NATIONAL HIGH MAGNETIC FIELD LABORATORY

2014 ANNUAL REPORT

ANNUAL REPORT 2014

National High Magnetic Field Laboratory

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NATIONAL MAGLAB

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DIRECTOR'S EXECUTIVE SUMMARY

Twenty years after launching our user program, the National MagLab continues to offer new instruments and experimental techniques for users to produce high magnetic field research results that further our understanding of materials, energy and life.

First and Foremost, A User Facility

In 2014, the National MagLab continued to grow our user community, hosting more than 1,440 researchers from over 330 universities, institutions and businesses around the world. The MagLab's 2014 users are both new and diverse with nearly 23 percent of 2014's users self-identifying as women (5 percent percent chose to not identify) or minorities (9.5 percent percent chose to not identify) and a quarter of the 368 principal investigators (PI) being first-time-ever PIs for National MagLab experiments.

Users submitted 452 research reports in 2014 that span the breadth of work performed at our interdisciplinary laboratory. Results from 20 percent of these reports are already published, another 11 percent have generated manuscripts that are submitted or accepted for publication, and another 46 percent have manuscripts in preparation. They feature the diverse capabilities of our magnets, techniques, and instrumentation and showcase the power of high magnetic field research in condensed matter physics, materials science, chemistry, magnet science and technology, and the life sciences.

Perhaps the best measure of the quality of the research performed at the National MagLab is in the 450 articles published in peer-reviewed journals in 2014, many in the scientific community's most prestigious journals like *Nature, Science, Physical Review Letters, Analytical Chemistry, Energy Fuels*, and *The Proceedings of the National Academy of Sciences.* To see a full list of our publications, visit https://nationalmaglab.org/research/publications-all/publications-search.

In the summer of 2014, more than 200 users participated in an annual survey and offered overwhelmingly positive feedback about their experiences working at the MagLab: 93 percent said they were satisfied or very satisfied with the performance of the facilities and equipment, 94 percent with the assistance provided by MagLab staff, and another 94 percent with the availability of the facilities and equipment.

The MagLab's user facilities continued to make ongoing enhancements in 2014 to provide users with a space that enables the highest quality research. In 2014, major facility upgrades took place at user facilities across all three sites.

- DC Field added a new laser system to advance optical spectroscopies, a calorimeter that can be rotated in the portable dilution refrigerator to measure between 0.1 K and 10 K, and made magnetic measurement improvements by determining the optimum measurement parameters for the piezoresistive cantilevers.
- The noise floor that is achievable in the 100 T at the Pulsed Field Facility was improved significantly leading to an increase by a factor of 10 in signal to noise.
- High B/T added ultra-low noise radiofrequency capabilities to Bay 2 to enable resistance detected NMR of quantum Hall effect samples.
- In NMR, AMRIS and EMR, dynamic nuclear polarization capabilities were expanded for in vivo studies on 4.7 T and 11/1 T systems
- The 21 T actively-shielded superconducting magnet was delivered and installed in the ICR Facility.

Attracting new potential users remained a priority in all user facilities in 2014. MagLab staff conducted over 360 presentations at conferences, workshops and events worldwide about the unique research and capabilities at the lab. Five workshops/conferences were also hosted by the MagLab itself, including the annual User Summer School and Winter Theory School that reached a combined 105 students and early career scientists.

Magnet Science and Technology (MS&T) and the Applied Superconductivity Center (ASC) continued to develop high-performance magnet systems and understand new materials that could be used for magnet design in 2014. MS&T completed the HZB neutron scattering magnet that performed to 26 T, one tesla stronger than designed. This magnet is now providing 52 percent higher field than any other neu-

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tron scattering instrument in the world. Both teams continued important work on the evaluation, understanding and application of HTS superconducting materials. The cold mass, cryostat, and current leads for the 36 T series connected hybrid magnet continued to be developed, and prototype construction of the 32 T all superconducting magnet was completed, both which will ultimately be housed within the headquarters facility. ASC continued to develop a high field, high homogeneity "Platypus" magnet and further explored REBCO, Bi-2212, and cable in conduit conductor technologies.

Investment in Science

Research at the National MagLab is supported primarily by the U.S. National Science Foundation, the State of Florida, and the U.S. Department of Energy. The U.S. National Institutes of Health, U.S. Department of Defense, U.S. Air Force Office of Scientific Research, U.S. Army, U.S. Navy, and numerous universities across the country and around the world also supported research performed at the lab this past year.

The MagLab itself continues to invest in scientific partnerships between in-house scientists and users to advance science and introduce new experimental techniques into the user program through the User Collaboration Grants Program. This year, 41 research reports were supported by this effort. An additional six projects were funded in 2014 to advance condensed matter, biological, and chemical sciences. The lab also invested over $80,000 to support 14 research projects through the Visiting Scientist Program.

Commitment to Diversity, Safety, Education and Collaborations

Following an American Physical Society climate survey in 2013, MagLab leadership formed a Diversity Task Force comprised of internal and external representatives to recommend changes to organization's diversity goals and committee. This Task Force suggested an expansion to the diversity committee as well as other changes to the committee's structure, meeting frequency, budget, and effort tracking. Recommendations were implemented during the fall of 2014 with Dr. Roxanne Hughes, the lab's education and outreach director, now serving as the Diversity Committee Chair.

In 2014, the lab invested nearly $140,000 to improve safety equipment and processes. Major investments were made in laser labs that included card readers on the doors of labs with class 4 lasers, improved automated laser curtains and personal protective equipment (PPE). A partnership with Public Affairs continued to grow safety awareness and culture around the lab, measured in a survey during September 2014. The survey showed that 97 percent of lab staff, faculty, and students believed that ISM had improved the safety at the lab (with 45 percent selecting significantly improved). Nearly 93 percent of respondents believed that they personally played a critical role in improving and maintaining safety at the lab, and all respondents felt that safety was important at the lab. Safety questions were also included in the annual user survey and 85 percent of users said they were satisfied or very satisfied with the training and safety procedures at the lab.

The MagLab works consistently to develop new partners and collaborations across universities, laboratories, institutes, community and educational groups, and private companies. In 2014, the lab had over 90 partnerships, more than half of which were with industry.

Education and outreach continued to reach students, teachers, and the public throughout 2014. Nearly 5,500 K-12 students had a tour or received outreach in 2014 from 65 different schools, 70 percent of which were Title 1. Scientists from across the lab helped facilitate an annual Open House for 6,000 visitors, and another 74 researchers engaged in additional outreach for 2,000 more people. More than 120 K-12 students participated in long-term mentorship, internship or camp programs in 2014, with another 29 undergraduates participating in the eight-week Research Experiences for Undergraduates.

Looking toward 2015…

The MagLab continues to make great progress on a number of large magnet projects. The Series Connected Hybrid (SCH) will provide 36 T at 1ppm homogeneity with only 14MW of power. This magnet will near completion in 2015 with first power and science coming early in 2016. Coupled with this magnet will be state-of-the-art field stabilization techniques and a custom spectrometer that will al-

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low unprecedented high field, high-resolution NMR experiments to be realized.

A second transformational magnet project is the 32T All Superconducting Magnet. This magnet will provide users with nearly a 50% increase in fields available from superconducting magnets. Key tests using prototype coils and the commercially developed outsert magnet will allow the design to be finalized and final construction to be initiated. This magnet will be completed in the first half of 2016.

Finally, a prototype high homogeneity coil made from Bi2212 round wire will be constructed and tested in a conventional superconducting magnet. The goal of this magnet is to provide high quality high-resolution NMR spectra that will demonstrate the feasibility of using High Tc materials to construct a high homogeneity NMR magnet at fields up to or exceeding 30T. Because of the transformation aspects of this project, it has been dubbed the "Platypus" magnet. First results from this project are expected in the fourth quarter of 2015.

The ICR Facility will be finalizing the instrumentation for the 21 T mass spectrometer. This instrumentation will provide unprecedented mass resolution and bring huge benefits to a wide variety of communities. User operations in this system are expected in late 2015.

Other facilities are making great progress on a wide variety of instrumentation developments and enhancements for users that can be viewed in their individual chapters.

The National MagLab is also looking to the future to develop our 2018-2022 renewal proposal. During the previous year, we held a series of strategic planning meetings to engage our scientists, users, and scientific experts from across the world. In the coming year, we will be taking that input and working with our External Advisory Committee, our User Advisory Committee, and our entire user community to articulate a shared vision for high magnetic field science in the years ahead.

CHAPTER 1
Year At A Glance

A Range of Research Possibilities

1 Lab, 3 Sites, 7 User Facilities, 3 In-House Research Groups & Magnet Development

The only facility of its kind in the United States, the National High Magnetic Field Laboratory (National MagLab) is the largest and highest powered magnet laboratory in the world.

Located at Florida State University, the University of Florida and Los Alamos National Laboratory, the National MagLab expands the boundaries of scientific knowledge and advances basic science, engineering and technology in the 21st century.

This year, more than 1,400 researchers from academia and the corporate world conducted cutting-edge research using our unique, world-record instruments. The MagLab exists for these users to explore promising new materials, research pressing global energy problems and expand our understanding of the biochemistry that underlies living things by performing experiments in our seven user facilities:

- Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS)
- DC Field
- Electron Magnetic Resonance
- High B/T
- Ion Cyclotron Resonance
- Nuclear Magnetic Resonance & Magnetic Resonance Imaging/Spectroscopy
- Pulsed Field

The lab also has a number of important in-house research groups that complement the user facilities through development of new techniques, theories and equipment, including **Condensed Matter Science**, **Geochemistry** and **Microscopy**.

The MagLab's **Magnet Science & Technology (MS&T)** group and **Applied Superconductivity Center (ASC)** work to develop the most efficient and the strongest resistive, pulsed, superconducting and hybrid magnets in the world.

WE USE MAGNETS TO STUDY

MATERIALS

Scientists use our magnets to explore semiconductors, superconductors, newly-grown crystals, buckyballs and materials from the natural world — research that reveals the secret workings of materials and empowers us to develop new technologies.

- Graphene
- Topological Matter
- Kondo/Heavy Fermion Systems
- Magnetism and Magnetic Materials
- Molecular Conductors
- Quantum Fluids and Solids
- Qubits & Quantum Entanglement
- Semiconductors
- Superconductivity - Basic Research

ENERGY

Scientists use magnets to study energy and the environment. They work to optimize petroleum refining, advance potential bio-fuels such as pine needles and algae, and fundamentally change the way we store and deliver energy by developing better batteries.

- Petroleomics
- Catalysis
- Dissolved Organic Matter
- Lithium Battery Imaging
- Biofuels
- Superconductivity - Applied Research
- Fuel cell membranes
- Geochemistry
- Environmental Analysis

LIFE

Scientists study the foundational science of protein and disease molecules that underlies the cells and creates life itself. This work could improve future treatment of AIDS, cancer, Alzheimer's and other diseases.

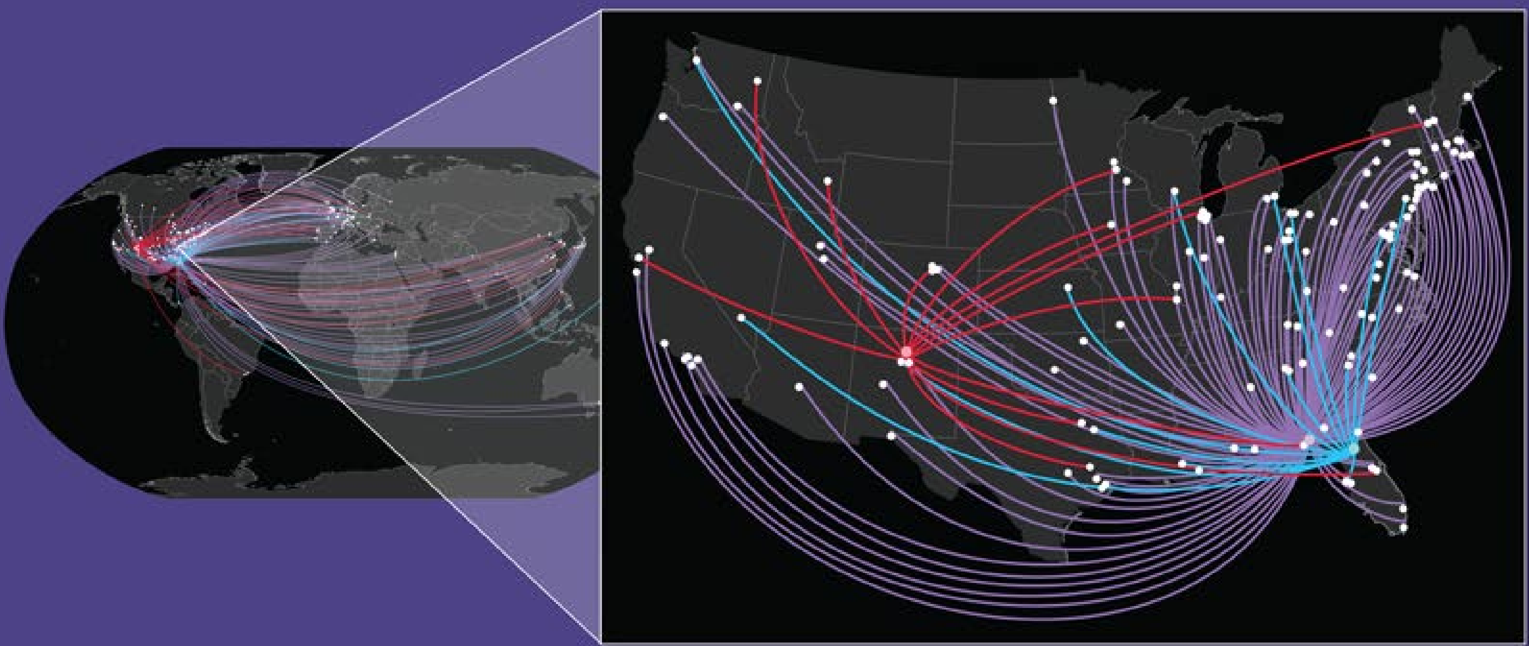
- Natural products
- Quadrupolar NMR
- Dynamic Nuclear Polarization
- Sodium MRI
- Membrane proteins
- Metabolomics
- Biomarkers

LAB STATS

Users in 2014	1,442
Percentage of Users that Were New in 2014	25
Awards & Honors	13
MagLab World Records	14
Articles Published in 2014 in Peer-reviewed Journals	450
Patents & other Products	5
Number of Principal Investigators in 2014	368
Books, Chapters, Reviews & other One-time Publications	11
Ph.Ds & Master Theses	69

MagLab's Worldwide User Community

In 2014, the MagLab's 1,442 users represented 199 universities, government labs and private companies in the United States and another 132 worldwide.



ATTRACTING VISITORS FROM AROUND THE WORLD

Scientists come to our unique facilties to use our world-record instruments for weeks at a time.

ANNUAL VISITOR IMPACT ON ECONOMY

IN FLORIDA	**$2,821,673** in economic output **23 jobs** created
IN THE USA	**$4,121,581** in economic output **29 jobs** created

A DIVERSE GROUP OF USERS

DC FIELD - **505**
NMR & AMRIS - **482**
PULSED FIELD - **132**
HIGH B/T - **20**
EMR - **143**
ICR - **160**

24% OF STUDENTS AND **23%** OF POSTDOCS ARE FEMALE

WHAT OUR USERS SAY

Very Satisfied: 60%
Satisfied: 33%
Neutral: 5%
Dissatisfied: 1%
Very Dissatisfied: 1%

Every year, the MagLab user research program invests:

$7M on Nanoscience & Engineering

$3.5M on Quantum Information Systems

$2.9M on Optics & Photonics

$2.2M on Energy Storage & Energy Transmission

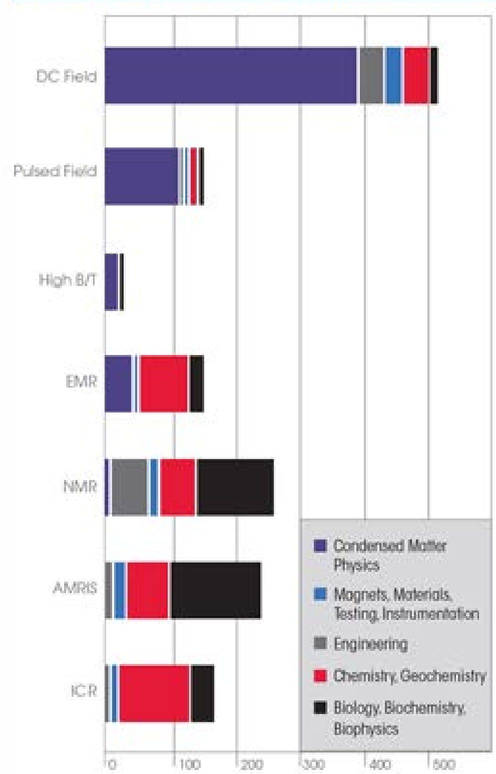
$0.6M on Brain-related Research

The MagLab's interdisciplinary research environment brings scientists from a variety of disciplines to explore materials, energy and life.

Very Satisfied: 88%
Satisfied: 6%
Neutral: 2%
Dissatisfied: 1%
Very Dissatisfied: 3%

All user responses were treated anonymously.
*All presented figures exclude internal responders.

2014 Users by Discipline



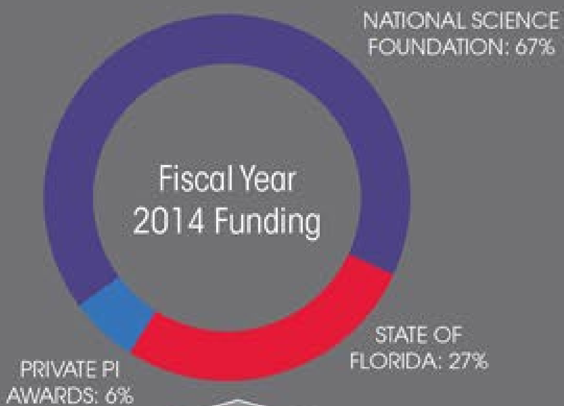
"I think the Magnet Lab is a great place to do research, not only because of its unique resources, but also because you can breathe science in the air! Everything is arranged so that you keep sharing your perspectives and projects with the staff scientists, the postdocs, the students and the visiting users. The lab environment encourages the interaction between all the members, which I think is crucial for scientific productivity."

Paula Giraldo-Gallo, Stanford University, 2014 Pulsed Field Facility user

Dollars and Cents

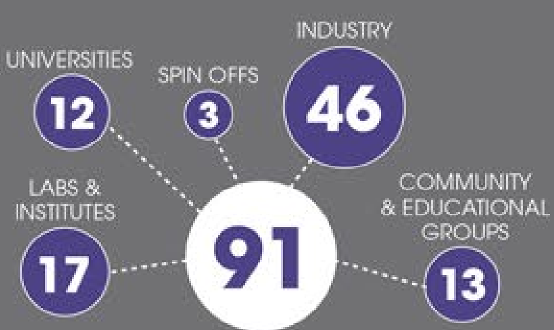
FINANCIAL REPORT

TOTAL BUDGET: $48,397,333



Physics & Materials Research: **40%**
Magnets, Materials, & Engineering: **15%**
Chemistry: **13%**
Biology & Biochemistry: **9%**
Management & Administration: **15%**
Education/Diversity: **3%**

PARTNERS



Cross-Sector Partners

The MagLab develops partnerships with the private sector to bring new technologies to the marketplace.

ECONOMIC IMPACT

THE MAGLAB
ANNUALLY GENERATES

IN FLORIDA
$121 million in economic output
more than **1,200 jobs**

IN THE US
$182 million in economic output
more than **1,560 jobs**

OVER THE NEXT 20 YEARS,
PROJECTED TO GENERATE

IN FLORIDA
$2.4 billion in economic output
more than **25,000 jobs**

IN THE US
$3.6 billion in economic output
more than **31,000 jobs**

RETURN ON INVESTMENT

$1 = **$6.57**

INVESTED BY THE STATE — **ECONOMIC ACTIVITY IN FLORIDA**

"The proximity and collaboration that Danfoss Turbocor has had with the MagLab has become instrumental in establishing Tallahassee as the global competence and design center for oil-free magnetic bearing technology."

Ricardo Schneider, President and CEO of Danfoss Turbocor

Building the STEM Pipeline

ENGAGING THE COMMUNITY

6,000 visitors at 2014 Open House

1,246 people toured the lab

74 scientists engaged in community outreach to **2,000** people

5 Science Cafés reaching **1,117** people

ENGAGING STUDENTS & TEACHERS

5,459 K-12 students had a tour or received outreach

65 schools participated in on-site or classroom outreach

70% of these schools were Title 1 schools

300+ members of MagLab Educators Club

125 students in long-term mentorship, internship or camp programs

54% of students in long-term programs were female

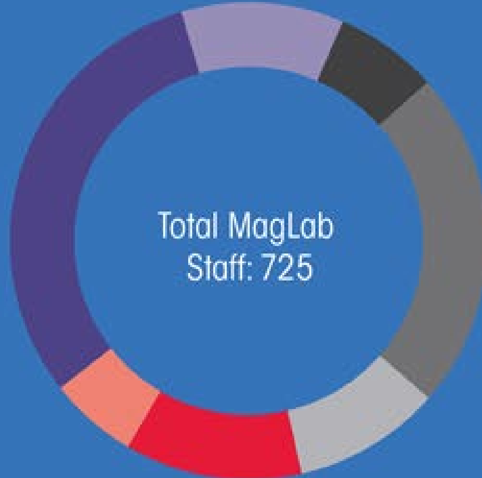
29 undergraduates in Research Experiences for Undergraduates Program

"The MagLab's REU program allowed me to experience what performing scientific research at a high level was really like. Coming from a small university, I was not fortunate enough to have this option readily available. The experience inspired me to pursue a PhD and eventually led me back to Florida State University and the Mag Lab."

Dan Brown, 2008 & 2009 REU program, Wabash College

MAGLAB STAFFING

Personnel at FSU, UF & LANL includes employees funded by the NSF Core Grant or State of Florida.



Senior Personnel: **221**
Other Professional: **83**
Postdoc: **52**
Graduate Student: **165**
Undergraduate Student: **74**
Support Staff - Technical/Managerial: **89**
Support Staff - Secretarial/Clerical: **41**

Postdocs, graduate students and undergraduate students make up **40%** of the staff.

38% of whom are female

Training the Future

654 of the MagLab's users are postdocs or students.

CHAPTER 2
Laboratory Management

CHAPTER 2 - LABORATORY MANAGEMENT

1. STRATEGIC PLAN

(Updated December 2014)

The MagLab strategic plan outlines eight institutional mission imperatives that describe our fundamental ongoing responsibilities as a national laboratory. Each imperative is followed by a prioritized set of supporting actions that the MagLab will undertake on behalf of its user program. Our plan also lays out a set of science drivers and technical frontiers – those opportunities that the MagLab and its user program intend to build out from and across existing programs and research activities. Together, the imperatives, science drivers and technical frontiers explain our highest-priority ongoing efforts and our aspirations for program development and enhancement. This is a five-year plan updated from the 2013-2017 renewal proposal submitted to the NSF in August 2011. It includes some activities that extend beyond the five-year horizon. This plan was further updated following strategic planning meetings in 2014 that will thoughtfully consider 2013 MacSci Report and its recommendations.

This plan is not a comprehensive overview of the many valued activities conducted within the MagLab and its user program. Rather, it is intended as a concise, high-level explanation of institutional direction and priorities for growth. More detailed descriptions of the full sweep of MagLab activities can be found in the MagLab Annual Report, MagLab Science Highlights, and the MagLab periodicals: *MagLab Reports* and *Flux* magazine.

MAGLAB USER PROGRAM SCIENCE DRIVERS

The specific MagLab research directions are ultimately determined by the most meritorious peer-reviewed proposals submitted by users. Input from the COHMAG report, the MagLab's user community, and advisory committees identifies the four most promising science drivers for the coming decade:

- **Quantum Matter**, the broadly challenging manifestations of quantum phenomena in materials, including • low-dimensional metals like graphene, where magnetic fields quench the kinetic energy to isolate correlation effects; • cuprate and Fe-based superconductivity, which despite many differences, both occur in proximity to magnetism; and • quantum phase transitions such as Bose-Einstein condensation in spin systems, where the density of spins is tuned by the applied magnetic field;

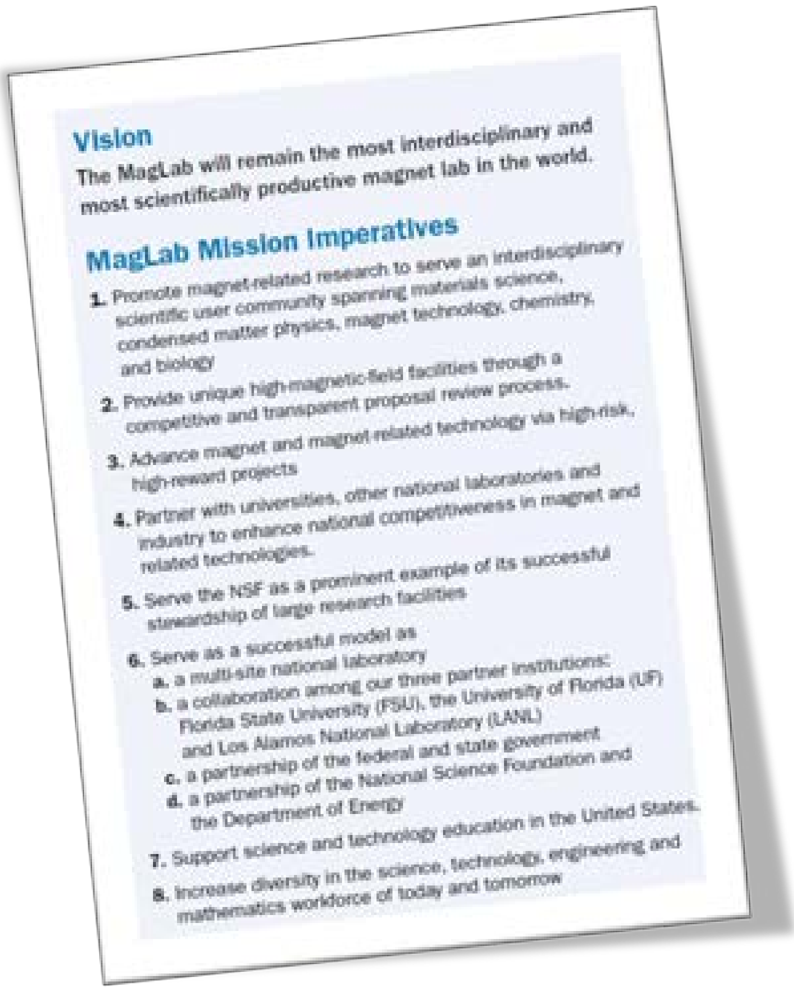
- **Spin Coherence and Spin Control**, the detection and manipulation of electron and nuclear spins, including • molecular magnets, where high fields enable study of systems with strong electron spin-orbit coupling; • quantum magnetism, which requires a very wide range of EPR frequencies; • spintronics and quantum computing, each requiring high fields and EPR frequencies; • high frequency pulsed EPR to resolve nanosecond dynamics; • highest-sensitivity NMR probes for both solution and solid-state NMR; • new contrast agents for single cell MRI; • novel NMR data processing; and high- magnetic-field dynamic nuclear polarization, which draws on MagLab EMR and NMR expertise.

- ***In Vitro* to *In Vivo***, the structure and dynamics of the molecular components of life using high magnetic fields for • structural studies of large heterogeneous membrane proteins using NMR; hydrogen/deuterium exchange to probe molecular complex dynamics using ICR, • high frequency pulsed EPR to measure distance and dynamics in macromolecules; • large zero-field energy level splitting of metal ions in biological molecules using high-frequency EPR • organic radicals important to physiological processes using high-field EPR; • cellular MRI of individual neurons and subcellular structures; • the assay of hundreds to thousands of small molecule metabolites using highest-field NMR and ICR; and • in vivo biochemistry and physiology measurements of nuclei in living animals;

- **Energy and Environment,** the increase in user research at five of the MagLab's six user facilities

CHAPTER 2 - LABORATORY MANAGEMENT

that spans organic chemistry, solid-state physical chemistry, and materials physics at inter- faces has required high magnetic fields where, for example • economic and environmental issues of energy production via molecular-level assaying of crude oil and candidate future fuels such as pine mulch and algae are revealed via the ICR sensitivity and resolution at the MagLab that launched the petroleomics research field; catalysis and the 'interface problem', where the highest magnetic fields change energy bands and local energy states sufficiently to provide reversible, quantitative tuning of nanostructured interfacial thermodynamics and kinetics • energy storage in batteries and chemicals, where the highest- sensitivity EMR and NMR determine local environment, location, and functionality.



Vision

The MagLab will remain the most interdisciplinary and most scientifically productive magnet lab in the world.

MagLab Mission Imperatives

1. Promote magnet-related research to serve an interdisciplinary scientific user community spanning materials science, condensed matter physics, magnet technology, chemistry, and biology
2. Provide unique high-magnetic-field facilities through a competitive and transparent proposal review process.
3. Advance magnet and magnet-related technology via high-risk, high-reward projects
4. Partner with universities, other national laboratories and industry to enhance national competitiveness in magnet and related technologies.
5. Serve the NSF as a prominent example of its successful stewardship of large research facilities
6. Serve as a successful model as
   a. a multi-site national laboratory
   b. a collaboration among our three partner institutions: Florida State University (FSU), the University of Florida (UF) and Los Alamos National Laboratory (LANL)
   c. a partnership of the federal and state government
   d. a partnership of the National Science Foundation and the Department of Energy
7. Support science and technology education in the United States.
8. Increase diversity in the science, technology, engineering and mathematics workforce of today and tomorrow

CHAPTER 2 - LABORATORY MANAGEMENT

TECHNICAL GOALS RESULTING FROM THE SCIENCE DRIVERS

The science drivers have determined the priorities for new initiatives and magnet technology articulated in this section. The highest priority technical goals are:

Increase Peak Magnetic Fields, the primary demand of the user community and the primary enabler of the Science Drivers, by leveraging major investments by the MagLab's partner institutions, including

- Develop 28MW magnets to take advantage of the $7.5M State- of-Florida funded 56MW DC Magnet power supply upgrade at Florida State University.
- Steadily increase from 93 T to 100 T the peak field delivered to the Pulsed Magnet Users as experience is gained in the operation, the performance, and the experimental challenges of the 100 T Multi-Shot Magnet.
- Launch a user program that accesses the 200T microsecond- duration pulsed magnetic fields enabled by $4.2M LANL funded infrastructure.
- Develop plans to increase maximum magnetic fields at High B/T facilities at the University of Florida.

Increase User Magnet Time in response to the growing user demand evidenced by User Committee surveys and magnet oversubscription rates.

Further develop EMR, NMR and MRI capabilities by investing in probes, gradient coils, upgraded electronics and new consoles.

Further develop cross-disciplinary utilization of MagLab facilities, including for example the use of

- the ultra-wide-bore 900 MHz magnet for temperature- dependent materials research of multi-ferroics and other quantum matter,
- MagLab MRI capabilities for in-situ profiling of lithium and hydrogen in batteries and fuel cells, and
- starting 2016, the 36T/1ppm-homogeneity Series Connected Hybrid to advance solid-state NMR to 1.5 GHz and multi- disciplinary Electron Magnetic Resonance to 1 terahertz.

Continue to develop MagLab high-Tc superconducting (HTS) materials and magnet technologies to significantly advance the peak fields achievable from superconducting magnets.

Continue to develop MagLab superconducting Cable-in- Conduit Conductor (CICC) technology for both Nb-based and HTS superconducting applications.

EDUCATION, DIVERSITY AND OUTREACH GOALS

- Establish the MagLab's programs as national leaders in informal science education, and STEM diversity, including K-12 outreach in Florida and New Mexico, REU and RET programs, SciGirls, summer camps and a periodical *MagLab Reports* for scientists.
- Continued mentorships to young scientists from under- represented groups, tailored to strengthen and advance each individual's career aspirations. This is a very high priority reflected by the roughly $200K/yr budget devoted to support the MagLab Diversity Action Plan.
- Continue the MagLab summer school for graduate students and postdocs to learn experimental techniques of importance to high magnetic field research. The one-week curriculum will include basic electronics, noise suppression, and grounding techniques, as well as the details of NHMFL measurement techniques such as transport, magnetization, specific heat, and nuclear magnetic resonance.
- Continue the MagLab Winter Theory School for graduate students and postdocs. The theory school will host a half-dozen leading theorists to present a week-long series of lectures on topics in condensed matter physics and materials science relevant to high-magnetic-field research.

SCIENCE ENABLING TECHNICAL FORNTIERS

The MagLab has world-leading magnet technology and unique capabilities to further advance a wide variety of technologies relevant next generation magnet and magnet materials. With the first priority listed first, MagLab technical priorities are listed below:

CHAPTER 2 - LABORATORY MANAGEMENT

Series Connected Hybrid – a pioneering MagLab magnet technology utilizing superconducting and resistive coils connected electrically in series. The system allows for multiple resistive insert coils to be positioned in the bore of a common superconducting outer coil.

- To realize 36T fields of unprecedented homogeneity (1ppm) for powered magnets. This insert coil is under construction.
- To realize 40T fields using only 14MW of power, half the amount required for an all-resistive magnet. Plans for this insert coil are under development.

28MW DC Magnets, first developing a 41T/32mm magnet and then a 37T/50mm magnet, exploiting the capabilities of the new 56MW DC Power Supply to increase user DC magnetic fields by ~18%, the largest increase in 20 years and a two-fold increase in 40T fields worldwide.

Develop high-field dynamic nuclear polarization (DNP) using existing MagLab strengths - NMR probes, high-frequency EMR, and NMR/MRI technique development – to enhance solid-state NMR and detection of critical biological molecules in living organisms, including *in vivo* metabolism and physiology.

Continue to define the technical roadmaps and provide impetus to the eventual realization of the two remaining COHMAG challenge magnets: the 30T NMR magnet and 60T Hybrid Magnet. Each of these magnets depends upon the development of new materials prior to the development of magnet construction proposals.

Magnets for Competing Magnet Labs - five of the world's six leading magnet labs use MagLab Florida-Bitter technology. The MagLab will continue to assist and collaborate with other magnet labs in both magnet technology and experimental techniques, in particular:

- EuroMagNET, the unified European magnet laboratory: Grenoble and Nijmegen (DC magnetic fields), and Toulouse and Dresden (pulsed magnetic fields)
- Magnet Labs in Japan: Kashiwa (pulsed magnetic fields)
- Magnet Labs in China: Hefei (DC magnetic fields) and Wuhan (pulsed magnetic fields)

Magnets to the Neutrons – commission a 26 T DC magnet for the neutron source at the HZB (Berlin, Germany); continue discussions with the Spallation Neutron Source at Oak Ridge National Laboratory

Magnets to the X-rays – develop plans with the Advanced Light Source at Argonne National Lab for either pulsed or DC magnetic fields.

CHAPTER 2 - LABORATORY MANAGEMENT

STRATEGIC PLAN PERFORMANCE METRICS

The MagLab publishes an Annual Report that showcases the programs and activities at the MagLab and includes the metrics used by MagLab management, the MagLab External Advisory Committee, the MagLab User Committee and the NSF Site Visit committees to evaluate the MagLab's performance. Each Annual Report includes:

- The Year in Review, written by the Director
- Science & Engineering Highlights
- Reports and statistics from the lab's user facilities
- Summaries from the magnet engineering and materials groups
- Summaries of management, administration, education, and diversity programs
- Results of the User Collaboration Grants Program
- Summaries of MagLab industrial partnerships and collaborations
- Lists of publications, presentations, theses and other activities

The MagLab receives expert evaluation of its scientific program by other scientists, including but not limited to reports by the MagLab External Advisory Committee, the MagLab User Committee and the NSF Site Visit Committees. Numerical metrics that characterize the MagLab's performance are reported in the Annual Report including:

- MagLab User Committee's survey of user satisfaction with:
    - Equipment availability
    - Equipment performance
    - MagLab scientist assistance
    - MagLab administrative assistance
    - MagLab training and safety procedures
    - MagLab user proposal submission and evaluation process
- MagLab User Profile report containing the breakdown of the total number of MagLab users by:
    - Senior investigators, postdocs, students and technicians
    - Gender and minority status
    - Affiliation of users: NHMFL, university, industry, national lab, or overseas.
    - Facility utilized: DC, Pulsed, High B/T, NMR/MRI, EMR & ICR.
- MagLab Facility Usage Profile report containing the breakdown of magnet days allocated by scientific discipline, affiliation of users, and facility utilized.
- User Collaboration Grants Program (UCGP) report, including:
    - Number of proposals received
    - Proposal acceptance rates
    - Usage of facility enhancements reported from UCGP solicitations
    - Publications reported from UCGP solicitations
- Education Program report that includes the number of participants in:
    - Research Experiences for Teachers
    - Research Experiences for Undergraduates
    - Middle School Mentorships
    - High School Mentorships
    - MagLab classroom outreach and laboratory tours.
- Science and Research Productivity statistics, including:
    - Publications in Peer-Reviewed Journals
    - Publications in Prominent Peer-Reviewed Journals, such as *Nature*, *Science*, the *Proceedings of the National Academy of Sciences*, and prominent, discipline-specific journals such as *Physical Review Letters* and *Journal of the American Chemical Society*.
    - Ph.D. degrees awarded
    - Masters' degrees awarded

Annual Reports are posted on the MagLab website, https://nationalmaglab.org/ at https://nationalmaglab.org/research/publications-all/annual-reports

CHAPTER 2 - LABORATORY MANAGEMENT

2. ORGANIZATIONAL CHART

The Florida State University, the University of Florida and Los Alamos National Laboratory jointly operate the National High Magnetic Field Laboratory for the National Science Foundation under a cooperative agreement that establishes the lab's goals and objectives. FSU, as the signatory of the agreement, is responsible for establishing and maintaining administrative and financial oversight of the lab 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 four figures below. **Figure 1** illustrates the external oversight and advisory committees, as well as the three internal committees that provide guidance to NHMFL leadership.

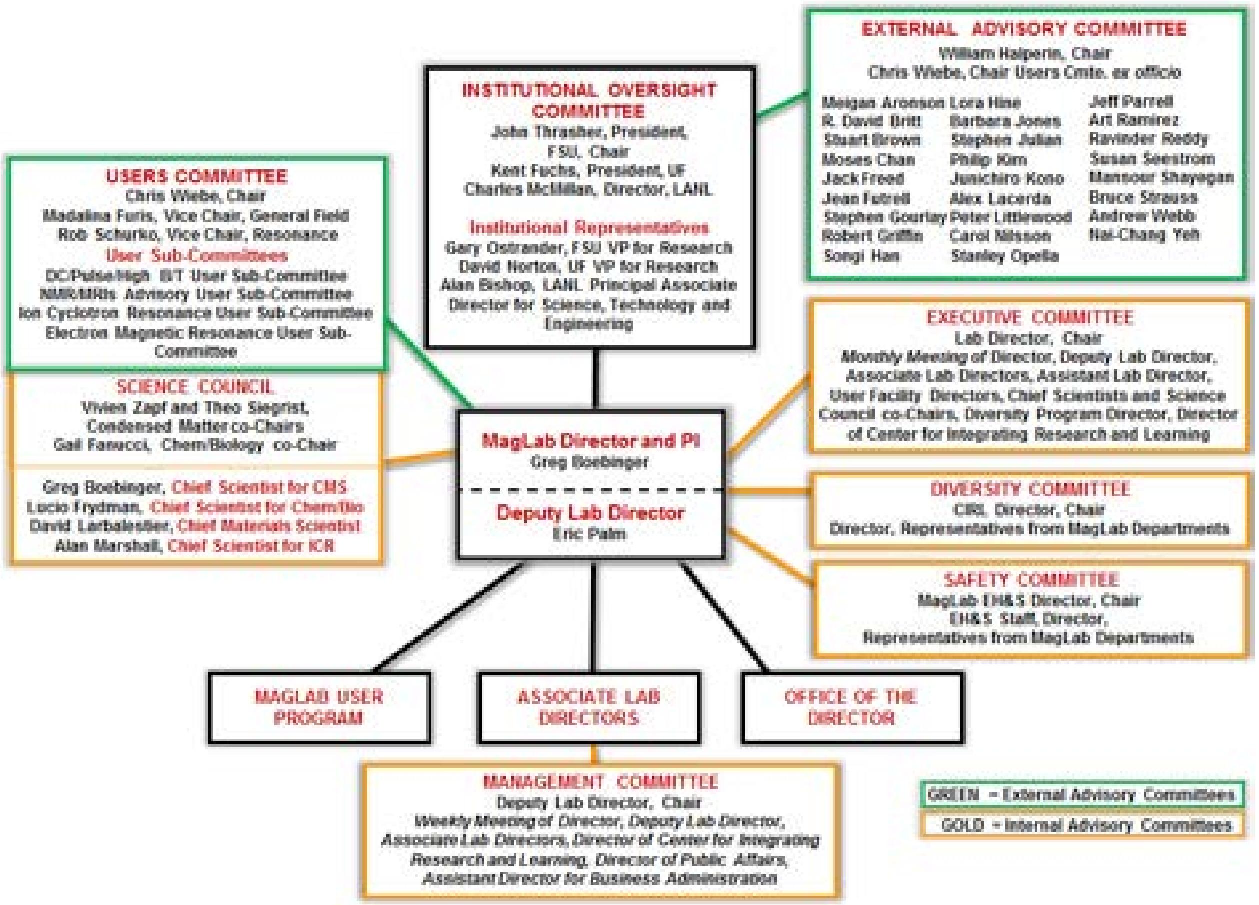


Figure 1: *Advisory Committees of the MagLab, showing internal and external advisory committees.*

Greg Boebinger is the Director of the MagLab and PI of the cooperative agreement. Together the Director and Deputy Laboratory Director, **Eric Palm**, function as a team to provide management oversight for the laboratory. The management committee — consisting of the Associate Lab Directors, co-chairs of the science council, director of CIRL and the Assistant Director for Business Administration —

CHAPTER 2 - LABORATORY MANAGEMENT

meets on a weekly basis to discuss issues of importance across the MagLab. The Executive Committee meets on a monthly basis to discuss lab wide issues as well as program – specific issues.

The lab's scientific direction is overseen by the Science Council, a multidisciplinary "think-tank" group of distinguished faculty from all three sites. Members are: Albert Migliori (co-chair), Jim Brooks (co-chair), Joanna Long (co-chair), Gail Fanucci, Zhehong Gan, Lev Gor'kov, Stephen Hill, Kevin Ingersent, Jurek Krzystek, David Larbalestier, Amy McKenna, Mark Meisel, Dragana Popović, Ryan Rodgers, Theo Siegrist, Glenn Walter, Huub Weijers, and Vivien Zapf. During the last quarter of the year, a reorganization of the science council took place by appointing three new co-chairs - Gail Fanucci, Theo Siegrist and Vivien Zapf – and adding the following new members: Luis Balicas, Neil Harrison, Ross McDonald, John Singleton, and Stan Tozer.

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 **Users 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 and their 2014 meetings are further described below.

Figure 2 shows the structure of the user program with its seven user facilities – DC Magnet Field Facility, Pulsed Magnetic Field Facility, High B/T Facility, Electron Magnetic Resonance Facility, Nuclear Magnetic Resonance and Magnetic Resonance Imaging at Florida State University and at University of Florida and ion Cyclotron Resonance.

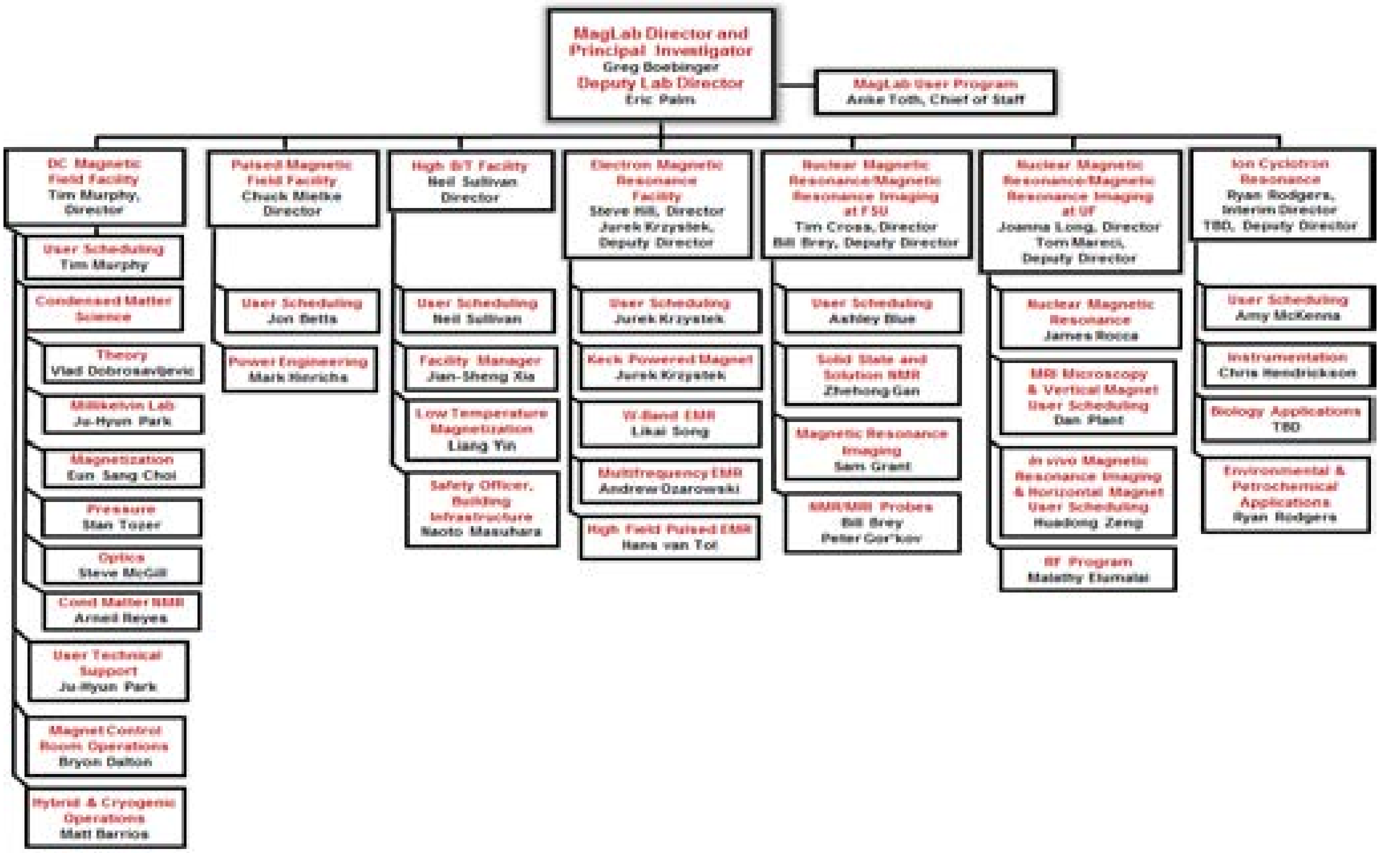


Figure 2: *NHMFL User Program*

CHAPTER 2 - LABORATORY MANAGEMENT

Figure 3 and 4 displays the internal, operational organization of the laboratory. **Figure 3** includes the seven user facilities, all Associate Lab Directors as well as the Office of the Director structure.

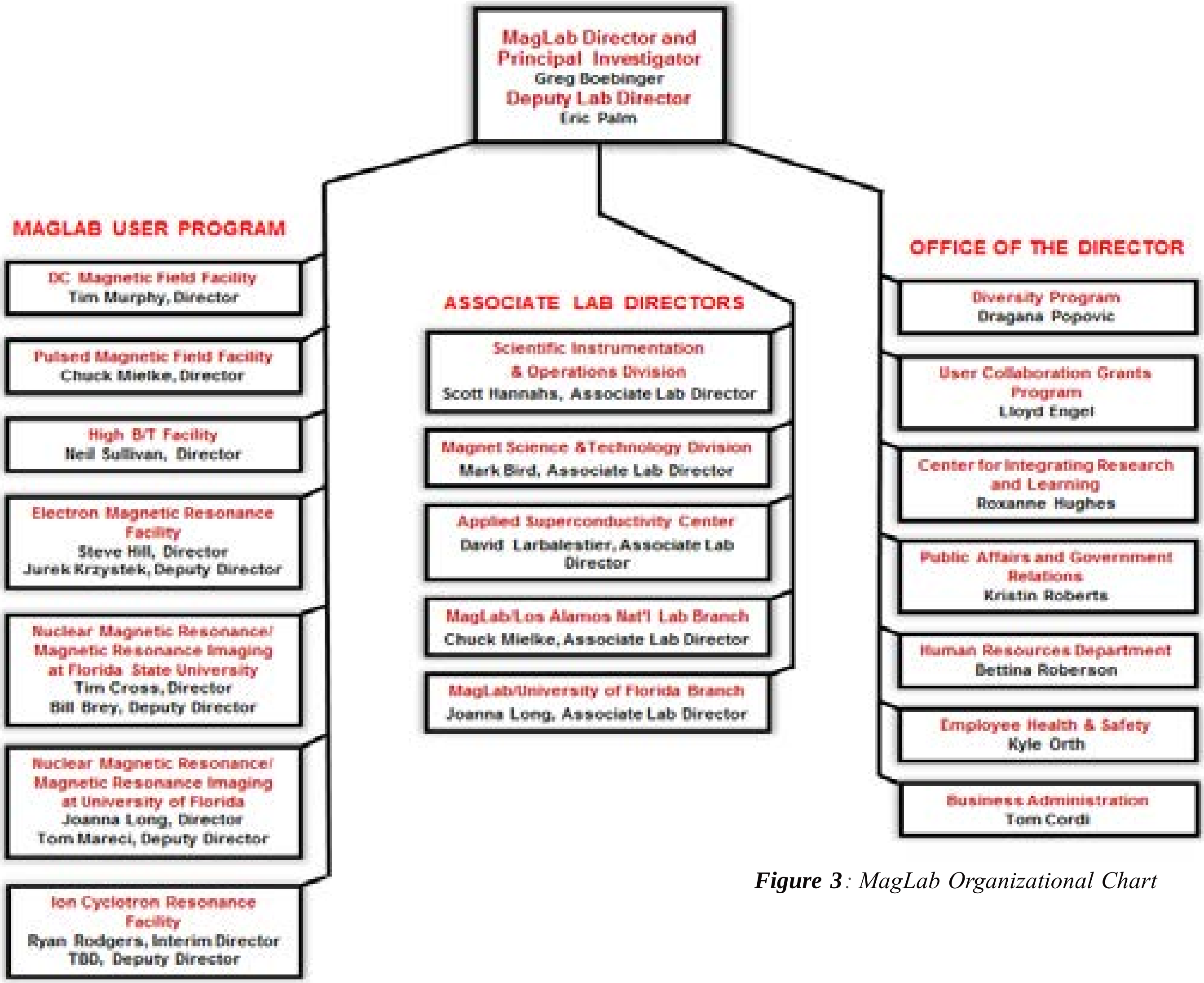


***Figure 3**: MagLab Organizational Chart*

Figure 4 lays out the organizational chart including the user facilities, Applied Superconductivity Center, Magnet Science and Technology Division and Scientific Instrumentation and Operations Division with their individual departments as well as the Office of the Director.

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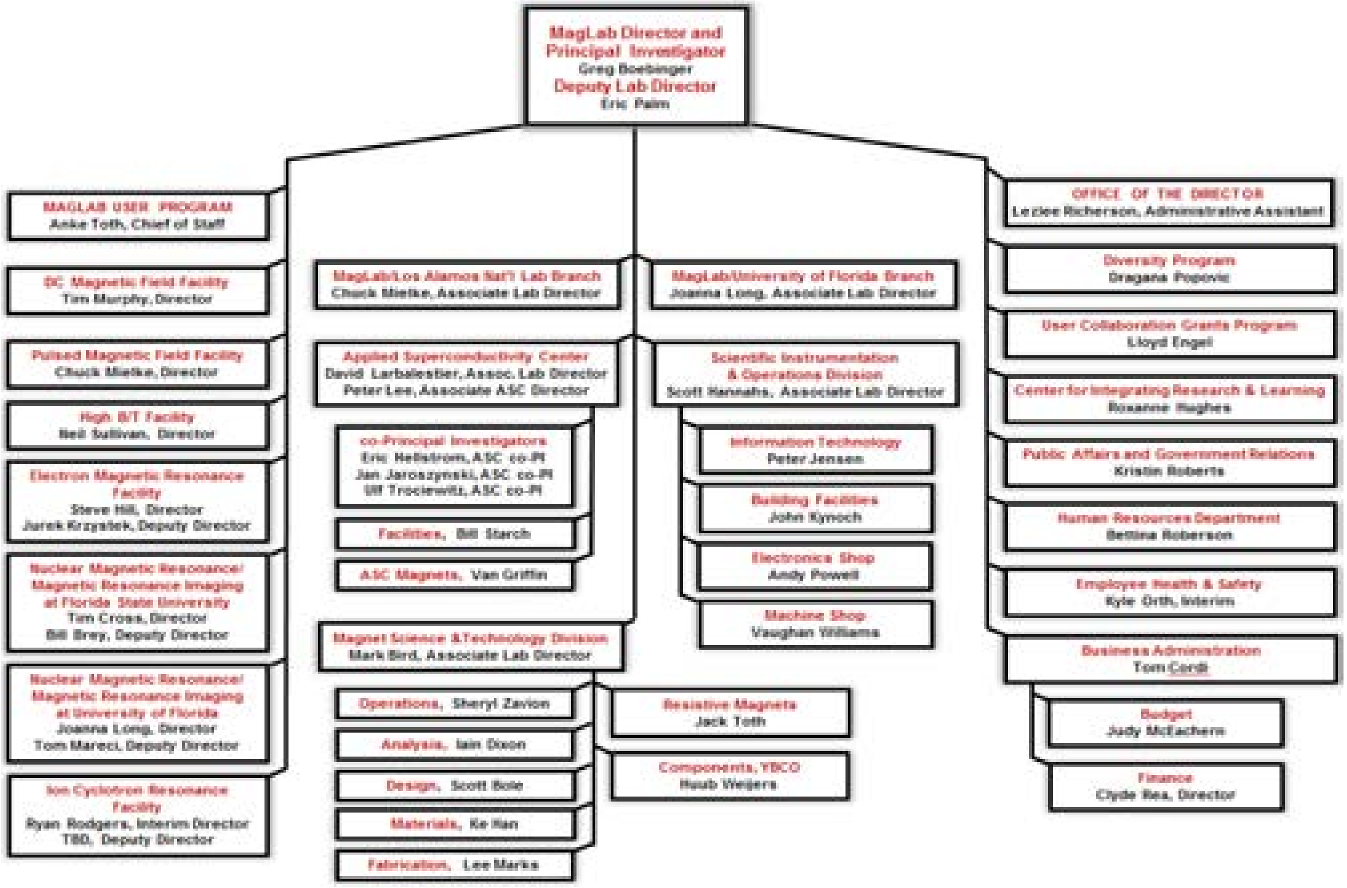

***Figure 4**: MagLab Organizational Chart including Departments*

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3. EXTERNAL ADVISORY COMMITTEE

The External Advisory Committee met July, 22–23, 2014, in Tallahassee and provided a report to Garnett S. Stokes, Interim-President of FSU; J. Bernard Machen, President of UF; and Charles F. McMillan, Director of Los Alamos National Laboratory. This report called out the success of the MagLab and provided advice in the form of recommended actions and priorities of the MagLab. This advice spanned challenges faced by budgetary constraints and the lab's expected recompetition in coming years. The list below shows External Advisory Committee members at the date of their 2014 meeting.

EXTERNAL ADVISORY COMMITTEE MEMBERS & AFFILIATIONS

William Halperin
External Advisory Committee Chair, Northwestern University

Ian Fisher
User Committee Chair (*ex officio* member of EAC), Stanford University

Lora Hine
Director of Educational Programs for the Cornell High Energy Synchrotron Source

Condensed Matter Subcommittee

Meigan Aronson, Brookhaven National Laboratory
Stuart Brown, University of California, Los Angeles
Moses Chan, Penn State University
Barbara A. Jones, IBM Almaden Research Center
Stephen Julian, University of Toronto
Philip Kim, Columbia University
Junichiro Kono, Rice University
Alex Lacerda, Los Alamos National Laboratory
Peter Littlewood, Argonne National Laboratory
Art Ramirez, Dean, Jack Baskin School of Engineering
Mansour Shayegan, Princeton University
Susan Seestrom, LANL Experimental Physical Sciences Directorate
Nai-Chang Yeh, California Institute of Technology

Magnet Technology and Materials Subcommittee

Steve Gourlay, Lawrence Berkeley National Laboratory
Jeff Parrell, Oxford Superconducting Technology
Bruce P. Strauss, US Department of Energy

Biology and Chemistry Subcommittee

R. David Britt, UC-Davis
Jack Freed, Cornell University
Jean Futrell, Battelle; Pacific Northwest National Laboratory
Robert Griffin, MIT, Director, Magnet Lab
Songi Han, University of California, Santa Barbara
Carol L. Nilsson, University of Texas Medical Branch
Stanley Opella, UC- San Diego
Ravinder Reddy, University of Pennsylvania
Andrew Webb, C.J. Gorter High Field Magnetic Resonance Center

CHAPTER 2 - LABORATORY MANAGEMENT

4. USER COMMITTEE

The Magnet Lab'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 Users Committee is elected from the user base of the NHMFL. Each facility has a subcommittee elected by its users to represent their interests to the NHMFL. Since the DC, Pulsed and High B/T facilities primarily deal with condensed matter physics, there is a single subcommittee representing the three user facilities. Likewise, the NMR facilities at UF and FSU have a single, combined subcommittee. Each subcommittee then elects members to represent it on the Users Executive Committee. This Users Executive Committee elects a chair and two vice chairs. The DC/Pulsed/High B/T Advisory Committee, the EMR Advisory Subcommittee, the NMR/MRI Advisory Committee, and the representative from the ICR Advisory Committee met October 10-11 at the MagLab in Tallahassee to discuss the state of the laboratory and provide feedback to the NSF and MagLab management. (Chapter 3)

USER ADVISORY COMMITTEE MEMBERS & AFFILIATIONS

DC/Pulsed/High B/T Advisory Committee

Kenneth Burch, University of Toronto
Jason Cooley, Los Alamos National Laboratory
Nicholas Curro*, University of California Davis
Ian Fisher*, Stanford University
Nathanael Fortune*, Smith College
Jeanie Lau, University of California, Riverside
Cedomir Petrovic, Brookhaven National Laboratory
Makariy Tanatar, US DOE The Ames Laboratory
Chris Wiebe, University of Winnipeg

EMR Advisory Committee

Christos Lampropoulos, University of North Florida
Gavin Morley, University of Warwick
Stefan Stoll, Department of Chemistry
Joshua Telser, Roosevelt University
Kurt Warncke*, Emory University
Sergei Zvyagin, Dresden High Magnetic Field Laboratory

ICR Advisory Committee

Jonathan Amster, University of Georgia
James Bruce, University of Washington
Michael Chalmers, Eli Lilly and Company
Michael Freitas, Ohio University Medical Center
Elizabeth Kujawinski, Woods Hole Oceanographic Institution
John Shaw, University of Alberta
Alexandra Stenson*, University of South Alabama
Forest White, Massachusetts Institute of Technology

NMR/MRIs Advisory Committee

Dmitri Artemov, Johns Hopkins University
Ari Borthakur, University of Pennsylvania
Joanna Collingwood, University of Warwick
Linda Columbus*, University of Virginia
Myriam Cotton, Hamilton College
Michael Harrington, Huntington Medical Research Institutes
Conggang Li, Wuhan Institute of Physics & Mathematics, Chinese Academy of Sciences
Manish Mehta, Oberlin College
Tatyana Polenova, University of Delaware
Scott Prosser, University of Toronto
Marek Pruski, Ames Laboratory, Iowa State University
Mark Rance, University of Cincinnati
Rob Schurko*, University of Windsor
Fang Tian, Penn State University
Ivan Tkac, University of Minnesota

*Member of Users Executive Committee

CHAPTER 2 - LABORATORY MANAGEMENT

5. PERSONNEL

A. Key Faculty and Staff

As of January 8, 2015, seven hundred twenty five people (725) worked for or were affiliated with the Magnet Lab at FSU, UF, and LANL in 2014 compared to 706 in 2013. A list of MagLab key facility faculty and staff is presented below. All information in the Personnel section is as of January 8, 2015.

PRINCIPLE INVESTIGATORS

Greg Boebinger
Director/Professor, Professor of Physics
Timothy Cross
Nuclear Magnetic Resonance (FSU)
Joanna Long
MagLab Chemistry & Biology Director and Associate Professor, Biochemistry & Molecular Biology (UF)
Alan Marshall
Ion Cyclotron Resonance (FSU)
Charles Mielke
Director, Pulsed Field Facility at LANL and Deputy Group Leader
Neil Sullivan
High B/T Facility (UF)

USER FACILITY DIRECTORS

Timothy Cross
Nuclear Magnetic Resonance (FSU)
Stephen Hill
Electron Magnetic Resonance
Joanna Long
Nuclear Magnetic Resonance (UF)
Alan Marshall
Ion Cyclotron Resonance
Chuck Mielke
Pulsed Field Facility
Tim Murphy
DC User Program
Neil Sullivan
High B/T Facility

KEY PERSONNEL

Director's Office

Boebinger, Gregory
Director/Professor, Professor of Physics
Hughes, Roxanne
Assistant Scholar/Scientist, Director, Center for Integrating Research and Learning
Orth, William
Asst Dir, Environmental, Safety, Health & Security Svcs
Palm, Eric
Deputy Lab Director
Roberson, Bettina
Assistant Director, Administrative Services
Roberts, Kristin
Director of Public Affairs
Rodman, Christopher
Industrial Safety & Health Eng.

CHAPTER 2 - LABORATORY MANAGEMENT

Management and Administration

Brooks, Richard
Facilities Superintendent
Cordi, Thomas
Assistant Lab Director, Business Administration
Davidson, Michael
Research Faculty I
Kynoch, John
Assistant Director
McEachern, Judy
Assistant Director, Business Systems
Payne, Jimmy
Scientific Research Specialist
Rea, Clyde
Assistant Director, Business & Financial / Auxiliary Services
Wood, Marshall
Facilities Electrical Supervisor

Dc Instrumentation

Dalton, Bryon
Scientific Research Specialist, Control Room Head
Hannahs, Scott
Research Faculty III
Jensen, Peter
Network Administrator
Powell, James
Research Engineer (Electronic Shop)
Williams, Vaughan
Research Engineer (Machine Shop)

Magnet Science and Technology

Adkins, Todd
Research Engineer
Bai, Hongyu
Research Faculty II
Bird, Mark
Research Faculty III, Director, Magnet Science & Technology
Bole, Scott
Research Engineer
Cantrell, Kurtis
Research Engineer
Dixon, Iain
Research Faculty III
Gavrilin, Andrey
Research Faculty III
Goddard, Robert
Scientific Research Specialist
Godeke, Arno
Research Faculty II
Gundlach, Scott
Research Engineer
Guo, Wei
Professor
Han, Ke
Research Faculty III
Hilton, David
Research Faculty I
Johnson, Zachary
Research Engineer
Li, Tianlei
Visiting Research Faculty I
Lu, Jun
Research Faculty II
Markiewicz, William
Research Faculty III

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Marks, Emsley
Research Engineer
Miller, George
Research Engineer
Noyes, Patrick
Associate in Research
O'Reilly, James
Research Engineer
Painter, Thomas
Sr Research Associate
Toth, Jack
Research Faculty III
Van Sciver, Steven
Professor
Viouchkov, Youri
Research Engineer
Voran, Adam
Research Engineer
Walsh, Robert
Sr Research Associate
Weijers, Hubertus
Research Faculty II
Xin, Yan
Research Faculty II
Zavion, Sheryl
Sr Research Associate (MS&T Operations Manager)

Condensed Matter Science

Albrecht-Schmitt, Thomas
Professor
Balicas, Luis
Research Faculty III
Baumbach, Ryan
Research Faculty I
Beekman, Christianne
Assistant Professor
Bonesteel, Nicholas
Professor
Cao, Jianming
Professor
Chiorescu, Irinel
Professor
Choi, Eun Sang
Research Faculty II
Coniglio, William
Research Faculty I
Dalal, Naresh
Professor
Dobrosavljevic, Vladimir
Professor
Engel, Lloyd
Research Faculty III
Fajer, Piotr
Professor
Gao, Hanwei
Assistant Professor
Gor'kov, Lev
Professor
Graf, David
Research Faculty I
Hill, Stephen
Professor/EMR Director
Hoch, Michael
Visiting Scientist/Researcher
Jaroszynski, Jan
Research Faculty II
Knappenberger, Kenneth
Assistant Professor
Kovalev, Alexey
Assistant In Research
Krzystek, Jerzy
Research Faculty III
Kuhns, Philip
Research Faculty III
Li, Zhiqiang
Research Faculty I
Manousakis, Efstratios
Professor
McGill, Stephen
Research Faculty II

CHAPTER 2 - LABORATORY MANAGEMENT

Murphy, Timothy
Director, DC Field Facility
Oates, William
Assistant Professor
Ozarowski, Andrzej
Research Faculty II
Park, Ju-Hyun
Research Faculty II
Popovic, Dragana
Research Faculty III
Ramakrishnan, Subramanian
Associate Professor
Reyes, Arneil
Research Faculty III
Riggs, Scott
Research Faculty I
Rikvold, Per
Professor
Schlottmann, Pedro
Professor
Shatruk, Mykhailo
Assistant Professor
Siegrist, Theo
Professor
Smirnov, Dmitry
Research Faculty III
Song, Likai
Research Faculty I
Suslov, Alexey
Research Faculty II
Telotte, John
Associate Professor
Tozer, Stanley
Research Faculty III
Trociewitz, Bianca
Research Engineer
Vafek, Oskar
Associate Professor
van Tol, Johan
Research Faculty III
Whalen, Jeffrey
Research Faculty I
Yang, Kun
Professor

LANL

Balakirev, Fedor
Staff Member
Betts, Jonathan
Technical Staff Member
Crooker, Scott
Staff Member
Harrison, Neil
Staff Member
Hinrichs, Mark
Electrical Engineer
Hundley, Mike
CMMS Group Leader
Jaime, Marcelo
Staff Member
McDonald, Ross
Staff Member
Mielke, Charles
Director, Pulsed Field Facility at LANL and
Deputy Group Leader
Migliori, Albert
Staff Member and LANL Fellow
Nguyen, Doan
Magnet Scientist
Rickel, Dwight
Staff Member
Singleton, John
Staff Member and LANL Fellow
Zapf, Vivien
Staff Member& Financial / Auxiliary Services

CHAPTER 2 - LABORATORY MANAGEMENT

NMR

Alamo, Rufina
Professor
Arora, Rajendra
Professor
Brey, William
Research Faculty III
Cross, Timothy
Professor
Frydman, Lucio
Scholar / Scientist
Fu, Riqiang
Research Faculty III
Gaffney, Betty
Professor of Biology
Gan, Zhehong
Research Faculty III
Gor'kov, Peter
Sr Research Associate
Grant, Samuel
Associate Professor
Hallinan, Daniel
Assistant Professor
Houpt, Thomas
Professor
Hu, Yanyan
Assistant Professor
Hung, Ivan
Assistant in Research
Kim, Jeong-su
Assistant Professor
Kitchen, Jason
NMR Engineer
Paravastu, Anant
Assistant Professor
Qin, Huajun
Associate in Research
Ranner, Steven
Research Engineer
Rosenberg, Jens
Visiting Research Faculty I
Schepkin, Victor
Research Faculty II
Shekar, Srinivasan
Research Faculty I
Smith, James
Professor
Wi, Sungsool
Research Faculty II
Zhang, Fengli
Research Faculty I
Zhou, Huan-Xiang
Associate Professor

ICR

Blakney, Gregory
Research Faculty II
Corilo, Yuri
Research Faculty I
Kaiser, Nathan
Research Faculty I
Lobodin, Vladislav
Research Faculty I
Lu, Jie
Assistant in Research
Marshall, Alan
Professor, Chief Scientist for Ion Cyclotron Resonance (ICR) and Robert O. Lawton Distinguished Professor of Chemistry
McKenna, Amy
Research Faculty II
Podgorski, David
Research Faculty I
Quinn, John
Research Engineer

CHAPTER 2 - LABORATORY MANAGEMENT

Rodgers, Ryan
Research Faculty III

Young, Nicolas
Research Faculty I

UF

Abernathy, Cammy
Professor, Materials Science & Engineering, Dean, College of Engineering
Andraka, Bohdan
Associate Research Professor
Angerhofer, Alexander
Professor, Chemistry
Ashizawa, Tetsuo
Melvin Greer Professor and Chairman, Department of Neurology, Executive Director McKnight Brain Institute
Biswas, Amlan
Associate Professor of Physics
Blackband, Stephen
Professor, Neuroscience
Bowers, Clifford
Associate Professor, Chemistry
Brey, Wallace
Professor Emeritus, Chemistry
Butcher, Rebecca
Assistant Professor
Cheng, Hai Ping
Professor of Physics
Christou, George
Drago Professor
Douglas, Elliot
Associate Professor, Materials Science & Engineering
Edison, Arthur
Professor, Biochemistry & Molecular Biology, Di-rector of the Southeast Center for Integrated Metabolomics at UF
Elumalai, Malathy
RF Engineer
Eyler, John
Professor Emeritus, Chemistry
Fanucci, Gail
Associate Professor
Febo, Marcelo
Assistant Professor
Fitzsimmons, Jeffrey
Professor, Radiology
Forder, John
Associate Professor of Radiology
Hamlin, James
Assistant Professor
Hebard, Arthur
Distinguished Professor of Physics
Hershfield, Selman
Professor
Hirschfeld, Peter
Professor
Ingersent, Kevin
Chair of UF Physics Department & Professor, Chair, UF Physics Dept.
Kumar, Pradeep
Professor
Labbe, Greg
Senior Engineer, Cryogenics Facility
Lai, Song
Associate Professor, Director, CTSI Human Imaging Core McKnight Brain Institute
Lee, Yoonseok
Professor
Long, Joanna
Associate Professor, NHMFL Director of AMRIS
Luesch, Hendrik
Associate Professor
Mareci, Thomas
Professor
Maslov, Dmitrii
Professor
Masuhara, Naoto
Senior Engineer, Microkelvin Laboratory

CHAPTER 2 - LABORATORY MANAGEMENT

Meisel, Mark
Professor
Murray, Leslie
Assistant Professor
Pearton, Stephen
Distinguished Professor, Alumni Professor of Materials Science & Engineering
Polfer, Nicolas
Assistant Professor
Stanton, Christopher
Professor
Stewart, Gregory
Professor
Sullivan, Neil
Professor, Director of High B/T Facility
Takano, Yasumasa
Professor
Talham, Daniel
Professor
Tanner, David
Distinguished Professor of Physics
Vaillancourt, David
Associate Professor
Vandenborne, Krista
Professor
Vasenkov, Sergey
Associate Professor
Walter, Glenn
Associate Professor
Xia, Jian-Sheng
Associate Scientist
Zeng, Huadong
Specialist, Animal MRI/S Applications

ASC

Abraimov, Dmytro
Research Faculty II
Griffin, Van
Associate In Research
Hellstrom, Eric
Professor
Jiang, Jianyi
Research Faculty II
Kametani, Fumitake
Research Faculty I
Kim, Youngjae
Research Faculty 1
Larbalestier, David
Chief Materials Scientist, Director, Applied Superconductivity Center
Lee, Peter
Research Faculty III
Pamidi, Sastry
Assistant Scholar / Scientist
Polyanskii, Anatolii
Research Faculty II
Starch, William
Associate in Research
Tarantini, Chiara
Research Faculty I
Trociewitz, Ulf
Research Faculty II

GEOCHEMISTRY

Chanton, Jeff
Professor
Cooper, William
Professor
Froelich, Philip
Scholar / Scientist
Humayun, Munir
Professor
Odom, Leroy
Professor

CHAPTER 2 - LABORATORY MANAGEMENT

Sachi-Kocher, Afi
Scientific Research Specialist
Salters, Vincent
Professor, Director, Geochemistry
Wang, Yang
Professor
White, Gary
Scientific Research Specialist
Zateslo, Theodore
Senior Engineer

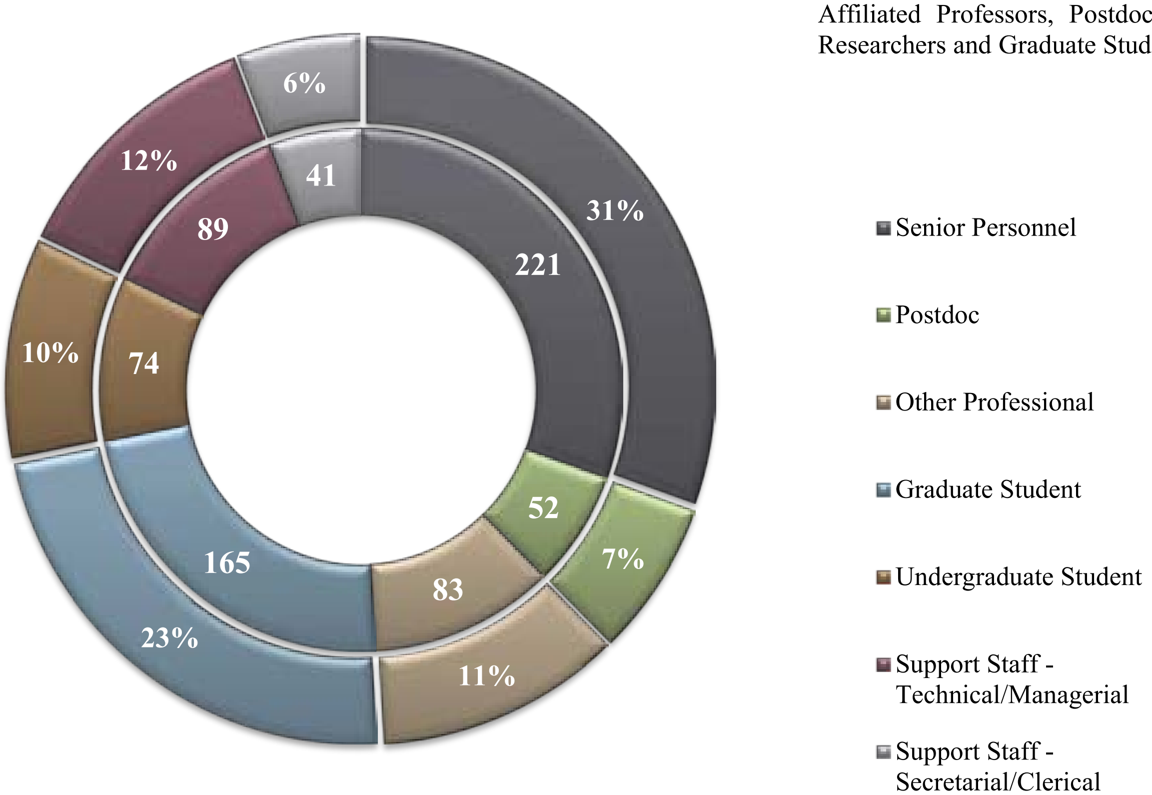
CHAPTER 2 - LABORATORY MANAGEMENT

B. Staffing and Demographics

The MagLab comprises 725 people at its three sites, who are paid by NSF use grant, State of Florida Funding, individual investigator awards, as well as home institutions and other sources. Of that number, senior personnel represent the largest group at 31%, followed by graduate students at 23% and support staff technical/managerial at 12%. The total distribution by NSF classification appears in **Figure 1.**

MagLab Staffing

Personnel at FSU, UF, and LANL includes NHMFL employees paid by the NSF Core Grant or State of Florida funding, plus all Affiliated Professors, Postdoctoral Researchers and Graduate Students.



Distribution by NSF Classification, January 8, 2015, Total Personnel: 725

***Figure 1:** Maglab Staffing*

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The NHMFL is committed to expanding and maintaining a diverse and inclusive organization to ensure a broad pool of highly qualified applicants for open positions to enhance our diversity efforts. Search committees are strongly encouraged to recruit minorities from underrepresented groups. Positions are advertised in venues that target women and minorities, e.g., Association for Women in Science (AWIS), National Society of Black Physicists (NSBP), etc. Additional contact is made through special subgroups of professional organizations, focused conferences and workshops. The Director's letter to each search committee chair for Senior Personnel, provides guidelines for best practices to increase the recruitment of members of underrepresented groups.

In addition, chairs of search committees for scientific staff meet with the Diversity Committee both before and after the search. This allows the Diversity Committee to help the search committee conduct a search that is as diverse as possible and then collects lessons learned from each committee to pass on to future search committees.

New permanent hires in 2014 include six scientific senior personnel (five White Males and one Asian Male), four STEM related staff personnel (three White Males, one White Female). Additionally, seven Postdoctoral Research Associates were hired (one White Female, two Asian Females, one Asian Male, one White Hispanic Male, two White Males).

Overall distribution of diversity for all three sites of the MagLab includes 49.1% white males, 23% Asian males and females, 17% white females, 5.3% black or African American, 4.8% Hispanic and <1% American Indian. The total distribution by Diversity appears in **Figure 2.**

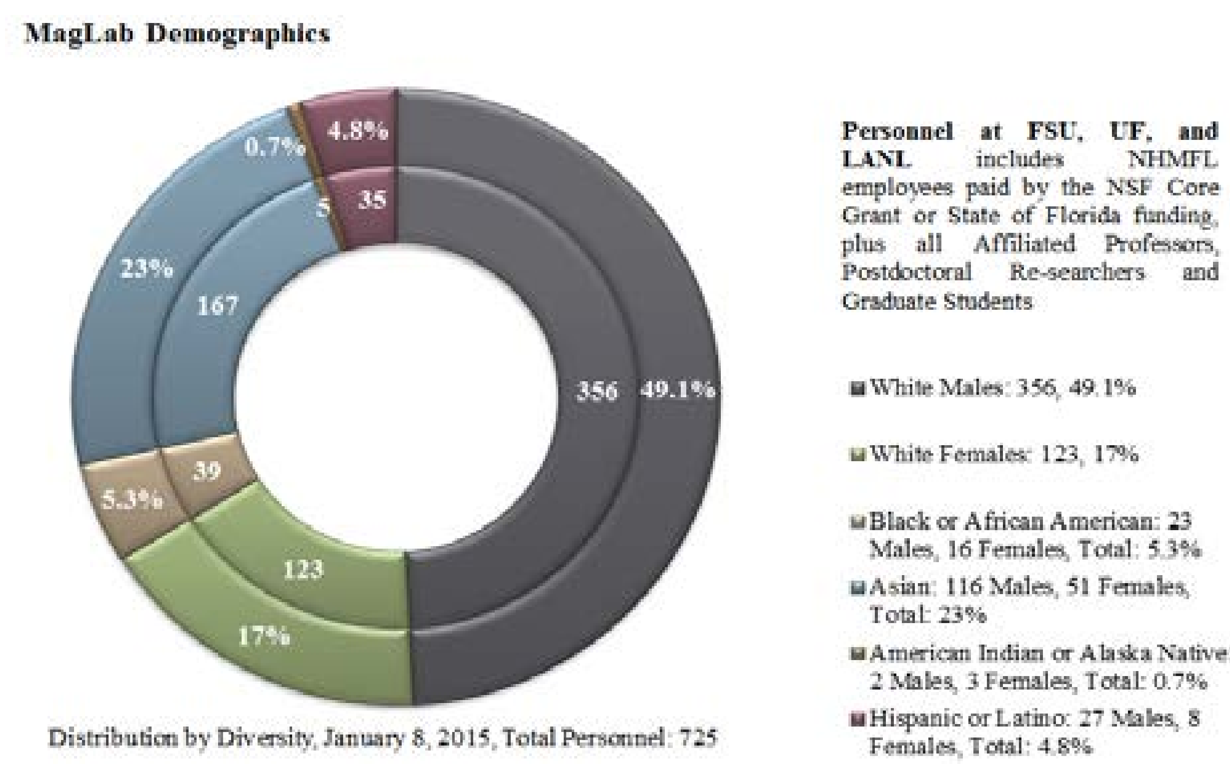

Figure 2: Maglab Demographics

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6. DIVERSITY

The National High Magnetic Field Laboratory (NHMFL) is committed to diversity. In 2013, the NHMFL administration through the efforts of Dragana Popović invited the American Physical Society (APS) to conduct a climate survey at the lab. In 2014, the Director of the lab created a diversity taskforce composed of faculty from the NHMFL and Florida State University (FSU) to review the Diversity Committee's work over its 10 years. The taskforce utilized the recommendations from the APS climate survey to drive their questions. The recommendations of the task force were approved by the Diversity Committee and the Executive Committee in October of 2014. These recommendations became bylaws for the Diversity Committee and can be found in at the end of this section. As part of the bylaws, the membership of the diversity committee was expanded. The members of the Diversity Committee can be found on the NHMFL website: https://nationalmaglab.org/staff-all/diversity-committees. Beginning in 2015, the diversity committee will develop their strategic plan with policies and procedures that align with the lab's diversity mission.

Since 2004, our Diversity Action Plan (DAP) has been the driver for our diversity programs and efforts. The DAP continued to be the driving force for our programs in 2014. In 2014, the Lab conducted the following activities that focused on the five areas identified within the DAP.

Building diversity permanence into the NHMFL scientific population

- Per the Director's Letter that was initiated in 2012, all hiring committees must have at least one member of the Diversity Committee serve on hiring committees for research faculty. This requirement was maintained in 2014.
- There were 9 research faculty position hires in 2015. 89% of these were advertised on minority serving organizations' websites or list serves including: Association for Women in Science, National Society of Black Physicists, National Society of Women Engineers, and the Society for the Advancement of Chicanos and Native Americans.
- Three female faculty became part of the Magnet Lab in 2014:
  - Christianne Beekman, Assistant Professor of Physics, affiliated with the MagLab. Focus: Thin-film growth and study of complex oxides.
  - Yan-Yan Hu, Assistant Professor of Chemistry, affiliated with the MagLab
  - Focus: Interface chemistry, including battery research and NMR technique development
  - Hazuki Tashima, Generator Operator for MagLab's Pulsed Field Facility.
- Five postdoctoral associates were hired in 2014, two are female and one is Hispanic.
- The sixth Faculty Recruitment for Excellence and Diversity (FRED) training session was held on April 22, 2014. The speaker was Florida State University's Professor Lara Perez-Felkner from The College of Education. Her research focuses on issues affecting underrepresented minorities in STEM at the higher education level. There were 29 attendees.
- The Dependent Care Travel Grant Program awarded funds to one female graduate student to support her travel to the NHMFL to conduct her research.

Developing and cultivating individually-crafted early career opportunities for members of underrepresented groups at the undergraduate level and above

- NHMFL scientists, engineers, and staff regularly traveled to publicize the research occurring at the lab and the opportunities available at the lab for undergraduates and beyond. Visits in 2014 included trips to HBCUs (Claflin University, Morehouse College, and Florida Agricultural and Mechanical University FAMU), California State University in Fresno (a Minority Serving Institution), FSU's chapter of Undergraduate Hispanic Engineers, Old Dominion University's chemistry and physics students from underrepresented groups, the annual Florida-Georgia Louis Stokes Alliance for Minority Par-

CHAPTER 2 - LABORATORY MANAGEMENT

ticipation expo in Jacksonville, FL, the annual Society for the Advancement of Chicanos and Native Americans (SACNAS) conference, and the Southeast Conference for Undergraduate Women in Physics.

- The partnerships developed between the NHMFL and Claflin and Morehouse have been in existence for more than five years and have resulted in students from these schools gaining valuable experience with research at the lab. Faculty from Claflin University submitted a proposal for an NSF grant to improve their NMR infrastructure. This partnership was started through the work of Art Edison.
- The NHMFL maintained their support for the "MagLab Fellowships" award for up to two first-year physics graduate students at Florida State University ($3000 per person per year for two years). Two second-year physics graduate students completed their fellowship in August 2014, and one first-year physics graduate student was awarded. The physics department did not award MagLab Fellowships to the incoming first-year students in fall 2014/2015.
- The Diversity Program partially supported four students (three graduate students and one undergraduate) and two postdocs in 2014. This funding was used to support these individuals in their research, particularly as they were transitioning into a new position or when funding from previous grants had expired.
- Support was provided to one female postdoc, two female graduate students and one female undergraduate for research-related travel.
- The NSF awarded an EAGER grant to FAMU (PI: M. Mochena, five co-PIs from FAMU Physics, Chemistry, College of Engineering) to fund a pilot program in materials research, a collaboration between FAMU and the NHMFL. The interdisciplinary projects will involve the NHMFL affiliated faculty members from FSU Physics (S. Hill), Chemistry (G. Strouse), and College of Engineering (T. Siegrist). The pilot program will lay the foundation for comprehensive research collaboration between the two neighboring institutions. It is expected that the successful completion of the program will place the FAMU researchers in highly competitive position to acquire millions of dollars in grants from the NSF Partnership for Research and Education in Materials (PREM).
- A. Marshall, A. McKenna and R. Hughes provided letters of commitment for the University of West Florida's (PI: Emily Williams, Karen Molek, Michael Huggins) 2014 NIH MARC U*STAR grant proposal. NHMFL support includes mentoring of undergraduates from UWF. The inaugural class of MARC Scholars began in June 2014 with the first four students. The MARC Scholars presented their summer research at the 2014 Annual Biomedical Research Conference for Minority Students.
- The NHMFL provided partial financial support for the January Southeastern Conference for Undergraduate Women in Physics. NHMFL scientists (Q. Zhou, J. Brooks, N. Craig) conducted tours of the lab for participants. In addition, D. Popović spoke at the 2014 conference.
- NHMFL and FSU scientists were awarded an APS Bridge Program grant ($202,833; PI: Simon Capstick, FSU Co-PIs: S. Hill and D. Popović) for a Masters Bridge Site at Florida State University. FSU is one of only 4 universities to be awarded an APS bridge grant. The NHMFL will be providing $10,000/year in matching support.
- Vivien Zapf joined LANL's Minority Institutions Partnership Program which identifies qualified underrepresented minority candidates to work in LANL's research programs.
- Marcelo Febo of LANL acted this year as 'Touchstone mentor' for 3 minority student fellows from other universities as part of the Society for Neuroscience's Minority Neuroscience Scholars Program.
- A. McKenna judged the research poster session for female undergraduates who participated in FSU's Women in Math, Science, and Engineering program.
- The annual NHMFL Winter Theory School, held in January, had 51 attendees (70% graduate students and 30% postdocs), including 6 women and one Hispanic.
- The annual NHMFL Summer School, held in May, attracted 28 graduate students, postdoctoral associates, and undergraduates, including: 6 women, 2 Hispanics, and one African American.

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- The summer REU program had 29 undergraduates participate including: 12 females (1 Asian, 4 Hispanic, 4 African American and 3 white), two Hispanic males, 4 African American males, and 5 students from Minority Serving institutions.
- D. Popović co-authored a chapter in the recently released book Alliances for Advancing Academic Women: Guidelines for Collaborating in STEM Fields, edited by Penny J. Gilmer, Berrin Tansel, & Michelle Hughes Miller (Sense Publishers, Rotterdam, 2014). The book is a product from AAFAWCE, the NSF ADVANCE-PAID grant (2009-2013) for five universities in the state of Florida. It provides important guidelines and examples of ways STEM faculty and administration can collaborate toward goals of recruiting, mentoring, and promoting leadership to academic women faculty.
- R. Hughes published a chapter in the recently released book, Girls and Women in Stem: A Never Ending Story (http://www.amazon.com/Girls-Women-Stem-Research-Education/dp/1623965578).
- D. Popović continues to serve on the FSU's Diversity and Inclusion Council through her membership on the Recruitment and Retention subcommittee, who in 2013 completed their recommendations for the university based on reviews of diversity practices at other universities nationwide.
- Tours for various undergraduate groups were conducted including: undergraduate students from the Science Students Together Reaching Instructional Diversity and Excellence (SSTRIDE), and undergraduate students from FSU's Women in Math, Science, and Engineering program.

Aiming educational outreach for K-12 and the general public to broad and diverse groups

- CIRL's outreach coordinator, C. Villa, conducted outreach in over 50 K-12 schools, reaching over 12,000 students. 70% of these schools are Title I schools.
- CIRL staff worked with 19 local Title I Elementary school teachers to develop and facilitate STEM challenges for students in their afterschool STEM clubs.
- K-12 tours that specifically reached underrepresented minorities included: high school students from the FAMU-FSU College of Engineering summer program, and K-12 girls attending the Oasis Center For Girls' Science Camp.
- General tours: J. Maddox and R. Rodgers toured separate groups of Veterans and some Active Military.
- Outreach outside of formal K-12 classrooms included: S. Zavion, H. Chen, and N. Craig who presented at a Women STEM Career event where over 500 K-12 girls attended; a college information night held at FSU for participants in NHMFL STEM programs wherein 47% of the attendees were underrepresented minorities.
- The SciGirls summer camp was held for its 9th consecutive year with partial financial support from the NHMFL: 36 middle school girls participated (5 African American and 1 Hispanic).
- The co-ed Magnet Lab summer camp reached 32 students including 8 females (1 African American and 1 African American male, 2 Hispanic males, and 4 four students from title I schools).
- The NHMFL RET program had twelve teachers participate: 7 male, 5 female, 4 African Americans (1F,3M), 3 Hispanics (1F,2M); and 66% from Title I schools.
- CIRL maintained its partnership with the FSU-FAMU College of Engineering and the Center for Advanced Power Systems as the director of the ERC-FREEDM's Pre-College Education effort, which includes Title I schools. The ERC FREEDM summer camp was held at the NHMFL. 13 students attended: 6 females (2 African American) and 2 African American males. The ERC FREEDM Young Scholars Program had 7 high school participants: 3 female (2 African American), and 1 African American male.
- The 2014 internship program had 30 high school and college students participate: 8 females (one African American), 1 African American male and 3 Hispanic males.
- The 2014 Fall Semester Middle School Mentorship program had 11 students, 55% of whom are female.
- A. McKenna and Y. Wang served as mentors for young women participating in the semester-long Middle School Mentorship program.

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- In 2014, SciGirls co-directors worked with the FSU Foundation to apply for financial support to expand SciGirls to local Title I schools as an afterschool program.
- A. McKenna served as a role model at two Career information sessions at Success Academy, a school for students who have been expelled from their public schools. (90% of these students are underrepresented minorities).
- The NHMFL provided partial financial support to the New Mexico Expanding Your Horizons conference which invites more than 150 middle school girls to meet STEM role models and participate in hands-on activities. LANL's M. Jaime participated in the conference.
- The lab continued its Science Café series, including one where A. McKenna spoke about her research in the Ion Cyclotron Resonance facility.
- Public Affairs secured wide media coverage for the NHMFL's Annual Open House utilizing radio, local newspapers, network television news, Facebook, Twitter, local Head Start programs, schools, and African-American churches. Over 6000 people attended.
- CIRL continues to keep a strong research agenda that focuses on improving underrepresented minorities' experiences in STEM fields. CIRL staff member, K. Roberts attended the Research on Women and Education conference (New Orleans, LA) where she presented research on retention rates for male and female STEM-undergraduate majors at FSU. R. Hughes published the following article and book chapters in 2014 which focus on women's experiences in STEM: Hughes, R., The Effects of a Single-Sex STEM Living and Learning Program on Female Undergraduates' Persistence, International Journal of Gender, Science, and Technology, 6 (1), 25-54 (2014); Hughes, R., "The Evolution of the Chilly Climate for Women in Science", Girls and Women in STEM Fields: A Never-Ending Story, 71-94, 2014; Hughes, R., "How Do Gender Stereotypes Affect Women's Persistence in STEM Fields?", Feminism: Perspectives, Stereotypes/Misperceptions and Social Implications, 121-140, 2014.
- John Singleton wrote a support letter and is co-PI of a proposal recently submitted to NSF by Dr. C.I Nichols, Taos High School, New Mexico. The grant will study ways to help Native Americans to succeed in traditional American colleges.

Maintaining awareness among NHMFL staff and user programs that Diversity Matters

- The Diversity Committee held regular, quarterly meetings.
- NHMFL Diversity demographics were maintained on a quarterly basis.
- The NHMFL Diversity Website was kept up to date.
- Several books on diversity issues were purchased for the "Diversity Library" to be located in the CIRL area.
- CIRL completed two reports: one includes historical national demographic data in STEM and the other includes a series of best practices at other labs and in other universities as a guide for developing the NHMFL's Diversity strategic plan
- R. Hughes worked closely with the Diversity and Inclusion Director at Argonne National Laboratory (ANL). This partnership has resulted in a survey to all DOE labs to determine best practices in diversity at these institutions. The NHMFL, LANL and ANL are working closely to share data and determine better ways to measure success.
- All actions were catalogued in a Diversity Tracker, which is updated on a quarterly basis.

Maintaining frequent external guidance and review of NHMFL diversity issues

- D. Popović continues to work on the Recruitment and Retention subcommittee of the FSU Diversity & Inclusion Council. In 2014, this subcommittee developed several policies for university-wide implementation based on their 2013 recommendations.
- In 2014, the NHMFL director convened a Diversity Taskforce to study the diversity initiatives at the lab. This taskforce included Lab directors from all three sites as well as a diversity expert from FSU. The recommendations submitted by this taskforce were approved in October 2014 by the NHMFL Diversity Committee and the Executive Committee. As part of these

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new bylaws, the diversity committee was expanded to include a representative from all of the NHMFL facilities, including an additional representative from UF and LANL. In addition the committee will now meet with hiring committees before the hiring process begins to review the job description and discuss recruitment (3 of these presentations were held once the bylaws were voted into effect) and before an offer is made to a final candidate to ensure all efforts for a fair process were made (3 of these presentations were given).

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MagLab Diversity Committee Bylaws
Implemented in Response to Recommendations of the Diversity Task Force
October 20, 2014

Membership

1. The Diversity Committee will include **five permanent members** from MagLab management –
    a. Director of the Center for Integrating Research and Learning (CIRL), who will serve as Chair of the Diversity Committee
    b. Director of Human Resources
    c. Director of Public Affairs
    d. User Program Chief of Staff
    e. Director of the MagLab (ex officio)
2. The Diversity Committee will include **rotating members** who serve two-year terms. Half the rotating members rotate off every year. New rotating members are selected by the heads of the groups listed below in consultation with the Chair of the Diversity Committee, who will confirm the willingness of new members to serve. One rotating member will originate from each of the following groups:
    a. Applied Superconductivity Center
    b. Condensed Matter Science
    c. DC Magnetic Fields
    d. Electron Magnetic Resonance
    e. Ion Cyclotron Resonance
    f. Magnet Science and Technology
    g. Nuclear Magnetic Resonance
    h. MagLab/FSU Postdoctoral researchers
    i. MagLab/FSU Graduate students

    Other rotating members will originate from the following groups:
    j. MagLab/LANL (Two representatives, serving staggered terms)
    k. MagLab/UF (Two representatives, preferably one each from High B/T and AMRIS, serving staggered terms)
    l. Other member(s) at large chosen by the MagLab Director.

Meeting Timing and Frequency

3. The Diversity Committee will reserve the first Tuesday at 2pm of every month for Diversity Committee meetings. Meetings will occur at least quarterly to discuss relevant topics.
4. A member of the Diversity Committee will serve on every STEM search. The Diversity Committee will meet with both the Search Committee and the Hiring Authority for every STEM search at the beginning of the search and prior to the offering of the position to a candidate, including prior to the conversion of a Visiting Scientist or other short-term appointment to a Permanent Scientist position. There is no formal quorum for these meetings. The effectiveness of the meetings will be part of the review of the effectiveness of the Search. The Diversity Committee will complete an evaluation form (see item 14 below) at the end of every search.
5. *Ad hoc* meetings of the Diversity Committee might be called to provide feedback and/or vote on issues related to the diversity budget and/or to address urgent needs, e.g. to respond to a rapidly-developing opportunity to hire a grad student, postdoc or research scientist from an underrepresented group.

Diversity Budget and Effort Tracking

6. The budget allocations and future commitments for the Diversity Committee budget will be made transparent to the committee at all Diversity Committee meetings. Budget planning for the next calendar year will occur prior to the User Committee meeting, which is typically held in October. A written line-item budget will be submitted to the Laboratory Director's Office during the laboratory budget meetings. Dis-

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cussions of policies, review of the previous year's performance and preparations for the NSF Site Visit will occur at spring meetings.

7. Decisions related to the budget will align with the goals of the Lab's diversity plan. The strategic use of funds will be informed by best practices occurring at other labs. The budget should include discretionary funds to be disbursed via a vote of the Diversity Committee as opportunities arise. The Diversity Committee can appeal to the Laboratory Director in special cases for additional support.
8. The Diversity Tracker will be eliminated, replaced by a diversity database. Diversity and Outreach information will be collected for all departments by CIRL in June and December. These will then be compiled and presented in the Annual Report (compiled in January through March), at the NSF site visit (late Spring), and at the EAC meeting (late July or early August). This presentation will include a comparison to national statistics and how we are addressing issues in representation.

Staffing

9. Responsibilities for the Director of CIRL include developing the agenda for Diversity Committee meetings and organizing and driving Diversity Committee initiatives between meetings.
10. The Director of CIRL will oversee primary staff support to the Diversity Committee who will help collect the data, compile reports, and work with HR to ensure compliance with diversity policies in hiring and recruitment.
11. The entire Diversity Committee has a responsibility to perform due diligence in reviewing all recruiting campaigns.

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7. SAFETY

It is the policy of the National High Magnetic Field Laboratory (NHMFL) to provide a safe working and educational environment for the lab community. Our Environmental, Health, and Safety (EH&S) Team works collaboratively with management, researchers, staff, and users, as well as with other public and private entities to proactively mitigate potential hazards in our industrial, laboratory, and office settings. We utilize a number of mechanisms to cultivate a forwarding thinking safety culture and diligently work to remain at the forefront of EH&S issues. Three of these tools that demonstrate our commitment to safety are:

Investments

Our investments in safety equipment and materials along with management support and employee involvement illustrates our willingness to prudently utilize resources in a manner that targets reducing injuries, illnesses and loss of property. In combination with implementing the ***Integrated Safety Management (ISM)*** system, the MagLab has strategically invested over ***$200,000*** in 2014 for safety related equipment and processes. The following examples provide a background of the sound investments and the value of safety and health at this "one of kind" research and development laboratory:

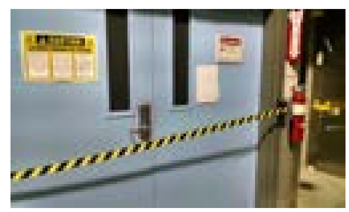
Electrical Safety Equipment

The MagLab invested *$25,000* on an automatic racking device (a circuit-breaker-removing robot).

Moving 12,470 volt breakers in and out is dangerous for humans to perform due to the possibility of an arc flash. This process is required to perform lockout isolation for maintenance on MagLab power supplies and DC magnets. The robot performs the work safely and reliably while electricians are kept a safe distance from the robot, well outside the arc flash danger zone.

Laser Lab Safety

Approximately $10,000 has been expanded to improve laser safety. This includes the installation of card readers on the doors of user labs containing class 4 lasers. In addition, doors and other barriers were added to the DC magnet user cell 5 because it contains the MagLab's unique 25T Split Magnet, a magnet that is often employed by users performing laser experiments. These improvements allow the MagLab to better control access to user laser labs, ensuring that only trained and authorized personnel enter these areas.



Personal Protective Equipment

The MagLab ***invested $10,000*** to improve arc-rated personal protective equipment (PPE) for electricians. This purchase included updated electrical gloves and new arc-rated protective suits, as well as ventilated arc-rated hoods to reduce fatigue when working in hot environments.

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Safety Training

In addition to our safety investments, the MagLab has increased awareness of safe work practices through regularly scheduled safety training initiatives. Safety training is designed to influence attitudes and knowledge of managers, supervisors, employees, users, and contractors concerning their safety and health responsibilities. In collaboration with other public and private entities, the MagLab offers a number of on-line safety training courses that intertwine with applicable hands-on safety training.

Online Safety Training Courses

In response to feedback from lab personnel, the NHMFL **improved our General Safety Training for employees and users**. These online courses are required for all employees and users. The content is streamlined and features important information with identifying and mitigating hazards through the use of ***Integrated Safety Management***.

On-Site/Hands-on Safety Training Courses

The MagLab realizes the importance of public/private safety training engagements. Through cooperation with Florida State University EH&S Department, we foster direct involvement from public/ private sector to augment and support our EH&S program. Some examples are an on-site practical regional domestic security task force exercise, which included a full scale exercise called "Operation Deep Freeze" with regional, state and local emergency responders and official evaluators who analyzed the

events and other safety training that includes: CPR/AED/First-aid training, arc flash, and fall protection training.

Safety Highlights – Communication

As we cultivate and nurture a proactive safety culture, we find that communicating safety through a variety of channels (e.g., safety committee meeting, quarterly director safety meetings, and group safety meetings) greatly enhances safety awareness while providing a harmonious balance with EH&S interests and state of the art research. A safety highlight of our comprehensive EH&S program is:

Safety Survey 2014

In order to gauge the effectiveness of the safety program and the overall attitude toward safety at the Maglab, the safety office in concert with public affairs, and the human resources department along with support and guidance from the Director's office, as well as researchers and employees conducted the inaugural Safety Survey. The data from over 200 respondents provided reliable and measurable feedback. The results of the Safety Survey indicate a favorable climate for the **ISM** process and OUR EH&S program.

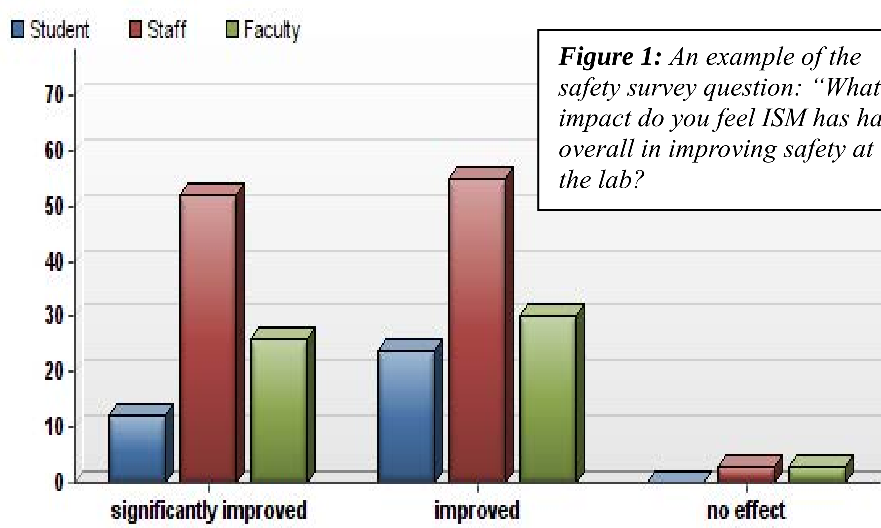

Figure 1: *An example of the safety survey question: "What impact do you feel ISM has had overall in improving safety at the lab?*

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8. BUDGET

Table 1: *Summary Proposal Budget January - December 2014*

	NSF - Funded Person-months			Funds Requested by Proposer
	CAL	ACAD	SUMR	
A. (62) TOTAL SENIOR PERSONNEL	409.29	0.00	0.00	3,015,221
B. OTHER PERSONNEL				
1. (11) POSTDOCTORAL ASSOCIATES	105.40	0.00	0.00	446,403
2. (76) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	577.47	0.00	0.00	2,830,407
3. (5) GRADUATE STUDENTS				128,442
4. (9) UNDERGRADUATE STUDENTS				58,027
5. (17) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				140,477
6. (0) OTHER Temporary				0
TOTAL SALARIES AND WAGES				6,618,977
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				2,118,337
TOTAL SALARIES, WAGES AND FRINGE BENEFITS				8,737,314
D. EQUIPMENT				1,352,989
E. TRAVEL				
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				269,433
2. FOREIGN				40,990
F. PARTICIPANT SUPPORT				
1. STIPENDS 133,200				
2. TRAVEL 9,000				
3. SUBSISTENCE 15,000				
4. OTHER 2,158				
TOTAL NUMBER OF PARTICIPANTS (22)	TOTAL PARTICIPANT COSTS			159,358

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G. OTHER DIRECT COSTS	
1. MATERIALS AND SUPPLIES	2,682,379
2. PUBLICATION/DOCUMENTATION/DISSEMINATION	0
3. CONSULTANT SERVICES	0
4. COMPUTER SERVICES	0
5. SUBAWARDS	8,667,897
6. OTHER	2,508,559
TOTAL OTHER DIRECT COSTS	13,858,835
H. TOTAL DIRECT COSTS	24,418,919
I. INDIRECT COSTS Rate: 70.0% Base $11,730,116	8,211,081
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)	32,630,000

The primary funding source for operation of the seven user programs of the National High Magnetic Field Laboratory (NHMFL) remains the National Science Foundation (NSF) and funds provided through the participating institutions: the Florida State University, the University of Florida, and the Los Alamos National Laboratory.

A. Personnel

The current level of staffing is required for the Lab to maintain user support, technology development, and science (NHMFL User Collaboration Grant Program) activities. Actual salary rates, plus a 3% increase, of existing NHMFL Staff have been used in the cost calculations. Florida State University's fringe benefit rates for permanent staff fluctuate depending on the benefit package chosen by the staff member. Therefore, an average fringe benefit rate of 34.75% is used to calculate the cost of fringe benefits for permanent staff. This rate includes social security, Medicare, health insurance, retirement, workers comp, and terminal leave payout. FSU's fringe benefit rate for postdocs and non-students is 2.25% plus the cost of health insurance. The fringe rate for Graduate and Undergraduate Students is 0.80% plus the subsidy for health insurance for Graduate Students of either $850 or $1,300 per FSU policy. In accordance with state law, Florida State University provides health insurance coverage to OPS employees working 30 hours or more per week. The annual rate for family insurance is $15,169 per employee while individual coverage is $7,098 per year.

Since the NHMFL is a large, complex, multidisciplinary user facility, there is a requirement for a larger than normal level of research and non-research support staff. The faculty included in the budget are twelve (12) month specialized research faculty (not tenured or tenure track nine (9) month teaching and research faculty). Therefore, the effort of these research faculty and the effort of other research and administrative staff identified in this proposed budget exceed the NSF two month limitation associated with regular tenure/tenure track nine (9) month teaching faculty.

Due to the mission of the NHMFL, a higher level of administrative support is required to insure successful operation of the facility. The primary responsibility of the NHMFL's administration is to ensure compliance with the terms and conditions of our sponsored project while facilitating the day-to-day work for our users and scientific staff. The NHMFL is an extension of Florida State University. Because of the requirements of the NSF Cooperative Agreement, the administrative staff exceeds the level of staff routinely provided by the university. To insure performance, the staff offers direct, on-site services to the user and research community. The administrative staff is responsible for a core set of activities including budget and finance; accounting; purchasing, shipping and receiving; human re-

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sources; facilities management and engineering; as well as safety, security and environmental protection. In addition to central departments and activities, the user divisions have a Program Associate to support and facilitate the non-science related tasks required to insure that the user program's operational needs are met. The services being provided by administrative staff are accrued solely for the benefit of the NHMFL core mission and exclusively support the NSF Cooperative Agreement. The total FTE required for administrative, secretarial, and clerical services to directly support this NSF project is thirty-one. The total administrative staff is comprised of 4.1 FTE in Secretarial/Clerical staff and 4.2 FTE in administrative staff classified as Other Professionals.

