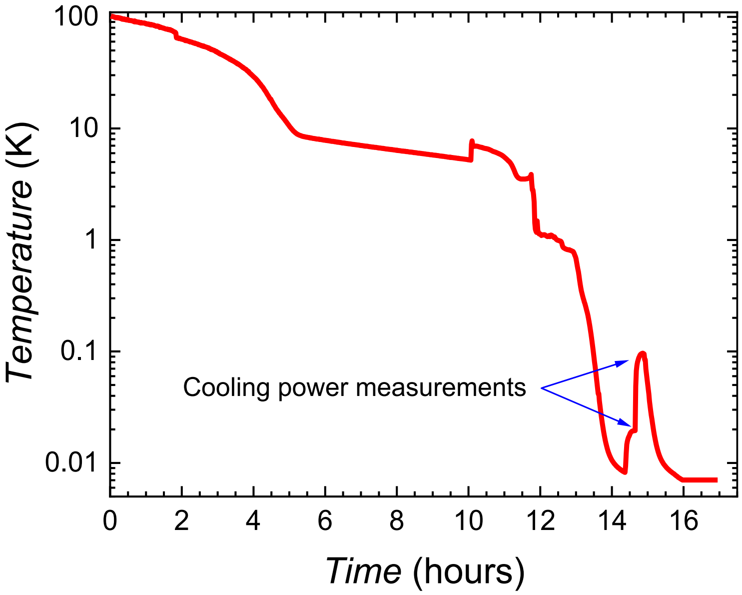


Figure 2. *The first cooling test of the new cryogen-free Bluefors LD250 cryostat is shown to take less than 15 hours to cool from 100K to below 10mK. The cooling power was tested to be 20μW at 20mK and 100μW at 100mK.*

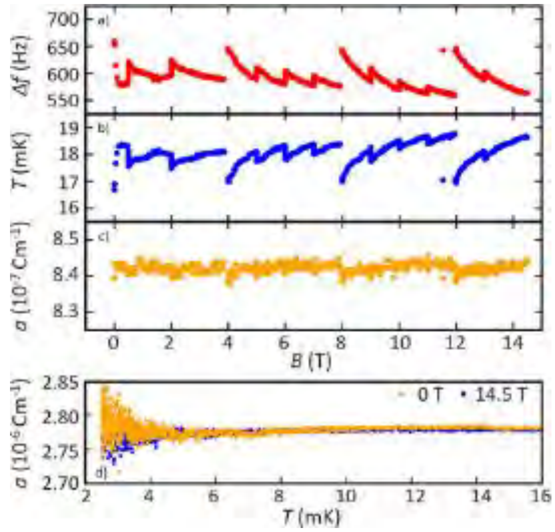


Figure 3. *(a) The resonance width of a typical tuning fork thermometer as a function of the applied magnetic field during a sequence of field sweeps. (b) The temperature inferred from the melting curve thermometer during the same field sweeps. (c) The tuning fork constant, α, as calculated from the fitted resonance curve as a function of the applied field. (d) The tuning fork constant, α, as a function of temperature during two different demagnetizations runs in 14.5T (blue) and 0T (orange). From Woods et al., J. Appl. Phys. 133, 024501 (2023), doi:10.1063/5.0132492.*

Major Research Activities and Discoveries/ Research Science Highlights

Developing compact tuning fork thermometers for sub-mK temperatures and high magnetic fields (A. J. Woods, A. M. Donald, R. Gazizulin, E. Collin*, and L. Steinke, MagLab HBT and UF Physics, *CNRS and Univ. Grenoble Alpes, France). To meet the growing user demand for calorimetric and thermal transport measurements, particularly on milligram-sized solid samples, scalable thermometers based on quartz tuning fork resonators immersed in liquid 3He have been developed. With the calibration of a single parameter, the miniature thermometer is independent of magnetic field, **Figure 3.** This advance will facilitate thermal probes for exploring the quantum phenomena of small solid-state samples in the extreme environments accessible in the MagLab HBT Facility.

Facility Plans and Directions

Table 1 summarizes the present and future capabilities, which are described in this section. Proposals for magnet time may be submitted at any time, and contact/discussions with staff is recommended prior to submission. Users work with the staff scientists to mount and tune the experiments on site. When the experiments begin, a member of the user team typically remains to assist the staff in performing the instant-to-instant steps. However, the users sometimes consult from off-site locations when the experiments span long periods of time due to the nature of long relaxation times at the extremes of parameter space.

Table 1. *The instrumentation available in the MagLab High B/T Facility tabulated, and their unique combination of temperature, magnetic field, and techniques are highlighted. Specialty shielding and filtering of the equipment provides the ultraquiet electromagnetic interference environment.*

Equipment	Features	Supported Research
Bay 3: 16.5T superconducting magnet, 20mm dia. sample space	Temperatures ≥ 1mK, by 8T demag of $PrNi_5$ + Cu stage.	Magnetization, quantum transport, torsional oscillator, viscosity, specific heat, dielectric, MEMS
Bay 2: 8T superconducting magnet, 32mm dia. sample space	Temperatures ≥ 0.5mK, by 8T demag of copper stage.	NMR, quantum transport, magnetization, heat capacity, pressure cell, thermal transport
Bay 1: 14T superconducting magnet, 32mm dia. sample space	Added 2022, Update/Revisions in progress, specs TBA for "nimble" instrument, to open 2022.	quantum transport, with rotation optical access planned, novel magnetometry, scanning probes
NPB B135 FTA: fast turnaround, 10T superconducting magnet, 52mm dia. sample space	Being relocated/revitalized to NPB B135, ≥ 20mK in 10T / 16T for efficient and fast sample/cell transfer to Bays 1-3, ready in 2023.	Exploratory, novel technique development, sample/cell verification prior to use on Bays 1-3

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

Amy Howe coordinated outreach efforts on behalf of both the AMRIS and High B/T Facilities at the University of Florida in Gainesville, FL. The total number of people directly contacted through in-person outreach efforts by UF MagLab personnel: 616 students and teachers in grades K-12; 66 college undergrad and graduate students and postdocs visiting the Gainesville facilities for a seminar, tour, or workshop; and approximately 1,300 scientists of various levels attending professional conferences where MagLab was promoted by AMRIS or HBT staff. The values have returned to levels of pre-pandemic outreach numbers. Complete details are available in the AMRIS Facility and Outreach sections of this annual report.

Facility Operations Schedule

Bays 1, 2, and 3 in the Microkelvin Facility are operational and open for new proposals from users. The High B/T Facility is operational year-round, including during University of Florida holidays and campus closure during the final week of December. Experiments can continue overnight and through closures when direct supervision of the experiment is not required. Visiting scientists from outside of Florida typically find short-term housing via online agencies when hotel options become prohibitively expensive. There are several times a year when local housing rates are at maximum levels due to sporting events, graduation weekends, and other special events. Users may contact staff to obtain advice on housing.

ICR Facility

During 2022 the Fourier Transform Ion Cyclotron Resonance (ICR) Mass Spectrometry program continued instrument and technique development as well as pursuing novel applications of FT-ICR mass spectrometry. These methods are made available to external users through the NSF National High-Field FT-ICR Mass Spectrometry Facility. The facility features nine staff scientists who support instrumentation, software, biological, petrochemical, and environmental applications, as well as a machinist, technician, and several rotating postdocs who are available to collaborate and/or assist with projects.

Unique Aspects of Instrumentation Capabilities

The Ion Cyclotron Resonance facility provides sample analysis that requires the ultrahigh resolution ($m/\Delta m_{50\%}$ > 1,000,000 at *m/z* 500, where $\Delta m_{50\%}$ is the full mass spectral peak width at half-maximum peak height) and sub-ppm mass accuracy only achievable by high-field FT-ICR MS. The facility's three FT-ICR mass spectrometers feature high magnetic fields (as high as 21T) and are compatible with multiple ionization and fragmentation techniques.

Table 1. *ICR systems at the MagLab in Tallahassee*

Field (T), Bore (mm)	Homogeneity	Ionization Techniques
21, 123	< 1ppm	ESI, APPI, APCI, MALDI
14.5, 104	1ppm	ESI, APPI, APCI, MALDI
9.4, 220	1ppm	ESI, APPI

Facility Developments and Enhancements

In 2015, the ICR facility commissioned the **first 21T Fourier transform ion cyclotron resonance mass spectrometer**. The 21T magnet is the highest field superconducting magnet ever used for FT-ICR and features high spatial homogeneity, high temporal stability, and negligible liquid helium consumption (**Figure 1**) (*J. Am. Soc. Mass Spectrum.,* **26**, 1626-1632 (2015)).

Figure 1. *Picture of the 21T FT-ICR mass spectrometer.*

Mass resolving power of 150,000 (m/Δm50%) is achieved for bovine serum albumin (66kDa) for a 0.38 second detection period (see **Figure 2**), and greater than 2,000,000 resolving power is achieved for a 12 second detection period. Externally calibrated broadband mass measurement accuracy is typically less than 150ppb rms, with resolving power greater than 300,000 at m/z 400 for a 0.76 second detection period. Combined analysis of electron transfer and collisional dissociation spectra results in 68% sequence coverage for carbonic anhydrase. The instrument is part of the NSF High-Field FT-ICR User Facility and is available free of charge to qualified users, with optimized experimental conditions, including top-down proteomics (*J. Amer. Soc. Mass Spectrom.*, **33**, 123-130 (2022)), ultrahigh resolution ion isolation via SWIFT Fourier Transform mass spectrometry (*Anal. Chem.,* **92**, 3213-3219 (2020)), MALDI imaging (*Anal. Chem.* **92**, 3133-3142 (2020)), and natural organic mixture analysis (*Commun. Earth Environ.,* **3,** 1-14 (2022)).

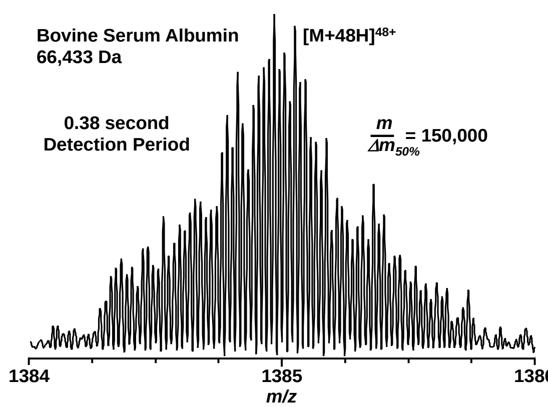


Figure 2. *Single-scan electrospray FT-ICR mass spectrum of the isolated 48+ charge state of bovine serum albumin following a 12s detection period. Mass resolving power is approximately 2,000,000, and the signal-to-noise ratio of the most abundant peak is greater than 500:1. The ion accumulation period was 250ms and the ion target was 5,000,000.*

The instrument includes a commercial dual linear quadrupole trap front end that features high sensitivity, precise control of trapped ion number, and collisional and electron transfer dissociation. A third linear quadrupole trap offers high ion capacity and ejection efficiency, and rf quadrupole ion injection optics deliver ions to a novel dynamically harmonized ICR cell.

An **actively-shielded 14.5T**, 104mm bore system offers the highest mass measurement accuracy (<300 parts-per-billion rms error) and highest combination of scan rate and mass resolving power available in the world. The spectrometer features electrospray, atmospheric pressure photoionization (APPI), atmospheric pressure chemical ionization sources (APCI); linear quadrupole trap for external ion storage, mass selection, and collisional dissociation (CAD); and automatic gain control (AGC) for accurate and precise control of charge delivered to the ICR cell. The combination of AGC and high magnetic field make sub-ppm mass accuracy routine without the need for an internal calibrant. Mass resolving power > 200,000 at m/z 400 is achieved at one scan per second. An additional pumping stage has been added to improve resolution of small molecules.

The **9.4T, passively-shielded**, 220mm bore system offers a unique combination of mass resolving power (m/Δm = 8,000,000 at mass 9,000 Da) and dynamic range (>10,000:1), as well as high mass range, mass accuracy, dual-electrospray source for accurate internal mass calibration, efficient tandem mass spectrometry (as high as MS^8), and long ion storage period (*J. Am. Soc. Mass Spectrom.,* **31**, 1783-1802 (2020); *Anal. Chem.,* **92**, 12193-12200 (2020)). A redesign to the custom-built mass spectrometer coupled to the 9.4T, 200mm bore superconducting magnet designed around custom vacuum chambers has improved ion optical alignment, minimized distance from the external ion trap to magnetic field center and facilitates high conductance for effective differential pumping (*J. Am. Soc. Mass Spectrom*. **22**, 1343-1351, (2011)). The length of the transfer optics is 30% shorter than the prior system, for reduced time-of-flight mass discrimination and increased ion transmission and trapping efficiency at the ICR cell (*J. Am. Soc. Mass Spectrom.* **25**, 943-949 (2014)). The ICR cell, electrical vacuum feed through, and cabling have been improved to reduce the detection circuit capacitance (and improve detection sensitivity) 2-fold (*Rev. Sci. Instrum.,* **85**, 066107 (2014)). When applied to compositionally complex organic mixtures such as dissolved organic matter (*J. Geophys. Res. Biogeosci.,* **127**, e2021JG006578 (2022), *Biogeochem.* (2022), soil organic matter (*Environ. Sci. Tech.* **56**, 4597-4609 (2022); *Environ. Sci. Technol.,* **55**, 9637-9656 (2021); emerging contaminants (*Environ. Sci. Tech.,* **56**, 12988-12998 (2022) biofuels (*iScience*, **25**, 104916 (2022); *Green Chem.*, **24**, 5125-5141 (2022) and petroleum fractions (*Energy Fuels* **36**, 13060-13070 (2022); *Energy Fuels,* **36,** 7542-7557 (2022)) mass spectrometer performance improves significantly, because those mixtures are replete with mass "splits" that are readily separated and identified by FT-ICR MS *(Anal. Chem*, **94**, 11382-11389 (2022)). The magnet is passively shielded to allow proper function of all equipment and safety for users. The system features external mass selection prior to ion injection for further increase in dynamic range and rapid (~100 ms time scale) MS/MS (*Anal. Chem.*, **75**, 3256-3262 (2003)), with ultrahigh resolution ion isolation via stored waveform inverse Fourier transform (SWIFT) followed by infrared multiphoton (IRMPD) dissociation (*Energy Fuels*, **36**,13060-13070 (2022); *Environ. Sci. Technol.*, **56**, 12988-12998 (2022)).

Major Research Activities and Discoveries/ Research Science Highlights

Complex mixture analysis benefits from the 21T FT-ICR system through high mass-resolving power, mass accuracy, and dynamic range, and fast scan speed that enables resolution and confident elemental formula assignment for tens of thousands of unique species in complex organic mixtures (*Anal. Chem.,* **94***,* 11382-11389 (2022)). We report

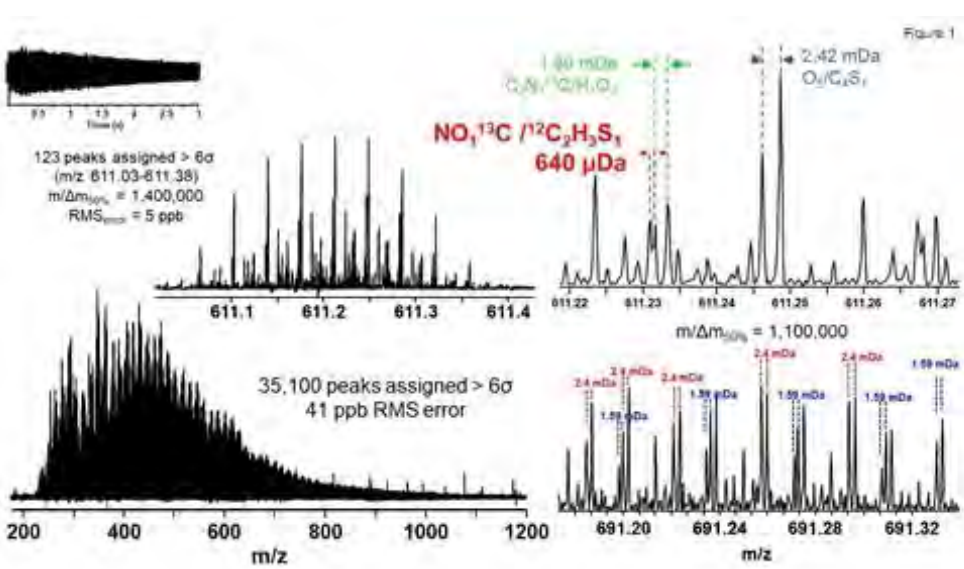


Figure 3. *Positive-ion ESI 21T FT-ICR mass spectrum of a pyOM extract. Bottom left: Broadband FT-ICR mass spectrum containing more than 35,000 assigned mass spectral peaks (m/z 200−1200) with a root-mean-square mass error of 41ppb, with m/Δm50% = 1,800,000 at m/z 400. Top left: 350mDa mass scale-expanded segment, showing resolution of more than 120 mass spectral peaks at m/z 611. Bottom right: mass scale-expanded segment across m/z 691.1−691.4, showing the increase in the number of isobaric overlaps at higher m/z. Top right: ~60mDa mass scale-expanded segment, showing resolution of three isobaric overlaps: 2.42mDa, 1.80mDa, and 640μDa (mass of an electron is 548μDa).*

enhanced speciation of organic N by positive-ion electrospray ionization (ESI) that leverages ultrahigh resolving power ($m/\Delta_{m50\%}$ = 1 800 000 at *m/z* 400) and mass accuracy (<10−100ppb) achieved by FT-ICR MS at 21T. Isobaric overlaps, roughly the mass of an electron (M_{e^-} = 548μDa), are resolved across a wide molecular weight range and are more prevalent in positive ESI than negative ESI. The custom-built 21T FT-ICR MS instrument identifies previously unresolved mass differences in CcHhNnOoSs formulas and assigns more than 30,000 peaks in a pyOM sample. This is the first molecular catalogue of pyOM by positive-ion ESI 21T FT-ICR MS and presents a method to provide new insight into terrestrial cycling of organic carbon and nitrogen in wildfire impacted ecosystems (*Anal. Chem.,* **94**, 2973-2980 (2022). **Figure 3** shows the broadband +ESI FTICR mass spectrum for a pyOM extract withe the more than 35,000 assigned mass spectral peaks between m/z 200 and 1300, centered at m/z 480. The mass scale-expanded segment at m/z 611 highlights the immense spectral density with ~123 peaks within a 0.3mDa window assigned with an RMS error of 5ppb (**Figure 3 (top left)).** The theoretical resolving power required to separate equally abundant species that differ in mass by ~640μDa at m/z 600 is 950,000.

Biological applications of FT-ICR MS culminate in "top-down" proteomics (*Science*, 375, 411-418 (2022)), which provides proteoform-specific structural information that is otherwise unobtainable. Human biology is tightly linked to proteins, yet most measurements do not precisely determine alternatively spliced sequences or posttranslational modifications. We present the primary structures of ~30,000 unique proteoforms, nearly 10 times more than in previous studies, expressed from 1690 human genes across 21 cell types and plasma from human blood and bone marrow. The results, compiled in the Blood Proteoform Atlas (BPA), indicate that proteoforms better describe protein-level biology and are more specific indicators of differentiation than their corresponding proteins, which are more broadly expressed across cell types. We demonstrate the potential for clinical application, by interrogating the BPA in the context of liver transplantation and identifying cell and proteoforms signatures that distinguish normal graft function from acute rejection and other causes of graft dysfunction. We employed negative or positive cell selection using specific antibodies to cell surface markers and fluorescence-activated cell sorting (FACS) to isolate cells of interest that were then analyzed for their proteoform content. In characterizing proteoforms across

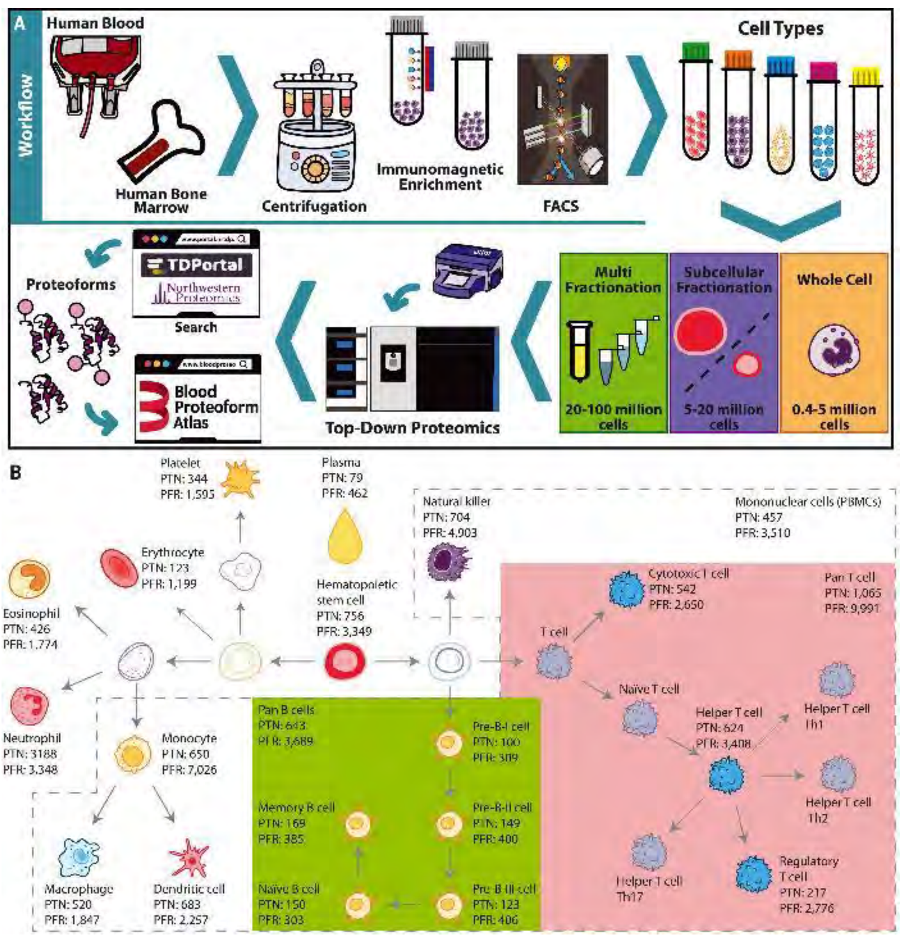


Figure 4. *Workflow and number of identified proteoforms in the Blood Proteoform Atlas. (A) Human blood or bone marrow samples were subjected to centrifugation, immunomagnetic enrichment, and/or FACS. (B) A map of hematopoiesis shows the number of proteoforms identified in each cell type. Certain cell groups (pan B cells, green; pan T cells, pink; and PBMCs, dashed gray lines) were also analyzed in pools. PTN, proteins; PFR, proteoforms.*

hematopoietic cell ontogeny, we took a three-pronged approach to protein fractionation, depending on cell number available (**Figure 4**).

Hemoglobinopathies detected at 21 Tesla. Hemoglobinopathies are one of the most prevalent genetic disorders, affecting millions throughout the world. These are caused by pathogenic variants in genes that control the production of hemoglobin (Hb) subunits, proteins responsible for oxygen transport in the blood. Researchers have identified more than 1,500 structurally abnormal hemoglobins in human patients, some of which cause debilitating diseases, including sickle cell disease. As the number of known Hb variants has increased, it has become more challenging to obtain unambiguous results from routine chromatographic assays employed in the clinical laboratory. Top-down proteomic analysis of Hb by mass spectrometry is a definitive method to directly characterize the sequences of intact subunits for accurate diagnosis of hemoglobinopathies in just a few minutes. More recently, we applied a "chimeric ion loading" technique in which product ions derived from complementary dissociation techniques are accumulated in a multipole storage device before delivery to the 21 T FT-ICR MS for simultaneous detection (*J. Amer. Soc. Mass Spectrom.*, **33**, 123-130 (2022)). The ultrahigh resolution and mass measurement accuracy achieved at 21 T for both intact protein precursor and product ions along with the extensive cleavages from combined CID and ETD fragmentation enable unequivocal identification and localization of the mutated AA(s) (**Figure 5**).

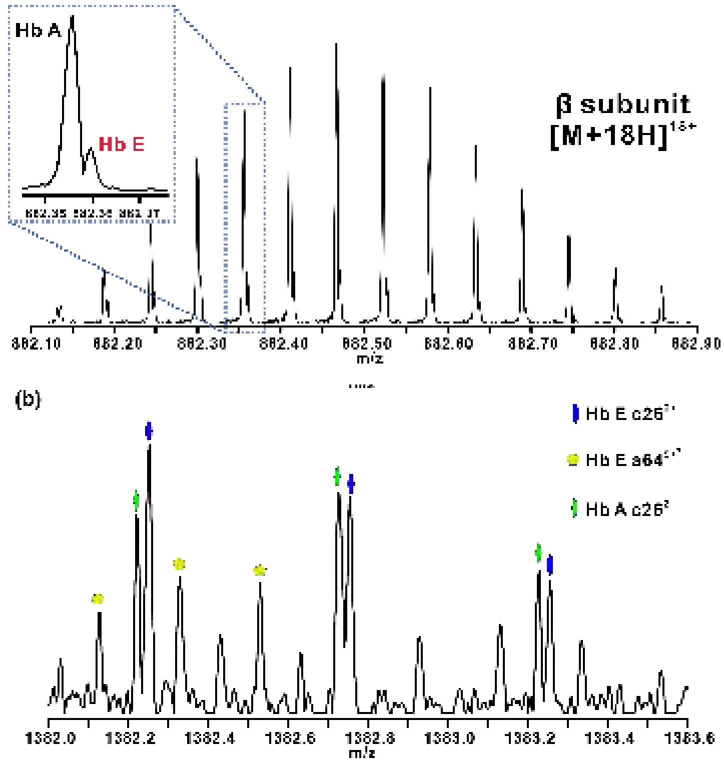


***Figure 5.** (Top) Isotopic distributions for the 18+ charge state of Hb AE β subunits were distinguished with a mass resolving power (m/Δm50%) of 270k and peaks assigned with RMS errors of 0.29 ppm (Hb A β) and 1.07 ppm (Hb E β). (Bottom) Scale-expanded segment of chimeric MS2 spectra for the 17+ charge state of patient Hb β variant (Hb AE). Isotopic envelopes for product ions are assigned, and color -coded for straightforward visualization.*

The 9.4T and 21T instruments are primed for immediate impact in **environmental and petrochemical analysis**, where previously intractably complex mixtures are common. The field of "petroleomics" has been developed largely due to the unique ability of high-field FT-ICR mass spectrometry to resolve and identify all of the components in complex environmental, petrochemical and biofuels samples (*Energy Fuels,* **36**, 10177-10190 (2022); *Fuel Proc. Technol.,* **227**, 107119 (2022); *J. Haz. Mat.,* **424**, 127598 (2022); *Green Chem.,* **24**, 5125-5141 (2022); *ChemRxiv*, (2022); *Energy Fuels,* **36,** 6159-6166 (2022); *iScience,* **25**, 104916 (2022).

Natural Organic Matter (dissolved organic matter) consists of soluble organic materials derived from the partial decomposition of organic materials (*Nat. Commun.,* **13**, 2153 (2022); *Sci. Adv.,* **8**, 27 (2022); *J. Geophys. Res.-Biogeosci.,* **127**, e2022JG006852 (2022); *Anal. Chem.,* **94**, 2973-2980 (2022); *Environ. Sci. Proc. Impacts.,* **24**, 1661-1677 (2022); *Anal. Chem.,* **94**, 11382-11389 (2022); *Commun. Earth Environ.,* **3**, 1-14 (2022). **Figure 6** investigates the microbial carbon pump (MCP) hypothesis suggests and suggests that successive transformation of labile dissolved organic carbon (DOC) by prokaryotes produces refractory DOC (RDOC) and contributes to the long-term stability of the deep ocean DOC reservoir. We tested the MCP by exposing surface water from a deep convective region of the ocean to epipelagic, mesopelagic, and bathypelagic prokaryotic communities and tracked changes in dissolved organic matter concentration, composition, and prokaryotic taxa over time. Prokaryotic taxa from the deep ocean were more efficient at consuming DOC and producing RDOC as evidenced by greater abundance of highly oxygenated molecules and fluorescent components associated with recalcitrant molecules. This first empirical evidence of the MCP in natural waters shows that carbon sequestration is more efficient in deeper waters and suggests that the higher diversity of prokaryotes from the rare biosphere holds a greater metabolic potential in creating these stable dissolved organic compounds.

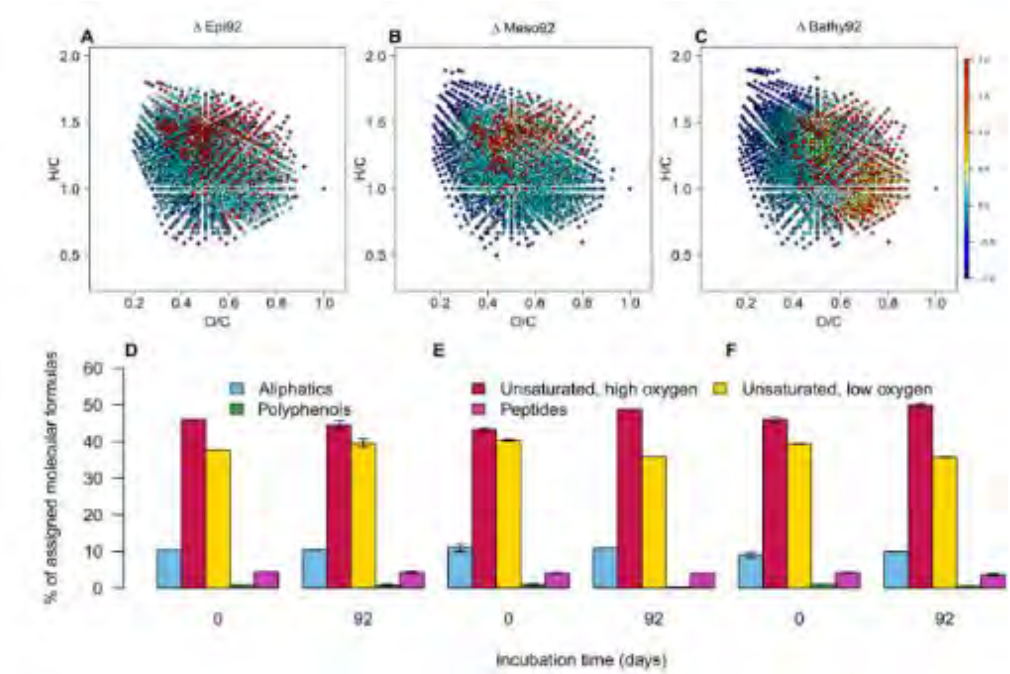


Figure 6. *Changes in DOM composition after 92 days across treatments using ESI-FT-ICR-MS. The top row shows the relative change in the abundance of MF using van Krevelen diagrams comparing MF at 92 days of incubation with those observed at time 0 in the epi- (A), meso- (B), and bathypelagic (C) treatments. Each point represents an MF and is positioned on the basis of its elemental stoichiometry (oxygen:carbon on the x axis, hydrogen:carbon on the y axis). Cold (dark blue) and hot (yellow to red) colors represent a loss and increase in MF's signal intensity, respectively, and blue-gray color represents marginal signal change over time. The bottom row shows the relative change of groups of compounds comparing MF at 92 days of incubation with those observed at time 0 in the epi- (**D**), meso- (**E**), and bathypelagic (**F**) treatments, where error bars represent the mean absolute deviation between treatment duplicates. (Sci. Adv., **8**, eabn0035 (2022)).*

Thermal processing and hydrotreatment of petroleum are used to decrease the viscosity of Alberta bitumen (*Energy Fuels,* **36**, 7542-7557 (2022); *Energy Fuels,* **36**, 10177-10190 (2022)). However, changes in bulk properties, such as API gravity and viscosity, do not correlate to the gravimetric content of maltenes and asphaltenes (**Figure 7**). Polarizable asphaltene fractions from severely hydrotreated samples feature S-containing species with a low aromaticity, which on the basis of their molecular composition suggests that they are composed of the expected, alkyl substituted, geologically stable thiophenic cores (e.g., benzothiophene) as well as "unexpected" sulfides and sulfoxides. Collectively, the results suggest that the high viscosity of thermally upgraded samples could be correlated to the survival of asphaltene species with high heteroatom content (up to five heteroatoms per molecule) and persistent, high abundance of archipelago structural motifs. Thus, it is suspected that nanoaggregation of such fractions prevents their transformation into lighter products. The ocean holds as much carbon in its dissolved organic matter (DOM) pool as the atmosphere does CO_2, with most oceanic dissolved organic carbon (DOC) resisting biodegradation for millennia thereby contributing to climate stability. Prokaryotes are suggested to produce most of this long-lived DOM either through successive and relatively rapid (days to months) transformation of labile DOC to intrinsically refractory DOC (RDOC) or by consuming compounds down to an energetically unprofitable

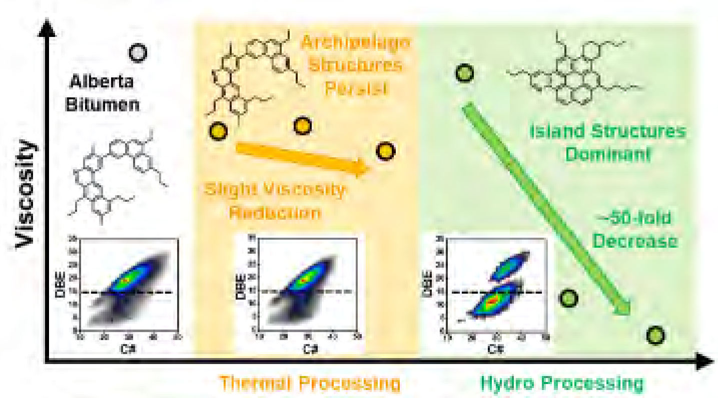


Figure 7. *APPI FT-ICR MS Ultrahigh- resolution mass spectrometry analysis demonstrates that such samples reveal neither a significant decrease in chemical polydispersity nor a change in the relative content of multicore/archipelago structural motifs post thermal treatment.*

threshold (via "dilution"). (*Sci. Adv.,* **8**, eabn0035 (2022)). **Figure 8** shows the changes in DOM composition after 92 days by ESI FT-ICR MS at 21 teslas. Each point represents an MF and is positioned on the basis of its elemental stoichiometry (oxygen:carbon on the x axis, hydrogen:carbon on the y axis). Cold (dark blue) and hot (yellow to red) colors represent a loss and increase in MF's signal intensity, respectively, and blue-gray color represents marginal signal change over time. The bottom row shows the relative change of groups of compounds comparing MF at 92 days of incubation with those observed at time 0 in the epi- (D), meso- (E), and bathypelagic (F) treatments, where error bars represent the mean absolute deviation between treatment duplicates. Samples were run in negative mode. Each MF was classified on the basis of stoichiometry; polyphenol [0.67 > modified aromaticity index (AImod) > 0.5], unsaturated, low oxygen (AImod < 0.5, H/C < 1.5, O/C < 0.5), unsaturated, high oxygen (AImod < 0.5, H/C < 1.5, O/C ≥ 0.5), aliphatic (H/C ≥ 1.5, N = 0), and peptide-like (H/C ≥ 1.5, N > 0).The two most dynamic groups are unsaturated, low oxygen (yellow, O:C < 0.5) and unsaturated, high oxygen (red, O:C > 0.5) compounds. These results suggest that deeper prokaryotic communities transformed DOM into more refractory compounds as evidenced by the decrease in H:C and increase in O:C caused during the oxidative degradation of DOM, replacing H atoms by O-rich functional groups such as COOH and COH.

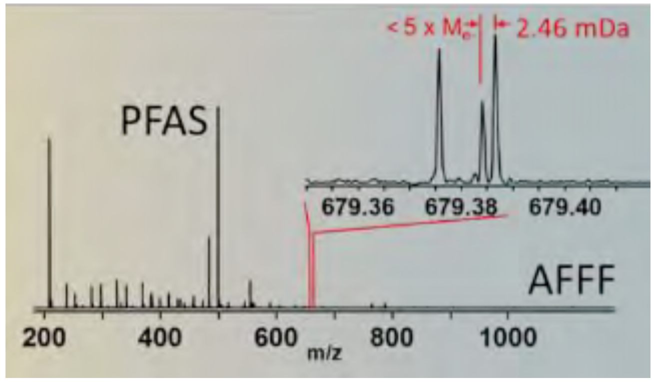


Figure 8. *Negative ion ESI 21 T FT-ICR mass spectra of PFAS compounds identified in aqueous film-forming foam (AFFF). (Environ. Sci. Technol.,* ***56,*** *2455-2465 (2022).*

Emerging contaminants of crude oil byproducts. In 2022, several studies investigated the quantity of species that are produced when asphalt byproducts were subjected to sunlight over time (*Energy Fuels,* **36**, 13060-13070 (2022); *J. Haz. Mat.,* **424**, 127598 (2022); *Environ. Sci. Technol.,* **56**, 12988-12998 (2022)). There is a general paucity of laboratory studies surrounding the characterization, transformation, and toxicity of DOMHC produced from the photo-dissolution of petroleum. Identifying the molecular composition of DOMHC and how it changes over time can

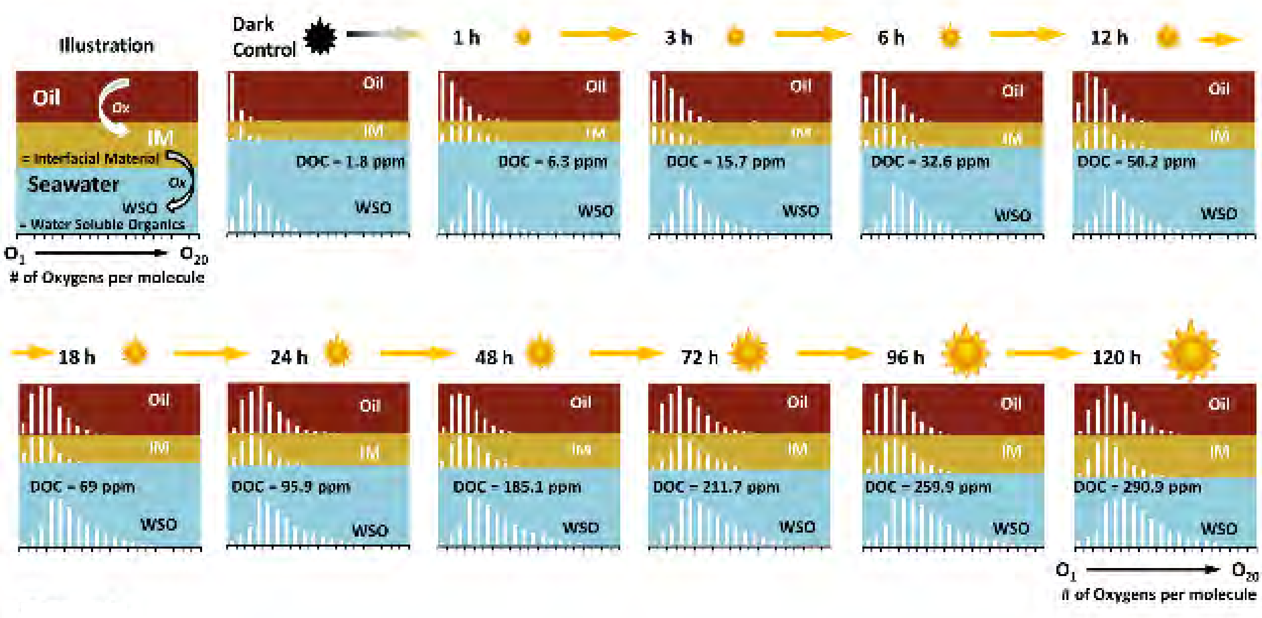


Figure 9. *Schematic summary of solar simulation microcosms depicting the temporal progression of O_x revealed by FT-ICR MS at 21 tesla. X-axis depicts the molecular oxygen content (O_1-O_{20}), and the y-axis shows the relative abundance of these oxygenated species. (STOTEN,* **813**, 151884 (2022)).

lead to important inferences about how it influences bioavailability, dissolution, and toxicity in the environment. (*STOTEN*, **813**, 151884 (2022). **Figure 9** shows the schematic summary of solar simulation microcosms that depict the temporal progression of O_x species revealed by 21T FT-ICR MS.

Per-and polyfluoroalkyl substances (PFASs) are a large family of thousands of chemicals, many of which have been identified using nontargeted time-of-flight and Orbitrap mass spectrometry methods. Comprehensive characterization of complex PFAS mixtures is critical to assess their environmental transport, transformation, exposure, and uptake. Because 21 tesla (T) Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR MS) offers the highest available mass resolving power and sub-ppm mass errors across a wide molecular weight range, we developed a nontargeted 21T FT-ICR MS method to screen for PFASs in an aqueous film-forming foam (AFFF) using suspect screening, a targeted formula database (C, H, Cl, F, N, O, P, S; ≤ 865 Da), isotopologues, and Kendrick-analogous mass difference networks (KAMDNs). (**Figure 8)** *Environ. Sci. Technol.*, **56,** 2455-2465 **(2022)**.

Facility Plans and Directions

The ICR facility will continue to expand its user facility to include user access to the world's first 21 tesla FT-ICR mass spectrometer, including expansion of the MALDI imaging sampling and acquisition capabilities, LC FT-ICR MS for complex organic mixtures, and upgrade of the front-end of the 21T.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

The ICR program provided magnet time to **20** new principal investigators in 2022. The ICR program also enhanced its undergraduate research and outreach program for several undergraduate scientists through the REU program, in addition to co-supervising nine graduate students from FAMU-FSU (Huan Chen, 4), Colorado State University (Amy McKenna, 4), and University of Santander, Colombia (Martha L. Chaćon-Patiño, 1). The ICR program in 2022 supported the attendance of research faculty; postdoctoral associates; and graduate, and undergraduate students at numerous in-person, virtual, and hybrid national and international conferences.

Facility Operations Schedule

The ICR facility operates year-round, with weekend instrument scheduled. Due to COVID-19 restrictions, the ICR facility shifted from on-site users to users sending samples for data acquisition by internal ICR support staff and was able to maintain an active user program with minimal downtime. In addition, the lab-wide power outage December 19, 2022, required all ICR instruments to be shut down with no instrument usage during that time. In 2022, the 9.4T active system was retired, and the 9.4T passive suffered a costly turbo pump failure that limited instrument usage.

NMR Facility

The NMR/MRI User Program at the MagLab in Tallahassee (FSU) is partnered with the AMRIS User Program in Gainesville (UF). Major research areas in Tallahassee include solid-state NMR (SSNMR) research in areas of materials science, chemistry, biology, and biochemistry; in vivo magnetic resonance imaging (MRI) of small animals and tissues; and solution NMR of biomolecules. There are fourteen NMR platforms on site, including three flagship instruments supported by the NSF core grant, including (i) the 36T Series Connected Hybrid (36T-SCH) platform, which operates at 35.2T/1.5 GHz for ^{1}H NMR, making it the highest-field magnet for NMR in the world; (ii) the 14.1T/600MHz/395GHz dynamic nuclear polarization (600-DNP) NMR platform, a unique DNP NMR platform in the world capable of running 24 hours per day for up to 21 consecutive days; (iii) the 21.1T/900MHz (900-UWB) platform, which is currently the highest-field MRI/S instrument in existence; as well as (iv) one 19.6T/830MHz (830) and two 18.8T/800 MHz platforms (800#1, 800#2), which are configured for biosolids and materials ssNMR, as well as for methods development and staging of UHF NMR experiments on the flagship platforms. These instruments are unique, in part, due to their coupling with staff expertise and some of the world's best NMR probes, which are designed and constructed by our NMR Technology Group. In addition, there are a series of moderate-field instruments (600#1, 600#2, 500WB), which are essential for triaging experiments for the high-field instruments, running unique high-temperature and/or $^{1}H/^{19}F/X$ experiments, and supporting the research of numerous users from around the U.S. and the world, including those from HBCUs, HSIs, WCUs, and PUIs.

*Annually, the NMR/MRI User Program, which is run by our Research Faculty and Staff Scientists, and directed by Dr. Rob Schurko, serves ca. 250-350 users from around the world, including PIs, students, postdocs, and technicians. In 2022, our number of users was **354**, surpassing our numbers during the COVID pandemic and pre-pandemic (2021: 311, 2020: 234, 2019: 286). The number of onsite users has increased since 2021, as well as the number of users who are conducting remote experimental operations and sending in samples. The magnet times for most instruments continue to run at near full capacity. Finally, the number of peer-reviewed publications from the NMR/MRI User Program for 2022 was **68**, well above the ten-year average (56.2), and second only to 2020, which had 75.*

Unique Aspects of Instrumentation Capabilities

Ultra-High Field (UHF) NMR: **36T-SCH**. The 36T-SCH was in its fourth year of user service in 2022, with its usage back to a pre-COVID pandemic maximum (93 days, 90 initially allotted), as the full team of engineers is now available for field ramping and monitoring, and the helium-liquefier turbine and a local substation transformer are back online after some downtime in 2021. This platform has resulted in **36** peer-reviewed publications since commissioning in November 2018 (including **10** in 2022, **8** in 2021, and **12** in 2020), and will see much use in 2023, with large time allocations upcoming from February to May of 2023 (the SCH is currently having its field mapped for shimming the newly installed inner A-coil).

The 36T-SCH continues to prove its unmatched value for the SSNMR of half-integer quadrupolar nuclei (*i.e.*, nuclear spins of 3/2, 5/2, 7/2, and 9/2, which constitute 73% of NMR-active nuclides in the Periodic Table) in a wide range of materials. A major focus in 2022 was ^{17}O SSNMR of chemicals, materials, and biological systems, where the SCH affords enormous gains in signal (especially for natural abundance samples, n.a.(^{17}O) = 0.037%) and resolution (since the central transition patterns of half-integer quadrupolar nuclides narrow as the inverse of B_0). Efforts at the MagLab and with our collaborators in France (D. Laurencin & T.X. Métro) on the use of mechanochemical methods for ^{17}O enrichment continues to bolster our success with ^{17}O SSNMR, which carries on in 2023. We also continue to have success studying challenging, unreceptive nuclei like ^{25}Mg and ^{67}Zn (I = 5/2) and have obtained SSNMR spectra of extremely unreceptive nuclides like ^{103}Rh (I = 1/2) and ^{99}Ru (I = 5/2) (publications forthcoming in 2023, *vide infra*).

We are continuing work with Drs. Bill Brey (MagLab) and Jeff Schiano (Penn State) on improving both the hardware and software used to reduce short- and long-term field fluctuations (we achieved a field homogeneity of ~0.3ppm, but have not yet achieved our stability goal of ~0.1ppm). One new probe (out of a total of six for the 36T-SCH) came online in November 2022: a 1.3mm HXY MAS probe (#64) with a MagLab-built stator, which will be used for indirect ^{1}H-detection experiments. The current collection of probes provides unprecedented opportunities for ultra-high field NMR of chemicals, materials, and biosolids, covering mid- and low-γ nuclides, with a wide array of tuning configurations due to the MagLab-designed tuning cards. Finally, Drs. Robert Schurko, Joanna Long, and Bill Brey submitted an NIH RI-1 proposal entitled "*National Resource for Advanced Biomedical NMR Technology*" in support of these SCH efforts, as well as those outlined below.

DNP MAS NMR: **600-DNP**. The 600-DNP platform, a joint effort between NMR, AMRIS, and EMR, which opened for users in late 2018, has yielded 37 publications so far, with 10 in 2022. This is the most efficient high field (*i.e.*, ≥ 600MHz/395GHz) MAS-DNP instrument in the world that is available to a large user base, due to the improved μw delivery and unique on-site expertise. The unique DNP platform is comprised of DNP MAS NMR and Overhauser DNP instruments (solids and solutions platforms, respectively, on two separate 600MHz magnets), which receive microwave irradiation via a quasi-optical table (built in-house) that splits the gyrotron microwave beam. Much of the developmental research takes advantage of the expertise across divisions at the MagLab, bridging between NMR/MRI and both EPR and ICR Facilities. The DNP can be operated continuously (24/7) for up to three weeks at a time, unlike any other DNP platform in the world, and at no cost for users. This enables extremely challenging DNP NMR experiments and support of PIs across the entire career spectrum, including numerous early-career professors who do not have routine access to DNP NMR. Finally, a benchtop EPR spectrometer and MAS spinner are available for sample screening: this improves sample preparation while avoiding probe damage due. The benchtop EPR is key for assessing biradical distributions, their interactions with substrates, and their decomposition.

Due to the expertise and diligence of Drs. Fred Mentink-Vigier and Thierry Dubroca, the 600-DNP had 235 magnet days in 2022 and several new PIs/research groups were recruited. The instrumentation has been improved via modification of the commercial hardware, the purchase of a better cold gas transfer line, and an upgraded console (delivered late 2022, installed early 2023). Further, continued in-house development of MAS-DNP NMR probes has been successful, with the commissioning of our first home-built 3.2mm HXY low-temperature (100K) DNP MAS probe (#61), which became available in July 2022 and involved the team of Dr. Faith Scott, Mr. Peter Gor'kov, Dr. Mentink-Vigier, Dr. Bill Brey and Dr. Joanna Long. Two more probes are currently under construction (1.9mm and 1.3mm HXY 100 K DNP MAS probes). Finally, Drs. Schurko, Mentink-Vigier, Hu, and Frydman submitted a preproposal for an NSF Mid-scale RI-1 (M1:IP), entitled: "*National Facility for High Field Dynamic Nuclear Polarization NMR*", which would bring the first 800 MHz DNP NMR platform that would be available to both U.S. and international users at no cost.

Facility Developments and Enhancements

Probes. The probes designed by the NMR Technology Group are a major factor in setting the MagLab apart from other facilities around the world and keeping our user program on the cutting edge. This team, led by Dr. Bill Brey and Mr. Peter Gor'kov, designs, manufactures, and implements probes of very high quality. They provide versatile tuning configurations for multinuclear ssNMR, low-*E* coils for lossy biosolids samples, and some of the best rf circuits and coils for detection of weak NMR signals. In 2022, two new probes were commissioned, including: (i) a 1.3mm HXY MAS probe (MagLab stator) for the 36T-SCH; and (ii) a 3.2mm HXY low-temperature (100 K) DNP MAS probe for the 600-DNP. Currently, 1.3 and 1.9mm HXY DNP probes are both being assembled. In 2021, a single-channel X MAS NMR prototype probe for the 32T-SCM was constructed and then tested in 2022, paving the way for the design of a low-T HX static NMR probe for this platform in 2023. In 2021, our static HX Low-E probe (#25) for the 900-UWB was configured for low-γ operation and special 5mm containers for air-sensitive samples were designed that are now being used; in 2022, this enabled the first ever acquisition of ^{103}Rh and ^{99}Ru SSNMR spectra on the 900-UWB, with analogous experiments conducted on a newly configured static HX low-E probe (#57) for the 36T-SCH! New tuning configurations were added to several probes, including (i) ^{1}H-^{29}Si-^{6}Li and ^{1}H-^{11}B-^{17}O triple resonance (HXY) modes for 3.2mm 800MHz MAS probes; (ii) ^{1}H-^{99}Ru HX modes for the 5.0mm 800MHz static probe; and (iii) ^{1}H-^{31}P-^{13}C HXY modes for 3.2mm 600MHz MAS probes. Additionally, Brey is working on the incorporation of HTS coils in solution NMR probes for optimized efficiency and increased sensitivity. At the beginning of 2022, Brey and the NMR Technology Group tested a new version of the 1.5mm ^{13}C-optimized HTS solution NMR probe at UF. The probe has a higher *Q* value and 30% better sensitivity than the original version and has since been installed and is moved to the Varian 600 system at MagLab/FSU where it is operating routinely. Also in 2022, a high sensitivity ^{13}C-optimized probe for 900MHz with an innovative sample cell developed in collaboration with Bruker and U. Georgia was completed, and is now operating at U. Georgia.

Probes (planned and in progress) for the coming year include: (i) 800MHz HXY MAS extended VT range; (ii) 850NB 2.5mm MAS HXY with a Phoenix 2.5mm stator for faster spinning and better sample filling factor; (iii) a low-E MAS HXY probe with Bruker stator, so bio-users can send precious samples with unpack and repack; and (iv) an HCNO 0.7mm MAS probe – the ultimate probe for ^{13}C/^{15}N/^{17}O SSNMR of labelled proteins and peptides.

Platform upgrades. The 900-UWB console was upgraded with a Bruker NEO console and new state-of-the-art gradient and shim systems (450V/300A), with shimming capabilities for *in vivo* MRI/S. With multiple channels and transceiver capabilities, this will offer enhanced capabilities in a new super-wide configuration to augment the existing microimaging and SSNMR applications. SSNMR on the 36T-SCH continues to benefit from the work of Dr. J. Schiano (Penn State). New algorithms for his cascade field regulation (CFR) system better compensate for fluctuations in cooling water temperature and have given us a very stable field with a homogeneity of ~ 0.3ppm. In addition, Drs. Bill Brey and Ilya Litvak continued working on the reductions in long-term field drift by improving the stability of the electronics in the CFR system. In late 2022, the 830MHz magnet went down after 31 years of service; we have secured NSF core funding and are obtaining a replacement 850MHz NMR magnet from Bruker, which should be installed in early- to mid-2023. We also obtained NSF core funding for replacement of the 600DNP gyrotron (late 2023), which is currently 9 years old at its end-of-life. Also with NSF core funding, the 600DNP console was replaced with a Bruker NEO console. Its current Avance III console was successfully moved to the 600#2 platform, to replace a very old (21 years! Bruker AV I console). The current state of our NMR consoles is very good.

Major Research Activities and Discoveries/ Research Science Highlights

36T-SCH. The 36T-SCH continued to prove its value for SSNMR studies of half-integer quadrupolar nuclei, due to the scaling of signal proportional to B_0^2, and the narrowing of central transition (+½ ↔ –½) pattern breadths scale as B_0^{-1}, which provides unparalleled enhancement of both signal and resolution. As mentioned, ^{17}O SSNMR has been a major focus on the 36T-SCH over the past year. In terms of biosolids applications, new ^{17}O SSNMR methods were used to identify and fingerprint individual water molecules in hydrated phospholipid bilayers (model membranes) [*J. Am. Chem. Soc.* **2022**, *144*; DOI] (**Figure 1**) and aid in the NMR crystallographic characterization of the structure of the active site in the protein tryptophan synthase [*PNAS* **2022**, *119*, e2109235119; DOI]. For problems in chemistry and materials science, major projects included an NMR crystallographic study of α-*D*-glucose/NaCl/H_2O (2/1/1) cocrystals, using site-specifically ^{17}O-enriched glucose molecules and first principles DFT calculations [*Chem. Sci.* **2022**, *13*, 2591–2603; DOI]; and a ^{17}O SSNMR characterization of a variety of ^{17}O-enriched zeolite catalyst preparations, in order to identify potential synergistic site structures with increased catalytic activity [*J. Am. Chem. Soc.* **2022**, *144*, 16916; DOI]. NMR of half-integer quadrupolar nuclei of **metal elements** continued to be pursued as well. For instance, ^{11}B (I = 3/2) SSNMR at 35.2T was used to identify NMR signals from pores and defect sites in mesoporous hexagonal boron nitride (*p*-BN), an important candidate material for hydrogen storage and filtering of water pollutants [*J. Am. Chem. Soc.* **2022**, *144*, 18766; DOI]. The incredible sensitivity and resolving power of ^{11}B SSNMR at

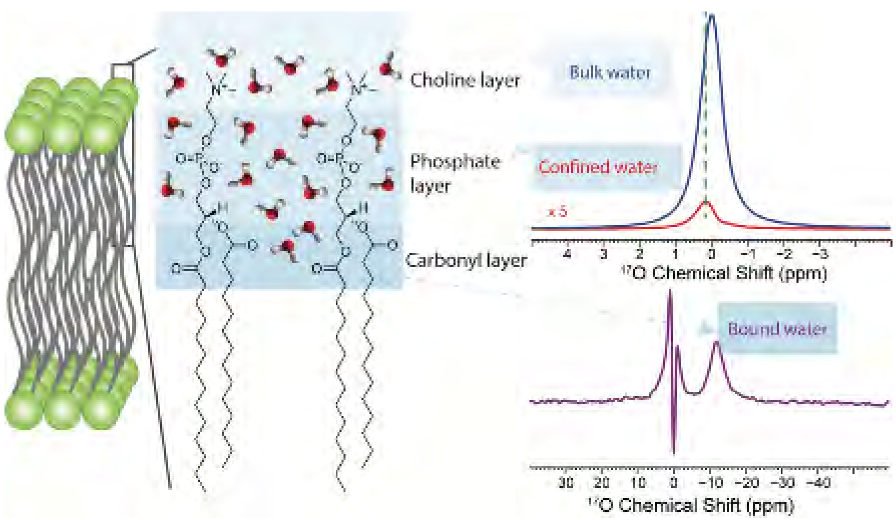


Figure 1. *Left: Molecules in the fore make up the hydrated DMPC bilayer. The hydration of the headgroup region is highlighted with different blue background shading reflecting the waters that interact with the choline, phosphate and carbonyl groups of the lipid headgroup. Right: The 17O SSNMR spectra acquired at 35.2 T of resonances of individual "bound" water molecules that are located in different layers of the DMPC headgroup region.*

35.2T afforded detailed site resolution via 1D ^{11}B MAS NMR, along with 2D ^{11}B{^{1}H} D-HMQC and ^{11}B DQ−SQ experiments. For similar reasons, ^{27}Al (I = 5/2) SSNMR was successfully used to characterize the structural properties of five-coordinate Al sites in aluminas, which play important roles in their use as either catalysts or catalyst support materials [*ACS Cent. Sci.* **2022**, *8*, 795; DOI].

600-DNP. In 2022, the 600-DNP platform continued to provide ground-breaking science in both DNP NMR developments and applications to a wide array of biosolids and materials. Major user projects focused on applications of biomaterials NMR, including work on DNP ^{1}H-^{13}C CP/MAS NMR investigations of the nanostructural assemblies in plant stems, with a focus on interactions between polysaccharides and lignocellulosic components of cell walls [*Nat. Commun.* **2022**,*13*, 538; DOI]; characterization of cell walls and polysaccharides in the cell walls of two fungi, *A, fumigatus* and *C. albicans*, which are implicated in fungal infections that are great threats to human health [*J. Struct. Biol. X* **2022**, *6*, 100070; DOI]; a combined DNP NMR and cryo-electron tomography exploration comparing cellulose microfibrils that were synthesized *in vitro* vs. those occurring naturally in *P. patens* and hybrid aspens [*Biomacromol.* **2022**, *23*, 2290; DOI] (**Figure 2**); and a study of the structure of insect wings – in particular, 1D ^{13}C and 2D ^{13}C DQ-SQ experiments were able to provide structural details on the chitin components that are simply not observable in spectra acquired on non-labelled samples at lower magnetic fields [*SSNMR* **2022**, *122*, 101838; DOI]. There were also exciting new developments for DNP NMR methodologies in both solid and liquid phases. For instance, the use of new radical polarizing agents, like cAsymPol-POK or PyrroTriPol, were shown to provide extraordinary DNP for high-field SSNMR experiments (up to 18.8T) on both proteins and pharmaceuticals [*Angew. Chemie Int. Ed.* **2022**, *61*, e202114103; DOI]. Additionally, in a collaboration between the NMR and EMR divisions, the first major report of ^{13}C-enhanced Overhauser DNP NMR was made, in which *J*-coupling based INEPT experiments were used to obtain indirectly detected solution ^{1}H NMR spectra with significant signal enhancements [*J. Magn. Reson.* **2022**, *343*, 107304; DOI].

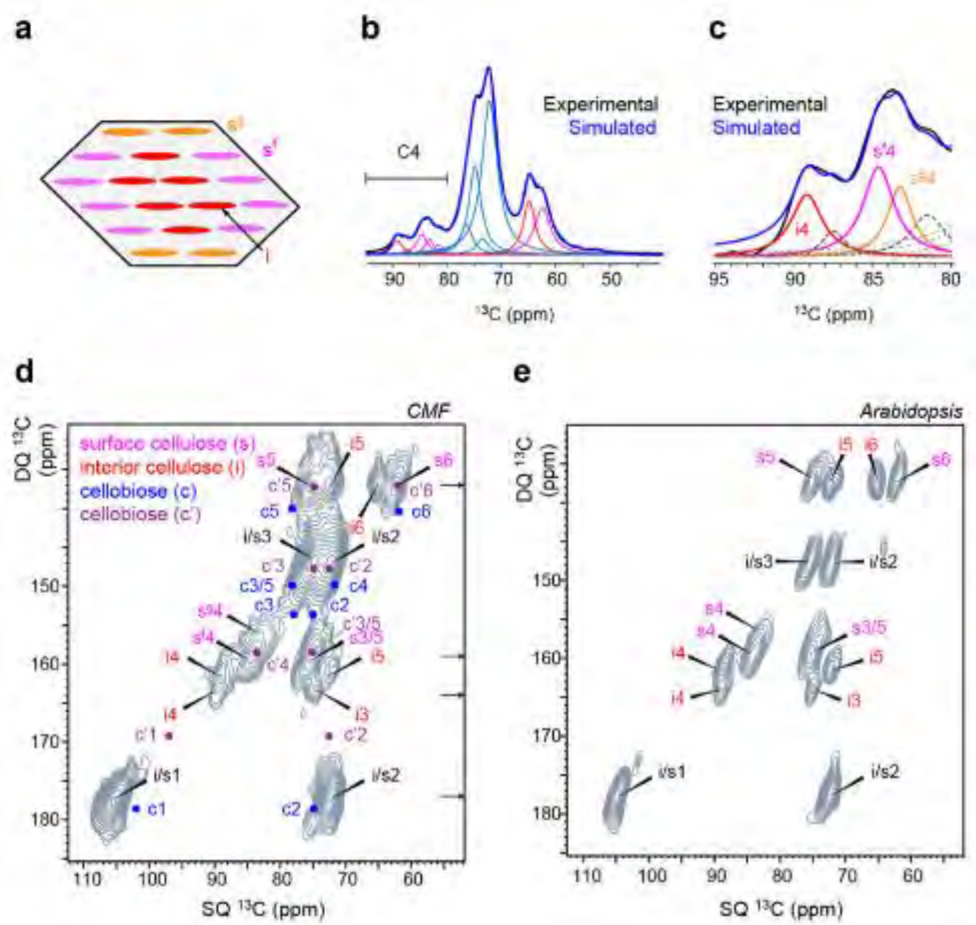


Figure 2. *(a) Cross-section of a model fibril with 18 glucan chains with one type of interior cellulose (**i**) and two surface units (**s**^{f} and **s**^{g}). (b) Spectral deconvolution of CMF spectra in blue, matched to experimental data in black. (c) C4 region of the deconvolution. (d) CP refocused INADEQUATE spectrum of CMFs collected on a 600 MHz/395 GHz DNP. (e) CP-based refocused INADEQUATE spectrum of secondary cell walls of Arabidopsis.*

900-UWB. The flagship 900-UWB platform, the highest-field MRI system in the world, yielded several MRI publications, including a study featuring the use of ^{23}Na and ^{1}H MRI to monitor recovery from ischemic stroke (in rodent models) following treatment with human mesenchymal stem cell aggregates (hSMC-agg) [*Transl. Stroke Res.* **2022**, *13*, 543; DOI]. MRI operations at 21.1T were limited over the course of 2022, due to console and gradient-related upgrades; as a result, we took the opportunity to acquire the first ever ^{103}Rh and ^{99}Ru SSNMR spectra at MagLab, with much success (these results will be published over the course of 2023). As mentioned above, MRI functionality is now available, and we expect ramping up of MRI operations throughout 2023.

Other major SSNMR instruments. Our 830, 800(×2), 600(×2) and 500 MHz platforms are the workhorses for the majority of high- and moderate-field SSNMR experiments, while also serving as screening platforms for flagship instruments. The 800#1, 800#2, and 830 NMR spectrometers are of great importance for SSNMR of biosolids (due to high sensitivity and large chemical shift dispersions) and well as for half-integer quadrupolar nuclides in chemicals, pharmaceuticals, and a wide range of materials (again, due to narrowing of CT powder patterns proportional to B_0^{-1}). 600#1 and 600#2 act in support of these instruments, providing unique opportunities for variable-temperature and/or HFX SSNMR. The 500 platform is heavily utilized for research on energy materials (*e.g.*, ^{7}Li NMR and MRI of energy materials) and is equipped with a laser for heating up to temperatures of *ca*. 700°C.

Some research highlights include: (i) catalysts: a ^{17}O and ^{27}Al SSNMR investigation of paired synergistic sites in zeolites (*i.e.*, key sites that by their proximity, have increased reactivities) [*J. Am. Chem. Soc.* **2022**, *144*, 16916; DOI]; the use of ^{1}H-^{17}O rotational-echo double resonance (REDOR) experiments to investigate the adsorption of CO_2 on MgO nanosheets [*Nat. Commun.* **2022**, *13*, 707; DOI]; (ii) biosolids: the development and application of a ^{1}H-detected 3D ^{1}H-^{13}C-^{17}O triple-resonance correlation technique, which was applied to peptides, and holds promise for investigations of larger biomolecules [*J. Phys. Chem. Lett.* **2022**, *13*, 6549; DOI]; the use of MAS and oriented sample (OS) ^{1}H/^{13}C/^{15}N SSNMR experiments for the structural characterization of the homotetrameric membrane protein structure of the S31N M2 protein from the Influenza A virus, with different symmetries about the main channel axes occurring with different protein:lipid ratios [*J. Am. Chem. Soc.* **2022**, *144*, 2137; DOI]; (iii) NMR crystallographic (NMRX) studies: an NMRX characterization of the framework structure of $Zn_3(OH)_4(BDC)$ metal organic frameworks (MOFs) (BDC = benzene-1,4-dicarboxylate or the "terephthalate" ligand) and interconversions of structures, enabled by a combination of ^{1}H, ^{13}C, and ^{17}O SSNMR, *in operando* Raman spectroscopy, and mechanochemical ^{17}O-enrichment methods [*Chem. Mater.* **2022**, *34*, 2292; DOI]; and, the use of ^{35}Cl and ^{14}N SSNMR, along with plane-wave dispersion-corrected density functional theory (DFT-D2*) calculations, for the characterization and NMRX of nutraceuticals in bulk and dosage forms [*Mol. Pharm.* **2022**, *19*, 440; DOI].

Facility Plans and Directions

In 2022, we interviewed candidates for a Research Faculty position to manage the 36T-SCH User Program and expand UHF SSNMR operations to the 32T-SCH platform. We were fortunate to hire Dr. Amrit Venkatesh (Ph.D. at Iowa State under Prof. A. Rossini, and currently a postdoc with Prof. Lyndon Emsley, EPFL), who will commence working with us in May 2023.

A number of new initiatives were started in 2022 and continue into 2023, with support from the NSF Core Grant, as well as from external funding sources, which continue to augment support of the NMR/MRI User Program: (i) the submission of an NIH RM1 to support biomedical NMR applications (essentially a renewal of our previous NIH P41), which will support operations on the 36T-SCH and 600-DNP platforms (we are awaiting final notice and administrative decisions); (ii) the submission of a preproposal for an NSF Mid-scale RI-1 for a National Facility for High Field Dynamic Nuclear Polarization NMR, which will feature the world's first open access 18.8T/800MHz DNP NMR platform; (iii) continued planning for a national network of UHF NMR instruments (28.2T/1.2GHz) with colleagues from five other universities across the U.S.; and (iv) continued work with the *DC Facility* and *CMP* on development of UW NMR techniques on and probes for the 32T-SCM. Despite significant cuts to the NSF core funding (2023-2028) to the NMR/MRI User Program, we are continuing to pursue (v) conversion of an 800MHz solutions NMR spectrometer to a dedicated SSNMR spectrometer for ^{1}H-indirect detection experiments on biosolids and repositioning of solution NMR operations at 700MHz in the Department of Chemistry and Biochemistry at FSU; (vi) development of DNP NMR methods at 30+ T; (vii) the design and/or purchase of ^{1}H/^{19}F/X fast MAS probe and low-temperature static H(F)X probe for experiments at 18.8T for our NMR User Program, which will make our collection of 800MHz spectrometers one of the most versatile such collections in the world.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

User community. With the gradual abatement of the COVID pandemic, in-person recruitment of users and project solicitations at conferences has increased dramatically. Our affiliated faculty members, research faculty, and staff scientists have attended major international conferences to support these efforts, including the Experimental NMR Conference, EuroMAR, International Society for Magnetic Resonance (ISMAR), International Society for Magnetic Resonance in Medicine, Rocky Mountain Conference for Magnetic Resonance, Alpine NMR Conference, American Chemical Society conferences (regional and international), among others. We have also increased our advertising and sponsorships at several of these meetings. Crucially, we hosted the first in-person Southeastern Magnetic Resonance Conference (SEMRC) in Nov. 2022 in Tallahassee, having ca. 100 in-person attendees on site (the scope of this meeting covered solution NMR, solids NMR, and EMR methods – Drs. Rob Schurko and Steve Hill co-chaired this meeting). We also offered MagLab tours to attendees.

We continued to organize and update our lists of spectrometers and probes. We also finished several interactive databases (on Google Sheets) that can be used to check on the status of probes for each instrument, bore sizes, general use and maintenance, and other capabilities. These advances aid us in presenting immediate information to users, as well as keeping the newly revised MagLab website updated with crucial information.

Education and training. In-person workshops and NMR schools also came back online in 2022 and will carry on into 2023. In May 2022, an NMR probe building workshop (associated with our NIH P41 grant) was offered, which featured a combination of presentations, tours, and hands-on work with the NMR Technology Group in Tallahassee (these activities also involved numerous Research Faculty). Some of our personnel also participated in the MRI RF coil workshop (hosted at AMRIS/UF in Gainesville), which also featured lectures and hands-on, practical work with coil building (4.7T quadrature rat surface coils were built). Finally, a pilot test of an NMR Winter School was planned during October-December of 2022 (and carried out in January 2023) and featured a visit from four undergraduates and one faculty member from Washington and Jefferson University. The students attended lectures and tours and participated in NMR experiments on one of the 800MHz platforms for four days, with the aim of organizing and presenting data and eventually publishing in a peer-reviewed journal. Organized by R. Schurko and Prof. R. Luliucci (W&J University), this NMR school featured participation by Drs. Mentink-Vigier, Scott, Grant; Mr. P. Gor'kov, and numerous graduate students from Schurko's group. This pilot will serve as the basis for a future NMR school, to be offered to senior undergraduates and junior graduate students, likely in late 2023 or early 2024. We hope to conduct an UHF NMR/36T-SCH workshop for our *Users Committee Meeting* in September 2023.

STEM Outreach. STEM outreach was outstanding in 2022, now that the restrictions of the COVID pandemic have largely lifted. Drs. Ilya Litvak and Faith Scott resumed in-person "Neighborhood Camp Fair" activities, which had 105 individual attendees (61 K-8 students, 44 adults, and the majority of attendees were from URM areas). Dr. Litvak and Ms. Malathy Elumalai also organized and ran a "Teen Summer Program Fair" aimed at Tallahassee South Side residents (28 middle- and high-school students; 21 adults, from a predominantly URM area). Dr. Sam Grant made STEM presentations to Godby High School students, Cub Scout day camps, and the Dr. B.L. Perry Jr. Library Branch of the Leon County Libraries. He also mentored two undergraduate thesis students, one elementary school teacher, and one COE undergraduate researcher, and presented a STEM session at a Mayo Clinic lunchtime symposium. Drs. Scott and Schurko conducted tours for the Women in Math, Science and Engineering (WIMSE) program at FSU, with 5-6 female undergraduates from across a wide swath of degree programs. Dr. Scott also managed the MagLab booth for the Tallahassee Science Festival and met weekly as a mentor for a middle-school science teacher to aid in lesson planning. Drs. Scott, Litvak, Elumalai, and Grant participated in organizing and judging local science fairs. Drs. Schurko, Elumalai, and Grant also supervised NSF REU summer research students. Finally, a good majority of our personnel conducted in-person tours of the MagLab facilities, for K-12 students, undergraduates, graduate students, the general public, and numerous other visitors and scientists. It has been great to see all of these in-person outreach activities blossom once again.

Facility Operations Schedule

The majority of our instruments saw continued increases of magnet days in comparison to 2021, largely due to increased numbers of in-person visitors and resumption of full-time research activities around the world. The 800#1, 800#2, 600#1, and 600#2 are back to numbers approaching 365 days per year, with very limited downtimes for maintenance and testing (the 830 was on track for this until the magnet quenched). We have also established robust routines for remote use, which greatly aid efforts on user projects. Drs. Z. Gan, I. Hung, R. Fu, and S. Wi continue to be largely responsible for the great success on these instruments, in terms of doing great science and keeping the instruments and probes in top condition. As mentioned, the 900-UWB was not operating at full capacity for MRI experiments in 2022; now that the new console and gradients are installed, a return to full MRI operations is expected. This will be greatly aided by a new MRI Research Faculty hire in 2023. We continued to fill available times with increased usage of the 900-UWB for SSNMR of unreceptive nuclei like ^{103}Rh (I = 1/2) and ^{99}Ru (I = 5/2) and achieved a remarkable **361** magnet days. NMR experimentation on the 36T-SCH increased to **93** days in 2022 (vs. **32** days in 2021, **42** in 2020, and **90** in 2019); pending successful field-mapping, we expect continued high usage. The 600-DNP platform continued its outstanding performance, operating for **235** magnet days in 2022 (down slightly, but not significantly, from **242** in 2021).

Pulsed Field Facility

The Pulsed Field Facility, located within Los Alamos National Laboratory (LNAL) in Los Alamos, NM, utilizes both LANL and U.S. Department of Energy assets to provide pulsed magnetic fields to our international community of users – from undergraduate students to senior investigators. Along with our magnets, we provide users with both robust scientific instrumentations engineered to operate in the transient pulsed magnetic field environment, along with support of scientists who are active researchers with expertise in high magnetic field-driven science.

Unique Aspects of Instrumentation Capabilities

Table 1. *Pulsed field magnets available to users at the MagLab-PFF.*

Capacitor Driven Pulsed Magnets				
Magnet System	**Bore, ^{3}He Sample Space**	**Rise Time, Max dB/dt**	**Pulse Duration**	**Supported Research***
65T Short Pulse (x4)	15mm, 9mm	8ms, 8.1T/ms	80ms	Magneto-optics – IR through UV Magnetization – extraction, torque Magnetic Susceptibility Magnetotransport – DC through MHz Pulse Echo Ultrasound Spectroscopy Fiber Bragg Grating Dilatometry Polarization Magnetocaloric Sample Temperatures: 400mK to 300K For compatible techniques: Pressures up to 5 GPa and in-situ sample rotation
75T Duplex		1.8ms, 25T/ms (30 - 75T)	80ms	
55T Mid-pulse		32ms, 1.8T/ms	300ms	
Generator Driven Pulsed Magnets**				
Magnet System	**Bore, ^{3}He Sample Space**	**Rise Time, Max dB/dt**	**Pulse Duration**	**Supported Research***
100T Multi-shot	10mm, 5mm	8ms, 7.5T/msec (40 – 100T)	3s	All techniques listed above
60T Controlled Waveform ("Long Pulse")	25mm, 18mm	Adjustable	3s, Up to 100 ms full field flat top	All techniques listed above, plus: Magnetothermal studies (heat capacity and magnetocaloric) FIR and THz optics Larger Sample Volumes

**Resources available to work with users to develop and field new and novel techniques as needed in our magnet systems.*

***Offline while LANL's 1.4 GW AC generator is being repaired.*

Table 1 lists the suite of magnets operated here at the PFF. At the heart of our magnet operations is a fully multiplexed (8 output) computer controlled 4MJ, 16kV capacitor bank. Currently this capacitor bank is responsible for providing power to all the operational pulsed magnet systems, including our workhorse 65T short-pulse magnets and our newest 55T mid-pulse and 75T duplex magnets. LANL is uniquely home to a pulsed power supply in the form of a 1.4GW AC generator, which provides the hundreds of megajoules required to run our 100T multi-shot magnet – the first and only magnet in the world to successfully perform a magnetic field pulsed to 100T in a non-destructive manner. The rectification of the generator output enables the control of the pulsed power waveform, allowing for the optimization of both the 100T multi-shot magnet and the 60T controlled waveform ("Long Pulse") magnet for existing experimental research techniques. Currently these two latter magnets are unavailable to users while the generator is under repair.

Facility Developments and Enhancements

85 T Duplex Magnet

In part to mitigate the unavailability of generator driven magnets providing fields above 75T, and to advance the R&D efforts of multiplexed magnet technology, work pressed ahead on the fabrication of a solely capacitor bank driven 85T duplex magnet. Fabrication of the prototype of this unique magnet was completed early in the third quarter of 2022, along with the hi-pot testing of the coaxial leads and power distribution assemblies. Operation requires power delivery from both the 16kV, 4MJ short pulse and 18kV, 2MJ 100T capacitor banks, and development of the necessary control and protection infrastructure which is on track for completion in 2023. The supporting structures and G10 blast box for this new duplex magnet are also complete, readying the entire system for commissioning once the necessary power infrastructure work is complete.

Helium Recovery Improvement Efforts

With the cost of helium gas continuing to rise and the low availability of supply on the open market, like many others the pulsed field facility has focused on reducing our dependence on liquid helium where possible as well as improving our helium gas recovery. Thanks to institutional investment by LANL, a new helium free 14T PPMS (Physical Properties Measurement System) was purchased to replace an aging PPMS that was consuming significant amounts of helium. While initially scheduled to be delivered in by September 2022, problems with the equipment have delayed its final installation until the beginning of 2023, after which it will help support both in-house science and user experiments.

To address the efficiency of helium recovery, investment has been made in a new Linde helium liquefier, purifier, and associated equipment. Replacing this key capability has provided the opportunity to relocate helium recovery and reliquefication operations, requiring the relocation of some machines from a nearby machine shop, as well as modifications to the existing electrical power distribution, chilled water lines, and LN_2 lines. In addition to this work on track to be completed in 2024, the entirety of the PVC gaseous helium recovery piping was replaced with natural gas rated piping that has a joint system designed to reduce leaks, which had developed in the PVC joints over time. Along with the upgraded piping, check valves were installed to further reduce pressure fluctuations and unnecessary cryogenic boil-off between interconnected systems, as well as additional gas meters to provide necessary information on the recovery rate of the entire PFF.

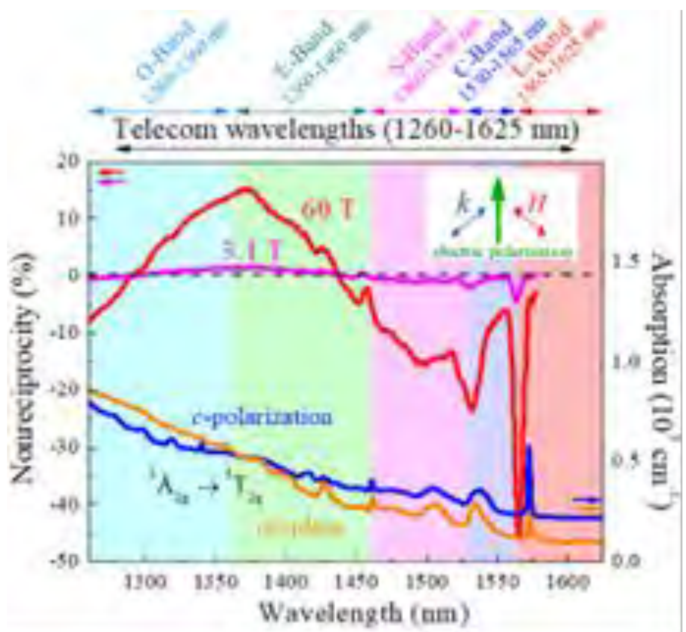


Figure 1. *Nonreciprocity at 60 tesla in the toroidal configuration (red line) spans the entire range of the telecommunications wavelengths. The signal at 1550nm is important for photonics applications and is tunable depending on the measurement geometry. The insert shows the toroidal measurement configuration.*

Major Research Activities and Discoveries/ Research Science Highlights

Users from the University of Tennessee investigated the nonreciprocal directional dichroism – often referred to as "one-way transparency" – in the magnetic material Ni3TeO6 using optical spectroscopy techniques in fields up to 60T. To observe this affect, whereby light is highly transmissible through this material in one direction but nearly opaque in the opposite direction, the time-reversal symmetry of the system must be broken, which can be done by switching the direction of an external magnetic field. Utilizing the high fields at the PFF the team of researchers discovered that one-way transparency was supported in a number of different measurements geometries, and more importantly that it persisted across the entire range of telecommunications wavelengths as shown in **Figure 1**. These findings not only open the door to possible applications of this material for high-efficiency optical diodes, but to photonics applications as well – particularly in the area of secure fiber optic telecommunications. For more details see: K. Park, et al. "Nonreciprocal directional dichroism at telecom wavelengths," Nature Quantum Materials (npj), 2022 (DOI: https://doi.org/10.1038/s41535-022-00438-6).

Another optical spectroscopic study performed in pulsed fields up to 60T focused on the interactions between electrons in the atomically thin semiconductor monolayer WSe_2. In such a material, the interactions between electrons can result in electron-hole pairs (excitons) which can be photoexcited and observed in optical based measurements. At low electron densities the formation of negatively charged excitons has been well studied. However, the origin of an additional exciton that emerges at high electron density – often called the mysterious $X^{-'}$ state – is not well understood despite being known about since 2013. It is this mysterious $X^{-'}$ state that scientists at the PFF and their collaborators set out to understand via polarized absorption spectroscopy of gated WSe_2 monolayers. Their results, highlighted in **Figure 2**, show that the $X^{-'}$ state is a multi-particle state that occurs due to the interaction between the exciton and multiple reservoirs of distinguishable electrons; a very different scenario than the usual exciton-one electron reservoir interaction observed at lower electron density in monolayer WSe_2 and other atomically-thin semiconductors. For more details see: J.Li *et al.* "Many-Body Exciton and Intervalley Correlations in Heavily Electron-Doped WSe_2 Monolayers," Nano Letters, 2022 (DOI: https://doi.org/10.1021/acs.nanolett.1c04217).

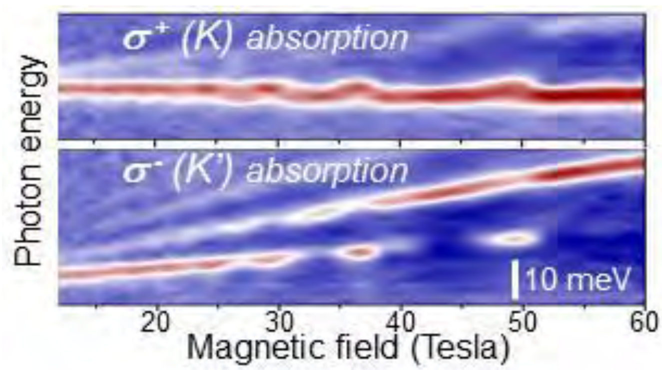


Figure 2. *For high electron density monolayer WSe_2 in large magnetic fields, modulations in the σ^+ circularly-polarized absorption spectrum – corresponding to a transition to the K momentum valley – occur when electrons fill or empty the opposite K' momentum valley. This result demonstrates that the $X^{-'}$ state is a many-body state, comprising a spin-up exciton in K, coupled to multiple (up to three) different distinguishable electron reservoirs.*

Facility Plans and Directions

Standardizing Experimental Magnet Cells

Building upon our experience using commercially available customizable stairs and platforms from ErectAStep in our Duplex and Midpulse magnet cell, we have designed new platforms for the 4-magnet cells currently in operation on the mezzanine. The existing multi-level platforms will be replaced with a single level that will allow for a more ergonomically friendly operation for both our users, and the staff who currently work in some tight spaces when maintaining the equipment. The new design will also replace the disparate layouts with one standardized configuration, which will enable an overall standardized instrumentation, data acquisition, and helium management set-up in each of the four cells, thereby enabling easy and quick transitions between cells should an experiment have to be quickly moved due to a magnet failure. We anticipate rolling out these changes in the second half of 2023.

Replacement and Upgrades to Existing Cooling Water Systems

The PFF's existing cooling water system which was installed to support the 1. GW motor generator operations is over 30 years old and is starting to show significant aging, especially in recent years as its use has now expanded to also support liquid helium production. Many of the components of this system are hard to access and/or not easily visible, which makes condition monitoring difficult and has resulted in a lack of proper maintenance. To replace and modernize this system, the PFF submitted a ~$10M multi-year proposal to an NNSA program known as CHAMP (Cooling and Heating Asset Management Program) in 2019; it was awarded in August 2022, with an estimated completion in the summer of 2024. This work will include separating our existing cooling system into two separate systems, one upgraded open loop for the generator's cooling needs and one closed loop chiller for helium operations. The existing cooling water tanks, cooling pumps, cooling towers, and piping will be demolished and replaced, and a new filter system will be installed to decrease the environmental impact of the wastewater, along with a modernized monitoring devices and alarm system.

Outreach to Generate New Proposals-Progress on STEM (Science, Technology, Engineering and Mathematics) and Building User Community

After over two years of largely virtual-only user outreach and community interactions, we saw an increase in the number of in-person conferences and university talks that our staff members participated in. Similarly, we saw a return to tour requests of our facility from LANL associated programs and organizations including judges from the LANL judicial summer school, NM congressional staffers, LANL's postdoc association, and several graduate summer school programs held here at LANL. The one LANL based outreach program that PFF members did participate in virtually this year was the now 6th annual Los Alamos National Laboratory (virtually) hosted Sumer Physics Camp for Young Women, a free camp that focuses on inspiring interest in STEM through inquiry-based labs led almost entirely by women currently working in STEM. The three scientists involved were instrumental in in the development and teaching of a hands-on magnet related lab, as well as giving a virtual tour of the pulsed field facility. Further from home, the return of an in-person DC Facility hosted MagLab User Summer School provided an opportunity for the PFF user program director to give an overview of the facility as well as a scientific overview of experimental techniques useful in both DC and pulsed fields.

Facility Operations Schedule

Jointly with the DC Facility, the PFF solicits proposals through a common call three times a year to streamline the application process and ensure the availability of personnel and magnet resources. The capacitor bank driven magnets operate Monday through Friday from 8 am to 7 pm, with a later start of 10 am on Mondays due to weekly maintenance. Generally, no more than three pulsed magnets – either three 65T magnets or two 65T magnets and either the 75T duplex or 55T mid-pulse – are scheduled for users each week to enable turnaround and continuation of an experiment following a magnet failure.

3. Education and Outreach

Education

The Center for Integrating Research and Learning (CIRL) guides the K-12 educational and broader mentoring efforts of the MagLab's education and outreach mission. Our programs are designed to include research-based best practices in science and engineering education for K-12 students as well as research-based practices in mentoring for students, teachers, postdocs and faculty in STEM. Our staff participate in and facilitate professional development in their specific disciplines so that we can ensure the MagLab is aware of best practices for building a more diverse STEM workforce.

In addition to the programs run by CIRL outlined in this chapter, MagLab students, staff, and faculty conduct additional education and outreach activities outside of CIRL programs (e.g., science nights at schools, undergraduate and graduate student tours). In 2022, 90 scientists and staff reached more than 5,200 people through their individual efforts. The break down for this number was 53.0% K-12 students, 37.0% general public, 9.8% undergraduate or graduate students, and 0.4% K-12 teachers. Of the 90 scientists who conducted outreach in 2022, 64 conducted long-term (i.e., longer than a tour or one-time event) outreach working with K12 or undergraduate students. These scientists mentored a total of 129 individuals this year.

The K-12 education and outreach along with mentoring across all educational and career levels would not be possible without the CIRL team. Below are some examples of the leadership and relative professional development initiatives that CIRL staff have engaged in over the last year.

CIRL Personnel Highlights in 2022:

- CIRL's K-12 Education Director Carlos R. Villa was reelected to be Area 2 Director of the Florida Association of Science Teachers, a position he has held since 2019. He also served as a reviewer for the NSF Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST). In September, Villa presented virtually on the Role of Major and Mid-scale Research Infrastructure in Fueling the US STEM Workforce Pipeline (PreK-12) at the 2022 NSF Research Infrastructure Workshop. He also presented two sessions at the Florida Association of Science Teachers Annual Conference in St. Augustine, FL. In 2022 he was a co-PI on the SciGirls in Space grant awarded by Twin Cities Public Television. The funds were used to support a space related SciGirls afterschool club for middle school students at Florida State University School.
- CIRL's Mentoring Director Dr. Kawana Johnson serves on the FSU Postdoctoral Advisory Board as a representative for MagLab postdoc needs. In September, she presented as part of a virtual panel discussion at the 2022 NSF Research Infrastructure Workshop. In October, she presented a session on Diversifying Innovation in STEM Through Mentored Experiences at the Mentoring Institute Conference at the University of New Mexico. Johnson also attended the 2022 ECMC CTE Leadership Collaborative Convening in Nashville, TN as an alum of the NC State Postsecondary Research Fellow's program. The ECMC Foundation is a national foundation working to improve postsecondary outcomes for underrepresented minority students and students from underserved backgrounds.
- CIRL's Director Dr. Roxanne Hughes served her second of a 4-year term as part of the Chair position of the American Physical Society's Forum on Outreach and Engaging the Public, wherein she will use CIRL's research to inform national efforts for physics educational outreach. She serves on the FSU Strategic Planning Committee wherein she represents the MagLab to ensure it continues to be an important part of FSU's future. Hughes was selected as an FSU Faculty Fellow, the first specialized faculty to be selected. In this role she has been integral to the FSU NSF ADVANCE grant submission and the planning of faculty initiatives aimed at improving women's persistence in STEM. She continues to represent the MagLab on the Florida State University (FSU) President's Council on Diversity and Inclusion.

3.1 Diversity and Inclusion in CIRL Education Programs

Diversity and inclusion are focal points of all MagLab's educational and outreach activities. **Table 1** highlights the demographics for CIRL's in-depth programs (i.e., one week or longer). More information about each of these programs is available later in this chapter.

Table 1. *Diversity of Education Programs*

2022	Total	% Women	%African American	% Hispanic	%American Indian/Native Hawaiian
Research Experiences for Undergraduates (REU) summer	25 undergraduates	44%	16%	4%	NA
Magnetic Momentum Scholars Program	14 undergraduates	64%	100%	NA	NA
Research Experiences for Teachers (RET) summer	14 K-12 teachers and informal STEM educators	86%	36%	7%	7%
High School Externship (2021-2022 Academic Year)	5 high school students	80%	20%	20%	0%
MagLab Godby Summer Scholars Program	6 high school students	100%	83%	17%	17%
Camp TESLA (1-week camp)	20 middle school students	45%	25%	25%	10%
SciGirls FAMU DRS Coding Camp (1-week camp)	4 middle school students	100%	75%	25%	NA
SciGirls Summer camp (1-week camp)	21 middle school students	100%	29%	14%	NA

3.2 Web-based Outreach

Magnet Academy

The Magnet Academy is the MagLab's web-based home for free resources on magnetism and electricity for educators and learners of all ages. Magnet Academy resources include lesson plans, recorded science demonstrations, and interactive activities for teachers, students, and parents. In 2022 there was a decrease in pageviews for Magnet Academy; however, these 2022 numbers are comparable with pre-pandemic numbers. **Table 1** shows a comparison with the previous year as well as 2019, the last full year before the COVID-19 pandemic.

Table 1. *Pageviews for Magnet Academy in 2022*

MagLab Magnet Academy Section	2019 Pageviews	2021 Pageviews	2022 Pageviews
Magnet Academy	662,868	1,035,741	758,093
Watch & Play	380,179	668,253	429,277
Learn the Basics	36,234	41,499	31,609
Explore History	169,935	213,270	221,339
Try This at Home	45,332	68,474	43,905
Plan a Lesson	18,225	30,071	25,320

3.3 K-12 Education Programs

CIRL provides two forms of educational outreach to K-12 classrooms and school groups. (1) Classroom Outreach includes in-person (i.e., Tallahassee and Gainesville) and virtual visits to classrooms. These visits engage students in MagLab related hands-on activities. (2) Fieldtrips are held at the Tallahassee location. These include a hands-on activity requested by the teacher in addition to a tour of the Tallahassee facility with a MagLab scientist. In 2022, Villa began hosting fieldtrips again; over the course of the year, 344 students came to the MagLab for educational fieldtrips. Both outreach and fieldtrips are advertised directly to local school administrators, to surrounding school boards, through the MagLab Educators Club (a mailing list with over 550 subscribers that include educators and parents), as well as through local and national educational organizations such as the Big Bend/Leon Association for Science Teaching, the Florida Association of Science Teachers, and the National Science Teaching Association.

Classroom Outreach

Classroom educational outreach is reported based on the school year as opposed to the calendar year. During the 2021-2022 academic year, Villa limited outreach to virtual activities and presentations using the Zoom platform **(Figure 1).** This allowed students to participate from their classrooms as well as from their homes. Classroom outreach is designed to provide MagLab-related lessons (e.g., magnetism and electricity) to teachers and their students. Each activity includes an introduction to the MagLab and an open-ended exploration activity about the facility, the magnets, and the research conducted at the MagLab. Each visit concludes with a review of the phenomena discussed during the activity and a question-and-answer session.

Tallahassee

Figure 1. *Students learn about the MagLab during a virtual outreach program.*

One of CIRL's diversity and broadening participation mission goals is to ensure at least 50% of our outreach includes Title I schools (i.e., schools in which children from low-income families make up at least 40 percent of enrollment who might not have access to innovative scientific resources like the MagLab). During the 2021-2022 school year, Villa provided outreach to 1,162 students, 72% of these were with Title I schools, an increase of 12% from the previous year. Like last year, *Magnet Exploration* was the most requested outreach activity, followed by *Electricity* and *Build an Electromagnet.* (For more information on the activities listed and all CIRL's outreach activities please visit the outreach website: https://nationalmaglab.org/education/teachers/). Most participating classrooms came from elementary schools (67%), with middle schools making up 17% of outreach and high school classes making up 13%. The remaining 5% was made up of mixed grade classes. Requests for virtual outreach in 2021-2022 came from seven states: Florida, Alaska, Georgia, Maryland, New York, North Carolina, and Virginia.

Metrics for Success. After each virtual visit, teachers were sent a short online survey asking them about their experience. Overall, the teachers were very satisfied with their experience. 100% of teachers rated their virtual outreach experience as very good or excellent. 100% of survey respondents said that the website provided them with enough information to appropriately select an activity and incorporate it into their class. **Table 1** presents average satisfaction scores (i.e., 5 rating = the highest) for the quality of the instruction that Villa provided. The data shows that the outreach experiences were well received by the educators. Individual comments from educators in the survey led to revisions to the materials listed in the pre-post visit packets that educators can download when they sign-up for outreach. One revision we have made is to add more commonly accessible household items to the list of materials to make the outreach more accessible to all students.

Table 1. *Teacher Ratings of Classroom Outreach*

Question (n=14)	Mean Response	Standard Deviation
The outreach educator employed instructional strategies that made the content/concept(s) understandable to my students	4.9	.26
The outreach educator used strategies to appeal to different types of students	4.9	.26
There were connections made between the content/concepts presented and the real world	5.0	.00
Students were encouraged to ask scientific questions to shape their understandings	5.0	.00
The content was relevant to my instructional needs	4.9	.35
The content was developmentally appropriate for my students	5.0	.00

(5 pt. Likert scale 5=Strongly Agree, 1=Strongly Disagree)

Lessons Learned. Based on the survey feedback, we plan to make the following changes for the Outreach program for the 2022-2023 academic year. The return to in-person field trips and tours will include an activity that is hands-on, and inquiry centered. This includes shortening the introduction section of the visit and allowing more time for student engagement and exploration.

Gainesville

During the 2021-2022 school year, Amy Howe conducted and facilitated outreach for the AMRIS and High B/T MagLab facilities in Gainesville, FL. Due to lingering COVID concerns, local teachers did not place requests for virtual or in-person visits until late-March 2022. Still, Amy reached 540 K-12 students through in-person classroom visits. Additionally, links to virtual content and tours were promoted on the MagLab and AMRIS websites and through flyers distributed at professional conferences and workshops.

Los Alamos

In 2022, LANL Pulsed Field Facility members participated virtually in the 6th annual Los Alamos National Laboratory Summer Physics Camp for Young Women, a free camp with about 40 participants that focuses on inspiring interest in STEM through inquiry-based labs led almost entirely by women currently working in STEM. The three MagLab scientists who participated were Johanna Palmstrom, Vivien Zapf, and Laurel Winter. They were instrumental in the development and teaching of a hands-on magnet related lab, as well as giving a virtual tour of the MagLab Pulsed Field Facility.

Middle School Mentorship

The MagLab Middle School Mentorship Program hosted its first in-person program since 2019. The goals of the program are to provide a space for participants to do science and/or engineering with a MagLab mentor; and to connect students' experience in the program to their lived experiences. In 2022, the program included 14 students from middle schools in Leon County. **Table 2** includes the list of students and their mentors. Mentorship students came to the MagLab on Friday mornings for three hours during the fall semester. The students spent that time in groups of two or three with their mentor developing a research project. The program culminates in a poster presentation session attended by their family, teachers, principals, and mentors.

Table 2*. Middle School Mentorship Students, Research Topics, and Mentors*

Participant (School)	Research Topic	Mentor (MagLab facility)
Sylvie Williamson (School of Arts and Sciences)	The Structure and Hardness of CuNb Conductor Wire	Dr. Rongmei Niu (MST)
Ella Dorn (North Florida Christian) and Mason Green (Cobb Middle)	The Copper Coil Magnetic Levitator	Dr. Daniel Davis (ASC)
Chiemelie Nwabu (Montford Middle), Jasper Croom (Home School), and Emanuel Hernández (Cobb Middle)	Magnets in Flight: How Our Magnet Shooter Works	Dr. Ernesto Bosque (ASC)

Participant (School)	Research Topic	Mentor (MagLab facility)
Penelope Cornais (Raa Middle) and Rakesh Raj (Fairview Middle)	Stopping Motion with LED Lights	Dr. Lloyd Engel (CMS)
Ellie Gillespie (Swiftcreek Middle) and Acadia Taylor (Cobb Middle)	School of Hard Tips (Mohs Hardness Identification)	Bob Walsh (MST)
Harmony Murphy (Tallahassee School of Math and Science) and Vikram Rhodes (Florida State University School)	Building an Efficient Solar Cooker	Dr. Hans Van Tol (EMR)
Jaeson Nickeo (Raa Middle) and Keya Patel (Maclay)	The Inverse Leidenfrost Effect: Levitation of Ethanol Droplet on the Surface of Liquid Nitrogen	Dr. Wei Guo and Mikai Hulse (CMS)

Metrics for Success. To assess the success of the program in meeting the goals, the participants were given pre- and post-surveys that measured their self-efficacy in learning science topics, perception of the relevance of STEM fields, growth mindset - believing that one can improve their STEM skills over time, level of engagement in the practices of STEM, sense of belonging in the program, and opinion of the program's success at introducing the participants to new STEM role models, careers, and disciplines. **Table 3** shows growth in two particular areas: understanding science topics and completing scientific activities. This growth shows that the program is meeting its goals by improving students' self-efficacy.

Table 3. *Pre and post mentorship averages for students' self-efficacy in learning science topics.*

Item	Mean (Pre) N=15	SD	Mean (Post) N=13	SD	*d**
I think I'm pretty good at understanding science topics.	4.3	.70	4.2	.69	.16
Compared to other people my age, I think I can quickly understand new science topics.	4.3	.70	4.3	.63	.08
It takes me a long time to understand new science topics.[1]	2.0	.85	2.0	.71	.10
I feel confident in my ability to explain science topics to others.	4.0	.53	4.0	.71	.00
I think I'm pretty good at following instructions for scientific activities.	4.7	.49	4.4	.65	.49
Compared to other people my age, I think I can do scientific activities pretty well.	4.3	.72	4.4	.51	.10
It takes me a long time to understand how to do scientific activities.[1]	1.8	.56	1.7	.85	-.22
I feel confident in my ability to explain how to do scientific activities to others.	3.8	.68	4.1	.64	.32

** Effect sizes for pre to post changes were measured using Cohen's d, which takes into account both the change in mean and the pooled standard deviation. A d value of 0.2 is considered small, a value of 0.5 is considered medium, and a value of 0.80 is considered large.*
1. Items were reverse coded for overall scale scores and alpha values.
(5 pt. Likert scale 5=Strongly Agree, 1=Strongly Disagree)

Lessons Learned. Based on the survey feedback and data collected during focus groups, we plan to make the following changes for the MSM Program. This year only 15 students were selected due to the low number of MagLab mentors who were able to commit to the program for three months. We plan to redesign the program so that the mentors' commitment will be less time intensive and allow for an increase in the number of participants. Villa is working on this redesign currently.

MagLab Summer Camps

MagLab Summer Camps were held in person in the summer of 2022, after being virtual the year before. The goal of the MagLab summer camps is to provide a space for participants to do MagLab-related science and to introduce participants to relevant MagLab careers and role models in STEM. This year's camps were able to achieve both goals by creating a program that included presentations and activities with relevant MagLab STEM professionals as well as activities that were connected to that role model's area of study. Campers came to the MagLab Monday-Friday from 9am – 4pm each day for one week. Each day is divided into a morning and afternoon session, with MagLab science content sessions in the morning and an opportunity to practice their science skills in the afternoon. Each day, campers were able to meet STEM professionals from around the lab and ask questions about their research, career, and educational path in addition to their hobbies and interests. Each camp culminates with a reception wherein the campers showcase the projects they completed during the week and compete in a live engineering challenge with their families.

Camp TESLA (Technology, Engineering, and Science in a Laboratory Atmosphere)

In 2022, Camp TESLA enrolled 20 campers to participate in a one-week summer camp **(Figure 2).** MagLab scientists and engineers joined the students during activities. The three highest rated activities were: (1) the liquid nitrogen demo showing the impacts of low temperatures; (2) building electromagnets wherein students built and tested their electromagnets with copper wire, paper clips, and batteries; and (3) building a working speaker using concepts they learned related to electricity and magnetism. During the reception the campers tested their spaghetti bridges.

Figure 2. *The 2022 Summer Camp TESLA group.*

SciGirls Summer Camp

In 2022, 21 girls participated in the SciGirls Summer Camp, which was also one weeklong **(Figure 3)**. SciGirls is a partnership with the MagLab's local PBS affiliate, WFSU, that introduces participating girls to relevant hands-on MagLab science and female STEM role models. The role models describe their paths to their STEM careers and answer questions from the campers. The top three highest rated activities were (1) building a working speaker using concepts they learned in camp related to electricity and magnetism; (2) the liquid nitrogen demo showing the impacts of low temperatures; (3a) the DNA activity wherein campers created different DNA models using candy and beads and then extracted their own DNA to put into a necklace charm; (3b) and the doghouse challenge where campers were tasked to build a doghouse to keep their pet safe from wind, rain, and sunlight. (The last two tied for third place.)

Like Camp TESLA, the SciGirls camp ended with a reception wherein the girls tested their spaghetti bridges. In addition, the SciGirls reception includes a panel with female scientists and engineers. The 2022 panel included two female MagLab scientists and two former SciGirls campers who are now pursuing degrees in STEM majors, one majoring in computation biology at Florida State University, and the other who was participating in the MagLab's REU program that summer.

Figure 3. Left: *The 2022 SciGirls Summer Camp* ***Middle:*** *Three SciGirls show off the electromagnet that they created during camp.* ***Right:*** *A SciGirl listens to music on a speaker she created during camp.*

SciGirls Coding Camp

This year, four girls participated in the SciGirls Coding Camp, which was offered at Florida Agricultural & Mechanical University Developmental Research School (FAMU DRS), a Title I school run by an Historically Black University. The camp used the Code: SciGirls curriculum developed by the SciGirls national program at Twin Cities Public Television. The curriculum engages girls with the Micro:bit - a pocket-sized computer – and shows them how software and hardware work together. As part of the curriculum, female role models in tech and computer sciences visit the camp to discuss their career trajectories. The camp offered activities in coding, augmented reality, and game design **(Figure 4)**. At the end of the week, the campers were able to show off their coding projects, which included a coded guitar that played musical notes depending on how the guitar was moved and a nightlight that sensed darkness and automatically illuminated with one of many pre-programmed light shows. All campers were able to keep their Micro:bit and accessories for future self-guided coding activities.

Figure 4. *FAMU DRS Students work on their Micro:bit project during the SciGirls Coding Camp.*

Metrics for Success: To assess how successful the camps were at achieving the goals, we gave each participant a pre- and post-program survey measuring their changes in understanding related to STEM careers and role models as well as their sense of belonging in the camp. **Tables 4, 5 and 6** show that each of the Summer Camps achieved their goals by giving campers a space to do science and introducing them to role models that were working in STEM. The tables highlight that 98% of all campers learned about new STEM disciplines and fields and 93% learned about how to achieve a career in STEM. Furthermore, 98% of the campers said that they felt they were a part of the camp and 98% of all campers said they felt accepted by their peers at camp, thereby demonstrating that the camps are creating a safe space for participants to practice their science skills and learn about STEM careers.

Table 4. *Participant self-reported learning about careers.*

During Camp...	TESLA Percent (n=19)	SciGirls Percent (n=21)	SciGirls Code Percent (n=4)
Did you learn about new STEM disciplines and fields?	100%	95%	100%
Did you learn about STEM careers you had not heard of before?	95%	90%	100%
Did you learn more about how to achieve a career in STEM?	95%	91%	100%

Table 5. *Participant connections to STEM role models.*

During Camp…	TESLA Percent (n=19)	SciGirls Percent (n=21)	SciGirls Code Percent (n=4)
Did you meet any STEM role models?	84%	91%	100%
Did you meet someone who taught you more about what it is like to work in science?	95%	95%	100%

Table 6. *Sense of Belonging in Camp*

During Camp…	TESLA Percent Agree	SciGirls Percent Agree	SciGirls Code Percent Agree
I was a part of the camp	95%	100%	100%
I was accepted by my peers at camp.	95%	100%	100%

Lessons Learned. Based on the survey feedback and data collected, we realized that (1) SciGirls and Tesla camp activity ratings varied quite a bit for the same activities, with SciGirls ratings being lower than TESLA. Comments helped us to understand that the SciGirls participants did not find the activities challenging enough. In 2023, we plan to focus more on the hands-on aspects of the activities and create opportunities for campers who complete the basic outcomes for each activity to challenge themselves with more advanced but related inquiry. (2) Some of the role model led activity ratings were lower than others. In 2023, we plan to provide educational communication training to our role models to help them present their research in a more engaging way with the campers.

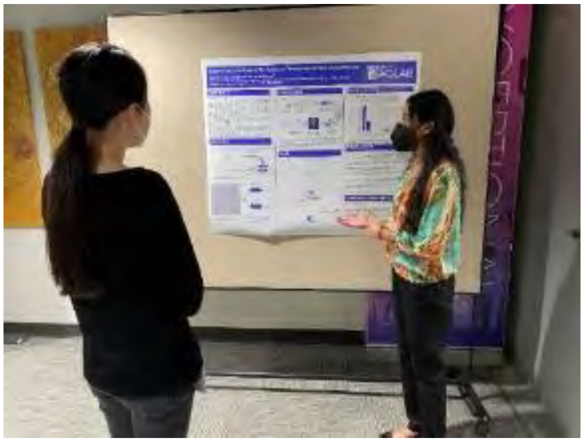


Figure 5. *A MagLab Extern explains her work during the High School Externship poster session.*

High School Externship

For CIRL's High School Externship program, Villa worked with local Tallahassee high schools to recruit students interested in a career in STEM. Once accepted these students are paired with a mentor at the MagLab to work on a STEM project for an entire school year. The goal of the externship program is to give students real-world experience in their interested STEM career path. During the 2021-2022 school year, the externship program was run virtually. Participants met with their mentor a few times a week to discuss research-related activities and analyze data or run simulations. During their time at the MagLab, the participants were able to meet their mentor's research team and interact with other STEM professionals. At the end of the school year, the MagLab was able to host an in-person poster session to provide the participants an opportunity to showcase the work they accomplished during the externship program to their friends, family, and MagLab staff **(Figure 5)**. A full list of students, their mentors, and their research topics are presented in **Table 7.**

Table 7. *High School Externship 2021-2022*

Student ***URM in italics***	Mentors	Research Subject
Gabrielle Bynum	Jamel Ali	Determining the Role of Biofluids on Pseudomonas aeruginosa Motility
Ananya Mundrathi	Jamel Ali	Determining the Role of Biofluids on Pseudomonas aeruginosa Motility
Chimaobi Nwabu	Scott Marshall	Curve Fitting Real-World Data
Sumana Posinasetty	Kari Roberts	Data Tasks and Programming in R

Student *URM in italics*	Mentors	Research Subject
Sarayu Vanga	Kaya Wei	Application of Thermoelectric Materials in Aiding in the Treatment of Cerebral Hypoxia and Other Related Conditions

Metrics for Success. Data collection for the evaluation of High School Externship was done through a post-program survey of participants. After their experience, 100% of externship students indicated that they planned to enroll in higher level math or science courses in the following school year and 100% said they think they will pursue a career in a STEM field. **Table 8** shows specific questions and responses as evidence of students' increased interest in STEM careers after participating in the program, thereby demonstrating that the program reached its goal of giving students real-world experience in STEM careers.

Table 8. *Externship students indicated the following benefits of participating in the externship program:*

My participation in externship...	Mean N=4	SD	Percent Agree
Helped me understand science better.	4.0	.00	100%
Led me to a better understanding of my own career goals.	3.8	.43	100%
Increased my interest in studying science in college.	3.8	.43	100%
Made me think more about what I will do after graduating.	3.8	.43	100%
Made me more confident in my ability to succeed in science.	3.5	.5	100%
Increased my confidence in my ability to participate in science projects or activities.	3.8	.43	100%

Lessons Learned. Based on the data collected from surveys, we have made the following changes. There was a lack of diversity in the demographics over the past few years, including a complete lack of students from Amos Godby High School, a local Title I school. The Godby Science Scholars program was created in the summer of 2022 as a feeder program into the High School Externship. At the start of the 2022-2023 school year, three of the six Godby Science Scholars students had arranged for placement in the externship program, the first three from Godby High School. Additionally, advertisement will be more focused on the two Title I schools in an effort to attract more historically excluded groups into the program.

Godby Science Scholars Program

In the summer of 2022, the MagLab hosted six students in the inaugural Godby Science Scholars program, a 3-week STEM enrichment program **(Figure 6)**. Godby High School is a local Title I school (40% of students are eligible for free lunch), with a student population of 73% Black/African American, 11% White, 10% Hispanic, 5% two or more races, <2% Asian, American Indian, Alaskan native. The program's goals are to show participants about research and careers in materials science at the MagLab and develop their scientific skills. The program culminates in their development of a poster that showcases a MagLab-related research proposal.

Figure 6*. The inaugural students of the MagLab Godby Science Scholars*

The program schedule included hands-on activities, tours of MagLab facilities, and presentations and interviews with STEM role models. Participants came to the MagLab Monday-Thursday for 4 hours each day. The day was divided into a morning session in which the students learned about scientific research at the MagLab and afternoon session in which they had opportunities to practice scientific research skills and develop their research proposal.

Metrics for Success. Data collection for the evaluation of the Godby Science Scholars was done through a pre- and post-program survey of participants. Before the program, 33% of participants said they were interested in pursuing a career in materials science. After the program, 100% of the participants said they were interested in pursuing a career in materials science. 100% of participants said that their participation in the program helped them understand materials science better and increased their interest in studying materials science in college.

Table 9 shows more measurements that show how the students' experiences increased their STEM skills, showing the success of the program in reaching the goal of having students learn about and practice skills used by MagLab staff.

Table 9. *All participants in the Godby Science Scholars STEM skills.*

	Pre			Post			
How would you rate your ability to…	**Mean N=6**	**Standard Deviation**	**Percent No Experience**	**Mean N=5**	**Standard Deviation**	**Percent No Experience**	***D****
Identify limitations of research methods and designs	3.3	.52	0%	4.6	.55	0%	2.68**
Contribute to science	4.0	.89	0%	4.6	.55	0%	1.79
Prepare a scientific poster	3.8	.45	17%	4.8	.45	0%	1.50
Figure out the next step in a research project	3.3	.52	0%	4.4	.55	0%	1.43*
Problem solve, in general	4.3	.82	0%	4.8	.45	0%	1.10
Feel a part of the scientific community	4.0	.89	0%	4.6	.55	0%	1.10
Feel like a scientist	4.0	1.10	0%	4.8	.45	0%	1.00

*(5 pt. Likert scale 5=Strongly Agree, 1=Strongly Disagree) *=p<.05, **=p<.01, ***=p<.001*
** Effect sizes for pre to post changes were measured using Cohen's d, which takes into account both the change in mean and the pooled standard deviation. A d value of 0.2 is considered small, a value of 0.5 is considered medium, and a value of 0.80 is considered large.*

Lessons Learned. Survey feedback and data collected during the focus groups provided two important lessons which we will use to inform changes for the 2023 Godby Science Scholars: (1) All of the participants mentioned that they would have liked the program to last longer. As it was, the 2022 program was only four hours per day and four days per week for three weeks. We plan to extend it to seven hours per day and five days per week. (2) Participants specifically mentioned a few activities and role models that they did not connect with. We plan to revise the activities to connect them more closely to the participants' everyday lives better and Villa will provide training to role models to ensure that they can better connect with these students.

K-12 Teachers and Informal STEM Educators

Besides the educational outreach and Magnet Academy resources, CIRL also facilitates professional development for educators (i.e., formal K-12 classroom teachers and informal STEM educators). These include both educator workshops and our Research Experiences for Teachers program. The Educator workshops are designed by Villa to introduce educators to MagLab-specific STEM topics that can be incorporated into the science lessons. Villa ensures that these workshops conform to state and national education standards. These hands-on workshops provide participating educators with strategies for engaging students in MagLab-related, inquiry-based, hands-on science activities. **Table 10** highlights the workshops offered in 2022.

Table 10. *Education Workshops offered by CIRL*

Date	Presentation Title	Conference/Organization	Attendance
4/15	Florida's Tesla Tales	Louis Stokes Alliances for Minority Participation (LSAMP) Central Florida STEM Alliance	26
4/27	Encouraging Wonder: Science for Young Learners	Leon County School Parents	14
6/20	Florida's Tesla Tales	Young Scholars Program	64
10/28	Magnets & the National Magnet Lab	Florida Association for Science Teachers	38
10/29	Florida's Tesla Tales	Florida Association for Science Teachers	28

Research Experiences for Teachers (RET) Program

Due to the success of the previous year's online program, the summer 2022 RET program was held virtually again. The goal of this summer's program was to help educators incorporate culturally responsive teaching strategies into their STEM lessons. To do this, we partnered with a faculty member from the FSU College of Education, Dr. Stacey Hardin, who has expertise in culturally responsive teaching to help us develop and facilitate the RET curriculum. Roxanne facilitated the program, which was held over seven weeks. The teachers met twice a week via Zoom: Tuesday sessions focused on culturally responsive STEM teaching strategies and the Thursday sessions focused on MagLab STEM research. **Table 11** has an outline of the schedule and MagLab presenters. Each teacher was paired with a MagLab scientist who served as a science consultant for their lesson plan development. The teachers met virtually with their MagLab scientist to develop a culturally responsive STEM lesson plan that incorporated MagLab resources and/or content. The lesson plans are available to the public on the RET website:
https://nationalmaglab.org/education/teachers/professional-development/research-experiences-for-teachers

Table 11. *RET Schedule*

	Tuesday Topic	Thursday Presenter
Week 1	Introductions and Orientation	Amy McKenna (ICR) and Shalinee Chikara (CMS)
Week 2	Self-Identity and Awareness	Mark Meisel (High B/T Facility) and Thierry Dubroca (NMR)
Week 3	Your Agency as an Educator	Teachers worked in groups on lesson plans
Week 4	Power and Privilege	Kaya Wei (CMS) and Shermane Benjamin (CMS)
Week 5	The -Isms	Small group practice and discussion sessions
Week 6	What's STEM Got to do with it	Small group practice and discussion sessions
Week 7	My students and myself	Educators presented lesson plan ideas

Fourteen educators, from seven states (California, Florida, Georgia, Maryland, Massachusetts, Minnesota, Texas) participated in the program. A list of the participants and their scientist mentor can be found in **Table 12**. 93% of the RET participants taught in Title I schools or worked with programs that served predominately low-income youth. 29% of RET participants worked with elementary students, 22% worked with middle school students, 29% worked with high school students, 14% worked with middle and high school students, and 7% worked with students ranging from K-12 grades.

Table 12. *2022 RET Participants*

RET Participant (School, State)	MagLab Mentor	Lesson Plan Title
Abigail C Singer (Parkdale High School, MD)	Ryan Baumbach	Orbital Diagrams: The Quantum Atom

RET Participant (School, State)	MagLab Mentor	Lesson Plan Title
Angela Maria Lopez	Huan Chen	KEYcosystems: The Role of Various Organisms in an Ecosystem
Casaree Czapla (Morton Ranch High School, TX)	Laurel Winter	AUTOCAD and SNAP Circuits
Diamond Hightower (Lealman Innovation Academy, FL)	Sam Grant	Symbiotic Relationships from a Multicultural Perspective
Jollyn Nolan (Martin County SMART Lab, FL)	Julia Smith	Humpty Dumpty and your Breakfast Saved by STEM
Kesher Denise Paul (Chaires Elementary School, FL)	Mike Shutrak	How my Garden Grows: Soil Comparisons in Rural Environments vs. City Environments
Koneisha Cofield (Griffin Middle School, FL)	Malathy Elumalai	My World of Scientists: Backgrounds, Talents, and Careers
Lilly Keefe-Powers (Global Arts Plus Lower School, MN)	Yang Wang	Oil Clean-Up
Marnie Klein (Buckingham Browne & Nichols School, MA)	Martha Chacon	The Spoils of Oil: The Wide Variety of Uses and Properties
Nicole Hubbard (Golden Hill K-8 School, CA)	Huan Chen	Food for Thought: An Examination of Grocery Gaps in Communities
Rachel Harbour (Pasco High School, FL)	Lissa Anderson	My Role in Society as a Scientist
Raechel Waddy (Bennett's Mill Middle School, GA)	Faith Scott	What is Nuclear Energy and Where Can We Find it in Our Everyday Lives?
Raymon Kidd (Griffin Middle School, FL)	Amy Howe	Dragon Genetics: Heredity and Genotypes
Ryan B Jones (Astoria Park Elementary School, FL)	Dan Davis	What are Electric Circuits, Conductors, and Insulators?

Metrics for Success. Our pre-/post-survey to all participants helped us to assess the success of the program. In terms of recruitment, the most successful form of communication about the program came from emails from principals and district supervisors. In addition, the RET participants credited their participation in the 2022 RET program to increases in their perspectives towards science teaching (see **Table 13**).

Table 13. *Participant Reported Impacts of the RET Program*

The RET Program...	Mean (N=13)	Percent Agree
Increased my interest in research and the ways that current STEM research can be applied to my STEM teaching.	5.5	100%
Stimulated me to think about ways I can improve my teaching.	5.3	100%
Increased my motivation to seek out other culturally responsive professional development activities.	5.2	85%
Increased my commitment to learning and seeking new ideas to implement into my teaching on my own.	5.5	100%
Increased my confidence as a teacher.	5.1	100%
Elevated my enthusiasm for teaching.	5.3	100%
Increased my interest and ability in networking with teachers and other professionals.	5.6	100%
Increased my confidence to use culturally responsive pedagogy in my teaching.	5.2	100%

Besides this self-reported evidence of success, we were also able to quantitatively measure actual changes in beliefs from pre- to post-program. To measure the success of the program on teachers' ability to incorporate culturally responsive teaching into their lessons, we measured the participants' teaching self-efficacy beliefs from pre- to post-program. This metric allowed us to see whether educators improved their views on their own abilities to effectively teach science to their students. **Table 14** shows the statistically significant improvements made from pre- to post-program which we relate to their participation in the program. These results provide evidence to support the successful accomplishment of our goals.

Table 14. *Changes in RET participants' Beliefs about Teaching*

	(Pre) N=14	SD	(Post) N=13	SD	*d**
When youths' STEM understanding improves, it is often due to their educator having found a more effective teaching approach.	4.7	0.61	5.2	0.73	0.61*
The inadequacy of a youth's STEM background can be overcome by good teaching.	4.6	0.85	5.2	1.09	0.67*
When a low-achieving youth progresses in STEM, it is usually due to extra attention given by the educator.	4.1	0.66	4.8	1.09	0.71*
I do not know what to do to turn youth on to STEM.	3.1	1.23	2.2	0.93	-0.86**
I know the steps necessary to teach STEM concepts effectively.	4.1	0.83	5	0.82	1.07**

*(5 pt. Likert scale 5=Strongly Agree, 1=Strongly Disagree) *=p<.05, **=p<.01, ***=p<.001*
** Effect sizes for pre to post changes were measured using Cohen's d, which takes into account both the change in mean and the pooled standard deviation. A d value of 0.2 is considered small, a value of 0.5 is considered medium, and a value of 0.80 is considered large.*

Lessons Learned. Based on the open-ended survey feedback and data collected during focus groups, we plan to make the following changes for the RET program in 2023: (1) We plan to host an in-person MagLab "bootcamp" as a kick-off to the RET program. This will bring teachers to the MagLab and allow them to meet their cohort, scientist mentors, and give the participants a physical connection to the work that will be continued virtually for the rest of the program; (2) We plan to have educators bring a MagLab-relevant science lesson plan that can incorporate MagLab-related science along with pedagogical techniques which will be covered during the fall virtual portion of the program. These additions will make the web-posted lesson plans more MagLab-specific, which will ensure that these lesson plans will help other educators incorporate MagLab resources and content into their lessons.

3.4 Undergraduate Students

Undergraduate students are at a crucial stage in the STEM workforce trajectory. It is at this stage that they develop research skills and can be introduced to specific STEM careers in more depth. The MagLab offers two undergraduate programs that are facilitated by CIRL's Mentoring Director, Kawana Johnson: (1) the Magnetic Momentum Scholars Program and (2) the Research Experiences for Undergraduates (REU) Program.

Magnetic Momentum Scholars Program

During the Spring 2022 semester, the MagLab hosted its inaugural class of 14 undergraduate Magnetic Momentum Scholars. This 6-week program was developed as a partnership with Florida A&M University (FAMU) designed to expose a diverse student population to STEM careers at the MagLab. Johnson worked with FAMU STEM faculty and administrators to promote the Momentum Scholars program to undergraduate STEM majors. Forty-one FAMU students applied and 14 were accepted. The Magnetic Momentum Scholars program also gives MagLab scientists and engineers an opportunity to develop their mentoring skills. Students were paired with mentors based on their interest and the research areas of the individual mentors.

Students were divided across all undergraduate stages: 21% freshmen, 29% sophomores, 29% juniors, and 21% seniors. The participants represented the following majors: 50% biological sciences, 43% engineering disciplines, and 7% mathematics. Johnson planned professional development sessions held once a week. These sessions included panels by STEM graduate students and postdocs, FSU, FAMU, and MagLab faculty/staff, and a panel of STEM industry professionals. These sessions allowed the students to gain professional advice and learn about various career paths in STEM. In addition, a group of MagLab faculty provided the students with weekly tours of the various departments and research areas within the lab. The program culminated in a 3-minute pitch presentation wherein the students described their experience in 3 minutes or less. A list of the Magnetic Momentum Scholars, mentor, and department can be found in **Table 15.**

Table 15. *2022 Magnetic Momentum Scholars*

First Name	Last Name	Mentor	Department
Makayla	*Bland*	Shalinee Chikara	DC Field CMS
Brianna	*Brown*	Faith Scott	CIMAR, NMR
Hanifah	*Choute*	Hadi Mohammadigoushki	CIMAR, NMR
Rahsaan	*Corbin II*	Dmitry Semenov	DC Field Instrumentation
Imhotep	*Hogan*	David Graf	DC Field CMS
Andly	*Jean*	Eun Sang Choi	DC Field CMS
Amanda	*Jean-louis*	Ashleigh Francis	ASC
Samiyah	*Lawrence*	Andre Juliao	ASC
Leyhma	*Leban*	Daniel Davis	ASC
Devin	*Lloyd*	Ali Bangura	DC Field CMS
Britney	*Lundy*	Huan Chen	CIMAR, ICR
Nathan	*Norman*	Theo Siegrist	CMS
Mycah	*Wells*	Temidayo Abiola Oloye	ASC
Jamyla	*Young*	Stephen McGill	DC Field CMS

Metrics for Success. Our pre-/post-survey to all participants helped us to assess the success of the program. All participants indicated that they learned new skills and that those skills will help them to be successful in their future career path. 86% of participants indicated that the program helped them to expand their professional network while 100% indicated that they worked well together with their mentor. In addition, 100% of participants were satisfied or very satisfied with their overall experience in the program.

In terms of mentors, 100% of mentors said they were able to effectively communicate their expectations with their student while 89% said they enjoyed their experience as a mentor in the program. One hundred percent of tour guide coordinators indicated they enjoyed their role as a tour coordinator and had enough information to plan their tour prior to the start of the program. 100% of mentors and tour coordinators who responded to the survey said they would be willing to participate in the program again in the future.

We asked students to tell us the effective strategies that their mentor used throughout the program. We also asked mentors to tell us what strategies they used to ensure the students understood their expectations. By asking both students and mentors to describe quality mentoring strategies, we were able to determine (1) what strategies were rated most impactful by Momentum Scholars and (2) whether mentors were using these best practices. The full list of strategies can be found in **Table 16.** We plan to present this information to mentors who volunteer for future programs so that they can see what types of strategies are most admired by undergraduates. The most impactful mentoring strategy was being available to answer questions.

Table 16. *Quality Mentoring Themes Triangulated by Momentum Scholars and Mentors*

Momentum Scholars	Momentum Scholar Mentors
Students were asked what strategies their mentor(s) used to check for understanding. The strategies identified were: • Being available to answer questions (n=6) • Asking questions and/or asking them to describe the work (n=4) • Providing additional materials on the topic (n=3) • Giving feedback on work (n=1) • Making sure to explain all technical terms (n=1)	Mentors were asked how they **checked for understanding** when communicating expectations to REU students. They indicated that they used the following strategies: • Discussed how to work well together early in the program (n=11)
Momentum Scholars were also asked about the overall mentoring strategies that mentors used that they found particularly impactful. The strategies identified were: • Being integrated into an actual lab environment (n=3) • Connecting to students' interests (n=4) • Reframing failure in research as an opportunity (n=2) • Giving the freedom to explore and learn anything (n=1) • Providing tailored feedback and teaching new skills (n=2)	Mentors were asked what **mentoring strategies** they used that they thought were **impactful**. They provided the following strategies: • Regular communication (n=6) • Reviewing and providing materials (n=2) • Being flexible (n=2) • Encouraging questions (n=1) • Consistent schedules (n= 2)

Lessons Learned. Based on the evaluation of the program, participants indicated that they would like to spend more time with their mentor working on their skill development and presentation. Consequently, we plan to make the following changes in 2023: (1) reducing the time for facility tours to provide more time for mentors to assist students with projects; and (2) increasing the length of the program by 1 week (i.e., from 6 to 7 weeks). According to the Center for the Improvement of Mentored Experiences in Research (CIMER), a mentoring compact can be used to align expectations around research projects and career development. Based on that knowledge, Johnson will encourage mentors to utilize a mentoring compact/agreement with each student and discuss the content during the first week of the program to ensure that all expectations and requirements are completely understood. Johnson will provide a copy of this document before the start of the program.

Research Experiences for Undergraduates (REU)

For the 2022 REU program, we returned to a completely in-person research experience but maintained virtual professional development sessions. The goals of the 10-week REU program are to provide undergraduate students with opportunities to learn research skills and explore MagLab-related research career options. The REU program also gives MagLab scientists and engineers an opportunity to develop their mentoring skills. To recruit participants, Johnson posted the opportunity to job boards through multiple sites (e.g., Handshake, Simplicity, multi-school listings via job management boards, Pathways to Science); shared details with deans and department chairs at Historically Black Colleges and Universities (HBCUs) throughout the country; and solicited assistance from MagLab faculty and staff in promoting the opportunity to students and colleagues within their sphere of influence. The MagLab REU program had 77 applicants. Mentors selected students from applications based on their research project and the students' interest in that type of discipline. Many of our selected students heard about the program from a MagLab employee (32%), their home institution (28%), by visiting the MagLab website (16%), or from pathwaystoscience.org (16%). Twenty-five REUs participated in the 2022 program and were divided across all undergraduate stages: 24% freshmen, 24% sophomores, 48% juniors, and 4% seniors. The participants represented a variety of majors: 52% physical science, 36% engineering, and 12% life sciences. Besides the demographic statistics provided in **Table 1.1** 16% of our REUs came from Minority Serving Institutions and community college.

Johnson planned professional development sessions that were held twice a week. These sessions included panels by MagLab research faculty, tenure-track faculty, graduate students, STEM entrepreneurs, and other industry professionals. As a result, students could gain an understanding of various types of STEM careers, including those at the MagLab. In addition, Johnson held professional development sessions on mentoring, researcher identity, graduate school applications, and communicating one's science. The mentoring session was based on the Center for the Improvement of Mentored Experiences in Research (CIMER) mentorship education curriculum, developed at the University of Wisconsin-Madison. Each week, REUs led virtual tours of their labs for the rest of the group. The program culminated in a 3-minute pitch presentation wherein the students described their research project in 3 minutes or less. MagLab faculty and staff were invited to serve as judges to provide participants with feedback and recognize the top 3 presenters with prizes. They had opportunities to practice their pitch with mentors and during professional development sessions. A list of the REU participants, their respective university/college, research topic and mentor can be found in **Table 17.**

Table 17. *2022 REU Participants*

First Name	Last Name	School	Research Area	Mentor	Department
Brandon	*Adams*	University of Florida	Using MATLAB in Solid State NMR: Data Processing and Numerical Simulations	Robert Schurko	CIMAR, NMR
Sebastian	*Aguero*	Cal State University San Marcos	Characterization of proteins in E. coli MG1655 for advanced applications	David Butcher	CIMAR, ICR
Hunter	*Bice*	Florida State University	Towards Light Coupled Scanning Probe Microscopy in Ni lab	Guangxin Ni	CMS
Caleb	*Bush*	Rochester Institute of Technology	The missing 1-2-2: a search for Novel Magnetic Materials"	Ryan Baumbach	CMS
Ashley	*David*	Florida State University	Analyzing the Soret Coefficient Using Time Resolved Fourier Transform Infrared Spectroscopy (FTIR)	Daniel Hallinan	CIMAR/NMR
Stephen	*Dubben*	Florida State University	Mapping Strain Variation in SRF Cavities Using Image Analysis.	Peter Lee	ASC
Gage	*Erwin*	University of Tennessee, Knoxville	Thermoelectric Properties of Kagome Metals	Kaya Wei	DC Field CMS
Sydney	*Garber*	Florida State University	Developing Coral Records for Paleoclimate Reconstruction	Alyssa Atwood	Geochemistry
Sarah	*Gatti*	Vanderbilt University	Fabrication of Magnetically Tunable Erythrocyte Based Micromotors	Jamel Ali	CMS
Garrett	*Hauser*	University of Rhode Island	Magnetic Properties of Pyorgel-XTE	Mark Meisel	UF, High B/T
Kegan	*Heaney*	University of North Carolina-Charlotte	Correlating uniaxial tensile stress and microhardness in annealed Cu 101	Peter Lee	ASC
Rayanna	*Johnson*	Florida A&M University	Molecular Characterization of Aging Products from Essential Oils Used in Everyday Applications	Martha Chacon & Huan Chen	CIMAR, ICR
Matthew	*Jutkofsky*	Florida State University	Different Humidity levels impact on polymer thermal conductivity	Daniel Hallinan	CIMAR/NMR
Samuel	*Little*	University of Maryland-College Park	Describing quantized vortex interaction in superfluid helium	Wei Guo	CMS
Devin	*Lloyd*	Florida A&M University	Analysis of the Tape-to-Tape Contacts Between ReBCO in CORC Wires	Lance Cooley	ASC
Annette	*Lu*	Duke University	Histidine tautomer identification using ^{13}C and ^{15}N solid-state NMR spectroscopy	Riqiang Fu	CIMAR, NMR
Brooke	*Mangano*	University of Georgia	Lipid Dynamics in Pulmonary Surfactant due to Surfactant Protein B	Joanna Long	UF, AMRIS
Kellan	*Moore*	Washington University - St. Louis	Characterization of Synthetic Tracheal Mucus Using Passive Microrheology	Jamel Ali	CMS
Joao Felipe	*Pereira*	University of Maryland-College Park	Molecular Dynamics Simulation of Cu-Ag	Ke Han	MS&T

First Name	Last Name	School	Research Area	Mentor	Department
Raven	*Rawson*	University of Florida	Cryogel: Aerogel Insulation for Cryogenic Applications	Mark Meisel	UF, High B/T
Megan	*Reid*	Florida State University	Validation of Flexible Lead Design	Adam Voran	MS&T
Javion	*Walters*	Florida State University	Characterization of proteins in E. coli MG1655 for advanced applications	David Butcher	CIMAR, ICR
Judy	*Wang*	University of Southern California	Molecular Characterization of Aging Products from Essential Oils Used in Everyday Applications	Martha Chacon & Huan Chen	CIMAR, ICR
Aaron	*Weiser*	Youngstown State University	Planar Tunneling Spectroscopy of Possible Topological Kondo Insulator YbB12	Wan Kyu Park	CMS
Mycah	*Wells*	Florida A&M University	Observing Glidcop as a Conductor	Yan Xin	MS&T

Metrics for Success. Our pre-/post-survey to all participants helped us to assess the success of the program. All participants indicated that the experience increased their positive perception of STEM careers or reaffirmed their already positive perception of STEM careers. Ninety-two percent of the REU students rated their mentor as above average or outstanding.

In terms of research skill development, we used a modified version of the undergraduate research student's self-assessment (URSSA) survey instrument (Weston & Laursen, 2015[1]). Although other REU programs have historically administered this assessment as a post-program survey, because the MagLab has an evaluator, we were able to incorporate a pre-program survey to measure actual changes in skills rather than retrospective self-reported changes. **Table 18** highlights the significant gains that REUs showed from pre- to post-program, demonstrating the success of the mentors in helping the students develop STEM competence.

Table 18. *Skill Development for REU Participants*

	Pre			Post			
How would you rate your ability to…	**Mean N=23**	**Standard Deviation**	**Percent No Experience**	**Mean N=24**	**Standard Deviation**	**Percent No Experience**	***d****
Analyze data for patterns	3.6	.67	8.7%	4.2	.58	0.0%	.78**
Figure out the next step in a research project	3.4	.67	8.7.%	4.2	.66	0.0%	1.01**
Understand the relevance of research to my coursework	3.7	.78	0.0%	4.4	.62	0.0%	.73*
Contribute to science	3.5	.98	8.7.%	4.4	.62	0.0%	1.22***
Understand what everyday research work is like	3.4	.99	21.7%	4.6	.51	0.0%	1.55***
Defend an argument when asked questions	3.4	.74	0.0%	4.1	.77	0.0%	1.24***
Explain my projects to people outside my field	3.6	.80	0.0%	4.3	.70	0.0%	.97**
Prepare a scientific poster	3.3	.89	4.3%	4.2	.54	0.0%	1.29***

[1] Weston, T. J., & Laursen, S. L. (2015). The undergraduate research student self-assessment (URSSA): Validation for use in program evaluation. *CBE—Life Sciences Education*, *14*(3), ar33.

	Pre			Post			
How would you rate your ability to…	Mean N=23	Standard Deviation	Percent No Experience	Mean N=24	Standard Deviation	Percent No Experience	*d**
Conduct observations in the lab or field	3.6	.59	0.0%	4.3	.60	0.0%	.97**
Calibrate instruments needed for measurement	2.8	.81	13.0%	4.0	.73	0.0%	2.00***
Engage in real-world science research	3.5	.69	21.7%	4.2	.68	0.0%	1.17***

*(5 point Likert scale 5= Very High 1=Very Low) *=p<.05, **=p<.01, ***=p<.001*
** Effect sizes for pre to post changes were measured using Cohen's d, which takes into account both the change in mean and the pooled standard deviation. A d value of 0.2 is considered small, a value of 0.5 is considered medium, and a value of 0.80 is considered large.*

To measure mentoring quality, we reviewed the categories of quality mentoring developed by the Center for the Improvement of Mentored Experiences in Research (CIMER) to determine which were most relevant to undergraduate mentees in the 10-week program. We focused on the following categories that were assessed through open-ended questions on the post-progam survey to REU participants and to REU mentors: aligning expectations, assessing understanding, and maintaining effective communication. We asked REUs to rate their mentors and to tell us the effective strategies that their mentor used throughout the program. We also asked mentors to tell us what strategies they used to ensure that REU understood their expectations and completed their projects. Eighty-four percent of the REU participants said they worked well together with their mentor, and 92% rated their primary supervisor as above average or outstanding. By asking both mentees and mentors to describe quality mentoring strategies we were able to determine (1) what strategies were rated most impactful by REUs and (2) whether mentors were using these best practices. The full list of strategies can be found in **Table 19.** We plan to present this information to mentors who volunteer for future programs so that they can see what types of strategies are most admired by undergraduates. The most impactful mentoring strategies were regular meetings and check-ins with REUs to ensure that they could receive ongoing coaching on their work and project as well as encouraging students to ask questions.

Table 19*. Quality Mentoring Themes Triangulated by REU Students and Mentors*

REU students	REU Mentors
Students were asked what strategies their mentor(s) used to check for understanding. The strategies identified were: • *Asking questions to the REUs (n=10)* • *Having regular meetings (n=6)* • *Encouraging REUs to ask questions (n=4)* • *Being available (n=2)*	REU mentors were asked how they **checked for understanding** when communicating expectations to REU students. They indicated that they used the following strategies: • Regular meetings (n=9) • Reviewing and providing materials (n=2) • Documenting expectations (n=1) • Asking questions (n=1)
REU participants were also asked about the overall mentoring strategies that mentors used that they found particularly impactful. The strategies identified were: • *Being available for questions and providing guidance on developing new skills (n= 9)* • *Giving freedom to complete tasks (n=3)* • *Providing encouragement (n=2)*	Mentors were asked what **mentoring strategies** they used that they thought were **impactful**. They provided the following strategies: • Regular meetings (n=9) • Reviewing and providing materials (n=2) • Documenting expectations (n=1) • Asking questions (n=1)

Lessons Learned. We were fortunate to return to a fully in-person REU experience this past summer while still incorporating virtual professional development sessions into the program. Although the virtual sessions provided flexibility, participants would like to see more in-person options in the future. To accommodate this request, we will reintroduce the in-person lab tour option for all participants and continue to provide a space where participants can come together in-person to watch any virtual professional development materials.

Based on the evaluation of the program, there are some additional changes that we plan to make moving forward. Eighty-seven percent of participants felt that the virtual 3-minute thesis format for the final presentations should continue into future years. We will make necessary modifications to the process, as suggested, and plan to continue this format for 2023. In addition, participants asked for more discussions with graduate students, faculty, and other STEM professionals during the professional development sessions. Johnson will investigate modifying the schedule to accommodate this request.

3.5 Graduate Students and Postdocs

According to a 2019 report by the National Academies of Sciences, Engineering, and Medicine (NASEM), mentoring plays a significant role in developing STEM professionals, but unfortunately has not received the same focused attention as other areas of professional development. During Spring 2022, Johnson coordinated a series of mentoring and professional development sessions for graduate students, postdocs, faculty, and staff. After reviewing feedback, a formal mentoring program was piloted during the fall 2022 semester. The MagLab Research Mentor Incubator (MRMI) is a program designed to give graduate students, postdocs, and faculty the resources and structure to grow professionally and achieve their mentoring goals. By introducing the Center for the Improvement of Mentored Experiences in Research (CIMER) mentorship education curriculum, this incubator supported mentor and mentee skill development while engaging participants in understanding their own individual needs and interests. Participants included 5 graduate students, 3 postdocs, and 5 faculty members. (Graduate students and postdocs met together for their sessions, separate from the faculty cohort). The program lasted 9 weeks and included seven one-hour mentoring workshops that gave participants the opportunity to develop an individual mentoring philosophy statement as a culminating project. **Table 1** provides a list of session topics and schedule. Participants that successfully completed the program received $500 that could be used toward travel taking place during the Spring 2023 semester. Sessions were facilitated by six MagLab employees that completed the CIMER training in 2021 (Kawana Johnson, Roxanne Hughes, Huan Chen, Kristin Roberts, Laurel Winter, and Kaya Wei). The goal is to offer a similar program every year.

Table 1. *Mentoring Session Topics and Schedule*

Faculty Meetings	Dates/Times
Introductory Meeting (What to expect/Introductions of participants and facilitators)	**All -** Monday, Sept. 19th @ 4 p.m.
Meeting #1 (Aligning Expectations)	**Postdocs/Grad Students -** Monday, Sept. 26th @ 3:00 p.m. **Faculty** - Wednesday, Sept. 28th @ 3:30 p.m.
Meeting #2 (Addressing Equity & Inclusion)	**Postdocs/Grad Students -** Monday, Oct. 3rd @ 3:00 p.m. **Faculty** - Wednesday, Oct. 5th @ 3:30 p.m.
Meeting #3 (Maintaining Effective Communication)	**Postdocs/Grad Students -** Monday, Oct. 10th @ 3:00 p.m. **Faculty** - Wednesday, Oct. 12th @ 3:30 p.m.
Meeting #4 (Promoting Professional Development)	**Postdocs/Grad Students -** Monday, Oct. 17th @ 3.00 p.m. **Faculty** - Wednesday, Oct. 19th @ 3.30 p.m.
Meeting #5 (Assessing Understanding)	**Postdocs/Grad Students -** Monday, Oct. 24th @3:00 p.m. **Faculty** - Wednesday, Oct. 26th @3:30 p.m.
Meeting #6 (Fostering Independence)	**Postdocs/Grad Students -** Monday, Oct. 31st @ 3:00 p.m. **Faculty** - Wednesday, Nov. 2nd @ 3:30 p.m.
Meeting #7 (Articulating Your Mentoring Philosophy & Plan)	**Postdocs/Grad Students -** Monday, Nov. 7th @ 3:00 p.m. **Faculty** - Wednesday, Nov. 9th @ 3:30 p.m.
Meeting #8 (Closing Session/Recognition)	**All -** Monday, Nov. 14th @ 3:30 p.m.

3.6 Evaluation and Research

Evaluation

Evaluation for MagLab educational programs is conducted by Kari Roberts. She stays up to date on the best practices in evaluation as outlined by experts in evaluation and the social sciences, and the National Science Foundation. All CIRL education programs are evaluated, and results are shared with program managers every year to allow for data-driven decision-making in planning programs for future years. Primary metrics for each program are determined based on the program's goals and mission and measured using appropriate methodology. Evaluation methodology for each program conducted in 2022 is described briefly below in **Table 1.**

Table 1. *Evaluation Description for 2021 MagLab Education and Outreach Programs*

Program	Form of Evaluation
Classroom outreach	Post-program survey to teachers after outreach conducted
Summer Camps	Pre-/Post-survey to students and post-camp interviews with teachers
REU	Pre-/Post-program survey to all REU participants, mid-program and post-program focus groups with REU participants, post-program survey to mentors
Magnetic Momentum Scholars Program	Pre-/Post-program survey to all FAMU internship participants, post-program focus group and individual interviews with participants, post-program survey to mentors
RET	Pre-/Post-program surveys to RET participants, mid-program and post-program focus groups with participants
High School Externship	Pre-/Post-program survey to externship participants, post-program survey to mentors
Godby High School Program	Pre-/Post-program survey to participants, mid- and post-program focus groups, and interview with the program teacher.

Research

A cornerstone of CIRL's programs is that they are developed based on research conducted by CIRL staff. Our research not only informs our MagLab programs but adds to scholarship for K-16 informal STEM education and mentoring programs nationally. Hughes continues to lead CIRL's research efforts, which are supported by a STEM identity lens (one's sense of belonging and future success in STEM). In 2022, Johnson's expertise in experiential learning and mentoring has added to the breadth of research for CIRL. In 2022, CIRL staff had multiple publications that added to the national and international dialogue related to STEM education and mentoring.