B. Equipment

Equipment funds will be devoted to mitigating equipment failures, purchasing new and updated equipment for the User Programs, and new Magnet technology. Within the five years of this grant, the overwhelming majority of equipment funds represent essential expenditures to maintain and enhance User Support.

Anticipated major equipment purchases are listed below by MagLab division. Note the total for the equipment listed below is more than our budget for equipment purchases. A portion of the equipment funds will be allocated to needs that arise throughout the project that cannot be specifically determined at this date. This need is based on historical experience in having to address unanticipated needs throughout the project period. We believe this to be a conservative estimate to cover those needs that will arise.

Throughout the year, equipment purchases will be approved based upon users' scientific needs and the progress of major projects. Our highest priority is to continue to maintain the highest quality of User Science.

Table 2: *NHMFL Specifically Budget Equipment*

Magnet Science and Technology	
PVD Sputter Equipment	200,000
32T magnet, CF 2 equipment, coil fabrication, system integration	150,000
Cu-Nb (3x77 mm, 100 meter in length) out coil for 100T MP35N for reinforcement	112,100
Cu-Nb (3 x 5.8 mm, 100 meter in length) insert coil for 100T or short pulsed coil	
Power Supply, Cell 16	20,000
DAQ equipment upkeep, Cell 16	15,000
Fabrication/Assembly Operations Milling Machine	9,500
Applied Superconductivity Center	
Replace of the Oxll 15T magnet	70,000
Bi2212 conductor (300m) for compensation coils in Platypus	50,000
Lockin Signal Recovery Model 7210	35,000
14x40 Swing geared head engine lathe	18,000
Hardness tester	10,000
National Instruments rapid, low noise data acquisition	10,000
Power resistor for dump resistor circuitry	5,000
LN2 dewar for Yates Star	5,000

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DC Field Facility	
Active Vibration Cancellation Systems (2)	120,000
Power Conditioners	80,000
Fiber Bragg Optical System	60,000
Lockin Amplifiers SR 124	28,000
LakeShore 370 AC Resistance Bridge	19,000
Keithley SMU	18,000
User Data Acquisition Computers	17,400
Lake Shore 350 Temperature Controller	5,000
Nuclear Magnetic Resonance (NMR-FSU)	
1.3 mm MAS probe	68,000
Milling machine	17,000
FTS sample cooler	10,000
Ion Cyclotron Resonance	
Replacement Turbopump (Pfeiffer)	43,000
Ultra-Centrifuge (30K g)	43,000
Lyophilizer	29,000
TSQ Quad Drivers and Associated Electronics	15,000
SpeedVac Refrigerated Vacuum Concentrator	11,750
Replacement Mechanical Pump (Edwards 40) high speed	9,000
Electron Magnetic Resonance (EMR)	
Integration of fast (ns) switch into HiPER	150,000
Replacement sweep source for the 17T broadband spectrometer	60,000
Schottky-diode high-frequency multiplier	10,000

C. Travel

Travel budget levels are required to maintain a basic level of user support, technology development and science activities. Total dollars of $269,433 are requested for domestic travel while funds of $40,990 are requested for foreign travel. Based on conference attendance and research performed in the past, the following expenditures are anticipated for travel to the following countries in 2014:

Scientific Conferences held in the United States, United Kingdom, Germany, Italy, Switzerland, and China.

Workshops held in in the United States, United Kingdom and Germany.

Research held in the United States, UK, France, and Germany.

D. Participant Support – Stipends

Research for Undergraduates:

This item is an estimate of the budget required to support the Research Experience for Undergraduates (REU) Program. Although students are

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recruited from across the United States, the requested funding is an estimate. If participants include students from FAMU or FSU (local students), housing and travel expenses are not incurred. This creates the flexibility to support more students than originally anticipated.

This summer internship program matches qualified undergraduate students with scientists and researchers at the NHMFL's three sites. The eight-week research experience offers unique opportunities to explore science at the extremes of magnetic field, pressure and temperature. Students explore contemporary science and engineering issues, working alongside some of the finest scientists, magnet designers and engineers in the world. Each student accepted by the program receives a stipend, and, if necessary, travel support and housing.

The NHMFL offers a wide range of science, math, engineering and interdisciplinary experiences in physics, chemistry, biological sciences, geochemistry, materials science and magnet science and engineering. Summer interns, working closely with their faculty mentors, are thoroughly integrated into these research and development activities. Students broaden their knowledge of the diverse research that takes place here by attending weekly seminars and colloquia.

In 2013, there were 24 students, 14 males and 10 females, and 6 minorities. There were 17 m Examples of student projects can be found at https://nationalmaglab.org/education. In 2014, the goal is to increase the number of students from underrepresented groups including women, African Americans, and Hispanic students. A special effort will be made to recruit students from HBCU, colleges and universities that serve a large percentage of African Americans, Hispanic, and other underrepresented students.

Costs: Approximately $5,880 per student – incudes $3,600 stipend; $1,000 housing; $600 non-local travel. Funds of $2,158 are reserved for mentors to purchase various supplies required for scientific experiments. Excess travel allowance not paid to local participants enables the lab to utilize these funds to increase the number of participates. The total amount of funds requested to support the REU program is $105,358.

The Research Experience for Teachers (RET) Program is a six week summer residential program that gives K-12 teachers the chance to participate in the real-world science of cutting-edge magnetic field research. Through various program activities, the teachers develop strategies and resources to translate the experience into material for their classrooms. In 2013, there were 10 teachers, 5 males and 5 females, and 1 minority. There were 6 mentors, all from FSU, who participated in the program.

The cost of the program is approximately $5,376 per teacher, which includes a stipend, housing, and non-local travel. The funding for the RET Program will be split between the NSF budget and other university funding. NSF funds will be used for stipends, while all other expenses will be covered by funds from other sources.

E. Other Direct Costs: Materials and Supplies

Approximately 1100 scientists annually request 'magnet time' for performing research and subsequently, publishing the results of their research in premier scientific journals. Other Direct expenses are necessary due to the complexity of operating and maintaining a large, international user facility while supporting the development of new magnet technology for the science community. In many cases these items may be charged to another source; however, since the NHMFL is a NSF funded user facility, these charges are directly related to the lab's mission as set forth in the Cooperative Agreement.

Specific purchases in this category include but are not limited to:

- Helium and nitrogen are required components for the operation of the assorted magnets located within the lab. These commodities represent a significant amount of the materials and supplies budget.
- Computer hardware and software which are dedicated to or support scientific instrumentation in the user facility or are required for experiment control, data acquisition, or scientific analysis. As a user facility, the NHMFL supports a variety of computing systems and services for international, academic, and government researchers which require computing hardware and specialized software. These costs are necessary to support the operations of a user facility and can be identified readily with the NSF Cooperative Agreement.
- Instrumentation and lab equipment such as voltmeters, current sources, thermometers, pumps, glassware, tape, etc. are required for various labs used by researchers and users.
- Chemicals and raw materials such as acids and bases, reagents, metal, plastics, etc. are required

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for researchers to conduct their research.

- Safety equipment such as safety glasses, gloves, fall protection, harnesses, electrical safety gear, etc. These items are required to insure the safety of the staff.
- Postage expense is used for activities required by the NSF Cooperative Agreement such as: MagLab Reports and other research reports to national and international users and prospective user, other documents deemed necessary to meet the needs of our users and to further our commitment to education, research and learning. In order to support education at all levels, K-12, technical, undergraduate, graduate and postdoctoral, the dissemination of educational materials through the mail becomes greater than customary in an academic department. These mailings are readily identifiable and significantly exceed the level of postage normally associated with other sponsored projects.

F. Sub-Awards

The proposed level of funding is required to maintain the level of operations for the AMRIS, High B/T and Pulsed Magnet User Programs that promote magnet-related research for the scientific user community. Detailed budgets and budget justifications for each individual division reflect their specific spending plan. A subaward to Steven Beu, Consultant, will be funded from the Ion Cyclotron Resonance (ICR) User Program fund. As in the past five years, Dr. Beu will continue to consult with the ICR Program on the development of new ion transfer optics and techniques for improved ion transmission and decreased time-of-flight mass discrimination in FT-ICR mass spectra.

G. Other Direct Cost

Electricity – Funds to cover part of the electrical costs for magnet use is requested. This cost is an extraordinary cost for electrical power and represents unlike circumstances since the magnets require large amounts of electricity to operate. The electrical costs attributed to the magnet operation which has been direct charged to the NSF Core since NSF first began funding the Lab is not included in FSU's indirect cost but has been treated as other direct costs charged to grants and included in our research base when preparing our F&A rate proposal.

These costs represent unlike circumstances because the electrical power does not support the general power needs required of all buildings and labs, i.e. overhead lights, small office and lab equipment, room heating and cooling, etc. The electrical power usage for the magnet operation is separately metered from other normal electrical demands. Because the magnet operations require such a huge amount of power, this is a cost directly required in order to support a user facility. The amount of available user time will be impacted without these funds to assist in covering the costs of magnet operations. The total electricity budget for FY 2014 is $2,645,323 of which $1,800,000 is a part of the NSF budget. The budget was based on the average cost of electricity over the last few years. Funds received from FSU in the amount of $845,323 will be used to subsidize the cost of electricity. At this time we do not expect an increase in the rates for electrical power from the City of Tallahassee.

Florida State University receives two power bills each month. One is the Electric Contract (Interruptible) and the other is the Electric Large Demand (Firm). These bills are generated from two different sets of meters. The electrical system is segregated into (1)the power required to run the high power DC Field magnets (Interruptible) and (2) all power that is for general building operations (lighting, heating and cooling, computers and any scientific equipment (Firm). For the magnets (Interruptible) the NHMFL has a special rate, since the City of Tallahassee can contact the lab and interrupt the power for magnets if the need occurs. Florida State University pays for the Electric Large Demand (Firm) from university funds, while the Electric Contract (Interruptible) is paid with NSF funds since that electricity is directly used for magnet operations.

Tuition –The NHMFL mandates that only In-State tuition waivers may be paid and tuition rates do not include student related fees. For FSU FY 2014-2015 the tuition rate per hour is $433.77. Graduate students are required to be enrolled for nine hours each semester. The cost of tuition for nine hours per semester is $3,904. These costs, which are the standard tuition rates for FSU, were used to calculate the tuition for each Graduate Student based on the length of their appointment. The total cost of tuition for Graduate Students for FY 2014 is $58,559.

Tuition rates and annual increases are set annually by the Florida Legislature and the Florida State University Board of Trustees. The current approved rate of increase is 7.5% per year.

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User Collaboration Grant Program -(UCGP)– The National Science Foundation has charged (through the Cooperative Agreement) the NHMFL with developing an in-house research program that utilizes the NHMFL facilities to carry out high quality high field research at the forefront of science and engineering; and advances the NHMFL facilities and their scientific and technical capabilities. To this end, the NHMFL's Users Collaboration Grants Program seeks to achieve these objectives through funded research projects of normally 2 years duration in the following categories:

- Collaborations between internal and/or external investigators that utilize their complementary expertise
- Bold but risky efforts which hold significant potential to extend the range and type of experiments
- Initial seed support for new faculty and research staff, targeted to magnet laboratory enhancements.

The UCGP strongly encourages collaboration between NHMFL scientists and external users of the NHMFL facilities.

Funds in the amount of $650,000 have been designated to support UCGP funding for FY 2014.

H. Indirect Cost

Per the Florida State University's Indirect Cost Rate Agreement, the approved indirect cost rate for NHMFL awards is 70% modified total direct costs (MTDC).

I. Budget Justification – UF – HIGH B/T FACILITY

Personnel

Neil S. Sullivan is the Director of the University of Florida's High B/T Facility for the National High Magnetic Field Laboratory (NHMFL) and is responsible for the overall operation of the Ultra-Low Temperature Program of the NHMFL. The facility is a User facility and is open to all qualified users. Users submit proposals that are reviewed by local and external scientists for scientific merit and feasibility.

Liang Yin, 12 calendar months, is a research scientist who operates both Bay 2 and Bay 3 of the Microkelvin Laboratory for external users. He is directly responsible for co-ordination with new users and the planning of experimental cells for installation on the nuclear demagnetization refrigerators.

Alessandro Serafin, 12 calendar months, is a post-doctoral fellow who leads the development of new instrumentation for users and who assists Liang Yin in the design and setup of experiments for users. *Allen Majewski*, 12 calendar months, is a graduate student who is developing a specialized superheterodyne pulsed spectrometer for deployment in the High B/T facility for low temperature high field studies. This technology is needed by users exploring the phase changes in quantum organic magnets and also for users studying pyrochlores and spin-ice candidates at very low temperatures. *Jian-sheng Xia* is a full-time research scientist who is the technical manager of the Microkelvin Laboratory and who operates the fast-turn around dilution refrigerator system.

Naoto Masuahara is a full-time engineer who operates Bay 2 of the UF Microkelvin Laboratory for NHMFL users and is responsible for building maintenance and safety issues.

Darline Latimer is responsible for the administrative activities necessary to run the NHMFL High B/T program.

Equipment

Equipment funds will be used for the purchase of new equipment in the High B/T Facility to support advanced instrumentation for the NHMFL external user program. This includes equipment for developing new transport measurements and new RF capabilities for NMR and NQR measurements at low temperatures. We plan to purchase an advanced RF power amplifier with blanking, a digital storage oscilloscope, and a precision DC source.

Travel

Travel support is requested to meet partial costs for selected staff to attend the American Physical Society meeting and the International Low Temperature Conference.

Materials and Supplies

Funds are requested to meet the costs of liquid helium and nitrogen supplied by the Department of Physics at $2.50 per liter. The remaining funds will be used to purchase small items such as tools, small electronic components, vacuum and gas plumbing, and miscellaneous supply items.

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Table 3: *High B/T Facility Specifically Budgeted Equipment*

RF Power Amplifier	28,584
Digital Storage Oscilloscope	7,610
Precision DC Source	5,671

J. Budget Justification – UF-AMRIS

Personnel

Joanna Long is the AMRIS Director and co-PI of the subcontract. She is responsible for the overall operation of the AMRIS user program, distributing the NHMFL supply money to pay for AMRIS fees.
She also directs the dynamic nuclear polarization technology program to enhance the NHMFL external user program. She has 3 months total effort, divided into 1.5 months for AMRIS and 1.5 months for the DNP initiative.
Thomas H. Mareci, 1.2 calendar months, is the AMRIS Associate Director and directs the high field structural and functional MRI program to enhance the NHMFL external user program.
Arthur S. Edison, 1.2 calendar months, directs the high sensitivity NMR technology program to enhance the NHMFL external user program and serves on the NHMFL diversity committee.
Glenn Walter, 1.2 calendar months, leads the molecular imaging technology program to enhance
the NHMFL external user program and serves on the Science Advisory board.
Steve Blackband, 1.2 calendar months, leads the micro imaging technology program to enhance the NHMFL external user program and is also the UF liaison in discussions of HTS magnet development projects.
Gail Fanucci, 1.2 calendar months, is a member of the Science Advisory board and develops technology in the DNP program. She is also the UF liaison between the EMR and NMR groups of the NHMFL.
Denise Mesa., 3.6 calendar months, is responsible for the reporting and secretarial activities necessary to run the NHMFL external user program.
Malathy Elumalai, 12 calendar months, is the RF engineer responsible for designing, constructing, testing, and maintaining unique RF coils for the horizontal animal imaging systems and the WB 750 system within the AMRIS facility as well as coordinating with new RF projects pursued by the NMR probe development group in Tallahassee.

Equipment

We have budgeted $100,000 each year for the purchase of new equipment in the AMRIS facility to support the NHMFL external user program. This includes equipment for 8 spectrometers, an RF engineering laboratory, and staff scientists. Typical items include new RF or gradient amplifiers, new NMR probes, RF frequency generators, computer workstations, network analyzers, and animal monitoring equipment.

In FY 2014 we will be specifically directing these funds to upgrade the larger gradient coils on our world unique 11 T / 40 cm MRI/S system, to develop new low temperature coils for DNP experiments, to develop quadrature coils for the WB 750 animal imaging system, to develop ^{13}C volume coils for the 11T and 4.7 T MRI/S systems, and to purchase a high power amplifier for ^{13}C excitation on these systems.

Travel

We have budgeted $32,000 for travel in FY 2014. This includes support for users on a limited basis, support for UF scientists to collect data in Tallahassee, travel to scientific meetings, and travel to NHMFL meetings.

Materials and Supplies

We have budgeted $312,718 for materials and supplies. These funds will be used to pay for AMRIS instrument time and staff fees for the NHMFL external user program. The AMRIS facility operates under federal cost accounting standards (CAS) and is required to charge users fees for all users. These

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fees are billed hourly for each instrument and for each staff member that provides direct support to a project via consulting rates. Our fee structure is audited annually so that our facility runs cost neutral and hourly rates are publicized on our website. These funds also pay for development time on the instruments for NHMFL initiatives, and an RF engineer who is responsible for designing, constructing, testing, and maintaining unique RF coils for the external user program as well as coordinating with new RF projects pursued by the NMR probe development group at the NHMFL-Tallahassee.

Table 4: *AMRIS Facility Specifically Budgeted Equipment*

Upgrade Gradient Coils on 11T/40CM MRI/S System	65,000
Develop New Low Temperature Coils for DNP	5,000
Develop Quadrature Coils for WB750 Animal Imaging System	5,000
Develop ^{13}C Volume Coils for the 11T and 4.7T MRI/S Systems	5,000
High Power Amplifier for ^{13}C excitation	20,000

K. Budget Justification –
LOS ALAMOS NATIONAL LABORATORY

The Pulsed Field Facility at Los Alamos National Laboratory continues to provide NHMFL users' access to pulsed magnetic fields for reviewed and approved research. We will continue to develop state-of-the-art pulsed magnet systems and operate them for qualified users. The total FY14 budget of $6,798,397 will be used for operation of the user program, which includes salaries, materials and supplies, and consumables such as liquid cryogens and a travel budget.

Personnel

Charles H. Mielke is the Director of the Pulsed Field Facility and is responsible for the overall operation of the Los Alamos National Laboratory based NHMFL-PFF.

Scientific User Support Staff will be assigned to work directly with qualified NHMNFL-PFF users to conduct experiments in high magnetic fields. The expert scientific staff possesses demonstrated competencies in magneto-transport, magnetic susceptibility, magneto-optical spectroscopy, thermal transport, radio frequency contactless transport, specialized non-metallic cryogenic systems and pulsed field diagnostic and analysis specializations. This skill set from this group of 9 individuals is first rate in the world for state-of-the-art pulsed magnetic field experimentation. Working to enable users to return home with a complete set of data that is analyzed and interpreted is an essential function of the NHMFL-PFF.

The Engineering Staff are responsible for the development of pulsed magnet systems and the engineering support/operation of the 1.43 billion watt generator system located at LANL. The world class 100 tesla Multi-Shot Magnet has set the World record for highest non-destructive pulsed magnetic field and more importantly delivered nearly 1000 high field pulses for users. This system requires expert attention and monitoring to safely operate it and maintain it for future experiments. The insert magnet system requires highly specialized design and optimization and monitoring. The NHMFL-PFF engineers are fully committed to the smooth operation of this world-class system, and their participation and dedication is essential.

Technician Support at the NHMFL covers direct interfacing with users to provide needed technical resources for a successful user experience, infrastructure support to maintain our user magnet cells, and ancillary equipment. The 65 tesla user magnets are manufactured fully in house because these are highly specialized units under tremendous stress. The workhorse magnets are fired approximately 6000 times each year for users and must be replaced about every 1000-1200 shots. Two technicians are dedicated to this effort currently. The operation and maintenance

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of the 1.43 billion watt generator system is used for the 100 tesla multi-shot magnet and the 60 tesla long pulse magnet. This generator system can safely deliver up to 600 million Joules of energy in its current configuration and is arguably the best and safest way to deliver the very large electrical energy pulse to our largest magnet systems. Three technicians are dedicated to operation of this system and the maintenance of the generator. The NHMFL-PFF has achieved first ever status on several magnet systems in part due to this LANL resource made fully available to the NHMFL-PFF program and our technicians are highly trained professionals needed to safely operate this system to deliver magnet pulses of immense electrical energy magnitudes. A total of seven technicians are required to operate the NHMFL-PFF as described above.

Postdocs and Students are an important aspect to the NHMFL-PFF. Postdocs and students are active at the NHMFL-PFF. Students that are funded through core NSF program support are of strategic design. The funded students are engaged in strategic scientific areas or targeted diversity development opportunities.

Contractor support is highly focused and relatively temporary in nature at the NHMFL-PFF. Contracts are annually renewed and may be task specific. Effort is directed towards magnet design and 3-D modeling, working very closely with the design engineers responsible for bringing our unique and world leading pulsed magnet designs forward into the future and ahead of the competition. The generator system requires the precise development and updating of its extensive control system and effort is also directed toward that project and the maintenance of the generator control system. That effort is essential as control components age beyond useful repair life cycles and must be repaired or replaced with safety certified components. A total of more than 5000 diagnostic signals are actively monitored and controlled continuously for every pulse of our 1.43 billion watt generator system and the controls engineer contractor is essential for completing the systems upgrades and maintenance to the level we need for sustained operations.

Equipment

No funds are requested for equipment.

Materials and Supplies

The amount of funds required for materials and supplies is determined by considering historical rates of consumption of products like liquid cryogens and magnet winding materials and allocating a flexible amount of remaining funds from our budget positioning projections based on labor planning so that low cost consumables may be purchased to enable the scientific staff, technicians and postdocs and students to have the flexibility to develop new pulsed field probes and measurement techniques based on general materials and consumables. Fiberglass rods, thermometer chips, fiber optical cable, and machined specialized parts are utilized for developing new research probes for pulsed field diagnostic developments.

Travel

Travel funds are used for experimental user support efforts at the NHMFL-DC Field Facility and to support travel to conferences and workshops for communication of the NHMFL-PPF user program capabilities and accomplishments.

L. Budget Justification - Steven Beu

Dr. Steven Beu will perform objective scientific analysis in support of new development in Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry. Dr. Beu will conceive new methods, develop models and experiments to test the methods, collect and interpret data, prepare manuscripts, present his findings at national meetings, and recommend future directions.

Services will be billed quarterly at a rate of $100 per hour for a total amount payable not to exceed $55,000 for FY 2014.

See Appendix V for Statement of Expenses and Encumbrances as of 12/31/14 and Statement of Residual Funds – FY 2014

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9. COST RECOVERY FROM SERVICE AND INDUSTRY USE

Seldom does the NHMFL incur costs due to resources used or sacrificed for companies doing proprietary research. On occasion, companies will need access to the unique equipment at the NHMFL, and they will contract for the use of said equipment. The NHMFL has established procedures to accumulate and report costs continuously, routinely, and consistently for all such contracts based upon an agreed-upon schedule of fees and costs to cover the use of such equipment that involves proprietary research.

Hourly rates have been calculated based on equipment, salary, consumables, and indirect expenses. For example, a company may need to use FT-ICR mass spectrometers, Liquid Chromatographic equipment, and/or low-resolution mass spectrometers as appropriate for particular experiments. They do so at an hourly basis based on the agreed-upon schedule of fees and costs that allow us to recover our costs.

In FY 2014, the NHMFL recovered cost reimbursements of $23,282.00, primarily from one contract for proprietary research. The contract was with OMICS, LLC. This company performed analysis of oil samples for such companies as ExxonMobil, BP, Nalco, Ecopetrol, GE, Cobalt, BakerPetrolite and Schlumberger DBR.

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10. INDUSTRIAL PARTNERS AND COLLABORATIONS

MAGNETS, MAGNET TECHNOLOGIES AND MATERIALS FOR MAGNETS

Advanced Conductor Technologies, Boulder, CO

The Applied Superconductivity Center and the Magnet Science and Technology division of the Magnet Lab are collaborating with Advanced Conductor Technologies on the development and testing of Coated Conductor Stranded Cable (CCSC), using multi-layer spiraling tapes around a core, for magnet applications. Danko van der Laan, director of the company and 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 (4 K and 20 T in Cell 4) continues to set new benchmarks for peak current, current density, bend radius and ramp rates.
(Magnet Lab contact: Huub Weijers, MS&T)

Bruker EAS GmbH, Hanau, Germany

Bruker EAS is manufacturing accelerator quality Nb_3Sn strands based on the powder-in-tube process that have the potential to provide the performance necessary for higher magnetic field upgrades to the Large Hadron Collider at CERN and the Applied Superconductivity Center is collaborating with Bruker and CERN to optimize the performance of the wire utilizing the electromagnetic testing and advanced microstructural and microchemical analysis facilities at the MagLab.
(Magnet Lab contacts: Chiara Tarantini, Peter J. Lee and David C Larbalestier, ASC)

Callaghan Innovations, Lower Hutt, New Zealand

The Applied Superconductivity Center and the Magnet Science and Technology division of the Magnet Lab are collaborating with researchers at New Zealand's Industrial Research Limited on the testing of Roebel-style cables based on REBCO coated conductors, a high temperature superconductor. Testing of a 15-strand cable with transposed 5 mm wide strands is in preparation. Roebel-style cables represent one of three viable concepts for REBCO coated conductor cables suitable for high field magnets.
(Magnet Lab contact: Bob Walsh, MS&T)

CERN, Geneva, Switzerland

The Large Hadron Collider (LHC) at CERN uses a 27 km ring of superconducting magnets based on Nb-Ti to accelerate particles in the world's largest and most powerful collider but plans to increase the energy capability of LHC will require higher magnetic fields. The Applied Superconductivity Center is collaborating with CERN to characterize and optimize a new generation of accelerator quality Nb_3Sn strands based on the powder-in-tube process that have the potential to provide the performance necessary for the next step in LHC upgrades.
(Magnet Lab contacts: David Larbalestier, Chiara Tarantini and Peter Lee, ASC)

Danfoss Turbocor Inc., 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 other materials for high performance and environmentally friendly compressors.
(Magnet Lab contact: Ke Han, MS&T)

EUCARD2 (European Collaboration for Accelerator R&D)

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 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 DOE-HEP support in the context of the Bismuth Strand and Cable Collaboration

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(BSCCo) that unites the MagLab, BNL, FNAL, LBNL and OST in a team developing this material for accelerator use. The MagLab is now the US point of contact for collaborations between EU-CARD2 and the US program.
(Magnet Lab contacts: David Larbalestier, Eric Hellstrom and Jianyi Jiang, ASC)

Fermilab, Batavia, IL

The shaping of Nb sheet to produce superconducting RF cavities introduces microstructural defects that may impact cavity performance; in collaboration with Fermilab the Applied Superconductivity Center is studying the surface and bulk superconductivity in deformed niobium wires. Controlled deformation is introduced into the Nb samples wire drawing and the resulting defects are quantified and compared to the measured superconducting properties.
(Magnet Lab contact: Peter J. Lee, ASC)

Helmholtz Zentrum Berlin, Berlin, Germany

The MagLab has partnered with the Helmholtz Zentrum Berlin (HZB) to develop the highest field magnet worldwide for neutron scattering at HZB. In March 2007, HZB (formerly the Hahn-Meitner Institute) signed an agreement with Florida State University Magnet Research and Development Inc. The magnet is intended to provide 25 T on-axis using 4.4 megawatts of DC power and have upstream and downstream scattering angles of 30 degrees. The magnet reached full field on October 16, 2014. Since then it has been moved from the test site into the neutron guide hall and is expected to be fully operational in the 2nd quarter of 2015.
(Magnet Lab contact: Mark D. Bird, MS&T)

High Performance Magnetics (HPM), Tallahassee, FL

HPM is a spin-off from the Magnet Lab's Magnet Science & Technology Division and is involved in the USDOE ITER program. The Cable-in-Conduit-Conductor (CICC) technology used successfully in the NHMFL has led to the development of a state-of-the-art CICC jacketing production line. HMP collaborates with the Magnet Lab to develop test methods and processes that are mutually beneficial for the advancement of CICC technology.
(Magnet Lab contact: Bob Walsh, MS&T)

Hyper Tech Research Inc, Columbus, OH

Hyper Tech Research Inc. develops and manufactures MgB_2 superconducting wires for MRI applications. In this collaboration, the Magnet Science and Technology division measures critical current of MgB_2 wires developed by Hyper Tech Research. The critical current measurements are performed at 4.2 K and in 0 – 10 tesla magnetic fields.
(Magnet Lab contact: Jun Lu, MS&T)

International Thermonuclear Experimental Reactor (ITER International Organization), Cadarache, France
US-ITER Project Office, Oak Ridge, TN
University of Twente, Enschede, the Netherlands

The Applied Superconductivity Center has for the last 5 years played a major role in helping ITER-IO understand the properties of the cables being wound into the Central Solenoid (CS) and the Tokamak Field (TF) coils. A central task has been the disassembly and metallographic analysis of the prototype Cable-in-Conduit-Conductors (CICCs) needed for TF and CS coils after testing in the SULTAN facility in conditions designed to simulate ITER operations. Many of these conductors Toroidal Field (ITER Organization) and Central Solenoid (US-ITER) CICCs typically suffered significant performance degradation during cyclic loading and occasional warm-up and cool-down cycles. The tests performed at the MagLab were able to identify many of the causes for this degradation and were instrumental in developing new cable patterns that resolved the degradation. This work was collaborative with groups at CEA-Cadarache, the University of Twente in the Netherlands and US-ITER.
(Magnet Lab contacts: Peter J. Lee and David C Larbalestier, ASC)

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. The MS&T's Mechanical Properties Lab is the US-ITER primary materials research and qualification laboratory supporting the US effort. The Tokamak machine consists of three types of very large, complex superconducting mag-

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nets that all utilize Cable-in-Conduit Conductors (CICC) as the main structural components. Another important component for stress management of the Central Solenoid is a massive CS pre-compression structure (Tie Plates). The conduit and tie plate alloys, and their welds, are being studied and characterized here to ensure their performance and reliability. The funding for this research is provided by US-DOE, US-ITER Project Office at ORNL.
(Magnet Lab contact: Bob Walsh, MS&T)

Jefferson Lab, Newport News, VA

Jefferson Lab are developing the next generation of Nb film coated Cu RF cavities and the Applied Superconductivity Center is assisting with the microstructural characterization of single-cell Cu cavities fabricated using a cathodic-arc-discharge (CAD) coating of Nb onto Cu.
(Magnet Lab contact: Peter J. Lee, ASC)

Key Laboratory of Electromagnetic Processing of Materials, Northeastern University, Shenyang, China

The collaboration between the Northeastern University and the Magnet Lab is related to the magnetic field impact on fabrication of high strength conductors. A student from Northeastern University joined the MagLab as a visiting scientist for two years to do the research. The collaboration is a continuous effort and a student arrived at the MagLab in 2013 and will stay for two years. A MagLab faculty member visited Northeastern University in 2014.
(Magnet Lab contact: Ke Han, MS&T)

Large Accelerator Project for the HiLumi upgrade of the CERN LHC, Brookhaven National Lab, Upton, NY

Accelerator magnets based on Nb_3Sn wires are required to provide the increased magnetic fields for the next LHC upgrade. The Applied Superconductivity Center is collaborating with Brookhaven National Lab to understand the design and heat treatment optimization of accelerator magnet quality strand fabricated by the internal Sn process with a view to driving high current density strands to smaller filament sizes. Close collaboration with the R&D billets being manufactured for LARP under the Conductor Development Program of DOE High Energy Physics is a key part of the work.
(Magnet Lab contacts: Chiara Tarantini, Peter J. Lee and David C Larbalestier, ASC)

Lawrence Berkeley Laboratory, Accelerator and Fusion Research, Berkeley, CA

The Applied Superconductivity Center and the Magnet Science and Technology division of the Magnet Lab are collaborating with researchers at the Berkeley National Laboratory on the testing of Roebel-style cables based on REBCO coated conductors, a high temperature superconductor. Testing of a 10-strand cable with transposed 2 mm wide strands is in preparation. Roebel-style cables represent one of three viable concepts for REBCO coated conductor cables suitable for high field magnets.
(Magnet Lab contact: Huub Weijers, MS&T)

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. NHMFL 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 NHMFL's unique test facility designed for tests of large conductors in a 12 tesla split solenoid superconducting magnet system.
(Magnet Lab contact: Bob Walsh, MS&T)

Michigan State University, Lansing, MI

The Applied Superconductivity Center is collaborating Michigan State University on a US-DOE funded project to study the impact of grain boundaries and associated microstructural defects on the performance of superconducting cavities using the advance microstructural, microchemical, and electromagnetic characterization techniques and expertise available in the MagLab. The new ultra-high resolution analytical TEM/STEM is particularly important for this work.
(Magnet Lab contact: Peter J. Lee, ASC)

Nb_3Sn superconducting strand verification testing for US-ITER, US-ITER Project Office, Oak Ridge, TN

The quality assurance testing is critically important to the international thermonuclear fusion project, ITER. The collaboration between the Magnet Science and Technology division and the US-

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ITER focuses on the characterization of Nb_3Sn wires used for ITER project. This involves large volume of quality assurance testing of superconducting properties of Nb_3Sn wires. The Nb_3Sn properties tested include the critical current, residual resistivity ratio, hysteresis loss, and room temperature metrology measurements.
(Magnet Lab contact: Jun Lu, MS&T)

Oxford Instruments, Abingdon, UK

Oxford Instruments is under contract to deliver a 15 T large-bore low temperature superconductor magnet to the NHMFL, to be combined with 17 T YBCO-coated conductor coils under development at the NHMFL to create the first 32 T 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 cannot be handled by routine specifications in a standard vendor relationship. Therefore, Oxford Instruments and NHMFL Magnet Science and Technology are collaborating on quench protection to endure compatibility of the coil sets and are developing a numerical code to model quench in combined YBCO-LTS magnets.
(Magnet Lab contact: Huub Weijers, MS&T)

Oxford Superconducting Technology (OST), Carteret, NJ

Extensive collaborations exist between ASC and OST 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 OST through the Conductor Development Program managed out of Lawrence Berkeley National Laboratory. In this way OST has been able to develop the most advanced Nb_3Sn and Bi-2212 conductors made.
(Magnet Lab contacts: David Larbalestier, Eric Hellstrom, Peter Lee, Chiara Tarantini, Jianyi Jiang, ASC)

Radboud University, Nijmegen, The Netherlands

The MagLab has partnered with the High Magnetic Field Lab in The Netherlands to develop a 45 T hybrid magnet using only 24 MW 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 4th hybrid outsert to be developed at the MagLab (MagLab 45 T, HZB, FSU SCH, Nijmegen) and the Dutch lab will benefit from our extensive experience. When complete it will be one of the two highest-field DC magnets in the world. Cable-in-conduit conductors are expected to arrive in Feb 2015 with winding to start thereafter, followed by jointing, reaction, impregnating and final assembly.
(Magnet Lab contact: Mark D. Bird, MS&T)

Shanghai University, Shanghai, China

The collaboration between the Shanghai University and the Magnet Lab is related to the solidification of metallic materials. A scientist from Shanghai University joined the MagLab as a visiting scientist for one year to do the research on inclusions formed during the solidifications.
(Magnet Lab contact: Ke Han, MS&T)

SuperPower Inc, Schenectady NY

The Applied Superconductivity Center and the Magnet Science and Technology division of the Magnet Lab 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. We work to improve our understanding of this product in support of the NHMFL 32 T project as well as to provide guidance to SuperPower on enhancing the quality of their product. We have 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.
(Magnet Lab contacts: David C Larbalestier, Dmytro Abraimov and Jan Jaroszynski, ASC and Huub Weijers MS&T)

SupraMagnetics, Inc., Plantsville, CT

The Applied Superconductivity Center is participating in the development of a superconducting Nb_3Sn wire that uses artificial flux-pinning centers to achieve high critical current densities. The MagLab provides microstructural and microchemical support for this work.
(Magnet Lab contact: Peter J. Lee, ASC)

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Texas A&M University, College Station, TX

Texas A&M University is fabricating Nb sheet and tubes with ultra-fine grain size and controlled textures for superconducting RF cavities by using the Equal Channel Angular Extrusion (ECAE) process; the Applied Superconductivity Center is providing microstructural characterization of the Nb primarily using the new fast-camera crystallographic orientation mapping system at the MagLab.
(Magnet Lab contact: Peter J. Lee, ASC)

Thomas Jefferson National Accelerator Facility, Newport News, VA

Large-grain Nb has become a viable alternative to fine-grain Nb for the fabrication of superconducting radio-frequency cavities. NHMFL collaborated with engineers at Jefferson Lab to evaluate the effect of thermal processing and grain size on the mechanical properties of Nb. The mechanical properties evaluation was carried out at MS&T's Mechanical Properties Lab.
(*Magnet Lab contact: Bob Walsh, MS&T*)

University of Colorado Boulder, Boulder, CO

Nb_3Sn is the primary superconductor for providing magnetic fields in the 11-22 T range but is brittle and there is the potential for filament fracture when subjected to the high Lorentz forces produced when the superconducting magnets are energized. The University of Colorado Boulder, (using the NIST-Boulder electromechanical testing facilities) has determined the strain sensitivity of a wide range of commercial Nb_3Sn wires and has found a large variation in irreversibility strains (the limit in strain that the wire can be subjected to before unrecoverable degradation in performance), and the Applied Superconductivity Center has been working with UC-Boulder to try and the understand reasons for these variations so that future strands will be able to withstand the forces generated at high magnetic fields.
(Magnet Lab contact: Peter J. Lee, ASC)

ULTRA-LOW TEMPERATURE RESEARCH (HIGH B/T)

European MicroKelvin Platform (EMP)

The University of Florida MicroKelvin Laboratory and the National High Magnetic Field Laboratory's High B/T Facility has entered into a co-operative agreement with the European Microkelvin Platform (EMP) to establish a program of collaborative research in areas of mutual interest at ultra-low temperatures, with a focus on promoting and facilitating, where feasible, exchange visits for scientists and students. The EMP is a consortium of 20 leading ultralow temperature physics and technology partners in Europe. The main aim of the consortium is the further integration of ultralow temperature research for the development of new ideas, knowledge, technology, applications and commercial exploitation to enhance further the innovation potential in this field. In addition to research activities, the parties to this agreement will co-operate in the training of ultra-low temperature physicists through course offerings to qualified candidates such as the European Advanced Cryogenics Course and the Cryogenics Course at the University of Florida.
(Magnet Lab contacts: Neil Sullivan)

Korea Advanced Institute of Science and Technology (KAIST)

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.
(Magnet Lab contacts: Yoonseok Lee)

ELECTRON MAGNETIC RESONANCE (EMR)

Bruker Biospin Corp, USA

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, 600 MHz/14.1 T DNP probe) beyond their normal commercial uses by making technical modifications. The modifications allow the DNP instruments to be more user program friendly without voiding the warranty.
(Magnet Lab contact: Stephen Hill, EMR)

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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.

(Magnet Lab contact: Likai Song, EMR)

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.

(Magnet Lab contact: Stephen Hill, EMR)

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 (1 kW) high-frequency (94 GHz) pulsed EPR spectrometer (HiPER) for its user program.

(Magnet Lab contact: Stephen Hill, EMR)

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 (14.1 T / 600 MHz). TK draws on tool-making skills to design and develop quasi-optical Terahertz systems and subsystems.

(Magnet Lab 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.

(Magnet Lab contact: Stephen Hill, EMR)

ION CYCLOTRON RESONANCE

Future Fuels Institute

The Future Fuels Institute (FFI) was established to enhance the existing Ion Cyclotron Resonance (ICR) Program at the NHMFL to deal specifically with biological 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 problem solving. FFI is actively seeking up to 6 industrial collaborators as corporate MEMBERS to support core research programs. Each of these corporate members will be asked to provide $250,000/year for 4 years. The MEMBER may terminate the membership by giving the INSTITUTE 30 days written notice prior to the membership renewable date.

Current corporate members include:

- ConocoPhillips
- Petrobras
- Reliance Industries

The institute also serves as a training center for fuel-related science and technology.

(MagLab contact/Director: Ryan Rodgers)

Leco Corporation

The ICR Program collaborates with the instrumentation and application scientists at Leco to determine the utility of high resolution mass spectrometry in energy and fuel research. Current work focuses on pyrolysis gas chromatographic analysis performed with a high resolution time-of-flight mass spectrometer.

(Magnet Lab Contact: Ryan Rodgers, ICR)

Scripps Research Institute

We continue to collaborate with Dr. Ming Guo (Scripps Florida), for structural characterization of transfer RNA synthetases functioning in roles other than protein synthesis. Those functions result from complexation of a given synthetase with one or more other proteins. Synthetase mutations lead to various diseases. Scripps provides the mutants, and we use

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hydrogen/deuterium exchange monitored by FT-ICR mass spectrometry to map the protein:protein contact surfaces in the complexes to establish structure function relationships.
(Magnet Lab Contact: Alan Marshall, ICR)

University of Texas Medical Branch at Galveston
The ICR Program collaborates with Profs. Carol L. Nilsson and Mark R. Emmett. One current project is proteomics and glycomics of brain cancer-derived stem-like cells correlated to gene expression data and patient outcomes. A second project involves FT-ICR mapping of lipid alterations in spinal cord injury.
(Magnet Lab Contact: Alan Marshall, ICR)

Waters Corporation
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.
(Magnet Lab Contact: Ryan Rodgers, ICR)

Woods Hole Oceanographic Institute
As part of FSU's Gulf Research Initiative Consortium, NHMFL collaborates with Christopher Reddy and Robert Nelson at WHOI in characterization of petroleum oil spills at the molecular level, by gas chromatography x gas chromatography and FT-ICR mass analysis. Characterization of the 2010 Macondo wellhead oil has been completed, and current research focuses on subsequent physical, chemical, and biological changes as the spill propagates into the environment.
(Magnet Lab Contact: Ryan Rodgers, ICR)

NUCLEAR MAGNETIC RESONANCE

Agilent Technologies, Life Sciences/ Chemical Analysis Division, Santa Clara, CA
Investigators from Magnet Lab facilities at UF and FSU collaborate with technical staff at Agilent on an NIH-funded project to develop improved superconductive cryogenic probes for solution NMR.
(Magnet Lab contacts: William Brey, NMR and Art Edison, AMRIS)

Bruker Biospin Corp., Billerica, MA
The Magnet Lab's NMR instrumentation program and Bruker Biospin collaborate on the development of Low-E probes for solid-state NMR in heat sensitive biological samples, such as proteins. Bruker Biospin manufactures a line of Efree probes based on the Low-E design developed at our lab.
(Magnet Lab contact: Peter Gor'kov, NMR)

Revolution NMR, LLC, Fort Collins, CO
Revolution NMR has licensed from FSU the Low-E probe technology developed at Magnet Lab in order to fabricate static NMR probes for biological (protein) samples. Additionally, the Magnet Lab's NMR instrumentation program and Revolution NMR collaborate on the development of stators for magic angle spinning NMR.
(Magnet Lab contact: Peter Gor'kov, NMR)

Southeast Center for Integrated Metabolomics, University of Florida, FL
With a new $9 million grant from National Institutes for Health, the University of Florida created a Southeast Center for Integrated Metabolomics which joins a consortium of five other regional resource centers and a national coordinating center to spur metabolomics research in the United States by funding training, technology development, standards synthesis and data-sharing initiatives. Metabolomics draws from many scientific disciplines, including chemistry, physiology, statistics, genetics, computer science and systems design and, as such, has many partners: the National High Magnetic Field Laboratory at Florida State University, Sanford-Burnham Medical Research Institute, Ohio State University, the University of Georgia, Imperial College London, the University of Geneva and industry partners IROA Technologies and Thermo Fisher Scientific.
(Magnet Lab contact: Arthur Edison, AMRIS)

EDUCATION

CAISE - Center for the Advancement of Informal Science Education
The Center for the Advancement of Informal Science Education (CAISE) works in collaboration with the National Science Foundation (NSF) Advancing Informal STEM Learning (AISL) Program to strengthen and advance the field of professional

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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.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

CPALMS – Collaborate, Plan, Align, Learn, Motivate, and Share, FL

CPALMS is part of the Florida Center for Research in STEM and is the state of Florida's platform for educators to Collaborate, Plan, Align, Learn, Motivate, and Share through online lesson plans and activities. The Center for Integrating Research & Learning (CIRL) has partnered with CPALMS to facilitate scientist interviews as part of their video accessories for lessons. Carlos Villa also works closely with CPALMS to discuss the role of informal STEM outreach.
(Magnet Lab 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.
(Magnet Lab Contact: Kristen Coyne, Public Affairs)

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.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

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. Currently, we utilize the expertise of FSU faculty for research projects. We also recruit graduate students from FSU departments to conduct research on CIRL programs.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Future Physicists of Florida, 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.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Leon County and City of Tallahassee Commission on the Status of Women and Girls (CSWG), FL

The Commission on the Status of Women and Girls was formed in April of 2011 by the Leon County Board of County Commissioners. The CSWG was established as a citizens advisory committee. In March of 2013, the City of Tallahassee proudly joined Leon County and created the new Tallahassee/Leon County Commission on the Status of Women and Girls (CSWG). By establishing and supporting this Commission, the City of Tallahassee and Leon County have taken a strong stand in support of women and girls in our community. Roxanne

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Hughes was selected to serve a two-year term by county commissioner Kristin Dozer.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Leon County Schools, 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.
(Magnet Lab Contact: Roxanne Hughes or Carlos Villa, Educational Programs)

Los Alamos National Laboratory Community Programs Office, NM

CIRL works closely with our counterpart, the Los Alamos National Laboratory Community Programs Office. Over the last year we have developed a partnership wherein we 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.
(Magnet Lab Contact: Roxanne Hughes or Carlos Villa, Educational Programs)

North Carolina State University, Raleigh, NC

In partnership with the Center for Advanced Power Systems and the FAMU-FSU College of Engineering, the Center for Integrating Research & Learning supports ERC FREEDM educational and assessment activities. Working with The Science House and the ERC FREEDM Center at North Carolina State University, CIRL facilitates the pre-college education program through summer camps, Young Scholars high school internship programs, and Research Experiences for Teachers. In addition, one full-time graduate student coordinates assessment at all locations participating in the FREEDM grant.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Oasis Center for Women and Girls, FL

The Oasis Center is a nonprofit organization in Tallahassee whose mission is to "improve the lives of women and girls through celebration and support". They are focused on personal, professional, and economic concerns facing women, girls and their families. CIRL has worked closely with this center through outreach including providing mentors and/or tours for their science summer camps.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Palmer Munroe Teen Center, FL

The Palmer Munroe Teen Center is a community center that focuses on teens from low income neighborhoods in Tallahassee. The center is run by the City of Tallahassee. CIRL works closely with students and staff at the center through outreach.
(Magnet Lab Contact: Roxanne Hughes, Educational Programs)

Panhandle Area Educational Consortium (PAEC), FL

The Panhandle Area Educational Consortium serves 13 school districts in the panhandle of Florida. PAEC provides leadership and support services to these districts, increases networking among members, and maximizes resources. Over the years, CIRL has provided teacher workshops and high school summer information sessions to students and teachers from these districts with PAEC's facilitation.
(Magnet Lab Contact: Roxanne Hughes, 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 is a 2-week camp for middle and high school girls with an interest in science. The collaboration between the Magnet Lab and WFSU-TV has resulted in a successful 6-year camp that has engaged the larger community. In addition, WFSU-TV and the Center partner to provide summer physics experiences for students entering high school.
(Magnet Lab contact: Roxanne Hughes, Educational Programs)

OPTICAL MICROSCOPY

89 North, Burlington, VT

Scientists at the Magnet Lab are working with applications specialists at 89 North to develop light-

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emitting diode technology for fluorescence microscopy. This collaboration involves testing the power output and usability of new high power LED technology in the emission region between 490 and 590 nanometers, a spectral region that is central to microscopy investigations.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Agilent Technologies, Santa Clara, CA

Agilent Technologies is entering the imaging arena with a new “Monolithic” laser combiner featuring acousto-optic-tunable filter (AOTF) control. The Magnet Lab is collaborating with Agilent to prototype the laser system for use in super-resolution imaging.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Allele Biotech, San Diego, CA

Allele is a manufacturer and distributor of fluorescent protein constructs made by Robert Campbell and Nathan Shaner. The Magnet Lab is collaborating with Allele to develop fusion vectors of selected fluorescent proteins.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Andor-Tech, Belfast, Northern Ireland

Andor-Tech is an imaging specialist involved with development of CCD camera systems designed to produce images at extremely low light levels. The Magnet Lab is collaborating with Andor-Tech to produce interactive tutorials describing electron multiplying CCD (EMCCD) technology and will work with the company to test new camera products in live-cell imaging.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

B&B Microscopes, Pittsburgh, PA

Scientists in the Optical Microscopy facility at the Magnet Lab are working with B&B engineers to develop new live-cell imaging techniques using the wide array of products offered by the company. Eventually, an educational website is planned.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Bioptechs, Butler, PA

The Magnet Lab is involved with Bioptechs of Pennsylvania to develop live-cell imaging techniques using the company’s advanced culture chambers. The collaboration involves timelapse imaging of living cells over periods of 36-72 hours using techniques such as differential interference contrast, fluorescence, and phase contrast.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Chroma, Rockingham, VT

A major supplier of Interference filters for fluorescence microscopy and spectroscopy applications, Chroma is collaborating with the Magnet Lab to build educational tutorials targeted at fluorescence microscopy. Working in conjunction with Nikon, engineers from Chroma and scientists from the Magnet Lab are examining the characteristics of a variety of filter combinations.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

The Cooke Corp., Romulus, MI

Scientists at the Magnet Lab are working with applications specialists at Cooke to field test the company’s cooled and electron-multiplied scientific CCD camera systems. Demanding applications in quantitative image analysis and high-resolution images are being explored, as well as time-lapse fluorescence microscopy and resonance energy transfer imaging.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

CoolLed Ltd., Andover, Hampshire, United Kingdom

Scientists at the Magnet Lab are working with applications specialists at CoolLed to develop light-emitting diode technology for fluorescence microscopy. This collaboration involves testing the power output and usability of new LED technology in the emission region between 490 and 590 nanometers, a spectral region that is central to microscopy investigations.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

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Covance Research Products, Berkeley, CA

Covance is a biopharmaceutical company involved with research and diagnostic antibody production. Magnet Lab scientists are working with Covance researchers to examine immunofluorescence staining patterns in rat and mouse brain thin and thick sections using a wide spectrum of antibodies.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Diagnostic Instruments, Sterling Heights, MI

Scientists at the Magnet Lab are working with applications specialists at Diagnostics to field test the company's new line of cooled scientific CCD systems. Demanding applications in quantitative image analysis and high-resolution images are being explored, as well as time-lapse fluorescence microscopy and resonance energy transfer imaging.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Evrogen, Moscow, Russia

Evrogen is a manufacturer and distributor of fluorescent protein constructs made by Dmitriy Chudakov and Vladislav Verkhusha. The Magnet Lab is collaborating with Evrogen to develop fusion vectors of selected fluorescent proteins.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

EXFO, Mississauga, Ontario, Canada

The Magnet Lab is collaborating with EXFO to examine the spectra and output power of various illumination sources for microscopy including metal halide lamps, light engines, LEDs, and the LiFi illumination system.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Hamamatsu Photonics, Bridgewater, NJ

Scientists at the Magnet Lab are working with applications specialists at Hamamatsu to field test the company's cooled and electron-multiplied scientific CCD camera systems. Demanding applications in quantitative image analysis and high-resolution images are being explored, as well as time-lapse fluorescence microscopy and resonance energy transfer imaging.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Linkam, Surrey, United Kingdom

Scientists at the Magnet Lab collaborate with Linkam engineers to design heating and cooling stages for observation of liquid-crystalline phase transitions in the optical microscope. In addition, microscopists are assisting Linkam in introducing a new heating stage for livecell imaging in fluorescence microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Lumencor Inc., Beaverton, OR

The Magnet Lab is collaborating with Lumencor to examine the spectra and output power of various illumination sources for microscopy including metal halide lamps, light engines, LEDs, and the LiFi illumination system.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

MBL International, Woburn, MA

Scientists at the Magnet Lab are collaborating with MBL to develop new fluorescent proteins for live-cell imaging applications. These include both optical highlighters and fluorescence resonance energy transfer (FRET) biosensors.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Media Cybernetics, Silver Spring, MD

Programmers at the Magnet Lab are collaborating with Media Cybernetics to develop imaging software for timelapse optical microscopy. In addition, the Optical Microscopy group is working to add new interactive tutorials dealing with fundamental aspects of image processing and analysis of data obtained with the microscope.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Molecular Probes/Invitrogen, Eugene, OR

A major supplier of fluorophores for confocal and wide-field microscopy, Molecular Probes is collaborating with the Magnet Lab to develop educa-

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tional tutorials on the use of fluorescent probes in optical microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Nikon USA, Melville, NY

The Magnet Lab 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 Magnet Lab is field-testing new Nikon equipment and developing new methods of fluorescence microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Olympus America, Melville, NY

The Magnet Lab is developing an education/technical website centered on Olympus products and will be collaborating with the firm on the development of a new tissue culture facility at the Magnet Lab in Tallahassee. This activity will involve biologists at the Magnet Lab and will feature Total Internal Reflection Fluorescence microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Olympus Corp., Tokyo, Japan

Investigators at the Magnet Lab 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.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Omega Optical, Brattleboro, VT

The Magnet Lab is involved in collaboration with Omega to develop interactive tutorials targeted at education in fluorescence filter combinations for optical microscopy. Engineers at Omega work with Magnet Lab microscopists to write review articles about interference filter fabrication and the interrelationships between various filter characteristics and fluorophore excitation and emission.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Photometrics (Roper Scientific Inc.), Tucson, AZ

The microscopy research team at the Magnet Lab is exploring single molecule fluorescence microscopy using electron-multiplying CCD camera systems developed by Photometrics. In addition, the team is conducting routine fixed-cell imaging with multiple fluorophores to gauge camera performance.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Prior Scientific Inc., Rockland, MA

Prior is a major manufacturer of illumination sources and filter wheels for fluorescence microscopy. The Magnet Lab team is collaborating with Prior to develop new illumination sources and mechanical stages for all forms of microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Qimaging, Burnaby, British Columbia, Canada

High-resolution optical imaging is the focus of the Magnet Lab collaboration with Qimaging, a Canadian corporation that specializes in CCD digital cameras for applications in quantitative image analysis and high-resolution images for publication. Target applications are interactive tutorials and image galleries that will be displayed on the Internet.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Semrock, Rochester, NY

The Magnet Lab Optical Microscopy group is collaborating with Semrock to develop interactive tutorials targeted at education in fluorescence filter combinations for optical microscopy. Engineers and support personnel at Semrock work with Magnet Lab microscopists to write review articles about interference filter fabrication and the interrelationships between various filter characteristics and fluorophore excitation and emission. In addition, Magnet Lab scientists produce images of living cells with Semrock filter combinations.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Sutter Instrument, Novato, CA

The Magnet Lab is collaborating with Sutter to examine the spectra and output power of various illumination sources for microscopy including metal halide lamps and the LiFi illumination system.

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(Magnet Lab contact: Mike Davidson, Optical Microscopy)

Zeiss Micro Imaging, Thornwood, NY

The Optical Microscopy group at the Magnet Lab is negotiating a contract with Zeiss on the development of an educational and technical support microscopy website, including the latest innovations in digital imaging technology. As part of the collaboration, microscopists are field-testing new Zeiss equipment and developing new methods of fluorescence microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

GEOCHEMISTRY

Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) of Chinese Academy of Sciences, China

The collaboration between the IVPP and the Magnet Lab is related to the investigation of Late Cenozoic Vertebrate Paleontology and Paleoenvironments of the Tibetan Plateau (China). Samples collected in this project are analyzed in the Geochemistry Laboratories in the Maglab.
(Magnet Lab contact: Yang Wang, Geochemistry Program)

Los Angeles County Museum of Natural History

The collaboration between the IVPP and the Magnet Lab 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.
(Magnet Lab contact: Yang Wang, Geochemistry Program)

South Florida Water Management District (SFWMD)

The collaboration between the SFWMD and the Magnet Lab is related to the investigation of landuse 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.
(Magnet Lab contact: Yang Wang, Geochemistry Program)

Woods Hole Oceanographic Institution (WHOI)

The collaboration between WHOI and the Magnet Lab is related to ocean crust formation. WHOI is providing samples and analyses of abyssal peridotites which are analyzed for Hf, Nd and Os-isotopic composition. We also participate 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 Magnet Lab and WHOI
(Magnet Lab contact: Vincent Salters, Geochemistry Program)

PRIVATE BUSINESSES SPUN OFF FROM THE MAGLAB

High Performance Magnetics

High Performance Magnetics was founded in 2008 by Thomas Painter, an engineer at the National High Magnetic Field Laboratory. High Performance Magnetics designs, fabricates and tests advanced cable-in-conduit magnet components and has established a nearly half-mile long superconducting cable jacketing facility located at the Tallahassee Regional Airport. High Performance Magnetics is jacketing Toroidal Field Nb_3Sn cable-in-conduit conductors for Oak Ridge National Laboratory as part of the United States contribution to an international clean energy experiment, ITER, which is being built in France.
(MagLab contact: Tom Painter)

Specialized Crystal Processing, Inc.

Specialized Crystal Processing, Inc. (SCPI) is an advanced materials processing, manufacturing and consultation spin-off of the National High Magnetic Field Laboratory. The SCPI home base facilities are in Innovation Park, Tallahassee, where a patent pending batch process is employed to produce specialized single crystalline materials like Europium (II) Oxide and Barium Oxytelluride. These crystals can be used for a variety of applications, including but not limited to high tech devices and sensors, advanced materials basic science research and crystalline additives for composite materials.
(MagLab contact: Jeffrey Whalen, Theo Siegrist)

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Omics LLC

Omics LLC is a spinoff company that serves the data analysis and interpretation needs of the high resolution mass spectrometry market. It was formed 8 years ago and has grown over the years to address a wider analytical community.
(MagLab contact: Ryan Rodgers)

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11. DATA MANAGEMENT PLAN (reprint of NHMFL renewal proposal 2013-2017)

The National High Magnetic Field Laboratory (NHMFL) user facilities serve a multi- and inter-disciplinary scientific research community. Users of NHMFL facilities are expected to promptly analyze and submit their data for publication, with authorship that accurately reflects the contributions of those involved, and including all scientific findings from experiments performed at the NHMFL.

The NHMFL Data Management Plan accommodates the specific environments and natures of data generated at each of its six user facilities: DC Magnets, Pulsed Magnets, High B/T, Ion Cyclotron Resonance, Electron Magnetic Resonance, and the Nuclear Magnetic Resonance/Magnetic Resonance Imaging (NMR/MRI) User Facilities located at three campuses: Florida State University, University of Florida and Los Alamos National Laboratory. The data management policy is driven by the needs of our user community and the standards of the relevant funding agencies. The policy is reviewed annually to stay current with user demands and changes in technology.

DATA TYPES

NHMFL user data consists primarily of electronic records of measurements taken during a scheduled experiment. Data from a facility can be generated on either a facility computer system, a visiting user's laptop, or special data acquisition systems provided by a user. These electronic records may or may not exist on a facility computer during the course of an experiment. All samples are considered to be under the control of the Principal Investigator (PI) and conforming to the requirements and standards under which the sample was generated. The NHMFL is able to temporarily store samples for experimenters at an NHMFL user facility as one of the services provided to the PI during an experimental project or for a period of time up to one year after the completion of an experiment. User samples are ultimately either returned to the PI or discarded with approval from the PI.

DATA STANDARDS

Standards for data vary as required by the experimental methods and equipment used: The most open standard for the DC Magnet facility is for ASCII text files in column format. High data rate experiments such as the Pulsed Field Facility necessitate the use of open-vendor-specified binary formats or custom file formats developed by NHMFL personnel. The ICR facility also stores data in an NHMFL-defined format as it develops new experimental protocols. For NMR experiments, data formats are dictated by the research equipment used, such as the vendor- specific format for NMR data collected by Bruker spectrometers. Data for the NMR/MRI imaging facility is in DICOM images for OSIRIX viewer. Data is made available to researchers through the use of the current picture archiving and communication systems (PACS) with dedicated computers on a local high speed network. All NHMFL-developed formats are open. Specifications and software to read and analyze data in these formats is available to the scientific community for free or at nominal reproduction costs. These software tools are provided on laboratory web sites and software storage areas.

Meta data can be recorded with the raw data files at the option of the researchers. Other meta data is recorded in the users written notebooks, lap top files, or other media at the option of the PI. Management of the meta data associated with standard data files is exclusively the purview of the PI.

DATA ACCESS POLICIES

The laboratory will ensure that the NHMFL Data Management and Sharing Policy continues to be aligned with the policy applied to NSF single investigator grants, as the NHMFL user community consists primarily of researchers supported by traditional single investigator grants.

The control of raw data files and rights to the data are retained by the PI for the experiment. The PI has full control of the use of the data, including its publication in the refereed literature. The PI is

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responsible for adhering to the policies and procedures of their funding agency.

DATA ARCHIVING

Data collected and stored on an NHMFL facility computer system are backed-up to local hard drives, tape storage or other common backup media. Data archiving is primarily the responsibility of the PI at their home institutions, but archived user data are retained at the NHMFL facility for a period ranging from six months to two years after collection at the NHMFL. This retention policy is reviewed annually and may be revised at the request of our user community, or in response to the continually evolving capabilities and reduction in costs of data storage. Archived data will only be made available to individuals at the request of the PI of the project.

Data will be archived on CDS or other similarly permanent media and provided to the user. User data can be further transferred to any portable drive or computer deemed appropriate by the user. Users my request data transfer consistent local facility administration policies, e.g. via a hard copy, secure FTP or standard network protocols for copying files over a TCP-based network.

DATA RE-USE POLICIES

The NHMFL requires all NHMFL users to submit a one-page annual report on each project for inclusion in the NHMFL Annual Report. These reports are available on the NHMFL web site and serve to illustrate the quantity, quality and breadth of research activities at the lab. Each year, thirty to forty of these reports are chosen as highlights to be published in a Special Issue of MagLab Reports, the NHMFL's quarterly magazine that is widely distributed to scientist, students, and granting agencies.

Data will not be reused nor any data-mining operations performed on past user data without permission of the PI. Once data are collected and provided to the user, it is solely the property of the PI. Any reuse of the data by the PI external to NHMFL is strictly at their discretion.

CHAPTER 3
User Facilities

CHAPTER 3 – USER FACILITIES

1. USER PROGRAM

The MagLab is one user program with seven user facilities - DC Field, Pulsed Field, High B/T, NMR-MRI@FSU, NMR-MRI@UF (AMRIS), EMR, and ICR – each with exceptional instrumentation and highly qualified staff scientists and staff, comprise the Magnet Lab's User Program. In this chapter of the annual report, information is being presented about the proposal review process, user safety training, special user funding opportunities, and user committee report.

A. Proposal Review Process

Across all seven facilities, proposals for magnet time are submitted online (https://users.magnet.fsu.edu/) and reviewed in accordance with the NHMFL User Proposal Policy (https://users.m agnet.fsu.edu/Documents/UserProposalPolicy.pdf). In brief, each user facility has a User Proposal Review Committee (UPRC) comprising 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 NHMFL 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 NHMFL discretion; to "F" – Proposal has little/no merit and magnet time should not be granted. The Facility Directors dovetail the UPRC recommendations with availability and scheduling of specific magnets, experimental instrumentation, and user support scientists and make recommendations for magnet time assignments to the NHMFL Director. The NHMFL Director is responsible for final decisions on scheduling of magnet time based on these recommendations.

Table 1: *Magnet Lab Facility Usage Profile (Type of Affiliation) for 2014*

	Total Days* Allocated / User Affil.	Condensed Matter Physics	Chem. Geochem.	Engineering	Magnets, Materials, Test, Instr.	Biology, Biochem., Biophys
NHMFL-Affiliated	**2,076**	472	550	12	226	816
Local	**1,836**	121	298	268	19	1,130
U.S. University	**3,548**	1,535	795	10	71	1,137
U.S. Govt. Lab.	**510**	421	57	0	2	30
U.S. Industry	**96**	25	53	0	18	0
Non-U.S.	**1,321**	733	424	7	10	147
Test, Calibration, Set-up, Maintenance, Inst. Dev.	**1,032**	115	45	0	865	7
Total:	**10,419**	**3,423**	**2,222**	**297**	**1,210**	**3,266**

* *User Units are defined as magnet days for four types of magnets. One magnet day is 7 hours in a water cooled resistive or hybrid magnet in Tallahassee. One magnet day is 12 hours in any pulsed magnet in Los Alamos and 24 hours in superconducting magnets in Tallahassee and the High B/T system in Gainesville. Magnet days for AMRIS instruments in Gainesville: Verticals (500, 600s, & 750 MHz), 1 magnet day = 24 hours (7 days/week); Horizontals (4.7, 11.1, and 3T), 1 magnet day = 8 hours (5 days/week).*

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In 2014, 1,442 users from around the world enjoyed access to magnet time at the lab's seven user facilities at three sites. The Magnet Lab was extremely pleased to welcome requests for magnet time from 81 new principal investigators in 2014: 16 in the DC Field Facility; 9 in the Pulsed Field; 1 in the High B/T; 13 in NMR-MRI@FSU; 5 in NMR-MRI@UF (AMRIS); 18 in EMR; and 19 in ICR. All 81 of these new PIs submitted a request and received magnet time or have been scheduled to receive magnet time during the year.

Table 2: *Magnet Lab User Profile (Demographics) for 2014*

	Users	Male	Female	No Response to Gender	Minority [1]	Non-Minority [1]	No Respond to Race	Affil. Users [2]	Local Users [2]	Uni. Users [3,5]	Indus. Users [5]	Nation. Lab Users [4, 5]
Senior Personnel, U.S.	**562**	471	70	21	17	510	35	154	89	459	25	78
Senior Personnel, non-U.S.	**187**	155	21	11	18	151	18	5	7	150	11	26
Postdocs, U.S.	**138**	92	31	15	6	110	22	32	43	111	3	24
Postdocs, non-U.S.	**53**	35	12	6	3	41	9	0	8	49	1	3
Students, U.S.	**364**	252	98	14	18	304	42	48	102	357	0	7
Students, non-U.S.	**99**	80	13	6	8	81	10	0	24	98	0	1
Technician U.S.	**35**	26	8	1	1	33	1	15	13	28	3	4
Technician non-U.S.	**4**	3	1	0	1	3	0	2	0	2	0	2
Total:	**1,442**	**1,114**	**254**	**74**	**72**	**1,233**	**137**	**256**	**286**	**1,254**	**43**	**145**

1. 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
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. The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators". "Users Sending Sample" refers to users who send the sample to the facility and the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
3. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
4. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
5. The total of university, industry, and national lab users will equal the total number of users.

CHAPTER 3 – USER FACILITIES

B. Research Reports

At the end of each year, Magnet Lab users and faculty at FSU, UF and LANL submit brief abstracts of their experiments, research and scholarly endeavors. All reports are available online at: https://nationalmaglab.org/research/publications-all/research-reports

Users generated 452 research reports in 2014.

Table 3: *2014 Research Reports by Facility*

FACILITIES	NUMBER OF REPORTS
DC Field Facility	133
Pulsed Field Facility	65
High B/T Facility	7
NMR-MRI@FSU	58
NMR-MRI@UF (AMRIS)	60
EMR Facility	46
ICR Facility	26

MAGLAB DEPARTMENTS & RELATED GROUPS	NUMBER OF REPORTS
Applied Superconductivity Center	15
Condensed Matter Theory/ Experiment (FSU)	14
Magnet Science & Technology	8
UF Physics	4
Geochemistry	16
TOTAL REPORTS	**452**

CHAPTER 3 – USER FACILITIES

C. User Safety Training by Facilities

Safety training, across all facilities, is an important component of the Lab's Integrated Safety Management.

DC FIELD FACILITY

Users of the DC Field Facility must complete the appropriate online safety training prior to being issued a badge and receiving access to the DC Magnet Building. Since there are a wide variety of experiments performed at the MagLab, the online training system begins with an evaluation to determine the work the researcher is doing and which training modules are needed in order for the user to safely perform their work at the MagLab. When magnet time is awarded the safety training status of the researchers who are traveling to the MagLab is checked by the DC Field User Program Coordinator several weeks prior to their arrival. Any users who either have not taken the required training or whose training has expired are directed to the training website: https://training.magnet.fsu.edu/Login/Default.aspx to take the appropriate training. Users who arrive at the lab without having completed the training are set up in one of our user offices so that they can complete the training and then access the magnet cells.

During the user's magnet time they are assigned an in-house scientist as well as a technician in order to provide scientific and technical support. This also ensures that the user performs their experiment in a safe manner. In addition, the control room operators monitor the magnet cells via cameras located in each cell. User operations on the 45 T hybrid magnet are also monitored directly by a hybrid operator who is present on the user platform while the hybrid magnet is in use.

PULSED FIELD FACILITY

Users of the Pulsed Field Facility (PFF) are treated equally as full time employees at Los Alamos National Laboratory (LANL) with respect to hazardous work activities and authorization.

All LANL workers are educated on a comprehensive approach towards safe work practices within the context of Integrated Safety Management at LANL before being authorized to perform hazardous work activities. The approach that LANL takes is based on "Human Performance Improvement" or HPI (available at: http://energy.gov/sites/prod/files/2013/06/f1/doe-hdbk-1028-2009_volume1.pdf) The use of engineering controls are preferred to keep workers safe and reduce the risk of a human based error whenever possible (example: door interlocks and "Kirk Keys" used to ensure safe equipment configuration in pulsed capacitor bank operations at the PFF). The knowledge of HPI practices and the approach to safety management is central to the safety aware work culture at the PFF and throughout LANL. All safety management is governed by LANL policies and procedures. All work performed at the PFF is categorized into one of three hazard classes (Low, Medium, or High). By default no Medium or High hazard work activities are permitted at the PFF unless needed and authorized.

All hazardous work that is categorized as Medium or High Hazard work activities (based on the LANL hazard categorization matrix found in the LANL Integrated Work Management policy P300 Hazard Grading Table Attachment B) require a written and approved work control process (called an Integrated Work Document or IWD) and documented work authorization by the Safety Responsible Line Manager (SRLM). All LANL workers (staff and users performing hazardous work) use an online system (called U-Train) to assign and track training and work authorization. All users are assigned one or two PFF Scientists to assist and support scheduled experiments. When users arrive they first complete a briefing by the assigned Scientist and the program specialist. The program specialist, based on the nature of the visit, then assigns any additional training to the user. Live training or on-line content is then completed by the user and tracked in U-Train. If hazardous work is to

CHAPTER 3 – USER FACILITIES

be performed by the user (e.g. operate the PFF User Capacitor Bank) the IWD is read, training is verified by the SRLM, and based on need and agreement with the Person In Charge of the IWD, the work authorization is granted by the SRLM (tracked in U-Train). At this time, PFF users may be authorized on work that is categorized as low or medium hazard work. All of the infrastructure and management support of the above work control process at LANL is provided by institutional support of programs.

HIGH B/T FACILITY

When conducting an experiment, all members of the user group must observe all the safety precautions required by the National High Magnetic Field Laboratory and the University of Florida (see http://opswiki.magnet.fsu.edu/wiki/pages/u3k2v1W4/Safety.html).

After magnet time is scheduled and prior to carrying out an experiment, all members of the user group planning to participate in an experiment at the Facility must pass the safety training provided by the Tallahassee site of the National High Magnetic Field Laboratory. (see https://nationalmaglab.org/user-facilities/).

Access to the High B/T Facility is limited to authorized personnel who will be provided with a key for entry. **All users must comply with the flowing safety instructions:**

1. No user may transfer cryogenic fluids.
2. No user may charge or discharge any magnets in the facility.
3. All undergraduate students must be accompanied by a supervising faculty or a staff member at all times.

NMR FACILITY

Internal Users

All of the NMR group members have become familiar with the ISM (Integrated Safety Management) principles. All of them attend the quarterly NHMFL Safety Meetings. A representative of the NMR group attends the monthly NHMFL Safety Committee meetings and reports on pertinent issues to the NMR group during its meetings.

NMR staff and faculty group meetings are conducted weekly. Every 6 weeks a meeting is dedicated to safety, safety issues and/ or safety training. All members of the NMR group are required to complete and pass the NHMFL online safety training courses and, they are required to keep those trainings current.

External Users

Each external user prior to carrying out an experiment at the NMR Facility is required to pass the online safety training course(s) provided by the NHMFL (https://nationalmaglab.org/user-facilities/) This is currently enforced by the NMR Administrative Assistant and/or CIMAR Coordinator, who will not issue a laboratory access card or any keys without all trainings being completed and passed.

Prior to an experiment, potential safety issues are discussed individually with each new user. During the actual experiments, users are accompanied/ supervised by one of the NMR science staff. All non-routine or increased-risk operations, such as refilling the magnets with liquid helium, are performed by NMR staff rather than by the user.

AMRIS FACILITY

All internal and external users that will assist in data acquisition (*i.e.* anyone who will enter the facility without direct supervision of AMRIS personnel) are required to attend a one hour safety class as a first step to getting keyed access. In this class, safe operation in high magnetic fields, working with RF cables, and the principles of ISM are presented and discussed. Anyone working with animals is required to carry documentation of their IUCAC approved protocol when working with animals in the AMRIS facility. The UF IUCAC office oversees all animal related safety training and authorization of work with animals at UF, including for external users. Users wanting to work independently in the 11 T room (*i.e.* without an AMRIS staff person present) are required to demonstrate instrument proficiency to AMRIS personnel and to attend an additional hour of safety training specific to the 11 T system.

AMRIS personnel have weekly staff meetings

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and at each of these meetings we review whether there are any safety issues or training needing discussion. If so, time is dedicated to discussing any incidents or changes in training/operation and ensuring all AMRIS personnel are apprised of them. We also regularly update our web pages to reflect current safety policies. All AMRIS personnel are required to keep both the NHMFL and UF safety training current. Regular inspections of AMRIS facilities are performed by the UF office of Environmental Health & Safety as well as by the IUCAC. AMRIS personnel directly accompany all new users in the facility and regularly interact with experienced users to discuss any issues which might arise during their facility use. All non-routine, increased-risk operations, such as refilling the magnets with cryogens, are performed by trained AMRIS personnel. Any use of cryogens during experiments to cool samples requires additional training in safe handling of cryogens.

All access to the AMRIS facility is via RFID keys; these keys are monitored and regulated through the UF Police Department so we have a record of their use and can revoke access to an individual user at any point in time if needed.

EMR FACILITY

Internal Users

All the EMR group members have become familiar with the ISM (Integrated Safety Management) principles. All of them also attend the quarterly NHMFL Safety Meetings. A representative of the EMR group attends the monthly NHMFL Safety Committee meetings and reports on pertinent issues to the EMR group during its meetings.

External Users

Each external user prior to carrying out an experiment at the EMR Facility is obliged to pass the on-line safety training course(s) provided by the NHMFL (https://nationalmaglab.org/user-resources/safety). This is currently enforced by the EMR Administrative Assistant, who will not issue a laboratory entrance card or any keys without proof of completion of the required course(s). Prior to an experiment, potential safety issues are discussed individually with each new user. During the actual experiments, each user is accompanied/ supervised by one of the EMR science staff. All non-routine or increased-risk operations such as refilling the magnets with liquid helium or sample changes are performed by the staff rather than the user.

ICR FACILITY

All internal ICR personnel and external users that will assist in data acquisition are required to select the labs that they will be working in prior to assignment of safety training. Safety training is assigned based on the working hazards that are within each lab space. For example, each person who will work in the ICR high bay is required to take the following safety training courses: cryogen safety, high magnetic field, general safety, laser safety and electrical safety. Additionally, no one is allowed to perform any cryogen fills or operate any instrument systems without extensive, supervised, hands-on safety training by an ICR staff member.

All users that will be entering all ICR lab spaces are required to complete online safety training, but are assisted by an internal ICR group member for all sample preparation, instrument start up and shutdown, and data acquisition. All ICR magnet system usage is limited to trained ICR personnel. No external users are allowed to start up or shut down ICR magnet systems. In addition, access to the ICR high bay is limited to only personnel that work within the NMR/ICR high bay area. All visitors are required to have an escort at all times, and everyone who enters any ICR lab space (C330, B239, B240, NM 113 and NM 117) are required to wear safety glasses with no exceptions. No food and drink is allowed in any ICR lab space except in designated areas that are marked with appropriate signs.

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D. Additional Funding Opportunities

User Collaboration Grants Program

The National Science Foundation charged the National High Magnetic Field Laboratory with developing an internal grants program that utilizes the NHMFL 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 UCGP seeks to achieve these objectives by funding research projects of normally one- to two-year duration in the following categories:

- small, seeded collaborations between internal and/or external investigators that utilize their complementary expertise;
- bold but risky efforts that hold significant potential to extend the range and type of experiments; and
- initial seed support for new faculty and research staff, targeted to magnet laboratory enhancements.

The Program strongly encourages collaboration between NHMFL scientists and external users of NHMFL 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 NHMFL cannot fund clinical studies.

Eighteen (18) UCGP solicitations have now been completed with a total of 512 pre-proposals being submitted for review. Of the 512 proposals, 267 were selected to advance to the second phase of review, and 117 were funded (22.86% of the total number of submitted proposals).

2013-14 Solicitation and Awards

The NHMFL UCGP has been highly successful as a mechanism for supporting outstanding projects in the various areas of research pursued at the laboratory. The proposal submission and two-stage proposal review process has been handled by means of a web-based system.

The 2013 solicitation was announced late in October, 2013. Owing to funding uncertainties, the solicitation was postponed from spring, which was when the solicitations of previous years were announced.

Of the 24 pre-proposals received, the committee recommended that 12 pre-proposals be moved to the full proposal state. Of the 12 full proposals, 6 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	11	6	4
Biological & Chemical Sciences	9	5	2
Magnet & Magnet Materials Technology	4	1	0
Total	**24**	**12**	**6**

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Table 2: *UCGP Funded Projects, 2014*

Principal Investigator	NHMFL Institution	PROJECT TITLE	FUNDING
Ryan Baumbach	NHMFL	Materials driven investigation of emergent phenomena in uranium-based compounds	$211,945
Zhenhong Gan	NHMFL	1H detected solid state NMR with ultrafast magic-angle spinning and high fields	$227,766
Samuel Grant	NHMFL	In vivo ultrahigh field Magnetic Resonance Spectroscopy and Spectroscopic Imaging	$188,000
Arneil Reyes	NHMFL	Nuclear Magnetic Resonance Probe for in situ variation of stress and strain	$193,234
Theo Siegrist	NHMFL	Electrocrystallization Facility to Support Science in High Magnetic Fields	$211,749
Charles Mielke	LANL	Advanced measurement system for 150 tesla science	$226, 369

2015 Solicitation

The 2015 Solicitation announcements should be released in January, 2015. Awards will be announced by the end of 2015.

Results Reporting

To assess the success of the UCGP, reports were requested in December 2014, on grants issued which had start dates near the beginnings of years 2009 through 2014. 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 collaborations with users, external grants, NHMFL 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. Results given here are totals for reports on 26 awards.

The PIs reported:

- 78 Collaborations with external user groups.
- At least partial support for 12 undergraduate researchers, 42 grad students and 23 postdocs.
- 14 funded external grants (at co PI or PI level) which were seeded by results from UCGP awards. The total dollar value of the external grants was $9.5 M.
- 81 publications, many in high profile journals, as summarized in **Table 3**.

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Table 3: *Publications Reported, 2008-2013 UCGP Solicitations*

App. Phys. Lett.	1
Applied Supercond.	2
Biomacromolecules	1
Chinese J. Magn. Resonance	1
Inorg. Chem.	2
Inst. of Phys. Conf. Series	12
J. Cryst. Growth	1
J. Low Temp. Phys.	1
J. Membrance Sci.	2
J. of Chemical Physics	2
J. of Controlled Release	1
J. of American Chemical Society	2
J. of Materials Chemical	1
J. of Materials Chemistry	1
J. of Magnetic Resonance	4
J. of Molecular Biology	4
J. Phys. Condens. Mat.	2

Note: Publications (including accepted for publication) as of December 2013, reported from UCGP grants.

Langmuir	1
Magnetic Reson. Med	5
Materials Science Forum	1
Molecular Pharmaceutics	1
Nature Materials	1
Nature Physics	1
Nature Struct. Mol. Bio.	1
Neuro Image	2
Phys. Rev. B	15
Phys. Rev. Lett	7
Physica C	1
PLOS1	1
RSC Advances	1
Scientific Report	1
Science & Technology of Advance Materials	1
Superconductor Sci. Technolgy	1

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Dependent Care Travel Grant Program

Eligible recipients are early career scientists, including undergraduate and graduate students, postdocs, and scientists with fewer than 10 years of active professional work since receiving a Ph.D. To be eligible, a scientist must be:

- An early career user traveling to a Magnet Lab facility in Tallahassee, Gainesville or Los Alamos to conduct an experiment as part of a user program (not including employees of Florida State University, the University of Florida or Los Alamos National Laboratory).
- A Magnet Lab early career scientist employed by any of the three Magnet Lab partner institutions who is selected to present results at scientific meetings, conferences or workshops.

A dependent is defined as 1) a child, newborn through 12 years of age (or any physically or mentally disabled child under the age of 18 who is unable to care for himself or herself), who resides with the applicant and for whom the applicant provides primary support, or 2) a disabled adult/elder (spouse, parent, parent-in-law, or grandparent) who spends at least eight hours per day in the applicant's home and for whom the applicant has responsibility.

The Dependent Care Travel Grant Program (DCTGP) is described in detail at https://nationalmaglab.org/user-resources/funding-opportunities/1126 .

In 2014, the external user Hyejin Ryu (F) who is a graduate student (Brookhaven National Lab. and Stony Brook University) working for Cedomir Petrovic applied and received $800. She used this award to travel to Tallahassee for her magnet time from September 8-12, 2014.

First-Time User Support

The NHMFL 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. Support for this funding is provided by the State of Florida and is available for Tallahassee facilities only.

Visiting Scientist Program

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 2014, the Visiting Scientist Program provided a total of $80,880 financial support for 14 research projects on a competitive basis.

The primary intent of this program is to provide greater access to the unique facilities at the Magnet Lab and to seed research programs that help advance the laboratory. State funding is being used and principally intended to partially support travel and local expenses. Requests for stipends are considered but given a lower priority. The amount of support generally ranges from a few thousand to $20,000. Beyond conducting the research as approved and maintaining fiscal integrity, the researcher has one additional responsibility, which is to provide the Magnet Lab with a progress report on request and a final report on their research to be included in the online version of **the NHMFL Annual Report. Participants in the NHMFL Visitors Program are expected to acknowledge support provided by the NHMFL in any publications coming from work during their visit or collaboration with the NHMFL.** 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 NHMFL. All requests for support must be submitted online at https://vsp.magnet.fsu.edu/ at any time throughout the year.

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E. User Advisory Committee Report

Report on the 2014 NHMFL User Advisory Committee meeting held in Tallahassee from Thursday, October 9 – Saturday, October 11, 2014

Chair: Chris Wiebe, Department of Chemistry, University of Winnipeg/University of Manitoba (adjunct, Department of Physics and Astronomy, McMaster University)

DC/Pulsed/High B/T Vice---Chair: Madalina Furis, Department of Physics, University of Vermont

NMR/MRI/ICR/EMR Vice---Chair: Robert Schurko, Department of Chemistry and Biochemistry, University of Windsor

User Committee Members:

DC/PFF/High B/T committee: James Analytis (University of California, Berkeley), Kenneth Burch (Boston College), Jason Cooley (Los Alamos National Laboratory), Nicholas Curro (University of California, Davis), Ian Fisher (Stanford University), Nathanael Fortune (Smith College, Executive Committee Member), Madalina Furis (Chair for DC/ Pulsed Field /High B/T, University of Vermont), Jeanie Lau (University of Calfornia, Riverside), Wei Pan (Sandia National Laboratory), Cedomir Petrovic (Brookhaven National Laboratory), Makariy Tanatar (US DOE The Ames Laboratory), Chris Wiebe (University of Winnipeg, User Committee Chair)

NMR/MRI committee: Robert Schurko (Chair, University of Windsor), Marek Pruski (Ames Lab, Iowa), Michael Harrington (Huntington Medical Research Institute), Brian Hansen (University of Aarhus), Eduard Chekmenev (Vanderbilt University), Len Mueller (UC Riverside), Fang Tian (Penn State University), Tatyana Polenova (University of Delaware), Scott Prosser (University of Toronto), Linda Columbus (Virginia)

EMR committee: Kurt Warncke (Emory University, U.S.; Chair), Chris Kay (University College, U.K.), Dane McCamey (University of New South Wales, Australia), Christos Lampropoulos (University of North Florida, U.S.), Stefan Stoll (University of Washington, U.S.), Sergei Zvyagin (Dresden High Magnetic Field Laboratory, Helmholtz---Zentrum Dresden---Rossendorf, Germany)

ICR User Advisory Committee: Jonathan Amster (Franklin College), Michael Chalmers (Eli Lilly and Company DCR&T Analytical), Michael Freitas (Ohio University Medical Center), Elizabeth Kujawinski (Woods Hole Oceanographic Institution), John Shaw (University of Alberta), Forest White (MIT)

Committee members who served in 2014 and are now retiring: Ian Fisher, Nick Curro, Cedomir Petrovic, Dmitri Artemov, Ari Borthakur, Conggang Li, Mark Rance, Ivan Tkac, and Joshua Telser

On behalf of the User Committee, we would like to express our appreciation for the NHMFL and Florida State University for hosting a productive and well--- organized meeting in Tallahassee for all three branches of the magnet lab. The feedback from the attendees was enormously positive, and many of the queries that arose prior to and during the meeting were addressed in a timely and efficient matter.

The National High Magnetic Field Laboratory, consisting of three separate branches in Tallahassee, FL, Gainesville, FL and Los Alamos, NM, continues to set the pace for cutting---edge research in high magnetic fields across many sub---disciplines of science and engineering, including condensed matter physics, solid---state chemistry, medical imaging research, and the design of state---of---the---art instrumentation. By nearly every metric, the NHMFL shows continued growth in terms of users, scientific publications, world---records in magnetic field production, and educational outreach. We are optimistic about a very bright future for the NHMFL, and wish to thank the three facilities and their affiliated host institutions (Florida State University, the University of Florida, and the Los Alamos National Laboratory) for their continued leadership, vision, and support.

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(1) Executive summary

Many of the topics discussed at the User Committee Meeting had a broad impact over the entire user base, and these will be discussed first before moving on to particular topics of the sub---committees concerning their disciplines. The overall discussion of these topics is ongoing, but productive, and many of the views here represent the majority of the represented community.

(i) Focus of the magnet lab

The User Committee gives a strong endorsement for the current vision and allocation of developmental priorities at the NHMFL. Recent choices of resources, in terms of investments in key magnet technologies, personnel, and future scientific endeavors, are all widely accepted and supported by the general user committee. Many of these particular choices will be outlined in the sub---committee reports below, but our overall assessment of the priorities set by administrative staff at the magnet lab are overwhelmingly positive, and the user base feels that most of its needs are met and usually exceeded.

(ii) Housing

The issue of housing at the Tallahassee branch in particular continues to be a concern for users. While there has been some positive developments with the lack of quality housing for visitors to the magnet lab, we feel as a community that future development is needed, especially with the growth that the NHMFL as seen in users. We strongly endorse for Florida State University to continue to work with the National High Magnetic Field Laboratory to work on bringing a guesthouse to Innovation Park for visiting users. For a variety of reasons, including personal safety and fast accessibility for users, we feel that it is crucial for concrete steps to be taken to bring a long---term plan for housing close to the Tallahassee lab closer to a reality.

(iii) Future hiring strategies

(a) The NHMFL has truly excelled in hiring the very best scientists and engineers over the years. The unique resources at the lab (including personnel, facilities, and access to new techniques), continues to be a great draw in attracting world---class talent. We encourage the NHMFL to continue this standard of excellence and to include the User Committee in the hiring process of new talent to the magnet lab, and we especially look forward to increasing the numbers of senior staff members. Many of our suggested future hires are listed in the sub---committee sections below.

(b) The User Committee is very encouraged by recent developments by FSU to secure a faculty line for a senior hire that would fill the role of Chief Science Officer for Condensed Matter Physics. This is increasingly important for the continued vitality of the laboratory and for the recompetition process. We encourage the NHMFL to draw upon the resources of the UAC and members of the scientific staff throughout this process.

(iv) Diversity

The User Committee is continually impressed by the efforts of all three branches of the NHMFL to increase diversity. The UAC was struck by the observation this year that our committee, itself, needs to increase its diversity. We would like to make a recommendation for the lab and current members of the UAC to choose a more diverse pool of nominees for future members of the UAC. The UAC is also a resource that the NHMFL can use to draw upon in the future for recommendations of hires that would increase diversity.

(v) The UCGP

The review of the UCGP was timely, thorough, and very informative for the UAC. The general view of the UAC was that this program is a success at the NHMFL that seeds new initiatives, establishes new young scientists, and brings new techniques up to the level that they can transition to the user program. It is not immediately clear if or how the UAC might be helpful in the process, but there was a general sentiment that there is at least a potential for beneficial interaction, possibly in the realm of providing additional perspective that might be helpful in forming an assessment of the relative merits of proposals (for example, the eventual user impact). Equally, there was also a general consensus that it is useful to have some input from upper administration for the allocation of funds within the current needs of the NHMFL community.

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(vi) Safety

The UAC found the update on safety initiatives, protocols, and success stories to be exceptional. While there is always room for improvement in terms of safety at national facilities, we feel that the NHMFL is leading the way for safety standards.

(vii) Summer school

The UAC applauds the highly successful summer schools organized by the NHMFL which has a tremendous impact on new and future users. This program is truly inspirational and has a overwhelmingly positive effect on future researchers, and on the staff involved.

(viii) User committee changes

(a) The UAC briefly discussed regularizing the Bylaws to be the same process for each of the divisions. The current suggestion is to modify so that the timing of nominations and elections, and the tenure on the committee (3 years) is the same for all divisions. We look forward to the recommendations of the NHMFL regarding these changes.

(b) Changes to the executive committee: The following new positions have been established by the User Committee:

NMR/AMRIS (2): Linda Columbus, Rob Schurko
EMR (1): Kurt Warncke
ICR (1): Jonathan Amster
DC/PFF/High B/T (3): Chris Wiebe, Madalina Furis, Nathanael Fortune

(2) Report on the DC/ Pulsed Field /High B/T Facility

Contributors to the DC/ Pulsed Field /High B/T report:

The committee is comprised of:

James Analytis (University of California, Berkeley)
Kenneth Burch (Boston College)
Jason Cooley (Los Alamos National Laboratory)
Nicholas Curro (University of California, Davis)
Ian Fisher (Stanford University)
Nathanael Fortune (Smith College, Executive Committee Member)
Madalina Furis (Univ. of Vermont; vice---chair for DC/ Pulsed Field /High B/T)
Jeanie Lau (University of California, Riverside)
Wei Pan (Sandia National Laboratory)
Cedomir Petrovic (Brookhaven National Laboratory)
Makariy Tanatar (US DOE The Ames Laboratory)
Chris Wiebe (University of Winnipeg, User Committee Chair)

(i) General comments:

The user committee commends the DC/Pulsed Field/ High B/T facilities for the outstanding support offered to users and continuing efforts to remain at the forefront of magnet science. We continue to enthusiastically support the plans for a high T_C superconducting magnet and reiterate our excitement to the definite progress on a 40 T / 28MW resistive magnet development. We find that a key priority for the lab should be a second DC system that gives access to fields up to 40 T (the hybrid is heavily oversubscribed; several of the experiments that require the hybrid could be accommodated on the 40 T resistive magnet). Furthermore, if the hybrid suffers either a short term failure, or a longer term problem, there is a second magnet that would be able to serve users who need fields in excess of 35 T. This would also help the magnet lab maintain its competitiveness with respect to the other DC field labs.

The user community is very happy with the new 65 T pulsed magnet coil design that enables longer pulses and faster cool down as well as the undergoing efforts for the 100 T redesign. There is a general consensus the new magnet engineer hire is a great success for the PF facility and the Maglab in general. Doan is dynamic and he already has plans for a 105 T magnet, using a smaller 7mm bore. Plans for a duplex magnet based on firing two capacitor banks are also exciting. We also note the plan for a cryostat with a space---free –optics compatible tail that would operate in a horizontal geometry. While this may not be a priority for the coming year, we encourage the lab to continue exploring this idea.

The committee endorses the idea of an 18 T/Dilution Refrigerator system for the High B/T facility. As an External Advisory Committee recommendation, this system would remove considerable pressure off the user schedule at this facility. While the design would be somewhat similar to some systems in the mK facility, the 18 T would be used for longer experiments than typical mK runs at the Tallahassee facility. It would also give users a

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fast turn---around system, which they are currently lacking.

On the experimental techniques development front, we strongly endorse attempts to increase the signal---to---noise ratio for the DC lab experiments. The commitment to continually striving to improve experimental techniques in parallel with development of new magnet technologies is a real strength of the DC program.

There was a general consensus that accepting common proposals for the DC and PFF facilities is very beneficial for users and experiments that need to explore a large parameter space in pursuit of one science goal (especially where different approaches of the same experimental techniques are better suited for different regions in that parameter space). The flexibility of collaborating with the same staff scientist at both facilities is, in this context, much preferred and appreciated.

The committee members discussed at length the proposal to split the DC and PFF committees. The consensus was that separating the DC and PFF committees would possibly bring more needed PFF expertise to the user committee as a whole. A final decision in favor of forming a separate PFF committee should come with provisions towards keeping the communications lines open with the DC committee to protect the interests of users of both facilities. By and large, the positives of splitting the committee outweigh the negatives and the committee feels synergies between the two programs can still be maintained.

(ii) ***The DC/Pulsed Field Optics Programs Review:***

The user committee requested that the DC and Pulsed Field facilities provide a detailed status report of the optics programs, the first one since the 2009 Workshop on Optics in the Florida Split Helix Magnet that set some directions for the future development of the optics program, on the eve of commissioning the first 25 T split---coil magnet compatible with free---space optics techniques. We summarize below our conclusions and feedback from users.

First and foremost, the committee is unanimously applauding the outstanding progress at both facilities. The committee recognizes the tremendous progress in the development of multiple, cutting---edge techniques, in particular ultrafast visible/near IR optics and Raman. This progress is in part due to the introduction of the split Helix magnet which attracts the interest of a wide array of new users. User support scientists have done a fabulous job of setting up the next generation of optics in high magnetic field experiments in the Helix and the pulsed field facility.

Specific achievements the committee wishes to point out for the optics program include:

- Ultrafast polarization and time--resolved techniques using a state of the art, multifunctional new laser amplifier system that covers a broad spectral range with instrument--limited temporal resolution. (Seed: 10nJ, 80MHz Amplifier Pulse energy 5mJ, repetition rate 1 kHz, pulse duration 15 fs OPA ---250nm--10μm pulse duration approx. 60---80fs)
- Ultrafast two--color pump probe
- Magnetic Circular Dichroism in thin film and solution (S/N approx. 0.0001)
- Capability for high intensity THz Generation (See laser spec above)
- 2D Coherent Ultrafast spectroscopy
- Spatially –resolved Raman spectroscopy and T< 1K Raman
- Mid IR single turn (150T+) cyclotron resonance

Most of the instrumentation and techniques have never been used in magnetic fields larger than 9 T prior to these developments.

The user community also appreciates the large diversity of optical spectroscopy experiments developed. Unlike other experimental techniques, spectroscopy involves a larger degree of customization added to the “standard” experiments list and the users would like to see that continues in the future. While better synergy between the various facets of the optics program (i.e., visible, far infrared, Raman and pulsed fields) should be improved, users don’t want to see that happening at the expense of limiting or cutting the great experi-

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mental portfolio that is so essential for the success of the optics program. They do recognize that a senior, full professor level hire in optics and spectroscopy might help this synergy, and they caution it is critically important that this future leader is someone with a commitment to a broad and inclusive vision of this field and appreciative of the great diversity of science enabled through optical experiments.

The program is now ready to move to the next level where many of these experiments that are unique need to be streamlined in order to serve a larger user base (i.e., spatially---resolved Raman, most Helix experiments, etc.). Given the diversity of techniques that now exists, the committee believes DC facility optics would greatly benefit from an additional dedicated technician that could be trained in standard laser maintenance procedures and daily optics setup debugging. Staff scientists in optics are seriously overworked to the point of compromising their own in---house research program, and thus the development of future advances.

In terms of further infrastructure development, the HELIX has clearly enabled a large array of new experiments, but the magnet geometry is really not ideal for most of the Faraday geometry experiments. While the range of experiments available at the DC facility is quite impressive, the users also think that the community could benefit greatly from the introduction of FTIR techniques into the Split Helix and ***they strongly emphasize the absolute need for the Faraday insert that would enable the Faraday geometry necessary for about 90% of ALL experiments in the HELIX***.

We believe that the pulsed facility could greatly benefit from a similarly optimized magnet to further expand the range of optics. The user committee is grateful to see that the PFF is considering such a design, though we suggest they consider a split---coil type system and encourage them to reach out to a wide array of potential users who could help in thinking through the design and potential experiments. There is particular interest in developing the ability to do initial experiments at the DC facility that can be extended to the pulsed facility as well as broadening the spectral range available at the pulsed facility.

The users understand that perhaps the issue of reaching base temperature as low as 5 K in the Helix cryostat may be challenging, but the committees wish the Maglab to continue exploring that idea, since the 5 to 15 K range is crucial to many optics experiments.

(iv) Priority list of recommendations and executive summary:

- Management should support the hiring of a FCE position to assist with the development of the optics program.
- We endorse the hiring of a new physics faculty member at FSU who can assume the role of CSO in experimental condensed matter at the NHMFL.
- We recommend the continued development of new DC magnets and in particular the 40 T/28 MW resistive magnet. The hybrid magnet is currently oversubscribed, and the 40 T would greatly relieve some of the stress on this facility. In addition, if the hybrid magnet fails, the 40 T would serve as a back---up system so that high field science can continue to flourish without a significant impact to the user program.
- Increased synergy between the DC and PFF is strongly endorsed for the future, even though we are considering separating the user groups to address specific concerns of each facility.
- We recommend future developments of higher fields at the PFF and new techniques. Plans for a duplex magnet based on firing two capacitor banks are exciting. Pulsed NMR experiments might be explored.
- We recommend looking into the possibility for an 18 T/DR magnet at the high B/T facility. This could be used for experiments which are longer in time scales compared to experiments at the Tallahassee branch, but shorter than the experiments currently completed in Gainesville. This would enable a faster turn---around for the high B/T facility in general.

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- We strongly encourage the continued repurposing of older magnets, which is an extremely cost effective way of building high field instruments at the MagLab (this is also endorsed by the MR report below).
- We note the value of the UCGP program at this point, and encourage its continuation and expansion, as it has provided funds to develop hardware and support a number of other worthwhile projects and research areas (this is also endorsed by the MR report below).
- The UC is concerned that developments in high field magnet technology would be dramatically compromised by a change of site, and see no conceivable reason that would justify disrupting the current situation (this is also endorsed by the MR report below).

(3) Report of the Magnetic Resonance Division User Committees

Sections: I. NMR and MRI, II. EPR and III. ICR

I. NMR and MRI

NMR/MRI UC and contributors to this section of the report: R.W. Schurko (Chair, Windsor), M. Pruski (Ames Lab, Iowa), Michael Harrington (Huntington Medical Research Institute), Brian Hansen (Aarhus), Eduard Chekmenev (Vanderbilt), Len Mueller (UC Riverside), Fang Tian (Penn State), Tatyana Polenova (Delaware), Scott Prosser (Toronto)

(i) ***Overview:*** The NMR UC is very pleased with the progress made in the NMR/MRI division over the past year *across the board*, including publication count and quality, user recruitment and activities, development and application of new experimental methods, applied projects in materials science, structural biology and MR imaging, and magnetic field technology development. Continued investments in personnel/support staff, faculty, equipment and facilities are all strongly endorsed. The NMR/MRI division continues to make the MagLab one of the premier sites in the world to do groundbreaking experiments in NMR.

(ii) ***Personnel**:* We are very impressed with the high quality of intellectual engagement and scientific leadership of Prof. Lucio Frydman in several major project areas, including the development of DNP methods and applications of MRI. Aside from spending 9+ weeks on site per year, he is in contact (via Skype, etc.) with Florida---based team members on a weekly basis. Productivity in terms of research progress and publication output is also impressive. We are also very glad to hear of the hiring of Dr. Yan---Yan Hu by the Department of Chemistry at FSU; her expertise in battery materials, interest in biomimetic composite materials, and proposed use of the DNP NMR facilities for these projects makes a crucial link between her department and the NHMFL. Earlier in the year, we were disappointed to hear of the departure of Prof. Rafael Bruschweiler, a world---renowned expert in NMR, from the Department of Chemistry at FSU. We strongly endorse the hiring of a new NMR faculty member at FSU, who can assume the role of associate director of biophysics (or another strategic area) at the NHMFL. We were pleased to hear that UF is considering other faculty hires to better utilize the AMRIS facility (e.g., brain research, metabolomics). We have several staffing concerns in the NMR area at the MagLab; in particular, we strongly suggest the hiring of two FTE positions: one for SCH/HTS magnet/spectrometer development and one for DNP applications and development. An enormous investment has already been made in these areas in terms of infrastructure – if they are to truly flourish, additional personnel must be put in place, with the eventual goal of translating them to user support and research personnel. Finally, management should explore the cost effectiveness of hiring a ½ FTE position that can deal with repairs of equipment (e.g., rf, amplifiers, etc.) that would otherwise cost too much to replace/repair via commercial sources.

(iii) ***Equipment, Infrastructure and Use of Facilities:*** Between the MagLab and AMRIS, there are 18 NMR and MRI spectrometers and magnets, with fields ranging from 3.0 to 21.1 T, which are used in a diverse range of applications including SSNMR of materials and biosolids, solution NMR (e.g., proteins, metabolomics, clinical) and imaging of animals and humans; this includes spectrometers incorporating new and innovative technologies such as DNP (dissolution, solutions and solids), HTS magnets, cryoprobes, and specialty probes developed at the MagLab

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(for solids, imaging, etc.). The spectrometers range in installation dates from 1994---2013, and several recent upgrades have been made. We strongly recommend the provision of both resources and support necessary to maintain and effectively use this impressive fleet of NMR spectrometers – failure to do so would undermine many of the ongoing projects, as well as the investments in this equipment.

Highlights. At FSU, the 900 MHz spectrometer, which has been active for 10 years, is the current flagship instrument of the MagLab. Its time is split between the SSNMR user program and MRI (in---house probes, mainly small animals). The 830 MHz narrow---bore magnet is used for materials SSNMR, and has freed up much time on the 900 MHz. The same can be said for the 800 MHz/63 mm system, which is a repurposed magnet from UMinn. Commercial NMR electronics and an in---house 3.2 mm MAS HXY probe (built by Gor'kov) have allowed increased materials and biosolids NMR experimentation. We strongly encourage the continued repurposing of existing magnets, which is a cost---effective way of building high---field instruments at the MagLab. In particular, we support the idea of acquiring another 800 MHz magnet, which will feature a low---E 3.2 mm probe and be coupled to a Bruker HD console. The UCGP (vide infra) has provided funds for the development of a 100 kHz MAS probe for this system.

At AMRIS, there has been much progress with DNP and imaging. The dissolution DNP NMR spectrometer (1 K/5 T/212 MHz/140 GHz) is being applied for in vivo metabolism studies, and will permit imaging of low---gamma nuclides; signal enhancements of 16000 and 11000 have been reported for 4.7 and 11.1 T, respectively. Future visions include a users facility for continued and future use in in vivo, multinuclear NMR, MRI and metabolomics projects. There is progress in the continued use and set---up of the solution and solids DNP NMR spectrometer, which will incorporate a single gyrotron and two 14.1 T magnets. Furthermore, continued projects in MRI continue successfully at AMRIS (NMR, clinical and animal/human imaging).

Publications & Funding. In 2013, publication output and funding for both locations is also very impressive. The FSU team reports 43 publications (11 in high impact journals), 210 users and 2775 user days on 9 instruments. AMRIS reports 51 publications, 184 users, and 1000+ users days on 8 instruments. We note the value of the UCGP at this point, and encourage its continuation and expansion, as it has provided funds to develop hardware and support a number of other worthwhile projects and research areas.

User recruitment and outreach. User numbers are good, but continued efforts must be made to increase the user base at FSU and AMRIS. In 2013, workshops were held which discussed potential use of SCH magnet spectrometers (annual UCM) and coil building for MRI (AMRIS). A 2015 workshop on high field magnet technology is currently being organized – we believe more such workshops are necessary. The NMR UC is delighted with the format of the new web site, and believes it will play a major role in attracting new users, collaborators and public interest, and should also serve to streamline the proposal review process.

(iv) ***Magnet Technologies****:* One aspect of the MagLab which differentiates it from all other facilities in the world is the continued development of new magnetic field technologies that will undoubtedly be transformative in the way that NMR spectroscopy is utilized. In particular, the Keck (25 T), Platypus (30 T), SCH (36 T) and NHMFL Hybrid (45 T) magnets and spectrometers all present different degrees of field strength and resolution that will enable a broad variety of applications – some never attempted before by NMR spectroscopists. We will focus our discussion on the latter three systems for the purposes of this report.

The ***36T SCH system*** can ramp from 0 to 36 T in 15 minutes, has field homogeneity of 1 ppm and no long term drift, and will be commissioned in early 2016. The committee is impressed by and strongly endorses the development of SCH probes, including low gamma MAS, CP MAS, static (PISEMA), static low gamma HX, a Zilm 1.6---

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mm ^{1}H---detection MAS probe and an imaging probe. An HR---MAS probe is being developed as a test instrument, and pending future improvements in resolution, the development of an HXY MAS probe for biosolids is a high priority. Static broad-band probes are a very high priority, since sub---1 ppm resolution is unnecessary, and can enable multinuclear SSNMR studies of many new materials. The proposed development of the ***30 T NMR system*** using HTS magnets is very exciting. New materials such as the REBCO tape and Bi---2212 round wire HTSs are being compared, and a demonstration magnet (Platypus) is in progress, with ca. 24 T as an intermediate goal. HTS technologies continue to be developed and advance, but resolution on the ***45 T Hybrid*** is still ca. 100 ppm (the SCH system can act as an intermediary system during development). Projects on increasing field homogeneity, probe design, power supplies, etc. are either in progress or will be initiated.

Support for these projects, in terms of funding and personnel, is absolutely essential. All of the NMR and MRI UC members can envision spectrometers operating at these magnetic fields which will enable new classes of experiments that will push the boundaries of what is possible, and permit the study of complex materials and biological systems that have hitherto been impossible to probe via NMR methods.

(v) ***DNP****:* We are very pleased with the excellent progress on the installation of the 395 GHz/600 MHZ DNP NMR instrumentation. Within the last few months the smart and cost---effective idea of coupling one gyrotron with two 14.1 T NMR magnets to serve both MAS DNP and Overhauser DNP (ODNP) instruments became a reality. The microwave (MW) beam splitter has been installed on a quasi---optics table, providing a flexible tool for the management of MW power, which can be independently controlled for both instruments. The MAS probe and associated cryogenics are already operational, but need additional adjustments of cryogenic gas delivery and minor facility upgrades (continuous source of compressed dry N_2 gas) to enable reliable 24/7 operation. The DNP MAS NMR capabilities should be available to users in 2015 after the installation of an NIH---funded field---swept magnet. The installation of ODNP instrument is also progressing well, with the commencement of user activities scheduled for 2017. The MAS and ODNP capabilities will complement the dissolution DNP user program at AMRIS. We note that active collaborations between the NMR and EMR divisions have made much of this possible.