- Ibourk, A., Hughes, R., & Mathis, C. (2022). "It is What it Is": Using Storied-Identity and Intersectionality Lenses to Understand What Shaped a Young Black Woman's STEM Identity Trajectory. *Journal of Research in Science Teaching*, 59(7), 1099-1133. https://doi.org/10.1002/tea.21753
- Johnson, K. W. (2022). Diversifying innovation in STEM through mentored experiences. *The Chronicle of Mentoring & Coaching, 6*(15), p. 80-85.
- Johnson, K. W. (2022). An exploration of employer participation in internships and other work-based learning experiences. *Journal of Career and Technical Education, 37*(1), p. none. http://doi.org/10.21061/jtce.v37i1.a1
- Roberts, K., & Hughes, R., (2022). Recognition Matters: The Role of Informal Science Education Programs in Developing STEM Identity. *Journal for STEM Education Research*. https://doi.org/10.1007/s41979-022-00069-3

In 2022, Hughes was awarded an NSF AISL grant (BRITE Girls Online STEM Practices: Building Relevance and Identity to Transform Experiences. NSF Advancing Informal Science Learning (AISL, #2215138), [8/15/22 – 7/31/25, $1,902,274]) as the PI. She is leading a team who is developing a virtual program for middle school girls and testing the impact of the program on the participating girls' STEM identity. The results of this study should inform MagLab programs as well as virtual programs across the country.

Public Outreach

Public outreach is run by the MagLab's Public Affairs team who use a comprehensive communications strategy to reach broad and diverse audiences with content designed for varying levels of scientific understanding. In 2022, the MagLab posted 10 news stories. On top of that, the MagLab was discussed in 1,950 news articles, blog posts and announcements featured in outlets such as the Tallahassee Democrat, AP, Yahoo, and Pittsburgh Post-Gazette reaching more than 1.6 billion readers worldwide.

Website and Social Media

In 2022, the MagLab website received 1.38 million total pageviews. The website saw growth in new visitors and mobile users in 2022 and many sections of the website experienced growth: "User Resources" increased 17%, "Careers" increased nearly 20%, the "Research" section had a 5% growth, and the "User Facility" pages increased more than 1%.

While our education pages saw decrease from the peaks driven by COVID shutdowns in 2020 and 2021, they returned to a higher than pre-COVID normal with pageviews normalizing at more than 13% higher than 2019 (**Figure 1**)

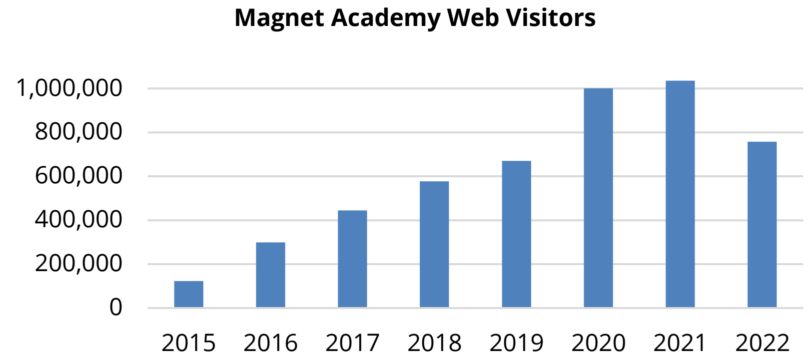


Figure 1. *Web visitors to Magnet Academy since 2015. 2020 and 2021 saw huge spikes because of COVID shutdowns, but 2022 is an expected return to still higher than pre-COVID levels.*

In addition, the Public Affairs team worked on a new and improved MagLab website in 2022 that will launch in early 2023.

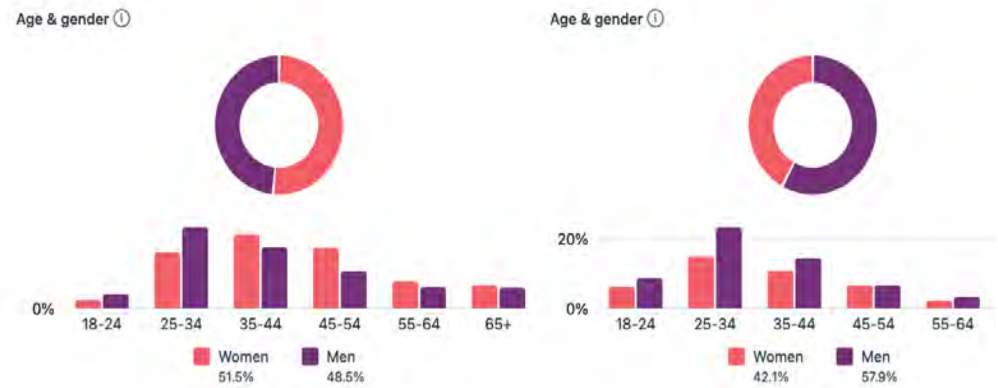


Figure 2. *Audience by gender and age on the MagLab's Facebook account (left) and Instagram (right) in 2022.*

While the number of worldwide social media users continued to grow in 2022, the social media landscape felt like it changed significantly with classic networks like Facebook and Twitter experiencing significant decreases in users. The MagLab's social media accounts continued to provide a connection point between the lab and our worldwide audiences. Our Facebook and Instagram accounts grew with posts reaching different ages, genders and geographic locations including India, Brazil, Pakistan, Bangladesh, Mexico, Iran, and Egypt. The lab's audience includes a larger percentage of women on Facebook and Facebook is better at reaching 45-65+ year old audiences, but the lab's audience distribution is broad across the network. Instagram favors younger audiences with the peak of visitors between in the 25-34 age group **(Figure 2)**,

The MagLab's Twitter account reached nearly 300,000 people in 2022 and saw growth in mentions, profile clicks and followers above 2021 levels. The MagLab's Twitter content experienced a 5,500% higher than average engagement rate (average 2022 Twitter engagement was 37%; average past engagement was 2.1%). Top tweets of 2022 aligned with recognitions of awards/accomplishments including the 32T R&D Award and the NSF Renewal Grant announcement, as well as jobs, events, and research findings (**Figure 3).**

Figure 3. *A collection of top tweets from the @NationalMagLab account in 2022.*

The lab's LinkedIn account saw growth in followers of more than 50% compared to 2021, gaining more than 718 followers in 2022 and reaching nearly 126,000 people across diverse career levels and industries **(Figure 4).**

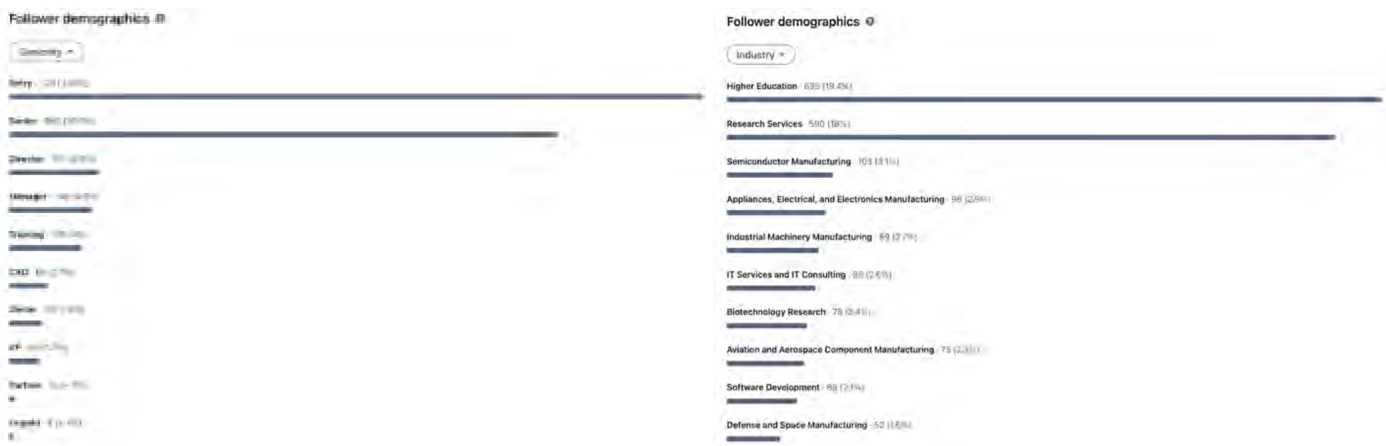


Figure 4. *The followers of the MagLab's LinkedIn profile come from diverse industries and career levels.*

MagLab videos received more than 14.4 million impressions on YouTube in 2022 and were viewed 1.2 million times. The lab's YouTube channel added 9,400 subscribers, and more than 35,000 hours of MagLab videos were watched in 2022. Peaks in views coincide with social media promotion and the release of new video content **(Figure 5).**

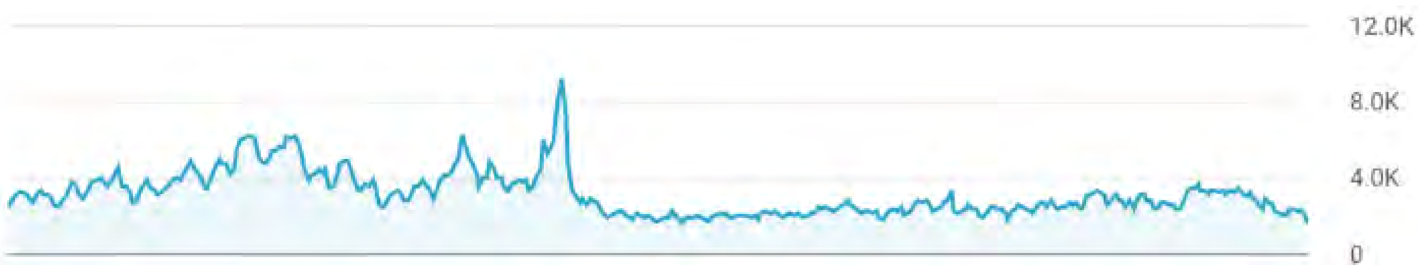


Figure 5. *YouTube video views 2022*

MagLab YouTube viewers come from all ages with more than 55% of viewers between 18 and 34 **(Figure 6)**. More than 19% of the MagLab's YouTube watchers are female and audiences come from around the globe including India, the Philippines, Pakistan, Bangladesh, Indonesia, United Kingdom, Canada, South Africa, Sri Lanka, Australia, Malaysia, Ethiopia, Turkey, Brazil, Kenya, Vietnam, Myanmar, Egypt, Germany, Thailand, Iraq, and Nigeria. 2022 saw growth in viewers from Africa with more than 5.5% of the MagLab's total YouTube viewers from Africa.

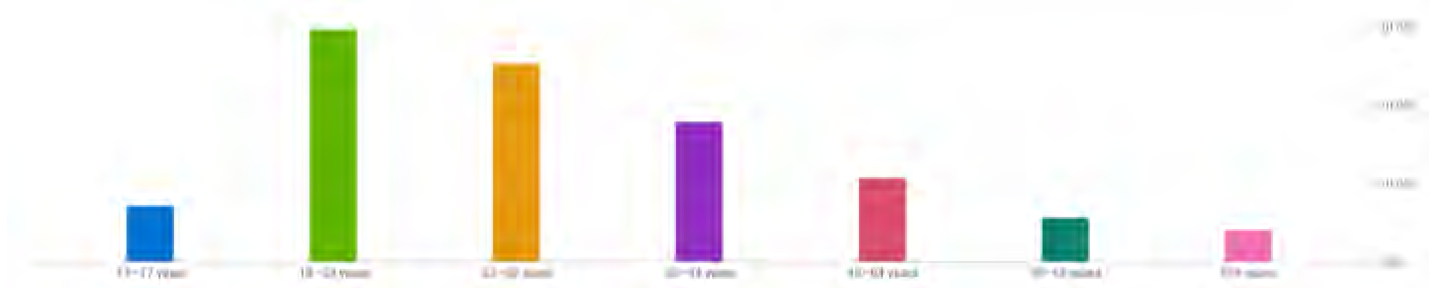


Figure 6. *YouTube views by viewer age group 2022.*

The most popular videos on the MagLab's YouTube channel continue to be the See-Thru Science video series which shows viewers what electricity and magnetism might look like if they weren't invisible. In 2022, the See-Thru Science series earned another million views bringing the series to more 10 million total views. New See-Thru Science videos were also added in 2022 including one on Eddy Currents which has more than 5,300 views and eight Spanish-language See-Thru Science videos that have more than 2,000 views so far and have helped reach new and diverse audiences. In total, the lab released 35 new videos in 2022 including video versions of REU presentations, two Meet the User features, and two virtual events **(Figure 7).**

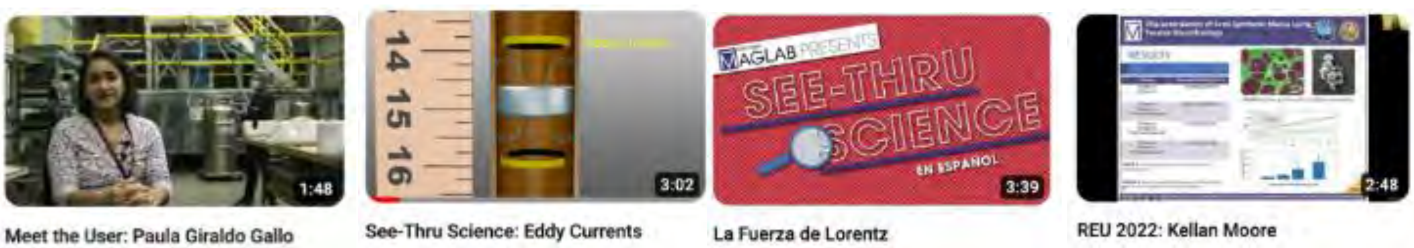


Figure 7. *New YouTube videos released in 2022 include expansions to our popular See-Thru Science Series, Meet the User features and virtual events/presentations.*

Events

COVID surges continued to impact the lab's public event portfolio during the first half of 2022 but returned to very excited and engaged audiences in the Fall. In August, the lab resumed monthly public tours as well as specialty tours for groups on request.

Figure 1. *Photos from 2022 events including Lunch & Learn sessions with the Senior Center and the Tallahassee Science Festival*

Partnering with the Tallahassee Senior Center, Public Affairs hosted a series of lunch and learn sessions where dozens of seniors had the chance to tour the lab and have lunch with MagLab researchers to discuss their work. We also took part in community events across the region including the Tallahassee Science Festival in Oct 2022 (**Figure 1**).

In partnership with the FSU Festival of the Creative Arts, the MagLab hosted two events that connected art and science for more than 350 attendees of all ages:

- **Science and Words** A cyborg poet, a Pulitzer Prize winning novelist, and a graphic novelist discuss how science inspires their writing. Featuring special readings from Robert Olen Butler, Russ Franklin, and Jillian Weise and Q&A sessions with MagLab researchers. October 7th 2 pm – 5 pm (**Figure 2**)

- **MagLab Masterpieces** Exploring the intersection of science and art at the world's strongest magnet lab. Part art show featuring science inspired sculptures, dioramas and AI-created paintings, participants got to see the MagLab's own masterpieces and create their own science-inspired artwork! October 9th 4:30 pm – 7 pm (**Figure 3**)

Figure 2. *Photos from the Science & Words event at the MagLab in October 2022 featuring special readings with Pulitzer Prize winning author Robert Olen Butler, author of Cosmic Hotel Russ Franklin, and self-identified cyborg, Jillian Weise.*

Julia Smith completed the 2021-2022 school year Science Night series with virtual events in early 2022 that live on the lab's YouTube page. In the Fall of 2022, the lab's Public Affairs team took over running the 2022-2023 **Science Night Series** by relaunching live sessions in September 2022 at Leon County Libraries. This season, Science Night features a science story read along with a MagLab Scientist which is used to help the scientist explain their exciting research to the mostly elementary-aged students and their families. Following the story, students get to do their own hands-on science with brand new dynamic activities designed to share the inspiration of science. They also get to engage with MagLab scientists and ask questions about all the things they've ever wondered.

Figure 3. *Web visitors to Magnet Academy since 2015. 2020 and 2021 saw huge spikes because of COVID shutdowns, but 2022 is an expected return to still higher than pre-COVID levels.*

This year's Science Night is also branching outside of the main library location to offer experiences at branch libraries across the community to reach new diverse audiences (**Figure 4 and Table 1**).

Figure 4. *Photos from the 2022 in -person Science Night events.*

Table 1. *List of Science Nights at library locations*

Date	Location	Topic/Activities	Featured Scientist/ Topic/Discipline	Attendees
September 15	Leon County Main Library	The stunning images produced by the new Webb Space telescope have captured our imaginations. But what exactly is all that space stuff we're seeing and what does it tell us about the universe? Come learn about star stuff and discover how pieces of the cosmos are all around us. **Featured Book:** *Star stuff - Carl Sagan and the Mysteries of the Cosmos* **Hands-on Activities:** - Search for Micrometeorites - Paint Mars	Munir Humayun Geochemistry	50
October 20	Leon County Main Library	Solids, liquids and gasses aren't so strange, but did you know that shapeshifting matter is among us. Learn about some of the weirder states of matter, like superconductivity, and how the MagLab uses magnets to investigate the eerie ways atoms move. **Featured Book:** Solid, Liquid, Gassy! (A Fairy Science Story) by Ashley Spires **Hands-on Activities:** - Catch a Ghost - Shapeshifting Slime - Tesla Coil	Tim Murphy & Ali Bangura Physics	65
November 17	B.L. Perry Branch Library	Your brain gets stronger every time you learn something new. Come and workout your neurons as we explore what makes that very smart organ of yours. We'll even pick the brain of a MagLab Scientist who studies them. **Featured Book:** Your Fantastic Elastic Brain by JoAnn Deak Ph.D. **Hands-on Activities:** - Candy Neurons - Brain Hemisphere Hats - Brain Cell Matching Game	Sam Grant NMR/MRI Research	30

Conferences and Workshops

Each year, the MagLab hosts or sponsors a variety of workshops and conferences related to high magnetic field research **(Table 1)**.

Table 1: *List of 2022 sponsored workshops and conferences.*

Event	Date	Location/ Type	Description	Attendees
Theory Winter School	January 10-14	Virtual	The 2022 School focused on "Non-equilibrium Quantum Matter," a subject inspired by recent developments in condensed matter physics. These developments shed new light on open questions of whether non-equilibrium dynamics can be simulated or on intermediate-scale quantum computers and whether quantum states can be manipulated while fighting decoherence.	221
User Summer School	May 9-13	In Person	A weeklong workshop with talks from experts in the field of condensed matter physics on: • Noise types and theory; noise suppression techniques • Transport techniques • Magneto-optics • Infrared and terahertz spectroscopy • NMR techniques for condensed matter • Cryogenic techniques • Heat capacity • Measuring fermi surfaces • The nuts and bolts of data acquisition	28
External Advisory Committee Meeting	August 8-9	In Person	The EAC is charged with reporting on the State of the MagLab to the leadership of its three partner institutions: Florida State University, the University of Florida, and Los Alamos National Laboratory.	45
User Committee Meeting	October 11-13	In Person	An annual meeting of users who represent the laboratory's broad multidisciplinary user community and advises lab leadership on all issues affecting users of our facilities. Hosted by the MagLab/LANL facility in Los Alamos, NM.	30
Applied Superconductivity Conference	October 23-23	In Person	Held in Hawaii, the conference featured a vibrant program with breaking plenaries, special sessions (including the 11th Transition-Edge Session (TES) Workshop, successfully held as part of the ASC since 2008), engaging talks and posters. An electronics program provided a unique opportunity for the **Quantum Information community** to present their latest results in quantum computing/ communication/sensing that involve the use of superconductors in any part of the Quantum System.	1,400
50thSoutheastern Magnetic Resonance Conference	November 4-6	In Person	Held in Downtown Tallahassee, SEMRC has brings together leading scientists to discuss the latest developments in NMR, EPR and MRI, with a focus on exchanges of ideas and recent magnetic resonance research highlights, including new applications and technique development. Particular emphasis is placed on activities in the Southeastern region, with strong participation of young researchers	100

Broadening Outreach

In addition to the Diversity and Education sections of this report which speak to the MagLab's work to broaden participation through education and outreach, MagLab staff regularly take advantage of conferences and workshops to share information about the lab's user program with diverse researchers from around the globe. Each talk, presentation, poster or abstract opportunity provides the chance for scientists to learn more about the lab's research capabilities and broaden our user program to new scientists from across disciplines and career level – from graduate students and postdocs to track faculty.

In 2022, MagLab staff gave **168** lectures, talks and presentations to organizations around the country and the world **(Figures 1 and 2)**. Coming out of the peak impacts of COVID-19, many national and international meetings resumed in-person or offered hybrid experiences. As such, 87% of the presentations were in-person in 2022 **(Figure 3)**.

During the year, the MagLab continued the important work to broaden participation through outreach and presentations at prominent meetings and conferences including the American Physical Society (APS) March Meeting, Applied Superconductivity Conference 2022; 34th American Institute of Chemical Engineers (AIChE) Annual Meeting, 63rd Experimental Nuclear Magnetic Resonance Conference, MEM22 and HTS4fusion; Muon Collider Collaboration Annual Meeting; Neuroscience 2022 (Society for Neuroscience Annual Meeting); 70th American Society for Mass Spectrometry (ASMS) Conference on Mass Spectrometry and Allied Topics; 2022 Ocean Sciences Meeting; 2022 In Vitro Biology Meeting; 2022 Experimental Nuclear Magnetic Resonance (NMR) Conference; Aspen Center for Physics Workshop on Novel States of Matter and Topological Particles in Bulk Quantum Materials; XXXVIII Biennial Meeting of the Spanish Royal Physics Society; XV Russian Conference on Semiconductor Physics; 5th International Caparica Symposium on Nanoparticles/ Nanomaterials and Applications 2022; and the 29th International Conference on Low Temperature Physics.

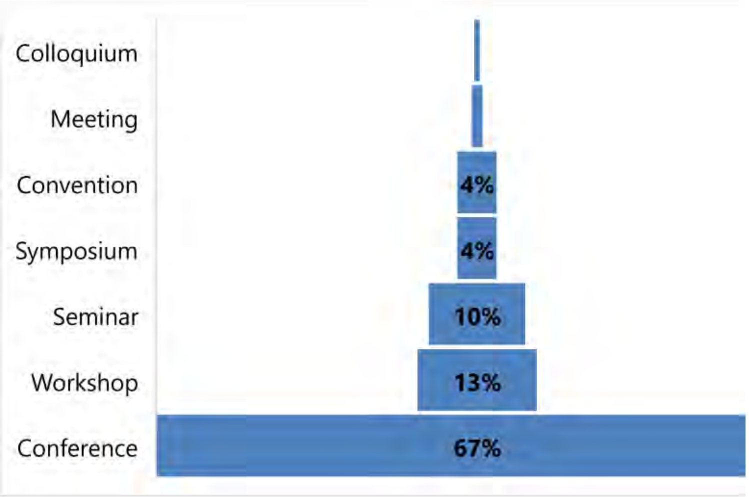


Figure 1. *2022 Presentation types*

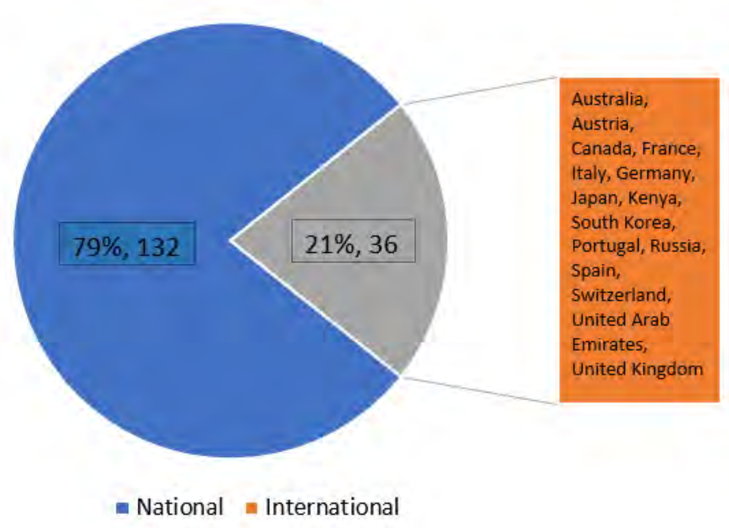


Figure 2. *Breakdown of 2022 presentations by geographic distribution*

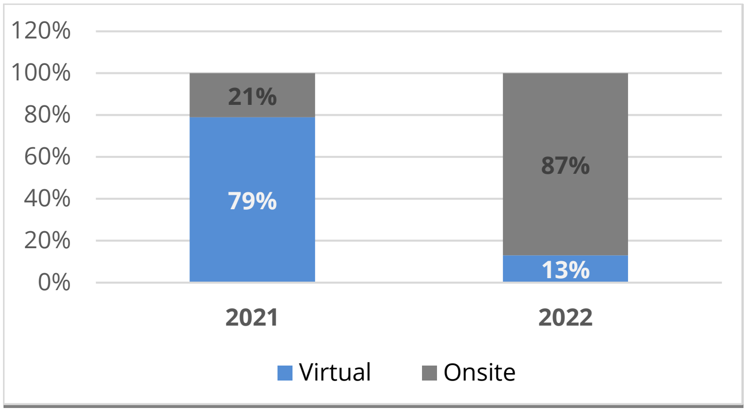


Figure 3. *Comparison of presentations given virtually in 2021 verses 2022*

4. In-house Research

4.1 Cryogenics Lab Report

The Cryogenics Laboratory located at the National High Magnetic Field Laboratory is a fully developed facility for conducting low temperature experimental research and development. A number of specialized experimental equipment items are available in the lab, including the Cryogenic Helium Experimental Facility (CHEF) for horizontal single and two-phase heat transfer and flow research, the Liquid Helium Flow Visualization Facility (LHFVF) for high Reynolds number superfluid helium (He II) pipe flow visualization research, the Laser Induced Fluorescence Imaging Facility (LIFIF) for high precision molecular tagging velocimetry measurement in both gaseous and liquid helium, and the Cryogenic Magnetic Levitation Facility (CMLF) for studying cryogenic fluid hydrodynamics in controlled gravity environment. The laboratory supports in-house development projects as well as contracted scientific work directed by Prof. Guo of the Mechanical Engineering department at Florida State University. Currently, the major research focus of the cryogenics lab includes: 1) quantum fluid dynamics and heat transfer in superfluid helium; 2) helium cryogenics for accelerator R&D; and 3) liquid hydrogen storage and drive system R&D for aviation applications; 4) helium-base dark matter detector R&D; and 5) novel quantum devices. These research activities are supported by external funding agencies including the Gordon and Betty Moore Foundation, National Science Foundation, US Department of Energy, NASA, and our industrial partners.

Background

Liquid ^{4}He becomes superfluid below about 2.17 K. In the superfluid phase, He II can be considered as a mixture of two miscible fluid components: an inviscid superfluid and a viscous normal fluid that consists of thermal quasiparticles. The flow of the superfluid is irrotational, and any rotational motion can emerge only with the formation of topological defects in the form of quantized vortex lines. These vortex lines are density-depleted thin tubes, each carrying a quantized circulation. As a two-fluid system, He II has many unique thermal and mechanical properties. For instance, it supports the most efficient heat transfer mode called thermal counterflow, and it is also known as an exceptional fluid material for high Reynolds number turbulence research. Furthermore, He II provides an ideal condensate system for studying the motion of quantized vortices and quantum turbulence. The knowledge gained from He II research could be broadly applicable to other quantum fluids, such as superfluid neutron stars and gravity-mapped holographic superfluid. In our Cryogenics Lab, we develop advanced flow visualization techniques applicable to liquid helium and apply these techniques for quantitative flow-field measurements in various He II flows generated by heat transfer or mechanical means.

Research progress

We have made some notable achievements in 2022. In what follows, we summarize our work by the topic areas.

Quantum fluid dynamics:

1) We successfully produced the first-ever movie showing the propagation of quantized vortex rings in He II [1]. By examining how these vortex rings spontaneously shrink and accelerate, we were able to produce long-awaited data to identify the best theoretical model on the dissipation experienced by quantized vortices in He II. This work eliminates long-standing ambiguities about the dissipative force on vortices, which should have a far-reaching impact since similar forces have been adopted for other quantum fluids such as superfluid neutron stars and gravity-mapped holographic superfluid.

2) We conducted systematic numerical simulations using full Biot-Savart integral to understanding the puzzling superdiffusion of quantized vortices observed in our past flow visualization study of He II turbulence [2]. For the first time, we showed that the quantized vortices in a random tangle indeed undergo superdiffusion regardless how dense the tangle is. Our analysis also reveals that this universal diffusion behavior is caused by a generic temporal correlation of the vortex velocity, which should exist in all quantum fluids where the Biot-Savart law applies [3]. Due to the ubiquitousness of UQT, the knowledge obtained in this study may offer valuable insights into the evolution and

quenching dynamics of diverse quantum fluid systems. This work was selected by the PRL editor as an Editor's Suggestion.
3) We have also applied particle tracking velocimetry technique to study the circulation statistics in He II quasiclassical turbulence generated by a towed grid. We were able to produce the first experimental data to support some recent theoretical predictions of the He II circulation statistics [4].
4) Some progress has also been made in developing a new flow visualization technique for He II research using neutron-He3 absorption reaction. We were able to produce molecular tracer clouds using this technique and successfully applied this technique to track thermal counterflow in He II. The details are reported in Ref. [5].

Helium-based dark matter detector R&D

A collaboration called "SPICE&HeRALD" on WIMP dark matter search using He II and other crystals as the target materials has been formed. The Level-1 executive committee includes D. McKinsey and M. Pyle (Berkeley); W. Guo (FSU); C. Chang (ANL); S. Hertel (UMass); R. Mahapatra (TAMU); and B. Penning (Brandeis Univ). This project is cross-disciplinary in nature as it involves cryogenic engineering, low-temperature quantum sensing, cosmology and particle physics. The Cryogenics Lab at FSU is mainly responsible for the design and testing of the cryogenics system to be used for cooling the detectors. In 2020, the collaboration was awarded $2.7M by the U.S. Department of Energy (DOE) for phase-1 planning work. Two papers were published in 2022 to report progress [6,7].

Helium cryogenics for accelerator R&D

Many modern particle accelerators employ superconducting ratio-frequency (SRF) cavities, cooled by He II, to accelerate charged particles. There is a strong demand to reach ever higher accelerating fields in these cavities so that the particles can gain higher energies over shorter distances. The maximum accelerating field of SRF cavities is limited by cavity quenching caused by Joule heating from tiny resistive defects on the cavity surface (i.e., quench spots). By locating and subsequently removing the defects, the maximum accelerating field can be improved. Therefore, a long-standing research effort in the accelerator field is to develop reliable methods to detect those sub-millimeter defects. Our lab is active in developing flow-visualization based technologies for surface quench spot detection. In 2022, we developed a theoretical model to describe the transient transfer in He II. A novel feature of the so-called peak heat flux for the onset of boiling in He II was discovered and reported [8], which will aid the interpretation of various experimental data.

Novel quantum devices

The Cryogenics Lab was involved in a collaboration on developing novel scalable qubit systems using electrons trapped on the surface of cryogenic fluids/solids. The team includes D. Jin (ANL); W. Guo (FSU); D. Schuster (U. Chicago); and K. Murch (U. Washington St. Louis). Our responsibility in this collaboration is to design and advise the growth procedure of LHe and solid neon substrates for trapping the electrons as well as to analyze the quantum states of these electrons. Our first paper has recently been published in *Nature*, in which we successfully demonstrated qubit operation of the electron state with a decoherent time comparable to that of the state-of-the-art superconducting circuit qubit systems [9]. We are currently developing a theoretical model to guide the design of the next generation e-neon qubit.

Education

Our research has allowed us to educate graduate and undergraduate students as well as postdoc researchers. Over the past few years, we have engaged more than 10 undergraduate students (including 4 females) and 10 graduate students in our quantum fluids research. The training that these students have received makes them well prepared for their career. For instance, some of our graduate students are now research scientists at the Facility for Rare Isotope Beams, the Jefferson National Lab, Fermi Lab, and the Lawrence Livermore National Lab. Some of them joined industry companies, such as the quantum computing team at Northrop Grumman. Our group has also been active in outreach and educational work. We have consistently contributed science demonstrations at the MagLab's annual open house. Dr. Guo has also participated in the NSF-funded REU program and mentored one REU student from University of Maryland in the summer of 2022. This research experience has motivated the student to pursue graduate degrees in the STEM fields. He also mentored one student through the Middle School Mentorship program, which is designed to provide students from participating middle schools in Leon County the opportunity to conduct a semester-long research project at the MagLab.

References

[1] Y. Tang, W. Guo, H. Kobayashi, S. Yui, M. Tsubota, and T. Kanai, “Imaging quantized vortex rings in superfluid helium to decipher quantum dissipation”, to appear in Nat. Commun. (2022). (arXiv: 2211.01560).

[2] Y. Tang, S. Bao, and W. Guo, “Superdiffusion of quantized vortices uncovering scaling laws in quantum turbulence”, PNAS 118, e2021957118 (2021).

[3] S. Yui, Y. Tang, W. Guo, H. Kobayashi, and M. Tsubota, “Universal anomalous diffusion of quantized vortices in ultra-quantum turbulence”, Phys. Rev. Lett., 129, 025301 (2022). Selected as PRL Editor's Suggestion.

[4] N. P. Müller, Y. Tang, W. Guo, G. Krstulovic, “Velocity circulation intermittency in finite-temperature turbulent superfluid helium”, Phys. Rev. Fluids, 7, 104604 (2022).

[5] X. Wen, L. McDonald, J. Pierce, W. Guo, and M. Fitzsimmons, “Observing flow of He II with unsupervised machine learning”, Sci. Rep., 12, 20383 (2022).

[6] SPICE/HeRALD Collaboration: A. Biekert, C. Chang, C. W. Fink, M. Garcia-Sciveres, E. C. Glazer, W. Guo, et al., “Scintillation yield from electronic and nuclear recoils in superfluid 4He”, Phys. Rev. D 105, 092005 (2022).

[7] SPICE/HeRALD Collaboration: A. Biekert, L. Chaplinsky, C.W. Fink, M. Garcia-Sciveres, W. C. Gillis, W. Guo, et al., “A backing detector for order-keV neutrons”, Nucl. Instrum. Methods Phys. Res. A, 1039 166981 (2022).

[8] H. Sanavandi, M. Hulse, S. Bao, Y. Tang, and W. Guo, “Boiling and cavitation caused by transient heat transfer in superfluid helium-4”, Phys. Rev. B 106, 054501 (2022).

[9] X. Zhou, G. Koolstra, X. Zhang, G. Yang, X. Han, B. Dizdar, D. Ralu, W. Guo, K. W. Murch, D. I. Schuster, D. Jin, “Single electrons on solid neon as a solid-state qubit platform”, Nature, 605, 46-50 (2022).

Written by Dr. Wei Guo

4.2 Geochemistry

The MagLab's geochemistry program primarily investigates natural processes, both recent and ancient, through the analysis of element content and isotopic compositions.

Introduction

The Geochemistry Program's main funding is through grants from the Directorate for Geosciences at NSF and NASA. This year we received also funding from DARPA, the US Army Research Office and the State of Florida.

The facility has seven mass spectrometers, which are available to outside users. Three instruments are single collector inductively coupled plasma mass spectrometers for elemental analysis, in which one is dedicated to *in situ* trace element analyses on solid materials using laser ablation. The other two are dedicated to elemental analyses of solutions. The facility has four mass spectrometers dedicated to determination of isotopic compositions. One is a multi-collector inductively coupled plasma mass spectrometer (NEPTUNE) used for determination of isotopic abundances of metals. A second is a thermal ionization multi collector mass spectrometer, which is mainly used for Sr-isotopic compositions. The third mass spectrometer is designed for the measurement of the light stable isotope compositions (C, N O). A fourth mass spectrometer is dedicated to sulfur isotope analyses.

Publication and Outreach

The program members have published 16 papers and given a large number of presentations at meetings and invited presentations at other institutions. The research of the geochemistry group covered a large range of topics. An area of concentrated interest are environmental events such as volcanism and asteroid impacts that can result in mass extinctions. The exact sequence of events associated with these extinctions can be investigated by trace element and isotopic compositions that are sensitive to environmental conditions. Other areas of interest include the composition of meteorites as they record the early conditions of our solar system; the cycling of nutrients and trace nutrients through the hydrosphere; origin and distribution of magmas in the subsurface in the vicinity of Mount St. Helens and Mt. Adams, Cascades, mid-ocean ridge volcanism and the Earth's heat budget. This year, new research was initiated on critical minerals and the potential of phosphate deposits (abundant in Florida) as source for REE metals. The program normally involves a large number of undergraduate students in their research as well as through the REU summer interns. However, this year, this activity was still limited.

Science Highlights

The MagLab's geochemistry program has made a wide range of exciting scientific discoveries over the past year. One example has been the program's breakthrough research on the environmental conditions and processes of natural selection that led to the development of the giraffe. The giraffe, with its long neck and thick skull, constitutes an extreme life form. Of the early giraffoids, *D. xiezhi* appears to exhibit the most optimized headbutting adaptation in vertebrate evolution when compared with the models of extant headbutters. The MagLab produced tooth enamel isotope data revealing that *D. xiezhi* had the second highest average $\delta^{13}C$ value among all herbivores and a large range of $\delta^{18}O$ values, with some individuals occupying an isotopic niche differing substantially from others in the fossil community. This indicates that *D. xiezhi* was an open land grazer with multiple sources of water intake, and its habitats likely included areas that were difficult for other contemporary herbivores to make use of. The program had this study published in the journal, *Science*.

Another important research finding that emerged from the geochemistry program over the past year concerns the decreasing availability of marine metal. Marine metal in low amounts is essential for organisms that use sunlight to produce energy. A significant reduction in its availability profoundly impacts the base of marine ecosystems. An article by Them et al in *AGU (American Geophysical Union) Advances* documents a significant decrease in the availability of molybdenum, a bioessential trace metal, during the Early Jurassic Pliensbachian-Toarcian mass extinction and the Toarcian Oceanic Anoxic Event (T-OAE), that likely contributed to the observed marine mass extinction. Using new Mo data, the researchers calculated the amount of organic carbon (OC) buried in the oceans and compared it with previous estimates of carbon release during the T-OAE. The new estimates suggest much more OC was buried than previously estimated. These findings have significant implications for our current times: if our modern oceans continue to lose oxygen at high rates, then the oceans may experience similar catastrophic reorganization of the marine ecosystem structure due to not only oxygen loss, but also major decreases in bioessential trace metals.

In a related scientific highlight of the year, the geochemistry program shed light on how ocean oxygen contents affect marine biodiversity. Researchers used paired iodine concentrations and sulfur isotope data to constrain marine oxygenation surrounding the Late Ordovician Mass Extinction (LOME; ~445 Ma), the second-largest mass extinction in Earth history, and the only of the “Big 5” that has been traditionally associated with short-lived icehouse conditions. The study presents the first multi-basinal and multiproxy dataset to specifically reconstruct local and global marine redox conditions surrounding the two LOME pulses. The study’s results suggest that a unique and vacillating combination of anoxic and euxinic (anoxic and sulfidic water column) marine conditions characterized the ocean during that time. Thus, redox variability tied with climatic cooling, and glacioeustacy were potential mechanisms leading to the first mass extinction in the Phanerozoic. The program had the study published in *AGU Advances*.

A fourth scientific highlight is the program’s findings related to mid-ocean ridge volcanism at the Marion Rise in the southern part of the Indian Ocean. Samples taken from a prominent near-ridge seamount have trace element and isotopic characteristics that are compatible with their source containing a component of lower continental crust. Crustal contributions to ocean magmatism have been contributing to crustal recycling in the deep mantle and subsequent return in a hot mantle plume. This work shows a different pathway of continental material into the upper mantle. Furthermore, our work on peridotites from the Marion Rise show ancient (>1Ga) melt extraction. Together with the thin crust on the Rise, this shows that the Rise is caused by ancient depletions resulting in compositional variations and a lighter sub-ridge asthenosphere resulting in an elevated ridge. This finding is important, because it contradicts the widely held belief that mid-ocean ridge rises are caused by thermal anomalies. Part of this work has been published in the journal, *Earth and Planetary Science Letters*.

Progress on STEM and Building the User Community

The Geochemistry lab is open to users of all disciplines, and we have a long-time collaboration with the South Florida Water Management District. The number of outside users, undergraduate students, and Grade 9-12 students we mentored was still limited in 2022. Graduate student users are 65% female. Within the area of Geosciences, our faculty have collaborations with researchers throughout the US, Europe as well as Asia. Locally, the geochemistry program’s collaborations range from magnet science to pharmacy and anthropology.

4.3 Condensed Matter Sciences

1. Overview – FSU CMP Experiment

In this section of the report, we highlight a few exciting research discoveries that have been driven not by our users, but by the MagLab's own faculty members. Although the MagLab is primarily a User Facility, our faculty are also internationally known for their frontline science. This international acclaim brings new users and stresses the eminence of our MagLab. The discoveries presented in this section have been selected by our Chief Scientist for their impact, but they represent only a small portion of the many exciting in-house research breakthroughs that we made over the past year.

Some of our faculty's most important achievements occurred within diverse materials research. Fundamentally, correlated electron materials represent dozens of unsolved questions and are "reservoirs for quantum phenomena" with the promise of unique applications involving superconductivity, thermoelectrics, and devices for quantum information sciences. In-house research in our DC Facility has elucidated the electronic landscape of a family of intermetallics ($ThCr_2Si_2$ structure) that provides roadmaps for accelerating discovery. Mapping out the phase diagrams of new layered compounds with triangular lanthanide nets have revealed new magnetic states arising from a complex interplay between crystalline anisotropy and magnetic energy scales. Frustrated magnetism was also investigated in the spin ice material $Ho_2Ti_2O_7$ by two methods: far infrared reflectometry and torque magnetometry. They revealed that the crystal field levels and vibronic states can be magnetically tuned, and the energy cost of monopole formation can be revealed through tracking magnetic-field-induced phase transitions. The Kondo insulator YB_{12} was found to show signatures of Dirac cones in the tunneling density of states making it another topological Kondo insulator candidate, besides SmB_6, with some evidence of spin exciton interaction with the surface states. Low-temperature photoluminescence studies of interlayer excitons in γ-InSe / ε-GaSe metal monochalcogenide heterostructures revealed pronounced exciton emission whose energy is layer thickness dependent and whose energy width is twist angle dependent over a significantly wider range than found previously in moiré materials. The propulsion efficiency of achiral microswimmers in non-Newtonian viscoelastic polymer fluids, whose velocity and orientation angle have an inverse relationship with polymer concentration, was shown to depend on the molecular weight of the polymer under constant viscosity. Progress in measurement techniques include the development of a novel torque magnetometer that allows measurements of critical current of high-Tc RBCO tapes at any field, temperature, or angle, previously not accessible by traditional transport measurements.

Electronic Landscape of the f-electron Intermetallics with the $ThCr_2Si_2$ Structure

Lai, Y. (FSU, MagLab), Chan, J. Y. (Baylor U.) and Baumbach, R. E. (FSU, MagLab)

Introduction

Although strongly correlated f-electron systems are well known as reservoirs for quantum phenomena, a persistent challenge is to design specific states. What is often missing are simple ways to determine whether a given compound can be expected to exhibit certain behaviors and what tuning vector(s) would be useful to select the ground state. In our review article published in *Science Advances* [1], we address this question by aggregating information about Ce, Eu, Yb, and U compounds with the $ThCr_2Si_2$ structure. We construct electronic/magnetic state maps that are parameterized in terms of unit cell volumes and d-shell filling, revealing useful trends including that (i) the magnetic and nonmagnetic examples are well separated, and (ii) the crossover regions harbor the examples with exotic states. These insights are used to propose structural/chemical regions of interest in these and related materials, with the goal of accelerating discovery of the next generation strongly correlated electron quantum materials.

Methods

There are approximately 100 compounds that crystallize in the $ThCr_2Si_2$ structure with the chemical formula LnT_2X_2 (Ln = Ce, Eu, Yb, U, T = transition metal, X = Si, Ge, P, As). Over more than four decades of research, these materials have been studied intensively with respect to their structure and bulk electronic/magnetic properties, but there has been limited progress in understanding their structural-chemical-physical trends that would enable prediction of phenomena (e.g., Kondo lattice hybridization, magnetism, or superconductivity). In order to address this, we aggregated data from throughout the literature and organized it in terms of unit cell volumes and d-shell filling.

Results and Discussion

Figure 1 presents the phase map for the compounds CeT_2(Si,Ge)$_2$ (T = transition metal) by providing the lattice constants and f-state as reported in literature [1]. By organizing these compounds based on their transition metal column and unit cell volume, it is seen that (i) there is a clear separaration between those with trivalent Ce and tetravalent or intermediate valence Ce, (ii) the crossover region includes all of the examples that exhibit Kondo lattice heavy fermion, quantum criticality, non-Fermi-liquid, and superconducting behavior, and (iii) that the crossover region depends on a nearly linear relationship between shell filling and unit cell volume. Related trends are observed for the CeT_2(P,As)$_2$, EuT_2(Si,Ge)$_2$, EuT_2(P,As)$_2$, YbT_2(Si,Ge)$_2$, and UT_2(Si,Ge)$_2$ analogues, although each case is distinct. For example, the crossover line is vertical for the U-based family, showing that applied pressure or unit cell compression is of little use in accessing much of the phenomena that occurs in that family.

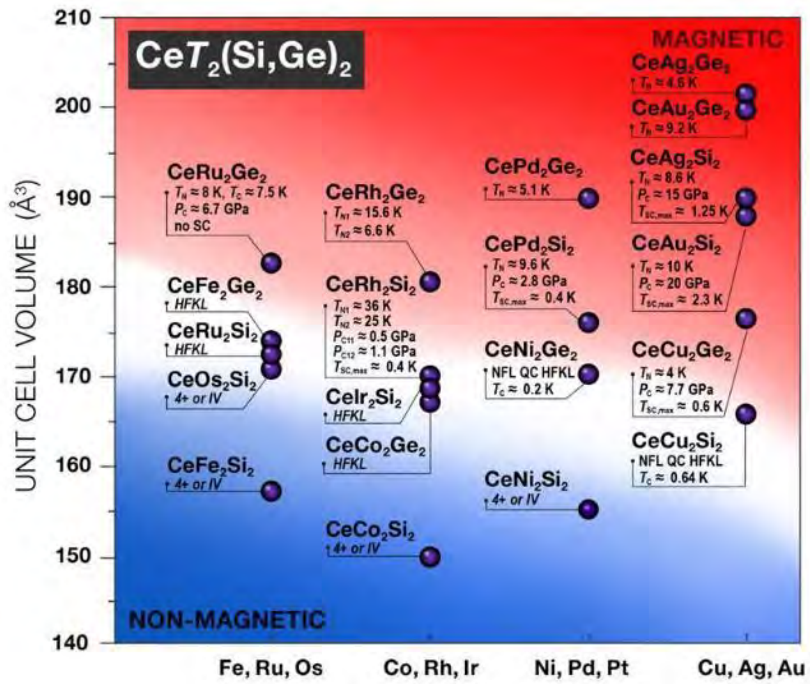


Figure 1. *Phase map for the valence and ground state behavior of the compounds cet2(si,ge)2 (t = transition metal and x = si/ge and p/as) that crystallize in the thcr2si2-type structure.*

Conclusions

These insights are immediately useful for focusing investigations of materials with the $ThCr_2Si_2$ structure. These insights will also help cast a wider net into the structural variants with the $CaBe_2Ge_2$-, $CeNiSi_2$-, $BaNiSn_3$-, and $U_2Co_3Si_5$-structure types, all of which are variants of the $ThCr_2Si_2$ structure. A preliminary survey indicates that these structural variants exhibit maps that are similar to those presented in this manuscript.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. R. B. acknowledges support from the National Science Foundation through NSF DMR-1904361. YL was supported in part by the Center for Actinide Science and Technology, an Energy Frontier Research Center funded by the U.S. Department of Energy (DOE), Office of Science, Basic Energy Sciences (BES), under Award Number DE-SC0016568. JYC acknowledges NSF DMR-2209804 and Welch Grant number AT-2056-20210327 for partial support.

References

1. Lai, Y. et al., Science Advances **8**, eabp8264 (2022).

Magnetic ordering in $GdAuAl_4Ge_2$ and $TbAuAl_4Ge_2$: Layered compounds with triangular lanthanide nets

Feng, K. (FSU, MagLab), Leahy, I. A. (U. Colorado, Boulder) Oladehin, O. (FSU, MagLab), Wei, K. (FSU, MagLab), Lee, M. (U. Colorado, Boulder) and Baumbach, R. E. (FSU, MagLab)

Introduction

Intermetallic f-electron materials have attracted sustained interest for decades because they host a variety of interesting structural, electronic, and magnetic phenomena. Very recently, there has been a surge of interest in a new group of these materials, namely centrosymmetric metals that exhibit skyrmion states in the absence of a Dzyaloshinskii–Moriya (DM) interaction. This is contrasted with earlier studies of materials such as MnSi, where the non-centrosymmetric crystal structure produces the DM interaction. In this new group of materials, a delicate balance between the crystalline anisotropy and various magnetic energy scales (e.g., geometric frustration, competing RKKY interactions) and possibly crystal electric field effects combine to produce their complex magnetic states. Motivated by this, we synthesized and characterized the bulk electronic and magnetic properties of $GdAuAl_4Ge_2$ and $TbAuAl_4Ge_2$ [1,2], where the planar triangular arrangement of the Gd/Tb ions resembles what is seen for the newly discovered centrosymmetric skyrmion system Gd_2PdSi_3.

Experimental

LnAuAl$_4$Ge$_2$ (Ln = Y, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, and Tm) single crystals were grown using an aluminum molten metal flux. Results from room temperature powder X-ray diffraction (PXRD) measurements were analyzed using the Winprep software. EDAX measurements were performed in order to verify the chemical composition. Magnetization M measurements were carried out at temperatures T = 1.8 – 300K under applied magnetic fields of $\mu_0 H$ = 0.5 - 9T using a Quantum Design VSM Magnetic Property Measurement System. Specific heat C measurements were performed for temperatures T = 1.8 – 70K in a Quantum Design Physical Properties Measurement Systems using a conventional thermal relaxation technique. DC electrical resistivity ρ measurements for temperatures T = 1.8 – 300K were performed in a four-wire configuration for a single crystal using the same system.

Results and Discussion

Temperature and magnetic field dependent magnetization, heat capacity, and electrical resistivity measurements reveal that both $GdAuAl_4Ge_2$ and $TbAuAl_4Ge_2$ exhibit several magnetically ordered states at low temperatures, with evidence for magnetic fluctuations extending into the paramagnetic temperature region. For magnetic fields applied in the ab-plane there is particularly rich behavior (**Figure 2**), with several ordered state regions that are separated by metamagnetic phase transitions. Despite Gd being an isotropic S-state ion and Tb having an anisotropic J-state, there are similarities in the phase diagrams for the two compounds, suggesting that factors such as the symmetry of the crystalline lattice, which features well separated triangular planes of lanthanide ions, or the Ruderman–Kittel–Kasuya–Yosida interaction control the magnetism.

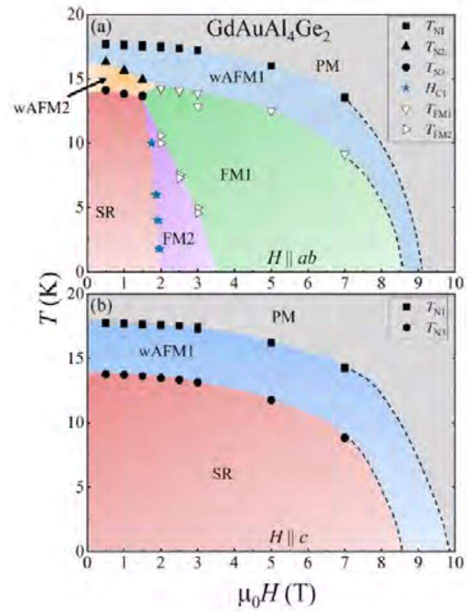


***Figure 2.** Temperature T vs. Magnetic field H phase diagram for gdaual4ge2 constructed from the magnetic susceptibility (T) and isothermal magnetization $M(H)$. The various regions wafm1, wafm2, sr, fm1, and fm2 represent distinct ordered states. Open symbols represent weak features that are only observed in (T).*

Conclusions

Based on these results, the family of materials LnAuAl$_4$Ge$_2$ emerges as a reservoir for novel metallic magnetism and invites investigations to search for nontrivial spin structures and novel electronic-magnetic behavior such as magnetocaloric effects and the topological Hall effect. This work has attracted interest and specimens are being provided to international collaborators.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. RB, KF, and OO were supported by the National Science Foundation through NSF DMR-1904361. Work at the University of Colorado Boulder was supported by Award No. DESC0021377 of the U.S. Department of Energy, Basic Energy Sciences, Materials Sciences, and Engineering Division.

References

1. Feng, K., et al., Journal of Magnetism and Magnetic Materials **564**, 170006 (2022).
2. Leahy, I. A., et al. Physical Review B **106**, 094426 (2022).

Magnetic field tuning of crystal field levels and vibronic states in the spin ice compound $Ho_2Ti_2O_7$ observed with far infrared reflectometry

Ozerov, M. (NHMFL), Anand, N (NHMFL), van de Burgt, L. J. (FSU-Chemistry), Lu, Z. (FSU-Physics), Holleman, J. (FSU-Physics), Zhou, H. (U of Tennessee-Physics), McGill, S. (NHMFL), and Beekman C. (FSU-Physics)

Introduction

Spin ices are geometrically frustrated magnets, which have an inherent incompatibility between the lattice geometry and the magnetic interactions, resulting in the material's inability to reach a single ground state even at ultra-low temperatures. Rather than establishing long-range magnetic order, they freeze into unusual non-collinear spin textures with emergent quasiparticle excitations equivalent to magnetic monopoles. In $Ho_2Ti_2O_7$ (HTO), magnetic moments reside on the Ho^{3+} ions in the material, which are periodically spaced in the pyrochlore crystal lattice. The Ising anisotropy found in spin ice materials is due to the localized spin momentum on the Ho^{3+} being strongly coupled with the 4f orbital momentum and the interaction of the 4f charge cloud with the crystal electronic field (CEF) from surrounding oxygens. We show that IR reflectivity measurements can be used to observe magnetic-dipole-allowed transitions between CEF levels (see Fig. 1 (a)) and identify the presence of a vibronic state in HTO (a mixed state in which a phonon couples to a CEF state). Modeling of magnetic field dependent IR spectra allows determination of the coefficients that make up the CEF Hamiltonian of this spin ice. Furthermore, the applied magnetic field can be used to tune the coupling between the phonon and the CEF state.

Experimental

The magnetoinfrared spectroscopy was performed at the MagLab employing a 17-T vertical-bore superconducting magnet coupled with Fourier transform infrared spectrometer Bruker Vertex 80v. A parabolic 90° mirror focused the IR radiation on the sample with ≈30° incident angle, while a second confocal mirror collected the reflected IR radiation inside the twin light pipe with the Si composite bolometer at the end. The reflective surface of the sample was oriented parallel to the magnetic field applied along [001] crystallographic direction. The reflection spectra were measured in the spectral range between 50 and 800cm^{-1} with instrumental resolution of 0.3cm^{-1}. Both sample and detector were cooled by low pressure helium gas to a temperature of 5K.

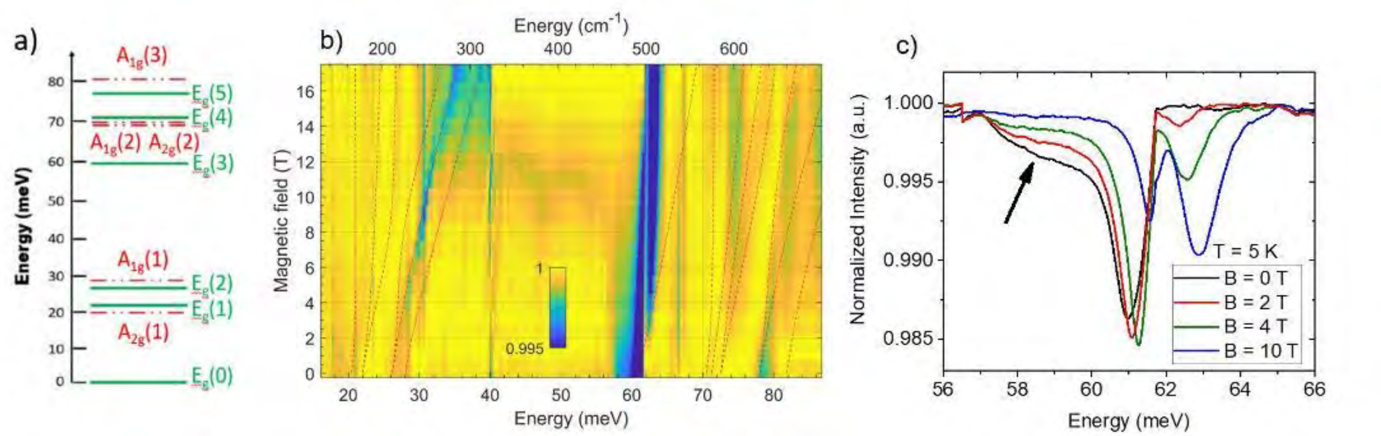


Figure 3. *(a) Schematic of the CEF levels (E_g doublets and A_{1g}/A_{2g} singlets) for HTO. (b) The normalized far IR reflection spectrum as a function of applied magnetic field. The red dashed lines are calculated field dependencies of the CEF levels. (c) Normalized spectra at several magnetic fields in the vicinity of 60meV. The arrow shows the shoulder associated with the vibronic state [1].*

Results and Discussion

The high sensitivity of the magneto-IR spectroscopy technique allows us to observe weak magnetic dipole transitions between CEF levels. This enables us to investigate the evolution of CEF levels in applied magnetic field in far IR reflection measurements. Normalized reflection spectra as a function of field and energy are shown in **Figure 3(b)**, which shows the field induced shifting of the observed CEF transitions. We have calculated the intensity of magnetic-dipole-allowed transitions at T = 5K using the EASYSPIN package in MATLAB [3,4] and determined their magnetic field dependence (red dashed lines in **Figure 3(b)**). In addition to extracting CEF coefficients from modeling our IR spectra, we also find evidence of a vibronic state. This is evident from the observation of a split CEF level at 60meV (see **Figure 3(c)**). The shoulder to this CEF level slowly disappears when the magnetic field is increased. This is consistent with a gradual decoupling between the phonon and the CEF level, as the CEF level shifts away when the field is increased.

Conclusions

We have investigated the magneto-optical response of HTO single crystals as a function of applied magnetic field. The weak magnetic-dipole excitations between CEF levels were revealed in far IR reflectivity. We model our spectra using the CEF Hamiltonian including a Zeeman term, leading to very good agreement with experimental observations. Our results unambiguously determine the CEF coefficients, a task which cannot be done in zero-field measurements. Additionally, our spectroscopic data also clearly show the presence of a vibronic state. This state only appears at low field as the coupling between the phonon and the CEF level diminishes as the CEF level shifts in applied magnetic fields.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. C.B. acknowledges support from the National Research Foundation, under Grant No. NSF DMR-1847887. H.D.Z acknowledges support from the NHMFL Visiting Scientist Program, which is supported by NSF Cooperative Agreement No. DMR-1157490 and the State of Florida.

References

1. Ozerov, M. et al., Physical Review B 105, 165102 (2022)
2. Stoll, S. et al., J. Magn. Reson. 178, 42 (2006)
3. Nehrkorn, J., et al. J. Phys. Chem. B 119, 13816 (2015)

Investigation of the Monopole Magneto-chemical Potential in Spin Ices Using Capacitive Torque Magnetometry

Anand, N (NHMFL), Barry, K. (FSU-Physics), Neu, J.N. (FSU-Physics), Graf, D.E. (NHMFL), Huang, Q. (U of Tennessee, Physics), Zhou, H. (U of Tennessee, Physics), Siegrist, T. (NHMFL, FAMU-FSU Engineering), Changlani, H.J. (FSU-Physics) and Beekman C. (FSU-Physics)

Introduction

Spin ices are geometrically frustrated magnets, which have an inherent incompatibility between the lattice geometry and the magnetic interactions, resulting in the material's inability to reach a single ground state even at ultra-low temperatures. Rather than establishing long-range magnetic order, they freeze into unusual non-collinear spin textures with emergent quasiparticle excitations equivalent to magnetic monopoles (spin-flip excitations). In $Ho_2Ti_2O_7$ (HTO), magnetic moments (or spins) reside on the Holmium ions in the material, which are periodically spaced in the pyrochlore crystal lattice. How strongly the near-neighbor spins interact with each other determines the relative energies of the different possible spin textures and the energy cost of spin-flip excitations on this lattice. We have benchmarked capacitive torque magnetometry (CTM) as a unique tool to characterize the transitions between noncollinear spin textures in spin-ice single crystals. Systematic characterization of these magnetic-field-induced phase transitions allows extraction of the energy cost associated with monopole formation [1].

Experimental

CTM measurements were performed at the MagLab in an 18T vertical-bore superconducting magnet with a 3He insert allowing for an operating temperature range between 250mK and 70K (SCM2). Single crystal samples were mounted onto a flexible BeCu cantilever, constituting the top plate of the parallel plate capacitor in our setup. An Andeen-Harling AH2700A Capacitance Bridge operating at frequencies between 1,000 and 7,000Hz was used to collect the capacitance data during each measurement. The measurement probe used allowed for rotation of the sample over a range of ~200° and a Hall Sensor was used to calibrate the sample rotation with respect to the applied magnetic field.

Results and Discussion

A typical CTM response as a function of magnetic field direction is shown in **Figure 4 (top)**. The sharp turnovers and zero crossings correspond to magnetic phase transitions between different spin textures. **Figure 4 (bottom)** shows the phase diagram associated with this CTM response. The phase boundaries occur at field dependent critical angles, which provide a measure of the energy cost of transitions between the different spin textures. These phase boundaries have been fit to extract the energy required for monopoles to nucleate on different magnetic sublattices in the material. We have been the first to show that spin excitations require different energies when nucleating on the sites that make up the two different spin sublattices, which provides estimates for beyond nearest-neighbor exchange terms needed to describe spin-ice systems. Our experiments have been modeled using Monte Carlo simulations, which allowed us to determine the interaction parameters describing HTO.

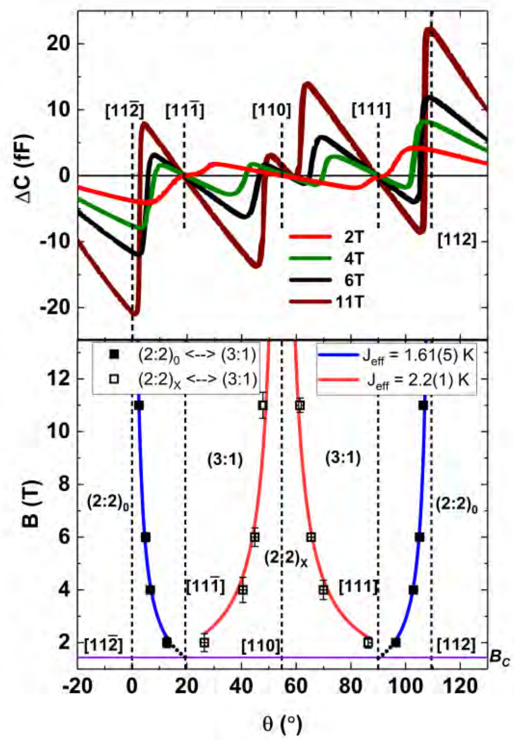


Figure 4. Torque response. The field is constrained to rotate within the (1-10) crystallographic plane (top) and phase diagram (bottom) as a function of field direction. Fits are used to extract the spin correlations strengths for the two magnetic sublattices.

Conclusions

We have shown that CTM can be used to evaluate the phase boundaries between specific noncolinear spin textures in spin-ice systems. The unique nature of the pyrochlore lattice and the spin-ice interactions allows us to evaluate the effects of higher order exchange terms of the Hamiltonian separately, i.e., by investigating different phase transitions. We believe that CTM in combination with Monte Carlo simulations may serve as a natural complement to neutron scattering, specific heat, and magnetization, as it can put stringent bounds on effective Hamiltonians and theories of magnetic materials, thereby aiding to complete the understanding of their low-energy properties and response to magnetic fields.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. C.B. acknowledges support from the National Research Foundation, under grant NSF DMR-1847887. *J.N. and T.S. acknowledge support from the National Research Foundation, under grant NSF DMR-1606952. H.D.Z acknowledges support from the NHMFL Visiting Scientist Program, which is supported by NSF Cooperative Agreement No. DMR-1157490 and the State of Florida. H.J.C. acknowledges support from the National Research Foundation, under grant NSF DMR-2046570, and start-up funds from Florida State University and the National High Magnetic Field Laboratory. The simulations were performed on the Research Computing Cluster (RCC) and the Planck cluster at Florida State University.*

References

1. Anand, N. et al., Nature Communications 13, 3818 (2022)

Topological Surface States in the Kondo Insulator YbB_{12} via Planar Tunneling Spectroscopy

Gupta, A. (NHMFL & FSU, Physics); Weiser, A. (Youngstown Univ, Physics, Astronomy, Geology, and Environmental Science); Greene, L.H. (NHMFL & FSU, Physics); Pressley, L. (Johns Hopkins Univ, Physics and Astronomy); Luo, Y. (Johns Hopkins Univ, Physics and Astronomy); Lygouras, C. (Johns Hopkins Univ, Physics and Astronomy); Trowbridge, J. (Johns Hopkins Univ, Chemistry); Phelan, W.A. (Johns Hopkins Univ, Physics and Astronomy, Chemistry, & Hopkins Extreme Materials Institute); Broholm, C.L. (Johns Hopkins Univ, Physics and Astronomy); McQueen, T. (Johns Hopkins Univ, Physics and Astronomy, Chemistry, & Materials Science and Engineering); Park, W.K. (NHMFL)

Introduction

Topological Kondo insulators are a representative class of topological phase in which strong correlations play a crucial role in dictating the properties of their topological surface states, as is much investigated in SmB_6 [1-3]. In contrast, the topological nature of YbB_{12}, another candidate material [4], is yet to be unveiled via spectroscopic studies.

Experimental

Planar tunnel junctions were prepared on the polished (001) surface of floating-zone grown YbB_{12} single crystals by forming a B_2O_3 layer at the surface via plasma oxidation and depositing Pb as the counter-electrode. The differential conductance was taken using a four-probe lock-in technique as a function of temperature and magnetic field [5].

Results and Discussion

Similar to SmB_6, the tunneling conductance exhibits a V-shape at low bias, strongly suggesting the existence of surface Dirac fermions [2]. However, it shows only one slope, in agreement with previous theoretical calculations predicting a single kind of Dirac cones [4]. The surface states become prominent only at very low temperatures (< 4K), similarly to SmB_6 but conductance features characteristic of their interaction with the spin excitons are not as clear as in SmB_6 [2,3] (**Figure 5**).

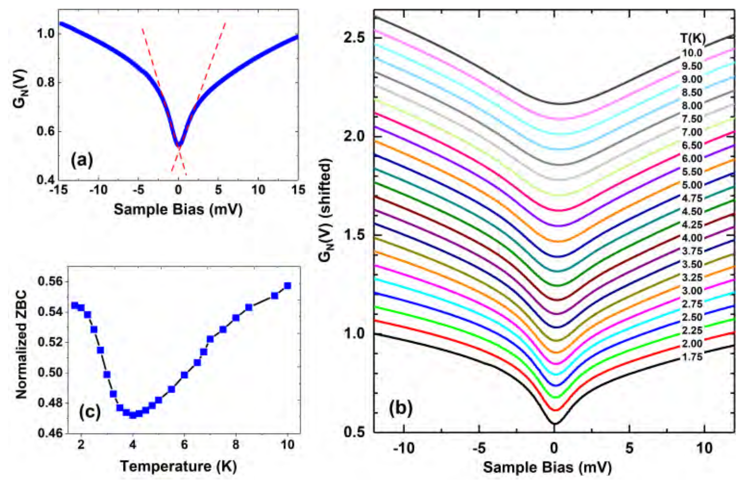


Figure 5. *(a) Normalized conductance at low bias reflecting V-shaped density of states (DOS) as expected for Dirac fermions. The linearity is similar on both sides of zero bias and tapers off slowly outside the ±2mV range. The red dashed lines are a guide to the eye. (b) Temperature evolution of the normalized conductance at low bias. The curves are shifted vertically for clarity. The linearity gradually becomes less prominent as the temperature is increased and vanishes above ~3K. (c) Normalized zero-bias conductance (ZBC) vs. temperature derived from (b). There is a turning point seen at around 4K due to the surface state contribution. At the lowest measurement temperature of 1.75K, there is a clear sign of plateauing, signifying that the surface state contribution dominates below this temperature.*

Conclusion

Results from our tunneling spectroscopic study of the Kondo insulator YbB_{12} [5] provides strong evidence that is it topological as predicted theoretically [4]. While the topological surface states exhibit some qualitative similarities to SmB_6 such as their emergence only at low temperature, there also exists a discrepancy in their detailed properties presumably caused by the difference in their interaction with the spin excitons, collective bulk excitations.

Acknowledgements

The NHMFL is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. The work at FSU and NHMFL was supported under Award No. NSF/DMR-1704712. The work at JHU was funded by the DOE/BES EFRC DE-SC0019331, JHU Catalyst Fund, and NSF/DMR(PARADIM)-2039380.

References

1. Dzero, M., *et al*., Annu. Rev. Condens. Matter Phys. **7**, 249 (2016).
2. Park, W.K., *et al*., Proc. Natl. Acad. Sci. (USA) **113**, 6599 (2016).
3. Park, W.K., *et al*., Phys. Rev. B. **103**, 155125 (2021).
4. Weng, H., *et al*., Phys. Rev. Lett. **112**, 016403 (2014).
5. Gupta, A., *et al*., arXiv:2301.03642 (under review in Phys. Rev. B).

Thickness and twist angle dependent interlayer excitons in metal monochalcogenide heterostructures

Zheng, W. (MagLab), Xiang, L. (MagLab), Quesada, F. (Stanford U., Physics), Augustin M. (U. Edinburgh, Physics), Lu, Z (MagLab), Wilson M. (U. Riverside, Physics), Sood, A. (Stanford U., Physics), Shcherbakov, D. (Ohio State U., Physics), Memaran, S. (MagLab), Baumbach, R. E. (MagLab), McCandless, G. T. (Baylor U., Chemistry), Chan, J. Y. (Baylor U., Chemistry), Liu, S., Edgar, J., Lau, C. N. (Ohio State U., Physics), Lui, C. H. (U. Riverside, Physics), Santos, E. J. G. (Edinburgh, Physics), Lindenberg, A. (Stanford U., Physics), Smirnov, D. (MagLab) and Balicas, L. (MagLab)

Introduction

Interlayer excitons, or bound electron-hole pairs whose constituent quasiparticles are located in distinct stacked semiconducting layers, are being intensively studied in heterobilayers of two-dimensional semiconductors.

Experimental

We performed systematic photoluminescence (PL) studies on γ-InSe / ε-GaSe heterostructures using the in-house cryo-optics set-up in Smirnov's lab.

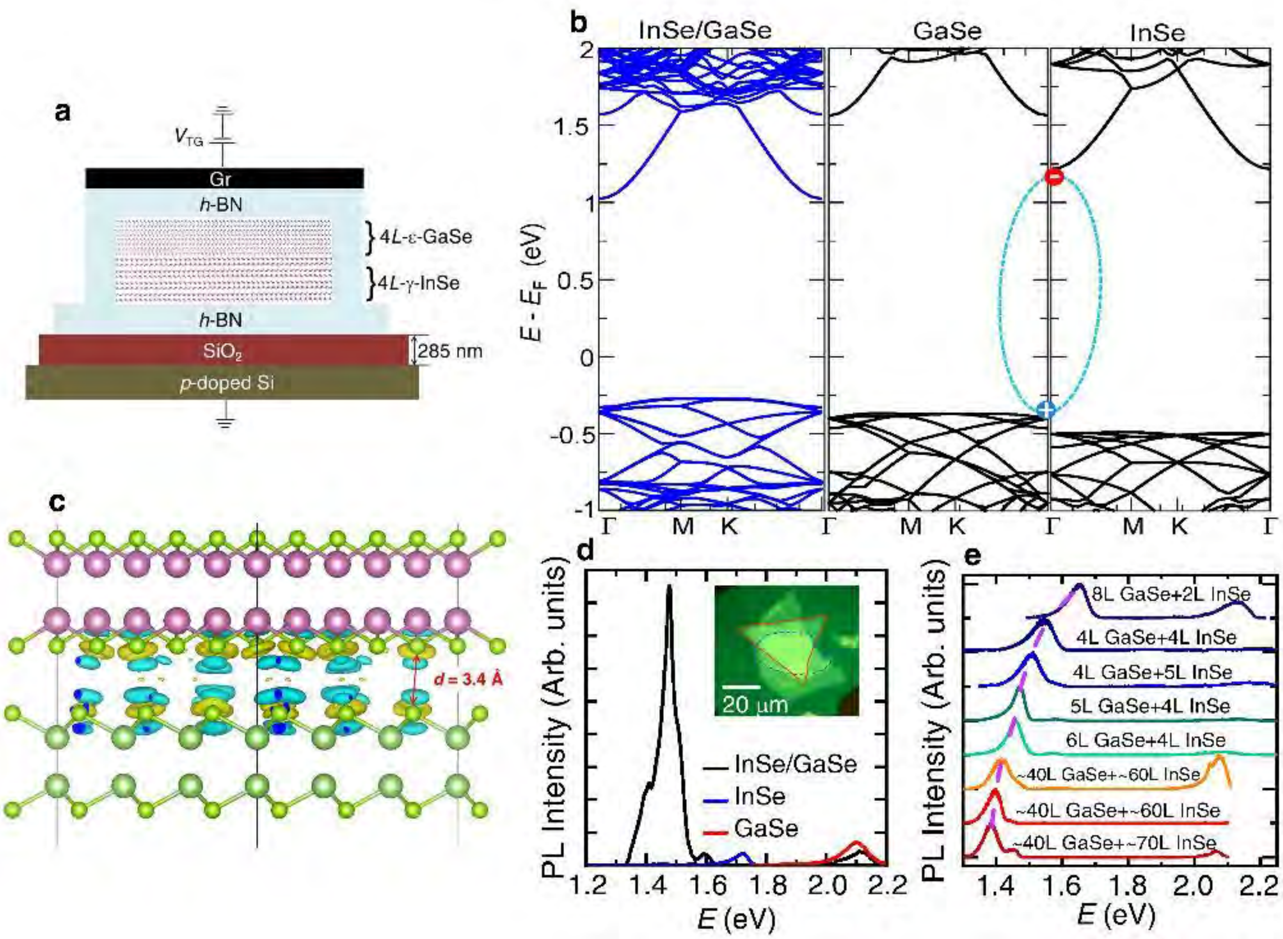


Figure 6. *(a) Sketch of a typical heterostructure based on n(Ga)L-e-GaSe on n(In)L-g-InSe encapsulated among h-BN layers (clear blue) with the entire stack transferred onto SiO_2 (granate). A top thin graphite (Gr) layer (thickness ~ 100nm) was transferred onto the top of the stack to act as the top electrical gate with h-BN acting as the dielectric layer. (b) Left to right: band structures of a stack composed of monolayer (1L) ε-GaSe and 1-L-γ-InSe, 1L-ε-GaSe (center), and 1-L-γ-InSe (right) within the reduced moiré Brillouin zone where the twist angle is $\phi = 0^o$. (c) Difference in charge density (2×10^5 eV/A^3) at the InSe/GaSe interface calculated through vdW-corrected ab-initio simulation methods. (d) Measured PL spectra from a n(In) = 4L InSe layer (blue line), a n(Ga) = 5L- ε -GaSe (red line), and from their interface (black line). The interfacial exciton IX peaks at a lower energy with respect to the intra-layer excitons X_0(Ga) and X_0(In) of the individual constituent layers. (e) Photoluminescence (PL) spectra for several n(Ga)L- ε -GaSe/n(In)L-γ-InSe heterostructures.*

Results and Discussion

We observed [1] a pronounced interlayer exciton (IX) in heterobilayers of metal monochalcogenides, namely γ-InSe on ε-GaSe, whose pronounced emission is adjustable just by varying their thicknesses given their number of layers dependent direct bandgaps. Time-dependent PL spectroscopy unveils considerably longer interlayer exciton lifetimes with respect to intralayer ones, thus confirming their nature. The envelope of IX is twist angle dependent and describable by superimposed emissions that are nearly equally spaced in energy, as if quantized due to localization induced by the small moiré periodicity (**Figure 6**).

Conclusions

In summary, we report a pronounced interlayer exciton emission in metal monochalcogenide heterostructures at low temperatures, whose energy is layer thickness dependent and whose width (in energy) is twist angle dependent. The overall phenomenology unveiled here is akin to previous reports on excitons subjected to the moiré potential intrinsic to twisted bilayers of transition metal dichalcogenides (TMDs). However, and in contrast to TMDs, this very pronounced interlayer emission occurs over the entire range of twist angles and a broad variation in layer thicknesses. We argue that its existence is attributable to the direct band gap at Brillouin zone center that is intrinsic to multilayered metal monochalcogenides.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. L.B. acknowledges support from US NSF-DMR 1807969 (synthesis, physical characterization, and heterostructure fabrication) and the Office Naval Research DURIP Grant 11997003 (stacking under inert conditions). L.B. also acknowledges the hospitality of the Aspen Center for Physics, which is supported by US NSF grant PHY-1607611.

References

1. Zheng, W., *et al.*, ACS Nano, **16**, 18695−18707 (2022).

Propulsion Efficiency of Achiral Microswimmers in Viscoelastic Polymer Fluids [1]

Quashie D. Jr, (FAMU-FSU, Chem. Eng.); Gordon D. (FAMU-FSU, Chem. Eng.); Nielsen P. (FAMU-FSU, Chem. Eng.); Kelley S. (FAMU-FSU, Chem. Eng.); Jermyn S. (FAMU-FSU, Chem. Eng.); Ali, J. (FAMU-FSU, Chem. Eng.)

Introduction

Achiral swimmers' velocity and orientation angle have been shown to have an inverse relationship with increasing polymer concentration [2]. The relationship also maintains a non-linear trend which has been attributed to the viscoelasticity of the polymer, although the fluids are characterized as Newtonian by mechanical rheology. In this work, we experimentally explore the effect of viscoelasticity on achiral swimmers by varying the molecular weight of the polymer while keeping their viscosity constant (**Figure 7A**). Additionally, we use elastic and shear thinning viscosity dominant polymers to determine which viscoelastic effect modifies the achiral swimming dynamics.

Experimental

Achiral swimmers were fabricated by binding functionalized ~ 4-micron superparamagnetic particles, with either biotin or streptavidin to form 3 and 4 bead assemblies. Methylcellulose (MC), polyacrylamide (PAAm) and xanthan gum (XG) were used to create the experimental fluids displaying Newtonian (MC) and Viscoelastic (PAAm, XG) behavior. All polymer concentrations chosen were below their overlap concentration and were characterized using a mechanical rheometer. Multiple particle tracking was further used to quantify the viscoelasticity of PAAm and XG. Finally, a magnetic field generator was used to create a homogeneous rotational field to actuate the achiral swimmers.

Results and Discussion

A range of frequencies is used to determine the maximum synchronous frequency that can be applied to the achiral swimmers known as the step-out frequency ω_{s-0}. The velocity at ω_{s-0} is compared in various molecular weight MC polymer solutions. We observe a monotonic increase in velocity as the molecular weight of MC increases, which is more pronounced at low viscosities. Normalizing the velocity with ω_{s-0} gives the propulsion efficiency, δ [3], which we compare with swimmers' orientation angle (**Figure 7B**). As the polymer concentration is increased, the orientation angle decreases and δ remains relatively constant in both the 15 and 44kg/mol MC polymer solutions. However, in the 88kg/mol MC solutions, δ monotonically decreases as the polymer concentration increases, which may be due to the increased non-linear behavior of this MC solution. In the viscoelastic fluids explored, we observe that the 3 bead achiral swimmers have higher δ in XG, while the 4 bead achiral swimmers have higher δ in PAAm (**Figure 7C**), indicating varying effects of swimmer geometry and fluid viscoelasticity on propulsion.

Conclusions

We have found that when the viscosity of the polymers is comparable (~3mPa·s **Figure 7D**), viscoelasticity plays an important role in achiral swimmer dynamics. Additionally, we demonstrate that swimmer size can also be used to exploit different viscoelastic effects.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. This work was funded by the National Science Foundation (No. HDR-2000202 and CMMI-2000330) and supported by the NSF FAMU CREST Center award (No. HDR-1735968). This research work was also supported by The Grainger Foundation Frontiers of Engineering Grant under the National Academy of Sciences Award Number: 2000013181. This material is based upon work supported by the Air Force Office of Scientific Research under award number FA9550-22-1-0247.

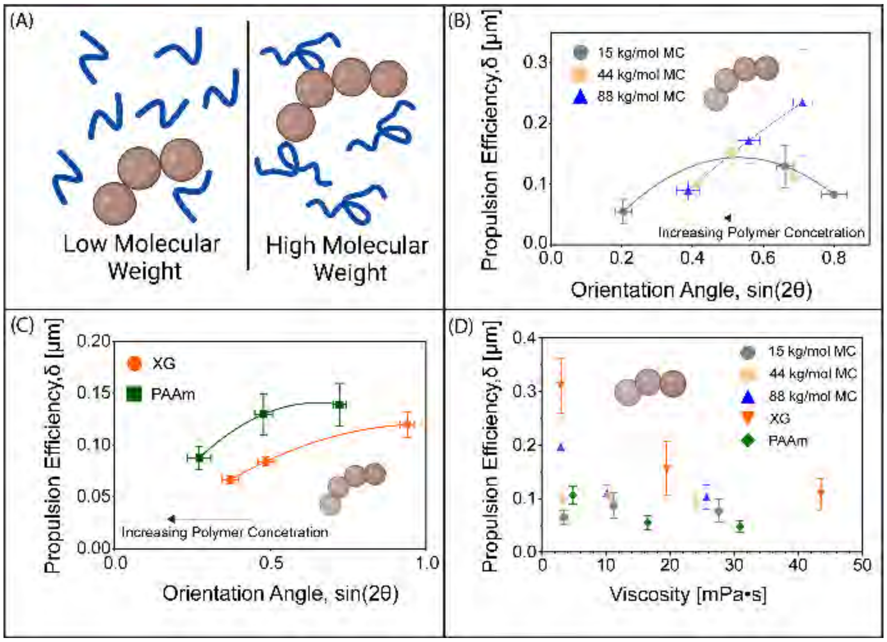


Figure 7. *(A) Schematic of achiral swimmers in polymer fluids of varying molecular weight. Propulsion efficiency of 4 bead achiral swimmers in (B) methylcellulose, and (C) viscoelastic polymer fluids. (D) Propulsion efficiency of 3 bead achiral swimmers in dilute polymeric fluids.*

References

1. Quashie. D, et. al., AIChE Journal, e17988. (2022)
2. Benhal. P, et. al., Appl. Phys. Lett. 118, 204103 (2021)
3. Morozov, K.I., et. al. Phys. Rev. Fluids, 2(4), 044202 (2017)

Magnetometer for Large Magnet Moments with Strong Anisotropy

Anca-Monia Constantinescu, Aixia Xu, Ashleigh Francis, and Jan Jaroszynski (MagLab)

Introduction

A novel torque magnetometer [1] makes it possible to directly measure torque exerted on REBCO CC tapes as well as to assess their critical current I_c at any field, field angle, and temperature that is very difficult using usual transport method for samples with kiloampere critical currents. It is also very useful in studying hard magnetic materials with high saturation fields, as neodymium (NdFeB) permanent magnets.

Experimental

Measurements in 31T resistive magnet (cell 7) and in the hybrid magnet resulted in massive characterization of around ninety different REBCO CC conductors that belong to the 40-tesla magnet project, to the 'little big coil" project, and to external users (Commonwealth Fusion Systems, SuperOx, UTHouston, Beijing). Also, commercial Nd magnets from another user, Noveon Magnetics were assessed up to 45T.

Results and Discussion

Data taken show a rich diversity of REBCO conductors nominally grew with the same protocol. It seems that the present production of SuperPower Inc. is of lower quality than that of 32 tesla projects. However, the **Figure 8** shows that recent intentional grading of the conductors is quite successful.

Our results make it possible to improve microstructure in both materials. REBCO CC critical current parameters are vital for superconducting magnet construction. Critical current data at very high field may also help in theoretical modeling and numerical simulations of pinning, in this difficult to describe regions with high density multi-vortex pinning centers occupation and interaction.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR 1644779 and the State of Florida. Work within User Collaboration Grants Program #5602 and FSU GAP commercialization program.

References

1. Jaroszynski, J. *et al*., Superconductor Science and Technology, 35, 095009 (2022); US patent pending.

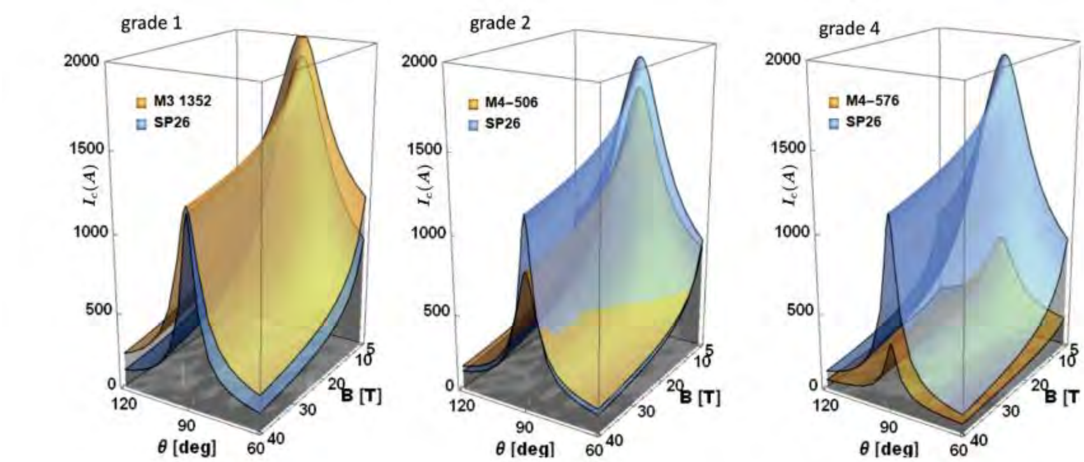


Figure 8. *Critical current vs. angle and magnetic field measured from 5T to 30T and extrapolated to 40T in three graded 40T project samples (yellow) compared to the vintage sample SP26 (blue).*

2. Overview – High B/T CMP Experiment

We have had two breakthroughs at the frontier of materials growth in extreme conditions, an internationally active research direction in which the US is entering. Research in high-entropy alloys is gaining momentum due to these alloys' wide range of intriguing mechanical, electronic, and magnetic properties. The long-standing puzzle of the origin of the magnetism in the equiatomic Cantor alloy CrMnFeCoNi was addressed with a wide set of analysis techniques (compositional and structural characterization, magnetization, Hall effect, muon spin relaxation, specific heat, and *ab initio* density functional theory) elucidated which magnetic transitions were intrinsic, not an impurity phase, and that they were likely ferrimagnetic and spin-glass-like transitions. We are also pioneering materials growth in applied magnetic fields, allowing phases not reachable through traditional growth methods, and have discovered a profound effect on the structure of cobalt applied magnetic field during growth: experiments were done with growth fields up to 9 Tesla. Another materials development was the characterization of the magnetic properties of Cryogel®. The magnetic properties of this commercially available silica-based aerogel product, designed for use in cryogenic environments, revealed it to be weakly diamagnetic, making it a candidate for MRI imaging that would allow the subject to be comfortable during *in vivo* metabolism studies. An integral component of the in-house research in this section that serves the user community is the opening and initial operation of a third bay in our HBT facility.

Magnetic Properties of Equiatomic CrMnFeCoNi

Elmslie, T.A. (UF, Physics); Startt, J. (Sandia National Lab, CINT); Soto-Medina, S. (UF, Materials Science & Engineering); Yang, Y. (UF, Materials Science & Engineering); Feng, K. (MagLab and FSU, Physics); Baumbach, R.E. (MagLab and FSU, Physics); Zappala, E. (Brigham Young Univ., Physics); Morris, G.D. (TRIUMF, CMMS); Frandsen, B.A. (Brigham Young Univ., Physics); Meisel, M.W. (MagLab High B/T and UF, Physics); Manuel, M.V. (UF, Materials Science & Engineering); Dingreville, R. (Sandia National Lab, CINT); Hamlin, J.J. (UF, Physics)

Introduction

The synthesis and characterization of high-entropy alloys is gaining momentum due to the wide-range of intriguing properties that have been observed, and the "Cantor alloy", CrMnFeCoNi, was first identified in 2004 [8]. Despite a flurry of studies that have been reported, the origin of the magnetism of CrMnFeCoNi lacked consensus. Our work provided a quantitative analysis of the magnetic properties of the equiatomic Cantor alloy CrMnFeCoNi based on a combination of compositional and structural characterization, magnetization studies, Hall effect measurements, muon spin relaxation (μSR) results, specific heat studies, and *ab initio* density functional theory (DFT) calculations [2].

Sample Synthesis and History

Samples were synthesized by combining stoichiometric amounts of elemental Cr, Mn, Fe, Co, and Ni and melting them together in an arc melter five times while being flipped time to improve sample homogeneity. Samples measured immediately after arc melting are referred to as "as-cast." Annealed samples were made by sealing as-cast samples in quartz tubes under Ar atmosphere and homogenizing them at 1100°C for 6 days, after which the tube containing the samples was quenched in water. Samples measured following this step are called "anneal A." Some samples from the anneal A batch were cold worked by flattening them in a press a total of three times using a pressure of about 0.5GPa, folding them in half between each flattening step. These samples are known as "cold-worked." After cold working, the samples were reannealed in quartz tubes under argon (Ar) atmosphere. A portion were annealed at 700°C for 1h, while others were again subjected to 1100°C for 6 days and are referred to as "anneal B" and "anneal C," respectively.

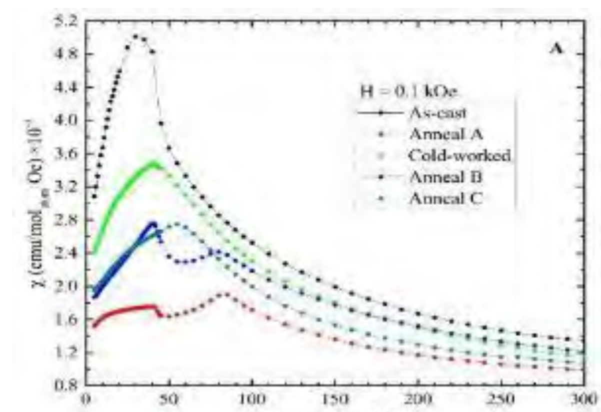


Figure 1. *Effects of annealing and cold working on the magnetic properties of equiatomic Cantor alloy CrMnFeCoNi for zero-field cooled susceptibility as a function of temperature in 0.1kOe.*

Results and Summary

Magnetic (**Figure 1**), specific heat, and structural properties of the equiatomic Cantor alloy CrMnFeCoNi system were studied between 5-300K, and up to fields of 70kOe. Magnetization measurements performed on as-cast, annealed, and cold-worked samples reveal a strong processing history dependence and that high-temperature annealing after cold working does not restore the alloy to a "pristine" state. Measurements on known precipitates show that the two transitions, detected at 43 and 85K, are intrinsic to the Cantor alloy and not the result of an impurity phase. Experimental and *ab initio* density functional theory computational results suggest that these transitions are a weak ferrimagnetic transition and a spin-glass-like transition, respectively, and magnetic and specific heat measurements provide evidence of significant Stoner enhancement and electron-electron interactions within the material.

Acknowledgements

Synthesis/characterization facilities at UF were developed under support from NSF-CAREER 1453752 (J.J.H.). We benefited from conversations with D.L. Maslov and G.R. Stewart. B.A.F. and E.Z. acknowledge support from Brigham Young University and also thank the CMMS staff at TRIUMF for support. A portion of this work was performed at the MagLab supported by NSF DMR-1644779 and the State of Florida. The computational work was performed, in part, at CINT, an Office of Science User Facility operated for the U.S. DOE. Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. DOE's National Nuclear Security Administration under Contract No. DE-NA0003525. This report describes objective technical results/analysis. Any subjective views or opinions that might be expressed do not necessarily represent the views of the U.S. DOE or the U.S. Government.

References

1 Cantor, B., *et al*., *Mater. Sci. Eng. A,* **375-377**, 213 (2004).
2 Elmslie, T.A., *et al*., *Phys. Rev. B*, **106**, 014418 (2022).

Effect of Applied Magnetic Field on the Growth of Co from a Cobalt Sulfide Flux

Steven Flynn (UF, Physics), Caeli L. Benyakco (UF, Physics), Michael E. Bates (UF, Physics), Jared C. Lee (UF, Physics), Mark W. Meisel (MagLab High B/T and UF, Physics), James J. Hamlin (UF, Physics)

Introduction

The application of high magnetic fields to materials at high temperatures is an emerging field of opportunity for the synthesis and/or processing of materials which have novel properties that are not accessible with traditional methods. Since a wide range of diverse and complex effects have been reported, Co is a popular model system due to its strong intrinsic magnetism, high Curie temperature ($T_C \approx$ 1393K), and established crystal structures of face-centered cubic (FCC) at high temperatures and a hexagonal close packed (HCP) structure below 673K. Previous work has already leveraged these properties for studies on supercooled Co melts, solidifying the product directly in the ferromagnetic phase despite the melting point being higher than the T_C [1]. Although the transition from a mobile liquid phase solidifying into a ferromagnetic state should facilitate the development of field effects, these effects are limited by the non-equilibrium conditions of the rapid precipitation from a supercooled melt used to solidify Co below its T_C. Potential effects on the crystallization process and resulting crystal structure, microstructure, morphology, and properties of the crystal grown in-field are lost in this approach. Instead, our work uses an alternative way to form Co from a liquid directly in the ferromagnetic state, by using a low melting Co-S eutectic as proposed by Lin, Bud'ko, and Canfield [2].

Experimental Details

Cobalt samples were synthesized using a Co-S binary flux. Stoichiometric amounts of Co (Cerac, 99.5%) and S (Alfa Aesar, 99.9995%) were precisely weighed for a final composition of $Co_{61}S_{39}$, which was selected to target the Co-rich side of the Co-S eutectic while fixing the liquidus temperature below 1323 K [3]. Sample mixtures were placed in an alumina crucible with the low melting S on top, and the loaded reaction vessel was subsequently sealed in a quartz tube after 5 cycles of evacuation and flushing with Ar gas. Using the ***BxT*** Facility at UF [4], samples of pure Co were grown directly in the ferromagnetic state in applied magnetic fields of 0, 3 tesla, and 9 tesla. Reacted samples consisted of a boule of solidified flux surrounding the Co flux products. The latter were mechanically separated from the former through careful application of force to the relatively brittle flux matrix. Flux products were identified visually through their distinct, metallic appearance and clear facets in some cases.

Results and Discussion

Isolated Co products exhibited progressively elongated morphologies, from cubes to rectangular rods to needle-like tendrils with poorly defined facets, **Figure 2**. The degree of elongation of the major axis was found to correlate with magnetic field strength, and the elongated axis formed parallel to the applied field. Such elongated morphology is not obtained under normal zero field conditions given the cubic structure in which cobalt crystallizes at these temperatures. Magnetization measurements show typical saturation magnetization in all samples, and variations in the magnetic response was observed when the measuring field was parallel or perpendicular to the elongation axis.

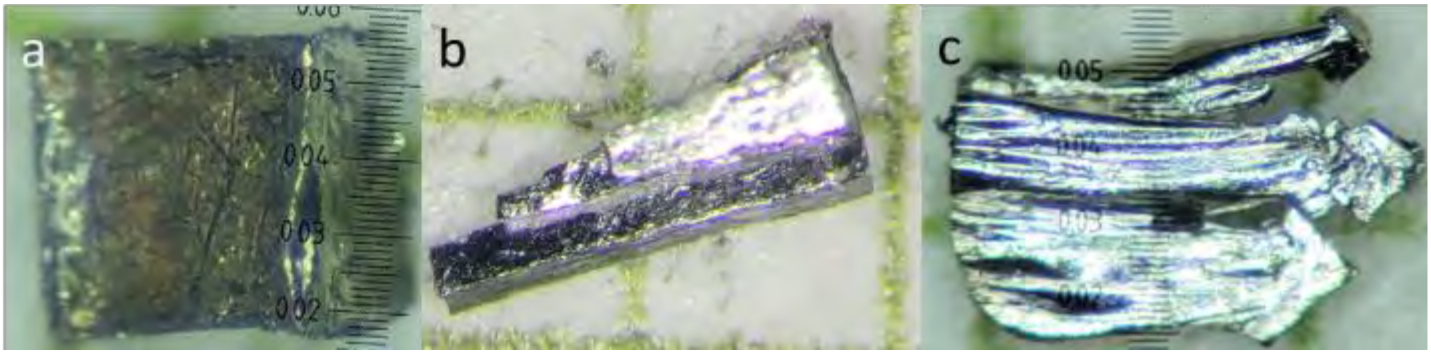


Figure 2. *Cobalt product morphology when grown from a cobalt-sulfur flux in applied magnetic fields of (a) 0, (b) 3 tesla, and (c) 9 tesla. Growth in high field allows the development of an elongated morphology (b and c) instead of the normally cubic habit (a) expected for crystallization in a cubic structure. The background grid of green lines is 1mm spacing, and foreground grid, if visible, is in inches.*

Acknowledgements

The MagLab work was supported by NSF DMR-1644779 and the State of Florida. Furnace development and assembly was supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Advanced Manufacturing Office award number DE-EE000913. The REU funding for CLB was provided by DMR-1708410 and DMR 1852138.

References

1. He, Y., *et al*., *J. Mater. Sci. Technol.,* **93**, 79–88 (2021), and references therein.
2. Lin, X., *et al*., *Philos. Mag*., **92**, 2436–2447 (2012).
3. Kuznetsov, V. G., *et al*., *Izvest Akad Nauk USSR Neorgan Mater*., **1**, 675–689 (1965).
4. Flynn, S., *et al*., *MagLab Annual Report,* Ch. 4, Sec. 4.3.2.5, 111-112 (2021).

Characterization of the Magnetic Properties of Cryogel®

Benyacko, C.L. (UF, Physics); Sherman, A.J. (UF, Physics); Rawson, R.J. (MagLab High B/T and UF, Physics); Wiebe, Q.L. (UF, Physics); Hauser, G.T. (MagLab High B/T and University of Rhode Island, Physics); Poottafai, K. (UF, Chemistry); Talham, D.R. (UF, Chemistry); Meisel, M.W. (MagLab High B/T and UF, Physics)

Introduction

A MagLab User Collaboration Grant Program (UCGP) award, which is developing cryo-cooled coils for low-gamma NMR imaging and spectroscopy in high magnetic fields of 11.1T [1], motivated a search for "new age" insulating materials that might be employed to improve the proximity of the coils to the live animals which are kept comfortable during the *in vivo* metabolism studies. A search found a commercially available silica-based aerogel product, known as Cryogel®, which was designed for use in low-temperature, cryogenic environments [2]. The thermal conductivity of one version of the product, Cryogel Z, has been reported by a CERN-based collaboration [3], but to date, the magnetic properties of the material have not been reported.

Experimental Details

Samples cut from various regions of commercially available 5mm and 10mm thick sheets of unsupported product, Cryogel x201 [2], were measured in a commercial magnetometer, QD MPMS XL7, operating between 2K to 300K and in magnetic fields up to 70kG. The low field, typically 1kG, zero field cooled (ZFC) and field cooled (FC) data sets were collected before additional, isothermal, typically 5K, data were collected while ramping the magnetic field from 0 to 7T and then from 7T to –1T, which allowed for coercivity to be checked.

Preliminary Results and Discussion

The high temperature magnetic response is dominated by a temperature independent diamagnetic signal associated with the amorphous silica aerogel, **Figure 3.** The Curie-like increase at low temperatures (*main panel*) and the field dependence of the magnetic signal at 5K (*inset*) cannot be explained as solely arising from isolated, dilute amounts of spin 1/2 entities that may be present after fabrication. A full set of data, analysis, and interpretations, along with the ICP (inductively coupled plasma) spectrometry data, are being compiled for a manuscript to be submitted and made available following *FAIR* [4] practices.

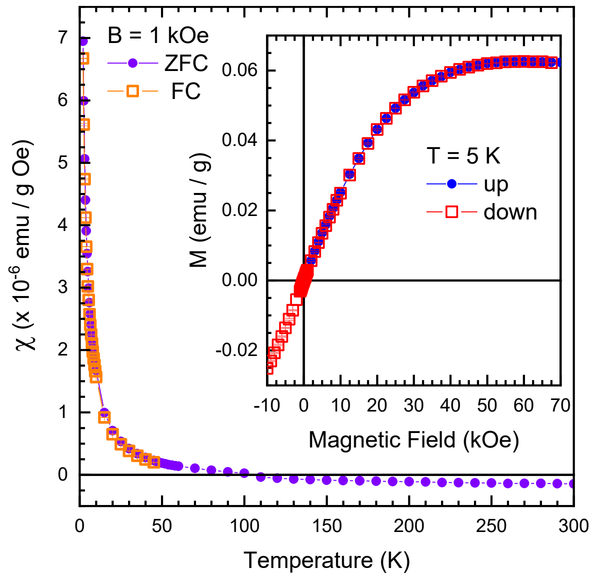


Figure 3. *For a sample of Cryogel x201 with mass of 35.35mg, the temperature dependence of the magnetic susceptibility measured in 1kOe is shown with no significant difference between zero-field cooled (ZFC) and field cooled (FC) data. (inset) The moment at 5K is shown as a function of magnetic field with no apparent hysteresis or coercivity.*

Acknowledgements

The participation of RJR and GTH was supported by the NSF REU Summer 2022 Program of the MagLab via DMR-1644779. Additional professional development and social networking activities were made possible by the UF Condensed Matter and Applied Materials REU Program funded by DMR-1852138, which also supported CLB in Summer 2022. Additional NSF REU funding came from DMR-1708410, which provided for the REU participation of AJS and QLW (Fall 2021) and AJS, QLW, and CLB (Spring 2022). The MagLab work was supported by NSF DMR-1644779 and the State of Florida.

References

1. Mareci, T.H., *et al*., MagLab User Collaboration Grant Program (2021-2022)
2. https://www.pacorinc.com/wp-content/uploads/Cryogel-x201-Datasheet.pdf
3. Ilardi, V., *et al*., *IOP Conf. Ser.: Mater. Sci. Eng*. **756** (2020) 012005, doi:10.1088/1757-899X/756/1/012005
4. MagLab Center for FAIR & Open Science, https://nationalmaglab.org/research/research-groups/center-for-fair-open-science/

Opening and Initial Operation of the Third Bay in High B/T Facility

Gazizulin, R. (MagLab High B/T and UF, Physics); Meisel, M.W. (MagLab High B/T and UF, Physics); Steinke, L. (MagLab High B/T and UF, Physics)

Introduction

There is a growing User interest in studying 2-dimensional electron systems (2DES) at ultra-low temperatures as a means of probing these valuable, tunable model systems to explore correlated electron phenomena. When these systems are cooled to ultra-low temperatures in a locally electromagnetically quiet environment, the competition between the repulsive Coulomb interaction and the kinetic energy can be varied *in situ*, thereby providing complex many-body ground states with competing orders. Different types of insulating states, including Wigner crystallization, and superconductivity have already been observed previously in 2DES [1,2] formed in different emerging materials. The experiments usually require ultra-low on-chip electron temperatures in nanodevices. Since the main cooling path to the electrons in a device is provided by electrons in the wiring, the immersion ^{3}He cell, comprising an individual silver sinter for each wire, was designed in MagLab High B/T Facility at UF, which is located in a specially designed building that offers low electromagnetic noise/interference levels. The cell is compatible with a new generation of dry dilution cryostats and can be used in high magnetic fields. Combined with the low electromagnetic noise background, the High B/T Facility provides users with unique environments that are not available in their home institutions.

Experimental preparation

The purchase order for a new cryogen-free BlueFors LD250 cryostat was issued in November 2021. At that time, detailed work was initiated to clear and renovate one of the instrument bays in the Microkelvin Building on the UF campus while the detailed specifications were finalized for the new cryostat. The installation was completed, and the successful performance test was performed on October 21, 2022. An enhanced feature of the new system is its faster cool down time compared to the conventional dilution cryostats which use liquid helium. Specifically, less than 15 hours were needed to cool down from 100K to 10mK, **Figure 4**. The cooling power test showed 20μW at 20mK and 100μW at 100mK. The large experimental space at base plate provides room for a wide range of possibilities to design and perform user experiments. The space will be used not only for samples but also for any low temperature equipment necessary for the experiment. For example, low temperature filters essential for reducing radio-frequency noise or cold amplifiers can be installed at different cold plates enhancing the variability of user experiments that can be performed in the High B/T Facility. A 14 Tesla magnet has been ordered and is scheduled to arrive in July 2023.

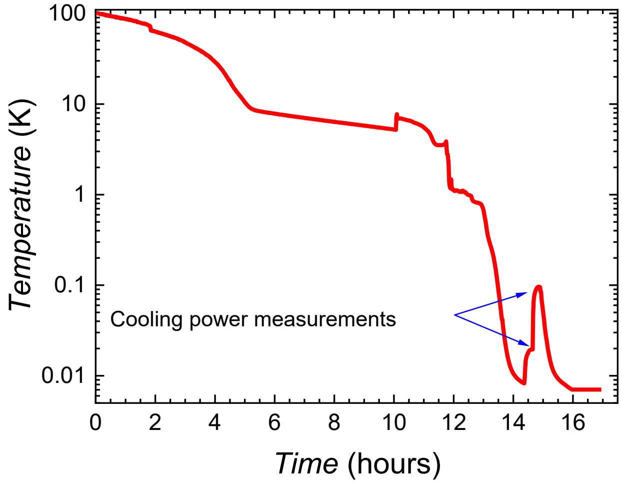


Figure 4. *Mixing Chamber temperature during first cool-down.*

A new ^{3}He immersion cell was designed to perform electron transport measurements at lowest possible temperatures. It comprises 16 silver sinters that will help to cool down the electrons in electrical leads lowering the on-chip electron temperature of the sample. A tuning fork thermometer installed in the cell will allow us to measure the temperature of the ^{3}He liquid. Specially designed thermal anchors have been attached to different stages of the Bluefors cryostat to cool the incoming ^{3}He gas and liquid before it arrives to the cell. Various tests have confirmed the condensing capillaries and the cell are leak-tight and ready to perform experiments.

Conclusions

Cryogen-free Bluefors cryostat is now operational, available for user experiments. The DC wiring is installed along with low-temperature filters and ^{3}He immersion cell which allow to efficiently thermalize electrons in nanodevices to the base temperature of the cryostat. The delivery of a 14 Tesla magnet system is scheduled for summer 2023.

Acknowledgements

The MagLab is supported by the NSF DMR-1644779 and the State of Florida. The special design for our facility was facilitated by Blue Fors engineer Raj Kumar and the installation/testing at UF was efficiently conducted by Blue Fors engineer Alessandro Serafin. Expert assistance from UF Physics engineering staff, Jake Bourdage, Greg Labbe, and Chris Ollmann during the preparation of the lab space and the installation of the new equipment is gratefully acknowledged.

References

1. J. Falson *et al*., Nature Materials **21**, 311 (2022).
2. H. Zhou *et al*., Nature **598**, 434 (2021).

3. Overview – PFF CMP Experiment

Research in our pulsed field facility expands our fundamental knowledge of correlated electron materials and continues to drive the frontiers in techniques for high-field pulsed magnet measurements. In-house materials research successes promise to impact quantum sensing, quantum computing, and AI in general. A promising qubit material would be a Kiatev quantum spin liquid (KQSL) because it is a correlated spin-orbit assisted Mott insulator. A wide range of measurement on $Na_2Co_2TeO_6$ (dc and ac magnetic susceptibility, dielectric constant, specific heat, and magnetostriction) along with c-axis magnetization and the magnetocaloric effect using the 65T pulsed field magnet revealed a rich phase diagram that further supports this material as a KQSL candidate. Kagome metals are magnetic materials whose layered hexagonal structure promotes magnetic frustration and are candidates for nontrivial, band topology, also are promising materials for qubits. High-sensitivity and novel quantum oscillation measurement in pulsed fields up to 75T on the recently discovered Kagome metal CsV_3Sb_5, revealed the strong possibility of chiral Fermi pockets and the intriguing interplay of electronic correlations and conventional electronic bands in quantum materials. Also related to these functional quantum materials is the study of asymmetric magnetic proximity interactions in the van der Waals heterostructure $MoSe_2/CrBr_3$ leading the way to the possibility of selectively controlling specific spin degrees of freedom for futures spintronics applications. Furthering our understanding the role of crystal structure on electronic structure in correlated electronic materials, our ultra-sensitive fiber-Bragg-gratings dilatometer, in comparison to Raman measurements, was able to show that the lattice plays an important role in stabilizing magnetic texture in $SrCu_2(BO_3)_2$. To facilitate these measurements and continue to lead the world in data acquisition at high fields, we have developed a technique which allows continuous measurements of non-linear voltage characteristics in HTS superconductors up to 55T.

Electronic and magnetic phase diagrams of Kitaev quantum spin liquid candidate $Na_2Co_2TeO_6$

Zhang, Shengzhi (LANL, MPA-MAGLAB); Lee, Sangyun (LANL, MPA-Q); Woods, Andrew J. (LANL, MPA-Q); Thomas, Sean M. (LANL, MPA-Q); Movshovich, Roman (LANL, MPA-Q); Brosha, Eric (LANL); Huang, Qing (University of Tennessee, Physics); Zhou, Haidong (U of Tennessee, Physics); Zapf, Vivien S. (LANL, MPA-MAGLAB); Lee, Minseong (LANL, MPA-MAGLAB)

Introduction

An immense science and engineering effort is currently underway to develop the hardware and algorithms needed for practical quantum computation. However, a key bottleneck is a short decoherent time of quantum state. Recently, several theoretical studies predicted that non-Abelian anionic excitations observed in Kitaev quantum spin liquid (KQSL) state can address this problem [1, 2]. Honeycomb lattice composed of magnetic ions with strong spin-orbit coupling are suitable for Kitaev exchange interactions [2] and multiple candidate materials have been suggested including α-$RuCl_3$ [3]. In real materials, other interactions besides the Kitaev interactions cause magnetic long-range ordering at zero magnetic field. However, the KQSL phase is still predicted to occur at high fields where long-range order is suppressed.

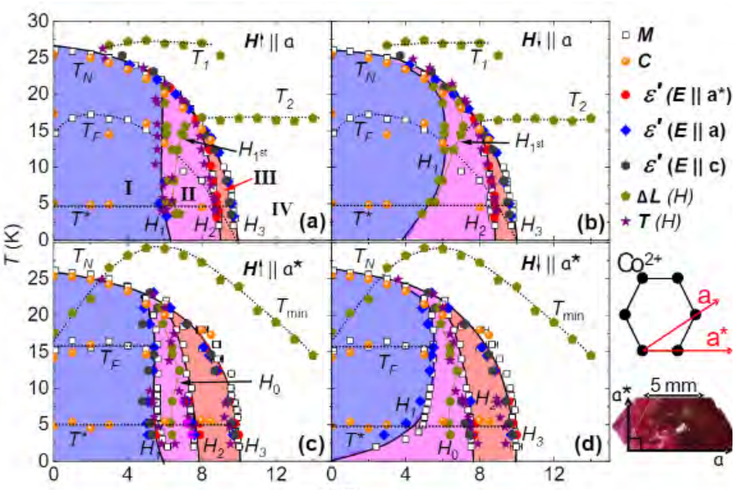


Figure 1. *Phase diagrams for H||a (a) and (b) and H||a* (c) and (d) constructed from dc and ac magnetic susceptibility (M), dielectric constant (ε'), specific heat (C), and magnetostriction (ΔL), and magnetocaloric effect (T).*

Despite the need for strong spin-orbit coupling, it has been proposed that $3d^7$ Co^{2+} in edge-sharing octahedra can have Kitaev exchange interaction and the one of the prominent compounds in this line is $Na_2Co_2TeO_6$ (NCTO) [4]. In previous investigations of NCTO, several magnetic phases were reported in the temperature (*T*) and magnetic field (*H*) phase diagrams, but their identities are not yet pinned down. In addition, the spin structure at zero magnetic field is not resolved. Not only the zig-zag spin structure but also a more exotic triple-Q spin structure has been suggested as possible ground state at zero field. In this report, we describe a comprehensive *T – H* phase diagram up to magnetic saturation along a and a* as shown in **Figure 1.** A detailed report of the complete work can be found in Reference 5.

Experimental

We measured dc and ac magnetic susceptibility (*M*), dielectric constant (*ε'*), specific heat (*C*), and magnetostriction (Δ*L*) measurements using PPMS at LANL MPA-MAGLAB, and magnetocaloric effect (*T*) using 65T pulsed field magnet. We also measured the magnetization along c-axis using 65T pulsed field magnet.

Results and Discussion

Three successive field-induced phases (Region I, II, III) are observed before the system reaches saturation (Region IV), separated by first and second order phase transitions, with increasing field. The dielectric constant is strongly dependent on magnetic field, and it reveals all the magnetic phase transitions, indicating that NCTO has a strong magnetoelectric coupling although it does not show net electric polarization. Regarding the debate of zig-zag vs. triple-Q spin structure for Region I, the absence of any electric polarization observed with or without poling, and with or without applied magnetic field, is more consistent with the zig-zag spin structure. The strong anisotropic behavior along the a- and a*-axes also support the zig-zag spin structure. The true nature of Region II and III still needs further investigation. The lower entropy in Region III is consistent both with the QSL phase and spin aligned phase along magnetic field, which also need additional studies to conclude. Above H_3, NCTO enters the spin polarized phase where a spin gap opens. Strong peaks in the dielectric constant at the boundary between Region III and magnetic saturation are consistent with the antiferroelectric or disordered-electric phase transition in conjunction with the magnetic phase.

Acknowledgements

This work was supported by the U.S. Department of Energy, Office of Science, National Quantum Information Sciences Research Centers, Quantum Science Center. The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1644779 and the State of Florida, and the U. S. Department of Energy. Q. H. and H. D. Z. grew the samples with support from the National Science Foundation grant DMR-2003117. M. L. also acknowledges LDRD program at Los Alamos National Laboratory. We thank Cristian D. Batista for discussions.

References

1. Kitaev, A. Y., Annals of Physics, **303**, 2 (2003).
2. Kitaev, A. Y., Annals of Physics, **321**, 2 (2006).
3. Jackeli, G. et al., Physical Review Letters, **102**, 017205 (2009).
4. Liu, H., International Journal of Modern Physics B, **35**, 2130006 (2021).
5. Zhang, Shengzhi et al., arXiv preprint 2212.03849 (2022).

Normal electrons as a probe of exotic quasiparticles in a Kagome metal

John Singleton (NHMFL-PFF, Los Alamos), Lu Li, Kuan-Wen Chen, Guoxin Zheng, Dechen Zhang, Aaron Chan, Yuan Zhu, Kaila Jenkins, Ziji Xiang (University of Michigan), Fanghang Yu, Mengzhu Shi, Jianjun Ying, Xianhui Chen (University of Science and Technology of China, Hefei), Ziqiang Wang (Boston College)

Introduction

Chiral Fermi pockets (CFPs) are predicted to host large spontaneous orbital magnetic moments. However, in most crystal symmetries, these moments align anti-ferromagnetically, completely cloaking any evidence for the CFPs. Here, we use interactions between the CFPs and “normal” band electrons to reveal the spontaneous moments, which are manifested as an anomalously large apparent g-factor.

Experimental

Single crystals of the recently discovered Kagome metal CsV_3Sb_5, thought to host CFPs, are studied in temperatures down to 500mK using the proximity detector oscillator (PDO) method. The sample sits inside a small coil, and changes in its conductivity are manifested as frequency shifts of the PDO circuit. Recent improvements in the PDO technique allow small features such as magnetic breakdown oscillations to be detected with very high sensitivity. Pulsed magnetic fields of up to 75T are provided by the Duplex magnet at the NHMFL Los Alamos Pulsed Field Facility. The samples are rotated in the field to high precision using a recently developed 3D-printed cryogenic goniometer.

Results and Discussion

The high magnetic fields promote magnetic breakdown between the CFP β-pocket and the conventional **δ** Fermi-surface section of CsV_3Sb_5 (**Figure 2**). Direct fits of quantum oscillations for many field orientations show spin-zeros in the magnetic breakdown oscillations. The apparent g-factor deduced from these spin zeros is around an order of magnitude larger than the value expected from Fermi-liquid theory and in fact reflects the energy splitting due to the large orbital moments of the CFPs.

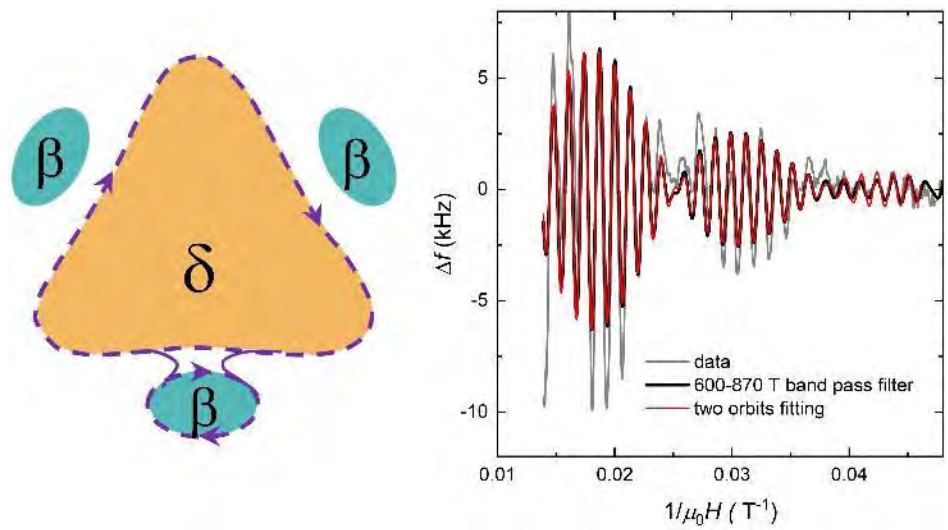


Figure 2. *Left: 75T magnetic fields produce magnetic breakdown in CsV_3Sb_5 between the CFP β-pocket and the **δ** Fermi-surface section. Right: The oscillations are observed with high signal-to-noise ratios, allowing direct fits to extract the amplitudes and phases of the various breakdown frequencies. The precise angle dependence of these amplitudes and phases allows the large effective g-factor to be extracted via the spin-zero effect.*

Conclusions

Berry-curvature-generated large orbital moments are almost always concealed by the other effects; here, magnetic breakdown orbits due to proximity to a conventional Fermi-surface section allow them to be very visibly manifested in the magnetic quantum oscillations. Such results provide a unique example of the interplay between electronic correlations and more conventional electronic bands in quantum materials.

Acknowledgements

The techniques used in this measurement were developed and improved as part of the DOE BES FWP program "Science of 100 T". The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1644779, the DOE and the State of Florida.

References

This work is currently in press.

Crystal Lattice *Witness* vs *Actor* Roles in Correlated Electronic Materials

Jaime, M. (Los Alamos National Laboratory)

Introduction

The line which separates a *witness* from an *actor* is very thin, and strongly correlated microscopic mechanisms in complex materials can be either or both at once. In some cases, such as the geometrically-frustrated quantum magnet, Shastry–Sutherland compound $SrCu_2(BO)_3$, the crystal lattice appears to stabilize field-induced magnetic texture. In others, such as the antiferromagnetic insulator UO_2, or the metallic URu_2Si_2 the lattice is arguably a silent witness for phase transitions, the symmetry of ordered states, unusual antiferromagnetic domains flip, and standing magneto-elastic waves. Understanding the roles assumed by different mechanisms when using external tuning parameters such as temperature, magnetic/electric fields, pressure, strain, or others is crucial to success in tuning desired functionality. [1-5]

Experimental

Fiber Bragg Gratings (FBGs) are passive optical devices containing periodic refractive index (RI) modulations in the core of telecommunications-type optical fibers, which are produced by taking advantage of the Germania (GeO_2)

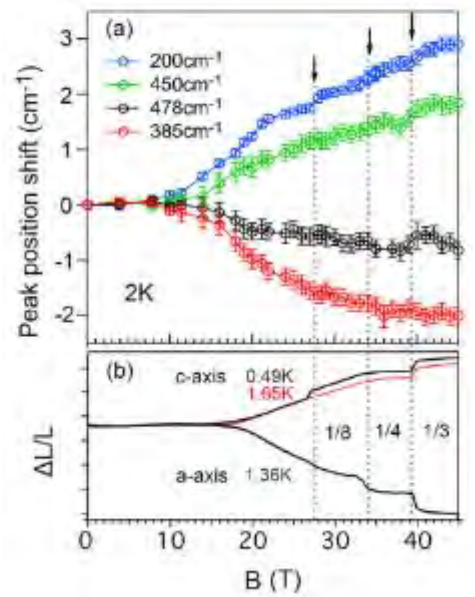


Figure 3. *Evolution of the energy of four Raman modes of SrCu2(BO3)2 with applied magnetic fields up to 45T. The arrows point to the anomalies detected in 200cm−1 mode coinciding with M/Ms = 1/8, 1/4, and 1/3 phases. (b) Magnetostriction along a- and c-axes measured at magnetic fields up to 45T.*

photosensitivity. A little over a decade ago FBG-based dilatometry was added to the high magnetic field experimental toolbox, enabling the study of lattice properties of materials in the milli- and micro-second time scale and fields to 150T for the first time. [3,5]

Results and Discussion

The dynamic and static crystal lattice properties of $SrCu_2(BO_3)_2$ were recently studied by means of Raman scattering and dilatometry measurements in magnetic fields to 45T. [6] Raman experiments versus temperature reveal phonon modes at 200cm^{-1} and 450cm^{-1} showing an unusual behavior: their frequencies soften, while modes at 385cm^{-1} and 478cm^{-1} harden when decreasing the temperature below 15K. Magneto-Raman experiments show that the former harden with applied magnetic fields while the latter soften with applied fields (see **Figure 3a**), correlating temperature with external field effects. Density functional theory was used to model and compute the energies of these modes, classifying them into two types: pantograph and non-pantograph. It was found that the former involves the modification of the intradimer exchange interaction J and the latter the interdimer J'. Dilatometry was used to correlate field-dependent Raman modes to the closing of the spin gap as well as fractional-magnetization spin texture states M = 1/4Ms and M = 1/3Ms, where M s is the saturation magnetization (see **Figure 3b**). Atomic displacements in the pantograph mode at 200cm-1 are schematically displayed in **Figure 4**.

Conclusions

The close match between plateaus in the energy of pantograph Raman modes (**Figure 3a**) and static lattice distortions (**Figure 3b**) at known magnetization plateaus strongly suggest that these modes play a role stabilizing magnetic texture and supporting the hypothesis that lattice plays an important actor role in $SrCu_2(BO_3)_2$.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.

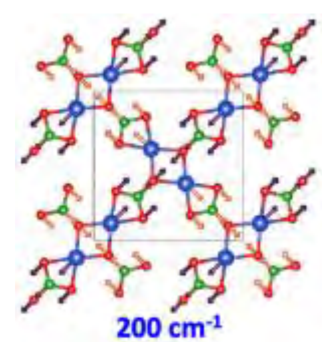


Figure 4. *Schematic representation of the pantograph phonon mode at 200cm^{-1}. The lengths of the arrows are proportional to the atomic displacements.*

References

1. Jaime, M., *et al.,* Proc. Natl. Acad. Sci., **109**, 12404-12407 (2012).
2. Radtke, G., *et al.*, Proc. Natl. Acad. Sci. **112**, 1971-1976 (2015).
3. Jaime M., *et al.,* Sensors 17, 2572 1-21 (2017).
4. Schönemann, R., *et al.*, Proc. Natl. Acad. Sci. **118** e2110555118 1-7 (2021).
5. Jaime, M., J. Phys. Soc. Jpn., **91**, 101005 1-14 (2022).
6. Thirunavukkuarasu, K., *et al.,* Phys. Rev. B (2023), in the press.

Asymmetric Magnetic Proximity Interactions in $MoSe_2/CrBr_3$ van der Waals Heterostructures

Choi, J., Lane, C., Zhu, J.-X., and Crooker, S.A. (Los Alamos National Laboratory)

The ability to impart magnetic functionality into otherwise non-magnetic materials has exciting prospects for hybrid devices that combine, for example, the optical and electrical properties of semiconductors with additional tuning parameters that couple to magnetic and spin degrees of freedom. We explore these interesting “magnetic proximity interactions” (MPIs) in layered stacks comprising magnetic and non-magnetic 2D materials, suggesting routes to control electron spins in nominally non-magnetic semiconductors, without the use of applied magnetic fields [1].

As recent work has demonstrated, MPIs can be achieved by placing an atomically thin sheet of semiconductor crystal directly atop the clean crystalline surface of a ferromagnet. The intimate proximity of the two materials allows for the electrons in the two materials to “see” each other and interact quantum mechanically. The hybrid structure is held together only by weak van der Waals interactions between the two layers, rather than actual chemical bonds.

These van der Waals heterostructures are assembled layer-by-layer by mechanical stacking of individual 2D crystals of the constituent materials. In sufficiently clean structures having pristine interfaces, MPIs originate in the nanometer-scale coupling between the spin-dependent electronic wavefunctions of the two materials. Historically,

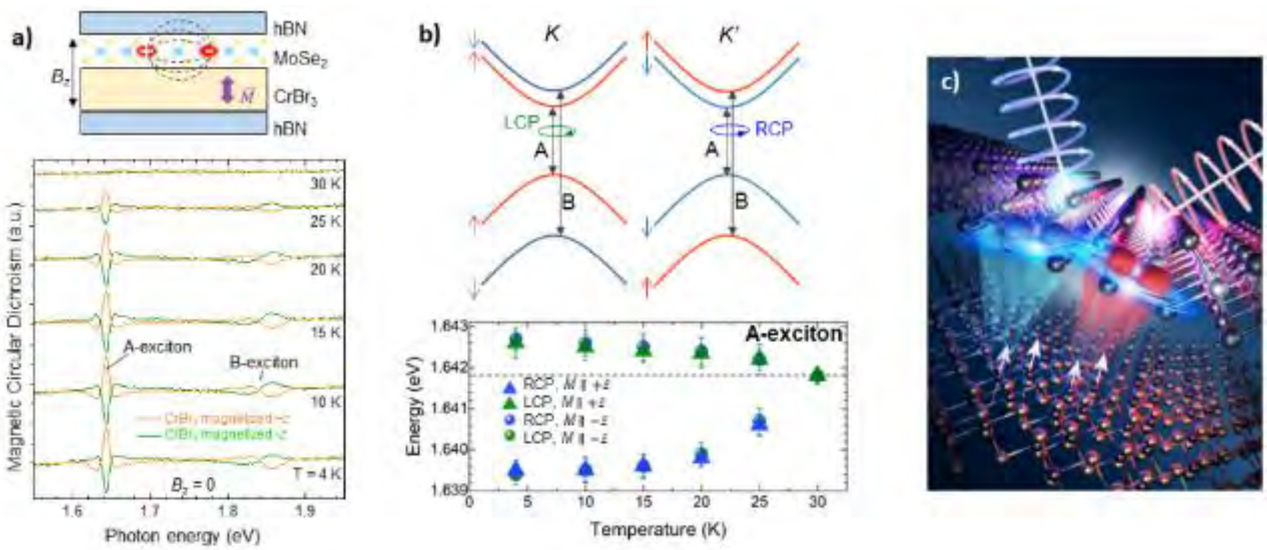


Figure 5 *a) The $MoSe_2/CrBr_3$ structure, and temperature dependent MCD spectra, showing magnetic behavior in the (nonmagnetic) $MoSe_2$, due to ferromagnetism in $CrBr_3$. b) Spin/valley optical transitions in monolayer $MoSe_2$. Energy shifts due to MPIs in K and K′ valleys are asymmetric. c) Depiction of MPIs in a hybrid 2D heterostructure. Spin-up and -down excitons reside in K and K′ valleys (red and blue, respectively), and couple selectively to right- and left circularly polarized light [artwork: Sarah Tasseff, LANL].*

the influence of such MPIs has been regarded as an effective magnetic field acting on the nominally nonmagnetic semiconductor.

This work showed that the widely held picture of effective magnetic fields, while useful, is in fact fundamentally incomplete. Rather, the influence of MPIs is actually quite asymmetric. That is, electrons with spin-up and spin-down are not affected equally and oppositely, as would be the case for a real magnetic field. We used circularly polarized optical spectroscopy of $MoSe_2/CrBr_3$ van der Waals structures to reveal strikingly different energy shifts for spin-up and spin-down excitons (electron-hole pairs) in the $MoSe_2$ semiconductor layer, due to MPIs from the ferromagnetic $CrBr_3$ layer. Importantly, spin-asymmetric MPIs were confirmed by density functional theory (DFT) calculations and were shown to depend sensitively on the spin-dependent hybridization of overlapping electronic bands in the two materials. As such, asymmetric MPIs are likely a general feature of all magnetic/nonmagnetic hybrid van der Waals structures.

An important implication of this work is the possibility of selectively controling specific spin (and also the associated valley) degrees of freedom in 2D semiconductors through rational design of component materials and their stacking arrangement. Such combinations open up new possibilities for combining functionality such as information processing and nonvolatile storage (**Figure 5**).

Acknowledgements

This work was supported by the Los Alamos LDRD Program. The National High Magnetic Field Laboratory is supported by the National Science Foundation through DMR-1157490/1644779 and the State of Florida.

References

1. Choi, J. *et al*., Nature Materials (Dec. 2022); https://doi.org/10.1038/s41563-023-01482-8

Mid-pulse magnet allows continuous measurements of non-linear voltage characteristics in HTS superconductors

Mizzi, C.A., Balakirev, F.F., Maiorov, B. (Los Alamos National Laboratory); Miura, M. (Seikei University, Japan)

Introduction

The surge in studying and improving superconductor performance at very high fields is driven by the need for superconducting magnets capable of supplying higher fields, both for understanding fundamental materials properties as well as for applications such as several world-wide efforts to use high temperature superconductors (HTS) for fusion confinement. The addition of artificial pinning centers has been fundamental in increasing the in-field performance of superconductors [1,2], allowing for the generation of high DC fields with HTS inserts [3].

Experimental

Non-linear current-voltage measurements were performed using an in-house approach based upon field-programmable gate arrays (FPGAs) [4]. The FPGA drives a sequence of DC current pulses into a sample and measures the induced voltage. In real-time, the FPGA checks that the induced voltage remains below a safety threshold set to keep the sample protected during the magnet pulse. We used an improved pattern design on the thin films to minimize the voltages induced by the rapidly changing magnetic fields.

Results and Discussion

In a recent manuscript we increased the superconductor's performance using a novel thermodynamic technique that is effective in conjunction with successful pinning routes [5]. Using the mid-pulse magnet, we have been able to study the evolution of critical current as a function of magnetic field in high critical current samples and tracked the onset of high field fluctuations at different temperatures with high accuracy and reproducibility.

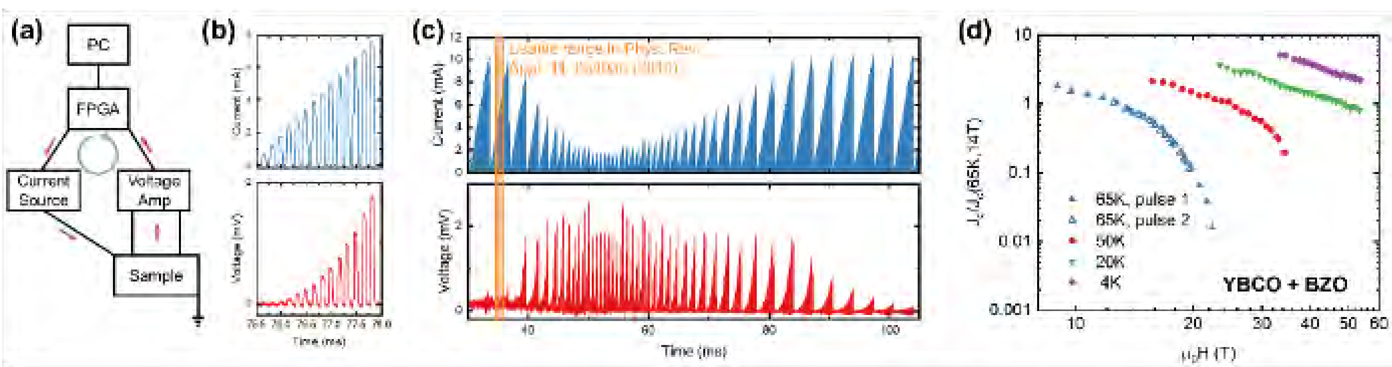


Figure 6 *(a) A FPGA sends a current sequence into a sample and measures the induced voltage, while simultaneously making rapid decisions (response time ~1μs) to protect the sample. (b) A typical non-linear current-voltage sequence used to characterize critical currents in superconductors. (c) A series of non-linear current and voltage sequences measured during a single pulse of the 55T mid-pulse magnet. (d) Critical current of an HTS thin film extracted from single pulses of the 55T mid-pulse magnet at 4 different temperatures. Notice the results at 65K from two different pulses, showing perfect agreement.*

Conclusions

Non-linear electrical transport capabilities at the MagLab PFF have been significantly advanced by adapting measurement methods to the 55T mid-pulse magnet, a capability unique to the PFF, and improvements in sample preparation. Our state-of-the-art equipment allows for the complete determination of the field dependence of the critical current during a single magnet pulse. Consequently, these technical advances reduce the number of magnet pulses required to characterize critical current in superconductors, enabling efficient, high-resolution studies of critical currents for superconducting applications. We thus can determine high field improvements produced by various pinning enhancement routes to engineer materials which will enable high field applications (**Figure 6)**.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. The high magnetic field work was also supported by the Los Alamos National Laboratory LDRD program, project number 20210320ER.

References

1. MacManus-Driscoll, J.L., *et al*., Nature Materials, **3**, 439-443 (2004).
2. Maiorov, B. *et al.*, Nature Materials, **8**, 398-404 (2009).
3. Hahn, S. *et al.*, Nature **570**, 496–499 (2019).
4. Leroux, M., *et al*., Physical Review Applied, **11**, 054005 (2019).
5. Miura, M., *et al*., NPG Asia Materials, **14**, 14:85 (2022).
6. Mizzi, C.A., *et al*., In preparation (2023).

4. Overview – FSU CMP Theory

Our CMS Theory group has been working closely with experimentalists and other theorists within the MagLab and has had fruitful collaborations, domestically and internationally. In the area of two-dimensional materials with van der Waals stacking, both twisted bilayer graphene (TBG) and transition metal dichalcogenides (TMD) have been addressed. A Lifshitz transition (an abrupt change in the topology of the Fermi surface) in TBG was predicted and later detected. In moiré TMD bilayers, electron interactions as a function of disorder over a wide temperature range were fit through the metal-insulator transition in a DMFT framework. The novel electronic behaviour in 2D van der Waals TMD plasmonic origami materials, as measured by STM, were modelled with charge and spin ordering considered. A Monte Carlo analysis of the pyrochlore magnet $Ce_2Zr_2O_7$ revealed further evidence of QSL behavior, and the computational strategies developed are applicable to a broad range of magnetic systems. Considering general free fermion systems, the entanglement entropy and the intrinsic complexity are interrelated, shedding light also on thermalization in quantum systems.

Unusual magnetotransport in twisted bilayer graphene from strain-induced open Fermi surfaces

Wang, X.W. (FSU, MagLab); Finney, J. (Stanford U); Sharpe A.L. (Sandia National Lab); Rosenbach L.K. (Stanford U); Hsueh C.L. (Stanford U); Watanabe K. (NIMS, Japan); Taniguchi T. (NIMS, Japan); Kastner M.A. (Stanford U, MIT), Vafek O. (FSU, MagLab, Physics), Goldhaber-Gordon D. (Stanford U)

Introduction

Moiré materials, such as the twisted bilayer graphene (TBG), are van der Waals materials engineered by stacking two-dimensional layers with a small lattice mismatch or a small twist. A small amount of heterostrain is introduced in the manufacturing process and is greatly amplified on the moiré superlattice scale. It is widely believed to play a crucial role in reshaping the electronic band structure as well as stabilizing various electronic phases of matter. In a recent experimental work by some of the coauthors, it was discovered that unintentionally strained off-magic-angle TBG device exhibit non-saturating magnetoresistance (MR) over a broad electron filling range. This calls for a systematic theoretical investigation of heterostrain effects on magnetotransport.

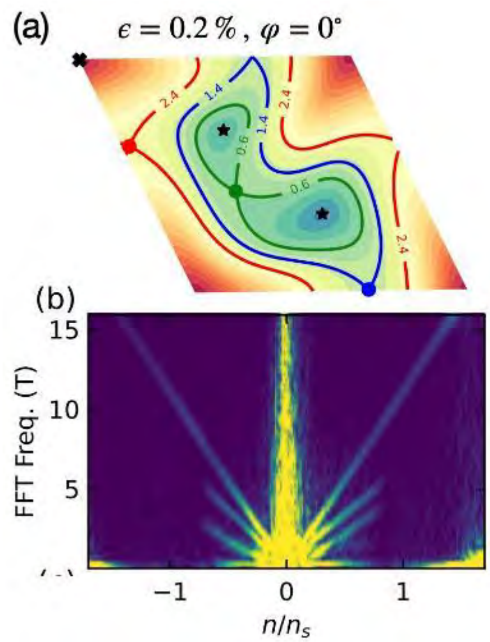


Figure 1. (a) Contour map of calculated band structure due to uniaxial heterostrain, revealing three energetically-split vHs. (b) Lifshitz transition revealed from quantum oscillation measurements.

Results and Discussion

In this combined theoretical and experimental work, we addressed the impact of uniaxial heterostrain on both the electronic band structure and magnetotransport in off-magic-angle TBG devices, not only addressing the microscopic origin for the non-saturating longitudinal MR, but also revealing a Lifshitz transition that is subsequently discovered in the quantum oscillation regime.

We showed that a small amount of uniaxial heterostrain (~0.2%) has strong effects on the band structure, lifting the energetic degeneracies of the three van Hove points (vHs) of a given band. As illustrated in **Figure 1(a)**, one of the vH (green dot) moves down in energy and marks a Lifshitz transition separating two small Fermi pockets surrounding the two Dirac points (DPs, black stars) and a larger Fermi pocket enclosing both DPs. This Liftshitz transition is subsequently confirmed from quantum oscillation measurements as shown in **Figure 1(b)**. The two remaining vHs (blue and red) bound a broad filling range of open Fermi surfaces, which are quasi-1D conducting channels along the shortest moiré triangular lattice bond direction.

To determine heterostrain's impact on the magnetotransport, we carried out a semiclassical Boltzmann equation calculation and treated magnetic field **B** non-perturbatively using the method of characteristics. We showed that the longitudinal MR exhibits a non-saturating $\mathbf{B}^2$ dependence from open Fermi surfaces. As illustrated in **Figure 2**, with a constant relaxation time approximation, we obtain very good agreement between the theory and experiment over the entire narrow band filling range, thereby confirming the crucial role of uniaxial heterostrain in TBG devices. Furthermore, we showed that the principal transport axis rotates dramatically with filling despite an absence of electronic interactions. This calls for more careful studies to dissect interaction vs. uniaxial heterostrain induced phenomena in moiré electronic materials.

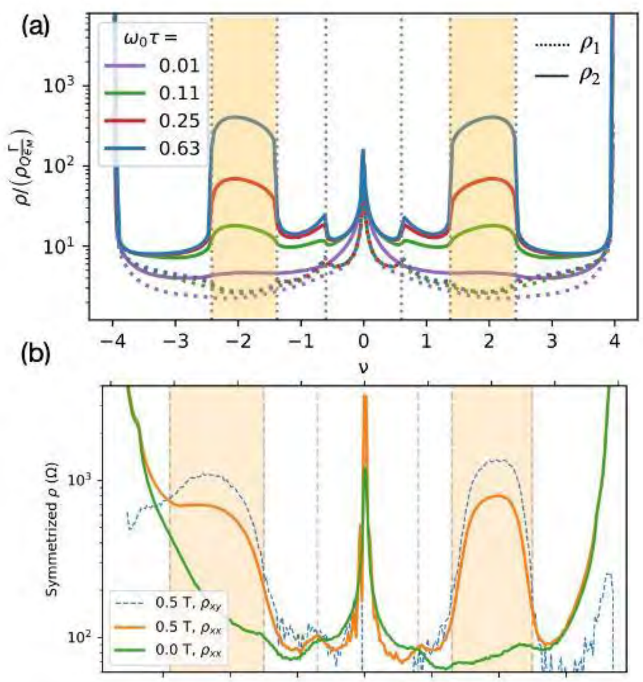


Figure 2. *Longitudinal MR from theory (a) and experiment (b) show good agreements over the entire filling range of TBG narrow band.*

Conclusions

Our work addressed the impact of uniaxial heterostrain on the band structure and magnetotransport in off-magic-angle TBG devices. The work showcases the important role which heterostrain plays in large-unit-cell moiré electronic materials and poses a tantalizing question on strain engineering of such devices to achieve effects which would be impossible in regular solids due to structural instabilities.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. In addition, we acknowledge support from the following funding sources: Gordon and Betty Moore Foundation's EPiQS Initiative Grant GBMF11070; U.S. Department of Energy, Office of Science, Basic Energy Sciences, Materials Sciences and Engineering Division, under contract DE-AC02-76SF00515; Gordon and Betty Moore Foundation's EPiQS Initiative through grant GBMF3429 and grant GBMF9460; Ross M. Brown Family Foundation; U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525; JSPS KAKENHI (Grant Numbers 19H05790, 20H00354 and 21H05233); National Science Foundation under award ECCS-2026822.

References

1. Wang, X.Y. *et al*., arXiv:2208.08204 (2022).

Disorder-dominated quantum criticality in moiré bilayers

Tan, Y. (FSU, Physics), Tsang, P.K.H. (FSU, Physics) and Dobrosavljević, V. (FSU, Physics)

Introduction

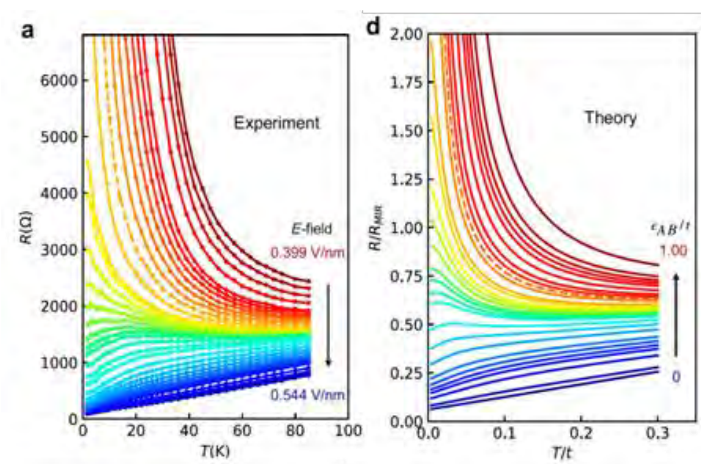


Figure 3. *Transport behavior across the metal-insulator transition at integer band filling. All the qualitative features found in experiments (left panels) are captured by our theory (right panel).*

The field of the metal–insulator transitions (MITs) is living a veritable revolution, largely thanks to the recent discovery of moiré bilayer materials of various kinds, which allows unprecedented control over the physical properties of the electron systems at hand. A particularly intriguing situation is found in moiré transition metal dichalcogenide (TMD) bilayers. Here, genuine Mott–Hubbard physics was theoretically predicted and observed close to half filling (f = 1, one electron per moiré cell). The same systems, on the other hand, demonstrated very different behavior in a regime far away from half-filling (f = 2, two electrons per moiré cell), displaying many similarities to other examples of disorder-dominated MITs. Here propose [1] a minimal theoretical model describing the interplay of interactions and disorder, which is able to capture all the universal aspects of quantum criticality, as observed in experiments performed on several devices.

Theoretical

Motivated by the experimental setup in moiré TMD bilayers, we consider [1] a two-band model of electrons at integer band filling, in presence of moderate disorder, and where interaction effects are represented by the coupling of carriers to a bosonic field. This model is solved using the CPA-DMFT self-consistent theory of interactions and disorder, which can be viewed as the minimal model for disorder dominated MITs in (moderately) interacting electron systems. It describes how certain interaction effects are generally enhanced in presence of disorder, leading to strong disorder renormalization, which in some cases also triggers polaron formation.

Results and Discussion

In this work, we presented a detailed solution of our model, which due to its simplicity can be analytically solved in several limits, while the corresponding numerical solution can be obtained with any desired accuracy. As in the experiment, the theoretical curves exhibit linear-T behavior at low temperatures on the metallic side of the transition. The evolution of the slope (TCR) with external field exactly matches the experimentally observed trends, as can be seen from **Figure 3**. The slope A initially increases upon application of the electric field, but at larger fields, the trend reverses, recovering the "Mooij correlation" behavior expected when disorder becomes dominant. A direct analysis of the resistivity curves (**Figure 3**), both experimental and theoretical, clearly indicates a continuous (i.e., quantum critical) character of the MIT. Remarkably, all the qualitative trends and the values of the critical exponents predicted by our model precisely match the experimental findings.