The NHMFL staff recognizes that further fundamental research is needed to reach the full potential of DNP in enhancing NMR's sensitivity. They installed an innovative console---controlled gated shutter, which is able to deliver the MW irradiation in pulsed mode, and thereby permit to study transient phenomena relevant to the DNP process. We strongly recommend that funding be provided for continuation of these efforts. DNP is a very labor---intensive technique, which requires constant attention of highly qualified scientific staff. As described in the personnel section above, we recommend the initiation of a search for a FTE staff scientist to work on the DNP development and facilitation of collaborations with users.

(vi) ***MRI:*** The Maglab continues to house some of the world's most advanced instruments for high field MRI and MR microscopy. The personnel on site are a valuable resource to users and collaborators alike and the work from the Maglab is an inspiration for the entire imaging community. It is important that the collaboration to magnet industry (Bruker) is healthy – the Maglab should continue to be a high priority customer to Bruker. Compared to some of the large scale projects launched in recent years (e.g., human neuroimaging, Connectome project), we believe that the microimaging is a very cost effective route to improve on our ability to interpret clinical MRI through validation studies and cellular level imaging. There continues to be great potential for gaining valuable insight into MR signal formation at the cellular level, especially microstructural imaging with diffusion weighted MRI and in vivo diffusion spectroscopy. For these reasons, we are pleased the MagLab responded to recommendations from the 2013 Users Committee by developing approaches to obtain imaging capability on the new generation of high field magnets (36 T). Long---term support for the continuation (hardware and staffing) of MRI

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hardware development is vital for the long---term success of high--- field MRI. For external users planning to do in vivo work on their own animal models, it is important that a system is in place to facilitate transfer to and housing of animals at the Maglab site.

In regard to a competitive renewal for the MagLab, we are very concerned that science in high field magnet technology would be dramatically compromised by a change of site. Extra---ordinary progress at the current sites has been achieved with a user---responsive and highly sophisticated physical, professional, educational, and staffing infrastructure that will be grossly disrupted for users by any change of the principal locations. The current users do not see any conceivable advantage that might justify disrupting this situation.

(vii) Priority list of recommendations and executive summary.

- Management should support the hiring of a minimum of two FTE positions: one for SCH/HTS magnet/spectrometer development and one for DNP applications and development. Part time personnel for electronics/rf repair is also recommended.
- We endorse the hiring of a new NMR faculty member at FSU (to replace Rafael Bruschweiler) who can assume the role of associate director of biophysics (or another strategic area) at the NHMFL.
- We strongly recommend the provision of both resources and support necessary to maintain and effectively use the impressive fleet of NMR spectrometers (18 in total between NHMFL and AMRIS); to pull back on this enormous investment as it is really starting to flourish would be unwise.
- Support for the HTS, SCH and hybrid magnet/spectrometer projects, in terms of funding and personnel, is absolutely essential. Within a few years, these systems will permit new NMR and MRI experimentation that was previously not possible; technologies from these developments may advance the entire field of NMR/MRI as a whole.
- We strongly recommend that funding be provided for continuation of efforts in DNP NMR. European institutes are currently far ahead of the U.S. in this area; it is crucial that new techniques and applications continue to be spurred at the NHMFL.
- We strongly encourage the continued repurposing of older magnets, which is an extremely cost effective way of building high field instruments at the MagLab. In particular, the acquisition of another 800 MHz magnet is supported.
- We note the value of the UCGP program at this point, and encourage its continuation and expansion, as it has provided funds to develop hardware and support a number of other worthwhile projects and research areas (this is also endorsed in the DC/PFF/High B/T report above).
- Efforts should be made to facilitate transfer to and housing of animals at the Maglab site.
- The NHMFL should maintain a healthy relationship with Bruker for acquisition of new equipment and perhaps future exchange of technologies and IP.
- The UC is concerned that developments in high field magnet technology would be dramatically compromised by a change of site, and see no conceivable reason that would justify disrupting the current situation (this is also endorsed in the DC/PFF/High B/T report above).
- Finally, we recommend that the Users and MagLab scientists contribute a prominent science publication for 2015 on the advances that will arise from the SCH, HTS and/or DNP systems, in order to inform the wider community prior to the rollout in 2016 of this unique instrument, and encourage proposals from external users.

II. EPR

EMR UAC committee: Kurt Warncke (Emory University, U.S.; Chair), Chris Kay (University College, U.K.), Dane McCamey (University of New South Wales, Australia), Christos Lampropoulos (University of North Florida, U.S.), Stefan Stoll (University of Washington, U.S.), Sergei Zvyagin

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(Dresden High Magnetic Field Laboratory, Helmholtz---Zentrum Dresden---Rossendorf, Germany)

(i) Director and Personnel

We were overall very impressed with the accomplishments of Electron Magnetic Resonance (EMR) program. Our review of the research output (count and content) over the 2013---2014 year, on---site viewing of the facilities, and interaction with EMR personnel, confirms that the EMR program at the NHMFL continues to be a world---leading high---field (HF) EMR facility. The EMR program continues to be remarkably productive, with 30 papers already published in 2014. The continued increase in the EMR user base (growth from 109 to 144 users over the previous, including 19 new PIs) is impressive.

EMR Director Steve Hill provides effective leadership, and wields both in--- depth technical expertise and knowledge of the science being performed by EMR group personnel and by users, which underpin a strong vision for the future of the EMR group. Hill displays a high degree of commitment and responsiveness to user needs, and user---driven scientific directions. This commitment and activity keeps the EMR user program at the forefront of high field EMR technical development and science.

EMR staff (Jurek Krzystek, Andrew Ozarowski, Likai Song, Johan van Tol, Sebastian Stoian) are all technical experts, and are driving the science in their areas with their respective instruments. New Dynamic Nuclear Polarization (DNP) –area postdoc Dubroca and EMR engineer Trociewitz, are viewed as valuable new contributors to the DNP effort. The close involvement of University of Florida (UF) faculty Alexander Angerhofer and Gail Fanucci is highly appreciated.

(ii) Instrumentation

HiPER Spectrometer. HiPER is a W---band EMR spectrometer that has been purchased from the group of Graham Smith at St. Andrews University, Scotland. HiPER is a state---of---the---art, high---power, high---sensitivity instrument with a unique non---resonant sample arrangement. The EMR UAC is pleased about the progress made with the HiPER instrument over 2013---2014, which includes operation at low power in continuous---wave (cw) mode, and the development of thin---layer sample holders for solution samples. A recent experiment at room temperature performed with nitroxide samples at a concentration of 10 μM shows an impressive signal---to--- noise ratio (SNR) increase of ~100, relative to the resonant probe configuration of the commercial Bruker W---band spectrometer. This was achieved with samples in collaboration with Professor Gail Fanucci (UF). This result confirms expectations for the HiPER instrument, and opens the door to a wide range of nitroxide probe and label experiments. In summary, there is clear evidence of success with HiPER, and high promise for the future.

Regarding the operation of HiPER at high power, the EMR UAC is concerned that the high---power amplifier (1 kW) has not been implemented, and that there is some uncertainty about the time for implementation. Funds have been appropriated for the full implementation of the high power capability. The amplifier itself has been on site for a while. The EMR group awaits the receipt of a laser with a silicon switch, as well as an Attocube drive. The incorporation is dependent on a site visit by the St. Andrews team. We strongly encourage the effort toward immediate implementation of the high power amplifier to the extent currently possible, by an EMR Group member. The UAC feels that the negotiations with the St. Andrews group must be brought to a close and any further delays should be avoided. The high---power mode of HiPER is crucial to the user base, especially in the structural biology field.

DNP. The UAC is excited by the progress in the area of DNP. We appreciate that the expertise in the lab allows combination of commercially available systems within---house equipment, especially the gyrotron source, which has been modified to enable DNP experiments for both solution and solid---state samples, simultaneously. This is proof of the strong synergy that is available between the EMR and NMR programs. We encourage continued collaboration between the EMR and NMR programs in this direction. This synergy is rapidly moving DNP forward at the MagLab, with impact on DNP worldwide.

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We note that EMR can continue to make strong contributions to the advancement of the DNP program. The implementation of quasi---optical technology in the DNP spectrometer is a direct contribution of the EMR group. EMR can investigate and optimize paramagnets (molecules and solution environments, other conditions) for the generation of DNP.

The UAC is excited by the plan to integrate an EMR spectrometer into the DNP spectrometer. We hope, however, that this will not dilute personnel effort on the other experiments, such as HiPER.

Terahertz Sources. We are extremely interested in extending the multi--- frequency capability to the high frequency range, to above 1 THz. A tunable or broad---band THz source is highly desirable. This would significantly expand the science that is accessible with the current high magnetic fields. The tunable THz is critical for the future technology and higher fields, which will come on---line with the series connected hybrid (SCH).

Transmission Spectrometer. A concern is the failure of the 180 A power supply for the 17 T magnet, that is part of the broadband transmission spectrometer. The power supply is broken, and needs to be replaced. The broadband transmission spectrometer is a workhorse instrument, and is now being run using an older power supply, that does not allow access to the highest magnetic fields (for which sources are available), limiting the science which can be explored. A large amount of science is produced by this instrument, and failure of the backup power supply would be catastrophic for the program.

The UAC feels that the purchase of an additional VDI source to cover gaps in the current source frequency range (approximately $60K) is necessary. This additional source will substantially improve the frequency coverage and improve data quality. A direct outcome will be to eliminate ambiguity in the analysis of experimental data.

Quasi---optical Spectrometer. The UAC recommends the purchase of a high--- power source for the high---power quasi---optical spectrometer. This will provide the power required to improve SNR, increase the range of timescales which can be accessed, and allow for quadrature detection.

Sample Control. There is a view that additional sample control, excitation and detection capabilities could be expanded. For example, optical and electrical detection of EMR would broaden the scope of experiments which can be undertaken with the spectrometers, and provide access to new areas of scientific inquiry.

One area in which rapid progress in this direction could be made would be the provision of a tunable optical source. Users have requested this capability, and the UAC supports this request.

This capability would significantly expand the ability of the EMR program to contribute to the energy and environmental systems areas. The tunable laser source will also be applied to the HiPER spectrometer, creating a worldwide unique user facility for time---resolved investigations.

(iii) EMR User Program

The user program currently operates at an oversubscription of 113%. Facility and personnel are at or beyond capacity. Given the anticipated growth in demand when the high---power capability of HiPER comes on---line, additional staff will be required to maintain user satisfaction, and the volume and quality of the user program.

The UAC supports the plan to hold an EMR user workshop by the end of fall 2015. We also recommend that the EMR user workshop be held annually. These workshops will help to recruit new users, promote awareness among researchers in the field of the experimental capabilities at the NHMFL, and consequently further expand the science output of the EMR group.

(iv) EMR Group Personnel

We are impressed with the depth of expertise, and superior level of commitment of each EMR Group member. The group drives both technical innovation and the science.

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There is a concern within the UAC that knowledge is concentrated in individuals, and knowledge needs to be transferred across the group. The group needs to be robust to unforeseen personnel changes. The ability of the EMR group to maintain their high---field EMR forefront position is vulnerable to this. This issue is acute in the case of HiPER, where the upcoming implementation of high power operation will require new skills and knowledge. We recommend the dedication of a group member to the implementation of high power operation of the HiPER instrument, and the subsequent management of users for this device.

(v) Priority list of recommendations and executive summary:

- HiPER spectrometer: Finalize implementation of high---power capability of HiPER, and make it available to the user community. If necessary, emphasize or shift personnel commitments of one group member to manage the effort on HiPER.
- Transmission spectrometer: Replace the broken power supply for the 17 T magnet. Purchase and install a new VDI source.
- Quasi---optical spectrometer: Purchase and install new source.
- Multi---instrument use: Obtain a tunable laser source for photoexcitation of samples.
- Extend the frequency range of sources to above 1 THz. This is an acute need for the Series Connected Hybrid (SCH) development.
- HiPER hire: Fill the postdoc position for the HiPER spectrometer that is currently in open---search/interview phase.
- New hire: Given the growth in the user program, and profound additional growth anticipated in the HiPER program, the UAC recommends an additional MagLab staff position within EMR. This position would expand the experimental effort in the biology area, and provide the capability to manage issues related to expertise concentration.

III. ICR

ICR User Advisory Committee: Jonathan Amster (Franklin College), Michael Chalmers (Eli Lilly and Company DCR&T Analytical), Michael Freitas (Ohio University Medical Center), Elizabeth Kujawinski (Woods Hole Oceanographic Institution), John Shaw (University of Alberta), Forest White (MIT)

(i) Summary

The ICR User Advisor committee was very impressed with the quality of the ICR User Facility. The NHMFL ICR Facility continues to maintain its competitive edge with regard to the latest in ICR magnet and MS instrument design. The UAC was especially impressed by the high field 21T horizontal bore, zero boil---off magnet. The facility has also been active in advancing innovation in ICR cells and instrument carts. We were especially impressed with improvements in the dynamically harmonized cell and modular hybrid instrument carts that have the potential to interface with a variety of commercial MS instruments. The application of ICR instrumentation to energy/environmental applications is a unique strength of the ICR program. The UAC felt that there is tremendous potential for growth in the area of petroleomics and environmental applications.

(ii) Instrumentation

- The 21 T is the most important recent instrumentation development. The 21 T provides 1.1 mDa resolution up to 1.6 KDa and 3.4 mDa out to 2 KDa for complex mixture analysis.
- The 21 T was installed in June 2014 and has been running continuously at field since that time.
- ICR program continues to innovate in ICR instrument design. They have designed and built a hybrid instrument for the 21 T based on the Thermo Velos Pro with Front ETD. The Velos Pro hybrid will provide FETD, HCD and CID external MS/MS experiments. The coupling of the Velos Pro with the ICR is modular so that other hybrid configurations can be used in the future.
- New cell designs based on the Dynamically Harmonized Cell hold the potential to greatly improve ICR performance at higher field.

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- UAC advises that the facility identify high---impact problems to illustrate the power of the 21 T.

(iii) Overview of Applications

Biological

- Neil Kelleher presented current capabilities and future applications of the 21 T magnet for top---down proteomics. Dr. Kelleher has a strong continuing relationship with the ICR program. He is providing the scientific leadership in developing biological applications of ICR---based LC---MS/MS for top---down proteomics.
- Top---down proteomics quantitation requires isotopic resolution. A 21 T uniquely provides this resolution from 30 KDa to 60 KDa. With regard to clinical proteomics, identification of proteoform difference can be done by top---down proteomics. The NHMFL is the only place that would allow for the demonstration of the benefit of high---field top---down proteomics using the highly innovative 21 T. The more comparable Orbitrap instruments do not have the resolving power to breach the 30 KDa barrier at this time. Kelleher reported that for 0---30 KDa the top---down proteomics method is ready to deploy for users in a more robust application platform.
- The UAC recommended that a novel approach to perform parallel 14.5/21 T LC--- MS/MS analysis be considered as an opportunity to showcase the capabilities of both instruments in this growth area.
- An immediate concern of the UAC is the appointment of a biological---applications director to facilitate biological applications of ICR. The bio director should bring a vision of how ICR (not just the 21 T) intersects with bio driven applications to fully capitalize on the strength of ICR.
- Potential areas for additional bio---applications include metabolomics and small molecule imaging. Large protein structure/proteoform/PTM mapping would be a strong application, potentially connecting top---down proteomics and HDX. The ICR group should avoid applications that can be performed routinely with commercial instruments of other types.

Complex Mixtures

- Advances in state---of---the---art ultrahigh resolution/high mass accuracy mass spectrometry will significantly improve the depth and breadth of complex mixture analysis. The data can be used for molecular characterization of oils, for understanding the biology of oil degradation in the environment and ultimately for development of a database of oils for source identification or for comparison of differences in chemistry. Ryan Rodgers described a future project where the toxic components of weathered fuels could be identified using state---of---the---art ICR MS. This project is exciting due to the intersection among the energy, environment and biology science drivers. Higher fields will increase the upper mass range of components that can be confidently characterized and the resolution of increasingly small mass differences.
- The ICR applications for the energy and environment science drivers are predominantly academic users. In addition, the Future Fuels Institute was established in 2012 and is a major user of the ICR facility.
- Petro Org is a commercial program developed at the NHMFL for petroleomic data analysis. Although the NHMFL retains the intellectual property, freeware versions are available for users to view their data. Adding quantification to the data viewing software is an important feature for future development. The ability to analyze data off---site was a concern in the user survey. Improvements in the distribution of data analysis software and data management are closely tied with the hiring of the informatics director.
- The ICR UAC noted the exceptionally strong performance of the petroleomics/complex mixture analysis program.

(iv) Personnel

- Personnel are a critical issue for the ICR program going forward.

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- Hiring of an ICR Director and Biological applications Director is critical in the next 12---18 months.
- Over the long---term, there is a need for hires in informatics and instrumentation.
- Adequate technical staff is in place to meet the users' needs.
- A long---term strategy would be to coordinate a search with the Biology Department or Medical School for senior leadership in biological applications that take advantage of ICR.
- The environmental work is clearly going to be a growth area for the ICR User Program. With the amount of work already being performed in petroleomics, the ICR User Facility should consider adding an environmental chemist to their staff to relieve the pressure on this subgroup. This staff member should have training in environmental chemistry (or a related earth science field), help set strategic priorities and liaise with user.

(iv) Priority list of Recommendations and Executive Summary

- We recommend the hiring of two positions --- an ICR Director and a Biological applications Director.
- The UAC and management need to propose a long---term plan to coordinate a search with host institutions for a senior faculty position in biological applications of ICR (e.g., through a medical school or Biology Department)
- The hiring of an environmental chemist to assist the petroleomics group would be worth exploring.
- A separate summer school for ICR techniques should be implemented
- ICR should solicit members of the UAC and select members of the user community for new proposals to UCGP.

(v) Comments Related to the NSF Site Visit

- The UAC endorses the ICR program's development of highly innovative applications in the areas of energy and the environment. The UAC felt that the energy/environment applications are a unique strength of the ICR program and represent an area of high growth.
- ICR expertise should be included on the NSF site visit team at annual and recompetition evaluation of the NHMFL.

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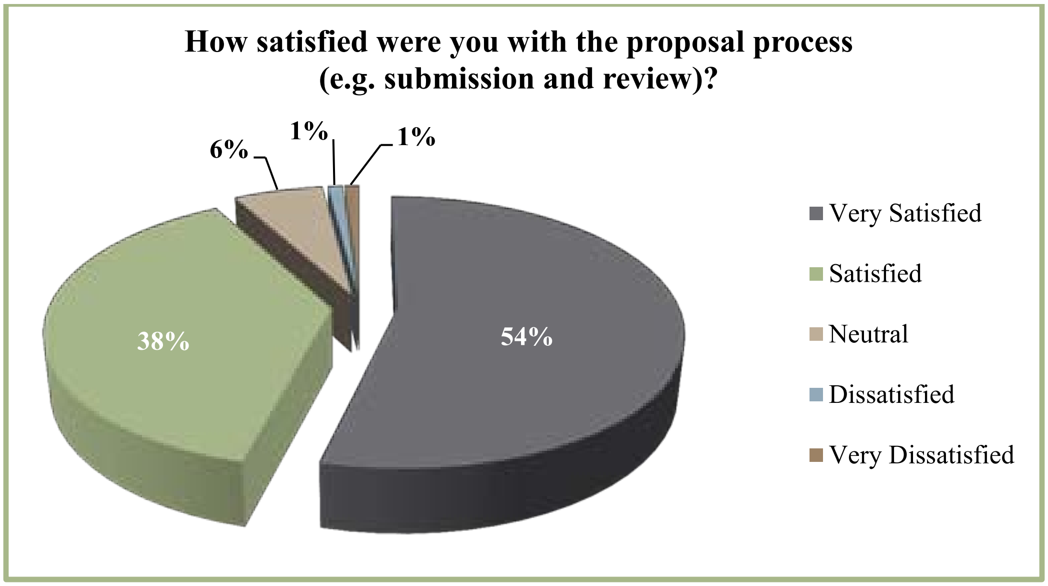
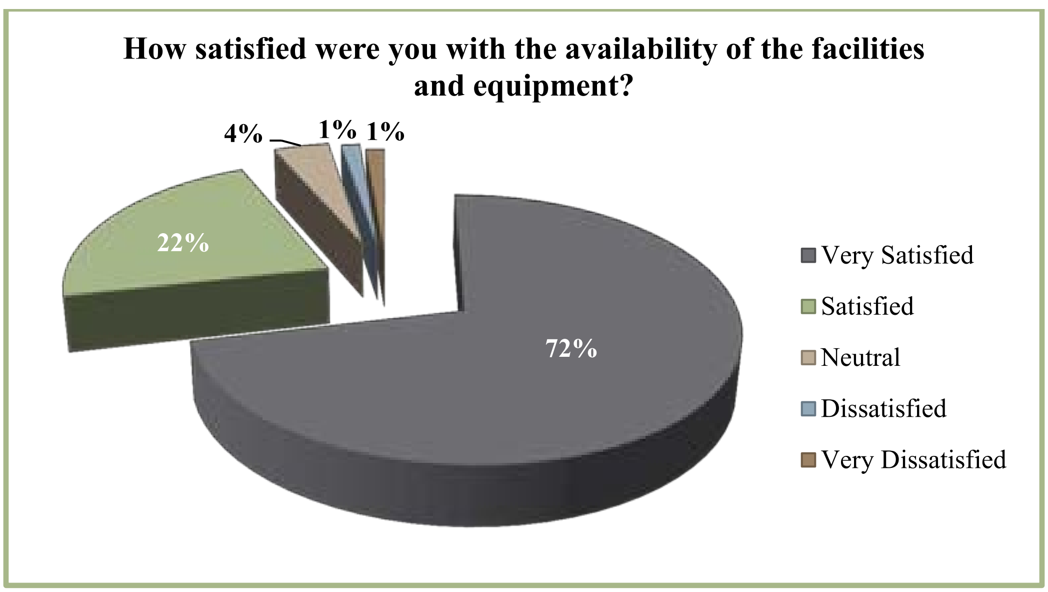
F. Annual User Program Survey

The National High Magnetic Field Laboratory conducted its fifth annual user survey between June 2, 2014 and July 01, 2014. User input assisted all seven facilities to respond to user needs, improve facilities and services, and guided the MagLab in setting priorities and planning for the future. This request was sent to all MagLab User Principal Investigators (PI) and to their collaborators who received magnet time between June 1, 2013 and May 31, 2014, including PIs who sent samples, where the experiment was performed by laboratory staff scientists.





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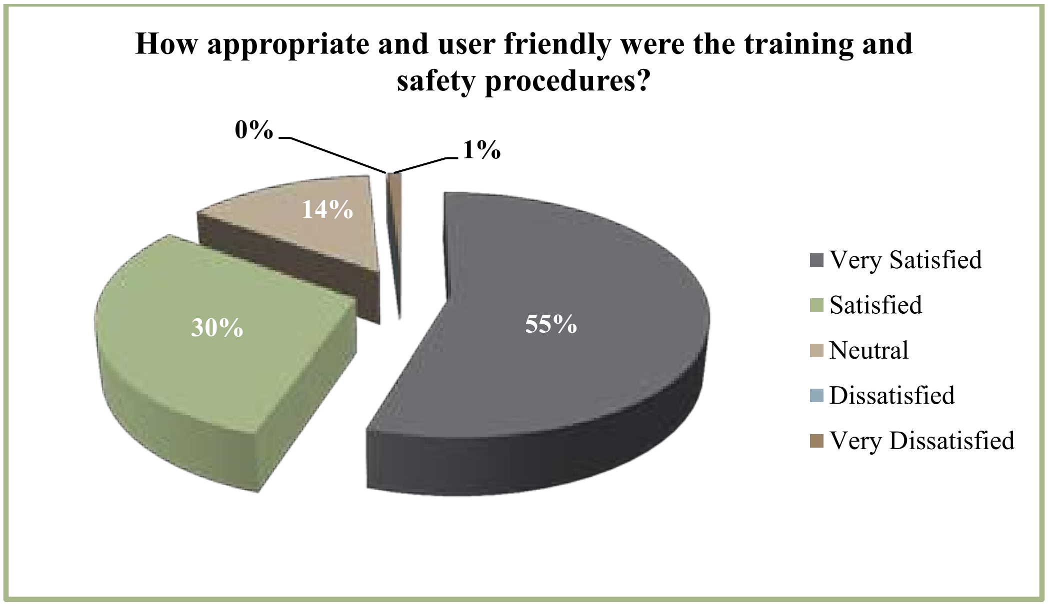

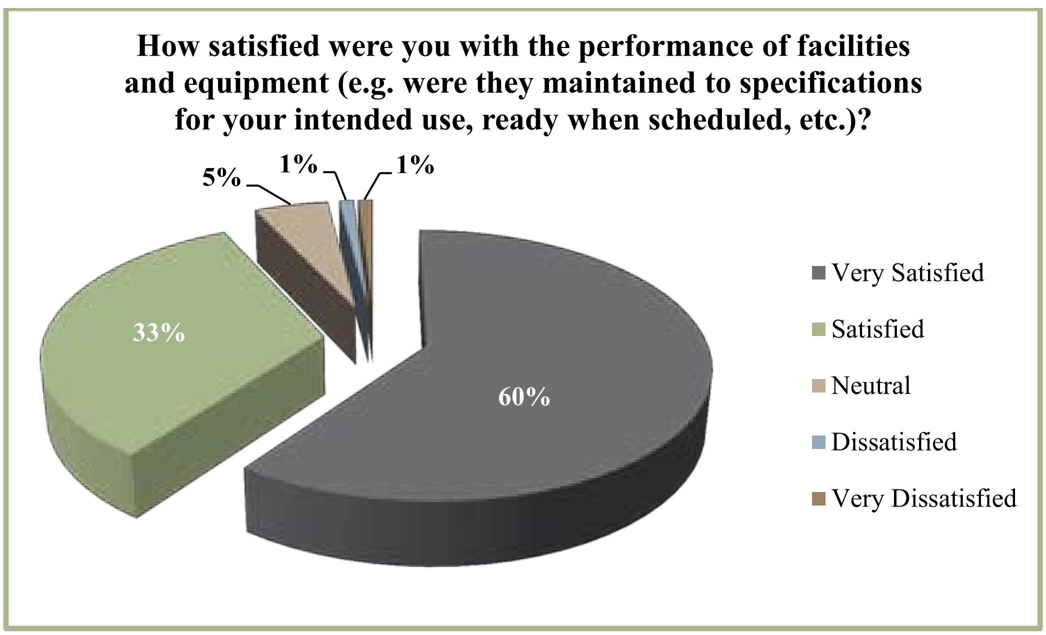

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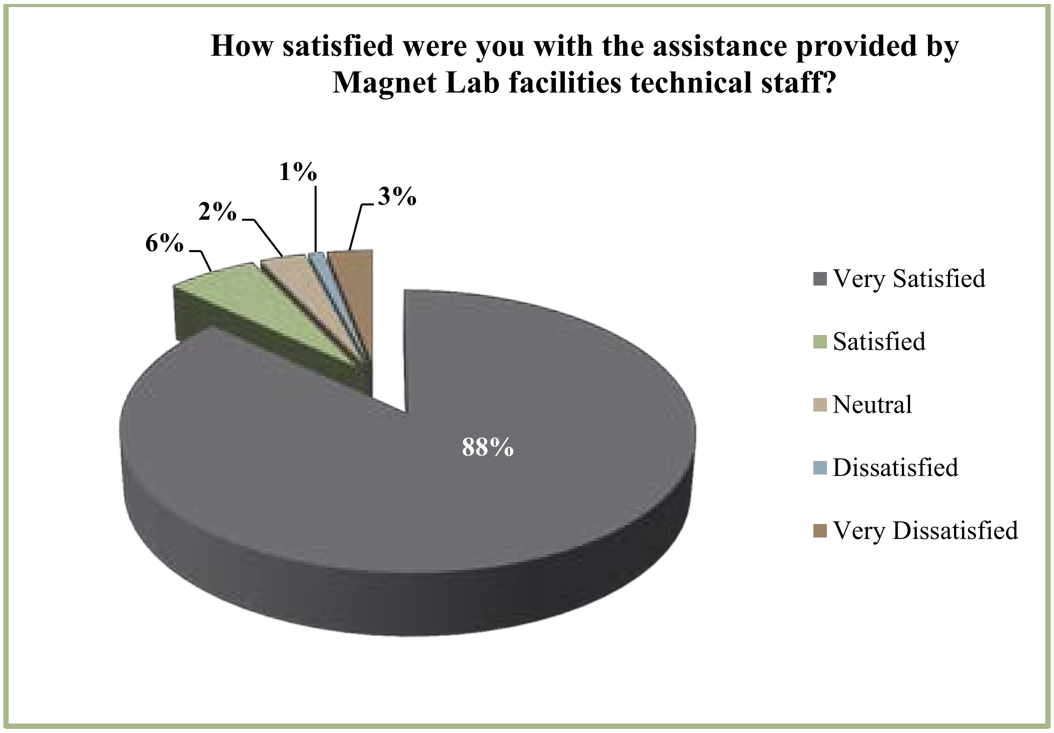

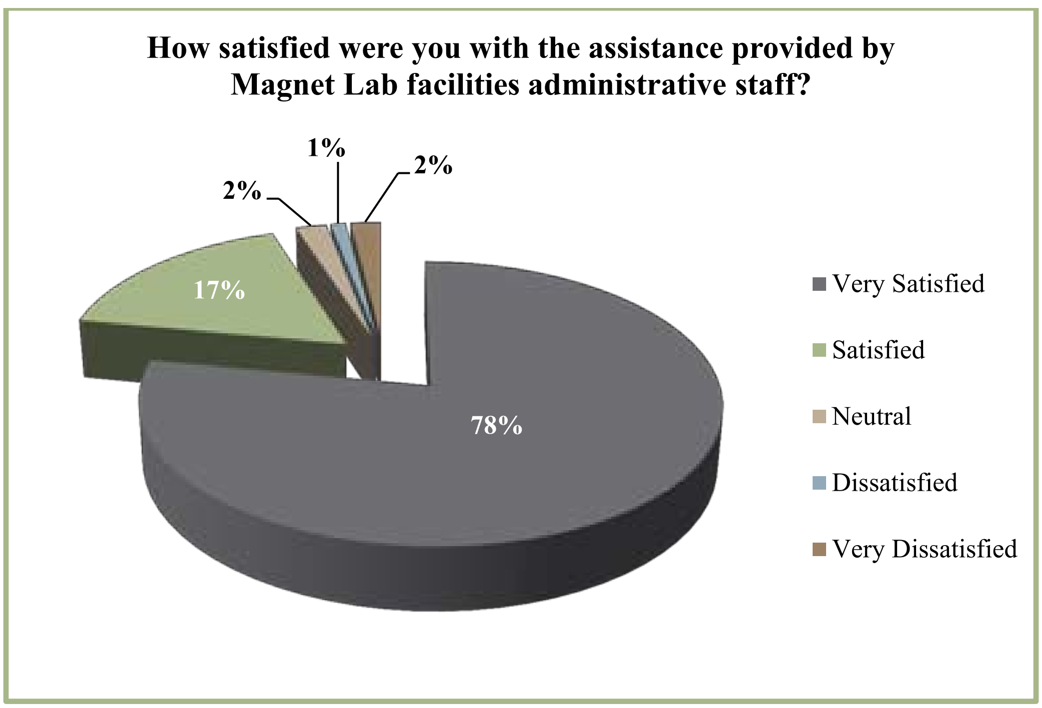

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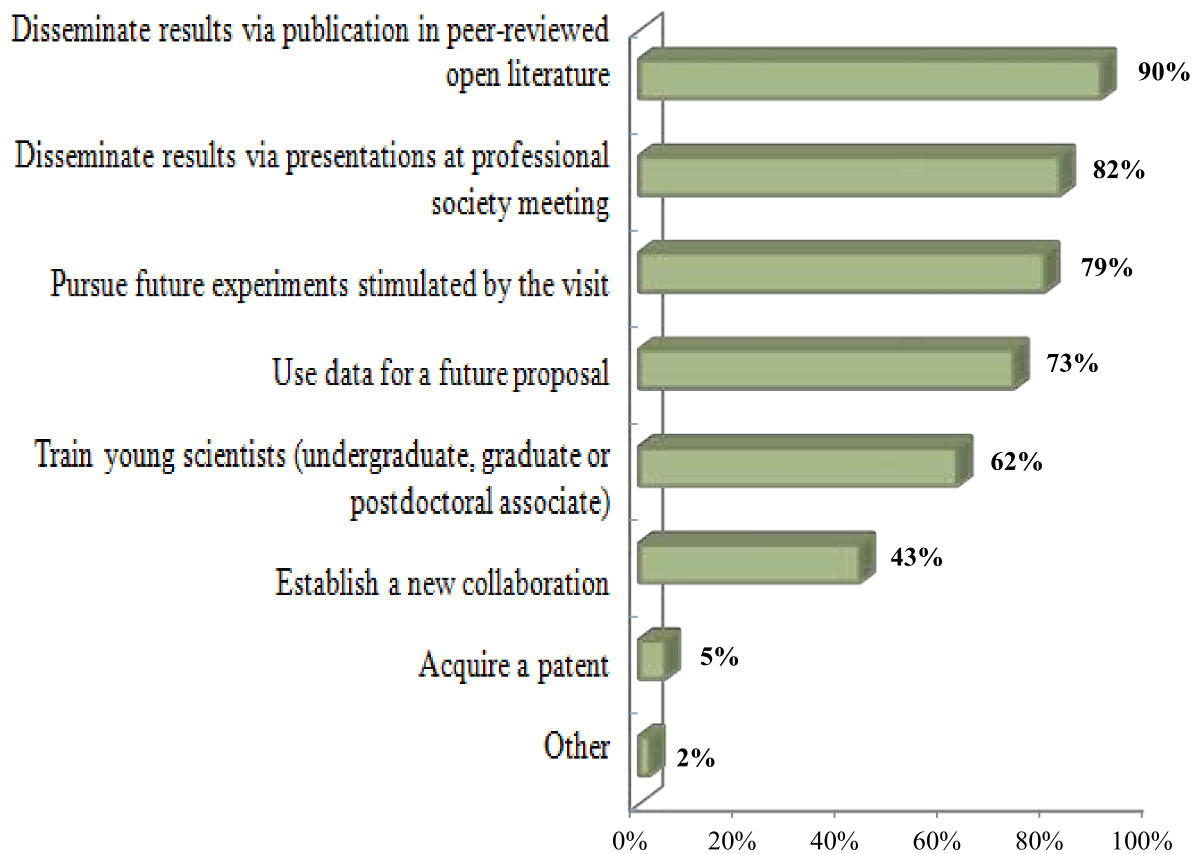
As a result of your use of the Magnet Lab facilities, do you expect to ...



All user responses were treated anonymously.
*All presented figures exclude internal responders.

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2. USER FACILITIES

DC FIELD FACILITY

The DC Field Facility in Tallahassee serves its 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, post docs 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.

1. Unique Aspects of Instrumentation Capability

FLORIDA-BITTER and HYBRID MAGNETS		
Field, Bore, (Homogeneity)	**Power (MW)**	**Supported Research**
45 T, 32 mm, (25 ppm/mm) **35 T**, 32 mm (x2) **31 T**, 32 mm to 50 mm[1] (x2) **30.5 T**, 32 mm (~50 ppm/mm)[2] **17 T**, 195mm **25 T**, 52 mm, (10 ppm/mm)[2] **25 T**, 32 mm bore (with optical access ports)[3]	30.4 19.2 18.4 18.3 18 18.6 27	Magneto-optics – ultra-violet through far infrared; Magnetization; Specific heat; Transport – DC to microwaves; Magnetostriction; High Pressure; Temperatures from 30 mK to 1500 K; Dependence of optical and transport properties on field, orientation, etc.; Materials processing; Wire, cable, and coil testing. Low to medium resolution NMR, EMR, and sub/millimeter wave spectroscopy.
SUPERCONDUCTING MAGNETS		
Field (T), Bore (mm)	**Sample Temperature**	**Supported Research**
18/20 T, 52 mm **18/20 T**, 52 mm **17.5 T**, 47 mm **10 T**, 34 mm[3]	20 mK – 1 K 0.3 K – 300 K 4 K – 300 K 0.3 K – 300 K	Magneto-optics – ultra-violet through far infrared, Magnetization, Specific heat, Transport – DC to microwaves, Magnetostriction; High pressure, Temperatures from 20 mK to 300 K, 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 32 mm 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

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The table above lists the magnets in the DC Field Facility. The NHMFL leads the world in available continuous magnetic field strength, number of high field DC magnets available to users and accessibility for scientific research. The 45 T hybrid magnet is the highest field DC magnet in the world, which is reflected in the number of proposals from PIs located overseas. The 35 T, 32 mm bore and 31 T, 50 mm bore magnets are coupled to top loading cryogenic systems that have impressive performance, flexibility and ease of use. The 25 T 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.

2. Facility Developments and Enhancements

IR Spectroscopy

A new IR transmission probe was designed and built by Zhiqiang Li and Dmitry Semenov that enables IR transmission measurements in SCM 3 and employs the newly purchased Bruker Vertex 80v FTIR spectrometer. This system has been in use since July 2014. The system is capable of IR measurements in the frequency range of 10-6,000 cm^{-1} (far-IR to mid-IR) in the Faraday geometry. Four samples can be loaded on the probe and shuttled in and out of the beam path mechanically to increase the efficiency of data acquisition for the users. The design improvements present in the new probe (larger parabolic mirror and larger diameter light pipe, etc) lead to a significantly improved detection efficiency of the IR signal compared to the old IR system that it replaced.

State-of-the-Art Light Source for the 25 T Split-Helix Magnet

Steve McGill brought online a ***new laser system that will be permanently paired with the split helix magnet in cell 5***. This new light source shown in Fig. 2 enables advanced optical spectroscopies that were not possible in high magnetic fields before the wide scattering volumes and free-space optical access provided by the Split-Helix magnet became available. The light source consists of three oscillator systems.

Figure 1: *New Bruker Vertex 80V FTIR Spectro - meter in SCM 3*

The first oscillator is a Vitara-T tunable Ti:Sapphire cavity that produces <20 fs pulses at an 80 MHz repetition rate. This laser is tunable from 750 – 850 nm depending on the desired bandwidth of the output, which can be as large as 80 – 100nm. The output of this laser is used to seed the second cavity, a regeneratively amplified Legend USX, that itself produces 25 fs, 5 mJ pulses at a 1 kHz repetition rate. To provide access to a wider range of optical frequencies, the Legend is used to excite the third optical cavity, an OPerA Solo, which is a white-light seeded optical parametric amplifier (OPA). Crystals within the OPA permit the creation of femtosecond light at frequencies spanning the entire visible spectrum and near-infrared ranges out to multiple microns in wavelength (**Figure 3**).

Simultaneous with the installation of this laser has been the development of several spectroscopies that require its use. The first of these spectroscopies is known as time-resolved photoluminescence excitation in which the exciting wavelength is tuned over a specified range while the sample's photoluminescence intensity, polarization, and lifetimes are recorded. For the latter half of the year, broadband time-resolved absorption studies were developed. In this particular case the goal was to measure time-resolved absorption of a molecular system over a continuum of optical frequencies simultaneously. This was made possible by using a spectrograph and CCD combination to record the pump-probe interaction of an ultra-broadband pulse having a bandwidth of >35 nm and duration of <40 fs.

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Figure 2: *New Split-Helix laser system*

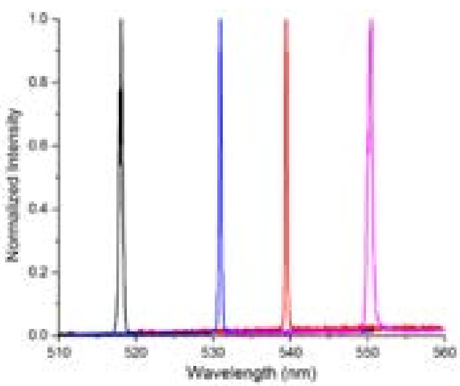

Figure 3: *Tunable pulsed light with 1 nm bandwidth*

Magnetic Measurements Improvements

Piezoresistive cantilevers are used extensively in the DC Field Facility to perform magnetic measurements and sensitive de Haas van Alphen measurements to obtain Fermi surface and band structure information about metallic samples. Since these devices are used so widely at the NHMFL an effort was undertaken by William Coniglio to ***determine the optimum measurement parameters for the piezoresistive cantilevers*** to achieve the best signal to noise ratio. The standard technique uses a lock-in amplifier with a Wheatstone bridge that is balanced at low temperature and zero magnetic field to reduce the dynamic range requirement of the lock-in amplifier. To further understand and optimize the measurement, we have considered the signal and noise as a function of lock-in frequency using an SRS830 lock-in amplifier. The material used to provide a signal was $CeIn_3$, a heavy fermion metal with a prominent dHvA orbit near 3300 T. The measurements were performed in a dilution refrigerator at 40 mK with a 16 T superconducting magnet. The results of the measurement (**Figure 4**) show that between 200 Hz and 20 kHz, the noise is low, and the signal is uniform. The upper cutoff frequency is likely dependent on the length and construction of the wiring to the probe, and with the longer cables necessary for resistive magnets, the higher frequencies may have higher noise levels. Therefore, it appears advantageous to drive piezoresistive cantilevers with frequencies in the range of 200 Hz to 10 kHz with a time constant of 100 ms or greater.

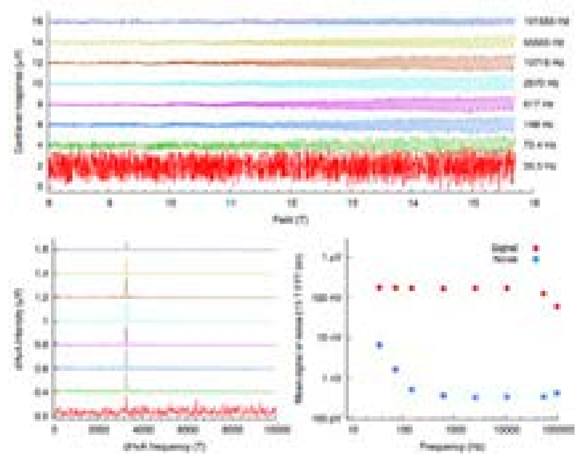

Figure 4: *dHvA signal evolution vs. frequency*

Development of a calorimeter for low temperatures & high magnetic fields.

Angular dependent thermodynamic measurements (specific heat and magnetocaloric effect) of materials at temperatures below 0.5 K and fields above 20 T has been achieved with the development of a small calorimeter that can be rotated in the portable dilution refrigerator. This calorimeter will allow measurements between 0.1 K and 10 K, fields up to 45 T and a rotation sweep of 360 degrees. The calorimeter, shown in **Figure 5**, has an outer diameter of 7.62 mm and a length of

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12.7 mm and can accommodate samples up to a maximum size of 1.4 mm x 1.4 mm x 0.5 mm. This calorimeter was developed by Professor Nathanial Fortune of Smith college in collaboration with Scott Hannahs as part of the Visiting Scientist Program.

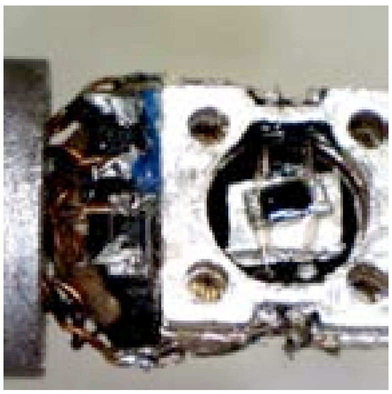

Figure 5: *Calorimeter thermal stage with sample and thermometer shown. The silver square with 4 holes measures 3 mm on a side*

Digital Control System (DCS) replacement

The Digital Control System for the NHMFL plant was replaced and upgraded to enhance reliability and the ability to add new magnet systems and equipment in the future. The control systems for the Series Connected Hybrid and helium recovery system sensors required more connections than our existing DCS was designed to handle. Thus to add these and future systems we performed an extensive upgrade to the entire system during our annual 2014 maintenance shutdown period.

3. Major Research Activities and Discoveries

Research by the users of the DC Field Facility spanned many areas of scientific interest in 2014. Graphene and topological insulators were again prominent as were superconductivity and magnetic materials. Of particular note was research done by Lu Li and co-workers from the University of Michigan that studied the topological insulator SmB_6. This was accomplished by observing quantum oscillations produced on the surfaces of the crystal which become conducting at low temperatures while the bulk of the crystal remained insulating. Other research by David Cardwell and co-workers from the University of Cambridge produced a new world record for a trapped magnetic field in a superconductor ($GdBa_2Cu_3O_7$) of 17.6 T. Work by Yoram Dagan's group from Tel Aviv University on $SrTiO_3/LaAlO_3$ nano-wires revealed the coexistence of magnetism and superconductivity at low temperatures with the superconducting transition occurring at a factor of 3 lower temperature (300 mK) than the ferromagnetic ordering temperature (952 mK).

4. Facility Plans and Directions

In 2015, work will commence on ***reducing the ambient vibration levels for experiments*** in the resistive and hybrid magnets. This will directly impact and improve the signal to noise ratio possible for a wide cross section of experiments. We are working with an acoustics/vibration engineer to arrive at an optimal solution.

Providing the cleanest possible AC power for the user instrumentation in the magnet cells is the second of our 2015 noise reductions goals. In 2014 Ju-Hyun Park evaluated power conditioners from multiple vendors to determine which ones would meet our requirements. There were two that met our specification and these will be deployed into the magnets cells over the coming year.

Building on the installation of the new Bruker VERTEX 80v spectrometer and development of the transmission probe in SCM 3 ***a new reflectance probe will be designed and constructed for SCM 3***. This will further increase the capability of the system for users and utilize the NHMFL's ability to manufacture IR optical elements on site.

Improvements to the noise levels of the 56 MW power supplies will begin in 2015 with the arrival of new inductive filter elements for the passive filters. These are being custom designed with close collaboration between scientists and engineers at the NHMFL and engineers at the vendor.

Delivery of the user experimental cryostat for the Series Connected Hybrid is expected in late summer. The cryostat will be evaluated to ensure

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that it meets specification and then work will begin on outfitting probes with sample holders so that it is ready for users when the magnet is brought online and made available for users.

Heat capacity measurements for users of the 35 T resistive magnets will become available in 2015. Scott Riggs has developed a calorimeter for the 35 T top loading cryogenic system located in cell 12. The calorimeter is currently being assembled and will be ready for use in the 3rd quarter of 2015.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

The DC Field Facility continued to be oversubscribed in 2014 as can be seen in the usage tables in Appendix A. In spite of this demand, however, the DC Field Facility has continued to make bringing new investigators into the NHMFL a priority. We are continuing our efforts to reach out wherever possible in order to expand our user program and enable principal investigators (PIs) from backgrounds that are underrepresented in the scientific community. In particular, the NHMFL sponsored a booth at the APS March Meeting in Denver to advertise our capabilities and opportunities. The booth is staffed by NHMFL scientists & staff who explain the spectrum of research possibilities and support available at the NHMFL. In addition our DC Field Facility user support scientists regularly travel to conferences to present results and showcase the capabilities of the laboratory and recruit new users.

In 2014, the DC Field Facility continued to attract new researchers. Appendix A, Table 8 shows we attracted ***16 new PIs in 2014.*** This is in addition to the 11 new PIs which we reported last year (2013) and 14 in 2012. These new PI's came from institutions as varied as the University of Cambridge, Penn State University, Michigan State University, and the Paul Scherrer Institute. One of the new PIs in 2014 was female.

The DC Field Facility also hosted the ***2014 NHMFL User Summer School*** that attracted 28 graduate students and post doc attendees (Fig. 6). It is a five day series of lectures and practical exercises in experimental condensed matter physics techniques developed and put on by the MagLab scientific staff from the 3 sites. It has proven to be a great way to pass on valuable knowledge to the next generation of scientists from the enormous trove of experience encompassed by the MagLab scientific staff. The summer school is an annual event and will be pre-
sented again in 2015. Feedback from participants and their advisors continues to be very positive.

Figure 6: *2014 User Summer School participants*

6. Facility Operations Schedule

At the heart of the DC Field Facility are the four 14 MW, low noise, DC power supplies. Each resistive magnet requires two power supplies to run and the 45 T hybrid magnet requires three power supplies. Thus the DC Field Facility operates in the following manner; in a given week there can be four resistive magnets + three superconducting magnets operating or the 45 T hybrid, two resistive magnets and three superconducting magnets. The powered DC resistive and hybrid magnets operated for 46 weeks out of the year in 2014 with a 4 week shutdown for infrastructure maintenance from November 17 to December 15 and a 2 week shutdown period for the university mandated holiday break from December 24, 2014 to January 5, 2015. The three superconducting magnets operated for 48 weeks out of the year with staggered maintenance periods as required. The hourly operation schedule for the resistive and hybrid magnets is as follows: 16 hours/day on Monday and 21 hours/day Tuesday-Friday. The superconducting magnets operate 24 hours/day.

CHAPTER 3 – USER FACILITIES

Tunable Fractional Quantum Hall Phases in Bilayer Graphene

P. Maher[1], L. Wang[1], Y. Gao[1], C. Forsythe[1], T. Taniguchi[2], K. Watanabe[2], D. Abanin[3,4], Z. Papić[3,4], P. Cadden-Zimansky[5], J. Hone[1], P. Kim[1,6], C.R. Dean[1,7] (1. Columbia University; 2. National Institute for Materials Science; 3. Perimeter Institute for Theoretical Physics; 4. Institute for Quantum Computing; 5. Bard College; 6. Harvard University; 7. The City College of New York)

The fractional quantum Hall effect is a notable example of emergent behavior in which strong Coulomb interactions drive the existence of a correlated many-body state.

Bilayer graphene represents a particularly interesting material in which to study the fractional quantum Hall effect because there are three distinct two-valued quantum numbers: layer index, electron spin, and the sublattice index of the graphene honeycomb. Recently achieved sample qualities, together with the MagLab's intense magnetic fields, allows observation of fractional quantum Hall states in bilayer graphene. By placing bilayer graphene (blue in **Fig. 1**) between top and bottom gates (yellow), researchers can tune the electric field between the graphene layers – the electric displacement field - to explore the effect of symmetry breaking on the stability of fractional quantum Hall states.

Researchers observe a number of interesting effects, most notably a series of transitions in the fractional quantum Hall states as the electric displacement field is varied. For most fractional fillings, n, transitions show clear correspondences with the transitions in integer quantum Hall states. The 5/3 fractional state, however, shows a unique and not-yet-understood transition pattern which indicates new and rich physics of symmetry breaking in this system.

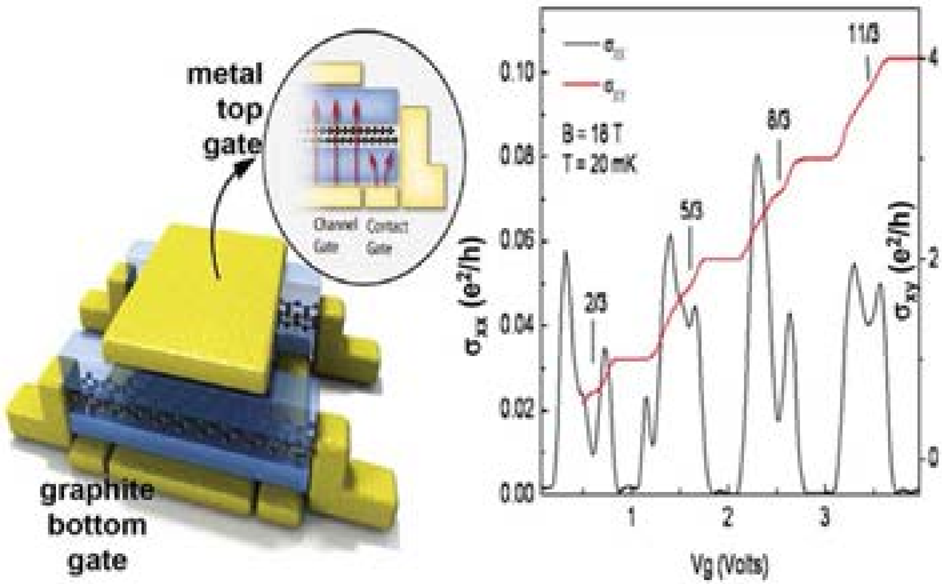
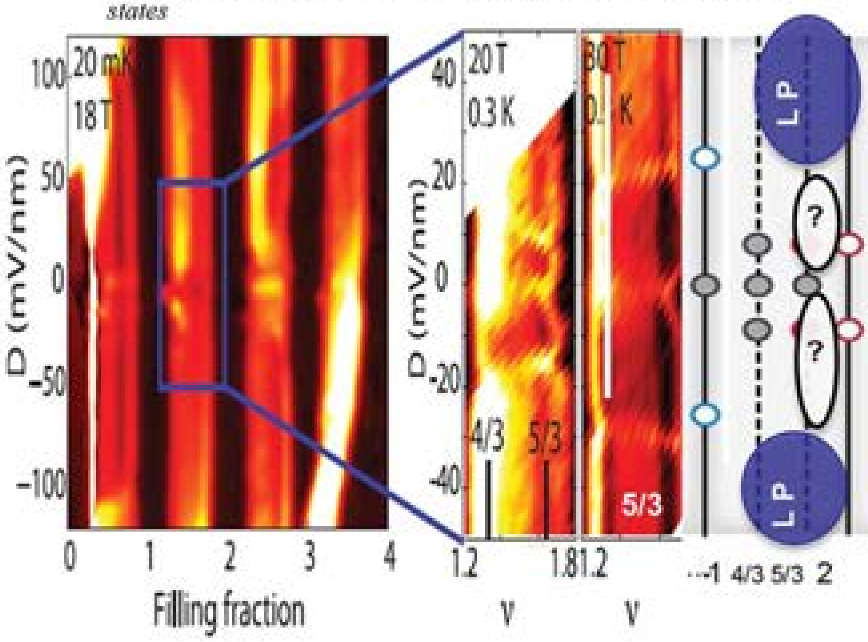


***Fig1:** (a) Bilayer graphene device architecture. (b) Fractional Hall states*



***Left:** Conductivity measurement showing well-formed quantum Hall states (black) as a function of electric displacement field. **Center:** The unique structure at filling fraction n = 5/3 (white lines) of three transitions (red) separating different fractional quantum Hall states (black). **Right:** Schematic showing regions of unidentified states (?) and layer-polarized (LP) states.*

Facilities: DC Field Facility: 18 T (SCM 1), 31 T (cell 9), 35 T (cell 8)

Acknowledgements : J. Hone (ONR N000141310662); P. Kim (DOE DE-FG02-05ER46215)

Citation: P. Maher, L. Wang, Y. Gao, C. Forsythe, T. Taniguchi, K. Watanabe, D. Abanin, Z. Papić, P. Cadden-Zimansky, J. Hone, P. Kim, C.R. Dean. Tunable fractional quantum Hall phases in bilayer graphene. ***Science*, 345**

61-64 (2014).

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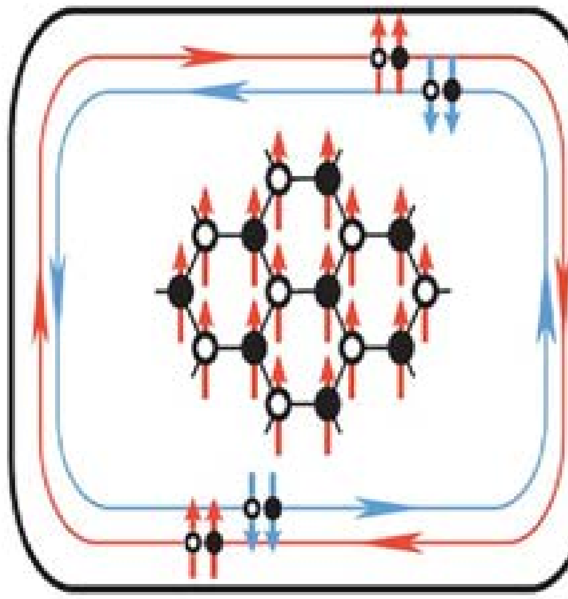
High Field Quantum Spin Hall State in Graphene

A.F. Young[1], J.D. Sanchez-Yamagishi[1], B. Hunt[1], S.H. Choi[1], K. Watanabe[2], T. Taniguchi[2], R.C. Ashoori[1] and P. Jarillo-Herrero[1] (1. MIT, Cambridge, MA; 2. NIMS, Tsukuba, Japan)

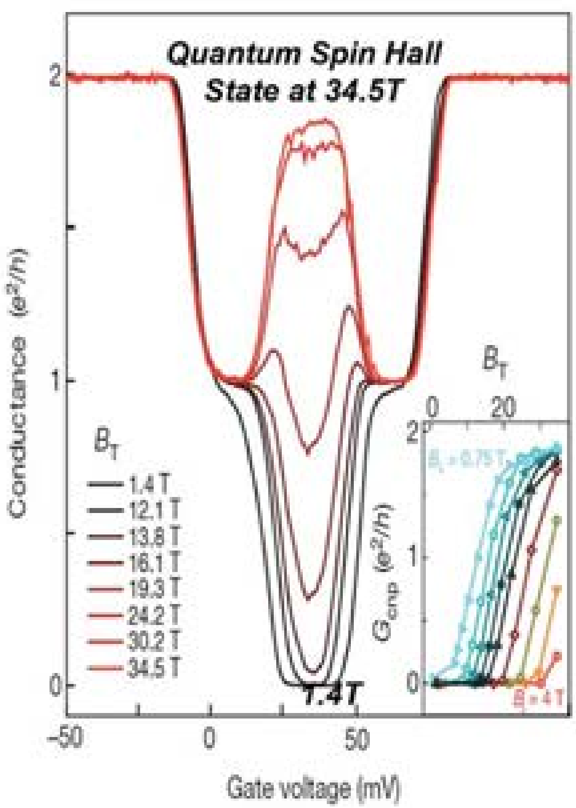
Symmetry-protected topological (SPT) phases in gapped electronic systems can host robust surface states that remain gapless as long as the relevant global symmetry remains unbroken. The nature of the charge carriers in SPT surface states is intimately tied to the symmetry of the bulk, resulting in one- and two-dimensional electronic systems with novel properties.

In our experiment, we use very large magnetic fields to induce a quantum spin Hall (QSH) state—the paradigmatic two dimensional SPT phase—in monolayer graphene. In a QSH state, electrons with opposite spin polarization carry current in opposite directions around an insulating bulk. Remarkably, because spin is a good quantum number these edge states carry current without backscattering, despite their proximity to a disordered graphene edge.

Unlike the QSH state observed in semiconductor quantum wells, in graphene the helical edge states can be controllably gapped by balancing the applied magnetic field against an intrinsic antiferromagnetic instability. In the resulting canted antiferromagnetic state the edge states can be selectively depleted to create spin diodes, and coupling this state to a superconductor may allow for a new realization of Majorana bound states, which may be appropriate for quantum computation.



Right: A graphene flake in the Quantum Spin Hall state. In the 2D bulk, electron spins on the two carbon sublattices are aligned with the applied field, leading to spin-filtered edge states carrying current in opposite directions along the sample boundary. Spin conservation prevents the edge states from mixing with each other.



Left: Experimental evidence for the transition to the QSH regime. As larger fields are applied in the plane of the graphene flake, (with the field perpendicular to the graphene flake kept constant), the zero conductance state at charge neutrality is replaced by a high conductance plateau. The ~$2e^2/h$ conductance value reflects the single channel (per direction) on two different edges connecting the electical contacts.

Facilities: DC Field facility, including 45 Tesla Hybrid

Citation*:* *"Tunable Symmetry Breaking and Helical Edge Transport in a Graphene Quantum Spin Hall State"* A.F. Young, J.D. Sanchez-Yamagishi, B. Hunt, S.H. Choi, K. Watanabe, T. Taniguchi, R.C. Ashoori and P. Jarillo-Herrero. ***Nature*****, 505**, 528–532 (2014)

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PULSED FIELD FACILITY

The National High Magnetic Field Laboratory - Pulsed Field Facility (NHMFL –PFF) is located in Los Alamos, New Mexico, at the Los Alamos National Laboratory (LANL) which is also home to another world class user program, The center for Integrated Nano Technology (CINT). The NHMFL-PFF utilizes LANL and US Department of Energy (DOE) owned equipment and resources to provide world record pulsed magnetic fields to users from the scientific and engineering community worldwide. The pulsed field users program is engineered to provide researchers with a balance of the highest research magnetic fields and robust scientific diagnostics specifically designed to operate in pulsed magnets. The connection with the DC Field Facility is strong and complementary in expertise. Although achieving the highest research magnetic fields possible is a fundamental competency at the NHMFL-PFF, we also strive to create the very best high-field research environment possible and to provide users with support from the world's leading experts in pulsed magnet science. All of the user support scientists are active researchers and collaborate with multiple users per year. A fully multiplexed and computer controlled, 6-position 4.0 mega-Joule (32 mF @ 16 kV) capacitor bank system is at the heart of the short pulse magnet activities. Many thousands of shots are fired for the users program, which accommodates approximately 150 different users each year and fires more than high magnetic field 6000 pulses each year for users. A 1.4GW AC generator is a unique in the world pulsed power supply that dwarfs all other magnet lab pulsed power systems. The AC rectification allows for a greatly flexible pulsed power waveform to be delivered and customized to optimize performance of the associated magnet system, As a result it provides users with the highest non-destructive magnetic fields available. We also have a Single Turn magnet system which produces 6 microsecond duration magnetic field pulsed approaching 300 tesla.

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1. Unique Aspects of Instrumentation Capability

Capacitor Driven Pulsed Magnets		
Magnet, Field (T), Bore (mm)	**Duration FWHM (ms)**	**Supported Research**
Cell 1, 65 T, 15.5 mm	20	Magneto-optics (IR through UV), magnetization, and magneto-transport from 350 mK to 300 K., Pressure from 10 kbar typical, up to 100 kbar. GHz conductivity, MHz conductivity, Pulse Echo Ultra-sound spectroscopy. Fiber Bragg grating dilatometry. IR & FIR transmission in the Single Turn Magnet.
Cell 2, 65 T, 15.5 mm	20	
Cell 3, 65 T, 15.5 mm	20	
Cell 4, 65 T, 15.5 mm	20	
Cell 294 Pulsed Power Test cell	N/A	
Bldg 125 Single Turn, 300 T, 10mm	0.003	

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Generator Driven Magnets		
Magnet, Field (T), Bore (mm)	**Duration FWHM (ms)**	**Supported Research**
100 T Multi-Shot, 101 T, 10 m. **60 T Controlled Waveform, 60 T, 32 mm**	15 300	Magneto-optics – ultra-violet through far infrared, Magnetization, Specific heat, Transport – DC to microwaves, Magnetostriction; High pressure, Temperatures from 320 mK to 300 K, Dependence of optical and transport properties on field orientation.

The table above lists the pulsed magnets available to users of the NHMFL-PFF. The 100 T multi-shot magnet is the first and only magnet in the world to successfully perform a magnetic field pulse to 100 tesla in a non-destructive manner. The NHMFL pulsed magnets are arguably the best and most capable pulsed magnets in the world that are available to any qualified user through the NSF-DMR supported user program. The expertise in pulsed power engineering and access to world-class materials scientists at both LANL and FSU focus attention on development and characterization of the best materials for magnets. Also at the PFF at LANL is the 60 T Controlled Waveform (A.K.A. "Long Pulse") which has the ability to customize pulse waveforms for optimal user research. The 300 tesla single turn magnet at the PFF was funded by LANL and is now part of the user program and also available to qualified users. Routine pulsed are to 170 tesla with a pulse duration of 6 microseconds. This research platform is mainly suitable to optical studies but is being expanded with highly specialized sample preparation techniques.

The contactless conductivity method was highly developed at the PFF in collaboration with researchers at the DC facility and at Clark University. The tunnel diode method (TDO) has mainly given way to the Proximity Detector Oscillator (PDO) method over the past 5 years. This specialized method is an excellent tool for users to detect upper critical field transitions in superconductors and this turns out to be a great tool for users to search for magneto-quantum oscillations in metals in very high fields. Sample preparation is extremely straightforward and usually involves simply placing an oriented sample in a ~1mm rf coil and securing it to the probe with grease.

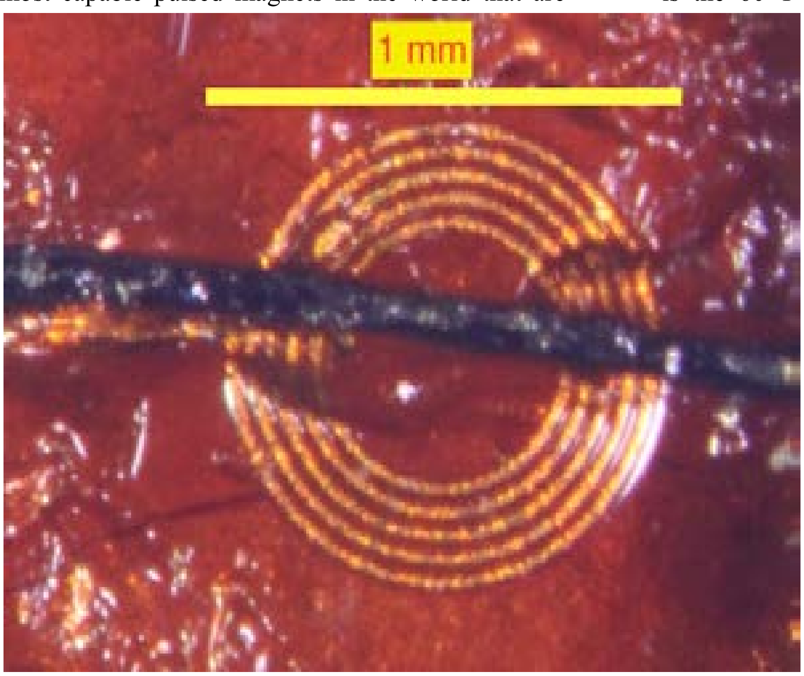

Figure 1: *A user's superconducting sample is placed in an rf coil and measured in pulsed magnetic field to determine the superconducting crossover.*

CHAPTER 3 – USER FACILITIES

Other configurations include wrapping coils directly around samples which increases the filling factor and hence the signal to noise. Professor James Brooks routinely had new and creative approaches to masurements in pulsed and static fields inspired these methods and worked losely with the PFF staff to guide us in new directions. The fiber Brag grating dilatometer technique has resulted in some excellent user experiments in many of our magnets. The technique was expanded this past year to the extreme fields of the Single Turn Magnet system. **Figure 2** shows a recent experiment by M. Jaime et al. performed in the Single Turn magnet up to 150 tesla.

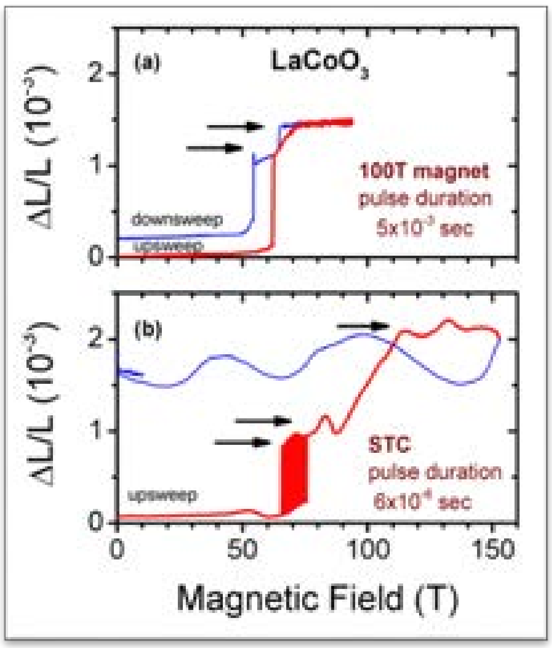

Figure 2: *(a) Optical FBG dilation experiment in a LaCoO3 single crystal sample in pulsed magnetic field to 100T. A sharp sample elongation is observed at Co-spin transitions in the 60-80T range. (b) Similar experiment performed using an ultrafast coherent optical time-domain spectrometer to interrogate the FBG strain gauge sensor in the NHMFL single turn coil (STC) magnet to 150T. A feature is observed above 100T that could be related to (i) additional Co-spin transition or (b) fracture propagation in the sample. Both are potentially interesting as the reveal magnetic and stress/strain properties of the material. The later could explain irreversibility in the data when magnetic field sweeps down to zero.*

2. Facility Developments and Enhancements

The noise floor that is achievable in the 100 T MS magnet has been improved significantly during 2014. Recent improvements in screening and grounding have led to a 10 times improvement in signal to noise. The figure of merit is now better than 5nV/Hz^0.5. Prior to this effort magneto transport conducted in the 65T short pulse magnets had better sig:noise than the 100T, now the flagship 100T MS magnet achieves the best sig:noise at the NHMFL-PFF. The **figure 3** below shows data taken on a high Tc sample in both systems. This is critical for detecting small changes in magnetoconductivity which for example is relevant when searching for magneto-quantum oscillations.

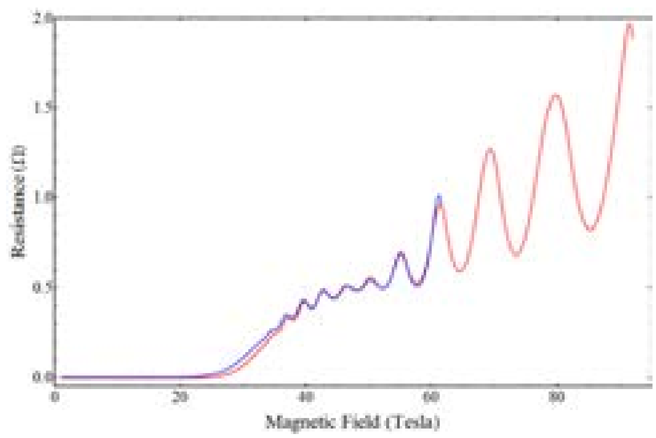

Figure 3: *Magneto-quantum oscillations measured in a High Tc sample in both the 65 T magnet and the 100T MS magnet.*

The liquid helium recovery system at the PFF is now in full operation. All user cells including the Single Turn are now plumbed into the recovery system and a purification and compression system is fully operational. Users need to order liquid helium before arrival so that we have it ready for the start of their experiment. **Figure 4** shows the system in operation with several dewars at the ready for low temperature physics experiments at very high magnetic fields.

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Figure 4: *The now operational liquid helium recovery and liquefaction system at the NHMFL-PFF.*

A new set of millimeter wave vector network analyzer heads that extends the frequency range up to 1 THz is now installed and probe cavities are being tested for user experiments. **Figure 5** shows a postdoctoral researcher tuning the system.

Figure 5: *Postdoctoral researcher Chris Beedle tuning the new MVNA heads.*

The system now is extended to 1 THz. The new system can be used for high magnetic field EPR or measuring GHz-THz conductivity. We also plan to use the new extensions for developing transmission probes for use in ultra-high magnetic fields with dielectric resonators. Potential uses could be for cyclotron resonance in metals with carrier masses in the 1-10 m_e range.

Following a suggestion from our user community a new model for user cells was adopted in 2014 that includes dedication of a user cell to a resident user support scientist. The new model allows for customization and optimization for a specific experiment and to fit the scientist's standard operational configurations. This has the added benefit of reduction of setting up the same equipment repeatedly. We have implemented the configuration in cell4 with added rf screening for high frequency conductivity, transport and torque, see **figure 6.**

Figure 6: *Postdocs Mun Chan (left) and Brad Ramshaw (top) work with graduate student Kim Putkonen (right) on an experiment in cell 4.*

3. Major Research Activities and Discoveries

Research at the Pulsed Field facility included numerous studies of topological insulators, magneto quantum oscillations in high temperature superconductors to advances in semi-conductor experimentation that will lead to the next generation

CHAPTER 3 – USER FACILITIES

of optoelectronic materials* (see **figure 7**). User Kirsten Alberi from NREL.

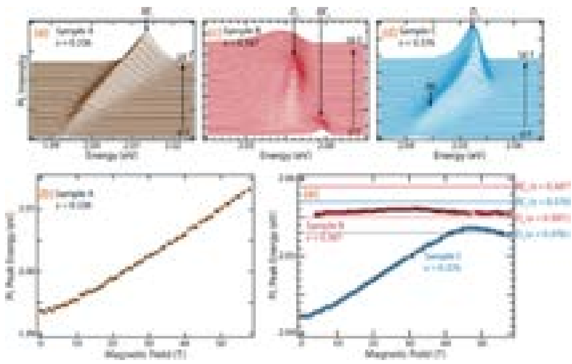

Figure 7: *Magneto-PL spectra from *Kirstin Alberi et al 2014 Appl. Phys. Express* ***7*** *111201 doi:10.7567/APEX.7.111201*

4. Facility Plans and Directions

During 2014 the facility underwent a major upgrade to the cooling tower system for the 1.4 billion watt generator. LANL invested institutional funds to improve the facility for the sole purpose of improving the capabilities for the NSF funded user program. Institutional funds were also used to perform inspection and maintenance of the generator system. **Figure 8** shows the generator enshrouded in scaffolding as the system was maintained and inspected. A series of new sensors and diagnostics were installed on the cooling water system and circulation pumps were fully refurbished. The outdoor cooling circuits were upgraded, valves maintained or replaced, insulated and freeze protection installed.

Figure 8: *The 1.4 billion watt generator gets a careful inspection and review before a fresh coat of paint in 2014. LANL paid for the entire operation.*

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

During 2014 there were numerous outreach events that the PFF participated in. The IEEE student group from New Mexico Tech toured the facility as well as the McDermott scholars from Dallas Texas. The local PFF user support scientists visited 6 area schools and gave presentations on the physics of magnetism and pulsed magnets. PFF Director Chuck Mielke successfully completed the “Scientist Ambassador” program sponsored by the Bradbury science museum. In June of 2014 congressional fellow Amber Johnson visited LANL and was given a tour though the PFF (see **figure 9**).

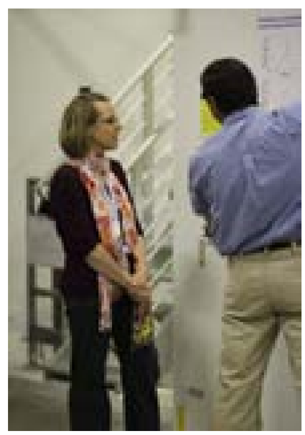

Figure 9: *Congressional fellow Amber Johnson (from Office of U.S. Rep. Randy Hultgren (IL-14)) touring by the big magnets of the NHMFL-PFF by PFF Director Chuck Mielke.*

6. Facility Operations Schedule

In 2014 we changed to a quarterly scheduling model and solicited the first quarterly call in concert with the DC facility. The reason for the change is to better serve users by fixing the schedules of the PFF user support scientists. The rolling model does not allow for planning for the user support scientists more than a few weeks out. We are committed to providing users with the best experience so we will test out this model and solicit feedback from our users to assess the success. Hours of operation are from 8:00am – 5:00pm. A16KV 4MJ User accessible capacitor bank is used to drive the 65T short pulse magnets, 4 cells are equipped with these magnets and typically 3 are in use Monday – Friday 7:30am to 10:30pm. Preventative maintenance is scheduled each week (Monday 8:00am-10:00am) or performed on an as needed basis.

PFF

PFF

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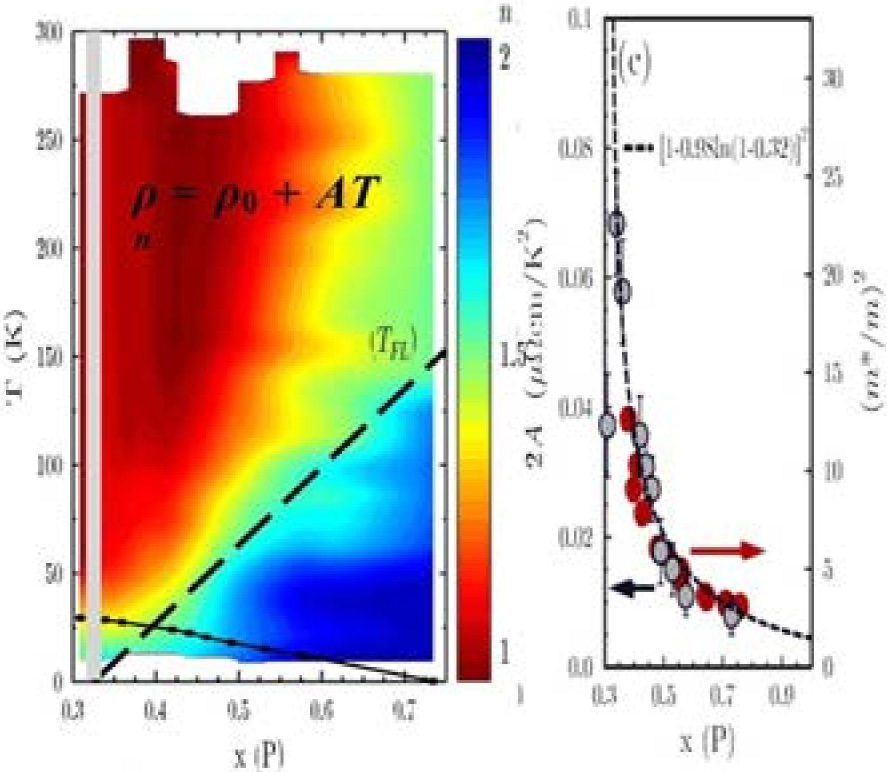
Transport in the Quantum Critical Regime of the Iron Arsenide Superconductor $BaFe_2(As_{1-x}P_x)_2$

J.G. Analytis[1,2], H-H. Kuo[2], R.D. McDonald[3], M. Wartenbe[3], P.M.C. Rourke[4], N. E. Hussey[4] and I. R. Fisher[1]
(1.Stanford University; 2. UC Berkeley; 3. National High Magnetic Field Laboratory; 4. University of Bristol)

Quantum criticality –The physics of quantum critical phase transitions connects to some of the most challenging and technologically relevant problems in condensed matter physics, including metal-insulator transitions, frustrated magnetism and high temperature superconductivity. Near a quantum critical point (QCP) a new kind of metal emerges, one whose thermodynamic and transport properties differ from the unified phenomenology with which we understand conventional metals – the Landau-Fermi liquid theory – which are characterized by a low temperature T^2 resistivity. Studying the evolution of this temperature dependence identifies a quantum phase transition at the heart of pnictide superconductivity.

We probe the transport properties of $BaFe_2(As_{1-x}P_x)_2$ at low temperatures by suppressing superconductivity with high magnetic fields. At sufficiently low temperatures, all compositions cross-over from a linear to quadratic temperature dependence, consistent with a low-temperature Landau-Fermi liquid groundstate. At optimal doping, we find a divergence of the electronic effective mass, derived from the T^2 resistivity coefficient via the Kadowaki-Woods ratio, indicating increased electron-electron correlations near the quantum critical point. This same doping gives the most robust superconductivity, indicating that these mass-enhancing electronic correlations are intimately tied to superconducting pairing in the pnictides.



a) Color plot of the power-law dependence n as a function of temperature and composition. b) divergence of the T^2 coefficient and effective mass approaching the quantum critical point

The resistance of conventional metals arises from electron scattering, which increases as the square of temperature (the blue region of the phase diagram).

By contrast, where superconductivity is most robust the resistance remains close to linear in temperature down to the onset of superconductivity (the red region of the phase diagram).

When high magnetic fields suppress superconductivity, the resistance returns to quadratic at low temperature, revealing that the T^2 coefficient diverges – the signature of a quantum critical point at the same doping that gives rise to the most robust superconductivity.

Facilities: Pulsed and DC Field facilities.
Instrument/Magnet: 65 T short pulse, 36 T resistive, 45 T Hybrid.

Citation: ***Transport near a quantum critical point in $BaFe_2(As_{1-x}P_x)_2$*** , J.G. Analytis, H-H. Kuo, R.D. McDonald, M. Wartenbe, P.M.C. Rourke, N. E. Hussey and I. R. Fisher, *Nature Physics*, 10, 194 (2014)

CHAPTER 3 – USER FACILITIES

Normal State Electronic Structure in Underdoped High-T_c Cuprates

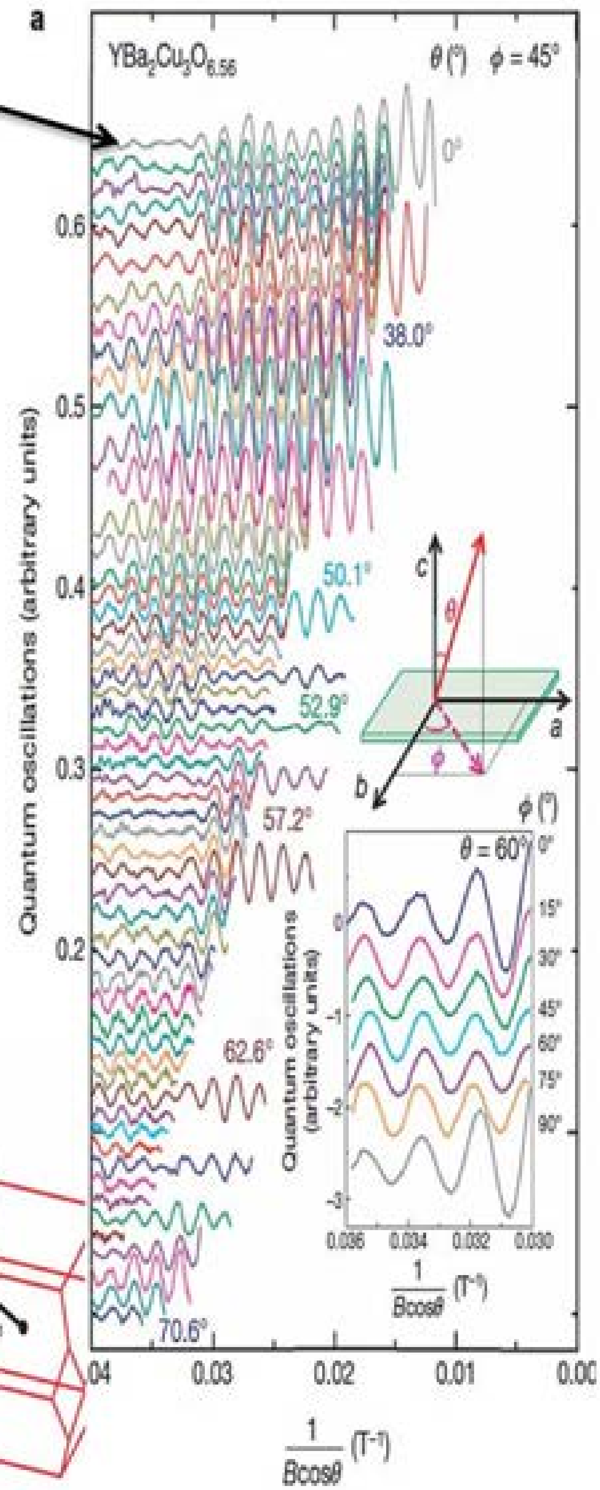
S.E. Sebastian[1], N. Harrison[2], F. F. Balakirev[2], M. M. Altarawneh[2,3], P. A. Goddard[4], Ruixing Liang[5,6], D. A. Bonn[5,6], W. N. Hardy[5,6] & G. G. Lonzarich[1] (1 Cambridge University; 2. Los Alamos National Labs.; 3. Mu'tah University; 4. University of Warrick; 5. University of British Columbia; 6. Canadian Institute for Advanced Materials)

One of the outstanding problems in high-temperature (high-Tc) superconductivity has been the identification of the normal state out of which superconductivity emerges in the mysterious underdoped regime, called the "pseudogap" state. Knowledge of this normal state is thought to be essential for finding the origin of superconducting pairing in momentum space and for identifying the ground state whose instability enhances the pairing.

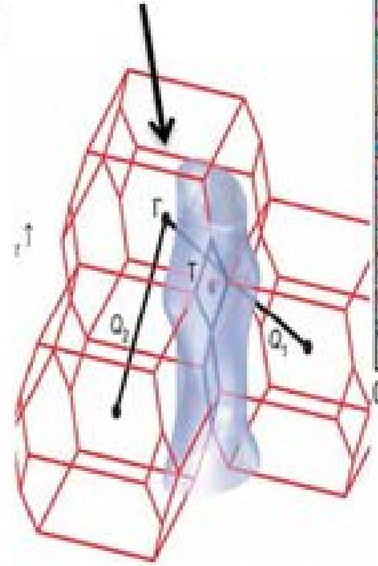
The authors address this longstanding problem by mapping out the electronic structure of $YBa_2Cu_3O_{6+x}$ in very high magnetic fields. Strong magnetic fields enable the normal state to be accessed by suppressing superconductivity. Fields approaching 100 tesla, in particular, enable comprehensive angle-resolved measurements of the Fermi surface to be made by way of quantum oscillations. By accessing a very broad range of angles, the authors arrive at a much clearer image of the normal state electronic structure than has previously been possible.

The symmetry of the electronic structure points uniquely to a body-centered orthorhombic superlattice resulting from charge order, in which small Fermi surface electron pockets are located along the nodes in the superconducting wave function. The results dovetail with recent observations of short range charge order in a number of high-Tc compounds, indicating its central role in high-Tc superconductivity.

Angle dependent quantum oscillations in $YBa_2Cu_3O_{6+x}$ plotted versus inverse magnetic field. The data represent sixteen 93T pulses and more than fifty 65T pulses devoted to one experiment!



Location of Fermi surface pocket at corners of the recon- structed body-centered orthorhombic Brillouin Zone (thereby placing it at the nodes in the super- conducting wave function).



Facilities: Pulsed and DC Field Facilities
Instrument/Magnet: 100 Tesla Magnet and 45 Tesla Hybrid
Citation: ***Normal-state nodal electronic structure in underdoped high-Tc copper oxides***, S.E. Sebastian, N. Harrison, F. F. Balakirev, M. M. Altarawneh, P. A. Goddard, Ruixing Liang, D. A. Bonn, W. N. Hardy & G. G. Lonzarich, Nature, 511, 61–64 (2014)

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HIGH B/T FACILITY

The High B/T Facility provides users with access to a unique combination of high magnetic fields (up to 16 T) and low temperatures (down to 0.4 mK). The experimental cells provide an ultra-quiet environment with advanced vibration isolation and electromagnetic shielding that is needed for high sensitivity measurements such as magnetic susceptibilities of small samples.

---

1. Unique Aspects of Instrumentation Capability

In collaboration with users Drs. Wei Pan and Dan Tsui, Dr. Jiang-sheng Xia has developed a unique cell (see **Figure 1**) for transport studies of 2D electron systems that uses sintered Ag powder heat exchangers to obtain electron spin temperatures as low as 4 mK. The electron temperatures were determined from the temperature dependence of the plateaus in the Hall conductivities.

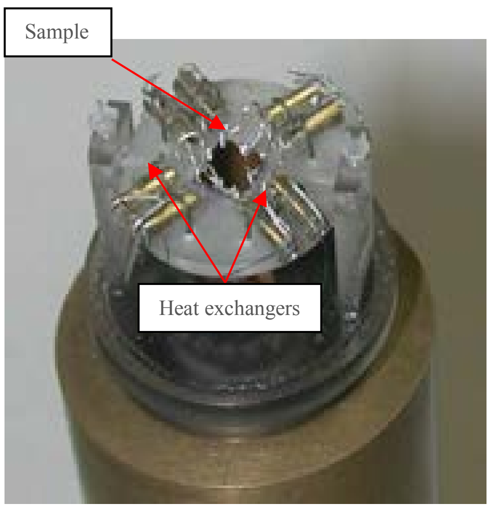

Figure 1: *Picture of transport cell for 2DES measurements. The heat exchangers contain sintered Ag and the cell is filled with superfluid ^{3}He.*

Instrumentation has also been developed for high sensitivity AC susceptibility measurements (see **Figure 2**) that also use sintered Ag posts to thermalize the leads to the cell. These cells have been used to measure weak magnetic susceptibilities down to 0.5 mK for frustrated magnet systems and organic quantum magnets in fields up to 14 T.

The High B/T Facility along with other user facilities at the University of Florida (AMRIS, Chemistry and Materials Sciences) use a campus-wide helium recovery and liquefaction facility with real-time monitoring of recovery rates and helium pressures at the sites of user experiments.

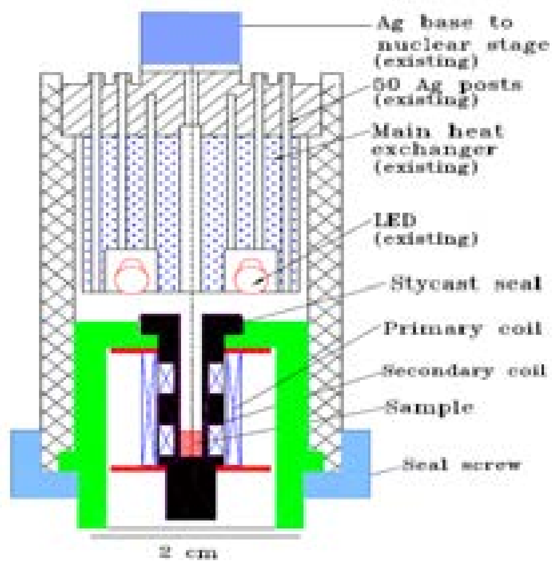

Figure 2: *Cross-section of AC magnetic susceptibility cell showing excitation and detection coils and the heat exchangers for thermalizing the electrical leads.*

2. Facility Developments and Enhancements

Ultra-low noise radiofrequency capabilities including superconducting coaxial cabling are being added to Bay 2 of the Facility to enable resistance detected NMR of quantum Hall effect samples. This technique will help probe the spin properties of exotic fractional quantum Hall states.

Ultra-low temperature contactless techniques are being developed to measure radio-frequency conductivities. High stability tunnel diode devices

CHAPTER 3 – USER FACILITIES

are being tested for this purpose in high magnetic fields at milliKelvin temperatures.

3. Major Research Activities and Discoveries

(i) Discovery of large magnetic field induced electric polarization in an organic quantum magnet. Bose glass states were created in an organic quantum magnet by introducing bond disorder. A high sensitivity capacitance cell for precision measurements of dielectric constants was used for the measurements. The studies were carried out on dichloro-tetrakis-thiourea (DTN) in which Ni spin magnons form a Bose-Einstein condensate at low temperatures and high magnetic fields. Replacing the Cl spacer atoms with Br creates the disorder. The polar axes of the thiourea molecules shift at the transitions to the Bose glass state leading to a significant electric polarization.

(ii) Dynamics of ^3He impurities in solid ^4He and quantum plasticity. The unusual lattice dynamics of solid ^4He has been explored by studying the motion of ^3He impurities using NMR techniques. A significant lattice distortion surrounds the impurity and as it travels through the ^4He matrix by ^3He-^4He quantum exchange, the motion is dependent on the elastic properties of the crystal.

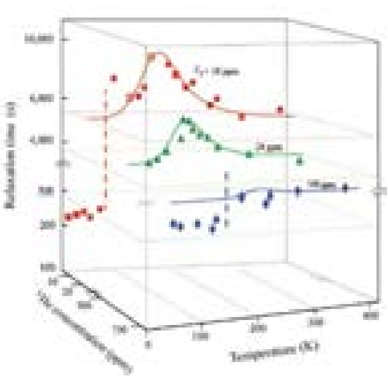

***Figure 3**. Comparison of observed temperature and concentration dependence of spin relaxation of ^3He impurities in solid ^4He with models for elasticity of solid ^4He. Solid lines, theoretical prediction, dashed lines mark phase separation.*

Careful analysis of the temperature dependence of the nuclear spin-lattice relaxation times (T_1) show that the anomalies observed for T_1 (**Figure 3**) are consistent with a giant quantum plasticity for the solid ^4He at low temperatures. No evidence is observed supporting a transition to a supersolid state.

4. Facility Plans and Directions

Following the recommendation of the External Advisory Committee and endorsed by the Users Committee we propose to add a 19T/10 mK superconducting magnet/dilution refrigerator ensemble to the High B/T capabilities. This addition would help reduce the length of time in the queue for assignment of magnet time to users whose research proposals have been approved. A new site will need to be identified for the location of the ensemble as there is no suitable space in the current location. In order to operate this new capability as a robust user facility funding will need to be obtained to acquire the system and to provide the required additional staff and instrumentation.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

The Facility has entered into a collaborative agreement with the European MicroKelvin Platform (EMF) to promote research and educational efforts between the High B/T Facility and institutions in Europe. The training of students in low temperature techniques, nuclear demagnetization techniques, low temperature thermometry and cryogenic engineering is of special interest.

A collaborative agreement is also established between Professor Lee of the High B/T Facility and Professor Choi of the Korea Advanced Institute of Science and Technology (KAIST) to develop nuclear demagnetization refrigerators at KAIST and foster common research interests in ultra-low temperature physics that will lead to future research and grant proposals.

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Figure 4: *Dr. Serafin discusses the operation of Bay 3 of the High B/T Facility to Science Quest Students (10th graders from North-Central Florida who spend a week on campus on selected research areas).*

6. Facility Operations Schedule

Experiments at the High B/T facility can take one to nine months to complete, depending on the complexity of the measurements. For this reason the facility operates 24/7 for 365 days a year except for planned shutdowns for maintenance and servicing. In 2014 we planned these shutdowns to coincide with the times for major international meetings when the workforce is appreciably reduced. These times were for the March meeting of the American Physical Society and for the Quantum Fluids and Solids Symposium held in Buenos Aires.

A key staff person, the operator for Bay 3 demagnetization refrigerator, left the NHMFL in the Fall of 2014. This departure has lengthened the queue in the last quarter of 2014 but we are planning to fill the position as soon as the second quarter of 2015.

CHAPTER 3 – USER FACILITIES

Competing Quantum Hall Phases in the Second Landau Level of 2D Electron Systems

W. Pan[1], A. Serafin[2], L. Yin[2], J.-S. Xia[2], N.S. Sullivan[2], K.W. Baldwin[3], K.W. West[3], L.N. Pfeiffer[3], and D.C. Tsui[3]
(1. Sandia National Laboratories; 2. University of Florida; 3. Princeton University)

Quantum Hall States in Second Landau Level

There is considerable interest in studying the exotic fractional quantum Hall states in the second Landau level where conventional models fail to explain the origin of exotic states such as the n=5/2 state. New physics such as a pairing mechanism has had to be invoked to explain the existence of this state and the particle-hole conjugate state at n=7/2. Recent progress in the fabrication of high quality low electron samples has allowed one to probe these states in new regimes where the electron-electron interactions are strong and Landau leveling can be appreciable, thereby testing the models for these exotic states.

New Low Temperature Results

Measurements of the resistivities R_{xx} and R_{yy} shown in Fig. 1 for a sample with density n = 5 10^{10} cm^{-2}, indicate a clear anisotropy for electron temperatures T_E =16 mK. This is the first time an anisotropic transport has been seen at n = 7/2 for a high quality dilute 2D electron system. The anisotropy disappears when the temperature reaches 24 mK. This new behavior in the dilute system is attributed to a large Landau level mixing that can occur if the pairing of composite fermions is weakened in the dilute limit.

Facility:
High B/T Facility
Instrument/Magnet:
Bay 3, MicroKelvin laboratory
Citation:
Competing quantum Hall phases in the second Landau level in the low density limit.
W. Pan et al., Phys. Rev B, 89, 241302(R) (2014)

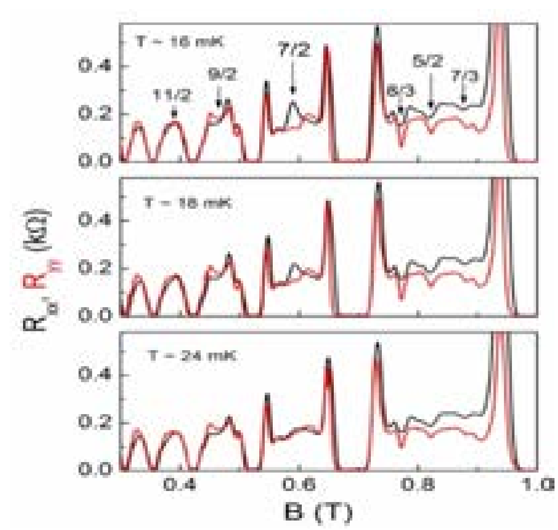

Figure 1: *Observed temperature dependence of the resistivities Rxx and Ryy for a high quality low density symmetric modulation-doped GaAs quantum wells. The 7/2 Hall state shows clear anisotropy at very low temperatures.*

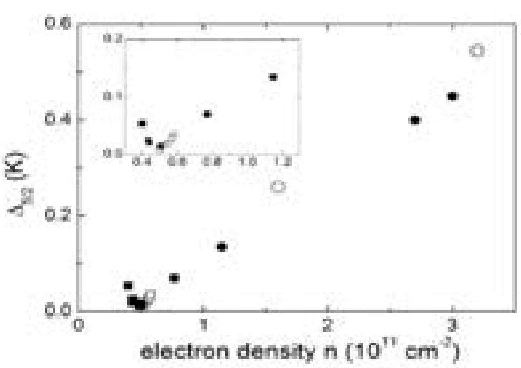

Figure 2: *The temperature dependence of low density samples has been measured down to n= 4.1 10^{10} cm^{-2}. A well-developed Arrhenius behavior is observed and a remarkable upturn in the value of the energy gap is seen for n< 5 10^{10} cm^{-2}.*

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Magnetic Field Induced Polarization in a Bose Glass State

Liang Yin[1], Jian-sheng Xia[1], Vivien Zapf[2], Adhuan Padhuan-Filho[3] (1. University of Florida; 2. Los Alamos National Laboratory; 3. Universidade de Sao Paulo, Brazil)

Bose Glass State

The formation of a Bose glass state (BG) can occur in materials that undergo Bose-Einstein condensation (BEC) with the introduction of appropriate disorder. This state has been elusive but successfully demonstrated at the NHMFL facilities (LANL and High B/T) for random bond doping of the organic quantum magnet, dichloro-tetrakis-thiourea, or DTN. It is the magnons associated with the Ni spins in DTN that undergo BEC for undoped samples. The replacement of Cl atoms by Br atoms modifies the interaction between Ni spins and introduces the disorder.

Magneto-electric Effects

In undoped DTN the thiourea molecules are polar and tilt toward the c-axis with zero net polarization in the undoped state. The magneto-electric effect in DTN is therefore expected to be determined by orientation of the thiourea molecules as they enter the spin ordered states. Because of the "glassy" nature of the BG state one expects that the magnetic field induced polarization would depend on the frequency of the magnetic field excitation. This effect has been demonstrated at low temperatures by using sensitive dielectric cells to measure the changes in the capacitance of a cell containing the doped DTN as the dielectric material. The induced AC polarization is strongly frequency dependent (see opposite ***figure***) and gives clear indications of the phase transitions form the BG state to BEC and to Mott insulator states.

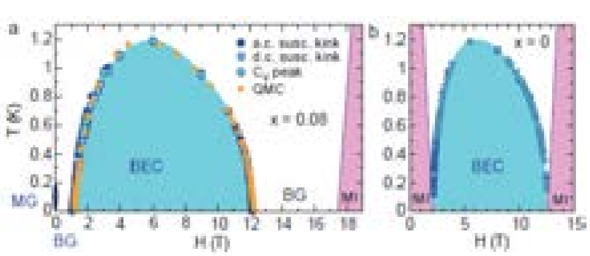

Figure 1: *Low temperature phase diagrams for (a) BEC condensed DTN, (b) Bose glass state in Br-doped DTN.*

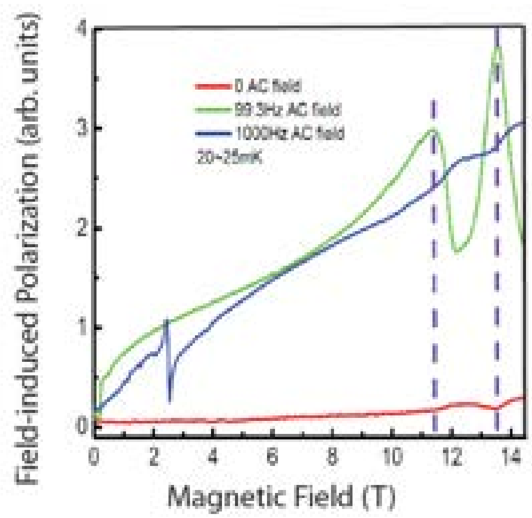

Figure 2*: Field dependence of observed field-induced electric polarization.*

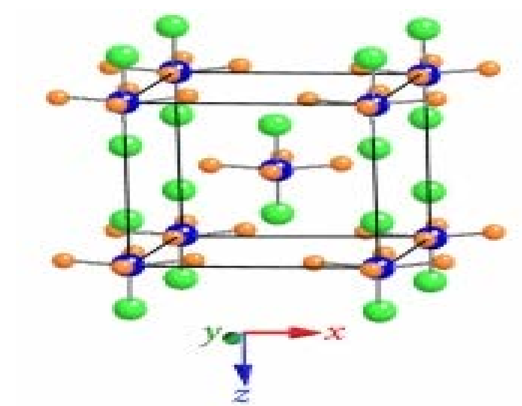

Figure 3: *Crystal structure of DTN: Ni spins blue, Cl separators green*

Facility: High B/T Facility, University of Florida, Gainesville, FL.
Instrument/Magnet:
Bay 3, MicroKelvin laboratory
Citation: Magnetic Bose Glass in Br-doped $NiCl_2$-$4SC(NH_2)_2$: Magneto-electric Effect.
L. Yin, J. S. Xia, V. Zapf, A. Paduan-Filho
Bull. Am. Phys. Soc. J28.5, March 2012.

CHAPTER 3 – USER FACILITIES

NMR FACILITY

The NMR and MRI User Program in Tallahassee is a partner with the AMRIS facility of the NHMFL at the Univ. of Florida Gainesville. The Tallahassee facility offers scientists access to high magnetic fields with the world's highest sensitivity NMR and MRI probe technology. Our flagship 900 MHz ultra-wide bore spectrometer is the world's highest field instrument for *in vivo* imaging and also offers leading capabilities in materials and biological solid state NMR. Lower field instruments offer users additional unique capabilities in solution, solid state NMR and imaging. Our technology efforts continue to be focused on the development of innovative probes for triple resonance solid state, high field *in vivo* imaging and spectroscopy as well as very high mass sensitivity solution NMR probes. We are beginning to offer DNP capabilities at 600 MHz with full-fledged capabilities available in mid-2015. Preparations are also underway for the launch of 36 T (1.54 GHz) NMR based on a hybrid magnet with 1 ppm homogeneity and stability that will become available in early 2016.

1. Unique Aspects of Instrumentation Capability

More than 50 NMR and MRI probes have been constructed by the RF group at the NHMFL that have unique capabilities in a broad range of scientific applications. The Low-E designs that provide greatly reduced heating for biological samples also provide superb B1 homogeneity and RF efficiency have become the industry standard. Solder-less replaceable components in the probes have greatly improved the down time for probes when repairs are needed and the opportunity to construct high-performance multi-purpose probes, such as very high sensitivity single frequency quadrupole nuclei probes.

Associated with a new initiative funded through an NSF MRI grant and the State of Florida, the NMR and EMR programs have teamed up to develop two new ultra-high sensitivity capabilities for the NHMFL, Overhauser solution Dynamic Nuclear Polarization (DNP) and Bio-solids DNP. The initial capabilities for these techniques are now available. An NIH High End Instrumentation proposal has been funded for a sweepable 14T 89 mm bore magnet with the Bio-solids DNP that will be delivered in mid-2015. This grant included research contributions from a dozen of the most highly respected NMR laboratories in the US.

2. Facility Developments and Enhancements

Efforts are underway to develop the hardware for shimming the Series Connected Hybrid (SCH) 36 T magnet that is expected to be operational in early 2016. Hardware and software for stabilizing the field is also underway through a collaboration with Prof. Jeff Schiano at Penn State. A variety of solid state NMR probes are under development for applications in materials, chemical and biological applications.

A 900 MHz 3.2 mm diameter magic angle spinning probe with stable temperature capability down to 130K has been made available to the user community this year. By cooling the bearing gas it was possible not only to lower the sample temperature, but to reduce the thermal gradient across the sample.

Remote access for a range of spectroscopic and imaging capabilities continues to expand. National and international remote access for both MAS ssNMR and for *in vivo* imaging were used throughout the year. This makes the NMR and MRI facility open to a much larger research community than just those who have the time and resources to travel to the facility in Tallahassee.

3. Major Research Activities and Discoveries

A partnership between Xiamen Univ., Florida State Univ. and the Magnet Lab have conducted research on *in situ* Li-ion battery cells with Stray-Field Imaging resulting in 1D images with 50 μm resolution that have been used to study ^{7}Li distributions following charge-discharge cycles.

A research team between Queen's Univ. (Canada) and the Magnet Lab have used ^{17}O NMR to characterize the energetics of breaking low-barrier hydrogen bonds in nicotinic acid and to measure the hydrogen bond distance through dipolar measurements in potassium hydrogen malate

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showing that low-barrier hydrogen bonds are not necessarily high energy hydrogen bonds.

A collaboration between the Weitzman Inst., Florida State Univ. and the Magnet Lab has resulted in the development of enhanced *in vivo* ^{1}H spectroscopy in the vicinity of the water resonance by avoiding the excitation of water.

Researchers at Corning, Univ. of California - Davis and the Magnet Lab have characterized the structure of As_xTe_{100-x} based glasses using ^{125}Te projection-Magic Angle Turning/CPMG NMR.

A collaboration between the Mayo Clinic, Florida State Univ. and the Magnet Lab has observed by solid state NMR β-sheet structure in the toxic oligomeric structures of Alzheimer's β-amyloid peptide.

A novel membrane protein structure characterized by solid state NMR from the *M. tuberculosis* cell division apparatus, CrgA, has been deposited in the Protein Data Bank resulting from a collaboration between the Magnet Lab, Univ. of Texas Health Center at Tyler and Florida State.

4. Facility Plans and Directions

During this past year an 800 MHz mid-bore magnet from Minnesota has become part of the NHMFL User Program. The concept of repurposing such magnets for which up-to-date commercial probes are not available has proven to be very successful. We continue to look for additional mid-bore 800 MHz magnets that might be available.

The NMR and MRI facility in conjunction with Prof. Yan-Yan Hu of the Department of Chemistry and Biochemistry at FSU have partnered for purchasing a Bruker, laser-based high temperature NMR spectroscopy probe that should be available for the users either late in 2015 or early 2016.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

This year we have instituted a new requirement for the scientific and engineering faculty of the NMR and MRI program who attend regional, national and international meetings – upon their return from these meetings they report on at least 3 new potential users with whom they have discussed the prospects of using our facility for their research. We continue to have a healthy turn-over of users, but we look forward to an even greater number of new users as our new capabilities come on line.

6. Facility Operations Schedule

The NMR and MRI facility of the NHMFL is open 24/7 52 weeks of the year.