Conclusions

In this work we were able – for the first time – to provide a convincing theoretical description of this mysterious regime and thus explain the spectacular experiments being done as we speak, including many at NHMFL/FSU. This achievement may very well be the first step in charting an entirely new pathway in directing upcoming scientific efforts, by providing a novel conceptual perspective on what goes on when electrons just happen to decide to begin their motion in quantum materials.

Acknowledgements

This work was supported by grant number NSF/ DMR-1822258 (V. Dobrosavljević)*, and by the National High Magnetic Field Laboratory through NSF/DMR-1644779 and the State of Florida.*

References

1. Tan, Y. *et al.,* **Nature Communications**, **13** (1), 7469 (2022).

Probing Correlated States with Plasmonic Origami

Michał, P. (University of California, Berkeley, Physics) and Lewandowski, C. (FSU, Physics and NHMFL)

Introduction

The moiré materials paradigm of combining 2D weakly interacting materials to yield strongly interacting systems is at the forefront of the current condensed matter research. Moiré systems exhibit a wide range of phenomena ranging from unconventional superconductivity to various interaction-induced (correlated) resistive states. Identification of the microscopic nature of the correlated states in the moiré systems is, however, difficult, as it relies on the interpretation of transport behavior or scanning-tunneling microscopy measurements. To that end, despite the intense experimental and theoretical efforts, the exact flavor of the ground states is often not certain; thus, new tools to help identify them and complement existing results are in high demand. One such new approach, and the subject of this research, can be based on the study of plasmons, the collective charge excitations of interacting electron systems, as well as the overall properties of the system's dynamical dielectric response. A defining characteristic of the moiré materials making their dielectric response distinct from that of conventional condensed matter systems is the large effective lattice constant (~10nm). The large unit cell size makes microscopic variations of the electric fields on the scale of the moiré period a significant effect, in contrast to the ordinary crystals with lattice constants ~0.1nm necessitating consideration of local-field effects - i.e., treatment of screening effects accounting for the variation of the electric field within the unit cell. This phenomenon of intracell charge fluctuations can, in principle, yield new branches of collective excitations that arise from "folding" of the conventional plasmon resonance on momentum scales, which in moiré materials is smaller, where crystal effects (here moiré lattice) become relevant.

Results and Discussion

We showed [1] that the "origami" structure of the folded plasmon resonances can allow for direct characterization of the microscopic nature of the correlated phases and their underlying ground states. While our findings are applicable to any moiré material, we focus on heterobilayer moiré transition metal dichalcogenides. Experimentally these systems exhibit interaction-induced insulating states at fractional and integer fillings consistent with generalized Wigner crystals pinned to the effective moiré lattice sites (**Figure 4(a)**). Specifically, when a Wigner crystal forms on top of the moiré lattice, the effective lattice constant of the crystal increases again. In momentum space, this

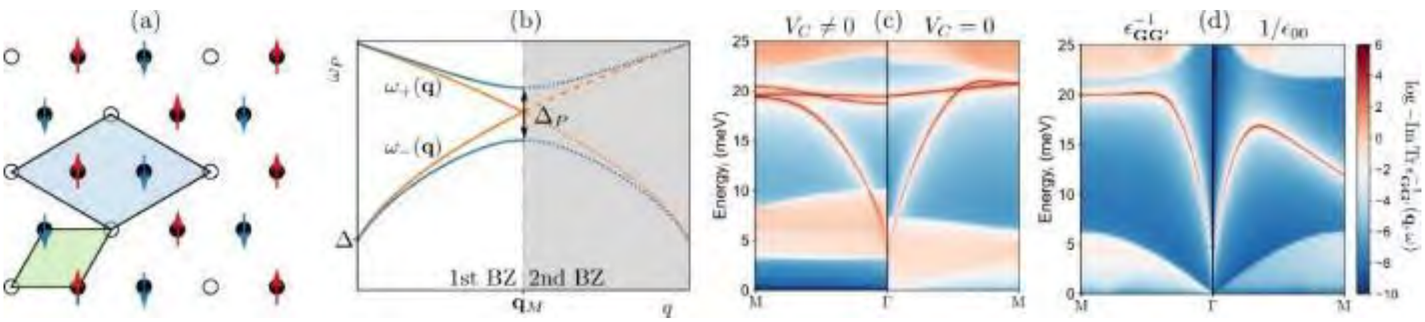


Figure 4*. With a correlated ground state, the moiré unit cell (green) expands to a larger effective cell (blue) that takes into account charge and spin ordering. An example is given for filling ν = 2/3 and antiferromagnetic state. (b) Schematic depiction of plasmon folding when crystal unit cell is extended. (c) The appearance of a correlated state introduces multiple plasmon branches (bright red feature) and opens up gaps both between plasmon bands as well as in the particle-hole continuum. (d) The inclusion of local field effects (left panel) drastically modifies plasmon dispersion even in the absence of the correlated states as compared to when such effects are neglected (right panel).*

translates to a "folding" of a plasmon mode, giving rise to a new plasmon (**Figure 4b**). There are several competing candidate ground states for these insulating states, and we show how the different candidates can result in drastically different dynamical responses (**Figure 4c**).

In our work, we show the necessity of including local-field effects (**Figure 4d**) in the calculation of the dynamical response, which future works could explore further. For example, the investigation of real space patterns of charge density oscillations could be observed using scanning near-field optical microscopy. Moreover, the presence of additional plasmon bands allows for a non-trivial plasmon "wavefunction" (in analogy to electron wavefunctions in crystals), which could allow the "origami" plasmons to exhibit non-trivial topological.

Acknowledgements

M.P. was supported by the Quantum Science Center (QSC), a National Quantum Information Science Research Center of the U.S. Department of Energy (DOE). M.P. received additional fellowship support from the Emergent Phenomena in Quantum Systems program of the Gordon and Betty Moore Foundation. C.L. was supported by start-up funds from Florida State University and the National High Magnetic Field Laboratory. The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR- 1644779 and the state of Florida.

References

1. Papaj, M. and Lewandowski, *C.* arXiv: 2212.01367 (2022) (under review in *Science Advances*)

Sleuthing out spin liquidity in the dipole-octupole pyrochlore magnet $Ce_2Zr_2O_7$

A. Bhardwaj (NHMFL/ FSU Physics), S. Zhang (University of California Los Angeles), H. Yan (Rice University, Texas), R. Moessner (Max Planck Institute for the Physics of Complex Systems, Dresden, Germany), A. Nevidomskyy (Rice University, Texas), H.J. Changlani (NHMFL/ FSU Physics)

Introduction

The search for quantum spin liquids -- topological magnets with fractionalized excitations -- has been a central theme in condensed matter and materials physics. While theories about the liquids' location are plentiful, tracking them down in materials has turned out to be tricky because of the difficulty in diagnosing experimentally a state with only topological, rather than conventional, forms of order. In this work, we analyzed recent thermodynamic and neutron scattering experiments on the pseudo spin-1/2 pyrochlore $Ce_2Zr_2O_7$ (CZO) using a combination of finite temperature Lanczos, Monte Carlo and spin dynamics calculations to identify its microscopic effective Hamiltonian [1]. The

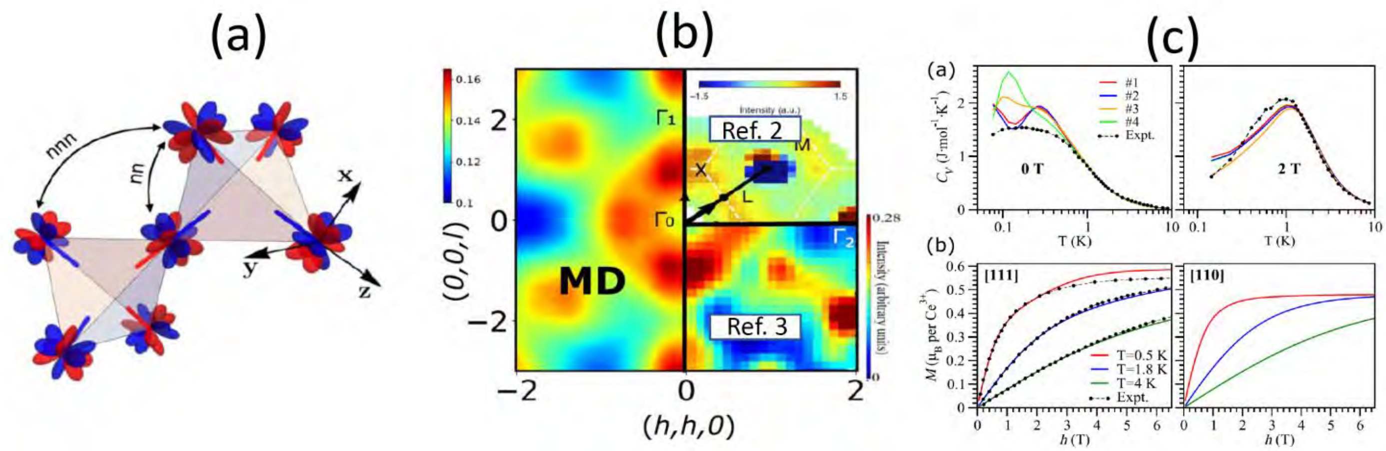


Figure 5. *(a) Schematic of dipole-octupole doublets on the pyrochlore lattice with nearest neighbor (nn) and next nearest neighbor (nnn) interactions. (b) Energy integrated spin molecular dynamics (MD) calculations in the (h,h,l) plane as compared to previous inelastic neutron scattering experiments [2,3]. (c) Numerically computed thermodynamic properties (specific heat and magnetization in two field directions) as compared to experiment [2]. Four Hamiltonian parameter sets are shown for the case of the specific heat (top panels).*

magnetic properties of CZO emerge from interactions between cerium (Ce^{3+}) ions, whose ground state doublet (with $J = 5/2, m_J = \pm 3/2$), with a dipole-octupole character, arises from strong spin orbit coupling and crystal field effects. The Hamiltonian parameter values we obtained suggest a previously theorized but unobserved exotic phase, a π-flux U(1) QSL, and it allows us to predict its response to applied magnetic fields..

Results and Discussion

Figure 5(a) schematically depicts a pyrochlore system with dipole-octupole doublets. These are unconventional in the sense that their local y-component does not couple to neutrons or an applied magnetic field. The symmetry of the pyrochlore lattice constrains what the form of the effective pseudo spin-1/2 interacting Hamiltonian can be, leaving us to determine what the couplings are. **Figure 5(b)** shows a comparison of our Monte Carlo dynamics results, obtained with our numerically determined Hamiltonian, with previous inelastic neutron scattering experiments [2,3] (from groups at Rice and McMaster). The overall agreement is very good. We find multiple parameter-sets of comparable quality – **Figure 5(c)** shows that they were obtained by fitting thermodynamic data (specific heat and magnetization), both in zero and applied magnetic fields.

Conclusions

We have presented a systematic theoretical analysis of experimental data [2,3] for the dipole-octupole pyrochlore magnet CZO. Our work determined the Hamiltonian parameters which can further be used to predict its behavior under different conditions. Within the framework of previous mean field results, combined with the observed absence of ordering at low temperatures, we provide evidence for quantum spin liquidity in this compound. Our general strategies for Hamiltonian determination are broadly applicable to other magnetic systems.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. H.J.C. was supported by NSF CAREER grant DMR-2046570. We thank the Research Computing Center (RCC) and Planck cluster at FSU for computing resources.

References

1. Bhardwaj, *et al., npj Quantum Materials*, **7**, 1, 51 (2022).
2. Gao, *et al., Nature Physics*, **15**, 1052–1057 (2019).

3. J. Gaudet, *et al., Phys. Rev. Lett.* ***122***, 187201 (2019).

Complexity, entanglement, and thermalization in fermion systems

Kun Yang (FSU Physics, NHMFL), A. Volya (FSU Physics), and Ken K. W. Ma (NHMFL)

Introduction

Statistical mechanics of isolated quantum systems is a topic of tremendous current interest. In particular, the understanding of entropy in a pure state and thermalization in isolated systems are two foundational questions in quantum statistical mechanics. It is common to use the entanglement entropy to quantify the entropy of a pure state, which requires a bipartition of the system. Meanwhile, it is believed that entropy should be a measure of the intrinsic complexity of a system or a state. This motivates us to identify a possible measure for such an intrinsic complexity. For understanding thermalization in isolated quantum systems, the eigenstate thermalization hypothesis (ETH) has provided important insights. Nevertheless, the discovery of many-body scar states demonstrates the possibility of violating the ETH. A common (although not always accurate) diagnostic of such scar states is their sub-extensive entanglement entropy. It is tempting to quantify the number of such "atypical states" in some paradigmatic systems, such as weakly interacting fermion systems.

Results and Discussion

In Reference [1], we suggest that Kolmogorov complexity provides a measure of the intrinsic complexity of free fermion systems. This is supported by showing that the scaling behavior of system size in the Kolmogorov complexity agrees with the scaling law of the entanglement entropy of the system. The connection allows us to quantify the number of states which are typical (having extensive entanglement entropy) and atypical (having sub-extensive entanglement entropy) in free fermion systems in arbitrary dimensions.

In Reference [2], we consider fermion systems with weak two-body interaction. Using the results from embedded random matrix theory and tools from quantum information theory, we demonstrate that the probability of an eigenstate of the system having sub-extensive entanglement entropy drops double exponentially of the system size. In other words, all eigenstates of the system in the thermodynamic limit have entanglement entropy that scale with the system size. This provides a quantitative support to the strong version of the ETH.

Conclusions

We have demonstrated theoretically that entanglement entropy and the intrinsic complexity of free fermion systems are interrelated. We also show that weakly interacting fermion system does not have eigenstates with low entanglement entropy in the thermodynamic limit. Our results shed new light on understand complexity, entanglement, and thermalization in quantum systems.

Acknowledgements

This research is supported by the National Science Foundation Grant No. DMR-1932796, and by the U.S. Department of Energy Office of Science under Award Number DE-SC0009883. Most of this work was performed at the National High Magnetic Field Laboratory, which is supported by National Science Foundation Cooperative Agreement No. DMR-1644779, and the State of Florida.

References

1. Ma, K. K. W., *et al*., Physical Review B **106**, 035143 (2022).
2. Ma, K. K. W., *et al.*, Physical Review B **106**, 214314 (2022).

4.4 FSU Biology/ FSU Chemistry

Overview

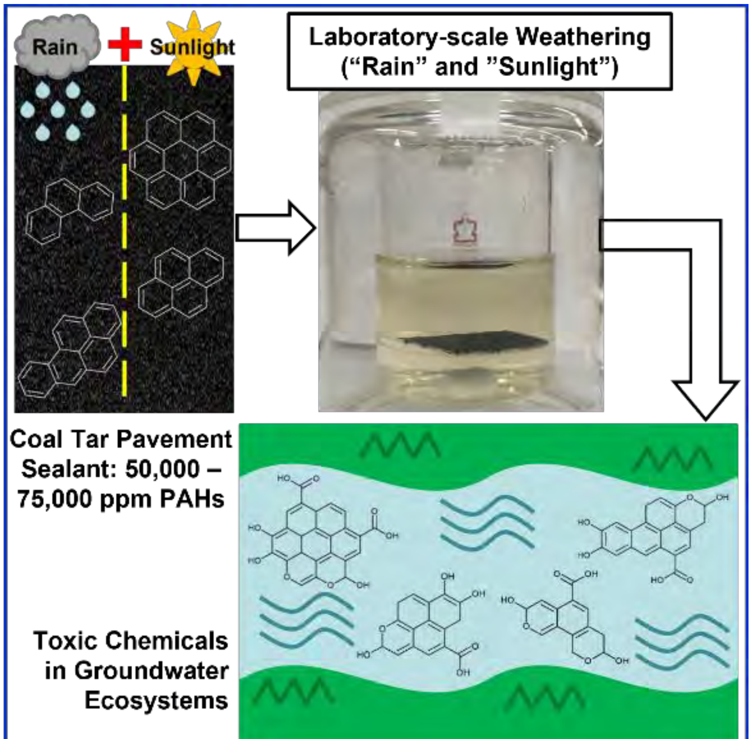
Coal tar pavement sealant can protect roads and parking lots from degradation. However, after exposure to laboratory-simulated sunlight, FT-ICR MS identified tens of thousands of compounds in the weathered sealant and the water fractions. Water fractions were tested for toxicity, which revealed that coal tar sealant can transfer toxic compounds into groundwater and marine environments. [1] The ICR group also contributed nearly a third of the recently compiled Blood Proteoform Atlas, including posttranscriptional and posttranslational modifications. [2] The EMR group developed two new families of biradicals for improved Magic-Angle Dynamic Nuclear Polarization, thereby significantly increasing NMR sensitivity for otherwise inaccessible biological samples. [3] Yan-Yan Hu *et al.* used high-resolution ^{17}O solid-state NMR (ssNMR) to distinguish local O structural environments and *in situ* ^{17}O ssNMR to monitor their evolution during electrochemical cycling. Combined with DFT calculations, the results reveal that O atoms at the stacking faults participate more actively in redox reactions with higher reversibility compared with O atoms in stacking-fault-free Li_2MnO_3. Robert W. Schurko *et al.* used a combination of ^{35}Cl, 14N, and ^{2}H SSNMR to investigate the fingerprinting and identification of active pharmaceutical ingredients (APIs) in crystalline and dosage forms thereby providing opportunities for structural modeling with NMR crystallographic methods and providing new pathways to rational design of new solid forms of APIs and nutraceuticals.

Pavement Sealant Leaches Environmental Contaminants

Glattke, T.J. (Dept. Chem. FSU, NHMFL); Chaćon-Patiño, M.L. (NHMFL); Hoque, S.S. (FAMU-FSU CoEng); Ennis, T.E. (City of Austin, Texas); Greason, S. (SiteLab Corp.); Marshall, A.G. (Dept Chem. FSU, NHMFL); Rodgers, R. P. (NHMFL)

Coal tar pavement sealant can protect roads and parking lots from degradation. However, these sealants are known to contain high concentrations of carcinogenic polycyclic aromatic hydrocarbons (PAHs). In this user collaboration, coal tar sealant was submerged in water and exposed to laboratory-simulated sunlight. The weathered sealant and water-soluble fraction were analyzed using ultrahigh-resolution Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS). FT-ICR MS assigned tens of thousands of compounds in the weathered sealant and the water fractions.

The FT-ICR data find that coal tar pavement sealants are oxidized by sunlight into toxic water-soluble compounds (oxy-PAHs) that can pollute waterways. Water fractions were tested for toxicity, which revealed that coal tar sealant can transfer toxic compounds into groundwater and marine environments.



Coal tar pavement sealant contains 50,000 to 75,000 ppm of carcinogenic polycyclic aromatic hydrocarbons (PAHs). Weathering by sunlight and rain can contaminate natural waterways through oxidation of the PAHs contained in the pavement sealant. Image Credit: Taylor Glattke, MagLab

Figure 1. *Coal tar pavement sealant contains 50,000 to 75,000 ppm of carcinogenic polycyclic aromatic hydrocarbons (PAHs). Weathering by sunlight and rain can contaminate natural waterways through oxidation of the PAHs contained in the pavement sealant.*

FT-ICR MS and toxicity testing provide evidence that coal tar-based sealants should be avoided. However, testing to determine toxic effects on humans requires additional research on human cell lines, research that is now underway in an ongoing collaboration with MIT (**Figure 1**).

Acknowledgements

A portion of this work was performed at the National High Magnetic Field Laboratory ICR User Facility, which is supported by the National Science Foundation Division of Chemistry through Cooperative agreement no. DMR-1644779 and the State of Florida. The authors thank Huan Chen for assistance with the performance of the Microtox bioassay experiments.

References

1. Glattke, T.J.., *et al*., Environmental Science and Technology, **56**, 12988-12998 (2022).

The Blood Proteoform Atlas: A Reference Map of Proteoforms in Human Blood Cells

Rafael D. Melani (Nortwestern U.), Vincent R. Gerbasi (Northwestern U.), Lissa C. Anderson (NHMFL), Kelleher, N.L. (Northwestern U.), et al.

Introduction

Nearly all our cells contain the same DNA blueprint, yet humans are a complex amalgamation of ~200 different cell types of various functions. Mass spectrometry-based protein analysis (proteomics) has cemented the linkage between protein biology and cellular phenotype. However, previous efforts to compositionally map proteins (PTN) across different cell and tissue types do not capture posttranscriptional and posttranslational processing. These dictate the distinct molecular ***proteoforms*** active in cells.

Melani *et al*. compiled a **Blood Proteoform Atlas**, a clarified map of ~30,000 unique proteoforms (PFR) as they appear in 21 different blood cell types. The **MagLab's 21 tesla FT-ICR mass spectrometer** contributed nearly a third of the atlas's proteoforms while comprising ~15% of the total instrument time devoted to what is now the largest "**top-down**" proteomics study ever conducted. This patient-specific, cell type-specific, and proteoform-specific data enabled the discovery of 24 biomarkers for liver transplant rejection. This advancement marks the beginning of a new era for more precise study of proteins in specific cells—**the Human Proteoform Project**. As the atlas grows, discoveries about fundamental biology, disease, aging and new therapeutics will accelerate.

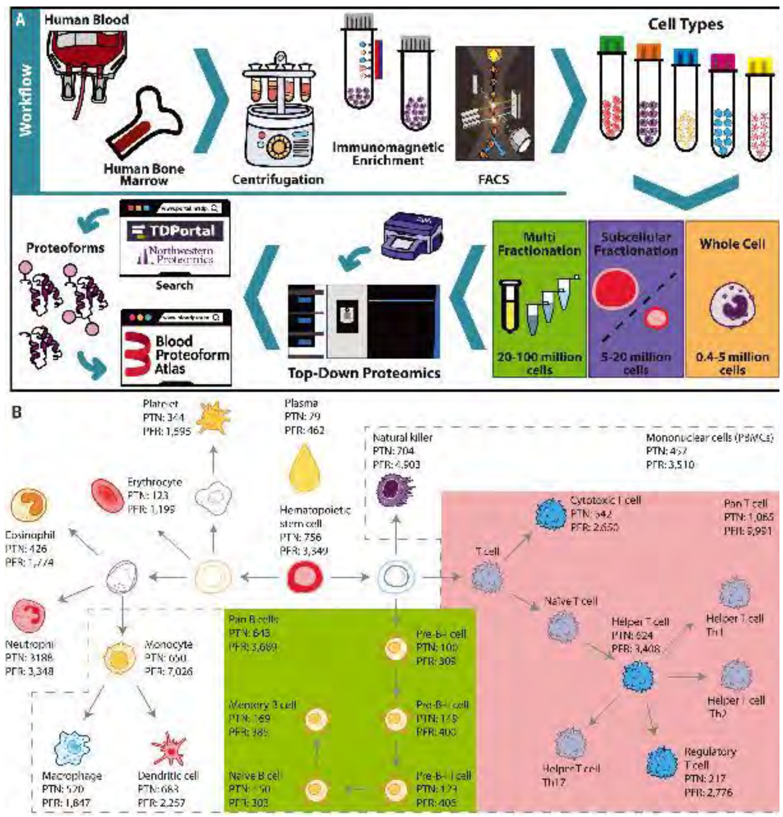


Figure 2. *Workflow for the Human Proteoform Project*

Through employment of state-of-the-art instru-mentation, including the **MagLab's 21T FT-ICR mass spectrometer**, proteoforms were identified intact in a form of "**top-down**" analysis rather than cutting them into small pieces (as is standard practice). This advancement realizes a truly molecular-level understanding of cell type and marks the beginning of a new era for more precise study of proteins in specific cells— the Human Proteoform Project. High-throughput identification of proteoforms from complex biological samples requires instrumentation capable of high mass resolving power, mass accuracy, sensitivity, and efficiency.

Workflow for the Human Proteoform Project (**Figure 2**) separates cell types found in blood. Proteoforms are identified using top-down proteomics enabled by the uniquely high mass resolving power, mass accuracy, sensitivity, and efficiency of the MagLab's 21T FT-ICR mass spectrometer. Proteoforms identified in human blood are deposited in the Blood Proteoform Atlas (BPA) website.

Reference

1. Melani, R.D., Gerbasi, V.R., Anderson, L.C., Sikora, J.W., Toby, T.K., Hutton, J.E., Butcher, D.S., Negrão, F., Seckler, H.S., Srzentić, K., Fornelli, L., Camarillo, J.M., LeDuc, R.D., Cesnik, A.J., Lundberg, E., Greer, J.B., Fellers, R.T., Robey, M.T., DeHart, C.J., Forte, E., Hendrickson, C.L., Abbatiello, S.E., Thomas, P.M., Kokaji, A.I., Levitsky, J., & Kelleher, N.L. (2022) The Blood Proteoform Atlas: A reference map of proteoforms in human hematopoietic cells. **Science,** 375 (6579), 411-419. https://doi.org/10.1126/science.aaz5284

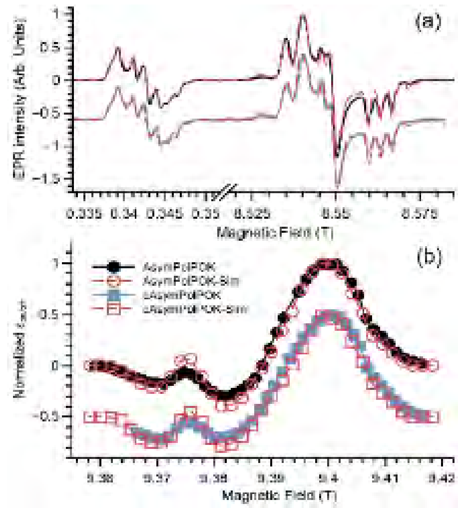


Figure 3. *(a) High Field EPR and (b) MAS-DNP NMR field profiles of (c-)AsymPol-POK. Red lines correspond to the simulated properties.*

Highly efficient polarizing agents for high-field MAS-DNP NMR

R. Harrabi, S. Paul, S. Hediger, D. Lee, G. De Paepe (CEA, Grenoble, France), T. Halbritter, S. Sigurdsson (U. Iceland, Reykjavik, Iceland), J. van Tol, F. Mentink-Vigier (CIMAR, NHMFL, USA)

Introduction

Magic-Angle Spinning Dynamic Nuclear Polarization (MAS-DNP) is a very efficient way to overcome the sensitivity limitations observed with conventional solid-state NMR (ssNMR), expanding the nature and diversity of the samples that can be studied at the atomic scale. MAS-DNP uses dopants under the form of tailored organic molecules to generate nuclear spin hyperpolarization, which boosts NMR sensitivity. Under MAS, the best dopants are biradicals, which must have relatively stringent properties, especially for use at high magnetic fields. We developed two new families of biradicals: the AsymPols and PyrroTriPols. AsymPol-POK is highly efficient for biomolecular applications at 600MHz/14.1T, even when the sample has a high ^{1}H concentration.[1] PyrroTriPols are effective for hyperpolarization at 800MHz/18.8T and fast MAS conditions.[2]

Experimental

Most of the experiments in this study were conducted at the MagLab on the 14.1T (600MHz) MAS-DNP NMR spectrometer and the multifrequency quasi-optical EPR spectrometer (operating at 240GHz).

Results and Discussion

Based on a combination of numerical simulations and experimental investigations, we have designed and explained the performance of the two biradical families. Using DFT, we predicted the geometries and magnetic properties of the AsymPols, which are revealed by the high-field EPR (**Figure 3**, **top**). These data are used as input to simulate their MAS-DNP properties[1] with a unique code written in-house.[3] The excellent agreement between the simulations and experimental results (**Figure 3, bottom**) demonstrate that these biradicals are insensitive to ^{1}H concentration, unlike previously developed biradicals. We then tackled biradicals with properties that are more challenging to predict, made with two different paramagnetic species, a trityl and a nitroxide, and are known to be very efficient for MAS-DNP at high field, notably TEMTriPol-I[4] (**Figure 4**, **top**). Such biradicals have significant drawbacks, as their electron-electron couplings are hard to control, due to difficulties in synthesizing a rigid

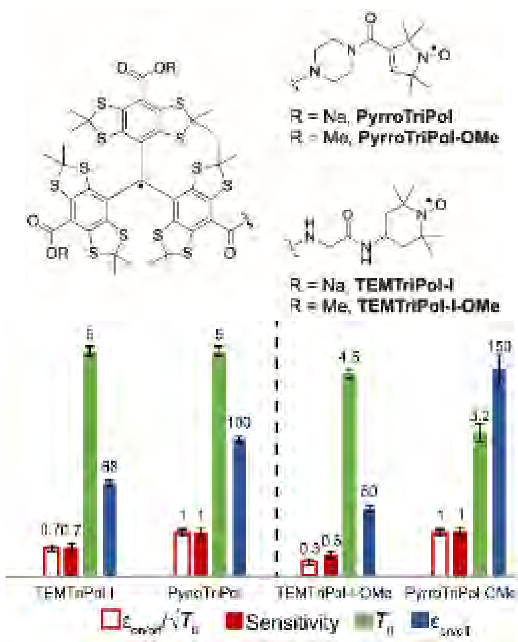


Figure 4. *Top: Structures of PyrroTriPol (-OMe) and TEMTriPol-I(-OMe). Bottom: efficiency of the molecules, returned sensitivity ($\epsilon_{on/off}/\sqrt{T_B}$) and actual sensitivity ($S_{on}/\sqrt{T_B}$), buildup times (T_B) and enhancement $\epsilon_{on/off}$ measured at 800MHz/18.8T and 40kHz MAS rate.*

bridge between the two radicals. Using DFT and molecular mechanics, we designed new biradicals, the PyrroTriPols (**Figure 4**, **top**), with a rigid bridge that enables control of this coupling.[2] This biradical outperforms most current biradicals, (**Figure 4**, **bottom**); it is very efficient MAS-DNP NMR of both biological samples and materials science applications at very high fields and fast MAS frequencies (*e.g.*, 18.8T and 40kHz). Furthermore, they can be prepared in large quantities, unlike TEMTriPol-I, which ensures a wider availability to the scientific community.

Conclusions

Our new methodologies, which are available for users at the MagLab, hold much promise for the expansion of MAS-DNP NMR applications, opening possibilities for characterization of molecular-level structure and dynamics for many new materials and biological samples that cannot otherwise be characterized at the atomic scale with solid-state NMR.

Acknowledgements

The NHMFL is supported by the NSF through NSF/DMR-1157490/1644779 and the State of Florida. French National Research Agency (CBH-EUR-GS and ARCANE ANR-17-EURE-0003, Glyco@Alps ANR-15-IDEX-02, and ANR-16-CE11-0030-03) and the European Research Council Grant ERC-CoG-2015 No. 682895. Icelandic Research Fund, grant No. 173727, and the University of Iceland Research Fund (S.Th.S). T.H. thanks the Deutsche Forschungsgemeinschaft (DFG) for a postdoctoral fellowship (414196920). The 14.1T DNP system at NHMFL is funded in part by NIH S10 OD018519 (magnet and console), NSF CHE-1229170 (gyrotron), and NIH P41 GM122698.

References

1. Harrabi, R.; Halbritter, et al. *Angew Chem Int Ed* **2022**, *61* (12).
2. Halbritter, T.; Harrabi, R. et al. ChemRxiv October 24, 2022.
3. Mentink-Vigier, F. et al. *J. Magn. Reson.* **2021**, *329*, 107026.
4. Mathies, G. et al. *Angew. Chemie* **2015**, *127* (40), 11936–11940.

Understanding Oxygen Redox in Battery Cathodes Using ^{17}O Solid-State NMR

Li, X.; Li, X.; Monluc, L.; Chen, B.; Tang, M.; Chien, P.-H.; Hung, I.; Gan, Z.; Urban, A. (Columbia U., MSE); Hu, Y.-Y. (FSU, Chemistry)

Introduction

Anionic redox chemistry, in particular, oxygen redox reactions, yield anomalous capacity and can significantly increase the energy density of layered Li-rich transition metal oxide cathodes. However, the mechanisms behind O redox reactions in these cathode materials are still under debate, partly due to the challenges in directly observing O atoms and following associated changes in their local structures during electrochemical cycling. This project uses high-resolution ^{17}O solid-state NMR (ssNMR) to distinguish local O structural environments and *in situ* ^{17}O ssNMR to monitor their evolution during electrochemical cycling. Combined with DFT calculations, the results reveal that O atoms at the stacking faults participate more actively in redox reactions with higher reversibility compared with O atoms in stacking-fault-free Li_2MnO_3.[1]

Experimental

To investigate the local O environments in a representative battery cathode material, Li_2MnO_3, we performed projection magic-angle-turning phase-adjusted-spinning-sidebands (pjMATPASS) ^{17}O ssNMR on ^{17}O-enriched Li_2MnO_3, which delivers the ^{17}O NMR spectrum with the highest resolution (**Figure 5**). In addition, ^{17}O-enriched Li_2MnO_3 cathodes were assembled into full battery cells. Both *ex-situ* and *in-situ* ssNMR were performed on Li_2MnO_3 at different states of charge. These experiments were carried out on the 830-MHz spectrometer at the MagLab using a custom-made 3.2mm NMR probe that allows in-field charging of the batteries and simultaneous NMR detection. Different samples with varied degrees of stacking faults were prepared, and their electrochemical performance was correlated with O redox activities.

Results and Discussion

Based on the high-resolution ^{17}O NMR spectra, we were able to identify O in different structured environments (4i & 8j in **Figure 5a, b**) *vs.* those at stacking faults (6c). Stacking faults (SFs) often occur along the *c* direction and stacking of the $Li_{1/3}Mn_{2/3}$ with a $P3_112$ space group has been proposed as the model for describing SFs in Li_2MnO_3 **(Figure 5c, d)**. *Ex-situ* and *in-situ* ^{17}O NMR carried out on Li_2MnO_3 at different states of charge reveal that O at stacking faults is more active in O redox reactions with relatively high reversibility. Based on this insight, Li_2MnO_3 cathodes were synthesized with a high concentration of SFs; Li_2MnO_3 cathodes with 27% SFs demonstrated a two-fold increase in capacity compared with those with 15% of SFs. The DFT calculations reveal the stabilization effects of SFs, *i.e.*, delithiated $Li_{2-x}MnO_3$ cathodes are stabilized by SFs; thus, the delithiation process is energetically more favorable for SF-$Li_{2-x}MnO_3$, leading to deeper delithiation in comparison to ideal $Li_{2-x}MnO_3$. Accordingly, O redox is activated for charge compensation. This study agrees well with our prior work using *in operando* EPR to examine coupled Mn-O redox.[2] Combining results from ^{17}O NMR, EPR, and DFT calculations, we were able to propose the cationic and anionic redox mechanisms involved in the (de)lithiation of Li_2MnO_3.

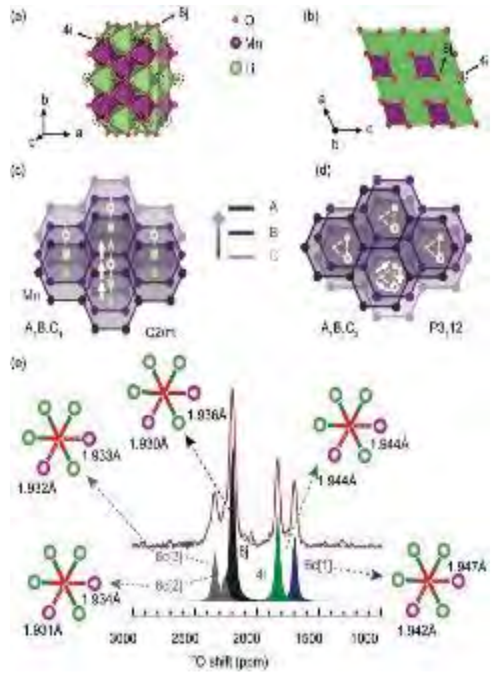


Figure 5. High-resolution ^{17}O-NMR for probing stacking faults in Li_2MnO_3 cathodes, and their roles in enhancing oxygen redox activity and reversibility.

Conclusions

The O activity in Li cathodes during electrochemical cycling is directly probed using high-resolution and *in-situ* ^{17}O NMR, which closely tracks O activities with temporal resolution and helps quantify reversible O redox reactions involving the pi(Mn-O) complex with delocalized electrons. Since the O redox mechanism in high-voltage cathodes is still under debate, ^{17}O ssNMR provides useful information about the redox activity of different O sites and allows discernment of reversible from irreversible O redox. In addition, the gained insights, especially the promotion of O redox participation by SFs via stabilizations effects, point toward new strategies for activating anion redox in Li cathodes.

Acknowledgments

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. Y.-Y. Hu acknowledges support from the National Science Foundation under the grant DMR-1847038.

References

1. Li, X., *et al*., *Advanced Energy Materials*, **12**, 2200427 (2022).
2. Tang, M., *et al*., *J. Phys. Chem. Lett.*, **8**, 4009-4016 (2017).

High-field ^{35}Cl solid-state NMR investigations of pharmaceuticals and nutraceuticals

S.T. Holmes (FSU, Chemistry; NHMFL), A.A. Peach (FSU, Chemistry; NHMFL), C.S. Vojvodin (FSU, Chemistry; NHMFL), J.M. Hook (Univ. New South Wales, Australia), L.K. Watanabe (Univ. of Windsor, Canada), J.M. Rawson (Univ. of Windsor, Canada), L.R. MacGillivray (Iowa State University), and R.W. Schurko (FSU, Chemistry; NHMFL)

Introduction

Solid-state NMR (SSNMR) spectroscopy of quadrupolar nuclides (spin $I > ½$) has emerged as an important means of analyzing molecular-level structure and dynamics in active pharmaceutical ingredients (APIs) and nutraceuticals. In particular, interest in ^{35}Cl SSNMR has been spurred by the ubiquity of chloride anions in HCl salts of APIs, as well as its ability to provide distinct spectral fingerprints for their polymorphs, solvates, hydrates, and cocrystals because of the strong dependence of the ^{35}Cl electric field gradient (EFG) on the local structural environments of chloride ions.[1] ^{35}Cl SSNMR can provide key insights into the hydrogen atoms participating in H···Cl^- hydrogen bonds, and is therefore relevant in NMR crystallographic investigations, along with other quadrupolar nuclides like ^2H, ^{14}N, and ^{17}O.

Furthermore, ^{35}Cl SSNMR can be used to study APIs in dosage forms because of the absence of interfering signals arising from excipients.[2,3]

Experimental

^{35}Cl SSNMR spectra were acquired on stationary samples and samples under conditions of magic-angle spinning (MAS) on spectrometers featuring 800MHz/18.8T/63mm bore and 600MHz/14.1T/89mm bore magnets at the MagLab in Tallahassee, FL. These experiments used 3.2mm HX and HXY MAS probes built in-house at the MagLab. The spectra acquired at 18.8T are especially valuable, since the ^{35}Cl central-transition (+1/2 ↔ –1/2) powder patterns could be subjected to MAS rates high enough to yield spectra from which quadrupolar parameters could be easily extracted; in addition, spectra must be acquired at two field to permit deconvolutions of contributions from the anisotropic quadrupolar and chemical shift interactions, yielding a unique eight-parameter fingerprint for each API.

Results and Discussion

In the past year, we have used a combination of ^{35}Cl, ^{14}N, and ^{2}H SSNMR to investigate (i) the fingerprinting and identification of nutraceuticals in crystalline and dosage forms (**Figure 6**);[4] (ii) the nature of the interactions between water molecules and drug molecules in solid hydrates of APIs;[5] (iii) the mechanochemical synthesis of urea-containing multicomponent crystals containing Cl^- anions;[6] and (iv) the thermodynamic stabilities of fluoxetine HCl cocrystals formed competitive and stability milling with several coformers, including benzoic, succinic, and fumaric acid.[7] In all cases, the ^{35}Cl SSNMR data not only provide evidence of the specific solid form of the API and/or cocrystal, but also provide opportunities for structural modelling with NMR crystallographic methods,[8,9] which feature DFT refinements of structure and calculations of ^{35}Cl EFG tensor parameters. Insights into the chloride anion environments are providing new pathways to rational design of new solid forms of APIs and nutraceuticals.

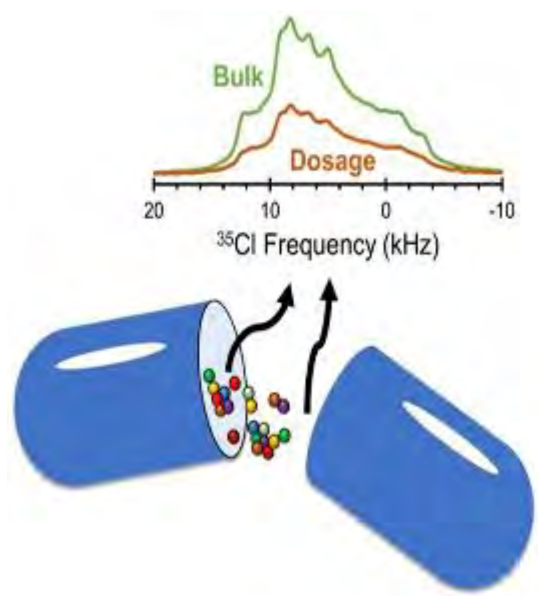


Figure 6. *35Cl SSNMR at 18.8T allows for easy identification of pharmaceutical ingredients in dosage forms (e.g., pills and capsules).*

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. RWS also acknowledges support from NSF-CMI and SSMC (NSF-2003854) and start-up funding from the Florida State University, National High Magnetic Field Laboratory, and State of Florida.

References

1. Hildebrand, M.; Hamaed, H.; Namespetra, A. M.; et al., *CrystEngComm* **16**, 7334 (2014).
2. Namespetra, A. M.; Hirsh, D. A.; Hildebrand, M. P.; et al., *CrystEngComm* **18**, 6213 (2016).
3. Hirsh, D. A.; Holmes, S. T.; Chakravarty, P.; et al., *Cryst. Growth Des.* **19**, 7349 (2019).
4. Holmes, S. T.; Hook, J. M.; and Schurko, R. W., *Mol. Pharm.* **19**, 440 (2022).
5. Holmes, S. T.; Vojvodin, C. S.; Veinberg, N.; et al., *Solid State Nucl. Magn. Reson.* **122**, 101837 (2022).
6. Vojvodin, C. S.; Holmes, S. T.; Watanabe, L. K.; et al., *CrystEngComm* **24**, 2626 (2022).
7. Peach, A. A.; Holmes, S. T.; MacGillivray, L. R.; and Schurko, R. W., *CrystEngComm* **25**, 213 (2023).
8. Holmes, S. T. and Schurko, R. W., *J. Phys. Chem. C* **122**, 1809 (2018).
9. Holmes, S. T.; Vojvodin, C. S.; and Schurko, R. W., *J. Phys. Chem. A* **124**, 10312 (2020).

4.5 UF Biology/ UF Chemistry

UF faculty and staff scientists affiliated with the AMRIS Facility are at the forefront of developing and exploiting magnetic resonance techniques to provide unique insights into complex chemical and biological problems. Particular areas of interest include enhancing sensitivity through hyperpolarization, developing multinuclear magnetic resonance approaches that take advantage of high magnetic fields, and pairing high magnetic fields with ultra-strong gradients to provide insights into structure, function, and diffusion on the nanometer to micrometer length scales. The unique RF engineering capabilities of the MagLab enable researchers to develop MRI and NMR coils which are tailored for specific nuclei and samples. Science and technology highlighted this year include characterization of polymer membranes for molecular separations [1]; understanding sources of phosphorus in water [2]; understanding biomolecular structure, dynamics, and function [3-6]; development of hardware for in vivo MR experiments [7-8]; and using diffusion tensor imaging combined with fMRI to characterize the effects of stress and ageing on brain connectivity networks [9-10].

Evidence for different diffusion pathways for water and chemical warfare agent simulant in Nafion [1]

Trusty, B. (UF, Chem. Eng.); Fang, J. (University of Cincinnati, Dept. of Chem. and Env. Eng.); Angelopoulos, A. (University of Cincinnati, Dept. of Chem. and Env. Eng.); Vasenkov, S. (UF, Chem. Eng.)

Introduction

Perfluorosulfonic acid (PSA) polymer membranes, such as the commercially available Nafion, are among the most promising materials in a wide variety of potential or current applications including fuel cells, water desalination processes, chemical sensing, and selective capture/immobilization of chemical warfare agents (CWA). Molecular diffusion plays an important role in these applications. However, detailed fundamental understanding of a relationship between microscopic diffusion of different types of molecules and structural properties of Nafion membranes is still under development. In the presence of water, the Nafion structure exhibits a hydrophobic semi-crystalline matrix made of a backbone of polytetrafluoroethylene and interfacial perfluoroether (PFE) regions containing channels available for water diffusion, viz. water channels.

Experimental details

^{1}H pulsed field gradient (PFG) NMR at 14 and 17.6T was utilized at the AMRIS facility of the MagLab to measure self-diffusivities of CWA simulant dimethyl methyl phosphonate (DMMP) and water in Nafion membranes at 296K. Our PFG NMR data allowed quantifying self-diffusion of DMMP and water as a function of the intra-membrane DMMP concentration for several fixed water concentrations in Nafion. The PFG NMR measurements were performed for a broad range of molecular displacements and the corresponding diffusion times.

Results and Discussion

The data in **Figure 1** show that DMMP concentration within the Nafion membrane has very little influence on the self-diffusivity of water inside the membrane in the limit of short diffusion times. At the same time, there is a much stronger dependence of the DMMP concentration on the DMMP self-diffusivity (**Figure 1**). This result indicates that water and DMMP are diffusing in different regions of the polymer. While water is known to diffuse in the domains of interconnected water channels, DMMP likely localizes itself in the PFE interfacial regions of the polymer. DMMP molecules have a “Janus” structure which contains a hydrophilic “head” and a hydrophobic “tail”. Hence, it is likely that these molecules mostly diffuse in the membrane interfacial regions. The conclusion about different diffusion pathways for water and DMMP in Nafion is also supported by the observation

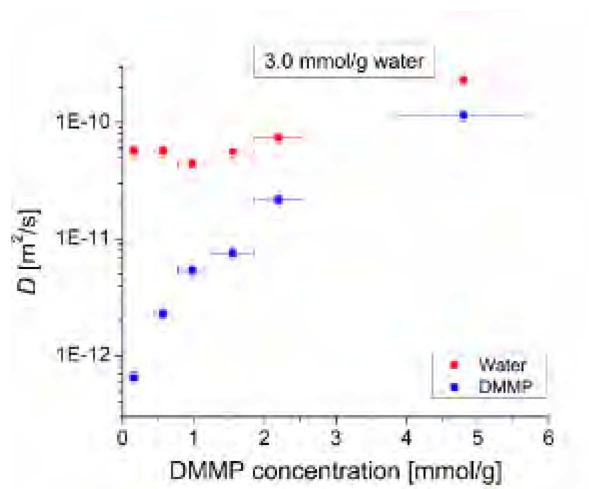


Figure 1. *Example of the dependencies of water and DMMP self-diffusivities in Nafion membranes measured as a function of DMMP intra-membrane concentration at 296K. The diffusion data for water are shown in the limit of short diffusion times.*

of a dependence of water diffusivities on diffusion time, and the absence of such dependence for DMMP. Such diffusivity dependence for water molecules in Nafion was previously reported by us and explained by the influence of transport barriers present inside water channels [1,2]. Since the diffusion of DMMP molecules is not influenced by these barriers it is unlikely that DMMP molecules diffuse in water channels. To our knowledge, this work represents the first microscopic measurements of diffusion of a CWA simulant in PSA polymers. The results of the study indicate that water and DMMP, and likely other CWAs and CWA simulants with similar structures, mostly diffuse in different local environments of Nafion. Similar separation of diffusion pathways was previously reported by us for diffusion of acetone and water in functionalized Nafion membranes [2]. The results of the current study increase the potential for use of Nafion and/or other PSA polymers to capture CWAs by targeted polymer functionalization of selected polymer regions with CWA traps, while still allowing water diffusion to occur uninhibited through water channels.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1644779 and the State of Florida. This work was supported by NSF/CBET-1836551 and NSF/CBET-1836556 as well as by NIH award, S10RR031637, for magnetic resonance instrumentation.

References

1. Berens, S. J., *et al*., *Journal of Physical Chemistry B*, **124,** 8943 (2020)
2. Trusty, B., *et al*., *Physical Chemistry Chemical Physics*, **24**, 10069 (2022)

Evaluating the Nature of Phosphorus Entering, Within and Leaving Everglades Stormwater Treatment Areas (STAs) [2]

Buchanan, A.C. and Judy, J. (University of Florida, Department of Soil, Water and Ecosystem Sciences)

The determination of P_i and P_o is often done through a series of sequential chemical extractions, notably the modified Hedley method. The limitation of this is that these techniques only provide semi-quantitative information to gauge the possible stability and significance of different phosphorus (P) fractions [1]. Without the knowledge of the true chemical or mineralogical nature of P to determine bioavailability, it's impossible to make the best management decisions. The main impediment to the advancement of our understanding of the composition and stability of P in the Everglades stormwater treatment areas (STAs) has been analytical. By pairing the information obtained from these standard laboratory practices with the information made possible through advanced spectroscopic approaches, including ^{31}P nuclear magnetic resonance (NMR) spectroscopy, there is the ability to confirm specific P_i and P_o forms and their relative proportions within the >0.45µm and <0.45µm fraction of STA surface water.

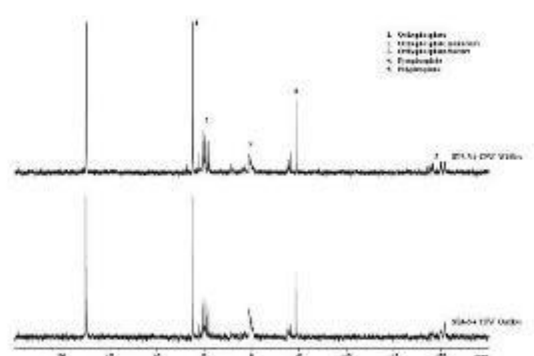


Figure 2. *Dry season ^{31}P-NMR spectra for >0.45µm-filtered phosphate water from the STA-3/4 Central Flow Way midflow and outflow sampling locations.*

Experimental

All data was collected at the MagLab's AMRIS facility at the University of Florida. Solution state ^{31}P-NMR was acquired using the wide bore Bruker Avance 600MHz-89mm magnet equipped with a 5-mm Smart BBOF Probe to determine organic and complex inorganic P species present in the >0.45µm and <0.45µm fraction of Everglades STA surface water. The ^{31}P-NMR spectra of sample solutions were acquired from 5-24 hours of acquisition time depending on P concentration. (**Figure 2**)

Results and Discussion

Spectroscopic data suggests that at the STA inflows, >0.45µm P is relatively diverse in nature. ^{31}P NMR data revealed that inorganic orthophosphate was the dominant P species in the >0.45µm fraction, with an average proportional concentration of 36%. This percentage of orthophosphate was the highest in the systems receiving the highest annual inflow flow-weighted mean concentrations (µg/L) of P during WY2021, and the lowest in well performing STA-2 and

STA-3/4, which receive a lower annual inflow P concentration [2]. This suggests orthophosphate may be the dominant form of inflow particulate P.

As distance from the inflow increased, ^{31}P NMR data indicates the proportion of >0.45μm P likely of biogenic nature increased, being significantly dominated by orthophosphate monoesters, orthophosphate diesters and polyphosphate during the wet season. Polyphosphates accounted for the largest increase between the inflow and the outflow, averaging 31% of total NaOH-EDTA extractable P in the wet season. Harold noted that there is a highly significant correlation between microbial P and long chain polyphosphates ($p < 0.0001$) [3]. Terminal peaks for long-chain polyphosphates were located between -3.5 and -4ppm, which are not always seen in environmental ^{31}P NMR samples but were seen in all >0.45μm samples here. The proportional fraction of orthophosphate monoesters and diesters similarly increased from inflow to outflow, totaling 50% of the total extractable and detectable P. With the addition of biogenic pyrophosphates (6%) and biogenic polyphosphates (31%), total biogenic P at the outflow during the wet season was 87%.

Phosphorus concentrations in the <0.45μm fraction were low and only resulted in an orthophosphate peak at varying intensities at the inflow and outflow. However, this does not imply that dissolved orthophosphate is the sole <0.45μm P species present at low concentrations.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1644779 and the State of Florida. This work was supported in part by an NIH award, S10 OD028753, for magnetic resonance instrumentation. Additionally, this work was supported by the South Florida Water Management District (SFWMD).

References

1. Reddy, K., et al., Soil phosphorus forms and storage in stormwater treatment areas of the Everglades: Influence of vegetation and nutrient loading. Science of The Total Environment, 2020: p. 138442.
2. SFWMD, Chapter 5B: Performance and Operation of the Everglades Stormwater Treatment Areas, in 2022 South Florida Environmental Report, M. Chimney, Editor. 2022.
3. Harold, F.M., Inorganic Polyphosphates in Biology - Structure Metabolism and Function. Bacteriological Reviews, 1966. 30(4): p. 772-794.

Probing the Dynamics of Human γS-Crystallin Deamidation Variants [3]

Rocha, M.A. (UCI, Chemistry); Kelz, J.I. (UCI, Chemistry); Mozafari, M. (UCI, Chemistry); Martin, R.W. (UCI, Chemistry and MB&B); Mehta, A. (UF, AMRIS)

Introduction

The human eye lens enables proper vision by focusing visible light on to the retina at the back of the eye. Therefore, the lens must be transparent and refractive. Lens cells are nearly devoid of all cellular machinery but contain high concentrations (400mg/mL) of impressively soluble and stable proteins called crystallins. The loss of crystallin solubility followed by the formation of light-scattering crystallin aggregates is one of the main causes of age-related cataracts, the leading cause of blindness worldwide. The leading hypothesis on the crystallin aggregation mechanism is that crystallins accumulate post-translation modifications (PTMs) throughout their decades-long lifespan until a critical point is reached where the proteins lose solubility and aggregate. The most common post-translation modification found cataractous lenses is deamidation. Deamidation is the conversion of asparagine or glutamine to glutamic acid or aspartic acid, respectively. As such, this conversion can be easily mimicked in recombinant protein through a simple amino acid replacement. In comparison to wild-type protein deamidation variants have shown reduced solubility, stability, and altered protein-protein interaction profiles.[1,2] Progressive deamidation can happen over time, resulting in extensively modified crystallins in

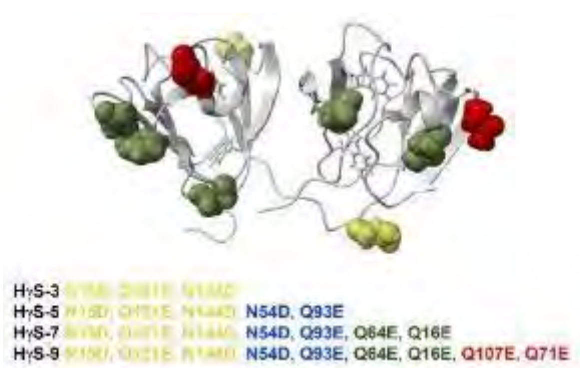


Figure 3. *Sites of deamidation on human γS-crystallin variants.*

aged lenses. The Martin Lab designed four deamidation variants of the human γS-crystallin that range from minimally to abundantly deamidated in order to mimic the extreme deamidation that could be found in aged lenses (**Figure 3**).[3] The variants include 3-, 5-, 7- and 9-site variants that are referred to as HγS3, HγS5, HγS7, and HγS9, respectively. These variants have reduced stability and increased aggregation propensity despite maintaining the overall fold of the wild-type (HγSWT) form as revealed by crystallography. Therefore, we hypothesize that the altered biophysical properties of these variants are a result of changed protein dynamics which thereby reduce the stability and increase the aggregation propensity of these variants. Here, we investigated the dynamics of these deamidation variants using NMR spectroscopy.

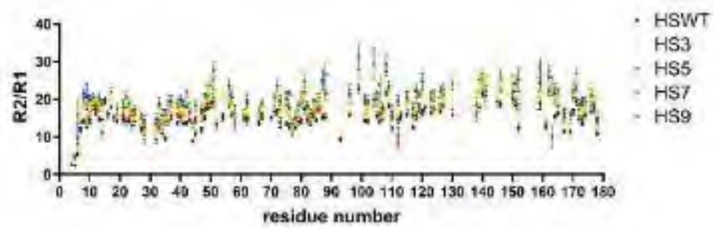


Figure 4. *R2/R1 values of HγSWT and deamidation variants.*

Experimental

^{1}H-^{15}N HSQCs or TROSY HSQCs were collected at AMRIS using the 18.8T NMR system. Delay times for R1 experiments were 0.01, 0.02, 0.22, 0.42, 0.62, 0.82, and 1.12 s. The delay times for R2 experiments were 10, 30, 50, 70, and 90ms. Time points were collected in random order and replicates were collected to estimate error. Relaxation rates were calculated using CcpNmr where the error was estimated using a bootstrap method.

Results and Discussion

We investigated the fast dynamics of the deamidation variants using R2/R1 values (**Figure 4**). The average R2/R1 values are increased in each deamidation variant. Interestingly, there is a large increase in dynamics at residue W163. This position has been shown to be crucial for the stability and aggregation. This increase in dynamics could result in the loss of stability of these deamidation variants.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. This project is additionally funded by the National Eye Institute, National Institutes of Health (Rocha, NIH F31EY034393 and Martin, NIH R01EY021514).

References

1. Forsythe, H.M., *et al*., Biochemistry, **58**, 4112-4124 (2019).
2. Pande, A., *et al.*, Biochemistry, **54**, 4890-4899 (2015)
3. Norton-Baker, B., *et al.*, Structure, **30**, 763-776 (2022)

Investigating Signaling Complexes of G Protein-Coupled Receptors and the Impact of Phospholipids on Cell Signaling [4]

Ferre, G.; Thakur, N.; Ray, A.; Jin, B.; Gopal Pour, N.; Eddy, M.T. (UF, Chemistry)

G protein-coupled receptors are sensory membrane proteins expressed by nearly all Eukaryotic organisms. Information from NMR spectroscopy on the dynamic behavior of GPCRs is critical to understanding mechanisms of cellular signaling and how complex signaling assemblies are controlled within the cellular environment. This report describes exciting progress in two emerging areas of cell signaling research: mechanisms of protein-protein recognition in the formation of signaling complexes and how they are regulated by the presence of endogenous membrane phospholipids (**Figures 5, 6**).

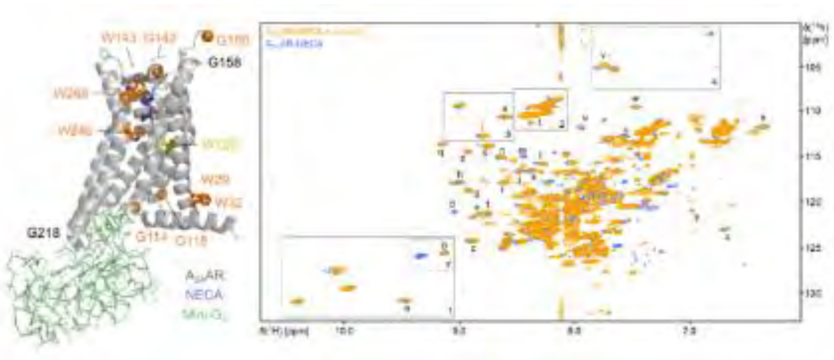


Figure 5. *The conformation of a GPCR ternary complex was compared to the conformation of the receptor alone in 2D [^{15}N,^{1}H]-TROSY NMR spectra recorded on an 800MHz Bruker instrument equipped with a cryoprobe. [1]*

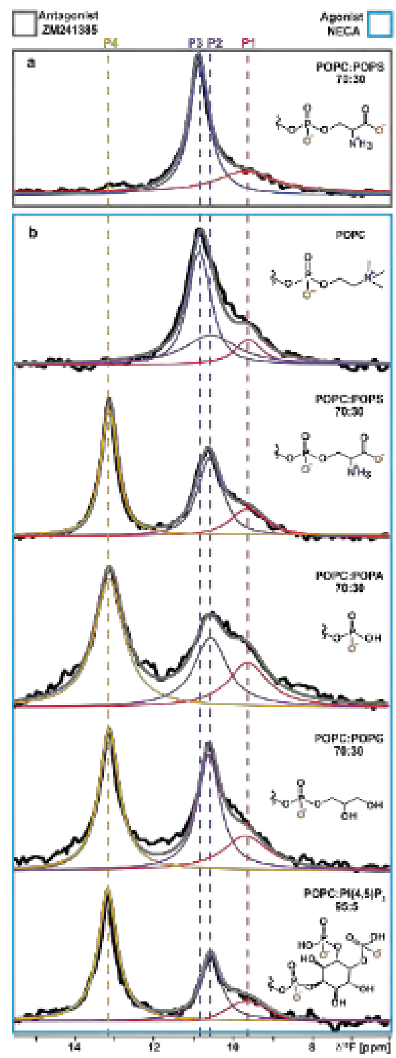


Figure 6. *^{19}F-NMR spectra recorded on the 600 Bruker wide-bore instrument with A_{2A}AR in nanodiscs containing different binary lipid mixtures, demonstrating anionic lipids were required to activate the receptor. [2]*

GPCR ternary complexes with drugs and intracellular signaling proteins

GPCR signaling is initiated by the formation of ligand-stimulated complexes with intracellular proteins termed G proteins. An important and open question is to what extent the structures of GPCRs differ between binary complexes with drugs and ternary complexes with drugs and partner proteins. Ternary complexes of [u-^{15}N, ~70% ^{2}H] stable-isotope labeled human A_{2A} adenosine receptor were investigated using 2D [^{15}N,^{1}H]-TROSY NMR spectroscopy [1]. The high resolution and good sensitivity of the instrument permitted for a comparison of the global conformation of the GPCR ternary complex to the complex of the GPCR with drug alone. The conformation of the GPCR in the ternary complex was globally highly similar to the conformation of the receptor in absence of a partner protein [1]. This provides new insights into the mechanisms of molecular recognition between A_{2A}AR and partner signaling proteins.

The impact of phospholipids on GPCR activation

Endogenous phospholipids are thought to influence the activity of GPCRs and their ability to form signaling complexes, but the mechanism for this is not understood. Using ^{19}F-NMR, Thakur et al. demonstrated that the presence of anionic phospholipids was required to activate an agonist-bound A_{2A} adenosine receptor and observed a synergy between the efficacy of bound drugs and membrane phospholipid composition [2]. NMR spectra of receptor variants pointed to the importance of lipid interactions with positively charged residues near the receptor intracellular surface, which are conserved across a broad range of GPCRs [2].

Integrating ^{19}F-NMR data with information from complementary biophysical techniques provides a powerful approach to better understand the dynamic behavior of GPCRs and their complexes. Detailed protocols have been organized and published [3] for preparing GPCR samples compatible with both NMR spectroscopy and single-molecule fluorescence with the goal of integrating information from multiple spectroscopic approaches.

Acknowledgements:

This work was supported by the NIH MIRA grant R35GM138291 (M.T.E.), an ORAU Ralph E. Power junior faculty award (M.T.E.) and by the National High Magnetic Field Laboratory, which is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.

References

1. Ferré *et al.* Cell Reports, 41, 2022
2. Thakur et al. Nature Communications (Accepted)

3. Thakur et al. STAR Protocols, 3, 2022.

Case Role of DNA Methylation in Liquid-liquid Phase Separation-mediated Heterochromatin Formation [5]

Dettori, L. (Upstate Med School, Biochem); Bah, A (Upstate Med School, Biochem); Mehta, A. (UF, AMRIS)

Introduction

R-loops are non-canonical, three-stranded nucleic acid structures composed of a DNA:RNA hybrid, a displaced single-stranded (ss)DNA and a trailing ssRNA overhang. R-loops perform critical biological functions in many physiological DNA processes, including DNA repair, transcription regulation and telomere stability. While previous high-throughput screens have identified multiple proteins that bind and regulate R-loop function[1,2], there is currently no known motif or protein domain, or unifying mechanism by which these proteins recognize R-loops. Thus, there is critical need to elucidate the precise molecular and structural mechanisms by which R-loop readers and enzymes recognize and resolve R-loops or modulate R-loop-mediated signaling. Excitingly, our recent discovery that the C-terminal intrinsically disordered region (C-IDR) of Fragile X Syndrome protein (FMRP), but not the N-terminal RNA binding folded domains, directly binds to and co-phase separates with R-loops provides a novel biophysical paradigm to understand the mechanisms underlying R-loop recognition, signaling and resolution. This discovery is a major breakthrough, as it demonstrates the first example of IDR recognition of a complex nucleic acid structure consisting of both DNA and RNA. It also provides an excellent model system for elucidating sequence- and structure-based mechanisms of liquid-liquid phase separation (LLPS)-mediated regulation of non-canonical nucleic acid structure and function.

Experimental

We used ^{13}C-detected TROSY experiments on the 800 MHz spectrometer equipped with a cryo probe at the MagLab AMRIS facility to obtain backbone and side-chain assignment. Direct ^{13}C-detect-based experiments are useful for dynamic systems like the C-IDR of FMRP due to wide ^{13}C chemical shift dispersion and favorable relaxation properties. These experiments are not limited by restrictive buffer conditions like high pH/temperature that broaden amide ^{1}H-detect experiments due to enhanced solvent exchange rates. ^{13}C-based TROSY NMR experiments will provide backbone and side chain chemical shift assignments, backbone J-coupling constants and Nuclear Overhauser effects (NOE) to determine the secondary structure, torsion angle and short ($\leq$ 6Å) distance restraints respectively.

Results and Discussion

We have developed a system of integrated cellular, biochemical and biophysical approaches to study the mechanism underlying the interaction between R-loops and the C-IDR of FMRP. Our preliminary data with binding techniques such as electrophoretic mobility shift assays (EMSA) and Isothermal Titration Calorimetry (ITC) and phase separation measurements using UV-Vis light scattering and differential interference contrast (DIC) microscopy set the stage to study the atomic resolution of the complexes. While cellular techniques for studying biomolecular condensates are rapidly being developed, studying the atomic-resolution structure and dynamics of the molecules driving or found in the condensates is quite challenging. We will use our data as restraints in NMR structure calculation packages, such as ARIA[3] and CYANA[4], or ensemble programs like ENSEMBLE[5,6]. Small angle X-ray scattering (SAXS) will also define low resolution, global conformation of R-loop:C-IDR complexes to complement NMR structural data. In addition to structural information, NMR relaxation experiments will provide data on the kinetics and thermodynamics of the C-IDR:R-loop interactions. NMR spectroscopy will study changes in structure and dynamics upon binding and phase separation, and how these are modulated by PTMs such as phosphorylation and methylation of the C-IDR. ^{13}C-dynamics of aromatic amino acids (Phe and Tyr) in free, bound and phase separated states will inform on local structure changes. ^{13}C TROSY and paramagnetic relaxation enhancement (PRE) experiments will monitor long-range interactions and changes upon binding and phase separation. These experiments will allow us to build a complete thermodynamic and structural picture of the R-Loop:C-IDR complex.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.

References

1. Cristini, A, *et al.*, Cell Rep. **23**, 1891–1905 (2018).
2. Wang, I. X. *et al.*, Genome Res. **28**, 1405–1414 (2018).
3. Rieping, *et al.*, Bioinformatics **23**, 381–382 (2007).
4. Herrmann, T., *et al.*, J. Mol. Biol. **319**, 209–227 (2002).
5. Bah, A. et al. Nature **519**, 106–109 (2015).
6. Krzeminski, M. *et al.*, Bioinformatics **29**, 398–399 (2013).

SSNMR of Animal Inward-Rectifier Potassium Channels [6]

Wylie, B.J. (Texas Tech University, Chemistry and Biochemistry); Yekefallah, M. (Texas Tech University, Chemistry and Biochemistry); Amani, R. (Texas Tech University, Chemistry and Biochemistry), Mehta, A.K. (University of Florida, AMRIS)

Introduction

G protein Activated Inward Rectifier K$^+$ (GIRK) Channels. GIRK channels shape the action potentials of excitable cells in the central nervous system (CNS). They are involved in epilepsy, addiction, Down's syndrome, ataxia, and Parkinson's disease. The activated states of these proteins are highly dynamic and depend upon their native lipid bilayer under physiological temperatures. Because of their large size and dynamic nature, high-field NMR as provided by AMRIS is the ideal structural technique to probe the activated states of these proteins. Our solid-sate NMR (SSNMR) investigation of GIRK channels starts with the Kir3.1-KirBac1.3 chimera. This construct shares regulatory features with human GIRK1 and GIRK2. Questions we seek to answer include: ***(a)*** *What is(are) the open state(s) of GIRK channels?* GIRK channels are gated by the coaction of PIP_2 and a $G_{\beta\gamma}$ dimer. They are also gated by ethanol and several pharmaceuticals. **(b)** *What is the basis for cholesterol helping to activate GIRK channels?* Comparing the Kir3.1-KirBac1.3 chimera to GIRK2 will be advantageous.

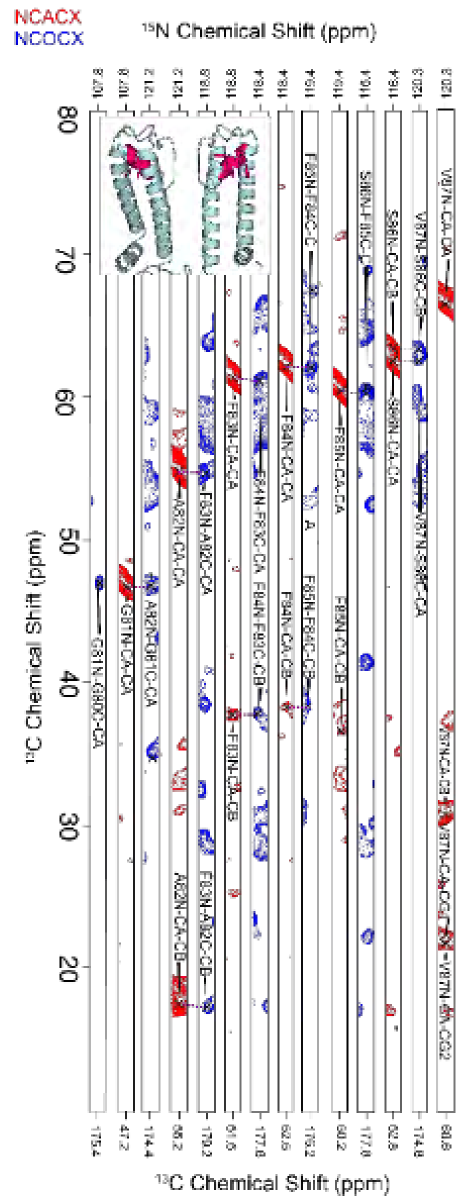


Figure 7. *^{15}N and ^{13}C chemical shift assignments carried out on the Kir3.1-KirBac1.3 chimera at 800MHz. Depicted is the "backbone walk" through the pore helix of the protein (magenta in figure insert) using NCACX (red) and NCOCX (blue) NCACX spectra.*

Experimental ^{13}C-^{13}C two-dimensional and ^{15}N-^{13}C-^{13}C three-dimensional SSNMR spectra were acquired on the 750MHz and 800MHz Bruker Avance III spectrometers at AMRIS. These instruments were equipped with a MagLab (Gainesville, FL) home-made low-E 3.2mm HCN triple-resonance biosolids Magic Angle Spinning (MAS) probe. This probe technology provided exceptional signal stability during the long 2–7-day acquisition times for each experiment. Additionally, the MagLab's implementation of cutting-edge experimental methodology allowed us to deploy Non-Uniform Sampling (NUS). These spectra allowed us to assign site-specific chemical shifts. Once completed, this will be one of the largest membrane proteins assigned via SSNMR (**Figures 7-9**).

Discussion and Results Our SSNMR data acquired at AMRIS has higher sensitivity and resolution than data acquired locally at 600MHz (**Figure 8**). This is especially true for aromatic residues like tryptophan which are capable of coordinating and recruiting activatory lipids (**Figure 9**). We identified arginine and tryptophan side chain ^{15}N chemical shift outliers that move with the addition of ethanol (**Figure 9 A, B**). $G_{\beta\gamma}$ dimers and ethanol may both increase GIRK-PIP_2 affinity, so it is possible we are observing a shift toward tighter PIP_2 association. Our SSNMR constructs are functional and conform to the expected fold using computed chemical shifts (**Figure 8C**).

Conclusions

High-field SSNMR data acquired at MagLab/AMRIS using specialized LowE probes are enabling the chemical shift assignment and structural analysis of eukaryotic membrane proteins closely tied to human disease.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.This research was funded by the National Institutes of Health, Maximizing Investigators' Research Award [MIRA], R35 GM124979

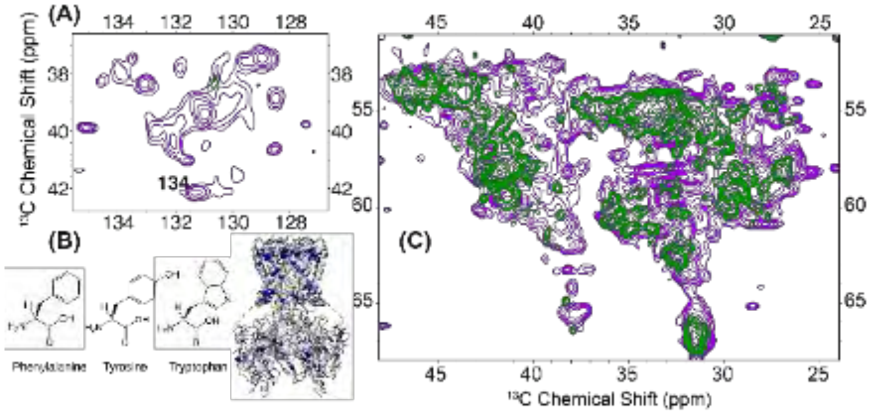


Figure 8. *SSNMR spectra acquired at 800 MHz (purple) and 600MHz (green). (A) Aromatic side chain region of DARR spectra. (B) The aromatic residues and their distribution in the Kir3.1-KirBac1.3 chimera are mapped in blue on the structure of the protein. (C) Region of the DARR spectra containing Ca correlations to aliphatic side chain resonances. The 800MHz spectrum is more complete and better resolved, indicating the dramatically improved performance of the MagLab high magnetic fields and probe technology compared to 600MHz.*

Cryo-cooled MR Coils for Low-Gamma NMR Imaging and Spectroscopy at High Magnetic Fields [7]

Mareci, T.H. (UF, Biochemistry and Molecular Biology), Thomas, J. (UF, Biochemistry and Molecular Biology), Merritt, M. E. (UF, Biochemistry and Molecular Biology), Brey, W.W. (FSU, NHMFL), Vo, E. (UF, Department of Biomedical Engineering), Greg Dowling, G. (UF, AMRIS), Zeng, H. (UF, AMRIS), Brazdeikis, A. (Cryosensors, LLC. Sugar Land, TX) and Wosik, J. (U. Houston, Electrical and Computer Engineering, and Cryosensors, LLC. Sugar Land, TX).

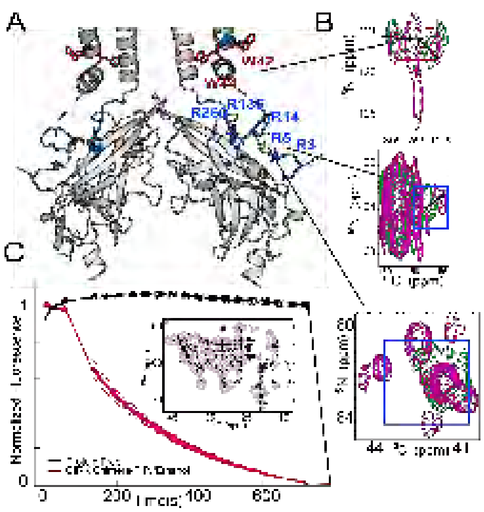


Figure 9. *(A) Functionally Important W And R Residues Labeled on The Chimera Structure (2QKS). (B) Spectra Show W Outliers (Top) And R Outliers (Bottom) Evolution In PE:PS:PIP₂ (Inactive, Green) Versus PE:PS:PIP₂:Etoh (Active, Magenta). (C) Functional Assay and Aliphatic Region Of 2D ^{13}C Correlation Spectrum (With Structurally Predicted Chemical Shifts) Showing The GIRK Chimera Is Folded And Functional.*

Introduction

A cryo-cooled MR receiver coil system is developed for measurement of magnetic resonance (MR) images and spectra of low-gamma nuclei (^2H) in a 11.1 Tesla, 40cm horizontal bore magnet. The coil system is used for *in vivo* rodent studies in the MagLab users' program at the AMRIS Facility. This project addresses the following specific aims: Aim 1: With Cryosensors LLC, we are developing a cryogenic ^2H superconducting MR received-only coil system with external room temperature volume ^1H transmit/receive, and ^2H transmit-only coil. Aim 2: We are assessing vacuum and temperature performance of cryo-cooled coil system, measuring loading, tuning, and matching performance, and measuring coil sensitivity at 11.1T. Then we are comparing the cryo-cooled MR coil performance with a room temperature coil of similar size and configuration. Aim 3: We are measuring *in vivo* metabolism using ^2H

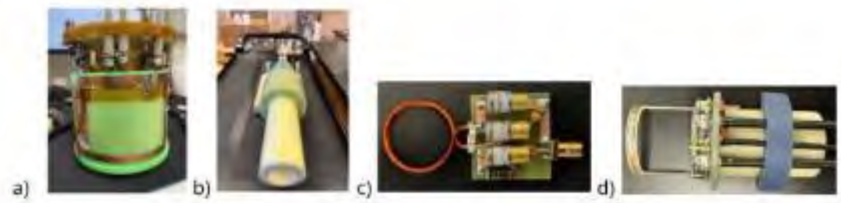


Figure 10. *RF Coils, a) ^1H TX/RX and ^2H RX only, b) cryo-cooled ^2H RF coil probe, c) 22 mm ^2H circular RX-only coil, d) 20 mm saddle 2H RX-only coil.*

NMR [1] in the rodent brain, fatty acid oxidation in the liver, and muscle creatine utilization with a range of ^{2}H labeled metabolic substrates (e.g., glucose, octanoate and creatine).

Experimental

A 72.2 MHz ^{2}H cryocooled coil system has been fabricated (see **Figure 10**, part b) with expected signal-to-noise ratio (SNR) gain over room temperature (RT) coils of similar size and configuration. The probe system is assembled, and preliminary tests have been completed. To support this work, normal metal room temperature coils [see **Figure10**, parts a), c) and d)] have been constructed for SNR comparison to the cryocooled coil system.

Results and Discussion

Table 1 contains the results from the measurement of low power Q coil. The last column shows the improvement of over 300% in coil performance for the cryocooled coil compared to a similar geometry room temperature coil.

Table 1. *^{2}H Rx RF coils*

Type	Shape	Filling Factor	T_{coil} (K)	T_{preamp} (K)[a]	Low Power Q[b]
Room Temperature	Saddle	Max	293	32	87
Room Temperature	22mm Two-Turn Spiral	↓	293	32	106
Cryogenic Copper	22mm Circular	Min	50	32	314

[a] Noise temperature. [b] Quality factor (Q) ∝ ω_0/R_{coil} measured using Q = $\omega_0/\Delta\omega$ where $\Delta\omega$ is the resonance-half-power bandwidth (-3 dB). All Q's were measured in a critically coupled (matched) condition at ω_0.

Conclusions

Once the cryocooled coil system is completed (need cryocooled preamp), further gains should be obtained in SNR with final integration into a system suitable for user applications.

Acknowledgements

The NHMFL is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. In addition, this project is funded by an NHMFL User Collaborative Grant Program award R000002798.

References

Mahar, R., et al., Magnetic Resonance in Medicine, 2021. 85(6): p. 3049-3059.

FMRI in mice during learning and performance of a forelimb force control task [8]

Jindal, W. (UF, APK), Wesson, D.W. (UF, Pharmacology), Vaillancourt, D. (UF, APK), and Vahdat, S. (UF, APK)

Introduction: Controlling the level of upper limbs force is crucial for performing daily activities. The neural mechanisms involved in learning appropriate force control are not well understood. Functional magnetic resonance imaging (fMRI) in rodents allows unbiased tracking of whole-brain activation maps during learning to pinpoint key cortical, subcortical, and brainstem structures. Yet the need for anesthesia to suppress head motion during scanning has limited its applications to study behavioral underpinnings in rodents [1]. Here, we developed and tested a novel MR-compatible head-fixation apparatus for awake mouse fMRI during an odor-cued forelimb force control task, minimizing noise and motion artifacts, and powerfully harnessing behavior.

Figure 11*. The schematic of our newly designed MR-compatible sled for mouse head-fixation. The orange part depicts the saddle shaped receive-transmit MR coil specifically designed and built by AMRIS facility at UF, to be mounted on our sled. The blue part is connected to ports for odor and water delivery. Force transducer is accessible to mouse via the black button.*

Experimental: We built an accurate (resolution 0.005N) MR-compatible miniature force transducer, as well as a 3D-printed head fixation system to shape and allow mice to engage in the forelimb force control task. We also designed and built a saddle linear MRI coil to fit our head fixation system (with an opening for fiber-optic cannula for opto-stimulation, **Figure 11**). The training paradigm involves wild-type water-deprived mice undergoing a reward-based forepaw press task. In initial shaping, the mice were shaped to press the force transducer in a water-motivated press/no-press task, cued by an odor. After the initial training days, the mice are further trained to press the force transducer at a required force level. Mice underwent an event-related awake SE-EPI fMRI scan in an 11T Bruker scanner while performing the forepaw press task (resolution 0.35x0.35x0.5 mm3, TR = 2s). T2w anatomical scans (resolution 0.1x0.1x0.35 mm3) were also acquired for registration to template.

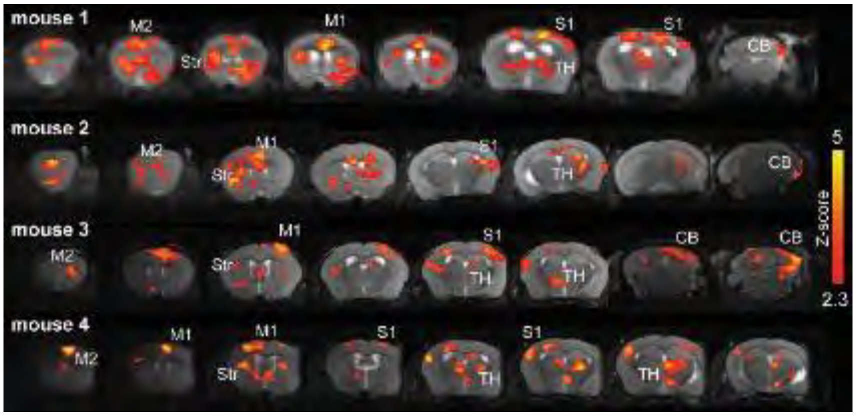


Figure 12. *fMRI activation maps related to forelimb force control in behaving mice. Significant activations (p < 0.05, corrected) in several structures including the primary motor cortex (M1) and secondary motor cortex (M2), somatosensory cortex (S1), thalamus (TH), cerebellum (CB), and striatum (Str), after removing the effects of odor presentation, water delivery an*d licking.

Results and Discussion: Our fMRI results (shown in **Figure 12**) demonstrated significant activation clusters ($p < 0.05$, corrected) related to forelimb force control in several structures, including the primary and secondary motor cortices, somatosensory cortex, thalamus, striatum, and piriform cortex, after removing the effects of odor presentation and licking. The average motion during functional scans was minimal (less than 0.25 mm in all 3 directions), and additional motion correction parameters from FSL software package were included in the regression model to ensure decoupling the effects of body motion from the activation maps.

Conclusion: Our study shows the feasibility of awake mouse fMRI in forelimb motor control and provides evidence for a widespread network of cortical and subcortical areas activated during force control. Future work can use this paradigm alongside optogenetics and/or fiber photometry to target specific neuronal circuits.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.

References

1. Vahdat, S, *et al*., Science Advanced, 7 (33), eabd9465 (2021).

Adolescent Obesogenic and Stress Environment Alters Adult Hippocampal Microstructure: A Developmental Neuro-Immune-Metabolic Link [9]

Ontiveros-Ángel, P. (LLU, Physiology); Vega-Torres, J. D. (LLU, Physiology); Simon, T. B. (LLU, Physiology); Williams, V. (LLU, Physiology); Inostroza-Nives, Y. (San Juan Bautista SoM, Biochemistry, Pharmacology); Alvarado-Crespo, N. (San Juan Bautista SoM, Biochemistry, Pharmacology); Vega-Gonzalez, Y. (San Juan Bautista SoM, Biochemistry, Pharmacology); Pompilus, M. (UF, Psychiatry); Katzka, W. (UCLA, Microbiome Center); Lou, J. (LLU, Behavioral Health); Sharafeddin, F. (LLU, Physiology); De la Peña, I. (LLU, Pharmaceutical Sciences); Dong, T. (UCLA, Microbiome Center); Gupta, A. (UCLA, Microbiome Center); Viet, C. T. (LLU, Oral & Maxillofacial Surgery); Febo, M. (UF, Psychiatry); Figueroa, J. D. (LLU, Physiology)

Introduction

Childhood overweight/obesity is associated with the development of stress-related psychopathology. However, the pathways connecting childhood obesity to stress susceptibility remain poorly understood. Here, we used a systems biology approach to determine linkages underlying obesity-induced stress susceptibility.

Experimental

Sixty-two adolescent Lewis rats (PND21) were fed for four weeks with a Western-like high-saturated fat diet (WD, 41% kcal from fat) or control diet (CD, 13% kcal from fat). Subsequently, a group of rats ($n = 32$) were exposed to a 31-day model of predator exposures and social instability (PSS). The effects of WD and PSS were assessed with a comprehensive battery of behavioral tests, DTI (diffusion tensor imaging), NODDI (neurite orientation dispersion and density imaging) on an 11.1 Tesla scanner (UF AMRIS), high-throughput 16S ribosomal RNA gene sequencing for gut microbiome profiling, hippocampal microglia morphological and gene analysis, and gene methylation status of the stress marker, FKBP5. Parallel experiments were performed on human microglial cells (HMC3) to examine molecular mechanisms by which palmitic acid primes these cells to aberrant responses to cortisol.

Results and Discussion

Rats exposed to the WD and PSS exhibited deficits in sociability indices and increased fear and anxiety-like behaviors, food consumption, and body weight. WD and PSS interacted to alter indices of microstructural integrity in hippocampal formation (subiculum) and subfields (CA1). Microbiome diversity and taxa distribution revealed that WD/PSS caused significant shifts in diversity of gut dominant bacteria and decreased the abundance of Prevotellaceae. Interestingly, WD and PSS synergized to promote hippocampal microglia morphological and gene signatures implicated in neuroinflammation. These alterations were associated with changes in the expression and methylation status of the corticosterone receptor chaperone rat gene *Fkbp5*. HMC3 responses to cortisol were markedly disrupted after incubating cells in palmitate, shown by morphological changes and pro-inflammatory cytokine expression and release. Notably, these effects were partly mediated by the human FKBP5 gene (**Figure 13**).

Conclusion

The combination of psychosocial stress and poor diet during adolescence has a deleterious long-term coalescing impact on neuroimmune function and brain hippocampal microstructure.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida.

References

1. Vega-Torres, J.D., *et al*., Translational Psychiatry, 12(1), 83 (2022).

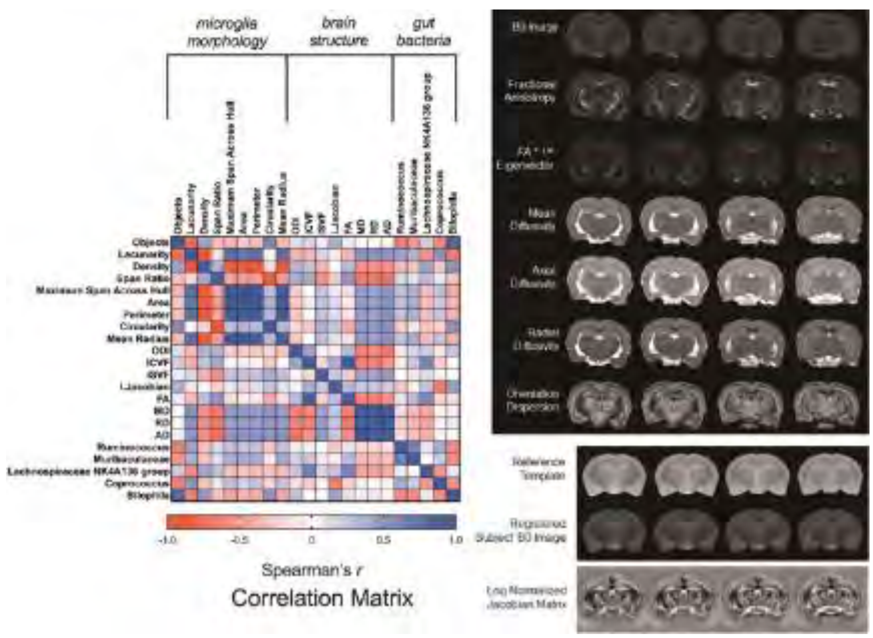


Figure 13. Statistical relationship between microglial morphology and neuroimmune signaling, brain structure, and gut microbiome. Shown to the right are representative DTI/NODDI maps (11.1 Tesla, UF AMRIS)

Early Life Adversity and the Ageing Brain – Obenaus Laboratory [10]

The Obenaus Laboratory at the University of California, Irvine (UCI) is utilizing the high-field MRI (17.6T) at AMRIS to examine regional and connectivity alterations within the brains of rodent models of disease. Specifically, we are using MRI to (1) unveil long-term alterations in the brain following early life adversity and their consequences later in life, and (2) identify microcellular features in the human Aβ knock-in (hAβKI) mouse model of Alzheimer's Disease (AD). In both research projects we are not only examining regional MRI metrics, but also probing connectivity between brain regions. These goals are accomplished using single and multi-shell diffusion MRI (dMRI), which is processed to characterize microcellular structures. Single-shell dMRI produces metrics including fractional anisotropy (FA), axial diffusivity (AxD), radial diffusivity (RD), and mean diffusivity (MD), but this method cannot account for intracellular vs extracellular fluids. Using the 17.6T MRI at AMRIS, we are able to acquire high-resolution multi-shell dMRI that enables the extraction of neurite orientation and dispersion density imaging (NODDI) metrics such as intra-cellular volume fraction, isotropic volume fraction, and the orientation dispersion index [1].

Early Life Adversity:

Characterization of the paraventricular nucleus of the thalamus and target connectivity. *Noarbe, B.N.; Wendel, K.M.; Obenaus, A. (UCI); Collins, J.H.P. (UF, AMRIS)*

The paraventricular nucleus of the thalamus (PVT) plays a crucial role in reward-seeking behaviors and has strong connectivity to the medial prefrontal cortex (mPFC), nucleus accumbens (NAcc), and amygdala [2]. The PVT is in very close proximity to its target regions, which results in angular tracts that are difficult to capture with lower-resolution imaging which is circumvented by use of the 17.6T at AMRIS. The tract that connects the PVT to the NAcc has been identified via viral-tracing studies [3] which has a distinct right angle turn as it descends from the PVT. The 17.6T easily captured this tract, mimicking the 3D-reconstructed viral-tracing data (**Figure 14**). We are unable to do this at 9.4T.

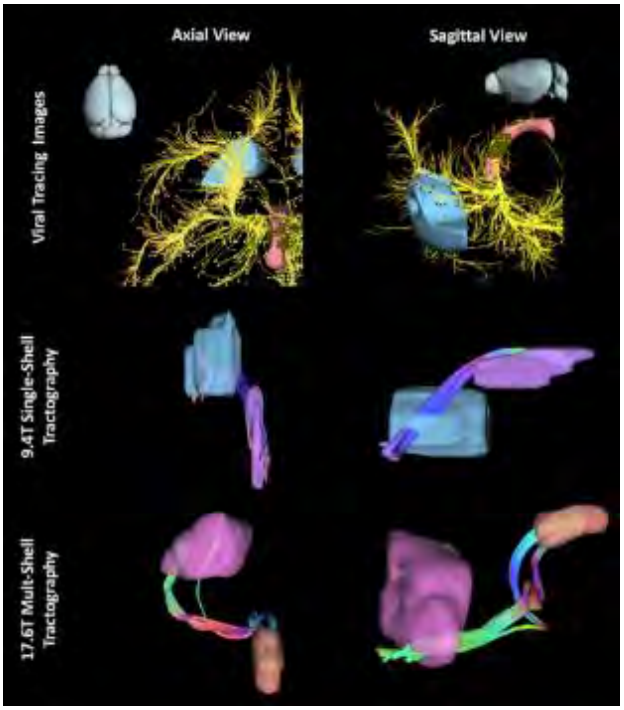


Figure 14. *Tractography generated from 17.6T scans between the PVT (colored red, purple, and orange from top to bottom) and NAcc (colored blue and purple from top to bottom) resemble the connections observed in viral tracing (top panel) but not at 9.4T.*

Alzheimer's Disease (AD):

Phenotyping a novel mouse model of late-onset AD, the hAβKI mouse. Noarbe, B.N.; *Jullienne, A.; Pad, R.; Obenaus, A. (UCI); Collins, J.H.P. (UF, AMRIS)*

The newly generated hAβKI mouse mimics late-onset AD with late in life cerebral Aβ and inflammation. No studies have reported dMRI investigations using this hAβKI mouse. Using the 17.6T at AMRIS, we documented that elevated FA in the hippocampus **(Figure 15**) is suggestive of reduced water symmetry and increased directionality. Previous studies in other AD mouse models [4] also report similar FA changes, but lower field MRI studies are not sensitive enough to distinguish between intra- and extracellular diffusivity. There is a strong correlation between the metrics generated with NODDI and AD pathology. In grey matter, the neurite dispersion index (NDI) had a strong correlation with Tau levels, while in white matter, the orientation dispersion index (ODI) was related to Tau pathology [4]. We will be assessing whether similar relationships apply with Aβ plaques using the data generated at AMRIS.

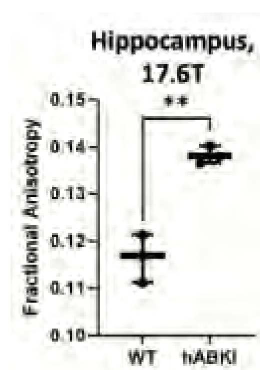


Figure 15. *FA is increased in the hippocampus of hAβKI mice, indicative of increased directionality and water asymmetry.*

Acknowledgements

This research in early life adversity and AD was financially supported by the National Institute of Mental Health (P50 MH 096889 06A1) and National Institute of Aging (NIH 1R21AG067613-01), respectively. A portion of these studies were conducted in the McKnight Brain Institute at the National High Magnetic Field Laboratory's AMRIS Facility, which is supported through NSF/DMR-1644779 and the State of Florida.

References

1. Barritt, A.W *et al, Frontiers in Neurology 9* (2018),
2. Kooiker, C., *et al*, *Frontiers in Behavioral Neuroscience 15* (2021),
3. Allen Institute for Brain Science, Allen Mouse Brain 3D Connectivity Viewer (2004), [4] Colgan, N., *et al, NeuroImage 125* (2016)

4.6 Magnets and Magnet Materials

Introduction

A central part of the MagLab's Mission is to develop, operate, and maintain the new magnet systems that enable a world-leading high-magnetic-field user program. One of the MagLab's science drivers is to develop the materials and other technologies required to enable these and other state-of-the art magnets. This effort is distributed among the MagLab's Magnet Science & Technology (MS&T) Division and Applied Superconductivity Center (ASC) at FSU and the Pulsed Field Facility (PFF) at LANL.

For twenty-six years, the MagLab's user facilities were based on copper alloys and low-temperature superconducting (LTS) materials. In 2020, the MagLab commissioned its first magnet using High Temperature Superconducting (HTS) materials, a 32T magnet, presently the highest field superconducting (SC) magnet worldwide. In 2022, this magnet won an R&D 100 award. The total cost to develop the technology and deliver the working system, which exceeded $16M, is an indication of the tremendous amount of development that went into characterizing the conductor. We developed an insulation system, joints, terminals, winding technology, quench-protection technology and controls system.

While this magnet produced a remarkable 7T more field than any other SC magnet worldwide when it was first tested in 2017, this is not the end of the story, rather just the beginning. The MagLab has initiated development of a 40T SC magnet using similar REBCO technology. In October 2021, we received a $15.8M grant from NSF's Mid-Scale Research Infrastructure program to fund the Preliminary and Final Designs of the 40T magnet system. This effort has been the centerpiece of work in MS&T during 2022. We intend to submit a proposal for construction of the magnet in 2025.

Meanwhile, development of ultra-high field (UHF) superconducting (SC) magnets (above 24T) has picked up pace worldwide, both in government labs and the commercial sector. Like the 32T and 40T magnets above, most efforts worldwide use the REBCO tape conductor. Uniquely, the MagLab has been leading the development of improved Bi-2212 ($Bi_2Sr_2CaCu_2O_{10}$) conductor and coils which show great potential for future UHF SC magnets, particularly due to the system's multi-filamentary structure and consequent low screening currents and resulting field distortion. Recent test coils have demonstrated very high current densities and great progress is being made to support the Lorenz forces inherent in UHF magnets.

In 2018, the generator that powers the 100T multi-shot (100TMS) and 60T long-pulse (60TLP) magnets was taken out of service for repair when damage was detected. To continue to provide state-of-the-art facilities to users of the pulsed field facility, a "Magnet Surge" project was introduced to accelerate the development of capacitor-driven magnets at the 75T level in short-pulses and the 60T level with longer pulses as well as an 80T short pulse magnet. The 75T has been operational since early 2020 and the 60T mid-pulse since mid-2021. The 80T project has been upgraded to 85T and is now ready for testing.

Materials development for magnet applications continues to advance with important developments in Bi-2212, Fe-based, and Nb_3Sn superconductors, qualification of REBCO from multiple suppliers, as well as reinforcing materials for pulsed and SC magnets.

Collaborations with leading industry, academic and government groups are synergistic with the materials and magnets science driver, and our report describes work in this broader context as well. Collaboration with the high-energy physics community continues, particularly regarding development of higher current-density superconductors, both LTS and HTS. The MagLab's ASC is one of the four central players in the US Magnet Development Program (MDP) funded by the Department of Energy's (DOE's) Office of High Energy Physics (HEP) to drive ultra-high field accelerator dipole magnet technology. In recent years, funding from DOE Fusion Energy Sciences (FES) has enabled some testing of coils based on cables.

REBCO Magnets & Conductors

40 T Superconducting Magnet:

The MagLab is developing a 40T all superconducting (SC) user magnet with a cold bore size of 34mm. When complete, the 40T SC magnet will be installed in the DC Field facility of the MagLab, near the existing 32T SC magnet. The 40T SC magnet will provide inhomogeneity less than 500 parts per million over a 10mm diameter spherical volume and a very low noise environment for experiments lasting days at a time, surpassing the time available from present-day powered (resistive and hybrid) magnets. Upon its commissioning, the 40T SC magnet will become a flagship in the MagLab's suite of high-field magnets that exist to serve the User Community.

The R&D Phase of the magnet started in late 2018 followed by a Conceptual Design stage starting in late 2019. A Design grant from NSF's Mid-Scale Research Infrastructure (MS-RI) program to cover the Preliminary and Final Design stages was received in late 2021. We expect the Final Design stage to start in 2023. The design grant will expire in 2026. We intend to submit a construction proposal for the 40T magnet to the MS-RI program in 2025. The paragraphs below highlight the achievements in 2022.

The 40T magnet conceptual design consists of a set of coils based on High Temperature Superconductor (HTS) providing 28T nested in the 320mm bore of a 12T coil set based on Low Temperature Superconductors (LTS). The LTS magnet will be acquired commercially and the 28T HTS insert will be designed and fabricated in house. The conceptual design of 28T HTS insert includes two options, both based on Rare Earth Barium Copper Oxide (REBCO) tape. Multi-Tape Insulated (MTI) REBCO uses multiple REBCO tapes in parallel within a turn and insulation between turns. Resistive Insulation (RI) REBCO uses a single REBCO tape in each turn, but controlled resistance between turns instead of insulation. **Figure 1** shows the field distribution.

While the MagLab designed, built and presently operates a 32T SC magnet that also uses REBCO conductor, the 40T magnet will require higher current density, different grades of conductors, better stress management, different coil-winding technology and a better quench protection system. Prior to committing to constructing the full-scale coils of the 40 T magnet the new technology will be demonstrated in a series of progressively larger test coils that are designed, built, and tested, with each coil building of knowledge gained in previous tests. During the R&D Phase we focused on "sub-scale" coils that used less than 250m of conductor. During the Conceptual Design Phase (2019 – 2021), we focused on "mid-scale" coils that use up to 1.2km of conductor. During 2022, we were working on larger test coils using up to 4.6km of conductor.

The coils of both the 32T and 40T SC magnets are constructed using "double-pancake" technology. One starts winding at the middle

Figure 1. *Installing the instrumentation wiring on TC2.*

Figure 2. *Testing of MTI-TC2*

Figure 3. *Test coil RI-NC after assembly.*

of a piece of tape and winds a spiral to make a planar coil (pancake) placing turns on top of each other from the inner diameter (ID) to the outer diameter (OD). One then returns to the ID of the completed pancake and winds a helical turn followed by numerous spiral turns to complete the second pancake. A double-pancake, or module, can thus be wound from a single piece of tape and have both terminals at the OD. Modules are stacked and jointed to make coils which are nested to make magnets.

(1) HTS technology validation via testing mid-scale HTS coils

In the 2022, two mid-scale test coils were fabricated and tested: one was Multi Tape Insulation test coil MTI-TC2, the other was Resistive Insulation with Nested Coils test coil RI-NC.

MTI-TC2 (**Figures 1, 2**) was built to validate a number of novel features of the 40T MTI-design including: (1) winding pancakes with two conductors in parallel, (2) use of multiple grades of REBCO conductor, (3) quench protection using a Pulse Forming Network (PFN) instead of a battery bank, (4) graded quench protection heaters, (5) improved mechanical support of the end pancakes and terminals, (6) high operating current (> 650A), (7) and high copper current density during quench (j_{cu} > 680A/mm^2). It consisted of a total of 12 modules with a total conductor length of 1.4km. Test coil MTI-TC2 reached the desired operating current and was intentionally quenched about 20 times without observing degradation in the HTS modules. The coil dishing was greatly reduced compared with previous test coils and the terminals did not show degradations.

RI-NC (**Figure 3**) was built to validate various novel RI-REBCO coil design features including (1) quench protection of nested RI-REBCO coils, (2) coils built with multiple grades of REBCO conductor, (3) controlled resistance between turns, (4) improved quench heaters, (5) inductive quench initiation coils, (6) a capacitor bank as an energy source for quench protection, (7) improved terminal design, (8) a new end pancake design to reduce distortion, (9) high nominal current density in the copper during quench (j_{cu} > 1500A/mm^2). The RI-NC consisted of 12 modules in the inner coil and 18 modules in the outer coil with a total conductor length of 3.5km. The test coil RI-NC was completed and it reached a maximum field of 19.2T without any background field with a current of 224A. A dozen quench tests were performed on RI-NC with a variety of different energy levels to the quench heaters and inductive coils. Coil degradation was observed after quench testing and several modules clearly showed damage after disassembly.

After the testing of the two mid-scale test coils, it became clear that while the RI-REBCO technology shows potential to enable higher current-density coils than is possible with MTI technology, more R&D is required at this time. MTI-REBCO was chosen as the technology for remainder of the 40T magnet project.

(2) REBCO conductor characterization

If all the conductors of the 40T magnet have the same critical current, I_c, the ones at the mid-plane of the magnet will be operating at a small ratio of operating to critical current (I_{op}/I_c). At low I_{op}/I_c the energy required to drive the REBCO conductor from the SC state to the normal state is large and the quench protection system needs to be sized appropriately. Also, strain due to screening current will be larger than ideal and more reinforcement will be required resulting in a larger coil. To produce a more compact magnet with modest energy storage in the quench protection system, different grades of conductor are used in different parts of the coil. The ends of the coils, where the angle between the tape's face and the magnetic field is large, require tapes with high I_c. Tapes near the mid-plane with small angle between the tape face and magnetic field require lower I_c.

REBCO tape manufacturers have typically not made a variety of grades of conductor in the past. Some suppliers are now agreeing to make graded tapes based on this need. The new tapes require extensive characterization to confirm that they meet the performance goals, similar to the more traditional ungraded tapes. Extensive tests on REBCO conductor were performed in the 40T project in 2022 measuring: (1) I_c at fixed angles and high field, (2) I_c dependence on field-angle and temperature, (3) room-temperature resistance ratio (RRR) of the copper cladding in the composite conductor, (4) tilt of the *ab*-plane of the REBCO crystal compared with the Hastelloy substrate, (5) electrical resistance of joints, (6) fatigue life, (7) yield strength, (8) the strain at which the I_c reduction becomes irreversible, and (9) imaging the defects in the REBCO tape, among others. **Figure 4** shows the measured I_c of the tapes received as part of the 40T project which varies over a large range as required by the 40T design.

The grading of I_c has been demonstrated by the vendor but the level of control of I_c is not yet ideal. **Figure 5** shows the variation in I_c from the preferred value for tapes received. As was done in the 32T magnet, we measure the I_c of all the tapes upon receipt and determine where they will be best used in the test coils. We expect to continue to do this for the 40T user magnet.

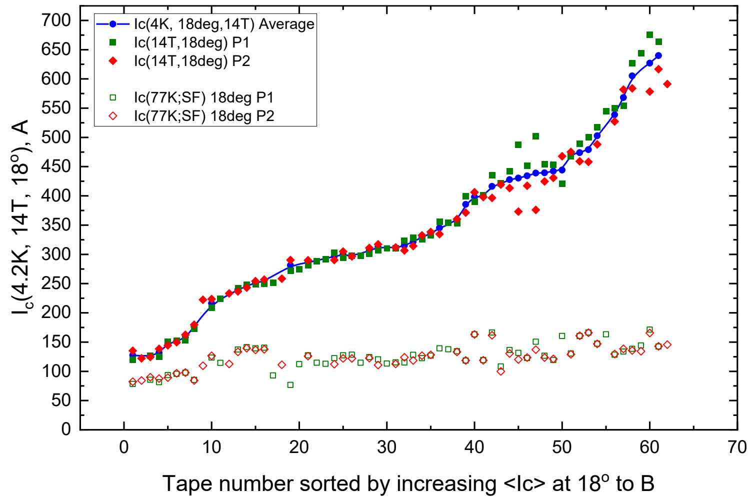


Figure 4. *REBCO conductor of graded I_c*

The critical current of REBCO tape depends on the magnet field, field angle and temperature. A new I_c measurement technology, Torque Magnetometry, was developed at the MagLab. When the REBCO sample is installed and rotated in the field, the screening current changes due to the I_c dependence on the angle, and then the torque caused by the screening current is measured. Then the critical current is calculated from the torque. **Figure 6** shows a typical measurement result by torque magnetometry. This measurement method provides much more data more quickly than our traditional approach and will be used in the next large scale test coils in the 40T.

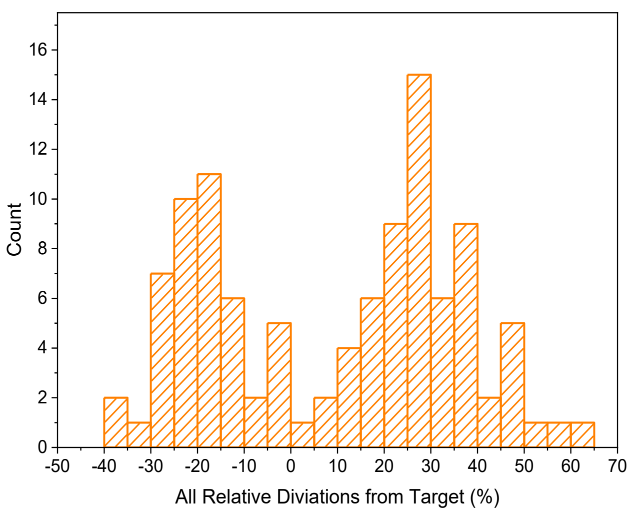


Figure 5. *The I_c deviation of received tapes*

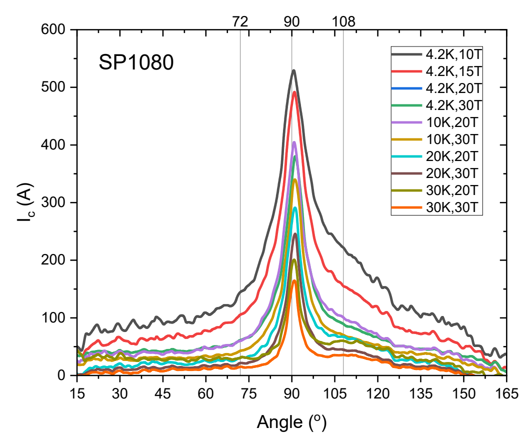


Figure 6. *Typical angular and temperature dependence of I_c, measured by torque magnetometry.*

(3) Technology review and selection for 40T magnet

In the 40T project, one major milestone was to select by the end of 2022 the insulation technology (MTI or RI) to be used for the remainder of the 40 T project.

The 40T project has two different external annual reviews. An international External Technical Advisory Committee (ETAC) is organized by the director of the MagLab. There are ten ETAC members with expertise in a number of different aspects of this project: three experts on REBCO superconductors, three on superconducting magnets, two on project management, and two on the science to be done by the magnet once it is complete. The first meeting of the ETAC was held in November 2022 at the MagLab. This date was chosen to allow us to get their input prior to making the decision on which insulation technology to use for the remainder of the project. The committee concluded that outstanding work has been performed on the 40T development and also expressed their opinion of the MTI technology appears to be more promising at this point.

A 40T Executive Steering Group (ESG) meeting was held in December where the ESG decided to select the MTI technology to be used for the 40T superconducting magnet. The RI technology was down selected from the 40T project.

The second annual review is a Site Visit organized by NSF with a separate external committee. This committee is expected to meet in March 2023 with two magnet designers, one project manager, and one expert on the scientific application of the magnet.

Mechanically Robust CORC™ Cable Solenoids:

The REBCO magnet technology above is focused on relatively small coils. For larger coils, particularly those needed for fusion or next-generation particle accelerators, higher-current cables are required. One potential route to high-current cables is the Conductor on Round Core (CORC®) approach developed by Advanced Conductor Technologies (ACT). In 2022, we have tested a magnet design in which a CORC® cable was wound into grooved metal mandrels with insulation but without epoxy or other filler as shown in **Figure 7** left. The coil was developed by ACT in collaboration with the Princeton Plasma Physics Laboratory (PPPL) and the Applied Superconductivity Center at the National High Magnetic Field Laboratory (ASC-NHMFL), as a potential route to manufacture high-field Ohmic Heating (OH) coils for compact fusion reactors. The 2-layer thick coil was about 60mm high, had a total of 12 turns with an ID of 119mm and an OD of 152mm. Initial stand-alone testing in liquid nitrogen and liquid helium at current ramp rates relevant for OH coils up to 5kA/s showed no limitations. Further testing at the ASC was carried out inside our 14T, 161mm cold bore LTS outsert magnet. At 12T, the coil had a critical current of about 4,500A, corresponding to an engineering current density of 193 – 197A/mm^2 and a peak hoop stress of 173.5MPa.

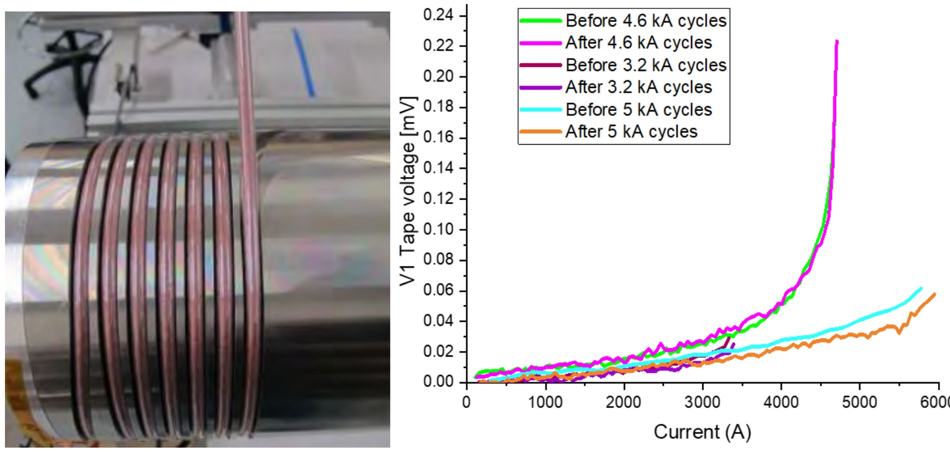


***Figure 7. Left** Prototype ohmic heating coil with REBCO CORC® cable wound into grooved stainless steel mandrels **Right** Voltage as a function of current measured with co-wound voltage pair V1 before and after each set of fatigue cycles in a background field of 5 to 12T at 4K.*

A primary goal of limited fatigue cycling was carried out judiciously given limited liquid helium availability, including 67 cycles to a peak stress of 173.5MPa. Cycling did not show any sign of conductor degradation. The results demonstrate the feasibility of operating dry-wound CORC® cable magnets in which cable movement is allowed, which significantly facilitates manufacturing of high-field coils that operate at high current densities and high current ramp rates, **Figure 7** [3].

Bi-2212 Magnets & Conductors

25T general science magnet with Bi-2212:

One of the goals the ASC's goal is to develop compact 25T, all superconducting, general science magnets. Two projects that we are currently working on are in collaboration with Cryomagnetics Inc. and Oxford Instruments (OI). The final magnet systems will consist of 17T low temperature superconducting (LTS) outserts with 8T Bi-2212 coils nested inside. While the Cryomagnetics project envisions the HTS insert to be powered separately from the LTS outsert, the

OI project envisions the insert to be powered in series thus requiring a specific (smaller) conductor Bi-2212 diameter [1].

28T SC magnet with high homogeneity (HH):

In 2022, ASC researchers resubmitted a proposal to the National Institutes of Health (NIH) for a 28T HH magnet system. If funded, this work will be carried out in collaboration with OI. This project will benefit highly from the results gained in our work on the 25T general science magnets while moving beyond those goals in terms of field increment and field stability. As an efficient way to reduce total costs, we intend to use our 12T LTS magnet made by OI as an "outsert". The preliminary design calls for an HTS insert to consist of two inner coils made with Bi-2212 conductor nested inside a layer-wound coil made with Bi-2223 (*i.e.,* $Bi_2Sr_2Ca_2Cu_3O_{14}$). By combining Bi-2212 and Bi-2223, we get a final product that is more cost effective than an all-Bi-2212 insert while also overcoming the minimum bending radius constraint of Bi-223 coils. Models, including of a particular arrangement of field compensation coils and shims (as per collaboration agreement with OINS, further details cannot be shown), predict a field homogeneity within the target range of 1ppm (**Figure 1**). Achieving this homogeneity would be a significant step toward a nuclear magnetic resonance (NMR) magnet at 1.1 GHz and above [2].

Bi-2212 and Bi-2223 Insert Coil Design for 28.2 T / 40 mm Bore UHF NMR Magnet System		
Bi-2212 Coil #1	a1; a2; z1; z2 [mm]	22.2; 40.5; -178.6; 178.6
	Turns	3920
	Field [T]	5.17
	wire length [km]	0.77
Bi-2212 Coil #2	a1; a2; z1; z2 [mm]	44.45; 55.3; -178.6; 178.6
	Turns	2240
	Field [T]	2.89
	wire length [km]	0.71
Bi-2223 Coil	a1; a2; z1; z2 [mm]	58.5; 81.4; -212.5; 212.5
	Turns	5767
	Field [T]	6.16
	wire length [km]	2.6
HTS Section Current [A]		380.5
Store Energy [MJ]		< 3 (~0.5 MJ in HTS)

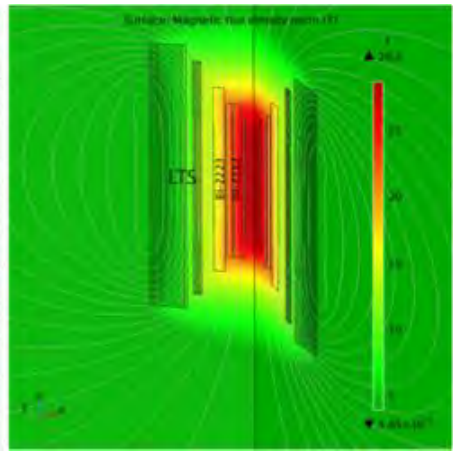


Figure 1: *Overview of the 28T HH magnet to be built in collaboration with OI. The magnet consists of three HTS sections (two Bi-2212 coils and one Bi-2223 coil) nested inside the 12T IMPDAHMA LTS magnet. The cold bore of the system will be ~40mm. Field compensators and shim-coil sets are not shown in this picture.*

Low inductance high-field coils with 2212 Rutherford cable:

The motivation of 2212 Rutherford cable related work in ASC is threefold:

- To explore a pathway towards low inductance (easier to protect) ultra-high field magnets, like research magnets or advanced HEP accelerator concepts including muon collider cooling magnets, which fits within the framework of the DOE Magnet Development Program (MDP), where we collaborate with other leading national laboratories.
- Develop a deeper understanding of the role Bi-2212 Rutherford cable can play within the framework of ASC's nuclear fusion efforts funded by DOE Fusion Energy Science (FES).
- To develop a pathway towards a 50+ T magnet system, which is a goal of the MagLab.

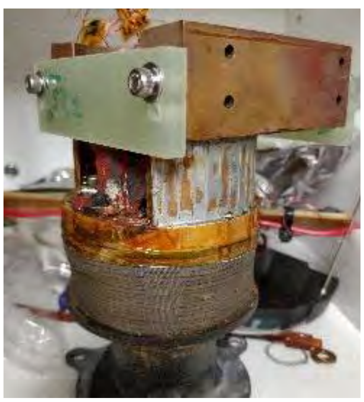


Figure 2. *The fully instrumented Rutherford cable coil and terminals before testing. Due to the small cross-sectional area, the copper terminals were laced with several strips of ReBCO conductor.*

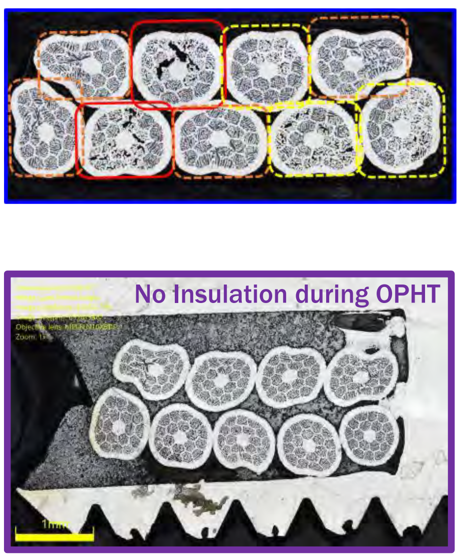


Figure 3. a) *A typical cross section of one of the cables used in the coil. Several instances of leakage but also a certain amount of interfilametary coupling are clearly visible.* ***b)*** *The cross section of the cable in the terminal area, where the alumino-silicate fiber was removed before the over-pressure heat treatment (OPHT), does not show any indications of conductor leakage.*

The 2212 Rutherford cable coil introduced here last year has since been tested in field and a postmortem examination was carried out to understand both the origin and extent of the conductor leakage throughout the winding pack, **Figure 2.** Postmortems have shown to be highly effective in not only understanding our solenoids but also in helping LBNL to understand their questions within their high-field dipole program. As expected from the amount of observed leakage, the coil was limited to a strand performance of about 40% of short sample performance. The coil nevertheless reached a central field of 1.17T at 8T background at an operating current of 1,649A and ramp rates of up to 438A/s. The postmortem revealed that the observed leakage is clearly not superficial and extends throughout the winding pack except the terminal section that was not exposed to the alumino-silicate insulation braid, (**Figures 3a, b**). While the high occurrence of leaks in this coil certainly provided a major contribution to its reduced performance, comparison to postmortems of LBNL dipole coils gives stronger correlations to the relative contribution from leakage and other factors, like interfilamentary coupling promoted by the deformation in the conductor cabling process, that appears to account for up to 15% of losses. More Rutherford cable coils will be made in 2023 particularly addressing the specifics of the TiO_2 coating of cable either by establishing a dedicated coating route for it or by switching to a different braiding material that may eliminate the need for a TiO_2 layer.

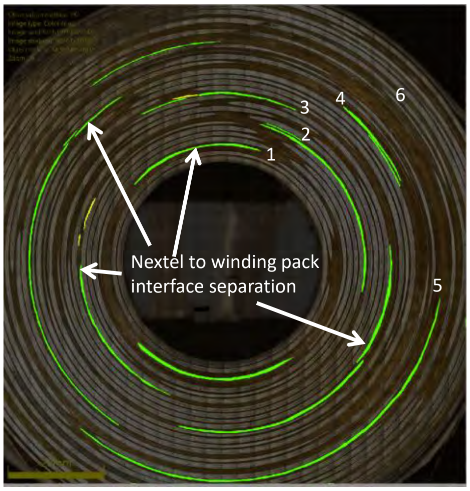


Figure 4. *Pattern of cracks in Cryo-4 as extracted from an optical microscope image panorama of a transverse cut through the coil.*

Bi-2212 strand-based coils:

Work continues in ASC on avenues to mechanical reinforcement of coils to make them withstand the enormous forces exerted on the coil windings under operating conditions. Two more medium size (~200m class) coils, Pup-10 and Cryo-4 have been made this year, tested in field, and a postmortem has been carried out on Pup-10. Guided by our FEA models, both coils were manufactured with two differing distributions but the same number of reinforcement bands inside the winding pack to evaluate their impact on the coil integrity. Shown in postmortem **Figure 4,** there are cracks within the reinforcement layers of the same kind as seen previously in the Pup-9 coil. However, their impact on the transport properties appears to be significantly smaller than observed in Pup-9 as can be seen clearly in **Figure 5**. Also, the trend of excellent transport properties in non-degraded sections throughout the winding pack still holds. For in-field

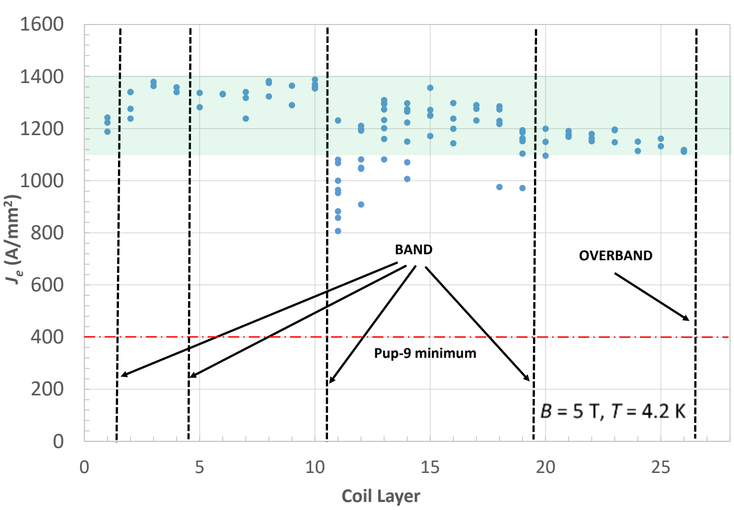


Figure 5. *Transport properties of extracted samples from Pup-10. The performance in the degraded samples around layer 11 is significantly less than observed in the previous Pup-9 coil. The transport properties in the undamaged layers of the coil are excellent throughout the winding pack.*

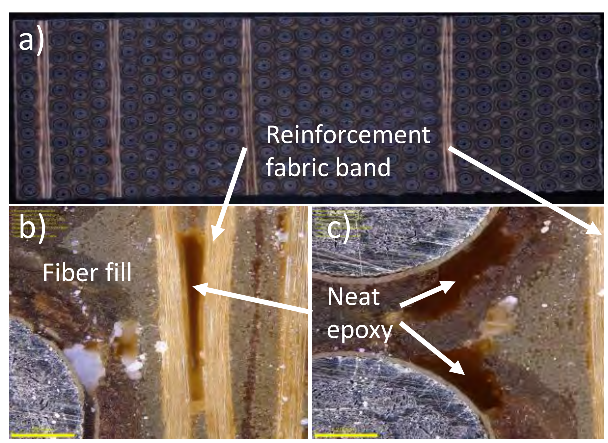


Figure 6. *a) Cross section of a Bi-2212 coil with internal fabric reinforcement layers. As typical for a woven fabric, some of the rovings run in azimuthal direction while some run in the axial direction of the coil. b) and c) Close ups of the reinforcement layer. The dark amber areas clearly show the presence of neat epoxy in the vicinity of it.*

tests, coil Cryo-4 shows the best performance thus far among all previously made coils. The coil could be stably operated at about 71% of the short sample limit, generating a combined peak field of 17.9T (12T LTS background). At a peak average hoop stress of about 386MPa, the coil was able to withstand an average stress equal to twice the breaking stress of a single wire highlighting the efficacy of the reinforcement scheme chosen for this coil. During repeated deliberate quenches at field, matrix current densities of up to 726A/mm^2 were reached. To address the observed tendency to develop cracks within the fabric reinforcement layers, these areas were studied in more detail. As can be seen in **Figure 6a**, a portion of the fibers within the fabric layer run parallel to the axis of the coil, which is not beneficial in terms of supporting hoop stresses and may promote cracks due to the presence of radial stresses under operational conditions. A closer look at the fabric layers also revealed the presence of larger quantities of neat (i.e., unfilled) epoxy that may contribute to the weakness of this area towards radial stress components, as shown in **Figures 6b, c**. The underlying reason for the presence of neat epoxy in this area is the fact that, for practical reasons, the fabric layer cannot be applied under well controlled back tension during the coil winding process thus leaving a certain amount of void space behind. In 2022, we started working on a different approach to apply the internal reinforcement bands, while at the same time exploring the perspectives for an exchange of the conductor braiding material with a material of better mechanical properties and chemical compatibility. About 150m of conductor have been wrapped with the new material and will be tested in depth this year.

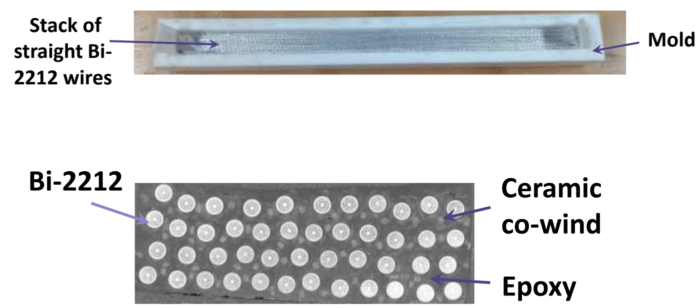


Figure 7. *(above) Bi-2212 wires stacked in Teflon mold. (below) Cross section of winding pack sample with reinforcement elements.*

Mechanical properties in a Bi-2212 coil pack:

Accurately predicting the stress-strain state of a superconducting magnet requires one to know the elastic moduli of the coil pack. Given that Bi-2212 coils are typically composed of a multitude of materials (Bi-2212 wire, insulating braid, ceramic co-winds, epoxy, etc.) and are loaded in three dimensions, the "rule-of-mixtures" does not provide sufficient accuracy. One PhD student at ASC has just started trying to measure the elastic moduli. A series of samples are being made that emulate important elements of a coil winding pack (**Figure 7**). Initial testing of samples

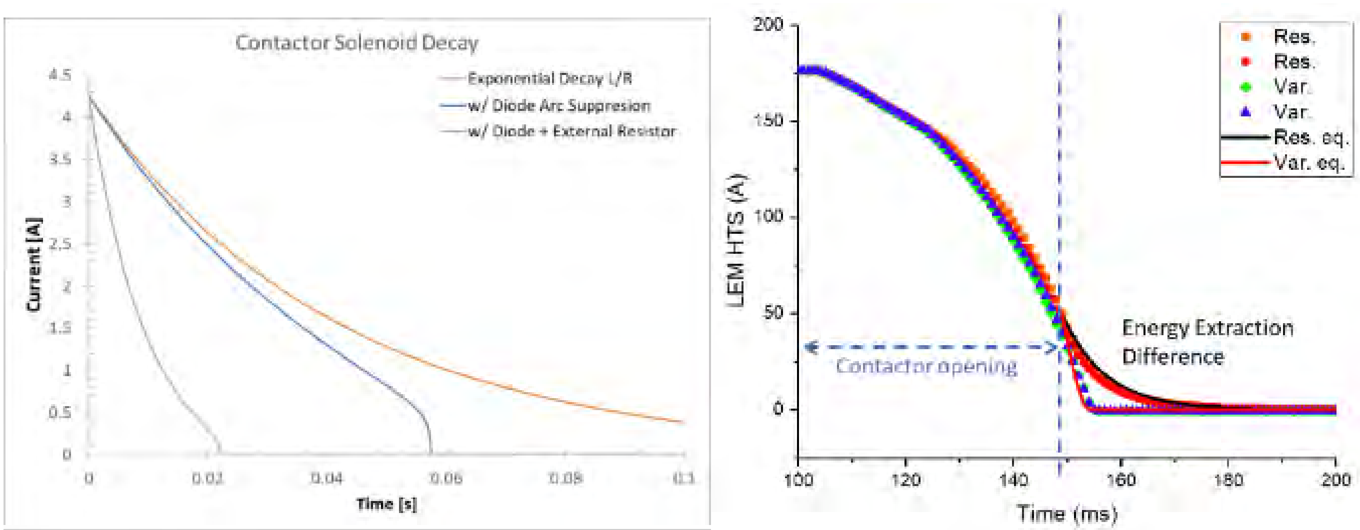


Figure 8. Left *Current decay calculation of mechanical contactor solenoids used for removing power supply from quenching magnet circuit show a trade-off between relay-driver over-voltage protection and arc suppression.* ***Right*** *Current decay measured during quench protection is improved by a non-linear varistor compared to a dump resistor, but quench is still limited by the contactor.*

representing both reinforced and un-reinforced winding packs have been completed on the Lab's MTS tensile testing machine at cryogenic temperatures. In 2023, there are plans for this experimental work to continue. New winding pack samples will be fabricated to confirm the findings of the initial tests. Alongside gathering data on the elastic moduli, these samples will also be used to study thermal contraction and fatigue behavior. Additionally, there are plans to fabricate and characterize the mechanical properties of samples representing different winding pack compositions (e.g., containing different kinds of epoxy). These samples will allow for the exploration of potential new winding pack compositions for Bi-2212 coils.

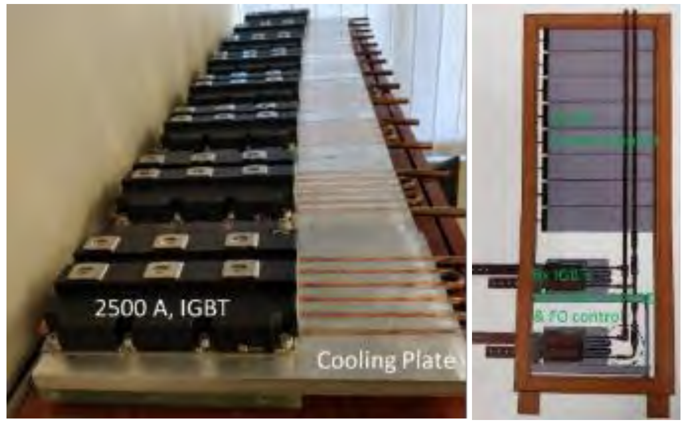


Figure 9. Left *Assembled IGBTs with thermal interface, cooling plates, and support plate.* ***Right*** *Drawing of IGBTs mounted below 10kA DC power supplies, replacing the existing mechanical contractors.*

Quench protection:

When an SC magnet quenches, the energy stored in the magnetic field must be dissipated safely. There are two basic approaches. For small magnets, the energy is typically distributed over the SC coils themselves. It must be distributed uniformly over the coils to prevent a hotspot from damaging the coils. For larger magnets, the energy is typically extracted to an external dump resistor. With either approach, the faster the detection and protection systems can work, the higher current density the magnet can support and more compact it will be. Work to evaluate non-linear varistor extraction showed only a portion of the predicted improvements, limited by the solenoid-driven mechanical contactors' arc-suppression time (**Figure 8**). A design to upgrade this circuitry replacing contactors with insulated-gate bipolar transistors (IGBT) has been completed. We anticipate this should allow switching times on the order of 1μs for the full 10kA capacity of our test facility. We are now in the process of implementing it, (**Figure 9**).

Over-pressure heat treatment (OPHT) process and furnace development and implementation

A new, larger OPHT furnace was installed at the ASC in 2021 with approximately 8 times the volume of the old one. It is now going through its final shakedown phase. Several test runs have been carried out at increasing temperatures and pressures. The newly developed LabView control software has performed very well during these tests and will from now on replace the older IDEC control software. During the most recent run an issue was identified leading to arcing between the heater insert and a part of the housing, which degraded the terminals of the heater insert. The heater insert is currently under repair at the manufacturer, where it will also be upgraded by adding additional electrical insulation at critical locations. We expect the repaired insert to be shipped back to us soon to continue and finish the commissioning phase of the new furnace and begin heat treating coils.

References for OPHT

[1] U.P. Trociewitz, Y. Kim, D.S. Davis, E.S. Bosque, Very High Field Superconducting Magnet Using Bi-2212, STTR with Cryomagnetics Inc., US Dept. of Energy (DOE) flow through, DOE Award Number: DE-SC0018683 (2022).

[2] U.P. Trociewitz, E.S. Bosque, L.D. Cooley, D.S. Davis, Y. Kim, D.C. Larbalestier, J. Long, W.S. Marshall, R. Shurko, Ultra-High Field NMR Magnets with Multifilament High temperature Superconductors, RO1 proposal to NIH, pending (2022).

[3] D.S. Davis, U.P. Trociewitz, G. Miller, A. Hernandez Chapa, Z. Johnson, J. Weiss, D.C. van der Laan, D.C. Larbalestier, Y. Zhai, Stress cycling performance of a dry-wound, two-layer CORC® cable solenoid within a 12 T background field, to be submitted to SUST (2022).

Other Superconducting Materials

Nb_3Sn superconducting wire

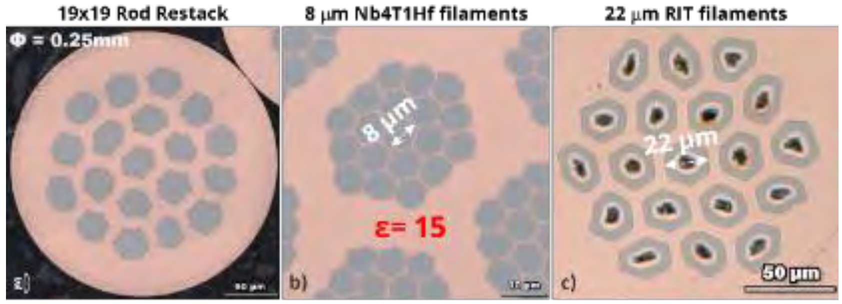


Figure 1. *(a-b) Nb4Ta1Hf rods restacked in a Cu matrix and drawn down to 8 µm diameter. (c) Nb4Ta1Hf tubes used in a rod-in-tube (RIT) wire drawn to 22 µm tube diameter.*

Improving the performance of high field Nb_3Sn wires is essential for the realization of the next generation of accelerator magnets, like for the Future Circular Collider (FCC) at CERN. In particular, present commercial wires cannot reach the required J_c and effective filament diameter (non-Cu J_c(4.2 K,16T) = 1500A/mm^2,d_{eff} <30µm), which stimulated researchers in ASC to develop our own Nb_3Sn wire. After our discovery of the beneficial effect of hafnium addition [1,2] to enhance J_c, we demonstrated that, despite the increase in hardness, the draw-ability of Nb4Ta1Hf is comparable to that of Nb47%Ti used to make long lengths of wire for most accelerator magnets. This draw-ability allows fabrication of very fine filaments both as rods in a Cu matrix (**Figure 1 (a-b)**) and as tubes **(Figure 1 (c)**) to make Nb-alloy Sn-Cu composites [3].

The key issue in forming high quality Ta- and Hf- alloyed Nb_3Sn with the A15 structure is understanding the effect of the intermediate Cu-Sn mixing reaction. To tackle this problem, we fabricated Rod-In-Tube wires made with both NbTa and NbTaHf tubes in 19 and 19×6 filament stacks using a "low-Sn" Cu:Sn ratio of 3:1 and later a more Sn-rich 6:5 mixture in the filament cores. We expected the low-Sn 3:1 mixture would lead to the formation of high quality A15 phase through a solid-state reaction, whereas the 6:5 mixture would melt at 408 °C, corroding the Nb alloy to form Nausite ($Nb_{0.75}Cu_{0.25}Sn_2$), which then leads to a disconnected internal A15 layer **(Figure 2** bottom). However, despite multiple heat treatment attempts, our 3:1 wires have always exhibited a T_c depressed by ~2 K, whereas the 6:5 wire produces T_c transitions better than even those from commercial wires. Consequently, further opportunity exists to properly mix the Sn and Cu to make Sn-rich bronze in contact with the Nb alloy. Indeed, a study led by an undergraduate student, John Tietsworth, **Figure 2,** clarified a vital difference between the lower (3:1) and higher (6:5) Sn wires. Even after a lengthy 3-stage mixing HT, almost Sn-free Cu rings are left at the Nb alloy interface for the 3:1 design. By contrast, the well-defined Nausite ring for the 6:5 design visible at 525 °C, degrades into an A15 rubble after 50 h/665 °C but with a high quality external A15 layer. This study showed that to find a proper Cu:Sn mixture and a proper reaction heat treatment to form high quality A15 with these alloying elements, we have to take into account both the complexity of the ternary Nb-Sn-Cu phase diagram and design features that assure shorter diffusion distances. This should allow us to make a fully saturated α-bronze (~9 at.%Sn) of high chemical activity in contact with the Nb-alloy tube and produce stoichiometric Ta- and Hf- alloyed Nb_3Sn (i.e. $(Nb,Ta,Hf)_3Sn$).

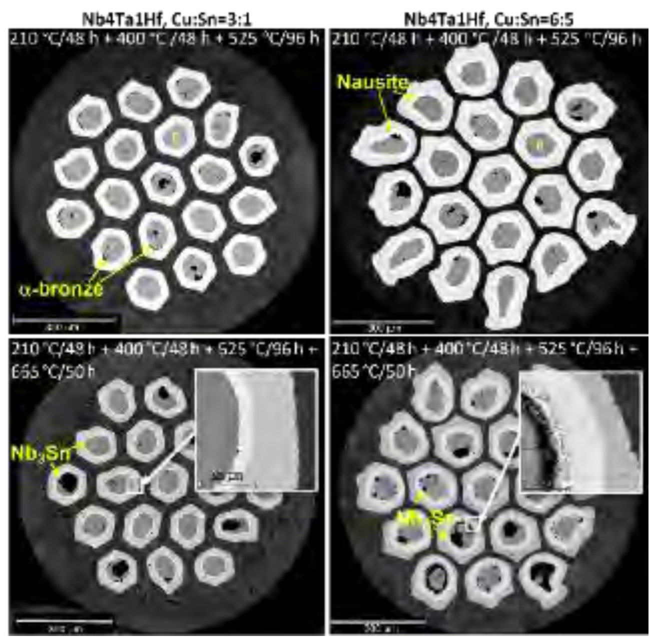


Figure 2. *FESEM-BSE images of 19-filaments Nb4Ta1Hf wires with Cu:Sn = 3:1 (left) and 6:5 (right). On top is mixing up to 525 °C, at bottom after A15 reaction at 665 °C. Direct reaction 3:1 shows uniform Nb3Sn layer, whereas the Nb6Sn5 layer made via Nausite has much large grain debris at the interface that does not carry current.*

References for Nb_3Sn

[1] S. Balachandran *et al*., Beneficial influence of Hf and Zr additions to Nb4at.%Ta on the vortex pinning of Nb_3Sn with and without an O source, *Supercond. Sci. Technol.* 32, 044006 (2019)

[2] C. Tarantini *et al*., Origin of the enhanced Nb_3Sn performance by combined Hf and Ta doping, *Sci. Rep.* 11, 17845 (2021)

[3] S. Balachandran *et al.*, Comparative drawability and recrystallization evaluation of Nb4Ta and Nb4Ta1Hf alloys, and the beneficial influence of Hf on developing finer Nb_3Sn grain size and higher superconducting critical current density, submitted

Acknowledgements for Nb_3Sn This work has been supported by grants from the Office of High Energy Physics under DE-SC0018683, and DE-SC0010421, which are amplified by the US Magnet Development Program.

Fe-based superconductors (FBS)

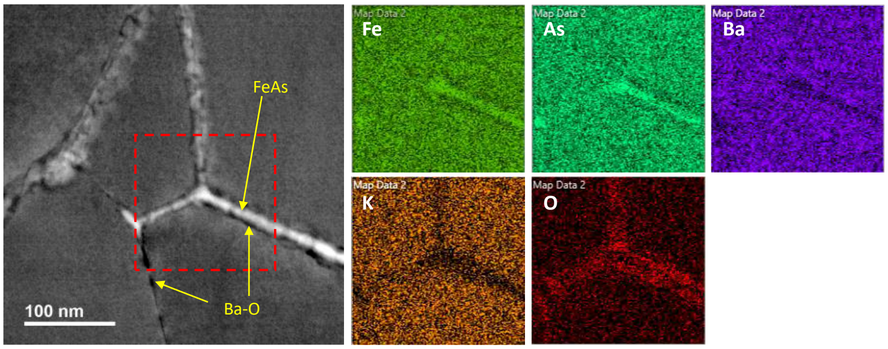


Figure 3. *Energy dispersive X-ray spectrum (EDS) elemental maps showing the compositional segregations in the Ag-HP sample. At the GBs, the continuous bright contrasts are FeAs, whereas the discontinuous dark contrasts are Ba-O [3].*

The highest J_c of polycrystalline $BaFe_2As_2$ (Ba122) reported to date is in flat tape conductors. It is considered that such high J_c tapes contain uniaxially textured Ba122 grains with the intrinsic grain-misorientation effects minimized as being consistent with bi-crystal studies. Also, the high packing density of Ba122 in tape after high-pressure pressing may also significantly enhance the physical connectivity. However, the important question is whether the J_c of those tapes is induced and/or is limited by the same mechanisms. For addressing such a question, researchers in ASC employed analytical scanning transmission electron microscopy (S/TEM) to investigate the grain and GB nanostructures in the similarly high J_c K-Ba122 tapes made by different fabrication processes. We examined the two K-Ba122 tapes, both of which were made by the powder-in-tube method. The first tape is Ag-sheathed and was prepared by the hot pressing (sample Ag-HP) [1]. The second tape is double-sheathed with the Ag-Sn alloy and stainless steel, made by cold pressing followed by the heat treatment in the ambient pressure (sample Ag-SS) [2]. The J_c values of samples Ag-HP and Ag-SS are 1500A/mm^2 and 1400A/mm^2 at 4.2K and 10T parallel to the tape planes, respectively. The cross-sectional specimens for scanning transmission electron microscopy (STEM) were prepared by focused ion beam in a FEI Helios G4 UC. The STEM imaging and elemental mapping by energy dispersive X-ray spectroscopy (EDS) was performed in a JEOL ARM200cF.

Strikingly, despite a high J_c of 1500A/mm^2, the Ag-HP sample possesses many grain boundaries (GBs) whose superconducting connectivity is significantly degraded. The high angle annular dark field (HAADF) STEM image of **Figure 3** shows large differences in Z-contrasts at the GBs, suggesting very different local chemical composition (= not Ba122) and/or lower density. The EDS elemental mapping of **Figure 3** revealed that such different Z-contrasts found in Ag-HP are caused by different elemental segregations. There are continuous bright contrasts in the center of GBs and discontinuous dark contrasts between the Ba122 grains and the bright bands at the center of the GBs. The EDS maps identify the former as made by a continuous Fe and As segregation along the GBs, indicating that the bright Z-contrast at the GBs is FeAs. The EDS of K and O shows significant O segregation and K depletion at the GBs too. Judged by the O location and Ba distribution, the discontinuous dark contrast at the GBs is consistent with Ba-O segregation.