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Metabolic Properties in Stroked Rats Revealed by Relaxation-enhanced MR Spectroscopy at 21.1 T

Noam Shemesh[1], Jens T Rosenberg[2,3], Jean-Nicolas Dumez[1], Jose Muniz[2,3], Samuel C Grant[2,3], Lucio Frydman[1,2] (1. Weizmann Institute of Science; 2. National High Magnetic Field Laboratory; 3. Florida State University)

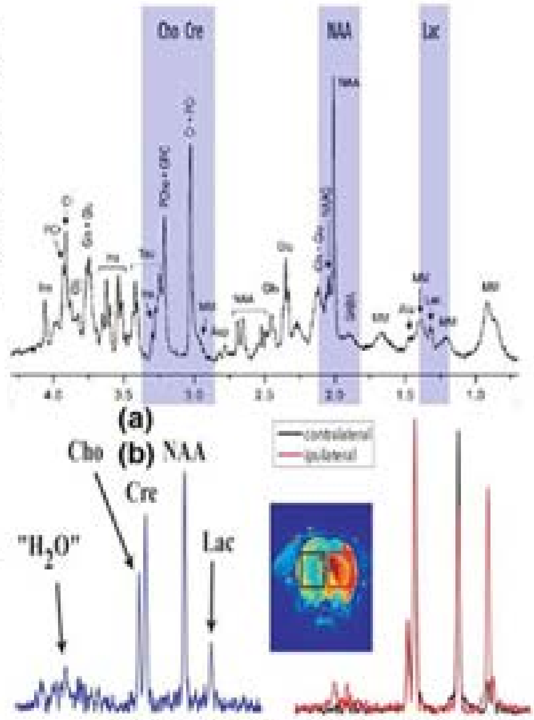
If sensitivity and spectral quality are sufficient, ^1H magnetic resonance spectroscopy (MRS) can yield site-specific signatures that directly report metabolic concentrations, biochemistry and kinetics. Here, very high magnetic fields (21.1T) are combined with highly selective spectral excitations to enable relaxation-enhanced (RE) MRS that delivers spectra exhibiting signal-to-noise ratios >50:1 in under 6 seconds for ~5×5×5 mm^3 voxels, with flat baselines and no interference from water.

With this spectral quality, MRS was used to interrogate a number of metabolic properties in stroked animal models.

- Metabolic confinements imposed by randomly-oriented microarchitectures were detected and found to change under ischemia.
- Intensities of downfield resonances were found to be selectively altered in stroked hemispheres.
- Longitudinal relaxation time of lactic acid was found to increase by over 50% its control value as early as 3 hours post-ischemia, paralleling the onset of cytotoxic edema.

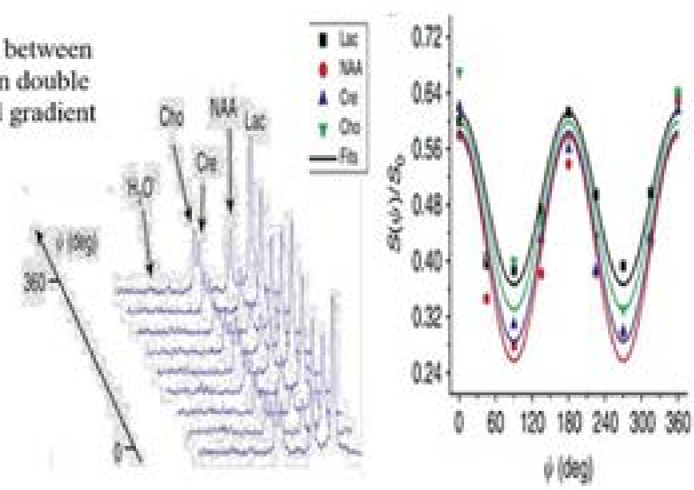
These results demonstrate the revolutionary potential of probing metabolic properties via ^1H MRS at ultra-high fields.

Facilities: NMR Facility and Animal Facility
Instrument/Magnet: 21.1 Tesla Magnet **Citations:**
Metabolic properties in stroked rats revealed by relaxation-enhanced magnetic resonance spectroscopy at ultrahigh fields. Shemesh N, Rosenberg JT, Dumez JN, Muniz JA, Grant SC, Frydman L., **Nature Communications 5, 4958 (2014)**
Metabolic T1 dynamics and longitudinal relaxation enhancement in vivo at ultrahigh magnetic fields on ischemia. Shemesh N, Rosenberg JT, Dumez JN, Grant SC, Frydman L., **Journal of Cerebral Blood Flow Metabolism. 34(11): 1810-7 (2014)**



Complete, broad-band spectrum of brain metabolites were used to define bands for choline (Cho), creatine (Cre), N-acetyl-aspartate (NAA) and lactic acid (Lac) that were excited selectivdy by Shinnar-Le Roux (SLR) pulses to achieve passbands for RE-MRS. (a) ^1H MRS recorded in 6 s from a 125-µL voxel centered in a stroked hemisphere of an *in vivo* rat brain. SNR of NAA exceeds 50:1, and little remains of the water resonance despite being ~10,000 times stronger. (b) Spectra acquired in 5 minutes from the ipsi- & contralateral hemispheres of a stroked rat, with localized voxels indicated on MRI.

Angularity between directions in double pulsed field gradient scan



RE-MRS from ipsilateral hemisphere of a stroked rat. Note the oscillations of the peaks upon varying angular ψ, which displays restricted iffusion ri on-spherical, randomly oriented regions.

CHAPTER 3 – USER FACILITIES

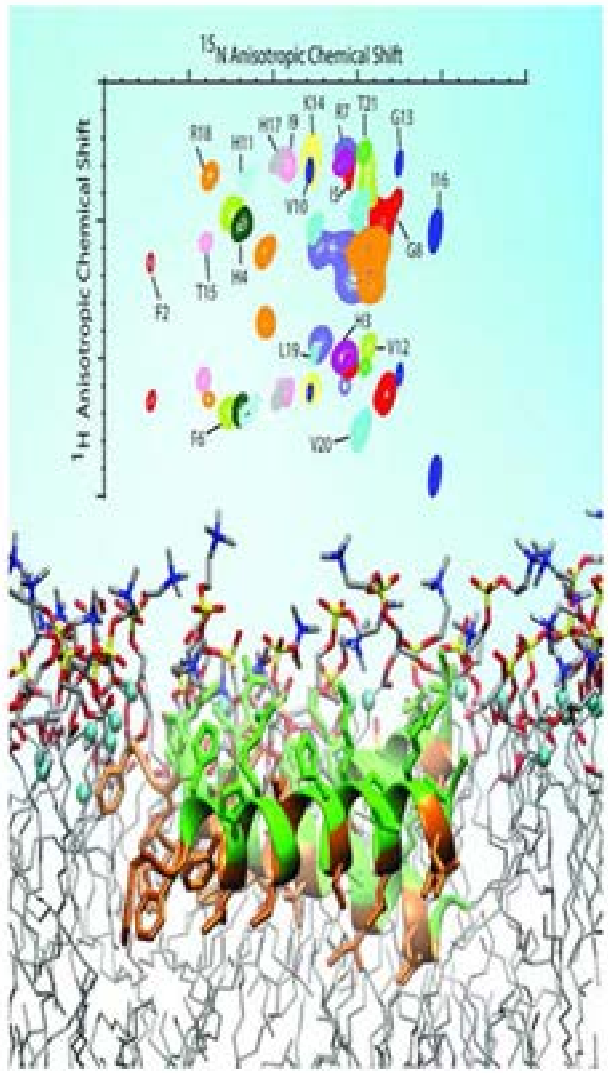
First High-Resolution Structures of Antimicrobial Peptides Piscidin 1 and Piscidin 3 in Fluid Bilayers Reveal Structural Features Important for Function

B.S. Perrin Jr. [1], Y. Tian[2], R. Fu[3], C.V. Grant[2], E.Y. Chekmenev[3]†, W.E. Wieczorek[4], A.E. Dao[4], R.M. Hayden[4], C.M. Burzynski[4], R.M. Venable[1], M. Sharma[5], S.J. Opella[2], R.W. Pastor[1], and M.L. Cotten[4] (1. National Institutes of Health; 2. University of California San Diego; 3. National High Magnetic Field Laboratory; 4. Hamilton College; 5. Harvard University)

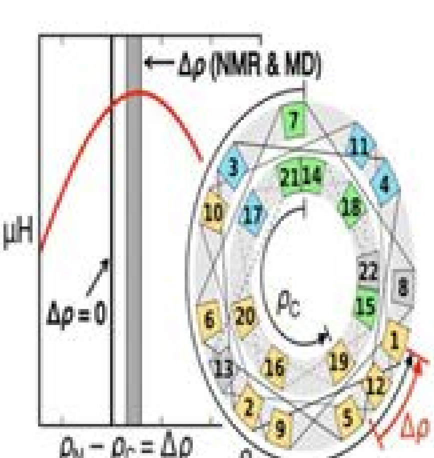
In addition to their strong efficacy, cationic α-helical antimicrobial peptides (AMPs) are characterized by low incidence of induced bacterial resistance, a significant problem that undermines the use of traditional antibiotics. Piscidin 1 (P1) is one of the most potent of more than 2,300 AMPs. With ascaphin-8, it is the only AMP with demonstrated activity against a broad spectrum of bacteria, HIV-1 and some cancer cells. Piscidin 3 (P3) is less active than P1 for reasons that are currently unknown.

To investigate molecular features of P1 and P3 that underlie their efficacy, high-resolution structures were solved by solid-state Nuclear Magnetic Resonance (NMR) in the presence of bacterial cell mimics. Interpreting the experimental data was difficult because the measurements could be biased by the motions occurring under the native-like conditions used for the studies. However, Molecular Dynamics simulations demonstrated the validity of the NMR data.

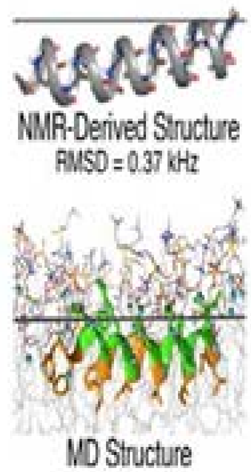
A significant finding of this work is that in contrast to the ideal structures shown in mechanistic studies of AMPs, the structures of both P1 and P3 are disrupted and kinked at a conserved central glycine, which results in stronger interactions with the lipid bilayers. The more pronounced imperfect amphipathicity of P1 over P3 that is revealed helps better understand why P1 more effectively mixes the lipids as needed to induce the greatest damage to bacterial cells.



Structures of antimicrobial peptides piscidins 1 and 3 were solved in two bacterial cell mimics by oriented sample solid-state NMR. Refinements using the NMR restraints yielded structures and orientations in agreement with molecular dynamics simulations that demonstrated ±15° fluctuations in peptide tilt and positioned the peptides below the lipid acyl chain C2 atoms.



Kinking at a central glycine results in two staggered helical wheels and an optimized hydrophobic moment (μH).



Facilities: NMR facility
Instrument/Magnet: 600 and 900 MHz superconducting magnets
Citation- Cover Story: ***High-Resolution Structures and Orientations of Antimicrobial Peptides Piscidin 1 and Piscidin 3 in Fluid Bilayers Reveal Tilting, Kinking, and Bilayer Immersion.*** B.S. Perrin Jr., Y. Tian, R. Fu,… and M.L. Cotten. J. Am. Chem. Soc., DOI: 10.1021/ja411119m.

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AMRIS FACILITY

The AMRIS facility at the University of Florida supports nuclear magnetic resonance studies of chemical compounds, biomolecular systems, tissues, small animals, large animals, and humans. We currently offer nine systems with different magnetic fields and configurations to users for magnetic resonance experiments. AMRIS has nine professional staff members to assist users, maintain instrumentation, build new coils and probes, and help with administration.

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1. Unique Aspects of Instrumentation Capability

Several of the AMRIS instruments offer users unique capabilities: the 750 MHz wide bore provides outstanding high-field microimaging for excised tissues and small animals; the 11.1 T horizontal MRI is the largest field strength magnet in the world with a 400 mm bore; the 600 MHz 1.5-mm HTS cryoprobe is the most mass-sensitive NMR probes in the world for ^{13}C detection and is ideal for natural products research; the 3 T human whole body has 32 channels for rapid parallel imaging and is the only whole body instrument in the state of Florida dedicated to research. The 5T DNP polarizer enables both fundamental studies of DNP mechanisms as well as in vivo metabolism measurements when coupled to either the 4.7 T or 11.1 T systems. These systems support a broad range of users from natural product identification to solid-state membrane protein structure determination to cardiac studies in animals and humans to tracking stem cells and gene therapy *in vivo* to functional MRI in humans.

NMR & MRI Systems in the AMRIS Facility at UF in Gainesville

^1H Frequency	Field (T), Bore (mm)	Homogeneity	Measurements
750 MHz	17.6, 89	1 ppb	Solution/solid state NMR and MRI
600 MHz	14.1, 52	1 ppb	NMR and microimaging
600 MHz	14.1, 52	1 ppb	Solution NMR (cryoprobe)
600 MHz	14.1, 54	1 ppb	Solution NMR (HTS cryoprobe)
500 MHz	11.7, 52	1 ppb	Solution/solid state NMR
470 MHz	11.1, 400 (260 mm useable bore)	0.1 ppm	DNP, MRI and NMR of animals
212 MHz	5.0, 89	1 ppm	DNP polarization
200 MHz	4.7, 330	0.1 ppm	DNP, MRI and NMR of animals
130 MHz	3.0, 900 (600 mm useable bore)	0.1 ppm	whole body MRI and NMR of humans and large animals

2. Facility Developments and Enhancements

With funding from the NHMFL, in 2014 we were able to accomplish three important goals within the AMRIS facility: 1) upgrade our 11.1 T MRI/S system with much stronger, more stable gradients, 2) begin offering dissolution dynamic nuclear polarization (dDNP) capabilities for in vivo studies on the 4.7 and 11.1 T MRI/S systems and 3) enhance in vivo MRI/S capabilities on the 750 MHz system.

The upgrade of the 11.1 T system has enabled us to increase the available resolution for MRI/S studies while mitigating vibration issues resulting from Lorentz forces during strong gradient pulses. In

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concert with the installation of the gradients, next-generation coils and a cantilever/positioning system. were developed by the RF support staff and are now available through the user program.

The installation in 2013 of a dissolution DNP polarizer realized a major part of the DNP initiative, as outlined in our renewal proposal to the NSF for 2013-2017. This polarizer is able to achieve significant polarization of NMR active nuclei in the polarizer, translating to a 10-20,000 gain in SNR on dissolution and injection into our 4.7 T or 11.1 T MRI/S scanners and enabling the study metabolic flux in vivo. In 2014 we added the polarizer to our user program and expanded the RF coils available on the MRI/S scanners for ^{13}C detection ex vivo and in vivo.

Through a UCGP award to Dr. Tom Mareci and external users/collaborators, we completed a new probe for in vivo imaging at 17.6 T on both rats and mice with multi-resonance and quadrature detection capabilities; coils for this probe will continue to be developed in response to user requests. The modular design of this probe enables ease of new coil integration with tailoring of coil geometries to maximize filling factor and SNR for the samples interrogated.

3. Major Research Activities and Discoveries

This year we saw growth in three new user areas. The first area was in offering DNP capabilities to external users. With these new users we have been able to fine-tune operations of the polarizer in concert with the 4.7 and 11.1 T MRI/S scanners and enable users to collect polarizer data at fields higher than is commercially available (**Figure 1)**. We also saw growth in the area of metabolomics through support of the NIH-funded SECIM grant which provides comprehensive and complementary resources for clinical and basic science metabolomics studies and has enabled us to expand our user program. A third area of growth was in the area of fMRI studies utilizing rodent models. Dr. Marcelo Febo, an NHMFL-affiliated member in the department of psychiatry at UF, has brought new capabilities to the 4.7 and 11.1 T MRI/S scanners which have enabled us to support fMRI studies in awake rodents (**Figure 2**). The AMRIS facility users reported 42 peer-reviewed publications 3 theses and 3 dissertations for 2014

4. Facility Plans and Directions

In spite of the continued challenging budgetary climate, our users have consistently successfully pursued federal funding to support their research programs and assisted the AMRIS facility in writing proposals to upgrade instrumentation. The successful partnership of the NHMFL user program with individual investigator research grants also provides constant scientific motivation for our technology development. Through larger program grants from the NIH we are seeking to continue to grow the user program in an era of flat funding from the core NHMFL grant.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

A January symposium was hosted by the McKnight Brain Institute to discuss new directions under the BRAIN initiative with over 100 experts in brain research from throughout the state of Florida participating; capabilities within the AMRIS facility and NHMFL as a whole were highlighted by several presentations.

Figure 1. *Postdoctoral research associate Bimala Lama is funded through the University of Florida matching support to the NHMFL and assists users with DNP experiments in addition to her own research.*

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In May, in partnership with the SECIM center, AMRIS hosted a metabolomics symposium and workshop in May. Over 60 scientists attended a series of presentations by leaders in the field of metabolomics and workshops within the AMRIS facility on NMR mixture analysis, dissolution DNP for in vivo tracking of metabolism, and HRMAS for analyzing metabolites in ex vivo tissue. The directors of the AMRIS and NMR/MRI facilities co-led a panel discussion on the future of HTS magnets at the International Conference on Magnetic Resonance in Biological Systems in August.

Art Edison visited Claflin University April 9-11 to give guest lectures in two undergraduate classes (advanced biochemistry and first semester organic chemistry), lecturing on nematode chemical ecology and presenting an overview of opportunities at the NHMFL for undergraduate students, graduate students, and faculty collaborations. As a result of his regular visits, Claflin students have been participating in the NHMFL REU program

Marcelo Febo acted this year as 'Touchstone mentor' for 3 minority student fellows from other Universities as part of the Society for Neuroscience's Minority Neuroscience Scholars Program. He was also invited to the Latin American Research Network on Addiction (LARNEDA) held at the University of Puerto Rico to give lecture on fMRI and addiction in animal models.

The 8-10 core faculty associated with the AMRIS facility are all active in recruiting and training undergraduate researchers as well as high school summer students. We consistently have 20-30 of these participants working on projects at any given time.

6. Facility Operations Schedule

The AMRIS facility operates year round, 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. Horizontals operate primarily 8 hr/day, 5 days/week due to the difficulty in running animal or human studies overnight. In 2014, the 11.1 T gradients and the 4.7 T gradient amplifier were upgraded leading to an increase in time categorized as development, test, calibration, set-up, or maintenance; full installation and calibration of the new gradients took approximately two months while installation and calibration of the amplifier took approximately one month. The AMRIS facility operates as an auxiliary under federal cost accounting standards. Local and NHMFL-affiliated users pay for magnet time from federally funded projects (primarily individual investigator grants); the NHMFL funds magnet time for users from outside the UF system and development projects.

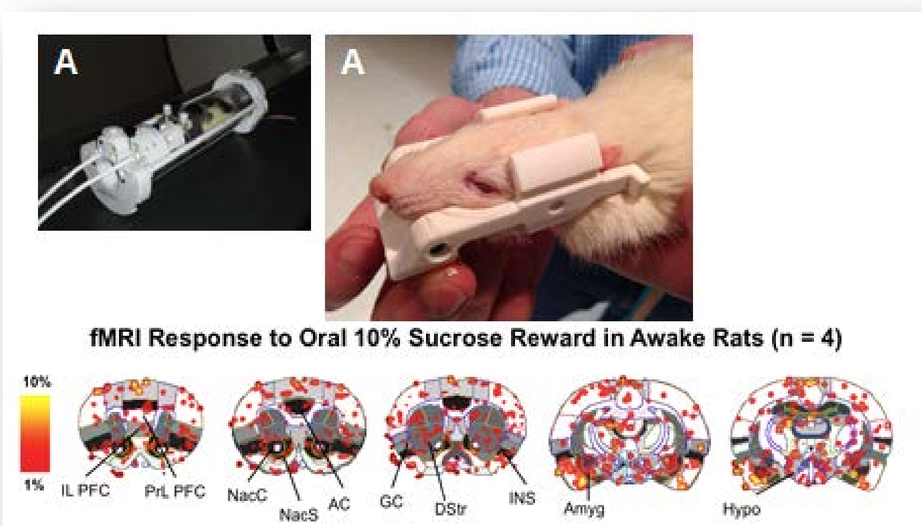

Figure 2. *A) Cradle and B) head positioning system that enables fMRI imaging of awake rats. This non-invasive technique enables the tracking of C) brain response to various stimuli such as ingestion of sucrose.*

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On Random Walks and Entropy in Diffusion-Weighted Magnetic Resonance Imaging Studies of Neural Tissue

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Anomalous Diffusion: In diffusion-weighted magnetic resonance imaging (MRI) of neural tissue, classical models assume the statistical mechanics of Brownian motion and predict mono-exponential signal decay.

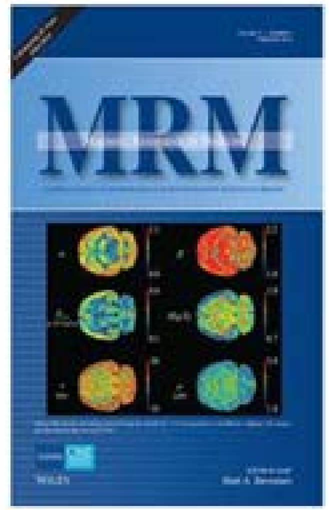
However, signal decay is not mono-exponential, particularly in white matter. In this work, we modeled diffusion in neural tissue from the perspective of a continuous time random walk. Here, the characteristic diffusion decay is represented by the Mittag-Leffler function (see figure), which relaxes *a priori* assumptions about the statistics governing diffusion. Then we used entropy as a measure of the anomalous features for the characteristic function.

Diffusion-weighted MRI measurements were performed on a fixed rat brain at 17.6 T with diffusion weightings arrayed up to 25,000 s/mm^2. Additionally, we examined the impact of varying either the gradient strength, q, or diffusion time, D, on the observed diffusion dynamics. In white and gray matter regions, the Mittag-Leffler and entropy parameters demonstrated new information regarding sub-diffusion and produced different image contrast from that of the classical diffusion. The choice of weighting on q and Δ produced different image contrast.

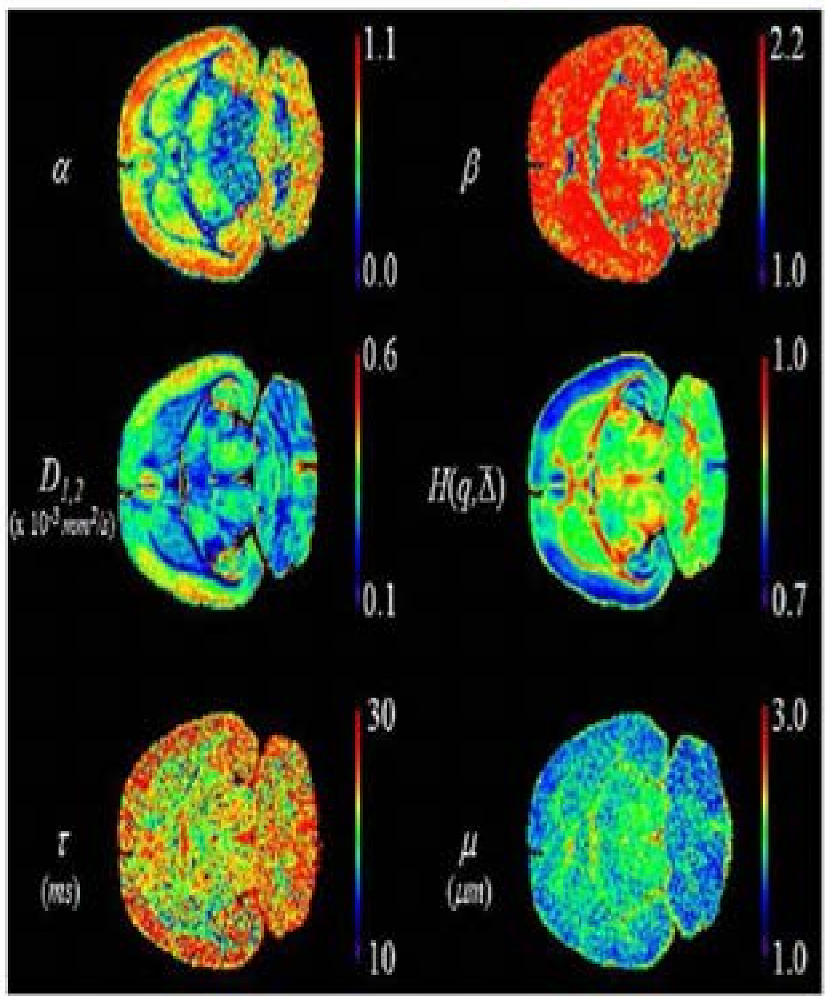
This non-Brownian model of anomalous diffusion provides new fractional order parameters of diffusion, entropy, waiting time and jump length that represent new and unique markers of morphology in neural tissue.

Mittag-Leffler function :

$$p\ (q,\overline{\Delta}) = E_\alpha\left(-D_{1,2}\frac{\tau^{1-\alpha}}{\mu^{2-\beta}}|q|^\beta\,\overline{\Delta}^\alpha\right)$$



Example single-slice images of (1st row) fractional derivative parameters, (2nd row) diffusion and entropy, and (3rd row) waiting time and jump length.



Facilities: AMRIS Facility, UF **Instrument/ Magnet:** 17.6 Tesla Magnet **Citation:** ***On Random Walks and Entropy in Diffusion-Weighted Magnetic Resonance Imaging Studies of Neural Tissue***, C. Ingo, R. L. Magin, L. Colon-Perez, W. Triplett, & T. H. Mareci, **Magnetic Resonance in Medicine 71, 617-627 (2014)**

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Imaging Gene Transfer and Muscle Metabolism

S.C. Forbes[1], E. Barton[2], H.L. Sweeney[2] and G.A. Walter[1,3] (1.University of Florida; 2. University of Pennsylvania; 3. National High Magnetic Field Laboratory)

Imaging Arginine Kinase (AK) Expression– Imaging gene expression in tissues often relies on tissue extracts or biopsies. MRI-based approaches are superior because they offer high spatial resolution within the living animal. MRI has been extremely successful in tracking cell delivery (for example the *in vivo* tracking of stem cells). MRI has, however, been limited in its ability to image the manufacturing of genes *within* skeletal muscle cells. In order to overcome this problem, we determined if an NMR spectroscopic method could be used to detect the intracellular manufacturing within the leg muscles of a mouse of a foreign gene (i.e. a gene found only in invertebrates).

Arginine kinase (**AK**) is typically found in invertebrates and catalyzes the rephosphorylation of ADP to ATP at the cost of phosphoarginine (PArg). Creatine kinase (**CK**) is the functionally-similar enzyme found in vertebrates with phosphocreatine (PCr) serving as the phosphate donor. Using the higher magnetic fields at the MagLab's AMRIS facility, researchers were able to resolve the different ^{31}P chemical shifts of PArg (red) and PCr (blue) (see Figure 1). In addition, with the increased signal sensitivity at high fields, researchers performed saturation transfer measurements to demonstrate the enzymatic activity of the foreign gene product in the mouse leg.

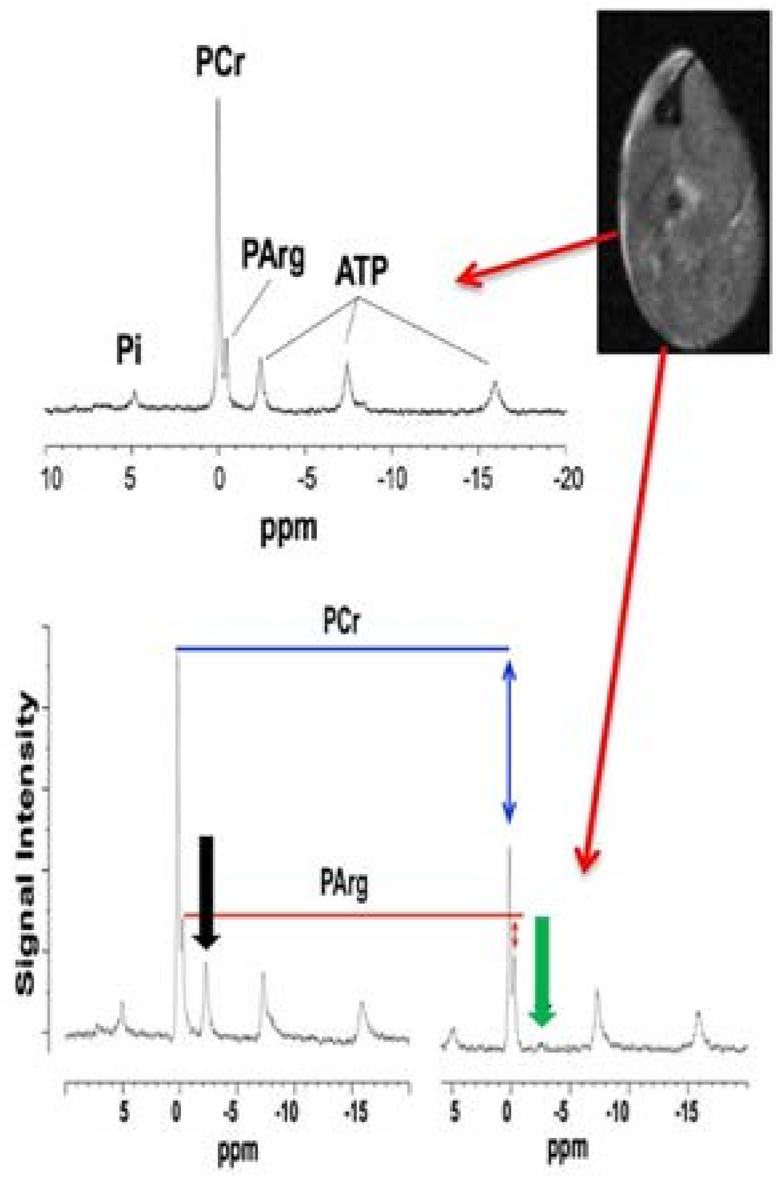

***Figure 1**. Top: ^{31}P spectrum acquired at 17.6T in a mouse hind limb injected with arginine kinase (AK) gene. Bottom ^{31}P spectra at 17.6T with/without saturation of gATP (green/black arrows). The saturation transfer experiments reveal that PArg (the invertebrate metabolite) was in chemical exchange with ATP in the mouse's muscle.*

Facilities: 17.6 Tesla and 11.1 Tesla Magnets of the NHMFL's Advanced Magnetic Resonance Imaging and Spectroscopy Facility

Citation: Forbes SC, Bish LT, Barton ER, Ye F, Baligand C, Plant D, Vandenborne K, Sweeney HL, and Walter GA. Gene transfer of arginine kinase to skeletal muscle using adeno-associated virus. **Gene Therapy (2014) 21, 387–392**

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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 metallo-proteins, spin-labeled proteins and other complex bio-molecules and their synthetic models.

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1. Unique Aspects Of Instrumentation

The EMR facility at the NHMFL offers users several home built high-field and multi-high-frequency instruments covering the continuous frequency range from 9 GHz to ~1 THz, with additional frequencies up to 2.5 THz using a molecular gas laser. Several transmission probes are available for continuous-wave (c.w.) measurements, which are compatible with a range of magnets at the lab, including the highest field 45 T 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 ~3 GPa). Quasi-optical (QO) reflection spectrometers are also available in combination with high-resolution 12 and 17 T superconducting magnet systems; a simple QO spectrometer has also been developed for use in the resistive and hybrid magnets (up to 45 T). EMR staff members can assist users in the DC field facility using broadband tunable homodyne and heterodyne spectrometers as well.

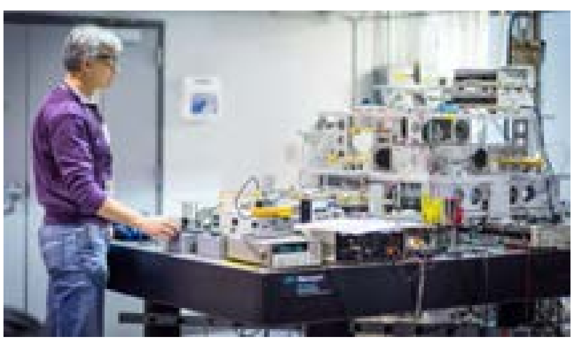

***Figure 1**: The 12 T quasioptical heterodyne 120, 240, 336 GHz pulsed EPR spectrometer.*

In addition to c.w. capabilities, the NHMFL EMR group boasts the highest frequency pulsed EPR spectrometer in the world, operating at 120, 240 and 336 GHz with 100 ns time resolution. A new quasi-optical 94 GHz spectrometer (HiPER) with 1 ns time resolution became available to users in a low-power mode in 2014. This spectrometer will be upgraded for high power (1 kW) operation in 2015. A commercial Bruker Elexsys 680 operating at 9/95 GHz (X-/W-band) is also available upon request. This unique combination of c.w. and pulsed instruments may be used for a large range of applications, including the study of optical conductivity, cyclotron resonance.

2. Facility Developments and Enhancements

2014 was a big year for activities focused on the development of high-field Dynamic Nuclear Polarization (DNP) capabilities for users, in collaboration with the NMR group. A 395 GHz, 40 W gyrotron source was delivered in April, and a quasioptical propagation system was installed over the summer, connecting the gyrotron output to separate 600 MHz NMR platforms: one for solid-state magic-angle-spinning (MAS); the other for Overhauser DNP (O-DNP) of samples dissolved in non-polar organic solvents, including supercritical CO_2. The MAS DNP platform became operational upon delivery of the gyrotron, meeting specifications at the end of April. This capability is now available to users, and the first publication appeared at the time of writing of this report [Angew. Chem. Int. Ed. **54**, 1542 (2015)]. The O-DNP instrument represents a longer term

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development that is funded separately from the NSF core, with user activities anticipated in 2017.

HiPER was integrated into the EMR user program during 2014. HiPER is a 94 GHz quasioptical pulsed EPR spectrometer, offering exceptional sensitivity and low deadtime. The spectrometer was developed at St. Andrews University and delivered to the MagLab two years ago. It is now fully operational in a low power mode, with an upgrade to high power (1 kW pulses) scheduled for the summer of 2015. This will enable $\pi/2$ pulses for $S = ½$ of just a few ns (shorter for larger spin values). HiPER features exceptional cross-polar isolation, enabling induction-mode detection while excitation pulses are incident on the sample. Thus, HiPER offers true nanosecond deadtime and the possibility to perform fourier-transform-type HFEPR measurements, akin to what is routinely achieved in NMR. Phase and frequency can be controlled on nanosecond timescales, permitting highly complex spin manipulations (with sequences of up to 16 pulses of arbitrary phase) and repetition rates of up to 80 kHz. During the past year, HiPER's excellent concentration sensitivity has been demonstrated for c.w. measurements, surpassing the performance of Bruker's commercial W-band instrument by at least an order of magnitude. HiPER represents the centerpiece of the EMR program's growth into biophysical/ biochemical EPR applications, whilst also bringing important new capabilities for users interested in spin quantum computing.

Figure 2: *The 94 GHz quastioptical HiPER spectrometer.*

3. Research Productivity and Achievements

In 2014 a large number of research groups and projects were accommodated by the EMR group, resulting in the submission of 46 research reports. In addition, 39 peer-reviewed journal articles were reported by our users, as well as numerous presentations at conferences. Many publications appeared in high-impact journals including: Journal of the American Chemical Society (5); Physical Review Letters (1); Chem. Comm. (1); Inorganic Chemistry (8); Dalton Transactions in Chemistry (2); Physical Review B (7); and J. Phys. Condens. Matter (2). Projects spanned a range of disciplines from applied materials research to studies of proteins; see also highlights below.

Members of the EMR staff also received significant recognitions in 2014. EMR Director Stephen Hill and Hans van Tol were jointly awarded the International EPR Society (IES) Silver Medal for Instrumentation. Hill was also selected to serve a three-year term as Vice President of the IES for the Americas. In addition, Hill was elected a Fellow of the American Physical Society.

4. Facility Plans and Directions

The EMR program has extensive plans for new capabilities during 2015, as well as solutions to oversubscription issues on some of its existing instruments. The group will also welcome a new postdoctoral researcher to bolster its biophysical/ biochemical user program; the new postdoc is expected to start during the summer.

A contract is in place for a high-power upgrade to the new quasioptical W-band pulsed EPR spectrometer, HiPER, involving integration of a 1 kW 94 GHz amplifier with 1 GHz instantaneous bandwidth. This will require several modifications to the existing setup – work that will be performed by St. Andrews University during the summer of 2015. The upgrade will enable highly sophisticated and sensitive pulsed electron double resonance (PELDOR or DEER) measurements at 94 GHz on spin-labeled biological samples, providing not only distance constraints but also information on the relative orientations of the g-tensors associated with the labels.

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Plans are afoot to incorporate a pulse-protection switch into the workhorse high-Frequency quasi-optical pulsed spectrometer (120, 240, and 336 GHz), thereby reducing its dead-time significantly from 300 ns to about 80 ns. This improvement will enable studies of coherent spin dynamics in a host of new materials where this was previously impossible due to short (< 100 ns) coherence times. Another planned upgrade for this spectrometer will involve the addition of a 2^{nd} 120 GHz fundamental mixer that will allow for super-heterodyne detection in cw-mode at 120 GHz. This will, in turn, lead to increases in sensitivity and allow for straightforward phase correction.

Finally, a new 15/17 T homodyne/transmission spectrometer is currently under development in order to alleviate oversubscription on the existing instrument. The new system leverages an older 15/17 T superconducting magnet that was under utilized, together with a series of older Gunn diode sources and harmonic multipliers that had been replaced by multiplier chains. The new spectrometer is expected to be operational by the 2^{nd} quarter of 2015, and will enable measurements in the following frequency bands: 70-102 GHz, 180-204 GHz, and 270-306 GHz, with the possibility of an additional 395±5 GHz band later in the year. It is also anticipated that the new transmission spectrometer will offer comparable sensitivity to the existing workhorse system, thereby providing a very credible alternative/backup.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

During 2014, the EMR group received 18 proposals from first time users out of a total of 65 on file, i.e., 28% of our users were new to the program. Over the past two years, we have witnessed a significant increase in our user base (there were 42 proposals on file at the end of 2012). This may be attributed to several new experimental capabilities that came online in 2013, including the 8 T Mössbauer spectrometer and HiPER. Interestingly, the Mössbauer facility has attracted new users who subsequently applied for time on the EPR spectrometers. The EMR program assisted 143 individual researchers in 2014, of which a quarter of those reporting were either female (17%) or minority (7%). In an effort to attract new users, the EMR group continues to provide up to $500 of financial support to first time visitors to the lab ($1000 for overseas users). The EMR group has also made progress in terms of the diversity of its own students and staff: 37% are female and 11% minority.

Members of the EMR group continue to make aggressive efforts to advertise the facility at international workshops and conferences. These efforts included attending and presenting at conferences outside of their own immediate research areas. The group also organized or participated in focused sessions/symposia at major conferences (e.g. APS and ACS) and provided financial support in the form of student travel grants for the two main EPR conferences in the US. The group participated in an undergraduate school on magnetism and magnetic materials, organized at Florida State University during the summer of 2014 as a means of outreach to the community. Finally, the EMR group has participated in several outreach activities, including the mentorship of summer REU students and local high-school interns.

6. Facility Operations Schedule

The most heavily used instrument in the EMR program is the 17 T homodyne/transmission spectrometer. This instrument has reached a point where it is significantly over-subscribed (at the time of writing, it is fully booked for the foreseeable future). The spectrometer was available for all of 2014, with the exception of 13 days due to magnet quenches that required a warm-up of the entire system. The usage (including maintenance) during 2014 was 315 days, implying that it was in use on EVERY SINGLE weekday, as well as on >60 weekend days and/or holidays. There have also been frequent instances of its operation overnight. As noted above, several steps will be taken during the coming year to alleviate some of the pressure on this instrument, including the purchase of a new power supply and the commissioning of a new spectrometer with similar, albeit slightly more modest specifications.

The 12 T heterodyne/pulsed instrument was also available for most of 2014. Just two days were dedicated to repairs, maintenance and installation of new hardware. This spectrometer is not straightforward to use, requiring constant oversight by the EMR staff member (van Tol) responsible for

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the instrument. Consequently, users are not usually scheduled when this staff member is traveling. 194 days of usage were reported in 2014, constituting about 80% of the available working days (not including weekends and holidays).

The two Mössbauer instruments were available throughout the year, with the exception of 10 days required for a new source calibration. When available, the high-field instrument was used practically constantly day and night due to the nature of the Mössbauer experiment. 385 total days have been logged in 2014.

The Bruker spectrometer was also over-subscribed in 2014. The total usage during 2014 was 316 days. The instrument is shared between the FSU biology department and the EMR user program. 30% of the machine time was originally designated for the MagLab user program. In 2014, due to high demand from users, 72% of its usage (237 days) was allocated for user operations.

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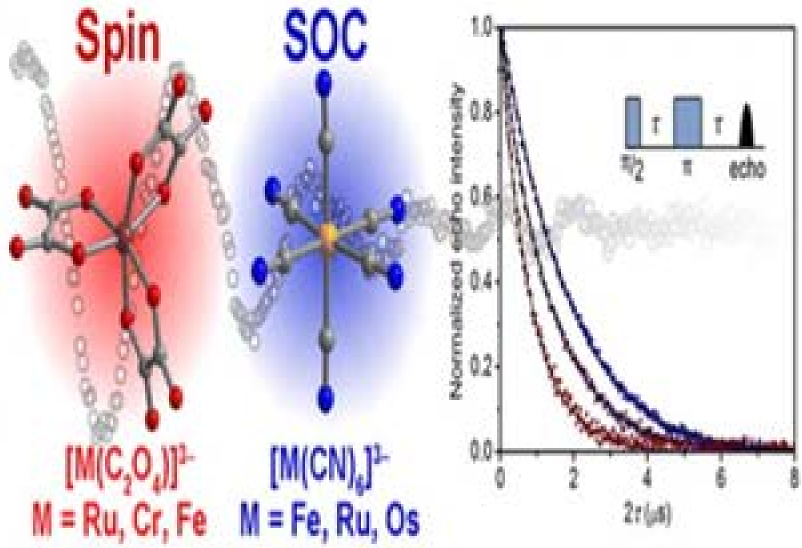
Influence of Electronic Spin and Spin−Orbit Coupling on Decoherence in Transition Metal Complexes

M.J. Graham,[1] J.M. Zadrozny,[1] M. Shiddiq,[2] J.S. Anderson,[1] M.S. Fataftah,[1] S. Hill[2] and D.E. Freedman[1] (1. Northwestern University, 2. National High Magnetic Field Laboratory/FSU)

Developing molecular design principles that minimize electron spin decoherence is a key step toward the rational synthesis of molecules for quantum information processing. Two series of paramagnetic coordination complexes, $[M(C_2O_4)_3]^{3-}$ (M = Ru, Cr, Fe) and $[M(CN)_6]^{3-}$ (M = Fe, Ru, Os), were prepared and subsequently interrogated by pulsed electron paramagnetic resonance (EPR) spectroscopy to assess quantitatively the influence of the magnitude of spin (S = $^1/_2$, $^3/_2$, $^5/_2$) and spin–orbit coupling (ζ = 464, 880, 3100 cm^{-1}) on decoherence. The measured coherence times (T_2) reveal a relatively small dependence on the two variables studied, demonstrating that the magnitudes of spin and spin–orbit coupling are not the primary drivers of electron spin decoherence.

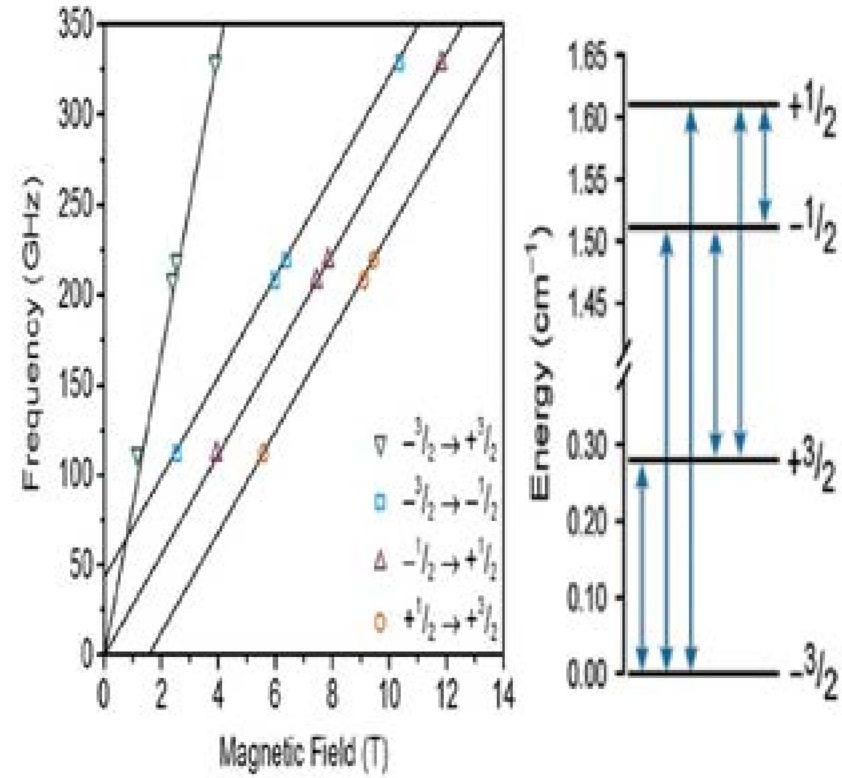


On the basis of this discovery, $[Ru(C_2O_4)_3]^{3-}$ was selected for further study. The two parameters establishing the viability of a spin qubit are a long coherence time, T_2, and the the ability exert coherent quantum control using appropriate microwave pulses. The complex $[Ru(C_2O_4)_3]^{3-}$ meets both of these criteria, establishing it as a potential molecular qubit candidate, thus highlighting the viability of coordination complexes as qubit platforms.

These results illustrate that the design of qubit candidates can be achieved with a wide range of paramagnetic ions and spin states while preserving a long-lived coherence. **Facility:** EMR.

Instrument/Magnet:
Bruker & 17 T Spectrometers

Citation: *"Influence of Electronic Spin and Spin-Orbit Coupling on Decoherence in Mononuclear Transition Metal Complexes;* M.J. Graham, J.M. Zadrozny, M. Shiddiq, J.S. Anderson, M.S. Fataftah, S. Hill, and D. Freedman, **J. Am. Chem. Soc. 136**, 7623−7626 (2014).



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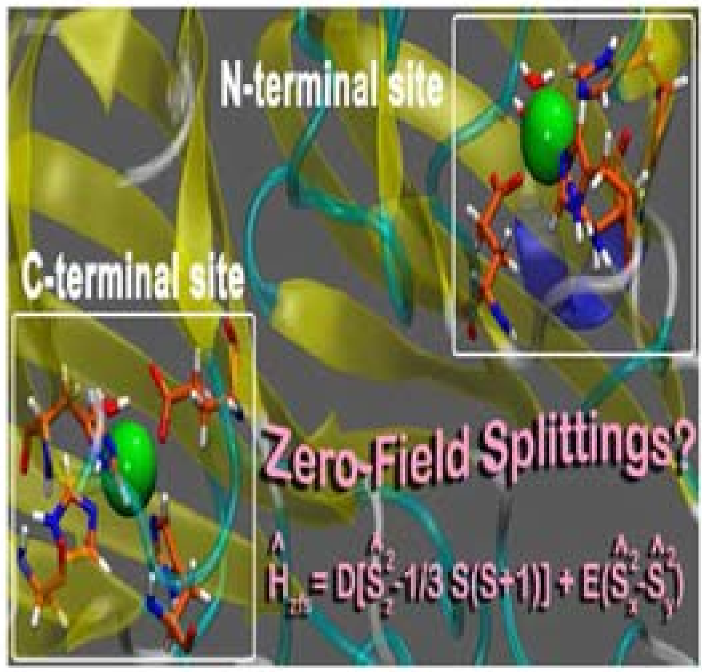
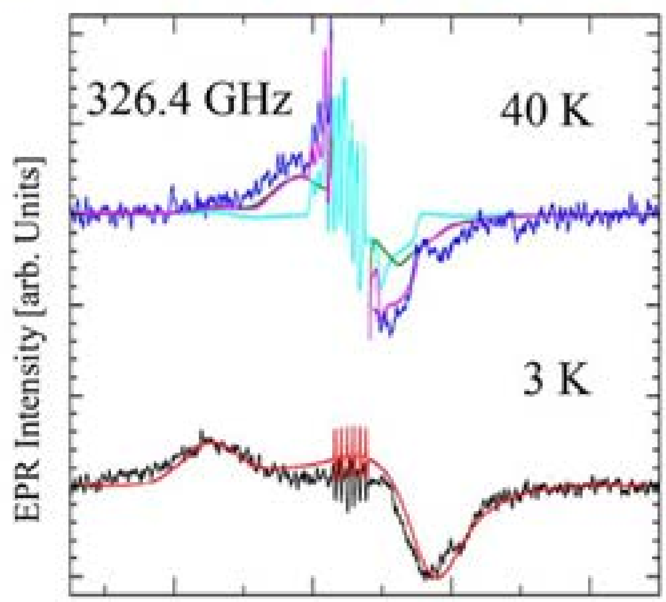
High-Field EPR Studies of the Fine Structure Parameters of the Mn(II) Centers in *Bacillus subtilis* Oxalate Decarboxylase

Nigel G. J. Richards,[1] Whitney F. Kellet,[1] Ursula Rothlisberger,[2] Pablo Campomanes,[2] Alexander Angerhofer,[3] Karen N. Allen,[4] Lindsey Easthon,[4] Andrew Ozarowski[5] (1. Indiana University Purdue University Indianapolis; 2. Ecole Polytechnique Fédérale de Lausanne; 3. University of Florida; 4. Boston University; 5. National High Magnetic Field Laboratory)

Oxalate Decarboxylase (OxDC) is an enzyme that catalyzes the manganese-dependent breakdown of the oxalate monoanion into carbon dioxide and formate. Although the enzyme is found in many fungi and some bacteria, its chemical mechanism remains poorly understood. The presence of Mn(II) in OxDC offers the opportunity to use Electron Paramagnetic Resonance (EPR) to explore the mechanistic role of the metal ion in catalysis. However, the situation is complicated by the fact that the enzyme contains two Mn(II) centers located in the N- and C-terminal cupin domains (green spheres in top figure).



High-frequency (326.4GHz) EPR measurements performed at high magnetic fields (~12 teslas, rather than typical fields of less than 1 tesla) greatly simplify the task of assigning fine structure parameters to each of the Mn(II) centers. This is because the large field-induced (Zeeman) energy splitting favors thermal population of only the lowest sub-level of the spin $s = {}^5/_2$ state of Mn(II) at the ~3K base temperature of the spectrometer (see lower figure, in which the smooth curves are simulations of the experimental spectra). By comparing the wild-type OxDC spectra with a single-site mutant, it is possible to assign features in the EPR spectra to the Mn(II) at the N-terminal site. The results provide new insights into the strengths and limitations of theoretical methods for understanding protein-bound Mn(II), setting the stage for future EPR studies of Mn(II) centers in OxDC.



Facilities: EMR. **Instrument/Magnet:** 17.5 Tesla Magnet

Citation: Campomanes, P.; Kellett, W.F.; Easthon, L.M.; Ozarowski, A.; Allen, K.N.; Angerhofer, A.; Rothlisberger, U. and Richards, N.G.J., *Assigning the EPR Fine Structure Parameters of the Mn(II) Centers in Bacillus subtilis Oxalate Decarboxylase by Site-Directed Mutagenesis and DFT/MM Calculations,* **J. Am. Chem. Soc., 136**, 2313−2323 (2014)

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ICR FACILITY

During 2014, 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 seven 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.

1. Unique Aspects of Instrumentation Capability

The Ion Cyclotron Resonance facility provides operations for 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 FT-ICR MS coupled to high magnetic fields. The facility's four FT-ICR mass spectrometers feature high magnetic fields < 21 tesla, and are compatible with multiple ionization and fragmentation techniques.

ICR Systems at the Magnet Lab in Tallahassee

Field (T), Bore (mm)	Homogeneity	Ionization Techniques
14.5, 104	1 ppm	ESI, AP/LIAD-CI, APCI, DART
9.4, 220	1 ppm	ESI, AP/LIAD-CI, APCI, APPI FT-ICR, DART, DAPPI
9.4, 155	1 ppm	FD, LD FT-ICR

2. Facility Developments and Enhancements

Delivery and installation of the **21 T actively-shielded superconducting magnet** occurred in 2014, and the magnet has reached full-field strength and been under vacuum. Optimization and automation of experimental scripts written in the instrument control software for ion transfer to the ICR cell will continue in 2015, with user access anticipated by early 2015.

The **9.4 T, passively-shielded**, 220 mm bore system offers a unique combination of mass resolving power ($m/\Delta m$ = 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.,* **25**, 943-949 (2014)). A redesign to the custom-built mass spectrometer coupled to the 9.4T, 200 mm 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. The ICR cell, electrical vacuum feed throughs, 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 (*Int. J. Mass Spectrom.,* **360**, 45-53 (2014)) and petroleum fractions (*Anal. Chem.*, **86**, 10708-10715 (2014), (*Energy Fuels*, **28**, 5043-5048 (2014), *J. Haz. Mat.,* **280**, 636-643 (2014)), mass spectrometer performance improves significantly, because those mixtures are replete with mass "splits" that are readily separated and identified by FT-ICR MS. The magnet is passively shielded to allow proper function of all equipment and safety for users. The

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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)). Available dissociation techniques include collision-induced (CID), infrared multiphoton-induced (IRMPD) (*J. Am. Soc. Mass Spectrom.,* **23**, 644-654 (2012)), and electron capture-induced (ECD) (*J. Phys. Chem. A*., **117**, 1189-1196 (2013).

The **9.4 T actively shielded** FT-ICR instrument is available for analysis of complex nonpolar mixtures and instrumentation development. The 9.4 T magnet is currently used for field desorption (*Anal. Chem.*, **80**, 7379-7382 (2008)) and elemental cluster analysis, and reported the formation of the smallest fullerene by stabilization through cage encapsulation of a metal by use of a pulsed laser vaporization cluster source (*J. Am. Chem. Soc.*, **134**, 9380-9389 (2012), which indicate that metallofullerenes should be constituents of stellar/circumstellar and interstellar space as well as fullerenes (*Proc. Natl. Acad. Sci. U.S.A.,* **110(45)**, 18081-18086 (2013)).

3. Major Research Activities and Discoveries

Automated broadband phase correction of FT-ICR data can in principle produce and absorption-mode spectrum with mass resolving power as much as a factor of 2 higher than conventional magnitude-mode display, an improvement otherwise requiring a more expensive increase in magnetic field strength. We have developed and implemented a robust and rapid automated method to enable accurate broadband phase correction for all peaks in the mass spectrum and present experimental FT-ICR absorption-mode mass spectra with increased number of resolved peaks and higher mass accuracy relative to magnitude mode spectra, and produce more complete and more reliable elemental composition assignments for nickel and vanadyl porphyrins in natural petroleum seeps (**Figure 1,** *Energy Fuels*., **28**, 2454-2462 (2014)).

To the best of our knowledge, this mass spectrum represents the most peaks resolved and identified in a single spectrum of any kind, and represents the highest broadband resolving power for any petroleum mass spectrum, and emphasizes

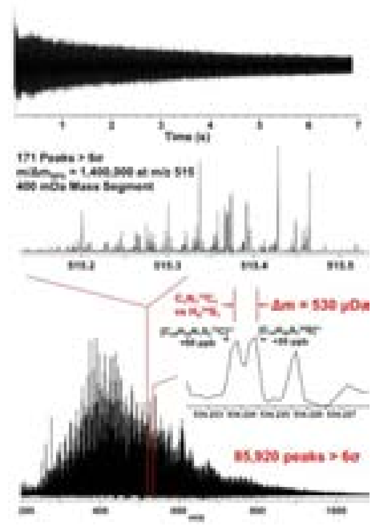

Figure 1. *Broadband positive-ion APPI FT-ICR mass spectrum for an Il Duomo asphalt volcano sample. The achieved resolving power $m/\Delta m_{50\%}$ = 1,400,000 at m/z 515 enables resolution of 85,920 mass spectral peaks, each with magnitude greater than 6σ of baseline rms noise (m/z 200-1100) with a mass distribution centered at m/z 400. The mass scale-expanded segment at m/z 515 shows ~171 peaks. The theoretical resolving power required to separate two equally abundant species that differ in mass by ~548 μDa at 9.4 tesla is 890,000. The presently achieved resolving power ($m/\Delta m_{50\%}$ = 1,400,000 at m/z 515) enables separation of species that differ in mass by $C_1N_1{}^{13}C_1$ versus $H_5{}^{34}S_1$, both of nominal mass 39 Da, and differing in mass by 530 μDa—i.e., less than the mass of an electron (548 μDa).*

the need for ultrahigh resolving power achievable only by FT-ICR MS sufficient to separate isobaric overlaps prevalent in complex seep samples.

Phase correction applied to complex petroleum fractions facilitates resolution and identification of ionic species that differ in mass by less than the mass of an electron (*Anal. Chem*., **86**, 10708-10715 (2014). Development of a fast, robust, and automated algorithm that flattens the absorption-mode spectral baseline by defining baseline data minima, followed by linear interpolation to generate a complete baseline, followed by boxcar smoothing, and baseline subtraction increases the number of

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detected peaks for petroleum and proteins (*Int. J. Mass Spectrom.* 325-327, 67-72 (2012)).

Implementation of an **electrically compensated** Fourier transform ion cyclotron resonance cell for the 9.4 T instrument enables separation and identification of isobaric species in complex natural organic petroleum mixtures, and preserves ion cloud coherences for longer transient duration by a factor of 2 (*Anal. Chem.,* **83**, 6907-6910 (2011)). The improved performance of the compensated ICR cell provides more symmetric peak shape and better mass accuracy through tunable compensation electrodes, critical for optimal performance.

A conventional Fourier transform-Ion Cyclotron Resonance (ICR) detection cell is azimuthally divided into four equal sections (**Figure 2**). One pair of opposed electrodes is used for ion cyclotron excitation, and the other pair for ion image charge detection. We demonstrate that an **appropriate electrical circuit facilitates excitation and detection** on one pair of opposed electrodes. The new scheme can be used to minimize the number of electrically independent ICR cell electrodes and/or improve the electrode geometry for simultaneously increased ICR signal magnitude and optimal post-excitation radius, which results in higher signal-to-noise ratio and decreased space-charge effects (**Figure 2**, (*Rev. Sci. Instrum.,* **85**, 066107 (2014)).

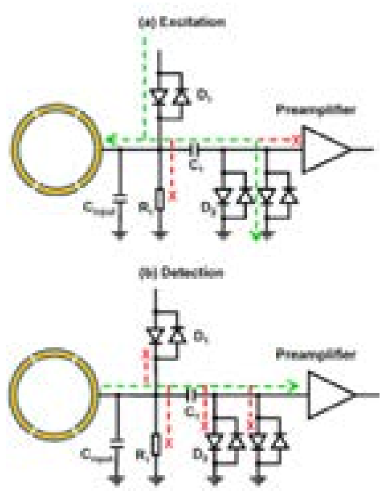

Figure 2. *Circuit used to achieve excitation and detection with one pair of electrodes. The top panel (a) displays the ac current path during excitation. The bottom panel (b) displays the ICR signal path during detection. D1 and D2 are PIN diodes (HSMP-3822). C1 is a 330 pF mica capacitor. R1 is a 10 M metal film resistor.*

FT-ICR MS typically uses an *m/z*-independent excitation magnitude to excite all ions to the same cyclotron radius, so that the detected signal magnitude is directly proportional to the relative ion abundance. An auxiliary rf waveform of the same amplitude and phase applied to all the rods of an ion accumulation multipole creates an *m/z*-dependent axial pseudo potential. Controlled decrease of the auxiliary rf amplitude releases ions from the accumulation multipole sequentially from high to low *m/z*. The slope of the auxiliary rf voltage ramp is adjusted so that ions of different *m/z* reach the center of the ICR cell at the same time point, which mitigates the typical time dispersion observed in external source FT-ICR and extends the observable mass range for a single data acquisition by 2- to 3-fold (**Figure 3**). For complex mixture analysis, twice the number of elemental compositions are assigned when the auxiliary rf ejection is applied compared with the standard gated trapping. (*J. Am. Soc. Mass SpectroM.,* **25**, 943-949 (2014)).

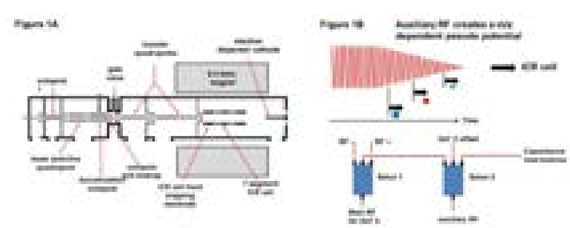

Figure 3. *(a) Schematic of the custom built 9.4 T FT-ICR mass spectrometer. (b) Schematic for application of the auxiliary rf. The auxiliary rf is applied to the center tap of the balun for the main rf drive of the accumulation octopole trap, and thus an auxiliary rf waveform of the same phase and voltage is applied to all the multipole rods. Ions are released from the accumulation multipole toward the ICR cell sequentially from high to low m/z as the auxiliary rf amplitude is ramped down.*

Development of novel ionization techniques such as Atmospheric Pressure Laser-Induced Acoustic Desorption Chemical Ionization (AP/LIAD-CI) and Laser Desorption Atmospheric Photochemical Ionization (LD/APPCI) decouples analyte desorption from subsequent ionization and enables rapid and independent optimization and generates analyte ions that are efficiently

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thermalized by collisions with atmospheric gases, thereby reducing fragmentation. The absence of matrix interference renders LD/APPCI MS particularly useful for analysis of small molecules (<2000 Da) such as those present in petroleum crude oil and petroleum deposits. $[M+H]^+$ and $M^{+\bullet}$ dominate the positive-ion mass spectra for olefins and polyaromatic hydrocarbons, whereas saturated hydrocarbons are observed mainly as $[M+H]^+$ and/or $M^{+\bullet}$. The source was coupled with a 9.4 T Fourier transform ion cyclotron resonance mass spectrometer (FT-ICR MS) to resolve and identify thousands of peaks from Athabasca bitumen heavy vacuum gas oil distillates (400−425 and 500−538 °C), enabling simultaneous characterization of their polar and nonpolar composition. We also applied LD/APPCI FTICR MS for rapid analysis of sodium and calcium naphthenate deposits with little to no sample pretreatment to provide mass spectral fingerprints that enable reliable compositional characterization **(Figure 4,** *Anal. Chem.*, **86**, 11151-11158 (2014)).

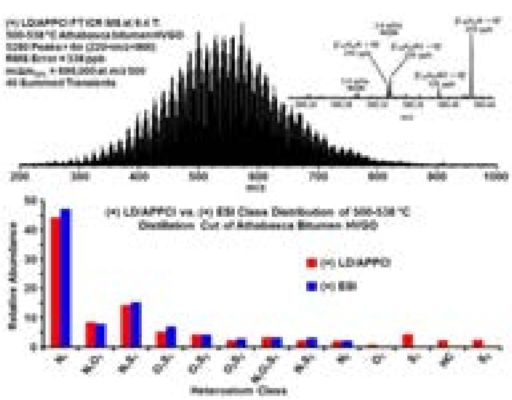

Figure 4. *Top: broad-band positive-ion LD/APPCI 9.4 T FT-ICR mass spectrum of a 500−538 °C distillation cut from Athabasca bitumen heavy vacuum gas oil (HVGO), and that shows a mass-scale-expanded segment spanning a 0.25 Da range. The mass resolution is more than sufficient to distinguish between peaks differing by only 3.4 mDa in mass (corresponding to a difference in elemental composition of C_3 versus SH_4, top, inset), for confident elemental composition assignments. Bottom: corresponding heteroatom class distribution for the 500−538 °C distillate by LD/APPCI and ESI 9.4 T FT-ICR MS.*

Tertiary and quaternary structure can also be probed. Automated **hydrogen/deuterium exchange** improved by depletion of heavy isotopes ($^{13}C/^{15}N$) for protein subunits of a complex can greatly simplify the mass spectrum, increase the signal-to-noise ratio of depleted fragment ions, and remove the ambiguity in assignment of *m/z* values to the correct isomeric species. Lysyl-tRNA synthetase (KRS), a protein synthesis enzyme in the cytosol, relocates to the plasma membrane after a laminin signal and stabilizes a 67-kDa laminin receptor (67LR) implicated in cancer metastasis. The small compound BC-K-YH16899 binds KRS and suppressed the dynamic movement of the N-terminal extension of KRS and inhibited the KRS-67LR interaction (*Nature Chem. Bio.,* **10**, 29-34 (2014)).

The detailed characterization of large protein assemblies in solution remains challenging to impossible. Nonetheless, these large complexes are common and often of exceptional importance. **Hydrogen/deuterium exchange** mass spectrometry (HDX-MS) applied to *E. coli* chaperonin GroEL conformation in solution. The ~800 kDa tetradecameric GroEL plays an essential role in the proper folding of many proteins via an ATP-driven cycle of conformational changes. Comparison of HDX-MS results for apo GroEL and GroEL-ATPγS enables the characterization of the nucleotide-regulated conformational changes throughout the entire protein with high sequence resolution. GroEL is by far the largest protein assembly yet mapped by HDX-MS, and the results achieved here establish the groundwork for further HDX-MS characterization of such large complexes. (*Scientific Reports*, **3**, 1247 (2013).

Current high-throughput **top-down proteomic** platforms provide routine identification of proteins less than 25 kDa with 4-D separations. Pilot project #1 – the identification ant characterization of human histone H4 proteoforms by top-down MS – is the first project launched by the Consortium for Top-Down Proteomics (CTDP) to refine and validate top-down MS (*Proteomics*, **14**, 1130-1140 (2014)). Within the initial results from seven participating groups, all reported probability-based identification of human histone H4 (UniProtaccession P62805) with exception values ranging from 10^{-13} to 10^{-105}. Regarding characterization, a total of 74 proteoforms were reported, with 21 done so unambiguously; one new PTM, K79ac, was identified. Inter-laboratory comparison reveals

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aspects of the results that are consistent, such as the localization of individual PTMs and binary combinations, while other aspects are more variable, such as the accurate characterization of low-abundance proteoforms harboring >2 PTMs (**Figure 4**).

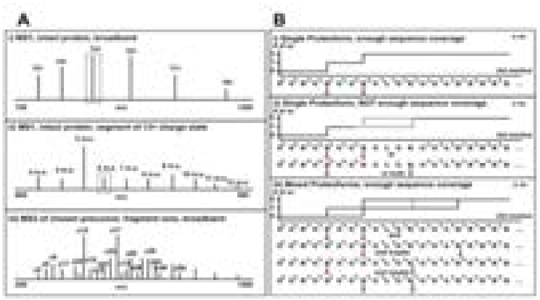

Figure 4. *(A) Scheme of top-down MS experiment. (i) The broadband mass spectrum of the intact protein. (ii) Segment of the 13+ charge state of the intact protein with methyl equivalents (m.e.) labeled. The proteoform with six m.e. is selected as the precursor for the MS2 experiment. (iii) Tandem mass spectrum for precursor chosen in (ii) to localize PTMs and identify proteoforms. (B) Ambiguity of Top-Down MS. (i) With only a single proteoform existing and enough (100%) sequence coverage, there is no ambiguity for the proteoform H4K5acK8ac. (ii) With a single proteoform existing but not enough sequence coverage, there is ambiguity on the localization of the second acetylation (K8 or K12), resulting in two ambiguous proteoforms, H4K5acK8ac or H4K5acK12ac. (iii) With mixed spectra for multiple proteoforms and enough (100%) sequence coverage, there remains uncertainty on the existence of an acetylation on K12, therefore two ambiguous proteoforms (H4K5acK12ac and H4K8acK12ac) arise.*

An open-access tool and discussion of proteoform scoring, along with a description of general challenges that lie ahead including improved proteoform separations prior to mass spectrometric analysis, better instrumentation performance, and software development were reported (*Proteomics*, 14, 1130-1140 (2014)). Ultraviolet photodissociation (UVPD) is a compelling fragmentation technique with great potential to enhance proteomics and top-down proteomics. With the extensive sequence coverage demonstrated by UVPD, combined with a very quick fragmentation time, the authors effectively demonstrate that UVPD is indubitably a powerful tool for top-down MS with a bright future (*Proteomics*, **14**, 1128-1129 (2014)).

The 7, 9.4, and 14.5 T 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 petroleum samples.

Solvent modification with **lithium (Figure 5**) and **silver** salts can significantly extend the compositional range for analysis of petroleum components by positive-ion ESI by accessing species that lack a basic nitrogen atom and hence remain undetected by conventional (+) ESI with formic acid. Lithium cationization (+) ESI Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) of Athabasca bitumen heavy vacuum gas oil (475−500 °C) and North and South American crude oils demonstrates considerable improvement over protonation for production of ions from compounds belonging to S_xO_y (SO, SO_2, SO_3, SO_4, S_2O, S_2O_2, etc.) heteroatom classes. (*Energy Fuels,* **28**, 6841-6847 (2014).

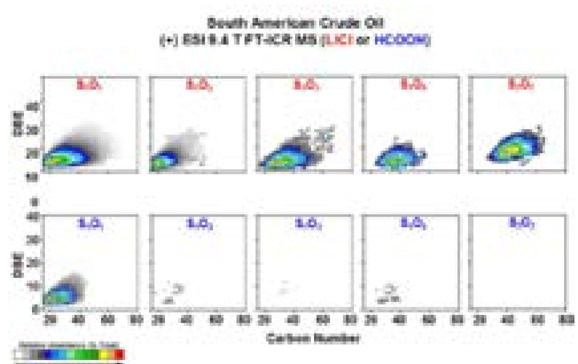

Figure 5. *Isoabundance-contoured plots of DBE versus carbon number for S_1O_1, S_1O_2, S_1O_3, S_1O_4, and S_2O_2 heteroatom classes from South American crude oil with LiCl or HCOOH as a modifier. Lithium cationization efficiently ionizes the S_xO_y classes over a wider DBE and carbon number range. S_1O_1 class compounds in the (+) ESI FT-ICR mass spectrum of the crude oil with LiCl as a*

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modifier range from DBE = 1−20 and 15−70 carbons.

Cationization with Ag+ (**Figure 6**) is essentially instantaneous and accesses hydrocarbons and nonpolar sulfur-containing heteroatom classes (e.g., S_s and S_sO_o), providing an attractive alternative to time-consuming derivatization by S-methylation to ionize sulfur-containing species. For each sample, we compare Ag+ cationization (+) ESI to conventional (+) ESI with formic acid to promote ion formation. Other ionization methods, such as chemical ionization (CI), field desorption (FD), matrix-assisted laser desorption ionization (MALDI) chemical ionization, field desorption ionization, and MALDI, are low in throughput and/or involve thermal processes that may degrade substrate molecules from non-volatile high-boiling petroleum components. Mix-and-spray Ag+ cationization avoids tedious separation and time-consuming derivatization and results in the rapid speciation of sulfur-containing compounds in petroleum and its fractions without the need for thermal desorption. (*Energy Fuels,* **28**, 447-452 (2014)).

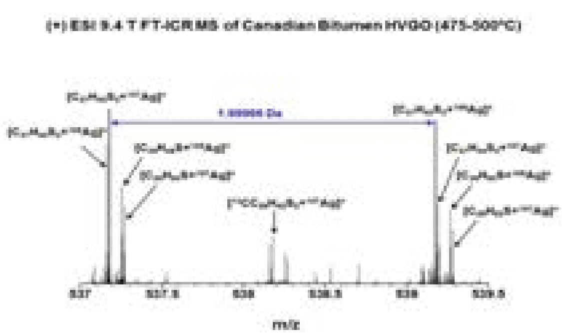

Figure 6. *Mass scale-expanded segment (537−539.5 Da) of the (+) ESI FT-ICR mass spectrum of Canadian bitumen HVGO (475−500 °C) with silver trifluoromethanesulfonate (CF_3SO_3Ag, AgOTf). The doublets corresponding to [M + ^{107}Ag]+ and [M + ^{109}Ag]+ ions are fully resolved for every silver-cationized elemental composition throughout the mass spectrum. Moreover, the distinctive isotope distribution because of the presence of silver isotopes enables further verification of elemental composition assignments. Thus, for example, although the possible mass difference of 0.074 mDa (H_5 ^{107}Ag versus C_4S_2) that requires ultrahigh resolving power (m/Δm50% > 6 800 000 at 500 Da) cannot be resolved in the broadband FT-ICR mass spectrum, detection of the corresponding H_5^{109}Ag isotopomer provides additional evidence for the correct molecular formula assignment, because the presence of the ^{109}Ag isotopic peak confirms that the (H_5 ^{107}Ag versus C_4S_2) peak derives from ^{107}Ag and not C_4S_2.*

Woody biomass has the potential to be utilized as an alternative fuel source through its pyrolytic conversion. **Fast pyrolysis bio-oils** derived from several western USA woody species are characterized by negative-ion ESI FT-ICR mass spectrometry to determine molecular-level composition. The bio-oils are comprised mainly of O_x species. Oak, mixed conifer, and scotch broom bio-oils contain lower O_x (O_1−O_7) species that exhibit bimodal distributions whereas mixed conifer feedstock from a fire salvage harvest contains a larger range of O_x species (O_2−O_{13}) that exhibit a mainly monomodal distribution (**Figure 7**, *Energy Fuels*, **28**, 6438-6446 (2014)).

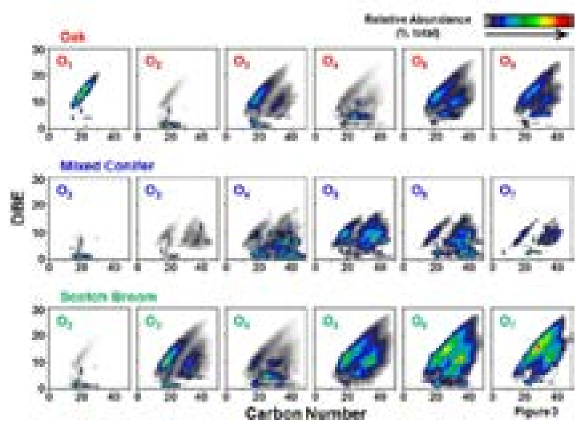

Figure 7. *Isoabundance-contoured plots of double bond equivalents (DBE) versus carbon number for oak, mixed conifer, and scotch broom bio-oils for O_2 – O_7 classes derived from negative-ion electrospray ionization FT-ICR MS. The multimodal distributions along with the similar slopes of all the O_x plots points to polymeric addition.*

Synthetically engineered copolymers are receiving growing attention for sorption and possible degradation of components in **oil sands processed water (OSPW)**. *β*-Cyclodextrin (*β*-CD) copolymers, for example, have been shown in recent studies of electrospray ionization (ESI) Fourier transform ion

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cyclotron resonance mass spectrometry (FT-ICR MS) to adsorb oil sands naphthenic acid fraction components (NAFCs) (*Energy Fuels,* **28**, 1611-1616 (2014)). APPI FT-ICR MS results reveal variable sorption for a complementary range of NAFCs with compound classes not detected by ESI. For example, sorption was observed for new classes of NAFCs: HC, N_1O_1, N_1O_2, N_1O_3, N_1O_4, N_1O_5, N_2O_1, N_2O_2, and N_2O_3, from OSPW in accordance with the nature of the cross-linker unit of the copolymer and the structure of the NAFCs (**Figure 8).**

Lignin is one of the most abundant and inexpensive natural biopolymers. It can be efficiently converted to low cost carbon fiber, monolithic structures, or powders that could be used directly in the production of anodes for lithium-ion batteries (*ACS Sustainable Chem. Eng.*, **2**, 2002-2010 (2014)). The microstructure development of

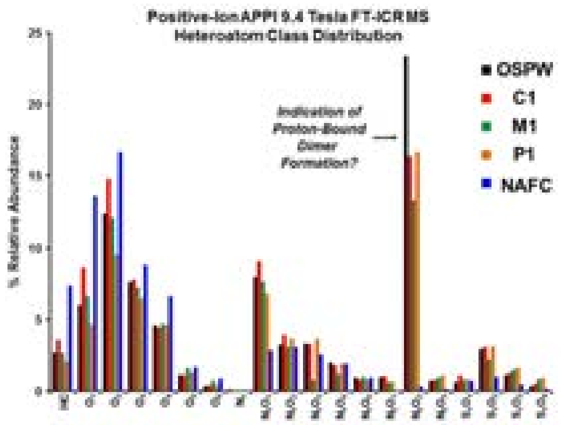

Figure 8. *The positive-ion APPI FT-ICR MS data reveal the sorption of many new compound classes not observed in earlier work: HC,* N_1O_1*,* N_1O_2*,* N_1O_3*,* N_1O_4*,* N_1O_5*,* N_2O_1*,* N_2O_2*, and* N_2O_3*. The* N_2O_2 *class could be a proton-bound dimer of* N_1O_1*, although attempts were made to minimize dimer formation by running the samples at low concentration. The levels of the* N_2O_2 *class in the NAFC are relatively low compared to the OSPW and treated OSPW, providing further indication that those components are likely proton-bound dimers.*

these carbons can be controlled through chemical modification of the lignin precursor and choice of carbonization parameters. Here, microstructured carbon materials are synthesized from lignin using a combination of chemical modification and carbon fiber processing techniques. Ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry shows the modification process does not affect the polymeric character of the lignin backbone. Esterifications result in moderate shifts in O:C and H : C ratios (**Figure 9**) (*RSC Adv.*, **4**, 4743-4753 (2014)).

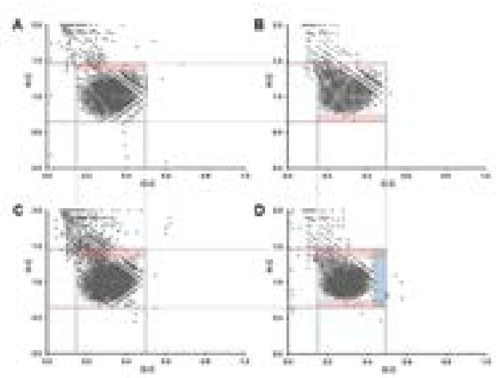

Figure 9. *Van Krevelen plots for (A) hardwood Alcell, (B) softwood Kraft, (C) phthalic anhydride modified hardwood Alcell and (D) phthalic anhydride modified softwood Kraft lignin derived from the assigned elemental composition for each peak in the mass spectra.*

Traditional tools for routine **environmental analysis** and **forensic chemistry of oil spills** have relied almost exclusively on gas chromatography-mass spectrometry (GC-MS), although many compounds in crude oil and its weathered transformation products are not amenable to GC-MS due to low volatility. Expansion of the analytical window for **oil spill characterization** provided 30,000 acidic, basic and nonpolar unique neutral elemental compositions for the Macondo well crude oil to provide an archive for future chemical analyses of the environmental impact of the 2010 *Deepwater Horizon* oil spill (*Env. Sci. Technol.,* **47**, 7530-7539 (2013)). Atmospheric pressure photoionization Fourier transform ion cyclotron resonance mass spectrometry (APPI FT-ICR MS) identified molecular transformations in oil-residue samples from the 2007 *M/V* Cosco Busan heavy fuel oil (HFO) spill (San Francisco, CA). Over 617 days, the abundance and diversity of oxygen-containing compounds increased relative to the parent HFO, likely from bio- and photodegradation. High molecular weight (HMW; > 400 Da), highly aromatic, alkylated compounds decreased in relative abundance concurrent with increased relative

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abundance of less alkylated stable aromatic structures (*Environ. Sci. Tech.*, **48**, 3760-3767 (2014)). Dealkylation trends and the overall loss of HMW species observed by FT-ICR MS has not previously been documented and is counterintuitive given losses of lower molecular weight species observed by GC (**Figure 10**). These results suggest a region of relative stability at the interface of these techniques, which provides new indicators for studying long-term weathering and identifying sources.

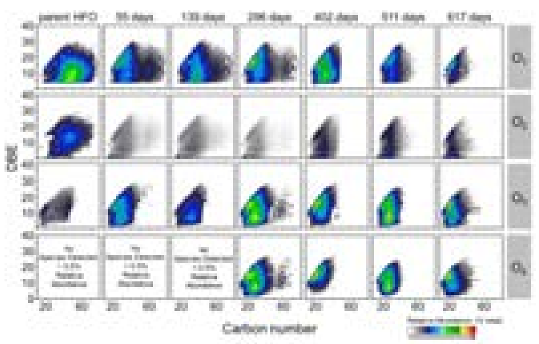

Figure 10. *Isoabundance-contoured plots of double bond equivalents (DBE) versus carbon number for the O_1 – O_4 heteroatom classes (shown on right) for the parent HFO and field samples collected from 55 to 617 days post-spill.*

Of the estimated 5 million barrels of crude oil released into the Gulf of Mexico from the Deepwater Horizon oil spill, a fraction washed ashore onto sandy beaches from Louisiana to the Florida panhandle. **Targeted petroleomics** characterized petrogenic material isolated from the Pensacola Beach sand displays greater than 2-fold higher molecular complexity than the MWO constituents, most notably in oxygenated species absent in the parent crude oil. Surprisingly, the diverse oxygenated hydrocarbons in the Pensacola Beach sediment extracts were dominant in all ionization modes investigated, (±) ESI and (±) APPI. Thus, the molecular-level information highlighted oxygenated species for subsequent "targeted" analyses (*Energy Fuels*, **28**, 4043-4050 (2014)). First, time-of-flight mass spectrometry analysis of model compounds attributes the unusually large oxygen signal magnitude from positive electrospray to ketone transformation products (O_1−O_8 classes) (**Figure 11**). Next, negative electrospray mass spectrometry reveals carboxylic acid transformation products.

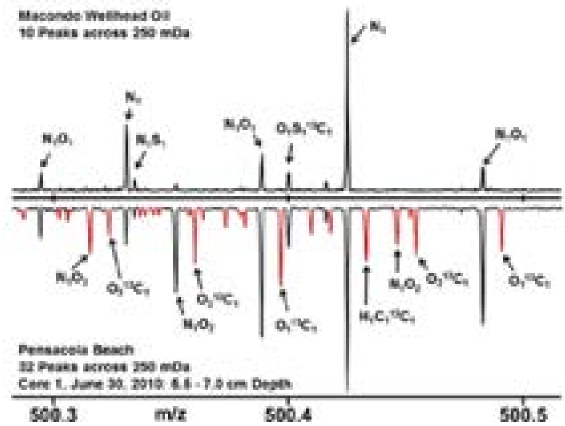

Figure 11. *Positive ESI 9.4 T FT-ICR mass scale-expanded segment at nominal m/z 500 for (top) Macondo well oil (MWO) and (bottom) June 30, 2010 Pensacola Beach contaminant (5.5−7.0 cm depth). Contaminant species not present in MWO are shown in red. Peaks detected from the Pensacola Beach sand extracts but not detected from the MWO are highlighted in red and expose the primary source of the increased complexity as oxidation.*

Endohedral metallofullerenes, which are metal-encapsulated nanoscale carbon cages, are of particular interest because of their unique properties that offer promise in biomedicine and photovoltaics. An understanding of chemical formation mechanisms is essential to achieve effective yields and targeted products. One of the most challenging endeavors is synthesis of molecular nanocarbon. Nevertheless, the mechanism of formation from metal-doped graphite has largely eluded experimental study, because harsh synthetic methods are required to obtain them (*Nat. Commun.* **5:5844**, 1-8 (2014)). **Figure 12** (right) shows molecular cage behavior and reactivity of Pr@C_{82} (I) under synthetic conditions that generate EMFs, namely at high temperature, in the presence of carbon evaporated from graphite, and at a low-pressure of He. Direct sampling of the chemical formation process is achieved by the use of a pulsed laser vaporization source analyzed by FT-ICR mass spectrometry. Pr@C_{82} (shown in blue) is unambiguously observed to undergo C_2 insertion reactions to form large and giant metallofullerenes (shown in orange) in a bottom-up formation

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mechanism. All observed product EMFs display excellent agreement with calculated isotope distributions (figure, inset). Charge transfer from the encapsulated metal to the carbon cage is found to be a determinate factor in the bottom-up mechanism shown by (figure) study of metallofullerene formation with virtually all elements of the periodic table. These results could enable production strategies that overcome problems that hinder current and future applications of metallofullerenes.

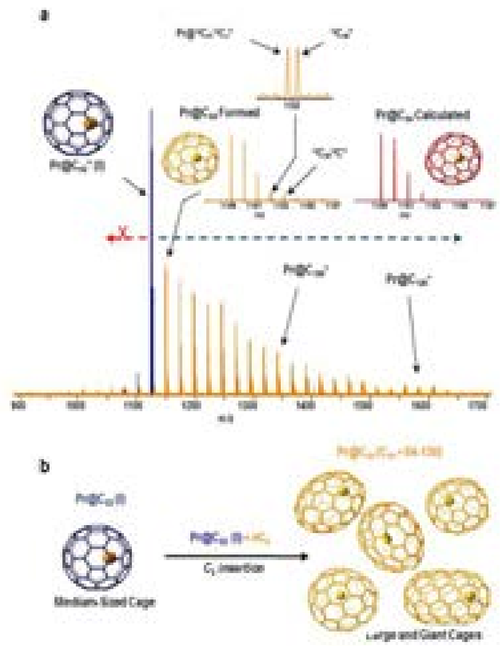

***Figure 12**. Bottom-up formation of large and giant mono-EMFs from Pr@C2v-C82. (a) FT-ICR mass spectrum of cluster cations after reaction of Pr@C82 with carbon evaporated from graphite in a low-pressure He atmosphere and (b) reaction scheme, with possible structures of the larger EMFs. The starting material is shown in blue, whereas bottom-up formation products are shown in orange.*

4. 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 in 2015.

5. Outreach to Generate New Proposals-Progress on Stem and Building User Community

The ICR program had **19** new principal investigators in 2014. The ICR program also enhanced its undergraduate research and outreach program for 4 undergraduate scientists, (one female). The ICR program in 2014 supported the attendance of research faculty, postdoctoral associates, graduate, undergraduate and high school students at numerous national conferences to present current results.

6. Facility Operations Schedule

The ICR facility operates year-round, with weekend instrument scheduled. Two shifts (8 hours each) are scheduled for each instrument year-round, including holiday shut-downs, which are utilized for routine instrument maintenance.

7. The Future Fuels Institute

The Future Fuels Institute completed its third full year in 2014, with 4 full share members ($250K each / year for 4 years) to support research thatto address challenges associated with petroleum production, processing and upgrading. In 2015, it will expand to 5 members. The Future Fuels Institute currently supports 2 fulltime Technicians and 4 fulltime Research Faculty to pursue analytical method development. For 2014 / 2015 the corporate members are: Reliance, ConocoPhillips, Total, PetroBras and EcoPetrol. Additionally, the FFI partners with 2 instrument manufacturers (Leco Instruments, Waters Instrument Company) for state-of-the-art instrumentation prior to commercial release.

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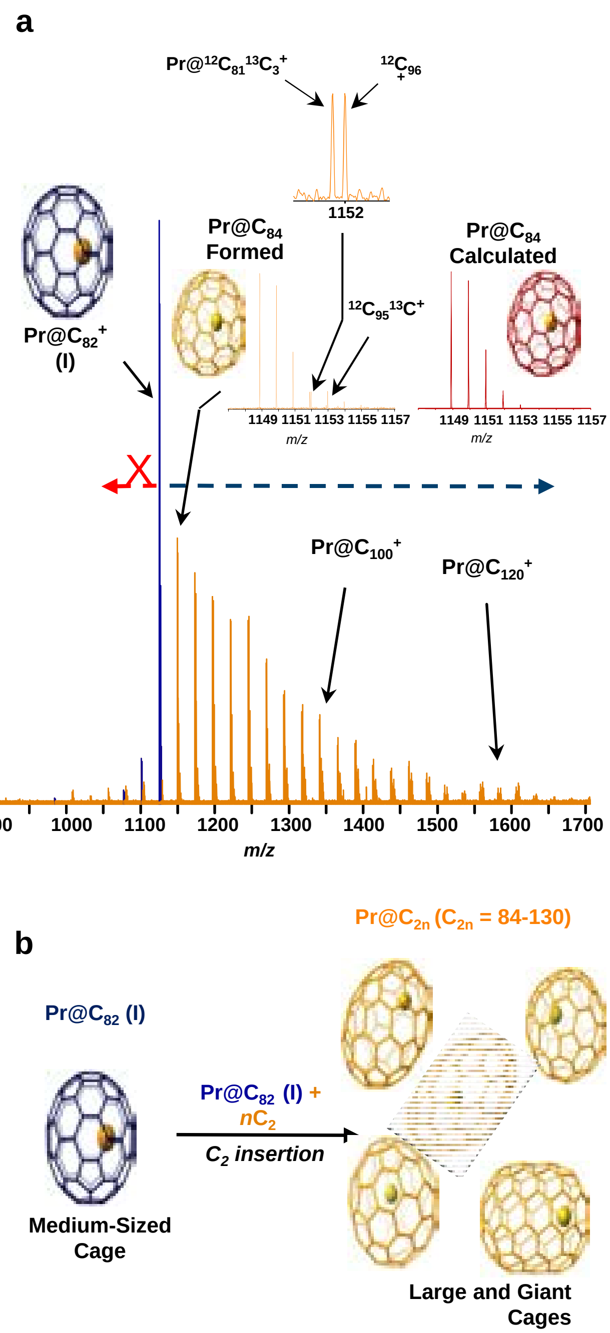
Bottom-Up Formation of Endohedral Mono-Metallofullerenes is Directed by Charge Transfer

Paul W. Dunk[1,2], Marc Mulet-Gas[3], Yusuke Nakanishi[4], Nathan K. Kaiser[2], Antonio Rodriguez-Fortea[3], Hisanori Shinohara[4], Josep M. Poblet[3], Alan G. Marshall[1,2], and Harold W. Kroto[1] [1. FSU; 2. NHMFL; 3. Universitat Rovira i Virgili (Spain); 4. Nagoya University (Japan)]

An understanding of chemical formation mechanisms is essential to achieve effective yields and targeted products. One of the most challenging endeavors is synthesis of molecular nanocarbon. Endohedral metallofullerenes, which are metal-encapsulated nanoscale carbon cages, are of particular interest because of their unique properties that offer promise in biomedicine and photovoltaics. Nevertheless, the mechanism of formation from metal-doped graphite has largely eluded experimental study, because harsh synthetic methods are required to obtain them. The figure (right) shows molecular cage behavior and reactivity of $Pr@C_{82}$ (I) under synthetic conditions that generate EMFs, namely at high temperature, in the presence of carbon evaporated from graphite, and at a low-pressure of He. Direct sampling of the chemical formation process is achieved by the use of a pulsed laser vaporization source analyzed by FT-ICR mass spectrometry. $Pr@C_{82}$ (shown in blue) is unambiguously observed to undergo C_2 insertion reactions to form large and giant metallofullerenes (shown in orange) in a bottom-up formation mechanism. All observed product EMFs display excellent agreement with calculated isotope distributions (figure, inset). Charge transfer from the encapsulated metal to the carbon cage is found to be a determinate factor in the bottom-up mechanism shown by (figure) study of metallofullerene formation with virtually all elements of the periodic table. These results could enable production strategies that overcome problems that hinder current and future applications of metallofullerenes.



Facilities: ICR Facility
Instrument/Magnet: 9.4 Tesla Actively-Shielded FT-ICR Mass Spectrometer
Citation: ***Bottom-up formation of endohedral mono-metallofullerenes is directed by charge transfer***, P.W.Dunk, M.Mulet-Gas, Y. Nakanishi, N.K. Kaiser, A. Rodriguez-Fortea., H.Shinohara, J.M.Poblet, A.G.Marshall, H.W.Kroto **Nature Commun., 5, 1-8 (2014)**

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Targeted Petroleomics: Macondo Well Oil Oxidation Products on Pensacola Beach

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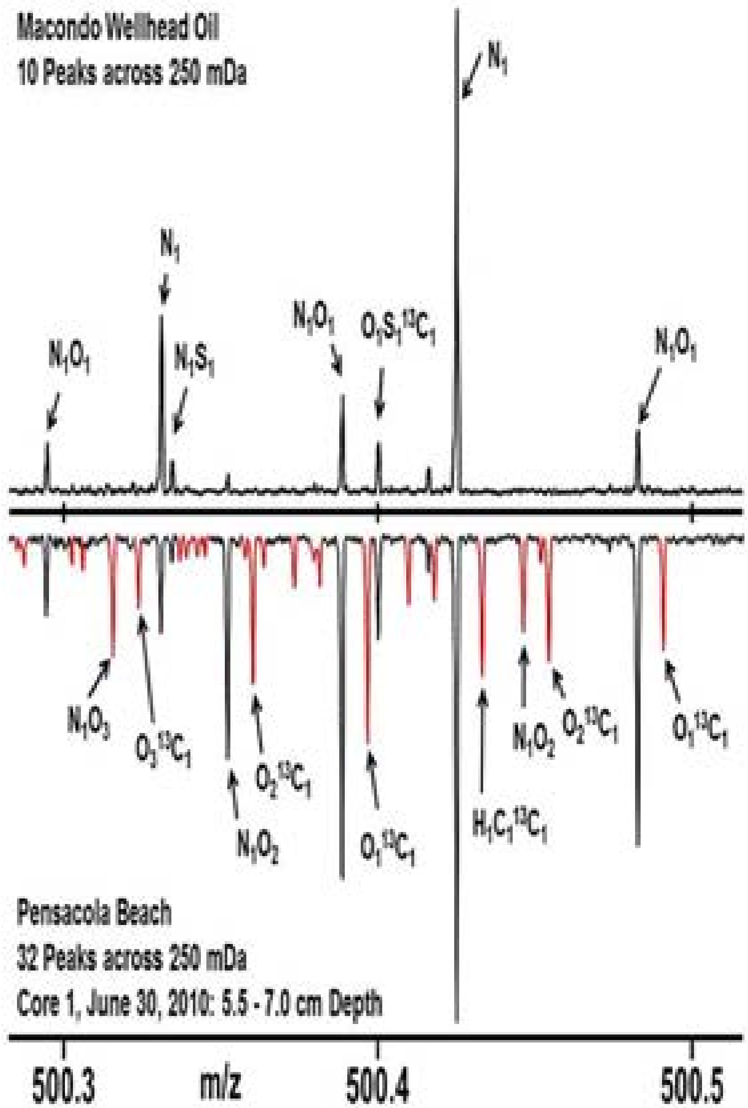
Of the estimated 5 million barrels of crude oil released into the Gulf of Mexico from the Deepwater Horizon oil spill, a fraction washed ashore onto sandy beaches from Louisiana to the Florida panhandle. Researchers at the MagLab compare the detailed molecular analysis of hydrocarbons in oiled sands from Pensacola Beach to the Macondo wellhead oil (MWO) using electrospray (ESI) and atmospheric pressure photoionization (APPI) Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS).

Material from Pensacola Beach sand displays greater than two-fold higher molecular complexity, most notably in oxygenated species absent in the parent MWO. Surprisingly, the diverse oxygenated hydrocarbons in the Pensacola Beach sediment extracts were dominant in all ionization modes investigated, (±) ESI and (±) APPI.

Precise FT-ICR MS of MWO identifies major environmental transformation products of high molecular weight (C>25) high-boiling point species, revealing the distribution of ketone, carboxylic, and higher numbered (3+) oxygen-containing products too polar to be analyzed by gas chromatography. The results expand the analysis of oxygen-containing functionalities beyond the classic naphthenic-acid-type species to complex ketone, hydroxyl, and carboxylic acid classes of molecules.



Positive-ion electrospray spectra from the 9.4 T FT-ICR magnet, mass scale-expanded at nominal mass of 500 Daltons for samples collected from (top) the Macondo well oil (MWO) and (bottom) Pensacola beach contaminant at 5.5 – 7.0 cm depth. Contaminant species not present in the fresh wellhead oil are shown in red, evidencing substantial oxidation of the MWO once released into the environment.

Facilities: ICR Facility: 9.4 Tesla FT-ICR Mass Spectrometer

Citation: ***Targeted Petroleomics: Analytical Investigation of Macondo Well Oil Oxidation Products from Pensacola Beach***, B.M. Ruddy, M. Huettel, J.E. Kostka, V.V. Lobodin, B.J. Bythell, A.M. McKenna, C. Aeppli, C.M. Reddy, R.K. Nelson, A.G. Marshall, R.P. Rodgers **Energy Fuels 28, 4043-4050 (2014)**

CHAPTER 4
Education & Outreach

CHAPTER 4 – EDUCATION & OUTREACH

1. THE CENTER FOR INTEGRATING RESEARCH AND LEARNING

In 2014, the Center for Integrating Research and Learning continued to help the Magnet Lab maintain their high quality broader impact for students of all ages and the general public. In addition, CIRL continues to evaluate our educational programs so that we can ensure that our programs are meeting our goals. CIRL expanded our K-12 outreach to Magnet Lab staff and representatives at our facilities at University of Florida and Los Alamos National Laboratory. For the first time, we had an RET conduct research at the University of Florida. Our new hire, has worked closely with postdoctoral associates (postdocs) at all three sites to ensure their professional development and mentoring needs are being met. In 2014, the Magnet Lab's Public Affairs team worked extensively on creating a new Magnet Lab website. The Education piece of this website is called Magnet Academy and has been updated with the help of CIRL, PA, and Magnet Lab scientists. As always, our programs and the work that we do is part of our mission to expand scientific literacy and to encourage interest in and the pursuit of scientific studies among educators and students of all ages has become more specifically targeted to encourage students – particularly students from underrepresented groups – to pursue STEM career paths. We also maintain a strong research agenda that keeps us at the forefront of knowledge related to educational outreach and informal education so that the Magnet Lab can maintain its commitment to broader impacts.

SciGirls Alumni volunteering in the MagLab Junior Section of the 2014 Open House

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K-12 STUDENTS

On-Site and Classroom Outreach conducted through CIRL

CIRL staff and Magnet Lab scientists conduct outreach in local schools each year. We record this outreach during the school year as opposed to the calendar year. During the 2013-2014 school year CIRL's Outreach Coordinator, Carlos Villa, provided outreach to over 4,000 students from school districts in Northern Florida and Southwest Georgia. More than a third (70.59%) of the schools reached through our outreach programs are Title I schools. The outreach staff offered 11 types of programs to all three educational levels. The top three outlets from which teachers learned about our programs included colleague communication (39.13%), magnet lab website (30.8%), and magnet lab staff (23.91%).

Table 1: *Details on CIRL Outreach*

Type of Outreach	Total Occurrences	Number of Schools or Organizations Served	Number of Students Served
K-12 Classroom Outreach	**56**	**36**	**4,540**
K-12 On-Site Outreach	**18**	**16**	**570**
K-12 Tour Only	**14**	**11**	**349**
Nights and Weekends Outreach	**8**	**2**	**-**

Outreach Coordinator Carlos Villa at the Open House

Beginning in 2012, Carlos Villa worked with graduate students in the University of Florida AMRIS program to help them learn how to use the Magnet Lab outreach kits. This project has continued since then, led by graduate student, Annaliese Thuijs. In 2014, UF graduate students conducted outreach in

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three schools and conducted a community outreach day at the local mall with the kits provided by the Magnet Lab.

As part of the NSF's recommendation to make the outreach efforts across all three Magnet Lab locations more synergistic, CIRL's outreach coordinator, Carlos Villa, has worked closely with Janelle Vigil-Maestas from the Community Programs Office (CPO) at LANL. The CPO handles outreach and classroom visits at LANL, including Science on Wheels. Before 2014, they did not have a magnet related activity. After discussing the best option to add to their selection, Carlos agreed to send a set of Magnet Exploration activities, and a complete lesson plan for that activity. It will consist of 30 kits to use with individual K-12 classrooms. These materials will be available for LANL staff to take to classroom visits, and also for teachers to borrow for use in their schools. The package will be sent to LANL in 2015 and will be available for outreach in early 2015.

Middle School Mentorship

For the second year the NHMFL Middle School Mentorship Program was offered to students from all Middle schools in Leon County. In 2014, 11 students participated in the program with five Magnet Lab scientists serving as mentors: Lloyd Engel, David Hilton, Amy McKenna, Hans VanTol, and Yang Wang. The students worked with their mentors over an entire semester. The program culminates in a presentation by each group to an audience of their family, teachers, principals, and mentors. This year's class had 6 female students participate and three students from Title I schools. This program is directed by Carlos Villa.

2014 Middle School Mentor Participants with Carlos Villa.

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Summer Programs

CIRL's busiest time of year is the summer. In 2014 we housed three middle school summer camps (ERC-FREEDM Summer Camp, MagLab Summer Camp, and SciGirls) and the ERC-FREEDM Young Scholars program for high school students.

ERC-FREEDM

CIRL Director, Roxanne Hughes served as the pre-college director for the ERC-FREEDM program at FSU-FAMU. Graduate student, *Smriti Jangra* facilitated the programs. The ERC Renewable Energy camp ran for one-week and had 13 students attend. Of the attendees, all were from Title I schools, 46% were female, and 31% were African American. The ERC Young Scholars program is a 5-week program for high school students. The 2014 program had seven students participate, 43% were female and 43% were African American.

MagLab Summer Camp

The MagLab Summer Camp was held for its fourth year. This camp runs for two one-week sessions. There were 32 students who participated in the program. This camp is run by Carlos Villa. In 2014, 25% of the campers were female, 6% of the campers were African American, and 6% were Hispanic. Highlights from the 2014 camp were the Robotic World Cup games.

2014 MagLab Summer Camp Participants Playing their Robotic World Cup Game

SciGirls Summer Camp

The SciGirls Summer camp has been in existence for 9 years. This program is based on a partnership between the Magnet Lab and our local public television station, WFSU. The program is closely associated with the SciGirls Connect program, an NSF funded national SciGirls Program associated with Minnesota Public Television. The camp includes two two-week camps for middle school girls. In 2014, 36 girls participated, 14% of whom were African American and 3% were Hispanic. The highlight of this year's camp was the chemistry presentation by Amy McKenna and the panel discussion that included Magnet Lab postdoc, Huan Chen.

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2014 SciGirls Camp participants

K-12 TEACHER

Leon County Schools Workshop

In 2014, the Leon County Schools district was awarded an AT&T grant to develop a STEM Bowl Challenge in all of the districts' elementary schools. CIRL staff members, Jose Sanchez and Carlos Villa, worked closely with the PI on the grant and the elementary teachers. The program began with a workshop in January 2014. CIRL staff facilitated a workshop that helped teachers understand how to incorporate engineering concepts and problem-solving activities in their classrooms and clubs. Then throughout the semester, CIRL staff visited each elementary school's STEM Bowl club to help the teachers and students develop, plan, and test their skills. The program culminated in a STEM Bowl Challenge (a hydro-turbine design challenge) that involved over 19 schools and 25 teachers. The teachers credited the success of the STEM challenge to CIRL's dedication to the project. This partnership is further evidence of CIRL and the Magnet Lab's commitment to education in Leon County.

Teachers participating in a CIRL Workshop in 2014

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Research Experiences for Teachers (RET)

The Magnet Lab RET program has been in existence since 1998. In 2014, ten teachers from the United States participated in the program and two teachers from Israel spent four weeks with the program. The RET program is a 6-week program wherein teachers are paired with scientist mentors. In 2014, of the 10 U.S. teachers, 80% came from Title I schools, 40% were African American, 30% were Hispanic, and 60% were male. For the first time, we were able to place one of our RET's with a Magnet Lab faculty member at UF (Art Edison). This pairing has resulted in a partnership between the RET and Dr. Edison which resulted in an ongoing partnership between Dr. Edison and the teacher and his students. The two teachers from Israel were sponsored by the local synagogue and provided an international perspective on education for all participants. All of the domestic participants indicated that they gained a greater understanding of STEM research and its applications to their daily lives.

2014 RET Participants working on a Classroom Laboratory Activity

MagLab Educators Club

The MagLab Educators Club is an email list that CIRL utilizes to send information about Magnet Lab community events, outreach, programs, and other exciting opportunities at the lab. We have over 300 members, providing further evidence of the interest of educators in Magnet Lab programs.

Magnet Academy – For Teachers

The Magnet Academy is the outreach portion of the Magnet Lab's website. This site has a page that focuses on teachers (https://nationalmaglab.org/education-magnet-academy/teachers).
This page provides lesson plans, science demonstrations, and interactive activities for teachers of students of all ages.

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OUTREACH TO THE NATIONAL STEM COMMUNITY AND MEMBERS OF THE PUBLIC

In collaboration with Public Affairs, the Magnet Lab also expanded its outreach efforts to the public in 2014. The Public Affairs team, under the direction of Kristin Roberts, uses a wide variety of communications tools to share scientific news with the Magnet Lab's diverse audiences.

Anniversary Campaign:

In October 2014, the Magnet Lab celebrated two decades of cutting-edge science with the launch of "Moving Science Forward," a yearlong celebration that includes a new visual identity and a reinvigorated commitment to its mission of pioneering science. To kick off the "Moving Science Forward" campaign, a new video was created and posted on our YouTube page which combined footage from the lab's original dedication event in 1994 with visuals from the lab's newest research areas. This video now has over 450 views on YouTube. The lab also released a new, modernized visual identity in October 2014. The lab's new look was created by Graphic Artist Caroline McNiel and symbolizes the scientific concept of magnetization, or what happens to a material inside a magnet. A new color palette to connect with the new logo features purple and red and was inspired by the electromagnetic spectrum of light.

The new logo

Throughout the 2014 fall semester, the Magnet Lab engaged in a creative collaboration with Florida State University's College of Fine Arts to design hands-on science exhibits and a fresh look for the lab's public spaces. M.K. Haley — a Disney Imagineer who is an expert in themed exhibit design and the Entrepreneur in Residence at the FSU College of Fine Arts — led the project with a class titled "Interaction and Advocacy for the National High Magnetic Field Laboratory." Her students focused on creating interactive experiences that emphasize the creativity of research and the groundbreaking projects occurring at the lab. In addition to Haley's class, students from the Department of Interior Design also worked with the lab to present ideas for a space that represents the caliber of research occurring at the Magnet Lab. In October 2014, over 120 students participated in a weeklong design charrette. Students were divided into five-member teams. Director Gregory Boebinger gave an overview presentation about the Magnet Lab and the goals for the project. Students were then given a tour of the facility and the opportunity to meet with scientific, infrastructure and educational experts. At the end of the week, the students brought 26 fully developed design boards to hang in the Magnet Lab lobby. Magnet Lab personnel had the opportunity to vote on their favorite posters.

Students from the College of Fine Arts at the 2014 Charrette

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Students from the Interior Design program displaying their Plans

Website:

The Magnet Lab's website, overseen by Web Content Director Kristen Coyne and Webmaster Nilubon Tabtimtong, is a critical tool for communicating important information about the lab to a variety of audiences, including: scientists, teachers/students, and the general public. Throughout 2014, the Magnet Lab public affairs team worked extensively with colleagues across the lab to design and build a new website that offers more science content, a revamped education section, and a modern, mobile-friendly look that showcases the lab's instruments, research output, and expertise. The new website integrates the lab's new logo and branding. The URL was updated to nationalmaglab.org. A key goal of the new site is to attract new users. The website overhaul was guided by a steering committee that included several scientists. Ideas and feedback from facility directors and other scientists were collected on an ongoing basis and resulted in some of the site's best enhancements. The Magnet Lab User Committee was given a pre-launch "sneak peak" of the nearly completed site in October 2014.

Important new content and features for scientists include:

- Dozens of new pages on measurement techniques available to users
- Details on new magnet projects
- Monthly science highlights that promote the most exciting new research at the lab
- Updates on high-profile publications generated by Magnet Lab research
- Search functions for finding the magnets and measurement techniques
- Easy access to experiment schedules and to the system for submitting proposals
- A clean, modern design featuring more photos, image galleries and lab panoramas
- A calendar to keep you up to date on Magnet Lab events and deadlines
- Better integration with the Magnet Lab's growing social media accounts
- More stories for lay readers on the lab's people, research and tools

Magnet Academy, the educational section of the new website, is designed for teachers and students. It has information on electricity and magnetism in a variety of formats including updated interactive tutorials, videos, lesson plans, and articles. Public Affairs and CIRL worked throughout 2014 to categorize this content by topic, age, and grade.

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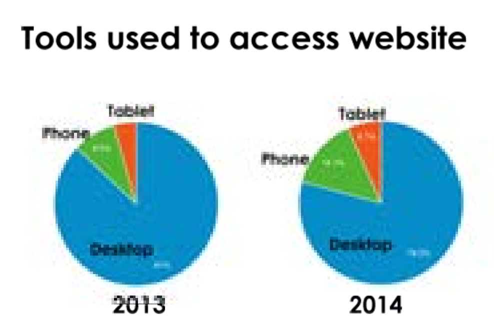
The new format for Magnet Academy

Web Trends from 2014:

In 2014 there were over 706,000 website sessions and 556,000 users of the webpage. As in previous years, the site's significant educational content draw's the most visitors – about 62% of all page views in 2014. Public affairs staff added important new content to the site in 2014, including 30 press releases and a new regular feature called "Mentoring Moments," in which scientists, teachers and students share their stories about mentorship at the lab. Although more than half of all sessions occurred in the U.S., the impact of the site is truly global, with sessions in nearly every country. Visits from Spain shot up 35% over 2013 numbers, perhaps in part due to Spanish-language content recently added to the site. The website saw increasing traffic from social media platforms. Sessions originating from Facebook, Twitter and similar tools increased more than 350% between 2013 and 2014, an upswing largely attributable to the Magnet Lab's growing use of social media tools. Finally, it is not surprising that an increasing number of visitors use their phones and tablets to come to our site, as seen in the charts below. Phone and tablet users made up 13% of site visits in 2013, compared to 21% in 2014.



The lab's new mobile-friendly website will make visits much easier and more enjoyable for non-desktop users.

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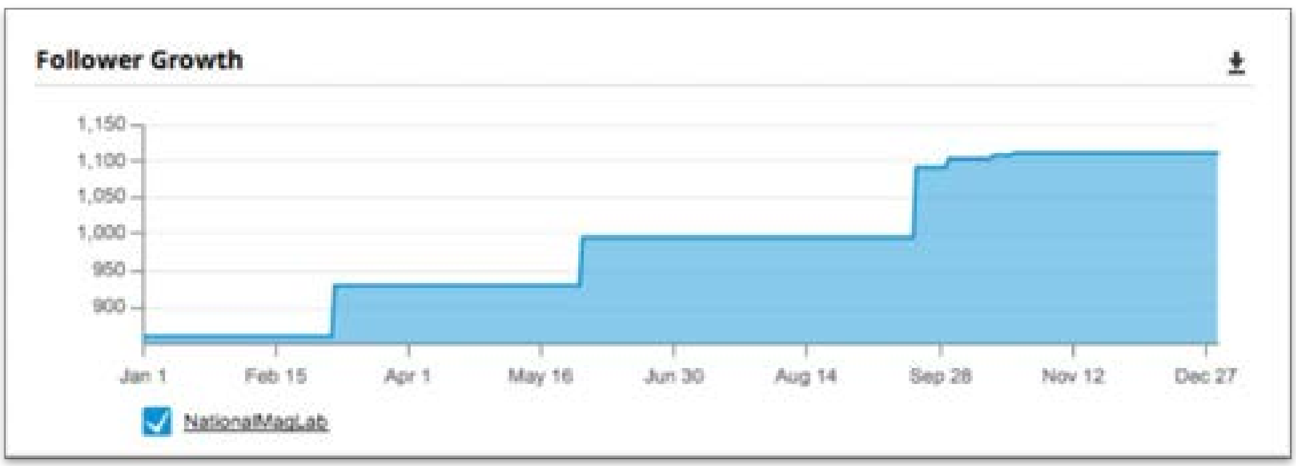
Social Media:

In 2014, the Magnet Lab's online presence was larger than just the website. Through social media networks, the Magnet Lab expanded its reach to public audiences with daily information on these networks.

Both our Facebook fan page and Twitter accounts saw a 106% growth from January to December. Facebook has an international audience with fans from 45 countries including Brazil, Egypt, India, South Africa, Mexico and the United Kingdom.

Facebook fan growth over 2014: From 586 to 1208.



Twitter follower growth over 2014: From 557 to 1150.

The Magnet Lab has had an active YouTube page since 2008. This channel now has over 560 subscribers with 77 new subscriptions in 2014. There are over 1 million lifetime views from around the world with 77,600 from 2014 alone. New video content was added in 2014, including

- Science Café: Chemistry of an Oil Spill (451 views)
- Science Café: Extreme Weather (91 views)
- Science Café: The Quest for Absolute Zero (116 views)
- Science Café: A Decade as Director (99 views)
- The Split Helix Magnet (1476 views)
- Celebrating Magnet Lab History: Moving Science Forward (459 views)

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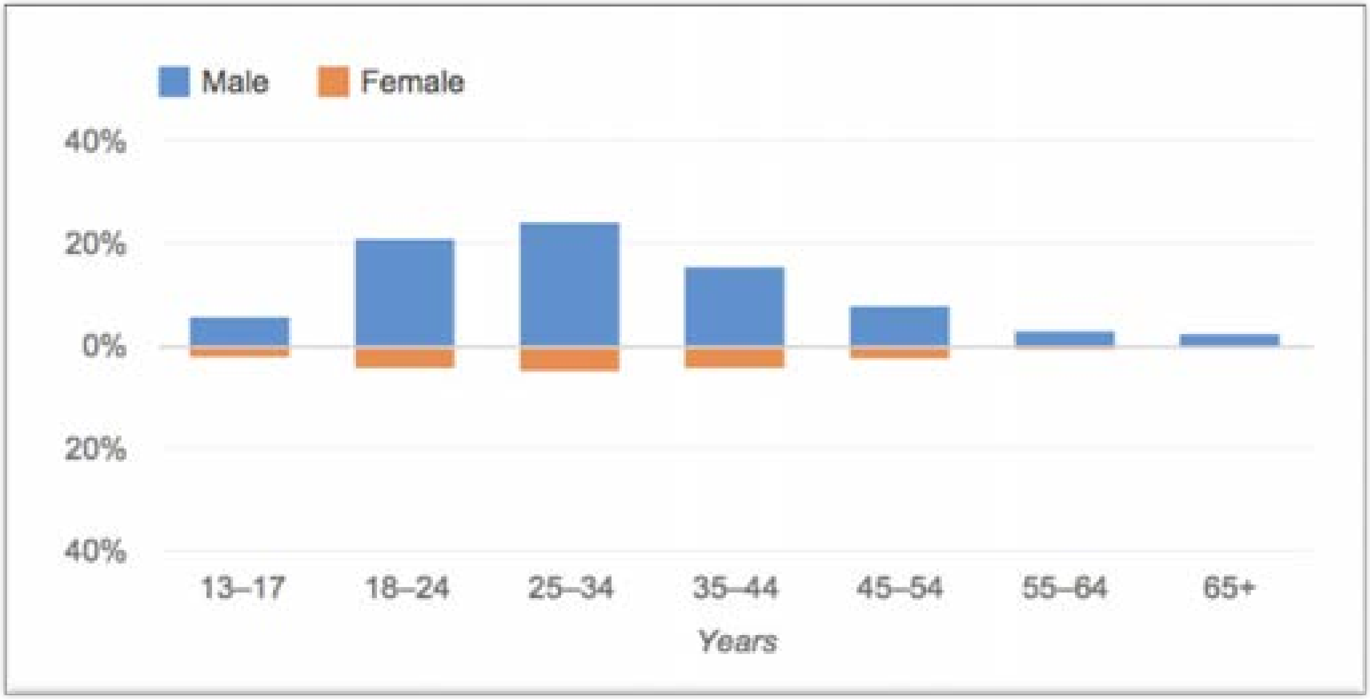

YouTube visitor distribution by age range and gender.

Science Café

The Magnet Lab's Science Café series continued in Spring 2014 with an average of 40-70 guests to each Café. The Spring Cafés were also video recorded, posted on the Magnet Lab's YouTube channel, and shared via social media, allowing this local series to have a broader impact than just the Tallahassee geographic area. In fall of 2014, Science Café transitioned from a monthly speaker series to a seasonal series and a café was held in September.

Science Café Presentations in 2014

Date	Topic	Speaker	Number of attendees/views online
February 4, 2014	The Nature of oil and the BP spill: The Good, the Bad and The Ugly	Amy McKenna, Research Faculty in Ion Cyclotron Resonance	100 attendees 451 views
March 4, 2014	Extreme Weather	Jeff Evans, National Weather Service Forecaster	45 attendees 91 views
April 1, 2014	A Decade as Director	Greg Boebinger, Magnet Lab Director	50 attendees 99 views
May 6, 2014	The Quest for Absolute Zero	Tim Murphy, Director of DC Field User Facility	90 attendees 116 views
September 30, 2014	The Quantum World	Winston Roberts, FSU professor in theoretical physics	75 attendees

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Open House

Every February, the Magnet Lab invites the public to spend the day at our world-class research laboratory, and in 2014, nearly 6,000 people attended. The free event transforms our 370,000 square foot lab into an interactive science playground featuring more than 80 hands-on demonstrations, self-guided tours, food, and the chance to meet and chat with Magnet Lab scientists. Open House visitors brought over 2,500 pounds of canned food to be donated to Second Harvest, a community food bank in the Big Bend area.

Open House 2014

Tours

The Magnet Lab, led by Public Affairs, holds monthly Public Tours on the third Wednesday of each month at 11:30 am. In addition, all Magnet Lab personnel with proper safety training are welcome to provide tours to students, families, and general members of the public. Each year CIRL holds a Magnet Lab tour training for interested Magnet Lab personnel with an actual walk through of the lab for new tour guides interested in providing outreach. In 2014, 897 people (outside of our K-12 student tours) received a tour of the lab.

Presentations in 2014

In addition to these many forms of outreach, CIRL staff also present at conference for teachers and the general public to inform them about the research conducted at the NHMFL. The 2014 educational outreach presentations included:

- C. Villa (April 2014). Magnets Are What We Do. Increasing Content Knowledge on Magnetism and Integrating Inquiry with Hands-on Activities. Presentation at the National Science Teachers Association (NSTA) Annual Conference, Boston, MA.
- C. Villa (April 2014). Tesla Tales. A Journey through Electromagnetic Discovery. Presentation at the National Science Teachers Association (NSTA) Annual Conference, Boston, MA.
- B. Nzekwe, J. Sanchez, and C. Villa (April 2014). National High Magnetic Field Laboratory Exhibitor Booth. USA Science and Engineering Festival, Washington, DC.
- C. Villa (May 2014) Magnets Are What We Do. Increasing Content Knowledge on Magnetism and Integrating Inquiry with Hands-on Activities. Presentation at the Florida Center for Research (FCR) STEM Conference, Fort Lauderdale, FL.
- C. Villa (May 2014) Tesla Tales. A Journey through Electromagnetic Discovery. Presentation at the Florida Center for Research (FCR) STEM Conference, Fort Lauderdale, FL.
- C. Villa (November 2014). Magnets Are What We Do. Increasing Content Knowledge on Magnetism and Integrating Inquiry with Hands-on Activities. Presentation at the National Science Teachers Association (NSTA) Regional Conference, Orlando, FL.

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CIRL staff members, Brandon Nzekwe and Jose Sanchez, at the National Science and Engineering Expo in Washington, DC.

UNDERGRADUATE, GRADUATE, AND POSTDOCS

Magnet Lab Internship Program (For students 17 years or older)

The Magnet Lab Internship program is facilitated by *Jose Sanchez*. The program runs on a semester basis. The fall and spring semester students volunteer, however, during the summer, students are paid for their internship work. This program provides stellar high school students with an interest in research to work with a scientist at the lab. It also provides undergraduates who may not have the research and course experience for acceptance into an REU program with the opportunity to gain that experience. In 2014, 30 high school and college students participated in this program, of these: 27% were female, 3% were African American, 10% were Hispanic, and 3% were Native American.

Undergraduate – Research Experiences for Undergraduates (REU)

The Magnet Lab's REU program has been facilitated by CIRL since 1999. Since then more than 300 students have participated. This program is one of CIRL's finest in its historical quality and demonstration of the commitment of the Magnet Lab to mentoring early career scientists. The director of the REU program is *Jose Sanchez*. Each year he is committed to diversity in his recruitment of undergraduates to apply to the REU program, visiting Minority serving institutions and speaking to minority serving organizations at colleges and universities. In 2014, 29 undergraduates participated in the REU program at all three Magnet Lab sites, of these students: 41% were female, 28% were African American, 23% were Hispanic, and 17% came from Minority Serving Institutions.

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Graduate Students and Postdocs Professional Development

In 2014, Kari Roberts was hired as the Postdoc Liaison and Evaluation Coordinator for the lab. She works closely with Postdocs to ensure that their mentoring and professional development needs are being met. The professional development opportunities that she organizes are also open to graduate students and any other Magnet Lab staff. In 2014 these professional development opportunities included:

A 2014 REU working with her research team

Session Topic	Date	Presenter	Attendance (Postdocs)
Preparing For Faculty Positions	January 2014	Eric Hellstrom, NHMFL	9(6)
Resume Writing	January 2014	Janet Lenz, FSU Career Center	7(1)
Teaching at the Graduate and Undergraduate Level	February 2014	Roxanne Hughes, NHMFL	1(1)
Writing an Academic Cover Letter	March 2014	Janet Lenz, FSU Career Center	9(3)
Preparing for Interviews	April 2014	Elizabeth Barwick, FSU Career Center	9(3)
Career Advice from Magnet Lab Scientists	*June 2014	Amy McKenna, Chiara Tarantini, and Ryan Baumbach, NHMFL	5(2)
Mentoring Advice	July 2014	Alan Marshall, NHMFL	11(8)
Designing Better Poster Presentations	August 2014	Caroline McNiel, NHMFL	10(5)
Developing your CV	September 2014	Casey Dozier, FSU Career Center	3(1)
Writing an Academic Cover Letter	October 2014	Janet Lenz, FSU Career Center	4(4)
Elevator Speeches	October 2014	Kari Roberts, NHMFL	8(3)
Research Proposal Development	November 2014	Emily Hutcheson, FSU Office of Proposal Development	8(3)
Applying for Startup Funds	December 2014	Micah Widen and Lucas Lindsey, DOMI Ventures	2(1)

**No formal events were held in May because of the Magnet Lab Summer School which takes up a week of the postdocs' and graduate students' time.*

In addition to these live sessions, postdocs also have access to recorded sessions on many of these topics online, which allows postdocs to revisit these topics at their leisure and as often as they find necessary.

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After each talk, attendees are given the opportunity to give feedback to the presenter. Attendance at these seminars ranges from 5-15 people. These seminars are typically held once a month.

Postdocs attending a 2014 Professional Development Session

Postdoc Seminars

Another available resource to postdocs at the lab is the Postdoc Seminar Series. This series provides postdocs with the opportunity to present, but the seminar itself is open to anyone at the Magnet Lab. This seminar series is designed to give postdocs the chance to perfect their presentation skills to a wider audience who may not be familiar with their research and to network with colleagues at the lab. Postdocs will often use these seminars as a chance to practice for upcoming conference presentations and job talks.

Evaluation of Postdoctoral Mentoring

Starting in August 2014, a post-session survey was given to attendees giving them an opportunity to provide immediate feedback on the session as well as share what other topics they would like to see covered through the Magnet Lab professional development sessions. This survey has 7 responses so far, and 100% of respondents indicated that they were satisfied with the session they attended and that the topics covered were relevant to their current position at the lab. Additionally, respondents said they were interested in the following topics:

Topic	**% Interested**
Presentation Skills	71%
Writing and Publication	71%
Career Preparation	100%
Research Ethics	57%
Mentoring	85%
Scientific Management	71%
Teaching	42%

Annual Survey to Postdocs and Graduate Students

The 2014 postdoc annual survey was sent out on November 5, 2014. At this time, there were 50 postdocs employed at all three sites. Five reminder emails spanning the course of three months were sent only to those who had not completed the survey. Of the 50 postdocs, 40 opened the email regarding the survey, and of those 40, 33 took the survey. Two respondents did not give permission to use their information for reporting purposes, bringing the response rate to 31 (62%). The survey asked postdocs about their interests in professional development topics as well as their satisfaction with the mentoring they received as well as their experience overall.

The demographics of the respondents overall resembles the demographics of the total postdoc population at the Magnet Lab. The survey also allowed us to collect new demographics on postdocs that are unavailable through other lab systems (e.g. year postdoc received PhD and length of postdoc position).

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Race and Ethnicity

Race/Ethnicity	Number	Percentage (N= 31)
Hispanic or Latino/a	1	3.2%
Asian	16	51.6%
Black/African American	0	0.0%
American Indian or Alaska Native	1	3.2%
White/Caucasian	14	45.2%
Other	2	6.4%

Gender

Male	Female
19 (61%)	12 (39%)

Year Respondent Received Ph.D.

Year	Number	Percentage (N= 32)
2006	1	3.2%
2007	1	3.2%
2008	1	3.2%
2009	2	6.5%
2010	4	12.9%
2011	3	9.7%
2012	8	25.8%
2013	8	25.8%
2014	2	6.5%
2015	1	3.2%

Citizenship Status

US Citizen or Permanent Resident	Visa Holder
10 (32%)	21 (68%)

Length of Postdoc Position

Duration	Number	Percentage (N= 27)
<2 years	6	22.2%
2 years	9	33.3%
3 years	10	37.1%
>3 years	2	7.4%

Professional Development Interests and Availability

Postdocs were surveyed to assess their interest in professional development topics as well as a general sense of their ideal career path. A large majority (69%) expressed that they would like to take an academic position after their current position. 13.8% indicated that they would like to pursue a career in industry next, and another 13.8% said they planned to take another postdoc position. 3.4% (n=1) responded “other” and in the comments section said they would like to work for a national lab.

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Interest in Professional Development Topics (1= Not Interested, 5=Very Interested)

Topic	Mean	Percent "interested" or "very interested"
Presentation Skills	4.07	67.7%
Writing and Publication	4.15	81.4%
CV's/Resumes	4.00	77.7%
Job Interviews	4.14	82.1%
Negotiating Job Offers	4.07	78.6%
Research Ethics	3.57	57.2%
Mentoring	3.89	71.4%
Scientific/Project Management	4.21	89.3%
Teaching	3.82	75.0%

The topics included in the survey (listed above) were selected based on the 7 competencies outlined for postdoctoral professional development by the National Postdoctoral Association. The three most popular topics were Scientific/Project Management, Writing and Publication, and Job Interviews. In order to accommodate the varying schedules of postdocs, sessions are recorded for later viewing, with the permission of the presenter.

NHMFL Postdoc working with Students from the College of Visual Arts during the Design Charrette

In 2014, Florida State University held its annual Postdoc Appreciation week which culminates in a poster presentation by postdocs from all departments on campus and the NHMFL. During the program, Peter Morton, Nihar Pradhan, and Huan Chen received the Postdoctoral Scholars Career Development Travel Award, and Peter Morton and Shengyu Wang won awards for their posters at the symposium.

CIRL helps to facilitate the postdoc mentoring plan **(Appendix IV)** for the lab through professional development programs and the work of our Postdoc Liaison, Kari Roberts who meets with postdocs regularly to assess their mentoring needs and is currently organizing a Postdoc Advisory Committee. The goal of this committee is to have a postdoc representative from each Magnet Lab facilities serve as a source of feedback and advice on ways to serve postdocs across all three sites. This committee will formally meet in 2015.

NHMFL SCIENTISTS' AND STAFFS' COMMITTMENT TO OUTREACH

NHMFL Personnel Outreach

CIRL is only one piece of the NHMFL's outreach, without the scientists and staff at the lab, there would be no role models to motivate students to pursue STEM and to inform the community about the NHMFL's commitment to materials, energy, and life. In 2014, 74 NHMFL scientists and staff members reported doing at least one type of outreach in the community. The outreach conducted by these scientists reached more than 2,000 people. Outreach conducted by NHMFL staff reached a wide range of ages, from elementary school students to senior scientists. The most common outreach group was the general public and undergraduate students, which accounted for about 31% and 29%, respectively, of the total outreach audience.

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In 2014, 53 scientists participated in long term commitment outreach efforts, reaching a total of 109 individual students. 78% of reported long-term outreach occurred through a program coordinated by CIRL. In fall 2014, these scientists mentored: 11 middle school mentorship students, and 6 interns. In spring and summer 2014, these scientists mentored: 12 RETs, 29 REUs, and 27 interns.

Table 2: *Long-Term Outreach Efforts by NHMFL Facilities*

	Spring 2014						Fall 2014			
Department (# of Scientists)	REU	RET	Spring Internship	Summer Internship	Mentored Undergraduate	Mentored K-12 Student	Fall Mentor-ship	Fall Intern-ship	Mentored Under-graduate	Mentored K12 Student
ASC (2)	2	1								
NMR (6)	6	2	1	3						
CMS (17)	11	2	3	2		1	5	3	5	4
Other* (4)				3				1		
DC (1)				2						
Geochemistry (4)	2	2	1	2			2			
ICR (3)	2			2			2			
LANL										
MST (12)	2	4	2	6	11	1	2	2	1	
UF (3)	4	1								

**Director's Office, Public Affairs, Optical Microscopy*

Table 3: *Short-Term Outreach by NHMFL Facilities (e.g. tours, K-12 classroom visits, presentations, etc.)*

	Tour of Magnet Lab Facility		**Presentation**		**Visit K-12 classroom**		**Judged Science Fair**	
Department	Number of Scientists	Number of people reached	Number of Scientists	Number of people reached	Number of Scientists	Number of people reached	Number of Scientists	Number of people reached
ICR	2	40	2	135	2	138	1	100
NMR			1	100				
CMS	5	41	6	187	1	130		
LANL								
UF	3	81	2	40				
MS&T			2	380	2	100	1	75
DC	2	19	2	258				
Geochem			2	65				
TOTAL	**12**	**181**	**16**	**1,165**	**6**	**368**	**2**	**175**

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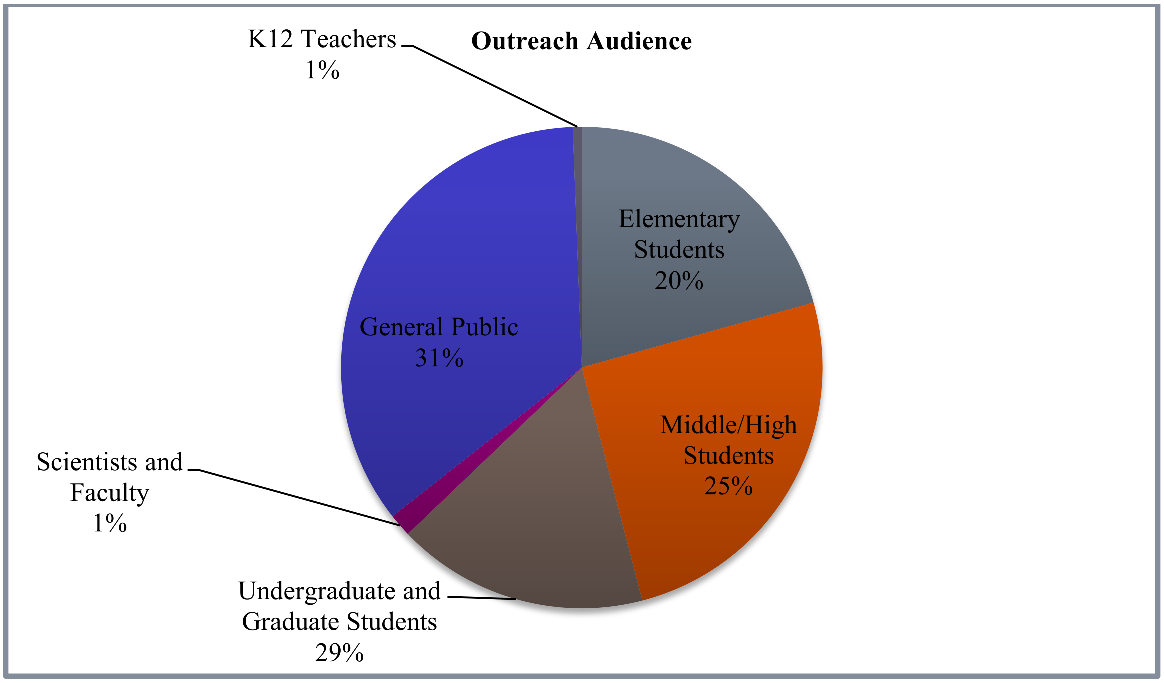

Figure 1: *Audiences Reached by NHMFL Personnel Outreach Efforts in 2014*

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Scientists and staff conducting outreach at the lab

RESEARCH AND EVALUATION

Evaluation

Kari Roberts joined CIRL in May of 2014. She is now conducting all evaluation for our programs. She provides the evaluation and research statistical expertise that will maintain the quality of CIRL's evaluation efforts. A list of our evaluation efforts can be found in the table below.

Outreach	Form of Evaluation
Classroom outreach	Post-survey to teachers after outreach conducted (formative assessment)
RET/REU/Summer Camps/Middle School Mentorship	Pre-/post-survey measuring attitudes toward STEM careers, perceptions of STEM careers, and self-efficacy in STEM (for teachers in teaching STEM) Annual tracking of past participants to determine persistence over time
Graduate Student/Postdoc Professional Development	Annual survey to current postdocs to determine professional development needs and assess mentoring, post-session surveys after each professional development event, annual tracking of graduate students and postdocs to determine career trajectories, and starting in 2015, entrance and exit interviews with postdocs.
NHMFL Winter Theory School and NHMFL Users Summer Schools	Post-survey assessing perceived value of program on their career trajectories.

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Research

In 2014, CIRL staff members (Kari Roberts and Roxanne Hughes) worked with FSU graduate student *Samantha Nix* to analyze and write the results of a research study that focused on FSU's STEM majors from 2001 to 2006. This resulted in a paper titled: Female Undergraduate STEM Persistence: A Focus on the Role of Living and Learning Communities which was accepted for presentation at the 2014 Research on Women and Education Conference, the 2014 Florida Educational Research Association Conference, and the 2015 American Educational Research Association Conference. The paper focuses on persistence rates for women who were part of a STEM living and learning community at FSU to the persistence rates of men and women from the general population of STEM majors during the same time.

In 2014, Roxanne Hughes worked with FSU graduate student Martin Bremer on a research project paid for by an FSU Council on Research and Creativity Planning grant. The researchers interviewed FSU physics majors to determine their motivations for majoring in physics, the obstacles they encountered in their major, and how they maintained their desire to persist. This study is the foundation for a larger study which would compare individuals who persist in physics to those who leave for other majors to determine ways that universities can address retention issues in STEM disciplines.

This research resulted in the following presentations in 2014:

R. Hughes (March 2014). The Longitudinal STEM Identity Trajectories of Middle School Girls who Participated in a Single-Sex Informal STEM Education Program. Presentation at the American Physical Society (APS), Denver, CO.

K. Roberts and S. Nix (October 2014). Female Undergraduate STEM Persistence: A Focus on the Role of Living and Learning Communities. Presentation at the annual Research on Women and Education Conference (RWE), New Orleans, LA.

K. Roberts (November 2014). Female Undergraduate STEM Persistence: A Focus on the Role of Living and Learning Communities. Presentation at the annual Florida Educational Research Association Conference (FERA), Cocoa Beach, FL.

The following are a list of CIRL staff publications in 2014:

Peer-reviewed articles:

Hughes, R. (2014). The Role of Access Policies: The Effects of a Single-Sex STEM Living and Learning Program on Female Undergraduates' Persistence. *International Journal of Gender, Science and Technology*, 6(1), 25-54.

Enderle, P., Dentzau, M., Roseler, K., Southerland, S., Granger, E., Hughes, R., Golden, B., & Saka, Y. (2014). Examining the Influence of RET's on Science Teachers' Beliefs and Practice. *Science Education*. DOI 10.1002/sce.21127

Book Chapters

Hughes, R. (2014). "How Do Gender Stereotypes Affect Women's Persistence in STEM Fields?" Stroud, Pearce (Ed.) Feminism: Perspectives, Stereotypes/Misperceptions and Social Implications. Nova Sense Publishers: New York, pp 121-140.

Hughes, R. (2014). "The Evolution of the Chilly Climate for Women in Science." Koch, Irby, & Polnick (Eds.) Girls and Women in STEM Fields: A Never-Ending Story. Information Age Publishing, Inc.: Charlotte, NC, pp. 71-94.

Grant Funding

CIRL's research agenda includes applications for external funding through grants. In 2014, CIRL received two grant awards:

Magnetism Outreach: A Transportable Magnetic Induction Levitating Apparatus (TIMLA): Roxanne Hughes worked with Outreach Coordinator Carlos Villa on a grant that was submitted to the American Physical Society's GMAG group. The resulting outreach demonstration was constructed with the $5000 funding and is ready for outreach efforts in 2015.

Exploring Gender Differences in Undergraduates' STEM Identity: Roxanne Hughes was awarded a $13,000 research grant from the FSU Council of Research and Creativity. With these funds, Dr. Hughes conducted a pilot study with FSU physics majors to determine issues that affect their interest and persistence in physics.

Grants Submitted in 2014

CIRL staff maintains a social science research agenda. As part of this agenda, we submit proposals for outside funding to address our research needs. These proposals build on the expertise that Dr. Hughes brings to informal science education and strengthen our diversity impact.

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Funding organization	Submission date	Title of Grant	Underrepresented group that was part of grant
NSF- ITEST	11/6/14 Hughes PI	Incorporating Sports into STEM for Middle School Students	Low income students
NSF-AISL	11/14/14 Hughes PI	STEM made Relevant for Middle School Students from Underrepresented Groups	Low income students
APS- Mini outreach grants	12/21/14 Hughes PI	Energy Misconceptions Gamed Away	NA

Plans for 2015 include:

- Determine improved ways of evaluating outreach conducted at UF and LANL
- Strengthen outreach partnerships with UF and LANL
- Publication of research conducted in 2014
- Continue annual tracking of all participants
- Maintain up-to-date knowledge of best practices in broader impacts

CIRL's 2014 Educational and Public Outreach Programs included:

2014 REU Participants

Participant	School	Research	Mentor
Alyssa Ambroise	Framingham State University	Fractional anisotropy and regional ADC of concussed rat brains using diffusion tensor imaging (DTI)	Sam Grant
Tessa Bartges	Florida State University		Amy Clingenpeel
Rishi Bhandia	Occidental College	Retrofit of a commercial dilatometer for cryogenic thermal expansion measurements	Bob Walsh
Elaine Bradford	Occidental College	Establishment of a new expression system to compare quality and yield of oxalate decarboxylase in bacillus subtilis	Alex Angerhofer
Winston Chu,	Florida State University	Establishment of a new expression system to compare quality and yield of oxalate decarboxylase in bacillus subtilis	Theo Siegrist
Jenni Crawford, University of Florida		Study of magnetic anisotropy in S=1 TpphNiBr using electron paramagnetic resonance	Steve Hill
Kursti DeLello, University of Central Florida		Hexagonal boron nitride as the dielectric in transition metal	Luis Balicas

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		dichalcogenide based field effect transistors	
Mathew Ennis, Skyline College		Can the fracture toughness of high Jc Superconducting Nb3Sn Layers in RRP wires be measured using micro-hardness indentation?	Peter Lee
Terence Fisher, Georgia State University		Model and design of a laser frequency Tripler	Steve McGill
Nyla Flowers, Spellman College		Fractional anisotropy and regional ADC of concussed rat brains using diffusion tensor imaging (DTI)	Sam Grant
Robert Franklin	Florida State University		Anant Paravastu
Stephen Gibbs	University of Florida	FTIR Analysis of polymorphism in radom chlorine substituted polyethlene	Rufina Alamo
Melissa Hirsch	John Brown University	Molecular dynamics simulations of copper crystallographic structures by LAMMPS software	Ke Han
Josh Johnson	Garner Webb-University		Huan Chen
Gregory Jones	Rochester Institute of Technology	Design and fabrication of magnetic lens for femtosecond electron diffraction	Jim Cao
Valentina Kucher	George Fox University	Using the non-local means algorithm to aid in tracking neuroprogenitor cells in association with TBI	Jens Rosenberg
Liliana Lozano	Universita Autonoma De Juarez	Heterostructures of van der waals solids as potential building blocks for opto-electronics	Luis Balicas
German Montero	Florida State University	Interaction of antibacterial alpha-AA peptide with lipid membranes defined by Multi-frequency EPR	Likai Song
Gerardo Nazario	University of Puerto Rico, Mayaguez	Heat treatment optimization and electromagnetic characterization of superconducting (Ba0.6K0.4) Fe2As2 Wires	Eric Hellstrom
Jacqueline Pleasant	Claflin University	Using a synthetic urine	Art Edison

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		mixture to predict histidine chemical shifts under differing pH	
Ryan Quinones	University of Florida	(RE) ALTADENA Effect on Fluoro-Olefins	Russ Bowers
Prince Emily Rably	Florida State University	Time series of mercury concentrations in red snappers before and after deepwater horizon oil spill	Munir Humayun
Edwin Simpson	Claflin University	Metabolic mechanisms of cold tolerance in Drosophila melanogaster	Art Edison
Nathan Strachen	LeTourneau University	Simulation design and testing of a capacitive matching network for HTS resonators in NMR	Bill Brey
Henry Travaglini	Bard College	Room temperature electron spin resonance on-a-chip	Irinel Chiorescu
Francisco Trujillo	Florida State University	Growth and Characterization of high temperature metal oxides crystalline material utilizing optical floating zone method	Ryan Baumbach
Ryan Voss	California State University	Femtosecond electron diffraction structure analysis of Al film and amorphous ZrCu	Jim Cao
Rachel Weinsend	Florida State University	Particulate trace elements sources, sinks, and cycles near Hawaiian islands	Peter Morton
Michael Woods	Florida State University	Electrowinning DU from a KCl/LiCl eutectic and temperature-dependent resistance characterization	Stan Tozer

2014 RET Participants

Participant	School	Research	Mentor
Jennifer Borges	Oak Ridge High School, Orlando, FL	The Quest for a Better Core for Bi-2212 Magnets	Anant Paravastu
Donald Bush	Lake Region High School, Eagle Lake FL	Solid State NMR Investigation of 150 kDa oligomers of the 42-residue Alzheimer's Beta-amyloid peptide	Anant Paravastu
Hilary Dennis	James A Shanks Middle School, Quincy FL	The Reconstruction of Ancient Diets and Environments	Yang Wang

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Mark Dignan	Rickards High School, Tallahassee FL	Zylon: Tougher Than a Bullet Proof Vest	Bob Goddard
Ashley Harvey	Apalachee Elementary, Tallahassee FL		
Alex Martinez	Duval Elementary, Gainesville FL	Growth Comparison of Natural Abundance, 5% and 95% 13C labeled C. elegans	Art Edison
Jeanne Murphy	James Weldon Johnson College Prep Middle, Jacksonville FL	The Quest for a Better Core for Bi-2212 Magnets	Eric Hellstrom
Jorge Natal	Walker Middle Magnet School of International Studies, Odessa FL	The Reconstruction of Ancient Diets and Environments	Yang Wang
Paul Rigel	Bok Academy, Lake Wales FL	Microstructure and Mechanical Characterization of Carbon Fiber	Yan Xin
Cedric Ward	Dr. Robert B Ingram Elementary, Opa-Locka FL		

2014 Middle School Mentorship Participants

Participant	School	Research Area	Mentor
Rohan Davidi **Jennifer Wen**	Fairview Middle School Deerlake Middle School	Using Carbon Isotopes to identify High Fructose Corn Syrup in Bee Honey	Yang Wang
Madeline Feiock **Gabby Thabes**	Cobb Middle School Montford Middle School	Solvents, Sorbents, and Crude Oil	Amy McKenna
Mickela Helms **Mallika Misra**	Fort Braden School Deerlake Middle School	Design and Construction of an Electric Relay by Reverse Engineering	David Hilton
James McGee **Diksha Jangra** **Blake Thacker**	Nims Middle School Cobb Middle School Montford Middle School	Detecting Electrical Signals within the Human Brain	Lloyd Engel

Education Programs in Diversity Classification

2014	Total	% Women	%African American	% Hispanic	%Native American	%Native Hawaiian and Pacific Islander
Research Experiences for Undergraduates (REU) summer	29 undergraduates	41%	28%	21%	NA	NA
Research Experiences for Teachers (RET) summer	10 K-12 teachers	30%	40%	30%	NA	NA

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Middle school Mentorship (Fall)	11 middle school students	55%	NA	NA	NA	NA
Internship spring	7 (high school/ college students)	29%	NA	NA	NA	NA
Internship summer	18 (high school/college students)	28%	6%	17%	6%	NA
Internship fall	5 (high school/college students)	20%	NA	NA	NA	NA
MagLab Summer Camp (Two 1-week camps)	32 (middle school students)	25%	6%	6%	NA	NA
SciGirls Summer camp (Two 2-week camps)	36 (middle school students)	100%	14%	3%	NA	NA
***ERC FREEDM Young Scholars summer**	7 (high school students)	43%	43%	NA	NA	NA
ERC FREEDM Research Experience for Teachers (RET) summer	1 (high school teacher)	NA	NA	NA	NA	NA
ERC FREEDM Middle school camp (1-week camp)	13 (middle school students)	46%	31%	NA	NA	NA

**Engineering Research Center – Future Renewable Electric Energy Delivery and Management*

ERC FREEDM programs - (this is a series of program we facilitate through an NSF grant that is managed by the Center for Advanced Power Systems and the College of Engineering)

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2. WORKSHOPS & CONFERENCES

Throughout the year, the National High Magnetic Field Laboratory hosts or sponsors a variety of workshops and conferences related to our science.

Theory Winter School
January 6-10, 2014
Tallahassee, FL

The National High Magnetic Field Laboratory hosted its third Theory Winter School on January 6, attracting a record 77 students from around the nation and the world. A record 120 people applied for spots in this year's school. The 2014 class is about 50 percent larger than classes from the first two years of the school, and includes 18 international students from as far away as Australia, China and Israel.

This year, the lectures focused on **Topological Phases of Condensed Matter**, a subject of great interest in Condensed Matter and Materials Research Theory. Nine distinguished speakers made presentations throughout the week, including Jason Alicea (CalTech), Joel Moore (Berkley), Phuan Ong (Princeton), Xiao-Liang Qi (Stanford) and Ying Ran (Boston College).

User Summer School
May 19-23, 2014
Tallahassee, FL

The fifth annual User Summer School introduced 28 students, early-career scientists and potential users to the MagLab's infrastructure, experimental options, and support staff. Through a combination of tutorials, talks and practical exercises, the User Summer School helped attendees develop skills for use in both their home laboratory and across user facilities worldwide.

MagLab User Summer School is designed to provide a "technique toolkit " to early career scientists that includes: noise types and theory, noise suppression techniques, transport techniques, magnetometry, heat capacity measurements, magneto-optics, infrared and terahertz spectroscopy, ultrasound spectroscopy, high-pressure methods, NMR techniques for chemistry, biology and condensed matter, electron paramagnetic resonance, cryogenic techniques, measurements at ultra-low temperatures, and the nuts and bolts of data acquisition.

New Developments in High Resolution and Mass Accuracy to Celebrate Alan Marshall's 70th Birthday
June 17, 2014
Baltimore, MD

Symposium organized by the NHMFL during the annual American Mass Spectrometry Meeting to discuss new developments in high resolution and mass accuracy, in addition to, honoring Alan Marshall for his works of contribution to this field of science. About 90 people attended.

High Magnetic Fields in Semiconductor Physics Conference (HMF 21)
August 3-8, 2014
Panama City, FL

Co-organized by the National High Magnetic Field Laboratory and Georgia Institute of Technology, the 21st International Conference was a forum for interdisciplinary discussions on the electronic, optical and magnetic properties of semiconductor and carbon-based structures and materials. Particular emphasis was on research in high magnetic fields including the Quantum Hall effect, magneto-transport and magneto-spectroscopy, spin-dependent phenomena and graphene. About 140 people were in attendance.

Condensed Matter Science User Strategic Planning Workshop
October 9th, 2014
Tallahassee, FL

This Condensed Matter Science Driven User Strategic Planning Workshop was designed to bring together a select group of researchers who are not only leaders in their respective fields, but who also

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have a vision of scientific research on a broader scale. Included were energy, technology and materials, and other mainstream areas that have an impact on, and can benefit from, high magnetic field science, technology and its associated infrastructure. The themes and roadmaps that emerge from this workshop will be used to craft the vision and strategy of the MagLab re-complete proposal to be submitted to the NSF in the summer of 2016. Approximately 50 people were in attendance.

Earlier strategic planning workshops were also held with Electron Magnetic Resonance (May 15, 2014), Pulsed Field Facility (June 4-5, 2014 at Los Alamos National Laboratory), in DC Field Facility (June 9-11, 2014) and with the Applied Superconductivity Center and Magnet Science and Technology groups (June 12-13, 2014). These strategic planning meetings served to inform the Condensed Matter User Strategic Planning Workshop discussed above.

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3. BROADENING OUTREACH

In addition to the Diversity and Education sections which speak to the MagLab's work in broadening outreach through education and underrepresented groups, the lab's staff are regularly presenting new research and sharing information about our user program at national and international conferences, workshops and seminars. Each presentation, poster or abstract opportunity offers the chance for scientists around the world the opportunity to learn more about the lab's research capabilities and broaden our user program to appeal to new scientists from varying levels – from graduate students and postdoc to seasoned scientists.

With a focus on broadening impacts to diverse and underrepresented groups, specific talks in 2014 occurred at HBCUs (Claflin University, Morehouse College, and Florida Agricultural and Mechanical University FAMU), California State University in Fresno (a Minority Serving Institution), FSU's chapter of Undergraduate Hispanic Engineers, Old Dominion University's chemistry and physics students from underrepresented groups, the annual Florida-Georgia Louis Stokes Alliance for Minority Participation expo in Jacksonville, FL, the annual Society for the Advancement of Chicanos and Native Americans (SACNAS) conference, and the Southeast Conference for Undergraduate Women in Physics.

In addition to these targeted presentations, all MagLab presentations, posters and abstracts are an opportunity to broaden the user community. In 2014, 362 were presented:

1	Aczel, A.A.; Li, L.; Yan, J.-Q.; Weickert, F.; Zapf, V. S.; Jaime, M.; Civale, L.; Movshovich, R.; Keppens, V.; Mandrus, D., *Low temperature magnetic ordering in the frustrated zigzag ladder system BaNd2O4*, APS March Meeting, Denver, CO, March (2014)
2	Afinfaderin, A.; Wi, S.; Dubroca, T.; Trociewitz, B.; Frydman, L. and Hill, S., *Towards improving Overhauser dynamic nuclear polarization at high magnetic field: preliminary insight from relaxation in supercritical fluids*, SEMRC 2014, Tuscaloosa, AL, October 24-26 (2014)
3	Artyukhin, S.; Oh, Y.S.; Yang, J. J.; Zapf, V. S.; Kim, J. W.; Cheong, S. W.; Vanderbilt, D., *Colossal magnetoelectric effect in Co3TeO6 family of compounds*, APS March Meeting, Denver, CO, March (2014)
4	Bai, H.; Markiewicz, W.D.; Weijers, H.W.; Voran, A.; Noyes, P.D.; Jarvis, B.; Sheppard, W.R.; Johnson, Z.L.; Gundlach, S.R. and Hannahs, S.T., *Impact of Trapped Helium Gas Bubble in Liquid Helium on the Cooling in High Magnetic Field*, ASC 2014, Charlotte, NC, August 12 (2014)
5	Baity, P.; Shi, X.; Shi, Z. and Popovic, D., *Zero-magnetic-field phase-decoherence transition in underdoped* $La_{2-x}Sr_xCuO_4$, American Physical Society March meeting, Denver, CO, March (2014)
6	Balicas, L., *Comparison between field-effect and Hall mobilities in field-effect transistors based on few-layered transition metal dichalcogenides (invited).*, 2014 Graphene and Beyond Workshop, State College, PA, April 1st-2nd (2014)
7	Balicas, L., *Divergence of the de Haas-van-Alphen quasiparticle effective mass upon approaching a field-induced quantum-critical point in CeCu2Ge2 (invited)*, Workshop in Modern Trends in Quantum Magnetism, Aspen Physics Center - Aspen, June 16th - 10th (2014)
8	Balicas, L., *New developments in superconductivity at high magnetic fields*, School on Multi-Condensates Superconductivity, Ettore Majorana Center, Erice-Sicily, Italy, July 19th-25th (2014)
9	Balicas, L., *New developments in superconductivity at high magnetic fields*, Physics Department, UC-Boulder, 02/07/2014 (2014)
10	Barrett, P.; Grand, M.; Landing,W.; Measures, M. and Resing, J., *Trace Metal Composition of Suspended Particulate Matter Along Meridional and Zonal CLIVAR Sections in the Indian Ocean.*, AGU Fall Meeting, San Francisco, CA, Dec. 15-19 (2014)
11	Barrett, P.M.; Resing, J.A.; Buck, N.J. and Landing, W.M., *Decadal Comparison Of The Distribution Of Particulate Trace Elements In The Top 1000 M Of The North Atlantic Ocean Along Clivar Section A16N*, AGU/ASLO Ocean Sciences Meeting, Feb. 23-28 (2014)
12	Bartges, T.E.; Clingenpeel, A.C.; Jarvis, J.M.; Robbins, W.K.; Marshall, A.G. and Rodgers, R.P., *Characterization of Interfacial Material from Fractionated Athabasca Bitumen by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*, National High Magnetic Field Laboratory Research Experience for Undergraduates Poster Session, Tallahassee, FL, August 1 (2014)
13	Beasley, R.L.; Lobodin, V.V.; Marshall, A.G. and Rodgers, R.P., *Targeted Ionization of Oxygen-Containing Compounds in Petroleum Crude Oil by Lithium Cationization Electrospray Ionization FT-ICR Mass Spectrometry*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
14	Besara, T.; Whalen, J.B.; Lundberg, M.S.; Ramirez, D.; Sun, J.; Dong, L. and Siegrist, T., *Single crystal synthesis and magnetism of the complete* $BaLn_2O_4$ *family*, American Physical Society March Meeting, Denver, CO, March 3-7 (2014)

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15	Besara, T.; Lundberg, M.S.; Sun, J.; Ramirez, D.; Dong, L.; Whalen, J.B. and Siegrist, T., *Single Crystal Growth and Magnetism of the $BaLn_2O_4$ Family*, Gordon Research Conference: Solid State Chemistry, Colby-Sawyer College, New London, NH, July 27 - August 1 (2014)
16	Beu, S.E.; Chen, Y.; Kaiser, N.K.; Hendrickson, C.L. and Marshall, A.G, *Effect of Extraction Electric Field on Radial Ion Confinement in a Linear Quadrupole Ion Trap Equipped with Angled-Wire Extraction Electrodes*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
17	Bindra, J.; Ramachandran, V.; van Tol, J.; McKenna, A.M.; Rodgers, R.P. and Marshall, A.G., *First HYSCORE Spectroscopic Study of Crude Oils & Tar Balls*, 90th FL Annual Meeting & Exposition, Innisbrook, FL, May 8-10 (2014)
18	Bird, M.D. and Boebinger, G.S., *A Celebration of the Completion of Assembly of the HZB Series-Connected Hybrid Magnet*, Final Assembly of the High-Field Magnet, Helmholtz-Zentrum Berlin, Germany, July 10 (2014)
19	Bird, M.D., *CICC Magnets at the National High Magnetic Field Lab*, Alstom, Belfort, France, April 14 (2014)
20	Bird, M.D., *CICC Magnets at the National High Magnetic Field Lab*, General Atomics, San Diego, CA, Jan. 28 (2014)
21	Bird, M.D., *DC Magnet Technology relevant for Neutron Scattering*, The Neutron Scattering in High Magnetic Fields Workshop, Oak Ridge National Lab, TN, Sept. 4-5 (2014)
22	Bird, M.D., *Development of Magnets for Scattering, Diffraction & Spectroscopy at the MagLab*, American Conference on Neutron Scattering, Oak Ridge, TN, June 2-5 (2014)
23	Bird, M.D., *Development of Magnets for Scattering, Diffraction & Spectroscopy at the MagLab*, Los Alamos Neutron Science Center, Los Alamos, NM, March 11 (2014)
24	Bird, M.D., *High-Field Magnet Projects at the NHMFL*, HMF-21, Panama City, FL, Aug 3-8 (2014)
25	Bird, M.D., *Magnet technologies Relevant for Neutron Scattering*, European Spallation Source, Lund, Sweden, Sept. 17 (2014)
26	Bird, M.D., *Magnets for Neutron & X-Ray Scattering @ > 25 T*, Paul Scherrer Institute, Villigen, Switzerland, Oct 31 (2014)
27	Bird, M.D., *Possibilities for >25 T Magnets for Neutron Scattering*, Neutron Scattering in Magnetic Fields Above 15 Tesla, Helmholtz Zentrum Berlin, Germany, Oct. 29-30 (2014)
28	Bird, M.D.; Budinger, T.F.; Frydman, L. and Long, J.R., *Magnet Technology Suitable for 14T-20T MRI*, FL Brain Project Symposium, Tallahassee, FL, July 28-29 (2014)
29	Bird, M.D.; Dixon, I.R. and Toth, J., *Large, High-Field Magnet Projects at the National High Magnetic Field Laboratory*, Applied Superconductivity Conference, Charlotte, NC, Aug 11-15 (2014); Published in IEEE Trans. Appl. Supercond. (0)
30	Blakney, G.T.; Weisbrod, C.R.; Kaiser, N.K.; Hendrickson, C.L. and Marshall, A.G., *Resolution Requirement for Isotopic Fine Structure Determination of Peptide Fragment with Introduced mDa Stable Isotope Encoding*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
31	Bonesteel, N.E., *Lectures on Topological Quantum Computation*, NHMFL Winter School on Topological Phases of Condensed Matter, Tallahassee, FL, January 6-10 (2014)
32	Bonesteel, N.E., *Simulating Fibonacci Anyons on a Quantum Computer*, RWTH Aachen University, Aachen, Germany, June 3 (2014)
33	Bonesteel, N.E., *Topological Quantum Computation (Series of three lectures)*, Princeton Summer School on Condensed Matter Physics: Quantum Information and Computation, Princeton, New Jersey, July 28-31 (2014)
34	Brown, M.; Segal, C.; Tarantini, C.; Starch, B.; Oates, W.S.; Lee, P.J. and Larbalestier, D.C., *RRP & PIT Comparative Rolling Deformation Study to Simulate Cabling Process*, Applied Superconductivity Conference 2014 (ASC 2014), Charlotte, NC, 08/11 - 08/15 (2014)
35	Brown, M.D.; Segal, C.; Tarantini, C.; Oates, W.; Lee, P.J.; Sung, Z.H. and Larbalestier, D.C., *Digital evaluation of filament distortion in drawn, rolled and cabled PIT and RRP Nb_3Sn wires*, 2014 Applied Superconductivity Conference, Charlotte, NC, August 14th (2014)
36	Brownstein, N.C. and Young, N.L., *Confidence Metrics for Identification of Proteins, Post-translational Modi cations (PTMs) and Proteoforms*, Eastern North Atlantic Region (ENAR) Meeting of the International Biometric Society, Baltimore, MD, March 16-19 (2014)
37	Brownstein, N.C. and Young, N.L., *Confidence Metrics for Identification of Proteins, Post-translational Modi cations (PTMs) and Proteoforms*, FL Chapter of the American Statistical Association Annual Meeting, Gainesville, FL, February 7-8 (2014)
38	Brownstein, N.C.; Bair, E. and Young, N.L., *Confidence Metrics for Identification of Proteins, Post-translational Modifications (PTMs) and Proteoforms*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
39	Buck, C.; Landing, W.; Aguilar-Islas, A. and Rember, R., *Trace Element Fractional Solubility in Ultrapure Water From Samples Collected During the US GEOTRACES Eastern Tropical South Pacific Section.*, AGU Fall Meeting, San Francisco, CA, Dec. 15-19 (2014)
40	Buck, C.S.; Bowman, K.; Gill, G.; Hammerschmidt, C. and Landing, W.M., *Partitioning, Speciation, And Flux Of Mercury In Gulf Of Mexico Estuaries*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)

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41	Budinger, T.; Bird, M.; Frydman, L.; Long, J. and Schepkin, V., *Ekosi Tesla Initiative for Human Brain Studies at 20 Tesla*, Ultrahigh Field Magnetic Resonance: Clinical Needs, Research Promises and Technical Solutions, Berlin, Germany, June 20 (2014); Published in Proceedings of the 5th Annual Scientific Symposium,, 30 (2014)
42	Cheggour, N.; Lee, P.J.; Goodrich, L.F.; Ghosh, A.K.; Stauffer, T.C. and Splett, J.D., *Irreversible Strain Limit of Nb_3Sn Wires Made by the Restacked-Rod Process: Review of the Effects of Doping, Heat-Treatment, and Microstructure.*, 2014 Applied Superconductivity Conference, Charlotte, NC, August 11th (2014)
43	Chen, H.; Aeppli, C.; Valentine, D.L.; Nelson, R.K.; Reddy, C.M.; Kellermann, M.; Rodgers, R.P.; Marshall, A.G. and McKenna, A.M., *Natural Seeps versus Human Spill: Characterization and Comparison of DWH Weathered Oil with Natural Petroleum Seeps by Ultrahigh Resolution FT-ICR Mass Spectrometry*, Association for the Sciences of Limnology & Oceanography 2014 Ocean Sciences Meeting, Honolulu, HI, February 23-28 (2014)
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57	Crooker, S. A., *Optically-Induced persistent magnetization in strontium titanate*, HMF-21, Panama City, FL, August 3-8 (2014)
58	Crooker, S. A., *Spectrally-resolved hyperfine interactions between polaron and nuclear spins in OLEDs*, ICPS-21, Austin, TX, August 10-15 (2014)
59	Crooker, S.A., *Optically-induced persistent magnetization in SrTiO3*, MESO-CNLS, Santa Fe, NM, March 10-15 (2014)
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63	Cvetkovic, V.; Vafek, O., *Space group symmetry, spin-orbit coupling, and the low-energy effective Hamiltonian for iron-based superconductors*, APS March meeting, March 3 (2014)

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68	Davis, L.M., *Transition metal compounds bearing sterically demanding dialkylamido ligands*, Betley group, Harvard University, July 3 (2014)
69	Dean, C.R., *Hofstadter's Butterfly in Graphene Superlattices*, LT27: 27th International Conference on Low Temperature Physics, Buenos Aires, Aug 6-13 (2014)
70	Dean, C.R., *Hofstadter's Butterfly in the Clean Limit*, HMF21: The 21st International Conference on "High Magnetic Fields in Semiconductor Physics", FL, Aug 3-8 (2014)
71	Dial, A.R.; Misra, S.; Salters, V.J.M. and Landing, W.M., *Magnesium Isotopes As A Geochemical Proxy For Paleoclimate*, FL Annual Meeting and Exposition, FL Section American Chemical Society, May (2014)
72	Dick, H.; Salters, V.; Sanfilippo, A.; Schouten, H. and Smith, D., *Focused Melt Flow and Abyssal Magmatism at Lower Magma Supply Rates*, Goldschmidt, Sacramento, CA, June 8-13 (2014)
73	Dobrosavljevic, V., *Bad Metal Behavior and Mott Quantum Criticality*, invited talk at the International Worship: "Quantum Criticality in Correlated Materials and Model Systems", Natal, Brazil, 21 July 21 - 1 August (2014)
74	Dobrosavljevic, V., *Bad Metal Behavior and Mott Quantum Criticality*, Physics Seminar at the Pohang University of Science and Technology, Pohang, South Korea, Aug. 18 (2014)
75	Dobrosavljevic, V., *Bad Metal Behavior and Mott Quantum Criticality*, Physics Seminar at the MIT Creative Research Center, ETRI, Daejeon, South Korea, Aug. 13 (2014)
76	Dobrosavljevic, V., *Quantum Critical Transport Near the Mott Transition*, Physics Seminar, Department of Physics, Michigan State University, East Lansing, MI, Apr. 28 (2014)
77	Dobrosavljevic, V., *Quantum critical transport near the Mott transition*, Physics Seminar, University of CO, Boulder, CO, May 6 (2014)
78	Dobrosavljevic, V., *Quantum critical transport near the Mott transition*, Physics Seminar, CO School of Mines, Golden, CO, May 7 (2014)
79	Dobrosavljevic, V., *Quantum critical transport near the Mott transition*, Physics Colloquium at the Deapartment of Physics, Royal Hallowey University of London, London, UK, Feb. 15 (2014)
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81	Dobrosavljevic, V., *Quantum critical transport near the Mott transition*, invited talk at the Aspen Winter Conference "Beyond Quasiparticles: New Paradigms for Quantum Fluids", Aspen Center for Physics, Aspen, CO, Jan. 13-17 (2014)
82	Dobrosavljevic, V., *Shock waves and commutation speed of memristors*, Physics Seminar at the MIT Creative Research Center, ETRI, Daejeon, South Korea, Aug. 13 (2014)
83	Dobrosavljevic, V., *Shock-waves and commutation speed of memristors*, Physics Seminar at the National Renewable Energy Laboratory, Golden, CO, May 9 (2014)
84	Drichko, I.L.; Malysh V.A.; Smirnov, I.Y.; Golub, L.E.; Tarasenko, S.A.; Suslov, A.V.; Mironov, O.A.; Kummer, M. and von Känel, H., *Decrease of g-factor in p-SiGe/Ge/SiGe by the in-plane magnetic field component*, 21st International Conference on High Magnetic Fields in Semiconductor Physics, Panama City Beach, FL, August 3-8 (2014); Published in Program of HMF-21 (2014)
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86	Dubroca, T.; Smith, A.N.; Trociewitz, B.; Akinfaderin, A.; van Tol, J.; Wi, S.; Brey, W.W.; Frydman, L.; Hill, S. and Long, J.R., *Dynamic Nuclear Polarization facilities at the National High Magnetic Field Laboratory*, Experimental nuclear magnetic resonance conference, Boston, MA, March (2014); Published in Poster and Abstract (0)
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90	Dubroca, T.; Trociewitz, B.; Akinfaderin, A.; Hill, S.; van Tol, J.; Brey, W.; Wi, S.; Frydman, L. and Long, J.R., *Dynamic Nuclear Polarization: a disruptive technology for Nuclear Magnetic Resonance*, 6th annual FL State University Sneak Peek conference, Tallahassee, FL, October (2014)
91	Dunk, P.W.; Barrett, R.A.; Kaiser, N.K.; Marshall, A.G. and Kroto, H.W., *Cluster Ion Source Coupled to a 9.4 T FT-ICR Mass Spectrometer for Experimental Study of Fullerene Formation and Gas-Phase Chemistry*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
92	Dunk, P.W.; Kaiser, N.K.; Quinn, J.P.; Blakney, G.T.; Ewels, C.P.; Shinohara, H.; Poblet, J.P.; Marshall, A.G. and Kroto, H.W., *Cluster Source to 9.4T FT-ICR MS for Complex Molecule Studies*, 90th FL Annual Meeting & Exposition, Innisbrook, FL, May 8-10 (2014)
93	Dunk, P.W.; Kaiser, N.K.; Rodriguez-Fortea, A.; Poblet, J.M.; Ewels, C.W.; Shinohara, H.; Marshall, A.G. and Kroto, H.W., *Recent Advances in Fullerene Science: Cluster Source for a 9.4 T FT-ICR Mass Spectrometer for Experimental Study of Nanocarbon Formation (invited talk)*, 29th International Syposium on Rarefied Gas Dynamics, Xi'an, China, July 13-18 (2014)
94	Dvoyashkin, M.; Bhase, H.; Mirnazari, N.; Wang, A.; Vasenkov, S. and Bowers, C.R, *Exploring transport resistances in single-file channels by a combination of hyperpolarized tracer exchange and high field diffusion NMR techniques*, MRPM12 - Magnetic Resonance in Porous Media, Wellington, New Zealand, 9th-13th February (2014)
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96	Ebling, A.M. and Landing, W.M., *Residence Times Of Trace Metals In The Sea Surface Microlayer (Abstract ID: 14291)*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
97	Eisterer, M.; Hecher, J.; Baumgartner, T.; Yamamoto, A.; Hayashi, Y.; Weiss, J.D.; Tarantini, C.; Jiang, J.; Kametani, F.; Polyanskii, A.A.; Hellstrom, E.E. and Larbalestier, D.C., *Understanding high critical current densities in weak-linked polycrystalline Ba-122*, 2014 Applied Superconductivity Conference, Charlotte, NC, August 11 (2014)
98	Ekanayake, E.V.; Qin, H.; Hung, I. and Cross,T.A., *Structural Insights of LspA, from Mycobacterium Tuberculosis, using Solid State NMR Spectroscopy*, Biophysical Society 58th Annual Meeting, San Francisco, CA, February 15 -19 (2014); Published in Biophysical J., 106 (2) (2014)
99	Eller, V.A.; Perrot, V.; Landing, W.M. and Salters, V.J.M., *Mercury Isotope Trends in Deepwater Horizon-Impacted Red Snapper and Control Area Gag Grouper*, 1st Deep-C Consortium Student Research Symposium, Tallahassee, FL, September 18-19 (2014)
100	Eo, Y.S.; Wolgast, S.; Kurdak, C.; Li, G.; Xiang, Z.; Tinsman, C.; Asaba, T.; Lawson, B.; Yu, F.; Li, L.; Sun, K.; Allen, J.W.; Kim, D.J. and Fisk, Z., *Low Field Magnetoresistance Measurements on the Surface States of Samarium Hexaboride using Corbino Structures*, Denver, CO, March 3–7 (2014); Published in Bulletin of the American Physical Society, 59 (2014)
101	Escobar, C. and Cross, T.A., *Expression, Purification and Preliminary Solid State NMR Expeximents of Mycobacterium tuberculosis FtsX membrane Protein*, 58th Annual Biophyscs Society Meeting, San Francisco, CA, February 15-19 (2014)
102	Farst, C.; Landing, W. and Stenson, A., *Isolation of Marine Siderophores, FL Annual Meeting and Exposition*, FL Section American Chemical Society, May (2014)
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105	Fortune, N.; Hannahs, S.; Park, J.-H.; Zhou, H.; Aoyama, C. and Takano, Y., *Calorimeteric determination of magnetic phase diagram of $Ba_3CoSb_2O_9$*, APS March Meeting, Denver, CO, March 3–7 (2014)
106	Furis, M.; Rawat, N.; Manning, L.W.; Headrick, R. and McGill, S., *Metal / Metal - Free Phthalocyanine Crystalline "Alloys": Organic Analogues to Diluted Magnetic Semiconductor*, American Physical Society March Meeting, Denver, CO, March 3-7 (2014)
107	Galfond, B.; Kadko, D.; Shelley, R. and Landing, W., *A Novel Method Of Determining Atmospheric Deposition Of Trace Elements To The Ocean/Ice System Of The Arctic*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
108	Gilmer, P.J.; Popovic, D. and Stokes, G., *Alliances for Advancing Academic Women: Extension to STEM Women Faculty and Staff in National Laboratories*, poster, NSF ADVANCE Program Workshop, Alexandria, VA, March (2014)
109	Gor'kov, P.L.; Mao, W.; Kitchen, J.A.; Hung, I.; Ward, M.; Ladizhansky, V. and Brey, W.W., *Building Sensitive and Robust 1H/X/Y Triple-Resonance MAS Probes for Biological Solids*, 55th Experimental NMR Conference, Boston, MA, March 23-28 (2014)
110	Gor’kov, L.P. and Teitel’baum, G.B., *Evolution of the energy spectrum of underdoped cuprates in the pseudogap phase*, International Conference Superstripes 2014, July 25-31 (2014)
111	Grand, M.M.; Measures, C.I.; Hatta, M.; Morton, P.L. and Landing, W.M., *Biogeochemistry Of Dissolved Fe And Al In The Eastern Indian Ocean: Insights From The Antarctic Margin To The Bay Of Bengal Along 95 °E*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
112	Guan, X.; Dang, X.; Chen, Y.; Tao, Y.; Young, N.L. and Marshall, A.G., *Determination of Site-Specific Protein Disulfide Bond Redox Potentials by Top-Down FT-ICR Mass Spectrometry*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)

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113	Guo, W., *Prospects for visualization below 1K with He2 excimer molecules*, Workshop on Quantum Turbulence and its Visualization, Abu Dhabi, AEU, 05/06 (2014)
114	Han, K.; Brown, D.R.; Cui, B.Z.; Goddard, R.; Xin, Y. and Siegrist, T., *Permanent Magnet for Energy Efficiency Systems*, 2014 FL Energy System Consodium Workshop, May 12-13 (2014)
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118	Harper, J. K.; Hung, I.; Gan, Z., *Measuring multiple 14N-13C distances with the RESPDOR experiment*, Rocky mountain conference on magnetic resonance, Copper mountian CO, July 13 - 17 (2014)
119	Hazelbaker, E.D.; Budhathoki, S.; Shah, J.K.; Maginn, E.J. and Vasenkov, S., *Influence of an exchange between the reacted and unrelated states of carbon dioxide in an amine-functionalized ionic liquid on diffusion*, 2014 American Institute of Chemical Engineers (AIChE) Annual Meeting, Atlanta, GA, November 16-21 (2014)
120	He, H.; Li, Y.-T.; Li, S.-C.; Young, N.L. and Marshall, A.G., *Differential Accumulation of Glycosphingolipids in a Tay-Sachs Disease Brain*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
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122	Henrick, S.R.; Dobrosavljevic, V.; Dick, H.J. and Salters, V.J.M., *Geochemistry of Basalts from the Asymmetric Spreading Ridge Segment at 16.5°N on the Mid-Atlantic Ridge*, AGU Fall Meeting, San Francisco, CA, Dec. 15-19 (2014)
123	Hernandez-Maldonado, A.J., *Carbon Dioxide Removal, Storage and Sustained Delivery: Rigid and Flexible Porous Adsorbents*, Technical Interchange Meeting on Closed Loop CO2 Removal Technologies, NASA Marshall Space Flight Center, NASA Marshall Space Flight Center, April 28-29 (2014)
124	Hernandez-Maldonado, A.J., *Rigid and Flexible Nanoporous Materials for Life Support Systems in Space*, NanoDays, College of Engineering, University of Puerto Rico - Mayaguez, University of Puerto Rico - Mayaguez, April 3 (2014)
125	Hill, S., *Materials for Spin-Based Information Technologies*, Research in Materials Science, FSU Retreat, Tallahassee, FL, January 11 (2014)
126	Hoch, M.J.R., Mun, E., Harrison, N. and Zhou, H., *Magnetization of rare earth kagome systems in pulsed fields*, American Physical Society, March Meeting, Denver, CO, March 3-7 (2014)
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131	Hughes, R., *The Longitudinal STEM Identity Trajectories of Middle School Girls who Participated in a Single-Sex Informal STEM Education Program*, American Physical Society, Denver, CO, March 3-7 (2014)
132	Hung, I. and Gan, Z., *Fast REDOR with CPMG multiple-echo acquisition*, 55th Experimental Nuclear Magnetic Resonance Conference, Boston, MA, March 22-28 (2014); Published in J. Magn. Reson., 238, 82-86 (2014)
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134	Jarvis, J.M.; Clingenpeel, A.C.; Bythell, B.J.; Weisbrod, C.R.; Robbins, W.K.; Marshall, A.G. and Rodgers, R.P., *Isolation and Characterization of Interfacially Active Species from Petroleum Crude Oil*, 15th Int'l Conf. on Petroleum Phase Behavior and Fouling, Galveston, TX, June 8-12 (2014)
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136	Javan Mard, H.; Hoyos, J.; Miranda, E. and Dobrosavljevic, V., *Strong disorder renormalization group study of Anderson localization*, American Physics Society March meeting (Talk), Denver, CO, March 3-7 (2014)

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137	Ji, H.; Dhomkar, S.; Ludwig, J.; Smirnov, D.; Tamargo, M.C. and Kuskovsky, I.L., *Giant Zeeman Splitting in Submonolayer ZnTe/ZnSe Quantum Dots*, The 21st International Conference on "High Magnetic Fields in Semiconductor Physics", HMF-21, Panama City Beach, FL, 3-8 August (2014)
138	Jiang, W.; Bai, H.; Kotchey, G.; Saidi, W.; Bythell, B.J.; Jarvis, J.M.; Marshall, A.G.; Robinson, R. and Star, A., *Mass Spectrometry-Based Analysis of Graphene Oxide Degradation Products*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
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141	Kaur, P.; Kwong, P.D.; Reinherz, E.L. and Song, L., *EPR Analysis of Anti-HIV Antibody 10E8 Induced Conformation Changes of its Membrane-Bound Epitope*, 4th Annual FSU Life Sciences Symposium: Frontiers in Biomolecular Communication, Tallahassee, FL, February 13-14 (2014)
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147	Krabbenhoft, D.; Maglio, M.; Ogorek, J.; Landing, W.; Morton, P.; Shelley,R. and Sunderland E., *Mercury and Methylmercury Distributions Along a Longitudinal Transect of the North Atlantic Ocean*, AGU Fall Meeting, San Francisco, CA, Dec. 15-19 (2014)
148	Krajewski, L.C.; Corilo, Y.E.; Rodgers, R.P. and Marshall, A.G., *Dynamic Range Enhancement by Stitching of Multiple Ultrahigh Resolution FT-ICR Mass Spectral Segments*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
149	Krzystek, J., *High-Frequency and -Field EPR*, 3rd EMR Forum, Krakow, Poland, June 22-24 (2014)
150	Krzystek, J., *High-Frequency and -Field EPR Spectroscopy of Vanadium(III): from Curiosity to Practicality*, 9th International Vanadium Symposium, Padua, Italy, June 29 - July 2 (2014)
151	Kumar, P., *Metamagnetism and Nonlinear Magnetic Susceptibility*, University of Virginia Colloquium, Department of Physics, January 31 (2014)
152	Kumar, P., *Metamagnetism and nonlinear magnetic susceptibility*, Northwestern University Seminar on Condensed Matter Phsyics, Northwestern Unversity, October 9 (2014)
153	Kumar, P., *Metamagnetism and nonlinear magnetic susceptibility*, University of Wisconsin Milwaukee Physics Colloquium, Milwaukee, WI, October 10 (2014)
154	Kurth, F.; Reich, E.; Hänisch, J.; Engelmann, J.; Schultz, L.; Holzapfel, B.; Iida, K.; Tarantini, C.; Jaroszynski, J.; Sakagami, A.; Mori, Y.; Kawaguchi, T. and Ikuta, H., *High-Field Transport Properties Of P-Doped Ba-122 Thin Films*, 2014 Applied Superconductivity Conference, Charlotte, NC, August 11 (2014)
155	Kuskovsky, I.L., *Excitonic Aharonov-Bohm Effect in Type-II Quantum Dots*, The 21st International Conference on "High Magnetic Fields in Semiconductor Physics", HMF-21, Panama City Beach, FL, 3-8 August (2014)
156	Kuskovsky, I.L.; Ji, H.; Dhomkar, S.; Ludwig, J.; Smirnov, D. and Tamargo, M.C., *Millikelvin magneto-photoluminescence of isoelectronic bound excitons in type-II quantum dot superlattices*, APS March Meeting 2014, Denver, CO, March 3–7 (2014); Published in Bulletin of the American Physical Society, 59 (1) (2014)
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158	Kweon, J.J.; Fu, R.; Brey, W.W.; Lee, C.E. and Dalal, N.S., *High Resolution Solid-State NMR Suggests a New Model of Protonic Conductivity in The Superionic Conductor LiH2PO4 : Critical Role of Physisorbed Wate*, The 55th ENC Experimental Nuclear Magnetic Resonance Conference, Boston, MA, March 23 - 28 (2014)
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160	Kweon, J.J.; Fu, R.; Kitchen, J.; Brey, W.W. and Dalal, N.S., *High Field MAS-NMR of the Phase Transition of the Model Hydrogen-Bonded Antiferroelectric NH4H2AsO4*, 43rd Southeastern Magnetic Resonance Conference, Tuscaloosa, AL, October 24-26 (2014)
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162	Kyritsis, P.; Grigoropoulos, A.; Sanakis, Y.; Pissas, M.; Psycharis, V. and Krzystek, J., *Spin relaxation properties of a mononuclear S=2 MnIIIO6-containing complex*, Challenges in Inorganic and Materials Chemistry ISACS13, Dublin, Ireland, July 1-4 (2014)
163	Lalli, P.M.; Rowland, S.M.; Corilo, Y.E.; Rodgers, R.P. and Marshall, A.G., *Determination of Isomers in Petroleum by Ion Mobility Mass Spectrometry*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
164	Landing, W.; Shelley, R. and Kadko, D., *Recent Rainfall and Aerosol Chemistry From Bermuda.*, AGU Fall Meeting, San Francisco, CA, Dec. 15-19 (2014)
165	Landing, W.M.; Morton, P.L.; Shelley, R.U.; Resing, J.A. and Barrett, P.M., *Dissolved Trace Metals In The North Atlantic From 2003 To 2013: Results From The A16n Clivar/Repeat Hydrography Sections*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
166	Landing, W.M.; Shelley, R.; Kilgore, B.; Krishnamurthy, N.; Kadko, D. and Galfond, B., *Using Berylium-7 To Quantify The Fluxes Of Trace Elements From The Atmosphere To The Oceans*, FL Annual Meeting and Exposition, FL Section American Chemical Society, May (2014)
167	Lee, M.; Hwang, J.; Choi, E.S; Ma, J.; Dela Cruz, C.R.; Zhu, M.; Ke, X.; Dun, Z.L. and Zhou, H.D., *Successive magnetic phase transitions and multiferroicity in quasi-two-dimensional triangular lattice Heisenberg antiferromagnets Ba3CoNb2O9 and Ba3MnNb2O9*, APS March Meeting 2014, Denver, Co, March (2014); Published in Phys. Rev. B, 89, 104420 (2014)
168	Lee, P.J.; Sung, Z.-H.; Tarantini, C.; Segal, C. and Larbalestier, D.C., *New perspectives on compositional and microstructural homogeneity in Nb_3Sn strands*, 2014 Applied Superconductivity Conference, Charlotte, NC, August 12th (2014)
169	Lee, P.J.; Tarantini, C.; Sung, Z.-H.; Sanabria, C.; Segal, C.; Brown, M.D. and Larbalestier, D.C., *Challenges in Low Temperature Superconductors for High Magnetic Field Applications*, MRS Spring Meeting, San Francisco, CA, April 23rd (2014)
170	Li, G.; Xiang, Z.; Yu, F.; Asaba, T.; Lawson, B.; Cai, P.; Tinsman, C.; Berkley, A.; Wolgast, S.; Eo, Y.S.; Kim, D.J.; Kurdak, C.; Allen, J.W.; Sun, K.; Chen, X.; Wang, Y.; Fisk, Z. and Li, L., *Two-Dimensional Fermi Surfaces In Kondo Insulator SmB6*, Denver, CO, March 3–7 (2014); Published in Bulletin of the American Physical Society, 59 (2014)
171	Li, Q., *Iron-based superconducting films*, MRS Spring meeting, San Francisco, CA, April. 21-25 (2014)
172	Li, Q., *Jc enhancement in coated conductors by ion irradiation*, International Workshop on Coated Conductors for Applications (CCA) 2014, Jeju, South Korea, Nov. 30 - Dec. 3 (2014)
173	Li, Q., *Pushing the Tc-Jc-Hc2 Boundaries of Iron-Chalcogenide Superconductors*, Electronic Materials and Applications, Orlando, FL, January 22-24 (2014)
174	Li, Q., *Superconductivity and Critical Current of Iron-Based Superconductors in High Field*, APS March Meeting, Denver, CO, March 3–7 (2014)
175	Li, Y.; Ludwig, J.; Low, T.; Chernikov, A.; Cui, X.; Arefe, G.; Kim, Y.D.; van der Zande, A.; Rigosi, A.; Hill, M.H.; Kim, S.H; Hone, J.; Li, Z.; Smirnov, D. and Heinz, T.F., *Magneto-optic Spectroscopy of Monolayer Transition Metal Dichalcogenides*, The Rank Prize Funds Symposium on 2D Materials for Optoelectronics, Plasmonics and Photonics, Grasmere, UK, 22nd to 25th September (2014)
176	Ling, S.; Yu, L.; Van Tol, H. and Song, L., *Interaction of HIV gp41 with the cholesterol-rich viral membrane defined by multi-frequency EPR*, 56th Rocky Mountain Conference on Magnetic Resonance, Copper Mountain, CO, July 13-17 (2014)
177	Litvak, I.M; Gor'kov, P.L.; Schiano, J.L.; McPheron, B.D.; Gan, Z; Toth, J.; Brey, W.W, *NMR hardware development for the 1.5 GHz series-connected hybrid (SCH) magnet at the National High Magnetic Field Laboratory*, 56th Annual Rocky Mountain Conference on Magnetic Resonance, Copper Mountain, CO, July 13-17 (2014)
178	Lobodin, V.V., *Petroleomics, A Pathway to "Greener Fuels"*, FAMU-FSU College of Engineering, Tallahassee, FL, February 14 (2014)
179	Lobodin, V.V.; Rodgers, R.P. and Marshall, A.G., *APCI and APPI-GC/MS for Characterization of the Macondo Oil Spill*, 2014 Gulf of Mexico Oil Spill and Ecosystem Science Conference, Mobile, AL, January 26-29 (2014)
180	Lobodin, V.V.; Rodgers, R.P. and Marshall, A.G., *APGC/MS for Characterization of the Macondo Crude Oil and the Oil Spill*, 248th Amer. Chem. Soc. Natl. Mtg, San Francisco, CA, August 10-14 (2014)
181	Lu, J.; Bai, H.; Gavrilin, A.V.; Zhang, G.; Markiewicz, W.D. and Weijers, H.W., *AC Losses of ReBCO Pancake Coils Measured by a Calorimetric Method*, Applied Superconductivity conference, Charlotte, NC, Aug. 10-15 (2014); Published in IEEE Trans. Appl. Supercond. (2015)
182	Ludwig, J.; Vasilyev, Yu. B.; Mikhailov, N.N.; Poumirol, J.M.; Jiang, Z..; Vafek, O.; Smirnov, D., *Cyclotron resonance of single valley Dirac fermions in a gapless HgTe quantum well*, APS March meeting, Denver, CO, March 6 (2014)
183	Mahmoudian, S.; Dobrosavljevic, V. and Miranda, E., *Landau theory of Anderson localization and STM spectra in Ga1−xMnxAs*, Americal Physical Society March meeting, Denver, CO, March 3–7 (2014)
184	Mahmoudian, S.; Dobrosavljevic, V.; Tang,S. and Miranda, E., *Landau-Ginzburg theory of Anderson localization*, Gordon research conferences, Mount Holyoke College, 21-27 (2014)

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185	Mao, L.; Chen. Y.; Chen, Y.; Kaiser, N.K.; Marshall, A.G. and Xu, W., *Toward Determination of Ion Collision Cross Sections for Biomolecules within FT-ICR Cells*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
186	Mareci, T.H., *The Virtual Brain*, 3rd Society for Industrial and Applied Mathematics Gators Conference, University of FL, Gainesville, FL, March 27-29 (2014)
187	Marshall, A.G., *40 Years of Fourier Transform Mass Spectrometry: Progress and Prospects*, 20th International Mass Spectrometry Conf., Geneva, Switzerland, August 24-29 (2014)
188	Marshall, A.G., *Fourier Transform Ion Cyclotron Resonance Mass Spectrometry: State of the Art*, 90th FL Annual Meeting & Exposition, Innisbrook, FL, May 8-10 (2014)
189	Marshall, A.G., *Ultrahigh Resolution Mass Spectrometry: Extending the Size and Detail of Biomolecule Structure Analysis*, 66th Southeast Regional Mtg. of the Amer. Chemical Soc, Nashville, TN, October 16-19 (2014)
190	Marshall, A.G.; Blakney, G.T.; Chen, T.; Chen, Y.; Hendrickson, C.L.; Kaiser, N.K.; McIntosh, D.G.; McKenna, A.M.; Quinn, J.P.; Rodgers, R.P. and Weisbrod, C.R., *Optimization of Mass Range, Dynamic Range, Signal-to-Noise Ratio, Mass Resolution, and Mass Accuracy for Characterization of Petroleum by FT-ICR Mass Spectrometry*, 248th Amer. Chem. Soc. Natl. Mtg., San Francisco, CA, August 10-14 (2014)
191	Marshall, A.G.; Blakney, G.T.; Chen, T.; Chen, Y.; Hendrickson, C.L.; Kaiser, N.K.; McIntosh, D.G.; McKenna, A.M.; Quinn, J.P.; Rodgers, R.P. and Weisbrod, C.R., *Optimization of Mass Range, Dynamic Range, Signal-to-Noise Ratio, Mass Resolution, and Mass Accuracy for Characterization of Oil Spills by FT-ICR Mass Spectrometry*, 2014 Gulf of Mexico Oil Spill and Ecosystem Science Conference, Mobile, AL, January 26-29 (2014)
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193	Marshall, A.G.; Blakney, G.T; Kaiser, N.K.; McKenna, A.M.; Rodgers, R.P.; Weisbrod, C.R. and Young, N.L., *NSF National High Field Fourier Transform Ion Cyclotron Resonance User Facility: Instrumentation, Science Drivers, Structure, and Operation*, PittCon 2014, Chicago, IL, March 2-6 (2014)
194	Marshall, A.G.; Chen, T.; Blakney, G.T; Hendrickson, C.L.; Kaiser, N.K.; McKenna, A.M.; Rodgers, R.P.; Weisbrod, C.R. and Young, N.L., *Fourier Transform Ion Cyclotron Resonance Mass Spectrometry: State of the Art*, 247th Amer. Chem. Soc. National Mtg., Dallas, TX, March 16-20 (2014)
195	Marshall, A.G.; Clingenpeel, A.C.; Jarvis, J.M.; Lu, J.; McKenna, A.M.; Podgorski, D.C.; Robbins, W.K.; Rodgers, R.P. and Rowland, S.M., *Petroleomics: GC/GC and LC to Separate Functional Groups and/or Isomers, and Increase Dynamic Range to Complement Elemental Compositions Resolved and Identified by Ultrahigh Resolution FT-ICR Mass Spectrometry*, PittCon 2014, Chicago, IL, March 2-6 (2014)
196	Marshall, A.G.; Lobodin, V.V.; Corilo, Y.E.; Lalli, P.M.; Krajewski, L.C.; Rowland, S.M.; McKenna, A.M. and Rodgers, R.P., *Petroleomics: Characterization of Crude Oil by Fourier Transform Ion Cyclotron Resonance and Ion Mobility Mass Spectrometry*, Petromass 2014: 10th Int'l Mass Spectrometry Conf. on Petrochemistry and Enviornmental, Tbilisi, Georgia, September 1-4 (2014)
197	Marshall, A.G; Beaslely, R.L.; Clingenpeel, A.C.; He, H.; Jarvis, J.M.; McKenna, A.M.; Robbins, W.K. and Rodgers, R.P., *Ultrahigh-Resolution Mass Spectrometry for Separations: Petroleomics to Proteomics*, HPLC 2014: 41st Int'l Symposium on High Performance Liquid Phase Separations and Related Techniques, New Orleans, LA, May 11-15 (2014)
198	Martens, M.; van Tol, H.; Bertaina, S.; Barbara, B.; Muller, A.; Miyashita, S. and Chiorescu, I., *Spin Hamiltonian analysis of the SMM V15 using high field ESR*, APS March Meeting 2014, Denver, CO, March 5 (2014)
199	McElhenie, S.D.; Wozniak, A.S.; Shelley, R.U.; Landing, W.M. and Hatcher, P.G., *Source-Specific Characteristics Of Aerosol Organic Matter Over The North Atlantic Ocean: Implications For The Identity Of Potential Iron Binding Ligands*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
200	McGuire, D.; Hill, S.; Brown, H.; Dellinger, K.; Niu, R.; McRae, D.; Han, K.; Xin, Y. and Lu, J., *Heat Treatment Sensitivity of ITER Nb3Sn Wire*, Applied Superconductivity Conference, Charlotte, NC, August 10-15 (2014)
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202	McKenna, A.M.; Chen, H.; Lemkau, K.T.; Nelson, R.K.; Valentine, D.; Reddy, C.M.; Rodgers, R.P. and Marshall, A.G., *Biodegradation at the Seafloor: Ultrahigh Resolution FT-ICR Mass Spectral Characterization of Natural Petroleum Seeps in the Gulf of Mexico*, Int'l Oil Spill Conference, Savannah, GA, May 5-8 (2014)
203	Meeker, M.; Magill, B.; Bhowmick, M.; Khodaparast, G.A.; McGill, S.; Feeser, C.; Wessels, B.W.; Saha, D.; Sanders, G.D. and Stanton, C.J., *Magneto-Optical and Time-Resolved Spectroscopy in Narrow Gap MOVPE Grown Ferromagnetic Semiconductors*, American Physical Society March Meeting, Denver, CO, March 3-7 (2014)
204	Mironov, O.A.; Morris, R.J.H.; Dobbie, A.; Hassan, A.H.A.; Leadley, D.R.; Berkutov, I.B.; Bengus, S.V.; Uhlarz, M.; Green, E.; Zvyagin, S.; Wosnitza, J.; Helm, M.; Drachenko, O.; Shi, Q.; Zudov, M.A.; Kozlov, D.V.; Gavrilenko, V.I.; Orlita, M.; Zhang, Qi; Kono, J. and Suslov, A.V., *Magnetotransport, Cyclotron Resonance (10 GHz-4.5 THz) and GHz-MIRO Investigations in the Range 25 mK - 300 K and up to 35 T for the 2DHG with Ultra-high μ > 10^6 cm^2/Vs in Ultra-pure Strained sGe-QW on Si_{0.2}Ge_{0.8}*, 21st International Conference on High Magnetic Fields in Semiconductor Physics, Panama City Beach, FL, August 3-8 (2014); Published in Program of HMF-21 (2014)

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205	Morton, P.L. and Landing, W.M., *Dissolved Trace Metals In The Indian Ocean: Results From The Clivar/Repeat Hydrography I8s/I9n And I5 Cruises*, AGU/ASLO Ocean Sciences Meeting, Honolulu, HI, Feb. 23-28 (2014)
206	Morton, P.L. and Landing, W.M., *Too Much Cd in the western North Pacific: Sources, sinks and the biological response*, FL American Chemical Society, Palm Harbor, FL, May (2014)
207	Morton, P.L.; Landing, W.M. and Grand, M., *Dissolved trace metals in the Indian Ocean: CLIVAR I8S/I9N and I5 cruises*, Ocean Sciences Meeting 2014, Honolulu, HI, February (2014)
208	Morton, P.L.; Weisend, R.E.; Landing, W.M.; Fitzsimmons, J.N.; Hayes, C.T. and Boyle, E.A., *Trace Element Cycling in Lithogenic Particles at Station ALOHA*, American Geophysical Union Fall Meeting, San Francisco, CA, December 15-19 (2014)
209	Mueller, R.; Zhang, S.; Zhang, C.; Koros, W.J.; Lively, R. and Vasenkov, S., *Microscopic Diffusion of Ethylene in 6FDA/DAM – ZIF-8 Mixed Matrix Membranes Using NMR Diffusometry*, 2014 American Institute of Chemical Engineers (AIChE) Annual Meeting, Atlanta, GA, November 16-21 (2014)
210	Mueller, R.; Zhang, S.; Zhang, C.; Koros, W.J.; Lively, R. and Vasenkov, S., *Microscopic View on Different Types of Transport of Light Gases in Mixed-Matrix Membranes: A Diffusion NMR Study*, 2014 American Institute of Chemical Engineers (AIChE) Annual Meeting, Atlanta, GA, November 16-21 (2014)
211	Mun, E.-D.; Chern, G.-W.; Pardo, V.; Rivadulla, F.; Sinclair, R.; Zhou, H. D.; Zapf, V. S.; Batista, C.D., *Magnetic Field Induced Quantum Phase Transition in Multiferroic Vanadium Spinels*, APS March Meeting, Denver, CO, March (2014)
212	Murray, J.; Vafek, O., *Renormalization group study of excitonic and superconducting order in doped honeycomb bilayer*, APS March Meeting, Denver, CO, March, 3 (2014)
213	Murray, J.M., *Topological and superconducting orders in two-dimensional quadratic band crossing systems*, University of Pennsylvania, April (2014)
214	Ngatia, L.; Hinz, F.; Normand, A.; Inglett, K.S.; Inglett, P.; Chanton, J. and Reddy, K.R., *Drivers of Methanogenesis Pathways In Subtropical Wetlands: FL Everglades As A Case Study*, Soil Science Society of America, Long Beach California, November 2nd-5th (2014)
215	Ni, Ni; Mun, E. D.; Jiang, Shan,; Zapf, V. S.; Cava, R. J.; Bauer, E. D.; Ronning, F., *Two band superconductivity in optimal doped Ca10(Pt3As8)(Fe2As2)5 superconductors revealed by anisotropic Hc2 measurement up to 65T*, APS March Meeting, Denver, CO, March (2014)
216	Niu, R.M. and Han, K., *Influence of Boundary Coherency on Stability in Nanotwinned Cu*, Materials Research Society, Boston, MA, Dec. 1 (2014)
217	Normand, A.E. and Reddy, K.R., *Carbon chemistry of peatland soil across climate zones*, Soil and Water Science Research Forum, Gainesville, FL, September 13 (2014)
218	Normand, A.E.; Hodgkins, S.B.; Smith, A.N.; Chanton, J.P.; Clark, M.W. and Reddy, K.R., *Chemical composition of soil organic matter in a subarctic peatland: Influence of shifting vegetation communities due to increased inundation*, Joint Aquatic Sciences Meeting, Portland, OR, May 20 (2014)
219	Oh, Y.; Artyukhin, S.; Yang, J. J.; Zapf, V. S.; Kim, J. W.; Vanderbilt, D.; Cheong, S.-W., *Non-hysteretic colossal magnetoelectric effect in a collinear antiferromagnet*, APS March Meeting, Denver, CO, March (2014)
220	Ozaki, T.; Si, W.; Zhang, C.; Wu, L.; Jaroszynski, J. and Li, Q., *Superconducting Properties of ion-irradiated iron chalcogenide films*, Applied Superconductivity Conference, Charlotte, NC, August 10-15 (2014)
221	Ozarowski, A., *High-Field EPR Studies on Binuclear and Polynuclear Transition Metal Complexes*, 3rd Forum EMR-PL, Cracow, Poland, June 23-26 (2014); Published in Conference Proceedings (0)
222	Ozarowski, A., *High-Field, High-Frequency EPR Investigations of the Metal-Metal Interactions in Small Transition Metal Cluster Complexes*, 37th International EPR Symposium, Copper Mountain, CO, July 13-17 (2014); Published in Conference Proceedings (0)
223	Ozarowski, A., *Metal-Metal Interactions in Polynuclear Complexes: High-Field EPR Studies*, Department of Chemistry, Kansas State University, Manhattan, KS, 09/11 (2014)
224	Paulino, J.; Hung, I. and Cross, T.A., *Dynamics of Influenza A M2 Proton Channel.*, Global and Local Motions in the Transmembrane Domain and in the Full Length Protein International Conference on Magnetic Resonance in Biological Systems, Dallas, TX, August 24-29 (2014)
225	Paulino, J.; Hung, I. and Cross, T.A, *Dynamics in thetransmembrane segment of the Influenza A M2 Proteon Channel*, 58th Annual Biophyscs Society Meeting, San Francisco, CA, February 15-19 (2014)
226	Perrot, V.; Eller, V.A.; Landing, W.M. and Salters, V.J.M., *Investigation Of Methylmercury Bioaccumulation And Detoxification In Gag Grouper (Mycteroperca microlepis) From The Northeastern Gulf Of Mexico Using Hg Stable Isotopes*, 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference, Mobile, AL, January 26-29 (2014)
227	Perrot, V.; Eller, V.A.; Landing, W.M. and Salters, V.J.M., *Mercury Stable Isotopes As Tracers Of Hg Cycling In The Water And Food Webs Of The Northeastern Gulf Of Mexico*, 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference, Mobile, AL, January 26-29 (2014)
228	Perrot, V.; Landing, W.M. and Salters, V.J.M., *Understanding Atmospheric Hg Deposition Above A Coastal Area Of The Gulf Of Mexico (Pensacola, FL) Using Hg Stable Isotopes*, 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference, Mobile, AL, January 26-29 (2014)
229	Petrovic, C., *Electronic Correlations and Thermoelectric Performance ofFeSb2 and (Sr,Ca)MnBi2*, Institut für Festkörperphysik TU Wien, Wien, Austria, April (2014)

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230	Petrovic, C., *Two dimensional Dirac fermions in bulk crystals*, Institute of Physics, University of Belgrade, Belgrade, Serbia, July (2014)
231	Petrovic, C., *Two dimensional Dirac fermions in bulk crystals*, The 7th Workshop for Emergent Materials, Max Planck/POSTECH, Postech, Korea, July (2014)
232	Petrovic, C., *Two-dimensional Dirac fermions in bulk crystals*, Budapest University of Technology and Economics, Budapest, Hungary, April (2014)
233	Podgorski, D.C.; Ray, P.Z.; Chen, H.; McKenna, A.M.; Rodgers, R.P.; Marshall, A.G. and Tarr, M.A., *Photochemically-Induced Leaching of Water-Soluble Organics from Macondo Crude Oil into the Environment*, 62nd Amer. Soc. for Mass Spectrometry Conf. on Mass Spectrometry & Allied Topics, Baltimore, MD, June 15-19 (2014)
234	Popovic, D., *Magnetic-field-driven superconductor-insulator transition in underdoped* $La_{2-x}Sr_xCuO_4$, invited talk at the International School and Workshop on Electronic Crystals (ECRYS-2014), Cargese, France, August (2014)
235	Popovic, D., *Magnetic-field-tuned superconductor-insulator transition in underdoped* $La_{2-x}Sr_xCuO_4$, invited talk at the conference Superstripes 2014, Erice, Italy, July (2014)
236	Popovic, D., *Quantum critical behavior in the magnetic-field-tuned superconductor-insulator transition in underdoped La2-xSrxCuO4*, invited talk at the 59th Annual Magnetism & Magnetic Materials Conference, Honolulu, HI, November (2014)
237	Popovic, D., *Superconductor-insulator transitions in underdoped* $La_{2-x}Sr_xCuO_4$, condensed matter physics seminar, Rutgers University, February (2014)
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290	Takano, Y., *Spin-1/2 Heisenberg antiferromagnets in one dimension*, University of Tennessee, Knoxville, TN, October 20 (2014)
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CHAPTER 5
In-house Research

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IN HOUSE RESEARCH GROUPS

MAGNETS & MAGNET MATERIALS

Introduction

A central feature of the MagLab's mission is the provision of unique, high-performance magnet systems that exploit the latest materials and magnet design developments for our users. As we move forward, the maintaining a balance of development of new magnet systems with development of new technology is of critical importance to keep us at the forefront. Collaborations with other leading industrial, academic and government groups that develop these new magnet technologies is built in to many of these thrusts.

Executive Summary

During 2014 the MagLab made significant progress on all fronts. In particular:

1) The 26 T resistive - superconducting hybrid magnet for neutron-scat-tering at the Helmholtz Zentrum Berlin (HZB) (**Figure 1**) has been fully assembled and tested to 26 T, 1 T beyond specification! This is the result of a seven-year cable-in-conduit magnet-development collaboration between the Berlin lab and the maglab. The magnet provides 52% higher field than any other neutron-scattering magnet worldwide and should be the centerpiece of the HZB user facility for years to come. This hybrid magnet includes many first: it has a horizontal bore, it has a conical bore to allow 30° of scattering both upstream and downstream from the sample, it is mounted on a swivel to allow it to rotate about a vertical axis and maximize the use of the conical scattering space.

Figure 1: *The 26 T hybrid magnet for HZB has reached full field and moved into the neutron guide-hall. Final system testing is expected in March 2015.*

2) The cold-mass, cryostat, and current-leads for a 36 T hybrid magnet for NMR and other experiments at FSU (**Figure 2**) have been completed. This magnet should reach full-field in late 2016 and provide stability and uniformity of 1 ppm over a 10-mm-diameter spherical volume. This magnet will provide a unique combination of field and uniformity to enable new condensed-matter NMR experiments to become feasible. The superconducting coil is a copy of the one recently tested for HZB. The resistive insert will use shimming technology developed by Oxford NMR and demonstrated in the MagLab's Keck magnet in 2013. The stabilization system has been developed by Prof. Jeff Schiano of Penn State and also demonstrated in the MagLab's Keck magnet.

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3) Testing of the MagLab's largest coils to-date using High-Temperature Superconductors (HTS) was completed in August 2014. These prototype coils **(Figure 3)** use all the same technology and components as the real HTS coils of the 32 T all-supercondcuting magnet which is being developed for installation in the MagLab's DC Field facility. The only difference is the coils are shorter and contain fewer modules than the real coils will. This test not only demonstrated HTS coils on a larger scale than had been done previously, but it included quenching the magnet from high current eighty times without degradation. The outer Nb-based coils for the 32 T magnet arrived in late 2014 from Oxford Instruments and should pass final acceptance testing in March 2015. All the YBCO tape for the HTS coils has arrived and we anticipate reaching full field in early 2016. When operational, this magnet will be the first high-field system to use HTS materials in a magnet that operates routinely as a scientific instrument.

Figure 2: *The 36 T hybrid magnet for FSU is entering the final assembly phase in cell 14 of the DC Field facility in Tallahassee. In early Feb. 2015 the 5.5-ton cold-mass was mated to the 6.5-ton cryostat for the first time.*

4) Significant progress was made in the evaluation and understanding of the 2 principal HTS conductors presently being employed at the MagLab. A huge amount of Quality-Assurance testing of the ReBCO conductor destined for 32 T was achieved. Although most of the conductor was accepted some conductor-lengths were out of specification. We also found evidence of an almost inevitable consequence of having such a highly engineered nano material, namely that the critical current density properties, which depend intimately on nanoscale defect concentrations, varied considerably. Our continuous evaluation machine for coated conductors entered routine service and contributed significantly to our understanding of these variations in properties.

Collaborations on the development of round wire Bi2212 continued very effectively, brokered by a collaboration supported by High Energy Physics (HEP) involving the US HEP magnet labs, US industrial partners and CERN. In particular we have been able to broaden the supplier base for Bi 2212 powder and to much better understand the role of the powder properties in determining the critical current density properties of Bi2212. This conductor work has very significantly supported our effort to demonstrate the value of this multifilament round wire conductor for high-resolution NMR. The test magnet Platypus, described later, is aimed at generating about 8T in a 16 T background in mid 2015. Although many aspects of the technology of overpressure processed 2212 are challenging in such a coil context, good progress has been made.

Figure 3: *Prototype coils for the HTS section of the MagLab's 32 T all-superconducting magnet were quenched 80 times without degradation.*

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HTS Magnets & Materials

32 T Magnet

The 32 T project is an ambitious undertaking to develop the first superconducting user magnet above 25 T, which is intended for long-term use as a research instrument at the NHMFL **(Figure 4)**. We intend to equip it with a dilution-refrigerator or variable-temperature insert. In concept, it consists of a 4.2 K, 15 T, 250 mm bore Low- Temperature Superconductor (LTS) magnet, developed by Oxford Instruments (OI) for this purpose, and two High-Temperature Superconductor (HTS) coils developed and built at the NHMFL and generating 17 T. The two HTS coils consist of dry-wound double pancake modules using Rare-Earth-Barium-Copper-Oxide (REBCO) tape conductor provided by SuperPower, Inc. Insulated co-wound stainless steel tapes provide reinforcement and turn-to-turn electrical insulation. Quench-protection is provided by a dedicated quench-detection system and quench-heaters embedded between modules. A multi-year targeted magnet-technology-development phase has preceded the present prototype-testing phase. Construction of the HTS coils and integration with the LTS outer magnet is expected to take place in 2015, followed by tests and operation to 32 T in the first half of 2016.

Prototype testing provides the last opportunity to test design choices and evaluate assembly procedures at a reduced scale. After the successful testing of the 32 T Coil 1 (inner) prototype in 2013 [1], a Coil 2 (outer) prototype was built and the Coil 1 prototype reworked. The prototype coils are built according to the design of the two HTS coils in 32 T, except for a reduced height. The combined prototypes use 1.9 km of REBCO tape, which represents about 20% of the HTS conductor mass in 32 T. A background field of 11.5 T was provided by the superconducting "outsert" of the 45 T Hybrid magnet. Removal of its resistive coils provided enough space to mount a 250 mm inner diameter cryostat to operate the prototype coils for the 32 T at 4.2 K. Data was collected from a large number of signals, including voltage taps on each of the 12 modules and the four terminals, the quench heaters, from an array of Hall sensors and a flow sensor on the helium vent.

As the first part of the test plan, quench initiation studies were performed, where the time and energy required generating a local normal zone is determined for various positions within the coils. It proved possible to introduce normal zones everywhere, even areas where the temperature-margins were in the range of 25-40 K. Sixty-six quench-

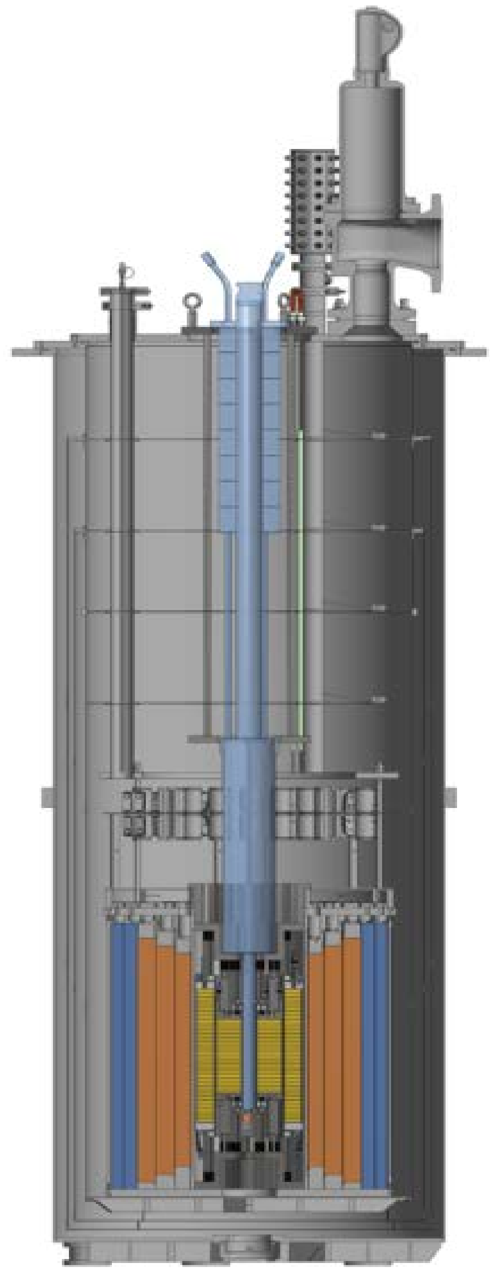

Figure 4: *Schematic view of the 32 T magnet system with some key cryostat dimensions (left) and a cross sectional view (right) with the LTS coils in bright blue (NbTi) and red (Nb3Sn), the REBCO coils in yellow and a dilution refrigerator in light blue.*

initiation runs were performed, using a dump-resistor to extract energy and protect the HTS coils. Next, quench-propagation experiments as a function of the coil operating-current and quench-heater power were used to determine the time needed to protect the HTS coils using only the quench-heaters to reduce their coil-current Figure P2) The shot History of the 100 T magnet since s and distribute

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the stored energy. Data from these 84 runs, all without observable coil degradation, is now being used to validate the 32 T quench analysis software [2].

Load cycling experiments on Coil 2 demonstrate that it can be operated above design stress (40 cycles to 110% of design stress and 2 cycles to 120%) without observable degradation. Voltage data from the coils during energization and de-energization imply that coil expansion and contraction under the Lorentz-forces is not as smooth as desirable. Measures to remedy this have been developed and will be tested in the next and presumably last round of prototype testing.

Shielding currents in the HTS tapes, a phenomenon inherent to the 4 mm wide tape single-filament architecture, cause minor hysteresis in the central magnetic field [3] that is quite reproducible and therefore predictable.

Helium boil-off was measured during all experiments to quantify the ramping losses [4], which continue to be lower than our initial expectations. This data is now used to develop and validate numerical codes to predict ramping losses in 32 T. Lower loss favorably implies lower helium-consumption during 32 T operations.

Testing of the reduced-height prototypes for both Coil 1 and Coil 2 of the 32 T magnet demonstrate that the prototype coils are quite robust, can handle load cycling above design stress, and can be protected with the present quench-heaters. The data obtained are used to validate numerical codes for quench-analysis in order to finalize the quench-protection parameters

LTS Outer magnet: Oxford Instruments fabricated the 15 T / 250 mm bore LTS outer magnet and its cryostat, and demonstrated compliance with all specifications in tests at their factory. Included in the specifications are the ability to ramp to 15 T in one hour, fully recover from a manually-induced quench at 15 T, and the ability to reach 15.3 T. The latter specification serves to prove that there is a reasonable margin when operating at 15.0 T with an HTS coil-set installed. Shipping and delivery took place in December 2014, somewhat delayed from initial expectations but within the timeframe set out in the purchase-agreement. The outer magnet is slated for a second round of testing, in early 2015 at the NHMFL, to complete the purchasing process. To ensure compatibility of the HTS and LTS coils, fruitful discussions on the mechanical interfaces and interaction between the LTS and HTS sections during quench took place and will continue through the review, assembly and test phases of the 32 T system.

REBCO conductor: SuperPower Inc. delivered the required amount of REBCO conductor in the second half of 2013 and the first half of 2014. Routine Quality Assurance measurements on fourteen parameters were carried out at the NHMFL, some using MS&T staff and facilities and with significant support from the ASC particularly for the critical current measurements and cross-sectional image analysis. Non-routine characterization measurements were performed on an ad-hoc basis and the results shared with the vendor, to help improve the production process. Whereas the delivered conductor met most specifications and demonstrated a general increase in critical-current performance with time, meeting the specification for the amount of copper stabilizer proved challenging for a large fraction of the deliveries. In collaboration with the NHMFL, the vendor identified and addressed a key factor affecting the copper amount and shape, demonstrating full compliance with the 32 T specifications. After consideration, the NHMFL has increased the specified acceptable range of copper, bringing most delivered conductor within the new specification, and SuperPower has committed to replace the previously delivered conductor that does not meet the new specification. In general, interactions with the vendor over the past years have led to the availability of commercial REBCO conductor that is suited for application in magnets, with a larger set of specifications and better run-to-run consistency of all specified parameters.