On the other hand, despite the minor J_c difference (only ~ 7%), the Ag-SS sample showed rather different grain and GB nanostructure compared with Ag-HP (**Figure 4**). Judged from the shape of grains and their configuration (**Figure 4 a)**, some large grains appear very slightly uniaxially textured, although most of the small grains appear rather randomly oriented. Also, there are many porosities of ~0.2-0.5µm in size, indicating the lower density of Ba122 core in Ag-SS than in Ag-HP; however, such low-density regions do not extend along the GBs. Interestingly, there are continuous clean GB networks in Ag-SS, in contrast to Ag-HP. The presence of GBs with no dark Z-contrast traces strongly implies that many Ba122 grains have become physically well-connected without losing the local density such as nano-cracks found in some Ba122 bulks [4] and that there is no compositional variation caused by secondary phases or oxide byproduct at such physically connected GBs. Although the clean GB networks are much more dominant, the Ag-SS sample is not free from disconnected GBs. As also evidenced in **Figure 4 a**, some of GBs parallel to the tape direction are physically disconnected by the impurity phase segregation. Such impurity phase clusters at the GBs as fine particles rather than the continuous layer as seen in the Ag-HP sample. The corresponding EDS elemental maps of **Figure 4 b** show sharp increase of Fe and As, as well as sharp reduction of Ba and K at the disconnected GBs, strongly suggesting that these impurity clusters are made of FeAs. Interestingly the EDS mapping detected almost no oxygen, excluding the presence of oxide byproduct and indicating that the dark contrasts around the FeAs clusters at the GBs have very small porosity.

Here we compared the grain and GB nanostructures in the two K-Ba122 tapes whose J_c is among the highest ever reported. Essentially there are two key factors for high J_c – the quality of GB connectivity and the number of GB connections. The former can be achieved by the grain alignment, and the latter can be increased by the clean synthesis and processing. It was revealed that even the state-of-art high J_c tapes utilize only one of those mechanisms, implying that the true J_c potential of K-Ba122 has not been fully explored yet. The clear direction for further J_c increment appears the development of clean processing with controlling the grain alignment.

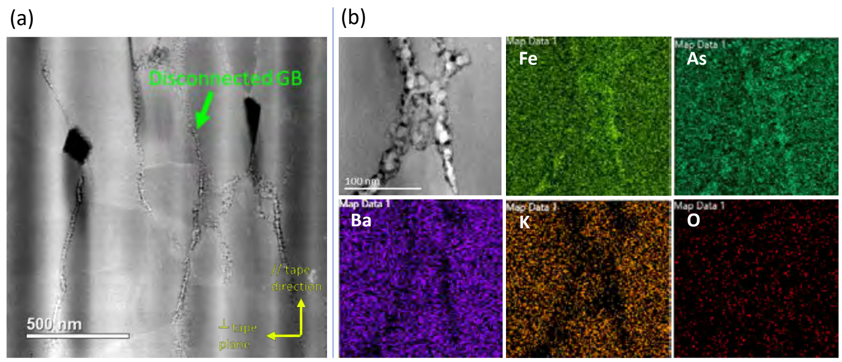


Figure 4. *(a) HAADF-STEM image showing some disconnected GBs in the Ag-SS sample. (b) High magnification HAADF-STEM image and corresponding EDS elemental maps of a junction of representative disconnected GBs [3].*

References for FBS

[1] Huang H et al., High transport current superconductivity in powder-in-tube $Ba_{0.6}K_{0.4}Fe_2As_2$ tapes at 27 T *Supercond. Sci. Technol*. **31** 015017 (2018)

[2] Gao Z et al., High transport Jc in stainless steel/Ag-Sn double sheathed Ba122 tapes *Supercond. Sci. Technol.* **30** 095012 (2017)

[3] Kametani F et al., On the mechanisms of Jc increment and degradation in high J_c Ba122 tapes made by the different processing, in preparation

[4] Pak C et al., Synthesis routes to eliminate oxide impurity segregation and their influence on intergrain connectivity in K-doped $BaFe_2As_2$ polycrystalline bulks *Supercond. Sci. Technol.* **33** 084010 (2020)

Acknowledgement for FBS: This work was supported by the US Department of Energy, Office of High Energy Physics under DE-SC0018750

Resistive Magnets & Materials

Pulsed Magnets & Materials:

Operation of User Magnets

In 2022, the Pulsed Field Facility operated several user magnets including the 65T workhorse, the 60T mid-pulsed and 75T duplex magnets. All the magnets have a robust maintenance program, with replacement coils manufactured at a rate to keep up with the program requirements. Specifically in 2022, the magnet team has built three 65T magnets, two inner coils for the 75T duplex magnets and one new 60T mid-pulsed magnet to ensure that we have spare magnet coils for all types of magnets and can provide smooth, continuous magnet operation for users.

The 75T duplex magnet so far has delivered more than 600 pulses of high magnetic fields in the range between 73 and 75 Tesla to users as seen in **Figure 1.** The user demand for the duplex magnet has remained very strong;

however, the total number of pulses in 2022 was slightly lower than in 2021, as the magnet's run-cycle became split with the newly commissioned mid-pulse magnet. The 60T mid-pulsed magnet which was launched for users in 2022 shares the test cell with the 75T duplex magnet and operation of the mid-pulsed magnet reduces our capability to serve users with the 75T duplex magnet. As a result, the pulsed field facility is exploring the possibility of replacing one of four 65T magnets by the 75T duplex magnet in 2023 so that the flagship 75T duplex and 60T mid-pulsed magnets have their own cells and can operate independently.

In 2022, the table-top pulsed magnet for the magneto-optic lab was upgraded from 31T to 41T using the new glidcop AL15 wire. The magnet was successfully tested and is now available for users. We also perform R&D activities to improve the magnet winding techniques and tooling for better quality control of magnet fabrication and stronger layer transitions in magnet winding. Additive manufacturing based on 3D printing technology of glass fiber-filled Nylon and PEEK (polyetheretherketone) materials has been studied to produce supporting parts for our pulsed magnets [1]. The potential replacement of these materials for the machined G-10 parts will significantly reduce the costs and lead time to fabricate our magnets.

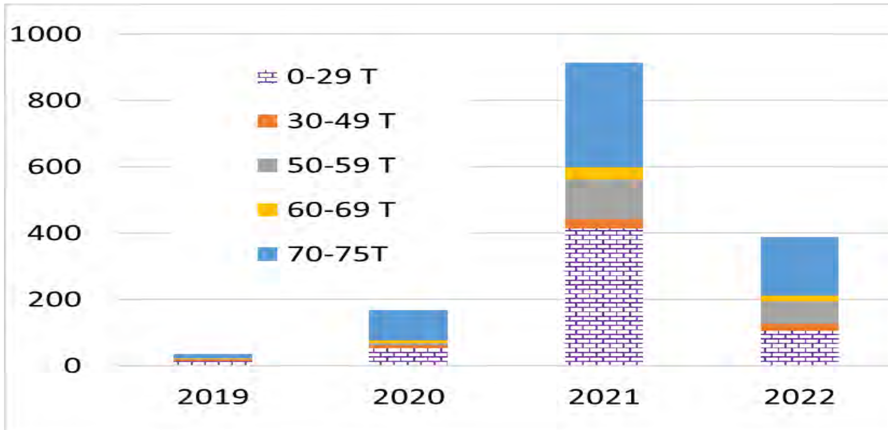


Figure 1. *Performance of 75-T duplex magnet to support users for the last several years. The magnet has been released to support users since 2020 and has delivered more than 600 pulses of 73T to 75T to users.*

Development of 85T duplex magnet

One of the PFF's highest priorities in 2022 was to complete the design and construction of an 85T duplex magnet. Further circuit simulations to mitigate the risks of secondary damages to the electrical components (switches, thyristors, capacitors…) in the power infrastructure during magnet failures have been completed in 2022. The CAD design and construction of the magnet and its associated components (such as the power distribution fixture, the blast-box to contain the magnet failures, the mechanical supporting structure) have been completed in Q2 of 2022 as planned. **Figure 2** is the picture of the 85T duplex magnet mounted in its blast-box, ready for testing.

Figure 2*. Picture of 85-T magnet mounted in its blast-box. The 65-T workhorse magnet is placed by the side of the box for comparison.*

Because of high demand from users for the 75T duplex magnet we decided to build new power transmission lines for the new 85T duplex magnet instead of using existing power infrastructure of the 75T duplex magnet as initially planned. This will allow the 75T duplex to continue to operate while the 85T duplex is being commissioned. The additional workload of connecting both the 4MJ and 2.5MJ capacitor banks to power the 85T duplex magnet has delayed the schedule to test the magnet into 2023.

Progress in redesigning and rebuilding large magnet coils

One of the PFF's important goals is to ensure the signature 60T LP and 100T magnets are ready to serve users when the generator come backs online. After the failure in late 2015, several of the most effected coils of the 60T LP magnet were redesigned by replacing an appropriate amount of Nitronic-40 metal shell with stronger, higher modulus Zylon fiber to improve their mechanical strength [2]. For instance, replacing 30% of the thickness of the Nitronic-40 shell by Zylon composite will significantly improve the mechanical performance of coil #4, the weakest coil which experiences the highest stress in the old design. Based on the fatigue stress-strain curves measured on AL60 conductor and reinforcing materials, we simulated the radial deformation (displacement) of coil 4 at its mid-plane for both the old and new designs [2]. **Figure 3** shows the radial displacement after 195 full-field pulses of 60T for coil #4 with the old and new designs, respectively. For the new design, deformation should progress at a much slower pace compared to the old design. With improved stress, the plastic displacement (displacement at no load condition) of the new coil #4 is much lower, only about 0.31mm compared to 1.8mm plastic displacement in the old design after the same 195 cycles of full-field pulses. This suggests the new design would significantly improve the magnet lifetime. The 60T coils #3 and #4 with large plastic deformation have been rebuilt with the new design, and we plan to complete rebuilding the redesigned coil #7 of that magnet in 2023 to have completed a set of 9 healthy coils for the magnet.

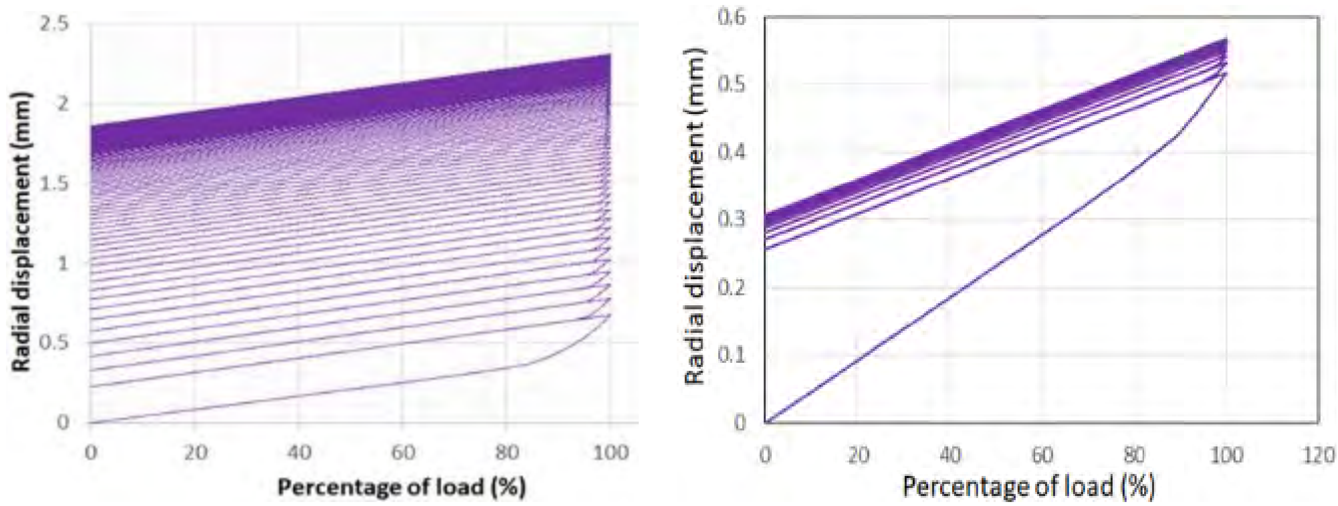


Figure 3. *Plastic radial displacement at the mid-plane of coil #4 (the weakest coil) after 195 cycles magnetic load at the peak magnetic field of 60T for (left) the old design and (right) the new design. The magnet starts at zero load and displacement. During the first pulse, the displacement increases to ~0.5mm in both designs. When the magnet returns to zero load, the displacement does not return to its initial value but has ~0.25mm of residual displacement (plastic deformation). On subsequent cycles more plastic deformation occurs. The calculation shows the new design being limited to ~0.55mm of deformation during 195 cycles while the old design has ~2.3mm of deformation.*

References

1. Redesign of the Coils for the 60T Controlled-Waveform Magnet at NHMFL Nguyen, D.N.; Vo, T.; Michel, J.; Dixon, I.R.; Adkins, T.; Han, K. IEEE Transactions on Applied Superconductivity, 32, 6, 4300504 (2022)
2. Mechanical and Thermal Properties of Glass Reinforced Composites Toplosky, V.J.; Betts, S.B.; Goddard, R.E.; Torres, J.A.; Nguyen, D.N.; Han, K. IEEE Transactions on Applied Superconductivity, 32, 7700805 (2022)

High-strength, high-conductivity materials:

In order to achieve ultrahigh-magnetic fields, resistive magnets require composite conductors with an optimized combination of mechanical strength and electrical conductivity. Deformed Cu-24wt%Ag composites are widely used in our laboratory as conductors for DC resistive magnets because they have both high strength and high conductivity. Their high strength is attributed to their high density of Ag fibers, most of which evolved from small-sized precipitates in the as-cast composites [1] that were then heavily elongated during cold-rolling. Because of the high cost of Ag, many researchers have reduced Ag content in Cu-Ag alloys to less than 8 wt%. At such low levels, however, completely dissolved Ag atoms have less strengthening effect than discrete Ag precipitates. At the same time, Cu with completely dissolved Ag has lower electrical conductivity. Researchers at the Maglab found that by aging Cu<8wt%Ag alloys so as to produce precipitates, one could improve both strength and conductivity [2-4]. In 2022, when we studied the nucleation and growth of Discontinuous Precipitates (DPs) in Cu-6 wt%Ag alloys, we found that DPs always nucleated on Cu grain boundaries [2]. The DPs close to the grain boundaries had undefined, irrational growth directions, indicating that growth was controlled by diffusion. Away from grain boundaries, some DPs grew along the rational [220] direction, with a coherent interface at the front and semi-coherent interfaces on the long sides **(Figure 4)**. Others far from the grain boundaries grew along the [3-11] direction. The semi-coherent interfaces provided barriers to the movement of dislocations, thus strengthening the materials [3]. In addition to interfaces between Cu and Ag, we also observed planer defects. We identified these as stacking faults that extended into nano-twins.) These planar defects formed during the early nucleation of Ag precipitates and extended into the surrounding Cu matrix [4]. The formation of planar defects released misfit strain on Cu/Ag interfaces, enhancing the subsequent nucleation and the growth of Ag precipitates. Unlike the intrinsic defects found in previous research, these defects were clearly extrinsic. The planar defects provided a row of additional sites for the nucleation of continuous Ag precipitates. By reducing dissolved Ag in the Cu matrix, the formation of new Ag precipitates increased conductivity significantly. Planar defects reduced electrical conductivity somewhat, but the synergy between Ag precipitation and planar defects had the effect of substantially increasing both strength and conductivity. Consequently, Ag-precipitate-strengthened Cu-Ag composites are now in development for pulsed magnets.

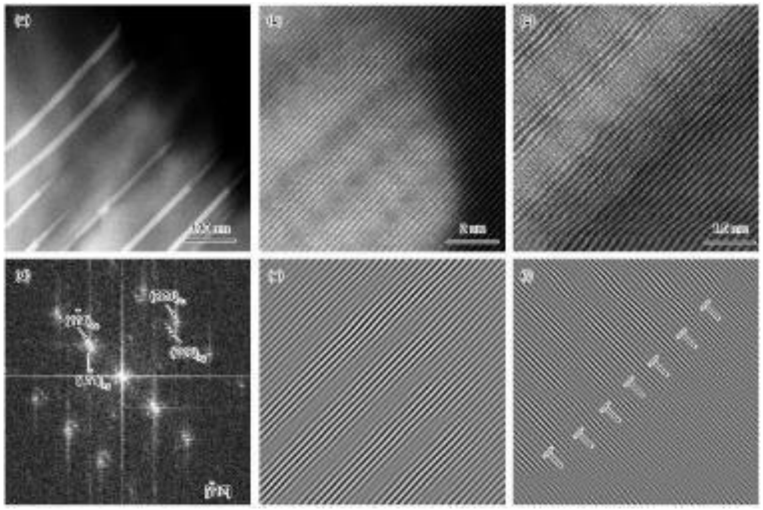


Figure 4. *High-angle-annular-dark-field (HAADF) images showing Ag precipitates in a Cu-6 wt%Ag sample aged at 450°C for 30min. HAADF is a better way to reveal Ag precipitates in Cu matrix than scanning electron microscopy, which has a lower resolution. HAADF is also better than bright field transmission electron microscope imaging, in which weak contrast between Cu and Ag is usually obscured by diffraction contour bands. Since HAADF image intensity is proportional to the square of atomic number, Ag, which has a higher atomic number, in Cu matrix shows brighter contrast than Cu. (a) Low magnification of precipitates growing from bottom left to top right. The light bands are from growing Ag precipitates. The gray areas between Ag precipitates are from Cu growing cooperatively with Ag after nucleation. The dark area is from Cu-Ag matrix where precipitation has not occurred. (b) High magnification of the Cu/Ag interface at the growth front of a precipitate. (c) High magnification of the Cu/Ag interface along with a precipitate. This interface is created after cooperative growth of Cu and Ag (d) Fast Fourier Transformation (FFT) image of figure (b), showing that the electron beam is [−112]$_{Cu}$, growth direction is [110]$_{Cu}$, and Cu and Ag has cube-on-cube orientation relationship. (e) Inverse FFT (IFFT) of figure (b), showing a coherent Cu/Ag interface (no misfit dislocations) at the growth front. (f) IFFT of figure (c) showing a semi-coherent Cu/Ag interface. Letter "T" indicates the positions of misfit dislocations. From the average dislocation distance, the estimated misfit is around 9.9%, which indicates that the misfit strain is not released completely by the misfit dislocations.*

Our Cu-Ag alloys achieved strength levels above 850MPa, along with conductivity around 70% IACS (international annealed copper standard). In some magnet coils (for example, the coils used in the 60T long-pulse magnet and the 60T mid-pulse magnet), we need conductors with conductivity higher than 70% IACS. One of the conductors investigated for such magnets is the Al_2O_3 particle-strengthened copper-matrix composite, which has conductivity of 80% IACS. In order to improve the fabrication methods of these conductors for magnet use, we investigated types of particles and their impact on the properties of the composites [5]. We identified both low density α-Al_2O_3 and high density η-Al_2O_3 particles. The small η-Al_2O_3 nanoparticles were of triangular shape with typical size of 5 to 30nm. They had a crystalline orientation to the Cu matrix (**Figure 5**). In cold-drawn wires, we observed dislocations pinned by η-Al_2O_3 nanoparticles. We believed that the main strengthening mechanism was the dislocation-looping of nearby η-Al_2O_3 particles, demonstrating the beneficial effect of η-Al_2O_3. We observed microcracks near large α-Al_2O_3 particles, demonstrating the detrimental effect of α- Al_2O_3 particles. These α-Al_2O_3 particles plus microcracks contributed to the difficulty of fabricating Al_2O_3-strengthened Cu into long length magnet conductors. Collaborating with Hypertech, Inc. and using the knowledge that we gained from our microscopy study, we were able to draw Al_2O_3 strengthened copper-matrix composite wire with a cross-section of 4 x 5.5mm^2 and continuous length greater than 800 meters, enough for numerous mid-pulsed magnets. Our initial characterization of this composite showed conductivity of 90% IACS, which meets the requirements for mid-pulse magnets. We have used this wire to upgrade the table-top pulsed magnet for the magneto-optic lab (10T increase) and plan to use this wire to wind mid-pulse magnets that will meet the needs of users who were previously using our 60T long pulse magnet, now offline for service to the generator.

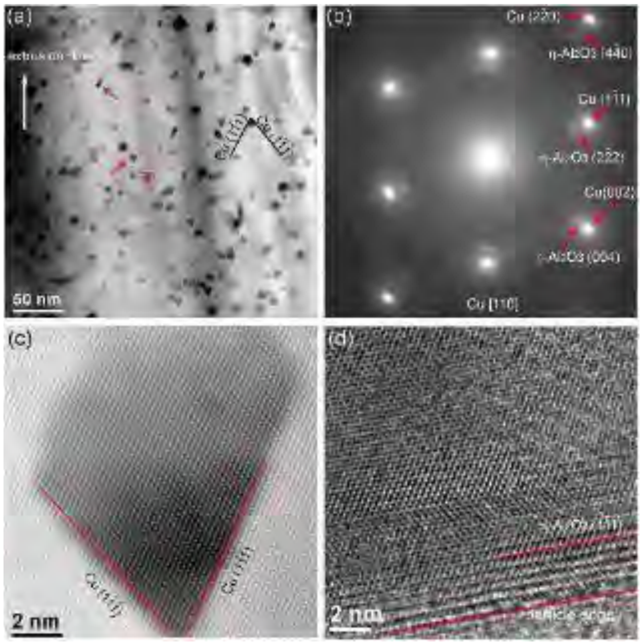


Figure 5. *(a) HAADF image of Al_2O_3 particles in a single Cu grain. The electron beam is along $[110]_{Cu}$ direction. The particles appear either square (red arrows) or triangular (red square). We believe that these are simply different views of a single type of particle. Most of these small particles have a triangle shape with two straight edges parallel to Cu {111} planes, as indicated by dark lines. (b) A selected area diffraction pattern from area with multiple triangle shaped particles showing that η-Al_2O_3 particles have single crystal pattern of [110], which is parallel to [110] of copper matrix. The particle and Cu matrix have a cube-on-cube crystal orientation relationship, i.e., η-Al_2O_3 {111}// Cu {111} and η-Al_2O_3 {001}// Cu {001}. This is topotaxy with two copper unit cell coherent with one η-Al_2O_3 cell. (c) Atomic resolution HAADF image of a particle in copper matrix. In this image, the atomic columns shown are mainly from Cu, the dark region is η-Al_2O_3 particle because atomic number of aluminums is lower than Cu. Two straight edges of the particle are parallel to Cu {111}. (d) High resolution Transmission Electron Microscopy image of the straight edge of an extracted loose triangle particle. The image demonstrates that the edge facets of the particle are η- Al_2O_3 {111}.*

In order to further optimize both strength and conductivity for large sized conductors, we also continued our study of Cu-Cr-Zr alloys [6]. We found that an aging treatment produced a high density of precipitates uniformly distributed throughout the Cu matrix. Their size varied from 1 to 4nm, much finer than the matrix grain size of 300nm, and their Cr content reached 8.4 at. %, significantly higher than the matrix. These precipitates contributed to a higher conductivity than has been achieved so far in commercial Cu-Cr-Zr alloys. In our recent trial, we fabricated, in collaboration with Hypertech, Inc., a conductor with cross-section of 5.5 x 10.5mm^2 and continuous length greater than 350 meters from this alloy for use in the coil 3 of our 100T+ magnet. We plan to characterize this conductor to prove that it outperforms existing conductors for coil 3.

References HSHC

[1] K. Han, V. Toplosky, C. Swenson, Deformation of Two Copper Matrix Conductors Under Cyclic Loading, IEEE Transactions on Applied Superconductivity 32(6) (2022) 711305.

[2] B. An, Y. Xin, R. Niu, Z. Xiang, E. Wang, K. Han, Nucleation and growth of discontinuous precipitates in Cu–Ag alloys, Materials Research Express 9(2) (2022) 026530.

[3] Y. Wei, L. Qiao, K. Han, L. Yang, Transient dislocation emission from the nanosized interface of Cu–Ag composite under the coupled thermal-mechanical shock: Molecular dynamics simulations study, Physica B: Condensed Matter 644 (2022) 414245.

[4] B. An, Y. Xin, R. Niu, Z. Xiang, Y. Su, J. Lu, E. Wang, K. Han, Stacking fault formation and Ag precipitation in Cu-Ag-Sc alloys, Materials Characterization (2022) 111965.

[5] Y. Xin, J. Lu, K. Han, Microstructure of Glidcop AL-60, IEEE Transactions on Applied Superconductivity 32(6) (2022) 7100105.

[6] R. Niu, V. Toplosky, K. Han, Cryogenic Temperature Properties and Secondary Phase Characterization of CuCrZr Composites, IEEE Transactions on Applied Superconductivity 32(6) (2022) 1-5.

DC Resistive Magnets:

2022 has been a very successful sixth year of operation of the MagLab's 36T, 1ppm Series-Connected Hybrid magnet, the world's highest field 1ppm magnet. The resistive insert for this magnet provides 23T while operating in the background 13T provided by the superconducting outsert. The insert had accumulated more than 4,240 hours of operation over a six-year period before the first replacement of its inner coil in October 2022. Most of the MagLab's resistive magnets running at similar stress levels require replacement after two or three years. The reduced maintenance requirements for this magnet are believed to be due to the fact that it is primarily used for NMR which results in fewer high-field sweeps (fatigue cycles) per day of operation than is experienced by other high field magnets which are only rarely used for NMR. To assure continued reliable operation of this magnet, the resistive coil maintenance also included a careful inspection of all other coils performing low current (50A) turn-to-turn voltage evaluations and comparing them with the data collected during commissioning of the magnet. All data checks and surface inspections turned out positive and allowed re-installation of all the remaining original coils without replacement.

To support smooth resistive magnet operations, the MagLab has completed fabrication and assembly of nine resistive spare coils as part of the routine 2022 maintenance program and performed over a dozen maintenance actions (coil tightening, replacement or other major scheduled tasks) in the resistive magnet cells. These quantities represent 100 percent typical counts and back to “normal” maintenance volumes compared to pre-COVID years. Hence 2022 has been another very busy and productive year for NHMFL Resistive Magnet Program.

Insulating Materials for Magnets

Insulation braiding machine:

With the support of FSU funds, a machine was purchased by ASC and commissioned in 2022 that braids fiber around a conductor, thereby providing insulation. This device will enable us to explore different materials as well as application procedures on both individual strands and Rutherford cables. In particular we intend to address the chemical compatibility issues that currently persist between the currently used alumino-silicate fiber and the Ag of the conductive matrix of the Bi-2212 conductor. Several braiding and wrapping tests have already been successfully carried out in preparation for use and further evaluation in test coils (**Figures 1 and 2**).

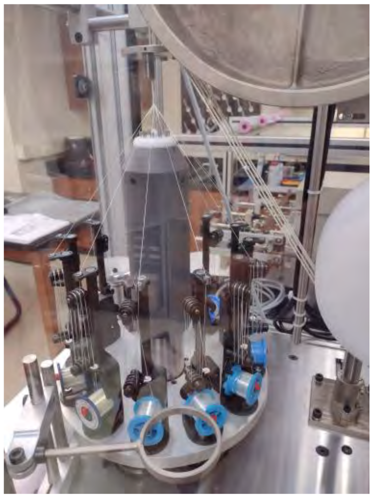


Figure 1. *The new insulation braiding machine at the ASC. This device allows us to evaluate new braiding materials as well as braiding methods. Shown here is the application of a wrap insulation on a strand of Bi-2212 conductor.*

3D Printed materials for magnets:

In our high field magnets, we frequently need insulating materials to provide structural support. Typically, G10 (glass-epoxy) is chosen. Frequently it needs to be formed into complex shapes, thus rendering the fabrication expensive, time-consuming, and potentially hazardous. In 2022, we explored the possibility of replacing machining with 3D printing, using as the raw material a composite consisting of two parts: 1. a strengthening component (either chopped E-glass fibers or beads) and 2. a thermo-plastic matrix (either nylon or the Polyether Ether Ketone material known as PEEK) [1].

Because our magnets operate between 4K and 295K, we measured mechanical properties at both 77K and room temperatures for samples made either from PEEK strengthened by glass fibers or from nylon strengthened by glass beads. The samples were subjected to stress in the direction parallel to the printing direction. At room temperature, typical compressive strength/displacement curves showed that the PEEK matrix composites were stronger than the nylon matrix composites. Both materials exhibited softening at larger strain values, PEEK significantly more than nylon. We observed shear failure in both composites. At 77K, the strength value for nylon, which increased by 300%, was clearly higher than that for PEEK (**Figure 3**).

Figure 2. *Pure alumina fiber wrapped (left) and braided (middle) and wrapped 9-strand Rutherford cable (right).*

References for 3D printed materials

[1] Mechanical and Thermal Properties of Glass Reinforced Composites, Toplosky, V.J.; Betts, S.B.; Goddard, R.E.; Torres, J.A.; Nguyen, D.N.; Han, K., IEEE Transactions on Applied Superconductivity, 32, 7700805 (2022)

Acknowledgements for ASC contribution

All work was performed at the National High Magnetic Field Laboratory, which is supported by National Science Foundation Cooperative Agreements NSF DMR-1644779 and by the State of Florida. Work in ASC is also supported by the US Department of Energy, Office of High Energy Physics under Award Number DE-SC0012083, and some work was performed in cooperation with the US Magnet Development Program. Additional work was supported by the US Department of Energy, Office of Fusion Energy Sciences under Award Number DE-SC0022011.

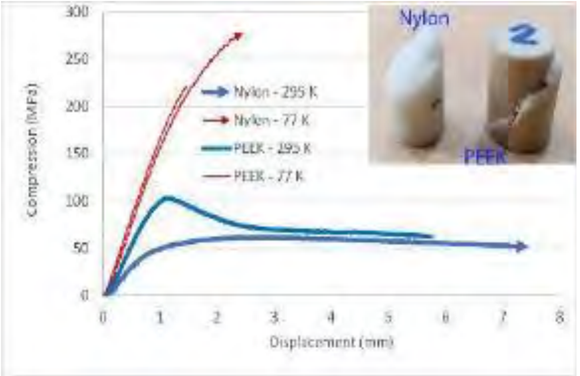


Figure 3. *Compressive stress vs. specimen displacement of two types of composites. The thick (blue) and thin (red) curves are from data collected at 295 and 77K, respectively. The curves with and without arrows are from data for nylon and PEEK, respectively. An inset shows fractured compression samples tested at room temperature. The tested sample shows a typical 45-degree shear failure.*

5. Publications

Peer Reviewed Publications

The Laboratory continued its strong record of publishing, with **352** articles appearing in peer-reviewed scientific and engineering journals in 2022. Among these, **311** acknowledge NSF support for the operation of the NHMFL and **161** (46 percent) appeared in significant journals. **Table 1** provides an overview about NSF-acknowledged peer-reviewed and significant peer reviewed publications by division then non-NSF funded units.

Table 1. *Submitted peer-reviewed publications from OPMS live database. The point-in-time snapshot was on March 28, 2022. A total number of publications per year should NOT be drawn from this report because a submitter may, as appropriate, link a publication to two or more facilities. We note that the State of Florida contributes significantly to NHMFL and hired faculty at UF and FSU to enhance NHMFL programs. Publications from these professors are included as they significantly enhance the NHMFL research effort and are listed here in the UF physics and CMT/E categories.*

Facility	2022 Peer Reviewed	2022 Significant Peer Reviewed	Acknowledges Core Grant
AMRIS Facility at UF	27	4	22
DC Field Facility at FSU	79	44	79
EMR Facility at FSU	28	16	28
High B/T Facility at UF	2	1	2
ICR Facility at FSU	36	14	35
NMR Facility at FSU	68	30	66
Pulsed Field Facility at LANL	28	19	25
ASC	8	6	7
MS & T	29	17	29
Education at FSU	2	-	2
CMT/E	49	28	NA[1]
Geochemistry Facility	10	1	NA[1]
MBI at UF	36	6	NA[1]
UF Physics	5	2	NA[1]

[1]Research not funded by NSF.

Table 2 summarizes the publications generated by external users and in-house research activities. A detailed list of these publications can be found below **Table 2.**

Table 2. *Overview of publications generated by external users and in-house research activities. A total number of publications per year should NOT be drawn from this report because a submitter may, as appropriate, link a publication to two or more facilities.*

Facility	All Internal Authors		Internal Corresponding Author(s) with External Co Authors		External Corresponding Author(s) with Internal Co Authors		All External Authors		Totals		Total
	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	Pubs for (selected period)
AMRIS Facility at UF	-	-	8	1	10	3	4	1	22	5	27
DC Field Facility at FSU	7	-	7	-	60	-	5	-	79	-	79
EMR Facility at FSU	2	-	2	-	24	-	-	-	28	-	28
High B/T Facility at UF	-	-	1	-	1	-	-	-	2	-	2
ICR Facility at FSU	2	-	6	-	26	1	1	-	35	1	36
NMR Facility at FSU	5	1	23	-	36	1	2	-	66	2	68
Pulsed Field Facility at LANL	3	-	8	2	14	1	-	-	25	3	28
ASC	3	-	2	-	2	1	-	-	7	1	8
MS & T	10	-	5	-	14	-	-	-	29	-	29
Education at FSU	1	-	1	-	-	-	-	-	2	-	2
CMT/E[1]	13	-	17	1	17	1	-	-	47	2	49
Geochemistry Facility[1]	-	-	6	-	4	-	-	-	10	-	10

Facility	All Internal Authors		Internal Corresponding Author(s) with External Co Authors		External Corresponding Author(s) with Internal Co Authors		All External Authors		Totals		Total
	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	NSF Core Grant Cited	NSF Core Grant Not Cited	Pubs for (selected period)
MBI at UF[1]	5	16	2	2	2	9	-	-	9	27	36
UF Physics[1]	-	-	4	-	1	-	-	-	5	-	5

[1]Research not funded by NSF.

Besides 352 peer reviewed publications, the following other products have also been published at the MagLab in 2021:

- Books: **2**
- Disseminations: **3**
- Product: **3**
- M.S. Theses: **7**
    - Local: 3
    - External: 4
- Ph.D. Theses: **46**
    - Local: 27
    - External: 19

Publications generated by AMRIS at UF (27)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Baniani, A.; Rivera, M.; Lively, R.; Vasenkov, S.	*Self-diffusion of mixed xylene isomers in ZIF-71 crystals dispersed in a polymer to form a hybrid membrane*	Microporous and Mesoporous Materials	338	-	111960	10.1016/j.micromeso.2022.111960	Yes
Baniani, A.; Wild, S.; Forman, E.; Risse, T.; Vasenkov, S.; Baumer, M.	*Disentangling catalysis and mass transport: Using diffusion measurements by pulsed field gradient NMR to reveal the microkinetics of CO oxidation over nanoporous gold*	Journal of Catalysis	413	-	1123--1131	10.1016/j.jcat.2022.08.020	Yes
Bracegirdle, J.; Casandra, D.; Rocca, J.R.; Adams, J.; Baker, B.	*Highly N-Methylated Peptides from the Antarctic Sponge Inflatella coelosphaeroides are Active against Plasmodium falciparum*	Journal of Natural Products	85	10	2454--2460	10.1021/acs.jnatprod.2c00684	Yes
Chang, M.; Mahar, R.; McLeod, M.; Giacalone, A.; Huang, X.; Boothman, D.; Merritt, M.E.	*Synergistic Effect of β-Lapachone and Aminooxyacetic Acid on Central Metabolism in Breast Cancer*	Nutrients	14	15	3020	10.3390/nu14153020	No
Chu, W.; Hall, J.; Gurrala, A.; Becsey, A.; Raman, S.; Okun, M.; Flores, C.; Giasson, B.; Vaillancourt, D.; Vedam-Mai, V.	*Evaluation of an Adoptive Cellular Therapy-Based Vaccine in a Transgenic Mouse Model of α-synucleinopathy*	ACS Chemical Neuroscience	14	2	235-245	10.1021/acschemneuro.2c00539	No
Cilenti, L.; Mahar, R.; Di Gregorio, J.; Ambivero, C.; Merritt, M.E.; Zervos, A.	*Regulation of metabolism by mitochondrial MUL1 E3 ubiquitin ligase*	Frontiers in cell and develop-mental biology	10	904728	1114	10.3389/fcell.2022.904728	No
Coelho, M.; Mahar, R.; Belew, G.; Torres, A.; Barosa, C.; Cabral, F.; Viegas, I.; Gastaldelli, A.; Mendes, V.; Manadas, B.; Jones, J.G.; Merritt, M.E.	*Enrichment of hepatic glycogen and plasma glucose from $H_2$18O informs gluconeogenic and indirect pathway fluxes in naturally feeding mice*	NMR in Biomedicine	epub	-	e4837	10.1002/nbm.4837	Yes
Gatto, R.G.; Weissmann, C.	*Preliminary examination of early neuroconnectivity features in the R6/1 mouse model of Huntington's disease by ultra-high field diffusion MRI*	Neural Regeneration Research	17	5	983-986	10.4103/1673-5374.324831	No
Giacalone, A.; Merritt, M.E.; Ragavan, M.	*Ex Vivo Hepatic Perfusion through the Portal Vein in Mouse*	JoVE (Journal of Visualized Experiments)	epub	181	e63154	10.3791/63154	Yes
Holmes, J.; Liu, V.; Caulkins, B.; Hilario, E.; Ghosh, R.; Drago, V.; Young, R.; Romero, J.A.; Gill, A.; Bogie, P.; Paulino, J.; Wang, X.; Riviere, G.; Bosken, Y.; Struppe, J.; Hassan, A.; Guidoulianov, J.; Perrone, B.; Mentink-Vigier, F.; Chang, C.; Long, J.R.; Hooley, R.; Mueser, T.; Dunn, M.; Mueller, L.	*Imaging active site chemistry and protonation states: NMR crystallography of the tryptophan synthase α-aminoacrylate intermediate*	Proceedings of the National Academy of Sciences of the USA (PNAS)	119	2	e2109235119	10.1073/pnas.2109235119	Yes
Johnston, T.; Edison, A.S.; Ramaswamy, V.; Freytag, N.; Merritt, M.E.; Thomas, J.; Hooker, J.; Litvak, I.; Brey, W.W.	*Application of Counter-Wound Multi-Arm Spirals in HTS Resonator Design*	IEEE Transactions on Applied	32	4	1-4	10.1109/TASC.2022.3146109	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		Superconductivity					
Khattri, R.; Batra, A.; Matheny, M.; Hart, C.; Henley-Beasley, S.; Hammers, D.; Zeng, H.; White, Z.; Ryan, T.; Barton, E.; Bernatchez, P.; Walter, G.A.	*Magnetic resonance quantification of skeletal muscle lipid infiltration in a humanized mouse model of Duchenne muscular dystrophy*	NMR in Biomedicine	36	13	e4869	10.1002/nbm.4869	Yes
Khattri, R.; Kim, K.; Anderson, E.; Fazzone, B.; Harland, K.; Hu, Q.; Palzkill, V.; Cort, T.; O'Malley, K.; Berceli, S.; Scali, S.T.; Ryan, T.E.	*Metabolomic profiling reveals muscle metabolic changes following iliac arteriovenous fistula creation in mice*	American Journal of Physiology-Renal Physiology	323	5	F577--F589	10.1152/ajprenal.00156.2022	Yes
Khattri, R.; Puglise, J.; Ryan, T.; Walter, G.A.; Merritt, M.E.; Barton, E.	*Isolated murine skeletal muscles utilize pyruvate over glucose for oxidation*	Meta-bolomics	18	12	1--12	10.1007/s11306-022-01948-x	Yes
Lopez, C.; Batra, A.; Moslemi, Z.; Rennick, A.; Guice, K.; Zeng, H.; Walter, G.A.; Forbes, S.C.	*Effects of muscle damage on 31phosphorus magnetic resonance spectroscopy indices of energetic status and sarcolemma integrity in young mdx mice*	NMR in Biomedicine	35	3	e4659	10.1002/nbm.4659	Yes
Lyndon, R.; Wang, Y.; Walton, I.; Ma, Y.; Liu, Y.; Yu, Z.; Zhu, G.; Berens, S.; Chen, Y.; Wang, S.; Vasenkov, S.; Sholl, D.; Walton, K.; Pang, S.; Lively, R.	*Unblocking a rigid purine MOF for kinetic separation of xylenes*	Chemical Communi-cations	58	88	12305--12308	10.1039/d2cc04387d	No
Mahar, R.; Ragavan, M.; Chang, M.; Hardiman, S.; Moussatche, N.; Behar, A.; Renne, R.; Merritt, M.E.	*Metabolic signatures associated with oncolytic myxoma viral infections*	Scientific Reports	12	1	1--13	10.1038/s41598-022-15562-3	Yes
Pritzlaff, A.; Ferre, G.; Mulry, E.; Lin, L.; Gopal Pour, N.; Savin, D.; Harris, M.; Eddy, M.T.	*Atomic-Scale View of Protein-PEG Interactions that Redirect the Thermal Unfolding Pathway of PEGylated Human Galectin-3*	Angewandte Chemie International Edition	61	-	e202203784	10.1002/anie.202203784	Yes
Ragavan, M.; McLeod, M.A.; Rushin, A.; Merritt, M.E.	*Detecting de novo Hepatic Ketogenesis Using Hyperpolarized [2-13C] Pyruvate*	Frontiers in Physiology	13	-	832403	10.3389/fphys.2022.832403	Yes
Schleyer, K.; Liu, J.; Chen, Z.; Wang, Z.; Zhang, Y.; Zuo, J.; Ybargollin, A.; Guo, H.; Cui, L.	*A Universal and Modular Scaffold for Heparanase Activatable Probes and Drugs*	Bioconjugate Chemistry	33	12	2290--2298	10.1021/acs.bioconjchem.2c00426	Yes
Schmidt, A.; Bowers, C.R.; Buckenmaier, K.; Chekmenev, E.; de Maissin, H.; Eills, J.; Ellermann, F.; Glooggler, S.; Gordon, J.; Knecht, S.; Koptyug, S.; Kuhn, J.; Pravdivtsev, A.; Reineri, F.; Theis, T.; Them, K.; Hovener, J.	*Instrumentation for Hydrogenative Parahydrogen-Based Hyperpolarization Techniques*	Analytical Chemistry	94	1	479-502	10.1021/acs.analchem.1c04863	Yes
Shen, Y.; Ghiviriga, I.; Abboud, K.; Schanze, K.; Veige, A.	*iClick synthesis of network metallopolymers*	Dalton Transactions	51	48	18520--18527	10.1039/d2dt01624a	Yes
Stowell, E.A.; Ehrenberger, M.A.; Lin, Y.L.; Chang, C.Y.; Rudolf, J.D.	*Structure-guided product determination of the bacterial type II diterpene synthase Tpn2*	Communi-cations Chemistry	5	146	1-8	10.1038/s42004-022-00765-6	Yes
Thakur, N.; Wei, S.; Ray, A.; Lamichhane, R.; Eddy, M.T.	*Production of human $A_{2A}AR$ in lipid nanodiscs for ^{19}F-NMR and*	STAR protocols	3	3	101535	10.1016/j.xpro.2022.101535	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	single-molecule fluorescence spectroscopy						
Thomas, J.N.; Johnston, T.L.; Litvak, I.M.; Ramaswamy, V.; Merritt, M.E.; Rocca, J.R.; Edison, A.S.; Brey, W.W.	*Implementing High Q-Factor HTS Resonators to Enhance Probe Sensitivity in 13C NMR Spectroscopy*	Journal of Physics: Conference Series	2323	1	12030	10.1088/1742-6596/2323/1/012030	Yes
Trusty, B.; Berens, S.; Yahya, A.; Fang, J.; Barber, S.; Angelopoulos, A.; Nickels, J.; Vasenkov, S.	*Influence of vanillic acid immobilization in Nafion membranes on intramembrane diffusion and structural properties*	Physical Chemistry Chemical Physics	24	17	10069 -- 10078	10.1039/d2cp01125e	Yes
Zhang, L.; Peng, W.; Wang, F.; Bao, H.; Zhan, P.; Chen, J.; Tong, Z.	*Fractionation and quantitative structural analysis of lignin from a lignocellulosic biorefinery process by gradient acid precipitation*	Fuel	309	-	122153	10.1016/j.fuel.2021.122153	Yes

Publications generated by DC Field at FSU (79)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Ambika, D.V.; Ding, Q.P.; Rana, K.; Frank, C.E.; Green, E.L.; Ran, S.; Butch, N.P.; Furukawa, Y.	*Possible coexistence of antiferromagnetic and ferromagnetic spin fluctuations in the spin-triplet superconductor UTe_2 revealed by ^{125}Te NMR under pressure*	Physical Review B	105	-	L220403	10.1103/PhysRevB.105.L220403	Yes
Anand, N.; Barry, K.; Neu, J.N.; Graf, D.E.; Huang, Q.; Zhou, H.; Siegrist, T.M.; Changlani, H.J.; Beekman, C.	*Investigation of the monopole magneto-chemical potential in spin ices using capacitive torque magnetometry.*	Nature Communi-cations	13	-	3818	10.1038/s41467-022-31297-1	Yes
Benjamin, S.M.	*Intercalate Superconductivity and van der Waals Equation*	ACS Materials AU	-	-	-	10.1021/acsmaterialsau.2c00015	Yes
Bhowmick, T.; Elatresh, S.; Grockowiak, A.; Coniglio, W.; Hossain, M.; Nicol, E.; Tozer, S.W.; Bonev, S.; Deemyad, S.	*Structure and pressure dependence of the Fermi surface of lithium*	Physical Review B	106	4	L041112	10.1103/PhysRevB.106.L041112	Yes
Broyles, C.; Graf, D.E.; Yang, H.; Dong, X.; Gao, H.; Ran, S.	*Effect of the Interlayer Ordering on the Fermi Surface of Kagome Superconductor CsV3Sb5 Revealed by Quantum Oscillations*	Physical Review Letters	129	-	157001	10.1103/PhysRevLett.129.157001	Yes
Cao, Y.; Dzuba, B.; Magill, B.A.; Senichev, A.; Nguyen, T.; Diaz, R.E.; Manfra, M.J.; McGill, S.A.; Garcia, C.; Khodaparast, G.A.; Malis, O.	*Photoluminescence Study of Carrier Localization and Recombination in Nearly Strain-Balanced Nonpolar InGaN/AlGaN Quantum Wells*	Physica Status Solidi (B): Basic Solid State Physics	2022	-	2100569	10.1002/pssb.202100569	Yes
Chappell, G.L.; Nelson, W.L.; Graf, D.E.; Baumbach, R.	*Electronic Tuning in URu2Si2 Through Ru to Pt Chemical Substitution*	Frontiers in Electronic Materials	2	-	861448	10.3389/femat.2022.861448	Yes
Chung, Y.; Graf, D.E.; Engel, L.W.; Villegas-Rosales, K.A.; Madathil, P.T.; Baldwin, K.W.; West, K.W.; Pfeiffer, L.N.; Shayegan, M.	*Correlated States of 2D Electrons near the Landau Level Filling v=1/7*	Physical Review Letters	128	-	26802	10.1103/PhysRevLett.128.026802	Yes
Clavel, M.B.; Murphy-Armando, F.; Xie, Y.; Henry, K.T.; Kuhn, M.; Bodnar, R.J.; Khodaparast, G.A.; Smirnov, D.; Heremans, J.J.; Hudait, M.K.	*Multivalley Electron Conduction at the Indirect-Direct Crossover Point in Highly Tensile-Strained Germanium*	Physical Review Applied	18	-	64083	10.1103/PhysRevApplied.18.064083	Yes
Das, D.; Gornicka, K.; Guguchia, Z.; Jaroszynski, J.J.; Cava, R.J.; Xie, W.; Luetkens, H.; Klimczuk, T.	*Time reversal invariant single-gap superconductivity with upper critical field larger than the Pauli limit in $NbIr_2B2_2$*	Physical Review B	106	-	94507	10.1103/PhysRevB.106.094507	Yes
Dissanayake, S.; Shi, Z.; Rau, J.G.; Bag, R.; Steinhardt, W.; Butch, N.P.; Frontzek, M.; Podlesnyak, A.; Graf, D.E.; Marjerrison, C.; Liu, J.; Gingras, M.J.P.; Haravifard, S.	*Towards understanding the magnetic properties of the breathing pyrochlore compound Ba3Yb2Zn5O11 through single-crystal studies*	Nature Partner Journals Quantum Materials (npj)	7	1	77	10.1038/s41535-022-00488-w	Yes
Dorn, R.W.; Heintz, P.M.; Hung, I.; Chen, K.; Oh, J.; Kim, T.; Zhou, L.; Gan, Z.; Huang, W.; Rossini, A.J.	*Atomic-Level Structure of Mesoporous Hexagonal Boron Nitride Determined by High-Resolution Solid-State Multinuclear Magnetic Resonance Spectroscopy and*	Chemistry of Materials	34	4	1649--1665	10.1021/acs.chemmater.1c03791	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	Density Functional Theory Calculations						
Dorn, R.W.; Mark, L.O.; Hung, I.; Cendejas, M.C.; Xu, Y.; Gor'kov, P.L.; Mao, W.; Ibrahim, F.; Gan, Z.; Hermans, I.; Rossini, A.J.	*An Atomistic Picture of Boron Oxide Catalysts for Oxidative Dehydrogenation Revealed by Ultrahigh Field 11B-17O Solid-State NMR Spectroscopy*	Journal of the American Chemical Society	144	41	18766 -- 18771	10.1021/jacs.2c08237	Yes
Eremets, M.I.; Minkov, V.S.; Drozdov, A.P.; Kong, P.P.; Ksenofontov, V.; Shylin, S.I.; Bud'ko, S.L.; Prozorov, R.; Balakirev, F.; Sun, D.; Mozaffari, S.; Balicas, L.	*High-Temperature Superconductivity in Hydrides: Experimental Evidence and Details*	Journal of Super-conductivity and Novel Magnetism	35	-	-	10.1007/s10948-022-06148-1	Yes
Fang, Y.; Grissonnanche, G.; Legros, A.; Verret, S.; Laliberté, F.; Collignon, C.; Ataei, A.; Dion, M.; Zhou, J.; Graf, D.E.; Lawler, M.J.; Goddard, P.A.; Taillefer, L.; Ramshaw, B.J.	*Fermi surface transformation at the pseudogap critical point of a cuprate superconductor*	Nature Physics	5	-	2022	10.1038/s41567-022-01514-1	Yes
Feng, K.; Leahy, I.A.; Oladehin, O.; Wei, K.; Lee, M.; Baumbach, R.	*Magnetic ordering in $GdAuAl_4Ge_2$ and $TbAuAl_4Ge_2$: Layered compounds with triangular lanthanide nets*	Journal of Magnetism and Magnetic Materials	564	-	170006	10.1016/j.jmmm.2022.170006	Yes
Freeman, M.L.; Lu, T.; Engel, L.W.	*Resistively loaded coplanar waveguide for microwave measurements of induced carriers*	Review of Scientific Instruments	93	4	43901	10.1063/5.0085112	Yes
Gan, Z.; Florian, P.; Muñoz, F.; Sánchez-Muñoz, L.	*Order Disorder Diversity of the Solid State by NMR: The Role of Electrical Charges*	Minerals (MDPI)	12	11	1-60	10.3390/min12111375	Yes
Gapud, A.A.; Ramakrishna, S.K.; Green, E.L.; Reyes, A.P.	*Martensitic transformation in V_3Si single crystal: ^{51}V NMR evidence for coexistence of cubic and tetragonal phases*	Physica C. Super-conductivity	602	-	1354137	10.1016/j.physc.2022.1354137	Yes
Gereka, A.; Quesada-Moreno, M.; Diaz-Ortega, I.; Nojiri, H.; Ozerov, M.; Krzystek, J.; Palacios, M.; Colacio, E.	*Large easy-axis magnetic anisotropy in a series of trigonal prismatic mononuclear cobalt (II) complexes with zero-field hidden single-molecule magnet behaviour: The important role of the distortion of the coordination sphere and intermolecular interactions on the slow relaxation*	Inorganic Chemistry Frontiers	9	-	2810-2831	10.1039/D2QI00275B	Yes
Goldberga, I.; Patris, N.; Chen, C.; Thomassot, E.; Trebosc, J.; Hung, I.; Gan, Z.; Berthomieu, D.; Metro, T.; Bonhomme, C.; Gervais, C.; Laurencin, D.	*First Direct Insight into the Local Environment and Dynamics of Water Molecules in the Whewellite Mineral Phase: Mechanochemical Isotopic Enrichment and High-Resolution 17O and 2H NMR Analyses*	Journal of Physical Chemistry C	126	29	12044 -- 12059	10.1021/acs.jpcc.2c02070	Yes
Gotze, K.; Pearce, M.J.; Coak, M.J.; Goddard, P.; Grockowiak, A.; Coniglio, W.; Tozer, S.W.; Graf, D.E.; Maple, M.B.; Ho, P.; Brown, M.C.; Singleton, J.	*Pressure-induced shift of effective Ce valence, Fermi energyand phase boundaries in CeOs4Sb12*	New Journal of Physics	24	-	43044	10.1088/1367-2630/ac643c	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Gould, C.A.; McClain, K.R.; Reta, D.; Kragskow, J.G.C.; Marchiori, D.A.; Lachman, E.; Choi, E.S.; Analytis, J.G.; Britt , R.D.; Chilton, N.F.; Harvey, B.G.; Long, J.R.	*Ultrahard magnetism from mixed-valence dilanthanide complexes with metal-metal bonding*	Science	375	6577	198-202	10.1126/science.abl5470	Yes
Hirose, H.T.; Terashima, T.; Hirai, D.; Matsubayashi, Y.; Kikugawa, N.; Graf, D.E.; Sugii, K.; Sugiura, S.; Hiroi, Z.; Uji, S.	*Electronic states of metallic electric toroidal quadrupole order in $Cd_2Re_2O_7$ determined by combining quantum oscillations and electronic structure calculations*	Physical Review B	105	-	35116	10.1103/PhysRevB.105.035116	Yes
Hossain, M. S.; Ma, M. K.; Chung, Y. J.; Singh, S. K.; Gupta, A.; West, K. W.; Baldwin, K. W.; Pfeiffer, L. N.; Winkler, R.; Shayegan, M.	*Fractional quantum Hall valley ferromagnetism in the extreme quantum limit*	Physical Review B	106	-	L201303	10.1103/PhysRevB.106.L201303	Yes
Huang, K.; Fu, H.; Hickey, D.; Alem, N.; Lin, X.; Watanabe, K.; Taniguchi, T.; Zhu, J.	*Valley Isospin Controlled Fractional Quantum Hall States in Bilayer Graphene*	Physical Review X	12	3	31019	10.1103/PhysRevX.12.031019	Yes
Huang, Q.; Lee, M.; Choi, E.S.; Ma, J.; Dela Cruz, C.; Zhou, H.D.	*Successive Phase Transitions and Multiferroicity in Deformed Triangular-Lattice Antiferromagnets Ca3MNb2O9 (M=Co, Ni) with Spatial Anisotropy*	ECS Journal of Solid State Science and Technology	11	6	63004	10.1149/2162-8777/ac7254	Yes
Hughey, K.; Lee, M.; Nam, J.; Clune, A.; O`Neal, K.; Tian, W.; Fishman, R.; Ozerov, M.; Lee, J.; Zapf, V.; Musfeldt, J.	*High-Field Magnetoelectric and Spin-Phonon Coupling in Multiferroic (NH4)2[FeCl5·(H2O)]*	Inorganic Chemistry	61	-	3434-3442	10.1021/acs.inorgchem.1c03311	Yes
Ikeda, A.; Saha, S.; Graf, D.E.; Saraf, P.; Sokratov, D.; Hu, Y.; Takahashi, H.; Yamane, S.; Jayaraj, A.; Slawinska, J.; Nardelli, M.; Yonezawa, S.; Maeno, Y.; Paglione, J.	*Quasi-two-dimensional Fermi surface of superconducting line-nodal metal $CaSb_2$*	Physical Review B	106	-	75151	10.1103/PhysRevB.106.075151	Yes
Jaime, M.	*Crystal Lattice Witness vs Actor Roles in Correlated Electronic Materials*	Journal of the Physical Society of Japan	91	-	101005	10.7566/JPSJ.91.101005	Yes
Jaroszynski, J.; Constantinescu, A.; Miller, G.E.; Xu, A.; Francis, A.; Murphy, T.P.; Larbalestier, D.C.	*Rapid assessment of REBCO CC angular critical current density Jc(B, T = 4.2 K, theta) using torque magnetometry up to at least 30T*	Super-conductor Science and Technology	35	9	95009	10.1088/1361-6668/ac8318	Yes
Jiang, Y.; Ermolaev, M.; Kipshidze, G.; Moon, S.; Ozerov, M.; Smirnov, D.; Jiang, Z.; Suchalkin, S.	*Giant g-factors and fully spin-polarized states in metamorphic short-period InAsSb/InSb superlattices*	Nature Communi-cations	13	1	5960	10.1038/s41467-022-33560-x	Yes
Kim, H.; Ok, J.M.; Cha, S.; Jang, B.G.; Kwon, C.I.; Kohama, Y.; Kindo, K.; Cho, W.J.; Choi, E.S.; Jo, Y.J.; Kang, W.; Shim, J.H.; Kim, K.S.; Kim, J.S.	*Quantum transport evidence of isolated topological nodal-line fermions*	Nature Communi-cations	13	-	7188	10.1038/s41467-022-34845-x	Yes
Kim, J.; Kim, K.; Choi, E.; Ko, Y.; Lee, D.; Lim, S.; Jung, J.; Lee, S.	*Magnetic phase diagram of a 2-dimensional triangular lattice*	Journal of Physics-	34	-	475803	10.1088/1361-648X/ac965f	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	antiferromagnet Na2BaMn(PO4)2	Condensed Matter					
Kolb-Bond, D.; Bird, M.D.; Painter, T.A.; Ramakrishna, S.K.; Reyes, A.P.	*Screening Current Induced Field Changes During De-Energization With Axial Clamping*	IEEE Transactions on Applied Super-conductivity	32	6	4701404	10.1109/TASC.2022.3162162	Yes
Kragskow, J.G.C.; Marbey, J.; Buch, C.D.; Nehrkorn, J.; Ozerov, M.; Piligkos, S.; Hill, S.; Chilton, N.F.	*Analysis of vibronic coupling in a 4f molecular magnet with FIRMS*	Nature Communi-cations	13	-	825	10.1038/s41467-022-28352-2	Yes
Ksiądzyna, M.; Kinzhybalo, V.; Bieńko, A.; Medycki, W.; Jakubas, R.; Rajnák, C.; Boca, R.; Ozarowski, A.; Ozerov, M.; Piecha-Bisiorek, A.	*Symmetry-Breaking Phase Transitions, Dielectric and Magnetic properties of Pyrrolidinium-Tetrahalidocobaltates*	Inorganic Chemistry Frontiers	-	-	Accept-ed	10.1039/D2QI00187J	Yes
Kunwar, D.L.; Panday, S.R.; Deng, Y.; Ran, S.; Baumbach, R.; Maple, M.B.; Almasan, C.C.; Dzero, M.O.	*Heat capacity of URu2−xOsxSi2 at low temperatures*	Physical Review B	105	-	L041106	10.1103/PhysRevB.105.L041106	Yes
Kuszynski, J.; Kays, J.C.; Conti III, C.R.; McGill, S.A.; Dennis, A.M.; Strouse, G.F.	*Effective Mass for Holes in Paramagnetic, Plasmonic Cu_5FeS_4 Semiconductor Nanocrystals*	Journal of Physical Chemistry C	126	30	12669 - 12679	10.1021/acs.jpcc.2c03459	Yes
Kyrk, T.M.; Kennedy, E.R.; Galeano Cabral, J.R.; Wei, K.; McCandless, G.T.; Scott, M.C.; Baumbach, R.; Chan, J.Y.	*Anisotropic magnetic and transport properties of orthorhombic o-$Pr_2Co_3Ge_5$*	Journal of Physics: Materials	5	-	44007	10.1088/2515-7639/ac9ad9	Yes
LaBarre, P.G.; Rydh, A.; Palmer-Fortune, J.; Frothingham, J.A.; Hannahs, S.T.; Ramirez, A.P.; Fortune, N.A.	*Magnetoquantum oscillations in the specific heat of a topological Kondo insulator*	Journal of Physics-Condensed Matter	34	36	36LT01	10.1088/1361-648x/ac7d2b	Yes
Legros, A.; Post, K.W.; Chauhan, P.; Rickel, D.G.; He, X.; Xu, X.; Shi, X.; Bozevic, I.; Crooker, S.; Armitage, N.P.	*Evolution of the cyclotron mass with doping in La2−xSrxCuO4*	Physical Review B	106	-	195110	10.1103/PhysRevB.106.195110	Yes
Liu, X.; Li, J.I.A.; Watanabe, K.; Taniguchi, T.; Hone, J.; Halperin, B.I.; Kim, P.; Dean, C.R.	*Crossover between strongly coupled and weakly coupled exciton superfluids*	Science	375	6577	205-209	10.1126/science.abg1110	Yes
Liu, Y.; Abeykoon, A.M.M.; Aryal, N.; Graf, D.E.; Hu, Z.; Yin, W.; Petrovic, C.	*Thermal transport properties of IrSbSe*	Physical Review B	106	-	195116	10.1103/PhysRevB.106.195116	Yes
Liu, Y.; Han, M.; Lee, Y.; Ogunbunmi, M.O.; Du, Q.; Nelson, C.; Hu, Z.; Stavitski, E.; Graf, D.E.; Attenkofer, K.; Bobev, S.; Ke, L.; Zhu, Y.; Petrovic, C.	*Polaronic Conductivity in $Cr_2Ge_2Te_6$ Single Crystals*	Advanced Functional Materials	-	-	2105111	10.1002/adfm.202105111	Yes
Lu, Z.; Hollister, P.; Ozerov, M.; Moon, S.; Bauer, E.D.; Ronning, F.; Smirnov, D.; Ju, L.; Ramshaw, B.J.	*Weyl Fermion magneto-electrodynamics and ultralow field quantum limit in TaAs*	Science Advances	8	2	eabj1076	10.1126/sciadv.abj1076	Yes
Magill, B.A.; Wang, K.; McGill, S.A.; Stanton, C.J.; Priya, S.; Khodaparast, G.A.	*Probe of the excitonic transitions and lifetimes in quasi-2D organic inorganic halide perovskites*	AIP Advances	12	-	015114-015121	10.1063/5.0072566	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Malis, O.; Nguyen, T.; Cao, Y.; Magill, B.A.; Druba, B.; McGill, S.A.; Garcia, C.; Khodaparast, G.A.; Manfra, M.	*Novel nitride quantum structures for infrared sensing*	SPIE Proceedings	12009	-	77-83	10.1117/12.2608173	Yes
Mapara, V.; Barua, A.; Turkowski, V.; Trinh, M.T.; Stevens, C.; Liu, H.; Nugera, F.A.; Kapuruge, N.; Gutierrez, H.R.; Liu, F.; Zhu, X.; Semenov, D.; McGill, S.A.; Pradhan, N.; Hilton, D.; Karaiskaj, D.	*Bright and Dark Exciton Coherent Coupling and Hybridization Enabled by External Magnetic Fields*	American Chemical Society Nano Letters	22	-	1680-1687	10.1021/acs.nanolett.1c04667	Yes
Mayo, A.H.; Takahashi, H.; Ishiwata, S.; Górnicka, K.; Winiarski, M.; Jaroszynski, J.J.; Cava, R.J.; Xie, W.; Klimczuk, T.	*Enhancement of the Magnetoresistance in the Mobility-Engineered Compensated Metal Pt5P2*	Advanced Electronic Materials	-	-	2201120	10.1002/aelm.202201120	Yes
Mazza, F.; Portnichenko, P.Y.; Avdoshenko, S.; Steffens, P.; Boehm, M.; Choi, E.; Nikolo, M.; Yan, X.; Prokofiev, A.; Paschen, S.; Inosov, D.S.	*Cascade of magnetic-field-driven quantum phase transitions in Ce3Pd20Si6*	Physical Review B	105	-	174429	10.1103/PhysRevB.105.174429	Yes
Moseley, D.; Liu, Z.M.; Bone, A.; Stavretis, S.; Singh, S.; Atanasov, M.; Lu, Z.; Ozerov, M.; Thirunavukkuarasu, K.; Cheng, Y.; Daemen, L.; Lubert-Perquel, D.V.; Smirnov, D.; Neese, F.; Ramirez-Cuesta, A.; Hill, S.; Dunbar, K.R.; Xue, Z.L.	*Comprehensive Studies of Magnetic Transitions and Spin-Phonon Couplings in a Tetrahedral Cobalt Complex*	Inorganic Chemistry	61	43	17123 - 17136	10.1021/acs.inorgchem.2c02604	Yes
Nguyen, T.; Aryal, N.; Pokharel, B.K.; Harnagea, L.; Mierstchin, D.; Popovic, D.; Graf, D.E.; Shrestha, K.	*Fermiology of the Dirac type-II semimetal candidates (Ni,Zr)Te_2using de Haas van Alphen oscillations*	Physical Review B	106	-	75154	10.1103/PhysRevB.106.075154	Yes
Oladehin, O.; Feng, K.; Haddock, J.W.; Galeano Cabral, J.R.; Wei, K.; Xin, Y.; Latturner, S.E.; Baumbach, R.	*Mn substitution in the topological metal Zr_2Te_2P*	Journal of Physics-Condensed Matter	34	-	485501	10.1088/1361-648X/ac9770	Yes
Ozerov, M.; Anand, N.; Burgt, L.; Lu, Z.; Holleman, J.; Zhou, H.; McGill, S.A.; Beekman, C.	*Magnetic field tuning of crystal field levels and vibronic states in the spin ice compound $Ho_2Ti_2O_7$ observed with far infrared reflectometry*	Physical Review B	105	-	165102	10.1103/PhysRevB.105.165102	Yes
Palmstrom, J.C.; Walmsley, P.; Straquadine, J. A. W.; Sorensen, M. E.; Hannahs, S.T.; Burns, D.H.; Fisher, I.R.	*Comparison of temperature and doping dependence of elastoresistivity near a putative nematic quantum critical point*	Nature Communi-cations	13	1	1011	10.1038/s41467-022-28583-3	Yes
Petkov, V.; Rao, T.D.; Milinda Abeykoon, A.M.; Galeano Cabral, J.R.; Wei, K.	*Spin-lattice coupling in magnetocaloric $Gd_5(Ge,Si)_4$ alloys by in situ x-ray pair distribution analysis in magnetic field*	Physical Review Materials	6	-	104407	10.1103/PhysRevMaterials.6.104407	Yes
Pouse, N.; Deng, Y.; Ran, S.; Graf, D.E.; Lai, Y.; Singleton, J.; Balakirev, F.; Baumbach, R.; Maple, M.B.	*Anisotropy of the T vs. H phase diagram and the HO/LMAFM phase boundary in URu2−xFexSi2https://doi.org/10.3389/femat.2022.991754*	Frontiers of Environmental Science & Engineering	2022	-	991754	10.3389/femat.2022.991754	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Prudkovskiy, V.S.; Hu, Y.; Zhang, K.; Hu, Y.; Ji, P.; Nunn, G.; Zhao, J.; Shi, C.; Tejeda, A.; Wander, D.; De Cecco, A.; Winkelmann, C.B.; Jiang, Y.; Zhao, T.; Wakabayashi, K.; Jiang, Z.; Ma, L.; Berger, C.; de Heer, W.A.	*An epitaxial graphene platform for zero-energy edge state nanoelectronics*	Nature Communi-cations	13	1	7814	10.1038/s41467-022-34369-4	Yes
R (Maruthi R), M.; Seehra, M.S.; Ghosh, S.; Medwal, R.; Rawat, R.S.; Weise, B.; Choi, E.; Thota, S.	*Determination of the tricritical point, H-T phase diagram and exchange interactions in the antiferromagnet MnTa2O6*	Journal of Physics-Condensed Matter	34	15	155801	10.1088/1361-648X/ac4cec	Yes
Sakhratov, YU. A.; Prokhnenko, O.; Shapiro, A. YA.; Zhou, H. D.; Svistov, L. E.; Reyes, A.P.; Petrenko, O. A.	*High-field magnetic structure of the triangular antiferromagnet* $RbFe(MoO_4)_2$	Physical Review B	105	-	14431	10.1103/PhysRevB.105.014431	Yes
Shcherbakov, D.; Yang, J.; Memaran, S.; Watanabe, K.; Taniguchi, T.; Smirnov, D.; Balicas, L.; Lau, C.N.	*Quantum Hall effect in a two-dimensional semiconductor with large spin-orbit coupling*	Physical Review B	106	-	45307	10.1103/PhysRevB.106.045307	Yes
Shen, J.; Terskikh, V.; Struppe, J.; Hassan, A.; Monette, M.; Hung, I.; Gan, Z.; Brinkmann, A.; Wu, G.	*Solid-state 17O NMR study of alpha-D-glucose: exploring new frontiers in isotopic labeling, sensitivity enhancement, and NMR crystallography*	Chemical Science	13	9	2591--2603	10.1039/d1sc06060k	Yes
Shi, Z.; Dissanayake, S.; Corboz, P.; Steinhardt, W.; Graf, D.E.; Silevitch, D.M.; Dabkowska, H.A.; Rosenbaum, T.F.; Mila, F.; Haravifard, S.	*Discovery of quantum phases in the Shastry-Sutherland compound SrCu2(BO3)2 under extreme conditions of field and pressure*	Nature Communi-cations	13	1	2301	10.1038/s41467-022-30036-w	Yes
Shrestha, K.; Chapai, R.; Pokharel, B.K.; Miertschin, D.; Nguyen, T.; Zhou, X.; Chung, D.Y.; Kanatzidis, M.G.; Mitchell, J.F.; Welp, U.; Popovic, D.; Graf, D.E.; Lorenz, B.; Kwok, W.K.	*Nontrivial Fermi surface topology of the kagome superconductor* CsV_3Sb_5 *probed by de Haas--van Alphen oscillations*	Physical Review B	105	-	24508	10.1103/PhysRevB.105.024508	Yes
Stepanov, P.; Shcherbakov, D.L.; Che, S.; Bockrath, M.W.; Barlas, Y.; Smirnov, D.; Watanabe, K.; Taniguchi, T.; Lake, R.K.; Lau, C.	*Tuning Spin Transport in a Graphene Antiferromagnetic Insulator*	Physical Review Applied	18	-	14031	10.1103/PhysRevApplied.18.014031	Yes
Terashima, T.; Hirose, H.T.; Kikugawa, N.; Uji, S.; Graf, D.E.; Morinari, T.; Wang, T.; Mu, G.	*Anomalous high-field magnetotransport in CaFeAsF due to the quantum Hall effect*	Nature Partner Journals Quantum Materials (npj)	7	1	62	10.1038/s41535-022-00470-6	Yes
Tin, P.; Bone, A.N.; Bui, N.N.; Zhang, Y.Q.; Chang, T.; Moseley, D.H.; Ozerov, M.; Krzystek, J.; Cheng, Y.; Daemen, L.L.; Wang, X.; Song, L.; Chen, Y.S.; Shao, D.; Wang, X.Y.; Chen, X.T.; Xue, Z.L.	*Advanced spectroscopic and computational studies of a cobalt(II) metal-organic framework with single-ion magnet properties*	Journal of Physical Chemistry C	126	-	1-15	10.1021/acs.jpcc.2c03083	Yes
Turker, O.; Yang, K.	*String-like theory of quantum Hall interfaces*	Physical Review B	106	-	245138	10.1103/PhysRevB.106.245138	Yes
Valles, F.; Palau, A.; Abraimov, D.V.; Jaroszynski, J.; Constantinescu, A.; Mundet, B.;	*Optimizing vortex pinning in YBa2Cu3O7-x superconducting films up to high magnetic fields*	Communi-cations Materials	3	-	45	10.1038/s43246-022-00266-y	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Obradors, X.; Larbalestier, D.C.; Puig, T.							
Villegas Rosales, K. A.; Madathil, P. T.; Chung, Y. J.; Pfeiffer, L. N.; West, K. W.; Baldwin, K. W.; Shayegan, M.	*Composite Fermion Mass: Experimental measurements in ultrahigh quality two-dimensional electron systems*	Physical Review B	106	-	L041301	10.1103/PhysRevB.106.L041301	Yes
Vinograd, I.; Zhou, R.; Mayaffre, H.; Kramer, S.; Ramakhrisna, S.K.; Reyes, A.P.; Kurosawa, T.; Momono, N.; Oda, M.; Komiya, S.; Ono, S.; Horio, M.; Chang, J.; Julien, M.H.	*Competition between spin ordering and superconductivity near the pseudogap boundary in $La_{2-x}Sr_xCuO_4$: Insights from NMR*	Physical Review B	106	-	54522	10.1103/PhysRevB.106.054522	Yes
Wang, C.; Gupta, A.; Singh, S. K.; Chung, Y. J.; Pfeiffer, L. N.; West, K. W.; Baldwin, K. W.; Winkler, R.; Shayegan, M.	*Even-denominator fractional quantum Hall state at filling factor ν = ¾*	Physical Review Letters	129	-	156801	10.1103/PhysRevLett.129.156801	Yes
Wang, J.; Wang, T.; Ozerov, M.; Bermejo-Ortiz, J.; Zhang, Z.; Bac, S.K.; Trinh, H.; Zhukovskyi, M.; Orlova, T.; Ambaye, H.; Keum, J.; de Vaulchier, L.A.; Guldner, Y.; Smirnov, D.; Lauter, V.; Liu, X.; Assaf, B.A.	*Magnetic proximity-induced energy gap of topological surface states*	arXiv	-	-	2207.07685	10.48550/arXiv.2207.07685	Yes
Wang, X.; Cao, J.; Liang, H.; Lu, Z.; Cohen, A.; Haldar, A.; Kitadai, H.; Tan, Q.; Burch, K.S.; Smirnov, D.; Xu, W.; Sharifzadeh, S.; Liang, L.; Ling, X.I.	*Electronic Raman scattering in the 2D antiferromagnet NiPS3*	Science Advances	8	2	eabl7707	10.1126/sciadv.abl7707	Yes
Xia, Y.; Chen, H.; Hung, I.; Gan, Z.; Sen, S.	*Structure and Fragility of Zn-phosphate glasses: Results from multinuclear NMR spectroscopy and calorimetry*	Journal of Non-Crystalline Solids	580	-	121395	10.1016/j.jnoncrysol.2022.121395	Yes
Xiang, Z.; Chen, K.; Chen, L.; Asaba, T.; Sato, Y.; Zhang, N.; Zhang, D.; Kasahara, Y.; Iga, F.; Coniglio, W.A.; Matsuda, Y.; Singleton, J.; Li, L.	*Hall Anomaly, Quantum Oscillations and Possible Lifshitz Transitions in Kondo Insulator YbB12: Evidence for Unconventional Charge Transport*	Physical Review X	12	-	21050	10.1103/PhysRevX.12.021050	Yes
Zhang, Q.; Liu, J.; Cao, H.; Phelan, A.; Graf, D.E.; DiTusa, J.F.; Tennant, D.A.; Mao, Z.	*Toward tunable quantum transport and novel magnetic states in Eu1−xSrxMn1−zSb2 (z < 0.05)*	NPG Asia Materials	14	1	22	10.1038/s41427-022-00369-5	Yes
Zhao, Z.; Xiao, D.; Chen, K.; Wang, R.; Liang, L.; Liu, Z.; Hung, I.; Gan, Z.; Hou, G.	*Nature of Five-Coordinated Al in g-Al2O3 Revealed by Ultra-High-Field Solid-State NMR*	ACS Central Science	8	6	795--803	10.1021/acscentsci.1c01497	Yes

Publications generated by EMR at FSU (28)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Arth, T.; Pregelj, M.; Khuntia, P.; Jagličić, Z.; Le, M.D.; Biswas, P.K.; Manuel, P.; Mangin-Thro, L.; Ozarowski, A.; Zorko, A.	*The Ising triangular-lattice antiferromagnet neodymium heptatantalate as a quantum spin liquid candidate*	Nature Materials	21	-	416-422	10.1038/s41563-021-01169-y	Yes
Aryal, C.M.; Bui, N.N.; Song, L.; Pan, J.	*The N-terminal helices of amphiphysin and endophilin*	Biochimica et Biophysica	1864	7	183907	10.1016/j.bbamem.2022.183907	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	have different capabilities of membrane remodeling	Acta Bio-membranes					
Blackaby, W.J.M.; Harriman, K.L.M.; Greer, S.; Folli, A.; Hill, S.; Krewald, V.; Mahon, M.F.; Murphy, D.M.; Murugesu, M.; Richards, E.; Suturina, E.; Whittlesey, M.K.	*Extreme g-Tensor Anisotropy and Its Insensitivity to Structural Distortions in a Family of Linear Two-Coordinate Ni(I) Bis-N-heterocyclic Carbene Complexes*	Inorganic Chemistry	61	-	1308-1315	10.1021/acs.inorgchem.1c02413	Yes
Blackmore, W.J.; Curley, S.P.; Williams, R.C.; Vaidya, S.; Singleton, J.; Birnbaum, S.M.; Ozarowski, A.; Schlueter, J.A.; Chen, Y.; Gillon, B.; Goukassov, A.; Kibalin, I.; Villa, D.Y.; Villa, J.A.; Manson, J.L.; Goddard, P.A.	*Magneto-structural Correlations in Ni2+Halide···Halide Ni2+ Chains*	Inorganic Chemistry	61	1	141-153	10.1021/acs.inorgchem.1c02483	Yes
Bonizzoni, C.; Maksutoglu, M.; Ghirri, A.; van Tol, J.; Rameev, B.; Affronte, M.	*Coupling Sub-nanoliter BDPA Organic Radical Spin Ensembles with YBCO Inverse Anapole Resonators*	Applied Magnetic Resonance	2022	-	-	10.1007/s00723-022-01505-8	Yes
Buch, C.D.; Kundu, K.; Marbey, J.; van Tol, J.; Weihe, H.; Hill, S.; Piligkos, S.	*Spin-Lattice Relaxation Decoherence Suppression in Vanishing Orbital Angular Momentum Qubits*	Journal of the American Chemical Society	144	38	17597-17603	10.1021/jacs.2c07057	Yes
de Souza, M.; Reis, S.; Stinghen, D.; Escobar, L.B.L.; Cassaro, R.A.; Poneti, G.; Bortolot, C.; Marbey, J.; Hill, S.; Vaz, M.	*High frequency EPR studies of new 2p-3d complexes based on a triazolyl substituted nitronyl nitroxide radical: the role of exchange anisotropy in a Cu-radical system*	Inorganic Chemistry	61	31	12118-12128	10.1021/acs.inorgchem.2c00679	Yes
Gamage, E.H.; Ribeiro, R.A.; Harmer, C.P.; Canfield, P.C.; Ozarowski, A.; Kovnir, K.	*Tuning of Cr Cr Magnetic Exchange through Chalcogenide Linkers in Cr2 Molecular Dimers*	Inorganic Chemistry	61	16	61606174	10.1021/acs.inorgchem.2c00298	Yes
Gereka, A.; Quesada-Moreno, M.; Diaz-Ortega, I.; Nojiri, H.; Ozerov, M.; Krzystek, J.; Palacios, M.; Colacio, E.	*Large easy-axis magnetic anisotropy in a series of trigonal prismatic mononuclear cobalt (II) complexes with zero-field hidden single-molecule magnet behaviour: The important role of the distortion of the coordination sphere and intermolecular interactions on the slow relaxation*	Inorganic Chemistry Frontiers	9	-	2810-2831	10.1039/D2QI00275B	Yes
Hanabe Subramanya, M.V.; Marbey, J.; Kundu, K.; McKay, J.E.; Hill, S.	*Broadband Fourier-Transform Detected EPR at W-band*	Applied Magnetic Resonance	1	1	1	10.1007/s00723-022-01499-3	Yes
Hansen, H.J.; Krzystek, J.; Telser, J.; Swain, A.; Rajamaran, G.; Wadepohl, H.; Enders, M.	*Solid-state conformational isomerism lacking a gas-phase energy barrier: its structural, spectroscopic and theoretical identification in an organochromium(III) complex*	Organo-metallics	41	-	1558-1564	10.1021/acs.organomet.2c00182	Yes
Harrabi, R.; Halbritter, T.; Aussenac, F.; Dakhlaoui, O.; van Tol, J.; Damodaran, K.K.; Lee, D.; Paul, S.; Hediger, S.; Mentink-Vigier, F.; Sigurdsson, S.; De Paepe, G.	*Highly Efficient Polarizing Agents for MAS-DNP of Proton-Dense Molecular Solids*	Angewandte Chemie International Edition	21	12	e202114103	10.1002/anie.202114103	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Jafari, M.; Fehn, D.; Reinhold, A.; Hernandez-Prieto, C.; Patel, P.; Gau, M.; Carroll, P.; Krzystek, J.; Liu, C.; Ozarowski, A.; Telser, J.; Delferro, M.; Meyer, K.; Mindiola, D.	*A tale of three molecular nitrides: mononuclear vanadium(V) and (IV) nitrides, as well as a mixed-valence trivanadium nitride having a V3N4 double diamond-core,*	Journal of the American Chemical Society	144	-	10201 - 10219	10.1021/jacs.2c00276	Yes
Khachatryan, L.; Barekati-Goudarzi, M.; Asatryan, R.; Ozarowski, A.; Boldor, D.; Lomnicki, S.M.; Cormier, S.A.	*Metal-Free Biomass-Derived Environmentally Persistent Free Radicals (Bio-EPFRs) from Lignin Pyrolysis*	American Chemical Society Omega	7	34	30241 30249	10.1021/acsomega.2c03381	Yes
Khatua, J.; Gomil□ek, M.; Orain, J. C.; Strydom, A. M.; Jagličić, Z.; Colin, C. V.; Petit, S.; Ozarowski, A.; Mangin-Thro, L.; Sethupathi, K.; Ramachandra Rao, M. S.; Zorko, A.; Khuntia, P.	*Signature of a randomness-driven spin-liquid state in a frustrated magnet*	Communi-cations Physics	5	99	1-10	10.1038/s42005-022-00879-2	Yes
Kisgeropoulos, E.C.; Gan, Y.J.; Greer, S.; Hazel, J.M.; Shafaat, H.S.	*Pulsed Multifrequency Electron Paramagnetic Resonance Spectroscopy Reveals Key Branch Points for One- vs Two-Electron Reactivity in Mn/Fe Proteins*	Journal of the American Chemical Society	144	27	11991 - 12006	10.1021/jacs.1c13738	Yes
Kragskow, J.G.C.; Marbey, J.; Buch, C.D.; Nehrkorn, J.; Ozerov, M.; Piligkos, S.; Hill, S.; Chilton, N.F.	*Analysis of vibronic coupling in a 4f molecular magnet with FIRMS*	Nature Communi-cations	13	-	825	10.1038/s41467-022-28352-2	Yes
Książdzyna, M.; Kinzhybalo, V.; Bieńko, A.; Medycki, W.; Jakubas, R.; Rajnák, C.; Boca, R.; Ozarowski, A.; Ozerov, M.; Piecha-Bisiorek, A.	*Symmetry-Breaking Phase Transitions, Dielectric and Magnetic properties of Pyrrolidinium-Tetrahalidocobaltates*	Inorganic Chemistry Frontiers	-	-	Accept-ed	10.1039/D2QI00187J	Yes
Kühne, I.A.; Ozarowski, A.; Sultan, A.; Esien, K.; Carter, A.B.; Wix, P.; Casey, A.; Heerah-Booluck, M.; Keene, T.D.; Müller-Bunz, H.; Felton, S.; Hill, S.; Morgan, G.G.	*Homochiral Mn3+ Spin Crossover Complexes - A Structural and Spectroscopic Study*	Inorganic Chemistry	61	-	3458-3471	10.1021/acs.inorgchem.1c03379	Yes
Kundu, K.; White, J.R.K.; Moehring, S.A.; Yu, J.M.; Ziller, J.W.; Furche, F.; Evans, W.J.; Hill, S.	*9.2-GHz clock transition in a Lu(II) molecular spin qubit arising from a 3,467-MHz hyperfine interaction*	Nature Chemistry	14	-	392-397	10.1038/s41557-022-00894-4	Yes
Li, Y.; Biswas, R.; Kopcha, W.P.; Dubroca, T.; Abella, L.; Sun, Y.; Crichton, R.A.; Rathnam, C.; Yang, L.; Yeh, Y.W.; Kundu, K.; Rodríguez-Fortea, A.; Poblet, J.M.; Lee, K.B.; Hill, S.; Zhang, J.	*Structurally Defined Water-Soluble Metallofullerene Derivatives towards Biomedical Applications*	Angewandte Chemie International Edition	1	1	1	10.1002/anie.202211704	Yes
Liu, Y.H.; Fernández, C.A.; Varanasi, S.A.; Bui, N.N.; Song, L.; Hatzell, M.C.	*Prospects for Aerobic Photocatalytic Nitrogen Fixation*	American Chemical Society Energy Letters	7	-	24-29	10.1021/acsenergylett.1c02260	Yes
Moseley, D.; Liu, Z.M.; Bone, A.; Stavretis, S.; Singh, S.; Atanasov, M.; Lu, Z.; Ozerov, M.; Thirunavukkuarasu, K.; Cheng, Y.; Daemen, L.; Lubert-Perquel,	*Comprehensive Studies of Magnetic Transitions and Spin-Phonon Couplings in a Tetrahedral Cobalt Complex*	Inorganic Chemistry	61	43	17123 - 17136	10.1021/acs.inorgchem.2c02604	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
D.V.; Smirnov, D.; Neese, F.; Ramirez-Cuesta, A.; Hill, S.; Dunbar, K.R.; Xue, Z.L.							
Moseley, I.P.; Ard, C.P.; DiVerdi, J.A.; Ozarowski, A.; Chen, H.; Zadrozny, J.M.	*Slowing magnetic relaxation with open-shell diluents*	Cell Reports Physical Science	3	3	100802	10.1016/j.xcrp.2022.100802	Yes
Soundararajan, M.; Dubroca, T.; van Tol, J.; Hill, S.; Frydman, L.; Wi, S.	*Proton-detected solution-state NMR at 14.1 T based on scalar-driven 13C Overhauser dynamic nuclear polarization*	Journal of Magnetic Resonance	343	-	107304	10.1016/j.jmr.2022.107304	Yes
Tin, P.; Bone, A.N.; Bui, N.N.; Zhang, Y.Q.; Chang, T.; Moseley, D.H.; Ozerov, M.; Krzystek, J.; Cheng, Y.; Daemen, L.L.; Wang, X.; Song, L.; Chen, Y.S.; Shao, D.; Wang, X.Y.; Chen, X.T.; Xue, Z.L.	*Advanced spectroscopic and computational studies of a cobalt(II) metal-organic framework with single-ion magnet properties*	Journal of Physical Chemistry C	126	-	1-15	10.1021/acs.jpcc.2c03083	Yes
Viaud, M.; Guillot-Deudon, C.; Gautron, E.; Caldes, M. T.; Berlanda, G.; Deniard, P.; Boullay, P.; Porcher, F.; La, C.; Darie, C.; Zorko, A.; Ozarowski, A.; Bert, F.; Mendels, P.; Payen, C.	*Crystal structures, frustrated magnetism, and chemical pressure in Sr-doped Ba3NiSb2O9 perovskites*	Physical Review Materials	6	124408	1-17	10.1103/PhysRevMaterials.6.124408	Yes
Wang, X.; Hale, A.R.; Hill, S.; Christou, G.	*High-Field EPR Investigation and Detailed Modeling of the Magnetoanisotropy Tensor of an Unusual Mixed-Valent $Mn^{IV}{}_2Mn^{III}{}_2Mn^{II}$ Cluster*	Applied Magnetic Resonance	1	1	1	10.1007/s00723-022-01517-4	Yes

Publications generated by High B/T at UF (2)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Adams, J.; Lewkowitz, M.; Huan, C.; Masuhara, N.; Candela, D.; Sullivan, N.S.	*Dynamics of ^{3}He in one dimension in the Luttinger liquid limit*	Physical Review B	106	-	195402	10.1103/PhysRevB.106.195402	Yes
Munir, R.; M Hasan Siddiquee, K.A.; Dissanayake, C.; Kumarasinghe, K.; Hu, X.; Takano, Y.; Sang Choi, E.; Nakajima, Y.	*Unusual superconductivity in the topological nodal-line semimetal candidate SnxNbSe2-Î´*	Journal of Physics: Conference Series	2164	1	12008	10.1088/1742-6596/2164/1/012008	Yes

Publications generated by ICR at FSU (36)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Arya, A.; Ray, J.; Sharma, S.; Cruz Simbron, R.; Lozano, A.; Smith, H.B.; Andersen, J.; Chen, H.; Meringer, M.; Cleaves, H.	*An Open Source Computational Workflow for the Discovery of Autocatalytic Networks in Abiotic Reactions*	Chemical Science	13	-	4838-4853	10.1039/D2SC00256F	Yes
Bahureksa, W.; Borch, T.; Young, R.B.; Weisbrod, C.; Blakney, G.T.; McKenna, A.M.	*Improved Dynamic Range, Resolving Power, and Sensitivity Achievable with FT-ICR Mass Spectrometry at 21 T Reveals the Hidden Complexity of Natural Organic Matter*	Analytical Chemistry	94	32	11382-11389	10.1021/acs.analchem.2c02377	Yes
Bahureksa, W.; Young, R.B.; McKenna, A.M.; Chen, H.; Thorn, K.A.; Rosario-Ortiz, F.L.; Borch, T.	*Nitrogen Enrichment during Soil Organic Matter Burning and Molecular Evidence of Maillard Reactions*	Environmental Science and Technology	56	7	4597-4609	10.1021/acs.est.1c06745	Yes
Barros, E.V.; Filgueiras, P.R.; Lacerda, Jr., V.; Rodgers, R.P.; Ramano, W.	*Characterization of Naphthenic Acids in Crude Oil Samples A Literature Review*	Fuel	319	-	123775	10.1016/j.fuel.2022.123775	Yes
Behnke, M.I.; Fellman, J.B.; D'Amore, D.V.; Gomez, S.M.; Spencer, R.G.M.	*From Canopy to Consumer: What Makes and Modifies Terrestrial DOM in a Temperate Forest*	Biogeo-chemistry	-	-	-	10.1007/s10533-022-00906-y	Yes
Chacon Patino, M.L.; Heshka, N.; Alvarez-Majmutov, A.; Hendrickson, C.L.; Rodgers, R.P.	*Molecular Characterization of Remnant Polarizable Asphaltene Fractions Upon Bitumen Upgrading and Possible Implications in Petroleum Viscosity*	Energy Fuels	36	14	7542-7557	10.1021/acs.energyfuels.2c01541	Yes
Chacon Patino, M.L.; Nelson, J.; Rogel, E.; Hench, K.; Poirier, L.; Lopez-Linares, F.; Ovalles, C.	*Vanadium and Nickel Distributions in Selective-separated n-heptane Asphaltenes of Heavy Crude Oils*	Fuel	312	-	122939	10.1016/j.fuel.2021.122939	Yes
Chen, H.; McKenna, A.M.; Niles, S.; Frye, J.; Glattke, T.; Rodgers, R.P.	*Time-dependent Molecular Progression and Acute Toxicity of Oil-soluble, Interfacially-active, and Water-soluble Species Reveals their Rapid Formation in the Photodegradation of Macondo Well Oil*	Science of the Total Environment	20	813	151884	10.1016/j.scitotenv.2021.151884	Yes
Dubnick, A.; Faber, Q.; Hawkings, J.R.; Bramall, N.; Christner, B.C.; Doran, P.T.; Nadeau, J.; Snyder, C.; Kellerman, A.M.; McKenna, A.M.; Spencer, R.G.M.; Skidmore, M.L.	*Biogeochemical Responses to Mixing of Glacial Meltwater and Hot Spring Discharge in the Mount St. Helens Crater*	JGR Bio-geosciences	127	10	e2022JG006852	10.1029/2022JG006852	Yes
Glattke, T.; Chacon Patino, M.L.; Hoque, S.S.; Ennis, T.E.; Greason, S.; Marshall, A.G.; Rodgers, R.P.	*Complex Mixture Analysis of Emerging Contaminants Generated from Coal Tar- and Petroleum-Derived Pavement Sealants: Molecular Compositions and Correlations with Toxicity Revealed by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*	Environ. Sci. Technol.	56	18	12988-12998	10.1021/acs.est.2c00582	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Glattke, T.; Chacon Patino, M.L.; Marshall, A.G.; Rodgers, R.P.	*Maltene and Asphaltene Contributions to the Formation of Water-Soluble Emerging Contaminants from Photooxidation of Paving Materials*	Energy Fuels	36	21	13060 - 13070	10.1021/acs.energyfuels.2c02936	Yes
Gray, M.R.; Chacón-Patiño, M.L.; Rodgers, R.P.	*Structure Reactivity Relationships for Petroleum Asphaltenes*	Energy Fuels	36	8	4370-4380	10.1021/acs.energyfuels.2c00486	Yes
Johnston, S.E.; Finlay, K.; Spencer, R.G.M.; Butman, D.E.; Metz, M.; Striegl, R.; Bogard, M.J.	*Zooplankton Release Complex Dissolved Organic Matter to Aquatic Environments*	Bio-geochemistry	157	-	313-325	10.1007/s10533-021-00876-7	Yes
Kurek, M.R.; Frey, K.E.; Guillemette, F.; Podgorski, D.C.; Tonwsend-Small, A.; Arp, C.D.; Kellerman, A.M.; Spencer, R.G.M.	*Trapped Under Ice: Spatial and seasonal dynamics of dissolved organic matter composition in tundra lakes*	Journal of Geophysical Research Bio-geosciences	127	4	e2021JG006578	10.1029/2021JG006578	Yes
Labrie, R.; Pequin, B.; St-Gelias, N.F.; Yashayaev, I.; Cherrier, J.; Gelinas, Y.; Guillemette, F.; Podgorski, D.C.; Spencer, R.G.M.; Tremblay, L.	*Deep Ocean Microbial Communities Produce More Stable Dissolved Organic Matter Through the Succession of Rare Prokaryotes*	Science Advances	8	-	27	10.1126/sciadv.abn0035	Yes
LeClerc, H.O.; Atwi, R.; Niles, S.; McKenna, A.M.; Timko, M.T.; West, R.H.; Teixeira, A.R.	*Elucidating the Role of Reactive Nitrogen Intermediates in Hetero-cyclization During Hydrothermal Liquefaction of Food Waste*	Green Chemistry	24	-	5125-5141	10.1039/D2GC01135B	Yes
LeClerc, H.O.; Page, J.R.; Tompsett, G.A.; Niles, S.; McKenna, A.M.; Valla, J.A.; Timko, M.T.; Teixeira, A.R.	*Emergent Chemical Behavior in Mixed Food and Lignocellulosic Green Waste Hydrothermal Liquefaction*	ChemRxiv	-	-	-	10.26434/chemrxiv-2022-0k0jg	Yes
LeClerc, H.O.; Tompsett, G.A.; Paulsen, A.D.; McKenna, A.M.; Niles, S.; Reddy, C.M.; Nelson, R.K.; Cheng, F.; Teixeira, A.R.; Timko, M.T.	*Hydroxyapatite Catalyzed Hydrothermal Liquefaction Transforms Food Waste from an Environmental Liability to Renewable Fuel*	iScience	25	9	104916	10.1016/j.isci.2022.104916	Yes
Lin, Y.; Agarwal, A.M.; Marshall, A.G.; Anderson, L.C.	*Characterization of Structural Hemoglobin Variants by Top-Down Mass Spectrometry and R Programming Tools for Rapid Identification*	Journal of the American Society for Mass Spectrometry	33	1	123-130	10.1021/jasms.1c00291	Yes
McDonough, L.K.; Andersen, M.S.; Behnke, M.I.; Rutlidge, H.; Oudone, P.; Meredith, K.; O'Carroll, D.M.; Santos, I.R.; Marjo, C.E.; Spencer, R.G.M.; McKenna, A.M.; Baker, A.	*A New Conceptual Framework for the Transformation of Groundwater Dissolved Organic Matter*	Nature Communi-cations	13	-	2153	10.1038/s41467-022-29711-9	Yes
McKenna, A.M.; Zander, P.D.; Wormer, L.	*Advancing Analytical Frontiers in Molecular Organic Biomarker Research Through Spatial and Mass Resolution*	Elements	18	2	107-113	10.2138/gselements.17.6.374	Yes
Medeiros, P.M.	*The effects of hurricanes and storms on the composition of dissolved organic matter in a southeastern U.S. estuary*	Frontiers in Marine Science	9	-	855720	10.3389/fmars.2022.855720	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Melani, R.D.; Gerbasi, V.R.; Anderson, L.C.; Sikora, J.W.; Toby, T.K.; Hutton, J.E.; Butcher, D.S.; Negrao, F.; Seckler, H.S.; Srzentic, K.; Fornelli, L.; Camarillo, J.M.; LeDuc, R.D.; Cesnik, A.J.; Lundberg, E.; Greer, J.B.; Fellers, R.T.; Robery, M.T.; DeHart, C.J.; Forte, E.; Hendrickson, C.L.; Abbatiello, S.E.; Thomas, P.M.; Kokaji, A.I.; Levitsky, J.; Kelleher, N.L.	*The Blood Proteoform Atlas: A Reference Map of Proteoforms in Human Hematopoietic Cells*	Science	375	6579	411-418	10.1126/science.aaz5284	Yes
Patzner, M.S.; Logan, M.; McKenna, A.M.; Young, R.B.; Zhou, Z.; Joss, H.; Mueller, C.W.; Hoeschen, C.; Scholten, T.; Straub, D.; Kleindienst, S.; Borch, T.; Kappler, A.; Bryce, C.	*Microbial Iron Cycling During Palsa Hillslope Collapse Promotes Greenhouse Gas Emissions Before Complete Permafrost Thaw*	Communi-cation Earth Environment	3	76	1-14	10.1038/s43247-022-00407-8	Yes
Reddy, C.M.; Nelson, R.K.; Hanke, U.M.; Cui, X.; Summons, R.E.; Valentine, D.L.; Rodgers, R.P.; Chacon Patino, M.L.; Niles, S.; Teixeira, C.E.P.; Bezerra, L.E.A.; Cavalcante, R.M.; Soares, M.O.; Oliveira, A.H.B.; White, H.K.; Swarthout, R.F.; Lemkau, K.L.; Radovic, J.R.	*Synergy of Analytical Approaches Enables a Robust Assessment of the Brazil Mystery Oil Spill*	Energy Fuels	36	22	13688-13704	10.1021/acs.energyfuels.2c00656	Yes
Roth, H.; Nelson, A.R.; McKenna, A.M.; Fegel, T.; Young, R.B.; Rhoades, C.; Wilkins, M.; Borch, T.	*Impact of Beaver Ponds on Biogeochemistry of Organic Carbon and Nitrogen Along a Fire-impacted Stream*	Environmental Science: Process & Impacts	24	-	1661-1677	10.1039/D2EM00184E	Yes
Roth, H.K.; Borch, T.; Young, R.B.; Bahureksa, W.; Blakney, G.T.; Nelson, A.R.; Wilkins, M.J.; McKenna, A.M.	*Enhanced Speciation of Pyrogenic Organic Matter from Wildfires Enabled by 21 T FT-ICR Mass Spectrometry*	Analytical Chemistry	94	6	2973-2980	10.1021/acs.analchem.1c05018	Yes
Ruger, C.P.; Neumann, A.; Kosling, P.; Vesga Martinez, S.J.; Chacon Patino, M.L.; Rodgers, R.P.; Zimmermann, R.	*Addressing Thermal Behavior and Molecular Architecture of Asphaltenes by a Thermal-Optical Carbon Analyzer Coupled to High-Resolution Mass Spectrometry*	Energy Fuels	36	17	10177-10190	10.1021/acs.energyfuels.2c02122	Yes
Terra, N.; Ligiero, L.M.; Molinier, V.; Giusti, P.; Agenet, N.; Loriau, M.; Hubert-Roux, M.; Afonso, C.; Rodgers, R.P.	*Characterization of Crude Oil Molecules Adsorbed onto Carbonate Rock Surface Using LDI FT-ICR MS*	Energy Fuels	36	12	6159-6166	10.1021/acs.energyfuels.2c00840	Yes
Tomco, P.L.; Duddleston, K.; Hatton, J.J.; Grond, K.; Wrenn, T.; Tarr, M.A.; Podgorski, D.C.; Zito, P.	*Dissolved Organic Matter Production from Herder Application and In-situ Burning of Crude Oil at High Latitudes: Bioavailable Molecular Composition Patterns and Microbial Community Diversity Effects*	Journal of Hazardous Materials	424	C	127598	10.1016/j.jhazmat.2021.127598	No
Whisenhart, E.A.; Zito, P.; Podgorski, D.C.; McKenna, A.M.; Redman, Z.C.; Tomco, P.L.	*Unique Molecular Features of Water-Soluble Photo-Oxidation Products among Refined Fuels, Crude Oil, and Herded Burnt*	ACS EST Water	2	6	994-1002	10.1021/acsestwater.1c00494	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	Residue under High Latitude Conditions						
Wise, S.A.; Rodgers, R.P.; Reddy, C.M.; Nelson, R.K.; Kujawinski, E.B.; Wade, T.L.	*Advances in Chemical Analysis of Oil Spills Since the Deepwater Horizon Disaster*	Critical Reviews in Analytical Chemistry	-	-	-	10.1080/10408347.2022.2039093	Yes
Xiong, Y.; Wang, B.; Zhou, C.; Chen, H.; Chen, G.; Tang, Y.	*Determination of Growth Kinetics of Microorganisms Linked with 1,4-dioxane Degradation in a Consortium Based on Two Improved Methods*	Frontiers of Environmental Science & Engineering	16	5	62	10.1007/s11783-022-1567-y	Yes
Young, R.B.; Pica, N.E.; Sharifan, H.; Chen, H.; Roth, H.K.; Blakney, G.T.; Borch, T.; Higgins, C.P.; Kornuc, J.J.; McKenna, A.M.; Blotevogel, J.	*PFAS Analysis with Ultrahigh Resolution 21T FT-ICR MS: Suspect and Nontargeted Screening with Unrivaled Mass Resolving Power and Accuracy*	Environmental Science and Technology	56	4	2455-2465	10.1021/acs.est.1c08143	Yes
Yu, J.; Audu, M.; Myint, M.T.; Cheng, F.; Jarvis, J.M.; Jena, U.; Nirmalakhandan, N.; Brewer, C.E.; Luo, H.	*Bio-crude Oil Production and Valorization of Hydrochar as Anode Material from Hydrothermal Liquefaction of Algae Grown on Brackish Dairy Wastewater*	Fuel Processing Technology	227	-	107119	10.1016/j.fuproc.2021.107119	Yes
Zhang, Z.; Asefaw, B.K.; Xiong, Y.; Chen, H.; Tang, Y.	*Evidence and Mechanisms of Selenate Reduction to Extracellular Elemental Selenium Nanoparticles on the Biocathode*	Environmental Science and Technology	56	22	16259-16270	10.1021/acs.est.2c05145	Yes

Publications generated by NMR at FSU (68)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Akinbi, G.O.; Ngatia, L.W.; Grace, J.M.; Fu, R.; Tan, C.; Olaborade, S.O.; Abichou, T.; Taylor, R.W.	*Organic matter composition and thermal stability influence greenhouse gases production in subtropical peatland under different vegetation types*	Heliyon	8	-	e11547	10.1016/j.heliyon.2022.e11547	Yes
Altenhof, A.; Gan, Z.; Schurko, R.W.	*Reducing the Effects of Weak Homonuclear Dipolar Coupling with CPMG Pulse Sequences for Static and Spinning Solids*	Journal of Magnetic Resonance	337	-	107174	10.1016/j.jmr.2022.107174	Yes
Altenhof, A.R.; Jaroszewicz, M.J.; Frydman, L.; Schurko, R.W.	*3D relaxation-assisted separation of wideline solid-state NMR patterns for achieving site resolution*	Physical Chemistry Chemical Physics	24	-	22792 - 22805	10.1039/D2CP00910B	Yes
Altenhof, A.R.; Mason, H.; Schurko, R.W.	*DESPERATE: A Python Library for Processing and Denoising NMR Spectra*	Journal of Magnetic Resonance	346	-	107320	10.1016/j.jmr.2022.107320	Yes
Asselman, K.; Radhakrishnan, S.; Pellens, N.; Vinod Chandran, C.; Houlleberghs, M.; Xu, Y.; Martens, J.A.; Pulinthanathu Sree, S.; Kirschhock, C.; Breynaert, E.	*HSIL-Based Synthesis of Ultracrystalline K, Na-JBW, a Zeolite Exhibiting Exceptional Framework Ordering and Flexibility*	Chemistry of Materials	34	16	7159--7166	10.1021/acs.chemmater.2c01059	Yes
Bayzou, R.; Trebosc, J.; Hung, I.; Gan, Z.; Lafon, O.; Amoureux, J.	*Indirect NMR detection via proton of nuclei subject to large anisotropic interactions, such as 14N, 195Pt, and 35Cl, using the T-HMQC sequence*	Journal of Chemical Physics	156	6	64202	10.1063/5.0082700	Yes
Bayzou, R.; Trebosc, J.; Hung, I.; Gan, Z.; Rankin, A.; Lafon, O.; Amoureux, J.	*Improved resolution for spin-3/2 isotopes in solids via the indirect NMR detection of triple-quantum coherences using the T-HMQC sequence*	Solid State Nuclear Magnetic Resonance	122	-	101835	10.1016/j.ssnmr.2022.101835	Yes
Chen, K.; Zornes, A.; Nguyen, V.; Wang, B.; Gan, Z.; Crossley, S.; White, J.	*17O Labeling Reveals Paired Active Sites in Zeolite Catalysts*	Journal of the American Chemical Society	144	37	16916 - 16929	10.1021/jacs.2c05332	Yes
Dasari, A. K. R.; Yi, S.; Coats, M. F.; Wi, S.; Lim, K. H.	*Toxic Misfolded Transthyretin Oligomers with Different Molecular Conformations Formed through Distinct Oligomerization Pathways*	Biochemistry	61	21	2358-2365	10.1021/acs.biochem.2c00390	Yes
Deligey, F.; Frank, M.; Cho, S.; Kirui, A.; Mentink-Vigier, F.; Swulius, M.; Nixon, B.; Wang, T.	*Structure of In Vitro -Synthesized Cellulose Fibrils Viewed by Cryo-Electron Tomography and 13 C Natural-Abundance Dynamic Nuclear Polarization Solid-State NMR*	Biomacro-molecules	-	-		10.1021/acs.biomac.1c01674	Yes
Dorn, R.W.; Heintz, P.M.; Hung, I.; Chen, K.; Oh, J.; Kim, T.; Zhou, L.; Gan, Z.; Huang, W.; Rossini, A.J.	*Atomic-Level Structure of Mesoporous Hexagonal Boron Nitride Determined by High-Resolution Solid-State Multinuclear Magnetic Resonance Spectroscopy and Density Functional Theory Calculations*	Chemistry of Materials	34	4	1649--1665	10.1021/acs.chemmater.1c03791	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Dorn, R.W.; Mark, L.O.; Hung, I.; Cendejas, M.C.; Xu, Y.; Gor'kov, P.L.; Mao, W.; Ibrahim, F.; Gan, Z.; Hermans, I.; Rossini, A.J.	*An Atomistic Picture of Boron Oxide Catalysts for Oxidative Dehydrogenation Revealed by Ultrahigh Field 11B-17O Solid-State NMR Spectroscopy*	Journal of the American Chemical Society	144	41	18766 -- 18771	10.1021/jacs.2c08237	Yes
Dorn, R.W.; Paterson, A.L.; Hung, I.; Gor'kov, P.L.; Thompson, A.J.; Sadow, A.D.; Gan, Z.; Rossini, A.J.	*Dipolar Heteronuclear Correlation Solid-State NMR Experiments between Half-Integer Quadrupolar Nuclei: The Case of 11B-17O*	Journal of Physical Chemistry C	126	28	11652 -- 11666	10.1021/acs.jpcc.2c02737	Yes
Du, J.; Chen, L.U.; Zhang, B.; Chen, K.; Wang, M.; Wang, Y.; Hung, I.; Gan, Z.; Wu, X.; Gong, X.; Peng, L.	*Identification of CO2 adsorption sites on MgO nanosheets by solid-state nuclear magnetic resonance spectroscopy*	Nature Communi-cations	13	1	1-6	10.1038/s41467-022-28405-6	Yes
Du, L.; Helsper, S.; Arabzadeh Nosratabad, N.; Wang, W.; Ann Fadool, D.; Amiens, C.; Grant, S.C.; Mattoussi, H.	*A Multifunctional Contrast Agent for 19F-Based Magnetic Resonance Imaging*	Bioconjugate Chemistry	33	5	881-891	10.1021/acs.bioconjchem.2c00116	Yes
Fernando, L.D.; Dickwella Widanage, M.C.; Shekar, S.; Mentink-Vigier, F.; Wang, P.; Wi, S.; Wang, T.	*Solid-state NMR analysis of unlabeled fungal cell walls from Aspergillus and Candida species*	Journal of Structural Biology: X	6	-	100070	10.1016/j.yjsbx.2022.100070	Yes
Gan, Z.; Hung, I.	*Second-order phase correction of NMR spectra acquired using linear frequency-sweeps*	Magnetic Resonance Letters	2	1	1--8	10.1016/j.mrl.2021.100026	Yes
Ghassemi, N.; Poulhazan, A.; Deligey, F.; Mentink-Vigier, F.; Marcotte, I.; Wang, T.	*Solid-State NMR Investigations of Extracellular Matrixes and Cell Walls of Algae, Bacteria, Fungi, and Plants*	Chemical Reviews	-	-		10.1021/acs.chemrev.1c00669	Yes
Goldberga, I.; Patris, N.; Chen, C.; Thomassot, E.; Trebosc, J.; Hung, I.; Gan, Z.; Berthomieu, D.; Metro, T.; Bonhomme, C.; Gervais, C.; Laurencin, D.	*First Direct Insight into the Local Environment and Dynamics of Water Molecules in the Whewellite Mineral Phase: Mechanochemical Isotopic Enrichment and High-Resolution 17O and 2H NMR Analyses*	Journal of Physical Chemistry C	126	29	12044 -- 12059	10.1021/acs.jpcc.2c02070	Yes
Gong, J.; Adnani, M.; Jones, B.T.; Xin, Y.; Wang, S.S.; Patel, S.; Lochner, E.J.; Mattoussi, H.; Hu, Y.; Gao, H.	*Nanoscale Encapsulation of Hybrid Perovskites Using Hybrid Atomic Layer Deposition*	Journal of Physical Chemistry Letters	13	-	4082-4089	10.1021/acs.jpclett.2c00862	Yes
Grazia Concilio, M.; Kuprov, I.; Frydman, L.	*J-Driven dynamic nuclear polarization for sensitizing high field solution state NMR*	Physical Chemistry Chemical Physics	24	4	2118--2125	10.1039/d1cp04186j	Yes
Harrabi, R.; Halbritter, T.; Aussenac, F.; Dakhlaoui, O.; van Tol, J.; Damodaran, K.K.; Lee, D.; Paul, S.; Hediger, S.; Mentink-Vigier, F.; Sigurdsson, S.; De Paepe, G.	*Highly Efficient Polarizing Agents for MAS-DNP of Proton-Dense Molecular Solids*	Angewandte Chemie International Edition	21	12	e202114103	10.1002/anie.202114103	Yes
He, J.; Chen, H.; Wang, D.; Zhang, Q.; Zhong, G.; Peng, Z.	*Interfacial Barrier of Ion Transport in Poly(ethylene oxide) $Li_7La_3Zr_2O_{12}$ Composite Electrolytes Illustrated by ^{6}Li-Tracer Nuclear Magnetic Resonance Spectroscopy*	Journal of Physical Chemistry Letters	13	6	1500--1505	10.1021/acs.jpclett.1c04085	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Helsper, S.; Bagdasarian, F.; Yuan, X.; Xu, K.; Lee, J.Y.; Rosenberg, J.T.; Borlongan, C.V.; Ma, T.; Grant, S.C.	*Extended Ischemic Recovery After Implantation of Human Mesenchymal Stem Cell Aggregates Indicated by Sodium MRI at 21.1 T*	Translational Stroke Research	13	4	543-555	10.1007/s12975-021-00976-4	Yes
Helsper, S.; Yuan, X.; Bagdasarian, F.A.; Athey, J.D.; Li, Y.; Borlongan, C.V.; Grant, S.C.	*Multinuclear MRI Reveals Early Efficacy of Stem Cell Therapy in Stroke*	Translational Stroke Research	1	-	1	10.1007/s12975-022-01057-w	Yes
Holmes, J.; Liu, V.; Caulkins, B.; Hilario, E.; Ghosh, R.; Drago, V.; Young, R.; Romero, J.A.; Gill, A.; Bogie, P.; Paulino, J.; Wang, X.; Riviere, G.; Bosken, Y.; Struppe, J.; Hassan, A.; Guidoulianov, J.; Perrone, B.; Mentink-Vigier, F.; Chang, C.; Long, J.R.; Hooley, R.; Mueser, T.; Dunn, M.; Mueller, L.	*Imaging active site chemistry and protonation states: NMR crystallography of the tryptophan synthase a-aminoacrylate intermediate*	Proceedings of the National Academy of Sciences of the USA (PNAS)	119	2	e2109235119	10.1073/pnas.2109235119	Yes
Holmes, S.; Hook, J.M.; Schurko, R.W.	*Nutraceuticals in Bulk and Dosage Forms: Analysis by 35Cl and 14N Solid-State NMR and DFT Calculations*	Molecular Pharma-ceutics	19	-	440-455	10.1021/acs.molpharmaceut.1c00708	Yes
Holmes, S.; Vojvodin, C.; Veinberg, N.; Iacobelli, E.M.; Hirsh, D.A.; Schurko, R.W.	*Hydrates of active pharmaceutical Ingredients: A 35Cl and 2H solid-state NMR and DFT study*	Solid State Nuclear Magnetic Resonance	122	-	101837	10.1016/j.ssnmr.2022.101837	Yes
Hung, I.; Keeler, E.G.; Mao, W.; Gor'kov, P.L.; Griffin, R.G.; Gan, Z.	*Residue-Specific High-Resolution 17O Solid-State Nuclear Magnetic Resonance of Peptides: Multidimensional Indirect 1H Detection and Magic-Angle Spinning*	Journal of Physical Chemistry Letters	13	28	6549-6558	10.1021/acs.jpclett.2c01777	Yes
Johnston, T.; Edison, A.S.; Ramaswamy, V.; Freytag, N.; Merritt, M.E.; Thomas, J.; Hooker, J.; Litvak, I.; Brey, W.W.	*Application of Counter-Wound Multi-Arm Spirals in HTS Resonator Design*	IEEE Transactions on Applied Super-conductivity	32	4	1-4	10.1109/TASC.2022.3146109	Yes
Kirui, A.; Zhao, W.; Deligey, F.; Yang, H.; Kang, X.; Mentink-Vigier, F.; Wang, T.	*Carbohydrate-aromatic interface and molecular architecture of lignocellulose*	Nature Communi-cations	13	1	538	10.1038/s41467-022-28165-3	Yes
Kundu, K.; Dubroca, T.; Rane, V.; Mentink-Vigier, F.	*Spinning-Driven Dynamic Nuclear Polarization with Optical Pumping*	Journal of Physical Chemistry A	-	-		10.1021/acs.jpca.2c01559	Yes
Leroy, C.; Metro, T.; Hung, I.; Gan, Z.; Gervais, C.; Laurencin, D.	*From Operando Raman Mechanochemistry to "NMR Crystallography": Understanding the Structures and Interconversion of Zn-Terephthalate Networks Using Selective 17O-Labeling*	Chemistry of Materials	34	5	2292--2312	10.1021/acs.chemmater.1c04132	Yes
Li, X.; Deck, M.J.; Hu, Y.	*Solid-State NMR and EPR Characterization of Transition-Metal Oxides for Electrochemical Energy Storage*	Transition Metal Oxides for Electro-chemical Energy Storage	1	-	299--318	10.1002/9783527817252.ch12	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Li, X.; Li, X.; Monluc, L.; Chen, B.L.; Tang, M.; Chien, P.; Feng, X.; Hung, I.; Gan, Z.; Urban, A.	*Stacking-Fault Enhanced Oxygen Redox in Li2MnO3*	Advanced Energy Materials	12	-	2200427	10.1002/aenm.202200427	Yes
Li, Y.C.; Zhang, S.Y.; Wu, Z.; Peng, X.H.; Fu, R.	*On the use of cross polarization in solid-state NMR: 1H spin-lock versus adiabatic demagnetization in the rotating frame*	Magnetic Resonance Letters	2	-	147-158	10.1016/j.mrl.2022.07.001	Yes
Lin, M.; Fu, R.; Xiang, Y.X.; Yang, Y.; Cheng, J.	*Combining NMR and molecular dynamics simulations for revealing the alkali-ion transport in solid-state battery materials*	Current Opinion in Electro-chemistry	35	-	101048	10.1016/j.coelec.2022.101048	Yes
Lin, M.; Xiong, J.F.; Su, M.T.; Wang, F.; Liu, X.S.; Hou, Y.F.; Fu, R.; Yang, Y.; Cheng, J.	*A machine learning protocol for revealing ion transport mechanisms from dynamic NMR shifts in paramagnetic battery materials*	Chemical Science	13	-	7863-7872	10.1039/d2sc01306a	Yes
Liu, C.; Helsper, S.; Marzano, M.; Chen, X.; Muok, L.; Esmonde, C.; Zeng, C.; Sun, L.; Grant, S.C.; Li, Y.	*Human Forebrain Organoid-Derived Extracellular Vesicle Labeling with Iron Oxides for In Vitro Magnetic Resonance Imaging*	Biomedicines	10	12	3060	10.3390/biomedicines10123060	Yes
Meirovitch, E.; Liang, Z.; Schurko, R.W.; Loeb, S.J.; Freed, J.H.	*Structural Dynamics by NMR in the Solid State: II. The MOMD Perspective of the Dynamic Structure of Metal Organic Frameworks Comprising Several Mobile Components*	Journal of Physical Chemistry B	126	13	2452--2465	10.1021/acs.jpcb.1c10120	Yes
Mentink-Vigier, F.; Eddy, S.; Gullion, T.	*MAS-DNP enables NMR studies of insect wings*	Solid State Nuclear Magnetic Resonance	-	-	101838	10.1016/j.ssnmr.2022.101838	Yes
Novakovic, M.; Hanopolskyi, A.; Wi, S.; Frydman, L.	*HORRENDOUS NMR: Establishing correlations in solution-state NMR by reinstating non-secular J-coupling terms*	Journal of Magnetic Resonance	337	-	107176	10.1016/j.jmr.2022.107176	Yes
Patel, S.; Truong, E.; Liu, H.; Jin, Y.; Chen, B.; Wang, Y.; Miara, L.; Kim, R.; Hu, Y.	*Interrupted anion-network enhanced Li+-ion conduction in Li3+ yPO4Iy*	Energy Storage Materials	51	-	88--96	10.1016/j.ensm.2022.06.026	Yes
Paulino, J.; Wright, A.K.; Cross, T.A.	*M2 Proton Channel from Influenza A: Example of Structural Sensitivity to Environment*	Encyclopedia of Biophysics	-	-	1-9	10.1007/978-3-642-35943-9_810-1	No
Peach, A.; Holmes, S.; MacGillivray, L.R.; Schurko, R.W.	*The formation and stability of fluoxetine HCl cocrystals investigated by multicomponent milling*	CrystEng Comm	25	2	213--224	10.1039/d2ce01341j	Yes
Qiao, A.; Sorensen, S.S.; Stepniewska, M.; Biscio, C.A.N.; Fajstrup, L.; Wang, Z.; Zhang, X.; Calvez, L.; Hung, I.; Gan, Z.; Smedskjaer, M.M.; Yue, Y.	*Hypersensitivity of the Glass Transition to Pressure History in a Metal-Organic Framework Glass*	Chemistry of Materials	34	11	5030--5038	10.1021/acs.chemmater.2c00325	No
Rassolov, P.V.; Scigliani, A.; Mohammadigoushki, H.	*Kinetics of shear banding flow formation in linear and branched wormlike micelles*	Soft Matter	18	32	6079--6093	10.1039/D2SM00748G	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Rosenberg, J.T.; Grant, S.C.; Topgaard, D.	*Nonparametric 5D D-R2 distribution imaging with single-shot EPI at 21.1 T: Initial results for in vivo rat brain*	Journal of Magnetic Resonance	341	-	107256	10.1016/j.jmr.2022.107256	Yes
Ruiz-Zamora, E.; De la Rosa, J.R.; Maldonado, C.S.; Lucio-Ortiz, C.J.; De Haro Del Rio, D.A.; Garza-Navarro, M.A.; Sandoval-Rangel, L.; Morales-Leal, F.; Wi, S.	*Siliceous self-pillared pentasil (SPP) zeolite with incorporated phosphorus groups in catalytic formation of butadiene by dehydra-decyclization of tetrahydrofuran: Study of catalyst stability by NMR and REDOR analysis*	Applied Catalysis A: General	640	25	118648	10.1016/j.apcata.2022.118648	Yes
Shekar, S.C.; Zhao, W.; Fernando, L.D.; Hung, I.; Wang, T.	*A 13C three-dimensional DQ-SQ-SQ correlation experiment for high-resolution analysis of complex carbohydrates using solid-state NMR*	Journal of Magnetic Resonance	336	-	107148	10.1016/j.jmr.2022.107148	Yes
Shen, J.; Terskikh, V.; Struppe, J.; Hassan, A.; Monette, M.; Hung, I.; Gan, Z.; Brinkmann, A.; Wu, G.	*Solid-state 17O NMR study of alpha-D-glucose: exploring new frontiers in isotopic labeling, sensitivity enhancement, and NMR crystallography*	Chemical Science	13	9	2591--2603	10.1039/d1sc06060k	Yes
Sil, A.; Deck, M.; Goldfine, E.; Zhang, C.; Patel, S.; Flynn, S.; Liu, H.; Chien, P.; Poeppelmeier, K.; Dravid, V.	*Fluoride Doping in Crystalline and Amorphous Indium Oxide Semiconductors*	Chemistry of Materials	34	7	3253--3266	10.1021/acs.chemmater.2c00053	Yes
Soundararajan, M.; Dubroca, T.; van Tol, J.; Hill, S.; Frydman, L.; Wi, S.	*Proton-detected solution-state NMR at 14.1 T based on scalar-driven 13C Overhauser dynamic nuclear polarization*	Journal of Magnetic Resonance	343	-	107304	10.1016/j.jmr.2022.107304	Yes
Thomas, J.N.; Johnston, T.L.; Litvak, I.M.; Ramaswamy, V.; Merritt, M.E.; Rocca, J.R.; Edison, A.S.; Brey, W.W.	*Implementing High Q-Factor HTS Resonators to Enhance Probe Sensitivity in 13C NMR Spectroscopy*	Journal of Physics: Conference Series	2323	1	12030	10.1088/1742-6596/2323/1/012030	Yes
Vanlommel, S.; Hoffman, A.E.; Smet, S.; Radhakrishnan, S.; Asselman, K.; Vinod Chandran, C.; Breynaert, E.; Kirschhock, C.E.; Martens, J.A.; Van Speybroeck, V.	*How Water and Ion Mobility Affect the NMR Fingerprints of the Hydrated JBW Zeolite: A Combined Computational-Experimental Investigation*	Chemistry a European Journal	28	68	e202202621	10.1002/chem.202202621	Yes
Vojvodin, C.; Holmes, S.; Watanabe, L.K.; Rawson, J.M.; Schurko, R.W.	*Multi-Component Crystals Containing Urea: Mechanochemical Synthesis and Characterization by 35Cl Solid-State NMR Spectroscopy and DFT Calculations*	CrystEng Comm	19	-	440-455	10.1039/d1ce01610e	Yes
Vugmeyster, L.; Fai Au, D.; Smith, M.; Ostrovsky, D.	*Comparative hydrophobic core dynamics between wild-type amyloid-β fibrils, glutamate-3 truncation, and Serine-8 phosphorylation*	ChemPhys Chem	23	3	e202100709	10.1002/cphc.202100709	Yes
Vugmeyster, L.; Ostrovsky, D.; Greenwood, A.; Fu, R.	*Deuteron rotating frame relaxation for the detection of slow motions in rotating solids*	Journal of Magnetic Resonance	337	-	107171	10.1016/j.jmr.2022.107171	Yes
Wang, L.; Patel, S.; Truong, E.; Hu, Y.; Haile, S.	*Phase Behavior and Superprotonic Conductivity in the System (1--x) CsH2PO4--x*	Chemistry of Materials	34	4	1809--1820	10.1021/acs.chemmater.1c04061	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
	H3PO4: Discovery of Off-Stoichiometric α-[Cs1--x H x] H2PO4						
Wang, R.; Zhao, Z.; Gao, P.; Chen, K.; Gan, Z.; Fu, Q.; Hou, G.	*Impact of Adsorption Configurations on Alcohol Dehydration over Alumina Catalysts*	Journal of Physical Chemistry C	126	24	10073 -- 10080	10.1021/acs.jpcc.2c03303	Yes
Wi, S.; Dwivedi, N.; Dubey, R.; Mentink-Vigier, F.; Sinha, N.	*Dynamic nuclear polarization-enhanced, double-quantum filtered 13C-13C dipolar correlation spectroscopy of natural 13C abundant bone-tissue biomaterialAuthor links open overlay panel*	Journal of Magnetic Resonance	335	-	107144	10.1016/j.jmr.2022.107144	Yes
Wright, A.; Paulino, J.; Cross, T.A.	*Emulating Membrane Protein Environments— How Much Lipid Is Required for a Native Structure: Influenza S31N M2*	Journal of the American Chemical Society	144	5	2137--2148	10.1021/jacs.1c10174	Yes
Xia, Y.; Chen, H.; Hung, I.; Gan, Z.; Sen, S.	*Structure and Fragility of Zn-phosphate glasses: Results from multinuclear NMR spectroscopy and calorimetry*	Journal of Non-Crystalline Solids	580	-	121395	10.1016/j.jnoncrysol.2022.121395	Yes
Yeo, T.; Cho, J.; Hung, I.; Gan, Z.; Sen, S.	*Structure and crystallization behavior of complex mold flux glasses in the system CaO-Na2O-Li2O-CaF2-B2O3-SiO2: A multi-nuclear NMR spectroscopic study*	Journal of the American Ceramic Society	105	10	6140-6148	10.1111/jace.18610	Yes
Zhang, R.; Cross, T.A.; Peng, X.H.; Fu, R.	*Surprising Rigidity of Functionally Important Water Molecules Buried in the Lipid Headgroup Region*	Journal of the American Chemical Society	144	-	7881-7888	10.1021/jacs.2c02145	Yes
Zhao, S.; Li, X.M.; Wen, Z.Y.; Zou, M.B.; Yu, G.; Liu, X.Y.; Mao, J.F.; Zhang, L.X.; Xue, Y.; Fu, R.; Wang, S.L.	*Dynamics of base pairs with low stability in RNA by solid-state NMR exchange spectroscopy*	iScience	25	-	105322	10.1016/j.isci.2022.105322	Yes
Zhao, W.; Deligey, F.; Chandra Shekar, S.; Mentink-Vigier, F.; Wang, T.	*Current limitations of solid-state NMR in carbohydrate and cell wall research*	Journal of Magnetic Resonance	341	-	107263	10.1016/j.jmr.2022.107263	Yes
Zhao, Z.; Xiao, D.; Chen, K.; Wang, R.; Liang, L.; Liu, Z.; Hung, I.; Gan, Z.; Hou, G.	*Nature of Five-Coordinated Al in g-Al2O3 Revealed by Ultra-High-Field Solid-State NMR*	ACS Central Science	8	6	795--803	10.1021/acscentsci.1c01497	Yes
Askey, B.; Liu, D.; Rubin, G.; Kunik, A.; Song, Y.; Ding, Y.; Kim, J.	*Metabolite profiling reveals organ-specific flavone accumulation in Scutellaria and identifies a scutellarin isomer isoscutellarein 8-O-**β** glucuronopyranoside*	Plant Direct	5	12	e372	10.1002/pld3.372	Yes

Publications generated by PFF LANL (28)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Bian, M.; Zhu, L.; Wang, X.; Choi, J.; Chopdekar, R.; Wei, S.; Wu, L.; Huai, C.; Marga, A.; Yang, Q.; Li, Y.; Yao, Y.; Yu, T.; Crooker, S.; Lin, J.; Zhang, S.; Hou, Y.; Zeng, H.	*Dative Epitaxy of Commensurate Monocrystalline Covalent van der Waals Moiré Supercrystal*	Advanced Materials	2022	-	2200117	10.1002/adma.202200117	Yes
Blackmore, W.J.; Curley, S.P.; Williams, R.C.; Vaidya, S.; Singleton, J.; Birnbaum, S.M.; Ozarowski, A.; Schlueter, J.A.; Chen, Y.; Gillon, B.; Goukassov, A.; Kibalin, I.; Villa, D.Y.; Villa, J.A.; Manson, J.L.; Goddard, P.A.	*Magneto-structural Correlations in Ni2+Halide···Halide Ni2+ Chains*	Inorganic Chemistry	61	1	141-153	10.1021/acs.inorgchem.1c02483	Yes
Blawat, J.; Marshall, M.; Singleton, J.; Feng, E.; Cao, H.; Xie, W.; Jin, R.	*Unusual Electrical and Magnetic Properties in LayeredEuZn2As2*	Advanced Quantum Technologies	2022	-	2200012	10.1002/qute.202200012	Yes
Chen, D.; Helms, P.; Hale, A.R.; Lee, M.; Li, C.; Gray, J.; Christou, G.; Zapf, V.; Chan, G.; Cheng, H.	*Using Hyperoptimized Tensor Networks and First-Principles Electronic Structure to Simulate the Experimental Properties of the Giant Mn84 Torus*	Journal of Physical Chemistry Letters	13	10	2365-2370	10.1021/acs.jpclett.2c00354	Yes
Dzsaber, S.; Zocco, D.A.; McCollam, A.; Weickert, D.F.; McDonald, R.; Taupin, M.; Eguchi, G.; Yan, X.; Prokofiev, A.; Tang, L.M.; Vlaar, B.; Winter, L.; Jaime, M.; Si, Q.; Paschen, S.	*Control of electronic topology in a strongly correlated electron system*	Nature Communi-cations	13	-	5729	10.1038/s41467-022-33369-8	Yes
Ekanayaka, T.K.; Wang, P.; Yazdani, S.; Phillips, J.; Mishra, E.; Dale, A.S.; N'Diaye, A.T.; Klewe, C.; Shafer, P.; Freeland, J.; Streubel, R.; Wampler, J.; Zapf, V.; Cheng, R.; Shatruk, M.; Dowben, P.A.	*Evidence of dynamical effects and critical field in a cobalt spin crossover complex*	Chemical Communi-cations	58	-	661-664	10.1039/D1CC05309D	No
Ghosh, S.; Kiely, T.; Shehter, A.; Jerzembeck, F.; Kikugawa, N.; Sokolov, D.; Mackenzie, A.; Ramshaw, B.	*Strong increase of ultrasound attenuation below Tc in SrRuO4*	Physical Review B	106	-	24520	10.1103/PhysRevB.106.024520	No
Goryca, M.; Zhang, X.; Watts, J.; Nisoli, C.; Leighton, C.; Schiffer, P.; Crooker, S.	*Magnetic field dependent thermodynamic properties of square and quadrupolar artificial spin ice*	Physical Review B	105	-	94406	10.1103/PhysRevB.105.094406	Yes
Gotze, K.; Pearce, M.J.; Coak, M.J.; Goddard, P.; Grockowiak, A.; Coniglio, W.; Tozer, S.W.; Graf, D.E.; Maple, M.B.; Ho, P.; Brown, M.C.; Singleton, J.	*Pressure-induced shift of effective Ce valence, Fermi energyand phase boundaries in CeOs4Sb12*	New Journal of Physics	24	-	43044	10.1088/1367-2630/ac643c	Yes
Harrison, N.; Chan, M.K.	*Magic Gap Ratio for Optimally Robust Fermionic Condensation and Its Implications for High-T_C Superconductivity*	Physical Review Letters	129	-	17001	10.1103/PhysRevLett.129.017001	Yes
Huang, Q.; Rawl, R.; Xie, W.W.; Chou, E.S.; Zapf, V.; Ding, X.X.; Mauws, C.; Wiebe, C.R.; Feng,	*Non-magnetic ion site disorder effects on the quantum magnetism of a spin-1/2*	Journal of Physics-Condensed Matter	34	20	205401	10.1088/1361-648x/ac5703	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
E.X.; Cao, H.B.; Tian, W.; Ma, J.J.; Qiu, Y.; Butch, N.; Zhou, H.	*equilateral triangular lattice antiferromagnet*						
Hughey, K.; Lee, M.; Nam, J.; Clune, A.; O`Neal, K.; Tian, W.; Fishman, R.; Ozerov, M.; Lee, J.; Zapf, V.; Musfeldt, J.	*High-Field Magnetoelectric and Spin-Phonon Coupling in Multiferroic (NH4)2[FeCl5·(H2O)]*	Inorganic Chemistry	61	-	3434-3442	10.1021/acs.inorgchem.1c03311	Yes
Jaime, M.	*Crystal Lattice Witness vs Actor Roles in Correlated Electronic Materials*	Journal of the Physical Society of Japan	91	-	101005	10.7566/JPSJ.91.101005	Yes
Li, J.; Goryca, M.M.; Choi, J.; Xu, X.; Crooker, S.	*Many-Body Exciton and Intervalley Correlations in Heavily Electron-Doped WSe2 Monolayers*	American Chemical Society Nano Letters	22	-	426	10.1021/acs.nanolett.1c04217	Yes
Nekrashevich, I.; Ding, X.N.; Balakirev, F.; Yi, H.; Cheong, S.; Civale, L.; Kamiya, Y.; Zapf, V.	*Reaching the equilibrium state of the frustrated triangular Ising magnet* $Ca_3Co_2O_6$	Physical Review B	105	-	24426	10.1103/PhysRevB.105.024426	Yes
Nguyen, D.N.; Vo, T.; Michel, J.; Dixon, I.R.; Adkins, T.; Han, K.	*Redesign of the Coils for the 60T Controlled-Waveform Magnet at NHMFL*	IEEE Transactions on Applied Super-conductivity	32	6	4300504	10.1109/TASC.2022.3151836	Yes
Owczarek, M.; Lee, M.; Liu, S.; Blake, E.R.; Taylor, C.S.; Newman, G.A.; Eckert, J.C.; Leal, J.H.; Semelsberger, T.A.; Cheng, H.; Nie, W.; Zapf, V.	*Near-Room-Temperature Magnetoelectric Coupling via Spin Crossover in an Iron(II) Complex*	Angewandte Chemie International Edition	-	-	e202214335	10.1002/anie.202214335	Yes
Owczarek, M.; Lee, M.; Zapf, V.; Nie, W.; Jakubas, R.	*Accessing One-Dimensional Chains of Halogenoindates(III) in Organic Inorganic Hybrids*	Inorganic Chemistry	61	14	5469-5473	10.1021/acs.inorgchem.2c00374	Yes
Park, K.; Yokosuk, M.; Goryca, M.M.; Yang, J.; Crooker, S.; Cheong, S.; Haule, K.; Vanderbilt, D.; Kim, H.; Musfeldt, J.	*Nonreciprocal directional dichroism at telecom wavelengths*	Nature Partner Journals Quantum Materials (npj)	7	1	38	10.1038/s41535-022-00438-6	Yes
Pouse, N.; Deng, Y.; Ran, S.; Graf, D.E.; Lai, Y.; Singleton, J.; Balakirev, F.; Baumbach, R.; Maple, M.B.	*Anisotropy of the T vs. H phase diagram and the HO/LMAFM phase boundary in URu2−xFexSi2https://doi.org/10.3389/femat.2022.991754*	Frontiers of Environmental Science & Engineering	2022	-	991754	10.3389/femat.2022.991754	Yes
Ren, L.; Lombez, L.; Roberts, C.; Beret, D.; Lagarde, D.; Urbaszek, B.; Renucci, P.; Taniguchi, T.; Watanabe, K.; Crooker, S.; Marie, X.	*Optical Detection of Long Electron Spin Transport Lengths in a Monolayer Semiconductor*	Physical Review Letters	129	-	27402	10.1103/PhysRevLett.129.027402	Yes
Sharma, Y.; Paudel, B.; Huon, A.; Schneider, M.; Roy, P.; Corey, Z.; Schoenemann, R.; Jones, A.; Jaime, M.; Yarotski, D.; Charlton, T.; Fitzsimmons, M.; Jia, Q.; Pettes, M.; Yang, P.; Chen, A.	*Induced Ferromagnetism in Epitaxial Uranium Dioxide Thin Films*	Advanced Science	22	-	2203473	10.1002/advs.202203473	Yes
Shehter, A.; Varma, C.	*Local Magnetic Moments due to Loop-currents in Metals*	Physical Review B	106	-	214419	10.1103/PhysRevB.106.214419	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Van Tuan, D.; Shi, S.; Xu, X.; Crooker, S.; Dery, H.	*Six-Body and Eight-Body Exciton States in Monolayer WSe2*	Physical Review Letters	129	-	76801	10.1103/PhysRevLett.129.076801	Yes
Wartenbe, M.; Tobash, P.H.; Singleton, J.; Winter, L.E.; Richmond, S.; Harrison, N.	*Pseudogap in elemental plutonium*	Physical Review B	105	-	L041107	10.1103/PhysRevB.105.L041107	Yes
Xiang, Z.; Chen, K.; Chen, L.; Asaba, T.; Sato, Y.; Zhang, N.; Zhang, D.; Kasahara, Y.; Iga, F.; Coniglio, W.A.; Matsuda, Y.; Singleton, J.; Li, L.	*Hall Anomaly, Quantum Oscillations and Possible Lifshitz Transitions in Kondo Insulator YbB12: Evidence for Unconventional Charge Transport*	Physical Review X	12	-	21050	10.1103/PhysRevX.12.021050	Yes
Yan, H.; Zeng, S.; Rubi, K.; Omar, G.; Zhang, Z.; Goiran, M.; Escoffier, W.; Ariando, A.	*Ionic Modulation at the $LaAlO_3/KTaO_3$ Interface for Extreme High-Mobility Two-Dimensional Electron Gas*	Advanced Materials Interfaces	9	-	2201633	10.1002/admi.202201633	Yes
Zapf, V.; Lee, M.; Rosa, P.F.S.	*Melted Spin Ice*	Nature Physics	-	-	1	10.1038/s41567-022-01814-6	No

Publications generated by ASC (8)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Ferracin, P.; Ambrosio, G.; Arbelaez, D.; Brouwer, L.; Barzi, E.; Cooley, L.; Garcia Fajardo, L.; Gupta, R.; Juchno, M.; Kashikhin, V.; Marinozzi, V.; Novitski, I.; Rochepault, E.; Stern, J.C.; Zlobin, A.; Zucchi, N.	*Towards 20 T Hybrid Accelerator Dipole Magnets*	IEEE Transactions on Applied Super-conductivity	32	6	1--6	10.1109/tasc.2022.3152715	No
Hu, X.; Polyanskii, A.A.; Abraimov, D.V.; Gavrilin, A.V.; Weijers, H.W.; Kametani, F.; Jaroszynski, J.J.; Larbalestier, D.C.	*Analysis of Local Burnout in a Sub-scale Test Coil for the 32T Magnet After Spontaneous Quenches During Fast Ramping*	Super-conductor Science and Technology	35	7	075009	10.1088/1361-6668/ac49a4	Yes
Jaroszynski, J.; Constantinescu, A.; Miller, G.E.; Xu, A.; Francis, A.; Murphy, T.P.; Larbalestier, D.C.	*Rapid assessment of REBCO CC angular critical current density Jc(B, T = 4.2 K, theta) using torque magnetometry up to at least 30T*	Super-conductor Science and Technology	35	9	95009	10.1088/1361-6668/ac8318	Yes
Oz, Y.; Davis, D.S.; Jiang, J.; Hellstrom, E.; Larbalestier, D.C.	*Influence of twist pitch on hysteretic losses and transport Jc in overpressure processed high Jc Bi-2212 round wires*	Super-conductor Science and Technology	35	6	64004	10.1088/1361-6668/ac68a8	Yes
Phifer, V.E.; Small, M.; Bradford, G.; Weiss, J.D.; van der Laan, D.; Cooley, L.	*Investigations in the tape-to-tape contact resistance and contact composition in superconducting CORC wires*	Super-conductor Science and Technology	35	6	65003	10.1088/1361-6668/ac662f	Yes
Shen, T.; Fajardo, L.G.; Myers, C.; Hafalia, Jr., A.; Fernández, J.L.R.; Arbelaez, D.; Brouwer, L.; Caspi, S.; Ferracin, P.; Gourlay, S.; Marchevsky, M.; Pong, I.; Prestemon, S.; Teyber, R.; Turqueti, M.; Wang, X.; Jiang, J.; Bosque, E.; Lu, J.; Davis, D.S.; Trociewitz, U.P.; Hellstrom, E.; Larbalestier, D.C.	*Design, fabrication, and characterization of a high-field high-temperaturesuperconducting Bi-2212 accelerator dipole magnet*	Physical Review Accelerators and Beams	25	12	122401	10.1103/PhysRevAccelBeams.25.122401	Yes
Valles, F.; Palau, A.; Abraimov, D.V.; Jaroszynski, J.; Constantinescu, A.; Mundet, B.; Obradors, X.; Larbalestier, D.C.; Puig, T.	*Optimizing vortex pinning in YBa2Cu3O7-x superconducting films up to high magnetic fields*	Communi-cations Materials	3	-	45	10.1038/s43246-022-00266-y	Yes
Wang, M.; Polyanskii, A.A.; Balachandran, S.; Chetri, S.; Crimp, M.; Lee, P.J.; Bieler, T.	*Investigation of the effect of structural defects from hydride precipitation on superconducting properties of high purity SRF cavity Nb using magneto-optical and electron imaging methods*	Super-conductor Science and Technology	35	4	45001	10.1088/1361-6668/ac4f6a	Yes