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REBCO Coated Conductor Evaluation Characterization and Development

About 10 km of REBCO conductor will be used for the 32 T all superconducting user magnet now under construction at the NHMFL. Developing a product specification requires that many properties are defined with specific tolerances. These specifications and the long lengths involved are challenging for conductor manufacturers. Here we describe the quality assurance (QA) procedures that we have established. Because of the large anisotropy of Jc, Ic (4.2K) of 4 mm wide tapes is specified at 17 T and at 18° angle between the tape plane and B, since this appears to be the critical orientation imposed by the large radial fields in the end pancakes. Because the

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tape is being delivered in ~100 m lengths, many joints are needed, making their resistance critical. In addition, the RRR, the magneto-resistance of the Cu stabilizer, the tape dimensional tolerances, and general property variability along length are all of great importance to the magnet designer and builders. To approach an understanding of the causes of Ic differences at 77K and 4.2K among delivered tapes, we measured R(T) and calculated bulk Tc. We present here a summary of findings on a 5 x 110 m of delivered conductor. A key result of the evaluation is shown in **Figure 5.**

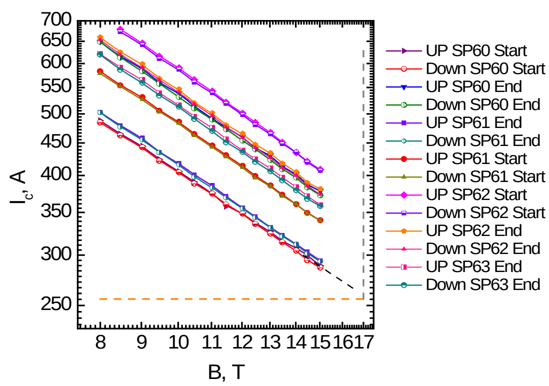

***Figure 5**: Representative selection of Ic(B) curves measured at 4.2 K with 18 degrees between sample plane and B. Dashed horizontal line represents 256 A minimum specified at 17 T. "Start" and "End" notes mark samples that were cut from the inner and outer spool ends. The 17 T, 18 degrees measurement is made because this is believed to define the minimum Ic position in the 32 T magnet. It arises from the strong angular anisotropy of Ic in REBCO.*

A representative selection of critical current (I_c) evaluations shows substantial variation from short samples cut from the leading and trailing ends of each length used for winding a pancake in the 32 T magnet. The cause of this variation is not yet fully understood and provides one of the justifications for the more extended lengthwise determination of critical current described below.

Because I_c is determined both by the vortex pinning occurring in the conductor and by the cross-section that is actually carrying supercurrent, it is not always easy to understand which one of these 2 factors is the primary determinant of I_c. Another considerable complication in the design of any magnet system is the fact that the vendor of coated conductors warrants their conductor in terms of an I_c measured at 77 K, self-field. For high field magnet use at 4.2 K there is often only a very weak or even an anti-correlation between the 77 K and 4 K measurements, as is indicated in **Figure 6.**

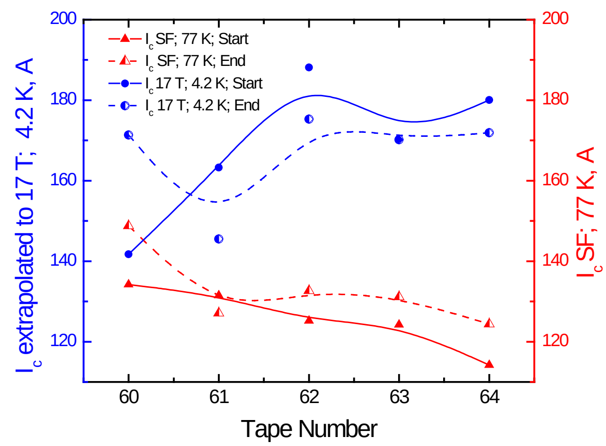

***Figure 6:** Anti-correlation between Ic at SF; 77 K and Ic extrapolated to 17 T from data obtained at 4.2 K at B perpendicular to tape plane. Lines are guides for the eye.*

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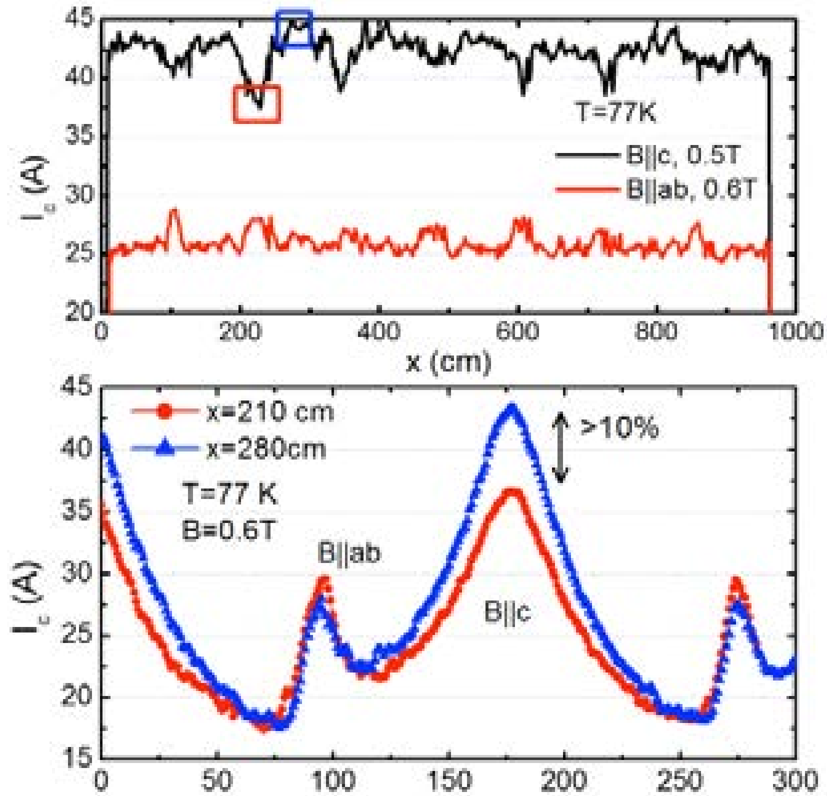

***Figure 7 (a):** Ic(x) with B||ab-plane, and B || c-axis.; **(b).** Angular dependence of Ic at the circled points.*

Characterization of the lengthwise variation of the superconducting properties: We continued work on continuous I_c measurements in REBCO CC using our unique reel-to-reel YateStar setup originally developed at LANL and subsequently heavily modified at the NHMFL. This instrument makes it possible to measure I_c as a function of position with a precision of ~ 2 cm in two different magnetic fields, one being of variable field orientation using the 4-probe transport method. A Hall probe array was added to YateStar that measures I_c from magnetization data. It measures J_c laterally across the width of the tape and also along the length of the tape, where it can resolve I_c on a scale of mm, which is ~20 times smaller than is possible by transport. We use this setup to characterize all conductor lengths destined for the 32 T all-SC magnet now in construction, as well as for more fundamental work aimed at understanding the nature of the spatial I_c inhomogeneity in REBCO that has appeared from the huge amount of QA testing done for 32 T.

Coated conductors (CC) made of REBCO are now produced in kilometer lengths. One of the issues applying CC (e.g. building magnets) is the variation of I_c along the length. In the recent conductors, $BaZrO_3$ nanorods are engineered as vortex pinning centers to increase the I_c(H) capability. In general, the measured I_c is controlled first by vortex pinning so that I_c(x) variations can stem from pinning center density and type variations at the nanometer scale, as well as variations in connectivity determined by obstructions to current flow such as blocking grain boundaries, second phase, cracks or variations in thickness or width. Studying the variations of I_c can provide important insights into the relations between I_c and the physical and chemical structures of the CC, and thus can give us feedback on how to improve the I_c value and homogeneity of CC during fabrication process. **Figure 7(a)** shows an example of such a study of I_c(x) for B off-the-tape plane (B||*c*-axis) and B|| in-plane (B||*ab*-plane). It is clearly seen that the observed minima of $I_c(x)$ for the off-plane configuration correspond to a maximum for in-plane B. **Figure 7(b)** shows the angular dependence of I_c ($I_c(\theta)$) at the extrema marked in (a). It is seen that $I_c(\theta)$ at x = 210 cm has substantially lower *c*-peak than that at x = 280 cm, while vice versa for *ab*-peak. This is in a good accordance with **Figure 7(a).**

The observed anti-correlation between the in- and off-plane I_c also shows up in other samples. It strongly suggests that either there is Zr deficiency in the region of lower *c*-peak, or Zr does not contribute to columnar defects. While TEM would discriminate between these mechanisms, the observed variations for sure cannot be explained by just cross-sectional changes along the conductor.

"Platypus": An HTS Demonstration Magnet to Generate High Field, Homogeneity, and Stability Using Bi-2212 Round Wire

One important goal at the NHMFL is developing high-field NMR-quality magnets beyond 30 T (>1.27 GHz) using high temperature superconductors (HTS). In an effort to evaluate HTS conductor use in NMR magnets, we have built and characterized several test coils using conductors made from two of the most promising available materials, Re-

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$Ba_2Cu_3O_{7-x}$ (REeBCO) coated conductor tape and $Bi_2Sr_2CaCu_2O_{8-x}$ (Bi-2212) round wire. Some of these coils achieved substantial field increments in high background fields of 31 T [1]. HTS tape conductors, however, have a highly aspected superconducting filament structure and in the case of REBCO the superconducting layer is essentially a single filament with the filament width equal to the tape width. Hence in coils wound with tape, substantial screening currents can be induced, particularly in sections where the radial field components are high. The decay of these currents causes substantial magnetic field drift, which affects the temporal stability of the field generated.

In contrast to tape conductors, Bi-2212 can be made in the much more desirable isotropic, round wire, twisted multifilament architecture that can be wound or cabled into arbitrary geometries, which are particularly valuable for high field NMR magnets as well as magnets with low inductance. Recent progress at the NHMFL processing Bi-2212 conductor using overpressure processing has significantly increased the critical current density in Bi-2212 [1,2,3].

We are in the process of building a layer-wound HTS demonstration magnet using Bi-2212 round wire that is expected to generate about 6.5 T inside a 16.5 T low temperature superconducting (LTS) outsert magnet made by Oxford Instruments. This test coil has been dubbed “Platypus” as it is seen as the first step towards an HTS mammal in an age of LTS dinosaurs. A pair of layer-wound Bi-2212 compensation coils will be used with it to achieve field homogeneity ($z^2 + z^4$ compensation) targeting the ppm range over 10-mm DSV. A cross-section of the whole insert assembly and its integration into the outsert magnet is shown in **Figure 8.** The central solenoid will be about 240 mm long at an ID of 44 mm and an OD of about 92 mm. About 700 m of 1.3 mm diameter conductor will be used for the main solenoid. A variable temperature insert (VTI) cryostat made by Oxford Instruments creates a 27 mm warm bore for an NMR probe that is being designed and built by the NMR science group of the NHMFL. The central solenoid and the compensation coil pair will be powered in series. Conductor on Round Core (CORC) cables made by Advanced Conductor Technologies (ACT) will be used as high-field bus-bars for the magnet.

The conductor and coil R&D has generated several results that are very important for the success of the project. Multiple test coils of various sizes have been tested to evaluate concepts and manufacturing procedures *e.g.* addressing the question of coil roundness given the orthocyclic winding approach which is most suitable for round wire. Design studies have shown that the circularity (roundness) of the coil is essential to generating a homogeneous field profile. Since the coil geometry has such a critical influence on the field homogeneity, a full size mock-up coil was made with copper wire using a winding approach that successfully addressed the issue as shown in **Figure 9.** Two other test coils that contain design features of the actual solenoid have been built

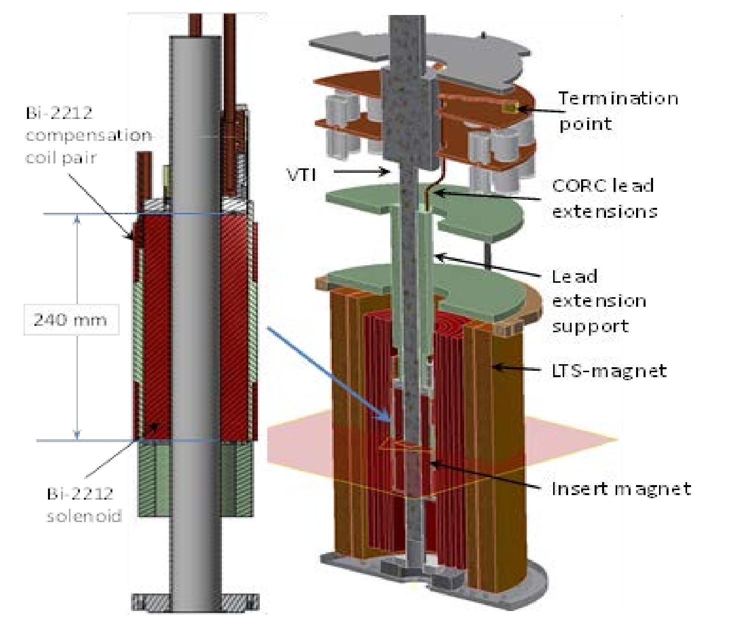

Figure 8: *Vertical section of the Platypus insert magnet assembly and integration into the LTS outsert magnet.*

to evaluate the heat treatment procedure and the in-field properties of the actual coil-design, particularly focusing on the performance of coil-terminals and Lorentz-force-induced stresses. One of these test coils incorporates most of the design elements of the actual coil at 10% of its actual height. This coil will be tested in the NHMFL large bore resistive magnet to evaluate coil-terminal and stress properties. The second coil has the same height as the actual coil but has only four layers. Its purpose will be to evaluate heat treatment parameters and the potential influence of conductor densification on the integrity of the coil.

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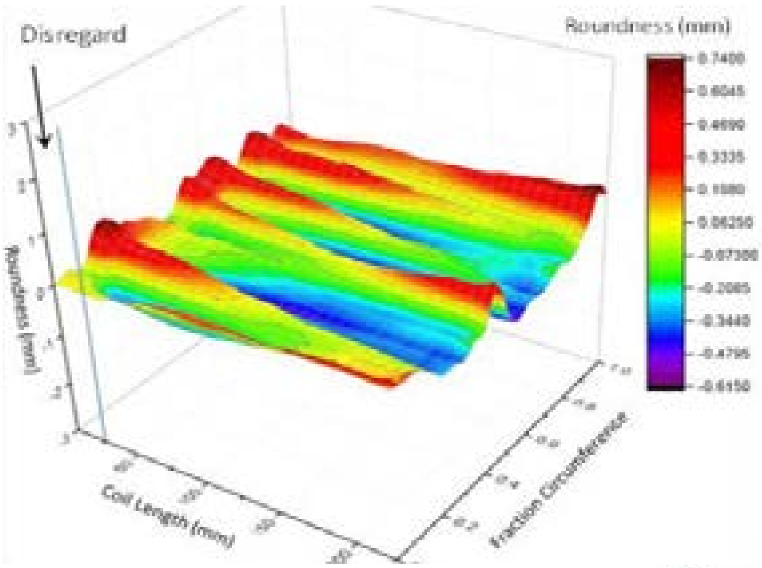

Figure 9: *Coil roundness vs. coil length and coil circumference as measured on the mock-up coil shows the viability of the orthocyclic winding approach with circumferentially distributed wire cross-overs between coil layers. Note: perfectly round = 0 mm.*

Densification that occurs during the overpressure heat-treatment decreases the wire diameter. An approach to limit the possible adverse effect of the conductor densification on coil integrity has been tested successfully, and will be part of the coil test.

Using Bi-2212 conductor in coils requires an electrical insulation that can withstand the high temperatures of the required heat treatment. An in-house conductor-insulation route was set up that can insulate continuous length of several hundred meters. It uses a dip-coating approach to apply a continuous thin TiO_2 film on the conductor and is currently being used to insulate the first piece-length of conductor for the actual HTS insert magnet. Several test runs have shown that a fairly homogeneous average coating-thickness of around 34 μm can be achieved in long conductor lengths. The coating thickness as measured with a laser micrometer during the coating process is shown in **Figure 10**. A new overpressure furnace, shown in **Figure 11,** has been installed and is currently undergoing calibration. This furnace will be used to heat treat this and future Bi-2212 wire wound coils up to 50 cm long and 15 cm in diameter at up to 100 bar total pressure. The furnace is discussed in more detail below.

Extensive finite element analysis (FEA) was performed on various aspects of the insert magnet. Magnetic field profiles were measured for the outsert magnet and then computed for the HTS insert. Thermal contraction of the insert magnet system was studied to predict the field-profile shift and thus allowing for proper room-temperature coil alignment. Mechanical stresses caused by both thermal contraction as well as Lorentz forces were modeled to ensure that the design does not exceed the stress limits of the Bi-2212 conductor. We believe that these design and test procedures will yield an HTS magnet system capable of generating the desired field quality.

The implementation of Bi-2212 conductor in magnets presents challenges at the conductor and at the magnet level. We are very fortunate to have substantial support

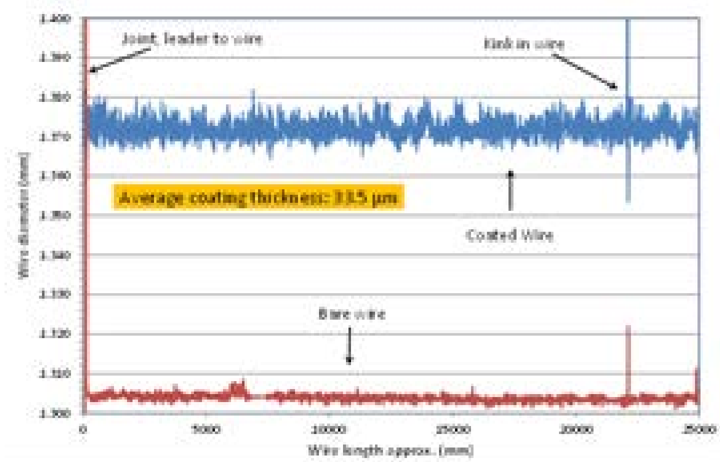

Figure 10: *In-line laser-micrometer measurements of the diameter of a 25 m length of wire while dip-coating the TiO_2 coating. A fairly homogeneous average coating thickness of around 34 μm can be achieved in long conductor lengths.*

from DOE-Office of High Energy Physics for conductor development in collaboration with the principal manufacturer of 2212 wire, Oxford Superconducting Technology, and to the HEP-supported national laboratory groups at BNL, FNAL, and LBNL.

Several of these challenges towards our ultimate technological goal of establishing Bi-2212 as a conductor of choice for HTS high-field and high-homogeneity magnet systems have been met successfully.

This work was also supported by a grant from the National Institute of Health under 1 R21 GM111302-01.

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Figure 11*: View of the new 100-bar overpressure furnace in closed (left) and open position (right) showing the full-size mock-up of the Platypus Bi-2212 coil mounted on a sample holder at the location inside the furnace where the actual coil will be heat-treated.*

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2212 Conductor Development

The fundamental premise of our Bi-2212 conductor development is that high current-density (actually a higher overall current-density than is presently possible in either Bi-2223 or REBCO CC) is possible when overpressure processing that densifies the wire is applied, removing the voids and defeating the deleterious effects of internal gas pressure generated by gas, or gas-making impurities (CO_2 and H_2O), trapped in the only ~70% dense filaments. Together they are the drivers for 2212 dedensification and low connectivity because gas agglomerates as filament-blocking bubbles and because of swelling of the Ag produced by gas-pressure induced creep. Thus all 1-bar studies that used I_c, J_c or J_E as evaluation parameters are suspect because they have not been able to control the highly uncertain and variable role of internal gas as a significant current-limiting mechanism (CLM). For this reason, we are studying the underlying science of this new generation of high-density, bubble-free 2212 conductors produced largely by overpressure (OP) processing. We organize our work around three main themes:

- Thrust 1 describes experiments aimed at understanding the relative importance of vortex pinning and connectivity limitation in determining J_c, by using the variation of the irreversibility field H_K as a marker for pinning and separately by evaluating the impact of 2nd phase and the grain boundary network on obstructing current flow within the filaments.
- Thrust 2 describes processing studies that deconstruct the present complex process using OP to avoid bubbles so as to allow study of what controls J_c in fully-dense conductors.
- Thrust 3 describes experiments aimed at defining what constitutes “good” powder and construction of a pilot scale powder production capability. This system was designed to provide new 2212 compositions intended to drive 2212 formation closer to completion, with the goal of increasing vortex pinning, improving phase purity and reducing 2nd phase current blockers. Having set up this capability with the help of an independent consultant, Alex Otto of Solid Material Solutions Inc. (SMS), we have transferred this capability to him so that he can attempt to scale up and industrialize this powder production process.

Our work is carried out within the broader Bismuth Strand and Cable Collaboration (BSCCo) involving coordinated efforts at BNL, FNAL, LBNL and the NHMFL. This US–based effort also supports the EUCARD2 effort led by CERN. Because we are the US point of contact between EUCARD2 and the BSCCo + OST effort, we developed a set of driving questions to better orient our collective work for advancing the technology of Bi-2212 RW conductors for high-field magnet applications. A key component of EUCARD2 was support by CERN directly to Nexans to reopen powder production; however, Nexans Superconductor is moving from Cologne to Hannover and will no longer produce 2212 powder after the move. This makes evaluating the performance of powder made at SMS and the two other US companies that recently began making powder (MetaMateria and nGimat) critically important for 2212 conductor development. We have been evaluating wires made by these three companies in using OP processing. This will continue in 2015.

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Table 1. *Overpressure (OP) furnace capabilities*

Furnace description	Maximum total pressure (bar)	Hot zone dimensions		Comments
		Diameter (cm)	Length (cm)	
Small 100 bar	100	2.6	17	Mainly used for research
MTI – 25 bar	25	4.8	8	Used for research and collaborations
MTI – 100 bar	100	4.5	15	Regularly used for collaborations
Deltech 100 bar	100	15.0	50	Undergoing final commissioning

Knowing the OP processing is a secure route to high *J* in long-length wires, we broadened our study-base in 2014 to try to strengthen all aspects of 2212 technology from the powder to the wire to the coil technology. We have 3 small OP processing furnaces **(Table 1)** with which we made samples for more than 10 outside collaborators. The NHMFL has funded a large OP furnace that can process 15 cm diameter, 50 cm long coils at 100 atm pressure. We will make this available to outside collaborations, especially to our HEP collaborators at BNL, CERN, FNAL, and LBNL.

Overpressure furnace-development at the NHMFL: Overpressure (OP) processing has greatly increased the critical current density, J_c, in Bi-2212 round wire [1]. OP processing requires special high-pressure furnaces that can go to 900 °C, apply 100 bar gas pressure to the Ag-sheathed wire, and have the Ar and O_2 gas mixture flow through the furnace. The high pressure and temperature densify the Bi-2212 wire, which increases J_c. We have several small OP furnaces for research, but we needed a larger furnace to OP process the Bi-2212 insert coil for Platypus. This past year we have been bringing on line what is the world's largest OP furnace dedicated to Bi-2212 studies. Description of the OP furnaces: We now have 4 OP furnaces listed in Table 1. Three are relatively small and one is large enough for the Platypus and future high-field coils. No company had a large off-the-shelf OP furnace, so we worked with Deltech to build the large OP furnace we needed for Platypus. The furnace, which is shown in **Figure 11 (above),** was designed with safety in mind. Once it was delivered we still had additional design and engineering to do on the furnace. We had to modify some components and to make it easier to operate the furnace, to further improve its safety, to homogenize both the hot zone and Ar/O_2 gas mixture in the furnace. Vertical furnaces are notoriously difficult to establish a long, homogeneous hot zone. To overcome this we are adding a stirrer, to make it like a convection oven that will circulate the hot gas to establish a longer, more homogeneous hot zone.

The capabilities of our four OP furnaces are shown in the table. With just the three small OP furnaces, we have done a lot of OP processing for the Bi-2212 community. With the new, larger Deltech furnace we already have collaborations with other groups to process larger coils. We did not know of any other high pressure furnace with a stirrer in it.

Fe-based Superconductors

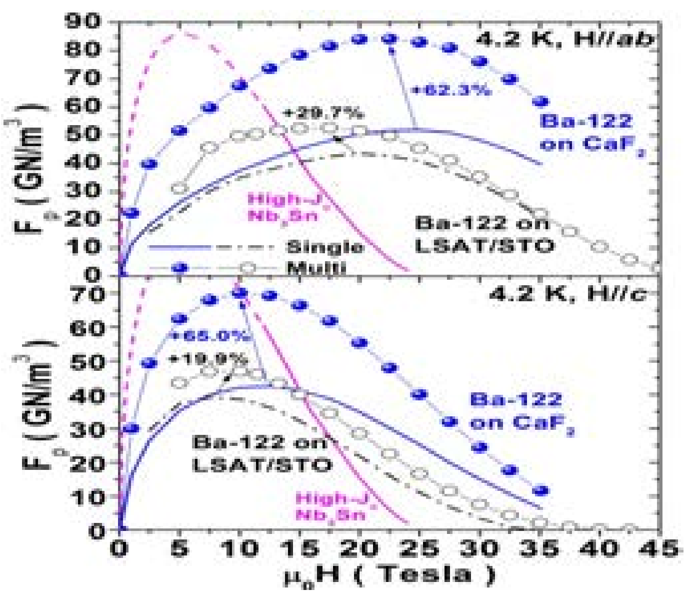

***Figure 12**: F_p curves on the single and multilayer Ba122 thin films deposited on CaF_2 in comparison with similar films deposited on LSAT and with high-J_c Nb_3Sn wire.*

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Work on iron-based superconductors concentrates on those aspects most important for making them into practical conductors. In this report we highlight two aspects of this, one on the properties of bulk samples that could be suitable for making into multifilamentary conductors and the 2nd in which we concentrate on the very high critical current-densities possible in thin films.

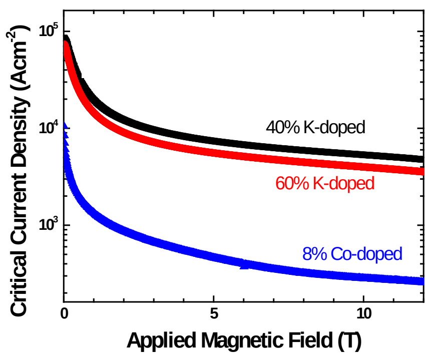

Figure 13: *Critical current density as a function of applied magnetic field for three superconducting samples with different dopants. [2]*

<u>Evidence for extrinsic impurity segregation at grain boundaries in high current-density K- and Co-doped $BaFe_2As_2$ (Ba-122) superconductors</u>

The problem of supercurrent-blocking at grain-boundaries (GBs) of complex superconductors is central to their use, so understanding whether this is intrinsic to their structure or induced by impurities or other artefacts is vital. We have shown that some Fe-based superconductors are very close to achieving the highly desirable critical current-density of 10^5 A cm^{-2} in strong fields [1], but we do not yet know whether blocking is an intrinsic or an extrinsic problem. Atom Probe Tomography (APT), which was done by Seidman's group at Northwestern University, enables high resolution, spatially resolved, mass spectrometry of GBs, resulting in unprecedented chemical analysis of GBs [2]. This data is correlated with electromagnetic characterization at the NHMFL **(Figure 13).** APT data presented in **Figure. 14** show that these high current-density superconducting Ba-122 polycrystals have significant GB compositional variations and oxygen impurities, suggesting there is a strong extrinsic component to weak links that may be overlooked by analytical TEM. Because high-field measurements revealed that samples with cleaner GBs carried significantly more current than samples with dirtier GBs, further development of our synthesis techniques are being

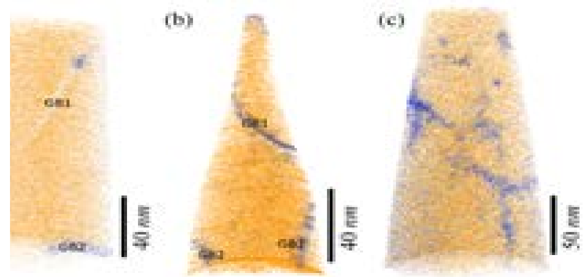

Figure 14: *3-D APT reconstructions of polycrystals showing oxygen (purple) segregating at grain boundaries in (a) 40% K-, (b) 60% K-, and (c) 8% Co-doped $BaFe_2As_2$ samples. [2]*

carried out to make samples with impurity-free GBs for use in future superconducting magnets.

<u>Critical-current and critical-field measurements made on thin films:</u> $Ba(Fe_{1-x}Co_x)_2As_2$ (Ba-122) is the most tunable of the iron-based superconductors (FBS) in terms of acceptance of high densities of self-assembled and artificially introduced pinning centres able to increase J_c. Moreover, FBS are very sensitive to strain, which can induce an important enhancement in critical temperature, T_c. In this work we study these two combined effects in Ba-122 films grown on CaF_2 substrate [1]. J_c measurements were performed at high temperature up to 16 T in ASC and at 4.2 K up to 35 T in DC field facility at NHMFL. Microstructure characterization was also performed in a JEOL ARM200cF transmission electron microscope (TEM) in order to identify the source of pinning.

We found that these new films have a T_c of 25.4-26 K, 3.2 K larger than in films deposited on LSAT [2]. **Figure 12** shows the field-dependence of the pinning force-density, $F_p = J_c \times \mu_0 H$, of single and multilayer films on CaF_2 compared with films deposited on LSAT. Ba-122 samples on CaF_2 perform much better reaching up to 84 GN/m^3 at 4.2 K (54 GN/m^3 on LSAT) and this change also underlies the T_c -improvement. Moreover for the multilayer sample deposited on LSAT, F_p increases 20 and 30% (*c* and *ab* directions, respectively) with respect to the single layer sample, whereas on CaF_2 the increase exceeds 60%. It is interesting to compare these results with Nb_3Sn, the conventional superconductor with the closest T_c in fact Ba-122 has a maximum of F_p similar to Nb_3Sn but at 10 and 22.5 T instead of 5 T. This result clearly shows why Ba-122 is considered of interest for applications.

The improvement in the CaF_2 samples is particularly remarkable considering their relatively clean microstructure. The single-layer film has no defects apart from a few threading dislocations (**Figure 15)**

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that have moderate pinning effect. In contrast, the multilayer film has multiple types of defects that act as strong pinning centers but their density is lower than that previously found in LSAT samples.

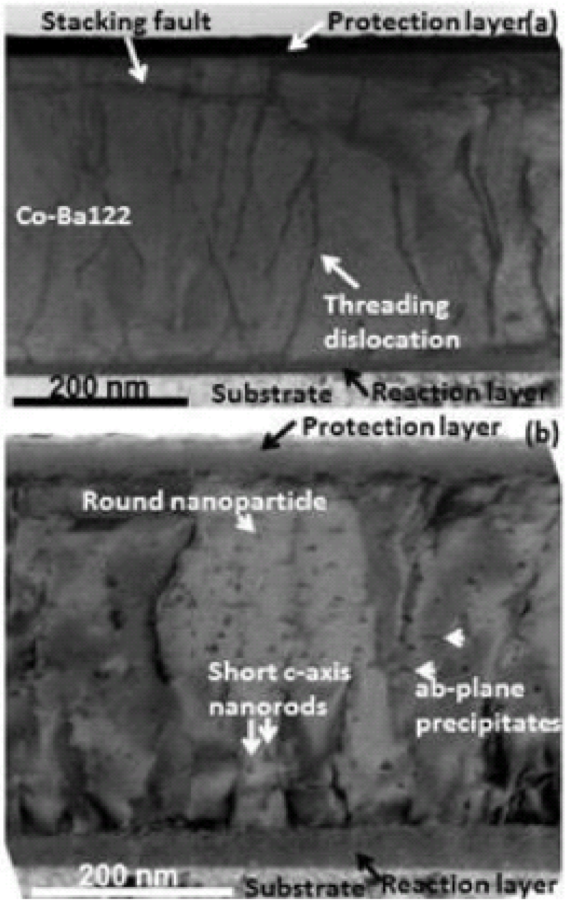

Figure 15: *TEM cross sections of single (a) and multilayer (b) Ba122 thin films on CaF2.*

We conclude that strain induced by the substrate improves J_c of both single and multilayer films by more than that expected simply due to the increase in T_c. Moreover the multilayer deposition of Ba-122 on CaF_2 increases F_p by more than 60% compared to a single layer film reaching the highest value ever reported in any 122 phase. These results make Ba122 a possible candidate for high-field applications.

LTS Magnets & Materials

HZB SCH

On March 29, 2007, the MagLab entered into a research collaboration with the Helmholtz-Zentrum Berlin (HZB) to build a 25-T, conical bore Series-Connected Hybrid (SCH) magnet for their neutron scattering center. The magnet system will be part of the Extreme Environment Diffractometer to study the structure and dynamics of materials, primarily high temperature superconductors. At 25 T and an opening angle of 30°, it will provide a significant increase in magnetic field strength and scattering angle that are presently available as shown in **Figure 16**. Now the collaboration is nearing a fruitful end with the successful operation of the hybrid magnet system to 26 T, exceeding expectations.

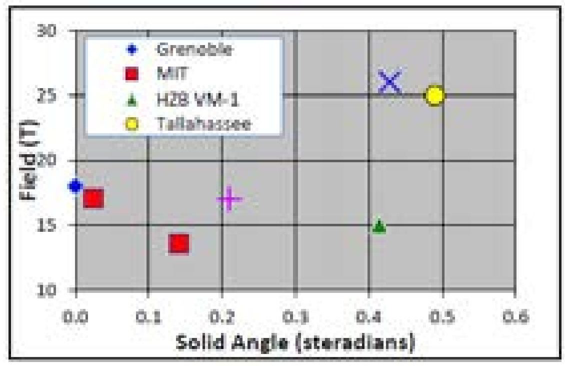

Figure 16: *Comparison of field and solid-angle of various magnets worldwide. The new MagLab/HZB magnet provides a 73% increase in field with a similar solid angle compared with the previous state-of-the-art magnet at HZB.*

Much of 2014 consisted of the final assembly of the cryostat around the superconducting coil and connection of the system to the house utilities. This includes connection to the helium refrigerator, high current power supply, chilled water system, and instrumentation/protection system. **Figure 17** shows the completed system as it stood in the "magnet assembly" hall. In spring of 2014 the resistive insert coils were inserted into the cryostat/insert housing as shown in **Figure 18**. Shortly after, an insert-only magnet test was conducted that brought the coil set to full current without incident. In late summer hybrid magnet testing took place in three stages: low (5 kA), mid (16 kA), and high (20 kA) current levels. The first two stages allowed time to adjust the quench protection, power controls, and cryogenic safety elements. The magnet reached 20 kA in Oct. 2014 without the outsert quenching and without the insert being adversely affected by the additional background field, which is often not the case.

Since the successful full-field test, HZB personnel have warmed up the system and moved it to its final location in the "neutron guide" hall where it will be interfaced with the beamline and experimental equipment.

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Figure 17: *The assemble HZB magnet.*

Figure 18: *Installation of the resistive coils into the cryostat.*

FSU SCH

The second hybrid magnet under construction should provide 36 T in a 40 mm bore with uniformity and stability of 1 ppm over a 10-mm diameter spherical

Figure 19: *5-ton cold-mass for FSU/NSF Series-Connected Hybrid Magnet.*

Early in the year the low-resistance joints that connect the multiple conductor piece-lengths were manufactured. Once completed the coil was placed

into volume, adequate for condensed-matter NMR. The cold-mass is essentially a copy of the one for HZB and has been completed. Substantial progress has also been made towards the cryostat, the cryogenic system, and the current leads.

its retort, where it underwent a vacuum leak check, and subsequently in its furnace for the reaction heat treatment for the formation of Nb_3Sn. Witness samples that were reacted along with the coil had yielded critical current and residual resistance ratio results indicating a positive outcome in the heat treatment.

The following critical process step of vacuum process impregnation was conducted as intended. Two high voltage tests were conducted to verify integrity of the insulation that had been made. This includes a Paschen test that checks for dielectric breakdown between the coil and its surroundings and a ringing surge test which checks for breakdown within the coil windings.

Since completion of the coil, the full cold-mass which consists of all components that operate at 4 K has been assembled as shown in **Figure 19**, is ready for assembly into the cryostat. Fabrication of the cryostat by an external vender, Criotec Impianti, was also completed in 2014. Once received at the MagLab it was quickly assembled and put to test along with the full cryogenic system. The turbined helium-refrigerator was connected to the cryogenic distribution box that unified the 45 T Hybrid, exist-

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ing large component test facility, and upcoming SCH. The 45 T Hybrid link was driven proved to work at the beginning of the year via a cool-down from room temperature to 4 K on that magnet. The SCH link was demonstrated late in 2014 through a cold test of the cryostat which contained a dummy heat load. After working out typical instrumentation and programming debugging issues the system was shown to yield 16 g/s at 300 W, which convincingly shows its adequacy for the SCH magnet. **Figure 20** shows the cryostat setup in the magnet cell during the cold test.

Figure 20: *Testing of the cryostat and cryogenic system for the FSU/NSF SCH.*

Fabrication of a pair of 20-kA current-leads for the MagLab Series-Connected Hybrid magnet was completed in 2014. A full-scale mockup lead was built first, to qualify and rehearse fabrication processes and quality assurance tests, including 11 weld, braze, and solder steps. Production of the leads followed. Technologies developed at the MagLab for the leads for the 45 T Hybrid magnet were used to fabricate the resistive section. The high-temperature superconducting section was made with stacked and soldered Bi-2223 conductors supplied by Sumitomo. The finished leads were shipped to the HFML Nijmegen for testing to full current **(Figure 21),** which was completed in January, 2015. The leads will be returned to Tallahassee in February for subsequent installation in the magnet cryostat.

Figure 21*: Finished pair of 20 kA current leads. Left – mounted to top flange of test cryostat. Right – mounted inside test cryostat, with power-supply cables attached.*

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Deconstruction of SULTAN-tested ITER CICCs

In the International Thermonuclear Experimental Reactor (ITER) being built in Cadarache in the south of France, the Central Solenoid (CS) coils are required to provide a 13 T peak magnetic field and maintain specifications over 30,000 plasma pulses; the severe cyclic Lorentz force loading of the brittle Nb_3Sn superconductor can result in degradation of the cable-in-conduit-conductor (CICC) and thus magnet performance. For this reason prototype cables for ITER were tested electromagnetically and thermally in the SULTAN facility in CRPP simulating magnet operation conditions to qualify the different designs. Almost all the CICCs degraded to some extent, and in order to understand this degradation, selected CS and TF conductors (a comparison of the TF and CS cables is shown in **Figure 22**) were sent to the Applied Superconductivity Center (ASC) at NHMFL for comprehensive macrostructural and microstructural analysis after testing.

Figure 22: *TF conductor (left) and CS conductor (right) with the jackets machined out and strands opened to show their transposition.*

Typically full SULTAN sample legs (~2.8 m) were supplied to NHMFL which allowed us to compare parts of the CICC that experienced full Lorentz force loading in the High Field Zone (HFZ) with regions subjected to less than 1 T in the Low Field Zne ("LFZ"). Sections were cut from the full lengths and either disassembled for individual component-analysis or impregnated with epoxy resin to fix the strands in place for subsequent cross-sectional analysis. Fully impregnated strand cross-sections were metallographically polished and then imaged using the Scanning Laser Confocal Microscope (SLCM) facility at ASC. The integrated digital stage and software of the SLCM allows us to create massive high resolution mosaics of conductor cross-sections with sufficient resolution to accurately determine the locations and sizes of the conductor components, allowing us to quantify their movement due to the Lorentz force loading. The SLCM also provides us with contactless measurement of surface roughness.

In addition, extracted strands for the disassembled sections were metallographically polished in longitudinal cross-section and were analyzed for frequency of Nb_3Sn filament breakage caused by the loading using high resolution FESEM images made along long lengths of extracted strands.

ASC fully analyzed six CS prototypes and two TF prototypes after their full tests at the SULTAN facility. As reported last year, all the CICCs tested to high magnetic field showed significant movement of the wires in the direction of the Lorentz force but some moved significantly more than others, depending on the CICC design and wire stiffness.

All the CICCs with significant wire movement had some degree of filament fracture. Our analyses showed that severe filament cracking during cyclic testing is usually associated with excessive bending of the strands around strand-to-strand cross-over pivot-points that are generated during cabling. The strands and sub-cables are twisted around each other at each stage of cable assembly to provide full strand transposition to reduce losses (as can be seen in **Figure 22**). It was found that use of a short first stage twist-pitch could mechanically lock the wires into position, eliminating filament fracture [1]. This is now the adopted solution for the production of CS CICC and it should allow the central solenoid to operate at designed fields over the full lifetime of ITER. However, we also examined a TF CICC which showed no degradation despite it having strands that showed high filament fracture densities **(Figure 23).** Subsequent analysis of both the full cross-sections and extracted strands resulted in an alternative model for reducing CICC degradation based on high strand-to-strand friction that prevents wire movement.

In **Figure 24** we show surface-roughness measurements made with the SLCM of strand surfaces from all eight ITER Nb_3Sn wire manufacturers and it is clear that there is a wide variation in surface roughness (these strands are all plated with Cr to

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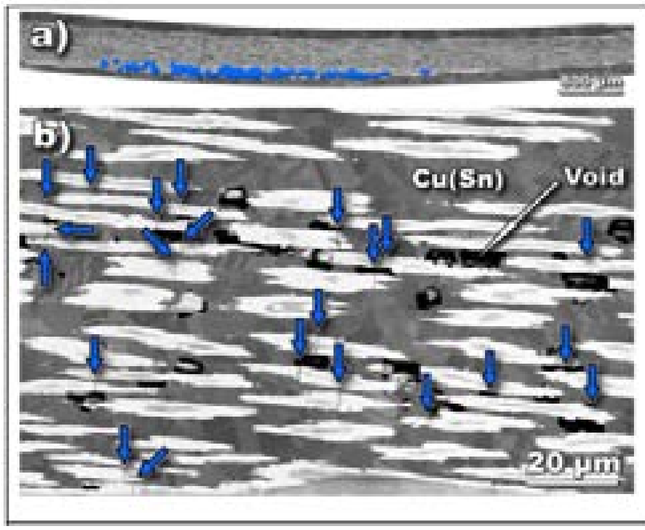

Figure 23 (a) Longitudinal cross-section of a strand extracted from the HFZ of a TF CICC that showed no Tcs degradation under cyclic loading. Filament fractures are highlighted by blue artificial markers. (b) A detail showing some of the filament fractures.

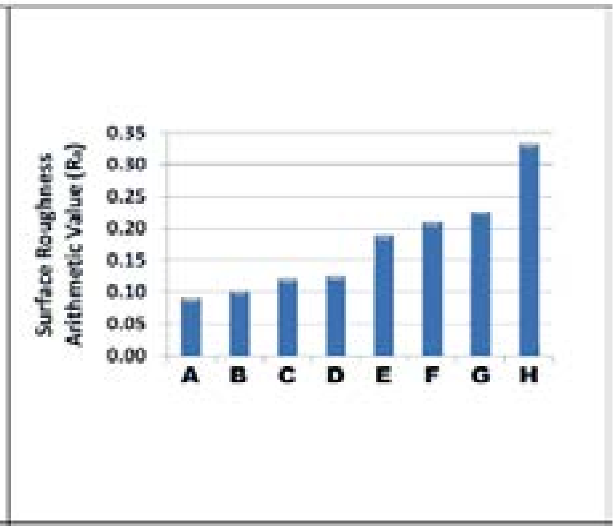

***Figure 24**: Surface roughness values for all eight ITER strand manufacturers. Supplierrs are labelled A-H to retain*

increase inter-strand resistance and stop strand-strand sintering during the Nb_3Sn reaction heat treatment). The strand with the highest surface roughness (manufacturer "H" on **Figure 24)** was the wire used in the anomalous TF CICC with low-degradation but high filament fracture (shown in **Figure 22).**

Graduate student Carlos (Charlie) Sanabria was awarded the 2nd Place prize in the competition for The Best Student Paper in Large Scale section of the competition at the 2014 Applied Superconductivity Conference, Charlotte NC, USA, for his presentation entitled "Autopsy of an ITER TF conductor without T_{cs} degradation reveals filament fractures and strand movement." His paper described this new model, which suggests that reducing strand movement by increasing the inter-strand friction (which rough Cr plating does) may be as effective in reducing cable degradation as locking the strands into place by employing short twist pitches. This may be an important tool in CICC design as it would provide more freedom in cable twist specification, which affects cable yield and AC loss.

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Optimization studies of high current density PIT and RRP Nb_3Sn wires

We here summarize the principal findings of our studies on Nb_3Sn (A15) RRP and PIT wires aimed for use in high energy physics quadrupole and dipole magnets:

1. In order to obtain high-field performance in Nb_3Sn wire the phase homogeny fundamental. We determine that the type of doping significantly affects the homogeneity of the A15 phase, changing the Sn diffusion kinetics and the equilibrium amount of Sn in the A15 phase. Studying the microstructure and microchemical composition of a 54/61 RRP® wire doped with Tantalum, we found significant composition gradients at the filament level (**Figure 25**) [1].

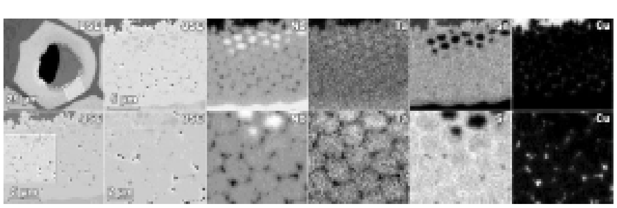

***Figure 25:** SEM images of a sub-element and of its A15 layer for a RRP® wire heat treated at 620°C for 192h (first column); EDS chemical maps of the different elements present in the same area (2nd-6th columns).*

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2. In order to protect superconducting magnets in case of quench the high purity of the Cu stabilizer has to be preserved by preventing diffusion barrier breaking and consequent Sn leakage into the Cu. We found that in RRP® wires the reduction of Sn quantity ensures Cu protection without significantly affecting the A15 phase properties. We studied the phase homogeneity of two RRP® wires made with standard and 5% reduced Sn, whose difference in non-Cu Jc was only 3-4%. Specific heat characterization showed that the phase-homogeneity of the two wires is substantially identical both at zero and high field. However, a slightly smaller amount of A15 phase produced in the reduced-Sn wire correlates well to its smaller J_c.
3. The critical problem that limits the magnet performance of both RRP and PIT strands is the degradation of the diffusion barrier and consequent loss of RRR in conductors damaged during Rutherford cable manufacture. We found that the filament damage-pattern changes with increasing deformation level, moving from the outer to the inner filaments. We found that the deformation should not exceed 15% in order to maintain a large RRR. In order to simulate the kind of damage occurring during cabling, we deformed PIT and RRP® wires by reducing their thickness by rolling. Before deformation we found that the external filaments have a slightly larger aspect ratio than the internal ones. In PIT this typically produces breaking of the diffusion barrier in 2-3 filaments in the 2 outermost rings [2]. **Figure 26** shows the deformation of a PIT wires with increasing thickness reduction (10% steps): we found that the aspect ratio progressively increases in the inner filaments producing more than 10 diffusion barrier breaks at 30% reduction [3].
4. J_c in PIT wire is 10-15% lower than in RRP Nb_3Sn wires, partly because of the presence of a large amount of poorly connectly A15 large grains that constitute one quarter of the total A15 phase and that do not carry current. We recently found that the ratio between small and large grains can be changed in favor of the well connected small grains: this could potentially increase the J_c performace. The SEM characterization of a PIT wire revealed significant difference in the composition of the filament cores. About 15% of the filaments had no residual Sn in the core revealing a better use of the Sn in the A15 phase formation. In fact these atypical filaments produce ~12% more small grains and ~25% less large grains **(Figure 27).** Obtaining such increase in the effective cross section of all filaments is highly desirable in order to increase the wire performance.

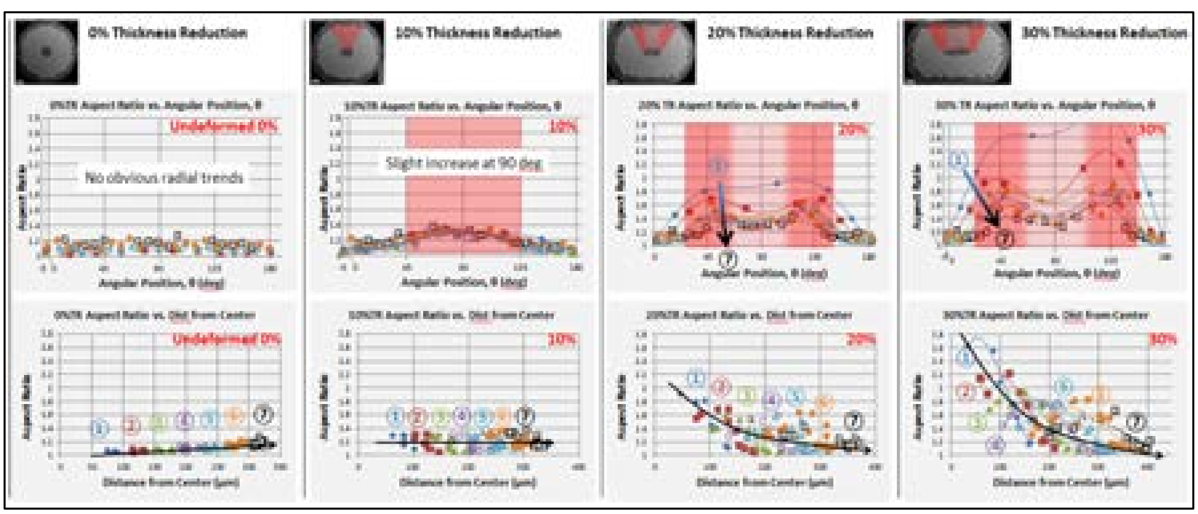

Figure 26: *Strand cross sections are shown with graphical representation of filament distortion characteristics. Aspect ratio of each filament in the top half of the cross section is displayed and grouped in rings, numbered 1 through 6 going from inner rings to outer rings.*

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References

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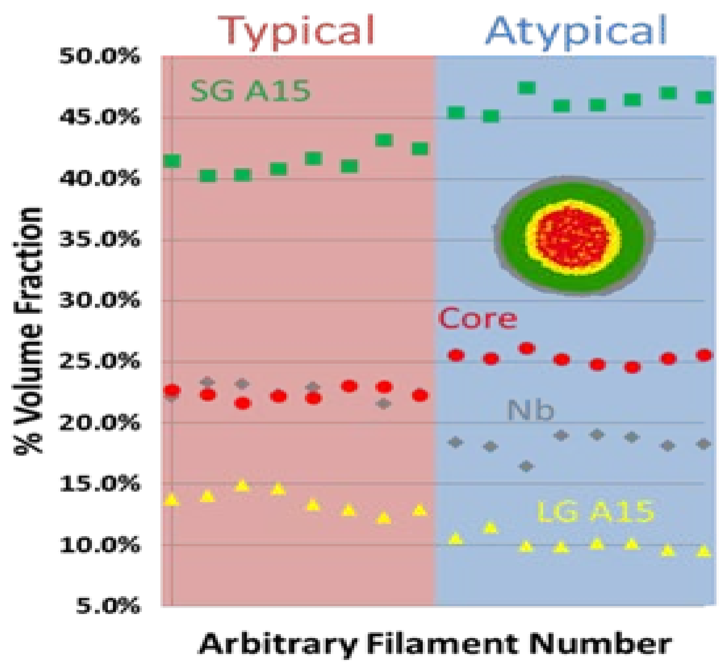

Figure 27: *Volume fraction of SG A15, LG A15, Nb barrier and core for 8 typical filament (left) and 8 atypical filaments (right) showing that the atypical one are able to produce more small grain A15.*

Structural Materials for LTS Magnets

High field magnets made by Cable-In-Conduit Conductor (CICC) technology require structural materials that should have high 4 K tensile strength and fracture toughness and large 4 K fatigue endurance. Most of the structural materials for CICC applications are austenitic stainless steels that should retain face-centered cubic structured phase at cryogenic temperatures. We studied Nitronic 50 and 316LN steels and compared their welds. The results will be used for CICC magnet design.

The 4 K tensile-test results of the Nitronic 50 base metal and the four welds are shown in **Figure** S1 as summary graphs of average tensile properties. The two upper graphs summarize the 4 K yield and tensile strength of the welds. The two lower graphs summarize the 4 K tensile ductility. The results indicate that N50W weld metals are stronger than 316LMN weld metals, where N50W is Nitronic 50 stainless steels for welding and 316LMN is a Mn-N-modified 316LN stainless steel. (The high Mn content in 316LMN content increases the solid solubility of N so that the material will have higher 4 K yield strength than 316 LN because of the enhanced interstitial solid solution strengthening by nitrogen. The materials should also have enhanced resistance to solidification cracking during

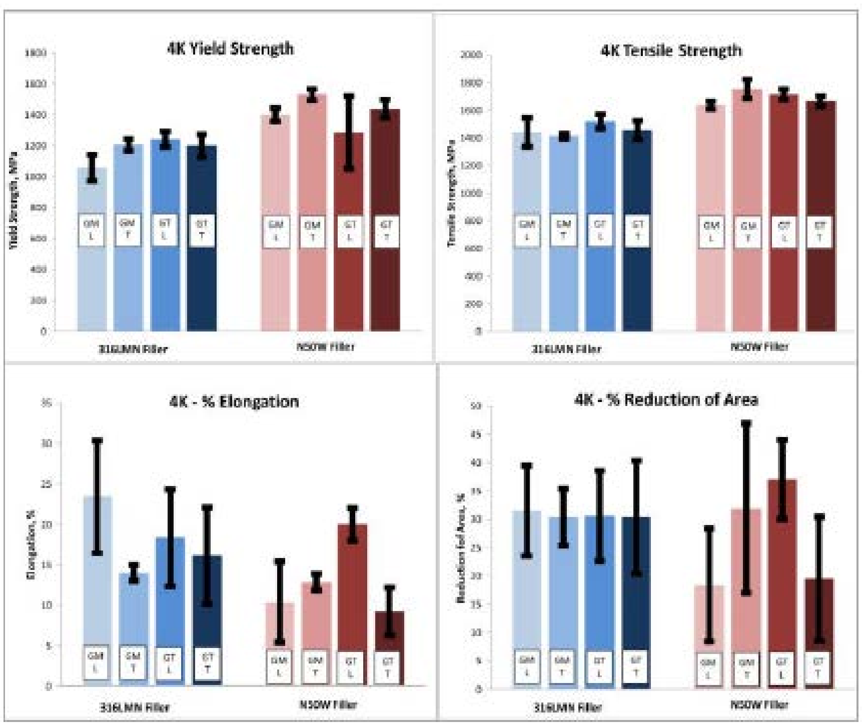

Figure 28: *Tensile properties summary graph comparing the 4 different weld metals. L and T indicate longitudinal and transverse direction of the materials.*

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the welding.) The aata also show that 316LMN welds are more ductile than N50W welds. In both types of materials, strength and ductility properties show no obvious anisotropy. In other words, although differences are observed in properties with respect to specimen orientation and/or location within each weld material there are no obvious or common trends in the subsets of data, i.e.; L (longitudinal) vs. T(transverse).

The 4 K fracture toughness test results demonstrated that the two welds made with 316LMN exhibit 4 K fracture toughness greater than 130 MPa $m^{0.5}$. The other two made with N50W filler have toughness below 70 MPa $m^{0.5}$. The N50W material's low toughness may be attributable to the welds' microstructure and related to low ductility of the materials. The N50W welds are observed to be ferromagnetic, indicating they contain ferrite, a body-centered cubic phase that usually shows low 4 K fracture toughness. The 316LMN welds do not show ferro-magnetic properties. This indicates that the material remains austenitic microstructure that is essential for 4 K ductility and toughness.

RESISTIVE MAGNETS & MATERIALS

Figure 29: *Snapshot of resistive housing during manufacturing (Hydrant 60% complete shown).*

Conical Bore Resistive Insert for Neutron Scattering. In 2012, the MagLab finished the design of a novel resistive insert for the Series-Connected Hybrid (SCH) magnet to be delivered and installed at the Helmholtz Zentrum Berlin (HZB) in Germany. This magnet design includes a *unique bore with 30 degree opening angle at world record 25 T central field* (*US patent no. 7,825,760*). The effective conical bore is created by stamping disks with different inner diameters and stacking them to form a series of steps.

Next, the NHMFL completed fabrication and assembly of the conical bore resistive insert coils which were successfully tested to full current in June 2014. Although conservatively planned for 12 T, the coils produced a central field of 13 T with expected coil resistances. Eventually, the NHMFL tested the combined system successfully to a world record 26 T magnetic field exceeding the design specification.

High Homogeneity Resistive Insert for FSU-SCH. In early 2014, the MagLab completed the electromagnetic as well as the structural design for a 4-coil resistive insert for the 36T 1PPM SCH. This insert employs a combination of axial current density grading in the A-Coil plus a ~22 mm gap in the B-Coil to meet the z^2-term homogeneity requirements. Furthermore, a design of the SCH resistive housing in compliance with the ASME BPVC was developed including a complete drawing package suitable for commercial fabrication of all magnet and housing parts **(Figure 29).** Meanwhile, with procurement starting mid-2014, fabrication of the FSU-SCH insert is well underway. The complete FSU SCH Magnet system is planned to be operational in 2015.

Resistive Maintenance. To support smooth operation of the resistive user program, the NHMFL has completed fabrication and assembly of fifteen spare resistive coils as part of the routine 2014 maintenance program. Considering that this is in addition to three coils delivered to HZB, this is an exceptionally high annual coil production volume (typically around ten coils per year). This increased replacement rate corresponds to the fact, that the NHMFL has in 2013 installed four spare coils built out of refurbished disks from prior coil assemblies after successful operation. Rebuilding coils yields shorter coil life times and requires additional in-house man-power compared to coil fabrication from new parts but still yields substantial overall cost savings particularly on the CuAg sheet metal.

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Pulsed

In 2014 we received a new shipment of CuNb wire from Rusnano corporation. This wire is to be used for new inserts for the 100 T magnet or high performance user magnets such as a new small bore user prototype magnet planned for production in 2015. **Figure 30** shows a simple bending radius test that we perform to ascertain the ability of the wire to be formed around a winding mandrel and the potential for fracture during the winding process. The figure shows a failed wire, which is not surprising given the material properties. A full series of cyclic fatigue, stress vs strain and microstructure analysis are performed on the wire as part of the certification process before use in pulsed magnets.

Figure 30: *CuNb wire failed radius test.*

As part of the upgrade project for the 100 T magnet a new coil #7, the largest coil for the 100 T magnet, was sent out for bid and we plan to procure the new coil#7 in 2015. The coil will be made to the same specifications as the existing coil #7. The inner coils of the magnet system are planned to be upgraded for increased level of performance by making use of different materials and modification of the design. In 2014 we fired a total of 100 shots on the 100 T magnet system with 46 being above 90 T. See **Figure 31.** The chart shows the total shots per year with a breakdown of shots for a given set of field ranges. The total number of shots on the 100 T magnet system is now above 1000 at the time of this report writing.

High Strength Conductors

In 2014, the National High Magnetic Field Laboratory (MagLab) directed a major effort towards the use and development of copper matrix composites as high-strength conductors. Cu-Ag is one of the strongest of these high-strength, metal-metal composites. As long as the size of the Ag fibers and the distances between them in the Cu matrix remain below 100 nm, Ag remains the strengthening component of the composite. To refine Cu-Ag to this

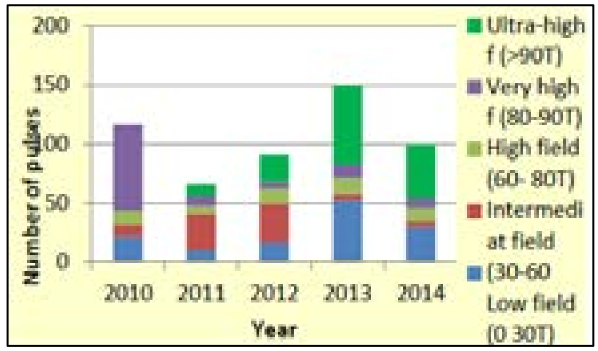

Figure 31: *The shot history of the 100T magnet since 2010.*

level, we used a combination of casting, deformation, and heat treatment. In order to achieve the highest possible strength while also maintaining the highest possible electrical conductivity, we had to fine-tune each of these procedures. The Maglab had been collaborating in researching this process with Tanaka Kikinzoku Group (Japan) and Northeastern University (China) and Dresden University of Technology (Germany). Tanaka and Maglab together studied a type of Cu-Ag that has a sheet geometry suitable for Florida-Bitter magnets. In collaboration with both Tanaka and Northeastern, the Maglab investigated how changing the fabrication procedure can affect the final properties of Cu-Ag composites. We found that large levels of lattice distortion resulting from severe plastic deformation may benefit strength but may also result in geometry distortion of Cu-Ag magnet conductors that complicates the manufacture of high field magnets. Thermo-mechanical fabrication procedures can be used to manage lattice distortion. For example, heat treatment can reduce lattice distortion but may also reduce mechanical strength. Maglab researchers discovered, however, that the strength of heavily deformed Cu-Ag composite showed no significant change as long as heat-treatments were done below

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Table 2: *Microstructure parameters of proeutectic Cu and Ag precipitates*

Region	Characterization	0T	12T
Proeutectic Cu	Length(μm)	115±3.0	114±3.9
	Dendrite arm spacing(μm)	51.2±3.6	60.3±2.7
	Volume fraction	82.2±1.7	85.5±2.1
Eutectic colony	Lamellar spacing (μm)	1.3±0.1	1.6±0.1
Ag precipitate in proeutectic Cu	Spacing (nm)	177±21	134±15
	Size (nm)	29±8	25±10

or around 200°C. At similar temperature ranges, engineers in Tanaka were able to reproduce these results using their own facilities. We also studied the impact of a high magnetic field (HMF) on the microstructure of Cu-Ag composites. **Table 2** compares microstructure parameters obtained in ingots solidified with and without 12 T HMF[1]. This table describes typical microstructure of hypoeutectic CuAg alloys using two components: (1) Cu-rich proeutectic dendrites embedded with Ag precipitates and (2) eutectic components that surround Cu-rich dendrites to form networks. The data show that an external 12T HMF increases both the average arm spacing of proeutectic Cu dendrites (by18%) and the spacing of eutectic lamella (by 20%), but it decreases the spacing of nano-sized Ag precipitates (by 24%). Reduced spacing between Ag precipitates may enhance mechanical strength in proeutectic Cu.

In 2014, MagLab also continued research on the Cu-Nb composites that are the major high-strength conductors now being used in pulsed magnets in high magnetic field laboratories in France, China, and the US. We plan to develop larger cross-section Cu-Nb conductors (>35 mm^2) for pulsed magnets with fields higher than 100 T. To achieve this goal, we began collaboration in 2013 with Nanoelectro, a Russian company. In 2014, Nanoelectro delivered the first batch of Cu-Nb conductor with cross-section greater than 15 mm^2. We characterized the basic properties of this conductor and found that it met the requirements for the new 80 T pulsed magnet. This will be a critical stepping-stone for building high field pulsed magnets of >100 T. In Cu-Nb composite, ribbons of Nb act as the strengthening component as long as the distance between ribbons is kept below 100 nm. To achieve this goal, we drew the composites to true strain greater than 10. We studied the evolution of the microstructure, hardness, strength, and electrical conductivity of *in-situ* Cu–Nb microcomposites as a function of drawing strain[2]. Both interface area-density and lattice-distortion were taken into account for analyzing hardness and resistivity at different levels of strain[3]. As expected, our results showed a decrease in the size of Nb filaments or ribbons with increasing strain. At low strain, most Nb filaments were deformed to thin bands or rods that are almost straight or slightly curved in cross-section. At large strain, Nb filaments became curled into ribbons. Deformation to a strain of 10 made all the Nb filaments curl and kink severely in our materials. We developed a model that describes the relationship between properties and microstructural dimensions including both spacing and curl of Nb ribbons. Based on this model, we derived a modified Hall–Petch formula. Our results suggest that interface area-density and lattice distortion have significant influence on both hardness and electrical resistivity. Our findings will impact the future manufacture of conductors for the next generation pulsed magnets.

Because coherent twin boundaries (TBs) in Cu have both high stability and high strengthening effects, the MagLab has also continued to study nanotwinned (NT) Cu. In 2014, we investigated the effect of boundary coherency on properties of NT Cu and were able to make NT Cu foils with about 99% coherent TBs[4]. By studying at atomic scales, using a high-angle annular dark-field scanning transmission electron microscope, we were able to relate stored energy and hardness (strength) of NT Cu to the interaction between dislocations and {111}-TBs. If fewer mobile dislocations occur at

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coherent TBs (CTBs) in as-deposited NT Cu, the material can develop a rare combination of stability and hardness. The introduction of numerous incoherent TBs (ITBs) reduces both stability and hardness. For example, deformed NT Cu, a material that is characterized by large numbers of ITB, exhibits high dislocation density and TB mobility. Thus, it has an increased driving force for recovery, coarsening, and recrystallization because it stored more energy in unstable ITBs than in stable CTBs. Consequently, as-deposited NT Cu is more suitable than as-deformed NT Cu for high field magnets.

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CONDENSED MATTER SCIENCE

NHMFL Condensed Matter Sciences

This section gives a few examples of the ongoing scientific activity by NHMFL in-house condensed matter scientists, both on the experimental and the theoretical front. It is not a comprehensive overview of these activities. This year, a main theme of the section is the developing capacity of investigators at the Laboratory to grow materials in-house, and to measure the resulting samples using the NHMFL's world-class magnets. This "vertical integration" capability gives enormous flexibility for optimizing materials systems, both for the clearest signatures of new physical effects, and for potential applications.

A) Experimental

A.1) Single crystal synthesis and characterization

An example of vertical integration which has yielded material with the potential for commercialization, is ongoing work in the groups of J. Whalen and T. Siegrist on the wide bandgap semiconducting oxide Ba_2TeO. This layered material has a direct gap of 2.9 eV that is tunable down to 1.65 eV by controlled doping with bismuth. Sizeable plate-shaped single crystals of ~ 1 cm^2 can be easily grown from BaO powder and elemental tellurium in a pure barium molten metal flux with near 100% yield using methods developed at the NHMFL. The structure of Ba_2TeO is related to the PbFCl-type, with an additional atom in the unit cell. The stoichiometry of this phase is stable in the molten metal fluxes used for synthesis, yet it melts incongruently and has moderate air sensitivity which has hidden this material from research until now. In fact, sintering BaO and BaTe powders at moderate temperatures will still not produce Ba_2TeO.

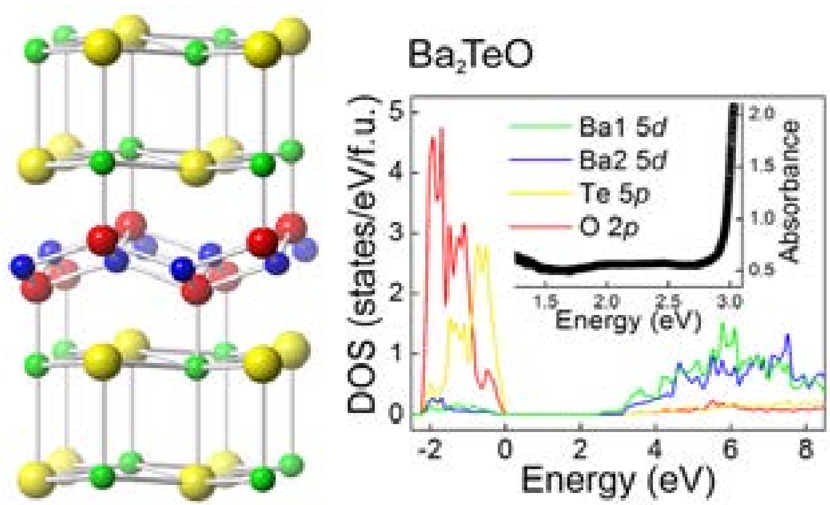

Figure A.1 *Left: The structure of Ba_2TeO is comprised of alternating BaTe (green-yellow) slabs of puckered rocksalt-type, and BaO (blue-red) layers related to a high-pressure phase. Right: Density of states calculations and optical was also used to grow the full lanthanide series absorbance measurements (inset) show that Ba_2TeO is a wide bandgap semiconductor with a gap of 2.9 eV. The valence band edge is dominated by the Te 5p states while the conduction bands are dominated by the Ba 5d states.*

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Collaborative research with Ba_2TeO is underway with further optoelectronic investigations, and the potential for technology transfer including the patent filing for Ba_2TeO as a new composition of matter. Oxide phase formation in molten barium of $BaLn_2O_4$, and structural as well as physical properties have been determined. In $BaLn_2O_4$, the lanthanide atoms form triangular chains, where antiferromagnetic interactions are potentially frustrated. This is reflected in the higher magnetic exchange interaction strength versus the observed low antiferromagnetic ordering temperature. Crystal field effects influence the low temperature magnetic susceptibility, with strongest effects observed for the Ce and Yb compounds.

A.2) Development of X-ray diffractometer for high magnetic fields

An NHMFL group led by Professor Theo Siegrist has continued development and improvement of a new X-ray diffractometer, which operates in the split coil 25 T magnet. This instrument will be a widely applicable and uniquely powerful tool for examining structural transitions induced by high magnetic fields.

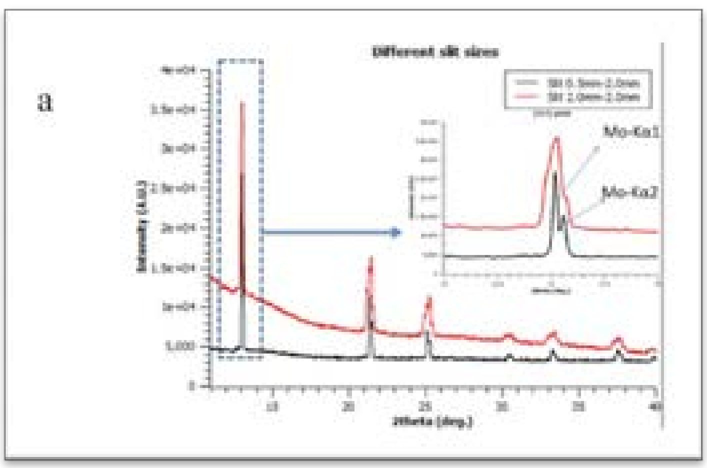
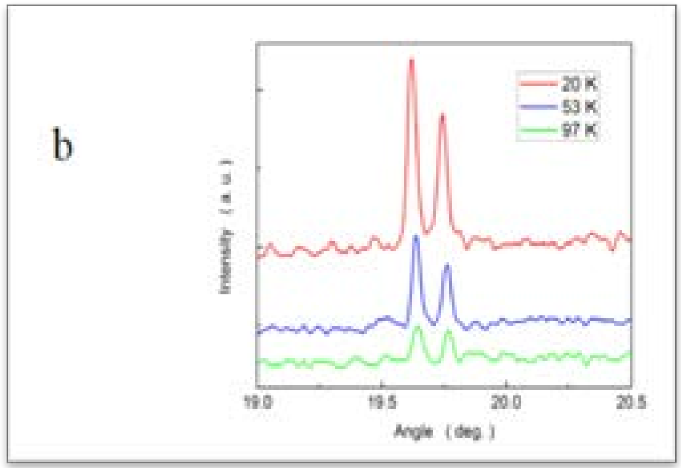


Figure A.2 *a) Standard Si powder X-ray diffraction data obtained in Cell 5.The (111) peak is highlighted. b) Angle dependence of the diffraction signal intensity from (003) diffractionplane of $Fe_{1.12}Te$ single crystal in the field of 24 T at various temperatures.*



In 2014 the angular resolution was improved high to separate Mo-K $_1$ and K $_2$ radiation lines, as shown in **Figure A.2a.** Low temperature measurements were performed in a cryostat, built by Janis Research that is specifically designed for the magnet and allows measurements in the range 15-295 K. Samples were mounted on a cold finger of a homemade probe. The sample probe coupled with a rotation stage to control rotation about its vertical axis for sample alignment and θ-2θ measurements, thus implementing a one-circle goniometer configuration. The diffractometer was used to investigate samples of iron-based superconductor crystal $Fe_{1.12}Te$, for example, as shown in **Figure A.2b.**

A.3) Unfolding the physics of URu_2Si_2 through chemical substitution

Anomalous correlated electron metals are important materials that are currently under investigation at NHMFL. These materials exhibit a breakdown of Fermi liquid behavior, non-phonon mediated superconductivity, anomalous ordered states, and span a broad chemical-structural phase space (e.g., cuprates, pnictides, heavy fermions, ruthenates, and iridates).

NHMFL scientist Ryan Baumbach is investigating URu_2Si_2, which can exhibit a broad range of phenomena including heavy fermion physics, spin and valence fluctuation behavior, collective non-integer valence states, a transition into an unknown broken symmetry state - so called “hidden order”, deviations from Fermi liquid behavior, and unconventional superconductivity.

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While it is apparent that the language in which to discuss the phenomena in this (and related) systems remains incomplete, experience shows that their phenomena can be unfolded through systematic tuning (e.g., through applied pressure or chemical substitution) which also provides insight into the underlying physics. Baumbach has recently investigated the new series $URu_2Si_{2-x}P_x$, finding a rich T-x phase diagram (**Figure A.3**). This study is another example of vertical integration: Baumbach's group made the work possible by developing a novel high temperature molten metal flux technique which allows use of high-vapor-pressure elements, such as phosphorous. They find that although the underlying correlated electron behavior is robust, the hidden order and superconductivity are strongly tuned with x, resulting in a hidden order quantum phase transition near x = 0.03.

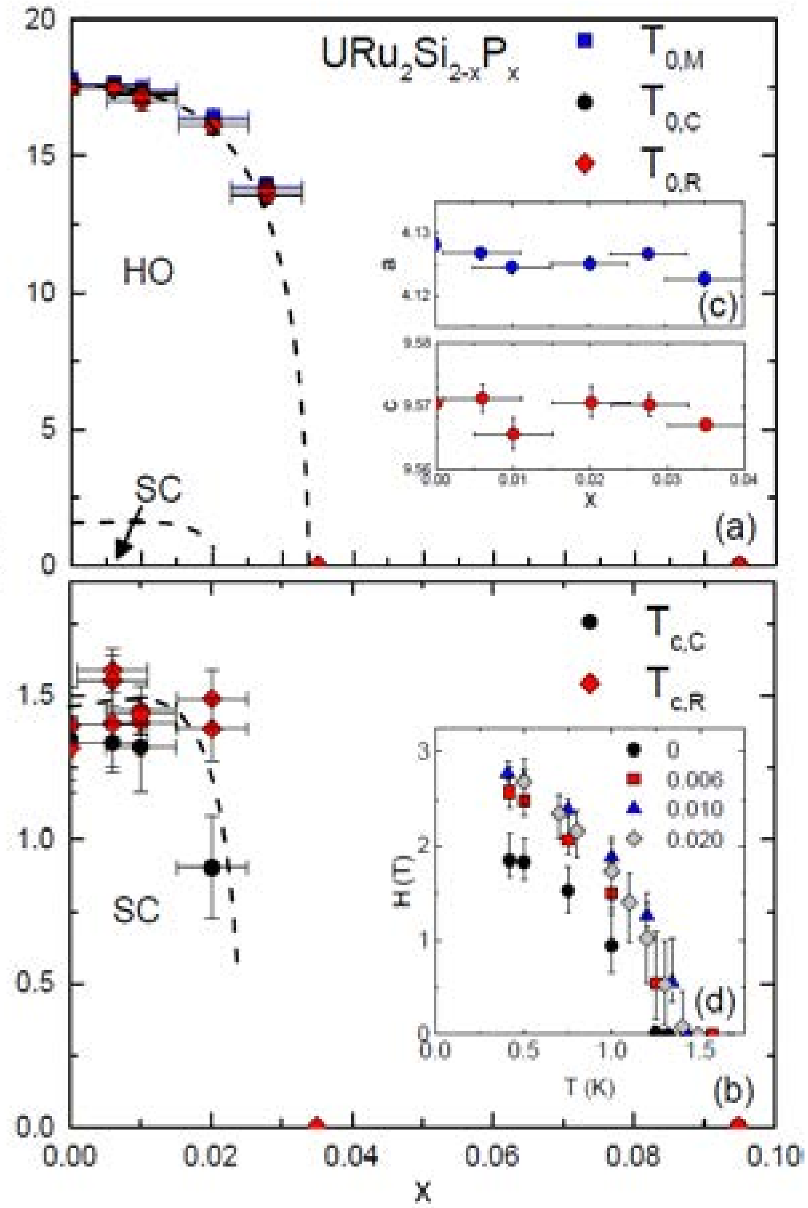

Figure A.3 *(a) Temperature T vs phosphorous concentration x phase diagram for* $URu_2Si_{2-x}P_x$ *constructed from magnetic susceptibility (red squares), heat capacity (black circles), and electrical resistivity (red diamonds). The T-x phase boundary* $T_0(x)$ *separates the paramagnetic heavy electron liquid phase from the hidden order phase. (b)* $T_c(x)$ *separates the hidden order and superconducting phases. (c) The lattice constants, a(x) and c(x), obtained from single crystal X-ray diffraction measurements. (d) The upper critical field curves* $H_{c2}(T)$ *obtained from electrical resistivity measurements at several values of x.*

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A.4) Superconductor-insulator transition in a magnetic field: quantum criticality in underdoped $La_{2-x}Sr_xCuO_4$

In the pseudo-gap regime of copper-oxide high-temperature superconductors, the normal state is commonly probed by applying a perpendicular magnetic field (*H*). However, the nature of the *H*-induced resistive state has been the subject of a long-term debate. Magneto-resistance measurements done in the group of NHMFL scientist Dragana Popovic on under-doped $La_{2-x}Sr_xCuO_4$ provide striking evidence for quantum-critical behavior of the resistivity – the signature of a superconductor-insulator transition tuned by magnetic field. The transition is accompanied by the emergence of an intermediate state, which is a superconductor only at temperature *T*=0.

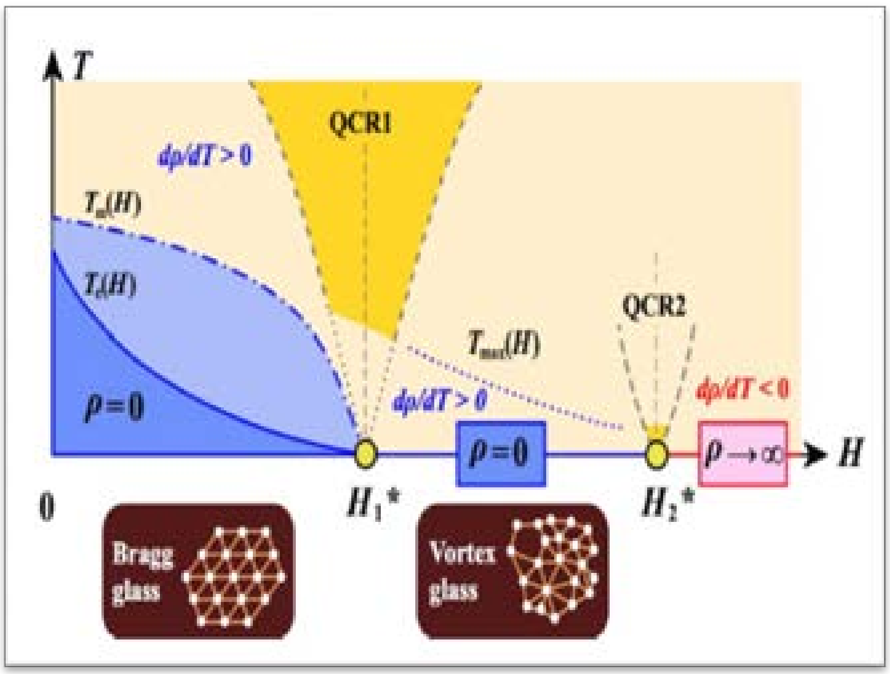

***Figure A.4** Sketch of the phase diagram as a function of the perpendicular magnetic field (H) and temperature (T). Two critical fields, H_1^* and H_2^*, separate three distinct phases at T=0: a superconductor with resistivity ρ=0 (dark blue) for all T < T_c(H), a superconductor with ρ=0 only at T=0 (that is, T_c=0), and an insulator (red) where ρ(T=0)➔∞. The difference between the two superconducting ground states, Bragg glass and vortex glass, is in the way the magnetic field penetrates the material, as shown schematically.*

That means the transition occurs in two stages, as shown in Figure A.4, and goes beyond the standard scenario in which a single quantum critical point separates the superconductor and the insulator [Shi, X.; Lin, P.V.; Sasagawa, T.; Dobrosavljevic, V. and Popovic, D., *Nature Physics*, **10**, 437-443 (2014)].

A.5) Bose glass state in a quantum magnet

Liang Yin and Jian-sheng Xia of the ultra-high B/T facility and Vivien Zapf of the pulsed field facility have collaborated in studying a magnetic Bose glass (BG) state in the metal-organic quantum magnet, dichloro-tetrakis-thiourea, or DTN. A BG state can occur in materials that undergo Bose-Einstein condensation (BEC) [Zapf, V.S.; Jaime, M. and Batista, C.D., *Rev. Mod. Phys.* **86**, 263 (2014)] with the introduction of appropriate disorder. In this system, the antiferromagnetically ordered Ni spins undergoes an approximate Bose-Einstein Condensation phase transition. The replacement of Cl atoms by Br atoms modifies the interaction between Ni spins and introduces magnetic disorder. This system is unusual in that the lattice remains unstrained by the substitution, allowing us to separate magnetic disorder from DTN has an electrically polar crystal structure, such that a magnetoelectric effect can occur when the magnetic order creates small displacements of the atoms. Because of the "glassy" nature of the BG state, one expects that the magnetic-field-induced electric polarization would depend on the frequency of the magnetic field excitation. This effect has been demonstrated at low temperatures by using sensitive dielectric cells to measure the changes in the capacitance of a cell containing the doped DTN as the dielectric material. The induced AC

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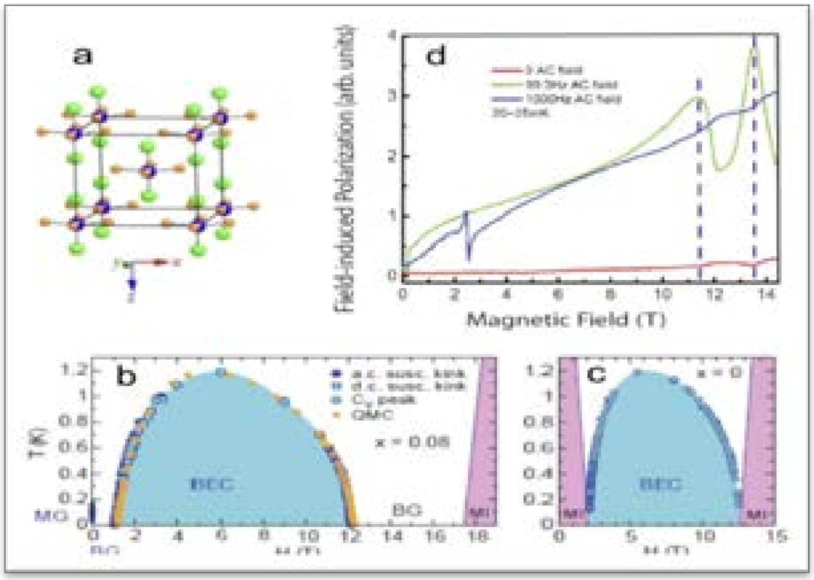

Figure A.5 *a) crystal structure of DTN b) low temperature phase diagram for BEC condensed DTN c) low temperature phase diagram for Bose glass state in Br-doped DTN d) Field-induced polarization vs magnetic field, at different measuring frequencies.*

polarization is strongly frequency dependent **(Figure A.5 d)** and gives clear indications of the phase transitions from the BG state to the BEC and Mott insulator states **(Figure A.5 b and c).**

A.6) (Quasi) two-dimensional transition-metal dichalcogenide devices

Quasi two-dimensional exfoliated transition-metal dichalcogenides (TMD) are of fundamental interest due to their band structures, but also are promising as the basis for a new kind of field-effect transistors (FET), a low-power switching device in electronic components. NHMFL scientist Luis Balicas and his coworkers have fabricated p-type FETs of WSe_2 grown by chemical vapor transport. Like the crystal growth discussed above, this is an example of vertical integration.

As shown in **Figure A.6a**, these devices, grown by chemical vapor transport, have high ratios between on and off resistance of up to 10^6, and high carrier mobilities of up to 676cm^2/Vs at 50K. The higher mobility could eventually translate to a higher speed device, as well as an improved system for basic science studies.

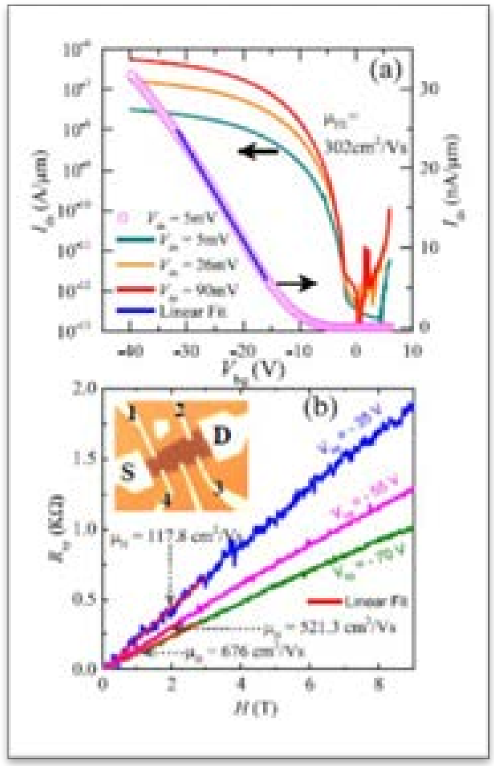

Figure A.6a *Characteristics of a WSe_2 field-effect transistor in a Hall bar configuration. a) Transfer characteristic, drain-source current (I_{ds}) vs. back gate voltage (V_{bg}) on linear and semi-logarithmic scales at room temperature. The blue fit line is used to determine the on resistance. b) Hall resistance vs applied magnetic field at 50K for different values of V_{bg}. The Hall mobilities are marked.*

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They also studied devices of other materials such as $MoTe_2$, which shows p-type behavior and $MoSe_2$, which shows ambipolar response. (N. R. Pradhan, L. Balicas et al. *ACS Nano* **8**, 7923-7929 (2014); *ibid.* **8**, 5911-5920 (2014))

Optical studies of different, two-dimensional TMD samples were carried out in collaboration of the groups of T.F. Heinz (Columbia), D. Smirnov (NHMFL) and Z. Li (NHMFL). This work showed that two-dimensional TMDs offer unprecedented control over their valley degree of freedom. Measurements of circularly polarized magneto-photoluminescence from neutral and charged excitons in monolayer $MoSe_2$ **(Figure A.6b)**, show how magnetic field lifts the valley degeneracy in the material. With the split K and K' valleys, it becomes possible to electrostatically control a valley polarization, i.e., an imbalance in the charge distribution in the two valleys, using a gate bias to dope the sample [Li, Y. *et al., Phys. Rev. Lett.* **113**, 266804 (2014)].

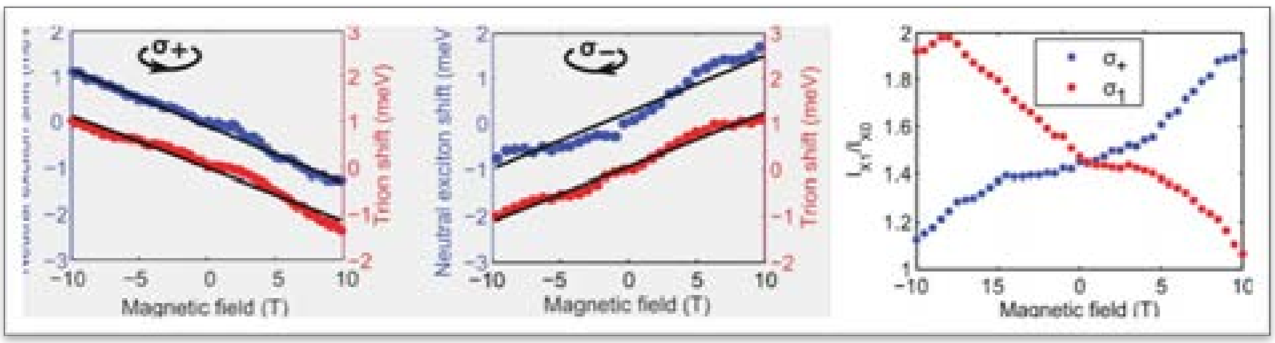

Figure A.6b: *Zeeman shift of the neutral and trion energies or σ+ and σ− photoluminescence (a, b) and their relative PL emission intensity as a function of the magnetic field. Lifting of the valley degeneracy is demonstrated through the opposite energy shifts induced in the excitonic transitions in the two valleys by the magnetic field. c) shows transition intensities that measure the relative population of the valleys.*

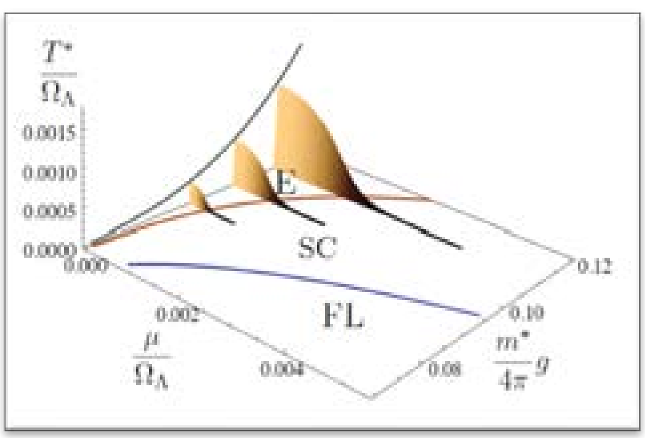

Figure B.1 *Temperature T* associated with ordering vs. chemical potential μ and the interaction strength g for the forward-scattering limit. The crossover lines shown correspond to asymptotic bounds for the phase boundaries between excitonic (E), superconducting (SC), and Fermi liquid (FL) states.*

CHAPTER 5 – IN-HOUSE RESEARCH

B) Theoretical

B.1) Superconductivity on the brink of spin-charge order in a doped honeycomb bilayer

Phase diagrams of a number of material classes exhibit unconventional superconductivity in close proximity to Neel anti-ferromagnetism and/or charge-ordered states. To date no consensus has emerged regarding the precise mechanism underlying this phenomenon, particularly whether the non-superconducting order is beneficial or detrimental to superconductivity. Using a controlled weak-coupling renormalization group approach, NHMFL theorist Oskar Vafek and collaborators established the mechanism of unconventional superconductivity in the vicinity of spin or charge ordered excitonic states for the case of electrons on the Bernal stacked bilayer honeycomb lattice [Vafek, O.; Murray, J.M. and Cvetkovic, V., *Phys. Rev. Lett.* **112**, 147002 (2014)]. They demonstrated that upon adding charge carriers to the system, the excitonic order is suppressed, and unconventional superconductivity appears in its place, before it is replaced by a Fermi liquid **(Figure B.1 above).**

B.2) Interaction-induced screening of disorder dramatically weakens Anderson localization

According to the scaling theory of localization, any amount of disorder suffices to localize all (noninteracting) electrons at T = 0 in dimension d =2. In the presence of electron-electron interactions, however, no such general statement exists, and the transport behavior of disordered interacting electrons has long remained an outstanding open problem. In this theoretical study, NHMFL theorist Vladimir Dobrosavljevic and collaborators [Javan Mard, H.; Andrade, E. C.; Miranda, E. and Dobrosavljevic, V., *Phys. Rev. Lett.* **114**, 056401 (2015)] performed variational studies of the interaction-localization problem to describe the interaction-induced renormalizations of the effective (screened) random potential seen by quasi-particles. They reported a large decrease of the conductance scale g* signaling the crossover to the strongly localized regime. Surprisingly, they found that this reduction is brought about by non-gaussian inter-site correlations, a mechanism overlooked in previous works. This opens the possibility that competing (e.g. Mott or Wigner-Mott) mechanisms for localization could become dominant well before Anderson localization effects set in.

B.3) ***Analytic Pulse Sequence Construction for Exchange-Only Quantum Computation***

The ability to adiabatically switch on and off, or "pulse," the isotropic exchange interaction, $J\mathbf{S_1}\mathbf{S_2}$, beetween pairs of spin-1/2 particles is a promising resource for quantum computation. In this paper, NHMFL theorist Nicholas Bonesteel and collaborators [Zeuch, D.; Cipri, R. and Bonesteel, N.E., *Phys. Rev.* B**90**, 045306 (2014)] construct a family of sequences consisting of 39 nearest-neighbor exchange pulses on a linear array of spins which perform entangling two-qubit gates on three-spin qubits, including a gate which is locally equivalent to CNOT. The main new feature of our construction is that it can be carried out purely analytically, requiring at most the solution of a transcendental equation in one variable. In addition, because this construction is analytic it allows one to envision alternate pulse sequences for carrying out two-qubit gates. This general approach of iteratively constructing pulse sequences acting on large Hilbert spaces by effectively reducing the size of the Hilbert space at each level of iteration may have wider applicability for constructing useful pulse sequences for quantum computation.

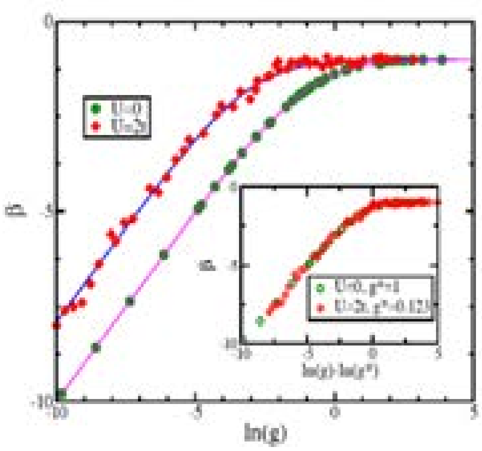

Figure B.2 *The beta function for U = 0 (non-interacting model) and U = 2t (with interactions). The numerical data are well described by the non-interacting model, however with g*(U = 0) = 1.0 and g*(U = 2t) = 0.123. Inset: The curve for U = 2t collapses onto the non-interacting one with a shift of ln(g*) along the*

CHAPTER 5 – IN-HOUSE RESEARCH

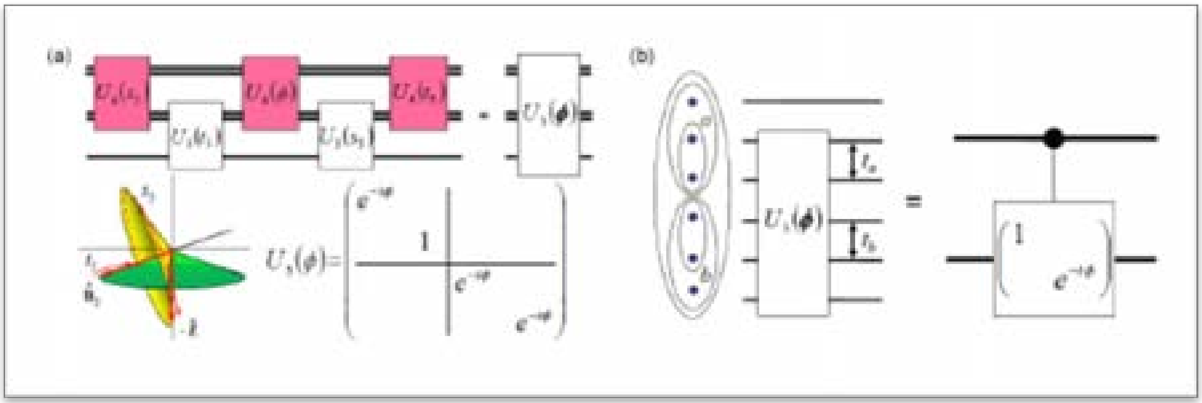

Figure B.3 *(a) Sequence of operations U_3 and U_4 acting on five spins resulting in the operation U_5. The two-step similarity transformation which carries out this diagonalization is illustrated by the two intersecting cones. (b) CPhase gate consisting of U_5 acting on five spins of two encoded qubits together with two exchange pulses of times t_a and t_b carrying out two single-qubit rotations which depend on the particular choice of short or long U_3 sequences.*

CHAPTER 5 – IN-HOUSE RESEARCH

GEOCHEMISTRY

The facility primarily investigates natural processes, both recent and ancient, through the analysis of trace element contents and isotopic compositions.

Introduction

The Geochemistry Program primary funding is through grants from the Geoscience directorate at NSF, NASA, GoMRI and the USGS. All tenure track faculty have their appointments in FSUs' College of Arts and Sciences. The facility has six mass spectrometers which are available to outside users. Three instruments are single collector inductively coupled plasma mass spectrometers for elemental analysis. One instrument is dedicated to i*n-situ* trace element analyses on solid materials using laser ablation. The other two are for elemental analyses of solutions. One instrument is a quadrupole ICP-MS with a collision cell. The quadrupole allows for very fast switching between isotopes and the collision cell removes major interferences created by the Ar-plasma. The second instrument is a high-resolution instrument. The high resolution allows separation of molecular interferences on atomic ions. The facility has three instruments 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, S).

Publications and Outreach

The group members have published 28 peer reviewed publications and a similar number of presentations at meetings and invited presentations at other institutions.

Science Highlight

First order observations indicate that, globally, the depth of the mid-ocean ridge is related to the thickness of the ocean crust. Based on the chemistry basaltic crust production can be related to degree of melting and temperature, with higher temperatures causing thicker crust. Composition is not thought to be an important factor. Our study of the chemistry of the crust of the mid-Atlantic Ridge at 16°30'N (Henrick et al. report) indicates that mantle composition can also be an important factor. At this location crust production rate is very low and the western side of the ridge is spreading by faulting with only intermittent magmatic production. This crust has very radiogenic Nd and Hf while Sr and Pb isotopic characteristics are unradiogenic indicating a time integrated history of earlier extraction of a large amount of melt. Consequently, this mantle can now yield only a small amount of melt and therefore crust production is low. This confirms an earlier study by our group that argues that the mantle beneath ocean ridges needs to be more depleted than previously thought to explain the depleted isotopic characteristics in residual peridotites. This can also reconcile the evidence that melting starts deep beneath ocean ridges (100km) while crust production is low because a significant part of the mantle is too depleted to yield significant amounts of melt during decompression. And thus temperature is not always the main factor that dictates crust production rates.

Progress on Stem and Building the User Community

The facility is open to users of all disciplines, and we have a long-time collaboration with the USGS and the South Florida Water Management District. During the summer we hosted one undergraduate student from the REU program; three undergraduate students are involved in research throughout the year. In the last year 58 users, of which 50% are female, used our analytical facilities. Within the area of Geosciences the faculty has collaborations with researchers throughout the US, Europe as well as Asia. The disciplines we service at a more local level range from magnet science to pharmacy. We also receive several requests per year from the public to identify rock samples that are found, often with the expectation that the sample is a meteorite. We also participated in the annual open house.

CHAPTER 5 – IN-HOUSE RESEARCH

OPTICAL MICROSCOPY LAB RESEARCH FOCUS

The primary focus of current Optical Microscopy Laboratory activities is in support of an on-going collaboration with Prof.s Lei Zhu (Dept. of Chemistry) and Cathy Levenson (Prog. in Neuroscience). We are developing fluorescent sensors and testing their capability for *in vitro* quantitative imaging of intracellular Zn^{2+} and glutamate ions: two very important signaling molecules of intense research interest, especially in the context of neuronal networks. We are exploring emerging methods for localizing small organic fluorescent dyes and sensors to specific sub-cellular compartments in living systems, specifically through the use of SNAP-tag and related technologies. The SNAP-tag protein is a 20 kDa mutant of the DNA repair protein O^6-alkylguanine-DNA alkyltransferase, it reacts bio-orthogonally with a fluorescently-labeled benzylguanine derivative leaving the fluorescent moiety covalently coupled to the SNAP-tag via a benzyl group. Like the thousands of fluorescent protein fusions that have been generated in the lab, SNAP-tags are genetically expressed attached to a given protein of interest that acts as a vector for precisely localizing the label to specific organelles or other compartments. Research by the Zhu lab has been focused on covalently attaching novel dyes and sensors to the benzylguanine SNAP-tag substrate, enabling highly specific cell labeling and novel imaging experiments.

Construction of SNAP-tag fusions requires standard molecular cloning techniques, including PCR, DNA digestion and ligation, bacterial transformation, DNA amplification and purification, and so forth. This is followed by expression in relevant biological systems, in this case several different tissue culture cell lines, including HeLa, human astrocytes, and a variety of other continuous glial and neuronal cell lines of both mouse and human origin. Expression is induced both transiently and stably using a variety of chemical and electrical transfection techniques. We are developing cell lines stably expressing SNAP-tag fusion proteins to a variety of locations, having recently established lines with fusions localizing to the mitochondrial lumen and the extracellular domain of the plasma membrane, respectively. We have also generated varieties of these lines co-expressing a genetically encoded glutamate sensor for co-imaging experiments. Such new cell lines represent important tools for signaling studies. We plan on constructing new SNAP-tag fusion proteins targeting other important cellular features, including glutamatergic synaptic vesicles in neurons. With these tools we plan on performing novel widefield and confocal microscopy co-imaging experiments of stimulated zinc and glutamate ion flux *in vitro*. We are excited about probing fast Zn^{2+} and glutamate signaling dynamics in cultured neuronal networks. Future work may also incorporate calcium imaging.

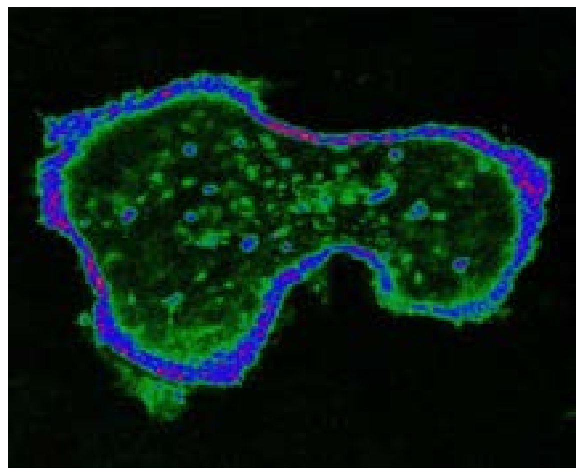

Fig. 1: *Illustrated below is a live HeLa S_3 cell expressing the genetically encoded glutamate sensor iGluSnFR on the extracellular domain of the plasma membrane. This ratiometric image shows the increase in fluorescence in response to increasing glutamate concentration, visible as the blue-red pseudo-coloring along the periphery. This image was acquired using a laser-scanning confocal microscope.*

In addition to this exciting avenue of research, the lab is engaged in a number of other activities. We continue to generate and distribute fluorescent protein fusions to a number of collaborators, part of a world-famous library for such probes. Recently we have taken an expanded role in providing equipment, training, and collaborative support for other labs at the NHMFL pursuing experiments involving optical microscopy. We have recently outfitted and

CHAPTER 5 – IN-HOUSE RESEARCH

trained personnel on an Olympus IX81 motorized fluorescence microscope for research by the FSU-led Deep-C Consortium and ICR into the role of bacteria in the oil-spill cleanup. Additionally, we have recently performed imaging for and trained personnel from the laboratories of Ryan Baumbach, Jeffrey Whalen, Dmitry Smirnov, and more.

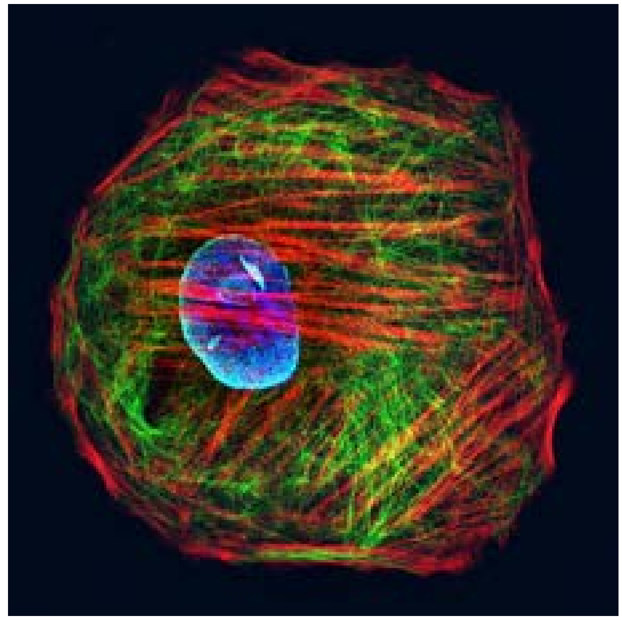

Fig. 2: *This is an image of a GMMe mink uterus epithelial cell acquired using the super-resolution structured illumination microscopy (SIM) technique. Super-resolution microscopies provide resolution significantly greater than should be possible considering the diffraction of light. This four channel image highlights several nuclear and cytoskeletal proteins, and with twice the resolution of typical wide-field fluorescence microscopies. The Davidson lab is actively engaged in advancing super-resolution techniques, publishing several reviews on the subject and working with Professor Zhu to develop and test new specialized fluorophores tailored towards such imaging modalities.*

CHAPTER 6
Accomplishments & Discoveries

CHAPTER 6 – ACCOMPLISHMENTS & DISCOVERIES

PRODUCTS OF MAGLAB USERS & FACULTY (as of 2/20/2015)

The laboratory continued its strong record of publishing, with **450** articles appearing in peer-reviewed scientific and engineering journals in 2014. The full listing, along with citations for over **362** presentations, is available on the Magnet Lab's Web site https://nationalmaglab.org/research/publications-all/publications-search

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This chapter lists publications by user facility, followed by publications attributed to Magnet Science & Technology, the NHMFL Applied Superconductivity Center, UF Physics, the Condensed Matter Theory/Experiment group, the Center for Integrating Research & Learning Geochemistry, and Optical Microscopy. Please note that publications may be listed with more than one facility or group, as the research may have resulted from e.g., using both DC and Pulsed Field Facilities, or from a collaboration that involves both user/ experimentalists and theorists.

Of the **450** publications, **245 (54%)** appeared in significant journals.

Presented on the remaining pages of this chapter are lists of one-time publications, internet disseminations, patents, awards, PhD dissertations, and Master theses.

Table 1: *Submitted Peer-Reviewed Publications from OPMS live database, the point-in-time snapshot was on February 20, 2015. 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 facilities.*

FACILITY/ DEPARTMENT	2014 Peer Reviewed	2014 Significant Peer Reviewed
DC Field Facility	103	80
Pulsed Field Facility	36	25
High B/T Facility	10	7
NMR Facility	62	27
MBI-UF AMRIS	42	11
EMR Facility	39	26
ICR Facility	32	17
MS & T	25	8
Applied Superconductivity Center	20	11
UF Physics	26	21
CMT/E	75	55
Education (NHMFL only)	2	-
Geochemistry Facility	27	3
Optical Microscopy	23	6

CHAPTER 6 – ACCOMPLISHMENTS & DISCOVERIES

DC FIELD FACILITY PUBLICATIONS (103)

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INTERNET DISSEMINATIONS (6)

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Rupnik, K., *Intelliom*, http://www.intelliome.com, (2014)

Singleton, J.; Kim, J.W.; Topping, C.V.; Hansen, A.; Mun, E.D.; Ghannadzadeh, S.; Goddard, P.; Luo, X.; Oh, Y.S.; Cheong, S.W. and Zapf, V.S., *55~Tesla coercive magnetic field in frustrated Sr\$_3\$NiIrO\$_6\$*, http://lanl.arxiv.org/abs/1408.0758, (2014)

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PATENTS & OTHER PRODUCTS (5)

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Jarvis, J.M.; Rodgers, R.P. and Robbins, W.K., *"Isolation of Interfacial Material from Organic Matrices",* US 2014/0110343 A1 April 24, 2014 (2014)

Schepkin, V.D. and Levenson, C.W., *"Tumor resistance and sodium/diffusion MRI",* USPN Patent 8,880,146 issued on November 4, 2014 (2014)

Singleton, J. and Los Alamos National Security LLC, *"Superluminal Antenna (European patent)",* European Patent (2014)

Singleton, J.; Schmidt, A.C.; Linehan, K.; Ardavan, A. and Ardavan H., *"Singleton, J., et al., "Feed Network and Electromagnetic Radiation Source"",* US Patent (2014)

AWARDS, HONORS, AND SERVICE (13)

Balicas, L.,
FSU Distinguished University Scholar (2014)

Balicas, L.,
Referee - Florida State University - Council on Research and Creativity (2014-present)

Balicas, L.,
Referee/Panelist - National Science Foundation - Division of Materials Research (2014)

Chen, H.,
Florida State University Postdoctoral Scholars Career Development Travel Award (2014-2015)

Dean, C.R.,
IUPAP young scientist prize in low temperature physics (2014)

Hill, S.,
International EPR Society Silver Medal - Instrumentation (2014)

Lee, P.J.,
IEEE Dr. James Wong Award for Continuing and Significant Contributions to Applied Superconductor Materials Technology (2014)

Rupnik, K.,
Louisiana State University, Baton Rouge - College of Science teaching Award 2014 (2014)

Sanabria, C.,
Best Student Paper, Large Scale, The Applied Superconductivity Conference 2014 – 2nd Place (2014)

Segal, C.,
IEEE Best Student Paper in Materials - First Place (2014)

Tarantini, C.,
Lee Osheroff Richardson Science Prize (2014)

Tremaine, D.M.,
VM Goldschmidt Student Travel Grant (2014)

Vasenkov, S.,
Fellowship at the Hanse-Wissenschaftskolleg (Institute for Advanced Study, Germany) to work on the project 'Aerogel Catalysts with a Hierarchy of Pore Sizes: Relationship between Gas Transport, Structural Properties and Catalytic Performance' (2014-2014)

Ph.D. DISSERTATIONS (58)

Fifty-eight (58) Ph.Ds. were reported for 2014:19 were awarded to users/ students at FSU or UF; 39 were awarded to users at other academic institutions.

Ph.Ds. awarded to users/students at FSU or UF (19):

Blankenship, Trevor, *"Zintl and Intermetallic Phases Grown from Calcium/Lithium Flux",* Florida State University, Chemistry and Biochemistry, advisor: Susan Latturner (2014)

Braide, Otonye, *"Monitoring the effects of synthetic lung surfactant peptides on lipid bilayer dynamics and fluidity",* University of Florida Department of Chemistry, advisor: Fanucci, Gail (2014)

Christian, Jonathan, *"Magnetometry and EPR Studies of Model Paramagnetic Complexes With Improved Magnetic Anisotropy",* Florida State University, advisor: Dalal, Naresh (2014)

Cipri, Robert, *"Gauge Fields and Composite Fermions in Bilayer Quantum Hall Systems",* Florida State University, Physics, advisor: Bonesteel, N.E. (2014)

Das, N., *"Structure Determination of Mycobacterium tuberculosis Small Helicl Membrane Proteins by Solid State NMR Spectroscopy",* Florida State University, Molecular Biophysics, advisor: Cross, T.A. (2014)

Deng, Lili, *"Anderson Impurity Models with Bosons as Descriptions of Molecular Devices and Heavy-Fermion Systems",* University of Florida, Department of Physics, advisor: K. Ingersent

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Hazelbaker, E., *"Transport Properties of Mixtures of Carbon Dioxide and Ionic Liquids by NMR",* University of Florida, Chemical Engineering Department, advisor: Vasenkov, S. (2014)

Hrishi, Bhase, *"Studies of Diffusion in Unidimensional Nanochannel Materials Using Hyperpolarized Xe-129 Tracer Exchange NMR",* University of Florida, Chemistry Department, advisor: Clifford R Bowers (2014)

Kemper, J.B., *"Measurement of the Heat Capacity of Cuprate Superconductors Inhigh Magnetic Fields",* Florida State University, advisor: Boebinger, G.S. (2014)

Kiswandhi, A., *"Physical and Chemical Pressure Effects on Magnetic Spinels",* Florida State University, Department of Physics, advisor: Zhou, H.D. (2014)

Leonard, S.R., *"Solid-State NMR Evaluation of Molecular Structural Engineering for Controller Peptide Self-Assembly",* Florida State University, Chemical and Biomedical Engineering, advisor: Paravastu, Anant K. (2014)

Meng, Dan, *"Structure and Dynamics Study of Cu",* Florida State University, Chemistry and Biochemistry, advisor: Rafael Bruschweiler (2014)

Mueller, R., *"Diffusion of Light Gases in Advanced Nanoporous Membranes and Catalysts via NMR Diffusometry",* University of Florida, Chemical Engineering Department, advisor: Vasenkov, S. (2014)

Murray, Dylan T., *"Structure of a Three Helix Membrane Protein in a Lipid Bilayer",* Florida State University, Molecular Biophysics, advisor: Timothy Cross (2014)

Poole, Katherine Maria, *"Theoretical and Experimental Exploration of 3D Transitional Metal Clusters and Their Magnetic Properties",* University of Florida Department of Chemistry, advisor: Christou, George (2014)

Stewart, Paul, *"Investigation of signaling pathways of human cancers of breast and prostate",* Florida State University, Chemistry Department, advisor: Amy Qing-Xiang Sang (2014)

Vanderlaan, M., *"Helium II heat transfer through random packed spheres",* Florida State University, Mechanical Engineering, advisor: Steven Van Sciver (2014)

Wood, Ryan, *"Strain Enhanced Optically Pumped Nuclear Magnetic Resonance in Bulk And Quantum Confined Iii-V Semiconductors",* University of Florida, Chemistry Department, advisor: Clifford R Bowers (2014)

Zhou, Ronghui, *"Studies of Hydrogenation Catalysis Using Hyperpolarized NMR",* University of Florida, Chemistry Department, advisor: Clifford R Bowers (2014)

Ph.Ds awarded by other academic institutions to external users/students (39):

Amet, F., *"Novel phenomena driven by interactions and symmetry breaking in graphene",* Stanford University Applied Physics, advisor: David Goldhaber-Gordon (2014)

Bombeck, Michael, *"High frequency magneto-acoustics in diluted magnetic semiconductors",* TU Dortmund, Physics, advisor: Manfred Bayer (2014)

Cao, Xiaoyan, *"Spectroscopic Characterization of Dissolved Organic Matter: Insights into the Linkage between Sources and Chemical Composition",* Old Dominion University, Department of Chemistry and Biochemistry, advisor: Jingdong Mao (2014)

Cornell, Nicholas L., *"Electrophysical Properties of Layered Superconducting Nanostructures: Advanced Synthesis and Tuning",* Department of Physics, University of Texas at Dallas, advisor: Prof. Myron B. Salamon (2014)

Cyr-Choiniere, Olivier, *"Anisotropic Fermi-surface reconstruction in the pseudogap phase of cuprate superconductors",* University of Sherbrooke, Physics, advisor: Louis Taillefer (2014)

Davis, L.M., *"Syntheses, properties, and reactions of transition metal complexes of di(tert-butyl)amide and 2,2,6,6-tetramethylpiperidide",* University of Illinois at Urbana-Champaign, Department of Chemistry, advisor: Girolami, Gregory S. (2014)

Deng, Liping, *"Research on Texture Evolution, Mechanical and Electrical Properties of Cu-Nb Composite Wires",* Chongqing University, P.R. China, advisor: Qing Liu (2014)

Edwards, Trenton Gerard, *"Characterization of Atomic Structure, Relaxation and Phase Transformation Mechanisms in Bulk and Thin Film Amorphous Chalcogenides and Gallium Antimonide",* University of California, Davis, Department of Chemical Engineering & Material Sciences, advisor: Sabyasachi Sen (2014)

Finnegan, E., *"Investigation of the Relationship between Iron and High Field MRI in Healthy and Alzheimer's Disease Tissue",* University of Warwick, advisor: Joanna Collingwood (2014)

Garitezi, Thales Macedo, *"Estudo de propriedades magnéticas e de transporte em novos materiais",* UNICAMP (Campinas State University), Quantum Electronics (DEQ), advisor: Ricardo R. Urbano (2014)

Geng, Jiafeng, *"Heme-dependent Tryptophan Oxidation: Mechanistic Studies on Tryptophan 2, 3-Dioxygenase and MauG",* Georgia State University, Chemistry, advisor: Aimin Liu (2014)

Ghannadzadeh, S., *"Investigating magnetism and superconductivity using high magnetic fields",* Clarendon Laboratory, University of Oxford, advisor: Paul A. Goddard (2014)

Gill, Richard L., *"Molecular Insights into the Generation and Recognition of Membrane Geometry",* Penn State University College of Medicine, Biochemistry and Molecular Biology, advisor: Fang Tian (2014)

Gingrich, Eric, *"Phase Control of the Spin-Triplet State in S/F/S Josephson Junctions",* Physics and Astronomy, advisor: Norman Birge (2014)

Guillemette, Jonathan, *"Electronic Transport in Hydrogenated Graphene",* Physics at McGill University, advisor: Thomas Szkopek & Guillaume Gervais (2014)

Huang, Rui, *"NMR structural studies on Membrane-Associated Cytochrome P450 Reductase",* University of Michigan, Department of Chemistry, advisor: Ramamoorthy, Ayyalusamy (2014)

Iyama, Ayato, *"Studies on the magneto electric coupling in transition metal oxides",* Osaka University, Graduate

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School of Engineering Science, advisor: Tsuyoshi Kimura (2014)

Jiao, Lin, *"Fermi surface reconstruction and multiple quantum phase transitions in the antiferromagnet CeRhIn5",* Zhejiang University, Physics, advisor: Huiqiu Yuan (2014)

Kamburov, D., *"Tunable Fermi Contour Anisotropy in GaAs Electron and Hole Systems",* Princeton University, Electrical Engineering, advisor: Mansour Shayegan (2014)

Kekäläinen, Timo, *"Characterization of petroleum and bio-oil samples by ultra-high-resolution Fourier transform ion cyclotron resonance mass spectrometry",* University of Eastern Finland, Chemistry, advisor: Janne Janis (2014)

Kumar, Pavan Challa, *"Optical Studies Of Bent-Core, Blue Phase And Twist-Bend Nematic Liquid Crystals In High Magnetic Fields",* Kent State, Physics, advisor: Gleeson (2014)

Kuo, Hsueh-Hui, *"Electronic Nematicity in Iron-Based Superconductors User Facility",* Stanford University, Materials Science and Engineering, advisor: I. R. Fisher (2014)

Lee, Yongjin, *"Electrical Properties of Trilayer Graphene",* Department of Physics and Astronomy, University of California, Riverside, advisor: C. N. Lau (2014)

Li, Y., *"Probing the response of 2D crystals by optical spectroscopy",* Physics Department, Columbia University, advisor: Tony F. Heinz (2014)

Liu, Yang, *"Magneto-Transport Study of Quantum Phases in Wide GaAs Quantum Wells",* Princeton University, Dept. of Electrical Engineering, advisor: Mansour Shayegan (2014)

Lu, Yu, *"Site Directed Spin Labeling Electron Paramagnetic Resonance Technique For Protein Structure Characterization",* University of Science and Technology of China, advisor: Changlin Tian (2014)

McPheron, Benjamin D., *"Flux Regulation in Powered Magnets: Enabling Magnetic Resonance Experiments with Pulsed Field Gradients",* The Pennsylvania State University, Dept. of Electrical Engineering, advisor: Jeffrey L. Schiano (2014)

Muroski, Megan Elizabeth, *"Nanoparticles as conjugated delivery agents for therapeutic applications",* The Florida State University, Department of Chemistry and Biochemistry, advisor: Geoffrey F. Strouse (2014)

Neal, Adam T., *"Transport Studies of Two-Dimensional Materials for Nanoelectronics Applications",* Purdue University, Electrical and Computer Engineering, advisor: Ye, Peide D. (2014)

Psaroudaki, C., *"Dynamics of field induced phases in spin S=1 antiferromagnetic chains.",* University of Crete, Department of Physics, Greece, advisor: Prof. X. Zotos (2014)

Qiu, Lei, *"Exploring Metal-Insulator Transition in p-GaAs Quantum Well with high rs",* Case Western Reserve University, Physics, advisor: Xuan Gao (2014)

Ray, Phoebe Z., *"Mechanisms and transients involved in the solar conversion of petroleum films in aquatic systems",* University of New Orleans, advisor: Matthew A. Tarr (2014)

Sato, Hiroki, *"The Relationship between Structural and Electrical Properties in Complex Oxide Heterostructures",* Department of Advanced Materials Science, The University of Tokyo, advisors: Prof. Hiroshi Okamoto and Prof. Harold Y. Hwang (2014)

Siddheshwar, Kawale Shrikant, *"Strain engineering in Iron chalcogenide superconducting thin films deposited by pulsed laser ablation",* University of Genoa, Physics, advisors: Marina Putti and Carlo Ferdeghini (2014)

Smith, Zachary, *"Fundamentals of Gas Sorption and Transport in Thermally Rearranged Polyimides",* Chemical Engineering, advisor: Benny D. Freeman (2014)

Winter, Stephen, *"Neutral Radicals as Strongly Correlated Materials: Insights from Theory and Experiment",* University of Waterloo, Chemistry, advisor: Richard Oakley (2014)

Wolk, Arron, *"Cryogenic Ion Spectroscopy of Reactive Organometallic Intermediates and Non-covalent Complexes",* Yale University, Chemistry Department, advisor: Mark A. Johnson (2014)

Yan, Si, *"Microtubule-Associated Cap-Gly Domain Of Dynactin: Structure, Dynamics, Conformational Plasticity,And Interactions With Microtubules And Microtubule Plus-End Tracking Proteins By Magic Angle Spinning Nmr Spectroscopy",* University of Delaware, Chemistry and Biochemistry, advisor: Tatyana Polenova (2014)

Yu, Wenlong, *"Infrared Magneto-spectroscopy of Graphite and Graphene Nanoribbons",* School of Physics, Georgia Institute of Technology, advisor: Zhigang Jiang (2014)

MASTER THESES (11)

Chance, W. Michael, *"Hydroflux Synthesis: A New and Effective Technique for Exploratory Crystal Growth",* University of South Carolina, advisor: unknown (2014)

Espinosa, Jilly B., *"Evaluation of the Toxicity and Antioxidant Activity, Partial Purification and Spectral Analysis of the Bioactive Components from the Leaves of Cnidoscolus chayamansa ("Chaya")",* Mindanao State University-Iligan Institute of Technology, advisor: Uy, Mylene M. (2014)

Kankan, Cong, *"Superfluorescence from a Two-Dimensional Electron-Hole System: Magnetic Field, Temperature, and Density Dependence",* Rice University, Applied Physics Program, advisor: Junichiro Kono (2014)

Lee, Wonjun, *"Magnetic resonance studies of frustrated quantum magnets",* Chung-Ang University, Physics, advisor: Kwang-Yong Choi (2014)

Muripaga, Zakariya T., *"Antioxidant Activity and Toxicity Assay-Guided Isolation of Bioactive Phytochemicals from Ageratum conyzoides L. ("Goatweed")",* Mindanao State University-Iligan Institute of Technology, advisor: Uy, Mylene M. (2014)

Teasdale, Nolan, *"Transport in Sb Quantum Wells",* University of Oklahoma, Engineering Physics, advisor: Sheena Murphy (2014)

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Tzitzoglaki, Christina, *"Synthesis of active aminoadamantane derivatives against S31N influenza virus",* Athens, Pharmacy, advisor: Antonios Kolocouris (2014)

Villanueva, Maryjane P., *"Toxicity and Antioxidant Evauation, Partial Isolation and Structure Determination of the Bioactive Phytochemicals from Piper baccatum Blume ("Climbing Pepper of Java")",* Mindanao State University-Iligan Institute of Technology, advisor: Uy, Mylene M. (2014)

Whittington, Andrew, *"Shrink Tube Insulation Apparatus for REBCO Superconducting Tapes for Use in High Field Magnets",* Mechanical Engineering, Florida State University, advisor: David Larbalestier (2014)

Yan, Yuanwei, *"Cryopreservation of embryonic stem cell-derived multicellular neural aggregates labeled with micron-sized particles of iron oxide for magnetic resonance imaging.",* Florida State University, Chemistry and Biomedical Engineering, advisor: Yan Li (2014)

Zimmerman, M.I., *"Peptide Nanostructure Formation Through Self-Assembly: Computations Guide Experimental Characterization and Amino Acid Sequence Design",* Florida State University, Chemical and Biomedical Engineering, advisor: Paravastu, Anant K. (2014)

APPENDIX I
User Facility Statistics

APPENDIX I – USER FACILITY STATISTICS

Seven user facilities — DC Field, Pulsed Field, High B/T, NMR-MRI@FSU, NMR-MRI@UF (AMRIS), EMR, and ICR — 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.

DC FIELD FACILITY

Table 1 – User Demographic

DC Field Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**165**	145	11	9	3	151	11	99	0	23	43
Senior Personnel, non-U.S.	**69**	57	6	6	0	61	8	32	0	11	26
Postdocs, U.S.	**52**	38	7	7	0	41	11	47	0	2	3
Postdocs, non-U.S.	**19**	13	2	4	0	14	5	11	0	3	5
Students, U.S.	**153**	126	21	6	8	125	20	141	0	1	11
Students, non-U.S.	**42**	34	3	5	1	32	9	34	0	2	6
Technician, U.S.	**4**	4	0	0	0	4	0	4	0	0	0
Technician, non-U.S.	**1**	1	0	0	0	1	0	0	0	0	1
Total:	**505**	**418**	**50**	**37**	**12**	**429**	**64**	**368**	**0**	**42**	**95**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

DC Field Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**165**	52	8	130	6	29
Senior Personnel, non-U.S.	**69**	1	0	52	1	16
Postdocs, U.S.	**52**	12	4	43	1	8
Postdocs, non-U.S.	**19**	0	0	16	0	3
Students, U.S.	**153**	14	19	150	0	3
Students, non-U.S.	**42**	0	0	41	0	1
Technician, U.S.	**4**	4	0	4	0	0
Technician, non-U.S.	**1**	0	0	1	0	0
Total:	**505**	**83**	**31**	**437**	**8**	**60**

1. 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.

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researchers at FSU, UF, FAMU, or LANL), even if they travel to another site.
The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".

2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

Table 3 – Users by Discipline

DC Field Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**165**	119	11	16	14	5
Senior Personnel, non-.S.	**69**	54	7	4	2	2
Postdocs, U.S.	**52**	45	1	2	3	1
Postdocs, non-U.S.	**19**	11	6	1	0	1
Students, U.S.	**153**	128	10	10	4	1
Students, non-U.S.	**42**	39	1	1	1	0
Technician, U.S.	**4**	1	0	1	2	0
Technician, non-U.S.	**1**	0	0	1	0	0
Total:	**505**	**397**	**36**	**36**	**26**	**10**

Table 4 – User Facility Operations

DC Field Facility	Resistive Magnets & Hybrid	Superconducting Magnets	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]			
NHMFL-Affiliated	125.34	204.00	329.34	18.29%
Local	23.95	63.00	86.95	4.83%
U.S. University	324.02	634.00	958.02	53.19%
U.S. Govt. Lab.	42.11	31.00	73.11	4.06%
U.S. Industry	8.19	19.00	27.19	1.51%
Non-U.S.	238.43	88.00	326.43	18.12%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	0	0	0	0%
Total:	**762.04**	**1039.00**	**1801.04**	**100%**

1. User Units are defined as magnet days. For the DC Field Facility, one magnet day is defined as 7 hours in a water-cooled resistive or hybrid magnet. Using this definition, a typical 24-hour day in the DC Field Facility contains three or four "magnet days". For experiments in the superconducting magnets, one “magnet day” is defined as 24 hours of use.

Table 5 – Operations by Discipline

DC Field Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
	Number of Magnet Days[1]					
NHMFL-Affiliated	329.34	239.82	0	3.11	86.41	0
Local	86.95	65.95	21.00	0	0	0
U.S. University	958.02	913.13	21.49	0	22.72	0.69
U.S. Govt. Lab.	73.11	71.18	0	0	1.94	0
U.S. Industry	27.19	25.49	0	0	1.70	0
Non-U.S.	326.43	298.95	20.47	7.00	0	0
Test, Calibration, Set-up, Maintenance, Inst. Dev.	0	0	0	0	0	0
Total:	**1801.04**	**1614.52**	**62.96**	**10.11**	**112.76**	**00.69**

1. User Units are defined as magnet days. For the DC Field Facility, one magnet day is defined as 7 hours in a water-cooled resistive or hybrid magnet. Using this definition, a typical 24-hour day in the DC Field Facility contains three or four "magnet days". For experiments in the superconducting magnets, one “magnet day” is defined as 24 hours of use.

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Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
363	39	290 (72.14%)	112 (27.86%)	402	138.62%

Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Boesl, Benjamin	Florida International University	P08315	Submitted 2014
Grosche, Malte	University of Cambridge	P08323	Scheduled 2014
Heiman, Don	Northeastern University	P08326	Received 2014
McCusker, James	Michigan State University	P08328	Received 2015
Hone, James	Columbia University	P08332	Submitted 2014
Checkelsky, Joseph	MIT	P08337	Received 2015
Scholes, Greg	University of Toronto	P08340	Received 2014
Rueegg, Christian	Paul Scherrer Institute	P08412	Scheduled 2014
Sakhratov, Yuriy	Kazan State Power Engineering University	P08424	Scheduled 2014
Riggs, Scott	NHMFL	P08428	Scheduled 2014
Zhu, Jun	Penn State University	P08487	Scheduled 2014
Iida, Kazumasa	Nagoya University	P09519	Under Review 2014
Katiyar, Ram	University of Puerto Rico	P09534	Submitted 2014
Ke, Xianglin	Michigan State University	P09567	Scheduled 2014
Shen, Tengming	Fermilab	P09570	Submitted 2014
Hwang, Harold	Stanford University	P09573	Scheduled 2014
Total:			**16**

Table 8 – Research Proposals Profile with Magnet Time

DC Field Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Number of Proposals	162	2	16	135	7	2	17	1

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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	# of Days Used
Scott Hannahs (S)	NHMFL	Instrumentation	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) Operations	DC Field Facility Magnet and Power Supply testing P00501	Magnets, Materials, Testing, Instrumentation	1	1
Tim Murphy (S)	NHMFL	Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Maintenance and testing of hybrid, resistive magnets and their associated infrastructure P02230	Magnets, Materials, Testing, Instrumentation	8	9
Xiaodong Xu (S)	University of Washington	Physics	National Science Foundation DMR-1150719	Cooling of Hot-Carriers with Landau Levels in Graphene P02040	Condensed Matter Physics	2	24
Mansour Shayegan (S)	Princeton University	Department of Electrical	Department of Energy DE-FG02-00-ER45841	Magnetotransport measurements of 2D electrons in strained AlAs quantum wells	Condensed Matter Physics	1	7

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		Engineering		P01265			
Yong Chen (S)	Purdue University	Physics	National Science Foundation NA	Magnetotransport in Graphene Nanostructures: Disorder and Interaction physics for Dirac fermions P01320	Condensed Matter Physics	1	6
Junichiro Kono (S)	Rice University	Electrical and Computer Engineering	National Science Foundation DMR-1006663	Ultrafast Spectroscopy of Cooperative Phenomena in Photoexcited Semiconductor Quantum Wells in High Magnetic Fields P02390	Condensed Matter Physics	3	42
Stan Tozer (S)	NHMFL	Physics	Department of Energy DE-NA0001979 Department of Energy DE-FG52-10NA29659 Department of Energy DE-NA0001979 0001 Department of Energy SSAA DE-NA0001979	High pressure magnetostriction studies of actinides and related materials P02128	Condensed Matter Physics	4	20
Michael Zudov (S)	University of Minnesota	School of Physics and Astronomy	Department of Energy	Magnetotransport in quantum Hall systems driven by sub-terahertz radiation P02426	Condensed Matter Physics	3	22
Haidong Zhou (S)	University of Tennessee	Physics and Astronomy	University of Tennessee National Science Foundation DMR-1350002	Probing the ground sates of new quantum magnets by using AC susceptibility P02341	Condensed Matter Physics	5	35
Paul Cadden-Zimansky (S) New PI 2013	Bard College	Physics	Other - Bard College Internal Support	The Quantum Hall Effect in Hybrid Graphene P02377	Condensed Matter Physics	2	10
Janice Musfeldt (S)	University of Tennessee, Knoxville	Department of Chemistry	Department of Energy DE-FG02-01ER-45885 National Science Foundation DMR-1233118	High field spectroscopy of materials P02415	Chemistry, Geochemistry	4	16
Phaedon Avouris (S) New PI 2012	IBM T. J. Watson Research Center	IBM T. J. Watson Research Center	Other - IBM	Magneto-optical Spectroscopy of Plasmons in Graphene P02079	Condensed Matter Physics	4	26
Thomas Howarth (S) New PI 2011	NAVSEA Division Newport	U. S. Navy	U.S. Navy NAVSEA Division Newport 5012433223	Acoustic Characterization of Magnetorheological Fluids P01702	Magnets, Materials, Testing, Instrumentation	1	1
Xiaowei Zuo (S)	MST	Materials Development and Characterization	Other - NSFC (National Natural Science Foundation of China) Engineering and Material Science Division	Impacts of High Magnetic Fields on Phase Transformation and Mechanical Properties in Mn-Cu Alloys during Fcc-Fct Antiferromagnetic Martensitic Transformation P02441	Engineering	1	3
David Goldhaber-Gordon (S)	Stanford University	Physics	Other - Stanford University Center for Probing the Nanoscale 1090079-120-QAACR National Science Foundation PHY-083022	Spin and Valley Effects and Fractional Quantum Hall Effect in Graphene p-n Junctions P02275	Condensed Matter Physics	3	16
Nathanael Fortune (S)	Smith College	Department of Physics	NHMFL Visiting Scientist Program DC Fields/Instruments	Field-Rotatable Low-Temperature Calorimeters: 0 - 45 T, 0.1 - 10 K P02447	Magnets, Materials, Testing, Instrumentation	2	12

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			& Operation 173				
Cedomir Petrovic (S)	Brookhaven National Laboratory	Condensed Matter Physics	Department of Energy DE-Ac02-98CH10886	High-field transport and oscillation study of the topological crystalline insulator (Pb1-xSnx)Te P02451	Condensed Matter Physics	1	4
Feng Wang (S)	University of California, Berkeley	Department of physics	Department of Energy DE-AC02-05CH11231 National Science Foundation 10-1006184 Department of Energy DE-SC0003949	Magneto-optical Spectroscopy of Graphene on Boron Nitride substrate P02456	Condensed Matter Physics	5	62
Yung Woo Park (S)	Seoul National University	Physics	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Investigation on Zero Magneto Conductance Phenomena in Low Dimensional Systems: Polymer Nanofibers and Charge Density Wave Materials P02331	Condensed Matter Physics	1	4
Tian-Heng Han (P) New PI 2013	University of Chicago	Physics	Department of Energy DE-AC02-06CH11357	Quantum Spin Liquids in High Fields P02458	Condensed Matter Physics	3	20
Alimamy Bangura (S)	Max Planck Institute for Solid State Physics	Quantum Materials	Other - Max Planck Institute Other - RIKEN, 2-1 Other - Max Planck Institute for Solid State Research	Quantum transport and spin orbit interaction in d-electron two dimensional electron gases P02449	Condensed Matter Physics	3	14
David Graf (S)	Florida State University	DC Field CMS	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Two-axis rotation using a piezo-stepper platform P02453	Magnets, Materials, Testing, Instrumentation	2	13
Lloyd Engel (S)	NHMFL	CMS	Department of Energy DE-FG02-05ER46212	Broadband microwave studies of high quality graphene in high magnetic field P02375	Condensed Matter Physics	1	8
Erik Henriksen (S) New PI 2013	Washington University in St. Louis	Physics	Other - Washington University in St. Louis new faculty startup funding Department of Energy DE-FG02-07ER46451	Cyclotron resonance in high mobility graphenes P02466	Condensed Matter Physics	3	29
Yuanbo Zhang (S)	Dept. of Physics, Fudan University	Physics	Other - Fudan University, China	Tunable Electron-electron Interaction in Graphene in Fractional Quantum Hall Regime P02467	Condensed Matter Physics	2	13
Martin Greven (S)	University of Minnesota	Physics and Astronomy	National Science Foundation NSF DMR-1006617	Temperature and field dependence of the c-axis resistivity in the electron-doped superconductor Nd2-xCexCuO4-d and Sm2-xCexCuO4-d P02468	Condensed Matter Physics	1	7
Jan Jaroszynski (S)	NHMFL	CMS	NHMFL User Collaboration Grants Program	Comparative study of usual and contact-free methods of the angular critical current measurement in YBCO coated conductors by means of Vector Vibrating Sample Magnetometer under development P02376	Magnets, Materials, Testing, Instrumentation	3	16

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Stephen McGill (S)	NHMFL	Condensed Matter Science	National Science Foundation 1229217	Raman Spectroscopy of a Low-dimensional Spin System P01494	Condensed Matter Physics	1	1
Oleh Myronov (S) New PI 2013	The University of Warwick	Department of Physics	Other - Funding from Univ of Warwick, Coventry, UK	Magnetotransport in a (100)Si/SiGe/Ge -based heterostructures with 2DHG of Ultra High Mobility in 100% pure Ge Quantum Wells in high magnetic fields B>16T and T<350 mK P02472	Condensed Matter Physics	2	12
Kang Wang (S)	UCLA	Electrical Engineering	Other - DARPA N66001-11-1-4105 Other - DARPA	Investigation of magnetic-field effect on topological insulator surface states P01920	Condensed Matter Physics	2	12
Venkat Selvamanickam (S) New PI 2012	University of Houston	Mechanical Engineering	Department of Energy DE-AR0000196	Critical current characterization of Zr-doped REBa2Cu3Ox coated conductors at 4 K for high field magnet applications above 25 T P02261	Magnets, Materials, Testing, Instrumentation	2	11
Talal Mallah (S) New PI 2011	Université Paris Sud XI	ICMMO	Other - CNRS (Centre National de la Recherche Scientifique), the Université Paris, the Université Paul Sabatier-Toulouse III, and the Agence Nationale de la Recherche ANR	EPR investigation of massively anisotropic trigonal bipyramidal Ni(II) complexes P01924	Chemistry, Geochemistry	1	6
Shanti Deemyad (S) New PI 2013	University of Utah	Physics and Astronomy	Other - University of Utah, Department of Physics and Astronomy Start up fund Department of Energy DE-NA0001979 Department of Energy DE-FG52-10NA29659	Shubnikov de-Haas study of the Fermi surfaces of lithium at high pressure. P02464	Condensed Matter Physics	2	14
Takao Ebihara (S)	Shizuoka University	Physics	Department of Energy DE-SC0002613	Evidence for field-induced quantum-critical behavior in CeCu2Ge2: a quest for the de Haas van Alphen effect. P02478	Condensed Matter Physics	2	12
Mansour Shayegan (S)	Princeton University	Department of Electrical Engineering	Department of Energy DE-FG02-00-ER45841 National Science Foundation DMR-0904117, DMR-1305691 and MRSEC DMR-0819860 0819860	Magnetotransport measurements in low-dimensional, interacting electronic systems P02480	Condensed Matter Physics	6	60
Alexey Eremin (S) New PI 2013	Otto von Guericke University	Nonlinear Phenomena	Other - DAAD (Germany) Other - DFG (Germany)	Magneto-optical properties of switchable colloidal suspensions from anisometric pigment particles. P02517	Condensed Matter Physics	1	4
Joshua Telser (S)	Roosevelt University	Chemistry	NASA Chemistry CHE-1112154, CHE-1059097 Other - Roosevelt University	High-frequency and -field EPR studies of complexes of Group 6 - 8 ions with unusual ligands P07145	Chemistry, Geochemistry	1	5
David Cardwell (S) New PI 2010	University of Cambridge	Engineering Department	Other - Boeing Corporation Boeing Research and	To demonstrate the extremely high flux pinning force in single grain RE-Ba-Cu-O bulk	Engineering	1	7

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			Technology	superconductors containing nano-scale pinning centres. P01570			
Filip Ronning (S)	Los Alamos National Laboratory	MPA-CMMS	NHMFL User Collaboration Grants Program	Pulsed field transport measurements of nano-machined Ce-based compounds P02510	Condensed Matter Physics	1	6
Sergei Zvyagin (S)	Dresden High Magnetic Field Laboratory	EPR	Other - EMFL and DFG	Magnetic properties of quantum spin systems P07174	Condensed Matter Physics	1	6
Tony Heinz (S) New PI 2013	Columbia University	Department of Physics	National Science Foundation 1124894	Magneto-Optical Study of Atomically Thin Transition Metal Dichalcogenide Crystals P07177	Condensed Matter Physics	4	55
Jens Hanisch (S) New PI 2011	Leibniz Institute for Solid State and Materials Research IFD Dresden	Institut für Metallische Werkstoffe	Other - IFW Dresden	Study the pinning and transport properties of Ba-122 superconductor thin films P01938	Condensed Matter Physics	1	4
Chun Ning (Jeanie) Lau (S)	University of California, Riverside	Department of Physics and Astronomy	Department of Energy National Science Foundation	Magneto-transport and Symmetry-broken Quantum Hall States in Few Layer Graphene P02457	Condensed Matter Physics	9	60
Greg Boebinger (S)	NHMFL	Directors Office	Other - Canadian Institute of advanced study Other - Florida State University NHMFL	High Field Heat Capacity of YBCO P01554	Condensed Matter Physics	1	4
Rui-Rui Du (S)	Rice University	Physics and Astronomy	Department of Energy DE-FG02-06ER46274 National Science Foundation DMR1207562 Other - Welch Foundation C-1682	Topological States Based on InAs/GaSb Quantum Wells P01831	Condensed Matter Physics	1	7
Luis Balicas (S)	NHMFL	Condensed Matter Experiment	Department of Energy DE-SC0002613	Quest for thermodynamic evidence for a field-induced phase-transition within superconducting state of Fe1+xSe0.4Te0.6 P07184	Condensed Matter Physics	1	5
Madalina Furis (S)	University of Vermont	Physics	National Science Foundation 1056589 National Science Foundation 1229217	Exchange Mechanisms in Organic Magnetic Semiconductors: Organic Analogues to Diluted Magnetic Semiconductors P07186	Condensed Matter Physics	2	7
N. Phuan Ong (S)	Princeton University	Physics	U.S. Army Army Research Office W911NF-11- 1-0379 National Science Foundation 0819860	High-field experiments on the Topological Crystalline Insulator Pb1-xSnxSe/Pb1-xSnxTe P02446	Condensed Matter Physics	1	5
Eun Sang Choi (S)	NHMFL	Physics Department	NHMFL User Collaboration Grants Program	Study of Magnetic Phase transitions and Multiferroicity of Triangular Lattice Antiferromagnets P02366	Condensed Matter Physics	3	22

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Peide Ye (S)	Purdue University	School of Electrical and Computer Engineering	Other - Semiconductor Research Corporation	Study of graphene physics coupled with metallic nanostructures P01711	Condensed Matter Physics	2	14
Taichi Terashima (S)	National Institute for Materials Science	Nano-quantum Transport Group	Other - NIMS, Japan	de Haas-van Alphen measurements on exotic superconductors and metals P07187	Condensed Matter Physics	2	11
William Halperin (S)	Northwestern University	Physics	Department of Energy DE-FG02-05ER46248	Vortex structures in Hg1201 single crystals: competition with antiferromagnetism and the pseudo gap P07171	Condensed Matter Physics	2	10
Yoram Dagan (S)	Tel Aviv University	School of Physics and Astronomy	Other - Israeli science foundation	Oxide-interface-based quantum wire P02354	Condensed Matter Physics	1	7
Hans Rudolf Ott (S) New PI 2013	ETH Zuerich	Physics	Other - SNF - Schweizerische Nationalfonds zur Foerderung der Wissenschaftlichen Forschung 200020_144519	Field-controlled soliton-soliton interactions in a frustrated low-dimensional quantum magnet P02362	Condensed Matter Physics	1	5
Pablo Jarillo-Herrero (S)	MIT	Physics	Department of Energy de-sc0001819	High-Field Quantum Transport in Twisted Bilayer Graphene P07185	Condensed Matter Physics	2	11
Naoki Kikugawa (S) New PI 2013	National Institute for Materials Science	Superconducting Properties Unit	Other - MEXT, Japan	High-Field Magneto-Transport Study of a Metallic Delafossite Oxide P07189	Condensed Matter Physics	2	12
William Brey (S)	NHMFL	NMR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Attenuation of Temporal Variations in Magnetic Field Strength using Digital Feedback Control for NMR Spectroscopy P07191	Magnets, Materials, Testing, Instrumentation	1	3
Philip Kim (S)	Columbia University	Department of Physics	Department of Energy DEFG02-05ER46215	Tunable Quantum Hall in Graphene Heterostructures P02330	Condensed Matter Physics	2	10
Tao Hong (S)	Oak Ridge National Laboratory	Quantum Condensed Matter Division	Department of Energy	Quantum critical behavior of low dimensional spin-1/2 antiferromagnets in high magnetic fields P07188	Condensed Matter Physics	1	7
Guo-Qing Zheng (S)	Okayama University	Department of Physics	Other - MEXT of Japan and NSFC of China	Revealing the low-temperature normal state of high temperature superconductors by high-field NMR P07194	Condensed Matter Physics	2	8
Yong Chen (S)	Purdue University	Physics	Other - DARPA, MESO program	Quantum Oscillations in Topological Insulators and Related Materials P02358	Condensed Matter Physics	3	16
Dmitry Semenov (T)	NHMFL	DC Field	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	SCM3 maintenance P02281	Magnets, Materials, Testing, Instrumentation	1	5
Ruslan Prozorov (S) New PI 2011	Ames Laboratory-Iowa State University	Physics	Department of Energy DE-AC02-O7CH11358	Angle – dependent upper critical field anisotropy in multi-gap superconductors P01930	Condensed Matter Physics	1	6

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Zhiqiang Li (S)	National High Magnetic Field Laboratory	DC Field CMS	NHMFL User Collaboration Grants Program DC field	Magneto-optical Spectroscopy of Graphene and Few-layer Graphene P01901	Condensed Matter Physics	5	30
Qiang Li (S)	Brookhaven National Lab	Condensed Matter Physics and Materials Science	Department of Energy DOE-BES FWP-Superconducting Materials (KC0201030).	Mechanism of high critical current in iron chacalgenide films under high magnetic field P02463	Condensed Matter Physics	2	12
Chris Wiebe (S)	University of Winnipeg	Department of Chemistry	Other - NSERC, Canada Research Chair, ACS Petroleum Fund	Elucidating the magnetic phase diagram in Pb-containing langasites P07196	Condensed Matter Physics	1	6
Ian Fisher (S)	Stanford University	Applied Physics	National Science Foundation 1155458-100-QAAFC	Effect of disorder on the magnetic ground states of the frustrated spin dimer system Ba3(Mn1-xVx)2O8 P02454	Condensed Matter Physics	2	21
Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	Department of Energy DE-FG02-07ER46451	Magneto-optics of 2D semiconducting transiton metal dichalcogenides P07197	Condensed Matter Physics	5	28
Dmytro Abraimov (S)	NHMFL	The Applied Superconductivity Center	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) ASC	Critical current densities of MOCVD ReBCO coated conductor in wide range of temperatures, magnetic fields and field orientations P01850	Magnets, Materials, Testing, Instrumentation	1	4
Stuart Brown (S)	UCLA	Department of Physics and Astronomy	National Science Foundation 1105531	High field NMR study of the spin liquid candidate EtMe3Sb[Pd(dmit)2]2 P01933	Condensed Matter Physics	1	7
Theo Siegrist (S)	NHMFL	Condensed Matter Experiment	National Science Foundation 1257649 National Science Foundation EAGER-1257649	Test of an X-ray diffractometer for the Florida Split Coil 25T Magnet P02431	Magnets, Materials, Testing, Instrumentation	3	11
Lu Li (S) New PI 2011	University of Michigan	Physics	Department of Energy DE-SC0008110 National Science Foundation ECCS 1307744	Exploration of novel magnetism in interfacial strongly correlated materials P01822	Condensed Matter Physics	5	25
Dmitry Shulyatev (S)	National University of Science and Technology "MISIS"	Theoretical Physics	Other - Russian Foundation for Basic Research	Weak localisation in decogonal qusicrystal Al-Cu-Co. P02363	Condensed Matter Physics	1	11
Yasu Takano (S)	University of Florida	Physics	Other - JSPS Other - The University of Tennessee	High field studies of novel low-dimensional quantum magnets P01830	Condensed Matter Physics	2	14
Xiaodong Xu (S)	University of Washington	Physics	Department of Energy DE-SC0008145	Magneto-optical Spectroscopy of 2D transition metal dichalcogenides P02450	Condensed Matter Physics	1	14
Huiqiu Yuan (S) New PI 2011	Zhejiang University	Physics Department	Other - National Science Foundation of China	Field induced quantum critical behavior in CeRhIn5 P01840	Condensed Matter Physics	2	11
Yejun Feng (S)	Argonne National	Advanced Photon Source	Department of Energy NEAC02- 06CH11357	Investigating the crossover from linear to quadratic field	Condensed Matter Physics	1	10

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New PI 2012	Laboratory			dependence in magneto-resistance of GdSi P02036			
Tim Murphy (S)	NHMFL	Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Maintenance and Testing of SCM 1 and SCM 2 P01892	Condensed Matter Physics	2	14
Louis Taillefer (S)	University of Sherbrooke	Physics	Other - NSERC, CFI, CIFAR (all in Canada)	Thermoelectric studies on high-temperature superconductors P01572	Condensed Matter Physics	1	6
David Mandrus (S)	Oak Ridge National Laboratory	Condensed Matter Sciences Division	Other - Florida State University NHMFL	High Field Measurements of the Heat Capacity of LSCO P02369	Condensed Matter Physics	2	9
David Goldhaber-Gordon (S)	Stanford University	Physics	U.S. Army Army Research Office W911- NF-09-1-0398	High Field Magneto-Transport in Two-Dimensional Electron Liquids in SrTiO3 P01699	Condensed Matter Physics	1	2
David Hilton (S)	University of Alabama-Birmingham	Physics	National Science Foundation 1229217 National Science Foundation 1056827	Development of a Broadband Ultrafast THz Spectrometer for High Magnetic Field Research P02198	Condensed Matter Physics	1	1
Joe Thompson (S)	Los Alamos National Laboratory	MPA-10	Department of Energy Complex Electronic Materials	Novel magnetic states in the heavy-fermion quantum-critical material CeRhIn5 at high magnetic fields studied by NMR P07200	Condensed Matter Physics	2	9
Suchitra Sebastian (S)	Cambridge University	Physics	Other - European Research Council	Transport and Quantum Oscillations in strongly correlated topological insulators P07182	Condensed Matter Physics	2	10
Giti Khodaparast (S)	Virginia Tech.	Physics	National Science Foundation DMR-0846834	Time Resolved Magnetic Optical Effects in InAsP Ternary Alloys P07204	Condensed Matter Physics	1	2
Martin Greven (S)	University of Minnesota	Physics and Astronomy	Department of Energy SC0006858	Kohler's Rule in the Normal-State Magnetoresistance of the model cuprate superconductor HgBa2CuO4+d P02470	Condensed Matter Physics	1	6
Lloyd Engel (S)	NHMFL	CMS	Department of Energy DE-FG02-05ER46212	Microwave spectroscopy of electron solids: fractional quantum Hall effect and controlled disorder P01841	Condensed Matter Physics	3	17
Cory Dean (S)	The City College of New York	Physics	Other - New Faculty Start Up Funds National Science Foundation 1351337	Resistively detected NMR study of spin polarization in 13C graphene P02272	Condensed Matter Physics	4	23
Jun Sung Kim (S) New PI 2011	POSTECH	Physics	Other - National Research Foundation Korea	Magnetotransport properties of layered transition-metal pnictide single crystals P01719	Condensed Matter Physics	2	13
Vesna Mitrovic (S)	Brown University	Physics	Other - Brown University	Resistively and inductively detected NMR as probe of 3D topological Kondo Insulators P07206	Condensed Matter Physics	2	14
Panayotis Kyritsis (S)	University of Athens	Chemistry	Other - University of Athens Department of Chemistry	Electronic properties of (i) synthetic analogues of metalloproteins' active sites and (ii) single-ion molecular magnet metal complexes, probed by HFEPR spectroscopy.	Chemistry, Geochemistry	1	6

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				P07143			
Sheena Murphy (S)	University of Oklahoma	Physics and Astronomy	National Science Foundation 1207537	Magneto-Transport of Quantum Confined Sb P01833	Condensed Matter Physics	1	7
Marc-Henri JULIEN (S)	CNRS Grenoble	Laboratoire National des Champs Magnétiques Intenses	Other - French ANR	NMR study of the field-induced charge-stripe order in high temperature superconductors P01939	Condensed Matter Physics	1	5
Luis Balicas (S)	NHMFL	Condensed Matter Experiment	Department of Energy DE-SC0002613	New multi-band transition-metal chalcogenide superconductors displaying extremely high upper critical fields P02251	Condensed Matter Physics	1	7
Ray Ashoori (S)	Massachusetts Institute of Technology	Physics	Department of Energy FG02-08ER46514	Probing Magnetism at Amorphous Oxide Interfaces P07208	Condensed Matter Physics	1	7
Kenneth Knappenberger (S)	Florida State University	Chemistry and Biochemistry	Other - Department of Defense	Magnetophotoluminescence Studies of Tunable Nanocrystals P01742	Chemistry, Geochemistry	2	14
YounJung Jo (S)	Kyungpook National University	Physics	Other - NRF (2010-0006377 and 2010-0020057)	Evolution of the upper critical field, its anisotropy and Hall effects of iron-pnictide epitaxial films with a high critical current density P07210	Condensed Matter Physics	1	7
R. Ramesh (S)	University of California, Berkeley	Department of Materials Science and Engineering	Department of Energy DE-AC02-76SF00515	High field transport studies of pyrochlore iridates P02264	Condensed Matter Physics	1	7
Stephen McGill (S)	NHMFL	Condensed Matter Science	National Science Foundation 12756	Charge-Spin-Lattice Coupling in Low-Dimensional Magnets P07215	Condensed Matter Physics	5	32
Chris Palmstrom (S)	UC Santa Barbara	ECE-Material Science	Other - Microsoft Research	Quantum Hall effect in narrow band gap semiconductors with superconducting contacts P07217	Condensed Matter Physics	3	21
Nobuko Naka (S)	Kyoto University	Physics	Other - Japanese Government International Training Program NSF-DMR 1309146	Magneto-optical spectroscopy of excitonic fine-structure in diamond P07233	Condensed Matter Physics	1	5
Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Magneto-Raman Spectroscopy of Graphite and Graphene P01738	Condensed Matter Physics	1	7
Joseph Johnson (O)	Applied Materials	CTO	Other - Applied Materials	Microstructure Modification under High Laser Fluence and High Magnetic Field P07149	Magnets, Materials, Testing, Instrumentation	1	2
Martin Nikolo (S)	Saint Louis University	Physics	Other - Saint Louis University Physics Department	Magnetic flux pinning properties of the iron-pnictide superconductors Ba(Fe0.91Co0.09)2As2, Ba(Fe0.93Co0.07)2As2, and Ba(Fe0.95Co0.05)2As2 P01820	Condensed Matter Physics	1	6
Guillaume Gervais (S)	McGill University	Physics department	Other - CRSNG (canada), Cifar (Canada) FRQNT (Qc)	Berry's Phase in 2D Condensed Matter Systems P08310	Condensed Matter Physics	1	5
Kresimir Rupnik (S)	Louisiana State University	Chemistry Department	NHMFL User Collaboration Grants Program	Polarization Phase Selective Spectroscopy (PPS) Studies P01838	Biology, Biochemistry, Biophysics	1	1

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			physics/materials 227000-520-022742 Other - LSU				
Norbert Buettgen (S)	University of Augsburg	Institute of Physics	Other - Russian Academy of Sciences, RAS P. Kapitza Institute for Physical Problems, Moscow Other - German Research Society, DFG Transregional Collaborative Research Center TRR80	Spin-Nematic Phase in the S = 1/2 Antiferromagnet LiCuVO4 Probed by Specific-Heat Experiments P08313	Condensed Matter Physics	1	6
Irina Drichko (S)	A.F.Ioffe PTI	Physics of Semiconductors and Dielectrics	Other - Russian Foundation for Basic Research	High Frequency Magnetotransport in High-Mobility n-AlGaAs/GaAs/AlGaAs Heterostructures in the Fractional Quantum Hall Regime. Acoustic Studies. P02442	Condensed Matter Physics	1	14
Naoki Kikugawa (S)	National Institute for Materials Science	Superconducting Properties Unit	Other - MEXT, Japan	Quantum oscillation measurements of a novel non-centrosymmetric superconductor P07190	Condensed Matter Physics	1	27
Chenglin Zhang (S)	The University of Tennessee	Department of Physics and Astronomy	National Science Foundation DMR-1309531 Department of Energy DE-FG02-05ER46202	Magneto-optical Spectroscopy of Iron-based Superconductors P02263	Condensed Matter Physics	2	10
Nathanael Fortune (S)	Smith College	Department of Physics	NHMFL Visiting Scientist Program DC Fields VSP #173	Calorimetric studies of magnetic-field-induced phase transitions in strongly correlated systems P02364	Condensed Matter Physics	1	6
Giti Khodaparast (S)	Virginia Tech.	Physics	National Science Foundation NSF-Career Award DMR-0846834	Magnetic Circular Dichroism Spectroscopy of InMnAs and InMnSb Ferromagnetic Semiconductors P08316	Condensed Matter Physics	1	3
Sergey Suchalkin (S)	SUNY at Stony Brook	Electrical and Computer Engineering	National Science Foundation DMR1160843	Magneto-spectroscopy of metamorphic InAsSb narrow band semiconductors P07180	Condensed Matter Physics	2	14
Igor Kuskovsky (S)	Queens College of CUNY	Physics	National Science Foundation DMR-1006050	Temperature studies of Aharonov Bohm oscillations in type-II magneto-excitons P02083	Condensed Matter Physics	1	7
Kee Hoon Kim (S)	Seoul National University	School of Physics	Other - National Creative Research Initiative NRF, Korea	Thermal properties of low-dimensional antiferromagnetic systems under high magnetic field P07211	Condensed Matter Physics	1	6
Clifford Bowers (S)	University of Florida	Chemistry	NHMFL User Collaboration Grants Program Condensed Matter Physics FSU# 227000-520-022742/ NSF# DMR-0654118	A New Probe for NMR Signal Detection of Optically Addressable Samples P02073	Magnets, Materials, Testing, Instrumentation	1	8
David Tanner (S)	University of Florida	Associate Director of MICROFABRITECH	Department of Energy DE-FG02-02ER45984 NHMFL User	Searching for quantum oscillations in new candidates for topological insulators 2	Condensed Matter Physics	2	19

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			Collaboration Grants Program	P02102			
Vinh Nguyen (S)	Virginia Tech	Physics	National Science Foundation ECCS 1358564	Magneto-optical studies of Er optical centers in semiconductors (Si and GaN) at high magnetic fields P08327	Condensed Matter Physics	1	7
Ian Fisher (S)	Stanford University	Applied Physics	U.S. Navy Department of Energy DEAC02-76SF00515	Measuring the high-magnetic field elasto-resisitivity coefficients in URu2Si2 P08314	Condensed Matter Physics	2	11
Ivan Bozovic (S)	Brookhaven National Lab	Condensed Matter and Materials Science	Department of Energy MA-509-MACA	Determination of the upper critical field of cuprates by electrical transport under high magnetic field P02266	Condensed Matter Physics	1	5
George Schmiedeshoff (S)	Occidental College	Department of Physics	National Science Foundation 1006118	Quantum criticality & phase diagrams of heavy fermion YbAgGe and YbBiPt studied with high-precision dilatometry P07155	Condensed Matter Physics	1	7
Cedomir Petrovic (S)	Brookhaven National Laboratory	Condensed Matter Physics	Department of Energy DE-Ac02-98CH10886	High Field Transport and Oscillation study of FeSb2 P08329	Condensed Matter Physics	1	5
Yuko Hosokoshi (S)	Osaka Prefecture University	Department of Physical Science	Other - MEXT of Japan NHMFL User Collaboration Grants Program	Thermodynamic studies of geometrically frustrated spin systems made of organic radicals P01737	Condensed Matter Physics	1	7
N. Phuan Ong (S) New PI 2013	Princeton University	Physics	U.S. Army Army Research Office W911NF-11- 1-0379 National Science Foundation 0819860	Shubnikov–de Haas quantum oscillations of Weyl Semimetal Cd3As2 at high fields P07241	Condensed Matter Physics	2	12
James Gleeson (S)	Kent State University	Physics	National Science Foundation DMR-1307674	Magneto-optical studies on complex fluids P07193	Condensed Matter Physics	1	5
Mitsuhiko Maesato (S)	Kyoto University	Division of Chemistry, Graduate School of Science	Other - KAKENHI	Quantum effect on the p–d hybrid molecular conductor P02352	Condensed Matter Physics	2	8
Don Heiman (S) New PI 2014	Northeastern University	Physics	National Science Foundation 0907007	Topological Crystalline Insulator SnTe Thin Films at High Magnetic Fields P08326	Condensed Matter Physics	1	3
Elizabeth Blackburn (S)	University of Birmingham	Quantum Matter Group-School of Physics and Astronomy	Other - UK EPSRC EP/J016977/1	Upper critical field characterization in Nb1-xSnx samples by different techniques P08330	Condensed Matter Physics	1	6
David Hilton (S)	University of Alabama-Birmingham	Physics	National Science Foundation DMR-1229217 National Science Foundation DMR-1056827	Development of Ultrafast Terahertz Spectroscopy Experiments for SCM3 P02175	Condensed Matter Physics	1	8
Yuri Vasilyev (S)	Ioffe Institute	Centre of Nanoheterostructure Physics	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	IR magnetospectroscopy on narrow gap semiconductor quantum wells in high magnetic fields P08331	Condensed Matter Physics	1	7
James Hone (S)	Columbia University	Mechanical Engineering	National Science Foundation	Quantum Oscillations in Two-Dimensional Transition Metal	Condensed Matter Physics	1	5

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New PI 2014			1122594	Dichalcogenide Heterostructures P08332			
Zhigang Jiang (S)	Georgia Institute of Technology	School of Physics	Department of Energy DE-FG02-07ER46451 National Science Foundation DMR-0820382	Quantum Transport and Infrared Spectroscopy of Graphene P02425	Condensed Matter Physics	2	14
Mark Murrie (S)	University of Glasgow	Chemistry	National Science Foundation DMR1309463	Single-ion magnets with giant axial magnetic anisotropy P08335	Chemistry, Geochemistry	1	6
Nicholas Curro (S)	University of California	Physics	National Science Foundation 1005393	NMR Investigation of Spin Fluctuations near Hc2 in Ba(Fe1-xCox)2As2 P02344	Condensed Matter Physics	1	6
Joseph Checkelsky (S) New PI 2014	MIT	Physics	Other - MIT	Interplay of Magnetism and Topological Phases P08337	Condensed Matter Physics	2	14
Rui-Rui Du (S)	Rice University	Physics and Astronomy	Department of Energy DE-FG02-06ER46274 National Science Foundation DMR1207562 Other - Welch Foundation C-1682	Quantum Transport of Exciton Condensates in InAs/GaSb Quantum Wells P08338	Condensed Matter Physics	2	11
Greg Boebinger (S)	NHMFL	Directors Office	Other - State of Florida	High Field Heat Capacity of High Tc Cuprate Superconductors P08321	Condensed Matter Physics	2	7
Alexey Suslov (S)	NHMFL	Condensed Matter Science	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Development of dilatometer with optical readout P08339	Magnets, Materials, Testing, Instrumentation	3	14
Louis Taillefer (S)	University of Sherbrooke	Physics	Other - CIFAR, NSERC, FQRNT, Canada Research Chair, CFI	Pressure studies of high-temperature superconductors P08341	Condensed Matter Physics	1	4
Malte Grosche (S) New PI 2014	University of Cambridge	Cavendish Laboratory	Other - EPSRC of the United Kingdom EP/K012894/1	Quantum oscillations in Mott insulators metallised under high pressure P08323	Condensed Matter Physics	1	5
Ray Ashoori (S)	Massachusetts Institute of Technology	Physics	Department of Energy DE-FG02-08ER46514	Magnetocapacitance of Dirac Materials P01844	Condensed Matter Physics	1	7
Sheena Murphy (S)	University of Oklahoma	Physics and Astronomy	National Science Foundation 1207537	Quantum Interference in Ultra-Thin Film Antimony P08333	Condensed Matter Physics	2	14
Wei Pan (S)	Sandia National Labatories	Semiconductor Devices and Science	Department of Energy DE-AC04-94AL85000	Two-Dimensional Conduction near the Metal-Insulator Transition in a Si/SiGe Quantum Well under In-Plane Magnetic Field P07151	Condensed Matter Physics	2	14
James Brooks (S)	Florida State University	Physics	Other - Grant-in-Aid for Scientific Research 22224006 JSPS	Electrical properties of Mott insulators beta'-ET2XCl2 (X=I, Au) under high quality hydrostatic pressure generated by diamond anvil cell P08394	Condensed Matter Physics	1	4
Suchitra Sebastian (S)	Cambridge University	Physics	Other - ERC	A search for topological surface states P08397	Condensed Matter Physics	1	6

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Luis Balicas (S)	NHMFL	Condensed Matter Experiment	U.S. Army ARO W911NF-11-1-0362	Studying the electronic structure of WTe2 as a function of the number of atomic layers P08406	Condensed Matter Physics	1	6
Lu Li (S)	University of Michigan	Physics	Department of Energy DE-SC0008110 National Science Foundation ECCS ECCS-1307744	Interaction-Driven Topological Materials P08418	Condensed Matter Physics	2	8
Christian Rueegg (S) New PI 2014	Paul Scherrer Institute	Laboratory for Neutron Scattering and Imaging	Other - Swiss National Science Foundation	Pressure-controlled Dimensionality of a Bi-layer Quantum Magnet P08412	Condensed Matter Physics	1	6
Lloyd Engel (S)	NHMFL	CMS	Department of Energy DE-FG02-05ER46212	Microwave spectroscopy of exotic electron solids in wide quantum wells P08420	Condensed Matter Physics	1	7
Ian Fisher (S)	Stanford University	Applied Physics	U.S. Army Multidisciplinary University Research Initiative (MURI) TXARN	High-field study of Superconducting thallium doped lead telluride (Pb1-xTlxTe) P02297	Condensed Matter Physics	1	8
Jianyi Jiang (S)	ASC-NHMFL	ASC	National Science Foundation 22700-520-030759	Irreversibility field in BSCCO-2212 tapes of variable composition P08422	Magnets, Materials, Testing, Instrumentation	1	5
Zhiqiang Li (S)	National High Magnetic Field Laboratory	DC Field CMS	NHMFL User Collaboration Grants Program DC field	Magneto-transport and Magneto-optical Study of Topological Insulators P02349	Condensed Matter Physics	2	8
Danko van der Laan (S)	National Institute of Standards and Technology	687.03	Department of Energy DE-SC0009545 Department of Energy DE-AI05-98OR22652	Critical current measurements of high-temperature superconducting CORC magnet cables at 4.2 K and high magnetic fields P08425	Magnets, Materials, Testing, Instrumentation	1	2
Kenneth Purcell (S)	University of Southern Indiana	Geology and Physics	Other - University of Southern Indiana	High pressure studies of NdIn3 P08427	Condensed Matter Physics	1	7
Ju-Hyun Park (S)	NHMFL	Instrumentation & Operations, User Support	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Thermometry Control in High Magnetic Fields P08414	Condensed Matter Physics	1	7
Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Magneto-Raman spectroscopy of correlated electron systems P08432	Condensed Matter Physics	1	7
Kenneth Knappenberger (S)	Florida State University	Chemistry and Biochemistry	Other - Department of Defense	State-Resolved Electron Dynamics in Structurally Precise Metal Clusters P08433	Chemistry, Geochemistry	1	7
James Hamlin (S)	University of Florida	Dept. of Physics	NHMFL User Collaboration Grants Program	High field studies of pressure-tuned quantum phase transitions P08434	Condensed Matter Physics	1	7
Greg Scholes (S) New PI 2014	University of Toronto	Chemistry	National Science Foundation DMR-1229217	Ultrafast Dynamics in Photosynthetic Protein Complexes P08340	Condensed Matter Physics	1	1
Philip Moll (G)	ETH Zurich	Laboratory for Solid State Physics	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Field Induced density wave in CeRhIn5 and CeCoIn5 P08435	Condensed Matter Physics	1	5

DC FIELD

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Zhiqiang Li (S)	National High Magnetic Field Laboratory	DC Field CMS	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Testing, calibrating and improving the new IR transmission probe in SCM3 P08449	Magnets, Materials, Testing, Instrumentation	1	7
Jun Zhu (S) New PI 2014	Penn State University	Physics	U.S. Navy N00014-11-1-0730	Symmetry breaking and kink states in few-layer graphene nanostructures P08487	Condensed Matter Physics	1	4
Total Proposals:				**162**	**Total Experiments:**	**290**	**1801**

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PULSED FIELD FACILITY

Table 1 – User Demographic

Pulsed Field Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**57**	48	3	6	3	48	6	34	0	14	9
Senior Personnel, non-U.S.	**20**	16	2	2	3	13	4	3	0	3	14
Postdocs, U.S.	**15**	12	2	1	1	11	3	15	0	0	0
Postdocs, non-U.S.	**7**	3	2	2	0	5	2	3	0	1	3
Students, U.S.	**23**	16	6	1	0	19	4	18	0	3	2
Students, non-U.S.	**9**	8	1	0	1	8	0	7	0	0	2
Technician, U.S.	**1**	0	1	0	0	1	0	1	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Total:	**132**	**103**	**17**	**12**	**8**	**105**	**19**	**81**	**0**	**21**	**30**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

Pulsed Field Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**57**	23	11	26	0	31
Senior Personnel, non-U.S.	**20**	0	0	18	0	2
Postdocs, U.S.	**15**	3	8	5	0	10
Postdocs, non-U.S.	**7**	0	0	7	0	0
Students, U.S.	**23**	4	5	19	0	4
Students, non-U.S.	**9**	0	0	9	0	0
Technician, U.S.	**1**	0	0	0	0	1
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**132**	**30**	**24**	**84**	**0**	**48**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

Pulsed Field Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**57**	46	5	3	1	2
Senior Personnel, non-U.S.	**20**	19	1	0	0	0
Postdocs, U.S.	**15**	15	0	0	0	0
Postdocs, non-U.S.	**7**	6	1	0	0	0
Students, U.S.	**23**	21	0	0	0	2
Students, non-U.S.	**9**	8	1	0	0	0
Technician, U.S.	**1**	1	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**132**	**116**	**8**	**3**	**1**	**4**

Table 4 – User Facility Operations

Pulsed Field Facility	Short Pulse	Mid Pulse	Long Pulse	100T	Single Turn	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]						
NHMFL-Affiliated	196	0	10	0	0	206	26.14%
Local	49	0	0	6	0	55	6.98%
U.S. University	174	0	8	9	0	191	24.24%
U.S. Govt. Lab.	25	0	34	5	0	64	8.12%
U.S. Industry	0	0	0	0	0	0	0%
Non-U.S.	190	0	28	0	37	255	32.36%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	3	0	0	0	14	17	2.16%
Total:	**637**	**0**	**80**	**20**	**51**	**788**	**100%**

1. User Units are defined as magnet days. For the Pulsed Field Facility, one magnet day is defined as 12 hours in any pulsed magnet system.

Table 5 – Operations by Discipline

Pulsed Field Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
	Number of Magnet Days[1]					
NHMFL-Affiliated	206	206	0	0	0	0
Local	55	55	0	0	0	0
U.S. University	191	191	0	0	0	0
U.S. Govt. Lab.	64	64	0	0	0	0
U.S. Industry	0	0	0	0	0	0
Non-U.S.	255	255	0	0	0	0
Test, Calibration, Set-up, Maintenance, Inst. Dev.	17	0	0	0	17	0
Total:	**788**	**771**	**0**	**0**	**17**	**0**

1. User Units are defined as magnet days. For the Pulsed Field Facility, one magnet day is defined as 12 hours in any pulsed magnet system.

Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
180	15	72 (36.92%)	123 (63.08%)	195	270.83%

APPENDIX I – USER FACILITY STATISTICS

Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Morosan, Emilia	Iowa State University	P07269	Received 2014
Nikolo, Martin	Saint Louis University	P07274	Received 2015
Chauviere, Ludivine	University of British Columbia	P07286	Received 2014
Wartenbe, Mark	FSU	P07304	Approved 2015
Cornell, Nicholas	University of Texas at Dallas	P08325	Scheduled 2015
Gofryk, Krzysztof	Idaho National Laboratory	P08358	Approved 2015
Hanisch, Jens	Leibniz Institute for Solid State and Materials Research IFD Dresden	P08468	Received 2015
Riggs, Scott	NHMFL	P08484	Received 2015
Chan, Mun	University of Minnesota	P09544	Submitted 2014
Total:			**9**

Table 8 – Research Proposals Profile with Magnet Time

Pulsed Field Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem, Biophys.
Number of Proposals	47	2	9	42	2	0	3	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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	Number of Days Used
Jamie Manson (S)	Eastern Washington University	Chemistry and Biochemistry	National Science Foundation 1005825	Magnetization studies of Ni(II)-based molecular and polymeric magnets P01531	Chemistry, Geochemistry	1	5.00
Ivan Bozovic (S)	Brookhaven National Lab	Condensed Matter and Materials Science	Other - The State of Florida	Magnetotransport in LSCO grown via Molecular Beam Epitaxy. P01736	Condensed Matter Physics	2	18.00
Vivien Zapf (S)	NHMFL-LANL	Physics	Department of Energy 20140177ER	Spin-state transitions as a route to multifunctionality P07242	Condensed Matter Physics	2	18.00
Chun Ning (Jeanie) Lau (S) New PI 2012	University of California, Riverside	Department of Physics and Astronomy	Other - UC Fees proposal	High field studies of topological insulators P02113	Condensed Matter Physics	2	14.00

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Huiqiu Yuan (S)	Zhejiang University	Physics Department	Other - National Science Foundation of China	Angle dependence of the dHvA effect in CeRhIn5 P02334	Condensed Matter Physics	1	5.00
James Brooks (S)	Florida State University	Physics	National Science Foundation 1005293	Investigation of interacting spin-Peierls (SP) and charge density wave (CDW) chains in Per2[Pt(mnt)2] by inductive methods above 45 T. P07144	Condensed Matter Physics	1	22.00
Emilia Morosan (G) New PI 2014	Iowa State University	Department of Physics and Astronomy	National Science Foundation 0847681	High Field Magnetization in an Itinerant Antiferromagnet P07269	Condensed Matter Physics	1	5.00
Agnieszka Lekawa-Raus (P)	Cambridge University	Department of Material Science	Other - European Research Council	Electromagnetic performance of CNT assemblies P02417	Condensed Matter Physics	1	47.00
Jonathon Kemper (G)	Florida State University	Director's Office-Science	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) Director's Office	Thermometry calibrations for specific heat experiments P01654	Condensed Matter Physics	1	29.00
Jorge Mira (S)	University of Santiago de Compostela	Departamento de Física Aplicada	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Multiferroic properties of a new metal-organic framework P02501	Condensed Matter Physics	3	46.00
Mark Wartenbe (G) New PI 2014	FSU	Director's Offcie	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	QCPs in (Ca-Sr)RuO3 P07304	Condensed Matter Physics	3	24.00

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Kee Hoon Kim (S)	Seoul National University	School of Physics	Other - National Creative Research Initiative NRF of South Korea	Thermal properties of low-dimensional antiferromagnetic systems under high magnetic field P07211	Condensed Matter Physics	3	15.00
Jun Sung Kim (S) New PI 2011	POSTECH	Physics	NSF	Magnetotransport properties of layered transition-metal pnictide single crystals P01719	Condensed Matter Physics	1	10.00
Martin Nikolo (S) New PI 2014	Saint Louis University	Physics	Other - Saint Louis University	Upper critical fields, magneto-transport properties and thermally activated flux flow in Ba(Fe0.91Co0.09)2As2, Ba(Fe0.95Ni0.05)2As2, and Ba(Fe0.94Ni0.06)2As2 superconductors P07274	Condensed Matter Physics	5	37.00
Doan Nguyen (S)	NHMFL - PFF	Pulsed Field Facility	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Testing and Training of pulsed magnets P07288	Magnets, Materials, Testing, Instrumentation	1	3.00
Zengwei Zhu (P)	Los Alamos National lab	MPA-CMMS	Department of Energy Director's funding	The fate of the three dimensional electron far beyond quantum limit P02324	Condensed Matter Physics	2	39.00
Vivien Zapf (S)	NHMFL-LANL	Physics	Department of Energy 201300601ER	Quenched 2nd order phase transitions P01761	Condensed Matter Physics	4	20.00
Dwight Rickel (S)	NHMFL @ LANL	National High Magnetic Field Laboratory	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Maintenance, diagnostics and testing of single turn magnet system P07290	Magnets, Materials, Testing, Instrumentation	1	7.00
Ludivine Chauviere (P)	University of British	Physics and	Department of	Magnetic Quantum Oscillations Through the Quantum Critical Point in	Condensed Matter Physics	1	12.00

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New PI 2014	Columbia	Astronomy	Energy LANLF100	Cuprate High Tc Superconductors P07286			
Filip Ronning (S)	Los Alamos National Laboratory	MPA-CMMS	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Pulsed field transport measurements of nano-machined Ce-based compounds P02510	Condensed Matter Physics	1	23.00
Nicholas Cornell (G) New PI 2014	University of Texas at Dallas	Physics	Other - University of Texas at Dallas Salamon Research	?(T,H=const) and (H,T) phase diagram determination for Fe(SeXTe1-X) P08325	Condensed Matter Physics	1	10.00
Tian-Heng Han (P) New PI 2013	University of Chicago	Physics	Department of Energy DE-AC02-06CH11357	Quantum Spin Liquids in High Fields P02458	Condensed Matter Physics	2	9.00
James Analytis (S)	University of California, Berkeley	Physics	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	High field magnetometry of strong spin-orbit coupled oxides P02271	Condensed Matter Physics	3	39.00
Ivan Bozovic (S)	Brookhaven National Lab	Condensed Matter and Materials Science	Department of Energy MA-509-MACA	Determination of the upper critical field of cuprates by electrical transport under high magnetic field P02266	Condensed Matter Physics	1	10.00
Stan Tozer (S)	NHMFL	Physics	Department of Energy DE-FG52-10NA29659	High pressure magnetostriction studies of actinides and related materials P02128	Condensed Matter Physics	1	12.00
N. Phuan Ong (S)	Princeton University	Physics	National Science Foundation 0819860	The thermal Hall conductivity of Dirac quasiparticles in YBa2Cu3O6+y in high fields P02268	Condensed Matter Physics	1	12.00

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N. Phuan Ong (S) New PI 2013	Princeton University	Physics	National Science Foundation 0819860	Shubnikov–de Haas quantum oscillations of Weyl Semimetal Cd3As2 at high fields P07241	Condensed Matter Physics	2	24.00
Paul Goddard (S)	Oxford University	Department of Physics	Other - EPSRC (UK) EP/H00324X/1	Fermi surface topology of under-doped cuprate superconductors using angle-dependent magnetoresistance P02265	Condensed Matter Physics	2	21.00
Yayu Wang (S)	Tsinghua University	Physics	NHMFL User Collaboration Grants Program Other - Tsinghua University	Transport measurement on (Bi1-xSbx)2Te3 thin films in 100T pulsed magnet P02327	Condensed Matter Physics	2	24.00
Krzysztof Gofryk (S) New PI 2014	Idaho National Laboratory	Fuel Performance & Design	Other - NEAMS Nuclear Fuels and Materials	Spin-lattice coupling in uranium dioxide probed by magnetostriction measurements at high magnetic fields P08358	Condensed Matter Physics	2	20.00
Nathan Smythe (S) New PI 2013	Chemistry Division	Inorganic, Isotope and Actinide Chemistry	Department of Energy XW94	Magnetic Study of a Dinitrogen Bridged Fe Dimer P02380	Chemistry, Geochemistry	1	10.00
Paul Goddard (S)	Oxford University	Department of Physics	Other - EPSRC	Determining the Fermi surface of colossal magnetoresistive materials P02111	Condensed Matter Physics	1	19.00
Scott Riggs (P)	NHMFL	CMS	National Science Foundation	Calibration of custom designed Cernox calorimeters P08402	Condensed Matter Physics	1	26.00
Paul Goddard (S)	Oxford University	Department of Physics	Other - EPSRC UK	Pulsed-field magneto caloric effect in low-dimensional magnets P08398	Condensed Matter Physics	1	16.00
Vivien Zapf (S)	NHMFL-LANL	Physics	Department of Energy XWA2	Multiferroic heterostructures P08364	Condensed Matter Physics	1	9.00
Marcin Zybert (G)	University of Rzeszow	CDNMiN	No other support (i.e. this experiment is entirely supported by NHMFL users services via its	Cyclotron Resonance above the Quantum Limit in the Double and Multiple Quantum Wells Structures P02518	Condensed Matter Physics	1	35.00

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			core grant)				
Ryan Baumbach (S)	National High Magnetic Field Laboratory	CMS	Other - 227000-520-030759 NHMFL Renewal Proposal	High magnetic fields, applied pressure, and materials science: A toolbox to understand Quantum Criticality P02269	Condensed Matter Physics	2	17.00
James Analytis (S)	University of California, Berkeley	Physics	Other - University of California Berkeley Physics	High field magneto-transport near a quantum critical point in high temperature superconductors. P02226	Condensed Matter Physics	1	5.00
Kirstin Alberi (T)	National Renewable Energy Lab	Materials Science	Department of Energy DE-AC36-08GO28308	Magneto-Photoluminescence Investigation of the Direct-Indirect Transition in AlxGa1-xAs P08458	Condensed Matter Physics	1	6.00
Gang Cao (S)	University of Kentucky	Department of Physics and Astronomy	National Science Foundation DMR-1265162	Probing Spin-Orbit Coupled 5d-Electron Iridates Using High Magnetic Field P02050	Condensed Matter Physics	1	5.00
Sang Wook Cheong (S)	Rutgers University	Physics and Astronomy	Department of Energy XW5D	Multiferroic behavior and slow dynamics in Ca3CoMnO6 and Sr3NiIrO6 P02092	Condensed Matter Physics	1	13.00
Mun Chan (P)	University of Minnesota	School of Physics & Astronomy	Department of Energy SC0006858	The ground-state of the cuprate high-temperature superconductor HgBa2CuO4+d P08467	Condensed Matter Physics	1	10.00
Marcelo Jaime (S)	MPA-CMMS	Physics	NHMFL User Collaboration Grants Program	Optical fiber Bragg gratings-based magnetostriction to 120T P09520	Magnets, Materials, Testing, Instrumentation	1	7.00
Scott Riggs (P) New PI 2014	NHMFL	CMS	Other - FSU	Fermi surface studies of systems near nematic critical points via strain P08484	Condensed Matter Physics	1	12.00
Kirstin Alberi (T)	National Renewable Energy Lab	Materials Science	Department of Energy DE-AC36-08GO28308	Magneto-Photoluminescence Investigation of Carrier Localization in Indirect AlxGa1-xAs P08459	Condensed Matter Physics	1	5.00

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Lu Li (S) New PI 2012	University of Michigan	Physics	Department of Energy DE-SC0008110	Magnetic property of high temperature superconductors in ultrahigh magnetic fields P02065	Condensed Matter Physics	1	8.00
Jens Hanisch (S) New PI 2014	Leibniz Institute for Solid State and Materials Research IFD Dresden	Institut für Metallische Werkstoffe	Other - European-Japanese collaborative project SUPER-IRON (No. 283204)	High-field transport properties of Fe-based superconducting thin films P08468	Condensed Matter Physics	1	5.00
			Total Proposals:	**47**	**Total Experiments:**	**72**	**788**

APPENDIX I – USER FACILITY STATISTICS

HIGH B/T FACILITY

Table 1 – User Demographic

High B/T Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**16**	15	0	1	0	14	2	6	0	8	2
Senior Personnel, non-U.S.	**1**	1	0	0	0	1	0	0	0	1	0
Postdocs, U.S.	**2**	2	0	0	0	2	0	2	0	0	0
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Students, U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Students, non-U.S.	**1**	1	0	0	0	1	0	1	0	0	0
Technician, U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Total:	**20**	**19**	**0**	**1**	**0**	**18**	**2**	**9**	**0**	**9**	**2**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

High B/T Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**16**	4	0	13	0	3
Senior Personnel, non-U.S.	**1**	0	0	1	0	0
Postdocs, U.S.	**2**	1	1	2	0	0
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**0**	0	0	0	0	0
Students, non-U.S.	**1**	0	0	1	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**20**	**5**	**1**	**17**	**0**	**3**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

High B/T Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**16**	13	0	3	0	0
Senior Personnel, non-U.S.	**1**	1	0	0	0	0
Postdocs, U.S.	**2**	2	0	0	0	0
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**0**	0	0	0	0	0
Students, non-U.S.	**1**	1	0	0	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**20**	**17**	**0**	**3**	**0**	**0**

Table 4 – User Facility Operations

High B/T Facility	16T Bay 3	8T Bay 2	10T Williamson Hall	4T Williamson Hall	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]					
NHMFL-Affiliated	0	0	0	0	0	0%
Local	0	0	0	0	0	0%
U.S. University	95	0	137	138	370	43.22%
U.S. Govt. Lab.	64	162	60	0	286	33.41%
U.S. Industry	0	0	0	0	0	0%
Non-U.S.	0	0	0	85	85	9.93%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	39	43	33	0	115	13.43%
Total:	**198**	**205**	**230**	**223**	**856**	**100%**

1. User Units are defined as magnet days. For the High B/T Facility, one magnet day is defined 24 hours in the superconducting magnets.

Table 5 – Operations by Discipline

High B/T Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
	Number of Magnet Days[1]					
NHMFL-Affiliated	0	0	0	0	0	0
Local	0	0	0	0	0	0
U.S. University	370	370	0	0	0	0
U.S. Govt. Lab.	286	286	0	0	0	0
U.S. Industry	0	0	0	0	0	0
Non-U.S.	85	85	0	0	0	0
Test, Calibration, Set-up, Maintenance, Inst. Dev.	115	115	0	0	0	0
Total:	**856**	**856**	**0**	**0**	**0**	**0**

1. User Units are defined as magnet days. For the High B/T Facility, one magnet day is defined 24 hours in the superconducting magnets.

APPENDIX I – USER FACILITY STATISTICS

Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
11	2	10 (76.92%)	3 (23.08%)	13	130%

Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Wang, Shanmin	University of Nevada at Las Vegas	P08319	Received 2014
Total:			**1**

Table 8 – Research Proposals Profile with Magnet Time

High B/T Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Number of Proposals	6	0	0	6	0	0	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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	Number of Days Used
Wei Pan (S)	Sandia National Labatories	Semiconductor Devices and Science	Department of Energy Sandia National Lab.	Two-Dimensional Conduction near the Metal-Insulator Transition in a Si/SiGe Quantum Well under In-Plane Magnetic Field P07151	Condensed Matter Physics	3	329.00
Guillaume Gervais (S) New PI 2013	McGill University	Physics department	Department of Energy Other - Candaian R Fndnesearch	Measurement of 1D-1D Coulomb Drag in the T=0 Limit P02503	Condensed Matter Physics	2	118.00
Shanmin Wang (S) New PI 2014	University of Nevada at Las Vegas	Physics	Department of Energy	Quantum Paraelectric Measurements in Perovskite PbCrO3 at Low Temperatures P08319	Condensed Matter Physics	1	84.00
Xuan Gao (S)	Case Western Reserve University	Physics	Department of Energy	Magnetic Field Induced Insulating Phases in a Strongly Correlated Two-Dimensional Hole System near the Metal-Insulator Transition P02210	Condensed Matter Physics	2	103.00

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Jian Huang (S)	Wayne State University	Department of Physics and Astronomy	Other - Wayne State University	Preliminary Exploration of Wigner Crystallization Effects in HIGFET Devices P02007	Condensed Matter Physics	1	138.00
Xuan Gao (S)	Case Western Reserve University	Physics	National Science Foundation 0906415	The Effect of Spin Polarization on the Wigner Crystal to Liquid Transition in a Strongly Correlated 2D Hole System P08445	Condensed Matter Physics	1	84.00
			Total Proposals:	**6**	**Total Experiments:**	**10**	**856**

APPENDIX I – USER FACILITY STATISTICS

NMR FACILITY

Table 1 – User Demographic

NMR Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**106**	86	18	2	4	95	7	48	5	23	30
Senior Personnel, non-U.S.	**20**	18	1	1	1	17	2	2	3	2	13
Postdocs, U.S.	**24**	15	6	3	1	19	4	18	1	3	2
Postdocs, non-U.S.	**10**	7	3	0	2	6	2	1	1	0	8
Students, U.S.	**72**	35	33	4	5	57	10	45	3	5	19
Students, non-U.S.	**8**	7	1	0	1	7	0	0	3	1	4
Technician, U.S.	**9**	5	4	0	1	8	0	9	0	0	0
Technician, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Total:	**249**	**173**	**66**	**10**	**15**	**209**	**25**	**123**	**16**	**34**	**76**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

NMR Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**106**	31	15	97	7	2
Senior Personnel, non-U.S.	**20**	2	0	16	1	3
Postdocs, U.S.	**24**	7	8	22	1	1
Postdocs, non-U.S.	**10**	0	0	9	1	0
Students, U.S.	**72**	13	30	72	0	0
Students, non-U.S.	**8**	0	0	8	0	0
Technician, U.S.	**9**	5	4	9	0	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**249**	**58**	**57**	**233**	**10**	**6**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

NMR Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**106**	4	25	24	6	47
Senior Personnel, non-U.S.	**20**	0	8	1	1	10
Postdocs, U.S.	**24**	1	2	5	1	15
Postdocs, non-U.S.	**10**	0	3	5	0	2
Students, U.S.	**72**	1	11	20	1	39
Students, non-U.S.	**8**	0	6	0	0	2
Technician, U.S.	**9**	0	0	1	1	7
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**249**	**6**	**55**	**56**	**10**	**122**

Table 4 – User Facility Operations

NMR Facility	900	830	800 NB	800 MB	720	600	600 WB	600 WB2	500	500 E	Total Days Used / User Affil.	Percentage Used/ User Affil.
	Number of Magnet Days[1]											
NHMFL-Affiliated	40	130	123	42	0	0	26	40	0	144	545	17.22%
Local	49	59	82	29	271	2	157	245	249	26	1169	36.94%
U.S. University	122	117	123	60	63	367	111	75	0	54	1092	34.50%
U.S. Govt. Lab.	26	0	0	0	0	0	0	0	0	0	26	0.82%
U.S. Industry	0	0	0	0	0	0	0	0	0	0	0	0%
Non-U.S.	123	40	0	0	0	0	0	0	0	0	163	5.15%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	4	0	0	9	0	0	12	4	118	23	170	5.37%
Total:	**364**	**346**	**328**	**140**	**334**	**369**	**306**	**364**	**367**	**247**	**3165**	**100%**

1. User Units are defined as magnet days. For the NMR Facility in Tallahassee, one magnet day is 24 hours in the superconducting magnets.

Table 5 – Operations by Discipline

NMR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
	Number of Magnet Days[1]					
NHMFL-Affiliated	545	0	304	0	39	202
Local	1169	0	57	268	1	843
U.S. University	1092	8	208	10	48	818
U.S. Govt. Lab.	26	0	0	0	0	26
U.S. Industry	0	0	0	0	0	0
Non-U.S.	163	0	58	0	10	95
Test, Calibration, Set-up, Maintenance, Inst. Dev.	170	0	0	0	165	5
Total:	**3165**	**8**	**627**	**278**	**263**	**1989**

1. User Units are defined as magnet days. For the NMR Facility in Tallahassee, one magnet day is 24 hours in the superconducting magnets.

APPENDIX I – USER FACILITY STATISTICS

Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
443	28	397 (84.29%)	74 (15.71%)	471	118.64%

Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Meints, Gary	Missouri State University	P07283	Received 2014
Budinger, Thomas	LBNL	P07296	Received 2015
Dmitrieva, Natalia	Program in Neuroscience	P07302	Received 2014
Jaroniec, Christopher	The Ohio State University	P08324	Received 2015
Krishnan Achary, Damodaran	University of Pittsburgh	P08355	Received 2014
Bae, Chulsung	Rensselaer Polytechnic Institute	P08440	Submitted 2015
Ryu, Chang	Rensselaer Polytechnic Institute	P08441	Scheduled 2015
Guest, James	University of Miami	P08462	Received 2015
Han, Songi	University of California Santa Barbara	P08470	Approved 2015
Suleiman, David	University of Puerto Rico	P08479	Received 2014
Tycko, Robert	The National Institutes of Health, NIDDK, LCP	P08483	Received 2014
Hu, Yan-Yan	Florida State University	P09504	Approved 2015
Casabianca, Leah	Clemson University	P11434	Approved 2015
Total:			**13**

Table 8 – Research Proposals Profile with Magnet Time

NMR Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Number of Proposals	84	6	14	3	22	7	8	44

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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	Number of Days Used
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 227000-520-022846	Structure-Function Studies of Nucleotide Hydrolysis in a Membrane Environment P01754	Biology, Biochemistry, Biophysics	3	10.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 227000-520-015450	In situ study of M2 protein P01810	Biology, Biochemistry, Biophysics	20	95.00
David Busath (S)	Brigham Young University,	Physiology and Developmental	National Institutes of Health AI 074805	31P and 15N solid-state NMR study for the development of a membrane protein drug-screening methodology	Biology, Biochemistry, Biophysics	18	79.00

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	Biology			P01780			
Lucio Frydman (S)	Weizmann Institute of Science	Dept. Chemical Physics	National Science Foundation OISE 1064075 Other - Fulbright Foundation Other - Feinberg Graduate School Other - Metaflux(EU-FP7) Other - Minerva Foundation	Ultrafast High Field Functional Magnetic Resonance Imaging and Spectroscopy P02112	Biology, Biochemistry, Biophysics	3	7.00
Naresh Dalal (S)	Florida St. University	Chemistry	NHMFL User Collaboration Grants Program	High resolution MAS NMR study on ion dynamics in superionic conductor LiH2PO4 P02479	Condensed Matter Physics	14	37.00
Samuel Grant (S)	NHMFL	Chemical & Biomedical Engineering	Other - American Heart Association Southeastern USA	In vivo tracking of exogenous and endogenous stem cells associated with stroke P01906	Biology, Biochemistry, Biophysics	12	85.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	MRI Tests, Development, and Maintenance P01859	Magnets, Materials, Testing, Instrumentation	3	4.00
Vladimir Ladizhansky (S) New PI 2012	University of Guelph	Physics	Other - Natural Science and Engineering Research Council of Canada	Resolution and sensitivity of magic angle spinning solid-state NMR spectra of membrane proteins at ultra high magnetic fields P02088	Biology, Biochemistry, Biophysics	5	38.00
Tatyana Polenova (S)	University of Delaware	Department of Chemistry	National Institutes of Health P50GM082251	Solid-State NMR Structural and Dynamics Studies of HIV-1 Protein Assemblies P01798	Biology, Biochemistry, Biophysics	1	7.00
Elan Eisenmesser (S)	University of Colorado Health Sciences Center	Biochemistry & Molecular Genetics	National Institutes of Health 1R01GM096019-01A1	Determining the Conformational Changes within Active Enzyme-Substrate Systems on both Sides of the Reactions. P02387	Biology, Biochemistry, Biophysics	12	365.00
Kwang Hun Lim (S)	East Carolina University	Chemistry	National Institutes of Health Ninds-National Institute Of Neurological Disorders And Stroke	Biofuels from Biomass: Characterization of Biomass using Solid State NMR Spectroscopy P01794	Chemistry, Geochemistry	7	51.00

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			1R15NS084138-01				
Rafael Bruschweiler (S)	Ohio State University	CCIC	National Science Foundation 1330150	Protein Dynamics Research at Microsecond to Millisecond Timescale P02001	Biology, Biochemistry, Biophysics	6	80.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 5R01AI073891	Dynamics of M2 – Understanding the dynamics of the transmembrane segment of the influenza A M2 proton channel P01885	Biology, Biochemistry, Biophysics	24	163.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 1PO1A1074805-01	Structural Characterization of FtsX P02213	Biology, Biochemistry, Biophysics	20	114.00
Sabyasachi Sen (S)	University of California at Davis	Chemical Engineering and Materials Science	National Science Foundation DMR1104869	High Field 73Ge NMR Spectroscopic Investigation of The Structural Nature of Transitions in GeTe-Sb2Te3 Phase Change Materials P01640	Condensed Matter Physics	1	8.00
Gang Wu (S) New PI 2013	Queen's University	Chemistry	Other - NSERC of Canada	Characterization of a low-barrier hydrogen bond in nicotinic acid crystals P02432	Chemistry, Geochemistry	7	40.00
Myriam Cotten (S)	Hamilton College	Chemistry	National Science Foundation 0832571 National Science Foundation CHE 0832571	Membrane Interaction and Atomic-Level Structures of Membrane-Active Peptides by 15N and 2H Solid-State NMR P02289	Biology, Biochemistry, Biophysics	4	18.00
Bo Chen (S) New PI 2013	University of Central Florida	Department of Physics	U.S. Army Air Force Office of Scientific Research BAA-AFOSR-2012-0005 Other - University of Central Florida Inhouse award U.S. Army Air Force Office of Scientific Research FA9550-13-0150	Structure and dynamics study of Rous Sarcoma Virus capsid assembly P02368	Biology, Biochemistry, Biophysics	8	59.00
Manish Mehta (S)	Oberlin College	Department of Chemistry	National Science Foundation 1012813	Solid State 13C NMR characterization of an Incommensurately Modulated Structure P01696	Chemistry, Geochemistry	1	4.00
David Busath (S)	Brigham Young	Physiology and	National Institutes of Health	Full length M2 Protein Structural Characterization	Biology, Biochemistry, Biophysics	3	19.00

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	University,	Developmental Biology	227000-520-015450	P01752			
William Oates (S)	FAMU-FSU College of Engineering	Department of Mechanical Engineering	Other - United State Airforce materials research directorate National Science Foundation CMMI 1054465	Solid State 19F NMR Light-Induced Isomerization of Azobenzene Glassy Polymer Networks P01961	Engineering	3	18.00
Srinivasan Chandrashekar (S)	NHMFL	NMR	U.S. Army Army CERDEC National Science Foundation Future Renewable Electric Energy Delivery and Management FREEDM	Battery MRI P02140	Magnets, Materials, Testing, Instrumentation	3	8.00
Annadanesh Shellikeri (G)	FAMU-FSU College of Engineering	Electrical & Computer Engineering	Department of Energy 031054	Solid State in-situ NMR Studies of Li-ion Capacitors P02124	Chemistry, Geochemistry	5	20.00
James Harper (S) New PI 2013	University of Central Florida	Chemistry	Other - University of Central Florida start-up funds Chemistry	Using 13C/14N distance measurements in NMR crystallography P02383	Chemistry, Geochemistry	2	11.00
Anant Paravastu (S) New PI 2011	FSU/FAMU College of Engineering	Chemical and Biomedical Engineering	National Science Foundation NSF DMR-1055215	Solid State NMR Structural Characterization of Designer a-helical Peptide Nanofibers P01874	Engineering	1	249.00
Aron Fisher (S) New PI 2012	Institute for Environmental Medicine, University of Pennsylvania	Physiology and Medicine	National Institutes of Health R01HL102016	Characterization of structure and dynamics of human peroxiredoxin 6 in solution P02120	Biology, Biochemistry, Biophysics	1	15.00
Karunya Kandimalla (S)	Florida A&M University	Pharmaceutical Sciences	Other - Alzheimer's Association	Development of Theranostic Nanovehicle to Target Toxic Amyloid Deposits in Cerebral Amyloid Angiopathy and Alzheimer's Disease P01747	Biology, Biochemistry, Biophysics	3	30.00
Hailong Chen (S)	Georgia Institute of Technology	School of Mechanical Engineering	U.S. Army CERDEC National Science Foundation FREEDM	battery MRI P07279	Magnets, Materials, Testing, Instrumentation	10	48.00

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Sungsool Wi (S) New PI 2012	NHMFL	NMR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Development and implementation of the state-of-the-art solid-state NMR pulse techniques 1) at ultrahigh magnetic fields and 2) for utilizing 14N overtone transition P02137	Chemistry, Geochemistry	12	135.00
Riqiang Fu (S)	NHMFL	NMR	National Institutes of Health AI230007	Designing Solid State MAS NMR experiments to Differentiate Histidine Tautomeric States P07270	Biology, Biochemistry, Biophysics	10	48.00
Zhehong Gan (S)	Florida State University	NHMFL	National Science Foundation DMR 1104869	Development of high-field solid-state NMR methods P02217	Chemistry, Geochemistry	10	67.00
Riqiang Fu (S)	NHMFL	NMR	NHMFL User Collaboration Grants Program	In Situ Imaging of Lithium Ion Pathway in Lithium Rechargeable Batteries by STRAFI P01770	Chemistry, Geochemistry	4	24.00
Fang Tian (S)	Penn State University	Biochemistry and Molecular Biology, Penn State Medical School	National Institutes of Health R01 GM105963 Other - Penn State University College of Medicine National Institutes of Health GM 094526-01	Spherical Nanoparticle Supported Lipid Bilayers for the Study of Membrane Architecture P02428	Biology, Biochemistry, Biophysics	7	34.00
Hans Jakobsen (S)	University of Aarhus	Department of Chemistry	Other - Aarhus University, Denmark Department of Chemistry	Dynamics in KMnO4 from low-temperature 17O VT MAS NMR at 21.1T: A collaboration between Aarhus University and NHMFL (FSU) P02233	Chemistry, Geochemistry	3	11.00
Mark Davis (S) New PI 2013	California Institute of Technology	Chemical Engineering	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Solid-state 67Zn NMR Characterization of Zincosilicates (CIT-6) P07137	Chemistry, Geochemistry	2	14.00
Gary Meints (S) New PI 2014	Missouri State University	Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Local Dynamic Properties of Damaged DNA by Deuterium SSNMR P07283	Biology, Biochemistry, Biophysics	4	33.00
Sabyasachi Sen (S)	University of California at Davis	Chemical Engineering and Materials Science	National Science Foundation DMR1104869	Structure and connectivity in Ge-Se glasses: 77Se NMR MAS-CSA correlation spectroscopy	Condensed Matter Physics	2	18.00

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				P01915			
Rafael Bruschweiler (S)	Ohio State University	CCIC	Other - NIH	Simultaneous de Novo identification of Molecules in Chemical Mixtures by Doubly Indirect Covariance NMR spectroscopy P01689	Biology, Biochemistry, Biophysics	1	9.00
Victor Schepkin (S)	NHMFL	CIMAR	Other - Grant from FSU Council on Research& Creativity (CRC) FSU: Multidisciplinary Support Award 2013	Sodium-Diffusion MRI and Rodent Glioma Resistance to Therapy P02404	Biology, Biochemistry, Biophysics	1	11.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 227000-520-015450 National Institutes of Health P01AI074805	Structure Study of the Full-length M2 Proton Channel in Membrane Bilayers P08302	Biology, Biochemistry, Biophysics	24	151.00
Armin Nagel (S) New PI 2013	German Cancer Research Center (DKFZ)	Medical Physics in Radiology	National Science Foundation DMR-0654118	39K MRI of rat brain at 21.1Tesla P07228	Magnets, Materials, Testing, Instrumentation	3	10.00
Natalia Dmitrieva (S) New PI 2014	Program in Neuroscience	Psychology	Other - My primary finding source this year is a grant (Grant4targets) and a contract funding from Bayer Pharmaceuticals Other - PI Support Account FSU Research Foundation	Endometriosis And Rat Brain Mapping Using 21.1t P07302	Biology, Biochemistry, Biophysics	2	9.00
Lucio Frydman (S)	Weizmann Institute of Science	Dept. Chemical Physics	Other - State of Florida	Relaxation Enhancements of unassigned brain metabolites resonances: new noninvasive stroke biomarkers assigned via in vivo 2D MRS P08345	Biology, Biochemistry, Biophysics	6	39.00
Christopher Jaroniec (S) New PI 2014	The Ohio State University	Chemistry & Biochemistry	National Institutes of Health R01GM094357 National Science Foundation 1243461	DARR 13C-13C correlation experiments of HuPrP23-144. P08324	Biology, Biochemistry, Biophysics	5	30.00
Damodaran Krishnan Achary (S)	University of Pittsburgh	Chemistry	Department of Energy National Energy Technology Lab	95Mo Solid State NMR investigation of the active catalytic site in ZSM-5 for Methane Dehydroaromatization	Chemistry, Geochemistry	1	8.00

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New PI 2014			RES1000027/158	P08355			
Zhehong Gan (S)	Florida State University	NHMFL	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	development, testing, maintenance & repairs P08360	Magnets, Materials, Testing, Instrumentation	4	26.00
Cathy Levenson (S)	FSU College of Medicine	Biomedical Sciences	U.S. Army MRMC W81XWH-11-2-0121	Use of zinc to improve outcomes after traumatic brain injury P02282	Biology, Biochemistry, Biophysics	2	6.00
Joanna Long (S)	NHMFL/UF Mcknight Brain Institute	Biochemistry & Molecular Biology	National Institutes of Health NIDCR R01DE021789 03 National Institutes of Health NIDCR 5R01DE021789 National Institutes of Health NIDCR R01de021789	Structural studies of adhesion protein P1 of Streptococcus mutans and its formation of amyloid fibrils P07158	Biology, Biochemistry, Biophysics	4	37.00
Tatyana Polenova (S)	University of Delaware	Department of Chemistry	National Institutes of Health P50GM082251	MAS and DNP NMR of HIV-1 Protein Assemblies: Structure and Dynamics Studies P08369	Biology, Biochemistry, Biophysics	2	16.00
Riqiang Fu (S)	NHMFL	NMR	NHMFL User Collaboration Grants Program NMR	Imaging Lithium Rechargeable Batteries by STRAFI P08370	Chemistry, Geochemistry	7	52.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health P01AI074805 National Institutes of Health R01AI1073891	Structure Determination of LspA, an M. Tuberculosis Transmembrane Protein P08362	Biology, Biochemistry, Biophysics	11	66.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health POIAI074805	Solid state NMR characterization of S31N M2 bound to novel adamantanes P08373	Biology, Biochemistry, Biophysics	15	94.00
Manish Mehta (S)	Oberlin College	Department of Chemistry	National Science Foundation 1012813	Solid State 13C NMR characterization of an Incommensurately Modulated Structure P08409	Chemistry, Geochemistry	1	3.00
Chulsung Bae (S) New PI 2014	Rensselaer Polytechnic Institute	Department of Chemistry & Chemical Biology	National Science Foundation CAREER 0747667	Study of Water Dynamics in Superacidic Hydrocarbon Proton Exchange Membranes UsingSolid-State and Pulsed-Field Gradient NMR Spectroscopy	Chemistry, Geochemistry	5	31.00

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			National Science Foundation CAREER NSF 0747667	P08440			
Edward Agyare (S)	Florida A & M	Pharmaceutics	Other - NIH NIMHHD U54MD008149	Thermosensitive Liposomal Loaded-gold Nanoparticles as Radiosensitizers for Pancreatic Cancer Therapy. P08365	Biology, Biochemistry, Biophysics	1	2.00
Kwang Hun Lim (S)	East Carolina University	Chemistry	National Institutes of Health NINDS 1R15NS084138	Mechanistic studies of transthyretin misfolding and amyloid formation using solid-state NMR P08372	Biology, Biochemistry, Biophysics	3	26.00
Robert Schurko (S)	University of Windsor	Chemistry	Other - NSERC (Canada) Chemistry - Discovery Grant n/a (Discovery Grant)	Multinuclear SSNMR of Unreceptive Nuclides Using Adiabatic Pulses P02490	Chemistry, Geochemistry	1	7.00
Liliya Vugmeyster (S)	University of Alaska Anchorage	Chemistry	National Institutes of Health R15 GM111681-01	Dynamics of amyloid Abeta peptide by deuteron NMR P08439	Biology, Biochemistry, Biophysics	2	2.00
Zhehong Gan (S)	Florida State University	NHMFL	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Development and applications of high-field solid-state NMR methods P08461	Magnets, Materials, Testing, Instrumentation	3	10.00
Robert Tycko (S) New PI 2014	The National Institutes of Health, NIDDK, LCP	Laboratory of Chemical Physics, NIDDK	National Institutes of Health NIDDK - Intramural Research Program DK075031 (Intramural Research Project Number)	Structural Study of Fibrils Formed by the Low-Complexity Domains of mRNA Binding Proteins P08483	Biology, Biochemistry, Biophysics	3	21.00
Thomas Budinger (S) New PI 2014	LBNL	Chair of the Department of BioEngineering	National Science Foundation DMR-0654118	Comparison Of Potassium, Chlorine And Sodium Triple Quantum Signals From In Vivo Rat Head At 21.1 T P07296	Biology, Biochemistry, Biophysics	2	5.00
Tim Cross (S)	Florida State University	NHMFL/Chemistry & Biochemistry	National Institutes of Health 5R01AI073891	Dynamics of M2 full length: Understanding the dynamics of the proton conductance and the gating mechanism of the full length M2 proton channel of Influenza A.	Biology, Biochemistry, Biophysics	7	48.00

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				P08486			
Chang Ryu (S) New PI 2014	Rensselaer Polytechnic Institute	Department of Chemistry & Chemical Biology	National Science Foundation 1308617	Investigation of the network structure of sustainable epoxy materials from vegetable oils P08441	Chemistry, Geochemistry	2	10.00
David Suleiman (S) New PI 2014	University of Puerto Rico	Chemical Engineering	U.S. Army Polymer Chemistry W911-NF-13-10166	Characterization of Sulfonated Poly-Ether-Ether-Ketone with Coordinated Counter-Ion Substitution P08479	Engineering	1	5.00
Vladimir Ladizhansky (S)	University of Guelph	Physics	Other - Natural Sciences and Engineering Research Council of Canada	Solid-state NMR studies Protein-Lipid Interactions P08504	Biology, Biochemistry, Biophysics	2	11.00
Songi Han (S) New PI 2014	University of California Santa Barbara	Department of Chemistry and Biochemistry	National Science Foundation 1443106	Characterization of surface accessible, catalytic, 27Al, 119Sn, and 17O species by DNP-enhanced NMR using targeted nitroxide spin probes as reactant models P08470	Chemistry, Geochemistry	2	7.00
Yan-Yan Hu (S) New PI 2014	Florida State University	Chemistry & Biochemistry	Other - FSU	High-temperature Solid-state NMR Studies of Ionic Conduction Mechanisms in Low-cost and Rare-earth-free Superior Fast Oxide-ion Conductor Sr3-3xNa3xSi3O9-1.5x P09504	Chemistry, Geochemistry	2	21.00
Thomas Manning (S) New PI 2012	Valdosta State University	Chemistry	Other - EPA # SU836033!	NMR and FT-ICR of Natural Products P02031	Chemistry, Geochemistry	1	7.00
Joanna Long (S)	NHMFL/UF Mcknight Brain Institute	Biochemistry & Molecular Biology	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Characterizing DNP mechanisms at high magnetic fields to enable membrane protein NMR studies P07148	Biology, Biochemistry, Biophysics	1	16.00
Gianluigi Veglia (S) New PI 2012	University of Minnesota	BMBB	National Institutes of Health GM 64742 and GM 72701	NMR Structural Analysis of CaATPase and Phospholamban in membranes P01990	Biology, Biochemistry, Biophysics	1	10.00
James Guest (S) New PI 2014	University of Miami	The Miami Project to Cure Paralysis	Other - The State of Florida Department of Health	Locomotor recovery threshold and Immune response associated to autologous Schwann cell transplants intended for remyelination strategies after spinal cord injury (SCI).	Biology, Biochemistry, Biophysics	1	39.00

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				P08462			
Arturo Hernandez-Maldonado (S)	University of Puerto Rico - Mayaguez	Chemical Engineering	NASA University Research Centers NNX08BA48A	Solid State NMR Characterization of Nanoporous Materials for Carbon Dioxide Removal: Porous Coordination Polymers and Alkaline Earth Metal Exchanged Silicoaluminophosphates P01785	Engineering	1	2.00
Arturo Hernandez-Maldonado (S)	University of Puerto Rico - Mayaguez	Chemical Engineering	National Science Foundation HRD HRD 0833112	Solid State NMR Characterization of Nanoporous Materials for Catalysis and Adsorption Applications: Flexible Titanosilicates & SBE Type Aluminophosphates P01784	Engineering	1	1.00
Gail Fanucci (S)	University of Florida	Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	NMR Backbone Dynamics Study of HIV-1 Protease Subtypes and Drug-resistant Mutants P02082	Biology, Biochemistry, Biophysics	1	2.00
Rufina Alamo (S)	FAMU/FSU College of Engineering	Department of Chemical Eng.	Other - FSU	Characterization of Ethylene 1-alkene copolymers P08503	Engineering	1	1.00
Brian Miller (S) New PI 2012	Florida State University	Chemistry	Other - NIDKK NIDDK	Quantification of Side Chain Dynamics Responsible for Allosteric Activation of Human Glucokinase P02216	Biology, Biochemistry, Biophysics	1	2.00
Benny Freeman (S) New PI 2013	The University of Texas at Austin	McKetta Department of Chemical Engineering	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Investigation of the structure of thermally rearranged polymers using solid-state nuclear magnetic resonance P07224	Engineering	2	2.00
Samuel Grant (S)	Florida State University & The National High Magnetic Field Laboratory	Chemical & Biomedical Engineering	National Science Foundation 0654118	Maintenance on the 500 MHz at Engineering School P02012	Magnets, Materials, Testing, Instrumentation	1	23.00
Samuel Grant (S)	Florida State University & The National High Magnetic	Chemical & Biomedical Engineering	NHMFL User Collaboration Grants Program	High-Field 1h/23na Magnetic Resonance Microscopy Of Neuronal Ganglia Under Perturbation P01904	Biology, Biochemistry, Biophysics	1	58.00

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	Field Laboratory						
Rosalind Sadleir (S)	Arizona State University	School of Biological and Health System Engineering	Other - Planning Grant Award FSU	MR Electrical Impedance Tomography at Ultra High Magnetic Fields P01684	Chemistry, Geochemistry	1	17.00
Samuel Grant (S)	Florida State University & The National High Magnetic Field Laboratory	Chemical & Biomedical Engineering	NHMFL User Collaboration Grants Program	High Field Magnetic Resonance Microscopy P01682	Chemistry, Geochemistry	1	26.00
Liliya Vugmeyster (S)	University of Alaska Anchorage	Chemistry	Other - University of Alaska ENRI	Characterization of unfrozen water in soils of Dry Valleys of Antarctica P01744	Chemistry, Geochemistry	1	1.00
Stephen Melville (S) New PI 2012	Virginia Tech	Biological Sciences	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Determination of the conformation and geometry of bacterial pilin proteins in an artificial membrane P02219	Biology, Biochemistry, Biophysics	1	1.00
Anant Paravastu (S)	FSU/FAMU College of Engineering	Chemical and Biomedical Engineering	DMR-1157490	Maintenance, Repairs, Testing on 500 MHz, Paravastu Magnet P02013	Magnets, Materials, Testing, Instrumentation	1	118.00
			Total Proposals:	**84**	**Total Experiments:**	**397**	**3165**

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AMRIS FACILITY

Table 1 – User Demographic

AMRIS Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**81**	63	18	0	5	76	0	44	0	37	0
Senior Personnel, non-U.S.	**22**	19	3	0	5	17	0	10	1	11	0
Postdocs, U.S.	**17**	11	6	0	4	13	0	16	0	1	0
Postdocs, non-U.S.	**13**	10	3	0	0	13	0	9	0	4	0
Students, U.S.	**52**	37	15	0	2	50	0	36	0	16	0
Students, non-U.S.	**33**	27	6	0	3	30	0	23	0	10	0
Technician, U.S.	**13**	11	2	0	0	13	0	11	0	2	0
Technician, non-U.S.	**2**	1	1	0	1	1	0	2	0	0	0
Total:	**233**	**179**	**54**	**0**	**20**	**213**	**0**	**151**	**1**	**81**	**0**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

AMRIS Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**81**	14	35	76	0	5
Senior Personnel, non-U.S.	**22**	2	7	22	0	0
Postdocs, U.S.	**17**	2	13	14	0	3
Postdocs, non-U.S.	**13**	0	8	13	0	0
Students, U.S.	**52**	0	36	52	0	0
Students, non-U.S.	**33**	0	24	33	0	0
Technician, U.S.	**13**	3	8	9	1	3
Technician, non-U.S.	**2**	2	0	0	0	2
Total:	**233**	**23**	**131**	**219**	**1**	**13**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

AMRIS Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem., Biophys.
Senior Personnel, U.S.	**81**	0	17	4	1	59
Senior Personnel, non-U.S.	**22**	0	5	2	2	13
Postdocs, U.S.	**17**	0	5	1	1	10
Postdocs, non-U.S.	**13**	0	5	0	2	6
Students, U.S.	**52**	0	18	0	3	31
Students, non-U.S.	**33**	0	15	1	4	13
Technician, U.S.	**13**	0	1	1	2	9
Technician, non-U.S.	**2**	0	0	1	1	0
Total:	**233**	**0**	**66**	**10**	**16**	**141**

Table 4 – User Facility Operations

AMRIS Facility	500 MHz NMR	600 MHz NMR / MRI	600 MHz cryo	600 MHz cryo2	750 MHz wb	4.7 T / 33 cm	11.1 T / 40 cm	3T whole body	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]									
NHMFL-Affiliated[2]	7.90	125.30	89.50	83.40	122.60	75.40	36.80	69.40	610.30	37%
Local[2]	12.80	15.60	8.60	15.40	10.80	65.60	9.70	110.90	249.40	15%
U.S. University	93.70	48.00	28.30	8.77	90.20	0.00	9.30	0.00	278.27	17%
U.S. Govt. Lab.	0	0	0	0	0	0	0	0	0	0%
U.S. Industry	0	0	0	0	0	0	0	0	0	0%
Non-U.S.	1.40	27.90	18.30	35.40	0.00	0	0.40	0	83.40	5%
Development[3]	26.50	2.70	4.60	18.00	4.00	35.60	15.50	0	106.90	6%
Test, Calibration, Set-up, Maintenance, Inst. Dev. [4]	8.30	8.80	35.10	20.00	37.50	87.30	96.40	31.20	324.60	20%
Total:	**150.60**	**228.30**	**184.40**	**180.97**	**265.10**	**263.90**	**168.1**	**211.5**	**1652.87**	**100%**

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, & 750 MHz), 1 magnet day = 24 hours. Horizontals (4.7, 11.1, and 3T), 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 4.7 T, 11 T and 3 T studies, almost all studies with external users were collaborative with UF investigators. In 2014 the 3T system was funded entirely off of non-NHMFL funds but is reported for historical purposes
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. The sum of NHMFL-Affiliated and Local usage equals what was formerly referred to as usage by "Internal Investigators".
   Note: Use in these categories is primarily paid by individual investigator grants and not the NHMFL.
3. Development was used for several purposes, primarily for establishing new capabilities such as building and testing coils, implementing new pulse sequences, and developing new protocols. **For merging with other NHMFL user tables, Development data will be added to Test, Calibration, Set-up, and Maintenance.**
4. In 2014, the gradients and gradient amplifiers were upgraded on the 4.7 T and 11.1 T systems leading to an increase in time for Test, Calibration, Set-up, and Maintenance. A significant delay in the delivery of critical components for the 600 cryoplatform led to additional led to a decrease in magnet days on the 500 compared to other years. A new HTS probe was also installed and tested on the 600 MHz cryo2 instrument.