Publications generated by MS&T (29)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
An, B.; Xin, Y.; Niu, R.; Xiang, Z.; Su, Y.; Lu, J.; Wang, E.G.; Han, K.	*Stacking fault formation and Ag precipitation in Cu-Ag-Sc alloys*	Materials Characteri-zation	189	-	111965	10.1016/j.matchar.2022.111965	Yes
An, B.; Xin, Y.; Niu, R.; Xiang, Z.; Wang, E.; Han, K.	*Nucleation and growth of discontinuous precipitates in Cu-Ag alloys*	Materials Research Express	31	-	109383	10.1088/2053-1591/ac5775	Yes
Babuska, T.F.; Curry, J.F.; Dugger, M.T.; Lu, P.; Xin, Y.; Klueter, S.; Kozen, A.C.; Grejtak, T.; Krick, B.A.	*Role of Environment on the Shear-Induced Structural Evolution of MoS2 and Impact on Oxidation and Tribological Properties for Space Applications*	American Chemical Society Applied Materials and Interfaces	-	-	-	10.1021/acsami.1c24931	Yes
Biekert, A.; Chang, C.; Fink, C.W.; Garcia-Sciveres, M.; Glazer, E.C.; Guo, W.; Hertel, S.A.; Kravitz, S.; Lin, J.; Lisovenko, M.; Mahapatra, R.; McKinsey, D.N.; Nguyen, J.S.; Novosad, V.; Page, W.; Patel, P.K.; Penning, B.; Pinckney, H.D.; Pyle, M.; Romani, R.K.; Seilnacht, A.S.; Serafin, A.; Smith, R.J.; Sorensen, P.; Suerfu, B.; Suzuki, A.; Velan, V.; Wang, G.; Watkins, S.L.; Yefremenko, V.G.; Yuan, L.; Zhang, J.	*Scintillation yield from electronic and nuclear recoils in superfluid 4He*	Physical Review D	105	-	92005	10.1103/PhysRevD.105.092005	Yes
Biekert, A.; Chaplinsky, L.; Fink, C.W.; Garcia-Sciveres, M.; Gillis, W.C.; Guo, W.; Hertel, S.A.; Heuermann, G.; Li, X.; Lin, J.; Mahapatra, R.; McKinsey, D.N.; Patel, P.K.; Penning, B.; Pinckney, H.D.; Platt, M.; Pyle, M.; Romani, R.K.; Serafin, A.; Smith, R.J.; Suerfu, B.; Velan, V.; Wang, G.; Wang, Y.; Watkins, S.L.; Williams, M.R.	*A backing detector for order-keV neutrons*	Nuclear Instrument and Methods in Physics Research	1039	-	166981	10.1016/j.nima.2022.166981	Yes
Dixon, I.R.; Bosque, E.; Buchholz, K.; Walsh, R.P.; Bai, H.	*REBCO Coils With Variable Co-Wind Dimensions Under Static and Cyclic Axial Pressure Loads at 77 K*	IEEE Transactions on Applied Super-conductivity	32	6	4	10.1109/TASC.2022.3163084	Yes
Gong, D.L.; Yang, J.; Hao, L.; Horak, L.; Xin, Y.; Karapetrova, E.; Strempfer, J.; Choi, Y.; Kim, J.W.; Ryan, P.J.; Liu, J.	*Reconciling Monolayer and Bilayer Jeff = 1=2 Square Lattices inHybrid Oxide Superlattice*	Physical Review Letters	129	-	187201-7	10.1103/PhysRevLett.129.187201	Yes
Gong, J.; Adnani, M.; Jones, B.T.; Xin, Y.; Wang, S.S.; Patel, S.; Lochner, E.J.; Mattoussi, H.; Hu, Y.; Gao, H.	*Nanoscale Encapsulation of Hybrid Perovskites Using Hybrid Atomic Layer Deposition*	Journal of Physical Chemistry Letters	13	-	4082-4089	10.1021/acs.jpclett.2c00862	Yes
Han, K.; Toplosky, V.J.; Swenson, C.A.	*Deformation of Two Copper Matrix Conductors Under Cyclic Loading*	IEEE Transactions on Applied Super-conductivity	32	6	711305	10.1109/TASC.2022.3166712	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Hu, X.; Polyanskii, A.A.; Abraimov, D.V.; Gavrilin, A.V.; Weijers, H.W.; Kametani, F.; Jaroszynski, J.J.; Larbalestier, D.C.	*Analysis of Local Burnout in a Sub-scale Test Coil for the 32T Magnet After Spontaneous Quenches During Fast Ramping*	Super-conductor Science and Technology	35	7	075009	10.1088/1361-6668/ac49a4	Yes
Kolb-Bond, D.; Bird, M.D.; Painter, T.A.; Ramakrishna, S.K.; Reyes, A.P.	*Screening Current Induced Field Changes During De-Energization With Axial Clamping*	IEEE Transactions on Applied Super-conductivity	32	6	4701404	10.1109/TASC.2022.3162162	Yes
Levitan, J.W.; Lu, J.; Jarvis, J.; Bai, H.	*Effects of Wax Impregnation on Contact Resistivity Between REBCO Tapes*	IEEE Transactions on Applied Super-conductivity	32	7	1-4	10.1109/TASC.2022.3179809	Yes
Marshall, W.S.; Bai, H.; Bosque, E.; Buchholz, K.; Dixon, I.R.; Kim, K.M.; Lu, J.; Voran, A.J.; Walsh, R.P.; Wright, A.K.	*Lap Joint Resistivity and Crossover Resistance of REBCO Conductors and Coils*	IEEE Transactions on Applied Super-conductivity	32	6	1-4	10.1109/TASC.2022.3156958	Yes
Messegee, Z.T.; Cho, J.S.; Craig, A.J.; Garlea, V.O.; Xin, Y.; Kang, C.J.; Proffen, T.E.; Bhandari, H.; Kelly, J.C.; Ghimire, N.J.; Aitken, J.A.; Jang, J.I.; Tan, X.Y.	*Multifunctional Cu2TSiS4 (T = Mn and Fe): Polar Semiconducting Antiferromagnets with Nonlinear Optical Properties*	Inorganic Chemistry	62	1	530-542	10.1021/acs.inorgchem.2c03754	Yes
Muller, N.P.; Tang, Y.; Guo, W.; Krstulovic, G.	*Velocity circulation intermittency in finite-temperature turbulent superfluid helium*	Physical Review Fluids	7	-	104604	10.1103/PhysRevFluids.7.104604	Yes
Nguyen, D.N.; Vo, T.; Michel, J.; Dixon, I.R.; Adkins, T.; Han, K.	*Redesign of the Coils for the 60T Controlled-Waveform Magnet at NHMFL*	IEEE Transactions on Applied Super-conductivity	32	6	4300504	10.1109/TASC.2022.3151836	Yes
Niu, R.; Toplosky, V.J.; Han, K.	*Cryogenic Temperature Properties and Secondary Phase Characterization of CuCrZr Composites*	IEEE Transactions on Applied Super-conductivity	32	6	4300405	10.1109/TASC.2022.3152992	Yes
Nugera, F.A.; Sahoo, P.K.; Xin, Y.; Ambardar, S.; Voronine, D.V.; Kim, U.J.; Han, Y.; Gutierrez, H.R.	*Bandgap Engineering in 2D Lateral Heterostructures of Transition Metal Dichalcogenides via Controlled Alloying*	Small	-	-	2106600	10.1002/smll.202106600	Yes
Sanavandi, H.; Hulse, M.F.; Bao, S.; Tang, Y.; Guo, W.	*Boiling and cavitation caused by transient heat transfer in superfluid helium-4*	Physical Review B	106	-	54501	10.1103/PhysRevB.106.054501	Yes
Shen, T.; Fajardo, L.G.; Myers, C.; Hafalia, Jr., A.; Fernández, J.L.R.; Arbelaez, D.; Brouwer, L.; Caspi, S.; Ferracin, P.; Gourlay, S.; Marchevsky, M.; Pong, I.; Prestemon, S.; Teyber, R.; Turqueti, M.; Wang, X.; Jiang, J.; Bosque, E.; Lu, J.; Davis, D.S.; Trociewitz, U.P.; Hellstrom, E.; Larbalestier, D.C.	*Design, fabrication, and characterization of a high-field high-temperaturesuperconducting Bi-2212 accelerator dipole magnet*	Physical Review Accelerators and Beams	25	12	122401	10.1103/PhysRevAccelBeams.25.122401	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Song, B.C.; Si, S.X.; Soleymani, A.; Xin, Y.; Hagelin-Weaver, H.E.	*Effect of ceria surface facet on stability and reactivity of isolated platinum atoms*	Nano Research	-	-	-	10.1007/s12274-022-4251-4	Yes
Toplosky, V.J.; Betts, S.B.; Goddard, R.E.; Torres, J.A.; Nguyen, D.N.; Han, K.	*Mechanical and Thermal Properties of Glass Reinforced Composites*	IEEE Transactions on Applied Super-conductivity	32	-	7700805	10.1109/TASC.2022.3181574	Yes
Wang, S. S.; Wang, W. T.; Donmez, S.; Xin, Y.; Mattoussi, H.	*Engineering Highly Fluorescent and Colloidally Stable Blue-Emitting CsPbBr3 Nanoplatelets Using Polysalt/PbBr2 Ligands*	Chemistry of Materials	34	11	4924-4936	10.1021/acs.chemmater.2c00082	Yes
Wen, X.; McDonald, L.; Pierce, J.; Guo, W.; Fitzsimmons, M.	*Observing flow of He II with unsupervised machine learning*	Scientific Reports	12	-	20383	10.1038/s41598-022-21906-w	Yes
Xin, Y.; Lu, J.; Han, K.	*Microstructure of Glidcop AL-60*	IEEE Transactions on Applied Super-conductivity	32	6	7100105	10.1109/TASC.2022.3159498	Yes
Yang, Y.; Deng, K.; Xu, Z.; Han, K.; Zheng, H.	*Revisiting high-temperature phase transition and magnetocaloric effect off $LaFe_{11.6}Si_{1.4}$ alloy*	Journal of Magnetism and Magnetic Materials	551	-	169168	10.1016/j.jmmm.2022.169168	Yes
Yu, H.; Lu, J.; Weiss, J.D.; van der Laan, D.C.	*Critical Current Measurement of REBCO Cables by Using a Superconducting Transformer*	IEEE Transactions on Applied Super-conductivity	32	4	1-5	10.1109/TASC.2022.3143093	Yes
Yui, S.; Tang, Y.; Guo, W.; Kobayashi, H.; Tsubota, M.	*Universal Anomalous Diffusion of Quantized Vortices in Ultraquantum Turbulence*	Physical Review Letters	129	-	25301	10.1103/PhysRevLett.129.025301	Yes
Zhou, X.; Koolstra, G.; Zhang, X.; Yang, G.; Han, X.; Dizdar, B.; Ralu, D.; Guo, W.; Murch, K.W.; Schuster, D.I.; Jin, D.	*Single electrons on solid neon as a solid-state qubit platform*	Nature	605	-	46	10.1038/s41586-022-04539-x	Yes
Askey, B.; Liu, D.; Rubin, G.; Kunik, A.; Song, Y.; Ding, Y.; Kim, J.	*Metabolite profiling reveals organ-specific flavone accumulation in Scutellaria and identifies a scutellarin isomer isoscutellarein 8-O-**β** glucuronopyranoside*	Plant Direct	5	12	e372	10.1002/pld3.372	Yes

Publications generated by Education at FSU (2)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Ibourk, A.; Hughes, R.; Mathis, C.	*It is What it Is" : Using Storied-Identity and Intersectionality Lenses to Understand What Shaped a Young Black Woman's STEM Identity Trajectory*	Journal of Research on Science Teaching	-	-	-	10.1002/tea.21753	Yes
Roberts, K.L.; Hughes, R.	*Recognition Matters: The Role of Informal Science Education Programs in Developing STEM Identity*	Journal for STEM Education Research	-	-	1-19	10.1007/s41979-022-00069-3	Yes

Publications generated by CMT/E (49)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Anand, N.; Barry, K.; Neu, J.N.; Graf, D.E.; Huang, Q.; Zhou, H.; Siegrist, T.M.; Changlani, H.J.; Beekman, C.	*Investigation of the monopole magneto-chemical potential in spin ices using capacitive torque magnetometry.*	Nature Communi-cations	13	-	3818	10.1038/s41467-022-31297-1	Yes
Bhardwaj, A.; Zhang, S.; Yan, H.; Moessner, R.; Nevidomskyy, A.H.; Changlani, H.J.	*Sleuthing out exotic quantum spin liquidity in the pyrochlore magnet Ce2Zr2O7*	Nature Partner Journals Quantum Materials (npj)	7	1	51	10.1038/s41535-022-00458-2	Yes
Biekert, A.; Chang, C.; Fink, C.W.; Garcia-Sciveres, M.; Glazer, E.C.; Guo, W.; Hertel, S.A.; Kravitz, S.; Lin, J.; Lisovenko, M.; Mahapatra, R.; McKinsey, D.N.; Nguyen, J.S.; Novosad, V.; Page, W.; Patel, P.K.; Penning, B.; Pinckney, H.D.; Pyle, M.; Romani, R.K.; Seilnacht, A.S.; Serafin, A.; Smith, R.J.; Sorensen, P.; Suerfu, B.; Suzuki, A.; Velan, V.; Wang, G.; Watkins, S.L.; Yefremenko, V.G.; Yuan, L.; Zhang, J.	*Scintillation yield from electronic and nuclear recoils in superfluid 4He*	Physical Review D	105	-	92005	10.1103/PhysRevD.105.092005	Yes
Biekert, A.; Chaplinsky, L.; Fink, C.W.; Garcia-Sciveres, M.; Gillis, W.C.; Guo, W.; Hertel, S.A.; Heuermann, G.; Li, X.; Lin, J.; Mahapatra, R.; McKinsey, D.N.; Patel, P.K.; Penning, B.; Pinckney, H.D.; Platt, M.; Pyle, M.; Romani, R.K.; Serafin, A.; Smith, R.J.; Suerfu, B.; Velan, V.; Wang, G.; Wang, Y.; Watkins, S.L.; Williams, M.R.	*A backing detector for order-keV neutrons*	Nuclear Instrument and Methods in Physics Research	1039	-	166981	10.1016/j.nima.2022.166981	Yes
Cochran, J.R.; Guzman, C.S.; Stiers, E.; Chiorescu, I.	*Electronic DC-SQUID Emulator*	IEEE Transactions on Circuits and Systems II: Express Briefs	1	-	1	10.1109/TCSII.2022.3188572	Yes
Das, D.; Gornicka, K.; Guguchia, Z.; Jaroszynski, J.J.; Cava, R.J.; Xie, W.; Luetkens, H.; Klimczuk, T.	*Time reversal invariant single-gap superconductivity with upper critical field larger than the Pauli limit in* $NbIr_2B2_2$	Physical Review B	106	-	94507	10.1103/PhysRevB.106.094507	Yes
De Raedt, H.; Miyashita, S.; Michielsen, K.; Vezin, H.; Bertaina, S.U.; Chiorescu, I.	*Sustaining Rabi oscillations by using a phase-tunable image drive*	European Physical Journal B	95	9	158	10.1140/epjb/s10051-022-00406-w	Yes
Eremets, M.I.; Minkov, V.S.; Drozdov, A.P.; Kong, P.P.; Ksenofontov, V.; Shylin, S.I.; Bud'ko, S.L.; Prozorov, R.; Balakirev, F.; Sun, D.; Mozaffari, S.; Balicas, L.	*High-Temperature Superconductivity in Hydrides: Experimental Evidence and Details*	Journal of Super-conductivity and Novel Magnetism	35	-	-	10.1007/s10948-022-06148-1	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Franco-Rivera, G.; Cochran, J.R.; Chen, L.; Bertaina, S.U.; Chiorescu, I.	*On-Chip Detection of Electronuclear Transitions in the ^{155,157}Gd Multilevel Spin System*	Physical Review Applied	18	-	14054	10.1103/PhysRevApplied.18.014054	Yes
Freeman, M.L.; Lu, T.; Engel, L.W.	*Resistively loaded coplanar waveguide for microwave measurements of induced carriers*	Review of Scientific Instruments	93	4	43901	10.1063/5.0085112	Yes
Gapud, A.A.; Ramakrishna, S.K.; Green, E.L.; Reyes, A.P.	*Martensitic transformation in V_3Si single crystal: ^{51}V NMR evidence for coexistence of cubic and tetragonal phases*	Physica C. Super-conductivity	602	-	1354137	10.1016/j.physc.2022.1354137	Yes
Gong, J.; Adnani, M.; Jones, B.T.; Xin, Y.; Wang, S.S.; Patel, S.; Lochner, E.J.; Mattoussi, H.; Hu, Y.; Gao, H.	*Nanoscale Encapsulation of Hybrid Perovskites Using Hybrid Atomic Layer Deposition*	Journal of Physical Chemistry Letters	13	-	4082-4089	10.1021/acs.jpclett.2c00862	Yes
Henck, H.; Mauro, D.; Domaretskiy, D.; Philippi, M.; Memaran, S.; Zheng, W.; Lu, Z.; Shcherbakov, D.; Lau, C.N.; Smirnov, D.; Balicas, L.; Watanabe, L.; Taniguchi, T.; Fal'ko, V.I.; Gutiérrez-Lezama, I.; Ubrig, N.; Morpurgo, A.F.	*Light sources with bias tunable spectrum based on van der Waals interface transistors*	Nature Communi-cations	13	-	3917	10.1038/s41467-022-31605-9	Yes
Hudis, J.B.; Cochran, J.R.; Franco-Rivera, G.; Guzman, C.S.; Lochner, E.J.; Schlottmann, P.U.; Xiong, P.; Chiorescu, I.	*Quantum interference in asymmetric superconducting nanowire loops*	Europhysics Letters	138	1	16003	10.1209/0295-5075/ac5dda	Yes
Karabin, M.; Mondal, W.; Ostlin, A.; Ho, W.D.; Dobrosavljevic, V.; Tam, K.; Terletska, H.; Chioncel, L.; Wang, Y.; Eisenbach, M.	*Ab initio approaches to high-entropy alloys: a comparison of CPA, SQS, and supercell methods*	Journal of Materials Science	57	-	10677 - 10690	10.1007/s10853-022-07186-9	No
Kolb-Bond, D.; Bird, M.D.; Painter, T.A.; Ramakrishna, S.K.; Reyes, A.P.	*Screening Current Induced Field Changes During De-Energization With Axial Clamping*	IEEE Transactions on Applied Super-conductivity	32	6	4701404	10.1109/TASC.2022.3162162	Yes
Kunwar, D.L.; Panday, S.R.; Deng, Y.; Ran, S.; Baumbach, R.; Maple, M.B.; Almasan, C.C.; Dzero, M.O.	*Heat capacity of URu2−xOsxSi2 at low temperatures*	Physical Review B	105	-	L041106	10.1103/PhysRevB.105.L041106	Yes
Lee, T.; Vucicevic, J.; Tanaskovic, D.; Miranda, E.; Dobrosavljevic, V.	*Mott domain walls: A (strongly) non-Fermi liquid state of matter*	Physical Review B	106	-	L161102	10.1103/PhysRevB.106.L161102	Yes
Lu, Z.; Hollister, P.; Ozerov, M.; Moon, S.; Bauer, E.D.; Ronning, F.; Smirnov, D.; Ju, L.; Ramshaw, B.J.	*Weyl Fermion magneto-electrodynamics and ultralow field quantum limit in TaAs*	Science Advances	8	2	eabj1076	10.1126/sciadv.abj1076	Yes
Ma, K.; Volya, A.; Yang, K.	*Eigenstate thermalization and disappearance of quantum many-body scar states in weakly interacting fermion systems*	Physical Review B	106	21	214313	10.1103/PhysRevB.106.214313	Yes
Ma, K.W.; Yang, K.	*Kolmogorov complexity as intrinsic entropy of a pure state: Perspective from entanglement in free fermion systems*	Physical Review B	106	-	35143	10.1103/PhysRevB.106.035143	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Ma, K.W.; Yang, K.	*Quantitative theory of composite fermions in Bose-Fermi mixtures at ν=1*	Physical Review B	105	-	35132	10.1103/PhysRevB.105.035132	Yes
Ma, K.W.; Yang, K.	*Simple analog of the black-hole information paradox in quantum Hall interfaces*	Physical Review B	105	-	45306	10.1103/PhysRevB.105.045306	Yes
Mayo, A.H.; Takahashi, H.; Ishiwata, S.; Górnicka, K.; Winiarski, M.; Jaroszynski, J.J.; Cava, R.J.; Xie, W.; Klimczuk, T.	*Enhancement of the Magnetoresistance in the Mobility-Engineered Compensated Metal Pt5P2*	Advanced Electronic Materials	-	-	2201120	10.1002/aelm.202201120	Yes
Muller, N.P.; Tang, Y.; Guo, W.; Krstulovic, G.	*Velocity circulation intermittency in finite-temperature turbulent superfluid helium*	Physical Review Fluids	7	-	104604	10.1103/PhysRevFluids.7.104604	Yes
Nguyen, D.; Haldane, F.D.; Rezayi, E.H.; Son, D.; Yang, K.	*Multiple Magnetorotons and Spectral Sum Rules in Fractional Quantum Hall Systems*	Physical Review Letters	128	-	246402	10.1103/PhysRevLett.128.246402	Yes
Ozerov, M.; Anand, N.; Burgt, L.; Lu, Z.; Holleman, J.; Zhou, H.; McGill, S.A.; Beekman, C.	*Magnetic field tuning of crystal field levels and vibronic states in the spin ice compound $Ho_2Ti_2O_7$ observed with far infrared reflectometry*	Physical Review B	105	-	165102	10.1103/PhysRevB.105.165102	Yes
Patel, A.A.; Changlani, H.J.	*Many-body energy invariant for T-linear resistivity*	Physical Review B: Rapid Comm/ Letters	105	20	L201108	10.1103/PhysRevB.105.L201108	Yes
Sakhratov, YU. A.; Prokhnenko, O.; Shapiro, A. YA.; Zhou, H. D.; Svistov, L. E.; Reyes, A.P.; Petrenko, O. A.	*High-field magnetic structure of the triangular antiferromagnet $RbFe(MoO_4)_2$*	Physical Review B	105	-	14431	10.1103/PhysRevB.105.014431	Yes
Sanavandi, H.; Hulse, M.F.; Bao, S.; Tang, Y.; Guo, W.	*Boiling and cavitation caused by transient heat transfer in superfluid helium-4*	Physical Review B	106	-	54501	10.1103/PhysRevB.106.054501	Yes
Schindler, F.; Vafek, O.; Bernevig, A.	*Trions in twisted bilayer graphene*	Physical Review B	105	-	155135	10.1103/PhysRevB.105.155135	Yes
Sharma, P.; Lee, K.; Changlani, H.J.	*Multimagnon dynamics and thermalization in the S=1 easy-axis ferromagnetic chain*	Physical Review B	105	-	54413	10.1103/PhysRevB.105.054413	Yes
Shashkin, A.A.; Melnikov, M.; Dolgopolov, V.; Radonjic, M.; Dobrosavljevic, V.; Huang, S.; Liu, C.; Zhu, A.Y.; Kravchenko, S.	*Spin effect on the low-temperature resistivity maximum in a strongly interacting 2D electron system*	Scientific Reports	12	1	5080	10.1038/s41598-022-09034-x	Yes
Shcherbakov, D.; Yang, J.; Memaran, S.; Watanabe, K.; Taniguchi, T.; Smirnov, D.; Balicas, L.; Lau, C.N.	*Quantum Hall effect in a two-dimensional semiconductor with large spin-orbit coupling*	Physical Review B	106	-	45307	10.1103/PhysRevB.106.045307	Yes
Shumiya, N.; Hossain, M.S.; Yin, J.X.; Wang, Z.; Litskevich, M.; Yoon, C.; Li, Y.; Yang, Y.; Jiang, Y.X.; Cheng, G.; Lin, Y.C.; Zhang, Q.; Cheng, Z.J.; Cochran, T.A.; Multer, D.; Yang, X.P.; Casas, B.W.; Chang, T.R.; Neupert, T.; Yuan, Z.; Jia, S.; Lin, H.; Yao, N.; Balicas, L.; Zhang, F.; Yao, Y.; Hasan, M.Z.	*Evidence of a room-temperature quantum spin Hall edge state in a higher-order topological insulator*	Nature Materials	21	-	1111	10.1038/s41563-022-01304-3	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Stepanov, P.; Shcherbakov, D.L.; Che, S.; Bockrath, M.W.; Barlas, Y.; Smirnov, D.; Watanabe, K.; Taniguchi, T.; Lake, R.K.; Lau, C.	*Tuning Spin Transport in a Graphene Antiferromagnetic Insulator*	Physical Review Applied	18	-	14031	10.1103/PhysRevApplied.18.014031	Yes
Tan, Y.; Dobrosavljevic, V.; Rademaker, L.	*How to Recognize the Universal Aspects of Mott Criticality?*	Crystals	12	7	932	10.3390/cryst12070932	Yes
Tan, Y.; Tsang, P.H.; Dobrosavljevic, V.	*Disorder-dominated quantum criticality in moire bilayers*	Nature Communi-cations	13	1	7469	10.1038/s41467-022-35103-w	Yes
Turker, O.; Yang, K.	*Multicritical point and unified description of broken-symmetry phases in spin-1/2 antiferromagnets on a square lattice*	Physical Review B	105	-	155150	10.1103/PhysRevB.105.155150	Yes
Vinograd, I.; Zhou, R.; Mayaffre, H.; Kramer, S.; Ramakhrisna, S.K.; Reyes, A.P.; Kurosawa, T.; Momono, N.; Oda, M.; Komiya, S.; Ono, S.; Horio, M.; Chang, J.; Julien, M.H.	*Competition between spin ordering and superconductivity near the pseudogap boundary in $La_{2-x}Sr_xCuO_4$: Insights from NMR*	Physical Review B	106	-	54522	10.1103/PhysRevB.106.054522	Yes
Wang, A.; Wu, L.; Du, Q.; Naamneh, M.; Brito, W.; Abeykoon, A.; Pudelko, W.; Jandke, J.; Liu, Y.; Plumb, N.C.; Kotliar, G.; Dobrosavljevic, V.; Radovic, M.; Zhu, Y.; Petrovic, C.	*Mooij Law Violation from Nanoscale Disorder*	Nano Letters	22	2	6900-6906	10.1021/acs.nanolett.2c01282	Yes
Wang, Q.H.; Bedoya-Pinto, A.; Blei, M.; Dismukes, A.H.; Hamo, A.; Jenkins, S.; Koperski, M.; Liu, Y.; Sun, Q.C.; Telford, E.J.; Kim, H.H.; Augustin, M.; Vool, U.; Yin, J.X.; Li, L.H.; Falin, A.; Dean, C.R.; Casanova, F.; Evans, R.F.L.; Chshiev, M.; Mishchenko, A.; Petrovic, C.; He, R.; Zhao, L.; Tsen, A.W.; Gerardot, B.D.; Brotons-Gisbert, M.; Guguchia, Z.; Roy, X.; Tongay, S.; Wang, Z.; Hasan, M.Z.; Wrachtrup, J.; Yacoby, A.; Fert, A.; Parkin, S.; Novoselov, K.S.; Dai, P.; Balicas, L.; Santos, E.J.G.	*The Magnetic Genome of Two-Dimensional van der Waals Materials (Review Article)*	American Chemical Society Nano	16	-	6960-7079	10.1021/acsnano.1c09150	Yes
Wang, X.; Berg, E.	*Low-frequency Raman response near the Ising-nematic quantum critical point: A memory-matrix approach*	Physical Review B	105	-	45137	10.1103/PhysRevB.105.045137	Yes
Wang, X.; Cao, J.; Liang, H.; Lu, Z.; Cohen, A.; Haldar, A.; Kitadai, H.; Tan, Q.; Burch, K.S.; Smirnov, D.; Xu, W.; Sharifzadeh, S.; Liang, L.; Ling, X.I.	*Electronic Raman scattering in the 2D antiferromagnet NiPS3*	Science Advances	8	2	eabl7707	10.1126/sciadv.abl7707	Yes
Wang, X.; Vafek, O.	*Narrow bands in magnetic field and strong-coupling Hofstadter spectra*	Physical Review B	106	-	L121111	10.1103/PhysRevB.106.L121111	Yes
Wen, X.; McDonald, L.; Pierce, J.; Guo, W.; Fitzsimmons, M.	*Observing flow of He II with unsupervised machine learning*	Scientific Reports	12	-	20383	10.1038/s41598-022-21906-w	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Yui, S.; Tang, Y.; Guo, W.; Kobayashi, H.; Tsubota, M.	*Universal Anomalous Diffusion of Quantized Vortices in Ultraquantum Turbulence*	Physical Review Letters	129	-	25301	10.1103/PhysRevLett.129.025301	Yes
Zheng, W.; Xiang, L.; de Quesada, F.A.; Lu, Z.; Wilson, M.; Sood, A.; Wu, F.; Shcherbakov, D.; Memaran, S.; Baumbach, R.; McCanfless, G.T.; Chan, J.Y.; Liu, S.; Edgar, J.H.; Lui, C.H.; Santos, E.J.G.; Lindenberg, A.; Smirnov, D.; Balicas, L.	*Thickness- and Twist-Angle-Dependent Interlayer Excitons in Metal Monochalcogenide Heterostructures*	American Chemical Society Nano	16	-	18695−18707	10.1021/acsnano.2c07394	Yes
Zhou, X.; Koolstra, G.; Zhang, X.; Yang, G.; Han, X.; Dizdar, B.; Ralu, D.; Guo, W.; Murch, K.W.; Schuster, D.I.; Jin, D.	*Single electrons on solid neon as a solid-state qubit platform*	Nature	605	-	46	10.1038/s41586-022-04539-x	Yes

Publications generated by Geochemistry (10)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Chen, X.; Li, S.; Newby, S.; Lyons, T.; Wu, F.; Owens, J.D.	*Iron and manganese shuttle has no effect on sedimentary thallium and vanadium isotope signatures in Black Sea sediments*	Geochimica et Cosmochimica Acta	317	-	218--233	10.1016/j.gca.2021.11.010	Yes
Connock, G.; Owens, J.D.; Liu, X.	*Biotic induction and microbial ecological dynamics of Oceanic Anoxic Event 2*	Communications Earth & Environment	3	1	1--10	10.1038/s43247-022-00466-x	Yes
Kozik, N.; Gill, B.C.; Owens, J.D.; Lyons, T.W.; Young, S.A.	*Geochemical Records Reveal Protracted and Differential Marine Redox Change Associated With Late Ordovician Climate and Mass Extinctions*	AGU Advances	3	1	e2021AV000563	10.1029/2021AV000563	Yes
Kozik, N.; Young, S.A.; Newby, S.M.; Liu, M.U.; Chen, D.; Hammarlund, E.U.; Bond, D.P.; Them, T.; Owens, J.D.	*Rapid marine oxygen variability: Driver of the Late Ordovician mass extinction*	Science Advances	8	46	eabn8345	10.1126/sciadv.abn8345	Yes
Mei, Q.; Chen, X.; Yang, J.; Zhu, Y.; Owens, J.D.	*Tracing Recycled Crustal Materials in the Subcontinental Lithospheric Mantle Using Thallium Isotopes*	Geophysical Research Letters	49	15	e2022GL099959	10.1029/2022GL099959	Yes
Qian, S.; Salters, V.; McCoy-West, A.; Wu, J.; Rose-Koga, E.; Nichols, A.; Zhang, L.; Zhou, H.; Hoernle, K.	*Highly heterogeneous mantle caused by recycling of oceanic lithosphere from the mantle transition zone*	Earth and Planetary Science Letters	593	-	117679	10.1016/j.epsl.2022.117679	Yes
Teplyakova, S.; Lorenz, C.; Ivanova, M.; Humayun, M.; Kononkova, N.; Borisovsky, S.; Korochantsev, A.; Franchi, I.; Zinovieva, N.	*Karavannoe: Mineralogy, trace element geochemistry, and origin of Eagle Station group pallasites*	Meteoritics and Planetary Science	57	6	1158-1173	10.1111/maps.13814	Yes
Them, T.; Owens, J.D.; Marroquín, S.M.; Caruthers, A.H.; Alexandre, J.P.; Gill, B.C.	*Reduced Marine Molybdenum Inventory Related to Enhanced Organic Carbon Burial and an Expansion of Reducing Environments in the Toarcian (Early Jurassic) Oceans*	AGU Advances	3	6	e2022AV000671	10.1029/2022AV000671	Yes
Wang, S.; Ye, J.; Meng, J.; Hou, S.; Li, C.; Costeur, L.; Mennecart, B.; Zhang, C.; Zhang, J.; Aiglstorfer, M.; Wang, Y.; Wu, Y.; Wu, W.; Deng, T.	*Sexual selection promotes giraffoid head-neck evolution and ecological adaptation.*	Science	376	-	eabl8316	10.1126/science.abl8316	Yes
Wu, F.; Owens, J.D.; German, C.; Mills, R.; Nielsen, S.	*Vanadium isotope fractionation during hydrothermal sedimentation: Implications for the vanadium cycle in the oceans*	Geochimica et Cosmochimica Acta	328	-	168--184	10.1016/j.gca.2022.05.002	Yes

Publications generated by MBI at UF (36)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Barnard, A.; Hammers, D.; Triplett, W.; Kim, S.; Forbes, S.C.; Willcocks, R.; Daniels, M.; Senesac, C.; Lott, D.; Arpan, I.; Rooney, W.; Wang, R.; Nelson, S.; Sweeney, L.; Vandenborne, K.H.E.; Walter, G.A.	*Evaluating Genetic Modifiers of Duchenne Muscular Dystrophy Disease Progression Using Modeling and MRI*	Neurology	99	21	e2406--e2416	10.1212/WNL.0000000000201163	No
Batra, A.; Barnard, A.; Lott, D.; Willcocks, R.; Forbes, S.C.; Chakraborty, S.; Daniels, M.; Arbogast, J.; Triplett, W.; Henricson, E.; Dayan, J.; Schmalfuss, C.; Sweeney, L.; Byrne, B.; McDonald, C.; Vandenborne, K.H.E.; Walter, G.A.	*Longitudinal changes in cardiac function in Duchenne muscular dystrophy population as measured by magnetic resonance imaging*	BMC Cardio-vascular Disorders	22	1	1--12	10.1186/s12872-022-02688-5	No
Bo, K.H.; Cui, L.; Yin, S.; Hu, Z.; Hong, X.; Kim, S.; Keil, A.; Ding, M.	*Decoding the temporal dynamics of affective scene processing*	NeuroImage	261	-	119532	10.1016/j.neuroimage.2022.119532	No
Boutzoukas, E.; O'Shea, A.; Kraft, J.; Hardcastle, C.; Evangelista, N.; Hausman, H.; Albizu, A.; Van Etten, E.; Bharadwaj, P.; Smith, S.; Song, H.; Porges, E.C.; Hishaw, A.; DeKosky, S.T.; Wu, S.S.; Marsiske, M.; Alexander, G.E.; Cohen, R.; Woods, A.J.	*Higher white matter hyperintensity load adversely affects pre-post proximal cognitive training performance in healthy older adults*	GeroScience	44	-	1--15	10.1007/s11357-022-00538-y	No
Chandrasekaran, J.; Petit, E.; Park, Y.; Tezenas du Montcel, S.; Joers, J.; Deelchand, D.; Povazhan, M.; Banan, G.; Valabregue, R.; Ehses, P.; Subramony, S.; Mareci, T.H.; Oz, G.	*Clinically meaningful MR endpoints sensitive to preataxic SCA1 and SCA3*	Annals of Neurology	epub	-	1-16	10.1002/ana.26573	Yes
Chu, W.; Wang, W.; Zaborszky, L.; Golde, T.; DeKosky, S.; Duara, R.; Loewenstein, D.A.; Adjouadi, M.; Coombes, S.A.; Vaillancourt, D.	*Association of Cognitive Impairment With Free Water in the Nucleus Basalis of Meynert and Locus Coeruleus to Transentorhinal Cortex Tract*	Neurology	98	7	e700--e710	10.1212/WNL.0000000000013206	No
Clancy, K.; Andrzejewski, J.; You, Y.; Rosenberg, J.T.; Ding, M.; Li, W.	*Transcranial stimulation of alpha oscillations up-regulates the default mode network*	Proceedings of the National Academy of Sciences of the USA (PNAS)	119	1	e21108681 19	10.1073/pnas.2110868119	Yes
Ekhtiari, H.; Ghobadi-Azbari, P.; Thielscher, A.; Antal, A.; Li, L.; Shereen, A.; Cabral-Calderin, Y.; Keeser, D.; Bergmann, T.; Jamil, A.; Woods, A.	*A checklist for assessing the methodological quality of concurrent tES-fMRI studies (ContES checklist): a consensus study and statement*	Nature Protocols	-	-	1--24	10.1038/s41596-021-00664-5	No
Ferguson, E.; Fiore, A.; Yurasek, A.; Cook, R.; Boissoneault, J.	*Association of therapeutic and recreational reasons for alcohol use with alcohol demand.*	Experimental and clinical psycho-	epub	-	early view	10.1037/pha0000554	No

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
		pharma-cology					
Forbes, S.C.	*Insights into neuromuscular fatigue using 31 P-MRS*	Journal of Physiology	600	13	3011-3012	10.1113/JP283331	No
Gastaldelli, A.; Cusi, K.; Lando, L.; Bray, R.; Brouwers, B.; Rodriguez, A.	*Effect of tirzepatide versus insulin degludec on liver fat content and abdominal adipose tissue in people with type 2 diabetes (SURPASS-3 MRI): a substudy of the randomised, open-label, parallel-group, phase 3 SURPASS-3 trial*	The Lancet Diabetes & Endo-crinology	10	6	393--406	10.1016/S2213-8587(22)00070-5	No
Georgiou-Karistianis, N.; Corben, L.; Reetz, K.; Adanyeguh, I.; Corti, M.; Deelchand, D.; Delatycki, M.; Dogan, I.; Evans, R.; Farmer, J.; Franca, M.; Gaetz, W.; Mareci, T.H.; Rosenberg, J.T.; Subramony, S.	*A natural history study to track brain and spinal cord changes in individuals with Friedreich's ataxia: TRACK-FA study protocol*	PLoS ONE	17	11	e0269649	10.1371/journal.pone.0269649	No
Gong, T.; Hui, S.; Zollner, H.; Britton, M.; Song, Y.; Chen, Y.; Gudmundson, A.; Hupfeld, K.; Davies-Jenkins, C.; Murali-Manohar, S.; Porges, E.; Oeltzschner, G.; Chen, W.; Wang, G.; Edden, R.	*Neurometabolic timecourse of healthy aging*	NeuroImage	264	-	119740	10.1016/j.neuroimage.2022.119740	No
Hardcastle, C.; Hausman, H.; Kraft, J.; Albizu, A.; Evangelista, N.; Boutzoukas, E.; O'Shea, A.; Langer, K.; Van Van Etten, E.; Bharadwaj, P.; Song, H.; Smith, S.; Porges, E.; DeKosky, S.; Hishaw, G.; Wu, S.; Marsiske, M.; Cohen, R.; Alexander, G.; Woods, A.	*Higher-order resting state network association with the useful field of view task in older adults*	GeroScience	44	-	131-145	10.1007/s11357-021-00441-y	No
Hardcastle, C.; Hausman, H.; Kraft, J.; Albizu, A.; O'Shea, A.; Boutzoukas, E.; Evangelista, N.; Langer, K.; Van Etten, E.; Bharadwaj, P.; Song, S.; Smith, S.; Porges, E.; DeKosky, S.; Hishaw, G.; Wu, S.; Marsiske, M.; Cohen, R.; Alexander, G.; Woods, A.	*Proximal improvement and higher-order resting state network change after multidomain cognitive training intervention in healthy older adults*	GeroScience	44	2	1011--1027	10.1007/s11357-022-00535-1	No
Jaiswal, M.; Tran, T.T.; Guo, J.; Zhou, M.; Diaz, J.G.; Fanucci, G.E.; Guo, Z.	*Enzymatic glycoengineering-based spin labelling of cell surface sialoglycans to enable their analysis by electron paramagnetic resonance (EPR) spectroscopy*	Analyst	147	5	784--788	10.1039/d1an02226a	No
Johnson, A.J.; Cole, J.; Fillingim, R.B.; Cruz-Almeida, Y.	*Persistent earNon-pharmacological Pain Management and Brain-Predicted Age Differences in Middle-Aged and Older Adults With Chronic Knee Pain*	Frontiers in Pain Research (Lausanne)	3	-	868546	10.3389/fpain.2022.868546	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Kraft, J.; Albizu, A.; O'Shea, A.; Hausman, H.; Evangelista, N.; Boutzoukas, E.; Hardcastle, C.; Van Etten, E.; Bharadwaj, P.; Song, H.; Smith, S.; DeKosky, S.; Hishaw, G.A.; Wu, S.; Marsiske, M.; Cohen, R.; Alexander, G.E.; Porges, E.; Woods, A.	*Functional Neural Correlates of a Useful Field of View (UFOV)-Based fMRI Task in Older Adults*	Cerebral Cortex	32	9	1993--2012	10.1093/cercor/bhab332	No
Kraft, J.; Hausman, H.; Hardcastle, C.; Albizu, A.; O'Shea, A.; Evangelista, N.; Boutzoukas, E.; Van Etten, E.; Bharadwaj, P.; Song, H.; Smith, S.; DeKosky, S.; Hishaw, G.; Wu, S.; Marsiske, M.; Cohen, R.; Alexander, G.; Porges, E.; Woods, A.	*Task-based functional connectivity of the Useful Field of View (UFOV) fMRI task*	GeroScience	-	-	1--17	10.1007/s11357-022-00632-1	No
Lin, T.; Pehlivanoglu, D.; Ziaei, M.; Liu, P.; Woods, A.; Feifel, D.; Fischer, H.; Ebner, N.	*Age-Related Differences in Amygdala Activation Associated With Face Trustworthiness but No Evidence of Oxytocin Modulation*	Frontiers in Physiology	13	-	838642	10.3389/fpsyg.2022.838642	Yes
Liu, P.; Lin, T.; Feifel, D.; Ebner, N.	*Intranasal oxytocin modulates the salience network in aging*	NeuroImage	253	-	119045	10.1016/j.neuroimage.2022.119045	Yes
Meyyappan, S.; Rajan, A.; Mangun, G.; Ding, M.	*Top-down control of the left visual field bias in cued visual spatial attention*	Cerebral Cortex	10	-	bhac402	10.1093/cercor/bhac402	No
Mitchell, T.; Wilkes, B.; Archer, D.; Chu, W.; Coombes, S.; Lai, S.; McFarland, N.; Okun, M.; Black, M.; Herschel, E.; Simuni, T.; Comella, C.; Afshari, M.; Xie, T.; Li, H.; Parrish, T.; Kurani, A.; Corcos, D.; Vaillancourt, D.	*Advanced diffusion imaging to track progression in Parkinson's disease, multiple system atrophy, and progressive supranuclear palsy*	NeuroImage: Clinical	34	-	103022	10.1016/j.nicl.2022.103022	Yes
Montesino-Goicolea, S.; Valdes-Hernandez, P.; Cruz-Almeida, Y.	*Chronic Musculoskeletal Pain Moderates the Association between Sleep Quality and Dorsostriatal-Sensorimotor Resting State Functional Connectivity in Community-Dwelling Older Adults*	Pain Research and Management	2022	-	12	10.1155/2022/4347759	Yes
Morar, U.; Izquierdo, W.; Martin, H.; Forouzannezhad, P.; Zarafshan, E.; Unger, E.; Bursac, Z.; Cabrerizo, M.; Barreto, A.; Vaillancourt, D.; DeKosky, S.; Adjouadi, M.	*A study of the longitudinal changes in multiple cerebrospinal fluid and volumetric magnetic resonance imaging biomarkers on converter and non-converter Alzheimer's disease subjects with consideration for their amyloid beta status*	Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring	14	1	e12258	10.1002/dad2.12258	No
Murphy, A.; O'Neal, A.; Cohen, R.; Lamb, D.; Porges, E.; Bottari, S.; Ho, B.; Trifilio, E.; DeKosky, S.; Heilman, K.; Williamson, J.	*The Effects of Transcutaneous Vagus Nerve Stimulation on Functional Connectivity Within Semantic and Hippocampal Networks in Mild Cognitive Impairment*	Neuro-therapeutics	-	-	1--12	10.1007/s13311-022-01318-4	Yes

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Nair, K.; Lott, D.; Forbes, S.; Barnard, A.; Willcocks, R.; Senesac, C.; Daniels, M.; Harrington, A.; Tennekoon, G.; Zilke, K.; Finanger, E.L.; Finkel, R.; Rooney, W.D.; Walter, G.A.; Vandenborne, K.H.	*Step Activity Monitoring in Boys with Duchenne Muscular Dystrophy and its Correlation with Magnetic Resonance Measures and Functional Performance*	Journal of Neuro-muscular Diseases	9	3	423--436	10.3233/JND-210746	No
Pedersini, P.; Gobbo, M.; Bishop, M.; Arendt-Nielsen, L.; Villafane, J.	*Functional and structural neuroplastic changes related to sensitization proxies in patients with Osteoarthritis: a systematic review*	Pain Medicine	23	3	488--498	10.1093/pm/pnab301	No
Peterson, J.; Strath, L.; Nodarse, C.; Rani, A.; Huo, Z.; Meng, L.; Yoder, S.; Cole, J.; Foster, T.; Fillingim, R.; Cruz-Almeida, Y.	*Epigenetic Aging Mediates the Association between Pain Impact and Brain Aging in Middle to Older Age Individuals with Knee Pain*	Epigenetics	17	13	2178--2187	10.1080/15592294.2022.2111752	No
Rahim, M.; Ragavan, M.; Deja, S.; Merritt, M.E.; Burgess, S.; Young, J.	*INCA 2.0: A tool for integrated, dynamic modeling of NMR-and MS-based isotopomer measurements and rigorous metabolic flux analysis*	Metabolic Engineering	69	-	275--285	10.1016/j.ymben.2021.12.009	No
Rosenberg, J.T.; Grant, S.C.; Topgaard, D.	*Nonparametric 5D D-R2 distribution imaging with single-shot EPI at 21.1 T: Initial results for in vivo rat brain*	Journal of Magnetic Resonance	341	-	107256	10.1016/j.jmr.2022.107256	Yes
Tanner, J.; Cardoso, J.; Terry, E.; Booker, S.; Glover, T.; Garvan, C.; Deshpande, H.; Deutsch, G.; Lai, S.; Staud, R.; Addison, A.; Redden, D.; Goodin, B.; Price, C.; Fillingim, R.; Sibille, K.	*Chronic pain severity and sociodemographics: An evaluation of the neurobiological interface*	The Journal of Pain	23	2	248--262	10.1016/j.jpain.2021.07.010	No
Terry, E.; Tanner, J.; Cardoso, J.; Sibille, K.; Lai, S.; Deshpande, H.; Deutsch, G.; Price, C.; Staud, R.; Goodin, B.; Redden, D.; Fillingim, R.	*Associations between pain catastrophizing and resting-state functional brain connectivity: Ethnic/race group differences in persons with chronic knee pain*	Journal of Neuroscience Research	100	4	1047--1062	10.1002/jnr.25018	No
Waddell, T.; Bagur, A.; Cunha, D.; Thomaides-Brears, H.; Banerjee, R.; Cuthbertson, D.; Brown, E.; Cusi, K.; Despres, J.; Brady, M.	*Greater ectopic fat deposition and liver fibroinflammation, and lower skeletal muscle mass in people with type 2 diabetes*	Obesity	30	6	1231	10.1002/oby.23425	No
Willcocks, R.; Barnard, A.; Wortman, R.; Senesac, C.R.; Lott, D.; Harrington, A.T.; Zilke, K.L.; Forbes, S.C.; Rooney, W.; Wang, D.; Finanger, E.; Tennekoon, G.; Daniels, M.; Triplett, W.; Walter, G.A.; Vandenborne, K.H.	*Development of Contractures in DMD in Relation to MRI-Determined Muscle Quality and Ambulatory Function*	Journal of Neuro-muscular Diseases	9	2	289-302	10.3233/JND-210731	No
Ziaei, M.; Oestreich, L.; Persson, J.; Reutens, D.C.; Ebner, N.C.	*Neural correlates of affective empathy in aging: A multimodal imaging and multivariate approach*	Aging, Neuro-psychology, and Cognition	29	3	577-598	10.1080/13825585.2022.2036684	No

Publications generated by UF Physics at UF (5)

Authors	Title	Journal Name	Vol	Issue	Pages	DOI	Cites NSF Core Grant
Adams, J.; Lewkowitz, M.; Huan, C.; Masuhara, N.; Candela, D.; Sullivan, N.S.	*Dynamics of ^{3}He in one dimension in the Luttinger liquid limit*	Physical Review B	106	-	195402	10.1103/PhysRevB.106.195402	Yes
Du, Y.; Behera, R.K.; Maligal-Ganesh, R.V.; Chen, M.; Zhao, T.; Huang, W.; Bowers, C.R.	*Mesoporous Silica Encapsulated Platinum-Tin Intermetallic Nanoparticles Catalyze Hydrogenation with an Unprecedented 20% Pairwise Selectivity for Parahydrogen Enhanced Nuclear Magnetic Resonance*	Journal of Physical Chemistry Letters	13	18	4125--4132	10.1021/acs.jpclett.2c00581	Yes
Ferrer, M.; Kuker, E.L.; Semenova, E.; Josh Gangano, A.; Lapak, M.P.; Grenning, A.J.; Dong, V.M.; Bowers, C.R.	*Adiabatic Passage through Level Anticrossings in Systems of Chemically Inequivalent Protons Incorporating Parahydrogen: Theory, Experiment, and Prospective Applications*	Journal of the American Chemical Society	-	-	-	10.1021/jacs.2c09000	Yes
Magill, B.A.; Wang, K.; McGill, S.A.; Stanton, C.J.; Priya, S.; Khodaparast, G.A.	*Probe of the excitonic transitions and lifetimes in quasi-2D organic inorganic halide perovskites*	AIP Advances	12	-	015114-015121	10.1063/5.0072566	Yes
Zhao, T.; Lapak, M.P.; Behera, R.; Zhao, H.; Ferrer, M.; Weaver, H.E.; Huang, W.; Bowers, C.R.	*Perpetual hyperpolarization of allyl acetate from parahydrogen and continuous flow heterogeneous hydrogenation with recycling of unreacted propargyl acetate*	Journal of Magnetic Resonance Open	1-13	-	100076	10.1016/j.jmro.2022.100076	Yes
Askey, B.; Liu, D.; Rubin, G.; Kunik, A.; Song, Y.; Ding, Y.; Kim, J.	*Metabolite profiling reveals organ-specific flavone accumulation in Scutellaria and identifies a scutellarin isomer isoscutellarein 8-O-**β** glucuronopyranoside*	Plant Direct	5	12	e372	10.1002/pld3.372	Yes

Books, Chapters, Reviews and other One-Time Publications (2)

Authors	Title	Facilities
Cardwell, D.A.; Larbalestier, D.C.; and Braginski, A.I.	*Handbook of Superconductivity: Characterization and Applications (2nd Edition)*	Applied Superconductivity Center
Sanabria, C. and Lee, P.J.	*An Introduction to Digital Image Analysis of Superconductors*	Applied Superconductivity Center

Internet Disseminations (3)

Authors	Title	Facilities
Belomestnykh, S; Posen, S; Bafia, D; Balachandran, S; Bertucci, M; Burrill, A; Cano, A; Checchin, M; Ciovati, G; Cooley, LD; Dalla Lana Semione, G; Delayen, J; Eremeev, G; Furuta, F; Gerigk, F; Giaccone, B; Gonnella, D; Grassellino, A; Gurevich, A; Hillert, W; Iavarone, M; Knobloch, J; Kubo, T; Kwok, WK; Laxdal, R; Lee, PJ; Liepe, M; Martinello, M; Melnychuk, OS; Nassiri, A; Netepenko, A; Padamsee, H; Pagani, C; Paparella, R; Pudasaini, U; Reece, CE; Reschke, D; Romanenko, A; Ross, M; Saito, K; Sauls, J; Seidman, DN; Solyak, N; Sung, Z; Umemori, K; Valente-Feliciano, A-M; Venturini Delsolaro, W; Walker, N; Weise, H; Welp, U; Wenskat, M; Wu, G; Xi, XX; Yakovlev, V; Yamamoto, A; and Zasadzinski J	*Key directions for research and development of superconducting radio frequency cavities*	Applied Superconductivity Center
Cooley, L., Larbalestier, D. and Amm, K.	*Challenges and opportunities to assure future manufacturing of magnet conductors for the accelerator sector*	Applied Superconductivity Center
Wartenbe, M.; Tobash, P.; Singleton, J.; Winter, L.; Richmond, S.; Harrison, N	*Pseudogap in elemental plutonium*	Pulsed Field Facility at LANL

Product (3)

Authors	Title	Product Information	Facilities
Baker, B.J.; Bracegirdle, J.; Olsen, S.S.H.; Teng, M.N.; Tran, K.C.; Amsler, C.D.; McClintock, J.B.	*Sesterterpenoids bioactive against the Respiratory Syncytial Virus (RSV)*	Disclosure filed 22 Dec 2022	AMRIS Facility at UF
Baker, B.J; Bracegirdle, J.; Cassandra, D.; Rocca, J.R.; Adams, J.H.; Wilson, N.G.	*Antimalaria peptides*	Disclosure 23T005 filed 21 Jul 2022	AMRIS Facility at UF
Mattoussi, H.; Du, L.; Wang, W. and Grant, S.C.	*Multi-Functional Contrast Agents and Methods*	U.S. Provisional Patent Application No. 63/333909	NMR Facility

Degrees

M.S. Degrees (3 Local/ 4 External)

Authors	Titles	MagLab Facilities	University	Department	Degrees
Grudny, Matteo	*Title is not available at this time*	AMRIS at UF	UF	Medical Sciences	M.S. (local)
Guess, Danielle	*Title is not available at this time*	AMRIS at UF	UF	Health Education and Behavior	M.S. (local)
Ho, Brian Duy	*Associations between Exercise Type, Fluid Intelligence, and Processing Speed in the Oldest-Old*	AMRIS at UF	UF	Psychology	M.S. (local)
Smith, Jasmine Alexandria	*Title is not available at this time*	AMRIS at UF	UF	Biomedical Engineering	M.S. (local)
Abdulla, Louae	*35Cl Solid-State NMR Characterization of Polymorphs and Cocrystals of Xylazine HCl*	NMR Facility	University of Windsor	Department of Chemistry and Biochemistry	M.S. (external)
Champiny, Ryan	*Chemical Composition and Degradability of Deep Podzolized Carbon*	ICR Facility	University of Florida	Soil and Water Sciences	M.S. (external)
Cooper, John	*Title is not available at this time; 4.7T MRI System at AMRIS Facility*	AMRIS at UF	East Carolina University	Physics	M.S. (external)
Whisenhant, Elizabeth	*Photoproducts and Transformations of Organic Pollutants in Aquatic Environments*	ICR Facility	Colorado State University	Chemistry	M.S. (external)

Ph.D. Degrees (27 Local/ 19 External)

Authors	Titles	MagLab Facilities	University	Department	Degrees
Altenhof, Adam	*New Methods for the Acquisition and Processing of Solid-State NMR Spectra*	NMR Facility	FSU	Department of Chemistry and Biochemistry	Ph.D. (local)
Behnke, Megan	*Organic Matter Sources, Transformations, and Fates in Northern High-Latitude Regions on the Forefront of Climate Change*	ICR Facility	FSU	Department of Earth, Ocean and Atmospheric Science	Ph.D. (local)
Boylan, Maeve Ryan	*Examining the Neurophysiology of Attention to Salient Features through Multimodal Imaging*	AMRIS at UF	UF	Psychology	Ph.D. (local)

Authors	Titles	MagLab Facilities	University	Department	Degrees
Brumley, David	*Synthesis of Anaenamides A-D and Strategic Analogues to Probe the Structure-Activity Relationship of a New Class of Natural Products from Marine Cyanobacteria*	AMRIS at UF	UF	Medicinal Chemistry	Ph.D. (local)
Cochran, Josiah	*Sensitive Spin Detection with Differential DC SQUIDs*	CMT/E	FSU	Physics	Ph.D. (local)
de Wit, Liselotte	*Procedural Learning, Its Neural Correlates, and Its Implications for Compensatory Training in Individuals with Amnestic Mild Cognitive Impairment and Mild Dementia Due to Alzheimer's Disease*	AMRIS at UF	UF	Clinical and Health Psychology	Ph.D. (local)
Dion, Catherine	*Contributions of Cardiovascular Burden, Peripheral Inflammation, and Depth of Anesthesia Variability on the Perioperative Cognitive Trajectory of Older Adults Receiving Total Knee Arthroplasty*	AMRIS at UF	UF	Clinical and Health Psychology	Ph.D. (local)
Franco-Rivera, Giovanni	*Spin-photon strong coupling of a diluted spin ensemble using on-chip superconducting resonators*	CMT/E	FSU	Physics	Ph.D. (local)
Freeman, Matthew	*Microwave spectroscopy of semiconductor-hosted two-dimensional electron systems*	DC Field Facility, CMT/E	FSU	Physics	Ph.D. (local)
Garcia, Andrew Ryan	*Thermodynamic and Kinetic Crystal Growth Theory for the Design of Metallic and Molecular Crystals*	AMRIS at UF	UF	Chemical Engineering	Ph.D. (local)
Glattke, Taylor	*Characterization of Emerging Contaminants from Weathered Fossil Fuel-derived Materials as Revealed by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS)*	ICR Facility	FSU	Chemistry	Ph.D. (local)

Authors	Titles	MagLab Facilities	University	Department	Degrees
Hardcastle, Cheshire	*Association of Speed-of-Processing Performance and Training with Higher-Order Resting State Networks in Healthy Older Adults*	AMRIS at UF	UF	Clinical and Health Psychology	Ph.D. (local)
Helsper, Shannon	*Efficacy of Stem Cell-Derived Therapy for Ischemic Stroke: A Multi-Nuclear MR Toolbox*	NMR Facility	FSU	Chemical & Biomedical Engineering	Ph.D. (local)
Hu, Xinzhe	*Thermodynamics, magnetism, and phase transitions of the frustrated pyrochlore ferromagnet Yb2Ti2O7 and the field-induced Kitaev quantum spin liquid α-RuCl3*	DC Field Facility, UF Physics	UF	Physics	Ph.D. (local)
Johnston, Taylor	*Development of High-Temperature Superconducting Resonators in NMR Probes For 13C NMR Spectroscopy*	AMRIS at UF	FSU	Chemistry	Ph.D. (local)
Kennedy, Jack	*Movement-Related Changes in Hippocampal and Cortical Local Field Potentials*	AMRIS at UF	UF	Neuroscience	Ph.D. (local)
Lakshmanan, Renuk	*Biochemical, Biophysical, and Structural Characterization of Parvovirus VP1u Domains*	AMRIS at UF	UF	Biochemistry and Molecular Biology	Ph.D. (local)
Lei, Jiajun	*Segmented Flow Strategies towards an Integrated Liquid Chromatography-Mass Spectrometry-Nuclear Magnetic Resonance Workflow for Lipid Structural Elucidation*	AMRIS at UF	UF	Chemistry	Ph.D. (local)
Lin, Yuan	*Application and Optimization of 21 Tesla FT-ICR Top-down Mass Spectrometry in Hemoglobinopathy*	ICR Facility	FSU	Chemistry	Ph.D. (local)
Liu, Dake	*Characterization of Enzymes for Drug Metabolism and Natural Product Biosynthesis*	AMRIS at UF	UF	Medicinal Chemistry	Ph.D. (local)
Popovic, Zeljka	*Applications of Liquid Chromatography Tandem Mass Spectrometry for*	ICR Facility	FSU	Chemistry	Ph.D. (local)

Authors	Titles	MagLab Facilities	University	Department	Degrees
	the Analysis of Complex Mixtures				
Thomas, Jeremy	*Novel Techniques for High Sensitivity NMR Spectroscopy*	NMR Facility, AMRIS at UF	FSU	Physics	Ph.D. (local)
Tsang, Pak Ki	*Strongly correlated electronic systems beyond the half-filled Hubbard model*	CMT/E	FSU	Physics	Ph.D. (local)
Walker, Ariel	*Using In Vivo Models to Determine Factors that Affect the Progression of Alzheimer's Disease and Related Dementias*	AMRIS at UF	UF	Neuroscience	Ph.D. (local)
Wang, Bang	*Functional Development of New Aptamers for Neurodegenerative Disease*	AMRIS at UF	UF	Chemistry	Ph.D. (local)
Zhang, Biwen	*Strongly Correlated Insulators for High Efficient Photovoltaics*	DC Field Facility, CMT/E	FSU	Physics	Ph.D. (local)
Zheng, Wenkai	*A Transport and Optical Study on Topological Semimetals and 2DMaterials*	CMT/E	FSU	Physics	Ph.D. (local)
Babcock-Adams, Lydia	*Molecular Characterization of Organically Bound Copper in the Marine Environment*	ICR Facility	University of Georgia	Marine Science	Ph.D. (external)
Bahureksa, William	*Transformation of Soil Organic Matter in Forest Fire Impacted Watersheds Elucidated by FT-ICR Mass Spectrometry*	ICR Facility	Colorado State University	Dept. of Chemistry	Ph.D. (external)
Costello, Whitney	*Enabling structural studies of the yeast prion protein within a cellular environment*	NMR Facility	University of Texas Southwestern Medical Center	Biophysics	Ph.D. (external)
Doting, Eva	*Molecular Level Characterization of Supraglacial Dissolved Organic Carbon Reveals Differences between Source and Exported Carbon Pools*	ICR Facility	Aarhus University	Environmental Science	Ph.D. (external)
Eaton, Alexander	*FeSb2: a riddle, inside an insulator, wrapped in a metal Electric and magnetic properties of the unconventional*	DC Field Facility	University of Cambridge	Physics	Ph.D. (external)

Authors	Titles	MagLab Facilities	University	Department	Degrees
	insulator iron diantimonide				
Fang, Yawen	*Magnetoresistance and surface acoustic waves measurements of quantum materials*	DC Field Facility	Cornell University	Physics	Ph.D. (external)
Gholi Jafari, Mehrafshan	*Investigation Of Early-Transition Metal Complexes Bearing Metal-Ligand Multiple Bonds: Synthesis, Reactivity Studies, And Exploration of Their Potential Applications In Catalysis*	EMR Facility	University of Pennsylvania	Chemistry	Ph.D. (external)
Harrabi, Rania	*Design and Evaluation of Polarizing Agents for DNP Enhanced Solid State Nuclear Magnetic Resonance*	NMR Facility	Grenoble Alpes University	CEA Grenoble	Ph.D. (external)
Jackson, Cassidy	*Investigations Into Magnetic Relaxation for Vanadium Complexes*	EMR Facility	Colorado State University	Chemistry	Ph.D. (external)
Jimenez Jacome, Miguel Fernando	*High Resolution Compositional Characterization of Degraded Crude Oils Using Petroleomics*	ICR Facility	University of North Dakota	Petroleum Engineering	Ph.D. (external)
Khanal, Dipak	*Optical & magneto-optical studies of 2D hybrid organic-inorganic perovskites for optoelectronic applications*	DC Field Facility	University of Utah	Physics & Astronomy	Ph.D. (external)
Kirui, Alex	*Functional Structure of Biomacromolecules in Plant Biomass Using Solid-State NMR and Dynamic Nuclear Polarization*	NMR Facility	Louisiana State University	Chemistry	Ph.D. (external)
Maksimovic, Nikola	*Advances in nearly magnetic superconductivity*	Pulsed Field Facility at LANL, High B/T Facility at UF	University of California Berkeley	Physics	Ph.D. (external)
Martins, Vinicius	*Solid-State NMR Spectroscopic Characterization of Metal-Organic Frameworks*	DC Field Facility, NMR Facility	Western University	Chemistry	Ph.D. (external)

Authors	Titles	MagLab Facilities	University	Department	Degrees
Moore, Oliver	*The Role of Electron Donors and Microbial Consortia in Arsenic Release from Iron Oxide Minerals*	ICR Facility	The University of Manchester	School of Earth, Atmospheric and Environmental Sciences	Ph.D. (external)
Poulhazan, Alexandre	*Nouvelles approches de résonance magnétique nucléaire de l'état solide pour l'étude de cellules de microalgues entières (New solid-state nuclear magnetic resonance approaches to study intact microalga cells)*	NMR Facility	Université du Québec à Montréal	Department of Chemistry	Ph.D. (external)
Rooney, Mary	*Metal-ion binding in the antimicrobial peptides piscidins 1 and 3: Insights into the molecular structures of metallopeptides and their mechanisms of membrane disruption*	NMR Facility	William & Mary	Applied Science	Ph.D. (external)
Xiong, Peng	*Structural and Functional Studies of Membrane-Interacting Antimicrobial and Neuroimmune Peptides: Insights Gained from Investigating Piscidin and Orexin*	NMR Facility	William & Mary	Applied Science	Ph.D. (external)
Zajicek, Zachary	*High pressure studies of iron-based superconductors*	DC Field Facility	University of Oxford	Physics	Ph.D. (external)

Appendices

1. Personnel

Data as of January 3, 2023

MagLab at FSU

Name	Title	Department
Abigail Williams	Laboratory Assistant 2	Applied Superconductivity Center
Abiola Oloye	Graduate Research Assistant	Applied Superconductivity Center
Adam Delong	Graduate Research Assistant	Applied Superconductivity Center
Ahmed Abuzar	Graduate Research Assistant	Applied Superconductivity Center
Aixia Xu	Visiting Scientist/Researcher	Applied Superconductivity Center
Alexander Cairns	Laboratory Assistant / Technician	Applied Superconductivity Center
Anatolii Polyanskii	Magneto Optical Research Specialist	Applied Superconductivity Center
Andre Juliao	Graduate Research Assistant	Applied Superconductivity Center
Andres Hernandez Chapa	Laboratory Assistant 2	Applied Superconductivity Center
Branham Channell	Laboratory Assistant / Technician	Applied Superconductivity Center
Charles English	Research Engineer	Applied Superconductivity Center
Chiara Tarantini	Research Faculty III	Applied Superconductivity Center
Cindonia Brady	Research Assistant	Applied Superconductivity Center
Connie Linville	Senior Administrative Specialist	Applied Superconductivity Center
Connor Zhou	Laboratory Assistant / Technician	Applied Superconductivity Center
Daniel Davis	Visiting Research Faculty, I	Applied Superconductivity Center
David Larbalestier	Professor	Applied Superconductivity Center
Devin Lloyd	Research Assistant	Applied Superconductivity Center
Dmytro Abraimov	Research Faculty III	Applied Superconductivity Center
Emma Martin	Graduate Research Assistant	Applied Superconductivity Center
Eric Hellstrom	Professor	Applied Superconductivity Center
Ernesto Bosque	Research Faculty II	Applied Superconductivity Center
Felicia Rogers	Coordinator, Administrative Services	Applied Superconductivity Center
Fumitake Kametani	Assistant Professor	Applied Superconductivity Center
Gabriel Watson	Laboratory Assistant / Technician	Applied Superconductivity Center
Garfield Murphy	Laboratory Assistant / Technician	Applied Superconductivity Center
George Miller	Research Engineer	Applied Superconductivity Center
Griffin Bradford	Graduate Research Assistant	Applied Superconductivity Center
James Gillman	Research Engineer	Applied Superconductivity Center
Jeseok Bang	Postdoctoral Associate	Applied Superconductivity Center
Jianyi Jiang	Research Faculty III	Applied Superconductivity Center
John Tietsworth	Laboratory Assistant / Technician	Applied Superconductivity Center
Jonathan Lee	Graduate Research Assistant	Applied Superconductivity Center
Joseph Bechara	Laboratory Assistant / Technician	Applied Superconductivity Center
Jozef Kvitkovic	Engineering Technician	Applied Superconductivity Center
Kayla Hancock	Office Assistant	Applied Superconductivity Center

Name	Title	Department
Lance Cooley	Professor	Applied Superconductivity Center
Liora Louis	Laboratory Assistant / Technician	Applied Superconductivity Center
Manish Mandal	Graduate Research Assistant	Applied Superconductivity Center
Najib Cheggour	Research Faculty III	Applied Superconductivity Center
Nawaraj Paudel	Graduate Research Assistant	Applied Superconductivity Center
Peter Lee	Research Faculty III	Applied Superconductivity Center
Rafsun Jani	Graduate Research Assistant	Applied Superconductivity Center
Santosh Chetri	Research Assistant	Applied Superconductivity Center
Sastry Pamidi	Associate Professor	Applied Superconductivity Center
Seungyong Hahn	Professor	Applied Superconductivity Center
Shah Alam Limon	Graduate Research Assistant	Applied Superconductivity Center
Shaon Barua	Graduate Research Assistant	Applied Superconductivity Center
Shreyas Balachandran	Visiting Research Faculty I	Applied Superconductivity Center
Simone Hruda	Associate Professor	Applied Superconductivity Center
Stephen Dubben	Laboratory Assistant / Technician	Applied Superconductivity Center
Takanobu Mato	Research Assistant	Applied Superconductivity Center
Tauben Brenner	Laboratory Assistant / Technician	Applied Superconductivity Center
Ulf Trociewitz	Research Faculty III	Applied Superconductivity Center
Van Griffin	Sr. Research Associate	Applied Superconductivity Center
Virginia Phifer	Graduate Research Assistant	Applied Superconductivity Center
William Starch	Sr. Research Associate	Applied Superconductivity Center
William Wartman	Laboratory Assistant / Technician	Applied Superconductivity Center
Yavuz Oz	Postdoctoral Associate	Applied Superconductivity Center
Youngjae Kim	Research Faculty II	Applied Superconductivity Center
Abby Scott	Research Assistant	CIMAR
Alan Marshall	Professor	CIMAR
Alfredo Scigliani	Graduate Research Assistant	CIMAR
Amy McKenna	Research Faculty III	CIMAR
Anamika Roy	Graduate Research Assistant	CIMAR
Arshia Arbabian	Graduate Research Assistant	CIMAR
Ashley Blue	Technical/Research Designer	CIMAR
Austin Peach	Graduate Research Assistant	CIMAR
Benhur Asefaw	Graduate Research Assistant	CIMAR
Blaine Gordon	Graduate Research Assistant	CIMAR
Bright Ogbolu	Postdoctoral Associate	CIMAR
Brittany Lindsay	Graduate Research Assistant	CIMAR
Cameron Vojvodin	Graduate Research Assistant	CIMAR
Carl Fleischer III	Graduate Student	CIMAR
Chad Weisbrod	Research Faculty II	CIMAR
Christopher Hendrickson	Research Faculty III	CIMAR
Daniel Hallinan	Associate Professor	CIMAR
David Butcher	Visiting Research Faculty, I	CIMAR

Name	Title	Department
David Quezada Estrada	Graduate Research Assistant	CIMAR
Dayna Richter	Graduate Research Assistant	CIMAR
Dennis Ssekimpi	Graduate Research Assistant	CIMAR
Erica Truong	Graduate Research Assistant	CIMAR
Ermias Tesfamariam	Graduate Research Assistant	CIMAR
Faith Scott	Postdoctoral Associate	CIMAR
Frederic Mentink-Vigier	Research Faculty II	CIMAR
Gregory Blakney	Research Faculty II	CIMAR
Grisel Fierros Romero	Graduate Research Assistant	CIMAR
Hadi Mohammadigoushki	Associate Professor	CIMAR
Hannah Bryant	Graduate Research Assistant	CIMAR
Heather Barnes	Program Assistant	CIMAR
Huan Chen	Research Faculty I	CIMAR
Huyen Bui	Research Assistant	CIMAR
Ifeoluwa Oyekunle	Postdoctoral Associate	CIMAR
Ilya Litvak	Associate In Research	CIMAR
Ivan Hung	Associate In Research	CIMAR
James Kimball	Graduate Research Assistant	CIMAR
Jamini Bhagu	Graduate Research Assistant	CIMAR
Jasmin Schoenzart	Graduate Research Assistant	CIMAR
Jason Kitchen	NMR Engineer	CIMAR
Jazmine Sanchez	Graduate Research Assistant	CIMAR
Jenna Radovich	Graduate Research Assistant	CIMAR
Jiaxing Fan	Graduate Research Assistant	CIMAR
Jie Lu	Research Assistant	CIMAR
John Quinn	Research Engineer	CIMAR
Joseph Collins	Scientific Research Specialist	CIMAR
Joseph Frye	Graduate Research Assistant	CIMAR
Katherine Martinez	Research Assistant	CIMAR
Kayla Lowry	Research Assistant	CIMAR
Kimberly Mozolic	Sr Administrative Specialist	CIMAR
Krista Jemmott	Program Associate	CIMAR
Lisa Monluc	Graduate Research Assistant	CIMAR
Lissa Anderson	Research Faculty II	CIMAR
Lucio Frydman	Professor	CIMAR
Lydia Babcock-Adams	Postdoctoral Associate	CIMAR
Malathy Elumalai	Associate In Research	CIMAR
Martha Chacon Patino	Research Faculty I	CIMAR
Mary Desilets	Administrative Support Assistant	CIMAR
Michael Deck	Graduate Research Assistant	CIMAR
Mojtaba Nouri Goukeh	Graduate Research Assistant	CIMAR
Peter Gor'kov	Sr. Research Associate	CIMAR

Name	Title	Department
Riqiang Fu	Research Faculty III	CIMAR
Robert Schurko	Professor	CIMAR
Robert Silvers	Assistant Professor	CIMAR
Robert Smith	Graduate Student	CIMAR
Ryan Rodgers	Research Faculty III	CIMAR
Samuel Grant	Professor	CIMAR
Samuel Holder	Graduate Research Assistant	CIMAR
Sara Termos	Graduate Research Assistant	CIMAR
Sean Holmes	Postdoctoral Associate	CIMAR
Shannon Helsper	Postdoctoral Associate	CIMAR
Steven Ranner	Research Engineer	CIMAR
Sungsool Wi	Research Faculty II	CIMAR
Taylor Glattke	Postdoctoral Associate	CIMAR
Tej Poudel	Graduate Research Assistant	CIMAR
Timothy Cross	Researcher/Scientist	CIMAR
Victor Schepkin	Research Faculty II	CIMAR
Wenhao Hu	Graduate Research Assistant	CIMAR
Wenping Mao	Visiting Assistant In Research	CIMAR
William Brey	Research Faculty III	CIMAR
Yan-Yan Hu	Assistant Professor	CIMAR
Yijue Xu	Postdoctoral Associate	CIMAR
Yongkang Jin	Graduate Research Assistant	CIMAR
Yudan Chen	Postdoctoral Associate	CIMAR
Zachary Baty	Research Assistant	CIMAR
Zachary Dowdell	Graduate Research Assistant	CIMAR
Zeljka Popovic	Graduate Research Assistant	CIMAR
Zhehong Gan	Research Faculty III	CIMAR
Aakash Gupta	Graduate Research Assistant	Condensed Matter Science
Aaron Ridall	Postdoctoral Associate	Condensed Matter Science
Abigail Centers	Application Developer/Designer	Condensed Matter Science
Adele Menezes	Laboratory Assistant / Technician	Condensed Matter Science
Aikaterini Katafygi Flessa Savvidou	Graduate Research Assistant	Condensed Matter Science
Aisha Qureshi	Administrative Assistant	Condensed Matter Science
Akil Dyson	Research Assistant	Condensed Matter Science
Albert Gapud	Associate Professor	Condensed Matter Science
Alex Moon	Graduate Research Assistant	Condensed Matter Science
Alexander Bieber	Graduate Research Assistant	Condensed Matter Science
Alexander Roubos	Graduate Research Assistant	Condensed Matter Science
Alexey Kovalev	Associate In Research	Condensed Matter Science
Alexey Suslov	Research Faculty III	Condensed Matter Science
Alimamy Bangura	Research Faculty II	Condensed Matter Science
Allison Cornelius	Research Assistant	Condensed Matter Science

Name	Title	Department
Amisha Martin	Research Assistant	Condensed Matter Science
Andrzej Ozarowski	Research Faculty III	Condensed Matter Science
Annie Scutte	Graduate Research Assistant	Condensed Matter Science
Arijit Gupta	Graduate Research Assistant	Condensed Matter Science
Arneil Reyes	Research Faculty III	Condensed Matter Science
Astrid Daugherty	Research Assistant	Condensed Matter Science
Ayomide Sijuade	Graduate Research Assistant	Condensed Matter Science
Bal Pokharel	Graduate Research Assistant	Condensed Matter Science
Balaji Krishna Kumar	Postdoctoral Associate	Condensed Matter Science
Benny Schundelmier	Graduate Research Assistant	Condensed Matter Science
Bianca Marius	Research Assistant	Condensed Matter Science
Bianca Trociewitz	Research Engineer	Condensed Matter Science
Bijay DC	Graduate Research Assistant	Condensed Matter Science
Biwen Zhang	Graduate Research Assistant	Condensed Matter Science
Biwu Ma	Associate Professor	Condensed Matter Science
Bobby Haney	Research Assistant	Condensed Matter Science
Brendon Jones	Graduate Research Assistant	Condensed Matter Science
Brian Casas	Postdoctoral Associate	Condensed Matter Science
Brittany Grimm	Graduate Research Assistant	Condensed Matter Science
Camilo Ramirez	Research Assistant	Condensed Matter Science
Catherine Fabiano	Graduate Research Assistant	Condensed Matter Science
Changchun Zeng	Assistant Professor	Condensed Matter Science
Charles Johnson	Graduate Research Assistant	Condensed Matter Science
Chelsey Ramer	Research Assistant	Condensed Matter Science
Chen Huang	Assistant Professor	Condensed Matter Science
Christianne Beekman	Associate Professor	Condensed Matter Science
Claire Jolowsky	Graduate Research Assistant	Condensed Matter Science
Clemente Guzman	Graduate Research Assistant	Condensed Matter Science
Colette Sullivan	Graduate Research Assistant	Condensed Matter Science
Cyprian Lewandowski	Assistant Professor	Condensed Matter Science
Daniel Betancourt	Graduate Research Assistant	Condensed Matter Science
Danilo Ratkovski	Postdoctoral Associate	Condensed Matter Science
David Gordon	Research Assistant	Condensed Matter Science
David Graf	Research Faculty II	Condensed Matter Science
David Quashie Jr	Graduate Research Assistant	Condensed Matter Science
Denis Le	Research Assistant	Condensed Matter Science
Dmitry Chichinadze	Postdoctoral Associate	Condensed Matter Science
Dmitry Smirnov	Research Faculty III	Condensed Matter Science
Dragana Popovic	Research Faculty III	Condensed Matter Science
Ellen Ding	Technician	Condensed Matter Science
Elvin Salerno	Postdoctoral Associate	Condensed Matter Science
Elyssa Roeder	Graduate Research Assistant	Condensed Matter Science

Name	Title	Department
Eric Lochner	Research Faculty II	Condensed Matter Science
Eun Sang Choi	Research Faculty III	Condensed Matter Science
Franchesca Bellevu	Research Assistant	Condensed Matter Science
Gabrielle Mayans	Graduate Research Assistant	Condensed Matter Science
Gary Germanton	Research Assistant	Condensed Matter Science
Govind Sasi Kumar	Graduate Research Assistant	Condensed Matter Science
Gregg Stanwood	Associate Professor	Condensed Matter Science
Gregory Moller	Graduate Research Assistant	Condensed Matter Science
Guangxin Ni	Assistant Professor	Condensed Matter Science
Haidong Zhou	Visiting Research Faculty, I	Condensed Matter Science
Hannah Cooper	Research Assistant	Condensed Matter Science
Hanwei Gao	Assistant Professor	Condensed Matter Science
Haoyun Deng	Graduate Research Assistant	Condensed Matter Science
Hitesh Changlani	Assistant Professor	Condensed Matter Science
Huiyang Ma	Graduate Research Assistant	Condensed Matter Science
Hunter Bice	Research Assistant	Condensed Matter Science
Ian Campbell	Graduate Research Assistant	Condensed Matter Science
Irinel Chiorescu	Professor	Condensed Matter Science
Jade Holleman	Graduate Research Assistant	Condensed Matter Science
Jaideep Katuri	Postdoctoral Associate	Condensed Matter Science
Jakob Consoliver-Zack	Graduate Research Assistant	Condensed Matter Science
Jakub Hrubý	Postdoctoral Associate	Condensed Matter Science
Jamel Ali	Assistant Professor	Condensed Matter Science
Jan Jaroszynski	Research Faculty III	Condensed Matter Science
Jasminka Terzic	Postdoctoral Associate	Condensed Matter Science
Jason King	Research Assistant	Condensed Matter Science
Jason Kuszynski	Research Assistant	Condensed Matter Science
Jean Ambrose	Graduate Research Assistant	Condensed Matter Science
Jeffrey Whalen	Research Faculty II	Condensed Matter Science
Jennifer Neu	Research Assistant	Condensed Matter Science
Jesse Olsson	Research Assistant	Condensed Matter Science
Jesus Garcia-Rendon	Research Assistant	Condensed Matter Science
Jianming Cao	Professor	Condensed Matter Science
Jin Gyu Park	Professor	Condensed Matter Science
Johan van Tol	Research Faculty III	Condensed Matter Science
John Schlueter	Visiting Scientist/Researcher	Condensed Matter Science
Jorge Galeano Cabral	Graduate Research Assistant	Condensed Matter Science
Julia Smith	Research Faculty II	Condensed Matter Science
Jurek Krzystek	Research Faculty III	Condensed Matter Science
Kaitai Xiao	Graduate Research Assistant	Condensed Matter Science
Kaya Wei	Research Faculty I	Condensed Matter Science
Keke Feng	Graduate Research Assistant	Condensed Matter Science

Name	Title	Department
Kersten Galeta	Research Assistant	Condensed Matter Science
Keshav Singh	Graduate Research Assistant	Condensed Matter Science
Kevin Barry	Graduate Research Assistant	Condensed Matter Science
Kiram Harrison	Research Assistant	Condensed Matter Science
Komalavalli Thirunavukkuarasu	Assistant Professor	Condensed Matter Science
Krishnendu Kundu	Postdoctoral Associate	Condensed Matter Science
Kun Yang	Professor	Condensed Matter Science
Kwok Wai Ma	Postdoctoral Associate	Condensed Matter Science
Kyungmin Lee	Postdoctoral Associate	Condensed Matter Science
Lea Nienhaus	Assistant Professor	Condensed Matter Science
Lexington Mandachi	Research Assistant	Condensed Matter Science
Li Xiang	Postdoctoral Associate	Condensed Matter Science
Likai Song	Research Faculty II	Condensed Matter Science
Lily Stanley	Research Assistant	Condensed Matter Science
Lingrui Mei	Graduate Research Assistant	Condensed Matter Science
Lloyd Engel	Research Faculty III	Condensed Matter Science
Luis Balicas	Research Faculty III	Condensed Matter Science
MacMillan Wheeler	Graduate Research Assistant	Condensed Matter Science
Madilyn Getz	Research Assistant	Condensed Matter Science
Manoj Vinayaka Hanabe Subramanya	Graduate Research Assistant	Condensed Matter Science
Mariana Trujillo	Research Assistant	Condensed Matter Science
Marissa Dickerson	Research Assistant	Condensed Matter Science
Mary Jean Savitsky	Research Assistant	Condensed Matter Science
Masoud Mardani	Graduate Research Assistant	Condensed Matter Science
Matthew Freeman	Graduate Research Assistant	Condensed Matter Science
Matthew Kurilich	Graduate Research Assistant	Condensed Matter Science
Matthew Wadsworth	Graduate Research Assistant	Condensed Matter Science
Md. Alamgir Hossain	Graduate Research Assistant	Condensed Matter Science
Mehmet Kaplan	Graduate Research Assistant	Condensed Matter Science
Mei Zhang	Associate Professor	Condensed Matter Science
Melanie Castro	Research Assistant	Condensed Matter Science
Melissa Davis	Graduate Research Assistant	Condensed Matter Science
Mengtian Liu	Graduate Research Assistant	Condensed Matter Science
Miguel Gakiya	Graduate Research Assistant	Condensed Matter Science
Mikai Hulse	Graduate Research Assistant	Condensed Matter Science
Milan Rede	Graduate Research Assistant	Condensed Matter Science
Mohammad Irfan	Graduate Research Assistant	Condensed Matter Science
Mohammed Ibrahim Hammam	Graduate Research Assistant	Condensed Matter Science
Mykhailo Shatruk	Assistant Professor	Condensed Matter Science
Mykhaylo Ozerov	Research Faculty II	Condensed Matter Science
Nafiza Anjum	Graduate Research Assistant	Condensed Matter Science
Nalaka Kapuruge	Graduate Research Assistant	Condensed Matter Science

Name	Title	Department
Naresh Dalal	Professor	Condensed Matter Science
Nathaniel Falb	Research Assistant	Condensed Matter Science
Navneet kaur	Postdoctoral Associate	Condensed Matter Science
Nicholas Bonesteel	Professor	Condensed Matter Science
Nicolas Azzi	Research Assistant	Condensed Matter Science
Oguz Turker	Postdoctoral Associate	Condensed Matter Science
Olatunde Oladehin	Graduate Research Assistant	Condensed Matter Science
Oskar Vafek	Associate Professor	Condensed Matter Science
Parmit Virdi	Graduate Research Assistant	Condensed Matter Science
Paul Eugenio	Graduate Research Assistant	Condensed Matter Science
Pedro Schlottmann	Professor	Condensed Matter Science
Peng Xiong	Professor	Condensed Matter Science
Pengsu Mao	Graduate Research Assistant	Condensed Matter Science
Peter McGoron	Research Assistant	Condensed Matter Science
Petru Andrei	Associate Professor	Condensed Matter Science
Piotr Fajer	Professor	Condensed Matter Science
Prakash Sharma	Graduate Research Assistant	Condensed Matter Science
Qi Wang	Research Assistant	Condensed Matter Science
Ran Peng	Graduate Research Assistant	Condensed Matter Science
Renee Luallen	Program Coordinator	Condensed Matter Science
Robert Huber	Research Assistant	Condensed Matter Science
Robert Stewart	Graduate Research Assistant	Condensed Matter Science
Rogelio Baucells	Research Assistant	Condensed Matter Science
Ronald Melendrez	Graduate Research Assistant	Condensed Matter Science
Ruojun Wang	Graduate Research Assistant	Condensed Matter Science
Ryan Baumbach	Research Faculty II	Condensed Matter Science
Sandugash Yergeshbayeva	Graduate Research Assistant	Condensed Matter Science
Sangsoo Kim	Graduate Research Assistant	Condensed Matter Science
Sanjay Kumar Devendhar Singh	Postdoctoral Associate	Condensed Matter Science
Sean Jackson	Research Assistant	Condensed Matter Science
Sean Psulkowski	Research Assistant	Condensed Matter Science
Sebastian Stoian	Assistant Professor	Condensed Matter Science
Sergio Torino	Research Assistant	Condensed Matter Science
Shalinee Chikara	Research Faculty I	Condensed Matter Science
Shane Reed	Research Assistant	Condensed Matter Science
Shantanu Chakraborty	Postdoctoral Associate	Condensed Matter Science
Shermane Benjamin	Research Faculty I	Condensed Matter Science
Shirin Mozaffari	Postdoctoral Associate	Condensed Matter Science
Shivani Sharma	Postdoctoral Associate	Condensed Matter Science
Shyam Raj Karullithodi	Graduate Research Assistant	Condensed Matter Science
Sofia Sheffler	Research Assistant	Condensed Matter Science
Songbin Cui	Postdoctoral Associate	Condensed Matter Science

Name	Title	Department
Sophie Jermyn	Research Assistant	Condensed Matter Science
Stanley Tozer	Research Faculty III	Condensed Matter Science
Stephen Hill	Professor	Condensed Matter Science
Stephen McGill	Research Faculty III	Condensed Matter Science
Steven Johnson	UROP	Condensed Matter Science
Subramanian Ramakrishnan	Associate Professor	Condensed Matter Science
Sydney Tindall	Research Assistant	Condensed Matter Science
Taiwo Sogbesan	Research Assistant	Condensed Matter Science
Taylor Vanderlinden	Research Assistant	Condensed Matter Science
Theo Siegrist	Professor	Condensed Matter Science
Thierry Dubroca	Research Faculty I	Condensed Matter Science
Thomas Albrecht-Schmitt	Professor	Condensed Matter Science
Timothy Burman	Research Assistant	Condensed Matter Science
Timothy Murphy	Research Faculty III	Condensed Matter Science
Toshiaki Kanai	Graduate Research Assistant	Condensed Matter Science
Tsegai Yhdego	Graduate Research Assistant	Condensed Matter Science
Tugrul Demirtas	Postdoctoral Associate	Condensed Matter Science
Ty Wilson	Research Assistant	Condensed Matter Science
Tyler Boshaw	Research Assistant	Condensed Matter Science
Tyler Gregory	Graduate Research Assistant	Condensed Matter Science
Vadym Kulichenko	Visiting Scientist/Researcher	Condensed Matter Science
Victoria Li	Graduate Research Assistant	Condensed Matter Science
Vladimir Dobrosavljevic	Professor	Condensed Matter Science
Wai-Ga Ho	Graduate Research Assistant	Condensed Matter Science
Wan Kyu Park	Research Faculty III	Condensed Matter Science
Wei Guo	Professor	Condensed Matter Science
Wei-Hao Chou	Graduate Research Assistant	Condensed Matter Science
Will Jackson	UROP	Condensed Matter Science
William Coniglio	Consultant	Condensed Matter Science
William Nelson	Postdoctoral Associate	Condensed Matter Science
William Oates	Assistant Professor	Condensed Matter Science
Xiaoyu Wang	Postdoctoral Associate	Condensed Matter Science
Yating Mao	Graduate Research Assistant	Condensed Matter Science
Yousef Alihosseini	Graduate Research Assistant	Condensed Matter Science
Yuan Tang	Postdoctoral Associate	Condensed Matter Science
Yuting Tan	Graduate Research Assistant	Condensed Matter Science
Yuxin Wang	Graduate Research Assistant	Condensed Matter Science
Zhibin Yu	Assistant Professor	Condensed Matter Science
Bryon Dalton	Scientific Research Specialist	DC Instrumentation
Christopher Thomas	Technical/Research Designer	DC Instrumentation
Clyde Martin	Scientific Research Specialist	DC Instrumentation
Daniel Freeman	Technical/Research Designer	DC Instrumentation

Name	Title	Department
Daniel McIntosh	Scientific Research Specialist	DC Instrumentation
David Sloan	Technician/Research Designer	DC Instrumentation
Dmitry Semenov	Research Engineer	DC Instrumentation
Edward Rubes	Research Engineer	DC Instrumentation
Eric Stiers	Research Engineer	DC Instrumentation
Glover Jones	Scientific Research Specialist	DC Instrumentation
Heinrich Boenig	Engineer	DC Instrumentation
James Powell	Research Engineer	DC Instrumentation
Jesus Torres Camacho	Technical/Research Designer	DC Instrumentation
Joel Piotrowski	Technical/Research Designer	DC Instrumentation
Jonathan Melendez	Technical/Research Designer	DC Instrumentation
Korey Getty	Research Engineer	DC Instrumentation
Larry Gordon	Scientific Research Specialist	DC Instrumentation
Mark Vanderlaan	Research Engineer, Cryogenic Operations	DC Instrumentation
Michael Hicks	Technical/Research Designer	DC Instrumentation
Robert Carrier	Technical/Research Designer	DC Instrumentation
Robert Nowell	Research Engineer	DC Instrumentation
Scott Hannahs	Research Faculty III	DC Instrumentation
Scott Maier	Research Engineer	DC Instrumentation
Sujana Sri Venkat Uppalapati	Scientific Research Specialist	DC Instrumentation
Troy Brumm	Research Engineer	DC Instrumentation
William Brehm	Technician/Research Designer	DC Instrumentation
Aaron Nobles	Assistant Laboratory Animals Technician	Director's Office
Albert Migliori	Research Faculty III	Director's Office
Alex Masterton	Electrical Building Inspector	Director's Office
Alfie Brown	Industrial Safety & Health Engineer	Director's Office
Andrew Davis	Asst Chemical Safety Officer	Director's Office
Andy Howard	Deputy Building Official	Director's Office
Anke Toth	Program Manager	Director's Office
Benjamin Arline	Asst Chem Safety Officer	Director's Office
Bettina Roberson	Assistant Director, Administrative Services	Director's Office
Carlos Villa	Outreach Coordinator	Director's Office
Caroline McNiel	Program Manager	Director's Office
Charles Coshatt	Assistant Animal Lab Tech	Director's Office
Christian Strickland	Chemical Safety Technician	Director's Office
Christianna Fayson	Receptionist	Director's Office
Christopher Rodman	Industrial Safety & Health Eng.	Director's Office
Cody Burch	Critical Systems Controls Tech	Director's Office
Colleen Ochat	Program Coordinator	Director's Office
Corey Furbee	Fire Tech	Director's Office
Crystal Brown	Assistant Lab Animal tech	Director's Office
Curt Rogers	EHS Fire Tech	Director's Office

Name	Title	Department
Darren Dime	FSU Fire Tech	Director's Office
Debin Hammons	Receptionist	Director's Office
Edan Schultz	Media Specialist	Director's Office
Eric Palm	Research Faculty III	Director's Office
Gregory Boebinger	Professor	Director's Office
Jaime White-James	Assistant Director, Laboratory Animal Resources	Director's Office
Jason Marconnet	Industrial Hygienist	Director's Office
Jason Nipper	Lab Animal Technologist	Director's Office
Jeffrey Braunwart	Assistant Director, Safety Director	Director's Office
Johnathan Parker	Critical Systems	Director's Office
Kari Roberts	Business Analyst	Director's Office
Kawana Johnson	Research Faculty II	Director's Office
Kristin Roberts	Director, Strategic Initiatives	Director's Office
Kurt Hodges	Coordinator, Animal Welfare Compliance	Director's Office
Laurie Whetstone	Quality Control Program Coord	Director's Office
Laymon Gray	Assistant Director Safety & Security	Director's Office
Lezlee Richerson	Chief of Staff	Director's Office
Mark Bird	Research Faculty III	Director's Office
Mark Klawinski	Industrial Hygienist	Director's Office
Marvin Woods	Assistant Director of Research Support	Director's Office
Mary Creason	Fire Code Inspector	Director's Office
Matt Howell	Fire Systems Technician	Director's Office
Matthew Maleszewski	EHS Technician	Director's Office
Michael Tentnowski	Licensing Manager	Director's Office
Neely Lewis	Building Code Inspector	Director's Office
Nia Terry	Media Assistant	Director's Office
Nilubon Tabtimtong	Application Developer Designer	Director's Office
Norman Anderson	VP Research	Director's Office
Pierre-Olivier Ledain	Laboratory Assistant / Technician	Director's Office
Raymond Allen	FSU Fire Tech	Director's Office
Renee Murray	Chemical Safety Officer	Director's Office
Richard Le	Biological Safety Officer	Director's Office
Ricky Gaytan	interim Radiation Safety Officer	Director's Office
Robert Moreno	Assistant Radiation Safety Officer	Director's Office
Rodney Brimm	Asst. Lab Animal Technician	Director's Office
Roxanne Hughes	Research Faculty III	Director's Office
Sam Sevor	Fire Safety Coordinator	Director's Office
Sara Bell	Asst. Lab Animal Technician	Director's Office
Seyedehsahar Mohammadi	Industrial Safety Hygienist	Director's Office
Stephen Bilenky	Videographer	Director's Office
Stephen Dyal	Critical Systems Technician	Director's Office

Name	Title	Department
Thomas Brasher	Fire Systems Technician	Director's Office
Thomas Williams	Critical Systems Technician	Director's Office
Tom Deckert	Building Code, Assistant Director EH & SC	Director's Office
William Hill	Director of LAR	Director's Office
Yanique Lawrence	Receptionist	Director's Office
Afi Sachi-Kocher	Scientific Research Specialist	Geochemistry
Alvin Haire	Office Assistant	Geochemistry
Alyssa Atwood	Assistant Professor	Geochemistry
Amy Holt	Graduate Research Assistant	Geochemistry
Amy Socha	Graduate Research Assistant	Geochemistry
Anne Kellerman	Postdoctoral Associate	Geochemistry
Anwen Zhou	Graduate Research Assistant	Geochemistry
Barry Walton	Graduate Research Assistant	Geochemistry
Burt Wolff	Assistant In Research	Geochemistry
Chance Hannold	Graduate Research Assistant	Geochemistry
Christian Gfatter	Graduate Research Assistant	Geochemistry
Cloe Knutson	Undergraduate Research Assistant	Geochemistry
Dominic Woelki	Postdoctoral Associate	Geochemistry
Emily Stewart	Assistant Professor	Geochemistry
Gary Fowler	Graduate Research Assistant	Geochemistry
Gary White	Scientific Research Specialist	Geochemistry
Isabelle Barta	Undergraduate Research Assistant	Geochemistry
Jade Greene	Graduate Research Assistant	Geochemistry
Jeff Chanton	Professor	Geochemistry
Jeremy Owens	Assistant Professor	Geochemistry
Johanna Imhoff	Graduate Research Assistant	Geochemistry
John Goodin	Graduate Research Assistant	Geochemistry
Justin Vaughan	undergraduate research assistant	Geochemistry
Kanwa Sengupta	Graduate Research Assistant	Geochemistry
Kyle Compare	Graduate Research Assistant	Geochemistry
Leroy Odom	Professor	Geochemistry
Lindsi Allman	Graduate Research Assistant	Geochemistry
Luis Rodriguez	Graduate Research Assistant	Geochemistry
Madison Walker	Undergraduate Research Assistant	Geochemistry
Mahdi Maaleki moghadam	Graduate Research Assistant	Geochemistry
Malia Hallaway	Undergraduate Research Assistant	Geochemistry
Martin Kurek	Graduate Research Assistant	Geochemistry
Maya Roselli	Undergraduate Research Assistant	Geochemistry
Merid Schwartz	Graduate Research Assistant	Geochemistry
Michael Stukel	Assistant Professor	Geochemistry
Munir Humayun	Professor	Geochemistry
Neda Mobasher	Graduate Research Assistant	Geochemistry

Name	Title	Department
Peter Morton	Visiting Assistant in	Geochemistry
Peter Rassolov	Postdoctoral Associate	Geochemistry
Philip Froelich	Research Faculty III	Geochemistry
Robert Spencer	Assistant Professor	Geochemistry
Samantha Bosman	Graduate Research Assistant	Geochemistry
Sayantan Saha	Graduate Research Assistant	Geochemistry
Sean Newby	Graduate Research Assistant	Geochemistry
Seth Young	Assistant Professor	Geochemistry
Siqi Li	Graduate Research Assistant	Geochemistry
Taylor Conklin	Graduate Research Assistant	Geochemistry
Theodore Zateslo	Senior Engineer	Geochemistry
Vincent Salters	Professor	Geochemistry
William Gladwin	Undergraduate Research Assistant	Geochemistry
William Landing	Professor	Geochemistry
Yang Wang	Professor	Geochemistry
Yin Zhang	Graduate Research Assistant	Geochemistry
Alwell Nwachukwu	Graduate Student Researcher	Gypsum/Rare Earth
Anthony Igboanugo	Graduate Research Assistant	Gypsum/Rare Earth
Donald Hendrix	Postdoctoral Associate	Gypsum/Rare Earth
Frank Pugh	Program Director, Science and Research	Gypsum/Rare Earth
Jacob Brannon	Graduate Research Assistant	Gypsum/Rare Earth
Jacqueline Kornegay	Program Manager	Gypsum/Rare Earth
Jane Wadhams	Analytical Geochemist	Gypsum/Rare Earth
Jeri Goldberg	Laboratory Assistant / Technician	Gypsum/Rare Earth
Nicholas Castle	Postdoctoral Associate	Gypsum/Rare Earth
Peter Rassolov	Postdoctoral Associate	Gypsum/Rare Earth
Ranjit Chandra Das	Graduate Research Assistant	Gypsum/Rare Earth
Shuying Yang	Postdoctoral Associate	Gypsum/Rare Earth
Srishti Sharma	Graduate Research Assistant	Gypsum/Rare Earth
Steffanie Sillitoe-Kukas	Graduate Research Assistant	Gypsum/Rare Earth
Zhuanling Bai	Graduate Research Assistant	Gypsum/Rare Earth
Adam Voran	Engineer	Magnet Science & Technology
Al Zeller	Visiting Scientist/Researcher	Magnet Science & Technology
Ana De Leon	Research Assistant	Magnet Science & Technology
Andrew Atallah	Research Assistant	Magnet Science & Technology
Andrey Gavrilin	Research Faculty III	Magnet Science & Technology
Catherine Fidd	Graduate Research Assistant	Magnet Science & Technology
Cecil Evers	Research Assistant	Magnet Science & Technology
Christopher Ray	Research Engineer	Magnet Science & Technology
Danyale Berry	Graduate Research Assistant	Magnet Science & Technology
Dharmendra Prasad Shukla	Postdoctoral Associate	Magnet Science & Technology
Dylan Kolb-Bond	Research Engineer	Magnet Science & Technology

Name	Title	Department
Emsley Marks	Research Engineer	Magnet Science & Technology
Erick Arroyo	Research Engineer	Magnet Science & Technology
Greg Erickson	Visiting Scientist/Researcher	Magnet Science & Technology
He Liu	Laboratory Assistant / Technician	Magnet Science & Technology
Hongyu Bai	Research Faculty III	Magnet Science & Technology
Iain Dixon	Research Faculty III	Magnet Science & Technology
Jack Toth	Research Faculty III	Magnet Science & Technology
James O'Reilly	Research Engineer	Magnet Science & Technology
James White	Research Engineer	Magnet Science & Technology
Jeffrey Jarvis	Research Engineer	Magnet Science & Technology
Jeremy Levitan	Research Engineer	Magnet Science & Technology
Joseph Lucia	Technical/Research Designer	Magnet Science & Technology
Jun Lu	Research Faculty III	Magnet Science & Technology
Justin Deterding	Research Engineer	Magnet Science & Technology
Kadisha Culpepper	Graduate Research Assistant	Magnet Science & Technology
Ke Han	Research Faculty III	Magnet Science & Technology
Keyou Mao	Microscopist	Magnet Science & Technology
Kurtis Cantrell	Research Engineer	Magnet Science & Technology
Kwangmin Kim	Research Faculty I	Magnet Science & Technology
Liang Chen	Research Assistant	Magnet Science & Technology
Lindsay Eaton	Senior Administrative Specialist	Magnet Science & Technology
Megan Reid	Research Assistant	Magnet Science & Technology
Mehul Tank	Graduate Research Assistant	Magnet Science & Technology
Murray Gibson	Professor	Magnet Science & Technology
Natalie Arnett	Associate Professor	Magnet Science & Technology
Peng Wang	Laboratory Assistant / Technician	Magnet Science & Technology
Peng Xu	Postdoctoral Associate	Magnet Science & Technology
Raymond Cone	Technical Research Designer	Magnet Science & Technology
Rebekah Sweat	Assistant Professor	Magnet Science & Technology
Robert Stanton	Research Engineer	Magnet Science & Technology
Robert Walsh	Sr. Research Associate	Magnet Science & Technology
Rongmei Niu	Associate In Research	Magnet Science & Technology
Salem Fa Aldawsari	Research Assistant	Magnet Science & Technology
Sarajeen Saima Hoque	Graduate Research Assistant	Magnet Science & Technology
Scott Gundlach	Research Engineer	Magnet Science & Technology
Steven Van Sciver	Visiting Research Faculty	Magnet Science & Technology
Thomas Painter	Sr. Research Associate	Magnet Science & Technology
Todd Adkins	Research Engineer	Magnet Science & Technology
Tyler Hunt	Graduate Research Assistant	Magnet Science & Technology
Vince Toplosky	Scientific Research Specialist	Magnet Science & Technology
William Markiewicz	Research Assistant	Magnet Science & Technology
William Marshall	Sr. Research Associate	Magnet Science & Technology

Name	Title	Department
Xingchi Chen	Graduate Research Assistant	Magnet Science & Technology
Yan Xin	Research Faculty III	Magnet Science & Technology
Yang Zhang	Visiting Research Faculty III	Magnet Science & Technology
Zahraa Khamis	Laboratory Assistant / Technician	Magnet Science & Technology
Aaron Young	Engineer Technician	Management and Administration
Alexander Rowney	Program Manager	Management and Administration
Andre Rollison	Sr. Electrician	Management and Administration
Andrew Rettig	Windows System Admin.	Management and Administration
Andrew Sapronetti	Administrative Specialist	Management and Administration
Becky Price	Network Architect	Management and Administration
Biff Quarles	FSU Facilities PM	Management and Administration
Billy Phinazee	Maintenance Mechanic	Management and Administration
Brad Rohrer	Sr Administrative Specialist	Management and Administration
Brian Fienemann	Plumber	Management and Administration
Carl Windham	Program Associate	Management and Administration
Carol Christensen	Cleaning Contractor	Management and Administration
Cary Winkler	Controls / Alarm Systems Technician	Management and Administration
Christopher Oxendine	Scientific & Research Technician	Management and Administration
Daniel Preston	Maintenance Mechanic	Management and Administration
Daniel Price	AC Technician	Management and Administration
Danny Lesley	Plumber	Management and Administration
David Barnes	Electrician	Management and Administration
David Hahn	Web Application Developer	Management and Administration
David Lunger	Director, Project Management	Management and Administration
Debra Booth	Business Systems Director	Management and Administration
Don Pagel	Maintenance Mechanic	Management and Administration
Douglas Clemons	Rotary Technician	Management and Administration
Douglas Davey	Electrician	Management and Administration
Dustin Stevens	Scientific & Research Technician	Management and Administration
Dustin Szelong	Technology Specialist	Management and Administration
Eric Clark	Assistant Director, Technology Services	Management and Administration
Eric Perkins	Critical Systems Shop Supervisor	Management and Administration
Ermal Liko	Scientific & Research Technician	Management and Administration
Gabriel O'Steen-Mann	Technical Support Analyst	Management and Administration
Holly Stafford	Administrative Specialist	Management and Administration
James Berhalter	Assistant Director, Technology	Management and Administration
James Kalnin	Facilities Specialist	Management and Administration
Jeffery Sutton	Maintenance Technician	Management and Administration
Jerry Alexander	Asst Dir, Facilities Maintenance	Management and Administration
Jessica Scott	Senior Accounting Specialist	Management and Administration
John Bell	Control Tech Critical Systems	Management and Administration
John Childs	Media Specialist (Graphic Artist)	Management and Administration

Name	Title	Department
John Daugherty	Technical Research Designer	Management and Administration
John Kynoch	Assistant Director	Management and Administration
Jonathon Howell	Controls/HVAC Technician	Management and Administration
Karen Joiner	Program Associate	Management and Administration
Karol Bickett	Assistant Director, Business Systems	Management and Administration
Kenneth Braverman	Research Assistant	Management and Administration
Kevin Gamble	Facilities Superintendent	Management and Administration
Kevin John	Media Specialist (Graphic Artist)	Management and Administration
Kyle Hawkins	Systems Administrator	Management and Administration
Larry English	Pipe Fitter/Welder	Management and Administration
Laura Greene	Professor	Management and Administration
Lindsay Grooms	UBA Associate Director	Management and Administration
Manjari Verma	Travel Coordinator	Management and Administration
Marc Helton	Fountain Maintenance Technician	Management and Administration
Marcela Castano	Maintenance Engineer	Management and Administration
Mark Hosey	Pest Control Technician	Management and Administration
Marques Buggs	General Maintenance Technician	Management and Administration
Marsha Jones	Administrative Specialist	Management and Administration
Marshall Wood	Facilities Electrical Supervisor	Management and Administration
Melisa Tabtimtong	Application Developer	Management and Administration
Michael Ochat	General Trades Technician	Management and Administration
Michael Pendergast	Program Associate	Management and Administration
Micheal Ivester	Maintenance Mechanic	Management and Administration
Miranda Hacker	Program Associate	Management and Administration
Monroe Walker	Network Specialist	Management and Administration
Noah Barrager	Rotary Equipment Technician	Management and Administration
Philip Hill	Program Associate	Management and Administration
Richard Ludlow	Media Specialist (Graphic Artist)	Management and Administration
Rob Allen	ITS Technician	Management and Administration
Rodney Shreve	Industrial Engineer	Management and Administration
Russ Cooper	Senior Electrician FSU Campus	Management and Administration
Ryan Porter	Maintenance Supervisor	Management and Administration
Samantha Nelson	Budget Analyst	Management and Administration
Sarita Finn	Technology Specialist	Management and Administration
Scott Hermance	Campus Service Assistant	Management and Administration
Shauna Walsh	Budget Analyst	Management and Administration
Stacy Slavichak	Water Resources Manager	Management and Administration
Steve Johnson	Maintenance Mechanic	Management and Administration
Steven Braman	Clerk	Management and Administration
Sylvonta Johnson	Maintenance Technician	Management and Administration
Tra Hunter	Plant Engineer	Management and Administration
Verbon Scott	Plumber	Management and Administration

Name	Title	Department
Walter Lee	Assistant Director, UBA Program	Management and Administration
William Barker	Campus Service Assistant	Management and Administration
William Morgan	Maintenance Technician	Management and Administration

MagLab at LANL

Name	Title	Department
Amanda Valdez	Administrative Assistant	LANL
Arkady Shehter	Research Faculty II	LANL
Ashish Bhardwaj	Research Faculty I	LANL
Boris Maiorov	Research Faculty III	LANL
Christopher Mizzi	Postdoctoral Associate	LANL
Doan Nguyen	Research Faculty III	LANL
Dwight Rickel	Research Faculty III	LANL
Fedor Balakirev	Research Faculty III	LANL
Gary Noe	Research Faculty II	LANL
Hazuki Teshima	Research Technician	LANL
James Michel	Research Technologist	LANL
James Wampler	Postdoctoral Researcher	LANL
Jason Lucero	Research Technician	LANL
Jeff Martin	Controls Specialist	LANL
Johanna Palmstrom	Research Faculty I	LANL
John Singleton	Research Faculty III	LANL
Josiah Srock	Operations Technician	LANL
Junho Choi	Postdoctoral Associate	LANL
Km Rubi	Postdoctoral Associate	LANL
Laurel Winter	Research Faculty II	LANL
Marcelo Jaime	Research Faculty III	LANL
Michael Rabin	Research Faculty III	LANL
Minseong Lee	Research Faculty I	LANL
Mun Keat Chan	Research Faculty II	LANL
Neil Harrison	Research Faculty III	LANL
Oscar Ayala Valenzuela	Technologist 2	LANL
Richard Herrera	R&D Technologist	LANL
Ross McDonald	Research Faculty III	LANL
Scott Betts	Technician	LANL
Scott Crooker	Research Faculty III	LANL
Shengzhi Zhang	Postdoctoral Associate	LANL
Sonya Almeida	Administrative Assistant 4	LANL
Thomas Kline	Technologist	LANL
Vivien Zapf	Research Faculty III	LANL

MagLab at UF

Name	Title	Department
Alexander Angerhofer	Professor	UF
Alexander Donald	Graduate Research Assistant	UF
Amy Howe	Research Coordinator II	UF
Anil Mehta	Core Research Facility Manager	UF
Anna Rushin	Graduate Research Assistant	UF
Arthur Hebard	Professor	UF
Austin Evans	Assistant Professor	UF
Chalermchai Khemtong	Associate Professor	UF
Chao Huan	Research Faculty I	UF
Christopher Stanton	Professor	UF
Clifford Bowers	Professor	UF
Cynthia Sager	Office Manager	UF
Daniel Talham	Professor	UF
David Tanner	Professor	UF
David Vaillancourt	Professor	UF
Dmitrii Maslov	Professor	UF
Dominique Laroche	Assistant Professor	UF
Gail Fanucci	Professor	UF
Glenn Walter	Professor	UF
Gregory Dowling	Engineer	UF
Gregory Stewart	Professor	UF
Hai Ping Cheng	Professor	UF
Hendrik Luesch	Professor	UF
Huadong Zeng	Research Faculty III	UF
James Collins	Core Research Facility Manager	UF
James Hamlin	Associate Professor	UF
James Rocca	Senior Chemist & NMR Applications Specialist	UF
Jeffrey Fitzsimmons	Professor	UF
Jens Rosenberg	Core Research Facility Manager / AMRIS Facilities Manager of Clinical MRI Instrumentation	UF
Joanna Long	Professor	UF
Joshua Slade	Engineering Technician	UF
Judith Steadman	MRI Technologist	UF
Kelly Jenkins	RF Coil Engineer	UF
Kevin Ingersent	Professor	UF
Krista Vandenborne	Professor	UF
Lucia Steinke	Research Faculty II	UF
Marcelo Febo	Associate Professor	UF
Maria Luiza Caldas Nogueira	Postdoctoral Associate	UF
Mario Chang	Graduate Research Assistant	UF

Name	Title	Department
Mark Meisel	Professor	UF
Matthew Eddy	Assistant Professor	UF
Matthew Merritt	Associate Professor	UF
Neil Sullivan	Professor	UF
Peter Hirschfeld	Professor	UF
Rasul Gazizulin	Assistant In Research	UF
Rebecca Butcher	Assistant Professor	UF
Reese Peppler	Engineer II	UF
Sean Forbes	Assistant Professor	UF
Selman Hershfield	Professor	UF
Sergey Vasenkov	Professor	UF
Shane Chatfield	3 T Tech	UF
Stephen Blackband	Professor	UF
Tammy Nicholson	Certified Radiology Technology	UF
Thomas Mareci	Professor	UF
Yasumasa Takano	Professor	UF
Yoonseok Lee	Professor	UF
Yousong Ding	Assistant Professor	UF

2. User Facility Statistics

Overview

Seven user facilities — AMRIS (NMR-MRI@UF), DC Field, EMR, High B/T, ICR, NMR-MRI @FSU, and Pulsed Field — each with exceptional instrumentation and highly qualified staff scientists and staff, comprise the magnet lab's user program. In this appendix, each facility presents detailed information about its user demographics, operations statistics and requests for magnet time. A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the magnet lab, are all considered users. All user numbers reflect distinct individuals, i.e., if a user has multiple proposals (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

AMRIS Facility

Table 1a. *Users by Demographic – NSF-Funded*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**49**	3	32	14	33	4	0	12
Senior Personnel, non-U.S.	**2**	1	1	0	2	0	0	0
Postdocs, U.S.	**9**	1	6	2	5	3	0	1
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**41**	1	16	24	14	10	0	17
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**3**	0	3	0	1	2	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
Total	**104**	**6**	**58**	**40**	**55**	**19**	**0**	**30**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status <u>includes</u> the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status <u>excludes</u> Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 1b. *Users by Demographic – Non-NHMFL Funded*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**116**	7	70	39	54	29	0	33
Senior Personnel, non-U.S.	**1**	0	1	0	1	0	0	0
Postdocs, U.S.	**38**	3	24	11	15	15	0	8
Postdocs, non-U.S.	**1**	0	0	1	0	1	0	0
Students, U.S.	**80**	12	31	37	22	28	0	30
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**40**	7	16	17	9	15	0	16
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
Total	**276**	**29**	**142**	**105**	**101**	**88**	**0**	**87**

Table 1c. *Users by Demographic – Summary*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
NSF Funded	**104**	**6**	**58**	**40**	**55**	**19**	**0**	**30**
Non-NHMFL Funded	**276**	**29**	**142**	**105**	**101**	**88**	**0**	**87**
TOTAL	**380**	**35**	**200**	**145**	**156**	**107**	**0**	**117**

Table 2a. Users by Participation – NSF-Funded

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**49**	28	2	0	19
Senior Personnel, non-U.S.	**2**	1	0	0	1
Postdocs, U.S.	**9**	5	0	0	4
Postdocs, non-U.S.	**0**	0	0	0	0
Students, U.S.	**41**	27	3	0	11
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**3**	2	0	0	1
Technician, non-U.S.	**0**	0	0	0	0
Total	**104**	**63**	**5**	**0**	**36**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 2b. Users by Participation – Non-NHMFL Funded

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**116**	82	0	0	34
Senior Personnel, non-U.S.	**1**	1	0	0	0
Postdocs, U.S.	**38**	34	1	0	3
Postdocs, non-U.S.	**1**	1	0	0	0
Students, U.S.	**80**	76	1	0	3
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**40**	39	1	0	0
Technician, non-U.S.	**0**	0	0	0	0
Total	**276**	**233**	**3**	**0**	**40**

Table 2c. Users by Participation – Summary

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
NSF Funded	**104**	**63**	**5**	**0**	**36**
Non-NHMFL Funded	**276**	**233**	**3**	**0**	**40**
TOTAL	**380**	**296**	**8**	**0**	**76**

Table 3a. Users by Organization – NSF-Funded

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**49**	22	12	15	2	47	0
Senior Personnel, non-U.S.	**2**	2	0	0	0	2	0
Postdocs, U.S.	**9**	4	5	0	0	9	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0
Students, U.S.	**41**	14	27	0	0	41	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**3**	1	0	2	0	3	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
Total	**104**	**43**	**44**	**17**	**2**	**102**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 3b. *Users by Organization – Non-NHMFL Funded*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**116**	14	83	19	2	109	5
Senior Personnel, non-U.S.	**1**	1	0	0	0	1	0
Postdocs, U.S.	**38**	3	34	1	0	38	0
Postdocs, non-U.S.	**1**	1	0	0	1	0	0
Students, U.S.	**80**	6	72	2	1	78	1
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**40**	4	36	0	2	38	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
Total	**276**	**29**	**225**	**22**	**6**	**264**	**6**

Table 3c. *Users by Organization – Summary*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
NSF Funded	**104**	**43**	**44**	**17**	**2**	**102**	**0**
Non-NHMFL Funded	**276**	**29**	**225**	**22**	**6**	**264**	**6**
TOTAL	**380**	**72**	**269**	**39**	**8**	**366**	**6**

Table 4a. *Users by Discipline – NSF-Funded*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry , Biophysics	Material Science
Senior Personnel, U.S.	**49**	1	14	9	0	25	0
Senior Personnel, non-U.S.	**2**	0	0	0	0	2	0
Postdocs, U.S.	**9**	1	4	0	0	4	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0
Students, U.S.	**41**	0	17	8	0	16	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**3**	0	0	2	0	1	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
Total	**104**	**2**	**35**	**19**	**0**	**48**	**0**

[1] Users using multiple facilities are counted in each facility listed.

Table 4b. *Users by Discipline – Non-NHMFL Funded*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry , Biophysics	Material Science
Senior Personnel, U.S.	**116**	0	13	13	1	88	1
Senior Personnel, non-U.S.	**1**	0	0	0	0	1	0
Postdocs, U.S.	**38**	0	4	5	1	28	0
Postdocs, non-U.S.	**1**	0	0	0	0	1	0
Students, U.S.	**80**	0	13	8	0	59	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**40**	0	1	0	0	39	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
Total	**276**	**0**	**31**	**26**	**2**	**216**	**1**

Table 4c. *Users by Discipline – Summary*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry , Biophysics	Material Science
NSF Funded	**104**	**2**	**35**	**19**	**0**	**48**	**0**
Non-NHMFL Funded	**276**	**0**	**31**	**26**	**2**	**216**	**1**
TOTAL	**380**	**2**	**66**	**45**	**2**	**264**	**1**

Table 5. *Subscription Rate - Summary*

	Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiments Subscription Percentage
NSF Funded	**15**	**17**	**31**	**96.9 %**	**1**	**3.1 %**	**32**	**103.2 %**
Non-NHMFL Funded	**45**	**80**	**121**	**96.8 %**	**4**	**3.2 %**	**125**	**103.3 %**
TOTAL	**60**	**97**	**152**		**5**		**157**	

Table 6a. *Research Proposals[1] Profile (Demographics) with Magnet Time*

	Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
NSF Funded	**31**	**4**	**24**	**3**	**7**	**22**	**0**	**2**
Non-NHMFL Funded	**105**	**8**	**66**	**31**	**30**	**49**	**0**	**26**
TOTAL	**136**	**12**	**90**	**34**	**37**	**71**	**0**	**28**

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. *Research Proposals Profile (Discipline) with Magnet Time*

	Total Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NSF Funded	**31**	**0**	**6**	**3**	**4**	**18**	**0**
Non-NHMFL Funded	**105**	**0**	**0**	**0**	**2**	**103**	**0**
TOTAL	**136**	**0**	**6**	**3**	**6**	**121**	**0**

Find the list of user proposals in **Appendix V** and on our **website**

Table 7a. *Operations by Magnet System Group – NSF-Funded*

	Total Days Used	Percentage of Total Days Used	600MHz NMR Spec-trometer - Perfusion Applications	600MHz NMR Spectro--meter	600MHz Wide Bore Spectro-meter	750MHz Wide Bore Spectro-meter	800MHz, 63mm bore NMR Spectro-meter	800MHz NMR Spec-trometer with Cryoprobe	4.7T/33 MRI System	11T/40 MRI System
NHMFL-Affiliated	**53.8**	**4.8 %**	7	5	2.3	0	33.5	4	2	0
Local	**65.8**	**5.9 %**	0	5.2	41.2	3	0	9	0	7.5
University, U.S.	**362.3**	**32.2 %**	104	0	55.2	163	16.5	22.7	1	0
University, non-U.S.	**11.8**	**1.1 %**	0	0	0	0	8.8	2	0	1
Government Lab, U.S.	**15.5**	**1.4 %**	0	0	0	15.5	0	0	0	0
Government Lab, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0
Industry, U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0
Industry, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0
Test/Calibration/ Maintenance	**282.7**	**25.1 %**	27.2	55.2	17	28	25.2	22.2	20	88
Method Development	**89.7**	**8 %**	4	35.3	10	0	17.5	20.3	1	1.5
Analytical Chemistry	**0**	**0 %**	0	0	0	0	0	0	0	0
Upgrade Cell Design/Hardware	**91.5**	**8.1 %**	10.5	32	3.5	15	20	3.5	0	7
Setup	**151.8**	**13.5 %**	28.3	45.3	22.8	9.5	16.5	20.3	1	8
Repair	**0**	**0 %**	0	0	0	0	0	0	0	0
TOTAL	**1,125**		**181**	**178**	**152**	**234**	**138**	**104**	**25**	**113**

Table 7b. *Operations by Magnet System Group – Non-NHMFL Funded*

	Total Days Used	Percentage of Total Days Used	600MHz NMR Spectrometer - Perfusion Applications	600MHz NMR Spectro--meter	600MHz Wide Bore Spectro-meter	750MHz Wide Bore Spectro-meter	800MHz, 63mm bore NMR Spectro-meter	800MHz NMR Spec-trometer with Cryoprobe	3 T Siemens Whole Body System	3 T Philips Whole Body System	4.7 T/33 MRI System	11 T/40 MRI System
NHMFL-Affiliated	**375.8**	**26.6 %**	18.5	2	119	34	4	68	9.5	34.3	2	84.5

	Total Days Used	Percentage of Total Days Used	600MHz NMR Spectrometer - Perfusion Applications	600MHz NMR Spectro--meter	600MHz Wide Bore Spectro-meter	750MHz Wide Bore Spectro-meter	800MHz, 63mm bore NMR Spectro-meter	800MHz NMR Spec-trometer with Cryoprobe	3 T Siemens Whole Body System	3 T Philips Whole Body System	4.7 T/33 MRI System	11 T/40 MRI System
Local	**398.3**	**28.2 %**	0	54.5	2	0	5	58	66	97.9	0	115
University, U.S.	**546.4**	**38.7 %**	39.5	31.5	0	21	32	103	164	88.9	29	38
University, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Government Lab, U.S.	**2.5**	**0.2 %**	0	0	0	0	0	2.5	0	0	0	0
Government Lab, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Industry, U.S.	**27.5**	**1.9 %**	0	0	0	0	0	23	0	0	0	4.5
Industry, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Test/Calibration/ Maintenance	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Method Development	**62.2**	**4.4 %**	0	0	0	0	0	0	9.6	22.6	0	30
Analytical Chemistry	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Upgrade Cell Design/ Hardware	**0.3**	**0%**	0	0	0	0	0	0	0	0.3	0	0
Setup	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
Repair	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0
TOTAL	**1,413**		**58**	**88**	**121**	**55**	**41**	**254**	**249**	**244**	**31**	**272**

Table 7c. *Operations by Magnet System Group –Summary*

	Total Days Used	600MHz NMR Spec-trometer - Perfusion Applications	600MHz NMR Spectro--meter	600MHz Wide Bore Spectro-meter	750MHz Wide Bore Spectro-meter	800MHz, 63mm bore NMR Spectro-meter	800MHz NMR Spec-trometer with Cryoprobe	3 T Siemens Whole Body System	3 T Philips Whole Body System	4.7 T/33 MRI System	11 T/40 MRI System
NSF Funded	**1,125**	**181**	**178**	**152**	**234**	**138**	**104**	**0**	**0**	**25**	**113**
Non-NHMFL Funded	**1,413**	**58**	**88**	**121**	**55**	**41**	**254**	**249**	**244**	**31**	**272**
TOTAL	**2,538**	**239**	**266**	**273**	**289**	**179**	**358**	**249**	**244**	**56**	**385**

Table 8a. *Operations by Discipline – NSF-Funded*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Develop-ment of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NHMFL-Affiliated	**53.8**	0	0	0	0	53.8	0
Local	**65.8**	0	46.3	0	0	19.5	0
University, U.S.	**362.3**	0	40.8	127	0	194.5	0
University, non-U.S.	**11.8**	0	0	0	0	11.8	0
Government Lab, U.S.	**15.5**	0	0	0	0	15.5	0
Government Lab, non-U.S.	**0**	0	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/Calibration/Maintenance	**282.7**	0	0	0	0	282.7	0
Method Development	**89.7**	0	0	0	0	89.7	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/Hardware	**91.5**	0	0	0	0	91.5	0
Setup	**151.8**	0	0	0	0	151.8	0
Repair	**0**	0	0	0	0	0	0
Total	**1,125**	**0**	**87.2**	**127**	**0**	**910.8**	**0**

Table 8b. *Operations by Discipline – NSF-Funded*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Develop-ment of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NHMFL-Affiliated	**375.8**	0	0	0	13	362.8	0
Local	**398.3**	0	36	0	0	362.3	0

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
University, U.S.	**546.4**	0	38	1	0	507.4	0
University, non-U.S.	**0**	0	0	0	0	0	0
Government Lab, U.S.	**2.5**	0	0	0	0	2.5	0
Government Lab, non-U.S.	**0**	0	0	0	0	0	0
Industry, U.S.	**27.5**	0	23	0	0	4.5	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/Calibration/Maintenance	**0**	0	0	0	0	0	0
Method Development	**62.2**	0	0	0	30	32.2	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/Hardware	**0.3**	0	0	0	0	0.3	0
Setup	**0**	0	0	0	0	0	0
Repair	**0**	0	0	0	0	0	0
Total	**1,413**	**0**	**97**	**1**	**43**	**1,272**	**0**

Table 8c. *Operations by Discipline – Summary*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NSF Funded	**1,125**	**0**	**87.2**	**127**	**0**	**910.8**	**0**
Non-NHMFL Funded	**1,413**	**0**	**97**	**1**	**43**	**1,272**	**0**
TOTAL	**2,538**	**0**	**184.2**	**128**	**43**	**2182.8**	**0**

Table 9a. *New PIs[1] and New Users – NSF-Funded*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**32**	4	8	24	**49**	9	10	39
Senior Personnel, non-U.S.	**1**	0	0	1	**2**	0	0	2
Postdocs, U.S.	**0**	0	0	0	**9**	3	3	6
Postdocs, non-U.S.	**0**	0	0	0	**0**	0	0	0
Students, U.S.	**0**	0	0	0	**41**	14	16	25
Students, non-U.S.	**0**	0	0	0	**0**	0	0	0
Technician, U.S.	**0**	0	0	0	**3**	0	1	2
Technician, non-U.S.	**0**	0	0	0	**0**	0	0	0
Total	**33**	**4**	**8**	**25**	**104**	**26**	**30**	**74**

[1] PIs who received magnet time for the first time.

Table 9b. *New PIs[1] and New Users – Non-NHMFL Funded*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**78**	13	13	65	**116**	9	10	106
Senior Personnel, non-U.S.	**0**	0	0	0	**1**	0	0	1
Postdocs, U.S.	**1**	1	1	0	**38**	3	4	34
Postdocs, non-U.S.	**0**	0	0	0	**1**	0	0	1
Students, U.S.	**1**	1	1	0	**80**	14	14	66
Students, non-U.S.	**0**	0	0	0	**0**	0	0	0
Technician, U.S.	**0**	0	0	0	**40**	1	2	38
Technician, non-U.S.	**0**	0	0	0	**0**	0	0	0
Total	**80**	**15**	**15**	**65**	**276**	**27**	**30**	**246**

__Table 9c.__ New PIs[1] and New Users – Summary

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
NSF Funded	**33**	**4**	**8**	**25**	**104**	**26**	**30**	**74**
Non-NHMFL Funded	**80**	**15**	**15**	**65**	**276**	**27**	**30**	**246**
TOTAL	**113**	**19**	**23**	**90**	**380**	**53**	**60**	**320**

__Table 10a.__ New[1] User PIs – NSF-Funded

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Alaji Bah	Suny Upstate Medical University	P19486	Received 2022	Yes
Leah Casabianca	Clemson University	P19891	Received 2022	No
Rachel Martin	University of California, Irvine	P19974	Received 2022	No
Gerald Schneider	Louisiana State University	P19693	Received 2022	Yes
Zachary Smith	Massachusetts Institute of Technology	P19806	Received 2022	Yes
Lee Sweeney	University of Florida	P20062	Received 2022	No
Shahabeddin Vahdat	University of Florida	P19971	Received 2022	No
Libin Ye	University of South Florida	P19783	Received 2022	Yes
TOTAL	**8**			

[1] PIs who received magnet time for the first time.

__Table 10b.__ New[1] User PIs – Non-NHMFL Funded

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Kyle Allen	University of Florida	P19984	Received 2022	Yes
Jared Baisden	Wertheim Scripps Inst (UF)	P20189	Received 2022	Yes
Alison Barnard	University of Florida	P19993	Received 2022	Yes
Steven Benner	Foundation for Applied Molecular Evolution	P19985	Received 2022	Yes
Lina Cui	University of Florida	P19991	Received 2022	Yes
Purushottam Dixit	University of Florida	P20113	Received 2022	Yes
Habibeh Khoshbouei	University of Florida	P20109	Received 2022	Yes
Nikolaus McFarland	University of Florida	P19986	Received 2022	Yes
Robert McKenna	University of Florida	P20185	Received 2022	Yes
Aaron Mickle	University of Florida	P20094	Received 2022	Yes
Jennifer Miller	University of Florida	P19995	Received 2022	Yes
Carl Pepine	University of Florida	P20098	Received 2022	Yes
Federico Pozzi	University of Florida	P19987	Received 2022	Yes
Lisa Scott	University of Florida	P20110	Received 2022	Yes
Ashutosh Shukla	University of Florida	P20021	Received 2022	Yes
TOTAL	**15**			

DC Field Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**172**	7	146	19	136	23	0	13
Senior Personnel, non-U.S.	**59**	4	35	20	39	7	0	13
Postdocs, U.S.	**67**	1	55	11	46	14	0	7
Postdocs, non-U.S.	**12**	2	7	3	6	3	0	3
Students, U.S.	**202**	10	143	49	136	36	1	29
Students, non-U.S.	**36**	3	21	12	22	10	0	4
Technician, U.S.	**6**	1	5	0	4	2	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**554**	**28**	**412**	**114**	**389**	**95**	**1**	**69**

1 Users using multiple facilities are counted in each facility listed.
2 NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
3 Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**172**	86	0	29	57
Senior Personnel, non-U.S.	**59**	6	0	16	37
Postdocs, U.S.	**67**	49	0	4	14
Postdocs, non-U.S.	**12**	4	0	2	6
Students, U.S.	**202**	152	0	12	38
Students, non-U.S.	**36**	15	0	4	17
Technician, U.S.	**6**	6	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**554**	**318**	**0**	**67**	**169**

1 Users using multiple facilities are counted in each facility listed.
2 "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
3 "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4 "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**172**	121	4	47	18	146	8
Senior Personnel, non-U.S.	**59**	59	0	0	11	46	2
Postdocs, U.S.	**67**	50	6	11	8	59	0
Postdocs, non-U.S.	**12**	12	0	0	3	9	0
Students, U.S.	**202**	166	20	16	2	199	1
Students, non-U.S.	**36**	36	0	0	1	35	0
Technician, U.S.	**6**	0	1	5	0	6	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
Total	**554**	**444**	**31**	**79**	**43**	**500**	**11**

1 Users using multiple facilities are counted in each facility listed.
2 NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
3 Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
4 Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
5 The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. *Users by Discipline*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry , Biophysics	Material Science
Senior Personnel, U.S.	**172**	110	27	12	15	8	0
Senior Personnel, non-U.S.	**59**	36	19	3	1	0	0
Postdocs, U.S.	**67**	52	5	2	5	2	1
Postdocs, non-U.S.	**12**	8	4	0	0	0	0
Students, U.S.	**202**	149	27	10	14	0	2
Students, non-U.S.	**36**	27	7	1	1	0	0
Technician, U.S.	**6**	0	0	1	4	1	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**554**	**382**	**89**	**29**	**40**	**11**	**3**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. *Subscription Rate (Experiments)*

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
370	46	288	69.2 %	128	30.8 %	416	1.4	144.4 %

Table 5b. *Subscription Rate (Magnet Days)*

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
2,941	1,414.6	19.2	353.9	95	1,882.7	1.6	156.2 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. *Research Proposals [1] Profile (Demographics) with Magnet Time*

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
156	6	133	17	26	124	0	6

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. *Research Proposals Profile (Discipline) with Magnet Time*

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochem., Biophys.	Material Science
156	115	23	2	11	4	1

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. *Operations by Magnet System Group*

	Total Days Used[1]	% of Total Days Used	45T	Resistive	SCH	Super-conducting
NHMFL-Affiliated	**353.9**	**18.8 %**	8	64.9	31	250
Local	**19.2**	**0**	0	5.2	0	14
University, U.S.	**1,036.9**	**55.1 %**	21	207.9	30	778
University, non-U.S.	**168.9**	**0**	3	56.9	37	72
Government Lab, U.S.	**176**	**9.3 %**	0	56	0	120
Government Lab, non-U.S.	**24**	**1.3 %**	0	6	4	14
Industry, U.S.	**8.9**	**0.5 %**	0	8.9	0	0
Industry, non-U.S.	**0**	**0 %**	0	0	0	0
Test/Calibration/Maintenance	**14**	**0.7 %**	0	0	0	14
Method Development	**81**	**4.3 %**	0	0	0	81
Analytical Chemistry	**0**	**0 %**	0	0	0	0

	Total Days Used[1]	% of Total Days Used	45T	Resistive	SCH	Super-conducting
Upgrade Cell Design/Hardware	**0**	**0 %**	0	0	0	0
Setup	**0**	**0 %**	0	0	0	0
Repair	**0**	**0 %**	0	0	0	0
TOTAL	**1,882.7**		**32**	**405.7**	**102**	**1,343**

[1] Each 20MW resistive magnet requires two power supplies to run, the 45T hybrid magnet requires three power supplies, and the 36T Series Connected Hybrid requires one power supply. Thus, there can be four resistive magnets + three superconducting magnets operating or the 45T hybrid, series connected hybrid, two resistive magnets and three superconducting magnets. User Units are defined as magnet days. Users of water-cooled resistive or hybrid magnets can typically expect to receive enough energy for 7 hours a day of magnet usage, so a magnet day is defined as 7 hours. Superconducting magnets are scheduled typically 24 hours a day.

Table 8. *Operations by Discipline*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochem., Biophys.	Material Science
NHMFL-Affiliated	**353.9**	288.8	25	0	40.1	0	0
Local	**19.2**	19.2	0	0	0	0	0
University, U.S.	**1,036.9**	863.9	115.8	19	17.1	0	21
University, non-U.S.	**168.9**	103.8	34	0	23.1	8	0
Government Lab, U.S.	**176**	169	0	0	7	0	0
Government Lab, non-U.S.	**24**	20	4	0	0	0	0
Industry, U.S.	**8.9**	0	0	0	8.9	0	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/ Calibration/ Maintenance	**14**	14	0	0	0	0	0
Method Development	**81**	81	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/Hardware	**0**	0	0	0	0	0	0
Setup	**0**	0	0	0	0	0	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**1,882.7**	**1,559.7**	**178.8**	**19**	**96.2**	**8**	**21**

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**102**	11	13	89	**172**	11	19	153
Senior Personnel, non-U.S.	**27**	8	9	18	**59**	14	17	42
Postdocs, U.S.	**1**	1	1	0	**67**	19	22	45
Postdocs, non-U.S.	**1**	1	1	0	**12**	3	5	7
Students, U.S.	**0**	0	0	0	**202**	75	85	117
Students, non-U.S.	**0**	0	0	0	**36**	15	20	16
Technician, U.S.	**0**	0	0	0	**6**	0	1	5
Technician, non-U.S.	**0**	0	0	0	**0**	0	0	0
TOTAL	**131**	**21**	**24**	**107**	**554**	**137**	**169**	**385**

[1] PIs who received magnet time for the first time.

Table 10. *New[1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Kaveh Ahadi	North Carolina State University	P19812	Received 2022	Yes
John Anderson	University of Chicago	P20043	Received 2022	Yes
Jake Ayres	University of Bristol	P19833	Received 2022	Yes
Julia Chan	Baylor University	P20085	Received 2022	Yes
Nicholas Chilton	University of Manchester	P19930	Received 2022	Yes
Scott Dietrich	Villanova University	P19917	Received 2022	Yes
Alex Eaton	University of Cambridge	P19943	Received 2022	Yes

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Alexander Forse	University of Cambridge	P20101	Received 2022	Yes
Paula Giraldo-Gallo	University of Los Andes	P19271	Received 2022	Yes
Michelle Jamer	U.S. Naval Academy	P20004	Received 2022	Yes
Luis Jauregui	University of California, Irvine	P19933	Received 2022	Yes
Long Ju	Massachusetts Institute of Technology	P19939	Received 2022	Yes
Isabelle Marcotte	University of Quebec at Montreal	P19442	Received 2022	No
Tyrel McQueen	Johns Hopkins University	P19695	Received 2022	No
Douglas Natelson	Rice University	P19795	Received 2022	Yes
Xinhua Peng	University of Science and Technology of China	P19983	Received 2022	Yes
Andreas Rydh	Stockholm University	P19624	Received 2022	Yes
Luis Sánchez-Muñoz	Consejo Superior de Investigaciones Científicas	P19961	Received 2022	Yes
Shivani Sharma	Brookhaven National Laboratory	P20103	Received 2022	Yes
Brandon Sorbom	Commonwealth Fusion Systems	P19831	Received 2022	Yes
Trevor Tyson	New Jersey Institute of Technology	P19612	Received 2022	Yes
Suguru Yoshida	Pennsylvania State University	P20047	Received 2022	Yes
Yuanzheng YUE	Aalborg University	P19967	Received 2022	Yes
Hans-Conrad zur Loye	University of South Carolina	P19830	Received 2022	No
TOTAL	**24**			

[1] PIs who received magnet time for the first time.

EMR Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**67**	3	55	9	51	9	0	7
Senior Personnel, non-U.S.	**14**	1	12	1	11	3	0	0
Postdocs, U.S.	**18**	1	12	5	12	5	0	1
Postdocs, non-U.S.	**4**	0	2	2	3	0	0	1
Students, U.S.	**54**	6	39	9	33	13	0	8
Students, non-U.S.	**6**	0	4	2	2	2	0	2
Technician, U.S.	**2**	0	1	1	0	1	0	1
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**165**	**11**	**125**	**29**	**112**	**33**	**0**	**20**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**67**	27	0	11	29
Senior Personnel, non-U.S.	**14**	0	0	6	8
Postdocs, U.S.	**18**	13	0	2	3
Postdocs, non-U.S.	**4**	0	0	1	3
Students, U.S.	**54**	34	0	11	9
Students, non-U.S.	**6**	2	0	2	2
Technician, U.S.	**2**	2	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**165**	**78**	**0**	**33**	**54**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**67**	46	2	19	4	63	0
Senior Personnel, non-U.S.	**14**	14	0	0	1	13	0
Postdocs, U.S.	**18**	9	6	3	0	18	0
Postdocs, non-U.S.	**4**	4	0	0	1	3	0
Students, U.S.	**54**	32	13	9	0	54	0
Students, non-U.S.	**6**	6	0	0	0	6	0
Technician, U.S.	**2**	1	0	1	0	2	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**165**	**112**	**21**	**32**	**6**	**159**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. *Users by Discipline*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry , Biophysics	Material Science
Senior Personnel, U.S.	**67**	16	40	3	0	8	0
Senior Personnel, non-U.S.	**14**	4	8	0	2	0	0
Postdocs, U.S.	**18**	6	9	0	2	0	1
Postdocs, non-U.S.	**4**	1	2	0	1	0	0
Students, U.S.	**54**	12	39	0	1	2	0
Students, non-U.S.	**6**	2	4	0	0	0	0
Technician, U.S.	**2**	0	1	0	0	1	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**165**	**41**	**103**	**3**	**6**	**11**	**1**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. *Subscription Rate (Experiments)*

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
112	18	116	89.2 %	14	10.8 %	130	1.1	112.1 %

Table 5b. *Subscription Rate (Magnet Days)*

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
827	504	6	74.5	114.5	699	1.2	118.3 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. *Research Proposals[1] Profile (Demographics) with Magnet Time*

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
57	4	47	6	8	45	0	4

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. *Research Proposals Profile (Discipline) with Magnet Time*

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
57	12	32	0	8	5	0

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. *Operations by Magnet System Group*

	Total Days Used[1]	Percentage of Total Days Used	12.5T Superconducting Magnet, Pulsed EPR	17T Superconducting Magnet	Bruker[2]	HiPER
NHMFL-Affiliated	**74.5**	**10.7 %**	26.5	18	0	30
Local	**6**	**0.9 %**	0	6	0	0
University, U.S.	**397.5**	**56.9 %**	127.5	149	10	111
University, non-U.S.	**103.5**	**14.8 %**	46	48.5	0	9
Government Lab, U.S.	**3**	**0.4 %**	0	3	0	0
Government Lab, non-U.S.	**0**	**0 %**	0	0	0	0
Industry, U.S.	**0**	**0 %**	0	0	0	0
Industry, non-U.S.	**0**	**0 %**	0	0	0	0
Test/Calibration/Maintenance	**110.5**	**15.8 %**	8	12.5	9	81
Method Development	**4**	**0.6 %**	0	0	3	1

	Total Days Used[1]	Percentage of Total Days Used	12.5T Superconducting Magnet, Pulsed EPR	17T Superconducting Magnet	Bruker[2]	HiPER
Analytical Chemistry	0	0 %	0	0	0	0
Upgrade Cell Design/Hardware	0	0 %	0	0	0	0
Setup	0	0 %	0	0	0	0
Repair	0	0 %	0	0	0	0
TOTAL	699		208	237	22	232

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.
[2] The nearly 25 years old Bruker spectrometer was out of commission from early 2022 and is currently undergoing repair in Germany.

Table 8. *Operations by Discipline*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics[1]	Material Science
NHMFL-Affiliated	74.5	4	34.5	0	32	4	0
Local	6	0	6	0	0	0	0
University, U.S.	397.5	60	316.5	0	4	4	13
University, non-U.S.	103.5	33.5	46.5	0	23.5	0	0
Government Lab, U.S.	3	0	3	0	0	0	0
Government Lab, non-U.S.	0	0	0	0	0	0	0
Industry, U.S.	0	0	0	0	0	0	0
Industry, non-U.S.	0	0	0	0	0	0	0
Test/ Calibration/ Maintenance	110.5	0	2	0	108.5	0	0
Method Development	4	0	0	0	4	0	0
Analytical Chemistry	0	0	0	0	0	0	0
Upgrade Cell Design/Hardware	0	0	0	0	0	0	0
Setup	0	0	0	0	0	0	0
Repair	0	0	0	0	0	0	0
TOTAL	699	97.5	408.5	0	172	8	13

[1] EMR's only bio research faculty member retired in 2022, resulting in a temporary hiatus in biological user activity during 2022.

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	43	11	13	30	67	3	6	61
Senior Personnel, non-U.S.	10	4	6	4	14	2	2	12
Postdocs, U.S.	0	0	0	0	18	10	11	7
Postdocs, non-U.S.	1	0	0	1	4	3	3	1
Students, U.S.	0	0	0	0	54	22	26	28
Students, non-U.S.	0	0	0	0	6	5	5	1
Technician, U.S.	0	0	0	0	2	1	2	0
Technician, non-U.S.	0	0	0	0	0	0	0	0
TOTAL	54	15	19	35	165	46	55	110

[1] PIs who received magnet time for the first time.

Table 10. *New[1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Christopher Bardeen	University of California, Riverside	P19789	Received 2022	Yes
Daniel Mindiola	University of Pennsylvania	P20072	Received 2022	Yes
Deepshikha Jaiswal-Nagar	IISER Thiruvananthapuram	P19914	Received 2022	Yes
Denis Karaiskaj	University of South Florida	P19859	Received 2022	No
Eric Breynaert	Catholic University Leuven	P19796	Received 2022	No

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Frédéric Perras	Ames Laboratory	P20092	Received 2022	Yes
Gaël Ung	University of Connecticut	P20015	Received 2022	Yes
Gary Guillet	Georgia Southern University	P19703	Received 2022	Yes
Hans Jurgen von Bardeleben	Sorbonne University	P20096	Received 2022	Yes
Michael Jensen	Ohio University	P20071	Received 2022	Yes
Muralee Murugesu	University of Ottawa	P19896	Received 2022	No
Natia Frank	University of Nevada Reno	P20070	Received 2022	Yes
Nicholas Chilton	University of Manchester	P19930	Received 2022	Yes
Petr Neugebauer	Brno University of Technology	P19968	Received 2022	Yes
Robert Comito	University of Houston	P20069	Received 2022	Yes
Stuart Brown	University of California, Los Angeles	P19422	Received 2022	No
Vincent Pecoraro	University of Michigan	P20120	Received 2022	Yes
William Evans	University of California, Irvine	P20194	Received 2022	Yes
Xiaoling Wang	California State University, East Bay	P20077	Received 2022	Yes
TOTAL	**19**			

[1] PIs who received magnet time for the first time.

High B/T Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**6**	0	6	0	6	0	0	0
Senior Personnel, non-U.S.	**2**	0	2	0	1	1	0	0
Postdocs, U.S.	**4**	0	2	2	2	1	0	1
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0
Students, U.S.	**3**	0	2	1	2	0	0	1
Students, non-U.S.	**0**	0	0	0	0	0	0	0
Technician, U.S.	**1**	0	1	0	1	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**16**	**0**	**13**	**3**	**12**	**2**	**0**	**2**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**6**	2	0	0	4
Senior Personnel, non-U.S.	**2**	0	0	0	2
Postdocs, U.S.	**4**	3	0	0	1
Postdocs, non-U.S.	**0**	0	0	0	0
Students, U.S.	**3**	1	0	0	2
Students, non-U.S.	**0**	0	0	0	0
Technician, U.S.	**1**	1	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**16**	**7**	**0**	**0**	**9**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**6**	4	0	2	1	5	0
Senior Personnel, non-U.S.	**2**	2	0	0	0	2	0
Postdocs, U.S.	**4**	1	2	1	0	4	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0
Students, U.S.	**3**	2	0	1	0	3	0
Students, non-U.S.	**0**	0	0	0	0	0	0
Technician, U.S.	**1**	0	0	1	0	1	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**16**	**9**	**2**	**5**	**1**	**15**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
Senior Personnel, U.S.	6	6	0	0	0	0	0
Senior Personnel, non-U.S.	2	2	0	0	0	0	0
Postdocs, U.S.	4	4	0	0	0	0	0
Postdocs, non-U.S.	0	0	0	0	0	0	0
Students, U.S.	3	3	0	0	0	0	0
Students, non-U.S.	0	0	0	0	0	0	0
Technician, U.S.	1	1	0	0	0	0	0
Technician, non-U.S.	0	0	0	0	0	0	0
TOTAL	16	16	0	0	0	0	0

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
1	4	5	100 %	0	0%	5	1	100 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
389	94	0	0	295	389	1	100 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. Research Proposals[1] Profile (Demographics) with Magnet Time

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
5	0	4	1	1	4	0	0

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. Research Proposals Profile (Discipline) with Magnet Time

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
5	5	0	0	0	0	0

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. Operations by Magnet System Group

	Total Days Used[1]	Percentage of Total Days Used	Bay 1 (UF Microkelvin Lab)	Bay 2 (UF Microkelvin Lab) 0.02mK, 8T	Bay 3 (UF Microkelvin Lab) 0.3mK, 16T
NHMFL-Affiliated	0	0 %	0	0	0
Local	0	0 %	0	0	0
University, U.S.	94	24.2 %	0	94	0
University, non-U.S.	0	0 %	0	0	0
Government Lab, U.S.	0	0 %	0	0	0
Government Lab, non-U.S.	0	0 %	0	0	0
Industry, U.S.	0	0 %	0	0	0
Industry, non-U.S.	0	0 %	0	0	0
Test/Calibration/Maintenance	60	15.4 %	5	33	22
Method Development	0	0 %	0	0	0
Analytical Chemistry	0	0 %	0	0	0

	Total Days Used[1]	Percentage of Total Days Used	Bay 1 (UF Microkelvin Lab)	Bay 2 (UF Microkelvin Lab) 0.02mK, 8T	Bay 3 (UF Microkelvin Lab) 0.3mK, 16T
Upgrade Cell Design/ Hardware	**170**	**43.7 %**	170	0	0
Setup	**65**	**16.7 %**	0	12	53
Repair	**0**	**0 %**	0	0	0
TOTAL	**389**		**175**	**139**	**75**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. *Operations by Discipline*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NHMFL-Affiliated	**0**	0	0	0	0	0	0
Local	**0**	0	0	0	0	0	0
University, U.S.	**94**	94	0	0	0	0	0
University, non-U.S.	**0**	0	0	0	0	0	0
Government Lab, U.S.	**0**	0	0	0	0	0	0
Government Lab, non-U.S.	**0**	0	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/ Calibration/ Maintenance	**60**	60	0	0	0	0	0
Method Development	**0**	0	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/Hardware	**170**	170	0	0	0	0	0
Setup	**65**	65	0	0	0	0	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**389**	**389**	**0**	**0**	**0**	**0**	**0**

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**4**	2	2	2	**6**	0	0	6
Senior Personnel, non-U.S.	**0**	0	0	0	**2**	0	0	2
Postdocs, U.S.	**1**	0	0	1	**4**	1	1	3
Postdocs, non-U.S.	**0**	0	0	0	**0**	0	0	0
Students, U.S.	**0**	0	0	0	**3**	1	1	2
Students, non-U.S.	**0**	0	0	0	**0**	0	0	0
Technician, U.S.	**0**	0	0	0	**1**	0	0	1
Technician, non-U.S.	**0**	0	0	0	**0**	0	0	0
TOTAL	**5**	**2**	**2**	**3**	**16**	**2**	**2**	**14**

[1] PIs who received magnet time for the first time.

Table 10. *New[1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Samaresh Guchhait	Howard University	P19768	Received 2022	Yes
Long Ju	Massachusetts Institute of Technology	P19811	Received 2022	Yes
TOTAL	**2**			

[1] PIs who received magnet time for the first time.

ICR Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**118**	2	72	44	59	21	0	38
Senior Personnel, non-U.S.	**52**	1	18	33	16	6	0	30
Postdocs, U.S.	**24**	1	16	7	13	8	0	3
Postdocs, non-U.S.	**7**	0	5	2	2	4	0	1
Students, U.S.	**79**	9	50	20	29	34	0	16
Students, non-U.S.	**22**	3	9	10	8	9	0	5
Technician, U.S.	**17**	0	3	14	2	1	0	14
Technician, non-U.S.	**7**	0	2	5	1	2	0	4
TOTAL	**326**	**16**	**175**	**135**	**130**	**85**	**0**	**111**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**118**	34	0	9	75
Senior Personnel, non-U.S.	**52**	1	0	10	41
Postdocs, U.S.	**24**	11	0	1	12
Postdocs, non-U.S.	**7**	0	0	1	6
Students, U.S.	**79**	33	0	9	37
Students, non-U.S.	**22**	5	0	3	14
Technician, U.S.	**17**	1	0	1	15
Technician, non-U.S.	**7**	0	0	0	7
TOTAL	**326**	**85**	**0**	**34**	**207**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**118**	85	18	15	12	96	10
Senior Personnel, non-U.S.	**52**	52	0	0	12	37	3
Postdocs, U.S.	**24**	14	7	3	3	21	0
Postdocs, non-U.S.	**7**	7	0	0	2	5	0
Students, U.S.	**79**	49	19	11	2	75	2
Students, non-U.S.	**22**	22	0	0	2	20	0
Technician, U.S.	**17**	17	0	0	2	8	7
Technician, non-U.S.	**7**	7	0	0	0	7	0
TOTAL	**326**	**253**	**44**	**29**	**35**	**269**	**22**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. Users by Discipline

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry Biophysics	Material Science
Senior Personnel, U.S.	**118**	0	62	24	0	32	0
Senior Personnel, non-U.S.	**52**	0	34	5	0	13	0
Postdocs, U.S.	**24**	0	13	5	0	6	0
Postdocs, non-U.S.	**7**	0	4	0	0	3	0
Students, U.S.	**79**	0	30	22	0	27	0
Students, non-U.S.	**22**	0	12	0	0	10	0
Technician, U.S.	**17**	0	2	2	0	13	0
Technician, non-U.S.	**7**	0	0	2	0	5	0
TOTAL	**326**	**0**	**157**	**60**	**0**	**109**	**0**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. Subscription Rate (Experiments)

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
129	5	104	77.6 %	30	22.4 %	134	1.3	128.8 %

Table 5b. Subscription Rate (Magnet Days)

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
1,550	288.6	44.5	29.9	15	378	4.1	410.1 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. Research Proposals[1] Profile (Demographics) with Magnet Time

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
76	2	66	8	15	57	0	4

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Table 6b. Research Proposals Profile (Discipline) with Magnet Time

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
76	0	47	9	0	20	0

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. Operations by Magnet System Group

	Total Days Used[1]	Percentage of Total Days Used	9.4T, 220mm bore FT-ICR MS[2]	14.5T Hybrid LTQ/ FT-ICR MS	21T Hybrid LTQ/FT-ICR MS
NHMFL-Affiliated	**29.9**	**7.9 %**	0	2.3	27.6
Local	**44.5**	**11.8 %**	16	7.8	20.7
University, U.S.	**129.1**	**34.1 %**	0	33.5	95.6
University, non-U.S.	**58.6**	**15.5 %**	0	0	58.6
Government Lab, U.S.	**1**	**0.3 %**	0	0	1
Government Lab, non-U.S.	**4.1**	**1.1 %**	0	0	4.1
Industry, U.S.	**90.8**	**24 %**	0	41.8	49
Industry, non-U.S.	**5**	**1.3 %**	0	0	5
Test/Calibration/Maintenance	**5.5**	**1.5 %**	0	0	5.5
Method Development	**0**	**0 %**	0	0	0
Analytical Chemistry	**9.5**	**2.5 %**	0	7.5	2
Upgrade Cell Design/ Hardware	**0**	**0 %**	0	0	0
Setup	**0**	**0 %**	0	0	0
Repair	**0**	**0 %**	0	0	0

	Total Days Used[1]	Percentage of Total Days Used	9.4T, 220mm bore FT-ICR MS[2]	14.5T Hybrid LTQ/ FT-ICR MS	21T Hybrid LTQ/FT-ICR MS
TOTAL	**378**		**16**	**93**	**269**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.
[2] The 9.4T active system was retired, and the 9.4T passive suffered a costly turbo pump failure that limited instrument usage.

Table 8. *Operations by Discipline*

	Total Days Used[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry Biophysics	Material Science
NHMFL-Affiliated	**29.9**	0	22.1	0	0	7.8	0
Local	**44.5**	0	32.3	5.4	0	6.8	0
University, U.S.	**129.1**	0	76	9.7	0	43.4	0
University, non-U.S.	**58.6**	0	49.4	0	0	9.2	0
Government Lab, U.S.	**1**	0	1	0	0	0	0
Government Lab, non-U.S.	**4.1**	0	3.8	0.3	0	0	0
Industry, U.S.	**90.8**	0	85.8	0	0	5	0
Industry, non-U.S.	**5**	0	5	0	0	0	0
Test/ Calibration/ Maintenance	**5.5**	0	5.5	0	0	0	0
Method Development	**0**	0	0	0	0	0	0
Analytical Chemistry	**9.5**	0	7.5	0	0	2	0
Upgrade Cell Design/ Hardware	**0**	0	0	0	0	0	0
Setup	**0**	0	0	0	0	0	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**378**	**0**	**288.4**	**15.4**	**0**	**74.2**	**0**

1 User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**42**	12	12	30	**118**	31	31	87
Senior Personnel, non-U.S.	**15**	6	6	9	**52**	21	21	31
Postdocs, U.S.	**2**	1	1	1	**24**	7	7	17
Postdocs, non-U.S.	**3**	1	1	2	**7**	1	1	6
Students, U.S.	**0**	0	0	0	**79**	33	33	46
Students, non-U.S.	**0**	0	0	0	**22**	8	8	14
Technician, U.S.	**0**	0	0	0	**17**	6	6	11
Technician, non-U.S.	**0**	0	0	0	**7**	0	0	7
TOTAL	**62**	**20**	**20**	**42**	**326**	**107**	**107**	**219**

1 PIs who received magnet time for the first time.

Table 10. *New [1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Jason Ahad	Natural Resources Canada	P19807	Received 2022	Yes
Simon Andersen	Schlumberger Canada Ltd	P20088	Received 2022	Yes
Thomas Atkinson	University of Alabama, Birmingham	P20022	Received 2022	Yes
Allan Bacon	University of Florida	P19879	Received 2022	Yes
David Barnidge	The Binding Site	P19691	Received 2022	Yes
Brice Bouyssiere	University of Pau and the Adour Region	P20108	Received 2022	Yes
David Butcher	National High Magnetic Field Laboratory	P19979	Received 2022	Yes
Alex Cobb	Singapore-MIT Alliance for Research and Technology	P19977	Received 2022	Yes
James Dumesic	University of Wisconsin, Madison	P19687	Received 2022	Yes
Michael Hoepfner	University of Utah	P20076	Received 2022	Yes
Daqian Jiang	University of Alabama, Tuscaloosa	P20102	Received 2022	Yes

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Liza McDonough	Australian Nuclear Science and Technology Organization	P19907	Received 2022	Yes
Garrett McKay	Texas A&M University	P19963	Received 2022	Yes
Matthew Reid	Cornell University	P19584	Received 2022	Yes
Christopher Rüger	University of Rostock	P19814	Received 2022	Yes
Gregg Stanwood	Florida State University	P19909	Received 2022	Yes
Caitlin Tressler	Johns Hopkins University School of Medicine	P19892	Received 2022	Yes
Bart van Dongen	University of Manchester	P19888	Received 2022	Yes
Derrick Vaughn	Florida State University	P20008	Received 2022	Yes
Renzun Zhao	North Carolina Agricultural and Technical State University	P19962	Received 2022	Yes
TOTAL	**20**			

[1] PIs who received magnet time for the first time.

NMR Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**120**	4	82	34	77	13	0	30
Senior Personnel, non-U.S.	**53**	4	16	33	22	8	0	23
Postdocs, U.S.	**39**	2	24	13	20	10	0	9
Postdocs, non-U.S.	**13**	0	6	7	2	6	0	5
Students, U.S.	**95**	6	57	32	42	28	0	25
Students, non-U.S.	**26**	1	9	16	14	3	0	9
Technician, U.S.	**6**	0	5	1	4	1	0	1
Technician, non-U.S.	**2**	0	1	1	1	0	0	1
TOTAL	**354**	**17**	**200**	**137**	**182**	**69**	**0**	**103**

1 Users using multiple facilities are counted in each facility listed.
2 NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
3 Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**120**	45	9	19	47
Senior Personnel, non-U.S.	**53**	5	4	14	30
Postdocs, U.S.	**39**	20	0	7	12
Postdocs, non-U.S.	**13**	3	1	5	4
Students, U.S.	**95**	58	4	17	16
Students, non-U.S.	**26**	4	6	6	10
Technician, U.S.	**6**	6	0	0	0
Technician, non-U.S.	**2**	0	0	0	2
TOTAL	**354**	**141**	**24**	**68**	**121**

1 Users using multiple facilities are counted in each facility listed.
2 "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
3 "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4 "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**120**	80	11	29	9	109	2
Senior Personnel, non-U.S.	**53**	53	0	0	11	40	2
Postdocs, U.S.	**39**	22	10	7	6	33	0
Postdocs, non-U.S.	**13**	13	0	0	4	9	0
Students, U.S.	**95**	46	28	21	0	95	0
Students, non-U.S.	**26**	26	0	0	4	22	0
Technician, U.S.	**6**	0	2	4	0	6	0
Technician, non-U.S.	**2**	2	0	0	1	0	1
TOTAL	**354**	**242**	**51**	**61**	**35**	**314**	**5**

1 Users using multiple facilities are counted in each facility listed.
2 NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
3 Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
4 Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
5 The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. *Users by Discipline*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry Biophysics	Material Science
Senior Personnel, U.S.	**120**	4	49	14	5	47	1
Senior Personnel, non-U.S.	**53**	3	34	2	4	9	1
Postdocs, U.S.	**39**	4	12	3	6	13	1
Postdocs, non-U.S.	**13**	0	11	0	0	2	0
Students, U.S.	**95**	2	50	14	1	28	0
Students, non-U.S.	**26**	0	18	1	0	7	0
Technician, U.S.	**6**	0	0	0	3	3	0
Technician, non-U.S.	**2**	0	2	0	0	0	0
TOTAL	**354**	**13**	**176**	**34**	**19**	**109**	**3**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. *Subscription Rate (Experiments)*

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
581	19	550	91.7 %	50	8.3 %	600	1.1	109.1 %

Table 5b. *Subscription Rate (Magnet Days)*

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
2,982	1,681.5	299	721	172.5	2,874	1	103.8 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. *Research Proposals[1] Profile (Demographics) with Magnet Time*

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
77	4	58	15	16	54	0	7

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. *Research Proposals Profile (Discipline) with Magnet Time*

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
77	1	32	7	5	31	1

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. *Operations by Magnet System Group*

Usage Type	Total Days Used	% of Total Days Used	900MHz, 105mm bore, 21.1T	830MHz, 31 m bore, 19.6T	800MHz, 63mm bore, (MB) 18.8T #1	800MHz, 63mm bore, (MB) 18.8T #2	800MHz, 54mm bore (NB), 18.8T	600MHz, 89mm bore, 14T #1	600MHz, 89mm bore, 14T #2	600MHz, 89mm bore MAS DNP	600 MHz, 52 mm bore, 14T	500MHz, 89mm bore, 11.7T	Cell 14 36T 40mm SCH
NHMFL-Affiliated	**721**	**25.1 %**	11	104	25.5	166	115	212.5	18	6	0	41	22
Local	**299**	**10.4 %**	115	0	0	0	0	0	0	0	0	184	0
University, U.S.	**1,059.5**	**36.9 %**	93	139	180	51	10	107.5	249	114	3	83	30
University, non-U.S.	**513.5**	**17.9 %**	57	62	83	144	0	20	35	57.5	0	18	37
Government Lab, U.S.	**17**	**0.6 %**	0	0	0	0	0	0	17	0	0	0	0
Government Lab, non-U.S.	**12.5**	**0.4 %**	0	7	0	0	0	0	0	1.5	0	0	4
Industry, U.S.	**79**	**2.7 %**	79	0	0	0	0	0	0	0	0	0	0
Industry, non-U.S.	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0	0
Test/Calibration/	**55**	**1.9 %**	6	5	0	1	0	0	25	18	0	0	0

Usage Type	Total Days Used	% of Total Days Used	900MHz, 105mm bore, 21.1T	830MHz, 31 m bore, 19.6T	800MHz, 63mm bore, (MB) 18.8T #1	800MHz, 63mm bore, (MB) 18.8T #2	800MHz, 54mm bore (NB), 18.8T	600MHz, 89mm bore, 14T #1	600MHz, 89mm bore, 14T #2	600MHz, 89mm bore MAS DNP	600 MHz, 52 mm bore, 14T	500MHz, 89mm bore, 11.7T	Cell 14 36T 40mm SCH
Maintenance													
Method Development	**95.5**	**3.3 %**	0	5	63.5	0	0	7	0	20	0	0	0
Analytical Chemistry	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0	0
Upgrade Cell Design/ Hardware	**13**	**0.5 %**	0	0	0	0	0	0	0	13	0	0	0
Setup	**9**	**0.3 %**	0	0	4	0	0	0	0	5	0	0	0
Repair	**0**	**0 %**	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**2,874**		**361**	**322**	**356**	**362**	**125**	**347**	**344**	**235**	**3**	**326**	**93**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 8. *Operations by Discipline*

	Total Days Used[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
NHMFL-Affiliated	**721**	4	511.5	19	123.5	63	0
Local	**299**	0	208	91	0	0	0
University, U.S.	**1,059.5**	0	373	109	12	555.5	10
University, non-U.S.	**513.5**	0	357	0	23	133.5	0
Government Lab, U.S.	**17**	0	17	0	0	0	0
Government Lab, non-U.S.	**12.5**	0	12.5	0	0	0	0
Industry, U.S.	**79**	0	0	0	0	79	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/ Calibration/ Maintenance	**55**	0	5	0	50	0	0
Method Development	**95.5**	0	15	10	70.5	0	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/ Hardware	**13**	0	0	13	0	0	0
Setup	**9**	0	9	0	0	0	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**2,874**	**4**	**1,508**	**242**	**279**	**831**	**10**

[1] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**47**	6	9	38	**120**	25	28	92
Senior Personnel, non-U.S.	**20**	8	8	12	**53**	14	15	38
Postdocs, U.S.	**1**	1	1	0	**39**	13	15	24
Postdocs, non-U.S.	**1**	0	0	1	**13**	2	2	11
Students, U.S.	**0**	0	0	0	**95**	42	45	50
Students, non-U.S.	**0**	0	0	0	**26**	9	9	17
Technician, U.S.	**1**	0	0	1	**6**	1	1	5
Technician, non-U.S.	**0**	0	0	0	**2**	0	0	2
TOTAL	**70**	**15**	**18**	**52**	**354**	**106**	**115**	**239**

[1] PIs who received magnet time for the first time.

Table 10. *New[1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Art Edison	University of Georgia	P20002	Received 2022	No
Pierre Florian	French National Center for Scientific Research	P19959	Received 2022	Yes
Alexander Forse	University of Cambridge	P20101	Received 2022	Yes

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Terry Gullion	West Virginia University	P19889	Received 2022	Yes
Kristopher Harris	Louisiana Tech University	P19886	Received 2022	Yes
Marina Ilkaeva	University of Aveiro	P19665	Received 2022	Yes
Sami Jannin	Ecole Normale Superieure de Lyon	P19284	Received 2022	Yes
Yanna Liang	University at Albany	P20116	Received 2022	Yes
Xinhua Peng	University of Science and Technology of China	P19983	Received 2022	Yes
Braulio Rodríguez-Molina	National Autonomous University of Mexico	P20064	Received 2022	Yes
Luis Sánchez-Muñoz	Consejo Superior de Investigaciones Científicas	P19961	Received 2022	Yes
Carsten Sievers	Georgia Institute of Technology	P19774	Received 2022	No
Zachary Smith	Massachusetts Institute of Technology	P19973	Received 2022	Yes
Xiaoling Wang	California State University, East Bay	P20105	Received 2022	Yes
Aaron Wilber	Florida State University	P20099	Received 2022	Yes
Hui Xiong	Boise State University	P20087	Received 2022	Yes
Yuanzheng YUE	Aalborg University	P19967	Received 2022	Yes
Joseph Zadrozny	Colorado State University	P20082	Received 2022	No
Total	**18**			

[1] PIs who received magnet time for the first time.

PFF Facility

Table 1. *Users by Demographic*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**65**	5	56	4	54	8	0	3
Senior Personnel, non-U.S.	**13**	0	7	6	6	2	0	5
Postdocs, U.S.	**36**	0	29	7	25	8	0	3
Postdocs, non-U.S.	**6**	0	4	2	3	2	0	1
Students, U.S.	**39**	2	25	12	24	8	0	7
Students, non-U.S.	**4**	0	2	2	2	1	0	1
Technician, U.S.	**0**	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0
TOTAL	**163**	**7**	**123**	**33**	**114**	**29**	**0**	**20**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 2. *Users by Participation*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**65**	33	0	5	27
Senior Personnel, non-U.S.	**13**	2	0	4	7
Postdocs, U.S.	**36**	27	0	2	7
Postdocs, non-U.S.	**6**	2	0	1	3
Students, U.S.	**39**	17	0	4	18
Students, non-U.S.	**4**	3	0	0	1
Technician, U.S.	**0**	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0
TOTAL	**163**	**84**	**0**	**16**	**63**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 3. *Users by Organization*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**65**	42	5	18	28	37	0
Senior Personnel, non-U.S.	**13**	13	0	0	6	7	0
Postdocs, U.S.	**36**	20	12	4	22	14	0
Postdocs, non-U.S.	**6**	6	0	0	2	4	0
Students, U.S.	**39**	39	0	0	1	38	0
Students, non-U.S.	**4**	4	0	0	2	2	0
Technician, U.S.	**0**	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**163**	**124**	**17**	**22**	**61**	**102**	**0**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The TOTAL of university, industry, and national lab users will equal the TOTAL number of users.

Table 4. *Users by Discipline*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
Senior Personnel, U.S.	**65**	55	2	1	3	3	1
Senior Personnel, non-U.S.	**13**	12	0	0	0	0	1
Postdocs, U.S.	**36**	33	1	0	1	0	1
Postdocs, non-U.S.	**6**	5	0	0	1	0	0
Students, U.S.	**39**	31	2	3	3	0	0
Students, non-U.S.	**4**	3	0	0	0	0	1
Technician, U.S.	**0**	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0
TOTAL	**163**	**139**	**5**	**4**	**8**	**3**	**4**

[1] Users using multiple facilities are counted in each facility listed.

Table 5a. *Subscription Rate (Experiments)*

Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experi-ments With Usage	Experiments with Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experiments Subscription Percentage
83	15	75	76.5 %	23	23.5 %	98	1.3	130.7 %

Table 5b. *Subscription Rate (Magnet Days)*

Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance[1]	Total Days Used	Days Subscription Rate	Days Subscription Percentage
628	373	47	106	0	526	1.2	119.4 %

[1] Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 6a. *Research Proposals[1] Profile (Demographics) with Magnet Time*

TOTAL Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response
48	2	43	3	14	31	0	3

[1] A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
[2] The number of proposals satisfying the following condition: The PI is a minority.
[3] The number of proposals satisfying the following condition: The PI is a female.

Note: The table refers to proposal disciplines.

Table 6b. *Research Proposals Profile (Discipline) with Magnet Time*

TOTAL Proposals	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry, Biophysics	Material Science
48	39	2	0	4	2	1

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. *Operations by Magnet System Group*

	Total Days Used	Percentage of Total Days Used	Duplex	Mid Pulse	Short Pulse
NHMFL-Affiliated	**106**	**20.2 %**	28	30	48
Local	**47**	**8.9 %**	0	0	47
University, U.S.	**226**	**43 %**	10	0	216
University, non-U.S.	**30**	**5.7 %**	5	0	25
Government Lab, U.S.	**80**	**15.2 %**	10	10	60
Government Lab, non-U.S.	**37**	**7 %**	0	0	37
Industry, U.S.	**0**	**0 %**	0	0	0
Industry, non-U.S.	**0**	**0 %**	0	0	0
Test/Calibration/ Maintenance	**0**	**0 %**	0	0	0
Method Development	**0**	**0 %**	0	0	0
Analytical Chemistry	**0**	**0 %**	0	0	0

	Total Days Used	Percentage of Total Days Used	Duplex	Mid Pulse	Short Pulse
Upgrade Cell Design/ Hardware	**0**	**0 %**	0	0	0
Setup	**0**	**0 %**	0	0	0
Repair	**0**	**0 %**	0	0	0
TOTAL	**526**		**53**	**40**	**433**

Table 8. *Operations by Discipline*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Development of Magnet Technology	Biology, Biochemistry Biophysics	Material Science
NHMFL-Affiliated	**106**	106	0	0	0	0	0
Local	**47**	41	0	0	6	0	0
University, U.S.	**226**	181	27	0	18	0	0
University, non-U.S.	**30**	30	0	0	0	0	0
Government Lab, U.S.	**80**	70	0	0	5	0	5
Government Lab, non-U.S.	**37**	37	0	0	0	0	0
Industry, U.S.	**0**	0	0	0	0	0	0
Industry, non-U.S.	**0**	0	0	0	0	0	0
Test/ Calibration/ Maintenance	**0**	0	0	0	0	0	0
Method Development	**0**	0	0	0	0	0	0
Analytical Chemistry	**0**	0	0	0	0	0	0
Upgrade Cell Design/ Hardware	**0**	0	0	0	0	0	0
Setup	**0**	0	0	0	0	0	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**526**	**465**	**27**	**0**	**29**	**0**	**5**

Table 9. *New PIs[1] and New Users*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**33**	3	8	25	**65**	5	9	56
Senior Personnel, non-U.S.	**2**	2	2	0	**13**	5	5	8
Postdocs, U.S.	**5**	3	3	2	**36**	9	13	23
Postdocs, non-U.S.	**1**	0	0	1	**6**	3	3	3
Students, U.S.	**0**	0	0	0	**39**	12	13	26
Students, non-U.S.	**0**	0	0	0	**4**	4	4	0
Technician, U.S.	**0**	0	0	0	**0**	0	0	0
Technician, non-U.S.	**0**	0	0	0	**0**	0	0	0
TOTAL	**41**	**8**	**13**	**28**	**163**	**38**	**47**	**116**

[1] PIs who received magnet time for the first time.

Table 10. *New[1] User PIs*

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Collin Broholm	Johns Hopkins University	P19958	Received 2022	No
Richard Greene	University of Maryland, College Park	P19698	Received 2022	No
Gaia Grimaldi	National Research Council CNR	P19243	Received 2022	Yes
Rubi Km	Los Alamos National Laboratory	P19730	Received 2022	Yes
Minseong Lee	Los Alamos National Laboratory	P19848	Received 2022	Yes
Seng Huat Lee	Pennsylvania State University	P19710	Received 2022	No
Jeffrey Long	University of California, Berkeley	P19520	Received 2022	No
Alessandro Mazza	Los Alamos National Laboratory	P20055	Received 2022	Yes
Kimberly Modic	Institute of Science and Technology Austria	P19639	Received 2022	Yes
Michael Pettes	Los Alamos National Laboratory	P19839	Received 2022	Yes

Name	Organization	Proposal	Year of Magnet Time	Is New to MagLab
Kemp Plumb	Brown University	P19836	Received 2022	Yes
Krista Sawchuk	Los Alamos National Laboratory	P19912	Received 2022	Yes
Venkat Selvamanickam	University of Houston	P19815	Received 2022	No
Total	**13**			

[1] PIs who received magnet time for the first time.

3. User Facility Overview

Table 1a. *Users by Demographic of All Facilities*

	Users[1]	Minority[2]	Non-Minority[2]	No Response to Race[3]	Male	Female	Other	No Response to Gender[3]
Senior Personnel, U.S.	**713**	31	519	163	470	107	0	136
Senior Personnel, non-U.S.	**196**	11	92	93	98	27	0	71
Postdocs, U.S.	**235**	9	168	58	138	64	0	33
Postdocs, non-U.S.	**43**	2	24	17	16	16	0	11
Students, U.S.	**593**	46	363	184	302	157	1	133
Students, non-U.S.	**94**	7	45	42	48	25	0	21
Technician, U.S.	**75**	8	34	33	21	22	0	32
Technician, non-U.S.	**9**	0	3	6	2	2	0	5
TOTAL	**1,958**	**114**	**1,248**	**596**	**1,095**	**420**	**1**	**442**

[1] Users using multiple facilities are counted in each facility listed.
[2] NSF Minority status includes the following races: American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. The definition also includes Hispanic Ethnicity as a minority group. Minority status excludes Asian and White-Not of Hispanic Origin.
[3] Includes pending user account activations.

Table 1b. *Users by Demographic by Facilities*

	Users	Minority	Non-Minority	No Response to Race	Male	Female	Other	No Response to Gender
AMRIS – NSF-Funded	**104**	6	58	40	55	19	0	30
AMRIS – Non-NHMFL Funded	**276**	29	142	105	101	88	0	87
DC Field	**554**	28	412	114	389	95	1	69
EMR	**165**	11	125	29	112	33	0	20
High B/T	**16**	0	13	3	12	2	0	2
ICR	**326**	16	175	135	130	85	0	111
NMR	**354**	17	200	137	182	69	0	103
Pulsed Field	**163**	7	123	33	114	29	0	20
TOTAL	**1,958**	**114**	**1,248**	**596**	**1,095**	**420**	**1**	**442**

Table 2a. *Users by Participation of All Facilities*

	Users[1]	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**713**	337	11	73	292
Senior Personnel, non-U.S.	**196**	16	4	50	126
Postdocs, U.S.	**235**	162	1	16	56
Postdocs, non-U.S.	**43**	10	1	10	22
Students, U.S.	**593**	398	8	53	134
Students, non-U.S.	**94**	29	6	15	44
Technician, U.S.	**75**	57	1	1	16
Technician, non-U.S.	**9**	0	0	0	9
TOTAL	**1,958**	**1,009**	**32**	**218**	**699**

[1] Users using multiple facilities are counted in each facility listed.
[2] "Users Operating Remotely" refers to users who operate the magnet system from a remote location. Remote operations are not currently available in all facilities.
[3] "Users Sending Sample" refers to users who send the sample to the facility and/or research group and the experiment is conducted by other collaborators on the experiment. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
[4] "Off-Site Users" are scientific or technical participants on the experiment; who will not be present, sending sample, or operating the magnet system remotely; and who are not located on the campus of that facility (i.e., they are off-site).

Table 2b. *Users by Participation by Facilities*

	Users	Users Present	Users Operating Remotely	Users Sending Sample	Off-Site Collaborators
AMRIS – NSF-Funded	**104**	63	5	0	36
AMRIS – Non-NHMFL Funded	**276**	233	3	0	40
DC Field	**554**	318	0	67	169

	Users	Users Present	Users Operating Remotely	Users Sending Sample	Off-Site Collaborators
EMR	**165**	78	0	33	54
High B/T	**16**	7	0	0	9
ICR	**326**	85	0	34	207
NMR	**354**	141	24	68	121
Pulsed Field	**163**	84	0	16	63
TOTAL	**1,958**	**1,009**	**32**	**218**	**699**

Table 3a. *Users by Organization of All Facilities*

	Users[1]	External Users	Local Users[2]	NHMFL-Affiliated Users[2,3,4]	Laboratory[3,5]	University[4,5]	Industry[5]
Senior Personnel, U.S.	**713**	414	135	164	76	612	25
Senior Personnel, non-U.S.	**196**	196	0	0	41	148	7
Postdocs, U.S.	**235**	123	82	30	39	196	0
Postdocs, non-U.S.	**43**	43	0	0	13	30	0
Students, U.S.	**593**	354	179	60	6	583	4
Students, non-U.S.	**94**	94	0	0	9	85	0
Technician, U.S.	**75**	23	39	13	4	64	7
Technician, non-U.S.	**9**	9	0	0	1	7	1
TOTAL	**1,958**	**1,256**	**435**	**267**	**189**	**1,725**	**44**

[1] Users using multiple facilities are counted in each facility listed.
[2] NHMFL-Affiliated users are defined as anyone in the lab's personnel system (i.e., on our web site/directory), even if they travel to another site. Local users are defined as any non-NHMFL-Affiliated researchers originating at any of the institutions in proximity to the MagLab sites (i.e., researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
[3] Users with primary affiliations at NHMFL/LANL are reported in NHMFL-Affiliated Users and National Laboratory.
[4] Users with primary affiliations at FSU, UF, or FAMU are reported in NHMFL-Affiliated Users and National University.
[5] The total of university, industry, and national lab users will equal the total number of users.

Table 3b. *Users by Organization by Facilities*

	Users	External Users	Local Users	NHMFL-Affiliated Users	Laboratory	University	Industry
AMRIS – NSF-Funded	**104**	43	44	17	2	102	0
AMRIS – Non-NHMFL Funded	**276**	29	225	22	6	264	6
DC Field	**554**	444	31	79	43	500	11
EMR	**165**	112	21	32	6	159	0
High B/T	**16**	9	2	5	1	15	0
ICR	**326**	253	44	29	35	269	22
NMR	**354**	242	51	61	35	314	5
Pulsed Field	**163**	124	17	22	61	102	0
TOTAL	**1,958**	**1,256**	**435**	**267**	**189**	**1,725**	**44**

Table 4a. *Users by Discipline of All Facilities*

	Users[1]	Condensed Matter Physics	Chemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics	Material Science
Senior Personnel, U.S.	**713**	192	207	76	24	211	3
Senior Personnel, non-U.S.	**196**	57	95	10	7	25	2
Postdocs, U.S.	**235**	100	48	15	15	53	4
Postdocs, non-U.S.	**43**	14	21	0	2	6	0
Students, U.S.	**593**	197	178	65	19	132	2
Students, non-U.S.	**94**	32	41	2	1	17	1
Technician, U.S.	**75**	1	4	5	7	58	0
Technician, non-U.S.	**9**	0	2	2	0	5	0
TOTAL	**1,958**	**593**	**596**	**175**	**75**	**507**	**12**

[1] Users using multiple facilities are counted in each facility listed.

Table 4b. *Users by Discipline by Facilities*

	Users	Condensed Matter Physics	Chemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics	Material Science
AMRIS – NSF-Funded	**104**	2	35	19	0	48	0
AMRIS – Non-NHMFL Funded	**276**	0	31	26	2	216	1
DC Field	**554**	382	89	29	40	11	3
EMR	**165**	41	103	3	6	11	1
High B/T	**16**	16	0	0	0	0	0
ICR	**326**	0	157	60	0	109	0
NMR	**354**	13	176	34	19	109	3
Pulsed Field	**163**	139	5	4	8	3	4
TOTAL	**1,958**	**593**	**596**	**175**	**75**	**507**	**12**

Table 5a. *Subscription Rate (Experiments) by Facilities*

	Experiments Submitted (Current Year)	Experiments Submitted (Deferred from prev. year)	Experiments With Usage	Experiments With Usage Percentage	Experiments Declined	Experiments Declined Percentage	Experiments Reviewed	Experiment Subscription Rate	Experi-ments Sub-scription Percentage
AMRIS – NSF-Funded	15	17	31	96.9 %	1	3.1 %	32	1.0	103.2 %
AMRIS – Non-NHMFL Funded	45	80	121	96.8 %	4	3.2 %	125	1.0	103.3 %
DC Field	371	46	288	69.1 %	129	30.9 %	417	1.4	144.8 %
EMR	112	18	116	89.2 %	14	10.8 %	130	1.1	112.1 %
High B/T	1	4	5	100 %	0	0 %	5	1	100 %
ICR	129	5	104	77.6 %	30	22.4 %	134	1.3	128.8 %
NMR	581	19	550	91.7 %	50	8.3 %	600	1.1	109.1 %
Pulsed Field	83	15	75	76.5 %	23	23.5 %	98	1.3	130.7 %
TOTAL	**1,337**	**204**	**1,290**		**251**		**1,541**		

Table 5b. *Subscription Rate (Magnet Days) by Facilities*

	Days Submitted	Days Used by External User	Days Used by Local User	Days Used by NHMFL-Affiliated User	Days Used for Inst., Dev., Test and Maintenance	Total Days Used	Days Sub-scription Rate	Days Sub-scription Percentage
AMRIS – NSF-Funded	1,125	389.7	65.8	53.8	615.7	1,125	1	100%
AMRIS – Non-NHMFL Funded	1,413	576.4	398.3	375.8	62.6	1,413	1	100%
DC Field	2,948	1,414.6	19.2	353.9	95	1,882.7	1.6	156.6%
EMR	827	504	6	74.5	114.5	699	1.2	118.3%
High B/T	389	94	0	0	295	389	1	100%
ICR	1,550	288.6	44.5	29.9	15	378	4.1	410.1%
NMR	2,982	1,681.5	299	721	172.5	2,874	1	103.8%
Pulsed Field	628	373	47	106	0	526	1.2	119.4%
TOTAL	**11,862**	**5,321.8**	**879.8**	**1,714.9**	**1,370.3**	**9,286.7**		

Table 6. *Research Proposals[1] Profile with Magnet Time by Facilities*

	Total Pro-posals[1]	Minor-ity[2]	Non-Minor-ity	No Race Re-sponse	Female[3]	Male	Other	No Gender Re-sponse	CMP	Chemis-try	Engi-neering	Mag-nets, Materi-als	Biology, Bio-chem, Bio-phys.	Materi-al Science
AMRIS – NSF-Funded	31	4	24	3	7	22	0	2	0	6	3	4	18	0
AMRIS – Non-NHMFL Funded	105	8	66	31	30	49	0	26	0	0	0	2	103	0
DC Field	156	6	133	17	26	124	0	6	115	23	2	11	4	1
EMR	57	4	47	6	8	45	0	4	12	32	0	8	5	0
High B/T	5	0	4	1	1	4	0	0	5	0	0	0	0	0
ICR	76	2	66	8	15	57	0	4	0	47	9	0	20	0
NMR	77	4	58	15	16	54	0	7	1	32	7	5	31	1

	Total Proposals[1]	Minority[2]	Non-Minority	No Race Response	Female[3]	Male	Other	No Gender Response	CMP	Chemistry	Engineering	Magnets, Materials	Biology, Biochem, Biophys.	Material Science
Pulsed Field	48	2	43	3	14	31	0	3	39	2	0	4	2	1
TOTAL	**555**	**30**	**441**	**84**	**117**	**386**	**0**	**52**	**172**	**142**	**21**	**34**	**183**	**3**

1 A "proposal" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one proposal.
2 The number of proposals satisfying the following condition: The PI is a minority.
3 The number of proposals satisfying the following condition: The PI is a female.
Note: The table refers to proposal disciplines.

Find the list of user proposals in **Appendix V** and on our **website**

Table 7. *Operations by User Type by Facilities*

	Total Days Used	Days Used by External User[8]	Days Used by Local User[9]	Days Used by NHMFL-Affiliated User[10]	Days of Instrumentation Development and Maintenance[11]
AMRIS – NSF-Funded[1]	**1,125**	389.7	65.8	53.8	615.7
AMRIS – Non-NHMFL Funded[1]	**1,413**	576.4	398.3	375.8	62.6
DC Field[2]	**1,882.7**	1,414.6	19.2	353.9	95
EMR[3]	**699**	504	6	74.5	114.5
High B/T[4]	**389**	94	0	0	295
ICR[5]	**378**	288.6	44.5	29.9	15
NMR[6]	**2,874**	1,681.5	299	721	172.5
Pulsed Field[7]	**526**	373	47	106	0
TOTAL	**9,286.7**	**5,321.8**	**879.8**	**1,714.9**	**1,370.3**

[1] User Units are defined as magnet days; time utilized is recorded to the nearest 15 minutes. Magnet day definitions for AMRIS instruments: Verticals (500, 600s, & 750MHz), 1 magnet day = 24 hours. Horizontals (4.7 and 11.1T), 1 magnet day = 8 hours. This accounts for the difficulty in running animal or human studies overnight. Magnet days were calculated by adding the total number of real used for each instrument and dividing by 24 (vertical) or 8 (horizontal). Note: Due to the nature of the 4.7T and 11T studies, almost all studies with external users were collaborative with UF investigators.
[2] Each 20MW resistive magnet requires two power supplies to run, the 45T hybrid magnet requires three power supplies, and the 36T Series Connected Hybrid requires one power supply. Thus, there can be four resistive magnets + three superconducting magnets operating or the 45T hybrid, series connected hybrid, two resistive magnets and three superconducting magnets. User Units are defined as magnet days. Users of water-cooled resistive or hybrid magnets can typically expect to receive enough energy for 7 hours a day of magnet usage, so a magnet day is defined as 7 hours. Superconducting magnets are scheduled typically 24 hours a day.
[3, 4, 5, 6] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.
[7] User Units are defined as magnet days. Magnets are scheduled typically 12 hours a day.
[8] Days to external users at facility => all U.S. University, U.S. Govt. Lab., U.S. Industry, Non-U.S. excluding NHMFL Affiliated, Local, Test, Calibration, Set-up, Maintenance, Inst. Dev.
[9] Days to local => local only
[10] Days to NHMFL-Affiliated (in-house) research => NHMFL-Affiliated only
[11] Days to instrument development and maintenance (combined) => Test/Calibration/ Maintenance, Method Development, Analytical Chemistry, Upgrade Cell Design/Hardware Setup, Repair

Table 8. *Operations by Discipline of All Facilities*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Magnets, Materials	Biology, Biochemistry Biophysics	Material Science
NHMFL-Affiliated	**1,715**	402.8	593.1	19	208.6	491.5	0
Local	**879.8**	60.2	328.7	96.4	6	388.5	0
University, U.S.	**3,851.7**	1,198.9	987.2	265.7	51.1	1,304.8	44
University, non-U.S.	**886.3**	167.3	486.9	0	69.6	162.5	0
Government Lab, U.S.	**295**	239	21	0	12	18	5
Government Lab, non-U.S.	**77.6**	57	20.3	0.3	0	0	0
Industry, U.S.	**206.2**	0	108.8	0	8.9	88.5	0
Industry, non-U.S.	**5**	0	5	0	0	0	0
Test/Calibration/ Maintenance	**527.7**	74	12.5	0	158.5	282.7	0
Method Development	**332.4**	81	15	10	104.5	121.9	0
Analytical Chemistry	**9.5**	0	7.5	0	0	2	0

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Magnets, Materials	Biology, Biochemistry Biophysics	Material Science
Upgrade Cell Design/Hardware	**274.8**	170	0	13	0	91.8	0
Setup	**225.8**	65	9	0	0	151.8	0
Repair	**0**	0	0	0	0	0	0
TOTAL	**9,287**	**2,515**	**2,595**	**404**	**619**	**3,104**	**49**

Table 8b. *Operations by Discipline of All Facilities*

	Total Days Used	Condensed Matter Physics	Chemistry	Engineering	Magnets, Materials	Biology, Biochemistry, Biophysics	Material Science
AMRIS – NSF-Funded	**1,125**	0	87.2	127	0	910.8	0
AMRIS – Non-NHMFL Funded	**1,413**	0	97	1	43	1,272	0
DC Field	**1,882.7**	1,559.7	178.8	19	96.2	8	21
EMR	**699**	97.5	408.5	0	172	8	13
High B/T	**389**	389	0	0	0	0	0
ICR	**378**	0	288.4	15.4	0	74.2	0
NMR	**2,874**	4	1,508	242	279	831	10
Pulsed Field	**526**	465	27	0	29	0	5
TOTAL	**9,286.7**	**2,515.2**	**2,594.9**	**404.4**	**619.2**	**3,104**	**49**

Table 9a. *New PIs[1] and New Users of All Facilities*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
Senior Personnel, U.S.	**381**	62	78	303	**713**	93	113	381
Senior Personnel, non-U.S.	**75**	28	31	44	**196**	56	60	75
Postdocs, U.S.	**11**	7	7	4	**235**	65	76	11
Postdocs, non-U.S.	**7**	2	2	5	**43**	12	14	7
Students, U.S.	**1**	1	1	0	**593**	213	233	1
Students, non-U.S.	**0**	0	0	0	**94**	41	46	0
Technician, U.S.	**1**	0	0	1	**75**	9	13	1
Technician, non-U.S.	**0**	0	0	0	**9**	0	0	0
TOTAL	**476**	**100**	**119**	**357**	**1,958**	**489**	**555**	**476**

[1] PIs who received magnet time for the first time.

Table 9b. *New PIs and New Users by Facilities*

	All PIs	New PIs at the MagLab	New PIs at Facility	Returning PIs at Facility	All Users	New Users at the MagLab	New Users at Facility	Returning Users at Facility
AMRIS – NSF-Funded	**33**	4	8	25	**104**	26	30	74
AMRIS – Non-NHMFL Funded	**80**	15	15	65	**276**	27	30	246
DC Field	**131**	21	24	107	**554**	137	169	385
EMR	**54**	15	19	35	**165**	46	55	110
High B/T	**5**	2	2	3	**16**	2	2	14
ICR	**62**	20	20	42	**326**	107	107	219
NMR	**70**	15	18	52	**354**	106	115	239
Pulsed Field	**41**	8	13	28	**163**	38	47	116
TOTAL	**476**	**100**	**119**	**357**	**1,958**	**489**	**555**	**1,403**

Table 10a. *Funding Source of Users' Research-Day Allotted (Counts) by Facilities*

	Total Days Used	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	Interna-tional	National	In-dustry[3]	Other
AMRIS – NSF-Funded	**1,125**	1,031.3	58.5	0	0	0	0	0	0	0	35.2	0	0

	Total Days Used	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	International	National	Industry[3]	Other
AMRIS – Non-NHMFL Funded	**1,413**	87.6	867.6	0	35.4	0	0	19.9	0	2.2	323.1	38.9	38.3
DC Field	**1,882.7**	1,018.8	18	442.8	31.9	3	0	0	0	147.9	190.8	29.4	0
EMR	**699**	383.8	19	149.3	14	0	0	0	0	78.5	48.3	6.0	0
High B/T	**389**	250	0	127	0	0	0	0	0	0	0	12	0
ICR	**378**	193.3	67.4	5.1	13.4	0	0	0	0	49.6	39.9	7.3	1.9
NMR	**2,874**	1,003.7	624.5	132	2	0	0	0	0	466	461.8	184	0
Pulsed Field	**526**	170	0	264.0	5	0	0	0	0	35	52	0	0
TOTAL	**9,286.7**	**4,139**	**1,655**	**1,120.2**	**101.7**	**3**	**0**	**19.9**	**0**	**779.2**	**1,151.1**	**277.6**	**40.2**

[1] Includes NSF, UCGP, and 'No other support'.
[2] Includes NASA, US Army, US Navy, and US Air force.
[3] Includes US Industry and Non-US Industry.

Table 10b. *Funding Source of Users' Research-Day Allotted (Percentage) by Facilities*

	NSF[1]	NIH	DOE	DOD[2]	VSP	FFI	UF MBI	EPA	International	National	Industry[3]	Other
AMRIS – NSF-Funded	91.7 %	5.2 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	3.1 %	0 %	0 %
AMRIS – Non-NHMFL Funded	6.2 %	61.4 %	0 %	1.5 %	0 %	0 %	1.4 %	0 %	0.2 %	22.9 %	2.8 %	2.7 %
DC Field	54.1 %	1 %	23.5 %	1.7 %	0.2 %	0 %	0 %	0 %	7.9 %	10.1 %	1.6 %	0 %
EMR	54.9 %	2.7 %	21.4 %	2 %	0 %	0 %	0 %	0 %	11.2 %	6.9 %	0.9 %	0 %
High B/T	64.3 %	0 %	32.6 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	3.1 %	0 %
ICR	51.1 %	17.8 %	1.3 %	0.2 %	0 %	0 %	0 %	0 %	13.1 %	10.6 %	1.9 %	0.5 %
NMR	34.9 %	21.7 %	4.6 %	0 %	0 %	0 %	0 %	0 %	16.2 %	16.1 %	6.4 %	0 %
Pulsed Field	32.3 %	0 %	50.2 %	1 %	0 %	0 %	0 %	0 %	6.7 %	9.9 %	0 %	0 %

4. Users' Geographic Distribution

AMRIS Facility – NSF-Funded National Users (102)

First Name	Last Name	Organization	State	Country
Diba	Allameh Zadeh	University of Florida	FL	USA
Tyler	Alsup	University of Florida	FL	USA
Reza	Amani	Texas Tech University	TX	USA
Anastasios	Angelopoulos	University of Cincinnati	OH	USA
Luke	Arbogast	National Institute of Standards and Technology	MD	USA
Alaji	Bah	Suny Upstate Medical University	NY	USA
Bill	Baker	University of South Florida	FL	USA
Sarah	Barber	University of Cincinnati	OH	USA
Elisabeth	Barton	University of Florida	FL	USA
Abhinandan	Batra	University of Florida	FL	USA
Juan	Beltran-Huarac	East Carolina University (ECU)	NC	USA
Karin	Bichler	Louisiana State University	LA	USA
Omar	Boloki	University of Florida	FL	USA
Clifford (Russ)	Bowers	University of Florida	FL	USA
Joe	Bracegirdle	University of South Florida	FL	USA
A. Caroline	Buchanan	University of Florida	FL	USA
Leah	Casabianca	Clemson University	SC	USA
Coray	Colina	University of Florida	FL	USA
John	Cooper	East Carolina University	NC	USA
Ike	de la Pena	Loma Linda University	CA	USA
Leonardo	Dettori	SUNY Upstate Medical University	NY	USA
Matthew	Eddy	University of Florida	FL	USA
Michelle	Ehrenberger	University of Florida	FL	USA
Alec	Esper	University of Florida	FL	USA
Junchuan	Fang	University of Cincinnati	OH	USA
Homeira	Faridnejad	East Carolina University	NC	USA
Marcelo	Febo	University of Florida	FL	USA
Johnny	Figueroa	Loma Linda University	CA	USA
Sean	Forbes	University of Florida	FL	USA
Timothy	Garrett	University of Florida	FL	USA
Niloofar	Gopal Pour	University of Florida	FL	USA
Hala	Hachem	University of Florida	FL	USA
Michael	Harris	University of Florida	FL	USA
Cora	Hart	University of Florida	FL	USA
Daniel	Icenhour	University of Florida	FL	USA
Bruno	Jakobi	Louisiana State University	LA	USA
Kelly	Jenkins	University of Florida	FL	USA
Beining (Kim)	Jin	University of Florida	FL	USA
Vishwas	Jindal	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Jonathan	Judy	University of Florida	FL	USA
Sushain	Kaul	University of Florida	FL	USA
Jessica	Kelz	University of California, Irvine	CA	USA
Ram	Khattri	University of Florida	FL	USA
Jimmy	Lawrence	Louisiana State University	LA	USA
Jiajun	Lei	University of Florida	FL	USA
Zining	Li	University of Florida	FL	USA
Ryan	Lively	Georgia Institute of Technology	GA	USA
Sandra	Loesgen	University of Florida	FL	USA
Joanna	Long	University of Florida	FL	USA
Rohit	Mahar	University of Florida	FL	USA
Thomas	Mareci	University of Florida	FL	USA
John	Marino	National Institute of Standards and Technology	MD	USA
Rachel	Martin	University of California, Irvine	CA	USA
Caitlin	McCadden	University of Florida	FL	USA
Anil	Mehta	University of Florida	FL	USA
Matthew	Merritt	University of Florida	FL	USA
Zhihui	Miao	University of Florida	FL	USA
Mina	Mozafari	University of California, Irvine	CA	USA
Emma	Mulry	University of Florida	FL	USA
Jonathan	Nickels	University of Cincinnati	OH	USA
Wenbo	Ning	University of Florida	FL	USA
Brenda Patricia	Noarbe	University of California, Irvine	CA	USA
Andre	Obenaus	University of California, Irvine	CA	USA
Nduka	Ogbonna	Louisiana State University	LA	USA
Perla	Ontiveros-Ángel	Loma Linda University	CA	USA
Enzo	Petracco	University of Florida	FL	USA
Marjory	Pompilus	University of Florida	PR	USA
Arka Prabha	Ray	University of Florida	FL	USA
Lewis	Reynolds	North Carolina State University	NC	USA
James	Rocca	University of Florida	FL	USA
Megan	Rocha	University of California, Irvine	CA	USA
Jens	Rosenberg	University of Florida	FL	USA
Pratik	Roy	University of Florida	FL	USA
Jeffrey	Rudolf	University of Florida	FL	USA
Gerald	Schneider	Louisiana State University	LA	USA
Yu-Hsuan	Shen	University of Florida	FL	USA
Timothy	Simon	Loma Linda University	CA	USA
Joshua	Slade	University of Florida	FL	USA
Zachary	Smith	Massachusetts Institute of Technology	MA	USA
Marina	Sokolsky	University of North Carolina at Chapel Hill	NC	USA
Brent	Sumerlin	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Lee	Sweeney	University of Florida	FL	USA
Daniel R.	Talham	University of Florida	FL	USA
Naveen	Thakur	University of Florida	FL	USA
Blake	Trusty	University of Florida	FL	USA
Shahabeddin	Vahdat	University of Florida	FL	USA
David	Vaillancourt	University of Florida	FL	USA
Lilit	Vardanyan	University of Florida	FL	USA
Sergey	Vasenkov	University of Florida	FL	USA
Julio	Vega-Torres	Loma Linda University	CA	USA
Adam	Veige	University of Florida	FL	USA
Glenn	Walter	University of Florida	FL	USA
Xiuting	Wei	University of Florida	FL	USA
Thomas	Weldeghiorghis	Louisiana State University	LA	USA
Daniel	Wesson	University of Florida	FL	USA
Benjamin	Wylie	Texas Tech University	TX	USA
Baofu	Xu	University of Florida	FL	USA
Libin	Ye	University of South Florida	FL	USA
Maryam	Yekefallah	Texas Tech University	TX	USA
Young Hee	Yoon	Georgia Institute of Technology	GA	USA
Richard	Yost	University of Florida	FL	USA
Huadong	Zeng	University of Florida	FL	USA

AMRIS Facility – NSF-Funded International Users (2)

First Name	Last Name	Organization	Country
Pascal	Bernatchez	University of British Columbia	Canada
Guillaume	Ferre'	Université Toulouse III - Paul Sabatier	France

AMRIS Facility – Non-NHMFL-Funded National Users (274)

First Name	Last Name	Organization	State	Country
Jose	Abisambra	University of Florida	FL	USA
Qutell	Adderley	Fisk University	TN	USA
Laura	Ahumada Hernandez	University of Florida	FL	USA
Meryl	Alappattu	University of Florida	FL	USA
Fatma	Al-Awadhi	University of Florida	FL	USA
Alejandro	Albizu	University of Florida	FL	USA
Seif	Aldalil	University of Florida	FL	USA
Kyle	Allen	University of Florida	FL	USA
Kara	Anazia	University of Florida	FL	USA
Melissa	Armstrong	University of Florida	FL	USA
Tetsuo	Ashizawa	University of Florida	FL	USA
Ahmed	Awad	University of Florida	FL	USA
Pratiksha	Awale	University of Florida	FL	USA
Jared	Baisden	Wertheim Scripps Inst (UF)	FL	USA

First Name	Last Name	Organization	State	Country
Fatemeh	Baniasad	University of Florida	FL	USA
Alison	Barnard	University of Florida	FL	USA
Adam	Barnas	University of Florida	FL	USA
Ana	Barran-Berdon	University of Florida	FL	USA
Abhinandan	Batra	University of Florida	FL	USA
Steven	Benner	Foundation for Applied Molecular Evolution	FL	USA
Mieniecia (Nieci)	Black	Laboratory for Rehabilitation Neuroscience	FL	USA
Shelby	Blaes	University of Florida	FL	USA
Jeff	Boissoneault	University of Florida	FL	USA
Mackenzie	Bolen	University of Florida	FL	USA
Zachary	Boogaart	University of Florida	FL	USA
Dawn	Bowers	University of Florida	FL	USA
Maeve	Boylan	University of Florida	FL	USA
Jeannine	Brady	University of Florida	FL	USA
Isadora	Braga	University of Florida	FL	USA
Alexis	Bragg	University of Florida	FL	USA
Audrius	Brazdeikis	Cryosensors LLC	TX	USA
William	Brey	National High Magnetic Field Laboratory	FL	USA
Ariana	Brice-Tutt	University of Florida	FL	USA
Fernando	Bril	University of Florida	FL	USA
Albert	Brotgandel	University of Florida	FL	USA
Madison	Bryan	University of Florida	FL	USA
Michael	Bubb	University of Florida	FL	USA
Roxana	Burciu	University of Florida	FL	USA
Rebecca	Butcher	University of Florida	FL	USA
Barry	Byrne	University of Florida	FL	USA
Maria Luiza	Caldas Nogueira	University of Florida	FL	USA
Martha	Campbell-Thompson	University of Florida	FL	USA
Josue	Cardoso	University of Florida	FL	USA
Paramita	Chakrabarty	University of Florida	FL	USA
Mario	Chang Reyes	University of Florida	FL	USA
Munish	Chauhan	Arizona State University	AZ	USA
Qiyin	Chen	University of Florida	FL	USA
Manyun	Chen	University of Florida	FL	USA
Zixin	Chen	University of Florida	FL	USA
Miriam	Cintron	University of Florida	FL	USA
Ginger	Clark	University of Florida	FL	USA
David	Clark	Malcom Randall VA Medical Center	FL	USA
Asia	Cobb	University of Florida	FL	USA
Ron	Cohen	University of Florida	FL	USA
Aaron	Colverson	University of Florida	FL	USA
Diego	Compte	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Stephen	Coombes	University of Florida	FL	USA
Taylor	Corcoran	University of Florida	FL	USA
Manuela	Corti	University of Florida	FL	USA
Tina	Cousins	University of Florida	FL	USA
Yenisel	Cruz-Almeida	University of Florida	FL	USA
Lina	Cui	University of Florida	FL	USA
Kenneth	Cusi	University of Florida	FL	USA
Daniel	DeYoung	University of Florida	FL	USA
Mingzhou	Ding	University of Florida	FL	USA
Yousong	Ding	University of Florida	FL	USA
Purushottam	Dixit	University of Florida	FL	USA
Natalie	Ebner	University of Florida	FL	USA
Matthew	Eddy	University of Florida	FL	USA
Ahmed	Elbanna	University of Florida	FL	USA
Nicole	Evangelista	University of Florida	FL	USA
Darin	Falk	Lacerta Therapeutics	FL	USA
Allie	Farone	University of Florida	FL	USA
Marcelo	Febo	University of Florida	FL	USA
Daniel	Ferris	University of Florida	FL	USA
Tyler	Fettrow	University of Florida	FL	USA
Matthew	Fillingim	University of Florida	FL	USA
Roger	Fillingim	University of Florida	FL	USA
Roberto	Firpi-Morell	University of Florida	FL	USA
Sara	Fleehart	U.S. Department of Veterans Affairs	FL	USA
Megan	Forbes	University of Florida	FL	USA
Sean	Forbes	University of Florida	FL	USA
Qiwen	Gao	University of Florida	FL	USA
Bailey	Garner	University of Florida	FL	USA
Joshua	Gertler	University of Florida	FL	USA
Anthony	Giacalone	University of Florida	Fl	USA
Drew	Gillett	University of Florida	FL	USA
Benjamin	Griffith	University of Florida	FL	USA
Jacob	Griffith	University of Florida	FL	USA
Anthony	Gruber	University of Florida	FL	USA
Cristian	Guerrero	University of Florida	FL	USA
Kimberly	Guice	University of Florida	FL	USA
Michael	Haller	University of Florida	FL	USA
Matthew	Hamm	Lacerta Therapeutics	FL	USA
Brian	Ho	University of Florida	FL	USA
Josh	Holbrook	University of Florida	FL	USA
Robert	Huigens	University of Florida	FL	USA
Kathleen	Hupfeld	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Bryant	Hutchins	University of Florida	FL	USA
Noelle	Jacobsen	University of Florida	FL	USA
Victoria	Jensen	Lacerta Therapeutics	FL	USA
Keyanni	Johnson	University of Florida	FL	USA
Amandine	Jullienne	University of California, Irvine	CA	USA
Mary	Kasper	University of Florida	FL	USA
Mallesh	Kathe	University of Florida	FL	USA
Sushain	Kaul	University of Florida	FL	USA
Ellen	Keeley	University of Florida	FL	USA
Andreas	Keil	University of Florida	FL	USA
Ram	Khattri	University of Florida	FL	USA
Chalermchai	Khemtong	University of Florida	FL	USA
Habibeh	Khoshbouei	University of Florida	FL	USA
Gee	Kim	University of Florida	FL	USA
Sofia	Kokkaliari	University of Florida	FL	USA
Jessica	Kraft	University of Florida	FL	USA
Lee	Kugelmann	University of Florida	FL	USA
Jeffrey	Kunath	University of Florida	FL	USA
Chavier	Laffitte	University of Florida	FL	USA
Song	Lai	University of Florida	FL	USA
Renuk	Lakshmanan	University of Florida	FL	USA
Damon	Lamb	University of Florida	FL	USA
Jada	Lewis	University of Florida	FL	USA
Chenglong	Li	University of Florida	FL	USA
Hong	Li	Florida State University	FL	USA
Yuqing	Li	University of Florida	FL	USA
DAKE	LIU	University of Florida	FL	USA
Chang	Liu	University of Florida	FL	USA
Joanna	Long	University of Florida	FL	USA
Christopher	Lopez	University of Florida	FL	USA
Donovan	Lott	University of Florida	FL	USA
Hendrik	Luesch	University of Florida	FL	USA
Paige	Lysne	University of Florida	FL	USA
Jessica	Magenheim	University of Florida	FL	USA
Rohit	Mahar	University of Florida	FL	USA
Wendi	Malphurs	University of Florida	FL	USA
Todd	Manini	University of Florida	FL	USA
Eleana	Manousiouthakis	University of Florida	FL	USA
Nesmine	Maptue	University of Florida	FL	USA
Thomas	Mareci	University of Florida	FL	USA
Kelsey	Marr	University of Florida	FL	USA
Carol	Mathews	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Johanna	McCracken	University of Florida	FL	USA
Christopher	McCurdy	University of Florida	FL	USA
Nikolaus	McFarland	University of Florida	FL	USA
Robert	McKenna	University of Florida	FL	USA
Marc	McLeod	University of Florida, College of Medicine	FL	USA
Ryan P	Mears	University of Florida	FL	USA
Borna	Mehrad	University of Florida	FL	USA
Anil	Mehta	University of Florida	Fl	USA
David	Mendez	University of Florida	FL	USA
Matthew	Merritt	University of Florida	FL	USA
Aaron	Mickle	University of Florida	FL	USA
Jennifer	Miller	University of Florida	FL	USA
Ann	Mislovic	University of Florida	FL	USA
Andrea	Mitchell	University of Florida	FL	USA
Amit	Mondal	University of Florida	FL	USA
Soamy	Montesino Goicolea	University of Florida	FL	USA
Sushobhan	Mukhopadhyay	University of Florida	FL	USA
Isabella	Nelson	University of Florida	FL	USA
John	Neubert	University of Florida	FL	USA
Binh	Nguyen	University of Florida	FL	USA
Sara	Nixon	University of Florida	FL	USA
Brenda Patricia	Noarbe	University of California, Irvine	CA	USA
Samantha	Norman	University of Florida	FL	USA
Andre	Obenaus	University of California, Irvine	CA	USA
Brian	Odegaard	University of Florida	FL	USA
Walter	O'Dell	University of Florida	FL	USA
Edward	Ofori	University of Florida	FL	USA
Michael	Okun	University of Florida	FL	USA
Naphlim	Olwe	University of Florida	FL	USA
Alexandria	O'Neal	University of Florida	FL	USA
Andrew	O'Shea	University of Florida	FL	USA
Rojina	Pad	University of California, Irvine	CA	USA
Christian	Panitz	University of Florida	FL	USA
Qingqing (Emily)	Peng	University of Florida	FL	USA
Carl	Pepine	University of Florida	FL	USA
Leronne	Perera	University of Florida	FL	USA
Eliany	Perez	University of Florida	FL	USA
Vanisa	Petriti	University of Florida	FL	USA
Isabella	Pinto	University of Florida	FL	USA
Marjory	Pompilus	University of Florida	PR	USA
Eric	Porges	University of Florida	FL	USA
Danielle	Poulton	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Cathy	Powers	University of Florida	FL	USA
Federico	Pozzi	University of Florida	FL	USA
Catherine	Price	University of Florida	FL	USA
Shane	Priester	University of Florida	FL	USA
Joseph	Pruitt	University of Florida	FL	USA
Zachary	Rabinowitz	University of Florida	FL	USA
Mukundan	Ragavan	St. Jude Children's Research Hospital	TN	USA
Rayn	Ramclam	University of Florida	FL	USA
Ranjala	Ratnayake	University of Florida	FL	USA
Sakthivel	Ravi	University of Florida	FL	USA
Alyssa	Ray	University of Florida, Cognitive Neuroscience Lab	FL	USA
Matthew	Reyna	University of Florida	FL	USA
Sutton	Richmond	University of Florida	FL	USA
Samuel	Riehl	University of Florida	FL	USA
Kyle	Rizer	University of Florida	FL	USA
Michael	Robinson	University of Florida	FL	USA
James	Rocca	University of Florida	FL	USA
Kelly	Rock	University of Florida	FL	USA
Alex	Rodriguez	University of Florida	FL	USA
Jens	Rosenberg	University of Florida	FL	USA
Garret	Rubin	University of Florida	FL	USA
Anna	Rushin	University of Florida	FL	USA
Terence	Ryan	University of Florida	FL	USA
Rosalind	Sadleir	Arizona State University	AZ	USA
Stephanie	Salabarria	University of Florida	FL	USA
Addison	Sans	University of Florida	FL	USA
Michael	Schär	Johns Hopkins University	MD	USA
Christine	Schmidt	University of Florida	FL	USA
Daniel	Schultz	University of Florida	FL	USA
Lisa	Scott	University of Florida	FL	USA
Julie	Segura	University of Florida	FL	USA
Rachael	Seidler	University of Florida	FL	USA
Medina	Serdarevic	University of Florida	FL	USA
Valay	Shah	University of Florida	FL	USA
Bryanna	Sharot	University of Florida	FL	USA
Ashutosh	Shukla	University of Florida	FL	USA
Kimberly	Sibille	University of Florida	FL	USA
Amanda	Slater	University of Florida	FL	USA
Glenn	Smith	University of Florida	FL	USA
Jessie	Somerville	University of Florida	FL	USA
Bethany	Stennett	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Amanda	Studnicki	University of Florida	FL	USA
Sub	Subramony	University of Florida	FL	USA
Maurice	Swanson	University of Florida	FL	USA
Clayton	Swanson	University of Florida	FL	USA
Lee	Sweeney	University of Florida	FL	USA
Tanja	Taivassalo	University of Florida	FL	USA
Ellen	Terry	University of Florida	FL	USA
Naveen	Thakur	University of Florida	FL	USA
Jeremy	Thomas	University of Florida	FL	USA
Grace	Thompson	University of Florida	FL	USA
Natasha	Tracy	University of Florida	FL	USA
Yvette	Trahan	University of Florida	FL	USA
Tram-Ahn	Tran	University of Florida	FL	USA
Nhi	Tran	Intellia Therapeutics, Inc	MA	USA
Blake	Trusty	University of Florida	FL	USA
Monica	Tschosik	University of Florida	FL	USA
David	Turbeville	University of Florida	FL	USA
Shahabeddin	Vahdat	University of Florida	FL	USA
David	Vaillancourt	University of Florida	FL	USA
Pedro Antonio	Valdes Hernandez	University of Florida	FL	USA
Krista	Vandenborne	University of Florida	FL	USA
Sergey	Vasenkov	University of Florida	FL	USA
Elizabeth	Vo	Malcom Randall VA Medical Center	FL	USA
Christopher	Vulpe	University of Florida	FL	USA
Aparna	Wagle Shukla	University of Florida	FL	USA
Glenn	Walter	University of Florida	FL	USA
Bang	Wang	University of Florida	FL	USA
Kevin (Ka)	Wang	University of Florida	FL	USA
Zheng	Wang	University of Florida	FL	USA
Jingying	Wang	University of Florida	FL	USA
Zhishen	Wang	University of Florida	FL	USA
Richard	Ward	University of Florida	FL	USA
Eric	Weber	University of Florida	FL	USA
Steven	Weisberg	University of Florida	FL	USA
Kara	Wendel	University of California, Irvine	CA	USA
Bradley	Wilkes	University of Florida	FL	USA
Rebecca	Willcocks	University of Florida	FL	USA
John	Williamson	University of Florida	FL	USA
Marcelo	Wood	University of California, Irvine	CA	USA
Adam	Woods	University of Florida	FL	USA
Jaroslaw	Wosik	University of Houston	TX	USA
Zhihui	Yang	University of Florida	FL	USA

First Name	Last Name	Organization	State	Country
Qiang	Yang	University of Florida	FL	USA
ChiSu	Yoon	University of Florida	FL	USA
Zareen	Zaidi	University of Florida	FL	USA
Huadong	Zeng	University of Florida	FL	USA
Chen	Zhou	University of Florida	FL	USA
Jie	Zhou	University of Florida	FL	USA
Tian	Zhu	University of Florida	FL	USA
Carla	Zingariello	University of Florida	FL	USA
Abigail	Zulich	University of Florida	FL	USA

AMRIS Facility – Non-NHMFL-Funded International Users (2)

First Name	Last Name	Organization	Country
Guillaume	Ferre'	Université Toulouse III - Paul Sabatier	France
Gwladys	Riviere	Max Planck Institute for Biophysical Chemistry, Goettingen	Germany

DC Field Facility – National Users (447)

First Name	Last Name	Organization	State	Country
Christer	Aakeroy	Kansas State University	KS	USA
Dmytro	Abraimov	National High Magnetic Field Laboratory	FL	USA
Gokul	Acharya	University of Arkansas	AR	USA
Charles	Agosta	Clark University	MA	USA
Kaveh	Ahadi	North Carolina State University	NC	USA
Arash	Akbari-Sharbaf	Villanova University	PA	USA
Kevin	Allen	Rice University	TX	USA
Kevin	Allen	Norfolk State University	VA	USA
Athby	Al-Tawhid	North Carolina State University	NC	USA
Adam	Altenhof	Florida State University	FL	USA
John	Anderson	University of Chicago	IL	USA
Petru	Andrei	Florida State University	FL	USA
Badih	Assaf	University of Notre Dame	IN	USA
Seul-Ki	Bac	University of Notre Dame	IN	USA
Rabindranath	Bag	Duke University	NC	USA
Paul	Baity	National High Magnetic Field Laboratory	FL	USA
Terence	Baker	Norfolk State University	VA	USA
Shreyas	Balachandran	Florida State University	FL	USA
Kirk	Baldwin	Princeton University	NJ	USA
Luis	Balicas	National High Magnetic Field Laboratory	FL	USA
Abhishek	Banerjee	Harvard University	MA	USA
Alimamy	Bangura	National High Magnetic Field Laboratory	FL	USA
Paola	Barbara	Georgetown University	DC	USA
Christopher	Barns	West Chester University	PA	USA
Arup	Barua	University of South Florida	FL	USA
Rabindra	Basnet	University of Arkansas	AR	USA
Ryan	Baumbach	National High Magnetic Field Laboratory	FL	USA
Christianne	Beekman	National High Magnetic Field Laboratory	FL	USA
Elliot	Bell	University of Minnesota, Twin Cities	MN	USA
Avishai	Benyamini	Columbia University	NY	USA
Shannon	Bernier	Johns Hopkins University	MD	USA
John	Berry	University of Wisconsin, Madison	WI	USA
Hari	Bhandari	George Mason University	VA	USA
Anand	Bhattacharya	Argonne National Laboratory	IL	USA
Joanna	Blawat	University of South Carolina	LA	USA
Alexandria	Bone	University of Tennessee, Knoxville	TN	USA
Ivan	Bozovic	Brookhaven National Laboratory	NY	USA
Alexander	Brassington	University of Tennessee, Knoxville	TN	USA
Moises	Bravo	Baylor University	TX	USA
Alexander	Breindel	University of California, San Diego	CA	USA
William	Brey	National High Magnetic Field Laboratory	FL	USA

First Name	Last Name	Organization	State	Country
Christopher	Broyles	Washington University in St. Louis	MO	USA
Troy	Brumm	National High Magnetic Field Laboratory	FL	USA
Nicholas	Butch	National Institute of Standards and Technology	MD	USA
Casey	Calhoun	Princeton University	NJ	USA
Fernando	Camino	Brookhaven National Laboratory	NY	USA
Ian	Campbell	Florida State University	FL	USA
Gang	Cao	University of Colorado, Boulder	CO	USA
Brian	Casas	National High Magnetic Field Laboratory	FL	USA
Jak	Chakhalian	Rutgers University	NJ	USA
Aaron	Chan	University of Michigan	MI	USA
Julia	Chan	Baylor University	TX	USA
Cui-Zu	Chang	Pennsylvania State University	PA	USA
Ramakanta	Chapai	Argonne National Laboratory	IL	USA
Joseph	Checkelsky	Massachusetts Institute of Technology	MA	USA
Alan	Chen	Massachusetts Institute of Technology	MA	USA
Kuan-Wen	Chen	University of Michigan	MI	USA
Liyang	Chen	Rice University	TX	USA
Lu	Chen	University of Michigan	MI	USA
Shaowen	Chen	Columbia University	NY	USA
Shuzhang	Chen	Brookhaven National Laboratory	NY	USA
Xiaotong	Chen	Rensselaer Polytechnic Institute	NY	USA
JL	Cheng	Commonwealth Fusion Systems	MA	USA
Shalinee	Chikara	National High Magnetic Field Laboratory	FL	USA
Eun Sang	Choi	National High Magnetic Field Laboratory	FL	USA
Su Kong	Chong	University of California, Los Angeles	CA	USA
Jiun-Haw	Chu	University of Washington	WA	USA
Judith	Clark	Florida State University	FL	USA
Orrin	Clarke Delgado	Norfolk State University	VA	USA
Xin	Cong	University of Florida	FL	USA
Anca	Constantinescu	National High Magnetic Field Laboratory	FL	USA
Matthew	Cothrine	University of Tennessee, Knoxville	TN	USA
Tim	Cross	National High Magnetic Field Laboratory	FL	USA
Pengcheng	Dai	University of Tennessee, Knoxville	TN	USA
Bijay	DC	Florida State University	FL	USA
Cory	Dean	City College of New York	NY	USA
Maximilien	Debbas	Massachusetts Institute of Technology	MA	USA
Fabien	Deligey	Louisiana State University	LA	USA
Vikram	Deshpande	University of Utah	UT	USA
Jonathan	DeStefano	University of Washington	WA	USA
Aravind	Devarakonda	Columbia University	NY	USA
Chetan	Dhital	Kennesaw State University	GA	USA

First Name	Last Name	Organization	State	Country
Rui	Diaz-Pacheco	Commonwealth Fusion Systems	MA	USA
Malitha	Dickwella Widanage	Louisiana State University	LA	USA
Scott	Dietrich	Villanova University	PA	USA
Charuni	Dissanayake	University of Central Florida	FL	USA
Sachith	Dissanayake	Duke University	NC	USA
Alexis	Dominguez	Baylor University	TX	USA
Rick	Dorn	Iowa State University	IA	USA
Qianheng	Du	Argonne National Laboratory	IL	USA
Thierry	Dubroca	National High Magnetic Field Laboratory	FL	USA
James	Ehrets	Harvard University	MA	USA
Zachery	Enderson	Georgia Institute of Technology	GA	USA
Lloyd	Engel	National High Magnetic Field Laboratory	FL	USA
Matthew	Ennis	Duke University	NC	USA
Yun Suk	Eo	University of Michigan	MI	USA
Adiat	Fakolujo	University of Tennessee, Knoxville	TN	USA
Keke	Feng	Florida State University	FL	USA
Adam	Fiedler	Marquette University	WI	USA
Ian	Fisher	Stanford University	CA	USA
Nathanael	Fortune	Smith College	MA	USA
Ashleigh	Francis	National High Magnetic Field Laboratory	FL	USA
Corey	Frank	National Institute of Standards and Technology	MD	USA
Matthew	Freeman	National High Magnetic Field Laboratory	FL	USA
Hailong	Fu	Pennsylvania State University	PA	USA
Riqiang	Fu	National High Magnetic Field Laboratory	FL	USA
XIaojun	Fu	University of Minnesota, Twin Cities	MI	USA
Gabriel	Gaertner	New Mexico Institute of Mining and Technology	NM	USA
Jorge	Galeano Cabral	Florida State University	FL	USA
Eduard	Galstyan	University of Houston	TX	USA
Zhehong	Gan	National High Magnetic Field Laboratory	FL	USA
Xueshi	Gao	Ohio State University	OH	USA
Madilyn	Getz	National High Magnetic Field Laboratory	FL	USA
Nirmal	Ghimire	George Mason University	VA	USA
Raju	Ghimire	Clark University	MA	USA
Augusto	Ghiotto	Columbia University	NY	USA
Spencer	Gibbs	University of Pennsylvania	PA	USA
David	Graf	National High Magnetic Field Laboratory	FL	USA
Elizabeth	Green	National High Magnetic Field Laboratory	FL	USA
Aliya	Greenberg	Commonwealth Fusion Systems	MA	USA
Brittany	Grimm	Florida State University	FL	USA
Gael	Grissonnanche	Cornell University	NY	USA
Yingdong	Guan	Pennsylvania State University	PA	USA

First Name	Last Name	Organization	State	Country
Onder	Gul	Harvard University	MA	USA
Chengqi	Guo	Pennsylvania State University	PA	USA
Yanbo	Guo	University of Florida	FL	USA
Aakash	Gupta	Florida State University	FL	USA
Adbhut	Gupta	Princeton University	NJ	USA
Minyong	Han	Massachusetts Institute of Technology	MA	USA
Sae Young	Han	Columbia University	NY	USA
Songi	Han	University of California, Santa Barbara	CA	USA
Tonghang	Han	Massachusetts Institute of Technology	MA	USA
Adam	Hand	University of Tennessee, Knoxville	TN	USA
Scott	Hannahs	National High Magnetic Field Laboratory	FL	USA
Zeyu	Hao	Harvard University	MA	USA
Sara	Haravifard	Duke University	NC	USA
James	Harper	Brigham Young University	UT	USA
Zahid	Hasan	Princeton University	NJ	USA
Eric	Hellstrom	National High Magnetic Field Laboratory	FL	USA
Stephen	Hill	National High Magnetic Field Laboratory	FL	USA
David	Hilton	University of Alabama, Birmingham	AL	USA
Sean	Holmes	Florida State University	FL	USA
Md Shafayat	Hossain	Princeton University	NJ	USA
Chaowei	Hu	University of California, Los Angeles	CA	USA
Jin	Hu	University of Arkansas	AR	USA
Xinzhe	Hu	University of Florida	FL	USA
Zhixiang	Hu	Brookhaven National Laboratory	NY	USA
Ke	Huang	Pennsylvania State University	PA	USA
Qing	Huang	University of Tennessee, Knoxville	TN	USA
John	Huckabee	New Mexico Institute of Mining and Technology	NM	USA
Ivan	Hung	National High Magnetic Field Laboratory	FL	USA
Robbie	Iuliucci	Washington and Jefferson College	PA	USA
Marcelo	Jaime	National High Magnetic Field Laboratory	NM	USA
Michelle	Jamer	U.S. Naval Academy	MD	USA
Jan	Jaroszynski	National High Magnetic Field Laboratory	FL	USA
Luis	Jauregui	University of California, Irvine	CA	USA
Kaila	Jenkins	University of Michigan	MI	USA
Michael	Jenkins	University of Tennessee, Knoxville	TN	USA
Yanyu	Jia	Princeton University	NJ	USA
Ningxin	Jiang	University of Chicago	IL	USA
Qianni	Jiang	University of Washington	WA	USA
Zhigang	Jiang	Georgia Institute of Technology	GA	USA
Rongying	Jin	University of South Carolina	SC	USA
Apoorv	Jindal	Columbia University	NY	USA

First Name	Last Name	Organization	State	Country
Caolan	John	Massachusetts Institute of Technology	MA	USA
Glover	Jones	National High Magnetic Field Laboratory	FL	USA
Sarah	Jones	Colorado School of Mines	CO	USA
Long	Ju	Massachusetts Institute of Technology	MA	USA
Nikolai	Kalugin	New Mexico Institute of Mining and Technology	NM	USA
Fumitake	Kametani	National High Magnetic Field Laboratory	FL	USA
Denis	Karaiskaj	University of South Florida	FL	USA
Sunil	Karna	Norfolk State University	VA	USA
Philip	Kim	Harvard University	MA	USA
Sangsoo	Kim	Florida State University	FL	USA
James	Kimball	Florida State University	FL	USA
Martin	Kirk	University of New Mexico	NM	USA
Mason	Klemm	Rice University	TX	USA
John	Koptur-Palenchar	University of Florida	FL	USA
Alexey	Kovalev	National High Magnetic Field Laboratory	FL	USA
Jurek	Krzystek	National High Magnetic Field Laboratory	FL	USA
Kapila	Kumarasinghe	University of Central Florida	FL	USA
Wai-Kwong	Kwok	Argonne National Laboratory	IL	USA
Hyunchul	Kwon	University of California, Berkeley	CA	USA
Henry	La Pierre	Georgia Institute of Technology	GA	USA
Antti	Laitinen	Harvard University	MA	USA
Samuel	Langelund Carerra	University of South Florida	FL	USA
Brett	Laramee	Clark University	CT	USA
David	Larbalestier	National High Magnetic Field Laboratory	FL	USA
Chun Ning (Jeanie)	Lau	Ohio State University	OH	USA
Ian	Leahy	University of Colorado, Boulder	CO	USA
Blake	Lee	University of Colorado, Boulder	CO	USA
Jonathan	Lee	National High Magnetic Field Laboratory	FL	USA
Jun Sik	Lee	SLAC National Accelerator Laboratory	CA	USA
Minhyea	Lee	University of Colorado, Boulder	CO	USA
Peter	Lee	Florida State University	FL	USA
Seng Huat	Lee	Pennsylvania State University	PA	USA
Sylvia	Lewin	University of Maryland, College Park	MD	USA
Cequn	Li	Pennsylvania State University	PA	USA
Jia	Li	Brown University	RI	USA
Lu	Li	University of Michigan	MA	USA
Zizhong	Li	University of Wisconsin, Madison	WI	USA
Zhen	Lian	Rensselaer Polytechnic Institute	NY	USA
Wen-Chen	Lin	University of Maryland, College Park	MD	USA
Ilya	Litvak	National High Magnetic Field Laboratory	FL	USA
Changjiang	Liu	State University of New York at Buffalo	NY	USA

First Name	Last Name	Organization	State	Country
Hengzhou	Liu	University of South Florida	FL	USA
I-LIn	Liu	University of Maryland, College Park	MD	USA
Jian	Liu	University of Tennessee, Knoxville	TN	USA
Jinyu	Liu	University of California, Irvine	CA	USA
Xinyu	Liu	University of Notre Dame	IN	USA
Yijing	LIU	Georgetown University	DC	USA
Jeffrey	Long	University of California, Berkeley	CA	USA
Dale	Lowder	Rice University	TX	USA
Zhengguang	Lu	Massachusetts Institute of Technology	MA	USA
Chun Hung	Lui	University of California, Riverside	CA	USA
Lei	Ma	Rensselaer Polytechnic Institute	NY	USA
Subin	Mali	Pennsylvania State University	PA	USA
Paul	Malinowski	University of Washington	WA	USA
David	Mandrus	University of Tennessee, Knoxville	TN	USA
Michael	Manfra	Nokia Bell Labs	NJ	USA
Caroline	Mangione	University of New Mexico	NM	USA
Wenping	Mao	National High Magnetic Field Laboratory	FL	USA
Zhiqiang	Mao	Pennsylvania State University	PA	USA
Varun	Mapara	University of South Florida	FL	USA
Brian	Maple	University of California, San Diego	CA	USA
Masoud	Mardani	National High Magnetic Field Laboratory	FL	USA
Sam	McCalpin	University of Michigan	MI	USA
Ross	McDonald	National High Magnetic Field Laboratory	NM	USA
Stephen	McGill	National High Magnetic Field Laboratory	FL	USA
Tyrel	McQueen	Johns Hopkins University	MD	USA
August	Meads	Kennesaw State University	GA	USA
Elena	Meirzadeh	Columbia University	NY	USA
Yuze	Meng	Rensselaer Polytechnic Institute	NY	USA
Joshua	Mengel	University of New Mexico	NM	USA
Shengnan	Miao	Rensselear Polytechnic Institute	NY	USA
Duncan	Mierstchin	West Texas A&M University	TX	USA
Dmitri	Mihaliov	University of Michigan	MI	USA
Paul	Miller	North Carolina State University	NC	USA
Lujin	Min	Pennsylvania State University	PA	USA
Camilla	Moir	University of California, San Diego	CA	USA
Jagadeesh	Moodera	MIT Plasma Science & Fusion Center	MA	USA
Alex	Moon	National High Magnetic Field Laboratory	FL	USA
Emilia	Morosan	Rice University	TX	USA
Shirin	Mozaffari	University of Tennessee, Knoxville	TN	USA
JP	Muncks	Commonwealth Fusion Systems	MA	USA
Tim	Murphy	National High Magnetic Field Laboratory	FL	USA
Janice	Musfeldt	University of Tennessee, Knoxville	TN	USA

First Name	Last Name	Organization	State	Country
Yasuyuki	Nakajima	University of Central Florida	FL	USA
Douglas	Natelson	Rice University	TX	USA
William	Nelson	NHMFL-FSU	FL	USA
Jennifer	Neu	National High Magnetic Field Laboratory	FL	USA
Paul	Neves	Massachusetts Institute of Technology	MA	USA
Thinh	Nguyen	West Texas A&M University	TX	USA
Guangxin	Ni	Florida State University	FL	USA
Martin	Nikolo	Saint Louis University	MO	USA
Chang	Niu	Purdue University	IN	USA
George	Nolas	University of South Florida	FL	USA
Robert	Nowell	National High Magnetic Field Laboratory	FL	USA
Olatunde	Oladehin	Florida State University	FL	USA
Michael	Onyszczak	Princeton University	NJ	USA
Andrew	Ozarowski	National High Magnetic Field Laboratory	FL	USA
Mykhaylo	Ozerov	National High Magnetic Field Laboratory	FL	USA
Johnpierre	Paglione	University of Maryland, College Park	MD	USA
Joyce	Palmer-Fortune	Smith College	MA	USA
Johanna	Palmstrom	Los Alamos National Laboratory	NM	USA
Wei	Pan	Sandia National Laboratories	NM	USA
Krishna	Pandey	University of Arkansas	AR	USA
Joon Young	Park	Harvard University	MA	USA
Abhay	Pasupathy	Columbia University	NY	USA
Nawaraj	Paudel	Florida State University	FL	USA
Austin	Peach	Florida State University	FL	USA
William	Peria	Los Alamos National Laboratory	NM	USA
Cedomir	Petrovic	Brookhaven National Laboratory	NY	USA
Loren	Pfeiffer	Princeton University	NJ	USA
Lily	Phillips	Smith College	CA	USA
Isabelle	Phinney	Harvard University	MA	USA
Samuel	Poage	North Carolina State University	NC	USA
Christopher	Pocs	University of Colorado, Boulder	CO	USA
Bal	Pokharel	National High Magnetic Field Laboratory	FL	USA
Richa	Pokharel Madhogaria	University of Tennessee, Knoxville	TN	USA
Dragana	Popovic	National High Magnetic Field Laboratory	FL	USA
Victoria	Posey	Columbia University	NY	USA
Naveen	Pouse	University of California, San Diego	CA	USA
Andy	Powell	National High Magnetic Field Laboratory	FL	USA
Bradley	Price	University of California, Santa Barbara	CA	USA
Davide	Prosperi	UMC	TX	USA
Andrej	Pustogow	University of California, Los Angeles	CA	USA
Ayyalusamy	Ramamoorthy	University of Michigan	MI	USA
Arun	Ramanathan	Georgia Institute of Technology	GA	USA

First Name	Last Name	Organization	State	Country
Arthur	Ramirez	University of California, Santa Cruz	CA	USA
Brad	Ramshaw	Cornell University	NY	USA
Sheng	Ran	Washington University in St. Louis	MO	USA
Zackary	Rehfuss	Washington University in St. Louis	MI	USA
John	Reno	Sandia National Laboratories	NM	USA
Arneil	Reyes	National High Magnetic Field Laboratory	FL	USA
Daniel	Rhodes	University of Wisconsin, Madison (UW)	WI	USA
Jacob	Rochester	Ohio State University	OH	USA
Grant	Roll	Smith College	NY	USA
Yuval	Ronen	Harvard University	MA	USA
Elliott	Rosenberg	Stanford University	CA	USA
Aaron	Rossini	Iowa State University	IA	USA
Xavier	Roy	Columbia University	NY	USA
Shanta	Saha	University of Maryland, College Park	MD	USA
Leroy	Salary	Norfolk State University	VA	USA
Prathum	Saraf	University of Maryland, College Park	MD	USA
Bhabesh	Sarangi	University of Houston	TX	USA
Govind	Sasi Kumar	Florida State University	FL	USA
Gicela	Saucedo Salas	University of Maryland, College Park	MD	USA
Jeffrey	Schiano	Pennsylvania State University	PA	USA
John	Schlueter	Argonne National Laboratory	IL	USA
Rico	Schoenemann	Los Alamos National Laboratory	NM	USA
Jasmin	Schoenzart	Florida State University	FL	USA
Leslie	Schoop	Princeton University	NJ	USA
Benny	Schundelmier	Florida State University	FL	USA
Robert	Schurko	Florida State University	FL	USA
Venkat	Selvamanickam	University of Houston	TX	USA
Dmitry	Semenov	National High Magnetic Field Laboratory	FL	USA
Sabyasachi	Sen	University of California, Davis	CA	USA
Shivani	Sharma	Brookhaven National Laboratory	NY	USA
Michael	Shatruk	National High Magnetic Field Laboratory	FL	USA
Mansour	Shayegan	Princeton University	NJ	USA
Arkady	Shehter	Los Alamos National Laboratory	NM	USA
Zhi-Xun	Shen	Stanford University	CA	USA
Mark	Sherwin	University of California, Santa Barbara	CA	USA
Ao	Shi	University of California, Riverside	CA	USA
Qianhui	Shi	University of California, Los Angeles	CA	USA
Sufei	Shi	Rensselaer Polytechnic Institute	NY	USA
Yue	Shi	University of Washington	WA	USA
En-Min	Shih	Columbia University	NY	USA
Keshav	Shrestha	Texas A&M University	TX	USA
David	Shultz	North Carolina State University	NC	USA

First Name	Last Name	Organization	State	Country
Wenda	Si	Duke University	NC	USA
Hasan	Siddiquee	Washington University in St. Louis	MO	USA
Peter	Siegfried	George Mason University	CO	USA
Theo	Siegrist	National High Magnetic Field Laboratory	FL	USA
Siddharth Kumar	Singh	Princeton University	NJ	USA
John	Singleton	National High Magnetic Field Laboratory	NM	USA
Dmitry	Smirnov	National High Magnetic Field Laboratory	FL	USA
Julia	Smith	National High Magnetic Field Laboratory	FL	USA
Layla	Smith	Norfolk State University	VA	USA
Robert	Smith	Florida State University	FL	USA
Danila	Sokratov	University of Maryland, College Park	MD	USA
Yuan	Song	Columbia University	NY	USA
Brandon	Sorbom	Commonwealth Fusion Systems	MA	USA
Lily	Stanley	National High Magnetic Field Laboratory	FL	USA
Mike	Sumption	Ohio State University	OH	USA
Alexey	Suslov	National High Magnetic Field Laboratory	FL	USA
Josh	Swann	Columbia University	NY	USA
Fazel	Tafti	Boston College	MA	USA
Chia-Tse	Tai	Princeton University	NJ	USA
Yasu	Takano	University of Florida	FL	USA
Pukun	Tan	Purdue University	IN	USA
Waroch	Tangbampensountorn	Pennsylvania State University	PA	USA
Chiara	Tarantini	National High Magnetic Field Laboratory	FL	USA
Haruko	Tateyama	Georgia Institute of Technology	GA	USA
Aya Batoul	Tazi	Columbia University	NY	USA
Evan	Telford	Columbia University	NY	USA
Joshua	Telser	Roosevelt University	IL	USA
Doyle	Temple	Norfolk State University	VA	USA
Michael	Terilli	Rutgers University	NJ	USA
Jasminka	Terzic	National High Magnetic Field Laboratory	FL	USA
Nishchal	Thapa Magar	George Mason University	VA	USA
Pranav	Thekke Madathil	Princeton University	NJ	USA
Komalavalli	Thirunavukkuarasu	Florida Agricultural and Mechanical University	FL	USA
Haidong	Tian	Ohio State University	OH	USA
Pagnareach	Tin	University of Tennessee, Knoxville	TN	USA
Bianca	Trociewitz	National High Magnetic Field Laboratory	FL	USA
Trevor	Tyson	New Jersey Institute of Technology	NJ	USA
Amit	Vashist	University of Utah	UT	USA
Greyson	Voigt	Ohio State University	OH	USA
Cameron	Vojvodin	Florida State University	FL	USA
Joshua	Wakefield	Massachusetts Institute of Technology	MA	USA

First Name	Last Name	Organization	State	Country
Fang	Wan	Fermi National Accelerator Laboratory	IL	USA
Chengyu	Wang	Princeton University	NJ	USA
Jiashu	Wang	University of Notre Dame	IN	USA
Jiayin	Wang	Ohio State University	OH	USA
Kang	Wang	University of California, Los Angeles	CA	USA
Pengjie	Wang	Princeton University	NJ	USA
Tianmeng	Wang	Rensselaer Polytechnic Institute	NY	USA
Tuo	Wang	Michigan State University	MI	USA
Xiaoling	Wang	California State University, East Bay	CA	USA
Youcheng	Wang	National High Magnetic Field Laboratory	FL	USA
Yunong	Wang	University of Florida	FL	USA
Yuxin	Wang	Florida State University	FL	USA
Kaya	Wei	National High Magnetic Field Laboratory	FL	USA
Ulrich	Welp	Argonne National Laboratory	IL	USA
Robert	Welser	University of California, Irvine	CA	USA
Thomas	Werkmeister	Harvard University	MA	USA
Ken	West	Princeton University	NJ	USA
MacMillan	Wheeler	American Superconductor	FL	USA
Brady	Wilson	Kennesaw State University	GA	USA
Matthew	Wilson	University of California, Riverside	CA	USA
Sanfeng	Wu	Princeton University	NJ	USA
Tsung-Chi	Wu	Rutgers University	NJ	USA
Yingying	WU	Massachusetts Institute of Technology	MA	USA
Li	Xiang	National High Magnetic Field Laboratory	FL	USA
Kaitai	Xiao	National High Magnetic Field Laboratory	FL	USA
Chengkun	Xing	University of Tennessee, Knoxville	TN	USA
Jie	Xing	University of South Carolina	SC	USA
Kejun	Xu	Stanford University	CA	USA
SiJie	Xu	Duke University	NC	USA
Xingchen	Xu	Fermi National Accelerator Laboratory	IL	USA
Yijue	Xu	National High Magnetic Field Laboratory	FL	USA
Ziling	Xue	University of Tennessee, Knoxville	TN	USA
Lalit	Yadav	Duke University	NJ	USA
Jiaqiang	Yan	Oak Ridge National Laboratory	TN	USA
Li	Yan	Rensselaer Polytechnic Institute	NY	USA
Hung-Yu	Yang	Boston College	MA	USA
Junyi	Yang	University of Tennessee, Knoxville	TN	USA
Weiliang	Yao	University of Tennessee, Knoxville	TN	USA
Xiaohan	Yao	Boston College	MA	USA
Peide	Ye	Purdue University	IN	USA
Hemian	Yi	Pennsylvania State University	PA	USA
Le	Yi	Pennsylvania State University	PA	USA

First Name	Last Name	Organization	State	Country
Hyeok	Yoon	University of Maryland, College Park	MD	USA
Suguru	Yoshida	Pennsylvania State University	PA	USA
S M Enamul Hoque	Yousuf	University of Florida	FL	USA
Guo	Yu	Princeton University	NJ	USA
Bing	Yuan	University of California, Davis	CA	USA
Miha	Zakotnik	Urban Mining Company	TX	USA
Jonathan	Zauberman	Harvard University	MA	USA
Dechen	Zhang	University of Michigan	MI	USA
Naiyuan	Zhang	Brown University	RI	USA
Qi	Zhang	Princeton University	NJ	USA
Qihang	Zhang	Massachusetts Institute of Technology	MA	USA
Rongfu	Zhang	National High Magnetic Field Laboratory	FL	USA
RuoXi	Zhang	Pennsylvania State University	PA	USA
Xiao-Xiao	Zhang	University of Florida	FL	USA
Yuxin	Zhang	Ohio State University	OH	USA
Zheneng	Zhang	Ohio State University	OH	USA
Zhuocheng	Zhang	Purdue University	IN	USA
Shu Yang	Zhao	Massachusetts Institute of Technology	MA	USA
Tianhao	Zhao	Georgia Institute of Technology	GA	USA
Yi-Fan	Zhao	Pennsylvania State University	PA	USA
Guoxin	Zheng	University of Michigan	MI	USA
Kent (Jingxu)	Zheng	Massachusetts Institute of Technology	NY	USA
Mingyang	Zheng	University of Florida	FL	USA
Haidong	Zhou	University of Tennessee, Knoxville	TN	USA
Lingjie	Zhou	Pennsylvania State University	PA	USA
Jun	Zhu	Pennsylvania State University	PA	USA
Junbo	Zhu	Massachusetts Institute of Technology	MA	USA
Yanglin	Zhu	Tulane University	LA	USA
Yuan	Zhu	University of Michigan	MI	USA
Michael	Ziebel	Columbia University	NY	USA
Andrew	Zimmerman	Harvard University	MA	USA
Michael	Zudov	University of Minnesota, Twin Cities	MN	USA
Hans-Conrad	zur Loye	University of South Carolina	SC	USA

DC Field Facility – International Users (107)

First Name	Last Name	Organization	Country
Louae	Abdulla	University of Windsor	Canada
Henri	Alloul	French National Center for Scientific Research	France
Amirreza	Ataei	University of Sherbrooke	Canada
Jake	Ayres	University of Bristol	UK
Jordan	Baglo	University of Sherbrooke	Canada
Geetha	Balakrishnan	University of Warwick	UK

First Name	Last Name	Organization	Country
Carla	Boix-Constant	University of Valencia	Spain
Marie-Eve	Boulanger	University of Sherbrooke	Canada
David	Bryce	University of Ottawa	Canada
Bernd	Buechner	Technical University of Dresden	Germany
David	Cardwell	University of Cambridge	UK
Jessica	Chapman	University of Cambridge	UK
Nicholas	Chilton	University of Manchester	UK
Enrique	Colacio	University of Granada	Spain
Yannick	Coppel	French National Center for Scientific Research	France
Eugenio	Coronado	University of Valencia	Spain
Alexander	Davies	University of Cambridge	UK
Fernando Luis	de Araujo Machado	Federal University of Pernambuco	Brazil
Martin	Dressel	University of Stuttgart	Germany
Irina	Drichko	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Russia
Caitlin	Duffy	High Field Magnet Laboratory, Radboud University	Netherlands
John	Durrell	University of Cambridge	UK
Alex	Eaton	University of Cambridge	UK
Pierre	Florian	French National Center for Scientific Research	France
Luis	Foa Torres	University of Chile	Chile
Alexander	Forse	University of Cambridge	UK
Sven	Friedemann	University of Bristol	UK
Tomislav	Friscic	McGill University	Canada
Masaki	Fujita	Tohoku University IMR	Japan
Jose	Galvis Echeverri	Central University Colombia	Colombia
Christel	Gervais	Sorbonne University	France
Ildar	Gilmutdinov	Kazan Federal University	Russia
Paula	Giraldo-Gallo	University of Los Andes	Colombia
Ieva	Goldberga	French National Center for Scientific Research	France
Adrien	Gourgout	University of Sherbrooke	Canada
Isabel	Guillamon	University of Bristol	UK
Edwin	Herrera Vasco	Autonomous University of Madrid	Spain
Alex	Hickey	University of Cambridge	UK
Roemer	Hinlopen	University of Bristol	UK
James	Hook	University of New South Wales	Australia
Liting	Huang	University of Cambridge	UK
Yanen	Huang	Zhejiang University	China
Yining	Huang	University of Western Ontario	Canada
Nigel	Hussey	University of Bristol	UK
Lin	Jiao	Zhejiang University	China
Alice	Jin	University of Cambridge	UK
Myrtil	Kahn	French National Center for Scientific Research	France
Kinga	Kaniewska	Gdansk University of Technology	Poland

First Name	Last Name	Organization	Country
Akash	Khansili	Stockholm University	Sweden
Andrew	King	D-Wave Systems Inc	Canada
Yoshimitsu	Kohama	University of Tokyo	Japan
Neha	Kondedan	Stockholm University	Sweden
Olivier	Lafon	University of Lille	France
Stuart	Langley	Manchester Metropolitan University	UK
Danielle	Laurencin	University of Montpellier	France
Etienne	Lefrançois	University of Sherbrooke	Canada
César	Leroy	French National Center for Scientific Research	France
Jiangxiazi	Lin	Hong Kong University of Science and Technology	China
Hsu	Liu	University of Cambridge	UK
Talal	Mallah	University of Paris-Sud	France
Samuel	Mañas-Valero	University of Valencia	Spain
Mijail	Mancera	University of Cambridge	UK
Isabelle	Marcotte	University of Quebec at Montreal	Canada
Yuji	Matsuda	Kyoto University	Japan
Irek	Mukhamedshin	Kazan Federal University	Russia
Hiroki	Nagashima	National Institute of Advanced Industrial Science and Technology	Japan
Adam	Nelson	Sorbonne University	France
Shimpei	Ono	Central Research Institute of Electric Power Industry	Japan
Xinhua	Peng	University of Science and Technology of China	China
Nicholas	Popiel	University of Cambridge	UK
Suzi	Pugh	University of Cambridge	UK
Jeremy	Rawson	University of Windsor	Canada
Benjamin	Rhodes	University of Cambridge	UK
Luis	Rivera	University of Los Andes	Colombia
Gilles	Rodway-Gant	University of Cambridge	UK
Julian	Rojas	University of Los Andes	Colombia
Andreas	Rydh	Stockholm University	Sweden
Flavio	Salvati	University of Cambridge	UK
Luis	Sánchez-Muñoz	Consejo Superior de Investigaciones Científicas	Spain
Daniel	SantaLucia	Max Planck Institute for Chemical Energy Conversion, Muelheim	Germany
Takao	Sasagawa	Tokyo Institute of Technology	Japan
Suchitra	Sebastian	University of Cambridge	UK
Zeping	Shi	East China Normal University	China
Zhenzhong	Shi	Soochow University	China
Diego	Silvera Vega	University of Los Andes	Colombia
Ivan	Smirnov	Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Russia
Oscar	Solomons-Tuke	Cambridge University	UK
Sergei	Studenikin	National Research Council of Canada	Canada

First Name	Last Name	Organization	Country
Hermann	Suderow	Autonomous University of Madrid	Spain
Louis	Taillefer	University of Sherbrooke	Canada
Hidekazu	Tanaka	Tokyo Institute of Technology	Japan
Takanori	Taniguchi	Tohoku University IMR	Japan
Julien	Trebosc	University of Lille	France
Michal	Valiska	Charles University, Prague, Czechia	Czech Republic
Olesia	Voloshyna	Technical University of Dresden	Germany
Lara	Watanabe	University of Windsor	Canada
Yasmin	Whyatt	University of Manchester	UK
Joachim	Wosnitza	Helmholtz Zentrum Dresden-Rossendorf	Germany
Wenbin	Wu	East China Normal University	China
Zheyu	Wu	University of Cambridge	UK
Ziming	Wu	Soochow University	China
Huiqiu	Yuan	Zhejiang University	China
Xiang	Yuan	East China Normal University	China
Yuanzheng	Yue	Aalborg University	Denmark
Cheng	Zhang	Fudan University	China
Wanli	Zhang	University of Western Ontario	Canada
Sergei	Zvyagin	Helmholtz Zentrum Dresden-Rossendorf	Germany

EMR Facility – National Users (141)

First Name	Last Name	Organization	State	Country
Yao	Abusa	Iowa State University	IA	USA
Rajarshi	Acharyya	Florida State University	FL	USA
Adewale	Akinfaderin	Florida State University	FL	USA
Anitha	Alanthadka	University of Nevada Reno	NV	USA
Adam	Altenhof	Florida State University	FL	USA
Lauren	Anderson-Sanchez	University of California, Irvine	CA	USA
Polly	Arnold	University of California, Berkeley	CA	USA
Kathleen	Arpin	Georgia Southern University	GA	USA
Christopher	Bardeen	University of California, Riverside	CA	USA
Shubham	Bisht	Florida State University	FL	USA
Alexandria	Bone	University of Tennessee, Knoxville	TN	USA
ChristiAnna	Brantley	University of Florida	FL	USA
Stuart	Brown	University of California, Los Angeles	CA	USA
Nhat Nguyen	Bui	National High Magnetic Field Laboratory	FL	USA
Scott	Carnahan	Iowa State University	IA	USA
Michael	Chini	University of Central Florida	FL	USA
Wei-Hao	Chou	Florida State University	FL	USA
George	Christou	University of Florida	FL	USA
Robert	Comito	University of Houston	TX	USA
Carl	Conti	Florida State University	FL	USA
Enrique	del Barco	University of Central Florida	FL	USA
Laxmi	Devkota	Marquette University	WI	USA
Alexander	Diodati	University of Florida	FL	USA
Linda	Doerrer	Boston University	MA	USA
Thierry	Dubroca	National High Magnetic Field Laboratory	FL	USA
William	Evans	University of California, Irvine	CA	USA
Catherine	Fabiano	Florida State University	FL	USA
Adam	Fiedler	Marquette University	WI	USA
Natia	Frank	University of Nevada Reno	NV	USA
Danna	Freedman	Northwestern University	IL	USA
Gregory	Fritjofson	University of Central Florida	FL	USA
Lucio	Frydman	National High Magnetic Field Laboratory	FL	USA
Riqiang	Fu	National High Magnetic Field Laboratory	FL	USA
Miguel	Gakiya	Florida State University	FL	USA
Eric	Gale	Massachusetts General Hospital	MA	USA
Eranga	Gamage	Iowa State University	IA	USA
Zhehong	Gan	National High Magnetic Field Laboratory	FL	USA
Thomas	Gately	University of California, Riverside	CA	USA
Subrata	Ghosh	University of Nevada Reno	NV	USA
Tuhin	Ghosh	University of Florida	FL	USA
Fabiola	Gonzalez	Florida State University	FL	USA

First Name	Last Name	Organization	State	Country
Rianna	Greer	Massachusetts Institute of Technology	MA	USA
Robert	Griffin	Massachusetts Institute of Technology	MA	USA
Brittany	Grimm	Florida State University	FL	USA
Gary	Guillet	Georgia Southern University	GA	USA
Ashlyn	Hale	University of Florida	FL	USA
Songi	Han	University of California, Santa Barbara	CA	USA
Manoj Vinayaka	Hanabe Subramanya	Florida State University	FL	USA
Adam	Hand	University of Tennessee, Knoxville	TN	USA
Jacob	Hanson-Flores	University of Central Florida	FL	USA
Stephen	Hill	National High Magnetic Field Laboratory	FL	USA
Jakub	Hruby	National High Magnetic Field Laboratory	FL	USA
Ivan	Hung	National High Magnetic Field Laboratory	FL	USA
Cassidy	Jackson	Colorado State University	CO	USA
Mehrafshan	Jafari	University of Pennsylvania	PA	USA
Michael	Jenkins	University of Tennessee, Knoxville	TN	USA
Michael	Jensen	Ohio University	OH	USA
Zhigang	Jiang	Georgia Institute of Technology	GA	USA
Denis	Karaiskaj	University of South Florida	FL	USA
Kirill	Kovnir	Iowa State University	IA	USA
Jurek	Krzystek	National High Magnetic Field Laboratory	FL	USA
Krishnendu	Kundu	National High Magnetic Field Laboratory	FL	USA
Jason	Kuszynski	Florida State University	FL	USA
Hyunchul	Kwon	University of California, Berkeley	CA	USA
Amy	Kynman	University of California, Berkeley	CA	USA
Trevor	Latendresse	Texas A&M University	TX	USA
Timothée	Lathion	University of Michigan	MI	USA
Teresa	Le	University of California, Los Angeles	CA	USA
David	Lederman	University of California, Santa Cruz	CA	USA
Jeffrey	Long	University of California, Berkeley	CA	USA
Daphné	Lubert-Perquel	University of Florida	FL	USA
Jamie	Manson	Eastern Washington University	WA	USA
Zachary	Manson	Eastern Washington University	WA	USA
Jonathan	Marbey	National High Magnetic Field Laboratory	FL	USA
Roxanna	Martinez	Colorado State University	CO	USA
Stephen	McGill	National High Magnetic Field Laboratory	FL	USA
Frederic	Mentink	National High Magnetic Field Laboratory	FL	USA
Daniel	Mindiola	University of Pennsylvania	PA	USA
Shawn	Moore	Boston University	MA	USA
Danh	Ngo	University of California, Berkeley	CA	USA
Michael	Nippe	Texas A&M University	TX	USA
Raul	Ortega	Florida State University	FL	USA
Brenden	Ortiz	University of California, Santa Barbara	CA	USA

First Name	Last Name	Organization	State	Country
Yifu	Ouyang	Massachusetts Institute of Technology	MA	USA
Andrew	Ozarowski	National High Magnetic Field Laboratory	FL	USA
Mykhaylo	Ozerov	National High Magnetic Field Laboratory	FL	USA
Anant	Paravastu	Georgia Institute of Technology	GA	USA
Vincent	Pecoraro	University of Michigan	MI	USA
Nathan	Peek	Florida State University (FSU)	FL	USA
Frédéric	Perras	Ames Laboratory	IA	USA
Cedomir	Petrovic	Brookhaven National Laboratory	NY	USA
Bradley	Price	University of California, Santa Barbara	CA	USA
Andrej	Pustogow	University of California, Los Angeles	CA	USA
Yifan	Quan	Massachusetts Institute of Technology	MA	USA
Chandrasekhar	Ramanathan	Dartmouth College	NH	USA
Arneil	Reyes	National High Magnetic Field Laboratory	FL	USA
Gia	Rivers	Florida State University	FL	USA
Aaron	Rossini	Iowa State University	IA	USA
Elvin	Salerno	National High Magnetic Field Laboratory	FL	USA
Paul	Sarte	University of California, Santa Barbara	CA	USA
John	Schlueter	Argonne National Laboratory	IL	USA
Robert	Schurko	Florida State University	FL	USA
Susannah	Scott	University of California, Santa Barbara	CA	USA
Kyle	Seabourn	University of Idaho	ID	USA
Hannah	Shafaat	Ohio State University	OH	USA
Michael	Shatruk	National High Magnetic Field Laboratory	FL	USA
Jennifer	Shepherd	Gonzaga University	WA	USA
Mark	Sherwin	University of California, Santa Barbara	CA	USA
Javad	Shokraiyan	Ohio University	OH	USA
Srinivasa Rao	Singamaneni	University of Texas, El Paso	TX	USA
Dmitry	Smirnov	National High Magnetic Field Laboratory	FL	USA
Robert	Smith	National High Magnetic Field Laboratory	FL	USA
Robert	Smith	Florida State University	FL	USA
Likai	Song	National High Magnetic Field Laboratory	FL	USA
Murari	Soundararajan	National High Magnetic Field Laboratory	FL	USA
Robert	Stewart	Florida State University	FL	USA
Albert	Stiegman	Florida State University	FL	USA
Sebastian	Stoian	University of Idaho	ID	USA
Stefan	Stoll	University of Washington	WA	USA
Rachelle	Stowell	University of Washington	WA	USA
Geoffrey	Strouse	National High Magnetic Field Laboratory	FL	USA
Fazel	Tafti	Boston College	MA	USA
Maxym	Tansky	University of Houston	TX	USA
Joshua	Telser	Roosevelt University	IL	USA
Janet	Tests	Columbia University	NY	USA

First Name	Last Name	Organization	State	Country
Pagnareach	Tin	University of Tennessee, Knoxville	TN	USA
Bianca	Trociewitz	National High Magnetic Field Laboratory	FL	USA
Gaël	Ung	University of Connecticut	CT	USA
Okten	Ungor	Colorado State University	CO	USA
Adam	Valaydon-Pillay	University of Idaho	ID	USA
Johan	van Tol	National High Magnetic Field Laboratory	FL	USA
Cameron	Vojvodin	Florida State University	FL	USA
Xiaoling	Wang	California State University, East Bay	CA	USA
Sungsool	Wi	National High Magnetic Field Laboratory	FL	USA
Ethan	Williams	Dartmouth College	NH	USA
Michael	Wojnar	Northwestern University	IL	USA
Li	Xiang	National High Magnetic Field Laboratory	FL	USA
Ziling	Xue	University of Tennessee, Knoxville	TN	USA
Joseph	Zadrozny	Colorado State University	CO	USA
Jianyuan	Zhang	Rutgers University	NJ	USA
Tianhao	Zhao	Georgia Institute of Technology	GA	USA

EMR Facility – International Users (24)

First Name	Last Name	Organization	Country
Alina	Bienko	University of Wroclaw	Poland
Eric	Breynaert	Catholic University Leuven	Belgium
Christian	Buch	University of Copenhagen	Denmark
Nicholas	Chilton	University of Manchester	UK
Rodolphe	Clérac	Centre de Recherche Paul Pascal	France
Enrique	Colacio	University of Granada	Spain
Jan	Dubský	Brno University of Technology	Czech Republic
Dyaln	Errulat	University of Ottawa	Canada
Paul	Goddard	University of Warwick	UK
Sandrine	Heutz	Imperial College London	UK
Deepshikha	Jaiswal-Nagar	IISER Thiruvananthapuram	India
Ulrich	Kortz	Jacobs University	Germany
Oleksii	Laguta	Brno University of Technology	Czech Republic
Stuart	Langley	Manchester Metropolitan University	UK
Andriy	Marko	Brno University of Technology	Czech Republic
Niki	Mavragani	University of Ottawa	Canada
Muralee	Murugesu	University of Ottawa	Canada
Dmytro	Nesterov	Technical University of Lisbon	Portugal
Petr	Neugebauer	Brno University of Technology	Czech Republic
Stergios	Piligkos	University of Copenhagen	Denmark
Daniel	SantaLucia	Max Planck Institute for Chemical Energy Conversion, Muelheim	Germany
Athira	Suresh	IISER Thiruvananthapuram	India
Hans Jurgen	von Bardeleben	Sorbonne University	France

First Name	Last Name	Organization	Country
Yasmin	Whyatt	University of Manchester	UK

High B/T Facility – National Users (14)

First Name	Last Name	Organization	State	Country
Collin	Broholm	Johns Hopkins University	MD	USA
Alexander	Donald	University of Florida	FL	USA
Rasul	Gazizulin	University of Florida	FL	USA
Alireza	Ghasemi	Johns Hopkins University	MD	USA
Samaresh	Guchhait	Howard University	DC	USA
Tianyi	Han	Massachusetts Institute of Technology	MA	USA
Tonghang	Han	Massachusetts Institute of Technology	MA	USA
Chao	Huan	University of Florida	FL	USA
Long	Ju	Massachusetts Institute of Technology	MA	USA
Dominique	Laroche	University of Florida	FL	USA
Mark	Meisel	University of Florida	FL	USA
John	Reno	Sandia National Laboratories	NM	USA
Lucia	Steinke	University of Florida	FL	USA
Andrew	Woods	University of Florida	FL	USA

High B/T Facility – International Users (2)

First Name	Last Name	Organization	Country
Guillaume	Gervais	McGill University	Canada
Suchitra	Sebastian	University of Cambridge	UK

ICR Facility – National Users (238)

First Name	Last Name	Organization	State	Country
Marianna	Acker	Woods Hole Oceanographic Institution	MA	USA
Jeramie	Adams	University of Wyoming	WY	USA
Archana	Agarwal	University of Utah	UT	USA
Sebastian	Aguero	California State University, San Marcos	CA	USA
Lissa	Anderson	National High Magnetic Field Laboratory	FL	USA
AnithaChristy	Arumanayagam	Methodist Hospital Research Institute	TX	USA
Benhur	Asefaw	Florida State University	FL	USA
Kadir	Aslan	Morgan State University	MD	USA
Thomas	Atkinson	University of Alabama, Birmingham	AL	USA
Rasha	Atwi	State University of New York at Stony Brook	NY	USA
Lydia	Babcock-Adams	National High Magnetic Field Laboratory	FL	USA
Allan	Bacon	University of Florida	FL	USA
William	Bahureksa	Colorado State University	CO	USA
David	Barnidge	The Binding Site	MN	USA
Megan	Behnke	University of Alaska, Southeast	AK	USA
Sara	Bell	University of Illinois at Urbana-Champaign	IL	USA
Jamini	Bhagu	Florida State University	FL	USA
Laurie	Blackmore	Atlanta Botanical Garden	GA	USA
Greg	Blakney	National High Magnetic Field Laboratory	FL	USA
Rene	Boiteau	Oregon State University	OR	USA
Thomas	Borch	Colorado State University	CO	USA
Nathan	Bramall	Leiden Technology LLC	CA	USA
Brian	Brazil	Waste Management Inc.	MD	USA
Joshua	Breithaupt	Florida State University	FL	USA
Corey	Broeckling	Colorado State University	CO	USA
Radha Krishna Murthy	Bulusu Raja	Florida State University	FL	USA
Ekaterina	Bulygina	Louisiana Universities Marine Consortium	LA	USA
David	Butcher	National High Magnetic Field Laboratory	FL	USA
David	Butman	University of Washington	WA	USA
Kathryn	Bywaters	Honeybee Robotics	CA	USA
Jesse	Canterbury	Thermo Fisher Scientific	CA	USA
Daniel	Castro	University of Illinois at Urbana-Champaign	IL	USA
Núria	Catalán	U.S. Geological Survey (USGS)	CO	USA
Peter	Chace	Oregon State University	OR	USA
Martha	Chacon	National High Magnetic Field Laboratory	FL	USA
Romy	Chakraborty	Lawrence Berkeley National Laboratory	CA	USA
Ryan	Champiny	University of Florida	FL	USA
Jeffrey	Chanton	Florida State University	FL	USA
Huan	Chen	National High Magnetic Field Laboratory	FL	USA
Mingfei	Chen	Lawrence Berkeley National Laboratory	CA	USA
Feng	Cheng	Worcester Polytechnic Institute	MA	USA

First Name	Last Name	Organization	State	Country
Feng	Cheng	University of Wisconsin, Madison	WI	USA
Brent	Christner	University of Florida	FL	USA
Emily	Coffey	Atlanta Botanical Garden	GA	USA
Nicole	Coffey	University of Delaware	DE	USA
Daniel	Colopietro	University of Florida	FL	USA
Timothy	Colston	Florida Agricultural and Mechanical University	FL	USA
Caitlin	Crocker	Atlanta Botanical Garden	GA	USA
Juliana	D'Andrilli	Louisiana Universities Marine Consortium	CA	USA
Surendra	Dasari	Mayo Clinic	MN	USA
James	Daubenspeck	University of Alabama, Birmingham	AL	USA
Todd	Dawson	University of California, Berkeley	CA	USA
Christian	Dewey	Oregon State University	OR	USA
Angela	Dispenzieri	Mayo Clinic, Rochester	MN	USA
Peter	Doran	Louisiana State University	LA	USA
Mark	Dornblaser	U.S. Geological Survey	CO	USA
Gregory	Druschel	Indiana University-Purdue University Indianapolis	IN	USA
Ashley	Dubnick	Montana State University	MT	USA
James	Dumesic	University of Wisconsin, Madison	WI	USA
Kevin	Dybvig	University of Alabama, Birmingham	AL	USA
Alina	Ebling	University of Delaware	DE	USA
Karam	Eeso	Florida State University	FL	USA
Brandon	Enalls	Lawrence Berkeley National Laboratory	CA	USA
Thomas	Ennis	City of Austin, Texas	TX	USA
Sasha	Ernst	Florida Department of Environmental Protection	FL	USA
Quincy	Faber	University of Florida	FL	USA
Somayeh	Fathabad	Morgan State University	MD	USA
Timothy	Fegel	USDA Forest Service	CO	USA
Jason	Fellman	University of Alaska, Southeast	AK	USA
Grisel	Fierros Romero	Florida Agricultural and Mechanical University	FL	USA
Heather	Forrer	Florida State University	FL	USA
Karen	Frey	Clark University	MA	USA
Joseph	Frye	National High Magnetic Field Laboratory	FL	USA
Rachel	Gallan	Florida State University	FL	USA
Fenix	Garcia-Tigreros	University of Washington	WA	USA
Sailee	Gawande	Lamar University	TX	USA
William	Ghann	Coppin State University	MD	USA
Samson	Gichuki	Morgan State University	MD	USA
Taylor	Glattke	Florida State University	FL	USA
Kristine	Glunde	Johns Hopkins University School of Medicine	MD	USA
Devon	Graham	Florida State University	FL	USA
Samuel	Grant	National High Magnetic Field Laboratory	FL	USA

First Name	Last Name	Organization	State	Country
Benjamin	Granzow	Woods Hole Oceanographic Institution	MA	USA
Sara	Gushgari-Doyle	Lawrence Berkeley National Laboratory	CA	USA
Jumanah	Hamdi	Louisiana Universities Marine Consortium	LA	USA
Daryl	Hatfield	Florida Department of Environmental Protection	FL	USA
Jon	Hawkings	Florida State University	FL	USA
Chris	Hawthorne	Florida Department of Environmental Protection	FL	USA
Chris	Hendrickson	National High Magnetic Field Laboratory	FL	USA
Anna	Hermes	University of Colorado, Boulder	CO	USA
Christopher	Higgins	Colorado School of Mines	CO	USA
Eve-Lyn	Hinckley	University of Colorado, Boulder	CO	USA
Michael	Hoepfner	University of Utah	UT	USA
Christopher	Holmes	Florida State University	FL	USA
Amy	Holt	Florida State University	FL	USA
Eran	Hood	University of Alaska, Southeast	AK	USA
Sarajeen Saima	Hoque	Florida State University	FL	USA
Taylor	Howard	Florida Agricultural and Mechanical University	FL	USA
George	Huber	University of Wisconsin, Madison	WI	USA
Jim	Ippolito	Colorado State University	CO	USA
Rajneesh	Jaswal	Florida Agricultural and Mechanical University	FL	USA
Nicole	Jenkinson	Johns Hopkins University School of Medicine	MD	USA
Nohyeong	Jeong	Colorado State University	CO	USA
Daqian	Jiang	University of Alabama, Tuscaloosa	AL	USA
Rayana	Johnson	Agilent Technologies	FL	USA
Anne	Kellerman	Florida State University	FL	USA
Eugene	Kelly	Colorado State University	CO	USA
Thomas	Kelly	Florida State University	FL	USA
David	Kenney	Worcester Polytechnic Institute	MA	USA
Ishwar	Kohale	Massachusetts Institute of Technology	MA	USA
Weiyi	Kong	The University of Utah	UT	USA
John	Kornuc	U.S. Naval Research Laboratory	DC	USA
Martin	Kurek	Florida State University	FL	USA
Ethan	Kyzivat	Brown University	RI	USA
Heather	LeClerc	Worcester Polytechnic Institute	MA	USA
Jingxuan	Li	Woods Hole Oceanographic Institution	MA	USA
Wenbo	Li	Florida State University	FL	USA
Yang	Lin	University of Florida	FL	USA
Yuan	Lin	Florida State University	FL	USA
Brittany	Lindsay	Florida Agricultural and Mechanical University	FL	USA
Bruce	Locke	Florida State University	FL	USA
Merritt	Logan	Colorado State University	CO	USA
Daniel	Lowenstein	Massachusetts Institute of Technology	MA	USA

First Name	Last Name	Organization	State	Country
Amie	Lund	University of North Texas	TX	USA
Synthia Parveen	Mallick	Marquette University	WI	USA
Thomas	Manning	Valdosta State University	GA	USA
Hairuo	Mao	University of Wyoming	WY	USA
TAHIR	MAQBOOL	University of Alabama, Tuscaloosa	AL	USA
Alan	Marshall	National High Magnetic Field Laboratory	FL	USA
Garrett	McKay	Texas A&M University	TX	USA
Amy	McKenna	National High Magnetic Field Laboratory	FL	USA
Frederic	Mentink	National High Magnetic Field Laboratory	FL	USA
Amin	Mirkouei	University of Idaho	ID	USA
Hadi	Mohammadigoush ki	Florida State University	FL	USA
Megan	Moore	Florida State University	FL	USA
David	Murray	Mayo Clinic, Rochester	MN	USA
Jay	Nadeau	Portland State University	OR	USA
David	Nauen	Johns Hopkins University School of Medicine	MD	USA
Amelia	Nelson	Colorado State University	CO	USA
Robert	Nelson	Woods Hole Oceanographic Institution	MA	USA
Natalie	Nichols	Indiana University-Purdue University Indianapolis	IN	USA
Sydney	Niles	National High Magnetic Field Laboratory	FL	USA
Devan	Nisson	Princeton University	NJ	USA
Mojtaba	Nouri Goukeh	Florida State University	FL	USA
Holly	Nowell	Florida State University	FL	USA
Tullis	Onstott	Princeton University	NJ	USA
Tianyin	Ouyang	University of Delaware	DE	USA
Rachel	Owrutsky	University of Delaware	DE	USA
Jeffrey	Page	University of Connecticut	CT	USA
Harsh	Patel	North Carolina Agricultural and Technical State University	NC	USA
Alex	Paulsen	Mainstream Engineering Corp	FL	USA
Tamlin	Pavelsky	University of North Carolina at Chapel Hill	NC	USA
Jade	Phillips	Valdosta State University	GA	USA
Nasim	Pica	Colorado State University	CO	USA
Zeljka	Popovic	Florida State University	FL	USA
Brett	Poulin	University of California, Davis	CA	USA
Bryan	Quaife	Florida State University	FL	USA
Rizwanur	Rahman	University of Utah	UT	USA
Chris	Reddy	Woods Hole Oceanographic Institution	MA	USA
Matthew	Reid	Cornell University	NY	USA
Clare	Reimers	Oregon State University	OR	USA
Daniel	Repeta	Woods Hole Oceanographic Institution	MA	USA
Charles	Rhoades	U.S. Department of Agriculture	CO	USA

First Name	Last Name	Organization	State	Country
Ryan	Rodgers	National High Magnetic Field Laboratory	FL	USA
Holly	Roth	Colorado State University	CO	USA
John	Sanford	University of Alabama, Birmingham	AL	USA
Yi	Sang	Cornell University	NY	USA
Mst	Sayadujjhara	Morgan State University	MD	USA
Leah	Schneider	University of North Texas	TX	USA
Michael	Senko	Thermo Fisher Scientific	VA	USA
Hamidreza	Sharifan	Colorado State University	CO	USA
Beth	Sharpe	Valdosta State University	GA	USA
Cameron	Shedlock	University of Scranton	PA	USA
Alexander	Shiklomanov	University of New Hampshire	NH	USA
Ronish	Shrestha	Worcester Polytechnic Institute	MA	USA
Viji	Sitther	Morgan State University	MD	USA
Mark	Skidmore	Montana State University	MT	USA
Ashlynn	Smith	Atlanta Botanical Garden	GA	USA
Donald	Smith	National High Magnetic Field Laboratory	FL	USA
Karl	Smith	National High Magnetic Field Laboratory	FL	USA
Laurence	Smith	Brown University	RI	USA
Carl	Snyder	Portland State University	OR	USA
Robert	Spangler	Florida Department of Environmental Protection	FL	USA
Robert	Spencer	Florida State University	FL	USA
Dennis	Ssekimpi	Florida State University	FL	USA
Gregg	Stanwood	Florida State University	FL	USA
Sommer	Starr	Florida State University	FL	USA
Sean	Stokes	Colorado State University	CO	USA
Rob	Striegl	U.S. Geological Survey	CO	USA
Ethan	Struhs	University of Idaho	ID	USA
Aron	Stubbins	Northeastern University	MD	USA
Michael	Stukel	Florida State University	FL	USA
Jonathan	Sweedler	University of Illinois at Urbana-Champaign	IL	USA
Behnam	Tabatabai	Morgan State University	MD	USA
Youneng	Tang	Florida State University	FL	USA
Huma	Tariq	Colorado State University	CO	USA
Andrew	Teixeira	Worcester Polytechnic Institute	MA	USA
Carson	Thompson	University of Wyoming	WY	USA
Michael	Timko	Worcester Polytechnic Institute	MA	USA
Geoffrey	Tompsett	Worcester Polytechnic Institute	MA	USA
Tiezheng	Tong	Colorado State University	CO	USA
Caitlin	Tressler	Johns Hopkins University School of Medicine	MD	USA
Pankaj	Trivedi	Colorado State University	CO	USA
Jamal	Uddin	Coppin State University	MD	USA

First Name	Last Name	Organization	State	Country
Christopher	Uejio	Florida State University	FL	USA
Julia	Valla	University of Connecticut	CT	USA
Jacob	VanderRoest	Colorado State University	CO	USA
Derrick	Vaughn	Florida State University	FL	USA
Cynthia	Vied	Florida State University	FL	USA
Alfred	Wadee	Lamar University	TX	USA
Sasha	Wagner	University of Georgia	GA	USA
Dy'mon	Walker	Morgan State University	MD	USA
Clifford	Walters	University of Texas, Austin	NJ	USA
Javion	Walters	National High Magnetic Field Laboratory	MD	USA
Robert	Wandell	Florida State University	FL	USA
Chao	Wang	University of North Carolina at Chapel Hill	NC	USA
Judy	Wang	National High Magnetic Field Laboratory	FL	USA
Chad	Weisbrod	National High Magnetic Field Laboratory	FL	USA
Richard	West	Northeastern University	MA	USA
Forest	White	Massachusetts Institute of Technology	MA	USA
Kimberly	Wickland	U.S. Geological Survey	CO	USA
Mike	Wilkins	Colorado State University	CO	USA
Henry	Williams	Florida Agricultural and Mechanical University	FL	USA
Rachel	Wilson	Florida State University	FL	USA
Marin	Wiltse	Colorado State University	CO	USA
Boswell	Wing	University of Colorado, Boulder	CO	USA
Andrew	Wozniak	University of Delaware	DE	USA
Xiaoqin	Wu	Lawrence Berkeley National Laboratory	CA	USA
LaDonna	Wyatt	Morgan State University	MD	USA
Li	Xiao	University of Alabama, Birmingham	AL	USA
Richard	Xie	University of Illinois at Urbana-Champaign	IN	USA
Jia	Xue	Florida Agricultural and Mechanical University	FL	USA
Neda	Yaghoobian	Florida State University	FL	USA
Yavuz	Yalcin	Morgan State University	MD	USA
Robert	Young	New Mexico State University, Main Campus	NM	USA
Oriane	Yvin	Florida State University	FL	USA
Renzun	Zhao	North Carolina Agricultural and Technical State University	NC	USA
Mengqiang	Zhu	University of Wyoming	WY	USA

ICR Facility – International Users (88)

First Name	Last Name	Organization	Country
Carlos	Afonso	Normandy University	France
Jason	Ahad	Natural Resources Canada	Canada
Martin	Andersen	University of New South Wales	Australia
Simon	Andersen	Schlumberger Canada Ltd	Canada
Alexandre	Anesio	Aarhus University	Denmark

First Name	Last Name	Organization	Country
Pieter	Aukes	University of Waterloo	Canada
Andy	Baker	University of New South Wales	Australia
Naji	Bassil	University of Manchester	UK
Tom	Battin	Ecole Polytechnique Federale de Lausanne	Switzerland
Tamzin	Blewett	University of Alberta	Canada
Jens	Blotevogel	Commonwealth Scientific and Industrial Research Organization	Australia
Matthew	Bogard	University of Lethbridge	Canada
Paolo	Bomben	Alberta Innovates	Canada
Michael	Böttcher	Leibniz Institute for Baltic Sea Research Warnemünde	Germany
Brice	Bouyssiere	University of Pau and the Adour Region	France
Sara	Cheema	Memorial University of Newfoundland	Canada
Alex	Cobb	Singapore-MIT Alliance for Research and Technology	Singapore
Marianny	Combariza	Industrial University of Santander	Colombia
Hendryk	Czech	University of Rostock	Germany
Maik	Damm	Technical University of Berlin	Germany
Vincent	De Staerke	Ecole Polytechnique Federale de Lausanne	Switzerland
Luis	Díaz-Sánchez	Industrial University of Santander	Colombia
Eva	Doting	Aarhus University	Denmark
Kerri	Finlay	University of Regina	Canada
Paul	Gammon	Natural Resources Canada	Canada
Deisy	Giraldo Davila	University of Pau and the Adour Region	France
Pierre	Giusti	Total	France
Murray	Gray	Alberta Innovates	Canada
Bertrand	Guenet	French National Center for Scientific Research	France
Benjamin-Florian	Hempel	Humboldt University of Berlin	Germany
Changchun	Huang	Nanjing University	China
Khoa	Huynh	Technical University of Denmark	Denmark
Manon	Janssen	University of Rostock	Germany
Anna-Kathrina	Jenner	Leibniz Institute for Baltic Sea Research Warnemünde	Germany
Sarah	Johnston	University of Lethbridge	Canada
Francesca	Kerton	Memorial University of Newfoundland	Canada
Anna	Khreptugova	Lomonosov Moscow State University	Russia
Steven	Kokelj	Northwest Territories Geological Survey	Canada
Paul	Kösling	University of Rostock	Germany
Dan	Lapworth	British Geological Survey	UK
Shuaidong	Li	Nanjing University	China
Jonathan	Lloyd	University of Manchester	UK
Stephanie	MacQuarrie	Cape Breton University	Canada
Caroline	Mangote	Total	France

First Name	Last Name	Organization	Country
Christopher	Marjo	University of New South Wales	Australia
Matthew	Marshall	University of Bristol	UK
Silvia	Martinez	University of Rostock	Germany
Liza	McDonough	Australian Nuclear Science and Technology Organization	Australia
Karina	Meredith	Australia's Nuclear Science and Technology Organization	Australia
Elizabeth	Mitchell	University of Southam	UK
Oliver	Moore	University of Manchester	UK
Ayse	Nalbantsoy	Ege University	Turkey
Anika	Neumann	University of Rostock	Germany
Denis	O'Carroll	University of New South Wales	Australia
Phetdala	Oudone	University of New South Wales	Australia
Ada	Pastor	Aarhus University	Denmark
Irina	Perminova	Lomonosov Moscow State University	Russia
Hannes	Peter	Ecole Polytechnique Federale de Lausanne	Switzerland
David	Polya	University of Manchester	UK
Olga	Popovicheva	Lomonosov Moscow State University	Russia
Erwin	Racasa	University of Rostock	Germany
Laura	Richards	University of Manchester	UK
Christopher	Rüger	University of Rostock	Germany
Helen	Rutlidge	University of New South Wales	Australia
Isaac	Santos	Southern Cross University	Australia
Krystyna	Saunders	Australian Nuclear Science and Technology Organization	Australia
Sherry	Schiff	University of Waterloo	Canada
Eric	Schneider	University of Rostock	Germany
Martina	Schön	Ecole Polytechnique Federale de Lausanne	Switzerland
Myrna	Simpson	University of Toronto (Toronto)	Canada
Olli	Sippula	University of Eastern Finland	Finland
Jaedyn	Smith	University of Alberta	Canada
Nikita	Sobolev	Lomonosov Moscow State University	Russia
Nivetha	Srikanthan	University of Toronto (Toronto)	Canada
Michael	Styllas	Ecole Polytechnique Federale de Lausanne	Switzerland
Roderich	Süssmuth	Technical University of Berlin	Germany
Suzanne	Tank	University of Alberta	Canada
Marina	Taskovic	University of Alberta	Canada
Nathaniel	Terra Telles Souza	University of Pau and the Adour Region	France
Matteo	Tolosano	Ecole Polytechnique Federale de Lausanne	Switzerland
Bart	van Dongen	University of Manchester	UK
Juliana	Vidal	Memorial University of Newfoundland	Canada
Catia Milene	von Ahn	Leibniz Institute for Baltic Sea Research Warnemünde	Germany

First Name	Last Name	Organization	Country
Jemma	Wadham	University of Bristol	UK
Wenzheng	Yu	Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences	China
Apoline	Zahorka	Ecole Normale Superieure	France
Mary	Zeller	Leibniz Institute for Baltic Sea Research Warnemünde	Germany
Ralf	Zimmermann	University of Rostock	Germany

NMR Facility – National Users (260)

First Name	Last Name	Organization	State	Country
Christer	Aakeroy	Kansas State University	KS	USA
Nastaren	Abad	Florida State University	FL	USA
Rajarshi	Acharyya	Florida State University	FL	USA
Moein	Adnami	Florida State University	FL	USA
Shiva	Agarwal	Western Michigan University	MI	USA
Hannah	Alderson	Florida State University	FL	USA
Adam	Altenhof	Florida State University	FL	USA
Jacob	Athey	Florida State University	FL	USA
Jochen	Autschbach	University of Buffalo	NY	USA
Frederick	Bagdasarian	Florida State University	FL	USA
Alimamy	Bangura	National High Magnetic Field Laboratory	FL	USA
Jamini	Bhagu	Florida State University	FL	USA
Ashley	Blue	National High Magnetic Field Laboratory	FL	USA
Paul	Bogie	University of Riverside	CA	USA
Richard	Bogie	University of Riverside	CA	USA
Cesario	Borlongan	University of South Florida	FL	USA
Yuliana	Bosken	University of California, Riverside	CA	USA
Clifford (Russ)	Bowers	University of Florida	FL	USA
Russell	Bowers	University of Florida	FL	USA
Jeannine	Brady	University of Florida	FL	USA
William	Brey	National High Magnetic Field Laboratory	FL	USA
Troy	Brumm	National High Magnetic Field Laboratory	FL	USA
Nhat Nguyen	Bui	National High Magnetic Field Laboratory	FL	USA
Bruce	Bunnell	Tulane University	LA	USA
Ercan	Cakmak	Oak Ridge National Laboratory	TN	USA
Maria Luiza	Caldas Nogueira	University of Florida	FL	USA
Thach	Can	Salk Institute for Biological Studies	CA	USA
Estely	Carranza	University of California, Davis	CA	USA
Bethany	Caulkins	University of California, Riverside	CA	USA
chia-en	Chang	University of California, Riverside	CA	USA
Bo	Chen	University of Central Florida	FL	USA
Kuizhi	Chen	National High Magnetic Field Laboratory	FL	USA
Yudan	Chen	Florida State University	FL	USA
Po-Hsiu	Chien	Florida State University	FL	USA
Mathew	Coats	East Carolina University	NC	USA
Carl	Conti	Florida State University	FL	USA
Myriam	Cotten	College of William and Mary	VA	USA
Tim	Cross	National High Magnetic Field Laboratory	FL	USA
Anvesh Kumar Reddy	Dasari	East Carolina University	NC	USA
Michael	Deck	Florida State University	FL	USA
Fabien	Deligey	Louisiana State University	LA	USA

First Name	Last Name	Organization	State	Country
Angelika	Dewicki	Washington and Jefferson College	PA	USA
Malitha	Dickwella Widanage	Louisiana State University	LA	USA
Hannah	Distaffen	University of Rochester	NY	USA
Rick	Dorn	Iowa State University	IA	USA
Justin	Douglas	University of Kansas	KS	USA
Zach	Dowdell	Florida State University	FL	USA
Victoria	Drango	University of Toledo	OH	USA
Liang	Du	Florida State University	FL	USA
Thierry	Dubroca	National High Magnetic Field Laboratory	FL	USA
Michael	Dunn	University of California, Riverside	CA	USA
Samuel	Eddy	West Virginia University	WV	USA
Art	Edison	University of Georgia	GA	USA
Elan	Eisenmesser	University of Colorado, Denver	CO	USA
Catherine	Fabiano	Florida State University	FL	USA
Debra	Fadool	Florida State University	FL	USA
Michael	Famiano	Western Michigan University	MI	USA
Daniel	Farb	University of California, Davis	CA	USA
Xuyong	Feng	Florida State University	FL	USA
Liyanage	Fernando	Michigan State University	MI	USA
Alberto	Fezda	University of Buffalo	NY	USA
Carl	Fleischer	Florida State University	FL	USA
Steven	Flynn	University of Florida	FL	USA
Blake	Fonda	University of California, Davis	CA	USA
Mark	Frank	Pennsylvania State University	PA	USA
Lucio	Frydman	National High Magnetic Field Laboratory	FL	USA
Riqiang	Fu	National High Magnetic Field Laboratory	FL	USA
Zhehong	Gan	National High Magnetic Field Laboratory	FL	USA
Rittik	Ghosh	University of California, Riverside	CA	USA
Adam	Gill	University of Riverside	CA	USA
Evan	Goodell	College of William and Mary	VA	USA
Petr	Gor'kov	National High Magnetic Field Laboratory	FL	USA
Samuel	Grant	National High Magnetic Field Laboratory	FL	USA
Alexander	Greenwood	University of Cincinnati	OH	USA
Robert	Griffin	Massachusetts Institute of Technology	MA	USA
Josef	Grundy	Colorado State University	CO	USA
Xiaodan	Gu	University of Southern Mississippi	MS	USA
Terry	Gullion	West Virginia University	WV	USA
Sossina	Haile	Northwestern University	IL	USA
David	Halat	Lawrence Berkeley National Laboratory	CA	USA
James	Harper	Brigham Young University (BYU)	UT	USA
Michael	Harrington	Huntington Medical Research Institutes	CA	USA
Kristopher	Harris	Louisiana Tech University	LA	USA

First Name	Last Name	Organization	State	Country
Karoline	Hebisch	Georgia Institute of Technology	GA	USA
Shannon	Helsper	National High Magnetic Field Laboratory	FL	USA
Katherine	Henzler-Wildman	University of Wisconsin, Madison	WI	USA
David	Hike	Florida State University	FL	USA
Eduardo	Hilario	University of Riverside	CA	USA
Anthony	Hoffman	Florida State University	FL	USA
Samuel	Holder	Florida State University	FL	USA
Jacob	Holmes	University of California, Riverside	CA	USA
Sean	Holmes	Florida State University	FL	USA
Jerris	Hooker	Florida Agricultural and Mechanical University	FL	USA
Lawrence	Hornak	University of Georgia	GA	USA
Wenhao	Hu	Florida State University	FL	USA
Yan-Yan	Hu	Florida State University	FL	USA
Ivan	Hung	National High Magnetic Field Laboratory	FL	USA
Sonjong	Hwang	California Institute of Technology	CA	USA
Sung	Hyun Cho	Pennsylvania State University	PA	USA
Stephan	Irle	Oak Ridge National Laboratory	TN	USA
Robbie	Iuliucci	Washington and Jefferson College	PA	USA
Khaled	Jami	University of California, Davis	CA	USA
Jaekyun	Jeon	National Institutes of Health	MD	USA
Yongkang	Jin	Florida State University	FL	USA
Taylor	Johnston	Florida State University	FL	USA
Brenton	Jones	Florida State University	FL	USA
Taigyu	Joo	Massachusetts Institute of Technology	MA	USA
Gang Seob	Jung	Oak Ridge National Laboratory	TN	USA
Xue	Kang	Louisiana State University	LA	USA
Baris	Key	Argonne National Laboratory	IL	USA
Md Imran	Khan	University of Central Florida	PR	USA
James	Kimball	Florida State University	FL	USA
Alex	Kirui	Louisiana State University	LA	USA
Abe	Kolko	University of California, Santa Barbara	CA	USA
Krishnendu	Kundu	National High Magnetic Field Laboratory	FL	USA
Vilius	Kurauskas	University of Wisconsin, Madison	WI	USA
Jason	Kuszynski	Florida State University	FL	USA
ralf	langen	University of Southern California	CA	USA
Edgar	Lara-Curzio	Oak Ridge National Laboratory	TN	USA
Choogon	Lee	Florida State University	FL	USA
Hyunhee	Lee	Massachusetts Institute of Technology	MA	USA
Jea-Young	Lee	University of South Florida	FL	USA
Cathy	Levenson	Florida State University	FL	USA
Xiang	Li	California Institute of Technology	CA	USA
Yanna	Liang	University at Albany	NY	USA

First Name	Last Name	Organization	State	Country
Kwang Hun	Lim	East Carolina University	NC	USA
Ilya	Litvak	National High Magnetic Field Laboratory	FL	USA
Haoyu	Liu	Florida State University	FL	USA
Haoyu	Liu	Argonne National Laboratory	IL	USA
Joanna	Long	University of Florida	FL	USA
Thorsten	Maly	Bridge12, Technologies, Inc.	MA	USA
Wenping	Mao	National High Magnetic Field Laboratory	FL	USA
Roxanna	Martinez	Colorado State University	CO	USA
Harris	Mason	Los Alamos National Laboratory	NM	USA
Jonathan	Mathews	Pennsylvania State University	PA	USA
Hedi	Mattoussi	Florida State University	FL	USA
William	McCall	Augusta University	GA	USA
Sam	McCalpin	University of Michigan	MI	USA
Steven	McKnight	University of Texas, Southwestern	TX	USA
Anil	Mehta	University of Florida	FL	USA
Frederic	Mentink	National High Magnetic Field Laboratory	FL	USA
Matthew	Merritt	University of Florida	FL	USA
Gellert	Mezei	Western Michigan University	MI	USA
Joel	Miller	University of Utah	UT	USA
John	Miller	Western Michigan University	MI	USA
Hadi	Mohammadigoushki	Florida State University	FL	USA
Lisa	Monluc	Florida State University	FL	USA
Lisa	Monluc	Florida State University	FL	USA
Leonard	Mueller	University of California, Riverside	CA	USA
Timothy	Mueser	University of Toledo	OH	USA
Tim	Murphy	National High Magnetic Field Laboratory	FL	USA
Dylan	Murray	University of California Davis	CA	USA
Karthik	Nagapudi	Genentech Inc.	CA	USA
Bradley	Nilsson	University of Rochester	NY	USA
B.	Nixon	Pennsylvania State University	PA	USA
Joseph	Noel	Salk Institute for Biological Studies	CA	USA
nada	Nosratabad	Florida State University	FL	USA
Robert	Nowell	National High Magnetic Field Laboratory	FL	USA
Jordan	Ogg	Florida State University	FL	USA
Raul	Ortega	Florida State University	FL	USA
Kevin	O'Shea	Florida International University	FL	USA
Dmitry	Ostrovsky	University of Alaska, Anchorage	AK	USA
Kayla	Osumi	University of California, Davis	CA	USA
Tyler	Ozvat	Colorado State University	CO	USA
Nitin	Pandey	Keck School of Medicine of USC	CA	USA
Anant	Paravastu	Georgia Institute of Technology	GA	USA
Sawankumar	Patel	Florida State University	FL	USA

First Name	Last Name	Organization	State	Country
Joana	Paulino	National High Magnetic Field Laboratory	FL	USA
Austin	Peach	Florida State University	FL	USA
Qingqing (Emily)	Peng	University of Florida	FL	USA
Linda	Petzold	University of California, Santa Barbara	CA	USA
Adam	Phillips	University of Buffalo	NY	USA
Kenneth	Poeppelmeier	Northwestern University	IL	USA
Andy	Powell	National High Magnetic Field Laboratory	FL	USA
Huajun	Qin	Florida State University	FL	USA
David	Quezada Estrada	Florida State University	FL	USA
Elena	Quigley	University of Rochester	NY	USA
Rosalynn	Quiñones	Marshall University	WV	USA
Jenna	Radovich	Florida State University	FL	USA
Ayyalusamy	Ramamoorthy	University of Michigan	MI	USA
Steven	Ranner	National High Magnetic Field Laboratory	FL	USA
Peter	Rassolov	Florida State University	FL	USA
Jeffrey	Reimer	University of California, Berkeley	CA	USA
Dayna	Richter	Florida State University	FL	USA
Jennifer	Romero	University of Riverside	CA	USA
Mary	Rooney	College of William and Mary	VA	USA
Jens	Rosenberg	University of Florida	FL	USA
Aaron	Rossini	Iowa State University	IA	USA
Edward	Saliba	Massachusetts Institute of Technology	MA	USA
Omid	Sanati	University of Georgia	GA	USA
Jazmine	Sanchez	Florida State University	FL	USA
Stephanie	Sanchez	Colorado State University	CO	USA
Sheel	Sangvi	Northwestern University	IL	USA
Victor	Schepkin	National High Magnetic Field Laboratory	FL	USA
Jeffrey	Schiano	Pennsylvania State University	PA	USA
Jasmin	Schoenzart	Florida State University	FL	USA
Robert	Schurko	Florida State University	FL	USA
Alfredo	Scigliani	Florida State University	FL	USA
Faith	Scott	National High Magnetic Field Laboratory	FL	USA
Sabyasachi	Sen	University of California, Davis	CA	USA
Michael	Shatruk	National High Magnetic Field Laboratory	FL	USA
S.	Shekar	Louisiana State University	LA	USA
A. Dean	Sherry	University of Texas, Southwestern	TX	USA
Ansgar	Siemer	University of Southern California	CA	USA
Carsten	Sievers	Georgia Institute of Technology	GA	USA
Aritra	Sil	Northwestern University	IL	USA
Robert	Silvers	Florida State University	FL	USA
Julia	Smith	National High Magnetic Field Laboratory	FL	USA
Robert	Smith	National High Magnetic Field Laboratory	FL	USA

First Name	Last Name	Organization	State	Country
Robert	Smith	Florida State University	FL	USA
Zachary	Smith	Massachusetts Institute of Technology	MA	USA
Likai	Song	National High Magnetic Field Laboratory	FL	USA
Murari	Soundararajan	National High Magnetic Field Laboratory	FL	USA
Albert	Stiegman	Florida State University	FL	USA
Geoffrey	Strouse	National High Magnetic Field Laboratory	FL	USA
Matthew	Swulious	Pennsylvania State University	PA	USA
Vasily	Sysoev	University of Texas, Southwestern	TX	USA
Mingxue	Tang	Florida State University	FL	USA
Waroch	Tangbampensountorn	Pennsylvania State University	PA	USA
Sara	Termos	Florida State University	FL	USA
Janet	Tests	Columbia University	NY	USA
Jason	Thomas	University of Florida	FL	USA
Jeremy	Thomas	University of Florida	FL	USA
Suzanne	Thomas	Salk Institute for Biological Studies	CA	USA
Erica	Truong	Florida State University	FL	USA
Okten	Ungor	Colorado State University	CO	USA
Jose	Uribe	University of California, Irvine	CA	USA
Johan	van Tol	National High Magnetic Field Laboratory	FL	USA
Cameron	Vojvodin	Florida State University	FL	USA
Liliya	Vugmeyster	University of Colorado, Denver	CO	USA
Louis	Wang	Northwestern University	IL	USA
Pengbo	Wang	Florida State University	FL	USA
Ping	Wang	University of Louisiana at Lafayette	LA	USA
Shengyu	Wang	National High Magnetic Field Laboratory	FL	USA
Tuo	Wang	Michigan State University	MI	USA
Wentao	Wang	Florida State University	FL	USA
Xiaoling	Wang	California State University, East Bay	CA	USA
Jeffery	White	Oklahoma State University	OK	USA
Sungsool	Wi	National High Magnetic Field Laboratory	FL	USA
Aaron	Wilber	Florida State University	FL	USA
Blake	Wilson	National Institutes of Health	MD	USA
Yuuki	Wittmer	University of California, Davis	CA	USA
Anna	Wright	National High Magnetic Field Laboratory	FL	USA
Yan	Xin	National High Magnetic Field Laboratory	FL	USA
Hui	Xiong	Boise State University	IN	USA
Kaya	Xu	University of South Florida	FL	USA
Yijue	Xu	National High Magnetic Field Laboratory	FL	USA
Hui	Yang	Pennsylvania State University	PA	USA
Jing Ying	Yeo	Massachusetts Institute of Technology	MA	USA
Sujung	Yi	East Carolina University	NC	USA
Robert	Young	Pacific Northwest National Laboratory	WA	USA

First Name	Last Name	Organization	State	Country
Ge	Yu	Florida State University	FL	USA
Bing	Yuan	University of California, Davis	CA	USA
Xuegang	Yuan	Florida State University	FL	USA
Joseph	Zadrozny	Colorado State University	CO	USA
Rongfu	Zhang	National High Magnetic Field Laboratory	FL	USA
Weilan	Zhang	University at Albany	NY	USA
Wancheng	Zhao	Michigan State University	MI	USA
Huan-Xiang	Zhou	University of Illinois at Chicago	IL	USA
Andrea	Zourou	College of William and Mary	VA	USA

NMR Facility – International Users (94)

First Name	Last Name	Organization	Country
Louae	Abdulla	University of Windsor	Canada
Catherine	Amiens	University of Toulouse	France
Alexander	Baer	University of Kassel	Germany
Jose Luis	Belmonte	National Autonomous University of Mexico	Mexico
Eric	Breynaert	Catholic University Leuven	Belgium
David	Bryce	University of Ottawa	Canada
Olivier	Cala	Center of Nuclear Magnetic Resonance at Very High Fields	France
Quentin	Chappuis	Ecole Normale Superieure de Lyon	France
Chia-Hsin	Chen	French National Center for Scientific Research	France
Yannick	Coppel	French National Center for Scientific Research	France
David	De Haro Del Rio	Autonomous University of Nuevo León	Mexico
Rivera	de la Rosa	Autonomous University of Nuevo León	Mexico
Gael	De Paepe	French Alternative Energies and Atomic Energy Commission	France
Richa	Dubey	Centre of Biomedical Research	India
Navneet	Dwivedi	Integral University	India
Pierre	Florian	French National Center for Scientific Research	France
Alexander	Forse	University of Cambridge	UK
Nicolas	Freytag	Bruker Biospin AG	Switzerland
Tomislav	Friscic	McGill University	Canada
Marco	Garza-Navarro	Autonomous University of Nuevo León	Mexico
Christel	Gervais	Sorbonne University	France
Ieva	Goldberga	French National Center for Scientific Research	France
jue	Gong	University of Electronic Science and Technology of China	China
Eric	Gottwald	Karlsruhe Institute of Technology	Germany
Thomas	Halbritter	University of Iceland	Iceland
Anton	Hanopolsky	Weizmann Institute of Science	Israel
Rania	Harrabi	French Alternative Energies and Atomic Energy Commission	France
Matthew	Harrington	McGill University	Canada

First Name	Last Name	Organization	Country
Alia	Hassan	Bruker Biospin AG	Switzerland
Sabine	Hediger	French Alternative Energies and Atomic Energy Commission	France
Ernesto	Hernandez-Morales	National Autonomous University of Mexico	Mexico
Erick	Hernandez-Santiago	National Autonomous University of Mexico	Mexico
James	Hook	University of New South Wales	Australia
Yining	Huang	University of Western Ontario	Canada
Igor	Huskic	McGill University	Canada
Marina	Ilkaeva	University of Aveiro	Portugal
Sami	Jannin	Ecole Normale Superieure de Lyon	France
Michael	Jaroszewicz	University of Windsor	Canada
Myrtil	Kahn	French National Center for Scientific Research	France
Dennis	Kleimaier	Heidelberg University	Germany
Xueqian	Kong	Zhejiang University	China
Olivier	Lafon	University of Lille	France
Danielle	Laurencin	University of Montpellier	France
Daniel	Lee	University of Manchester	UK
César	Leroy	French National Center for Scientific Research	France
Józef	Lewandowski	University of Warwick	UK
Jiangnan	Li	University of Manchester	UK
Carlos Javier	Lucio Ortiz	Autonomous University of Nuevo León	Mexico
Luís	Mafra	University of Aveiro	Portugal
Isabelle	Marcotte	University of Quebec at Montreal	Canada
Ildefonso	Marin-Montesinos	University of Aveiro	Portugal
Vinicius	Martins	University of Western Ontario	Canada
Georg	Mayer	University of Kassel	Germany
Jose	Mejia-Aleman	National Autonomous University of Mexico	Mexico
Thomas-Xavier	Métro	Institut des Biomolécules Max Mousseron	France
Francisco José	Morales-Leal	Autonomous University of Nuevo León	Mexico
Hiroki	Nagashima	National Institute of Advanced Industrial Science and Technology	Japan
Armando	Navarro-Huerta	National Autonomous University of Mexico	Mexico
Adam	Nelson	Sorbonne University	France
Mihajlo	Novakovic	Weizmann Institute of Science	Israel
Subrhadip	Paul	French Alternative Energies and Atomic Energy Commission	France
Xinhua	Peng	University of Science and Technology of China	China
Daniel	Pereira	University of Aveiro	Portugal
Arthur	Pinon	University of Gothenburg	Sweden
Alexandre	Poulhazan	University of Quebec at Montreal	Canada
Suzi	Pugh	University of Cambridge	UK
Vijay	Ramaswamy	Bruker Biospin AG	Switzerland
Dr Vinayak	Rane	Indian Institute of Geomagnetism	India

First Name	Last Name	Organization	Country
Jeremy	Rawson	University of Windsor	Canada
Simon	Reichert	Heidelberg University	Germany
Benjamin	Rhodes	University of Cambridge	UK
Gwladys	Riviere	Max Planck Institute for Biophysical Chemistry, Goettingen	Germany
Lizbeth	Rodriguez-Cortes	National Autonomous University of Mexico	Mexico
Braulio	Rodríguez-Molina	National Autonomous University of Mexico	Mexico
Evelin	Ruiz-Zamora	Autonomous University of Nuevo León	Mexico
Luis	Sánchez-Muñoz	Consejo Superior de Investigaciones Científicas	Spain
Ladislao	Sandoval-Rangel	Monterrey Institute of Technology and Higher Education	Mexico
Mariana	Sardo	University of Aveiro	Portugal
Lothar	Schad	Heidelberg University	Germany
Stephan	Schmidt	Heinrich Heine University Düsseldorf	Germany
Snorri	Sigurdsson	University of Iceland	Iceland
Neeraj	Sinha	Centre of Bio-Medical Research (CBMR)	India
Carolina	Solis Maldonado	Veracruzan University	Mexico
Jessica	Spackova	University of Montpellier	France
Pingchuan	Sun	Nankai University	China
Nidhi	Tiwari	Centre of Biomedical Research	India
Julien	Trebosc	University of Lille	France
Fenfen	Wang	Nankai University	China
Lara	Watanabe	University of Windsor	Canada
Gang	Wu	Queen's University at Kingston	Canada
Yuanzheng	Yue	Aalborg University	Denmark
Chi	Zhang	Institute of Semiconductors	China
Wanli	Zhang	University of Western Ontario	Canada
Lina	Zhou	University of Cambridge	UK

Pulsed Field Facility – National Users (140)

First Name	Last Name	Organization	State	Country
James	Analytis	University of California, Berkeley	CA	USA
Fedor	Balakirev	National High Magnetic Field Laboratory	NM	USA
Alimamy	Bangura	National High Magnetic Field Laboratory	FL	USA
Eric	Bauer	Los Alamos National Laboratory	NM	USA
Ryan	Baumbach	National High Magnetic Field Laboratory	FL	USA
Jonathan	Betts	National High Magnetic Field Laboratory	NM	USA
Anand	Bhattacharya	Argonne National Laboratory	IL	USA
Joanna	Blawat	University of South Carolina	LA	USA
Avery	Blockmon	University of Tennessee, Knoxville	TN	USA
Greg	Boebinger	National High Magnetic Field Laboratory	FL	USA
Matthew	Brahlek	Oak Ridge National Laboratory	TN	USA
Collin	Broholm	Johns Hopkins University	MD	USA
Sergey	Bud'ko	Ames Laboratory	IA	USA
John	Bulmer	Air Force Research Laboratory	FL	USA
Nicholas	Butch	National Institute of Standards and Technology	MD	USA
Marshall	Campbell	Los Alamos National Laboratory	NM	USA
Paul	Canfield	Ames Laboratory	IA	USA
Aaron	Chan	University of Michigan	MI	USA
Mun	Chan	National High Magnetic Field Laboratory	NM	USA
Cui-Zu	Chang	Pennsylvania State University	PA	USA
Greta	Chappell	Los Alamos National Laboratory	NM	USA
Shouvik	Chatterjee	University of California Santa Barbara	CA	USA
Joseph	Checkelsky	Massachusetts Institute of Technology	MA	USA
Aiping	Chen	Los Alamos National Laboratory	NM	USA
Kuan-Wen	Chen	University of Michigan	MI	USA
Tong	Chen	Johns Hopkins University	MD	USA
Sang Wook	Cheong	Rutgers University	NJ	USA
Junho	Choi	Los Alamos National Laboratory	NM	USA
Su Kong	Chong	University of California, Los Angeles	CA	USA
George	Christou	University of Florida	FL	USA
Scott	Crooker	National High Magnetic Field Laboratory	NM	USA
Maximilien	Debbas	Massachusetts Institute of Technology	MA	USA
Connor	Dempsey	University of California, Santa Barbara	CA	USA
Aravind	Devarakonda	Columbia University	NY	USA
Qianheng	Du	Brookhaven National Laboratory	NY	USA
Priscila	Ferrari Silveira Rosa	Los Alamos National Laboratory	NM	USA
Corey	Frank	National Institute of Standards and Technology	MD	USA
Eduard	Galstyan	University of Houston	TX	USA
Yuxiang	Gao	Rice University	TX	USA
Aranya	Goswami	University of California, Santa Barbara	CA	USA
David	Graf	National High Magnetic Field Laboratory	FL	USA

First Name	Last Name	Organization	State	Country
Richard	Greene	University of Maryland, College Park	MD	USA
Yingdong	Guan	Pennsylvania State University	PA	USA
Shannon	Haley	University of California, Berkeley	CA	USA
Minyong	Han	Massachusetts Institute of Technology	MA	USA
Neil	Harrison	National High Magnetic Field Laboratory	NM	USA
Tim	Haugan	Air Force Research Laboratory	Oh	USA
Joseph	Hayden	University of Maryland, College Park	MD	USA
Pei-Chun	Ho	California State University, Fresno	CA	USA
Hadass	Inbar	University of California, Santa Barbara	CA	USA
Daniel	Jackson	National High Magnetic Field Laboratory	NM	USA
Marcelo	Jaime	National High Magnetic Field Laboratory	NM	USA
Luis	Jauregui	University of California, Irvine	CA	USA
Kaila	Jenkins	University of Michigan	MI	USA
Rongying	Jin	University of South Carolina	SC	USA
Caolan	John	Massachusetts Institute of Technology	MA	USA
Rubi	Km	Los Alamos National Laboratory	NM	USA
Seyed	Koohpayeh	Johns Hopkins University	MD	USA
Satya	Kushwaha	Los Alamos National Laboratory	NM	USA
Hyunchul	Kwon	University of California, Berkeley	CA	USA
Antu	Laha	Pennsylvania State University	PA	USA
Minseong	Lee	Los Alamos National Laboratory	NM	USA
Sangyun	Lee	Los Alamos National Laboratory	NM	USA
Seng Huat	Lee	Pennsylvania State University	PA	USA
Shiming	Lei	Rice University	TX	USA
Sylvia	Lewin	University of Maryland, College Park	MD	USA
Lu	Li	University of Michigan	MA	USA
Yanan	Li	Pennsylvania State University	PA	USA
Yi	Li	University of Houston	TX	USA
Jinyu	Liu	Tulane University	LA	USA
Yu	Liu	Brookhaven National Laboratory	NY	USA
Jeffrey	Long	University of California, Berkeley	CA	USA
Chris	Lygouras	Johns Hopkins University	MD	USA
Boris	Maiorov	Los Alamos National Laboratory	NM	USA
Nikola	Maksimovic	University of California, Berkeley	CA	USA
David	Mandrus	University of Tennessee, Knoxville	TN	USA
Zhiqiang	Mao	Pennsylvania State University	PA	USA
Brian	Maple	University of California, San Diego	CA	USA
Alessandro	Mazza	Los Alamos National Laboratory	NM	USA
Ross	McDonald	National High Magnetic Field Laboratory	NM	USA
Tony	McFadden	University of California, Santa Barbara	CA	USA
Robert	McQueeney	Ames Laboratory	IA	USA
Lujin	Min	Pennsylvania State University	PA	USA

First Name	Last Name	Organization	State	Country
Christopher	Mizzi	Los Alamos National Laboratory	NM	USA
Emilia	Morosan	Rice University	TX	USA
Roman	Movshovich	Los Alamos National Laboratory	NM	USA
Janice	Musfeldt	University of Tennessee, Knoxville	TN	USA
Brianna	Musico	Los Alamos National Laboratory	NM	USA
Vikram	Nagarajan	University of California, Berkeley	CA	USA
Nityan	Nair	University of California, Berkeley	CA	USA
Paul	Neves	Massachusetts Institute of Technology	MA	USA
Martin	Nikolo	Saint Louis University	MO	USA
Magdalena	Owczarek	Los Alamos National Laboratory	NM	USA
Chris	Palmstrom	University of California, Santa Barbara	CA	USA
Johanna	Palmstrom	Los Alamos National Laboratory (LANL)	NM	USA
Kiman	Park	University of Tennessee, Knoxville	TN	USA
Michael	Pettes	Los Alamos National Laboratory	NM	USA
William	Phelan	Los Alamos National Laboratory	NM	USA
Kemp	Plumb	Brown University	RI	USA
Lucas	Pressley	Johns Hopkins University	MD	USA
Luke	Pritchard Cairns	University of California, Berkeley	CA	USA
Brad	Ramshaw	Cornell University	NY	USA
Sheng	Ran	Washington University in St. Louis	MO	USA
Dan	Read	University of California, Santa Barbara	CA	USA
Josue	Rodriguez	University of California, Berkeley	CA	USA
Filip	Ronning	Los Alamos National Laboratory	NM	USA
Nitin	Samarth	Pennsylvania State University	PA	USA
Tarapada	Sarkar	University of Maryland, College Park	MD	USA
Gicela	Saucedo Salas	University of Maryland, College Park	MD	USA
Krista	Sawchuk	Los Alamos National Laboratory	NM	USA
Rico	Schoenemann	Los Alamos National Laboratory	NM	USA
Katherine	Schreiber	National High Magnetic Field Laboratory	NM	USA
Venkat	Selvamanickam	University of Houston	TX	USA
Michael	Shatruk	National High Magnetic Field Laboratory	FL	USA
Arkady	Shehter	Los Alamos National Laboratory	NM	USA
John	Singleton	National High Magnetic Field Laboratory	NM	USA
Max	Stanley	Pennsylvania State University	PA	USA
Fazel	Tafti	Boston College	MA	USA
Paul	Tobash	National High Magnetic Field Laboratory	NM	USA
Joshua	Wakefield	Massachusetts Institute of Technology	MA	USA
James	Wampler	Los Alamos National Laboratory	NM	USA
Ping	Wang	Florida State University	FL	USA
Qiaochu	Wang	Brown University	RI	USA
Thomas	Ward	Oak Ridge National Laboratory	TN	USA
Mark	Wartenbe	Los Alamos National Laboratory	NM	USA

First Name	Last Name	Organization	State	Country
Laurel	Winter	National High Magnetic Field Laboratory	NM	USA
Ziji	Xiang	University of Michigan	MI	USA
Vamsi	Yerraguravagari	University of Houston	TX	USA
Hemian	Yi	Pennsylvania State University	PA	USA
Vivien	Zapf	National High Magnetic Field Laboratory	NM	USA
Dechen	Zhang	University of Michigan	MI	USA
Shengzhi	Zhang	Los Alamos National Laboratory	NM	USA
Shu Yang	Zhao	Massachusetts Institute of Technology	MA	USA
Yi-Fan	Zhao	Pennsylvania State University	PA	USA
Guoxin	Zheng	University of Michigan	MI	USA
Kent (Jingxu)	Zheng	Massachusetts Institute of Technology	NY	USA
Haidong	Zhou	University of Tennessee, Knoxville	TN	USA
Jun	Zhu	Pennsylvania State University	PA	USA
Junbo	Zhu	Massachusetts Institute of Technology	MA	USA
Yanglin	Zhu	Tulane University	LA	USA

Pulsed Field Facility – International Users (23)

First Name	Last Name	Organization	Country
Ariando	Ariando	National University of Singapore	Singapore
Andrea	Augieri	ENEA Research Center, Frascati	Italy
Geetha	Balakrishnan	University of Warwick	UK
Giuseppe	Celentano	ENEA Research Center, Frascati	Italy
Matthew	Coak	University of Warwick	UK
Paul	Goddard	University of Warwick	UK
Kathrin	Goetze	Deutsches Elektronen-Synchrotron DESY	Germany
Gaia	Grimaldi	National Research Council CNR	Italy
Junxiong	Hu	National University of Singapore	Singapore
Masood	Khan	University of Salerno	Italy
Agnieszka	Lekawa-Raus	University of Cambridge	UK
Antonio	Leo	University of Salerno	Italy
Eran	Maniv	Ben Gurion University of the Negev	Israel
Xavier	Marie	National Institute for Applied Sciences, Toulouse	France
Yuji	Matsuda	Kyoto University	Japan
Kimberly	Modic	Institute of Science and Technology Austria	Austria
Amit	Nathwani	Institute of Science and Technology Austria	Austria
Muhammad	Nauman	Institute of Science and Technology Austria	Austria
Angela	Nigro	University of Salerno	Italy
Joonbum	Park	Helmholtz Zentrum Dresden-Rossendorf	Germany
Bernhard	Urbaszek	National Institute for Applied Sciences, Toulouse	France
Shroya	Vaidya	University of Warwick	UK
Valeska	Zambra	Institute of Science and Technology Austria	Austria

APPENDIX 5 - USER PROPOSAL

AMRIS Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Daniel R. Talham (S)	PI	University of Florida	Chemistry	No other support			**P17951**	Polymer coated lanthanide nanoparticles as PARACEST MRI contrast agents	Chemistry	1	0.83
Pratik Roy (G)	C	University of Florida	Chemistry								
Pascal Bernatchez (S)	PI	University of British Columbia	Anesthesiology, Pharmacology, & Therapeutics	No other support			**P18061**	Imaging tissue heterogeneity in a new model of chronic muscle damage with fibrofatty infiltration and wasting.	Biology, Biochemistry, Biophysics	1	11.83
Elisabeth Barton (S)	C	University of Florida	Applied Physiology and Kinesiology								
Abhinandan Batra (G)	C	University of Florida	Physical therapy								
Ram Khattri (P)	C	University of Florida	Biochemistry and molecular biology/medicine								
Glenn Walter (S)	C	University of Florida	Physiology and Aging								
Huadong Zeng (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff								
Benjamin Wylie (S)	PI	Texas Tech University Department of Chemistry and Biochemistry	Chemistry and Biochemistry	No other support		DMR1644779	**P19164**	Determining the dynamic structure of lipid-membrane protein complexes via solid-state NMR	Biology, Biochemistry, Biophysics	1	12.5
Reza Amani (G)	C	Texas Tech University	Chemistry and Biochemistry								
Anil Mehta (S)	C	University of Florida	AMRIS								
Maryam Yekefallah (G)	C	Texas Tech University	Chemistry and Biochemistry								
Adam Veige (S)	PI	University of Florida	Chemistry	NSF	CHE - Chemistry	CHE1808234	**P19170**	Quantification of End Groups in Cyclic vs. Linear Polyacetylenes by Carbon-13 Magic Angle Spinning Nuclear Magnetic Resonance Spectroscopy	Biology, Biochemistry, Biophysics	1	13.5
Clifford (Russ) Bowers (S)	C	University of Florida	Chemistry								
Alec Esper (G)	C	University of Florida	Chemistry								
Zhihui Miao (G)	C	University of Florida	Department of Chemistry								
Yu-Hsuan Shen (G)	C	University of Florida	Chemistry								
Brent Sumerlin (S)	C	University of Florida	Chemistry								
Johnny Figueroa (S)	PI	Loma Linda University	Center for Health Disparities and Molecular Medicine	No other support			**P19197**	Microstructural Correlates of Adolescent Adversity	Biology, Biochemistry, Biophysics	1	45
Marcelo Febo (S)	C	University of Florida	Psychiatry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Marjory Pompilus (G)	C	University of Florida	Psychiatry						
Matthew Eddy (S)	PI	University of Florida	Chemistry	No other support	**P19419**	ML-EDDY-002: Small molecule fragment screening with GPCRs in natural membranes by HRMAS NMR	Biology, Biochemistry, Biophysics	1	37.5
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology						
Guillaume Ferre' (S)	C	Université Toulouse III - Paul Sabatier	Institut de Pharmacologie et Biologie Structurale						
Niloofar Gopal Pour (G)	C	University of Florida	Chemistry						
Hala Hachem (G)	C	University of Florida	Chemistry						
Beining (Kim) Jin (G)	C	University of Florida	Chemistry						
Emma Mulry (G)	C	University of Florida	Chemistry						
Enzo Petracco (G)	C	University of Florida	Chemistry						
Arka Prabha Ray (G)	C	University of Florida	Chemistry						
Naveen Thakur (G)	C	University of Florida	Chemistry						
Jeffrey Rudolf (S)	PI	University of Florida	Chemistry	No other support	**P19437**	Bacterial terpenoids and their biosynthesis	Biology, Biochemistry, Biophysics	1	11.17
Tyler Alsup (G)	C	University of Florida	Chemistry						
Michelle Ehrenberger (G)	C	University of Florida	Chemistry						
Daniel Icenhour (G)	C	University of Florida	Chemistry						
Zining Li (P)	C	University of Florida	Chemistry						
Caitlin McCadden (G)	C	University of Florida	Chemistry						
Wenbo Ning (G)	C	University of Florida	Chemistry						
Xiuting Wei (G)	C	University of Florida	Chemistry						
Baofu Xu (P)	C	University of Florida	chemistry						
Jonathan Judy (S)	PI	University of Florida	Soil and Water Sciences	South Florida Water Management District Other	**P19466**	Evaluating the Nature of Phosphorus Entering, Within and Leaving Everglades Stormwater Treatment Areas (STAs)	Chemistry	1	35.17
A. Caroline Buchanan (G)	C	University of Florida	Ag - Soil and Water Science						
Lilit Vardanyan (P)	C	University of Florida	Soil and Water Science						

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alaji Bah (S)	PI *	SUNY Upstate Medical University	Biochemistry & Molecular Biology	No other support	**P19486**	ML-BAH-001: Elucidating the role of PTMs in regulating the Structure, Dynamics, binding and phase separation of Intrinsically Disordered Proteins (IDPs)	Biology, Biochemistry, Biophysics	1	7.5
Leonardo Dettori (G)	C	SUNY Upstate Medical University	Biochemistry and Molecular Biology						
Anil Mehta (S)	C	University of Florida	AMRIS						
Joanna Long (S)	PI	University of Florida	Biochemistry & Molecular Biology	No other support	**P19543**	MAINTENANCE: Routine maintenance of existing equipment (formerly P09510 and P17541)	Development of Magnet Technology	1	244
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology						
Thomas Mareci (S)	C	University of Florida	Biochemistry and Molecular Biology						
Anil Mehta (S)	C	University of Florida	AMRIS						
James Rocca (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Jens Rosenberg (S)	C	University of Florida	AMRIS						
Huadong Zeng (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Joanna Long (S)	PI	University of Florida	Biochemistry & Molecular Biology	No other support	**P19551**	New equipment/upgrades/troubleshooting on horizontals (formerly P09509 and P17540	Development of Magnet Technology	1	28.5
Malathy Elumalai (O)	C	Florida State University	NMR-MRI						
Kelly Jenkins (T)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Joshua Slade (T)	C	University of Florida	AMRIS						
Huadong Zeng (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Joanna Long (S)	PI	University of Florida	Biochemistry & Molecular Biology	No other support	**P19552**	New equipment/upgrades/troubleshooting on verticals (formerly P09507 and P17539)	Development of Magnet Technology	1	207.67
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology						
Malathy Elumalai (O)	C	Florida State University	NMR-MRI						
Anil Mehta (S)	C	University of Florida	AMRIS						
James Rocca (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Joshua Slade (T)	C	University of Florida	AMRIS						
Joanna Long (S)	PI	University of Florida	Biochemistry & Molecular Biology	No other support	**P19554**	New user training (formerly P09511 and P17542)	Development of Magnet Technology	1	151.83
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology						
Malathy Elumalai (O)	C	Florida State University	NMR-MRI						

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Thomas Mareci (S)	C	University of Florida	Biochemistry and Molecular Biology						
Anil Mehta (S)	C	University of Florida	AMRIS						
James Rocca (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Huadong Zeng (S)	C	University of Florida	AMRIS Affiliated Faculty & Staff						
Luke Arbogast (S)	PI	National Institute of Standards and Technology MD	Institute for Bioscience and Biotechnology Research	No other support	**P19588**	Investigation of solid-state NMR for characterization of stability in spray-dried protein therapeutic formulations	Biology, Biochemistry, Biophysics	1	15.5
John Marino (S)	C	National Institute of Standards and Technology MD	Institute for Bioscience and Biotechnology Research						
Anil Mehta (S)	C	University of Florida	AMRIS						
Sandra Loesgen (S)	PI	Whitney Laboratory (UF)	Chemistry	No other support	**P19658**	Structural characterization of novel microbial metabolites and their biological activity	Chemistry	1	3
Matthew Merritt (S)	PI	University of Florida	Biochemistry and Molecular Biology	No other support	**P19683**	Segmented Flow LC-NMR-MS for Lipidomic Analysis	Biology, Biochemistry, Biophysics	1	10.33
Timothy Garrett (S)	C	University of Florida							
Jiajun Lei (G)	C	University of Florida	Chemistry						
Rohit Mahar (P)	C	University of Florida	Biochemistry and molecular biology						
Richard Yost (S)	C	University of Florida	Chemistry						
Gerald Schneider (S)	PI *	Louisiana State University	Chemistry	No other support	**P19693**	Long-term Diffusion of Bottlebrush Polymers in Different Environments	Biology, Biochemistry, Biophysics	1	13.5
Karin Bichler (P)	C	Louisiana State University	Chemistry						
Bruno Jakobi (P)	C	Louisiana State University	Chemistry						
Thomas Weldeghiorghis (S)	C	Louisiana State University	Chemistry						
Bill Baker (S)	PI	University of South Florida	Chemistry	No other support	**P19767**	Natural Product Drug Discovery for Infectious Diseases and the need for High-Sensitivity NMR Equipment	Biology, Biochemistry, Biophysics	1	7.33
Joe Bracegirdle (P)	C	University of South Florida	Chemistry						
Jimmy Lawrence (S)	PI	Louisiana State University	Chemical Engineering	No other support	**P19782**	Advanced NMR Spectroscopy as a Versatile Platform for Elucidating the Structure-Property Relationship of Bottlebrush Polymers	Chemistry	1	10
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology						
Nduka Ogbonna (G)	C	Louisiana State University	Chemical engineering						

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Libin Ye (S)	PI	*	University of South Florida	Cell Biology, Microbiology and Molecular Biology	No other support			**P19783**	Conformational transition, dynamics, and signaling transductions of GPCRs	Biology, Biochemistry, Biophysics	1	4
Zachary Smith (S)	PI	*	Massachusetts Institute of Technology	Chemical Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET2034734	**P19806**	PFG NMR quantification of gas diffusion inside composite membranes based on metal–organic frameworks as a function of diffusion length scale and membrane composition	Engineering	1	64.83
Omar Boloki (G)	C		University of Florida	Chemical Engineering								
Sergey Vasenkov (S)	C		University of Florida	Chemical Engineering								
Ryan Lively (S)	PI		Georgia Institute of Technology	School of Chemical & Biomolecular Engineering,	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1836735	**P19852**	Influence of polymer crosslinking on microscopic diffusion in ZIF-based mixed-matrix membranes by high field diffusion NMR	Engineering	1	24.17
Blake Trusty (G)	C		University of Florida	Chemical Engineering								
Sergey Vasenkov (S)	C		University of Florida	Chemical Engineering								
Young Hee Yoon (G)	C		Georgia Institute of Technology	School of Chemical & Biomolecular Engineering								
Anastasios Angelopoulos (S)	PI		University of Cincinnati	Department of Chemical and Environmental Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1836551	**P19860**	ML-ANGELOPOULOS-002: Quantification of diffusion of molecules with the "Janus" structure in Nafion by high field diffusion NMR	Engineering	1	38
Sarah Barber (G)	C		University of Cincinnati	Department of Chemical and Environmental Engineering								
Junchuan Fang (G)	C		University of Cincinnati	Chemical Engineering								
Jonathan Nickels (S)	C		University of Cincinnati	Department of Chemical and Environmental Engineering								
Blake Trusty (G)	C		University of Florida	Chemical Engineering								
Sergey Vasenkov (S)	C		University of Florida	Chemical Engineering								
Michael Harris (S)	PI		University of Florida	Chemistry	No other support			**P19877**	ML-HARRIS-002: NMR Spectroscopic Characterization of Protein-Polymer Conjugates in Aqueous Solutions	Biology, Biochemistry, Biophysics	1	3
Coray Colina (S)	C		University of Florida	Chemistry								
Matthew Eddy (S)	C		University of Florida	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Brent Sumerlin (S)	C		University of Florida	Chemistry							
Leah Casabianca (S) Anil Mehta (S)	PI C	*	Clemson University University of Florida	Department of Chemistry AMRIS	No other support			**P19891**	Structural Investigation of Self-Assembling Peptides in Solution	Chemistry	1	4
Juan Beltran-Huarac (S) John Cooper (G) Homeira Faridnejad (G) Lewis Reynolds (S) Marina Sokolsky (S)	PI C C C C		East Carolina University (ECU) East Carolina University East Carolina University North Carolina State University University of North Carolina at Chapel Hill	Physics Physics Physics clreynol@ncsu.edu UNC Eshelman School of Pharmacy	No other support			**P19911**	ML-BELTRANHUARAC-002: High-Relaxivity Surface-Complexed Iron Oxide Nanoparticles and Magnetic Extracellular Vesicles as MRI Contrast Agents for Targeted Cancer Imaging	Biology, Biochemistry, Biophysics	1	1
Shahabeddin Vahdat (S) Vishwas Jindal (G) Sushain Kaul (G) David Vaillancourt (S) Daniel Wesson (S)	PI C C C C	*	University of Florida University of Florida University of Florida University of Florida University of Florida	Applied Physiology and Kinesiology Applied Physiology and Kinesiology Biomedical Engineering Applied Physiology and Kinesiology Pharmacology	No other support			**P19971**	ML-VAHDAT-001: Identification of neural mechanisms of force control using awake mouse optogenetic fMRI	Biology, Biochemistry, Biophysics	1	7.5
Rachel Martin (S) Jessica Kelz (G) Anil Mehta (S) Mina Mozafari (P) Megan Rocha (G)	PI C C C C	*	University of California, Irvine University of California, Irvine University of Florida University of California, Irvine University of California, Irvine	Chemistry Chemistry AMRIS Chemistry Chemistry	No other support			**P19974**	ML-MARTIN-001: Characterizing the dynamics of deamidation variants of human gamma-S crystallin to elucidate aggregation mechanisms	Biology, Biochemistry, Biophysics	1	23.33
Daniel R. Talham (S) Diba Allameh Zadeh (G) Brent Sumerlin (S)	PI C C		University of Florida University of Florida University of Florida	Chemistry Chemistry Chemistry	No other support			**P20026**	Self-Assembled Polymer Nanostructures as paraCEST MRI Contrast Agents	Chemistry	1	30
Lee Sweeney (S) Sean Forbes (S)	PI C	*	University of Florida University of Florida	Pharmacology & Therapeutics Departments of Physical Therapy and Physiology	NIH	NIAMS - National Institute of Arthritis and Musculoskeletal and Skin Diseases	AR052646	**P20062**	Interrogating the role of perturbed bioenergetics in the dystrophin-deficient heart	Biology, Biochemistry, Biophysics	1	2

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Cora Hart (G)	C	University of Florida	Pharmacology and Therapeutics								
Glenn Walter (S)	C	University of Florida	Physiology and Aging								
Johnny Figueroa (S)	PI	Loma Linda University	Center for Health Disparities and Molecular Medicine	NIH	NIDDK - National Institute of Diabetes and Digestive and Kidney Diseases	DK124727	**P20078**	Neuroanatomic Abnormalities in Stress-Induced Obesity	Biology, Biochemistry, Biophysics	1	56.5
James H.P. Collins (O)	C	University of Florida	Biochemistry & Molecular Biology								
Ike de la Pena (S)	C	Loma Linda University	Pharmaceutical & Administrative Sciences								
Marcelo Febo (S)	C	University of Florida	Psychiatry								
Brenda Patricia Noarbe (T)	C	University of California, Irvine	Pediatrics								
Andre Obenaus (S)	C	University of California, Irvine	Pediatrics								
Perla Ontiveros-Ángel (G)	C	Loma Linda University	Center of Health Disparities and Molecular Medicine								
Marjory Pompilus (G)	C	University of Florida	Psychiatry								
Timothy Simon (U)	C	Loma Linda University	Neuroscience								
Julio Vega-Torres (G)	C	Loma Linda University	Center of Health Disparities and Molecular Medicine								
								Total Proposals:	**Experiments:**		**Days:**
								31	**31**		**1,125**

DC Field Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Dragana Popovic (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science / Experimental	NSF	DMR - Division of Materials Research	DMR1707785	**P17479**	Transport Studies of Magnetic-Field-Tuned Phase Transitions in Cuprates	Condensed Matter Physics	1	6.13
Paul Baity (G)	C	National High Magnetic Field Laboratory	Physics								
Shimpei Ono (S)	C	Central Research Institute of Electric Power Industry	Materials Science Research Laboratory								
Bal Pokharel (G)	C	National High Magnetic Field Laboratory	Physics								
Takao Sasagawa (S)	C	Tokyo Institute of Technology	Materials and Structures Laboratory								
Zhenzhong Shi (S)	C	Soochow University	School of Physical Science and Technology & Institute for Advanced Study								
Lily Stanley (G)	C	National High Magnetic Field Laboratory	Physics and CMS, NHMFL								
Jasminka Terzic (P)	C	National High Magnetic Field Laboratory	CMS								
Youcheng Wang (P)	C	National High Magnetic Field Laboratory	NHMFL								
Yuxin Wang (G)	C	Florida State University	CMS								
Henri Alloul (S)	PI	French National Center for Scientific Research	Physics	VSP			**P17513**	Magnetic, transport and Fermi surface properties of Na ordered cobaltates Nax CoO2	Condensed Matter Physics	1	3.04
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Ildar Gilmutdinov (P)	C	Kazan Federal University	Institute of Physics								
Irek Mukhamedshin (S)	C	Kazan Federal University	Institute of Physics, General Physics Department								
Rico Schoenemann (P)	C	Los Alamos National Laboratory	MPA-MAG								
Sanfeng Wu (S)	PI	Princeton University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1942942	**P17871**	Exploring Topological Quantum Phases and Devices Based on 2D Materials	Condensed Matter Physics	3	21
Yanyu Jia (G)	C	Princeton University	Physics	NSF	DMR - Division of Materials Research	DMR2011750					

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Michael Onyszczak (G)	C		Princeton University	Physics								
Leslie Schoop (S)	C		Princeton University	Chemistry								
Pengjie Wang (P)	C		Princeton University	Department of Physics								
Guo Yu (G)	C		Princeton University	Physics								
Christianne Beekman (S)	PI		National High Magnetic Field Laboratory	Physics	NSF	CAREER - Faculty Early Career Development Program	1847887	**P17889**	The effect of strain and confinement on spin ice physics in pyrochlore titanate thin films.	Condensed Matter Physics	1	7
Sangsoo Kim (G)	C		Florida State University	Physics								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Long Ju (S)	PI	*	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1752784	**P17913**	Photocurrent study of magneto-excitons in 2D materials	Condensed Matter Physics	1	8
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Qihang Zhang (G)	C		Massachusetts Institute of Technology	Electrical Engineering & Computer Science								
Nicholas Butch (S)	PI		National Institute of Standards and Technology MD	NIST Center for Neutron Research	NIST	US Government Lab		**P17928**	Physical properties of spin triplet superconductor UTe2 in high magnetic field	Condensed Matter Physics	2	21.07
Corey Frank (P)	C		National Institute of Standards and Technology MD	NCNR								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Sylvia Lewin (P)	C		University of Maryland, College Park	physics								
Sufei Shi (S)	PI		Rensselaer Polytechnic Institute	Chemical and Biological Engineering	NSF	DMR - Division of Materials Research	DMR1945420	**P17976**	Probing Excitonic Fine Structures in Van der Waals Heterostructures	Condensed Matter Physics	3	11.36
Zhen Lian (G)	C		Rensselaer Polytechnic Institute	chemical engineering								
Lei Ma (G)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Yuze Meng (P)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Shengnan Miao (G)	C	Rensselear Polytechnic Institute	Chemical Engineering								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Tianmeng Wang (G)	C	Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Li Xiang (P)	C	National High Magnetic Field Laboratory	DC field								
Li Yan (G)	C	Rensselaer Polytechnic Institute	Chemical engineering								
Badih Assaf (S)	PI	University of Notre Dame	Physics	NSF	DMR - Division of Materials Research	DMR1905277	**P17982**	Symmetry breaking in Landau quantized topological crystalline insulators	Condensed Matter Physics	3	25
Seul-Ki Bac (P)	C	University of Notre Dame	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Xinyu Liu (S)	C	University of Notre Dame	.								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Jiashu Wang (G)	C	University of Notre Dame	Physics								
Jagadeesh Moodera (S)	PI	MIT Plasma Science & Fusion Center	Physics	DOD	ARO - Army Research Office	W911NF-20-2-0061	**P18015**	Quantum transport at low temperatures and high fields in 2D materials subjected to induced ferromagnetic proximity coupling	Condensed Matter Physics	1	7
Scott Hannahs (S)	C	National High Magnetic Field Laboratory	Instrumentation	NSF	DMR - Division of Materials Research	DMR1231319					
Yingying WU (P)	C	Massachusetts Institute of Technology	physics								
Jian Liu (S)	PI	University of Tennessee, Knoxville	Physics	DOE	BES – Basic Energy Sciences	DE-SC0020254	**P18024**	Low-temperature high-field magnetotransport study of geometrically frustrated spin ice heterostructures	Condensed Matter Physics	2	14
Qing Huang (G)	C	University of Tennessee, Knoxville	Physics								
Chengkun Xing (G)	C	University of Tennessee, Knoxville	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Weiliang Yao (P)	C	University of Tennessee, Knoxville	Physics								
Adam Fiedler (S)	PI	Marquette University	Chemistry	No other support			**P18030**	Probing the Magnetic Anisotropy of Co(II) Complexes Featuring Radical Ligands	Chemistry	1	7
John Berry (S)	C	University of Wisconsin, Madison	Department of Chemistry								
Kinga Kaniewska (G)	C	Gdansk University of Technology	Department of Inorganic Chemistry								
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								
Zhi-Xun Shen (S)	PI	Stanford University	Physics	DOE	BES – Basic Energy Sciences	DE-AC02-76SF00515	**P18038**	Fermi Surfaces in Correlated Insulators	Condensed Matter Physics	1	5.96
Jessica Chapman (G)	C	University of Cambridge	Physics								
Shalinee Chikara (S)	C	National High Magnetic Field Laboratory	CMS, DC Field Facility								
Alexander Davies (G)	C	University of Cambridge	Physics								
Alex Eaton (S)	C	University of Cambridge	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Alex Hickey (G)	C	University of Cambridge	Department of Physics								
Liting Huang (U)	C	University of Cambridge	Physics								
Alice Jin (U)	C	University of Cambridge	QM								
Hsu Liu (G)	C	University of Cambridge	Physics								
Nicholas Popiel (G)	C	University of Cambridge	Physics								
Gilles Rodway-Gant (U)	C	University of Cambridge	Cavendish Laboratory								
Flavio Salvati (U)	C	University of Cambridge	Quantum Mechanics								
Suchitra Sebastian (S)	C	University of Cambridge	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Oscar Solomons-Tuke (U)	C	Cambridge University	Quantum Matter								
Kejun Xu (G)	C	Stanford University	Applied Physics								
Miha Zakotnik (S)	PI	Urban Mining Company	research	No other support			**P18071**	Recycled NdFeB permanent magnets and their role in circular economy	Development of Magnet Technology	1	3
Petru Andrei (S)	C	Florida State University	Electrical and Computer Engineering								
Davide Prosperi (S)	C	UMC	research								
Luis Balicas (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Experiment	DOE	BES – Basic Energy Sciences	DE-SC0002613	**P19122**	Understanding the anomalous Hall-effect in the magnetic topological semi-metallic candidates Fe3GeTe2 and Fe5GeTe2	Condensed Matter Physics	2	20
Brian Casas (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Michael Zudov (S)	PI	University of Minnesota, Twin Cities	School of Physics and Astronomy	DOE	BES – Basic Energy Sciences	DE-SC0002567	**P19127**	Broken-symmetry states in high Landau levels of GaAs/AlGaAs quantum wells	Condensed Matter Physics	3	23
Kirk Baldwin (S)	C	Princeton University	Electrical Engineering								
Elliot Bell (G)	C	University of Minnesota, Twin Cities	School of Physics and Astronomy								
XIaojun Fu (G)	C	University of Minnesota, Twin Cities	Physics								
Michael Manfra (S)	C	Nokia Bell Labs	Semiconductor Physics Research								
Loren Pfeiffer (S)	C	Princeton University	Electrical Engineering								
Sergei Studenikin (S)	C	National Research Council of Canada	Quantum Physics Group								
Ken West (S)	C	Princeton University	Princeton Institute for the Science and Technology of Materials								
Haidong Zhou (S)	PI	University of Tennessee, Knoxville	Physics and Astronomy	DOE	BES – Basic Energy Sciences	DE-SC0020254	**P19130**	Manipulating the strong quantum spin fluctuations in new triangular lattice antiferromagnets with spin-1/2	Condensed Matter Physics	5	42
Alexander Brassington (G)	C	University of Tennessee, Knoxville	Physics	NSF	DMR - Division of Materials Research	DMR2003117					
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Zachery Enderson (P)	C	Georgia Institute of Technology	School of Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Qing Huang (G)	C	University of Tennessee, Knoxville	Physics								
Chengkun Xing (G)	C	University of Tennessee, Knoxville	Physics								
Nirmal Ghimire (S)	PI	George Mason University	Physics and Astronomy	George Mason University	US College and University		**P19163**	High field magnetization and quantum oscillations of metallic Kagome net magnets	Condensed Matter Physics	1	5.79
Hari Bhandari (G)	C	George Mason University	Physics								
Nirmal Ghimire (S)	C	George Mason University	Physics and Astronomy								
Peter Siegfried (P)	C	George Mason University	Physics and Astronomy								
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								
Nishchal Thapa Magar (G)	C	George Mason University	Physics and Astronomy								
Eun Sang Choi (S)	PI	National High Magnetic Field Laboratory	Physics Department	No other support			**P19217**	Magnetometry instrumentation: calibration and background measurements	Condensed Matter Physics	3	21
Yanbo Guo (G)	C	University of Florida	Physics								
Yasu Takano (S)	C	University of Florida	Physics								
Xiao-Xiao Zhang (S)	PI	University of Florida	Physics	UCGP		R000002800	**P19224**	Magneto-optical investigation of Van der Waals magnetic-semiconductor heterostructure	Condensed Matter Physics	4	19.18
Xin Cong (P)	C	University of Florida	Physics	UCGP							
John Koptur-Palenchar (G)	C	University of Florida	Physics	University of Florida	US College and University						
Stephen McGill (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Yunong Wang (G)	C	University of Florida	Department of Physics								
S M Enamul Hoque Yousuf (G)	C	University of Florida	Electrical and Computer Engineering								
Mingyang Zheng (G)	C	University of Florida	Physics Department								
Henry La Pierre (S)	PI	Georgia Institute of Technology	School of Chemistry and Biochemistry	NSF	CAREER - Faculty Early Career Development Program	1943452	**P19236**	Magnetic Properties Characterization of Kagome Lattice Compounds,	Chemistry	1	7

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS					(CH3NH3)2MM'3F12 (M = Na+, K+ and NH4+, M' = V3+ and Ti3+)			
Arun Ramanathan (G)	C	Georgia Institute of Technology	Chemsitry								
Haruko Tateyama (G)	C	Georgia Institute of Technology	School of Chemistry and Biochemistry								
Xiang Yuan (S)	PI	East China Normal University	state key laboratory of precision spectroscopy	East China Normal University	Non US College and University		**P19239**	Probing electronic structure of topological semimetal under magnetic field by infrared spectroscopy	Condensed Matter Physics	2	14
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Zeping Shi (G)	C	East China Normal University	State Key Laboratory of Precision Spectroscopy								
Wenbin Wu (G)	C	East China Normal University	State Key Laboratory of Precision Spectroscopy								
Cheng Zhang (S)	C	Fudan University	Institute for Nanoelectronic Devices and Quantum Computing								
Jin Hu (S)	PI	University of Arkansas	Physics	DOE	BES – Basic Energy Sciences	DE-SC002200	**P19251**	High Field Transport of Nonsymmorphic Topological Semimetals	Condensed Matter Physics	1	4.84
Gokul Acharya (G)	C	University of Arkansas	Physics								
Rabindra Basnet (G)	C	University of Arkansas	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Krishna Pandey (G)	C	University of Arkansas	Physics								
Paula Giraldo-Gallo (S)	PI *	University of Los Andes	Physics	Universidad de Los Andes	Non US College and University		**P19271**	High field study of quasi-1D transition metal chalcogenides and related charge-ordered compounds	Condensed Matter Physics	1	6.1
Ian Fisher (S)	C	Stanford University	Applied Physics								
Jose Galvis Echeverri (P)	C	Central University Colombia	Natural Sciences								
Isabel Guillamon (P)	C	University of Bristol	Physics								
Edwin Herrera Vasco (P)	C	Autonomous University of Madrid	Condesed Matter								
Luis Rivera (G)	C	University of Los Andes	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Julian Rojas (G)	C	University of Los Andes	Bogota								
Diego Silvera Vega (G)	C	University of Los Andes	Physics								
Hermann Suderow (S)	C	Autonomous University of Madrid	Condesed Matter								
Janice Musfeldt (S)	PI	University of Tennessee, Knoxville	Department of Chemistry	Jan Musfeldt + David Bernholdt	Other		**P19343**	High field spectroscopy of materials with broken symmetry and strong spin-orbit coupling	Chemistry	1	7
Carla Boix-Constant (G)	C	University of Valencia	ICMol								
Eugenio Coronado (S)	C	University of Valencia	Chemistry								
Samuel Mañas-Valero (G)	C	University of Valencia	ICMol (Institute for Molecular Science)								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Wei Pan (S)	PI	Sandia National Laboratories	Semiconductor Devices and Science	DOE	NNSA - National Nuclear Security Administration	DE-NA0003525	**P19350**	Quantum Hall Canted Antiferromagnetism in GaAs Double Quantum Wells under Driving Electromagnetic Fields	Condensed Matter Physics	1	7
John Reno (S)	C	Sandia National Laboratories	-								
Nikolai Kalugin (S)	PI	New Mexico Institute of Mining and Technology	Department of Materials Engineering	NSF	DMR - Division of Materials Research	DMR2120475	**P19351**	Floquet-Bloch states in Quantum Hall systems	Condensed Matter Physics	2	34.57
Paola Barbara (S)	C	Georgetown University	Department of Physics	NSF	DMR - Division of Materials Research	DMR2104770					
Luis Foa Torres (S)	C	University of Chile	Department of Physics, FCFM								
Gabriel Gaertner (U)	C	New Mexico Institute of Mining and Technology	Materials Engineering								
John Huckabee (G)	C	New Mexico Institute of Mining and Technology	Materials Engineering								
YIJING LIU (G)	C	Georgetown University	Physics								
Alexey Suslov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Pengcheng Dai (S)	PI	University of Tennessee, Knoxville	Physics	NSF	DMR - Division of Materials Research	DMR2100741	**P19360**	Investigation into Orbital Pairing Mechanism of	Condensed Matter Physics	1	4.18

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment					Superconducting Electrons in Ni doped $BaFe_2As_2$			
Mason Klemm (G)	C	Rice University	Physics								
David Graf (S)	PI	National High Magnetic Field Laboratory	DC Field CMS	No other support			**P19363**	Two-axis rotation for DC magnetic fields	Condensed Matter Physics	5	28.16
Nicholas Butch (S)	C	National Institute of Standards and Technology MD	NIST Center for Neutron Research								
Sylvia Lewin (P)	C	University of Maryland, College Park	physics								
Jurek Krzystek (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science	No other support			**P19369**	Development of high-resolution THz EPR spectrometer based on the series-connected hybrid	Development of Magnet Technology	2	10.28
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								
Songi Han (S)	C	University of California, Santa Barbara	Department of Chemistry and Biochemistry								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Bradley Price (G)	C	University of California, Santa Barbara	Physics								
Mark Sherwin (S)	C	University of California, Santa Barbara	Physics								
Bianca Trociewitz (T)	C	National High Magnetic Field Laboratory	EMR								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
Philip Kim (S)	PI	Harvard University	Department of Physics	DOE	BES – Basic Energy Sciences	DOE DE-SC0012260	**P19376**	Emergent phenomena in graphene heterostructures at the extreme quantum limit	Condensed Matter Physics	1	13
Abhishek Banerjee (P)	C	Harvard University	Physics								
James Ehrets (G)	C	Harvard University	Physics								
Onder Gul (P)	C	Harvard University	Department of Physics								
Zeyu Hao (G)	C	Harvard University	Physics								
Antti Laitinen (P)	C	Harvard University	Department of Physics								
Joon Young Park (P)	C	Harvard University	Physics								
Isabelle Phinney (G)	C	Harvard University	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yuval Ronen (P)	C	Harvard University	Physics								
Thomas Werkmeister (G)	C	Harvard University	Applied Physics								
Jonathan Zauberman (G)	C	Harvard University	Physics								
Andrew Zimmerman (P)	C	Harvard University	Physics								
Abhay Pasupathy (S)	PI	Columbia University	Physics	NSF	MRSEC - Materials Research Science and Engineering Centers	DMR-1420634	**P19383**	Topologically protected quasiparticle excitations in 2D superconductors	Condensed Matter Physics	3	15.55
Augusto Ghiotto (G)	C	Columbia University	Physics	NSF	MRSEC - Materials Research Science and Engineering Centers	1420634					
Apoorv Jindal (G)	C	Columbia University	Physics								
Zizhong Li (G)	C	University of Wisconsin, Madison	Department of Materials Science and Engineering								
Daniel Rhodes (S)	C	University of Wisconsin, Madison (UW)	Materials Science and Engineering								
Yuan Song (G)	C	Columbia University	Physics								
Aya Batoul Tazi (U)	C	Columbia University	Physics								
Fazel Tafti (S)	PI	Boston College	Physics	DOE	BES – Basic Energy Sciences	DE-SC0002613	**P19384**	Hydrodynamic Electron Flow in NbGe2	Condensed Matter Physics	1	7
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Brian Casas (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Hung-Yu Yang (G)	C	Boston College	Physics								
Cedomir Petrovic (S)	PI	Brookhaven National Laboratory	Condensed Matter Physics	DOE	BES – Basic Energy Sciences	DE-SC0012704	**P19385**	Size effects and Electronic transport anisotropy in correlated electron Dirac and Weyl semimetals	Biology, Biochemistry, Biophysics	6	47.23
Fernando Camino (S)	C	Brookhaven National Laboratory	Center for Functional Nanomaterials								
Shuzhang Chen (G)	C	Brookhaven National Laboratory	Condensed Matter Physics								
Qianheng Du (P)	C	Argonne National Laboratory	Materials Science Division								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Spencer Gibbs (U)	C	University of Pennsylvania	Chemistry								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Zhixiang Hu (G)	C	Brookhaven National Laboratory	Condensed Matter Physics								
Cedomir Petrovic (S)	C	Brookhaven National Laboratory	Condensed Matter Physics								
Mike Sumption (S)	PI	Ohio State University	CSMM, MSE	DOE	HEP – High Energy Physics	DE-SC0013849	**P19391**	High Field Transport in Ternary and Quaternary APC type Nb3Sn Conductors with Increased Engineering Je and Stability	Development of Magnet Technology	2	12.3
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS	DOE							
Jacob Rochester (G)	C	Ohio State University	Materials Science	DOE	SBIR - Small Business Innovation Research	DE-SC0019816,					
Fang Wan (P)	C	Fermi National Accelerator Laboratory	APPLIED PHYSICS AND SUPERCONDUCTING TECHNOLOGY DIVISION	DOE	SBIR - Small Business Innovation Research	DE-SC0013849					
Xingchen Xu (S)	C	Fermi National Accelerator Laboratory	Magnet System								
Chun Ning (Jeanie) Lau (S)	PI	Ohio State University	Department of Physics and Astronomy	DOE	BES – Basic Energy Sciences	DE-SC0020187	**P19392**	Symmetry-broken phases and topological phenomena in layered quantum materials	Condensed Matter Physics	2	13.02
Xueshi Gao (G)	C	Ohio State University	Physics	NSF	DMR - Division of Materials Research	DMR1922076					
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Haidong Tian (G)	C	Ohio State University	Physics								
Greyson Voigt (G)	C	Ohio State University	Dept of Physics								
Jiayin Wang (G)	C	Ohio State University	Physics								
Yuxin Zhang (G)	C	Ohio State University	Physics								
Zheneng Zhang (G)	C	Ohio State University	Physics								
Johnpierre Paglione (S)	PI	University of Maryland, College Park	Center for Nanophysics and Advanced Materials, Department of Physics	NSF	DMR - Division of Materials Research	DMR1905891	**P19400**	Study of Multiple Superconducting phases and Fermi Surface in Spin-Triplet Superconductor UTe2	Condensed Matter Physics	1	5.53

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Nicholas Butch (S)	C	National Institute of Standards and Technology MD	NIST Center for Neutron Research								
Yun Suk Eo (G)	C	University of Michigan	Physics Department								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Wen-Chen Lin (G)	C	University of Maryland, College Park	physics								
I-LIn Liu (G)	C	University of Maryland, College Park	Chemical Physics								
Sheng Ran (S)	C	Washington University in St. Louis	Physics								
Shanta Saha (P)	C	University of Maryland, College Park	Physics								
Prathum Saraf (G)	C	University of Maryland, College Park	Physics								
Danila Sokratov (G)	C	University of Maryland, College Park	Physics								
Hyeok Yoon (P)	C	University of Maryland, College Park	Department of Physics								
Zhigang Jiang (S)	PI	Georgia Institute of Technology	School of Physics	DOE	BES – Basic Energy Sciences	DE-FG02-07ER46451	**P19401**	Magneto-infrared Spectroscopy Study of Emerging Topological Materials with Layered Structures	Condensed Matter Physics	2	14
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Li Xiang (P)	C	National High Magnetic Field Laboratory	DC field								
Tianhao Zhao (G)	C	Georgia Institute of Technology	School of Physics								
Cory Dean (S)	PI	City College of New York	Physics	DOE	BES – Basic Energy Sciences	DE-SC0016703	**P19404**	Electron correlation and topology in van der Waals heterostructure under high magnetic field	Condensed Matter Physics	3	18.88
Avishai Benyamini (P)	C	Columbia University	Mechanical Engineering	DOE	BES – Basic Energy Sciences	DE-SC00167703					
Shaowen Chen (G)	C	Columbia University	Applied Physics and Applied Mathematics								
Aravind Devarakonda (P)	C	Columbia University	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Qianhui Shi (S)	C		University of California, Los Angeles	Physics								
En-Min Shih (G)	C		Columbia University	Physics								
Josh Swann (G)	C		Columbia University	Physics								
Evan Telford (G)	C		Columbia University	Physics								
Dmitry Smirnov (S)	PI		National High Magnetic Field Laboratory	Instrumentation & Operations	DOE	BES – Basic Energy Sciences	DE-FG02-07ER46451	**P19412**	Electrical and magnetic field control of optical processes in atomicallythin layers and van der Waals heterostructures	Condensed Matter Physics	1	7
Zhigang Jiang (S)	C		Georgia Institute of Technology	School of Physics								
Chun Ning (Jeanie) Lau (S)	C		Ohio State University	Department of Physics and Astronomy								
Zhengguang Lu (P)	C		Massachusetts Institute of Technology	Physics								
Sufei Shi (S)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Li Xiang (P)	C		National High Magnetic Field Laboratory	DC field								
Irina Drichko (S)	PI		Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics	No other support		19-02-00124	**P19427**	Magnetotransport Properties of High-Mobility p-AlGaAs/GaAs/AlGaAs Structures: Acoustic Studies.	Condensed Matter Physics	1	7
Loren Pfeiffer (S)	C		Princeton University	Electrical Engineering								
Ivan Smirnov (S)	C		Ioffe Physical-Technical Institute of the Russian Academy of Sciences	Physics of Semiconductors and Dielectrics								
Alexey Suslov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Ken West (S)	C		Princeton University	Princeton Institute for the Science and Technology of Materials								
Isabelle Marcotte (S)	PI	*	University of Quebec at Montreal	Chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI151321	**P19442**	Chlamydomonas reinhardtii cell-wall and whole cell glycan architecture studied by high-field and DNP Solid-State NMR	Biology, Biochemistry, Biophysics	1	4
Fabien Deligey (P)	C		Louisiana State University	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Name	Role	Org.	Dept.	Funding Agency	Division	Award #					
Malitha Dickwella Widanage (G)	C	Louisiana State University	chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Tuo Wang (S)	C	Michigan State University	Chemistry								
Sara Haravifard (S)	PI	Duke University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1828348	**P19445**	High Pressure Studies of Frustrated Magnets	Condensed Matter Physics	3	18.88
Rabindranath Bag (P)	C	Duke University	Physics	Duke University	US College and University						
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Sachith Dissanayake (P)	C	Duke University	Physics								
Matthew Ennis (G)	C	Duke University	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Wenda Si (U)	C	Duke University	Department of Physics								
SiJie Xu (G)	C	Duke University	Physics								
Lalit Yadav (G)	C	Duke University	Physics								
Keshav Shrestha (S)	PI	Texas A&M University	Chemistry and Physics	The Welch Foundation at West Texas A&M University, Killgore Research Faculty Grant, Killgore USR Grant, and Killgore GSR Grant	US College and University	AE-025	**P19467**	Search of Topological Phases of Materials	Condensed Matter Physics	1	3.83
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Duncan Mierstchin (U)	C	West Texas A&M University	Chemistry and Physics								
Thinh Nguyen (G)	C	West Texas A&M University	Chemistry and Physics								
Sheng Ran (S)	PI	Washington University in St. Louis	Physics	Washington University in St. Louis	US College and University		**P19470**	Study of high magnetic field induced superconductivity and Fermi surface of UTe2	Condensed Matter Physics	1	6.7
Christopher Broyles (G)	C	Washington University in St. Louis	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Zackary Rehfuss (G)	C	Washington University in St. Louis	Physics								
Hasan Siddiquee (P)	C	Washington University in St. Louis	Physics								
Lin Jiao (S)	PI	Zhejiang University	Physics	NSF	DMR - Division of Materials Research	DMR1644779	**P19480**	High Magnetic Field Probe Design and Technique Development	Condensed Matter Physics	5	44
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS								
Ryan Baumbach (S)	C	National High Magnetic Field Laboratory	CMS								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Elizabeth Green (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Robert Nowell (T)	C	National High Magnetic Field Laboratory	DC User Support								
Arneil Reyes (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Enrique Colacio (S)	PI	University of Granada	Inorganic Chemistry	No other support			**P19485**	High-frequency and -field EPR and FIRMS of prismatic trigonal Co(II) and pentagonal bipyramidal Dy(III) SIMs complexes	Chemistry	1	9
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Talal Mallah (S)	PI	University of Paris-Sud	ICMMO	No other support			**P19496**	Electronic structure of magnetic Ni(II) complexes as potential quantum bits	Development of Magnet Technology	1	7
Brittany Grimm (G)	C	Florida State University	Physics								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Yining Huang (S)	PI	University of Western Ontario	Chemistry	NSERC of Canada	Other		**P19515**	17O and 91Zr solid-state NMR of metal-	Chemistry	1	4

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL					organic frameworks at 35.2 T			
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Wanli Zhang (G)	C	University of Western Ontario	Chemistry								
Jeffrey Long (S)	PI	University of California, Berkeley	Chemistry	NSF	CHE - Chemistry	CHE2102603	**P19520**	Hard Permanent Magnetism from Mixed-Valence Dilanthanide Complexes with Metal-Metal Bonding	Chemistry	4	20.59
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Hyunchul Kwon (G)	C	University of California, Berkeley	Chemistry								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Danielle Laurencin (S)	PI	University of Montpellier	Institut Charles Gerhardt de Montpellier	ERC	Other		**P19532**	Identification of interfacial bonding environments in functional nanomaterials and biomaterials using high resolution solid state NMR at (ultra)-high fields	Chemistry	2	5
Pierre Florian (S)	C	French National Center for Scientific Research	CEMTHI	ANR	Other	"TOGETHER" project					
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	CNRS	Other						
Christel Gervais (S)	C	Sorbonne University	Laboratoire de Chimie de la Matière Condensée								
Ieva Goldberga (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
César Leroy (P)	C	French National Center for Scientific Research	ICGM - UMR 5253								
Adam Nelson (G)	C	Sorbonne University	Chemistry								
Joseph Checkelsky (S)	PI	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1231319	**P19540**	High Field Studies of Novel Layered Materials	Condensed Matter Physics	7	46.69
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alan Chen (G)	C	Massachusetts Institute of Technology	EECS								
Maximilien Debbas (G)	C	Massachusetts Institute of Technology	Physics								
Aravind Devarakonda (P)	C	Columbia University	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Minyong Han (G)	C	Massachusetts Institute of Technology	Physics								
Caolan John (G)	C	Massachusetts Institute of Technology	Physics								
Paul Neves (G)	C	Massachusetts Institute of Technology	Physics								
Joshua Wakefield (G)	C	Massachusetts Institute of Technology	Physics								
Shu Yang Zhao (P)	C	Massachusetts Institute of Technology	Physics								
Kent (Jingxu) Zheng (P)	C	Massachusetts Institute of Technology	Physics								
Junbo Zhu (G)	C	Massachusetts Institute of Technology	Physics								
Theo Siegrist (S)	PI	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering	NSF	DMR - Division of Materials Research	DMR1625780	**P19541**	Exploring the effect of magnetic field on structural properties across the valence state transition in EuPd2Si2	Condensed Matter Physics	1	6.68
Madilyn Getz (U)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Alexey Kovalev (S)	C	National High Magnetic Field Laboratory	CMS								
Masoud Mardani (G)	C	National High Magnetic Field Laboratory	CMS								
Shivani Sharma (P)	C	Brookhaven National Laboratory	NSLS-2								
Julia Smith (S)	C	National High Magnetic Field Laboratory	DC Field								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alexey Suslov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Zhiqiang Mao (S)	PI	Pennsylvania State University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1917579	**P19544**	Studies of exotic quantum phenomena near the quantum limit in Dirac semimetals AMnSb2 (A=Sr, Ba and Yb)	Condensed Matter Physics	1	5.73
Yingdong Guan (G)	C	Pennsylvania State University	Physics Department								
Seng Huat Lee (S)	C	Pennsylvania State University	Physics								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Lujin Min (G)	C	Pennsylvania State University	Department of Physics								
Johanna Palmstrom (P)	C	Los Alamos National Laboratory (LANL)	MPA-MAG								
Zahid Hasan (S)	PI	Princeton University	Physics	Gordon and Betty Moore Foundation	US Foundation	GBMF4547	**P19566**	Magnetotransport studies of topological magnets under hydrostatic pressure	Condensed Matter Physics	6	37.09
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Brian Casas (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Md Shafayat Hossain (P)	C	Princeton University	Physics								
Qi Zhang (P)	C	Princeton University	Physics								
David Mandrus (S)	PI	University of Tennessee, Knoxville	Materials Science and Engineering	DOD	US Air Force		**P19572**	Topological Hall Effect in Kagome Lattice Materials	Condensed Matter Physics	2	10.08
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment	Gordon and Berry Moore	Other	GBMF9069					
Shirin Mozaffari (P)	C	University of Tennessee, Knoxville	Materials Science and Engineering								
Richa Pokharel Madhogaria (P)	C	University of Tennessee, Knoxville	Materials Science and Engineering								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Louis Taillefer (S)	PI	University of Sherbrooke	Physics	Natural Sciences and Engineering Research Council of Canada	Non US Council		**P19605**	Zooming in on the strange metal physics and pseudogap phase of cuprates	Condensed Matter Physics	2	7.64
Amirreza Ataei (G)	C	University of Sherbrooke	Physics	Fonds de Recherche du Québec – Nature et Technologies	Non US Foundation						
Jordan Baglo (P)	C	University of Sherbrooke	Department of Physics	Canadian Institute for Advanced Research	Non US Foundation						
Marie-Eve Boulanger (G)	C	University of Sherbrooke	Physics								
Lu Chen (G)	C	University of Michigan	Physics								
Caitlin Duffy (G)	C	High Field Magnet Laboratory, Radboud University	HFML								
Adrien Gourgout (P)	C	University of Sherbrooke	Physics								
Gael Grissonnanche (P)	C	Cornell University	LASSP								
Etienne Lefrançois (G)	C	University of Sherbrooke	Physics								
Shimpei Ono (S)	C	Central Research Institute of Electric Power Industry	Materials Science Research Laboratory								
Brad Ramshaw (S)	C	Cornell University	Laboratory of Atomic and Solid State Physics								
Zhi-Xun Shen (S)	C	Stanford University	Physics								
Kejun Xu (G)	C	Stanford University	Applied Physics								
Aaron Rossini (S)	PI	Iowa State University	Chemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1916809	**P19606**	High-Field Solid-State NMR of Heterogeneous Catalysts and Inorganic Materials	Chemistry	2	7
Rick Dorn (G)	C	Iowa State University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Tim Murphy (S)	PI		National High Magnetic Field Laboratory	Operations	No other support			**P19611**	Testing of DCFF magnets, power supplies and associated equipment	Condensed Matter Physics	8	35.08
Alimamy Bangura (S)	C		National High Magnetic Field Laboratory	CMS								
Troy Brumm (T)	C		National High Magnetic Field Laboratory	DC Field								
Eun Sang Choi (S)	C		National High Magnetic Field Laboratory	Physics Department								
Elizabeth Green (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Glover Jones (T)	C		National High Magnetic Field Laboratory	Instrumentation & Operations								
Robert Nowell (T)	C		National High Magnetic Field Laboratory	DC User Support								
Andy Powell (S)	C		National High Magnetic Field Laboratory	Operations								
Arneil Reyes (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Julia Smith (S)	C		National High Magnetic Field Laboratory	DC Field								
Eric Stiers (O)	C		National High Magnetic Field Laboratory	DC Field								
Sujana Sri Venkat Uppalapati (O)	C		National High Magnetic Field Laboratory	DC Field Facility								
Trevor Tyson (S)	PI	*	New Jersey Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1809931	**P19612**	Probing Magnetic Field-Induced Order and Field-Coupled Structural Changes in Multiferroic HoAl3(BO3)4	Condensed Matter Physics	1	4.03
Alexey Kovalev (S)	C		National High Magnetic Field Laboratory	CMS								
Masoud Mardani (G)	C		National High Magnetic Field Laboratory	CMS								
William Nelson (G)	C		NHMFL-FSU	CMS-Physics								
Jennifer Neu (G)	C		National High Magnetic Field Laboratory	CMS								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Theo Siegrist (S)	C	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering								
Alexey Suslov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Vikram Deshpande (S)	PI	University of Utah	Physics & Astronomy	NSF	DMR - Division of Materials Research	DMR1936383	**P19613**	Quantum Transport in Intrinsic Magnetic Topological Insulators	Condensed Matter Physics	2	10.7
Griffin Bradford (O)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Su Kong Chong (P)	C	University of California, Los Angeles	Department of Electric and Computer Engineering								
Anca Constantinescu (P)	C	National High Magnetic Field Laboratory	ASC								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS								
Seng Huat Lee (S)	C	Pennsylvania State University	Physics								
Zhiqiang Mao (S)	C	Pennsylvania State University	Department of Physics								
Amit Vashist (P)	C	University of Utah	Department of Physics & Astronomy								
Kang Wang (S)	C	University of California, Los Angeles	Electrical Engineering								
Cui-Zu Chang (S)	PI	Pennsylvania State University	Physics	DOE	BES – Basic Energy Sciences	DE-SC0019064	**P19615**	Quantum Anomalous Hall Sandwiches Under High Magnetic Fields	Condensed Matter Physics	1	7
Hemian Yi (P)	C	Pennsylvania State University	Department of physics								
RuoXi Zhang (G)	C	Pennsylvania State University	Physics								
Yi-Fan Zhao (G)	C	Pennsylvania State University	Physics								
Lingjie Zhou (G)	C	Pennsylvania State University	Physics Department								
Peide Ye (S)	PI	Purdue University	School of Electrical and Computer Engineering	NSF	EFMA - Emerging Frontiers and Multidisciplinary Activities	EFMA1433459	**P19617**	Quantum transport in n-type chiral semiconductor Tellurene	Condensed Matter Physics	3	18.81
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Lin Jiao (S)	C		Zhejiang University	Physics								
Chang Niu (G)	C		Purdue University	Electrical and Computer Engineering								
Pukun Tan (G)	C		Purdue University	Electrical Engineering								
Zhuocheng Zhang (G)	C		Purdue University	Electrical and Computer Engineering								
Jun Zhu (S)	PI		Pennsylvania State University	Physics	NSF	DMR - Division of Materials Research	DMR1904986	**P19619**	Valley Isospin-Driven Correlated Phenomena in Bilayer Graphene	Condensed Matter Physics	2	13.1
Hailong Fu (P)	C		Pennsylvania State University	Physics								
Chengqi Guo (G)	C		Pennsylvania State University	Physics								
Ke Huang (G)	C		Pennsylvania State University	Physics								
Cequn Li (G)	C		Pennsylvania State University	Physics								
Le Yi (G)	C		Pennsylvania State University	Physics								
Andreas Rydh (S)	PI	*	Stockholm University	Department of Physics	Swedish Science Foundation	Non US Council		**P19624**	Quantum Materials with Anisotropic Heavy Fermions	Condensed Matter Physics	1	4.46
Alimamy Bangura (S)	C		National High Magnetic Field Laboratory	CMS								
Akash Khansili (G)	C		Stockholm University	Department of Physics								
Neha Kondedan (G)	C		Stockholm University	Department of Physics								
Arkady Shehter (S)	C		Los Alamos National Laboratory	LANL MPA-MAGLAB								
Lu Li (S)	PI		University of Michigan	Physics	DOE	BES – Basic Energy Sciences	DE-SC0020184	**P19627**	Search for novel electronic, magnetic, and thermal properties in intense magnetic fields	Condensed Matter Physics	8	49.75
Aaron Chan (G)	C		University of Michigan	Department of Physics	NSF	DMR - Division of Materials Research	DMR2004288					
Kuan-Wen Chen (P)	C		University of Michigan	Physics								
Kaila Jenkins (G)	C		University of Michigan	Department of Physics								
David Mandrus (S)	C		University of Tennessee, Knoxville	Materials Science and Engineering								
Yuji Matsuda (S)	C		Kyoto University	Physics								
Dmitri Mihaliov (G)	C		University of Michigan	Applied Physics								
Emilia Morosan (S)	C		Rice University	Physics and Astronomy								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Dechen Zhang (G)	C	University of Michigan	Department of Physics								
Guoxin Zheng (G)	C	University of Michigan	Department of Physics								
Yuan Zhu (G)	C	University of Michigan	Department of Physics								
Dragana Popovic (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science / Experimental	NSF	DMR - Division of Materials Research	DMR1707785	**P19628**	Electrical Transport Studies of Quasi-Two-Dimensional Strongly Correlated Materials	Condensed Matter Physics	7	50.82
Bernd Buechner (S)	C	Technical University of Dresden	Institute for Solid State Research	NSF	DMR - Division of Materials Research	DMR2104193					
Martin Dressel (S)	C	University of Stuttgart	1. Physikalisches Institut								
Masaki Fujita (S)	C	Tohoku University IMR	Materials Property Division								
Jun Sik Lee (S)	C	SLAC National Accelerator Laboratory									
Bal Pokharel (G)	C	National High Magnetic Field Laboratory	Physics								
Andrej Pustogow (P)	C	University of California, Los Angeles	Physics and Astronomy								
Takao Sasagawa (S)	C	Tokyo Institute of Technology	Materials and Structures Laboratory								
Takanori Taniguchi (S)	C	Tohoku University IMR	Materials Property Division								
Olesia Voloshyna (P)	C	Technical University of Dresden	Institute for Solid State Research								
Yuxin Wang (G)	C	Florida State University	CMS								
MacMillan Wheeler (G)	C	American Superconductor	Physics								
Zhenzhong Shi (S)	PI	Soochow University	School of Physical Science and Technology & Institute for Advanced Study	Soochow University	Non US College and University		**P19630**	Studies of Thermal Transport Properties of cuprates in High Magnetic Field	Condensed Matter Physics	2	14
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Bal Pokharel (G)	C	National High Magnetic Field Laboratory	Physics								
Dragana Popovic (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science / Experimental								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Youcheng Wang (P)	C	National High Magnetic Field Laboratory	NHMFL								
Yuxin Wang (G)	C	Florida State University	CMS								
Ziming Wu (G)	C	Soochow University	School of Physical Science and Technology & Institute for Advanced Study								
Xavier Roy (S)	PI	Columbia University	Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0019443	**P19632**	Magnetic Order and Correlated Electronic Phenomena in Novel 2D van der Waals Materials	Chemistry	3	18.25
Aravind Devarakonda (P)	C	Columbia University	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Sae Young Han (G)	C	Columbia University	Chemistry								
Elena Meirzadeh (P)	C	Columbia University	Chemistry								
Victoria Posey (G)	C	Columbia University	Chemistry								
Evan Telford (G)	C	Columbia University	Physics								
Michael Ziebel (P)	C	Columbia University	Chemistry and Physics								
Yasu Takano (S)	PI	University of Florida	Physics	No other support			**P19638**	Calorimetric and magnetic studies of quantum spin liquid candidates	Condensed Matter Physics	2	15
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Matthew Cothrine (G)	C	University of Tennessee, Knoxville	Materials Science and Engineering								
Yanbo Guo (G)	C	University of Florida	Physics								
Xinzhe Hu (G)	C	University of Florida	Physics								
Guangxin Ni (S)	PI	Florida State University	Physics	DOE	BES – Basic Energy Sciences	100792	**P19684**	Exploring the nature of 2D twistronics under photon excitations	Condensed Matter Physics	1	8
James Ehrets (G)	C	Harvard University	Physics								
Zeyu Hao (G)	C	Harvard University	Physics								
Philip Kim (S)	C	Harvard University	Department of Physics								
Andrew Zimmerman (P)	C	Harvard University	Physics								
Ziling Xue (S)	PI	University of Tennessee, Knoxville	Chemistry	NSF	CHE - Chemistry	CHE2055499	**P19694**	Probing Molecular Magnetism by Far-IR	Chemistry	2	20

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alexandria Bone (G)	C		University of Tennessee, Knoxville	Chemistry					and Raman Magneto-Spectroscopies			
Adiat Fakolujo (G)	C		University of Tennessee, Knoxville	Chemistry								
Adam Hand (G)	C		University of Tennessee, Knoxville	Chemistry								
Michael Jenkins (G)	C		University of Tennessee, Knoxville	Chemistry								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Pagnareach Tin (G)	C		University of Tennessee, Knoxville	Chemistry								
Tyrel McQueen (S)	PI	*	Johns Hopkins University	Chemistry and Physics and Astronomy	DOE	BES – Basic Energy Sciences	Co-design Center for Quantum Advantage	**P19695**	Magnetization studies of pyrochlores simulated by quantum annealing	Condensed Matter Physics	2	14
Shannon Bernier (G)	C		Johns Hopkins University	Chemistry	David and Lucile Packard Foundation	Other						
Andrew King (S)	C		D-Wave Systems Inc	Performance Research								
Mykhaylo Ozerov (S)	PI		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS	No other support			**P19696**	Far-Infrared magneto-spectroscopy at DC-facility, NHMFL: New developments, tests and optimization of experimental protocols	Condensed Matter Physics	4	26.4
George Nolas (S)	PI		University of South Florida	Department of Physics	NSF	DMR - Division of Materials Research	DMR1748188	**P19700**	Investigation of transport and potential topological complexity in GdTe1.8 using high magnetic field	Condensed Matter Physics	1	7
Jorge Galeano Cabral (G)	C		Florida State University	College of Engineering								
Kaya Wei (P)	C		National High Magnetic Field Laboratory	CMS								
Jiun-Haw Chu (S)	PI		University of Washington	Physics	DOE	EFRC - Energy Frontier Research Centers	635930	**P19709**	Probing Lifshitz transitions in Magnetic topological materials	Condensed Matter Physics	3	13.59
Jonathan DeStefano (G)	C		University of Washington	Physics	DOD	US Air Force						
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Chaowei Hu (G)	C		University of California, Los Angeles	Department of Physics and Astronomy								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Qianni Jiang (G)	C	University of Washington	Physics								
Paul Malinowski (G)	C	University of Washington	Physics								
Elliott Rosenberg (G)	C	Stanford University	Applied Physics								
Yue Shi (G)	C	University of Washington	MSE								
Seng Huat Lee (S)	PI	Pennsylvania State University	Physics	NSF	MIP - Materials Innovation Platform	DMR-1539916	**P19710**	Seeking for Exotic Quantum State in Intrinsic Ferromagnetic Topological Insulator MnBi6Te10	Condensed Matter Physics	2	10.69
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS	NSF	MIP - Materials Innovation Platform	DMR-2039351					
Yingdong Guan (G)	C	Pennsylvania State University	Physics Department								
Zhiqiang Mao (S)	C	Pennsylvania State University	Department of Physics								
Jun Zhu (S)	C	Pennsylvania State University	Physics								
Yanglin Zhu (G)	C	Tulane University	Department of Physics and Engineering Physics								
Denis Karaiskaj (S)	PI	University of South Florida	Physics	NSF	ECCS - Electrical, Communications, and Cyber Systems	ECCS1952957	**P19712**	Electronic and spin dynamics of materials at very high magnetic fields explored with coherent multidimensional spectroscopy	Condensed Matter Physics	1	5.12
Arup Barua (G)	C	University of South Florida	Physics								
David Hilton (S)	C	University of Alabama, Birmingham	Physics								
Samuel Langelund Carerra (G)	C	University of South Florida	Physics								
Hengzhou Liu (G)	C	University of South Florida	Physics								
Varun Mapara (G)	C	University of South Florida	Physics								
Nathanael Fortune (S)	PI	Smith College	Department of Physics	No other support			**P19714**	thermodynamic studies of novel quantum materials as a function of magnetic field strength and orientation	Condensed Matter Physics	2	12.48
Yanbo Guo (G)	C	University of Florida	Physics								
Scott Hannahs (S)	C	National High Magnetic Field Laboratory	Instrumentation								
Tyrel McQueen (S)	C	Johns Hopkins University	Chemistry and Physics and Astronomy								
Joyce Palmer-Fortune (S)	C	Smith College	Physics								
Lily Phillips (U)	C	Smith College	Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Arthur Ramirez (S)	C	University of California, Santa Cruz	Physics								
Grant Roll (U)	C	Smith College	Physics								
Yasu Takano (S)	C	University of Florida	Physics								
Jiaqiang Yan (S)	C	Oak Ridge National Laboratory	Materials Science and Technology Division								
Ryan Baumbach (S)	PI	National High Magnetic Field Laboratory	CMS	NSF	DMR - Division of Materials Research	DMR1904361	**P19716**	Investigation of Fermi Surface Topography in the Topological Metals (Ti,Zr,Hf)2Te2(P,As)	Condensed Matter Physics	1	5.54
Keke Feng (G)	C	Florida State University	Physics								
Jorge Galeano Cabral (G)	C	Florida State University	College of Engineering								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Olatunde Oladehin (G)	C	Florida State University	Physics								
Benny Schundelmier (G)	C	Florida State University	Physics								
Kaya Wei (P)	C	National High Magnetic Field Laboratory	CMS								
Minhyea Lee (S)	PI	University of Colorado, Boulder	Physics	DOE	BES – Basic Energy Sciences	DE-SC0021377	**P19717**	Investigating thermal transport properties in strong spin-orbit coupled systems	Condensed Matter Physics	3	21
Gang Cao (S)	C	University of Colorado, Boulder	Department of Physics.								
Sarah Jones (U)	C	Colorado School of Mines	Physics								
Ian Leahy (G)	C	University of Colorado, Boulder	Physics								
Blake Lee (G)	C	University of Colorado, Boulder	Physics								
Christopher Pocs (G)	C	University of Colorado, Boulder	Physics								
Jie Xing (P)	C	University of South Carolina	Department of physics and astronomy								
Chun Hung Lui (S)	PI	University of California, Riverside	Physics	NSF	DMR - Division of Materials Research	DMR1945660	**P19723**	Exploring novel correlated states in 2D materials and moiré superlattices	Condensed Matter Physics	1	7
Ao Shi (G)	C	University of California, Riverside	Physics and Astronomy	American Chemical Society Petroleum Research Fund	Other	61640-ND6					
Matthew Wilson (G)	C	University of California, Riverside	Physics and Astronomy								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Suchitra Sebastian (S)	PI	University of Cambridge	Physics	European research council	Non US Council		**P19724**	Quantum Oscillations in an Unconventional Insulator	Condensed Matter Physics	2	12.79
Jessica Chapman (G)	C	University of Cambridge	Physics	European Research Council	Other						
Alex Eaton (S)	C	University of Cambridge	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Nicholas Popiel (G)	C	University of Cambridge	Physics								
Gilles Rodway-Gant (U)	C	University of Cambridge	Cavendish Laboratory								
Dmitry Smirnov (S)	PI	National High Magnetic Field Laboratory	Instrumentation & Operations	DOE	BES – Basic Energy Sciences	DE-FG02-07ER46451	**P19727**	Testing new probes and techniques for high-field optical magnetospectroscopy	Condensed Matter Physics	1	14
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Semenov (T)	C	National High Magnetic Field Laboratory	DC Field								
Komalavalli Thirunavukkuarasu (S)	C	Florida Agricultural and Mechanical University	Physics								
Li Xiang (P)	C	National High Magnetic Field Laboratory	DC field								
Charles Agosta (S)	PI	Clark University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1905950	**P19729**	Search for Inhomogeneous Superconductivity using field and angular sweeps.	Condensed Matter Physics	1	7
Raju Ghimire (G)	C	Clark University	Physics								
Brett Laramee (G)	C	Clark University	Physics								
John Schlueter (S)	C	Argonne National Laboratory	Materials Science								
Michael Shatruk (S)	PI	National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR1905499	**P19737**	Investigation of Magnetic Properties of Liquid-Exfoliated 2D Materials	Development of Magnet Technology	4	27
Ian Campbell (G)	C	Florida State University	Chemistry and Biochemistry								
Judith Clark (G)	C	Florida State University	Chemistry and Biochemistry								
Govind Sasi Kumar (G)	C	Florida State University	Chemistry and Biochemistry								
Theo Siegrist (S)	PI	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering	No other support			**P19750**	Investigating the origin of various magnetic anomalies in EuPd2-xAxSi2-yBy series	Condensed Matter Physics	1	7
Masoud Mardani (G)	C	National High Magnetic Field Laboratory	CMS								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Shivani Sharma (P)	C		Brookhaven National Laboratory	NSLS-2								
Ayyalusamy Ramamoorthy (S)	PI		University of Michigan	Chemistry & Biophysics	NIH	NIGMS - National Institute of General Medical Sciences	GM351395	**P19766**	Measurement of 17O Residual Quadrupolar Couplings in Small Molecules Using Lipid Nanodiscs	Chemistry	1	4
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Sam McCalpin (G)	C		University of Michigan	Chemistry								
Rongfu Zhang (P)	C		National High Magnetic Field Laboratory	NHMFL								
Ulrich Welp (S)	PI		Argonne National Laboratory	Materials Science Division	DOE	BES – Basic Energy Sciences	W-31-109-ENG-38	**P19781**	Exploring the Fermi surface topology of Kagome lattice superconductors AV3Sb3 (A = K, Rb, Cs) under high magnetic field	Condensed Matter Physics	1	5.42
Ramakanta Chapai (P)	C		Argonne National Laboratory	Materials Science Division								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Wai-Kwong Kwok (S)	C		Argonne National Laboratory	MSD 223 C129								
Douglas Natelson (S)	PI	*	Rice University	Physics and Astronomy	DOE	BES – Basic Energy Sciences	DE-FG02-06ER46337	**P19795**	Shot noise in the field-enhanced normal state of cuprate tunnel junctions	Condensed Matter Physics	1	7
Ivan Bozovic (S)	C		Brookhaven National Laboratory	Condensed Matter and Materials Science								
Liyang Chen (G)	C		Rice University	Physics and Astronomy								
Jan Jaroszynski (S)	C		National High Magnetic Field Laboratory	CMS								
Dale Lowder (G)	C		Rice University	Physics and Astronomy								
Chetan Dhital (S)	PI		Kennesaw State University	Physics	No other support			**P19797**	Investigation of magnetic and electrical transport properties of non-centrosymmetric rare earth magnets.	Condensed Matter Physics	1	7
Kaveh Ahadi (S)	PI	*	North Carolina State University	Materials Science and Engineering	NCSU Startup funding	Other		**P19812**	Revealing hidden orders in a 2D superconductor	Condensed Matter Physics	2	14
Athby Al-Tawhid (P)	C		North Carolina State University	MSE	NC State University FRPD fund							
Shalinee Chikara (S)	C		National High Magnetic Field Laboratory	CMS, DC Field Facility								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Samuel Poage (G)	C	North Carolina State University	Materials Science Engineering								
Martin Nikolo (S)	PI	Saint Louis University	Physics	Saint Louis University			**P19816**	Investigation of high magnetic field properties of Kondo insulators via torque magnetometry	Condensed Matter Physics	1	7
Aakash Gupta (G)	C	Florida State University	Physics								
Guangxin Ni (S)	C	Florida State University	Physics								
Sheng Ran (S)	C	Washington University in St. Louis	Physics								
Kaitai Xiao (G)	C	National High Magnetic Field Laboratory	CMS								
Chiara Tarantini (S)	PI	National High Magnetic Field Laboratory	Applied Superconductivity Center	DOE	HEP – High Energy Physics	DE-SC0012083	**P19818**	Characterization of Nb3Sn wires with improved high-field performance	Condensed Matter Physics	1	5.21
Shreyas Balachandran (P)	C	Florida State University	Applied Superconductivity Center								
David Larbalestier (S)	C	National High Magnetic Field Laboratory	ASC								
Peter Lee (S)	C	Florida State University	Applied Superconductivity Center								
Nawaraj Paudel (G)	C	Florida State University	Physics								
William Starch (O)	C	Florida State University	Applied Superconductivity Center								
Rongying Jin (S)	PI	University of South Carolina	Department of Physics and Astronomy	No other support			**P19819**	Quantum behavior in a topological material candidate	Condensed Matter Physics	1	7
Joanna Blawat (G)	C	University of South Carolina	Physics and Astronomy								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Jie Xing (P)	C	University of South Carolina	Department of physics and astronomy								
Brian Maple (S)	PI	University of California, San Diego	Inst for Pure & Applied Physical Sciences	DOE	BES – Basic Energy Sciences	DEFG02-04-ER46105	**P19821**	Magnetostriction of URu2-xFexSi2 in High Magnetic Fields	Condensed Matter Physics	1	4
Alexander Breindel (G)	C	University of California, San Diego	Physics	NSF	DMR - Division of Materials Research	DMR1810310					
Marcelo Jaime (S)	C	National High Magnetic Field Laboratory	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Camilla Moir (P)	C		University of California, San Diego	Physics								
William Peria (P)	C		Los Alamos National Laboratory	MPA-MAGLAB								
Naveen Pouse (G)	C		University of California, San Diego	Physics								
Sheng Ran (S)	C		Washington University in St. Louis	Physics								
Hans-Conrad zur Loye (S)	PI	*	University of South Carolina	Chemistry and Biochemistry	DOE	BES – Basic Energy Sciences	DE-SC0018739	**P19830**	Magnetic Susceptibility of Uranium Platinum Group Sulfides	Chemistry	1	8
Brandon Sorbom (S)	PI	*	Commonwealth Fusion Systems	Research & Development	Commonwealth Fusion Systems			**P19831**	Angularly Resolved Critical Current Characterization of REBCO High Temperature Superconductors for High-Field Fusion Magnets	Development of Magnet Technology	1	5.87
JL Cheng (S)	C		Commonwealth Fusion Systems	Research & Development								
Rui Diaz-Pacheco (S)	C		Commonwealth Fusion Systems	Research & Development								
Aliya Greenberg (S)	C		Commonwealth Fusion Systems	Research & Development								
Jan Jaroszynski (S)	C		National High Magnetic Field Laboratory	CMS								
JP Muncks (S)	C		Commonwealth Fusion Systems	Manufacturing								
Aixia Xu (O)	C		Florida State University	ASC								
Jake Ayres (P)	PI	*	University of Bristol	Physics	EPSRC - Engineering and Physical Sciences Research Council	Non US Council	EP/T517872/1	**P19833**	Delineating nematic and magnetic quantum criticality in Fe(S, Se)	Condensed Matter Physics	1	4.88
Sven Friedemann (S)	C		University of Bristol	Department of Physics								
Roemer Hinlopen (G)	C		University of Bristol	Physics								
Nigel Hussey (S)	C		University of Bristol	H.H. Wills Physics Laboratory								
Mansour Shayegan (S)	PI		Princeton University	Department of Electrical Engineering	NSF	DMR - Division of Materials Research	DMR2104771	**P19835**	Search for valley skyrmions at Landau level filling factor 1/3 in high-quality AlAs quantum wells	Condensed Matter Physics	2	20
Adbhut Gupta (P)	C		Princeton University	Electrical and Computer Engineering	DOE	BES – Basic Energy Sciences	DEFG02-00-ER45841					
Siddharth Kumar Singh (G)	C		Princeton University	Electrical Engineering								
Pranav Thekke Madathil (G)	C		Princeton University	Electrical Engineering								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Chengyu Wang (G)	C	Princeton University	Electrical and Computer Engineering								
Elizabeth Green (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science	NSF	DMR - Division of Materials Research	DMR2105191	**P19842**	NMR Knight Shift of spin triplet superconductor UTe2 in high magnetic field	Condensed Matter Physics	2	11
Nicholas Butch (S)	C	National Institute of Standards and Technology MD	NIST Center for Neutron Research	NIST	US Government Lab						
Corey Frank (P)	C	National Institute of Standards and Technology MD	NCNR								
Sylvia Lewin (P)	C	University of Maryland, College Park	physics								
Sheng Ran (S)	C	Washington University in St. Louis	Physics								
Gicela Saucedo Salas (G)	C	University of Maryland, College Park	Physics								
Sunil Karna (S)	PI	Norfolk State University	Physics Department	NSF	DMR - Division of Materials Research	DMR1832031	**P19847**	Investigation of quantum oscillations in chiral Mn1/3NbS2	Condensed Matter Physics	1	7
Kevin Allen (U)	C	Norfolk State University	Physics Department								
Terence Baker (G)	C	Norfolk State University	Physics Department								
Orrin Clarke Delgado (G)	C	Norfolk State University	Physics Department								
Layla Smith (U)	C	Norfolk State University	Physics								
Doyle Temple (S)	C	Norfolk State University	Physics Department								
Zhehong Gan (S)	PI	National High Magnetic Field Laboratory	NHMFL	No other support			**P19856**	Development and implementation of solid-state NMR methods at high magnetic fields	Chemistry	1	5
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Wenping Mao (P)	C	National High Magnetic Field Laboratory	NMR								
Robert Schurko (S)	C	Florida State University	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yijue Xu (P)	C	National High Magnetic Field Laboratory	solid-state NMR								
Jeffrey Schiano (S)	PI	Pennsylvania State University	Electrical Engineering	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19858**	Flux Regulation for Powered Magnets	Engineering	2	6
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Waroch Tangbampensountorn (G)	C	Pennsylvania State University	Electrical Engineering								
Fernando Luis de Araujo Machado (S)	PI	Federal University of Pernambuco	Departamento de Física	FACEPE	Other		**P19862**	Giant magnetoresistance in.YCd6	Condensed Matter Physics	1	5.46
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment	CNPq	Other						
Brian Casas (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Fernando Luis de Araujo Machado (S)	C	Federal University of Pernambuco	Departamento de Física								
David Mandrus (S)	PI	University of Tennessee, Knoxville	Materials Science and Engineering	Gordon and Betty Moore Foundation	US Foundation	GBMF9069	**P19874**	Thermal transport properties of Ho2RhIn8	Condensed Matter Physics	1	21
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
Shirin Mozaffari (P)	C	University of Tennessee, Knoxville	Materials Science and Engineering								
Sabyasachi Sen (S)	PI	University of California, Davis	Chemical Engineering and Materials Science	NSF	DMR - Division of Materials Research	DMR1855176	**P19876**	High-Field NMR Investigation of the Structural Evolution during Nucleation in Glass-Ceramics: Towards an Atomistic Understanding	Engineering	3	13
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Bing Yuan (G)	C	University of California, Davis	Engineering								
Robert Schurko (S)	PI	Florida State University	Chemistry	Florida State University	US College and University	Startup	**P19885**	Multinuclear Solid-State NMR of	Chemistry	3	13

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Christer Aakeroy (S)	C	Kansas State University	Chemistry and Biochemistry					Quadrupolar Nuclei in Active Pharmaceutical Ingredients: New Pathways for the Characterization of Polymorphs, Hydrates, Cocrystals, and Dosage Forms			
Louae Abdulla (G)	C	University of Windsor	Chemistry								
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry								
Tomislav Friscic (S)	C	McGill University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
James Harper (S)	C	Brigham Young University (BYU)	Chemistry and Biochemistry								
Sean Holmes (P)	C	Florida State University	Chemistry and Biochemistry								
James Hook (S)	C	University of New South Wales	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Robbie Iuliucci (S)	C	Washington and Jefferson College	Chemistry								
James Kimball (G)	C	Florida State University	Chemistry								
Austin Peach (G)	C	Florida State University	Chemistry and Biochemistry								
Jeremy Rawson (S)	C	University of Windsor	Department of Chemistry and Biochemistry								
Jasmin Schoenzart (G)	C	Florida State University	Chemistry and Biochemistry								
Robert Smith (G)	C	Florida State University	Chemistry and Biochemistry								
Cameron Vojvodin (G)	C	Florida State University	Chemistry and Biochemistry								
Lara Watanabe (G)	C	University of Windsor	Chemistry and Biochemistry								
Emilia Morosan (S)	PI	Rice University	Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR1903741	**P19894**	High magnetic field resistivity and angle dependent magnetization in EuGa4	Condensed Matter Physics	1	2.7
Kevin Allen (G)	C	Rice University	Physics and Astronomy								
Luis Balicas (S)	C	National High Magnetic Field Laboratory	Condensed Matter Experiment								
Theo Siegrist (S)	PI	National High Magnetic Field Laboratory	Chemical and Biomedical Engineering	No other support			**P19906**	Magnetic properties of EuPd1.8Ni0.2Si2, EuPd1.6Ni0.4Si2, EuPd2Si1.8Ge0.2 and EuPd2Si1.6Ge0.4	Condensed Matter Physics	1	7
Masoud Mardani (G)	C	National High Magnetic Field Laboratory	CMS								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Shivani Sharma (P)	C		Brookhaven National Laboratory	NSLS-2								
Scott Dietrich (S)	PI	*	Villanova University	Physics	NSF	DMR - Division of Materials Research	DMR1943389	**P19917**	Microwave spectroscopy of van der Waals heterostructures	Condensed Matter Physics	2	14
Arash Akbari-Sharbaf (P)	C		Villanova University	Physics								
Christopher Barns (U)	C		West Chester University	Physics								
Lloyd Engel (S)	C		National High Magnetic Field Laboratory	CMS								
Matthew Freeman (G)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Minhyea Lee (S)	PI		University of Colorado, Boulder	Physics	DOE	BES – Basic Energy Sciences	DE-SC0021377	**P19922**	Investigation of the crystal electric field effects in rare earth magnets	Condensed Matter Physics	1	6
Zhigang Jiang (S)	C		Georgia Institute of Technology	School of Physics								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C		National High Magnetic Field Laboratory	Instrumentation & Operations								
Li Xiang (P)	C		National High Magnetic Field Laboratory	DC field								
Jie Xing (P)	C		University of South Carolina	Department of physics and astronomy								
Martin Kirk (S)	PI		University of New Mexico	Department of Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0020199	**P19926**	Magneto-photoluminescence and Magneto-vibrational Studies of Exchange-Coupled Systems	Chemistry	1	7
Caroline Mangione (G)	C		University of New Mexico	Chemistry and Chemical Biology								
Joshua Mengel (G)	C		University of New Mexico	Chemistry and Chemical Biology								
Paul Miller (G)	C		North Carolina State University	Chemistry								
David Shultz (S)	C		North Carolina State University	Chemistry								
Fazel Tafti (S)	PI		Boston College	Physics	DOD	US Air Force	FA2386-21-1-4059	**P19927**	Chiral Crystals at the Extreme Quantum Limit	Condensed Matter Physics	2	12.14
Eun Sang Choi (S)	C		National High Magnetic Field Laboratory	Physics Department								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Xiaohan Yao (G)	C		Boston College	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Cedomir Petrovic (S)	PI		Brookhaven National Laboratory	Condensed Matter Physics	DOE	BES – Basic Energy Sciences	DE-SC0012704	**P19928**	Pressure-induced structural changes in two-dimensional van der Waals materials	Condensed Matter Physics	1	7
Shuzhang Chen (G)	C		Brookhaven National Laboratory	Condensed Matter Physics								
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Zhixiang Hu (G)	C		Brookhaven National Laboratory	Condensed Matter Physics								
Nicholas Chilton (S)	PI	*	University of Manchester	Department of Chemistry	European Research Council		ERC-2019-STG-851504	**P19930**	FIRMS measurements on an air-stable single-molecule magnet	Development of Magnet Technology	1	7
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Stuart Langley (S)	C		Manchester Metropolitan University	Chemistry								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Yasmin Whyatt (G)	C		University of Manchester	Chemistry								
Huiqiu Yuan (S)	PI		Zhejiang University	Physics Department	The National Natural Science Foundation of China	Non US Foundation	12034017	**P19932**	High field study of quantum critical heavy fermion ferromagnet CeRh6Ge4	Condensed Matter Physics	1	5.17
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Yanen Huang (G)	C		Zhejiang University	Center for Correlated Matter and Department of Physics								
Luis Jauregui (S)	PI	*	University of California, Irvine	Department of Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR2146567	**P19933**	Magnetotransport of gate-tunable van der Waals topological heterostructures	Condensed Matter Physics	3	21
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS	NSF	MRSEC - Materials Research Science and Engineering Centers	Seed funds					
Jinyu Liu (P)	C		University of California, Irvine	Department of Physics and Astronomy								
Robert Welser (G)	C		University of California, Irvine	Department of Physics and Astronomy								
Sanfeng Wu (S)	PI		Princeton University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1942942	**P19936**	Correlated Quantum Matter in the Two-		1	6

Participants (Name, Role, Org., Dept.)	Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yanyu Jia (G), C, Princeton University, Physics Pengjie Wang (P), C, Princeton University, Department of Physics Guo Yu (G), C, Princeton University, Physics	NSF, DMR - Division of Materials Research, DMR2011750 DOD, ONR - Office of Naval Research, N00014-21-1-2804		Dimensional WTe2 Systems	Condensed Matter Physics		
Rongying Jin (S), PI, University of South Carolina, Department of Physics and Astronomy Jie Xing (P), C, University of South Carolina, Department of physics and astronomy	No other support	**P19937**	Frustrated magnetism in rare-earth triangular lattice materials	Condensed Matter Physics	1	8
Jian Liu (S), PI, University of Tennessee, Knoxville, Physics Eun Sang Choi (S), C, National High Magnetic Field Laboratory, Physics Department Chengkun Xing (G), C, University of Tennessee, Knoxville, Physics Weiliang Yao (P), C, University of Tennessee, Knoxville, Physics	DOE, BES – Basic Energy Sciences, DE-SC0020254	**P19938**	Emergent magnetotransport phenomena of geometrically frustrated heterostructures	Condensed Matter Physics	2	14
Long Ju (S), PI, *, Massachusetts Institute of Technology, Physics Tonghang Han (G), C, Massachusetts Institute of Technology, Physics Zhengguang Lu (P), C, Massachusetts Institute of Technology, Physics	NSF, DMR - Division of Materials Research, DMR1231319	**P19939**	Electron Correlation in A Rhombohedral Trilayer Graphene/hBN Moiré Superlattice	Condensed Matter Physics	2	15
David Larbalestier (S), PI, National High Magnetic Field Laboratory, ASC Dmytro Abraimov (S), C, National High Magnetic Field Laboratory, The Applied Superconductivity Center Griffin Bradford (O), C, National High Magnetic Field Laboratory, Applied Superconductivity Center Ashleigh Francis (T), C, National High Magnetic Field Laboratory, ASC Jan Jaroszynski (S), C, National High Magnetic Field Laboratory, CMS Fumitake Kametani (P), C, National High Magnetic Field Laboratory, ASC	DOE, FES - Office of Fusion Energy Sciences, DE-SC0022011	**P19940**	Torque magnetometry study of the full field, angle, and temperature dependence of the critical current density in ReBCO Coated Conductors in relation to their pinning center arrays	Development of Magnet Technology	1	2.57

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jonathan Lee (G)	C		National High Magnetic Field Laboratory	Applied Superconductivity Center								
Aixia Xu (O)	C		Florida State University	ASC								
Alex Eaton (S)	PI	*	University of Cambridge	Physics	EPSRC UK	Non US Council		**P19943**	High magnetic field study of a spin-triplet superconductor candidate	Condensed Matter Physics	3	16.16
Alex Hickey (G)	C		University of Cambridge	Department of Physics								
Mijail Mancera (G)	C		University of Cambridge	Physics								
Nicholas Popiel (G)	C		University of Cambridge	Physics								
Michal Valiska (S)	C		Charles University, Prague, Czechia	Physics								
Zheyu Wu (G)	C		University of Cambridge	Department of Physics								
Sufei Shi (S)	PI		Rensselaer Polytechnic Institute	Chemical and Biological Engineering	NSF	DMR - Division of Materials Research	DMR1945420	**P19944**	Magneto-optical Spectroscopy of Correlated Physics in Semiconducting Moiré Superlattices	Condensed Matter Physics	2	20
Xiaotong Chen (P)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Lei Ma (G)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Yuze Meng (P)	C		Rensselaer Polytechnic Institute	Chemical and Biological Engineering								
Dmitry Smirnov (S)	C		National High Magnetic Field Laboratory	Instrumentation & Operations								
Li Xiang (P)	C		National High Magnetic Field Laboratory	DC field								
Li Yan (G)	C		Rensselaer Polytechnic Institute	Chemical engineering								
Yasuyuki Nakajima (S)	PI		University of Central Florida	Physics	NSF	DMR - Division of Materials Research	DMR1944975	**P19948**	Transport and magnetic properties of novel quantum phases of matter associated with flat bands	Condensed Matter Physics	1	5.44
Eun Sang Choi (S)	C		National High Magnetic Field Laboratory	Physics Department								
Charuni Dissanayake (G)	C		University of Central Florida	Physics								
Kapila Kumarasinghe (G)	C		University of Central Florida	Physics								
Suchitra Sebastian (S)	PI		University of Cambridge	Physics	UCGP			**P19950**	Phase diagram of a Correlated Insulator		1	4.43

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS						Condensed Matter Physics		
Nicholas Popiel (G)	C	University of Cambridge	Physics								
Gilles Rodway-Gant (U)	C	University of Cambridge	Cavendish Laboratory								
Geetha Balakrishnan (S)	PI	University of Warwick	Physics	European Research Council	Non US Council		**P19951**	Quantum Oscillations in New Families of Correlated Insulators	Condensed Matter Physics	1	5.64
Nicholas Popiel (G)	C	University of Cambridge	Physics								
Gilles Rodway-Gant (U)	C	University of Cambridge	Cavendish Laboratory								
Suchitra Sebastian (S)	C	University of Cambridge	Physics								
Alexey Suslov (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Science	No other support			**P19953**	Improvement of the ultrasonic techniques at the DC field facility: 2022	Condensed Matter Physics	3	21
Robert Nowell (T)	C	National High Magnetic Field Laboratory	DC User Support								
Jak Chakhalian (S)	PI	Rutgers University	physics	Gordon and Betty Moore Foundation	Other		**P19954**	Magnetotransport study on Weyl semimetal pyrochlore iridate thin films	Condensed Matter Physics	2	21
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Michael Terilli (G)	C	Rutgers University	Physics								
Tsung-Chi Wu (G)	C	Rutgers University	Physics								
Christianne Beekman (S)	PI	National High Magnetic Field Laboratory	Physics	NSF	DMR - Division of Materials Research	DMR1847887	**P19955**	Study of the Magneto-elastic Coupling in Thin Films and Bulk Samples of Frustrated Magnets	Condensed Matter Physics	4	32
Bijay DC (G)	C	Florida State University	Physics								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Sangsoo Kim (G)	C	Florida State University	Physics								
Luis Sánchez-Muñoz (S)	PI *	Consejo Superior de Investigaciones Científicas	Geology	No other support			**P19961**	27Al MAS NMR spectra at 1.5 GHz in alkali feldspars	Chemistry	1	4
Pierre Florian (S)	C	French National Center for Scientific Research	CEMTHI								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yuanzheng Yue (S)	PI	*	Aalborg University	Department of Chemistry and Bioscience	The Independent Research Fund Denmark	Other	1026-00318B	**P19967**	Probing the local structure of metal-organic frameworks via high field NMR	Development of Magnet Technology	1	4
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Olivier Lafon (S)	PI		University of Lille	Chemical Engineering	CNRS	Non US Government Lab		**P19969**	67Zn and 33S NMR of ZnS and ZnS/ZnO nanocrystals at 35.2 T	Chemistry	1	4
Yannick Coppel (S)	C		French National Center for Scientific Research	LCC								
Myrtil Kahn (S)	C		French National Center for Scientific Research	LCC								
Hiroki Nagashima (S)	C		National Institute of Advanced Industrial Science and Technology	Interdisciplinary Research Center for Catalytic Chemistry								
Julien Trebosc (S)	C		University of Lille	Unite de Catalyse et de Chimie du Solide								
Adam Fiedler (S)	PI		Marquette University	Chemistry	NSF	CHE - Chemistry	CHE1900562	**P19970**	Elucidating the Magnetic and Electronic Features of High-Symmetry Fe(II) and Co(II) Complexes	Chemistry	1	3
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Daniel SantaLucia (P)	C		Max Planck Institute for Chemical Energy Conversion, Muelheim	Molecular Theory and Spectroscopy								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								
David Bryce (S)	PI		University of Ottawa	Department of Chemistry and Biomolecular Sciences	Natural Sciences and Engineering Research Council Canada	Non US Council		**P19976**	Rhenium-185-187 Solid-State NMR Investigation of Non-Covalent Matere Bonds	Chemistry	2	8
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yijue Xu (P)	C		National High Magnetic Field Laboratory	solid-state NMR								
Sunil Karna (S)	PI		Norfolk State University	Physics Department	NSF	DMR - Division of Materials Research	DMR1832031	**P19978**	Magnetic susceptibility and magnetization measurements of chiral Mn1/3NbS2	Condensed Matter Physics	2	14
Orrin Clarke Delgado (G)	C		Norfolk State University	Physics Department								
Leroy Salary (S)	C		Norfolk State University	Physics Department								
Doyle Temple (S)	C		Norfolk State University	Physics Department								
Xinhua Peng (S)	PI	*	University of Science and Technology of China	Physics	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19983**	New 17O NMR method for protein channel water study	Biology, Biochemistry, Biophysics	1	4
Tim Cross (S)	C		National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry								
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Rongfu Zhang (P)	C		National High Magnetic Field Laboratory	NHMFL								
Michelle Jamer (S)	PI	*	U.S. Naval Academy	Physics	NSF	DMR - Division of Materials Research	DMR1904446	**P20004**	Understanding metallic behavior in Fe3Ga4 under application of pressure	Development of Magnet Technology	1	7
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Anand Bhattacharya (S)	PI		Argonne National Laboratory	Materials Science Division & Center for Nanoscale Materials	DOE	BES – Basic Energy Sciences	PRJ100081	**P20006**	Upper critical field measurements of superconducting KTaO3 interfaces	Biology, Biochemistry, Biophysics	1	7
Qianheng Du (P)	C		Argonne National Laboratory	Materials Science Division								
Changjiang Liu (S)	C		State University of New York at Buffalo	Physics								
Alexey Suslov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Junyi Yang (G)	C		University of Tennessee, Knoxville	Physics and Astronomy								
Wei Pan (S)	PI		Sandia National Laboratories	Semiconductor Devices and Science	DOE	LDRD - Laboratory Directed R&D	DE-NA00-03	**P20027**	Electronic transport and optical studies of semiconductor artificial quantum materials	Condensed Matter Physics	1	7
Chetan Dhital (S)	PI		Kennesaw State University	Physics	NSF	DMR - Division of Materials Research	DMR2213443	**P20032**			1	5.59

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
August Meads (U)	C	Kennesaw State University	Physics					Study of quantum oscillations in flat band Kagome metals.	Condensed Matter Physics		
Brady Wilson (U)	C	Kennesaw State University	Physics								
Sergei Zvyagin (S)	PI	Helmholtz Zentrum Dresden-Rossendorf	Dresden High Magnetic Field Laboratory	SFB 1143	Other		**P20035**	Frustration and competing interactions in quantum antiferromagnets	Condensed Matter Physics	2	13.02
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Yoshimitsu Kohama (S)	C	University of Tokyo	Institute for Solid State Physics (ISSP)								
Hidekazu Tanaka (S)	C	Tokyo Institute of Technology	Physics								
Joachim Wosnitza (S)	C	Helmholtz Zentrum Dresden-Rossendorf	Dresden High Magnetic Field Laboratory (HLD)								
John Durrell (S)	PI	University of Cambridge	Engineering Department	Boeing			**P20036**	High Field Trapping in Hybrid Reinforced Bulk Superconductors	Material Science	1	5.13
David Cardwell (S)	C	University of Cambridge	Engineering Department	EPSRC	Non US Council						
Eric Hellstrom (S)	C	National High Magnetic Field Laboratory	Applied Superconductivity Center								
Jan Jaroszynski (S)	C	National High Magnetic Field Laboratory	CMS								
Sheng Ran (S)	PI	Washington University in St. Louis	Physics	Washington University in St. Louis	US College and University		**P20040**	Physics properties of odd parity superconductors in high magnetic fields	Condensed Matter Physics	1	7
Christopher Broyles (G)	C	Washington University in St. Louis	Physics								
Eun Sang Choi (S)	C	National High Magnetic Field Laboratory	Physics Department								
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Martin Nikolo (S)	C	Saint Louis University	Physics								
Hasan Siddiquee (P)	C	Washington University in St. Louis	Physics								
Mansour Shayegan (S)	PI	Princeton University	Department of Electrical Engineering	NSF	DMR - Division of Materials Research	DMR2104771	**P20041**	Role of layer thickness on enhancement of spin susceptibility of an interacting 2DES	Condensed Matter Physics	1	7
Casey Calhoun (G)	C	Princeton University	Electrical and Computer Engineering	DOE	BES – Basic Energy Sciences	DEFG02-00-ER45841					

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Adbhut Gupta (P)	C		Princeton University	Electrical and Computer Engineering								
Siddharth Kumar Singh (G)	C		Princeton University	Electrical Engineering								
Chia-Tse Tai (G)	C		Princeton University	Electrical and Computer Engineering								
Pranav Thekke Madathil (G)	C		Princeton University	Electrical Engineering								
Chengyu Wang (G)	C		Princeton University	Electrical and Computer Engineering								
John Anderson (S)	PI	*	University of Chicago	Chemistry	DOD	ARO - Army Research Office		**P20043**	Physical Property Studies on Sulfur-based Coordination Polymers	Chemistry	1	7
Ningxin Jiang (P)	C		University of Chicago	Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0019215					
Jia Li (S)	PI		Brown University	Department of Physics	NSF	DMR - Division of Materials Research	DMR2143384	**P20045**	Nematicity, nonreciprocity, and their interplay in a moire flatband	Condensed Matter Physics	1	7
Jiangxiazi Lin (G)	C		Hong Kong University of Science and Technology	Center for Quantum materials								
Naiyuan Zhang (G)	C		Brown University	Department of Physics								
Suguru Yoshida (S)	PI	*	Pennsylvania State University	Materials Research Institute	NSF	MIP - Materials Innovation Platform	DMR-2039351	**P20047**	High-Entropy Engineering of the Valley Electronic Structure in a Three-Dimensional Dirac Semimetal	Condensed Matter Physics	1	5.36
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Yingdong Guan (G)	C		Pennsylvania State University	Physics Department								
Seng Huat Lee (S)	C		Pennsylvania State University	Physics								
Subin Mali (G)	C		Pennsylvania State University	Physics								
Zhiqiang Mao (S)	C		Pennsylvania State University	Department of Physics								
Venkat Selvamanickam (S)	PI		University of Houston	Mechanical Engineering	DOE	SBIR - Small Business Innovation Research	DE-SC0020717	**P20049**	Critical current characterization of STAR® REBCO wires at 4.2 K and very high magnetic fields	Development of Magnet Technology	1	4.78
Eduard Galstyan (S)	C		University of Houston	Texas Center for Superconductivity								
Bhabesh Sarangi (G)	C		University of Houston	Material Science and Engineering								
Mykhaylo Ozerov (S)	PI		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS	No other support			**P20053**	Probing crystal electric field in lanthanide-based	Chemistry	1	7

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Talal Mallah (S)	C		University of Paris-Sud	ICMMO					qubits and functional molecules by high-field optical magneto spectroscopy			
Julia Chan (S)	PI	*	Baylor University	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR2209804	**P20085**	Characterization of Highly Correlated f-Electron Systems	Chemistry	1	21
Luis Balicas (S)	C		National High Magnetic Field Laboratory	Condensed Matter Experiment	Welch	Other	AT-2056-20210327					
Ryan Baumbach (S)	C		National High Magnetic Field Laboratory	CMS								
Moises Bravo (G)	C		Baylor University	Chemistry and Biochemistry								
Alexis Dominguez (G)	C		Baylor University	Chemistry and Biochemistry								
Kaya Wei (P)	C		National High Magnetic Field Laboratory	CMS								
Chetan Dhital (S)	PI		Kennesaw State University	Physics	NSF	DMR - Division of Materials Research	DMR2213443	**P20090**	Investigation of topological magnetic textures in non-centrosymmetric oxides	Condensed Matter Physics	1	7
August Meads (U)	C		Kennesaw State University	Physics								
Brady Wilson (U)	C		Kennesaw State University	Physics								
Alexey Suslov (S)	PI		National High Magnetic Field Laboratory	Condensed Matter Science	No other support			**P20091**	Tests of X-ray instrumentation in cell 5	Condensed Matter Physics	1	0.06
Alexey Kovalev (S)	C		National High Magnetic Field Laboratory	CMS								
Masoud Mardani (G)	C		National High Magnetic Field Laboratory	CMS								
Dmitry Semenov (T)	C		National High Magnetic Field Laboratory	DC Field								
Theo Siegrist (S)	C		National High Magnetic Field Laboratory	Chemical and Biomedical Engineering								
Alexander Forse (S)	PI	*	University of Cambridge	Chemistry	Leverhulme Trust	Non US Foundation		**P20101**	17O NMR studies of CO2 capture mechanism in hydroxide-based materials	Chemistry	1	4
Suzi Pugh (P)	C		University of Cambridge	Dr								
Benjamin Rhodes (G)	C		University of Cambridge	Chemistry								
Shivani Sharma (P)	PI	*	Brookhaven National Laboratory	NSLS-2	No other support			**P20103**	Investigating the nature of various transition in	Condensed Matter Physics	1	7

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Kaya Wei (P)	C	National High Magnetic Field Laboratory	CMS					Ge.5Mn.5Co2O4 using heat capacity			
Luis Balicas (S)	PI	National High Magnetic Field Laboratory	Condensed Matter Experiment	DOE	BES – Basic Energy Sciences	DE-SC0002613	**P20119**	Understanding the topological spin textures in the magnetic topological semi-metallic candidates Fe3GeTe2 and Fe5GeTe2	Condensed Matter Physics	1	14
Brian Casas (P)	C	National High Magnetic Field Laboratory	Condensed Matter Sciences								
Alex Moon (G)	C	National High Magnetic Field Laboratory	Condensed Matter								
								Total Proposals:	**Experiments:**		**Days:**
								156	**288**		**1,882.70**

EMR Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Lucio Frydman (S)	PI	National High Magnetic Field Laboratory	NMR	No other support			**P17754**	Three-Spins Solution State DNP	Biology, Biochemistry, Biophysics	1	4
Adewale Akinfaderin (G)	C	Florida State University	Physics								
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Murari Soundararajan (P)	C	National High Magnetic Field Laboratory	CIMAR, NMR								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Michael Nippe (S)	PI	Texas A&M University	Chemistry	NSF	CHE - Chemistry	CHE1753014	**P17842**	Exploring Magnetic Coupling and Spin Relaxation in Ln-[1]metallocenophane Compounds using High-Field and Pulsed EPR spectroscopy	Chemistry	1	6
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Trevor Latendresse (G)	C	Texas A&M University	Chemistry								
Jonathan Marbey (G)	C	National High Magnetic Field Laboratory	EMR								
Sandrine Heutz (S)	PI	Imperial College London	London Centre for Nanotechnology	No other support			**P18041**	Molecular magnetic superstructures	Chemistry	1	3
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C	University of Florida	Physics								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Jianyuan Zhang (S)	PI	Rutgers University	Chemistry and Chemical Biology	No other support			**P18049**	A Route to Molecular Quantum Technologies Using Endohedral Metallofullerenes	Chemistry	2	29
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Manoj Vinayaka Hanabe Subramanya (G)	C	Florida State University	Physics								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Jonathan Marbey (G)	C	National High Magnetic Field Laboratory	EMR								
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								
Jamie Manson (S)	PI	Eastern Washington University	Chemistry and Biochemistry	NSF	DMR - Division of Materials Research	DMR2104167	**P19143**	Determining phase diagrams in bespoke S = 1 Ni(II) quantum magnets	Condensed Matter Physics	1	8.5
Paul Goddard (S)	C	University of Warwick	Department of Physics								
Zachary Manson (T)	C	Eastern Washington University	Chemistry and Biochemistry								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Danna Freedman (S)	PI	Northwestern University	Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0019356	**P19174**	Optically Addressable Molecular Qubits	Chemistry	2	11
Rianna Greer (G)	C	Massachusetts Institute of Technology	Chemistry								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Michael Wojnar (P)	C	Northwestern University	Chemistry								
Dmytro Nesterov (P)	PI	Technical University of Lisbon	Chemistry Department	FCT - Fundação para a Ciência e Tecnologia (Portugal)	Non US Foundation		**P19177**	Magnetic Properties and EPR spectroscopy of Tetranuclear Copper Complexes	Chemistry	6	26
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
George Christou (S)	PI	University of Florida	Chemistry	DOE	EFRC - Energy Frontier Research Centers	DE-SC0019330	**P19185**	High-Field EPR Studies of Exchange Coupling Within Single-Molecule Magnet Oligomers	Chemistry	4	24
ChristiAnna Brantley (G)	C	University of Florida	Chemistry								
Alexander Diodati (G)	C	University of Florida	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Tuhin Ghosh (P)	C	University of Florida	Department of Chemistry								
Ashlyn Hale (P)	C	University of Florida	Chemistry								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C	University of Florida	Physics								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
Johan van Tol (S)	PI	National High Magnetic Field Laboratory	EMR	No other support			**P19207**	Testing and Maintenance	Condensed Matter Physics	1	4
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								
Frederic Mentink (S)	PI	National High Magnetic Field Laboratory	CIMAR	No other support			**P19241**	Improving biradicals for MAS-DNP at high field: a combined approach of Spin-Dynamics theory, DFT and high-field EPR	Chemistry	2	11
Manoj Vinayaka Hanabe Subramanya (G)	C	Florida State University	Physics								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								
Likai Song (S)	PI	National High Magnetic Field Laboratory	EMR	No other support			**P19282**	Instrument Development and Maintenance	Development of Magnet Technology	4	99
Brittany Grimm (G)	C	Florida State University	Physics								
Manoj Vinayaka Hanabe Subramanya (G)	C	Florida State University	Physics								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								
Linda Doerrer (S)	PI	Boston University	Chemistry Department	NSF	CHE - Chemistry	CHE1800313	**P19306**	A Unique {Mn6} Cluster with Axial Symmetry as a Single-Molecule Magnet Candidate	Chemistry	3	12
Shawn Moore (G)	C	Boston University	Chemistry								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Stergios Piligkos (S) Christian Buch (G) Stephen Hill (S) Jonathan Marbey (G) Johan van Tol (S)	PI C C C C	University of Copenhagen University of Copenhagen National High Magnetic Field Laboratory National High Magnetic Field Laboratory National High Magnetic Field Laboratory	Department of Chemistry Chemistry EMR EMR EMR	No other support			**P19318**	Pulsed EPR of Yb(trensal) based quantum gates	Development of Magnet Technology	2	8
Kirill Kovnir (S) Yao Abusa (G) Eranga Gamage (G) Andrew Ozarowski (S)	PI C C C	Iowa State University Iowa State University Iowa State University National High Magnetic Field Laboratory	Chemistry Chemistry Chemistry EMR	Iowa State University	US College and University		**P19330**	EPR investigation of Cr2Se2 dimer	Chemistry	2	9
Albert Stiegman (S) Jurek Krzystek (S) Nathan Peek (G) Susannah Scott (S)	PI C C C	Florida State University National High Magnetic Field Laboratory Florida State University (FSU) University of California, Santa Barbara	Chemistry Condensed Matter Science Chemistry and Biochemistry Chemical Engineering	DOE	BES – Basic Energy Sciences	DE-FG-02-03ER15467	**P19345**	Characterization of the active sites in the Phillip's ethylene polymerization catalyst with EPR spectroscopy	Chemistry	2	6
Jurek Krzystek (S) Thierry Dubroca (S) Songi Han (S) Stephen Hill (S) Bradley Price (G) Elvin Salerno (P)	PI C C C C C	National High Magnetic Field Laboratory National High Magnetic Field Laboratory University of California, Santa Barbara National High Magnetic Field Laboratory University of California, Santa Barbara National High Magnetic Field Laboratory	Condensed Matter Science EMR Department of Chemistry and Biochemistry EMR Physics EMR	No other support			**P19369**	Development of high-resolution THz EPR spectrometer based on the series-connected hybrid	Development of Magnet Technology	3	11.5

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Mark Sherwin (S)	C	University of California, Santa Barbara	Physics								
Bianca Trociewitz (T)	C	National High Magnetic Field Laboratory	EMR								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
Geoffrey Strouse (S)	PI	National High Magnetic Field Laboratory	Chemistry	NSF	DMR - Division of Materials Research	DMR1905757	**P19372**	Multinuclear solid-state NMR investigation of plasmonic and photoluminescent nanocrystals	Chemistry	4	14
Rajarshi Acharyya (G)	C	Florida State University	Chemistry and Biochemistry								
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry								
Nhat Nguyen Bui (P)	C	National High Magnetic Field Laboratory	CMS								
Carl Conti (G)	C	Florida State University	Chemistry & Biochemistry								
Catherine Fabiano (G)	C	Florida State University	Chemistry								
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Fabiola Gonzalez (G)	C	Florida State University	Chemistry and Biochemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Jason Kuszynski (G)	C	Florida State University	Chemistry & Biochemistry								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Raul Ortega (G)	C	Florida State University	Chemistry & Biochemistry								
Anant Paravastu (S)	C	Georgia Institute of Technology	School of Chemical & Biomolecular Engineering								
Robert Schurko (S)	C	Florida State University	Chemistry								
Robert Smith (G)	C	National High Magnetic Field Laboratory									
Robert Smith (G)	C	Florida State University	Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Likai Song (S)	C		National High Magnetic Field Laboratory	EMR								
Janet Tests (S)	C		Columbia University	Chemistry								
Cameron Vojvodin (G)	C		Florida State University	Chemistry and Biochemistry								
Zhigang Jiang (S)	PI		Georgia Institute of Technology	School of Physics	DOE	BES – Basic Energy Sciences	DE-FG02-07ER46451	**P19401**	Magneto-infrared Spectroscopy Study of Emerging Topological Materials with Layered Structures	Condensed Matter Physics	1	7
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Dmitry Smirnov (S)	C		National High Magnetic Field Laboratory	Instrumentation & Operations								
Li Xiang (P)	C		National High Magnetic Field Laboratory	DC field								
Tianhao Zhao (G)	C		Georgia Institute of Technology	School of Physics								
Stuart Brown (S)	PI	*	University of California, Los Angeles	Department of Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR2004553	**P19422**	High field studies of the frustrated quantum antiferromagnets k-(ET)2Cu2(CN)3, k-(ET)2Hg(SCN)2Cl	Condensed Matter Physics	1	5
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Teresa Le (G)	C		University of California, Los Angeles	Physics and Astronomy								
Andrej Pustogow (P)	C		University of California, Los Angeles	Physics and Astronomy								
Arneil Reyes (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
John Schlueter (S)	C		Argonne National Laboratory	Materials Science								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Michael Shatruk (S)	PI		National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry	No other support			**P19472**	EPR Investigation of Lantanide Complexes as Potential Hosts for Clock Transitions and Molecular Qubits	Development of Magnet Technology	5	27
Shubham Bisht (G)	C		Florida State University	Chemistry and Biochemistry								
ChristiAnna Brantley (G)	C		University of Florida	Chemistry								
Miguel Gakiya (G)	C		Florida State University	Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Manoj Vinayaka Hanabe Subramanya (G)	C	Florida State University	Physics								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Ulrich Kortz (S)	C	Jacobs University	School of Engineering and Science								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C	University of Florida	Physics								
Gia Rivers (U)	C	Florida State University	Chemistry and Biochemistry								
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								
Robert Stewart (G)	C	Florida State University	Physics								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Enrique Colacio (S)	PI	University of Granada	Inorganic Chemistry	No other support			**P19485**	High-frequency and -field EPR and FIRMS of prismatic trigonal Co(II) and pentagonal bipyramidal Dy(III) SIMs complexes	Chemistry	2	7
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Andrew Ozarowski (S)	PI	National High Magnetic Field Laboratory	EMR	No other support			**P19505**	Calibration and Maintenance of the 15/17 T EPR Instrument	Development of Magnet Technology	1	10.5
Jeffrey Long (S)	PI	University of California, Berkeley	Chemistry	NSF	CHE - Chemistry	CHE2102603	**P19520**	Hard Permanent Magnetism from Mixed-Valence Dilanthanide Complexes with Metal-Metal Bonding	Chemistry	3	11.5
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Jakub Hruby (P)	C	National High Magnetic Field Laboratory	EMR								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Hyunchul Kwon (G)	C	University of California, Berkeley	Chemistry								
Danh Ngo (G)	C	University of California, Berkeley	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Aaron Rossini (S)	PI	Iowa State University	Chemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1916809	**P19606**	High-Field Solid-State NMR of Heterogeneous Catalysts and Inorganic Materials	Chemistry	2	7
Scott Carnahan (G)	C	Iowa State University	Chemistry								
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								
Joseph Zadrozny (S)	PI	Colorado State University	Chemistry	NSF	CAREER - Faculty Early Career Development Program	2047325	**P19618**	High-Field/Frequency Spin Relaxation Phenomena in Metal Complexes	Chemistry	3	17
Manoj Vinayaka Hanabe Subramanya (G)	C	Florida State University	Physics	Research Corporation for Scientific Advancement	US Foundation	27663					
Cassidy Jackson (G)	C	Colorado State University	Chemistry	Research Corporation for Scientific Advancement	US Foundation						
Roxanna Martinez (G)	C	Colorado State University	Chemistry								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Okten Ungor (P)	C	Colorado State University	Chemistry								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Ziling Xue (S)	PI	University of Tennessee, Knoxville	Chemistry	NSF	CHE - Chemistry	CHE2055499	**P19694**	Probing Molecular Magnetism by Far-IR and Raman Magneto-Spectroscopies	Chemistry	3	10
Alexandria Bone (G)	C	University of Tennessee, Knoxville	Chemistry								
Adam Hand (G)	C	University of Tennessee, Knoxville	Chemistry								
Michael Jenkins (G)	C	University of Tennessee, Knoxville	Chemistry								
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Pagnareach Tin (G)	C		University of Tennessee, Knoxville	Chemistry								
Chandrasekhar Ramanathan (S)	PI		Dartmouth College	Physics and Astronomy	NSF	OIA - Office of Integrative Activities	1921199	**P19697**	Spectral diffusion of electron spins in semiconductors at high magnetic field	Condensed Matter Physics	1	12
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR	NSF	DMR - Division of Materials Research	DMR1747426					
Ethan Williams (G)	C		Dartmouth College	Department of Physics and Astronomy								
Gary Guillet (S)	PI	*	Georgia Southern University	Chemistry	No other support			**P19703**	Investigating the magnetic anisotropy of triiron extended metal atom chain	Chemistry	1	4
Kathleen Arpin (U)	C		Georgia Southern University	Chemistry								
Rodolphe Clérac (S)	C		Centre de Recherche Paul Pascal	CNRS								
Brittany Grimm (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Daphné Lubert-Perquel (P)	C		University of Florida	Physics								
Polly Arnold (S)	PI		University of California, Berkeley	Chemistry	DOE	BES – Basic Energy Sciences	DE-AC02-05CH11231	**P19738**	Electronic structure of new f-block molecular qubits	Chemistry	2	10
Jakub Hruby (P)	C		National High Magnetic Field Laboratory	EMR								
Amy Kynman (G)	C		University of California, Berkeley	Chemistry								
Elvin Salerno (P)	C		National High Magnetic Field Laboratory	EMR								
Sebastian Stoian (S)	PI		University of Idaho	Chemistry	University of Idaho	US College and University		**P19784**	Elucidating the Electronic Structure and Magnetic Ordering of Extended Chains Incorporating Co(II) and Fe(II) Ions	Chemistry	2	26
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Kyle Seabourn (G)	C		University of Idaho	Chemistry								
Adam Valaydon-Pillay (G)	C		University of Idaho	Chemistry								
Christopher Bardeen (S)	PI	*	University of California, Riverside	Chemistry	NSF	CHE - Chemistry	CHE1800187	**P19789**	Stable Photo-Patterned Crystalline Arylnitrenes with Potential Applications in Quantum Information Science	Chemistry	4	18
Thomas Gately (G)	C		University of California, Riverside	Chemistry	NSF	PHY - Physics	PHY1839153					
Manoj Vinayaka Hanabe Subramanya (G)	C		Florida State University	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Srinivasa Rao Singamaneni (S)	PI		University of Texas, El Paso	Physics	NSF	DMR - Division of Materials Research	DMR2105109	**P19791**	Magnetic Correlations and Anisotropy in Layered quasi-2D van der Waals Magnets: A VeryHigh Frequency Electron Paramagnetic Resonance Study	Condensed Matter Physics	4	13
Cedomir Petrovic (S)	C		Brookhaven National Laboratory	Condensed Matter Physics								
Fazel Tafti (S)	C		Boston College	Physics								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Eric Breynaert (S)	PI	*	Catholic University Leuven	M2S	FWO Vlaanderen	Other	G083318N	**P19796**	NMR for Convergence Research with focus on Nanoporous materials, Molecular Water Science, Energy and Food and Health Science	Chemistry	1	4
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Eric Gale (S)	PI		Massachusetts General Hospital	Radiology	NIH	NIDDK - National Institute of Diabetes and Digestive and Kidney Diseases	DK120663	**P19823**	Mechanisms of High-Spin Fe(III) Nuclear Magnetic Relaxation	Chemistry	2	6
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
Hannah Shafaat (S)	C		Ohio State University	Chemistry and Biochemistry								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Denis Karaiskaj (S)	PI	*	University of South Florida	Physics	DOD	DARPA - Defense Advanced Research Projects Agency		**P19859**	Using the hyperfine impurity transitions of isotopically enriched silicon for time keeping.	Biology, Biochemistry, Biophysics	1	2
Muralee Murugesu (S)	PI	*	University of Ottawa	Chemistry	Canada Foundation for Innovation	Non US Foundation		**P19896**	EPR Investigation of low coordinate bis(silylamide) Ln2+/3+ Complexes	Development of Magnet Technology	4	22.5
Dyaln Errulat (G)	C		University of Ottawa	Chemistry								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jakub Hruby (P)	C		National High Magnetic Field Laboratory	EMR								
Niki Mavragani (G)	C		University of Ottawa	Chemistry and Biomolecular Sciences								
Elvin Salerno (P)	C		National High Magnetic Field Laboratory	EMR								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Deepshikha Jaiswal-Nagar (S)	PI	*	IISER Thiruvananthapuram	Physics	IISER Thiruvananthapuram	Non US Government Lab		**P19914**	ESR study of field-induced quantum phase transition in a 1D spin ½ Heisenberg antiferromagnet C12H14CuN4O5	Condensed Matter Physics	1	2
Athira Suresh (G)	C		IISER Thiruvananthapuram	Physics								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Nicholas Chilton (S)	PI	*	University of Manchester	Department of Chemistry	European Research Council		ERC-2019-STG-851504	**P19930**	FIRMS measurements on an air-stable single-molecule magnet	Development of Magnet Technology	1	6
Wei-Hao Chou (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Stuart Langley (S)	C		Manchester Metropolitan University	Chemistry								
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Yasmin Whyatt (G)	C		University of Manchester	Chemistry								
Petr Neugebauer (S)	PI	*	Brno University of Technology	Central European Institute of Technology	Central European Institute of Technology	Other	21-20716X	**P19968**	High frequency pulsed EPR experiments on paramagnetic systems for DNP applications	Condensed Matter Physics	3	19.5
Thierry Dubroca (S)	C		National High Magnetic Field Laboratory	EMR								
Jan Dubský (G)	C		Brno University of Technology	Central European Institute of Technology								
Oleksii Laguta (P)	C		Brno University of Technology	Central European Institute of Technology								
Andriy Marko (P)	C		Brno University of Technology	CEITEC								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Adam Fiedler (S)	PI	Marquette University	Chemistry	NSF	CHE - Chemistry	CHE1900562	**P19970**	Elucidating the Magnetic and Electronic Features of High-Symmetry Fe(II) and Co(II) Complexes	Chemistry	2	13
Laxmi Devkota (G)	C	Marquette University	Chemistry								
Jurek Krzystek (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Mykhaylo Ozerov (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Daniel SantaLucia (P)	C	Max Planck Institute for Chemical Energy Conversion, Muelheim	Molecular Theory and Spectroscopy								
Joshua Telser (S)	C	Roosevelt University	Biological, Physical and Health Sciences								
Stefan Stoll (S)	PI	University of Washington	Chemistry	Canada Research Coordinating Committee	Other Non US Federal Agency		**P20000**	Mechanism and active-site structure of an unusual manganese-dependent enzyme	Biology, Biochemistry, Biophysics	1	4
Andrew Ozarowski (S)	C	National High Magnetic Field Laboratory	EMR								
Jennifer Shepherd (S)	C	Gonzaga University	Chemistry								
Rachelle Stowell (G)	C	University of Washington	Chemistry								
Michael Nippe (S)	PI	Texas A&M University	Chemistry	DOE	EERE - Energy Efficiency and Renewable Energy	DE-EE0019330	**P20005**	Exploring Magnetic Coupling and Spin Relaxation Times in Ln-[1]metallocenophane Compounds using High-Field and Pulsed EPR Spectroscopy	Development of Magnet Technology	1	4
Trevor Latendresse (G)	C	Texas A&M University	Chemistry								
Robert Stewart (G)	C	Florida State University	Physics								
Gaël Ung (S)	PI *	University of Connecticut	Chemistry	DOE	QIS - Quantum Information Science	DE-SC0020260	**P20015**	Optical and electronic structural investigations of a chiral Yb3+ compound	Biology, Biochemistry, Biophysics	4	21.33
Anitha Alanthadka (P)	C	University of Nevada Reno	Department of Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0020260					
Miguel Gakiya (G)	C	Florida State University	Chemistry and Biochemistry								
Stephen Hill (S)	C	National High Magnetic Field Laboratory	EMR								
Stephen McGill (S)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Elvin Salerno (P)	C	National High Magnetic Field Laboratory	EMR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Michael Shatruk (S)	C		National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Enrique del Barco (S)	PI		University of Central Florida	Physics	DOD	US Air Force	FA9550-19-1-0307	**P20018**	Optically Driven Spin Dynamics in Antiferromagnets for Coherent THz Oscillators	Condensed Matter Physics	1	12
Michael Chini (S)	C		University of Central Florida	Physics								
Gregory Fritjofson (G)	C		University of Central Florida	Physics								
Jacob Hanson-Flores (G)	C		University of Central Florida	Physics								
David Lederman (S)	C		University of California, Santa Cruz	Physics								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Robert Griffin (S)	PI		Massachusetts Institute of Technology	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM132997	**P20068**	High field pulsed DNP	Chemistry	1	13
Thierry Dubroca (S)	C		National High Magnetic Field Laboratory	EMR								
Yifu Ouyang (G)	C		Massachusetts Institute of Technology	Chemistry								
Yifan Quan (P)	C		Massachusetts Institute of Technology	Francis Bitter Magnet Laboratory								
Robert Comito (S)	PI	*	University of Houston	Chemistry	University of Houston	US College and University		**P20069**	High Field EPR Spectroscopy of a Series of Dinuclear Vanadium Complexes Containing both Oxygen- and Nitrogen-based Bridging Ligands	Chemistry	1	1.83
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR	Welch Foundation	US Foundation	E-1983–20190330					
Maxym Tansky (G)	C		University of Houston	Chemistry								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								
Natia Frank (S)	PI	*	University of Nevada Reno	Chemistry	NSF	CHE - Chemistry	CHE1956301	**P20070**	EPR Investigation of Optically Gated Spin State Switching in Photochromic Cobalt Dioxolenes for Quantum Information Science	Chemistry	2	11
Anitha Alanthadka (P)	C		University of Nevada Reno	Department of Chemistry								
Subrata Ghosh (P)	C		University of Nevada Reno	Chemistry								
Brittany Grimm (G)	C		Florida State University	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Elvin Salerno (P)	C		National High Magnetic Field Laboratory	EMR								
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Michael Jensen (S)	PI	*	Ohio University	Chemistry & Biochemistry	No other support			**P20071**	High-Frequency and -Field EPR Spectroscopy of High-Spin, Pseudo-tetrahedral Nickel(II)–Phenylchalcogenide Complexes	Biology, Biochemistry, Biophysics	1	0.83
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Javad Shokraiyan (G)	C		Ohio University	Chemistry and Biochemistry								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								
Daniel Mindiola (S)	PI	*	University of Pennsylvania	Chemistry	NSF	CHE - Chemistry	CHE2154620	**P20072**	Applying High-Frequency and -Field EPR Spectroscopy of High-Spin First Row Transition Metal Ions that Hold Relevance as Catalysts for Cyclic Polymers	Chemistry	1	5.5
Mehrafshan Jafari (G)	C		University of Pennsylvania	Chemistry								
Jurek Krzystek (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Joshua Telser (S)	C		Roosevelt University	Biological, Physical and Health Sciences								
Xiaoling Wang (S)	PI	*	California State University, East Bay	Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0017752	**P20077**	Investigation of Magnetic Properties of Quantum Spin Ice Candidates using High Field EPR	Condensed Matter Physics	4	22
Manoj Vinayaka Hanabe Subramanya (G)	C		Florida State University	Physics	DOE	MSE - Materials Science and Engineering	DE-SC0017752					
Brenden Ortiz (P)	C		University of California, Santa Barbara	Material Science								
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR								
Paul Sarte (P)	C		University of California, Santa Barbara	Materials/California NanoSystems Institute								
Alina Bienko (S)	PI		University of Wroclaw	Faculty of Chemistry	Wroclaw University, Poland	Non US College and University		**P20080**	Toward "better" molecular magnets.	Chemistry	1	0.5

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Andrew Ozarowski (S)	C		National High Magnetic Field Laboratory	EMR					Correlation between structure and magnetic anisotropy.			
Mykhaylo Ozerov (S)	C		National High Magnetic Field Laboratory	Condensed Matter Science, DC Field CMS								
Frédéric Perras (S)	PI	*	Ames Laboratory	Chemical and Biological Sciences	DOE	BES – Basic Energy Sciences	DE-AC02-07CH11358	**P20092**	Low-Temperature EPR Relaxometry of a Methyl-Driven Overhauser MAS-DNP Polarizing Agent	Chemistry	1	3
Thierry Dubroca (S)	C		National High Magnetic Field Laboratory	EMR								
Hans Jurgen von Bardeleben (S)	PI	*	Sorbonne University	INSP	No other support			**P20096**	Magnetic resonance study of the gallium vacancy in beta-Ga2O3	Condensed Matter Physics	1	5
Johan van Tol (S)	C		National High Magnetic Field Laboratory	EMR								
Vincent Pecoraro (S)	PI	*	University of Michigan	Chemistry	DOE	BES – Basic Energy Sciences	DE-SC0020260	**P20120**	Pulsed microwave resonance studies of a pure Gd2 molecular dimeric crystal towards arbitrary inter spin control	Chemistry	1	11
Manoj Vinayaka Hanabe Subramanya (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Timothée Lathion (P)	C		University of Michigan	Chemistry								
Elvin Salerno (P)	C		National High Magnetic Field Laboratory	EMR								
Johan van Tol (S)	PI		National High Magnetic Field Laboratory	EMR	No other support			**P20140**	Maintenance and testing	Condensed Matter Physics	2	8
Elvin Salerno (P)	C		National High Magnetic Field Laboratory	EMR								
George Christou (S)	PI		University of Florida	Chemistry	DOE	EFRC - Energy Frontier Research Centers	DE-SC0019330	**P20172**	EPR Investigation of 3d Transition Metal Complexes as Molecular Qubits	Chemistry	1	12
ChristiAnna Brantley (G)	C		University of Florida	Chemistry								
Wei-Hao Chou (G)	C		Florida State University	Physics								
Manoj Vinayaka Hanabe Subramanya (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Robert Stewart (G)	C		Florida State University	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
William Evans (S)	PI	*	University of California, Irvine	Department of Chemistry	DOE	BES – Basic Energy Sciences	DE-SC00012738	**P20194**	Investigation of clock transitions in lanthanide-based molecular qubits	Chemistry	1	18
Lauren Anderson-Sanchez (G)	C		University of California, Irvine	Department of Chemistry								
Manoj Vinayaka Hanabe Subramanya (G)	C		Florida State University	Physics								
Stephen Hill (S)	C		National High Magnetic Field Laboratory	EMR								
Jakub Hruby (P)	C		National High Magnetic Field Laboratory	EMR								
Krishnendu Kundu (P)	C		National High Magnetic Field Laboratory	EMR								
									Total Proposals:	**Experiments:**		**Days:**
									57	**116**		**699**

High B/T Facility

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Dominique Laroche (S)	PI		University of Florida	Physics	UCGP		TBD	**P19332**	Coulomb drag of spin-polarized Luttinger liquids at ultra-low temperatures - UCGP	Condensed Matter Physics	1	29
Rasul Gazizulin (T)	C		University of Florida	Physics								
Guillaume Gervais (S)	C		McGill University	Physics department								
Gregory Labbe (O)	C		University of Florida	Physics								
John Reno (S)	C		Sandia National Laboratories									
Lucia Steinke (P)	C		University of Florida (UF)	High B/T Facility								
Collin Broholm (S)	PI		Johns Hopkins University	Physics and Astronomy	DOE	BES – Basic Energy Sciences	DE-SC0019331	**P19504**	NaBaYb(BO3)2, spin liquid candidate with triangular lattice	Condensed Matter Physics	1	127
Rasul Gazizulin (T)	C		University of Florida	Physics								
Alireza Ghasemi (G)	C		Johns Hopkins University	Physics and Astronomy								
Chao Huan (P)	C		University of Florida	Physics								
Gregory Labbe (O)	C		University of Florida	Physics								
Lucia Steinke (P)	PI		University of Florida (UF)	High B/T Facility	NSF	Other	R000002799	**P19653**	Probing exotic quasiparticles in calorimetric and thermal transport experiments at ultra-low temperatures	Condensed Matter Physics	1	46
Alexander Donald (G)	C		University of Florida	Physics								
Rasul Gazizulin (T)	C		University of Florida	Physics								
Suchitra Sebastian (S)	C		University of Cambridge	Physics								
Andrew Woods (P)	C		University of Florida	Physics								
Samaresh Guchhait (S)	PI	*	Howard University	Physics and Astronomy	Howard University			**P19768**	Study of Unconventional Superconductivity in Non-Centrosymmetric Materials	Condensed Matter Physics	1	12
Rasul Gazizulin (T)	C		University of Florida	Physics								
Chao Huan (P)	C		University of Florida	Physics								
Gregory Labbe (O)	C		University of Florida	Physics								
Lucia Steinke (P)	C		University of Florida (UF)	High B/T Facility								
Long Ju (S)	PI	*	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1231319	**P19811**	Study of Electron Correlation in 2D Moire Superlattices	Condensed Matter Physics	1	175

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Rasul Gazizulin (T)	C	University of Florida	Physics						
Tianyi Han (P)	C	Massachusetts Institute of Technology	Physics						
Tonghang Han (G)	C	Massachusetts Institute of Technology	Physics						
Gregory Labbe (O)	C	University of Florida	Physics						
Mark Meisel (S)	C	University of Florida	Department of Physics						
Lucia Steinke (P)	C	University of Florida (UF)	High B/T Facility						
						Total Proposals:	Experiments:		Days:
						5	5		389

ICR Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Daniel Repeta (S)	PI	Woods Hole Oceanographic Institution	Marine Chemistry	UCGP		227000-520-38653	**P18079**	Molecular speciation of organic nutrients in marine dissolved organic matter	Chemistry	1	10
Marianna Acker (G)	C	Woods Hole Oceanographic Institution	Watson Laboratory	NSF	OCE - Ocean Sciences	OCE1634080					
Lydia Babcock-Adams (P)	C	National High Magnetic Field Laboratory	CIMAR, ICR	NSF	OCE - Ocean Sciences	OCE1736280					
Benjamin Granzow (G)	C	Woods Hole Oceanographic Institution	Watson Laboratory	Simmons Foun-dation	Other	SCOPE POP 49476					
Jingxuan Li (S)	C	Woods Hole Oceanographic Institution	Watson Laboratory								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Jeramie Adams (S)	PI	University of Wyoming	Transportation Technology	Petroleum			**P18097**	Investigation of Fractionated and Chemically Modified Interfacial Asphaltenes	Biology, Biochemistry, Biophysics	1	1
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Alan Marshall (S)	PI	National High Magnetic Field Laboratory	ICR	NASA		not yet submitted	**P19115**	Organic Chemical Composition of Lunar Soil	Biology, Biochemistry, Biophysics	1	1.83
Greg Blakney (S)	C	National High Magnetic Field Laboratory	ICR								
Joseph Frye (G)	C	National High Magnetic Field Laboratory	CIMAR								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Sarah Johnston (P)	PI	University of Lethbridge	Biological Sciences	NASA		ABoVE Project 14-TE14-0012	**P19190**	The Chemical Composition of Freshwater Zooplankton Dissolved Organic Matter Cycling	Chemistry	1	13.83
Matthew Bogard (S)	C	University of Lethbridge	Biological Sciences	NASA		ABoVE NNX15AU07A					
Kerri Finlay (S)	C	University of Regina	Department of Biology	Delta Stewardship Council Delta Science Program	Other	5298					
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science								
Viji Sitther (S)	PI	Morgan State University	Biology	NSF	CBET - Chemical, Bioengineering Environmental, and Transport Systems	CBET1900966	**P19201**	Excellence in Research: Oxidative stress induced impact of cell-penetrating nanoparticles on cellular constituents	Biology, Biochemistry, Biophysics	1	10

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
AnithaChristy Arumanayagam (T)	C	Methodist Hospital Research Institute	Department of Pathology					in a cyanobacterial model			
Kadir Aslan (T)	C	Morgan State University	Civil Engineering								
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Somayeh Fathabad (T)	C	Morgan State University	Biology Department								
William Ghann (T)	C	Coppin State University	Department of Natural Sciences								
Yuan Lin (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Behnam Tabatabai (G)	C	Morgan State University	Biology								
Jamal Uddin (T)	C	Coppin State University	Department of Natural Sciences								
Dy'mon Walker (T)	C	Morgan State University	Department of Biology								
Alan Marshall (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			**P19213**	Derivatization of carboxylic acid and alcohol functional groups from photo-oxidized petroleum samples	Chemistry	1	1.5
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Joseph Frye (G)	C	National High Magnetic Field Laboratory	CIMAR								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Michael Stukel (S)	PI	Florida State University	Earth, Ocean, and Atmospheric Science	NSF	OCE - Ocean Sciences	OCE1637632	**P19226**	Characterizing alterations in sinking organic matter in the pelagic ocean	Chemistry	3	20.83
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	OCE - Ocean Sciences	OCE1756610					
Heather Forrer (G)	C	Florida State University	Earth Ocean and Atmospheric Sciences	NSF	OCE - Ocean Sciences	OCE1851347					
Thomas Kelly (G)	C	Florida State University	Earth, Ocean & Atmospheric Sciences	NOAA	Other US Federal Agency	NOAA-NOS-NCCOS-2017-2004875					
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Jeffrey Chanton (S)	PI	Florida State University	Department of Earth, Ocean and Atmospheric Science	DOE	Award No. Pending	DE-SC0007144	**P19276**	Characterizing the relationship between peatland temperature stability and DOM composition	Chemistry	2	4
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	Oak Ridge National Laboratory	DE-AC05-00OR22725	DE-SC0012088					
Rachel Wilson (S)	C	Florida State University	EOAS	DOE	Other						

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	NSF	DEB - Division of Environmental Biology	DEB1145932	**P19289**	Global perspective on the sources, cycling and composition of dissolved organic matter exported from mountain glaciers	Chemistry	4	3.17
Tom Battin (S)	C	Ecole Polytechnique Federale de Lausanne	ENAC IEE SBER	NSF	OCE - Ocean Sciences	OCE1333157					
Vincent De Staerke (T)	C	Ecole Polytechnique Federale de Lausanne	Stream Biofilm and Ecosystem Research Laboratory	NSF	OIA - Office of Integrative Activities	OIA-1757348					
Jason Fellman (S)	C	University of Alaska, Southeast	Environmental Science								
Amy Holt (G)	C	Florida State University	EAOS								
Eran Hood (S)	C	University of Alaska, Southeast	Environmental Science								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Wenbo Li (G)	C	Florida State University	Earth, Ocean& Atomospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Hannes Peter (S)	C	Ecole Polytechnique Federale de Lausanne	Stream Biofilm and Ecosystem Research Lab								
Martina Schön (T)	C	Ecole Polytechnique Federale de Lausanne	Stream Biofilm and Ecosystem Research Laboratory								
Aron Stubbins (S)	C	Northeastern University	Marine and Environmental Science								
Michael Styllas (P)	C	Ecole Polytechnique Federale de Lausanne	Stream Biofilm and Ecosystem Research Laboratory								
Matteo Tolosano (T)	C	Ecole Polytechnique Federale de Lausanne	Stream Biofilm and Ecosystem Research Laboratory								
Sasha Wagner (P)	C	University of Georgia	Marine Sciences and Oceanography								
Thomas Manning (S)	PI	Valdosta State University	Chemistry	NSF	DUE - Division of Undergraduate Education	DUE1240059	**P19292**	Bryostatin Analysis	Chemistry	1	1
Taylor Glattke (G)	C	Florida State University	ICR								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jade Phillips (U)	C	Valdosta State University	Chemistry								
Beth Sharpe (U)	C	Valdosta State University	Chemistry								
Núria Catalán (S)	PI	U.S. Geological Survey (USGS)	Water Mission Area	European Comission	Non US Council	H2020-MSCA-IF-2018-839709	**P19310**	CHROME: Linking chemical diversity and reactivity of arctic dissolved organic matter for its integration in Earth system models	Chemistry	1	0.75
Bertrand Guenet (S)	C	French National Center for Scientific Research	Laboratoire des sciences du climat et de l'environnement								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Ada Pastor (P)	C	Aarhus University	Bioscience-Aquatic Biology								
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science								
Kimberly Wickland (S)	C	U.S. Geological Survey	National Research Program								
Apoline Zahorka (U)	C	Ecole Normale Superieure	Geosciences								
Thomas Borch (S)	PI	Colorado State University	Soil and Crop Science	DOE	Other	SC0021349	**P19338**	Forest fire-impacted soil organic matter chemistry	Chemistry	2	3.42
William Bahureksa (G)	C	Colorado State University	Chemistry	DOE	Other	DE-SC0020205					
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	USDA - Department of Agriculture		AFRI 2021-67019034608					
Timothy Fegel (S)	C	USDA Forest Service	Rocky Mountain Research Station	USDA - Department of Agriculture		COL00292D/1020695					
Jim Ippolito (S)	C	Colorado State University	Soil and Crop Sciences	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1512670					
Eugene Kelly (S)	C	Colorado State University	College of Agricultural Sciences	NSF	DEB - Division of Environmental Biology	DEB2114868					
Merritt Logan (G)	C	Colorado State University	Chemistry	USDA – Department of Agriculture		AFRI2021-67019-33726					
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	United States-Israel	Other	2018130					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
				Binational Science Foun dation							
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Amelia Nelson (G)	C	Colorado State University	Soil and Crop Sciences								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								
Charles Rhoades (S)	C	U.S. Department of Agriculture	Rocky Mountain Research Station								
Holly Roth (G)	C	Colorado State University	Chemistry								
Myrna Simpson (S)	C	University of Toronto (Toronto)	2Environmental NMR Centre and Department of Physical & Environmental Sciences								
Nivetha Srikanthan (S)	C	University of Toronto (Toronto)	Environmental NMR Centre and Department of Physical & Environmental Sciences								
Jacob VanderRoest (G)	C	Colorado State University	Chemistry								
Mike Wilkins (S)	C	Colorado State University	College of Agricultural Sciences								
Robert Young (S)	C	New Mexico State University, Main Campus	Chemical Analysis & Instrumentation Laboratory								
Jonathan Sweedler (S)	PI	University of Illinois at Urbana-Champaign	Department of Chemistry	NIH	NHGRI - National Human Genome Research Institute	HG010023	**P19357**	High Resolution MALDI Mass Spectrometry for Single-cell and Subcellular Measurements	Biology, Biochemistry, Biophysics	1	6
Sara Bell (G)	C	University of Illinois at Urbana-Champaign	Department of Chemistry	NIH	NIDA - National Institute on Drug Abuse	DA018310					
Daniel Castro (G)	C	University of Illinois at Urbana-Champaign	Molecular and Integrative Physiology								
Donald Smith (S)	C	National High Magnetic Field Laboratory	ICR								
Karl Smith (P)	C	National High Magnetic Field Laboratory	ICR								
Richard Xie (G)	C	University of Illinois at Urbana-Champaign	Department of Bioengineering								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	USGS Biological Carbon Sequestration Program			**P19435**	Characterizing DOM compositions across a changing arctic	Chemistry	1	3
Pieter Aukes (S)	C	University of Waterloo	Department of Earth & Environmental Studies	NASA		ABoVE 80NSSC19M0104					
David Butman (S)	C	University of Washington	Civil & Environmental Engineering	NSF	Other	AON-1107596					
Mark Dornblaser (T)	C	U.S. Geological Survey	Water Resource MIssion Area	Advancing Climate Change Science in Canada	Other Non US Federal Agency	ACCPJ-536045-2018					
Gregory Druschel (S)	C	Indiana University-Purdue University Indianapolis	School of Science								
Karen Frey (S)	C	Clark University	Graduate School of Geography								
Fenix Garcia-Tigreros (S)	C	University of Washington	Department of Civil and Environmental Engineering,								
Martin Kurek (G)	C	Florida State University	Earth, Ocean, and Atmospheric Science								
Ethan Kyzivat (S)	C	Brown University	Department of Earth, Environmental & Planetary Sciences and Institute at Brown for Environment & Society								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Natalie Nichols (G)	C	Indiana University-Purdue University Indianapolis	School of Science								
Sydney Niles (G)	C	National High Magnetic Field Laboratory	Chemistry								
Tamlin Pavelsky (G)	C	University of North Carolina at Chapel Hill	Earth, Marine and Environmental Sciences								
Brett Poulin (S)	C	University of California, Davis	Environmental Toxicology								
Sherry Schiff (S)	C	University of Waterloo	Department of Earth & Environmental Studies								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Laurence Smith (S)	C	Brown University	Department of Earth, Environmental & Planetary Sciences and Institute at Brown for Environment & Society								
Rob Striegl (T)	C	U.S. Geological Survey	Water Resources Mission Area								
Chao Wang (S)	C	University of North Carolina at Chapel Hill	11Department of Earth, Marine and Environmental Sciences								
Kimberly Wickland (S)	C	U.S. Geological Survey	National Research Program								
Ryan Rodgers (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			**P19464**	Understanding of Emulsion Formation from Photo-Oxidized Crude Oils	Chemistry	2	7.5
Joseph Frye (G)	C	National High Magnetic Field Laboratory	CIMAR								
Alan Marshall (S)	C	National High Magnetic Field Laboratory	ICR								
Mary Zeller (P)	PI	Leibniz Institute for Baltic Sea Research Warnemünde	Department of Marine Geology	Deutsche Forschungsgemeinschaft	Non US Foundation	GRK 2000/1	**P19474**	Linking the carbon and sulfur cycles in the regeneration process of a historically brackish diked peatland	Chemistry	1	0.5
Michael Böttcher (S)	C	Leibniz Institute for Baltic Sea Research Warnemünde	Geosciences								
Manon Janssen (P)	C	University of Rostock	Faculty for Agricultural and Environmental Sciences								
Anna-Kathrina Jenner (G)	C	Leibniz Institute for Baltic Sea Research Warnemünde	Geochemistry and stable Isotope Geochemistry								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Erwin Racasa (G)	C	University of Rostock	Hydrology								
Catia Milene von Ahn (G)	C	Leibniz Institute for Baltic Sea Research Warnemünde	Marine Geology								
Jon Hawkings (P)	PI	Florida State University	Earth, Ocean and Atmospheric Sciences	NASA		80NSSC18K1738	**P19475**	Glacial influence on organic matter export in polar watersheds	Chemistry	1	0.5
Nathan Bramall (S)	C	Leiden Technology LLC	Technology	NSF	OPP - Office of Polar Programs	OPP2000649					
Kathryn Bywaters (S)	C	Honeybee Robotics	.	University of Florida Water Institute	Other						

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Brent Christner (S)	C	University of Florida	Microbiology & Cell Science	European Research Council	Non US Council	793962					
Peter Doran (S)	C	Louisiana State University	Geobiology and Geophysics								
Ashley Dubnick (P)	C	Montana State University	Earth Sciences								
Quincy Faber (G)	C	University of Florida	Microbiology and Cell Science								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Matthew Marshall (G)	C	University of Bristol	School of Geographical Sciences								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Elizabeth Mitchell (G)	C	University of Southam	School of Ocean and Earth Sciences								
Jay Nadeau (S)	C	Portland State University	Physics								
Mark Skidmore (S)	C	Montana State University	Department of Earth Sciences								
Carl Snyder (G)	C	Portland State University	Physics								
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science								
Jemma Wadham (S)	C	University of Bristol	School of Geographical Sciences								
Ryan Rodgers (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			**P19499**	Molecular Characterization of Water-Soluble Photooxidation Products from Coal Tar Sealant and Asphalt Emulsion Sealant to Determine Anthropogenic Effects on the Built Environment	Chemistry	1	3.33
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Thomas Ennis (S)	C	City of Austin, Texas	Watershed Protection Department								
Taylor Glattke (G)	C	Florida State University	ICR								
Steve Greason (O)	C	Sitelab Corporation	Lab Dept.								
Sarajeen Saima Hoque (G)	C	Florida State University	Civil and Environmental Engineering								
Ishwar Kohale (G)	C	Massachusetts Institute of Technology	Koch Institute								
Forest White (S)	C	Massachusetts Institute of Technology	Biological Engineering								
Alexandre Anesio (S)	PI	Aarhus University	Environmental Science	European Research Commission	Other	856416	**P19510**	Glacial biomarkers: searching for source-specific glacial algae proxies	Biology, Biochemistry, Biophysics	2	1.58
Eva Doting (G)	C	Aarhus University	Environmental Science	Danish Ministry of Higher	Non US Ministry	9096-00101B					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
				Education and Science							
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science								
Yang Lin (S)	PI	University of Florida	Soil and Water Sciences	No other support			**P19511**	Chemical characterization of dissolved deep podzolized carbon	Biology, Biochemistry, Biophysics	1	0.25
Allan Bacon (S)	C	University of Florida	Soil and Water Sciences								
Ryan Champiny (G)	C	University of Florida	Soil and Water Sciences								
Daniel Colopietro (G)	C	University of Florida	Soil and Water Sciences								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Rene Boiteau (S)	PI	Oregon State University	College of Earth, Ocean, Atmospheric Sciences	UCGP			**P19547**	Deciphering the sources of trace element binding organic ligands in coastal sediments.	Chemistry	2	19.42
Lydia Babcock-Adams (P)	C	National High Magnetic Field Laboratory	CIMAR, ICR	NSF	OCE - Ocean Sciences	OCE1829761					
Peter Chace (G)	C	Oregon State University	College of Earth, Ocean and Atmospheric Science								
Nicole Coffey (G)	C	University of Delaware	School of Marine Science and Policy								
Christian Dewey (P)	C	Oregon State University	CEOAS								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Clare Reimers (S)	C	Oregon State University	College Earth, Ocean and Atmospheric Sciences								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Michael Senko (S)	PI	Thermo Fisher Scientific	R&D	No other support			**P19548**	Analytical Method Development for FT-ICR MS	Chemistry	5	90.33
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR	NIH	NIGMS - National Institute of General Medical Sciences	GM037537					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Lydia Babcock-Adams (P)	C	National High Magnetic Field Laboratory	CIMAR, ICR								
Greg Blakney (S)	C	National High Magnetic Field Laboratory	ICR								
Jesse Canterbury (T)	C	Thermo Fisher Scientific	LSMS R&D								
Daniel Lowenstein (G)	C	Massachusetts Institute of Technology	EAPS								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Chad Weisbrod (S)	C	National High Magnetic Field Laboratory	ICR								
Brett Poulin (S)	PI	University of California, Davis	Environmental Toxicology	NSF	CAREER - Faculty Early Career Development Program	1945388	**P19575**	Tracing agricultural sulfur inputs to the environment using advanced dissolved organic sulfur characterization	Chemistry	1	0.25
Thomas Borch (S)	C	Colorado State University	Soil and Crop Science	NSF	EAR - Earth Sciences	EAR1629698					
Todd Dawson (S)	C	University of California, Berkeley	Department of Integrative Biology	University of Colorado Boulder Center for Water, Earth Science and Technology	US College and University						
Anna Hermes (G)	C	University of Colorado, Boulder	Institute of Arctic and Alpine Research	University of Colorado Center for Water, Earth Science, and Technology George R. Aiken Endowed Memorial Research Fellowship	US College and University						
Eve-Lyn Hinckley (S)	C	University of Colorado, Boulder	Institute of Arctic and Alpine Research								
Merritt Logan (G)	C	Colorado State University	Chemistry								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Boswell Wing (S)	C	University of Colorado, Boulder	Department of Geological Sciences								
Henry Williams (S)	PI	Florida Agricultural and Mechanical University	School of the Environment	NSF	OCE - Ocean Sciences	OCE1948758	**P19583**	Characterization of Prey Cellular Organic Matter Released as Lysis Products as a	Chemistry	1	5.5
Timothy Colston (P)	C	Florida Agricultural and Mechanical University	School of the Environment								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Grisel Fierros Romero (P)	C		Florida Agricultural and Mechanical University	School of the environment					Result of Predation by Micropredators			
Taylor Howard (G)	C		Florida Agricultural and Mechanical University	School of the Environment								
Rajneesh Jaswal (P)	C		Florida Agricultural and Mechanical University	School of the Environment								
Brittany Lindsay (G)	C		Florida Agricultural and Mechanical University	School of the Environment								
Zeljka Popovic (G)	C		Florida State University	Ion Cyclotron Resonance								
Jia Xue (P)	C		Florida Agricultural and Mechanical University	School of Environment								
Matthew Reid (S)	PI	*	Cornell University	Civil and Environmental Engineering	NSF	CHE - Chemistry	CHE1905175	**P19584**	Water-soluble organics from lignocellulose decomposition in denitrification beds or wetlands	Chemistry	2	1.25
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance	NSF	CBET - Chemical, Bioengineering , Environmental, and Transport Systems	CBET1804975					
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Yi Sang (G)	C		Cornell University	Civil and Environmental Engineering								
Changchun Huang (S)	PI		Nanjing University	School of Geography	Nanjing Normal University	Non US College and University		**P19601**	Molecular-level insights into the degradation and transformation processes of dissolved organic matter in sediment and fluvial ecosystems	Chemistry	1	1.5
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Shuaidong Li (G)	C		Nanjing University	School of Geography								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Archana Agarwal (S)	PI		University of Utah	Department of Pathology/ARUP Laboratories	NSF	DMR - Division of Materials Research	DMR1644779	**P19602**	Characterization of beta thalassemia on 21T FT-ICR MS with the application of proton transfer reduction	Biology, Biochemistry, Biophysics	1	0.33
Lissa Anderson (S)	C		National High Magnetic Field Laboratory	ICR								
Yuan Lin (G)	C		Florida State University	Department of Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alan Marshall (S)	C	National High Magnetic Field Laboratory	ICR								
Ryan Rodgers (S)	PI	National High Magnetic Field Laboratory	ICR	iC2MC grant (IPA-5923)	Non US College and University		**P19648**	Biofuels derived from Algae and Wood / Plastic Pyrolysis	Chemistry	1	13.83
Brice Bouyssiere (S)	C	University of Pau and the Adour Region	IPREM								
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Pierre Giusti (S)	C	Total	Research & Technology								
Caroline Mangote (S)	C	Total	Research & Technology								
Michael Timko (S)	PI	Worcester Polytechnic Institute	Chemical Engineering	DOE	BETO - Bioenergy Technologies Office	DE-EE0008513	**P19652**	Comprehensive Mass Spectrometer Analysis of Real Food and Lignocellulosic Waste Hydrothermal Liquefaction and Upgrading Products	Engineering	1	0.5
Rasha Atwi (G)	C	State University of New York at Stony Brook	Department of Chemical Engineering	NSF	GRFP - Graduate Research Fellowship Program	GRFP2038257					
Feng Cheng (T)	C	Worcester Polytechnic Institute	Chemical Engineering	DOE	Other	DE-EE0008302					
David Kenney (G)	C	Worcester Polytechnic Institute	Chemical Engineering								
Heather LeClerc (G)	C	Worcester Polytechnic Institute	Chemical Engineering								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Robert Nelson (S)	C	Woods Hole Oceanographic Institution	Dept Marine Chemistry and Geochemistry								
Jeffrey Page (G)	C	University of Connecticut	Department of Chemical and Biomolecular Engineering								
Alex Paulsen (S)	C	Mainstream Engineering Corp	Defense and Space								
Chris Reddy (S)	C	Woods Hole Oceanographic Institution	Geochemistry								
Ronish Shrestha (G)	C	Worcester Polytechnic Institute	Chemical Engineering								
Andrew Teixeira (S)	C	Worcester Polytechnic Institute	Chemical Engineering								
Geoffrey Tompsett (S)	C	Worcester Polytechnic Institute	Chemical Engineering								
Julia Valla (S)	C	University of Connecticut	Department & Biomolecular Engineering								
Richard West (S)	C	Northeastern University	Department of Chemical Engineering								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Robert Spencer (S)	PI	Florida State University	Earth, Ocean & Atmospheric Science	NSF	GRFP - Graduate Research Fellowship Program	GRFP1000284	**P19660**	Tracing organic matter signatures in the Arctic Ocean: do terrestrial inputs persist?	Biology, Biochemistry, Biophysics	3	3.17
Ekaterina Bulygina (S)	C	Louisiana Universities Marine Consortium	Ocean Sciences								
Sarah Johnston (P)	C	University of Lethbridge	Biological Sciences								
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science								
Anna Khreptugova (G)	C	Lomonosov Moscow State University	Chemistry								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Irina Perminova (S)	C	Lomonosov Moscow State University	Chemistry Department								
Alexander Shiklomanov (S)	C	University of New Hampshire	Water Systems Analysis Group								
Nikita Sobolev (S)	C	Lomonosov Moscow State University	Dept of Chemistry								
Sommer Starr (G)	C	Florida State University	Earth, Ocean, and Atmospheric Science								
Alan Marshall (S)	PI	National High Magnetic Field Laboratory	ICR	No other support			**P19662**	Electron Transfer Dissociation with Beam-collision Activated Dissociation for Improved Fragmentation of Intact Proteins	Biology, Biochemistry, Biophysics	3	9.83
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Yuan Lin (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Hadi Mohammadigoushki (S)	PI	Florida State University	Chemical and Biomedical Engineering	Florida State University Planning Grant	Other		**P19663**	Probing adsorption of monoclonal antibodies at the oil-water interface	Engineering	1	4.58
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Jamini Bhagu (G)	C	Florida State University	Chemical ENG								
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Zeljka Popovic (G)	C	Florida State University	Ion Cyclotron Resonance								
Tullis Onstott (S)	PI	Princeton University	Dept. of Geosciences	NSF	EAR - Earth Sciences	EAR1917682	**P19668**	Abiotic Organic Chemistry in an Ancient South African Hypersaline Brine	Biology, Biochemistry, Biophysics	1	7.5
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Devan Nisson (G)	C	Princeton University	Geosciences								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ryan Rodgers (S)	C		National High Magnetic Field Laboratory	ICR								
Clifford Walters (S)	C		University of Texas, Austin	Bureau of Economic Geology								
James Dumesic (S)	PI	*	University of Wisconsin, Madison	Chemical Engineering	DOE	BES – Basic Energy Sciences	DE-SC0018409	**P19687**	Chemical Characterizations of Lignin from Gamma-Valerolactone-Process and Lignin Monomers/Oligomers from Hydrogenolysis by Ultrahigh Resolution Mass Spectrometry	Engineering	1	0.75
Feng Cheng (P)	C		University of Wisconsin, Madison	Chemical and Biological Engineering								
George Huber (S)	C		University of Wisconsin, Madison	College of Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
David Barnidge (S)	PI	*	The Binding Site	Research and Development	Mayo Clinic	Other		**P19691**	Mass spectrometry analysis of monoclonal immunoglobulins in patients with plasma cell proliferative disorders	Biology, Biochemistry, Biophysics	1	5
Lissa Anderson (S)	C		National High Magnetic Field Laboratory	ICR								
Surendra Dasari (T)	C		Mayo Clinic	Department of Health Science Research								
Angela Dispenzieri (S)	C		Mayo Clinic, Rochester	Hematology								
Alan Marshall (S)	C		National High Magnetic Field Laboratory	ICR								
David Murray (S)	C		Mayo Clinic, Rochester	Laboratory Medicine and Pathology								
Zeljka Popovic (G)	C		Florida State University	Ion Cyclotron Resonance								
Chad Weisbrod (S)	C		National High Magnetic Field Laboratory	ICR								
Romy Chakraborty (S)	PI		Lawrence Berkeley National Laboratory	Ecology	DOE	BER - Biological & Environmental Research	DE-AC02-05CH11231	**P19706**	Characterizing transformation of natural organic matter by key indigenous microorganisms interrestrial subsurface sediments	Chemistry	1	0.25
Mingfei Chen (P)	C		Lawrence Berkeley National Laboratory	Earth and Environmental Science Area	Lawrence Berkely Lab	US Government Lab	ENIGMA-Ecosystems and Networks Integrated with Genes and Molecular Assemblies					
Brandon Enalls (P)	C		Lawrence Berkeley National Laboratory	Ecology								
Sara Gushgari-Doyle (P)	C		Lawrence Berkeley National Laboratory	Earth & Environmental Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Xiaoqin Wu (S)	C		Lawrence Berkeley National Laboratory	Department of Ecology								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Amie Lund (S)	PI	University of North Texas	Biological Sciences - Advanced Environmental Research Institute	NIH	NIEHS - National Institute of Environmental Health Sciences	ES026795	**P19719**	Top-Down Proteomics Analysis of Alterations in Protein Expression and Modification in the Liver of C57Bl/6 Mice in Response to Mixed Vehicle Emissions and/or High Fat Diet Consumption.	Biology, Biochemistry, Biophysics	1	7.92
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Leah Schneider (G)	C	University of North Texas	Department of Biological Sciences								
Ryan Rodgers (S)	PI	National High Magnetic Field Laboratory	ICR	Proprietary			**P19743**	OMICS LLC	Chemistry	1	1
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Chris Hendrickson (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance Program								
Murray Gray (S)	PI	Alberta Innovates	Advanced Hydrocarbons	No other support			**P19753**	Molecular Characterization of Carbon Fiber Feedstocks Derived From Oilsands Bitumen	Chemistry	1	2.5
Paolo Bomben (S)	C	Alberta Innovates	Advanced Hydrocarbons								
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR								
Christopher Rüger (S)	C	University of Rostock	Interdisciplinary Faculty, Department Life, Light & Matter								
Francesca Kerton (S)	PI	Memorial University of Newfoundland	Chemistry	Natural Sciences and Engineering Research Council (NSERC)	Non US Foundation		**P19754**	Analytical methods for biochar characterization by FT-ICR MS	Chemistry	1	0.5
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	Canada Foundation for Innovation	Non US Foundation						
Sara Cheema (G)	C	Memorial University of Newfoundland	Chemistry	Provincial Govt of Newfoundland and Labrador	Other Non US Federal Agency						
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance	Memorial University of Newfoundland (MUN)	Non US College and University						
Stephanie MacQuarrie (S)	C	Cape Breton University	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	Proposal is not subject to external funding	Other Non US Federal Agency		**P19769**	First Large-Scale Proteomic Analysis of Viperine Venoms by 21T FT-ICR MS	Biology, Biochemistry, Biophysics	1	7.58
Juliana Vidal (G)	C	Memorial University of Newfoundland	Chemistry								
Roderich Süssmuth (S)	PI	Technical University of Berlin	Institut für Chemie								
Lissa Anderson (S)	C	National High Magnetic Field Laboratory	ICR								
Maik Damm (G)	C	Technical University of Berlin	Department of Chemistry								
Benjamin-Florian Hempel (P)	C	Humboldt University of Berlin	BCRT								
Ayse Nalbantsoy (S)	C	Ege University	Bioengineering								
Youneng Tang (S)	PI	Florida State University	Civil and Environmental Engineering	Hinkley Center for Solid and Hazarouds Waste Managemen t			**P19776**	Non-Thermal Plasma Degradation of Per- and Polyfluoroalkyl Substances from Landfill Leachate	Engineering	1	0.83
Benhur Asefaw (G)	C	Florida State University	Civil and Environmental Engineering								
Radha Krishna Murthy Bulusu Raja (G)	C	Florida State University	Chemical and Biomedical Engineering								
Huan Chen (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Karam Eeso (U)	C	Florida State University	Chemical Engineering								
Rachel Gallan (G)	C	Florida State University	chemical engineering								
Bruce Locke (S)	C	Florida State University	FAMU-FSU College of Engineering								
Mojtaba Nouri Goukeh (G)	C	Florida State University	Civil and Environmental engineering								
DENNIS SSEKIMPI (G)	C	Florida State University	Civil&Environment al Engineering								
Robert Wandell (S)	C	Florida State University	Chemical and Biomedical Engineering								
Viji Sitther (S)	PI	Morgan State University	Biology	NSF	CBET - Chemical, Bioengineering , Environmental, and Transport Systems	CBET1900966	**P19779**	Oxidative stress induced impact of cell-penetrating nanoparticles on cellularconstituents in a cyanobacterial model	Chemistry	1	5

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Samson Gichuki (G)	C		Morgan State University	Department of Biology								
Mst Sayadujjhara (G)	C		Morgan State University	Biology								
LaDonna Wyatt (U)	C		Morgan State University	Biology								
Yavuz Yalcin (P)	C		Morgan State University	Biology								
Robert Spencer (S)	PI		Florida State University	Earth, Ocean & Atmospheric Science	NSF	OPP - Office of Polar Programs	OPP2029585	**P19786**	Tracing Permafrost Thaw DOM on the Peel Plateau, Canada	Chemistry	1	0.5
Steven Kokelj (S)	C		Northwest Territories Geological Survey	Geochemistry	NSF	OPP - Office of Polar Programs	OPP2124464					
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR	NSF	DEB - Division of Environmental Biology	DEB2029585					
Megan Moore (G)	C		Florida State University	Earth, Ocean, and Atmospheric Sciences								
Jaedyn Smith (G)	C		University of Alberta	Biological Sciences								
Suzanne Tank (S)	C		University of Alberta	Department of Biological Sciences								
Marina Taskovic (G)	C		University of Alberta	Biological Sciences								
Andrew Wozniak (S)	PI		University of Delaware	School of Marine Science and Policy	NSF	OCE - Ocean Sciences	OCE2123402	**P19787**	The impact of sulfurization on carbon accumulation in the Great Marsh, DE	Chemistry	1	1.25
Alina Ebling (T)	C		University of Delaware	EARTH, OCEAN & ENVIRONMENT								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Rachel Owrutsky (G)	C		University of Delaware	School of Marine Science and Policy								
Andrew Wozniak (S)	PI		University of Delaware	School of Marine Science and Policy	NSF	OCE - Ocean Sciences	OCE2123402	**P19788**	The integrated influence of river discharge, seasonality, and land use/land cover on exported DOM pool in Murderkill River Estuary	Chemistry	2	2.75
Alina Ebling (T)	C		University of Delaware	EARTH, OCEAN & ENVIRONMENT	NSF	OIA - Office of Integrative Activities	1757353					
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Tianyin Ouyang (G)	C		University of Delaware	College of Earth, Ocean & Environment								
Jason Ahad (S)	PI	*	Natural Resources Canada	Geological Survey of Canada	Natural Resources Canada GEM Geo-North Program	Non US Government Lab		**P19807**	Innovative geochemical methods for investigating permafrost and active	Chemistry	1	0.5

Participants (Name)	Role		Org.	Dept.	Funding Agency	Division	Award #	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Paul Gammon (S)	C		Natural Resources Canada	Geological Survey of Canada					layer processes in northern Canada			
Amy Holt (G)	C		Florida State University	EAOS								
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Christopher Rüger (S)	PI	*	University of Rostock	Interdisciplinary Faculty, Department Life, Light & Matter	• European Network of Fourier-Transform Ion-Cyclotron-Resonance Mass Spectrometry Centers	Other Non US Federal Agency	ID: 731077	**P19814**	Chemical characterization of carbonaceous wildfire emissions from chamber experiments by 21 T Fourier transform ion cyclotron resonance mass spectrometer	Chemistry	1	5
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance	DFG grant ZI 764/24-1	Other Non US Federal Agency						
Hendryk Czech (S)	C		University of Rostock	Analytical Chemistry, Joint Mass Spectrometry Centre	Helmholtz International Lab	Non US Government Lab	12083					
Paul Kösling (S)	C		University of Rostock	Joint Mass Spectrometry Centre								
Silvia Martinez (S)	C		University of Rostock	Joint Mass Spectrometry Centre								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Anika Neumann (G)	C		University of Rostock	Department Life Light & Matter								
Olga Popovicheva (S)	C		Lomonosov Moscow State University	Dept. of Microelectronics								
Eric Schneider (G)	C		University of Rostock	Analytical Chemistry								
Olli Sippula (S)	C		University of Eastern Finland	Department of Environmental and Biological Sciences, Fine Particle and Aerosol Technology Laboratory (FINE)								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ralf Zimmermann (S)	C	University of Rostock	Division of Analytical and Technical Chemistry								
Jemma Wadham (S)	PI	University of Bristol	School of Geographical Sciences	UK NERC	Other Non US Federal Agency	NE/R011524/1	**P19861**	Controls on the composition and bioavailability of dissolved organic matter in glacial freshwaters	Chemistry	1	2
Anne Kellerman (P)	C	Florida State University	Earth, Ocean and Atmospheric Science	Globalink Research Award	Other Non US Federal Agency	Mitacs Canada & UKRI, FR47805					
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR	Global Research Challenges Fund	Other Non US Federal Agency	Hi-ICE project					
Robert Spencer (S)	C	Florida State University	Earth, Ocean & Atmospheric Science	NERC, CONCYTEC, Newton Fund	Other Non US Federal Agency						
Martha Chacon (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Jumanah Hamdi (P)	C	Louisiana Universities Marine Consortium	Environmental Chemistry								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Jens Blotevogel (S)	PI	Commonwealth Scientific and Industrial Research Organization	Land and Water	DOD	ER - Environmental Research Program	ER21_3550	**P19867**	High-Field 21 Tesla FT-ICR Mass Spectrometry for Forensic Identification of PFASs	Engineering	1	0.67
Greg Blakney (S)	C	National High Magnetic Field Laboratory	ICR	DOD	ER - Environmental Research Program	ER21-SO-3550 - CY21					
Thomas Borch (S)	C	Colorado State University	Soil and Crop Science	DOD	ER - Environmental Research Program	ER20-1265					
Chris Hendrickson (S)	C	National High Magnetic Field Laboratory	Ion Cyclotron Resonance Program	DOD	ER - Environmental Research Program	ER-2718					
Christopher Higgins (S)	C	Colorado School of Mines	Civil and Environmental Enginnering								
John Kornuc (S)	C	U.S. Naval Research Laboratory	Emerging contaminants, site characterization								
Amy McKenna (S)	C	National High Magnetic Field Laboratory	ICR								
Nasim Pica (P)	C	Colorado State University	Environmental engineering								
Holly Roth (G)	C	Colorado State University	Chemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)		Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Hamidreza Sharifan (P)	C		Colorado State University	Civil and Environmental Engineering							
Robert Young (S)	C		New Mexico State University, Main Campus	Chemical Analysis & Instrumentation Laboratory							
Amy McKenna (S)	PI		National High Magnetic Field Laboratory	ICR	FSU Office of Research Collaborativ e Collision	Other US Federal Agency	**P19868**	Collaborative Accelerator. The Environmental Impact of Prescribed Burns in Florida: Soil & Emission Characteristics for Risk Mitigation	Chemistry	2	2.25
William Bahureksa (G)	C		Colorado State University	Chemistry							
Laurie Blackmore (S)	C		Atlanta Botanical Garden	Conservation and Research							
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance							
Emily Coffey (S)	C		Atlanta Botanical Garden	Conservation and Research							
Caitlin Crocker (T)	C		Atlanta Botanical Garden	Conservation and Research							
Sasha Ernst (T)	C		Florida Department of Environmental Protection	Bureau of Natural and Cultural Resources							
Daryl Hatfield (T)	C		Florida Department of Environmental Protection	District Prescribed Fire Management Coordinator							
Chris Hawthorne (T)	C		Florida Department of Environmental Protection	Topsail Hill Preserve State Park							
Christopher Holmes (S)	C		Florida State University	Earth, Ocean, and Atmospheric Science							
Sam McKenna (O)	C		National High Magnetic Field Laboratory	ICR							
Holly Nowell (P)	C		Florida State University	Earth Ocean and Atmospheric Sciences							
Bryan Quaife (S)	C		Florida State University	Department of Scientific Computing							
Holly Roth (G)	C		Colorado State University	Chemistry							
Ashlynn Smith (G)	C		Atlanta Botanical Garden	Conservation and Research							
Robert Spangler (T)	C		Florida Department of Environmental Protection	Topsail Hill Preserve State Park							
Christopher Uejio (S)	C		Florida State University	Department of Geography							
Neda Yaghoobian (S)	C		Florida State University	Mechanical Engineering							
Allan Bacon (S)	PI	*	University of Florida	Soil and Water Sciences	No other support		**P19879**	Chemical Signatures of Biosolid Movement		1	1.5

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science					Across the St Johns River Watershed	Biology, Biochemistry, Biophysics		
Yang Lin (S)	C		University of Florida	Soil and Water Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Bart van Dongen (S)	PI	*	University of Manchester	Department of Earth and Environmental Sciences	UKRI National Environment Research Council	Other Non US Federal Agency	GOAM (NERC grant reference: NE/P01304X/1	**P19888**	Aquatic organic matter at arsenic-prone aquifers in Kandal Province, Cambodia	Chemistry	2	0.75
Naji Bassil (S)	C		University of Manchester	School of Earth and Environmental Sciences								
Amy Holt (G)	C		Florida State University	EAOS								
Martin Kurek (G)	C		Florida State University	Earth, Ocean, and Atmospheric Science								
Dan Lapworth (S)	C		Britich Geological Survey	Maclean Building, Wallingford OX10 8BB, UK								
Jonathan Lloyd (S)	C		University of Manchester	School of Earth and Environmental Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Oliver Moore (G)	C		University of Manchester	Earth and Environmental Sciences								
David Polya (S)	C		University of Manchester	Earth and Environmental Sciences								
Laura Richards (S)	C		University of Manchester	Department of Earth and Environmental Sciences and Williamson Research Centre for Molecular Environmental Science								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Caitlin Tressler (S)	PI	*	Johns Hopkins University School of Medicine	Radiology	NIH	NCI - National Cancer Institute	CA213428	**P19892**	N-Glycan MALDI Imaging of COVID-19 Infected Patient Lungs	Biology, Biochemistry, Biophysics	1	4
Kristine Glunde (S)	C		Johns Hopkins University School of Medicine	School of Medicine	NIH	NCI - National Cancer Institute	CA213492					
Nicole Jenkinson (G)	C		Johns Hopkins University School of Medicine	School of Medicine								
David Nauen (S)	C		Johns Hopkins University School of Medicine	School of Medicine								
Cameron Shedlock (U)	C		University of Scranton	Johns Hopkins School of Medicine								
Karl Smith (P)	C		National High Magnetic Field Laboratory	ICR								
Mengqiang Zhu (S)	PI		University of Wyoming	Ecosystem Science and Management	NSF	DEB - Division of Environmental Biology	DEB2027284	**P19893**	Interrogating the Composition and Formation of Mineral-stabilized Organic Matter in Soils across an Ecoclimatic Gradient	Engineering	1	4.5
Hairuo Mao (P)	C		University of Wyoming	Ecosystem science and management	NSF	EAR - Earth Sciences	EAR1752903					
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Carson Thompson (G)	C		University of Wyoming	Dept. ECOSYSTEM SCIENCE AND MANAGEMENT								
Thomas Borch (S)	PI		Colorado State University	Soil and Crop Science	Cutrale Juices - FL			**P19905**	Compositional Changes of Soil Organic Matter in Response to Agricultural Management Practices	Chemistry	1	0.75
Jim Ippolito (S)	C		Colorado State University	Soil and Crop Sciences								
Merritt Logan (G)	C		Colorado State University	Chemistry								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Sean Stokes (G)	C		Colorado State University	Soil & Crop Science								
Pankaj Trivedi (S)	C		Colorado State University	Agricultural Biology								
Liza McDonough (P)	PI	*	Australian Nuclear Science and Technology Organisation	Environment	Australian Research Council Special Research Initiative in Excellence in Antarctic Science	Other Non US Federal Agency	Project ID SR200100005	**P19907**	Investigating carbon cycling in Antarctic and sub-Antarctic lakes	Chemistry	1	0.25
Martin Andersen (S)	C		University of New South Wales	School of Civil and Environmental Engineering	Australian Research Council	Other Non US Federal Agency	DP160101379					

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Andy Baker (S)	C		University of New South Wales	School of Biological, Earth and Environmental Sciences	National Collaborative Research Infrastructure Strategy (NCRIS).	Other Non US Federal Agency						
Megan Behnke (P)	C		University of Alaska, Southeast	Natural Science								
Amy Holt (G)	C		Florida State University	EAOS								
Christopher Marjo (T)	C		University of New South Wales	School of Biological, Earth and Environmental Sciences								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Karina Meredith (T)	C		Australia's Nuclear Science and Technology Organisation	Australia's Nuclear Science and Technology Organisation								
Denis O'Carroll (T)	C		University of New South Wales	School of Civil and Environmental Engineering								
Phetdala Oudone (G)	C		University of New South Wales	School of Biological, Earth and Environmental Sciences,								
Helen Rutlidge (T)	C		University of New South Wales	School of Civil and Environmental Engineering								
Isaac Santos (S)	C		Southern Cross University	National Marine Science Centre								
Krystyna Saunders (S)	C		Australian Nuclear Science and Technology Organisation	Environment								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Gregg Stanwood (S)	PI	*	Florida State University	Biomedical Sciences	NIH	Other	MH116429	**P19909**	Mass Spectrometry Imaging Analysis of a Novel Mouse Model of Antidepressant Activity and Behavioral Resilience	Biology, Biochemistry, Biophysics	1	6.5
Devon Graham (S)	C		Florida State University	Biomedical Sciences								
Karl Smith (P)	C		National High Magnetic Field Laboratory	ICR								
Cynthia Vied (S)	C		Florida State University	Translational Science Laboratory								
Marianny Combariza (S)	PI		Industrial University of Santander	Chemistry	Universidad Industrial de Santander	Non US College and University		**P19920**	Characterization of photosynthetic and photoprotective pigments in microalgae	Chemistry	1	5
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Marianny Combariza (S)	C		Industrial University of Santander	Chemistry								
Luis Díaz-Sánchez (G)	C		Industrial University of Santander	Santander								
Renzun Zhao (S)	PI	*	North Carolina Agricultural and Technical State University	Civil, Architectural and Environmental Engineering	NSF	CBET - Chemical, Bioengineering , Environmental, and Transport Systems	CBET2101053	**P19962**	Elevated temperature landfill leachate characterization and implications: Humic substance isolation, aromaticity, and biodegradability	Engineering	2	2.58
Brian Brazil (S)	C		Waste Management Inc.	Waste Management								
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Sailee Gawande (G)	C		Lamar University	Civil and Environmental Engineering Department								
Synthia Parveen Mallick (G)	C		Marquette University	Civil, Construction & Environmental Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Harsh Patel (G)	C		North Carolina Agricultural and Technical State University	Computational Science and Engineering								
Alfred Wadee (G)	C		Lamar University	Civil and Environmental Engineering								
Wenzheng Yu (S)	C		Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences	State Key Laboratory of Environmental Aquatic Chemistry								
Garrett McKay (S)	PI	*	Texas A&M University	Civil & Environmental Engineering	NSF	CBET - Chemical, Bioengineering , Environmental, and Transport Systems	CBET2050934	**P19963**	Evaluating the molecular composition of autoxidized hydroquinone and other surrogates for natural organic matter using FT-ICR MS	Engineering	1	0.5
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR	NSF	CHE - Chemistry	CHE1808126					
Thomas Borch (S)	PI		Colorado State University	Soil and Crop Science	USDA - Department of Agriculture			**P19965**	Oilfield-produced water as alternative source for agricultural irrigation: Impact on soil and crop health	Chemistry	1	0.33
Tamzin Blewett (S)	C		University of Alberta	Engineering	National Institute of Food and Agriculture	Other US Federal Agency						

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Corey Broeckling (S)	C		Colorado State University	Bioanalysis and Omics Center: Analytical Resources Core								
Nohyeong Jeong (S)	C		Colorado State University	Civil Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Huma Tariq (G)	C		Colorado State University	Chemistry								
Tiezheng Tong (S)	C		Colorado State University	Department of Civil and Environmental Engineering								
Marin Wiltse (G)	C		Colorado State University	Chemistry								
Robert Spencer (S)	PI		Florida State University	Earth, Ocean & Atmospheric Science	NSF	Other	80NSSC19M0104	**P19972**	Large-scale Comparison of DOM Composition from Various Solid Phase Extraction Procedures	Chemistry	3	2.42
Jon Hawkings (P)	C		Florida State University	Earth, Ocean and Atmospheric Sciences	NASA		ABoVE-80NSSC19M0104					
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Martin Kurek (G)	C		Florida State University	Earth, Ocean, and Atmospheric Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Oriane Yvin (G)	C		Florida State University	Earth,Ocean,and Atmospheric Science								
Alex Cobb (S)	PI	*	Singapore-MIT Alliance for Research and Technology	Center for Environmental Sensing and Modeling	Universiti Brunei Darussalam	Non US College and University		**P19977**	Comparative study of organic matter and nutrient fate in pristine and disturbed Bruneian peatlands	Biology, Biochemistry, Biophysics	1	1
Jeffrey Chanton (S)	C		Florida State University	Department of Earth, Ocean and Atmospheric Science								
Anne Kellerman (P)	C		Florida State University	Earth, Ocean and Atmospheric Science								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
David Butcher (S)	PI	*	National High Magnetic Field Laboratory	ICR	NSF	CHE - Chemistry	CHE1644779	**P19979**	REU: Development of workflows for high-throughput analysis and cell-free	Biology, Biochemistry, Biophysics	1	8.5
Sebastian Aguero (U)	C		California State University, San Marcos	Undergraduate								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Lissa Anderson (S)	C		National High Magnetic Field Laboratory	ICR					synthesis of isotopically depleted proteoforms			
Javion Walters (U)	C		National High Magnetic Field Laboratory	N/A								
Huan Chen (S)	PI		National High Magnetic Field Laboratory	Ion Cyclotron Resonance	No other support			**P19998**	REU Experience: Molecular Characterization of Aging Products from Essential Oils by GC×GC MS and FT-ICR MS	Chemistry	1	1
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Rayana Johnson (U)	C		Agilent Technologies	Chemistry								
Judy Wang (U)	C		National High Magnetic Field Laboratory	ICR								
Derrick Vaughn (P)	PI	*	Florida State University	Earth, Atmospheric, and Ocean Sciences	No other support			**P20008**	Impacts of ecosystem shifts on Florida coastal wetland DOM composition	Chemistry	1	0.5
Joshua Breithaupt (S)	C		Florida State University	Coastal and Marine Laboratory								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Robert Spencer (S)	C		Florida State University	Earth, Ocean & Atmospheric Science								
Thomas Atkinson (S)	PI	*	University of Alabama, Birmingham	Pediatrics	University of Alabama at Birmingham	US College and University		**P20022**	Investigating Non-Canonical Glycosylation in Synthetic and Natural Minimal Genome Bacteria	Biology, Biochemistry, Biophysics	3	13.5
Lissa Anderson (S)	C		National High Magnetic Field Laboratory	ICR								
James Daubenspeck (S)	C		University of Alabama, Birmingham	Pediatrics-Allergy								
Kevin Dybvig (S)	C		University of Alabama, Birmingham	Pediatrics								
John Sanford (G)	C		University of Alabama, Birmingham	Pediatrics								
Li Xiao (S)	C		University of Alabama, Birmingham	Medicine								
Alan Marshall (S)	PI		National High Magnetic Field Laboratory	ICR	No other support			**P20024**	Molecular Characterization of Dissolved Organic Material in Non-terrestrial Samples	Chemistry	2	11
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Joseph Frye (G)	C		National High Magnetic Field Laboratory	CIMAR								
Ryan Rodgers (S)	C		National High Magnetic Field Laboratory	ICR								
Amin Mirkouei (S)	PI		University of Idaho	Mechanical and Biological Engineering	USGS	Other	104b grant	**P20073**	Molecular Characterization of used char filters after fish farm downstream water treatment: Multi-level chemical analyses and fractionation scheme	Chemistry	1	0.33
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ethan Struhs (G)	C		University of Idaho	Engineering								
Michael Hoepfner (S)	PI	*	University of Utah	Chemical Engineering	No other support			**P20076**	Understanding Asphaltene Molecular Properties Critical for Heterogeneous Nucleation and Deposition in Diluted Bitumen	Chemistry	1	1.83
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Weiyi Kong (G)	C		The University of Utah	Chemical Engineering								
Rizwanur Rahman (G)	C		University of Utah	Chemical Engineering								
Simon Andersen (S)	PI	*	Schlumberger Canada Ltd	DBR tech center	Technical University of Denmark	Other		**P20088**	Separation and characterization of heteroatomic compounds in Danish crude oils and fractions	Chemistry	1	5
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Taylor Glattke (G)	C		Florida State University	ICR								
Khoa Huynh (G)	C		Technical University of Denmark	DHRTC - DTU Chemistry								
Ryan Rodgers (S)	C		National High Magnetic Field Laboratory	ICR								
Carlos Afonso (S)	PI		Normandy University	Chemistry	Total Energies			**P20095**	Molecular Characterization of the Impact of SMART Water EOR Practices on Bound / Unbound Petroleum Species	Chemistry	1	3
Brice Bouyssiere (S)	C		University of Pau and the Adour Region	IPREM								
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Pierre Giusti (S)	C		Total	Research & Technology								
Ryan Rodgers (S)	C		National High Magnetic Field Laboratory	ICR								
Nathaniel Terra Telles Souza (G)	C		University of Pau and the Adour Region	IPREM								
Daqian Jiang (S)	PI	*	University of Alabama, Tuscaloosa	Civil Construction and Environmental Engineering	USDA - Department of Agriculture		NIFA grant 2020-670223-31472	**P20102**	Molecular-level characterization of the dissolved organic matter in electrokinetic remediation of sediments	Engineering	1	0.5
Lydia Babcock-Adams (P)	C		National High Magnetic Field Laboratory	CIMAR, ICR								
Huan Chen (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance								
Tahir Maqbool (P)	C		University of Alabama, Tuscaloosa	Civil, Construction, and Environmental Engineering								
Amy McKenna (S)	C		National High Magnetic Field Laboratory	ICR								
Brice Bouyssiere (S)	PI	*	University of Pau and the Adour Region	IPREM	International Humic Substances Society	Other		**P20108**	Tracing lead species in peat samples from the French Pyrenees as a function of depth using SEC-ICP-MS and FT ICR-MS	Biology, Biochemistry, Biophysics	1	3
Martha Chacon (S)	C		National High Magnetic Field Laboratory	Ion Cyclotron Resonance	Université de Pay et des	Other						

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)	Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Deisy Giraldo Davila (G)	C	University of Pau and the Adour Region	Chemistry						
Ryan Rodgers (S)	C	National High Magnetic Field Laboratory	ICR						
						Total Proposals:	Experiments:		Days
						76	104		378

NMR Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Samuel Grant (S)	PI	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering	NSF	DMR - Division of Materials Research	DMR1644779	**P17559**	500 MRI Maintenance	Engineering	4	19
Malathy Elumalai (O)	C	Florida State University	NMR-MRI								
Robert Schurko (S)	PI	Florida State University	Chemistry	NSF	CHE - Chemistry	CHE2003854	**P17946**	Multinuclear Solid-State NMR of Quadrupolar Nuclei in Active Pharmaceutical Ingredients	Biology, Biochemistry, Biophysics	12	44
Christer Aakeroy (S)	C	Kansas State University	Chemistry and Biochemistry	State of Florida	Other	n/a					
Rajarshi Acharyya (G)	C	Florida State University	Chemistry and Biochemistry	NSERC	Other Non US Federal Agency	NSERC RGPIN-2016_06642					
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry	NSERC	Non US Council	n/a					
Jochen Autschbach (S)	C	University of Buffalo	Chemistry	nserc	Non US Council	NSERC RGPIN-2016_06642					
Carl Conti (G)	C	Florida State University	Chemistry & Biochemistry								
Zach Dowdell (G)	C	Florida State University	Chemistry								
Alberto Fezda (P)	C	University of Buffalo	Chemistry								
Carl Fleischer (G)	C	Florida State University	Chemistry								
Tomislav Friscic (S)	C	McGill University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Anthony Hoffman (G)	C	Florida State University	Chemistry and Biochemistry								
Sean Holmes (P)	C	Florida State University	Chemistry and Biochemistry								
James Hook (S)	C	University of New South Wales	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Igor Huskic (P)	C	McGill University	Chemistry and Biochemistry								
James Kimball (G)	C	Florida State University	Chemistry								
Karthik Nagapudi (S)	C	Genentech Inc.	Small Molecule Pharmaceutical Sciences								
Austin Peach (G)	C	Florida State University	Chemistry and Biochemistry								
Jeremy Rawson (S)	C	University of Windsor	Department of Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jazmine Sanchez (G)	C	Florida State University	Chemistry and Biochemistry								
Robert Smith (G)	C	National High Magnetic Field Laboratory									
Robert Smith (G)	C	Florida State University	Chemistry and Biochemistry								
Albert Stiegman (S)	C	Florida State University	Chemistry								
Cameron Vojvodin (G)	C	Florida State University	Chemistry and Biochemistry								
Lara Watanabe (G)	C	University of Windsor	Chemistry and Biochemistry								
Neeraj Sinha (S)	PI	Centre of Bio-Medical Research (CBMR)	Bio-medical department	Science and Engineering Research Board, Government of India	Other Non US Federal Agency	EMR/2015/001758	**P18099**	Structural and interaction study of collagen protein in native bone and cartilage through dynamic nuclear polarization	Biology, Biochemistry, Biophysics	1	13
Richa Dubey (G)	C	Centre of Biomedical Research	Department of Advanced Spectroscopy and Imaging								
Navneet Dwivedi (G)	C	Integral University	Physics								
Faith Scott (P)	C	National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
Nidhi Tiwari (G)	C	Centre of Biomedical Research	NMR								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Victor Schepkin (S)	PI	National High Magnetic Field Laboratory	CIMAR	No other support			**P18100**	Non-invasive assessment of rat glioma using 17O labeled glucose	Biology, Biochemistry, Biophysics	2	5
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Shannon Helsper (G)	C	National High Magnetic Field Laboratory	NMR								
Cathy Levenson (S)	C	Florida State University	Biomedical Sciences								
Steven Ranner (T)	C	National High Magnetic Field Laboratory	Instrumentation & Operations								
Lothar Schad (S)	C	Heidelberg University	Computer Assisted Clinical Medicine								
A. Dean Sherry (S)	C	University of Texas, Southwestern	Advanced Imaging Research Center								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yan-Yan Hu (S)	PI	Florida State University	Chemistry & Biochemistry	Solid Power			**P19111**	Structure-property correlation in Cl-doped tetragonal Na3PS4 (t-Na3PS4)	Chemistry	7	173
Yongkang Jin (G)	C	Florida State University	Chemistry and Biochemistry								
Pengbo Wang (G)	C	Florida State University	Chemistry								
Lina Zhou (G)	C	University of Cambridge	Chemistry Department								
Michael Harrington (S)	PI	Huntington Medical Research Institutes	Molecular Neurology	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS201072	**P19167**	Evaluating Brain Dysfunction in Migraine	Biology, Biochemistry, Biophysics	14	48
Nastaren Abad (G)	C	Florida State University	Chemical-Biomedical Engineering								
Hannah Alderson (U)	C	Florida State University	Chemical & Biomedical Engineering								
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Samuel Holder (G)	C	Florida State University	Chemical & Biomedical Engineering								
Linda Petzold (S)	C	University of California, Santa Barbara	Computer Science								
Yan-Yan Hu (S)	PI	Florida State University	Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1720139	**P19169**	In-situ and Operando MRI studies of All-solid-state Batteries	Chemistry	7	26
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Haoyu Liu (G)	C	Florida State University	Chemistry								
Erica Truong (G)	C	Florida State University	Chemistry and Biochemistry								
Sossina Haile (S)	PI	Northwestern University	Materials Science and Engineering, and Chemistry	NSF	DMR - Division of Materials Research	DMR1720139	**P19180**	Multinuclear Solid-state NMR Investigations of Oxyhalides, Oxynitrides and Chalcohalides	Biology, Biochemistry, Biophysics	9	63
Michael Deck (G)	C	FSU	Chemistry								
Yan-Yan Hu (S)	C	Florida State University	Chemistry & Biochemistry								
Sawankumar Patel (G)	C	Florida State University	Chemistry								
Sheel Sangvi (G)	C	Northwestern University	Chemistry								
Erica Truong (G)	C	Florida State University	Chemistry and Biochemistry								
Louis Wang (G)	C	Northwestern University	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Joseph Noel (S)	PI	Salk Institute for Biological Studies	Chemical Biology and Proteomics	Harnessing Plants Initiative, Salk Institute for Biological Studies	Other		**P19225**	Structural, Quantitative and Genetic Characterization of Plant Biopolymers by Solid-state NMR	Biology, Biochemistry, Biophysics	1	8
Thach Can (P)	C	Salk Institute for Biological Studies	Chemical Biology and Proteomics								
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Suzanne Thomas (P)	C	Salk Institute for Biological Studies	Chemical Biology and Proteomics								
Xueqian Kong (S)	PI	Zhejiang University	Chemistry	Zhejiang University	Non US College and University		**P19234**	Solid state NMR Investigation of highly conductive solid electrolytes	Biology, Biochemistry, Biophysics	1	18
Moein Adnami (G)	C	Florida State University	Physics								
jue Gong (S)	C	University of Electronic Science and Technology of China	Physics								
Yan-Yan Hu (S)	C	Florida State University	Chemistry & Biochemistry								
Yongkang Jin (G)	C	Florida State University	Chemistry and Biochemistry								
Brenton Jones (G)	C	Florida State University	Physics								
Sawankumar Patel (G)	C	Florida State University	Chemistry								
Erica Truong (G)	C	Florida State University	Chemistry and Biochemistry								
Frederic Mentink (S)	PI	National High Magnetic Field Laboratory	CIMAR	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19241**	Improving biradicals for MAS-DNP at high field: a combined approach of Spin-Dynamics theory, DFT and high-field EPR	Chemistry	2	7
Gael De Paepe (S)	C	French Alternative Energies and Atomic Energy Commission	Institute for Nanoscience and Cryogenics								
Thomas Halbritter (P)	C	University of Iceland	Chemistry								
Rania Harrabi (G)	C	French Alternative Energies and Atomic Energy Commission	DRF/IRIG/MEM/RM								
Sabine Hediger (S)	C	French Alternative Energies and Atomic Energy Commission	Institute for Nanoscience and Cryogenics								
Krishnendu Kundu (P)	C	National High Magnetic Field Laboratory	EMR								
Daniel Lee (S)	C	University of Manchester	Chemical Engineering								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Subhradip Paul (T)	C		French Alternative Energies and Atomic Energy Commission	DRF/IRIG/MEM/RM								
Dr Vinayak Rane (S)	C		Indian Institute of Geomagnetism	Instrumentation								
Snorri Sigurdsson (S)	C		University of Iceland	Chemistry								
Sami Jannin (S)	PI	*	Ecole Normale Superieure de Lyon	CRMN	Horozon 2020 (EUROPEAN COMMISSION, Research Executive Agency)	Other Non US Federal Agency	766402	**P19284**	Study of 1H polarization transfers through the spin diffusion barrier indynamic nuclear polarization using microwave gating	Chemistry	1	3.5
Olivier Cala (S)	C		Center of Nuclear Magnetic Resonance at Very High Fields	ENS								
Quentin Chappuis (G)	C		Ecole Normale Superieure de Lyon	High field NMR centre								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Arthur Pinon (S)	C		University of Gothenburg	NMR Swedish center								
James Harper (S)	PI		Brigham Young University (BYU)	Chemistry and Biochemistry	No other support			**P19307**	Verifying the existence of 3.0 Å long C-C bonds with 13C solid-state NMR	Chemistry	1	3
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Joel Miller (S)	C		University of Utah	Chemistry								
Pingchuan Sun (S)	PI		Nankai University	College of Chemistry	National Natural Science Foundation of China	Other		**P19331**	Probing the Transesterification Reaction and Topology Freezing Transition Temperature in Vitrimer by VT 17O and 13C Chemical Exchange SSNMR	Chemistry	9	66
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Fenfen Wang (P)	C		Nankai University	College of Chemistry								
Robert Griffin (S)	PI		Massachusetts Institute of Technology	Chemistry	NIH	NIA - National Institute on Aging	R01-AG058504	**P19370**	Structural Studies on the Human Voltage-Dependent Anion-Selective Channel Protein 1 (VDAC1) by Solid-State NMR	Biology, Biochemistry, Biophysics	1	6
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Edward Saliba (P)	C	Massachusetts Institute of Technology	Francis Bitter Magnet Laboratory								
Robert Silvers (S)	C	Florida State University	Chemistry and Biochemistry								
Geoffrey Strouse (S)	PI	National High Magnetic Field Laboratory	Chemistry	NSF	DMR - Division of Materials Research	DMR1905757	**P19372**	Multinuclear solid-state NMR investigation of plasmonic and photoluminescent nanocrystals	Chemistry	15	45
Rajarshi Acharyya (G)	C	Florida State University	Chemistry and Biochemistry	NSF							
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry								
Nhat Nguyen Bui (P)	C	National High Magnetic Field Laboratory	CMS								
Carl Conti (G)	C	Florida State University	Chemistry & Biochemistry								
Catherine Fabiano (G)	C	Florida State University	Chemistry								
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Jason Kuszynski (G)	C	Florida State University	Chemistry & Biochemistry								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Raul Ortega (G)	C	Florida State University	Chemistry & Biochemistry								
Anant Paravastu (S)	C	Georgia Institute of Technology	School of Chemical & Biomolecular Engineering								
Robert Schurko (S)	C	Florida State University	Chemistry								
Robert Smith (G)	C	Florida State University	Chemistry and Biochemistry								
Likai Song (S)	C	National High Magnetic Field Laboratory	EMR								
Janet Tests (S)	C	Columbia University	Chemistry								
Cameron Vojvodin (G)	C	Florida State University	Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Hadi Mohammadigoushki (S)	PI	Florida State University	Chemical and Biomedical Engineering	No other support		FSU-CRC	**P19421**	Probing in situ structure of monoclonal antibodies at water-air and water-oil interfaces via high field nuclear magnetic resonance spectroscopy	Engineering	22	84
Jamini Bhagu (G)	C	Florida State University	Chemical ENG	No other support							
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1942150					
Peter Rassolov (P)	C	Florida State University	Chemical and Biomedical Engineering	NSF	CAREER - Faculty Early Career Development Program	1942150					
Alfredo Scigliani (G)	C	Florida State University	Chemical & Biomedical Engineering	FSU-CRC	Other						
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR	Florida State University-CRC	Other						
Liliya Vugmeyster (S)	PI	University of Colorado, Denver	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM111681	**P19439**	Variant-specific dynamics of amyloid-beta fibrils by solid-state deuteron NMR.	Biology, Biochemistry, Biophysics	7	20
Alexander Greenwood (S)	C	University of Cincinnati	Department of Chemistry	CU Denver CLAS/start up fund	Other						
Dmitry Ostrovsky (S)	C	University of Alaska, Anchorage	Mathematics								
Elan Eisenmesser (S)	PI	University of Colorado, Denver	Biochemistry & Molecular Genetics	NSF	CHE - Chemistry	CHE1807326	**P19441**	SARS-CoV Nucleocapsid protein dynamics and their role in host protein interactions.	Biology, Biochemistry, Biophysics	1	10
Isabelle Marcotte (S)	PI	University of Quebec at Montreal	Chemistry	NSF	MCB - Molecular and Cellular Biosciences	MCB1942665	**P19442**	Chlamydomonas reinhardtii cell-wall and whole cell glycan architecture studied by high-field and DNP Solid-State NMR	Biology, Biochemistry, Biophysics	3	16
Fabien Deligey (P)	C	Louisiana State University	Chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI151321					
Malitha Dickwella Widanage (G)	C	Louisiana State University	chemistry								
Liyanage Fernando (G)	C	Michigan State University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Xue Kang (P)	C	Louisiana State University	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Alex Kirui (G)	C	Louisiana State University	Chemistry								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
S. Shekar (P)	C	Louisiana State University	chemistry								
Tuo Wang (S)	C	Michigan State University	Chemistry								
Hui Yang (S)	C	Pennsylvania State University	Department of Biology								
Wancheng Zhao (G)	C	Michigan State University	Chemistry								
Ashley Blue (T)	PI	National High Magnetic Field Laboratory	NHMFL	No other support			**P19456**	NMR System Maintenance	Development of Magnet Technology	10	167
William Brey (S)	C	National High Magnetic Field Laboratory	NMR	No other support		GM122698					
Justin Douglas (S)	C	University of Kansas	Molecular Structures Group	NIH	NIGMS - National Institute of General Medical Sciences	GM122698					
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Petr Gor'kov (S)	C	National High Magnetic Field Laboratory	CIMAR								
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Jaekyun Jeon (P)	C	National Institutes of Health	Laboratory of Chemical Physics								
Joanna Long (S)	C	University of Florida	Biochemistry & Molecular Biology								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Jose Uribe (G)	C	University of California, Irvine	Chemistry								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Blake Wilson (P)	C	National Institutes of Health	Laboratory of Chemical Physics, National Institute for Diabetes and Digestive and Kidney Diseases								
Sungsool Wi (S)	PI	National High Magnetic Field Laboratory	NMR	No other support			**P19492**	Utilization of 1H-1H correlation schemes for the structural study of perdeuterated/non-perdeuterated 13C and/or 15N-labeled biosolids	Biology, Biochemistry, Biophysics	17	104
Carolina Solis Maldonado (S)	C	Veracruzan University	Chemical Sciences	NSF	CHE - Chemistry	CHE2203405					
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry								
David De Haro Del Rio (G)	C	Autonomous University of Nuevo León	FACULTAD DE CIENCIAS QUIMICAS								
Rivera de la Rosa (S)	C	Autonomous University of Nuevo León	Chemical Engineering								
Lucio Frydman (S)	C	National High Magnetic Field Laboratory	NMR								
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Marco Garza-Navarro (S)	C	Autonomous University of Nuevo León	FACULTAD DE INGENIERIA MECANICA Y ELECTRICA								
Anton Hanopolsky (G)	C	Weizmann Institute of Science	Chemical and Biological Physics								
Michael Jaroszewicz (G)	C	University of Windsor	Chemistry								
James Kimball (G)	C	Florida State University	Chemistry								
Józef Lewandowski (S)	C	University of Warwick	Chemistry								
Kwang Hun Lim (S)	C	East Carolina University	Chemistry								
Carlos Javier Lucio Ortiz (S)	C	Autonomous University of Nuevo León	FACULTAD DE CIENCIAS QUIMICAS								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Francisco José Morales-Leal (S)	C	Autonomous University of Nuevo León	Chemical Sciences								
Mihajlo Novakovic (G)	C	Weizmann Institute of Science	Chemical and Biological Physics								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Evelin Ruiz-Zamora (G)	C	Autonomous University of Nuevo León	Chemistry								
Ladislao Sandoval-Rangel (P)	C	Monterrey Institute of Technology and Higher Education	Escuela de Ingeniería y Ciencias								
Neeraj Sinha (S)	C	Centre of Bio-Medical Research (CBMR)	Bio-medical department								
Murari Soundararajan (P)	C	National High Magnetic Field Laboratory	CIMAR, NMR								
Johan van Tol (S)	C	National High Magnetic Field Laboratory	EMR								
Shengyu Wang (P)	C	National High Magnetic Field Laboratory	Condensed Matter Science								
Ge Yu (S)	C	Florida State University	Chemistry								
Yining Huang (S)	PI	University of Western Ontario	Chemistry	NSERC of Canada	Other		**P19515**	17O and 91Zr solid-state NMR of metal-organic frameworks at 35.2 T	Chemistry	4	20
Kuizhi Chen (P)	C	National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Vinicius Martins (G)	C	University of Western Ontario	Chemistry								
Jeffery White (S)	C	Oklahoma State University	Chemical Engineering								
Wanli Zhang (G)	C	University of Western Ontario	Chemistry								
Tim Cross (S)	PI	National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI119178	**P19516**	Structural Characterization of SARS-CoV-2 E protein in lipid bilayer with Solid-State NMR	Biology, Biochemistry, Biophysics	34	219.5
Wenhao Hu (G)	C	Florida State University	Chemistry and Biochemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM122698					
Yan-Yan Hu (S)	C	Florida State University	Chemistry & Biochemistry								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Lisa Monluc (G)	C	Florida State University	Department of Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Lisa Monluc (G)	C	Florida State University	Chemistry								
Joana Paulino (P)	C	National High Magnetic Field Laboratory	CIMAR								
Huajun Qin (T)	C	Florida State University	Chemistry & Biochemistry								
Anna Wright (G)	C	National High Magnetic Field Laboratory	Molecular Biophysics								
Rongfu Zhang (P)	C	National High Magnetic Field Laboratory	NHMFL								
Huan-Xiang Zhou (S)	C	University of Illinois at Chicago	Physics and Chemistry								
Danielle Laurencin (S)	PI	University of Montpellier	Institut Charles Gerhardt de Montpellier	ERC	Other		**P19532**	Identification of interfacial bonding environments in functional nanomaterials and biomaterials using high resolution solid state NMR at (ultra)-high fields	Chemistry	10	46
Chia-Hsin Chen (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier	CNRS	Other						
Pierre Florian (S)	C	French National Center for Scientific Research	CEMTHI	ERC	Other	772204					
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	ANR	Other	TOGETHER Project					
Christel Gervais (S)	C	Sorbonne University	Laboratoire de Chimie de la Matière Condensée	ANR	Other	"TOGETHER" project					
Ieva Goldberga (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
César Leroy (P)	C	French National Center for Scientific Research	ICGM - UMR 5253								
Adam Nelson (G)	C	Sorbonne University	Chemistry								
Cesario Borlongan (S)	PI	University of South Florida	College of Medicine, Neurosurgery	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS102395	**P19565**	In vivo assessment of cell-derived therapies for treatment of stroke: 23Na MRI and 1H MRS	Biology, Biochemistry, Biophysics	19	44
Catherine Amiens (S)	C	University of Toulouse	Chemistry	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS115490					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Jacob Athey (U)	C	Florida State University	Chemical & Biomedical Engineering								
Frederick Bagdasarian (G)	C	Florida State University	College of Engineering								
Jamini Bhagu (G)	C	Florida State University	Chemical ENG								
Bruce Bunnell (S)	C	Tulane University	Pharmacology								
Liang Du (G)	C	Florida State University	Department of Chemistry and Biochemistry								
Debra Fadool (S)	C	Florida State University	Biological Sciences								
Shannon Helsper (G)	C	National High Magnetic Field Laboratory	NMR								
David Hike (G)	C	Florida State University	Chemical and Biomedical Engineering								
Jea-Young Lee (P)	C	University of South Florida	Center of Excellence for Aging & Brain Repair								
Hedi Mattoussi (S)	C	Florida State University	Chemistry & Biochemistry								
nada Nosratabad (G)	C	Florida State University	Biochemistry and Molecular Biology								
Jenna Radovich (G)	C	Florida State University	Chemical & Biomedical Engineering								
Jens Rosenberg (S)	C	University of Florida	AMRIS								
Alfredo Scigliani (G)	C	Florida State University	Chemical & Biomedical Engineering								
Wentao Wang (G)	C	Florida State University	Biochemistry and Molecular Biology								
Kaya Xu (P)	C	University of South Florida	Center of Excellence for Aging & Brain Repair								
Xuegang Yuan (G)	C	Florida State University	Chemical & Biomedical Engineering								
Leonard Mueller (S)	PI	University of California, Riverside	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM097569	**P19571**	DNP-Enabled Solid-State NMR of PLP Enzymes: Tyrosine Phenol Lyase	Chemistry	8	69
Paul Bogie (S)	C	University of Riverside	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM122698					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Richard Bogie (S)	C	University of Riverside	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM137008					
Yuliana Bosken (S)	C	University of California, Riverside	Chemistry								
Maria Luiza Caldas Nogueira (P)	C	University of Florida	Biochemistry and Molecular Biology								
Bethany Caulkins (G)	C	University of California, Riverside	Chemistry								
chia-en Chang (S)	C	University of California, Riverside	Chemistry								
Victoria Drango (G)	C	University of Toledo	Chemistry								
Michael Dunn (S)	C	University of California, Riverside	Biochemistry								
Rittik Ghosh (G)	C	University of California, Riverside	Chemistry								
Adam Gill (P)	C	University of Riverside	Chemistry								
Alia Hassan (S)	C	Bruker Biospin AG	Chemistry								
Eduardo Hilario (S)	C	University of Riverside	Chemistry								
Jacob Holmes (G)	C	University of California, Riverside	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Joanna Long (S)	C	University of Florida	Biochemistry & Molecular Biology								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Timothy Mueser (S)	C	University of Toledo	Chemistry								
Joana Paulino (P)	C	National High Magnetic Field Laboratory	CIMAR								
Gwladys Riviere (P)	C	Max Planck Institute for Biophysical Chemistry, Goettingen	German Center for Neurodegenerative Diseases								
Jennifer Romero (G)	C	University of Riverside	Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Faith Scott (P)	C	National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
Robert Young (S)	C	Pacific Northwest National Laboratory	Chemistry								
Michael Famiano (S)	PI	Western Michigan University	Physics	Moore Foundation	US Foundation	7799	**P19582**	Applications of NMR to Astrobiology: Measurement of Shielding Tensor Components of Chiral Molecules	Biology, Biochemistry, Biophysics	3	25
Shiva Agarwal (G)	C	Western Michigan University	Physics	Moore Foundation	Other	7799					
Sonjong Hwang (S)	C	California Institute of Technology	Chemistry and Chemical Engineering								
Gellert Mezei (S)	C	Western Michigan University	Chemistry								
John Miller (S)	C	Western Michigan University	Chemistry Dept								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Kwang Hun Lim (S)	PI	East Carolina University	Chemistry	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS097490	**P19589**	Characterization of Structural Features of Cytotoxic Transthyretin Oligomers and their Interaction with Membranes	Biology, Biochemistry, Biophysics	4	27
Mathew Coats (G)	C	East Carolina University	Chemistry								
Anvesh Kumar Reddy Dasari (G)	C	East Carolina University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Sujung Yi (G)	C	East Carolina University	Chemistry								
Alexander Baer (P)	PI	University of Kassel	Zoology	German Research Foundation	Non US Foundation	MA 4147/7-2	**P19600**	Study of the Euperipatoides rowelli velvet worm slime and its unique high molecular weight phosphonated proteins by DNP Solid-State NMR	Biology, Biochemistry, Biophysics	3	21.5
Alexander Baer (P)	C	University of Kassel	Zoology	European Research Council	Other Non US Federal Agency	101008500					
Pierre Florian (S)	C	French National Center for Scientific Research	CEMTHI								
Matthew Harrington (S)	C	McGill University	Department of chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Isabelle Marcotte (S)	C	University of Quebec at Montreal	Chemistry								
Georg Mayer (S)	C	University of Kassel	Zoology								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Alexandre Poulhazan (G)	C	University of Quebec at Montreal	Chemistry								
Stephan Schmidt (S)	C	Heinrich Heine University Düsseldorf	Institut für Organische Chemie und Makromolekulare Chemie								
Aaron Rossini (S)	PI	Iowa State University	Chemistry	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET1916809	**P19606**	High-Field Solid-State NMR of Heterogeneous Catalysts and Inorganic Materials	Chemistry	3	17
Rick Dorn (G)	C	Iowa State University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Tim Murphy (S)	PI	National High Magnetic Field Laboratory	Operations	No other support			**P19611**	Testing of DCFF magnets, power supplies and associated equipment	Condensed Matter Physics	1	4
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS								
Troy Brumm (T)	C	National High Magnetic Field Laboratory	DC Field								
Robert Nowell (T)	C	National High Magnetic Field Laboratory	DC User Support								
Andy Powell (S)	C	National High Magnetic Field Laboratory	Operations								
Julia Smith (S)	C	National High Magnetic Field Laboratory	DC Field								
Eric Stiers (O)	C	National High Magnetic Field Laboratory	DC Field								
Sujana Sri Venkat Uppalapati (O)	C	National High Magnetic Field Laboratory	DC Field Facility								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ercan Cakmak (S)	PI	Oak Ridge National Laboratory	Materials Science and Technology	DOE	Other	N/A FEAA155	**P19640**	Solid State C13 NMR Measurements of Industrially Relevant Coals to Aid in the Development of Advanced Coal Molecular Models with Predictive Capabilities	Chemistry	2	17
Stephan Irle (S)	C	Oak Ridge National Laboratory	Computational Sciences and Engineering Division	DOE	Other	N/A					
Gang Seob Jung (S)	C	Oak Ridge National Laboratory	Computational Science and Engineering Division								
Edgar Lara-Curzio (S)	C	Oak Ridge National Laboratory	Materials Science & Technology Division								
Jonathan Mathews (S)	C	Pennsylvania State University	Energy and Mineral Engineering								
Sungsool Wi (S)	C	National High Magnetic Field Laboratory	NMR								
Bo Chen (S)	PI	University of Central Florida	Department of Physics	No other support			**P19664**	Molecular Basis of Tunable Iridescence of Cephalopods	Biology, Biochemistry, Biophysics	4	31
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL	NSF	MCB - Molecular and Cellular Biosciences	MCB1856055					
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Md Imran Khan (P)	C	University of Central Florida	Physics								
Marina Ilkaeva (S)	PI *	University of Aveiro	Department of Chemistry	Fundação para a Ciência ea Tecnologia: FCT	Non US Foundation		**P19665**	Atomic-level understanding of the sorption mechanisms in Li silicate sorbents for pre-combustion CO2 capture	Development of Magnet Technology	3	14
Pierre Florian (S)	C	French National Center for Scientific Research	CEMTHI	Fundação para a Ciência ea Tecnologia: FCT	Other						
Luís Mafra (S)	C	University of Aveiro	Chemistry								
Ildefonso Marin-Montesinos (S)	C	University of Aveiro	Chemistry								
Daniel Pereira (G)	C	University of Aveiro	CICECO-Aveiro Institute of Materials								
Mariana Sardo (S)	C	University of Aveiro	Chemistry								
Katherine Henzler-Wildman (S)	PI	University of Wisconsin, Madison	Biochemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM141748	**P19681**	17O NMR of Ion Channels	Biology, Biochemistry, Biophysics	1	4
Vilius Kurauskas (P)	C	University of Wisconsin, Madison	Biochemistry								
Lothar Schad (S)	PI	Heidelberg University	Computer Assisted Clinical Medicine	DAAD - German Academic Exchange Service	Other Non US Federal Agency		**P19689**	Characterization of sodium MR environments	Biology, Biochemistry, Biophysics	12	33

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Eric Gottwald (S)	C	Karlsruhe Institute of Technology	Institute for Biological Interfaces (IBG 5)	DAAD - Germman Academic Exchange Service	Other Non US Federal Agency			based on T1 and T2 TQ signals			
Dennis Kleimaier (G)	C	Heidelberg University	Computer Assisted Clinical Medicine	Heidelberg University	Non US College and University						
Simon Reichert (G)	C	Heidelberg University	Medical Faculty Mannheim	German Academic Exchange Service (DAAD)	Non US Foundation						
Victor Schepkin (S)	C	National High Magnetic Field Laboratory	CIMAR	German Academic Exchange Service	Other Non US Federal Agency						
				German Academic Exchange Service	Non US Foundation						
Frederic Mentink (S)	PI	National High Magnetic Field Laboratory	CIMAR	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19765**	P41 MAS-DNP probe development	Biology, Biochemistry, Biophysics	5	38
Thierry Dubroca (S)	C	National High Magnetic Field Laboratory	EMR								
Thomas Halbritter (P)	C	University of Iceland	Chemistry								
Joanna Long (S)	C	University of Florida	Biochemistry & Molecular Biology								
Thorsten Maly (S)	C	Bridge12, Technologies, Inc.	R&D								
Faith Scott (P)	C	National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
Snorri Sigurdsson (S)	C	University of Iceland	Chemistry								
Ayyalusamy Ramamoorthy (S)	PI	University of Michigan	Chemistry & Biophysics	NIH	NIGMS - National Institute of General Medical Sciences	GM351395	**P19766**	Measurement of 17O Residual Quadrupolar Couplings in Small Molecules Using Lipid Nanodiscs	Chemistry	1	4
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Sam McCalpin (G)	C	University of Michigan	Chemistry								
Rongfu Zhang (P)	C	National High Magnetic Field Laboratory	NHMFL								
Robbie Iuliucci (S)	PI	Washington and Jefferson College	Chemistry	No other support			**P19772**	NMR Crystallography of Pharmaceuticals and Biologically Relevant Nanocrystals Augmented by Multinuclear High Field Solid-State NMR	Chemistry	3	6
Angelika Dewicki (U)	C	Washington and Jefferson College	Chemistry								
Sean Holmes (P)	C	Florida State University	Chemistry and Biochemistry								
Rosalynn Quiñones (S)	C	Marshall University	Chemistry								
Robert Schurko (S)	C	Florida State University	Chemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Carsten Sievers (S)	PI	*	Georgia Institute of Technology	School of Chemical & Biomolecular Engineering	LyondellBasell		N/A	**P19774**	Spatially and time resolved evolution of carbonaceous deposits on an isomerization catalyst	Chemistry	1	11
Karoline Hebisch (G)	C		Georgia Institute of Technology	Chemical and Biomolecular Engineering								
Anil Mehta (S)	C		University of Florida	AMRIS								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Myriam Cotten (S)	PI		College of William and Mary	Applied Science	NSF	MCB - Molecular and Cellular Biosciences	MCB1716608	**P19777**	Leveraging Solid-State NMR to Investigate Host Defense Mechanisms at Biological Membranes	Biology, Biochemistry, Biophysics	12	66
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR	NIH	NIGMS - National Institute of General Medical Sciences	GM126527					
Evan Goodell (G)	C		College of William and Mary	Applied Science								
Mary Rooney (G)	C		College of William and Mary	Applied Science								
Andrea Zourou (G)	C		College of William and Mary	Applied Science								
Eric Breynaert (S)	PI		Catholic University Leuven	M2S	FWO Vlaanderen	Non US Foundation	V401721N	**P19796**	NMR for Convergence Research with focus on Nanoporous materials, Molecular Water Science, Energy and Food and Health Science	Chemistry	18	74
Clifford (Russ) Bowers (S)	C		University of Florida	Chemistry	FWO Vlaanderen	Non US Foundation	G083318N					
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Samuel Grant (S)	C		National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
James Kimball (G)	C		Florida State University	Chemistry								
Victor Schepkin (S)	C		National High Magnetic Field Laboratory	CIMAR								
Robert Schurko (S)	C		Florida State University	Chemistry								
Cameron Vojvodin (G)	C		Florida State University	Chemistry and Biochemistry								
Sungsool Wi (S)	C		National High Magnetic Field Laboratory	NMR								
Yijue Xu (P)	C		National High Magnetic Field Laboratory	solid-state NMR								
Xiaodan Gu (S)	PI		University of Southern Mississippi	Polymer Sience and Engineering	DOE	BES – Basic Energy Sciences	DESC0022050	**P19855**	Illuminating the Rigid Amorphous Fraction of	Development of Magnet Technology	2	10

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry					Conjugated Polymers and its Pivotal Influence on Optoelectronic Behavior			
Riqiang Fu (S)	C	National High Magnetic Field Laboratory	NMR								
Robert Schurko (S)	C	Florida State University	Chemistry								
Robert Smith (G)	C	National High Magnetic Field Laboratory									
Zhehong Gan (S)	PI	National High Magnetic Field Laboratory	NHMFL	No other support			**P19856**	Development and implementation of solid-state NMR methods at high magnetic fields	Chemistry	16	100
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Wenping Mao (P)	C	National High Magnetic Field Laboratory	NMR								
Robert Schurko (S)	C	Florida State University	Chemistry								
Yijue Xu (P)	C	National High Magnetic Field Laboratory	solid-state NMR								
Jeffrey Schiano (S)	PI	Pennsylvania State University	Electrical Engineering	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19858**	Flux Regulation for Powered Magnets	Engineering	2	6
William Brey (S)	C	National High Magnetic Field Laboratory	NMR								
Ilya Litvak (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Waroch Tangbampensountorn (G)	C	Pennsylvania State University	Electrical Engineering								
Sabyasachi Sen (S)	PI	University of California, Davis	Chemical Engineering and Materials Science	NSF	DMR - Division of Materials Research	DMR1855176	**P19876**	High-Field NMR Investigation of the Structural Evolution during Nucleation in Glass-Ceramics: Towards an Atomistic Understanding	Engineering	13	83
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Bing Yuan (G)	C	University of California, Davis	Engineering								
Bradley Nilsson (S)	PI	University of Rochester	Chemistry	NSF	CHE - Chemistry	CHE1904528	**P19881**	Interrogating the packing architecture of self-assembled biomaterials	Biology, Biochemistry, Biophysics	3	13
Hannah Distaffen (G)	C	University of Rochester	Chemistry								
Elena Quigley (G)	C	University of Rochester	Chemistry								
Robert Schurko (S)	PI	Florida State University	Chemistry	NSF	CHE - Chemistry	CHE2003854	**P19885**	Multinuclear Solid-State NMR of Quadrupolar Nuclei in Active Pharmaceutical Ingredients: New Pathways for the Characterization of Polymorphs, Hydrates, Cocrystals, and Dosage Forms	Chemistry	130	437.5
Christer Aakeroy (S)	C	Kansas State University	Chemistry and Biochemistry	Florida State University	US College and University	Startup					
Louae Abdulla (G)	C	University of Windsor	Chemistry	Florida State University	US College and University	Start up funds					
Adam Altenhof (G)	C	Florida State University	Chemistry and Biochemistry	National High Magnetic Field Laboratory	US Government Lab	Start-up funds from DMR-1644779					
Jochen Autschbach (S)	C	University of Buffalo	Chemistry								
Eric Breynaert (S)	C	Catholic University Leuven	M2S								
Zach Dowdell (G)	C	Florida State University	Chemistry								
Carl Fleischer (G)	C	Florida State University	Chemistry								
Tomislav Friscic (S)	C	McGill University	Chemistry								
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
Ieva Goldberga (P)	C	French National Center for Scientific Research	Institut Charles Gerhardt de Montpellier								
James Harper (S)	C	Brigham Young University (BYU)	Chemistry and Biochemistry								
Anthony Hoffman (G)	C	Florida State University	Chemistry and Biochemistry								
Sean Holmes (P)	C	Florida State University	Chemistry and Biochemistry								
James Hook (S)	C	University of New South Wales	Chemistry								
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Robbie Iuliucci (S)	C	Washington and Jefferson College	Chemistry								
Michael Jaroszewicz (G)	C	University of Windsor	Chemistry								
James Kimball (G)	C	Florida State University	Chemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)		Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Danielle Laurencin (S)	C		University of Montpellier	Institut Charles Gerhardt de Montpellier							
Harris Mason (S)	C		Los Alamos National Laboratory	Chemistry							
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR							
Thomas-Xavier Métro (S)	C		Institut des Biomolécules Max Mousseron	Equipe Chimie Verte et Technologies Innovantes							
Austin Peach (G)	C		Florida State University	Chemistry and Biochemistry							
Adam Phillips (P)	C		University of Buffalo	Chemistry							
David Quezada Estrada (G)	C		Florida State University	Chemistry & Biochemistry Department							
Jeremy Rawson (S)	C		University of Windsor	Department of Chemistry and Biochemistry							
Jazmine Sanchez (G)	C		Florida State University	Chemistry and Biochemistry							
Jasmin Schoenzart (G)	C		Florida State University	Chemistry and Biochemistry							
Faith Scott (P)	C		National High Magnetic Field Laboratory	Biochemistry & Molecular Biology							
Robert Smith (G)	C		National High Magnetic Field Laboratory								
Robert Smith (G)	C		Florida State University	Chemistry and Biochemistry							
Jessica Spackova (P)	C		University of Montpellier	Chemistry							
Albert Stiegman (S)	C		Florida State University	Chemistry							
Sara Termos (G)	C		Florida State University	Department of Chemistry and Biochemistry							
Cameron Vojvodin (G)	C		Florida State University	Chemistry and Biochemistry							
Lara Watanabe (G)	C		University of Windsor	Chemistry and Biochemistry							
Yijue Xu (P)	C		National High Magnetic Field Laboratory	solid-state NMR							
Kristopher Harris (S)	PI	*	Louisiana Tech University	Chemistry	NASA	NNH21ZHA004C	**P19886**	Determining disorder and edge	Chemistry	1	2

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Robert Schurko (S)	C		Florida State University	Chemistry					terminations in 2D-flake nanomaterials			
Robert Smith (G)	C		Florida State University	Chemistry and Biochemistry								
Terry Gullion (S)	PI	*	West Virginia University	Chemistry	No other support			**P19889**	DNP-MAS of Honey Bee Wings	Biology, Biochemistry, Biophysics	3	17.5
Samuel Eddy (G)	C		West Virginia University	Chemistry								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Faith Scott (P)	C		National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
Sungsool Wi (S)	C		National High Magnetic Field Laboratory	NMR								
Eric Breynaert (S)	PI		Catholic University Leuven	M2S	FWO Vlaanderen	Non US Foundation	V401721N	**P19898**	Dependence of field homogeneity on chip capacitors used in loop gap resonator coils	Development of Magnet Technology	1	2
Petr Gor'kov (S)	C		National High Magnetic Field Laboratory	CIMAR								
Tuo Wang (S)	PI		Michigan State University	Chemistry	NSF	MCB - Molecular and Cellular Biosciences	MCB1942665	**P19901**	Solid-State NMR and DNP Investigations of Moss Carbohydrates and Biomaterials	Biology, Biochemistry, Biophysics	6	40
Fabien Deligey (P)	C		Louisiana State University	Chemistry	NIH	NIAID - National Institute of Allergy and Infectious Diseases	AI149289					
Liyanage Fernando (G)	C		Michigan State University	Chemistry								
Mark Frank (G)	C		Pennsylvania State University	Biochemistry and Molecular Biology								
Sung Hyun Cho (S)	C		Pennsylvania State University	Biochemistry and Molecular Biology								
Alex Kirui (G)	C		Louisiana State University	Chemistry								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
B. Nixon (S)	C		Pennsylvania State University	Biochemistry and Molecular Biology								
Faith Scott (P)	C		National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
S. Shekar (P)	C		Louisiana State University	chemistry								
Matthew Swulious (S)	C		Pennsylvania State University	Biochemistry and Molecular Biology								
Ping Wang (S)	C		University of Louisiana at Lafayette	Microbiology, Immunology & Parasitology								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Wancheng Zhao (G)	C		Michigan State University	Chemistry								
Dylan Murray (S)	PI		University of California Davis	Chemistry	NIH	NIGMS - National Institute of General Medical Sciences	GM142892	**P19910**	Molecular Determinants for the Assembly of Low Complexity Protein Domains	Biology, Biochemistry, Biophysics	5	31
Estely Carranza (G)	C		University of California, Davis	Chemistry								
Daniel Farb (G)	C		University of California, Davis	Chemistry								
Blake Fonda (G)	C		University of California, Davis	Chemistry								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Khaled Jami (G)	C		University of California, Davis	Chemistry								
Steven McKnight (S)	C		University of Texas, Southwestern	Medical Center								
Kayla Osumi (G)	C		University of California, Davis	Chemistry								
Vasily Sysoev (P)	C		University of Texas, Southwestern	Biochemistry								
Yuuki Wittmer (G)	C		University of California, Davis	Chemistry								
Pierre Florian (S)	PI	*	French National Center for Scientific Research	CEMTHI	No other support			**P19959**	27Al MAS NMR spectra at 1.5 GHz in alkali feldspars	Chemistry	1	7
Pierre Florian (S)	C		French National Center for Scientific Research	CEMTHI								
Daniel Lee (S)	PI		University of Manchester	Chemical Engineering	EPSRC (UK)	Other		**P19960**	MAS-DNP for structural investigations of porous materials	Chemistry	1	4
Jiangnan Li (P)	C		University of Manchester	Chemistry								
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Luis Sánchez-Muñoz (S)	PI	*	Consejo Superior de Investigaciones Científicas	Geology	No other support			**P19961**	27Al MAS NMR spectra at 1.5 GHz in alkali feldspars	Chemistry	1	4
Pierre Florian (S)	C		French National Center for Scientific Research	CEMTHI								
Yuanzheng Yue (S)	PI	*	Aalborg University	Department of Chemistry and Bioscience	The Independent Research Fund Denmark	Other	1026-00318B	**P19967**	Probing the local structure of metal-organic frameworks via high field NMR	Development of Magnet Technology	2	7
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Olivier Lafon (S)	PI		University of Lille	Chemical Engineering	CNRS	Non US Government Lab		**P19969**	67Zn and 33S NMR of ZnS and ZnS/ZnO nanocrystals at 35.2 T	Chemistry	2	9
Yannick Coppel (S)	C		French National Center for Scientific Research	LCC								
Myrtil Kahn (S)	C		French National Center for Scientific Research	LCC								
Hiroki Nagashima (S)	C		National Institute of Advanced Industrial Science and Technology	Interdisciplinary Research Center for Catalytic Chemistry								
Julien Trebosc (S)	C		University of Lille	Unite de Catalyse et de Chimie du Solide								
Zachary Smith (S)	PI	*	Massachusetts Institute of Technology	Chemical Engineering	DOE	ECRP - Early Career Research Program	DE-SC0019087	**P19973**	Correlating chemical and physical properties with gas transport properties for gas separation membranes	Engineering	3	16
Richa Dubey (G)	C		Centre of Biomedical Research	Department of Advanced Spectroscopy and Imaging								
Navneet Dwivedi (G)	C		Integral University	Physics								
Taigyu Joo (G)	C		Massachusetts Institute of Technology	Chemical Engineering								
Hyunhee Lee (G)	C		Massachusetts Institute of Technology	Chemical Engineering								
Neeraj Sinha (S)	C		Centre of Bio-Medical Research (CBMR)	Bio-medical department								
Sungsool Wi (S)	C		National High Magnetic Field Laboratory	NMR								
Jing Ying Yeo (G)	C		Massachusetts Institute of Technology	Chemical Engineering								
David Bryce (S)	PI		University of Ottawa	Department of Chemistry and Biomolecular Sciences	Natural Sciences and Engineering Research Council Canada	Non US Council		**P19976**	Rhenium-185-187 Solid-State NMR Investigation of Non-Covalent Matere Bonds	Chemistry	8	50
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Yijue Xu (P)	C		National High Magnetic Field Laboratory	solid-state NMR								
Xinhua Peng (S)	PI	*	University of Science and Technology of China	Physics	NIH	NIGMS - National Institute of General Medical Sciences	GM122698	**P19983**	New 17O NMR method for protein channel water study	Biology, Biochemistry, Biophysics	1	4
Tim Cross (S)	C		National High Magnetic Field Laboratory	NHMFL/Chemistry & Biochemistry								
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR								
Rongfu Zhang (P)	C		National High Magnetic Field Laboratory	NHMFL								
Art Edison (S)	PI	*	University of Georgia	CCRC, Biochemistry and Genetics	NIH	NIGMS - National Institute of General Medical Sciences	GM120151	**P20002**	Probe testing, development, repairs	Engineering	1	3
William Brey (S)	C		National High Magnetic Field Laboratory	NMR								
Nicolas Freytag (S)	C		Bruker Biospin AG	R&D								
Jerris Hooker (P)	C		Florida Agricultural and Mechanical University	NMR								
Lawrence Hornak (S)	C		University of Georgia	School of Electrical and Computer Engineering								
Taylor Johnston (G)	C		Florida State University	Chemistry								
Ilya Litvak (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
Matthew Merritt (S)	C		University of Florida	Biochemistry and Molecular Biology								
Vijay Ramaswamy (T)	C		Bruker Biospin AG	n/a								
Omid Sanati (G)	C		University of Georgia	School of Electrical and Computer Engineering								
Jason Thomas (U)	C		University of Florida	Physics								
Jeremy Thomas (P)	C		University of Florida	Biochemistry and Molecular Biology								
Gang Wu (S)	PI		Queen's University at Kingston	Chemistry	NSERC of Canada	Non US Council		**P20014**	Probing the hydrogen atom	Chemistry	6	42

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL					location in short OHN and OHO hydrogen bonds by 17O solid-state NMR			
Ivan Hung (S)	C	National High Magnetic Field Laboratory	CIMAR/NMR								
Michael Harrington (S)	PI	Huntington Medical Research Institutes	Molecular Neurology	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS072497	**P20016**	CSF Dynamics, 23Na Fluxes and Ventricular Anatomy Interplay Between Migraine and Choroid Plexus	Biology, Biochemistry, Biophysics	11	31
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Samuel Holder (G)	C	Florida State University	Chemical & Biomedical Engineering								
Abe Kolko (G)	C	University of California, Santa Barbara	Mechanical Engineering								
Linda Petzold (S)	C	University of California, Santa Barbara	Computer Science								
Jenna Radovich (G)	C	Florida State University	Chemical & Biomedical Engineering								
Dayna Richter (G)	C	Florida State University	Chemical & Biomedical Engineering								
Ansgar Siemer (S)	PI	University of Southern California	Physiology and Neuroscience	NIH	NINDS - National Institute of Neurological Disorders and Stroke	NS120704	**P20054**	Structural characterization of huntingtin exon-1 oligomers using DNP	Biology, Biochemistry, Biophysics	1	8.5
ralf langen (S)	C	University of Southern California	Physiology and Neuroscience								
Frederic Mentink (S)	C	National High Magnetic Field Laboratory	CIMAR								
Nitin Pandey (S)	C	Keck School of Medicine of USC	Physiology and Neuroscience								
Faith Scott (P)	C	National High Magnetic Field Laboratory	Biochemistry & Molecular Biology								
Braulio Rodríguez-Molina (S)	PI *	National Autonomous University of Mexico	Institute of Chemistry	CONACYT	Non US Council		**P20064**	Dynamics in Fluorescent Crystalline Rotors using Solid-State Nuclear Magnetic Resonance	Chemistry	8	29
Jose Luis Belmonte (P)	C	National Autonomous University of Mexico	Institute of Chemistry								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Carl Fleischer (G)	C	Florida State University	Chemistry								
Ernesto Hernandez-Morales (G)	C	National Autonomous University of Mexico	Institute of Chemistry								
Erick Hernandez-Santiago (G)	C	National Autonomous University of Mexico	Institute of Chemistry								
Jose Mejia-Aleman (G)	C	National Autonomous University of Mexico	Institute of Chemistry								
Armando Navarro-Huerta (G)	C	National Autonomous University of Mexico	Institute of Chemistry								
Lizbeth Rodriguez-Cortes (G)	C	National Autonomous University of Mexico	Institute of Chemistry								
Robert Schurko (S)	C	Florida State University	Chemistry								
Cameron Vojvodin (G)	C	Florida State University	Chemistry and Biochemistry								
Yan-Yan Hu (S)	PI	Florida State University	Chemistry & Biochemistry	NSF	DMR - Division of Materials Research	DMR1720139	**P20081**	In Situ and Operando NMR & MRI Studies of All-Solid-State Batteries	Chemistry	2	9
Yudan Chen (G)	C	Florida State University	Chemistry and Biochemistry								
Po-Hsiu Chien (G)	C	Florida State University	Chemistry and Biochemistry								
Xuyong Feng (P)	C	Florida State University	Chemistry and Biochemistry								
Steven Flynn (P)	C	University of Florida	Physics								
Samuel Grant (S)	C	National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Xiang Li (P)	C	California Institute of Technology	Physics								
Sawankumar Patel (G)	C	Florida State University	Chemistry								
Kenneth Poeppelmeier (S)	C	Northwestern University	Chemistry								
Aritra Sil (G)	C	Northwestern University	Chemistry								
Mingxue Tang (P)	C	Florida State University	Chemistry & Biochemistry								
Erica Truong (G)	C	Florida State University	Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Yan Xin (S)	C		National High Magnetic Field Laboratory	MST								
Chi Zhang (S)	C		Institute of Semiconductors	State Key Laboratory of Superlattice and Microstructure								
Joseph Zadrozny (S)	PI	*	Colorado State University	Chemistry	NSF	CHE - Chemistry	CHE2047325	**P20082**	Solid-state NMR characterization of 59Co NMR thermometers	Chemistry	6	14
Zhehong Gan (S)	C		National High Magnetic Field Laboratory	NHMFL								
Josef Grundy (G)	C		Colorado State University	Chemistry								
Sean Holmes (P)	C		Florida State University	Chemistry and Biochemistry								
Ivan Hung (S)	C		National High Magnetic Field Laboratory	CIMAR/NMR								
James Kimball (G)	C		Florida State University	Chemistry								
Roxanna Martinez (G)	C		Colorado State University	Chemistry								
Tyler Ozvat (G)	C		Colorado State University	Chemistry								
Stephanie Sanchez (U)	C		Colorado State University	Chemistry								
Robert Schurko (S)	C		Florida State University	Chemistry								
Sara Termos (G)	C		Florida State University	Department of Chemistry and Biochemistry								
Okten Ungor (P)	C		Colorado State University	Chemistry								
Sossina Haile (S)	PI		Northwestern University	Materials Science and Engineering, and Chemistry	NSF	DMR - Division of Materials Research	DMR1720139	**P20084**	Multinuclear Solid-state NMR Investigations of Hydrogen Transport and Transfer in Functional Inorganic Solids	Chemistry	1	18
Yan-Yan Hu (S)	C		Florida State University	Chemistry & Biochemistry								
Erica Truong (G)	C		Florida State University	Chemistry and Biochemistry								
Hui Xiong (S)	PI	*	Boise State University	Materials Science and Engineering	DOE	ASCR - Advanced Scientific Computing Research	DE-SC0019121	**P20087**	7Li and 23Na Solid-State NMR Investigation of High-Performance Cathodes for Na-Ion Batteries	Chemistry	5	79
Michael Deck (G)	C		Florida State University	Chemistry								
Yan-Yan Hu (S)	C		Florida State University	Chemistry & Biochemistry								
Yongkang Jin (G)	C		Florida State University	Chemistry and Biochemistry								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Aaron Wilber (S)	PI	*	Florida State University	Psychology	NIH	NIA - National Institute on Aging	AG010700	**P20099**	DTI and rs-fMRI of TgF344-AD Female Rats as a Model of Alzheimer's Disease	Biology, Biochemistry, Biophysics	3	7
Samuel Grant (S)	C		National High Magnetic Field Laboratory	Chemical & Biomedical Engineering								
Choogon Lee (S)	C		Florida State University	Biomedical Sciences								
William McCall (S)	C		Augusta University	Psychiatry and Health Behavior								
Jordan Ogg (T)	C		Florida State University	Psychology								
Jenna Radovich (G)	C		Florida State University	Chemical & Biomedical Engineering								
Alexander Forse (S)	PI	*	University of Cambridge	Chemistry	Leverhulme Trust	Non US Foundation		**P20101**	17O NMR studies of CO2 capture mechanism in hydroxide-based materials	Chemistry	1	4
Suzi Pugh (P)	C		University of Cambridge	Dr								
Benjamin Rhodes (G)	C		University of Cambridge	Chemistry								
Xiaoling Wang (S)	PI	*	California State University, East Bay	Chemistry	NSF	CHE - Chemistry	CHE1955754	**P20105**	Solid-state NMR Investigations of Spin Crossover Complexes	Chemistry	3	31
Riqiang Fu (S)	C		National High Magnetic Field Laboratory	NMR	NSF	DMR - Division of Materials Research	DMR2003057					
Frederic Mentink (S)	C		National High Magnetic Field Laboratory	CIMAR								
Michael Shatruk (S)	C		National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry								
Sungsool Wi (S)	C		National High Magnetic Field Laboratory	NMR								
Jeannine Brady (S)	PI		University of Florida	Oral Biology	NIH	NIDCR - National Institute of Dental and Craniofacial Research	DE021789	**P20106**	Structural studies of adhesin protein P1 of S. mutans, its quaternary structure, and formation of functional amyloid.	Biology, Biochemistry, Biophysics	1	5
Maria Luiza Caldas Nogueira (P)	C		University of Florida	Biochemistry and Molecular Biology								
Joanna Long (S)	C		University of Florida	Biochemistry & Molecular Biology								
Qingqing (Emily) Peng (G)	C		University of Florida	Department of Biochemistry and Molecular Biology								
Yanna Liang (P)	PI	*	University at Albany	Environmental and Sustainable Engineering	NSF	CBET - Chemical, Bioengineering, Environmental, and Transport Systems	CBET95058__	**P20116**	Understanding binding between per- and polyfluoroalkyl	Engineering	1	1

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Weilan Zhang (S)	C	University at Albany	Environmental and Sustainable Engineering					substances (PFAS) and innovative sorbents			
Russell Bowers (S)	C	University of Florida	Chemistry								
Kevin O'Shea (S)	C	Florida International University	Chemistry and Biochemistry								
Jeffrey Reimer (S)	PI	University of California, Berkeley	Chem and BioM Engineering	DOE	Other	JCESR	**P20168**	NMR Investigation of Anti-Perovskite Mg-Ion Solid Electrolytes	Material Science	1	10
Zhehong Gan (S)	C	National High Magnetic Field Laboratory	NHMFL								
David Halat (P)	C	Lawrence Berkeley National Laboratory	Materials Sciences Division								
Baris Key (S)	C	Argonne National Laboratory	CSE								
Haoyu Liu (P)	C	Argonne National Laboratory	Chemical Sciences and Engineering Division								
Robert Schurko (S)	C	Florida State University	Chemistry								
Xiaoling Wang (S)	C	California State University, East Bay	Chemistry								
								Total Proposals:	**Experiments:**		**Days:**
								77	**550**		**2,874**

Pulsed Field Facility

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
James Analytis (S)	PI	University of California, Berkeley	Physics	DOE	BES – Basic Energy Sciences	DE-AC02-05CH11231	**P17891**	High field magnetic phase transitions in intercalated transition metal dichalcogenides	Condensed Matter Physics	1	8
Shannon Haley (G)	C	University of California, Berkeley	Physics	Gordon and Betty Moore Foundation	US Foundation	GBMF9067					
Nikola Maksimovic (G)	C	University of California, Berkeley	Physics								
Eran Maniv (S)	C	Ben Gurion University of the Negev	Physics								
Vikram Nagarajan (G)	C	University of California, Berkeley	Physics								
Nityan Nair (G)	C	University of California, Berkeley	Physics								
Josue Rodriguez (G)	C	University of California, Berkeley	Physics								
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								
Chris Palmstrom (S)	PI	University of California, Santa Barbara	ECE-Material Science	DOE	BES – Basic Energy Sciences	DE-SC0014388	**P18013**	Revealing topological properties of Heusler compounds via magneto-transport under high magnetic field.	Condensed Matter Physics	1	5
Shouvik Chatterjee (P)	C	University of California Santa Barbara	Electrical & Computer Engineering								
Connor Dempsey (G)	C	University of California, Santa Barbara	ECE								
Aranya Goswami (G)	C	University of California, Santa Barbara	ECE								
Hadass Inbar (G)	C	University of California, Santa Barbara	Materials								
Tony McFadden (G)	C	University of California, Santa Barbara	ECE								
Johanna Palmstrom (P)	C	Los Alamos National Laboratory (LANL)	MPA-MAG								
Dan Read (S)	C	University of California, Santa Barbara	Materials								
Laurel Winter (S)	PI	National High Magnetic Field Laboratory	Physics	No other support			**P18062**	Testing and development of pulsed field probes	Development of Magnet Technology	1	5
Neil Harrison (S)	PI	National High Magnetic Field Laboratory	Physics	DOE	BES – Basic Energy Sciences	LANLF100	**P19131**	Science of High Magnetic Fields	Biology, Biochemistry, Biophysics	4	39
Ryan Baumbach (S)	C	National High Magnetic Field Laboratory	CMS	DOE	BES – Basic Energy Sciences	F101					
Mun Chan (S)	C	National High Magnetic Field Laboratory	Pulsed field Facility								
Scott Crooker (S)	C	National High Magnetic Field Laboratory	Nat High Magnetic Field Lab								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Priscila Ferrari Silveira Rosa (P)	C	Los Alamos National Laboratory	MPA-CMMS								
Daniel Jackson (P)	C	National High Magnetic Field Laboratory	MPA/MAG								
Marcelo Jaime (S)	C	National High Magnetic Field Laboratory	Physics								
Rubi Km (P)	C	Los Alamos National Laboratory	MPA-MAGLAB								
Satya Kushwaha (S)	C	Los Alamos National Laboratory	MPA-MAG								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Christopher Mizzi (P)	C	Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Joonbum Park (P)	C	Helmholtz Zentrum Dresden-Rossendorf	Dresden High Magnetic Field Laboratory								
William Phelan (S)	C	Los Alamos National Laboratory	MST-16								
Lucas Pressley (G)	C	Johns Hopkins University	Chemistry								
Katherine Schreiber (P)	C	National High Magnetic Field Laboratory	NHMFL Pulsed Field Facility								
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								
Mark Wartenbe (P)	C	Los Alamos National Laboratory	MST-16								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								
Arkady Shehter (S)	PI	Los Alamos National Laboratory	LANL MPA-MAGLAB	NSF	DMR - Division of Materials Research	DMR1157490	**P19136**	Longitudinal and Hall transport in critically doped cuprates at very high magnetic fields. Field-temperature competition as a signature of quantum criticality.	Condensed Matter Physics	1	10
Alimamy Bangura (S)	C	National High Magnetic Field Laboratory	CMS	DOE	BES – Basic Energy Sciences	"Science at 100T"					
Jonathan Betts (S)	C	National High Magnetic Field Laboratory	NHMFL-PFF								
Greg Boebinger (S)	C	National High Magnetic Field Laboratory	Directors Office								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Kimberly Modic (S)	C	Institute of Science and Technology Austria	Physics								
Brad Ramshaw (S)	C	Cornell University	Laboratory of Atomic and Solid State Physics								
James Analytis (S)	PI	University of California, Berkeley	Physics	DOE	MSE - Materials Science and Engineering	DE-SC0205112	**P19137**	High-field phase transitions in the Kitaev hyperhoneycomb beta-Li2IrO3	Condensed Matter Physics	1	5
Nikola Maksimovic (G)	C	University of California, Berkeley	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Kimberly Modic (S)	C		Institute of Science and Technology Austria	Physics								
Luke Pritchard Cairns (P)	C		University of California, Berkeley	Physics								
Gaia Grimaldi (S)	PI	*	National Research Council CNR	SPIN Institute	CNR	Non US Government Lab		**P19243**	The anisotropy of iron-chalcogenide Fe(Se,Te) thin films: still a puzzling problem	Condensed Matter Physics	1	10
Andrea Augieri (S)	C		ENEA Research Center, Frascati	Fusion and Nuclear Safety								
Giuseppe Celentano (S)	C		ENEA Research Center, Frascati	Fusion and Technology for Nuclear Safety and Security Department								
Masood Khan (G)	C		University of Salerno	Physics								
Antonio Leo (S)	C		University of Salerno	Physics								
Angela Nigro (S)	C		University of Salerno									
Robert McQueeney (S)	PI		Ames Laboratory	physics & astronomy	DOE	BES – Basic Energy Sciences	DE-AC02-07CH11358	**P19250**	Investigation of exotic topological states using high magnetic fields	Condensed Matter Physics	1	5
Anand Bhattacharya (S)	C		Argonne National Laboratory	Materials Science Division & Center for Nanoscale Materials								
Qianheng Du (P)	C		Argonne National Laboratory	Materials Science Division								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Johanna Palmstrom (P)	C		Los Alamos National Laboratory (LANL)	MPA-MAG								
Janice Musfeldt (S)	PI		University of Tennessee, Knoxville	Department of Chemistry	NSF	DMR - Division of Materials Research	DMR1707846	**P19343**	High field spectroscopy of materials with broken symmetry and strong spin-orbit coupling	Chemistry	1	5
Avery Blockmon (G)	C		University of Tennessee, Knoxville	Chemistry								
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG								
Kiman Park (G)	C		University of Tennessee, Knoxville	Chemistry								
Haidong Zhou (S)	PI		University of Tennessee, Knoxville	Physics and Astronomy	DOE	BES – Basic Energy Sciences	0	**P19406**	Magnetic field-induced quantum phase transitions in a Kitaev spin liquid candidate.	Condensed Matter Physics	1	5
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG								
Sangyun Lee (P)	C		Los Alamos National Laboratory	MPAQ								
Roman Movshovich (S)	C		Los Alamos National Laboratory	MPA-CMMS								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Brad Ramshaw (S)	PI		Cornell University	Laboratory of Atomic and Solid State Physics	NSF	DMR - Division of Materials Research	DMR1752784	**P19410**	Seebeck effect in ultra-high magnetic fields to unveil the Fermi surface transformation across the pseudogap critical doping in cuprates	Condensed Matter Physics	1	10
Mun Chan (S)	C		National High Magnetic Field Laboratory	Pulsed field Facility								
Pei-Chun Ho (S)	PI		California State University, Fresno	Physics	NSF	DMR - Division of Materials Research	DMR1905636	**P19415**	Investigation of Valance Transition in Ce1-xRxOs4Sb12 (R = Pr, Nd) and Fermi-Surface Topologies of SmOs4Sb12	Condensed Matter Physics	2	10
Paul Goddard (S)	C		University of Warwick	Department of Physics								
Kathrin Goetze (P)	C		Deutsches Elektronen-Synchrotron DESY	FS-US								
Brian Maple (S)	C		University of California, San Diego	Inst for Pure & Applied Physical Sciences								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
Jeffrey Long (S)	PI	*	University of California, Berkeley	Chemistry	NSF	CHE - Chemistry	CHE2102603	**P19520**	Hard Permanent Magnetism from Mixed-Valence Dilanthanide Complexes with Metal-Metal Bonding	Chemistry	3	22
Neil Harrison (S)	C		National High Magnetic Field Laboratory	Physics								
Hyunchul Kwon (G)	C		University of California, Berkeley	Chemistry								
Lu Li (S)	PI		University of Michigan	Physics	DOE	BES – Basic Energy Sciences	DE-SC0020184	**P19528**	Search for novel electronic and magnetic state in ultraintensive magnetic fields	Condensed Matter Physics	4	20
Aaron Chan (G)	C		University of Michigan	Department of Physics	NSF	DMR - Division of Materials Research	DMR2004288					
Kuan-Wen Chen (P)	C		University of Michigan	Physics								
Kaila Jenkins (G)	C		University of Michigan	Department of Physics								
David Mandrus (S)	C		University of Tennessee, Knoxville	Materials Science and Engineering								
Yuji Matsuda (S)	C		Kyoto University	Physics								
Ziji Xiang (P)	C		University of Michigan	Physics								
Dechen Zhang (G)	C		University of Michigan	Department of Physics								
Guoxin Zheng (G)	C		University of Michigan	Department of Physics								
Matthew Coak (P)	PI		University of Warwick	Department of Physics	European Research Council	Non US Council	681260	**P19533**	High-field properties of two-dimensional magnetic van-der-Waals materials	Condensed Matter Physics	2	15
Geetha Balakrishnan (S)	C		University of Warwick	Physics	EPSRC	Non US Council						
Paul Goddard (S)	C		University of Warwick	Department of Physics	ERC	Non US Council	681260					

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
John Singleton (S)	C	National High Magnetic Field Laboratory	Physics								
Shroya Vaidya (G)	C	University of Warwick	Department of Physics								
Mun Chan (S)	PI	National High Magnetic Field Laboratory	Pulsed field Facility	DOE	LDRD - Laboratory Directed R&D	DE-ER20-21ER0320_	**P19534**	Unconventional superconductivity in nickelates and cuprates	Condensed Matter Physics	3	20
Ariando Ariando (S)	C	National University of Singapore	Department of Physics/ NUSNNI	DOE	BES – Basic Energy Sciences	LANLF101					
Neil Harrison (S)	C	National High Magnetic Field Laboratory	Physics	DOE	BES – Basic Energy Sciences	F0101					
Rubi Km (P)	C	Los Alamos National Laboratory	MPA-MAGLAB								
Boris Maiorov (S)	C	Los Alamos National Laboratory	MPA-MAGLAB								
Christopher Mizzi (P)	C	Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Joseph Checkelsky (S)	PI	Massachusetts Institute of Technology	Physics	NSF	DMR - Division of Materials Research	DMR1231319	**P19540**	High Field Studies of Novel Layered Materials	Condensed Matter Physics	4	30
Maximilien Debbas (G)	C	Massachusetts Institute of Technology	Physics	DOE	BES – Basic Energy Sciences	DE-SC0022028					
Aravind Devarakonda (P)	C	Columbia University	Physics								
Minyong Han (G)	C	Massachusetts Institute of Technology	Physics								
Caolan John (G)	C	Massachusetts Institute of Technology	Physics								
Paul Neves (G)	C	Massachusetts Institute of Technology	Physics								
Joshua Wakefield (G)	C	Massachusetts Institute of Technology	Physics								
Shu Yang Zhao (P)	C	Massachusetts Institute of Technology	Physics								
Kent (Jingxu) Zheng (P)	C	Massachusetts Institute of Technology	Physics								
Junbo Zhu (G)	C	Massachusetts Institute of Technology	Physics								
Scott Crooker (S)	PI	National High Magnetic Field Laboratory	Nat High Magnetic Field Lab	Los Alamos LDRD	Other		**P19567**	Optical Spectroscopy of "Twisted" Moire Crystals in High Magnetic Fields	Condensed Matter Physics	1	20
Junho Choi (P)	C	Los Alamos National Laboratory	NHMFL								
Xavier Marie (S)	C	National Institute for Applied Sciences, Toulouse	Laboratoire de Physique et Chimie des Nano-objets								
Bernhard Urbaszek (S)	C	National Institute for Applied Sciences, Toulouse	Laboratoire de Physique et Chimie des Nano-objets								

Participants (Name, Role, Org., Dept.)				Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Cui-Zu Chang (S)	PI	Pennsylvania State University	Physics	NSF	DMR - Division of Materials Research	DMR1847811	**P19621**	Interfacial Superconductivity in Bi2Te3/FeTe Heterostructures under High Magnetic Fields	Condensed Matter Physics	3	23
David Graf (S)	C	National High Magnetic Field Laboratory	DC Field CMS								
Seng Huat Lee (S)	C	Pennsylvania State University	Physics								
Zhiqiang Mao (S)	C	Pennsylvania State University	Department of Physics								
Hemian Yi (P)	C	Pennsylvania State University	Department of physics								
Yi-Fan Zhao (G)	C	Pennsylvania State University	Physics								
Filip Ronning (S)	PI	Los Alamos National Laboratory	MPA-CMMS	DOE	BES – Basic Energy Sciences	E1FR	**P19631**	Magnetically frustrated f-electron intermetallics	Condensed Matter Physics	1	5
Eric Bauer (S)	C	Los Alamos National Laboratory	MST-10								
Neil Harrison (S)	C	National High Magnetic Field Laboratory	Physics								
Yu Liu (P)	C	Brookhaven National Laboratory	Condensed Matter Physics								
Ross McDonald (S)	C	National High Magnetic Field Laboratory	Physics								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								
James Wampler (P)	PI	Los Alamos National Laboratory	MPA-MAG	DOE	Other		**P19634**	In search of quantum spin liquid states in 5f compounds	Condensed Matter Physics	2	16
Priscila Ferrari Silveira Rosa (P)	C	Los Alamos National Laboratory	MPA-CMMS								
Marcelo Jaime (S)	C	National High Magnetic Field Laboratory	Physics								
Rico Schoenemann (P)	C	Los Alamos National Laboratory	MPA-MAG								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								
James Wampler (P)	PI	Los Alamos National Laboratory	MPA-MAG	DOE	EFRC - Energy Frontier Research Centers	DE-SC0019330	**P19635**	Investigation of the field-driven Spin Crossover Transition in a tautomeric Co complex	Condensed Matter Physics	1	5
Minseong Lee (S)	C	Los Alamos National Laboratory	MPA-MAG								
Michael Shatruk (S)	C	National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry								
Ping Wang (P)	C	Florida State University	physics								
Vivien Zapf (S)	C	National High Magnetic Field Laboratory	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Kimberly Modic (S)	PI	*	Institute of Science and Technology Austria	Physics	Institute of Science and Technology Austria	Non US Government Lab		**P19639**	High field resonant torsion in quantum spin liquids	Condensed Matter Physics	1	10
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Muhammad Nauman (P)	C		Institute of Science and Technology Austria	Division of Mathematical and Physical Sciences								
Brad Ramshaw (S)	C		Cornell University	Laboratory of Atomic and Solid State Physics								
Arkady Shehter (S)	C		Los Alamos National Laboratory	LANL MPA-MAGLAB								
Valeska Zambra (G)	C		Institute of Science and Technology Austria	Physics								
Nitin Samarth (S)	PI		Pennsylvania State University	Physics	NSF	DMR - Division of Materials Research	DMR2039351	**P19651**	High magnetic field measurements of superconductivity in high Tc FeSe films	Condensed Matter Physics	1	6
Scott Crooker (S)	C		National High Magnetic Field Laboratory	Nat High Magnetic Field Lab								
Yanan Li (G)	C		Pennsylvania State University	Physics Department								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Max Stanley (G)	C		Pennsylvania State University	Physics								
Richard Greene (S)	PI	*	University of Maryland, College Park	Physics	NSF	DMR - Division of Materials Research	DMR2002658	**P19698**	High Field Studies of Electron-Doped Cuprate Thin Films	Condensed Matter Physics	1	5
Joseph Hayden (U)	C		University of Maryland, College Park	Physics								
Tarapada Sarkar (P)	C		University of Maryland, College Park	Physics								
Nicholas Butch (S)	PI		National Institute of Standards and Technology MD	NIST Center for Neutron Research	National Institute of Standards and Technology	US Government Lab		**P19704**	Studies of high-field states of UTe2	Condensed Matter Physics	1	10
Corey Frank (P)	C		National Institute of Standards and Technology MD	NCNR								
Sylvia Lewin (P)	C		University of Maryland, College Park	physics								
Gicela Saucedo Salas (G)	C		University of Maryland, College Park	Physics								
Laurel Winter (S)	C		National High Magnetic Field Laboratory	Physics								
Seng Huat Lee (S)	PI	*	Pennsylvania State University	Physics	NSF	MIP - Materials Innovation Platform	DMR-2039351	**P19710**	Seeking for Exotic Quantum State in Intrinsic	Condensed Matter Physics	1	10

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Su Kong Chong (P)	C		University of California, Los Angeles	Department of Electric and Computer Engineering					Ferromagnetic Topological Insulator MnBi6Te10			
David Graf (S)	C		National High Magnetic Field Laboratory	DC Field CMS								
Yingdong Guan (G)	C		Pennsylvania State University	Physics Department								
Zhiqiang Mao (S)	C		Pennsylvania State University	Department of Physics								
Jun Zhu (S)	C		Pennsylvania State University	Physics								
Yanglin Zhu (G)	C		Tulane University	Department of Physics and Engineering Physics								
Neil Harrison (S)	PI		National High Magnetic Field Laboratory	Physics	LANL Seaborg Institute	US Government Lab		**P19715**	Plutonium in High Magnetic Fields	Condensed Matter Physics	1	3
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
Paul Tobash (P)	C		National High Magnetic Field Laboratory	MPA-cmms								
Rubi Km (P)	PI	*	Los Alamos National Laboratory	MPA-MAGLAB	DOE	MSE - Materials Science and Engineering	DE-SC1157490	**P19730**	High-field magnetotransport in two-dimensional electron systems at the complex oxide interfaces	Condensed Matter Physics	2	16
Ariando Ariando (S)	C		National University of Singapore	Department of Physics/ NUSNNI	DOE	BES – Basic Energy Sciences	LANLF101					
Mun Chan (S)	C		National High Magnetic Field Laboratory	Pulsed field Facility								
Neil Harrison (S)	C		National High Magnetic Field Laboratory	Physics								
Christopher Mizzi (P)	C		Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Venkat Selvamanickam (S)	PI	*	University of Houston	Mechanical Engineering	DOE	BES – Basic Energy Sciences	DE-SC0016220	**P19815**	Critical current characterization of 4+ um thick film Zr- and Hf-doped RE-Ba-Cu-O tapes in ultra-high magnetic fields	Development of Magnet Technology	1	10
Eduard Galstyan (S)	C		University of Houston	Texas Center for Superconductivity								
Yi Li (S)	C		University of Houston	Mechanical Engineering								
Vamsi Yerraguravagari (G)	C		University of Houston	Mechanical Engineering								
Rongying Jin (S)	PI		University of South Carolina	Department of Physics and Astronomy	University of South Carolina	US College and University		**P19819**	Quantum behavior in a topological material candidate	Condensed Matter Physics	1	10
Joanna Blawat (G)	C		University of South Carolina	Physics and Astronomy								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Martin Nikolo (S)	PI		Saint Louis University	Physics	Saint Louis University	US College and University		**P19829**	Investigation of high magnetic field properties of Kondo insulators via tunnel-diode oscillator technique (TDO) and the magnetic torque in pulsed fields	Condensed Matter Physics	1	5
Sheng Ran (S)	C		Washington University in St. Louis	Physics								
Kemp Plumb (S)	PI	*	Brown University	Physics	DOE	BES – Basic Energy Sciences	DESC0021223	**P19836**	Magnetization Plateaus in a Heisenberg Pyrochlore Antiferromagnet	Condensed Matter Physics	2	10
Qiaochu Wang (G)	C		Brown University	Physics Department	DOE	BES – Basic Energy Sciences	DE-SC0021223					
Michael Pettes (S)	PI	*	Los Alamos National Laboratory	Center for Integrated Nanotechnologies	DOE	Other	20210782ER	**P19839**	Anomalous High Field Transport in Dirac Semimetals	Development of Magnet Technology	2	10
Marshall Campbell (G)	C		Los Alamos National Laboratory	Center for Integrated Nanotechnologies	NSF	DMR - Division of Materials Research	DMR2011967					
Luis Jauregui (S)	C		University of California, Irvine	Department of Physics and Astronomy								
Jinyu Liu (G)	C		Tulane University	Department of Physics and Engineering Physics								
Rubi Km (P)	PI	*	Los Alamos National Laboratory	MPA-MAGLAB	DOE	BES – Basic Energy Sciences	LANLF101	**P19841**	High-field magneto-transport on graphene/SrTiO3 devices	Condensed Matter Physics	1	10
Ariando Ariando (S)	C		National University of Singapore	Department of Physics/ NUSNNI								
Mun Chan (S)	C		National High Magnetic Field Laboratory	Pulsed field Facility								
Neil Harrison (S)	C		National High Magnetic Field Laboratory	Physics								
Junxiong Hu (P)	C		National University of Singapore	Physics								
Christopher Mizzi (P)	C		Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Zhiqiang Mao (S)	PI		Pennsylvania State University	Department of Physics	NSF	DMR - Division of Materials Research	DMR1917579	**P19844**	Seeking bulk quantum Hall effect in the spin-valley locked Dirac semimetal BaMnBi2	Condensed Matter Physics	1	10
Marcelo Jaime (S)	C		National High Magnetic Field Laboratory	Physics								
Antu Laha (P)	C		Pennsylvania State University	Department of Physics								
Seng Huat Lee (S)	C		Pennsylvania State University	Physics								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Lujin Min (G)	C		Pennsylvania State University	Department of Physics								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Vivien Zapf (S)	PI		National High Magnetic Field Laboratory	Physics	DOE	BES – Basic Energy Sciences	0	**P19845**	High magnetic field investigation on a Kitaev spin liquid candidate	Condensed Matter Physics	3	20
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG	DOE	Other	AA-000000000					
Fazel Tafti (S)	C		Boston College	Physics								
Shengzhi Zhang (P)	C		Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Emilia Morosan (S)	PI		Rice University	Physics and Astronomy	NSF	DMR - Division of Materials Research	DMR1903741	**P19846**	Magnetic Torque Measurement on BaGa2 and SrGa2 single crystals in pulsed magnetic field	Condensed Matter Physics	1	5
Yuxiang Gao (G)	C		Rice University	Physics and Astronomy								
Neil Harrison (S)	C		National High Magnetic Field Laboratory	Physics								
Shiming Lei (G)	C		Rice University	Physics and Astronomy								
Minseong Lee (S)	PI	*	Los Alamos National Laboratory	MPA-MAG	DOE	BES – Basic Energy Sciences	0	**P19848**	Kitaev spin liquid phase in a 3d transition metal oxides	Development of Magnet Technology	3	19
Marcelo Jaime (S)	C		National High Magnetic Field Laboratory	Physics								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								
Shengzhi Zhang (P)	C		Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Haidong Zhou (S)	C		University of Tennessee, Knoxville	Physics and Astronomy								
Krista Sawchuk (P)	PI	*	Los Alamos National Laboratory	NHMFL	DOE	BES – Basic Energy Sciences	DE-AC02-07CH11358	**P19912**	High pressure, high field measurements on BaFe2As2	Condensed Matter Physics	1	5
Fedor Balakirev (S)	C		National High Magnetic Field Laboratory	PFF								
Sergey Bud'ko (S)	C		Ames Laboratory	Physics and Astronomy								
Paul Canfield (S)	C		Ames Laboratory	Physics & Astronomy								
Laurel Winter (S)	PI		National High Magnetic Field Laboratory	Physics	No other support			**P19931**	Graphite studies beyond the quantum limit	Condensed Matter Physics	1	5
Greta Chappell (P)	C		Los Alamos National Laboratory	MPA-MAGLAB								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Leah Snyder (O)	C		Los Alamos National Laboratory	Pulsed Field Facility								
Magdalena Owczarek (P)	PI		Los Alamos National Laboratory	CINT	DOE	EFRC - Energy Frontier Research Centers	DE-SC0019330	**P19934**	Spin-electric coupling in molecular magnets	Biology, Biochemistry, Biophysics	2	15

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
George Christou (S)	C		University of Florida	Chemistry								
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG								
Michael Shatruk (S)	C		National High Magnetic Field Laboratory	Department of Chemistry and Biochemistry								
James Wampler (P)	C		Los Alamos National Laboratory	MPA-MAG								
Ping Wang (P)	C		Florida State University	physics								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								
Kimberly Modic (S)	PI	*	Institute of Science and Technology Austria	Physics	NSF	DMR - Division of Materials Research	DMR1157490	**P19945**	Thermodynamic measurements of topological superconductors	Condensed Matter Physics	1	10
Nicholas Butch (S)	C		National Institute of Standards and Technology MD	NIST Center for Neutron Research								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Amit Nathwani (U)	C		Institute of Science and Technology Austria	Physics								
Muhammad Nauman (P)	C		Institute of Science and Technology Austria	Division of Mathematical and Physical Sciences								
Brad Ramshaw (S)	C		Cornell University	Laboratory of Atomic and Solid State Physics								
Arkady Shehter (S)	C		Los Alamos National Laboratory	LANL MPA-MAGLAB								
Valeska Zambra (G)	C		Institute of Science and Technology Austria	Physics								
John Bulmer (S)	PI		Air Force Research Laboratory	Air Force	DOD	US Air Force	RQ18COR100	**P19956**	High Magnetic Field Transport in Advanced Carbon Conductors	Condensed Matter Physics	1	5
Tim Haugan (S)	C		Air Force Research Laboratory	Air Force								
Agnieszka Lekawa-Raus (P)	C		University of Cambridge	Department of Material Science								
Collin Broholm (S)	PI	*	Johns Hopkins University	Physics and Astronomy	No other support			**P19958**	High field studies of Weyl fermions in NdAlSi	Condensed Matter Physics	2	9
Tong Chen (P)	C		Johns Hopkins University	Physics and Astronomy								
Marcelo Jaime (S)	C		National High Magnetic Field Laboratory	Physics								
Seyed Koohpayeh (S)	C		Johns Hopkins University	Physics								
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG								

Participants (Name, Role, Org., Dept.)					Funding Sources (Funding Agency, Division, Award #)			Proposal #	Proposal Title	Discipline	Exp. #	Days Used
Chris Lygouras (G)	C		Johns Hopkins University	Physics								
Sang Wook Cheong (S)	PI		Rutgers University	Physics and Astronomy	DOE	BES – Basic Energy Sciences		**P20050**	Exploring magnetoelectricity and multiferroicity of magnetic insulators with exotic spin structure based on symmetry operational similarity analysis.	Condensed Matter Physics	1	5
Minseong Lee (S)	C		Los Alamos National Laboratory	MPA-MAG								
Vivien Zapf (S)	C		National High Magnetic Field Laboratory	Physics								
Shengzhi Zhang (P)	C		Los Alamos National Laboratory	MPA-MAGLAB: MPA-MAG LAB NHMFL GROUP								
Alessandro Mazza (P)	PI	*	Los Alamos National Laboratory	MPA-CINT	DOE	BES – Basic Energy Sciences	89233218CNA000001	**P20055**	Distinguishing the role of local disorder in dictating long-range magnetic order in high entropy oxides	Material Science	1	5
Matthew Brahlek (P)	C		Oak Ridge National Laboratory	physics								
Aiping Chen (P)	C		Los Alamos National Laboratory	Center for Integrated Nanotechnologies (MPA-CINT)								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Brianna Musico (S)	C		Los Alamos National Laboratory	Sigma-1								
John Singleton (S)	C		National High Magnetic Field Laboratory	Physics								
Thomas Ward (S)	C		Oak Ridge National Laboratory	Materials Science and Technology Division								
Arkady Shehter (S)	PI		Los Alamos National Laboratory	LANL MPA-MAGLAB	DOE	BES – Basic Energy Sciences	100T science	**P20063**	high-field magneto-transport in the strange metal state of curates across critical doping	Condensed Matter Physics	1	5
Mun Chan (S)	C		National High Magnetic Field Laboratory	Pulsed field Facility								
Neil Harrison (S)	C		National High Magnetic Field Laboratory	Physics								
Ross McDonald (S)	C		National High Magnetic Field Laboratory	Physics								
Kimberly Modic (S)	C		Institute of Science and Technology Austria	Physics								
Brad Ramshaw (S)	C		Cornell University	Laboratory of Atomic and Solid State Physics								
									Total Proposals: 48	**Experiments: 75**		**Days 526**

2022

Supported by the National Science and the State of Florida

NATIONAL HIGH MAGNETIC FIELD LABORATORY

Florida State University • University of Florida • Los Alamos National Lab