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Table 5 – Operations by Discipline

AMRIS Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem., Biophys.
	Number of Magnet Days[1]					
NHMFL-Affiliated[2]	610.27	0	26.06	9.22	1.38	573.61
Local[2]	249.54	0	13.21	0	7.25	229.08
U.S. University	278.20	0	181.76	0	0	96.44
U.S. Govt. Lab.	0	0	0	0	0	0
U.S. Industry	0	0	0	0	0	0
Non-U.S.	83.44	0	41.40	0	0.44	41.60
Development[3]	107.02	0	0	0	107.02	0
Test, Calibration, Set-up, Maintenance, Inst. Dev.[4]	324.59	0	0	0	324.59	0
Total:	**1653.05**	**0.00**	**262.43**	**9.22**	**440.67**	**940.74**

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, & 750 MHz), 1 magnet day = 24 hours. Horizontals (4.7, 11.1, and 3T), 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 4.7 T, 11 T and 3 T studies, almost all studies with external users were collaborative with UF investigators. In 2014 the 3T system was funded entirely off of non-NHMFL funds but is reported for historical purposes
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. The sum of NHMFL-Affiliated and Local usage equals what was formerly referred to as usage by "Internal Investigators".
   Note: Use in these categories is primarily paid by individual investigator grants and not the NHMFL.
3. Development was used for several purposes, primarily for establishing new capabilities such as building and testing coils, implementing new pulse sequences, and developing new protocols. **For merging with other NHMFL user tables, Development data will be added to Test, Calibration, Set-up, and Maintenance.**
4. In 2014, the gradients and gradient amplifiers were upgraded on the 4.7 T and 11.1 T systems leading to an increase in time for Test, Calibration, Set-up, and Maintenance. A significant delay in the delivery of critical components for the 600 cryoplatform led to additional led to a decrease in magnet days on the 500 compared to other years. A new HTS probe was also installed and tested on the 600 MHz cryo2 instrument.

Table 6 – User Program Experiment Pressure

Days Requests Received	Days Requests Deferred from Prev. Year	Days Requests Granted	Day Requests Declined/ Deferred	Days Requests Reviewed	Subscription Rate
1800	0	1601 (90%)	200 (9%)	1800	112%

Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Beltran-Huarac, Juan	University of Puerto Rico	P08489	Submitted 2014
Qi, Xin	University of Florida	P07282	2014
Turck, Chris	Max Planck Institute of Psychiatry	P08322	2014
Lumata, Lloyd	University of Texas Dallas	P08501	2014
Boroujerdi, Arezue	Claflin University	P08502	2014
Total:			**5**

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Table 8 – Research Proposals Profile with Magnet Time

AMRIS Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem., Biophys.
Number of Proposals	61	5	17	0	14	2	9	36

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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Number of days
Agbandje-McKenna, M.	UF	Biochem & Mol Bio	NIH GMS	NMR Studies of the AAV Capsid Minor Viral Protein 1 Unique Region (VP1) P02429	Biology, Biochemistry, Biophysics	0.0
Baumer, M. (S)	Bremen Univ.	Phys. Chem.	NSF Division of Chemical, Bioengineering, Environmental, and Transport Systems	Different Types of Diffusion of Carbon Dioxide in Samaria/Alumina Aerogel Catalyst by High Field Diffusion NMR P02223	Chemistry, Geochemistry	42.8
Biggs, J.S. (S)	Univ. of Guam	Marine Laboratory	NSF IOS at NSF	Enzymatic Detoxifying Systems for Diet-derived Chemicals in Herbivorous Marine Fish P07142	Biology, Biochemistry, Biophysics	0.2
Blackband, S.J. (S)	UF	Neuroscience	NIH	Microsurface Coil MR Microscopy of Aplysia Neurons P02489	Biology, Biochemistry, Biophysics	35.5
Brady, L.J. (S)	UF	Oral Biology	NIH NIDCR	Study of the Streptococcus mutans cell surface localized adhesin P1 protein using MAS NMR P07158	Biology, Biochemistry, Biophysics	12.3
Brey, W.W., (S)	FSU	NHMFL	NIH NIBIB	Double-Resonance HTS Coils toward Dual-Optimized High-Sensitivity NMR Probes P09513	Magnets, Materials, Testing, Instrumentation	16.4
Briggs, R.W. (S)	Georgia St. Univ.	Physics and Astronomy	NSF External Users Program	31P NMR of the P301L Mouse Model of Frontotemporal Dementia and AD P07170	Biology, Biochemistry, Biophysics	15.1
Butcher, R.A. (S)	UF	Chemistry	NIH NIGMS	Identification of Pheromones from Entomopathogenic Nematodes P01980	Chemistry, Geochemistry	3.6
Butcher, R.A. (S)	UF	Chemistry	Human Frontier Science Program	Identification of Novel Pheromones from Caenorhabditis elegans using Comparative Metabolomics and Multi-		2.6

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				dimensional NMR Spectroscopy P02201		
Comment, A. (S)	EPFL	Physics	NHMFL Visitng Science Program	Development of a 13C Volume Coil for Ultra-High Field Metabolic Imaging Via Dissolution Dynamic Nuclear Polarization P09512	Magnets, Materials, Testing, Instrumentation	16.5
Cusi, K. (S)	UF	Medicine	UF Opportunity Seed Award	Biomarker Discovery and Metabolic Profiling in Plasma for Non-Alcoholic Steatohepatitis P02340	Biology, Biochemistry, Biophysics	6.1
Deacon, T.W. (S)	UC Berkeley	Anthropology	NSF	Determining the Embryonic Origin of Primate Encephalization via High Resolution MRI P02394	Biology, Biochemistry, Biophysics	11.3
Deacon, T.W. (S)	UC Berkeley	Anthropology	NSF	MRI Microscopy of Human Motor Neurons Progress Report P07285	Biology, Biochemistry, Biophysics	0.0
Edison, A.S. (S)	UF	Biochem & Mol Bio	NIH NIBIB	A Natural Abundance 13C NMR Approach for Metabolomic Studies of Complex Mixtures “External funding”	Biology, Biochemistry, Biophysics	38.3
Edison, A.S. (S)	UF	Biochem & Mol Bio	NIH NIGMS	Global Metabolomics of Complications in Pregnancy. “External funding”	Biology, Biochemistry, Biophysics	5.9
Edison, A.S. (S)	UF	Biochem & Mol Bio	NIH NIGMS	SECIM NMR Workflow for Metabolite Profiling of Biofluids “External funding”	Biology, Biochemistry, Biophysics	80.7
Edison, A.S. (S)	UF	Biochem & Mol Bio	NIH NIBIB	13C-Enriched Global Metabolomics Approach Using Inadequate “External funding”	Biology, Biochemistry, Biophysics	18.7
Erickson, M. (S)	VA Hospital		NHMFL External Users Program	Augmented Tune/Match Circuits for High Performance Dual Nuclear Transmission Line Resonators P02196	Engineering	0.0
Fernandez-Funez, P. (S)	UF	Neurology	NIH NIBIB	Three-dimensional MRM of the Drosophila brain at high resolution P07157	Biology, Biochemistry, Biophysics	9.8
Foote, K.D. (S)	UF	Neurosurgery	UCGP	17.6T MR Microscopy of Movement Disorders as a Guide For Deep Brain Stimulation P02393	Biology, Biochemistry, Biophysics	0.2
Forbes, S.C. (S)	UF	Physical Therapy	Muscular Dystrophy Association	Skeletal Muscle H_2O T_2 Analyzed for Multiple Components in mdx Mice after Downhill Running “External funding”		1.3

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Ghislain, M. (S)	ICIPE		Rockefeller Foundation	Toxic Ipomeamarone Accumulation in Healthy Parts of Sweetpotato (Ipomoea batatas L. Lam) Storage Roots on Infection by Rhizopus stolonifera "External funding"		0.9
Hahn, D.A. (S)	UF		NSF	Energy Balance in the Cold in Drosophila Melanogaster P02313	Biology, Biochemistry, Biophysics	21.8
Heldermon, C (S)	UF	Oncology	NHMFL External Users Program	Characterization of Brain Morphology in Mucopolysaccharidosis Type IIIB Affected Mice Using Magnetic Resonance Imaging P01777	Biology, Biochemistry, Biophysics	12.7
Lively, R. (S)	Georgia Inst. of Tech.	Chem. Biomol. Eng.	NSF DOE	Relationship between Long-Range Diffusion and Diffusion in the ZIF-8 and Polymer Phases of a Mixed-Matrix Membrane by High Field NMR Diffusometry P07227	Chemistry, Geochemistry	29.3
Long, J.R. (S)	UF	Biochem & Mol Bio	UF Division of sponsored research	Hyperpolarization of Small Metabolites without Glassing Agent for Dissolution DNP at 5 T and <1.2 K "External funding"	Magnets, Materials, Testing, Instrumentation	8.2
Long, J.R. (S)	UF	Biochem & Mol Bio	NHMFL	A Method for Dynamic Nuclear Polarization Magic Angle Spinning NMR of Membrane Proteins P09512	Magnets, Materials, Testing, Instrumentation	16.5
Long, J.R. (S)	UF	Biochem & Mol Bio	NHMFL	Development of 13C R.F. coils and MR sequences for dissolution DNP experiments P09512	Magnets, Materials, Testing, Instrumentation	16.5
Long, J.R. (S)	UF	Biochem & Mol Bio	Gates Foundation	Residue Specific Partitioning Of KL4 into Phospholipid Bilayers P01395	Biology, Biochemistry, Biophysics	8.2
Long, J.R. (S)	UF	Biochem & Mol Bio	Gates Foundation	Delineation of the dynamic properties of individual lipid species in native and synthetic pulmonary surfactants P01395	Biology, Biochemistry, Biophysics	8.2
Long, J.R. (S)	UF	Biochem & Mol Bio	Gates Foundation	Structural Analysis of the C-Terminus of Lung Surfactant Protein B (SP-B) P01395	Biology, Biochemistry, Biophysics	8.2
Long, J.R. (S)	UF	Biochem & Mol Bio	NHMFL	Dissolution Dynamic Nuclear Polarization for in vivo Application P09512	Biology, Biochemistry, Biophysics	16.5
Luesch, H (S)	UF	Medicinal Chem	Bankhead-Coley Cancer Research grant	Total Synthesis and Biological Evaluation of Potent Apratoxin S4 Based	Chemistry, Geochemistry	19.1

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				Anticancer Agents “External funding”		
Lumata, L.L. (S)	Univ. of Texas Dallas	Physics	NSF External Users Program	The Effect of Glassing Matrix Deuteration on 13C Dynamic Nuclear Polarization at 5 T P08501	Chemistry, Geochemistry	2.5
Magin, R.L. (S)	Univ. of Illinois	Bioengineerin g	NIH NIBIB	Entropy as a Measure of Non-Gaussian Diffusion in Fixed Rat Brain Tissues P02319	Biology, Biochemistry, Biophysics	4.0
Mareci, T.H. (S)	UF	Biochem & Mol Bio	NIH	Phase Contrast MRI with Reduced Eddy Current Distortion “External funding”	Magnets, Materials, Testing, Instrumentation	11.4
Mareci, T.H. (S)	UF	Biochem & Mol Bio	NIH	Development of Diffusion-weighed MRI to Study Structural Changes in the Brain Stem following Mild Traumatic Brain Injury “External funding”	Magnets, Materials, Testing, Instrumentation	1.4
Mareci, T.H.(S)	UF	Biochem & Mol Bio	NIH	Calculated Magnetic Field Produced by Low-Amplitude Electric Current Injection Into a Hydrogel Using Magnetic Resonance Electrical Impedance Tomography (MREIT) “External funding”	Engineering	9.2
Martin, G.D.A. (S)	UNIV. OF TAMPA	Chemistry	NHMFL External Users Program	Biotransformation of Formestane By Rhizopus Oryzae P07213	Chemistry, Geochemistry	16.8
Martin, G.D.A. (S)	UNIV. OF TAMPA	Chemistry	NHMFL External Users Program	Biotransformation of Curcumin and its Analogs by Rhizopus Oryzae and Beauveria Bassiana P07214	Chemistry, Geochemistry	4.8
Pochi, S.R. (S)	Univ. of Miami		NHMFL External Users Program	Structural Determination of the Active Anti Cancer Molecule in Achyranthes Aspera P02328	Biology, Biochemistry, Biophysics	0.0
Prosser, R.S (S)	Univ. Toronto	Chem. Biochem.	NHMFL External Users Program	Magnetic Resonance Imaging of PLA-PEG Drug Delivery Systems P01956	Magnets, Materials, Testing, Instrumentation	0.4
Qi, X.	UF	Medicinal Chem	NHMFL External Users Program	Explore Novel Drugs To Target HIV RNA for AIDS Therapy P07282	Chemistry, Geochemistry	0.7
Reddy, K.R. (S)	UF	Soil and Water	NSF GRFP	Soil Organic Matter Response to Climate Warming in a Subarctic Peatland “External funding”	Chemistry, Geochemistry	11.0
Rhoton, A.L.	UF	Neurology	NHMFL External Users Program	Investigation of the Internal Structures of the Brainstem and Cerebellum in Post-Mortem Brains with Surgical Fiber Dissection	Biology, Biochemistry, Biophysics	4.1

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				and Diffusion Tensor MRI P07140		
Sarntinoranont, M. (s)	UF	Mech &Aero Eng	NIH NINDS	Characterizing Blood Brain Barrier Breakdown with Status Epilepticus Brain Injury P08375	Magnets, Materials, Testing, Instrumentation	7.0
Schmelz, E.A. (S)	USDA		NSF IOS at NSF	Characterization of Novel Acidic Sequiterpenoid Phytoalexins in Maize P02207	Biology, Biochemistry, Biophysics	11.5
Tari, A.M (S)	UF	Neuroscience	UF OPPORTUNITY SEED AWARD	Magnetic Resonance Imaging of Gadolinium-Filled Neurophilic Lipid Nanoparticles P02221	Biology, Biochemistry, Biophysics	0.0
Turck, C.W.	Max Plank Inst.	Psychiatry	NHMFL External Users Program	Metabolomic profiling of 13C-enriched mouse tissue using 1D and 2D NMR P08322	Biology, Biochemistry, Biophysics	22.9
Turner, B.L. (S)	Smithsonian Tropical Research Institute		NHMFL External Users Program	Drivers of Methanogenesis Pathways in Subtropical Wetlands: Florida Everglades as a Case Study P02397	Chemistry, Geochemistry	31.3
Turner, B.L.(S)	Smithsonian Tropical Research Institute	Tropical Research	NSF GRFP	Carbon Chemistry of Peatland Soil Across Climate Zones P02293	Chemistry, Geochemistry	34.3
Uy, M.M.	MSU-IIT	Chemistry	NSF External Users Program	Characterization of the Bioactive Compounds from Philippine Medicinal Plants P02418	Chemistry, Geochemistry	32.5
Vaillancourt, D.E. (S)	UF	Applied Physiology and Kinesiology	NIH NINDS	MRI Reveals Brain Abnormalities in Drug-Naive Parkinson's Disease "External funding"	Biology, Biochemistry, Biophysics	38.3
Vandenborne, K.(S)	UF	Physical Therapy	Wellstone Muscular Dystrophy Cooperative Center Grant	MR Microscopy of Healthy and Dystrophic "External funding"	Biology, Biochemistry, Biophysics	23.7
Vandenborne, K.(S)	UF	Physical Therapy	Wellstone Muscular Dystrophy Cooperative Center Grant	MR Characterization of Dystrophic Murine Models with different Genetic background "External funding"	Biology, Biochemistry, Biophysics	6.4
Vasenkov, S (S)	UF	Chemistry	NSF Chemistry	Exchange Kinetics of CO2 Molecules between the Reacted and Unreacted States in the Mixtures of an Ionic Liquid and CO2 by High Field NMR P07167	Chemistry, Geochemistry	13.9
Walter, G.A. (S)	UF	Physio & Func Gen	NIH NIAMS	In Vivo Metabolomics in Mice with Glycogen Storage Disease "External funding"	Biology, Biochemistry, Biophysics	29.3
Walter, G.A. (S)	UF	Physio & Func Gen	NIH NIAMS	Metabolomic Analysis of Urine to Track Disease	Biology, Biochemistry,	80.7

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				Progression in Duchenne Muscular Dystrophy "External funding"	Biophysics	
Walter, G.A. (S)	UF		NIH NIAMS	Biomarker Discovery in Duchenne Muscular Dystrophy Through Global Metabolomic Analysis "External funding"	Biology, Biochemistry, Biophysics	36.7
Walter, G.A. (S)	UF	Physio & Func Gen	DOD	A Generic Gene Reporter for MR Microscopy "External funding"	Biology, Biochemistry, Biophysics	36.7
Walter, G.A. (S)	UF	Physio & Func Gen	DOD	Magnetic Resonance and Optical Imaging as Biomarkers for Muscle Disease and Injury "External funding"	Biology, Biochemistry, Biophysics	6.4
Total Proposals:				**61**	**Total Experiments:**	**961.3**

Note: The majority of costs for instrument acquisition and user experiments within the AMRIS facility are paid through non-NSF sources; Tables 8 and 9 report on user projects for which NSF-funding was used to either pay for user time or for development of specific functionalities as described in their project reports. Total usage of instruments is reported in tables 4 and 5. Tracking of time is done through a calendar rather than individual experiment numbers to enable users needed flexibility in how they utilize their time for individual projects.

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EMR FACILITY

Table 1 – User Demographic

EMR Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**58**	49	8	1	1	51	6	26	0	17	15
Senior Personnel, non-U.S.	**38**	30	6	2	6	28	4	7	0	11	20
Postdocs, U.S.	**11**	6	2	3	0	8	3	9	0	1	1
Postdocs, non-U.S.	**4**	2	2	0	1	3	0	1	0	2	1
Students, U.S.	**27**	20	5	2	1	22	4	13	0	6	8
Students, non-U.S.	**4**	2	1	1	1	2	1	1	0	0	3
Technician, U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Technician, non-U.S.	**1**	1	0	0	0	1	0	0	0	0	1
Total:	**143**	**110**	**24**	**9**	**10**	**115**	**18**	**57**	**0**	**37**	**49**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be "sample senders" for facilities located on their campuses.
4. "Off-Site Collaborators" 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

EMR Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**58**	19	6	55	2	1
Senior Personnel, non-U.S.	**38**	0	0	36	0	2
Postdocs, U.S.	**11**	4	3	9	1	1
Postdocs, non-U.S.	**4**	0	0	4	0	0
Students, U.S.	**27**	7	4	27	0	0
Students, non-U.S.	**4**	0	0	4	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**1**	0	0	1	0	0
Total:	**143**	**30**	**13**	**136**	**3**	**4**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. <u>In addition to</u> external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. <u>In addition to</u> external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

EMR Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**58**	15	29	0	0	14
Senior Personnel, non-U.S.	**38**	12	20	0	2	4
Postdocs, U.S.	**11**	5	4	0	1	1
Postdocs, non-U.S.	**4**	1	3	0	0	0
Students, U.S.	**27**	8	15	0	1	3
Students, non-U.S.	**4**	2	2	0	0	0
Technician, U.S.	**0**	0	0	0	0	0
Technician, non-U.S.	**1**	0	1	0	0	0
Total:	**143**	**43**	**74**	**0**	**4**	**22**

Table 4 – User Facility Operations

EMR Facility	17T	12T	Mossbauer	Bruker	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]					
NHMFL-Affiliated	15	42	34	8	99	9%
Local	37	45	104	15	201	18%
U.S. University	126	39	70	190	425	38%
U.S. Govt. Lab.	0	2	49	3	54	5%
U.S. Industry	0	0	0	0	0	0%
Non-U.S.	124	64	118	20	326	29%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	13	2	10	1	26	2%
Total:	**315**	**194**	**385**	**237**	**1131**	**100%**

1. User Units are defined as magnet days. For the EMR Facility, one magnet day is defined as 24 hours in superconducting magnets.

Table 5 – Operations by Discipline

EMR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
NHMFL-Affiliated	**99**	26	37	0	32	4
Local	**201**	0	162	0	11	28
U.S. University	**425**	53	231	0	0	141
U.S. Govt. Lab.	**54**	0	54	0	0	0
U.S. Industry	**0**	0	0	0	0	0
Non-U.S.	**326**	94	222	0	0	10
Test, Calibration, Set-up, Maintenance, Inst. Dev.	**26**	0	0	0	26	0
Total:	**1131**	**173**	**706**	**0**	**69**	**183**

1. User Units are defined as magnet days. For the EMR Facility, one magnet day is defined as 24 hours in superconducting magnets.

Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
36	40	67 (88.16%)	9 (11.84%)	76	113.43%

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Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Veige, Adam	University of Florida	P07226	Scheduled 2014
Holynska, Malgorzata	Philipps University Marburg	P07291	Scheduled 2014
Liu, Junjie	University of Oxford	P07299	Scheduled 2014
Wojciechowska, Agnieszka	Wroclaw University of Technology	P07301	Approved 2014
Lampropoulos, Christos	University of North Florida	P08309	Scheduled 2014
Osipov, Vladimir	Ioffe Physical-Technical Institute	P08312	Scheduled 2014
Schlenoff, Joseph	Chemistry and Biochemistry	P08349	Scheduled 2014
Cai, Jianfeng	University of South Florida	P08354	Scheduled 2014
Goswami, Sanchita	University of Calcutta, India	P08374	Scheduled 2014
Engen, John	Northeastern University	P08380	Scheduled 2014
Lumata, Lloyd	University of Texas at Dallas	P08395	Scheduled 2014
Andruh, Marius	University of Bucharest	P08419	Scheduled 2014
Grubba, Rafal	Gdansk University of Technology	P08455	Scheduled 2014
Ghirri, Alberto	CNR-Istituto Nanoscienze	P08473	Scheduled 2014
Groysman, Stanislav	Wayne State University	P08475	Scheduled 2014
Brusso, Jaclyn	University of Ottawa	P08481	Approved 2015
Friedman, Jonathan	Amherst College	P09522	Approved 2014
Christou, George	University of Florida	P11440	Scheduled 2014
Total:			**18**

Table 8 – Research Proposals Profile with Magnet Time

EMR Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem, Biophys.
Number of Proposals	65	2	8	16	34	0	3	12

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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	Number of Days Used
Ewa Bienkiewicz (S) New PI 2012	FSU	College of Medicine	Other - FSU/COM seed grant	EPR analysis of an intrinsically disordered amino-proximal domain of Prion protein P01982	Biology, Biochemistry, Biophysics	1	12.00
Thomas Albrecht-Schmitt (S) New PI 2013	Florida State University	Chemistry	Department of Energy Heavy Elements Chemistry	High Field and High Frequency EPR Study of Novel Heterobimetallics P07153	Magnets, Materials, Testing, Instrumentation	1	11.00

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Johan van Tol (S)	NHMFL	CIMAR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	High Frequency Pulsed EPR/ENDOR instrumentation testing P00082	Magnets, Materials, Testing, Instrumentation	1	34.00
Ping-Yu Chen (S) New PI 2013	National Chung-Hsing University	Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	HFEPR studies of iron porphyrin biomimetic models P07239	Chemistry, Geochemistry	1	14.00
Kim Dunbar (S)	Texas A&M University	Chemistry	Department of Energy DE-FG02-02ER45999	EPR Spectroscopy Studies to Investigate the Role of Spin-Orbit Coupling/Zero-field Splitting Effects on The Properties of Vandium(III) Compounds P02155	Chemistry, Geochemistry	1	2.00
Joanna Long (S)	NHMFL/UF Mcknight Brain Institute	Biochemist. & Molecular Biology	Other - UF Matching Support to the NHMFL for the DNP Program	Characterizing DNP mechanisms at high magnetic fields to enable membrane protein NMR studies P07148	Biology, Biochemistry, Biophysics	1	6.00
Naresh Dalal (S)	NHMFL	Chemistry	Future Fuels Institute	High-field EPR and ENDOR Studies of Fossil-Fuel and Related Materials P02481	Chemistry, Geochemistry	1	4.00
Jamie Manson (S) New PI 2013	Eastern Washingt. University	Chemistry and Biochemistry	National Science Foundation 1005825	High-field ESR of novel S=1 molecular and polymeric magnets P07136	Condensed Matter Physics	1	21.00
Likai Song (S)	NHMFL	EMR	NHMFL User Collaboration Grants Program	HIV-1 membrane analysis by multi-frequency EPR at 9, 95 and 240 GHz P02094	Biology, Biochemistry, Biophysics	1	4.00
Ellis Reinherz (S) New PI 2010	Dana-Farber Cancer Institute	Medicine	Other - Gates Foundation	Structural analysis of HIV-1 MPER segment from clade C viruses using EPR P01518	Biology, Biochemistry, Biophysics	1	27.00
Srinivasa Rao Sing-amaneni (P)	North Carolina State University	Materials Science and Engineerg.	Other - Home Institution	Temperature Dependent High Frequency EMR investigations on Nd1-xYxMnO3: Probing Competing Magnetic Interactions	Condensed Matter Physics	1	5.00

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				P02421			
Danna Freedman (S) New PI 2013	Northwestern University	Chemistry	Other - Northwestern University Start-up Fund Chemistry	Systematic analysis of decoherence sources for spin-based quantum computation P02333	Chemistry, Geochemistry	1	75.00
Alex Angerhofer (S)	NHMFL	Department of Chemistry	National Science Foundation 0809725	High Field EPR of Oxalate Decarboxylase P01641	Biology, Biochemistry, Biophysics	1	5.00
Likai Song (S)	NHMFL	EMR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Instrument testing P02439	Magnets, Materials, Testing, Instrumentation	1	1.00
Changlin Tian (S) New PI 2010	University of Science and Technolog. of China	School of Life Science	Other - National Key Basic Science Research Plan--Protein Science, China	Interaction and Dynamics Studies of Potassium Channel and its Modulation Subunit using Pulsed EPR P01583	Biology, Biochemistry, Biophysics	1	7.00
Tony Heinz (S) New PI 2013	Columbia University	Department of Physics	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Magneto-Optical Study of Atomically Thin Transition Metal Dichalcogenide Crystals P07177	Condensed Matter Physics	1	8.00
Joan Cano (S) New PI 2013	Universita de Valencia	Instituto de Ciencia Molecular	Other - Universitat de Valencia	Building arrays from mononuclear single-molecule magnets based on Mn(III) and other 3d transition metal ions. In pursuit of new physics in spintronics. P07202	Chemistry, Geochemistry	1	7.00
Gregory Girolami (S) New PI 2013	University of Illinois at Urbana-Champaign	Chemistry	National Science Foundation 11-12360	Zero- and applied-field Mössbauer studies of a nearly linear two-coordinate iron(II) amide P02493	Chemistry, Geochemistry	1	3.00
Adam Veige (S) New PI 2014	University of Florida	Chemistry	National Science Foundation 1265993	A square-planar high-spin Fe(II) center stabilized by a trianionic pincer-type ligand P07226	Chemistry, Geochemistry	2	53.00
Enrique Colacio (S)	Universida de Granada	Inorganic Chemistry	Other - MINECO (Spain) (Project CTQ2011-24478)	Co(II)-Based Single-Ion Magnets P07181	Chemistry, Geochemistry	1	7.00

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New PI 2013			Other - , the Junta de Andaluca (FQM-195 and Project of excellence P08-FQM-03705), and the University of Granada.				
Zhiqiang Li (S)	NHMFL	DC Field CMS	NHMFL User Collaboration Grants Program DC field, CMS	Magneto-optical Spectroscopy of Graphene and Few-layer Graphene P01901	Condensed Matter Physics	1	9.00
Malgorzata Holynska (S) New PI 2014	Philipps University Marburg	Chemistry	Other - German Research Council (DFG) Other - Philipps University Marburg	New magnetic materials based on bridged manganese complexes P07291	Chemistry, Geochemistry	1	15.00
Joshua Telser (S)	Roosevelt University	Chemistry	National Science Foundation CHE-1112154 Other - Roosevelt University - Research Leave Program	High-frequency and -field EPR studies of complexes of Group 6 - 8 ions with unusual ligands P07145	Chemistry, Geochemistry	1	33.00
Changlin Tian (S)	University of Science and Technolog. of China	School of Life Science	Other - National Key Basic Science Research Plan-Protein Science, China	Structure characterization of transmembrane protein rhodanese YgaP by EPR P07240	Biology, Biochemistry, Biophysics	1	3.00
Junjie Liu (P) New PI 2014	University of Oxford	Physics	Other - Engineer and Physical Sciences Research Council	High-Frequency Electron Spin Resonance of the S = 1 Square Lattices NiX2(pyz)2 (X = Cl, Br, I and NCS) P07299	Condensed Matter Physics	1	10.00
Hans-Conrad zur Loye (S) New PI 2013	University of South Carolina	Chemistry and Biochemist ry	Department of Energy DE-SC0001061	Mössbauer Investigation of a Series of Alkali-Barium Ferrites Structurally Related to Sodalite P07235	Chemistry, Geochemistry	1	18.00
Andrew Ozarowski (S)	NHMFL	EMR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	CALIBRATION AND MAINTENANCE OF THE MÖSSBAUER INSTRUMENTS P02498	Chemistry, Geochemistry	1	29.00
Naresh Dalal (S)	NHMFL	Chemistry	National Science Foundation DMR 0701482I	High Frequency EPR of Fe doped CdSe Quantum Dots P07221	Chemistry, Geochemistry	1	28.00

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			Other - Florida State University Chemistry P07221				
Andreja Bakac (S) New PI 2013	Ames Laboratory, Iowa State University	Ames Laboratory	Department of Energy DE-AC02-07CH11358	Mossbauer spectroscopy of Fe(IV) species in acetonitrile. P02513	Chemistry, Geochemistry	1	54.00
Mircea Dinca (S) New PI 2013	Massachusetts Institute of Technolog.	Department of Chemistry	Department of Energy DE-SC0006937	Using 57Fe Mössbauer Spectroscopy and High-Field EPR to Establish the Electronic Structure of Fe Sites in Lacunary Zn4O Clusters of MOF-5 P02384	Chemistry, Geochemistry	1	46.00
Naresh Dalal (S)	NHMFL	Chemistry	Other - DFG (Deutsche Forschungsgemeinschaft-German Research Foundation Chemistry	High Field and High Frequency EPR Study of Coordinately Unsaturated Transition Metal Complexes with Possible SMM Behavior P08311	Chemistry, Geochemistry	1	11.00
Panayotis Kyritsis (S)	University of Athens	Chemistry	Other - University of Athens Other - Empirikion Foundation, Greece	Electronic properties of (i) synthetic analogues of metalloproteins' active sites and (ii) single-ion molecular magnet metal complexes, probed by HFEPR spectroscopy. P07143	Chemistry, Geochemistry	1	73.00
Igor Tupitsyn (S) New PI 2013	University of British Columbia	Pacific Institute of Theoretical Physics	Other - London Centre for Nanotechnology, UK; and Marie Curie Research Fellowship, Harvard University, US	Controlling the Environmental Decoherence in Thin Films of Metallo-Organic Semiconductors P07163	Condensed Matter Physics	1	8.00
Michael Shatruk (S)	Florida State University	Department of Chemistry	National Science Foundation 0955353	Study of Magnetic Ordering in AlFe2-xMnxB2 by Mössbauer Spectroscopy P02021	Chemistry, Geochemistry	1	16.00

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Raj Sharma (S) New PI 2013	Panjab University	Chemistry	Other - Panjab University Department of Chemistry Other - UGC, New Delhi, India F.No. 40-60/ 2011	Magnetic and EPR Properties of Supramolecular Copper (II) Complexes P07146	Chemistry, Geochemistry	2	16.00
Christos Lampropoulos (S) New PI 2014	University of North Florida	Chemistry	Other - University of North Florida Chemistry Other - Research Corporation for Science Advancement Cottrell College Science Awards (CCSA) 22598	HFEPR investigations on (i) the anisotropy of magnetic clusters, and (ii) the quantum mechanical interactions between structural building units in polymers P08309	Chemistry, Geochemistry	1	8.00
Albert Stiegman (S) New PI 2013	FSU	Chemistry	National Science Foundation 0911080	Electron Spin Resonance (ESR) Studies of the Phillip's Ethylene Polymerization Catalyst. P02403	Chemistry, Geochemistry	1	3.00
Jianfeng Cai (S) New PI 2014	University of South Florida	Department of Chemistry	Other - University of South Florida New Researcher Grant	Multi-frequency EPR analysis of AApeptides with membranes P08354	Biology, Biochemistry, Biophysics	1	69.00
John Engen (S) New PI 2014	Northeastern University	Chemistry	National Institutes of Health GM101135	Membrane interaction of ADP Ribosylation Factor-1 defined by multi-frequency EPR P08380	Biology, Biochemistry, Biophysics	1	22.00
Irinel Chiorescu (S)	NHMFL	CMT/E	National Science Foundation 1206267	Dephasing properties of the total spin of the molecular cluster V15 P08391	Condensed Matter Physics	1	5.00
Euan Brechin (S)	University of Edinburgh	School of Chemistry	National Science Foundation CHE 0924374 Other - Engineering and Physical Sciences Research Council EP/H004106/1	EPR characterization of molecular magneto-structural correlations under pressure P07168	Condensed Matter Physics	1	9.00

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Christine Thomas (S) New PI 2013	Brandeis University	Department of Chemistry	Department of Energy DE-SC0004019	Variable temperature and variable field 57Fe Mossbauer and high field EPR studies of Fe-containing homo- and heterobimetallic complexes P02508	Chemistry, Geochemistry	1	4.00
Joseph Schlenoff (S) New PI 2014	Chemistry and Biochemistry		National Science Foundation 1207188	Using 57Fe Mössbauer Spectroscopy to determine the composition of magnetic nanoparticles embedded in polymer P08349	Chemistry, Geochemistry	1	10.00
Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) DE-FG02-07ER46451	Electron Phonon Coupling in graphite-related systems P01553	Condensed Matter Physics	1	3.00
Aimin Liu (S)	Georgia State University	Chemistry	National Institutes of Health R01GM108988	High-Field EPR of Trp-Derived Radicals in TTQ Cofactor Biogenesis P08448	Biology, Biochemistry, Biophysics	1	3.00
Stephen Holmes (S) New PI 2011	University of Missouri-St. Louis	Chemistry and Biochemist.	National Science Foundation CHE 0914935 Other - Missouri Research Board	High-Field EPR Studies of Low-Spin Iron (III) Complexes and Clusters. P01979	Chemistry, Geochemistry	1	5.00
Ellis Reinherz (S)	Dana-Farber Cancer Institute	Medicine	Other - Bill and Melinda Gates Foundation	Structural analysis of HIV-1 MPER segment from clade C viruses using EPR P07139	Biology, Biochemistry, Biophysics	1	20.00
Lloyd Lumata (S) New PI 2014	University of Texas at Dallas	Physics	Other - Department of Defense CDMRP Prostate Cancer Research Program W81XWH-14-1-0048	X- and W-band Electron Spin Resonance (ESR) relaxation properties of DNP free radical polarizing agents P08395	Chemistry, Geochemistry	1	21.00
Joshua Telser (S)	Roosevelt University	Chemistry	National Science Foundation 0804167	HFEPR on Macrocyclic Complexes of Transition Metals in High Oxidation States	Chemistry, Geochemistry	1	2.00

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				P01522			
Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	NHMFL User Collaboration Grants Program	Magneto-Raman Spectroscopy of Graphite and Graphene P01738	Condensed Matter Physics	1	2.00
Vladimir Osipov (S) New PI 2014	Ioffe Physical-Technical Institute	Division of Solid State Electronics	NHMFL Visiting Scientist Program	High-frequency EPR studies of spin-spin interaction between pi-electronic edge-localized spin states and molecular oxygen in defective carbon onions P08312	Condensed Matter Physics	1	22.00
Marius Andruh (S) New PI 2014	University of Bucharest	Chemistry	Other - University of Bucharest Department of Inorganic Chemistry	Using High-Field EPR to explore the electronic structure of heterometallic, 3d-4f complexes P08419	Chemistry, Geochemistry	1	115
Alberto Ghirri (S) New PI 2014	CNR-Istituto Nanoscienze	Centro S3	Other - Consiglio Nazionale delle Ricerche (Italy) Other - US AFOSR/AOARD Other - Italian Ministry of Research FIRB project	Study of decoherence and relaxation in single-crystals of molecular nanomagnets P08473	Condensed Matter Physics	1	21.00
Li-Chun Tung (S)	University of North Dakota	Physics and Astrophys.	Other - University of North Dakota-Faculty Seed Grant	Spectroscopic study of magnetoelastic CrOCl P02057	Condensed Matter Physics	1	11.00
Rafal Grubba (P) New PI 2014	Gdansk University of Techn.	Department of Inorganic Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Phosphanylphosphido complexes of iron: synthesis, chemical and magnetic properties P08455	Chemistry, Geochemistry	1	30.00
Evgeny Dikarev (S)	University at Albany, SUNY	Department of Chemistry	National Science Foundation 1152441	Investigation of Low-Coordinate Fe(II) beta-Diketonates by High-Frequency EPR Spectroscopy P02022	Chemistry, Geochemistry	1	1.00
Sylvain Bertaina (S)	IM2NP - CNRS	Nanosc.	Other - CNRS	High Frequencies EPR in 1D organic (TMTTF)2X P02025	Condensed Matter Physics	1	6.00
Alex Angerhofer (S)	University of Florida	Department of Chemistry	National Science Foundation 1213440	High-Field EPR of Oxalate Decarboxylase P08361	Biology, Biochemistry, Biophysics	1	5.00

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Dmitry Smirnov (S)	NHMFL	Instrumentation & Operations	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Magneto-Raman spectroscopy of correlated electron systems P08432	Condensed Matter Physics	1	7.00
Mark Murrie (S)	University of Glasgow	Chemistry	National Science Foundation 1309463	Single-ion magnets with giant axial magnetic anisotropy P08335	Chemistry, Geochemistry	1	3.00
Andrej Zorko (S)	"Jozef Stefan" Institute	Solid State Physics Department	Other - Slovenian Research Agency	Local ESR Insight into Geometrically Frustrated Antiferromagnets P02399	Condensed Matter Physics	1	18.00
Stanislav Groysman (S) New PI 2014	Wayne State University	Chemistry	National Science Foundation CHE-1349048	Using High-Field EPR to Explore Electronic Structures of Bis(aldimino)pyridine Nickel Complexes P08475	Chemistry, Geochemistry	1	5.00
Ziling Xue (S)	University of Tennessee	Chemistry	Other - American Chemical Society Petroleum Research Fund	Studies of Metalloporphyrins by High-Frequency and –Field Electron Paramagnetic Resonance Spectroscopy P09505	Chemistry, Geochemistry	1	2.00
Sanchita Goswami (S) New PI 2014	University of Calcutta, India	Chemistry	Other - Department of Science and Technology, New Delhi, India	EPR spectroscopy: an important tool for magnetic materials and bioinorganic chemistry P08374	Chemistry, Geochemistry	1	5.00
George Christou (S) New PI 2014	University of Florida	Chemistry	National Science Foundation CHE-000000	High Frequency EPR Spectroscopy on Single-Molecule Magnets P11440	Chemistry, Geochemistry	1	19.00
			Total Proposals:	**65**	**Total Experiments:**	**67**	**1131**

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ICR FACILITY

Table 1 – User Demographic

ICR Facility	Users	Male	Female	Prefer Not to Respond to Gender	Minority[1]	Non-Minority[1]	Prefer Not to Respond to Race	Users Present	Users Operating Remotely[2]	Users Sending Sample[3]	Off-Site Collaborators[4]
Senior Personnel, U.S.	**79**	65	12	2	1	75	3	32	0	20	27
Senior Personnel, non-U.S.	**17**	14	3	0	3	14	0	5	0	4	8
Postdocs, U.S.	**17**	8	8	1	0	16	1	11	0	1	5
Postdocs, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Students, U.S.	**37**	18	18	1	2	31	4	30	0	2	5
Students, non-U.S.	**2**	1	1	0	1	1	0	1	0	1	0
Technician, U.S.	**8**	6	1	1	0	7	1	4	0	2	2
Technician, non-U.S.	**0**	0	0	0	0	0	0	0	0	0	0
Total:	**160**	**112**	**43**	**5**	**7**	**144**	**9**	**83**	**0**	**30**	**47**

1. 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
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 the experiment is conducted by in-house user support personnel. Users at UF, FSU, and LANL cannot be “sample senders” for facilities located on their campuses.
4. “Off-Site Collaborators” 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).

Note: Users using multiple facilities are counted in each facility listed.

Table 2 – User Affiliation

ICR Facility	Users	NHMFL-Affiliated Users[1]	Local Users[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Senior Personnel, U.S.	**79**	11	14	62	10	7
Senior Personnel, non-U.S.	**17**	0	0	5	9	3
Postdocs, U.S.	**17**	3	6	16	0	1
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**37**	10	8	37	0	0
Students, non-U.S.	**2**	0	0	2	0	0
Technician, U.S.	**8**	3	1	6	2	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**160**	**27**	**29**	**128**	**21**	**11**

1. 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.
   The sum of NHMFL-Affiliated and Local users equals what was formerly referred to as "Internal Investigators".
2. In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.
3. In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.
4. The total of university, industry, and national lab users will equal the total number of users.

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Table 3 – Users by Discipline

ICR Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Senior Personnel, U.S.	**79**	0	48	5	5	21
Senior Personnel, non-U.S.	**17**	0	17	0	0	0
Postdocs, U.S.	**17**	0	11	0	1	5
Postdocs, non-U.S.	**0**	0	0	0	0	0
Students, U.S.	**37**	0	26	0	1	10
Students, non-U.S.	**2**	0	2	0	0	0
Technician, U.S.	**8**	0	5	2	1	0
Technician, non-U.S.	**0**	0	0	0	0	0
Total:	**160**	**0**	**109**	**7**	**8**	**36**

Table 4 – User Facility Operations

ICR Facility	14.5 T Hybrid	9.4. T Passive	9.4. T Active	Total Days Used / User Affil.	Percentage Used / User Affil.
	Number of Magnet Days[1]				
NHMFL-Affiliated	105	179	2	286	27.90%
Local	26	7	42	75	7.32%
U.S. University	31	194	9	234	22.83%
U.S. Govt. Lab.	4	3	0	7	0.68%
U.S. Industry	16	53	0	69	6.73%
Non-U.S.	0	49	33	82	8.00%
Test, Calibration, Set-up, Maintenance, Inst. Dev.	197	23	52	272	26.54%
Total:	**379**	**508**	**138**	**1025**	**100%**

1. For the ICR Facility, one magnet day is defined as 24 hours of use.

Table 5 – Operations by Discipline

ICR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
NHMFL-Affiliated	286	0	183	0	67	36
Local	75	0	45	0	0	30
U.S. University	234	0	153	0	0	81
U.S. Govt. Lab.	7	0	3	0	0	4
U.S. Industry	69	0	53	0	16	0
Non-U.S.	82	0	82	0	0	0
Test, Calibration, Set-up, Maintenance, Inst. Dev.	272	0	45	0	225	2
Total:	**1025**	**0**	**564**	**0**	**308**	**153**

1. For the ICR Facility, one magnet day is defined as 24 hours of use.

Table 6 – User Program Experiment Pressure

Experiment Requests Received	Experiment Requests Deferred from Prev. Year	Experiment Requests Granted	Experiment Requests Declined/Deferred	Experiment Requests Reviewed	Subscription Rate
54	36	77 (85.56%)	13 (14.44%)	90	116.88%

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Table 7 – New User PIs

Name	Organization	Proposal	Year of Magnet Time
Barton, Michelle	M. D. Anderson Cancer Center	P07262	Approved 2014
Cao, Xiaoyan	Old Dominion University	P07289	Scheduled 2014
Mapolelo, Mmili	Schlumberger Canada	P07294	Scheduled 2014
Lusk, Mary	University of Florida	P08348	Scheduled 2014
Timko, Michael	Worcester Polytechnic Institute	P08366	Scheduled 2014
Fondufe-Mittendorf , Yvonne N	University of Kentucky	P08371	Scheduled 2014
Bugni, Tim	University of Wisconsin-Madison	P08390	Scheduled 2014
Gunjan, Akash	Florida State University College of Medicine	P08392	Scheduled 2014
Merdrignac, Isabelle	IFP Energies nouvelles	P08437	Scheduled 2014
Fleming, Heath	HK Petroleum, LTD	P08465	Scheduled 2014
Koolen, Héctor	Woods Hole Oceanographic Institution	P08469	Scheduled 2014
Coronell, Orlando	University of North Carolina at Chapel Hill	P08472	Approved 2014
Kim, Teddy	Vanton Research Laboratory	P08480	Scheduled 2015
Gueneli, Nur	The Australian National University	P08490	Scheduled 2014
Shammai, Michael	Baker Hughes Oilfield Operations Inc	P08491	Scheduled 2014
Bianchi, Thomas	University of Florida	P08495	Approved 2014
Echegoyen, Luis	University of Texas at El Paso	P09517	Approved 2014
Jagoe, Charles	Florida Agricultural and Mechanical University	P09600	Scheduled 2015
Tycko, Robert	The National Institutes of Health, NIDDK, LCP	P11431	Scheduled 2015
Total:			**19**

Table 8 – Research Proposals Profile with Magnet Time

ICR Facility	Total	Minority[2]	Female[3]	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Materials, Testing, Instrum.	Biology, Biochem. Biophys.
Number of Proposals	75	4	15	0	50	0	5	20

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 one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the proposal includes minority participants.
3. The number of proposals satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the proposal includes female participants.

Table 9 – User Proposal

PI	Organization	Department	Funding Source(s)	Proposal Title & ID#	Proposal Discipline	Experiments Scheduled	Number of Days Used
Friedemann Freund (S)	NASA Ames Research Center	Earth Science Division	NASA Ames Research Center 227000-524-030259	Characterization of Stereochemically Constrained Complex Organic Molecules Extracted from Olivine Crystal Matrix P01878	Chemistry, Geochemistry	1	1.00
Andrew Yen (S)	Nalco Energy Service	Ultra Deep Research Group	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Co-Precipitate Evolution as a Function of Extraction Time P01997	Chemistry, Geochemistry	1	2.00
Nate Kaiser (S)	NHMFL	ICR	National Science Foundation CHE-1016942 National Science Foundation	21 Tesla Fourier Transform Ion Cyclotron Resonance Instrumentation design and development P01998	Magnets, Materials, Testing, Instrumen-tation	1	164

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			1019193				
Thomas Manning (S)	Valdosta State University	Chemistry	Other - Valdosta State University	NMR and FT-ICR P02045	Biology, Biochemistry, Biophysics	1	1.00
Min Guo (S)	The Scripps Research Institute - Florida	Department of Cancer Biology	Other - Sydney Kimmel Cancer Scholar Award SKF-11-003 (Guo)	HDX FT-ICR MS to Study the conformations of tRNA synthetases P02118	Biology, Biochemistry, Biophysics	2	8.00
Ryan Rodgers (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	The Separation and Characterization of Oxygenated Species from Petroleum P02105	Chemistry, Geochemistry	1	15.00
Micheal Trakselis (S) New PI 2012	University of Pittsburgh	Department of Chemistry	Other - American Cancer Society RSG-11-049-01-DMC	Individual DNA Strand Interactions with Hexameric Helicase Investigated by High Resolution Hydrogen/Deuterium Exchange Mass Spectrometry P02202	Biology, Biochemistry, Biophysics	1	1.00
Michael Freitas (S) New PI 2012	Ohio University Medical Center	Medical Center	National Institutes of Health 5 R01 CA107106 07	Top-down characterization of H1 phosphorylation isoforms P02204	Biology, Biochemistry, Biophysics	1	9.00
Nate Kaiser (S)	NHMFL	ICR	National Science Foundation 1019193	Redesign of Ion Source, Ion Transfer, and Ion Accumulation for 9.4 Tesla FT-ICR Mass Spectrometer P02205	Chemistry, Geochemistry	1	2.00
Thomas Manning (S)	Valdosta State University	Chemistry	Other - VSU-QEP; EPA-P3	Bryostatin P02243	Biology, Biochemistry, Biophysics	1	1.00
Jennifer Isaacs (S) New PI 2013	Medical University of South Carolina	Cell and Molecular Pharmacology	Other - DOD PC110235	How secreted Hsp90 modulates histone modifications in prostate epithelial cells P02291	Biology, Biochemistry, Biophysics	1	23.00
Ryan Rodgers (S)	NHMFL	ICR	Future Fuels Institute	Comprehensive Simulation/Projection of Heavy Crude Oil Distillation and Detailed Molecular Composition Prediction by Direct-Infusion Fourier Transform Ion Cyclotron Mass Spectrometry. P02294	Chemistry, Geochemistry	1	33.00
Dave Valentine (S) New PI 2013	University of California Santa Barbara	Department of Geological Sciences	Other - BP/Gulf of Mexico Research Initiative Deep-C Consortia	Molecular-Level Characterization Of Petroleum Seeps, Volcanoes, And Sediments From Santa Barbara Basin By Ft-Icr	Chemistry, Geochemistry	1	7.00

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				Mass Spectrometry P02304			
Albert Stiegman (S) New PI 2013	FSU	Chemistry	National Science Foundation 0911080	Mass Spectroscopic Studies of the Productions of the Early Stages of the Phillip's Ethylene Polymerization Process P02309	Chemistry, Geochemistry	1	1.00
Luc Moens (S) New PI 2013	National Renewable Energy Laboratory	National Bioenergy Center	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Renewable Hydrocarbon Production through Hydrodeoxygenat. of Lignocellulosic Bio-Oil P02312	Chemistry, Geochemistry	1	2.00
Christoph Aeppli (P) New PI 2013	Woods Hole Oceanographic Institute	Dept Marine Chemistry & Geochemistry	Other - BP/Gulf of Mexico Research Initiative Deep-C Consortia	Molecular level characterization of Carpinteria terrestrial tar pits by comprehensive GC X GC and FT-ICR MS P02314	Chemistry, Geochemistry	1	6.00
Nate Kaiser (S)	NHMFL	ICR	National Science Foundation CHE 1016942 National Science Foundation CHE-1019193	Novel Fourier Transform Ion Cyclotron Resonance Cell design and performance P01987	Magnets, Materials, Testing, Instrumenta-tion	1	17.00
Aixin Hou (S) New PI 2013	Louisiana State University	Department of Environmental Sciences	Other - BP/Gulf of Mexico Research Initiative	Characterization of the BP petroleum residuals in the sediment of the Salt Marshes in the Northern Gulf of Mexico P02345	Chemistry, Geochemistry	1	10.00
Elizabeth Stroupe (S) New PI 2013	Florida State University	Biological Science	National Science Foundation MES 1149763	HDX FT-ICR MS to Study the conformations of electron transfer complex in sulfite reductase P02385	Biology, Biochemistry, Biophysics	1	6.00
Pamela Vaughan (S) New PI 2013	University of West Florida	Department of Chemistry	Other - Gulf of Mexico Research Consortia Deep-C	Development of Water Accommodated Fractions from MC252 Surrogate Oil:The role of photochemistry P02406	Chemistry, Geochemistry	1	6.00
Matthew Tarr (S) New PI 2013	University of New Orleans	Department of Chemistry	National Science Foundation 1111525 National Science Foundation 1004869	High Resolution MS of Phototreated Crude Oil P02408	Chemistry, Geochemistry	1	10.00
Ryan Rodgers (S)	NHMFL	ICR	Other - Future Fuels Institute	Characterization of Exploratory Crudes (Future Fuels Institute) P02414	Chemistry, Geochemistry	1	8.00
Stephen Dalton (S) New PI 2013	University of Georgia	Department of Biochemistry and Molecular Biology	National Institutes of Health P01GM85354	Characterizing histone modification dynamics of human pluripotent stem cells during cell	Biology, Biochemistry, Biophysics	1	17.00

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				cycle transitions P02422			
Ryan Rodgers (S)	NHMFL	ICR	National Science Foundation DMR-11-57490	Characterization of Petroleum using Spectral Stitching by High Resolution FT-ICR MS P02452	Chemistry, Geochemistry	1	11.00
Amy McKenna (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Molecular Characterization of Petroporphyrins in Crude Oil by Atmospheric Pressure Photoionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometry P02504	Chemistry, Geochemistry	1	7.00
Michael Duncan (S) New PI 2013	University of Georgia	Department of Chemistry	Other - Air Force Office of Scientific Research (AFOSR) FA9550-12-1-0116	Absolute Mass Determination for Ligand-Coated Metal-Oxide Nanoclusters P02506	Chemistry, Geochemistry	1	3.00
Chandra Saravanan (S) New PI 2013	Reliance Oil	R&D	Future Fuels Institute	Educational Training and Evaluation of FT-ICR MS Facilities and Future Fuels Institute at Florida State University (Future Fuels Institue) P02497	Chemistry, Geochemistry	1	2.00
Priyanka Juyal (S)	Nalco Energy Services	Energy	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) 1157490	Characterization of Interfacial Material from Crude Oil by FT-ICR MS P07156	Chemistry, Geochemistry	1	1.00
Dewey McCafferty (S) New PI 2013	Duke University	Chemistry and Biochemistry	U.S. Army U.S. Army Medical Research And Materiel Command (Usamrmc) W81XWH-13-1-0400	Determination of the Substrate Specificity and Interfaces of Interaction of Lysine-Specific Demethylase 1 in Biologically Relevant Samples P07159	Biology, Biochemistry, Biophysics	1	8.00
John Syka (S) New PI 2013	Thermo Fisher Scientific	Research and Development	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Front End ETD coupled to 14.5T FTICR P07160	Magnets, Materials, Testing, Instrumentation	1	16.00
Jonathan Dennis (P) New PI 2013	Florida State University	Department of Biological Science	National Institutes of Health NIDA - National Institute on Drug Abuse R01 DA033775	Dynamic Changes in Histone Sequence Variants and Post-Translational Modifications During HIV activation P07166	Biology, Biochemistry, Biophysics	1	1.00
Nate Kaiser (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core	Maintenance and Cleaning of the FT-ICR MS instrumentation P07172	Magnets, Materials, Testing, Instrumentation	1	111

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			grant)				
Harold Kroto (S)	Florida State Unversity	Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Study of encapsulation of clusters and metals in carbon cages by high resolution FT-ICR mass spectrometry P07175	Chemistry, Geochemistry	1	42.00
Min Guo (S)	The Scripps Research Institute - Florida	Department of Cancer Biology	Other - Sydney Kimmel Cancer Scholar Award	HDX FT-ICR MS to Study the conformations of tRNA synthetases P07229	Biology, Biochemistry, Biophysics	1	1.00
Nicolas Young (S)	NHMFL	Ion Cyclotron Resonance Program	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant) ICR	Determination of Site-Specific Proteins Disulfide Bond Redox Potentials by Top Down FTICR Mass Spectrometry P07237	Biology, Biochemistry, Biophysics	1	28.00
Hengli Tang (S)	Florida State University	Biological Science	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Lipids Involved in Viral Infection P07261	Biology, Biochemistry, Biophysics	1	3.00
Ryan Rodgers (S)	NHMFL	ICR	Future Fuels Institute	Continued Development of Novel Method for Isolation of Interfacial Material from Crude Oil P07265	Chemistry, Geochemistry	1	72.00
Kenneth Roux (S)	Florida State University	Department of Biological Science	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Discovery of Nature of Cross-reactivity between Cashew and Pistachio 7S Proteins by HDX Mass Spectrometry P07267	Biology, Biochemistry, Biophysics	1	17.00
Josep Poblet (S)	Universitat Rovira i Virgili	Departament de Quimica Fisica i Inorganic	Other - Spanish Ministry of Science and Innovation	Trimetallic nitride endohedral metallofullerenes P07275	Chemistry, Geochemistry	1	33.00
Gheorghe Bota (S)	Institute for Corrosion and Multiphase Technology at Ohio Univerisy	Chemical and Biomolecular Engineering	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Identification of Corrosive Naphthenic Acids Characterization of Ketones Formed from Ferrous Naphthenate Thermal Decomposition P07287	Chemistry, Geochemistry	1	33.00
Donald Smith (S)	NHMFL	ICR	National Science Foundation 0938158	Development of Ionization Sources for 21 T FT-ICR MS P07293	Chemistry, Geochemistry	1	42.00
Mmili Mapolelo (S) New PI 2014	Schlumberger Canada	Heavy Oil Characterization	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	FT-ICR-MS Analysis of Asphaltene Subfractionation by N-Methyl-2-pyrrolidone Proprietary P07294	Chemistry, Geochemistry	1	6.00
Andrew Yen (S)	Nalco Energy Service	Ultra Deep Research	No other support (i.e. this experiment	FT-ICR MS Analysis of Petroleum Crude Oil	Chemistry, Geochemistry	1	7.00

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		Group	is entirely supported by NHMFL users services via its core grant)	Emulsions from the Gulf of Mexico P07295			
Xiaoyan Cao (G) New PI 2014	Old Dominion University	Chemistry and Biochemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Characterization of Dissolved Organic Matter by NMR Spectroscopy and FTICR Mass Spectrometry: Insights into the Links between Sources and Chemical Composition P07289	Chemistry, Geochemistry	1	3.00
Ian MacDonald (S)	Florida State University	Dept of Oceanography	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	FT-ICR MS characterization of natural oil seep (Megaplume) from Gulf of Mexico. P08305	Chemistry, Geochemistry	1	1.00
John Headley (S)	Environment Canada	National Hydrology Research Centre	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	High resolution FTICR-MS analyses of polymers and industrial additives P08307	Chemistry, Geochemistry	1	3.00
Ryan Rodgers (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Optimization of lithium cationization for selected detection of low abundance species in crude oil by FT-ICR MS P08347	Chemistry, Geochemistry	1	10.00
Mary Lusk (G) New PI 2014	University of Florida	Soil and Water Science Dept.	Other - University of Florida Center for Landscape Conservation and Ecology	Ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry to characterize the molecular composition of dissolved organic nitrogen in urban and nonurban streams P08348	Chemistry, Geochemistry	1	2.00
Robert Nelson (S)	Woods Hole Oceanographic Institute	Dept Marine Chemistry and Geochemistry	Other - Deep-C Consortium SA 12-12, GoMRI-008	Reexamining the Exxon Valdez Oil Spill and the Effects of Cold Climate Weathering: Molecular Characterization by Fourier Transform Ion Cyclotron Resonance P08350	Magnets, Materials, Testing, Instrumentation	1	8.00
Alexandra Stenson (S)	University of South Alabama	Chemistry	Other - University of South Alabama Center for Environmental Resiliency	Investigation of Disinfection Byproducts formed by different NOM fractions P08352	Chemistry, Geochemistry	1	6.00
Alexandra Stenson (S)	University of South Alabama	Chemistry	National Science Foundation CBET 1228615	Characterization of Leachate from PEX Drinking Water Pipes P08356	Chemistry, Geochemistry	1	6.00
Ryan Rodgers	NHMFL	ICR	No other support	Optimization of APCI	Chemistry,	1	3.00

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(S)			(i.e. this experiment is entirely supported by NHMFL users services via its core grant)	for detection of crude oil saturate fraction by FT-ICR MS P08359	Geochemistry		
Michael Timko (S) New PI 2014	Worcester Polytechnic Institute	Chemical Engineering	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Comprehensive Mass Spectrometer Analysis of Algae Hydrothermal Liquefaction Products P08366	Chemistry, Geochemistry	1	1.00
Manhoi Hur (T)	Iowa State University of Science and Technology	Genetics Development & Cell Biology-LAS	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Application of volcano plots for quantitative visualization and comparison of a set of two spectra obtained by high-resolution mass spectrometric analysis of crude oils P08367	Chemistry, Geochemistry	1	1.00
Yvonne N Fondufe-Mittendorf (S) New PI 2014	University of Kentucky	Department of Molecular & Cellular Biochemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	The effect of arsenite-induced modifications on chromatin structural proteins in mediating gene expression P08371	Biology, Biochemistry, Biophysics	1	12.00
Tim Bugni (S) New PI 2014	University of Wisconsin-Madison	Pharmaceutical Sciences	National Institutes of Health GM104192	Structure Elucidation of a Putative Novel Antibiotic Produced via Co-cultivation of Marine Invertebrate-associated Bacteria P08390	Chemistry, Geochemistry	1	1.00
Akash Gunjan (S) New PI 2014	Florida State University College of Medicine	Biomedical Sciences	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Role of histone H3 3 in DNA repair and pediatric glioblastomas P08392	Biology, Biochemistry, Biophysics	1	3.00
Ryan Rodgers (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Characterization of Interfacial Material Isolated from Athabasca Bitumen P08399	Chemistry, Geochemistry	1	2.00
Ryan Rodgers (S)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Photochemically-Induced Weathering of Interfacial Material Isolated from Petroleum P08400	Chemistry, Geochemistry	1	3.00
Isabelle Merdrignac (S) New PI 2014	IFP Energies nouvelles	Chemistry	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Relationship between structure and reactivity in hydrotreatment / hydroconversion of residues P08437	Biology, Biochemistry, Biophysics	1	9.00
Rosana	Petrobras	Petrobras	Future Fuels	Future Fuels Institute : Investigation of	Chemistry, Geochemistry	1	13.00

APPENDIX I – USER FACILITY STATISTICS

Cardoso (S)			Institute	Oxygenated Hydrocarbons in Diesel Fuel Precipitates P08438			
Ryan Rodgers (S)	NHMFL	ICR	Future Fuels Institute	Correlation of mass spectral data to petroleum bulk properties P08456	Chemistry, Geochemistry	1	6.00
Matthew Tarr (S)	University of New Orleans	Department of Chemistry	National Science Foundation CHE-1111525, DMR-1004869	High Resolution MS of Phototreated Crude Oil P08463	Chemistry, Geochemistry	1	12.00
Heath Fleming (S) New PI 2014	HK Petroleum, LTD	Bulk Sales	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Characterization of Municipal Solid Waste Pyrolysis Oil by FT-ICR MS P08465	Chemistry, Geochemistry	1	6.00
Héctor Koolen (G) New PI 2014	Woods Hole Oceanographic Institution	Department of Marine Chemistry and Geochemistry	Other - BP/The Gulf of Mexico Research Initiative to the Deep-C Consortium	Advanced characterization of oil residues on Texas beaches after Kirby oil spill P08469	Chemistry, Geochemistry	1	13.00
Geoffrey Klein (S)	Christopher Newport University	Department of Molecular Biology and Chemistry	Other - ACS Petroleum Research Fund 50670-UR6, 2011 National Science Foundation GK-12 0841295, 2009	Access to the Ultra-High Resolution FT-ICR Mass Spectrometers at the NHMFL for Analysis of the Maltene Fractions of Three Different Crude Oils P08471	Chemistry, Geochemistry	1	13.00
Kristina Håkansson (S)	University of Michigan	Department of Chemistry	National Science Foundation CHE-1152531 National Institutes of Health 1-R01-GM-107148-01-A1	ICR Program Proposal Kristina Håkansson, Department of Chemistry, University of Michigan P08478	Chemistry, Geochemistry	2	8.00
Nur Gueneli (G) New PI 2014	The Australian National University	ANU College of Physical & Mathematical Sciences	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Characterization of the world's oldest (1.1 Ga) porphyrins P08490	Chemistry, Geochemistry	1	6.00
Michael Shammai (S) New PI 2014	Baker Hughes Oilfield Operations Inc	Heavy Oil Research Proje cts	Other - Baker Hughes	Characterizing the Compositional and Structural Changes in Crude Oil and Asphaltenes P08491	Chemistry, Geochemistry	1	3.00
Chris Hendrickson (S)	NHMFL	Ion Cyclotron Resonance Program	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Method development for characterizing post-translational modifications of Histone H4 P08493	Biology, Biochemistry, Biophysics	1	38.00

APPENDIX I – USER FACILITY STATISTICS

Luis Echegoyen (S)	University of Texas at El Paso	Chemistry	National Science Foundation CHE-1408865	Identification of C70-based adducts for organic photovoltaics P09516	Biology, Biochemistry, Biophysics	1	6.00
Jackie Jarvis (P)	NHMFL	ICR	No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)	Separation-Enhanced Characterization of Bio-oils by FT-ICR MS P09527	Chemistry, Geochemistry	1	1.00
Charles Jagoe (S) New PI 2014	Florida Agricultural and Mechanical University	School of the Environment	Other - The Environmental Cooperative Science Center Cooperative Agreement Award NA11SEC4810001	Changes in the Molecular Composition of a Gulf of Mexico Crude Oil Resulting from the Pseudomonas aeruginosa Biodegradation P09600	Chemistry, Geochemistry	1	1.00
Robert Tycko (S) New PI 2014	The National Institutes of Health, NIDDK, LCP	Laboratory of Chemical Physics, NIDDK	National Institutes of Health Intramural Research Program DK075031 (Intramural Research Project Number)	Structural Study of Fibrils Formed by the Low-Complexity Domains of mRNA Binding Proteins P11431	Biology, Biochemistry, Biophysics	1	4.00
Omics LLC (O)	Omics, LLC	Omics	Other - Omics, LLC	OMICS Fee For Service Proprietary Research P11443	Chemistry, Geochemistry	1	27.00
			Total Proposals:	**75**	**Total Experiments**	**77**	**1025**

OVERALL STATISTICS
Across All NHMFL User Facilities

APPENDIX I – USER FACILITY STATISTICS

Overall Statistics across All NHMFL User Facilities

Table 1- Instrument Operations

User Facility	Total # days Instr. Operations	# days to outside users at facility	# days in-house (NHMFL Affiliated) research	# days instrument development and maintenance (Combined)	# days to awardee institution faculty (local)
DC Field [1]	1,801.04	1,384.75	329.34	0	86.95
PF Field [2]	788	510	206	17	55
HBT [3]	856	741	0	115	0
NMR [4]	3165	1,281	545	170	1,169
AMRIS [5]	1,652.87	361.67	610.3	431.5	249.4
EMR [6]	1,131	805	99	26	201
ICR [7]	1,025	392	286	272	75

[1] **Note:** Since each resistive magnet requires two power supplies to run and the 45 T hybrid magnet requires three power supplies, there can be four resistive magnets + three superconducting magnets or the 45 T hybrid, two resistive magnets + three superconducting magnets operated in a given week. 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. There is an annual four weeks shutdown in fall of powered DC resistive and hybrid magnets for infrastructure maintenance and a two weeks shutdown period for the university mandated holiday break.

[2] User Units are defined as magnet days. Magnets are scheduled typically 12 hours a day.

[3, 4, 6, 7] User Units are defined as magnet days. One magnet day is defined as 24 hours in superconducting magnets.

[5] 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, & 750 MHz), 1 magnet day = 24 hours. Horizontals (4.7, 11.1, and 3T), 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 4.7 T, 11 T and 3 T studies, almost all studies with external users were collaborative with UF investigators. In 2014 the 3T system was funded entirely off of non-NHMFL funds but is reported for historical purposes

Table 2 - User Program Proposal Pressure by User Facility

User Facility	# experiments received (requested and deferred)	# experiments reviewed	# days requested in reviewed experiments	# days allocated to outside users	# days allocated to awardee institution personnel (local)	Total # days allocated	% Subscription (# days requested / # days allocated)
DC Field	402	402	3,265	1,385	86.95	1,801.04	181%
PF Field	195	195	1,442	510	55	788	183%
HBT	13	13	871	741	0	856	102%
NMR	471	471	3,057	1,281	1,169	3,165	97%
AMRIS	428	428	1,800	361.67	249.4	1,652.87	109%
EMR	76	76	474	805	201	1,131	42%*
ICR	90	90	365	392	75	1,025	36%*

*In 2014, ICR and EMR did not report magnet time usage for separate experiments instead added on time to first experiment when probes were not finished.

APPENDIX I – USER FACILITY STATISTICS

Table 3 - Funding Source of User's Research- Days allotted (counts)

User Facility	NSF [including UCGP+No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)]	NIH	DOE	DOD (NASA, U.S. Army, U.S. Navy, U.S. Airforce)	NHMFL VSP	FFI	UF McKnight Brain Institute	Other (Enter the name of e.g. home institution or university; corporation; foundation; academy of science, society, etc.)				Sum (# of days)
								EPA	International	National	Industry	
DC Field	755.10	0	455.93	87.34	17.56	0	0	0	288.90	143.86	52.35	1,801
PFF	370	0	196	0	0	0	0	0	140	82	0	788
HBT	84	0	562	0	0	0	0	0	72	138	0	856
NMR	1,021.91	1,584.1	28.5	75.16	0	0	0	7	111.3	333.02	4	3,165
AMRIS	401.45	439.2	14.65	43.1	16.5	0	0	0	0	46.4	0	961.3*
EMR	395.5	25	135	28	22	4	0	0	256.5	265	0	1,131
ICR	679.5	36	0	35	0	125	0	1	42	75.5	30	1,025

*AMRIS did not reported funding sources for independently funded users.

Table 4 - Funding Source of User's Research- Fraction of Days allotted (percentage)

User Facility	NSF [including UCGP+No other support (i.e. this experiment is entirely supported by NHMFL users services via its core grant)]	NIH	DOE	DOD (NASA, U.S. Army, U.S. Navy, U.S. Airforce)	NHMFL VSP	FFI	UF McKnight Brain Institute	Other (Enter the name of e.g. home institution or university; corporation; foundation; academy of science, society, etc.)				Sum (# of days)
								EPA	International	National	Industry	
DC Field	42%	0%	25%	5%	1%	0%	0%	0%	16%	8%	3%	1,801
PFF	47%	0%	25%	0%	0%	0%	0%	0%	18%	10%	0%	788
HBT	10%	0%	66%	0%	0%	0%	0%	0%	8%	16%	0%	856
NMR	32%	50%	1%	2%	0%	0%	0%	0%	4%	11%	0%	3,165
AMRIS	42%	45%	2%	4%	2%	0%	0%	0%	0%	5%	0%	961.3
EMR	36%	2%	12%	2%	2%	0%	0%	0%	23%	23%	0%	1,131
ICR	67%	4%	0%	3%	0%	12%	0%	0%	4%	7%	3%	1,025

APPENDIX II
Geographic Distribution

APPENDIX II – GEOGRAPHIC DISTRIBUTION

NATIONAL DISTRIBUTION

Magnet Usage Start Date: 1/1/2014 Magnet Usage End Date: 12/31/2014

User Type and Country: Senior Personnel, U.S./PI

DC FIELD FACILITY (165)

Name	Organization	Country
Dmytro Abraimov (S/PI)	NHMFL	USA (FL)
Ray Ashoori (S/PI)	Massachusetts Institute of Technology	USA (MA)
Phaedon Avouris (S/PI)	IBM T. J. Watson Research Center	USA (NY)
Fedor Balakirev (S/PI)	NHMFL - LANL	USA (NM)
Luis Balicas (S/PI)	NHMFL	USA (FL)
Eric Bauer (S/PI)	Los Alamos National Laboratory	USA (NM)
Ryan Baumbach (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Gregory Belenky (S)	SUNY at Stony Brook	USA (NY)
Stephen Berus (S)	Lake Shore Cryotronics	USA (OH)
Greg Boebinger (S/PI)	NHMFL	USA (FL)
Scott Bole (S)	NHMFL	USA (FL)
Clifford Bowers (S/PI)	University of Florida	USA (FL)
Ivan Bozovic (S/PI)	Brookhaven National Lab	USA (NY)
William Brey (S/PI)	NHMFL	USA (FL)
James Brooks (S/PI)	Florida State University	USA (FL)
Stuart Brown (S/PI)	UCLA	USA (CA)
Sergey L Bud'ko (S/PI)	Iowa State University	USA (IA)

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Bill Butler (S)	University of Alabama	USA (AL)
Paul Cadden-Zimansky (S/PI)	Bard College	USA (NY)
Marshall Calhoun (S)	Lake Shore Cryotronics	USA (OH)
Paul Canfield (S/PI)	Iowa State University	USA (IA)
Joseph Checkelsky (S/PI)	MIT	USA (MA)
Yong Chen (S/PI)	Purdue University	USA (IN)
Sang Wook Cheong (S/PI)	Rutgers University	USA (NJ)
Eun Sang Choi (S/PI)	NHMFL	USA (FL)
William Coniglio (S)	NHMFL-FSU	USA (FL)
Jason Cooley (S/PI)	Alloy Design and Development Team, MST-6	USA (NM)
Nicholas Curro (S/PI)	University of California	USA (CA)
Bryon Dalton (S/PI)	NHMFL	USA (FL)
Cory Dean (S/PI)	The City College of New York	USA (NY)
Shanti Deemyad (S/PI)	University of Utah	USA (UT)
Fraser Douglas (S)	Advanced Conductor Technologies	USA (CO)
Rui-Rui Du (S/PI)	Rice University	USA (TX)
Lloyd Engel (S/PI)	NHMFL	USA (FL)
Yejun Feng (S/PI)	Argonne National Laboratory	USA (IL)
Ian Fisher (S/PI)	Stanford University	USA (CA)
Zachary Fisk (S/PI)	University of California Irvine	USA (CA)
Nathanael Fortune (S/PI)	Smith College	USA (MA)
Frank Fratantonio (S)	NAVSEA Div Newport	USA (RI)
Madalina Furis (S/PI)	University of Vermont	USA (VT)
Zhehong Gan (S/PI)	Florida State University	USA (FL)

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James Gleeson (S/PI)	Kent State University	USA (OH)
David Goldhaber-Gordon (S/PI)	Stanford University	USA (CA)
David Graf (S/PI)	Florida State University	USA (FL)
Martin Greven (S/PI)	University of Minnesota	USA (MN)
Genda Gu (S)	Brookhaven national lab	USA (NY)
Arun Gupta (S)	University of Alabama	USA (AL)
William Halperin (S/PI)	Northwestern University	USA (IL)
James Hamlin (S/PI)	University of Florida	USA (FL)
Ke Han (S/PI)	NHMFL	USA (FL)
Scott Hannahs (S/PI)	NHMFL	USA (FL)
Trevor Hayton (S)	University of California, Santa Barbara	USA (CA)
Don Heiman (S/PI)	Northeastern University	USA (MA)
Tony Heinz (S/PI)	Columbia University	USA (NY)
Eric Hellstrom (S)	NHMFL	USA (FL)
Erik Henriksen (S/PI)	Washington University in St. Louis	USA (MO)
Stephen Hill (S/PI)	NHMFL	USA (FL)
David Hilton (S/PI)	University of Alabama-Birmingham	USA (AL)
James Hone (S/PI)	Columbia University	USA (NY)
Tao Hong (S/PI)	Oak Ridge National Laboratory	USA (TN)
Thomas Howarth (S/PI)	NAVSEA Division Newport	USA (RI)
Eric Isaacs (S)	Argonne National Laboratory	USA (IL)
Antal Jakli (S)	Kent State University	USA (OH)
Pablo Jarillo-Herrero (S/PI)	MIT	USA (MA)
Jan Jaroszynski (S/PI)	NHMFL	USA (FL)

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Jianyi Jiang (S/PI)	ASC-NHMFL	USA (FL)
Zhigang Jiang (S/PI)	Georgia Institute of Technology	USA (GA)
Glover Jones (S)	NHMFL	USA (FL)
Giti Khodaparast (S/PI)	Virginia Tech.	USA (VA)
Philip Kim (S/PI)	Columbia University	USA (NY)
Gela Kipshidze (S)	SUNY at Stony Brook	USA (NY)
Kenneth Knappenberger (S/PI)	Florida State University	USA (FL)
Junichiro Kono (S/PI)	Rice University	USA (TX)
Jurek Krzystek (S/PI)	NHMFL	USA (FL)
Philip Kuhns (S)	NHMFL	USA (FL)
Hung-I Kuo (S)	Lake Shore Cryotronics	USA (OH)
Igor Kuskovsky (S/PI)	Queens College of CUNY	USA (NY)
David Larbalestier (S/PI)	National High Magnetic Field Lab	USA (FL)
Chun Ning (Jeanie) Lau (S/PI)	University of California, Riverside	USA (CA)
Lu Li (S/PI)	University of Michigan	USA (MA)
Qiang Li (S/PI)	Brookhaven National Lab	USA (NY)
Zhiqiang Li (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Ilya Litvak (S)	NHMFL	USA (FL)
Yong Liu (S)	The Ames Laboratory	USA (IA)
Serge Luryi (S)	SUNY at Stony Brook	USA (NY)
David Mandrus (S/PI)	Oak Ridge National Laboratory	USA (TN)
Michael Manfra (S)	Bell Labs	USA (NJ)
Ivar Martin (S)	Argonne National Laboratory	USA (IL)
Ross McDonald (S/PI)	NHMFL - LANL	USA (NM)

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George Miller (S)	NHMFL	USA (FL)
Ireneusz Miotkowski (S)	Purdue University	USA (IN)
John Mitchell (S/PI)	Argonne National Laboratory	USA (IL)
Vesna Mitrovic (S/PI)	Brown University	USA (RI)
Sheena Murphy (S/PI)	University of Oklahoma	USA (OK)
Tim Murphy (S/PI)	NHMFL	USA (FL)
Janice Musfeldt (S/PI)	University of Tennessee, Knoxville	USA (TN)
Vinh Nguyen (S/PI)	Virginia Tech	USA (VA)
Martin Nikolo (S/PI)	Saint Louis University	USA (MO)
Daniel Nocera (S/PI)	Harvard University	USA (MA)
Patrick Noyes (S/PI)	NHMFL	USA (FL)
N. Phuan Ong (S/PI)	Princeton University	USA (NJ)
Andrew Ozarowski (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Johnpierre Paglione (S/PI)	University of Maryland	USA (MD)
Eric Palm (S/PI)	NHMFL-FSU	USA (FL)
Chris Palmstrom (S/PI)	UC Santa Barbara	USA (CA)
Wei Pan (S/PI)	Sandia National Laboratories	USA (NM)
Ju-Hyun Park (S/PI)	NHMFL	USA (FL)
Cedomir Petrovic (S/PI)	Brookhaven National Laboratory	USA (NY)
Loren Pfeiffer (S)	Princeton University	USA (NJ)
Ruslan Prozorov (S/PI)	Ames Laboratory-Iowa State University	USA (IA)
Kenneth Purcell (S/PI)	University of Southern Indiana	USA (IN)
R. Ramesh (S/PI)	University of California, Berkeley	USA (CA)

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Filip Ronning (S/PI)	Los Alamos National Laboratory	USA (NM)
Tom Rosenbaum (S/PI)	Univ. of Chicago	USA (IL)
Kresimir Rupnik (S/PI)	Louisiana State University	USA (LA)
Michael Santos (S/PI)	University of Oklahoma	USA (OK)
Jeffrey Schiano (S)	Penn State University	USA (PA)
Darrell Schlom (S)	Cornell University	USA (NY)
Pedro Schlottmann (S)	Florida State University	USA (FL)
John Schlueter (S/PI)	Argonne National Laboratory	USA (IL)
George Schmiedeshoff (S/PI)	Occidental College	USA (CA)
Venkat Selvamanickam (S/PI)	University of Houston	USA (TX)
Mansour Shayegan (S/PI)	Princeton University	USA (NJ)
Weidong Si (S)	Brookhaven National Laboratory	USA (NY)
Theo Siegrist (S/PI)	NHMFL	USA (FL)
Daniel Silevitch (S)	University of Chicago	USA (IL)
Dmitry Smirnov (S/PI)	NHMFL	USA (FL)
Sam Sprunt (S/PI)	Kent State University	USA (OH)
Christopher Stanton (S/PI)	University of Florida	USA (FL)
Kevin Storr (S/PI)	Prairie View A&M University	USA (TX)
Sergey Suchalkin (S/PI)	SUNY at Stony Brook	USA (NY)
Alexey Suslov (S/PI)	NHMFL	USA (FL)
Yasu Takano (S/PI)	University of Florida	USA (FL)
Makariy Tanatar (S/PI)	Ames Laboratory	USA (IA)
David Tanner (S/PI)	University of Florida	USA (FL)

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Joshua Telser (S/PI)	Roosevelt University	USA (IL)
Mauricio terrones (S)	Penn State U	USA (PA)
Humberto Terrones (S)	Rensselaer Polytechnic	USA (NY)
Joe Thompson (S/PI)	Los Alamos National Laboratory	USA (NM)
Stan Tozer (S/PI)	NHMFL	USA (FL)
Ulf Trociewitz (S/PI)	NHMFL	USA (FL)
Daniel Tsui (S/PI)	Princeton University	USA (NJ)
Danko van der Laan (S/PI)	National Institute of Standards and Technology	USA (CO)
Johan van Tol (S/PI)	Florida State University	USA (FL)
David Vanderbilt (S)	Rutgers University	USA (NJ)
Feng Wang (S/PI)	University of California, Berkeley	USA (CA)
Kang Wang (S/PI)	UCLA	USA (CA)
Hubertus Weijers (S/PI)	NHMFL	USA (FL)
Jeremy Weiss (S)	Applied Superconductivity Center, NHMFL, FSU	USA (FL)
Ken West (S)	Princeton University	USA (NJ)
James Willit (S)	Argonne National Laboratory	USA (IL)
Jie Wu (S)	Brookhaven National Laboratory	USA (NY)
Aixia Xu (S)	University of Houston	USA (TX)
Xiaodong Xu (S/PI)	University of Washington	USA (WA)
Peide Ye (S/PI)	Purdue University	USA (IN)
Vivien Zapf (S/PI)	NHMFL-LANL	USA (NM)
Lin Zhang (S/PI)	NHMFL	USA (FL)
Chenglin Zhang (S/PI)	The University of Tennessee	USA (TN)

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Jun Zhu (S/PI)	Penn State University	USA (PA)
Michael Zudov (S/PI)	University of Minnesota	USA (MN)
Xiaowei Zuo (S/PI)	MST	USA (FL)

PULSED FIELD FACILITY (57)

Name	Organization	Country
James Analytis (S/PI)	University of California, Berkeley	USA (CA)
Abul Azad (S)	LANL	USA (NM)
Fedor Balakirev (S/PI)	NHMFL - LANL	USA (NM)
Cristian Batista (S)	Los Alamos National Laboratory	USA (NM)
Eric Bauer (S/PI)	Los Alamos National Laboratory	USA (NM)
Ryan Baumbach (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Greg Boebinger (S/PI)	NHMFL	USA (FL)
Ivan Bozovic (S/PI)	Brookhaven National Lab	USA (NY)
James Brooks (S/PI)	Florida State University	USA (FL)
John Bulmer (S/PI)	AFRL	USA (FL)
Gang Cao (S/PI)	University of Kentucky	USA (KY)
Sang Wook Cheong (S/PI)	Rutgers University	USA (NJ)
Eun Sang Choi (S/PI)	NHMFL	USA (FL)
William Coniglio (S)	NHMFL-FSU	USA (FL)
Jason Cooley (S/PI)	Alloy Design and Development Team, MST-6	USA (NM)
Scott Crooker (S/PI)	Los Alamos National Lab	USA (NM)
Michael Fitzsimmons (S/PI)	Los Alamos National Laboratory	USA (NM)
Brian Fluegel (S)	National Renewable Energy Lab	USA (CO)

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Krzysztof Gofryk (S/PI)	Idaho National Laboratory	USA (ID)
David Graf (S/PI)	Florida State University	USA (FL)
Genda Gu (S)	Brookhaven national lab	USA (NY)
Neil Harrison (S/PI)	NHMFL-LANL	USA (NM)
Eric Hellstrom (S)	NHMFL	USA (FL)
Michael Hoch (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Eric Isaacs (S)	Argonne National Laboratory	USA (IL)
Marcelo Jaime (S/PI)	MPA-CMMS	USA (NM)
Quanxi Jia (S)	Mpa-cint: center for integrated nanotechnologies	USA (NM)
Jianyi Jiang (S/PI)	ASC-NHMFL	USA (FL)
Chun Ning (Jeanie) Lau (S/PI)	University of California, Riverside	USA (CA)
Lu Li (S/PI)	University of Michigan	USA (MA)
Boris Maiorov (S/PI)	Los Alamos National Laboratory	USA (NM)
Jamie Manson (S/PI)	Eastern Washington University	USA (WA)
Angelo Mascarenhas (S/PI)	National Renewable Energy Lab	USA (CO)
Ross McDonald (S/PI)	NHMFL - LANL	USA (NM)
Charles Mielke (S/PI)	NHMFL - LANL	USA (NM)
John Mitchell (S/PI)	Argonne National Laboratory	USA (IL)
Tim Murphy (S/PI)	NHMFL	USA (FL)
Doan Nguyen (S/PI)	NHMFL - PFF	USA (NM)
Martin Nikolo (S/PI)	Saint Louis University	USA (MO)
N. Phuan Ong (S/PI)	Princeton University	USA (NJ)
Eric Palm (S/PI)	NHMFL-FSU	USA (FL)
Ju-Hyun Park (S/PI)	NHMFL	USA (FL)

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Dwight Rickel (S/PI)	NHMFL @ LANL	USA (NM)
George Rodriguez (S)	LANL	USA (NM)
Filip Ronning (S/PI)	Los Alamos National Laboratory	USA (NM)
Tom Rosenbaum (S/PI)	Univ. of Chicago	USA (IL)
Myron Salamon (S/PI)	University of Texas at Dallas	USA (IL)
John Schlueter (S/PI)	Argonne National Laboratory	USA (IL)
John Singleton (S/PI)	NHMFL - LANL	USA (NM)
Nathan Smythe (S/PI)	Chemistry Division	USA (NM)
Stan Tozer (S/PI)	NHMFL	USA (FL)
Haiyan Wang (S/PI)	Texas A&M University	USA (TX)
Jeremy Weiss (S)	Applied Superconductivity Center, NHMFL, FSU	USA (FL)
Jie Wu (S)	Brookhaven National Laboratory	USA (NY)
Anvar Zakhidov (S)	University of Texas at Dallas	USA (TX)
Vivien Zapf (S/PI)	NHMFL-LANL	USA (NM)
Wojciech Zurek (S)	Los Alamos National Lab	USA (NM)

HIGH B/T FACILITY (16)

Name	Organization	Country
Greg Boebinger (S/PI)	NHMFL	USA (FL)
Xuan Gao (S/PI)	Case Western Reserve University	USA (OH)
Jian Huang (S/PI)	Wayne State University	USA (MI)
Michael Lilly (S)	Sandia National Labs	USA (NM)
Naoto Masuhara (S)	University of Florida	USA (FL)
Wei Pan (S/PI)	Sandia National Laboratories	USA (NM)
Loren Pfeiffer (S)	Princeton University	USA (NJ)

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John Reno (S)	Sandia National Laboratories	USA (NM)
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NMR FACILITY (106)

Name	Organization	Country
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Mark Davis (S/PI)	California Institute of Technology	USA (CA)
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Aron Fisher (S/PI)	Institute for Environmental Medicine, University of Pennsylvania	USA (PA)
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Zhehong Gan (S/PI)	Florida State University	USA (FL)
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EMR FACILITY (58)

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Ewa Bienkiewicz (S/PI)	FSU	USA (FL)
Jianfeng Cai (S/PI)	University of South Florida	USA (FL)
Marc Caporini (S)	Bruker Biospin	USA (MA)
Irinel Chiorescu (S/PI)	NHMFL & Florida State University	USA (FL)
George Christou (S/PI)	University of Florida	USA (FL)
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Stephen Hill (S/PI)	NHMFL	USA (FL)
Stephen Holmes (S/PI)	University of Missouri-St. Louis	USA (MO)
Zhigang Jiang (S/PI)	Georgia Institute of Technology	USA (GA)
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Junichiro Kono (S/PI)	Rice University	USA (TX)
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Christos Lampropoulos (S/PI)	University of North Florida	USA (FL)
Chun Ning (Jeanie) Lau (S/PI)	University of California, Riverside	USA (CA)
Zhiqiang Li (S/PI)	National High Magnetic Field Laboratory	USA (FL)
Aimin Liu (S/PI)	Georgia State University	USA (GA)
Joanna Long (S/PI)	NHMFL/UF Mcknight Brain Institute	USA (FL)
Lloyd Lumata (S/PI)	University of Texas at Dallas	USA (TX)
Jamie Manson (S/PI)	Eastern Washington University	USA (WA)
Alan Marshall (S/PI)	NHMFL	USA (FL)
Amy McKenna (S/PI)	NHMFL	USA (FL)
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ICR FACILITY (79)

Name	Organization	Country
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Elizabeth Blackburn (S/PI)	University of Birmingham	United Kingdom
Doug Bonn (S/PI)	University of British Columbia	Canada
Norbert Buettgen (S/PI)	University of Augsburg	Germany
David Cardwell (S/PI)	University of Cambridge	United Kingdom
Xian Hui Chen (S)	Hefei National Laboratory for Physical Sciences	China
F. C. Chou (S)	National Taiwan University	Taiwan
Heng Bo Cui (S/PI)	RIKEN	Japan
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Ivan Smirnov (S)	A.F.Ioffe PTI	Russia
Sergey Sosin (S)	Russian Academy of Science, RAS	Russia
Michael Sutherland (S/PI)	University of Cambridge	United Kingdom
Leonid Svistov (S/PI)	Russia Academy of Science	Russia
Thomas Szkopek (S)	McGill University	Canada
Louis Taillefer (S/PI)	University of Sherbrooke	Canada
Taichi Terashima (S/PI)	National Institute for Materials Science	Japan
Yuri Vasilyev (S/PI)	Ioffe Institute	Russian Federation
Engang Wang (S/PI)	Northeastern University	China
Zhenxing Wang (S/PI)	Huazhong University of Science and Technology	China
Chris Wiebe (S/PI)	University of Winnipeg	Canada

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Tao Wu (S)	University of Science and Technology of China	China
Huiqiu Yuan (S/PI)	Zhejiang University	China
Yuanbo Zhang (S/PI)	Dept. of Physics, Fudan University	China
Guo-Qing Zheng (S/PI)	Okayama University	Japan
Sergei Zvyagin (S/PI)	Dresden High Magnetic Field Laboratory	Germany

PULSED FIELD FACILITY (20)

Name	Organization	Country
Manuel Almeida (S)	ITN, Sacavém	Portugal
Bertram Batlogg (S/PI)	ETH	Switzerland
Kamran Behnia (S/PI)	ESPCI	France
Doug Bonn (S/PI)	University of British Columbia	Canada
F. C. Chou (S)	National Taiwan University	Taiwan
Paul Goddard (S/PI)	Oxford University	United Kingdom
Jens Hanisch (S/PI)	Leibniz Institute for Solid State and Materials Research IFD Dresden	Germany
Kazumasa Iida (S/PI)	Nagoya University	Japan
Hiroshi Ikuta (S)	Nagoya University	Japan
Woun Kang (S/PI)	Ewha Womans University	South Korea
Jun Sung Kim (S/PI)	POSTECH	Korea
Kee Hoon Kim (S/PI)	Seoul National University	South Korea
Ruixing Liang (S)	University of British Columbia	Canada
Jorge Mira (S/PI)	University of Santiago de Compostela	Spain
Armando Paduan-Filho (S)	Universidade de Sao Paulo	Brazil
Manuel Sanchez-Anduljar (S)	Universidade de Coruna	Spain
Suchitra Sebastian (S/PI)	Cambridge University	United Kingdom

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Maria Señarís-Rodríguez (S)	Universidade de Coruna	Spain
Yayu Wang (S/PI)	Tsinghua University	China
Huiqiu Yuan (S/PI)	Zhejiang University	China

HIGH B/T FACILITY (1)

Name	Organization	Country
Guillaume Gervais (S/PI)	McGill University	Canada

NMR FACILITY (20)

Name	Organization	Country
Jean-Paul Amoureux (S/PI)	Université des Sciences et Technologies de Lille	France
Henrik Bildsoe (S)	Aarhus University	Denmark
Michael Brorson (S)	Haldor Topsoe	Denmark
Leonid Brown (S)	University of Guelph	Canada
Jean-Nicolas Dumez (S)	Centre National de la Recherche Scientifique (CNRS)	France
Lucio Frydman (S/PI)	Weizmann Institute of Science	Israel
Oc Hee Han (S/PI)	Korea Basic Science Institute	South Korea
Hans Jakobsen (S/PI)	University of Aarhus	Denmark
Svend Knak Jensen (S)	Aarhus University	Denmark
Antonios Kolocouris (S)	National and Kapodistrian University of Athens	Greece
Sunil Krishnan (S)	MD Anderson Cancer Center	USA
Vladimir Ladizhansky (S/PI)	University of Guelph	Canada
Joon-Hyung Lee (S)	Kyungpook National University	Korea
Conggang Li (S/PI)	Wuhan Institute of Physics & Mathematics, Chinese Academy of Sciences	China
Armin Nagel (S/PI)	German Cancer Research Center (DKFZ)	Germany
Tangi Roussel (S)	Weizmann Institute of Science	Israel

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Robert Schurko (S/PI)	University of Windsor	Canada
Jorgen Skibsted (S)	Aarhus University	Denmark
Gang Wu (S/PI)	Queen's University	Canada
Yong Yang (S)	Xiamen University	China

AMRIS FACILITY (14)

Name	Organization	Country
Baumer, Marcus	Bremen University	Germany
Comment, Amaud	Ecole Polytechnique Fédérale de Lausanne	Switzerland
Cornelissen J.H.	Amsterdam	Netherlands
Ghislain, M.	International Centre of Insect Physiology and Ecology (ICIPE)-African Insect Science for Food and Health	Kenya
Hansen, Brain	AARHUS University	Denmark
MacDonald, P.M.	University of Toronto	Canada
Macuka, J.H.	International Centre of Insect Physiology and Ecology (ICIPE)-African Insect Science for Food and Health	Kenya
Maniania, N.K.	International Centre of Insect Physiology and Ecology (ICIPE)-African Insect Science for Food and Health	Kenya
Mathur, Sunita	University of Toronto	Canada
Prosser, R. Scott	University of Toronto	Canada
Torto, B.	International Centre of Insect Physiology and Ecology (ICIPE)-African Insect Science for Food and Health	Kenya
Turck, Chris	Max Planck Institute of Psychiatry	Germany
Turner, Ben	Smithsonian	Panama
Uy, Mylene	Mindanao State University-Iligan Institute of Technology	Philippines

APPENDIX II – GEOGRAPHIC DISTRIBUTION

EMR FACILITY (38)

Name	Organization	Country
Gabriel Aeppli (S)	UCL	United Kingdom
Marco Affronte (S/PI)	CNR	Italy
Marius Andruh (S/PI)	University of Bucharest	Romania
Fabrice Bert (S)	Laboratoire de Physique des Solides	France
Sylvain Bertaina (S/PI)	IM2NP - CNRS	France
Euan Brechin (S/PI)	UniVersity of Edinburgh	United Kingdom
Joan Cano (S/PI)	Universita de Valencia	Spain
Isabel Castro (S)	Universitat de València	Spain
Ping-Yu Chen (S/PI)	National Chung-Hsing University	Taiwan
Enrique Colacio (S/PI)	Universidad de Granada	Spain
Toshiaki Enoki (S)	Tokyo Institute of Technology	Japan
Andrea Ferrari (S)	Cambridge University	United Kingdom
Andrew Fisher (S)	UCL	UK
Alberto Ghirri (S/PI)	CNR-Istituto Nanoscienze	Italy
Paul Goddard (S/PI)	Oxford University	United Kingdom
Sanchita Goswami (S/PI)	University of Calcutta, India	India
Sandrine Heutz (S)	ICL	United Kingdom
Malgorzata Holynska (S/PI)	Philipps University Marburg	Germany
Julia Jezierska (S/PI)	Wroclaw University	Poland
Miguel Julve (S)	Universitat de Valencia	Spain
Christopher Kay (S)	UCL	United Kingdom
Maria Korabik (S)	University of Wroclaw	Poland
Panayotis Kyritsis (S/PI)	University of Athens	Greece

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Francesc Lloret (S)	Universitat de València	Spain
Philippe Mendels (S)	Laboratoire de Physique des Solides	France
Gavin Morley (S/PI)	University of Warwick	UK
Mark Murrie (S/PI)	University of Glasgow	United Kingdom
Vladimir Osipov (S/PI)	Ioffe Physical-Technical Institute	Russia
Emilio Pardo (S)	Universitat de València	Spain
Paul Plieger (S)	Massey University/ University of New Zealand	New Zealand
Alexander Shames (S)	Ben-Gurion University of the Negev	Israel
Raj Sharma (S/PI)	Panjab University	India
Federico Spizzo (S/PI)	University of Ferrara	Italy
Kazuyuki Takai (S)	Hosei University	Japan
Changlin Tian (S/PI)	University of Science and Technology of China	China
Igor Tupitsyn (S/PI)	University of British Columbia	Canada
Zhenxing Wang (S/PI)	Huazhong University of Science and Technology	China
Andrej Zorko (S/PI)	"Jozef Stefan" Institute	Slovenia

ICR FACILITY (17)

Name	Organization	Country
Simon Andersen (S)	Schlumberger	Canada
Chris Boreham (S)	Geoscience Australia	Australia
Jochen Brocks (S)	The Australian National University	Australia
Rosana Cardoso (S/PI)	Petrobras	Brazil
Ramachandra Chakravarthy (S)	Reliance	India
Christopher Ewels (S)	Universite de Nantes	France
John Headley (S/PI)	Environment Canada	Canada

APPENDIX II – GEOGRAPHIC DISTRIBUTION

Anu Krishnan (S)	Reliance	India
Mmili MAPOLELO (S/PI)	Schlumberger Canada	Canada
Isabelle Merdrignac (S/PI)	IFP Energies nouvelles	France
Naohiko Ohkouchi (S)	Japan Agency for Marine Earth Science & Technology (JAMSTEC)	Japan
Josep Poblet (S/PI)	Universitat Rovira i Virgili	Spain
Antonio Rodriguez-Fortea (S)	Universitat Rovira i Virgili	Spain
Chandra Saravanan (S/PI)	Reliance Oil	India
Hisanori Shinohara (S)	Nagoya University	Japan
Biswajit Shown (S)	Reliance	India
Wilfried Weiss (S)	IFPEN	France

APPENDIX III
Personnel

APPENDIX III – PERSONNEL

Senior Personnel at FSU, UF & LANL (221)

Name	Position Title
100 - Management and Administration	
Cordi, Thomas	Assistant Lab Director, Business Administration
Davidson, Michael	Research Faculty I
Rea, Clyde	Assistant Director, Business & Financial / Auxiliary Services
Zhu, Lei	Assistant Professor
300 - DC Instrumentation	
Hannahs, Scott	Research Faculty III
400 - Magnet Science & Technology	
Bai, Hongyu	Research Faculty II
Bird, Mark	Research Faculty III, Director, Magnet Science & Technology
Crooks, Roy	Visiting Assistant Scholar / Scientist
Dixon, Iain	Research Faculty III
Gavrilin, Andrey	Research Faculty III
Godeke, Arno	Research Faculty II
Grondstra, Pim	Visiting Assistant Scholar / Scientist
Guo, Wei	Professor
Han, Ke	Research Faculty III
Hilton, David	Research Faculty I
Kalu, Peter	Professor
Li, Huigai	Visiting Assistant Scholar / Scientist
Li, Tianlei	Visiting Research Faculty I
Lu, Jun	Research Faculty II
Mao, PingLi	Visiting Scientist
Markiewicz, William	Research Faculty III
Marshall, William	Sr Research Associate
Morgan, Martha	Visiting Assistant Scholar / Scientist
Painter, Thomas	Sr Research Associate
Toth, Jack	Research Faculty III
Van Sciver, Steven	Professor
Walsh, Robert	Sr Research Associate
Weijers, Hubertus	Research Faculty II
Xia, Jing	Visiting Scientist

APPENDIX III – PERSONNEL

400 - Magnet Science & Technology (cont.)	
Xin, Yan	Research Faculty II
Zavion, Sheryl	Sr Research Associate (MS&T Operations Manager)
Zheng, Jianping	Professor
500 - Condensed Matter Science	
Albrecht-Schmitt, Thomas	Professor
Balicas, Luis	Research Faculty III
Baumbach, Ryan	Research Faculty I
Beekman, Christianne	Assistant Professor
Bertaina, Sylvain	Visiting Scientist/Researcher
Bonesteel, Nicholas	Professor
Cao, Jianming	Professor
Chiorescu, Irinel	Professor
Choi, Eun Sang	Research Faculty II
Coniglio, William	Research Faculty I
Dalal, Naresh	Professor
Dobrosavljevic, Vladimir	Professor
Engel, Lloyd	Research Faculty III
Fajer, Piotr	Professor
Gao, Hanwei	Assistant Professor
Gilmer, Penny	Adjunct Professor
Gor'kov, Lev	Professor
Graf, David	Research Faculty I
Hill, Stephen	Professor/EMR Director
Hoch, Michael	Visiting Scientist/Researcher
Jaroszynski, Jan	Research Faculty II
Kikugawa, Naoki	Visiting Associate Scholar / Scientist
Knappenberger, Kenneth	Assistant Professor
Kovalev, Alexey	Assistant In Research
Krzystek, Jerzy	Research Faculty III
Kuhns, Philip	Research Faculty III
Li, Zhiqiang	Research Faculty I
Liu, Tao	Associate Professor
Ma, Biwu	Associate Professor
Manousakis, Efstratios	Professor
McGill, Stephen	Research Faculty II

APPENDIX III – PERSONNEL

500 - Condensed Matter Science (cont.)	
Murphy, Timothy	Director, DC Field Facility
Oates, William	Assistant Professor
Ozarowski, Andrzej	Research Faculty II
Park, Ju-Hyun	Research Faculty II
Popovic, Dragana	Research Faculty III
Ramakrishnan, Subramanian	Associate Professor
Reiff, William	Visiting Associate Scholar / Scientist
Reyes, Arneil	Research Faculty III
Riggs, Scott	Research Faculty I
Rikvold, Per	Professor
Schlottmann, Pedro	Professor
Schneemeyer, Lynn	Visiting Associate in
Shatruk, Mykhailo	Assistant Professor
Siegrist, Theo	Professor
Smirnov, Dmitry	Research Faculty III
Song, Likai	Research Faculty I
Suslov, Alexey	Research Faculty II
Telotte, John	Associate Professor
Tozer, Stanley	Research Faculty III
Vafek, Oskar	Associate Professor
van Tol, Johan	Research Faculty III
Whalen, Jeffrey	Research Faculty I
Yang, Kun	Professor
Yu, Zhibin	Assistant Professor
Zhang, Mei	Associate Professor
Zhou, Haidong	Adjunct Assistant Scholar/Scientist
600 - LANL	
Balakirev, Fedor	Staff Member
Betts, Jonathan	Technical Staff Member
Crooker, Scott	Staff Member
Harrison, Neil	Staff Member
Hinrichs, Mark	Electrical Engineer
Hundley, Mike	CMMS Group Leader
Jaime, Marcelo	Staff Member
McDonald, Ross	Staff Member

APPENDIX III – PERSONNEL

600 – LANL (cont.)	
Mielke, Charles	Director, Pulsed Field Facility at LANL and Deputy Group Leader
Migliori, Albert	Staff Member and LANL Fellow
Nguyen, Doan	Magnet Scientist
Rickel, Dwight	Staff Member
Singleton, John	Staff Member and LANL Fellow
Zapf, Vivien	Staff Member
700 – CIMAR	
Alamo, Rufina	Professor
Arora, Rajendra	Professor
Blakney, Gregory	Research Faculty II
Brey, William	Research Faculty III
Corilo, Yuri	Research Faculty I
Cross, Timothy	Professor
Frydman, Lucio	Scholar / Scientist
Fu, Riqiang	Research Faculty III
Gaffney, Betty	Professor of Biology
Gan, Zhehong	Research Faculty III
Gor'kov, Peter	Sr Research Associate
Grant, Samuel	Associate Professor
Hallinan, Daniel	Assistant Professor
Hendrickson, Christopher	Visiting Research Faculty III
Houpt, Thomas	Professor
Hu, Yanyan	Assistant Professor
Hung, Ivan	Assistant in Research
Jakobsen, Hans	Visiting Professor
Kaiser, Nathan	Research Faculty I
Kim, Jeong-su	Assistant Professor
Litvak, Elizaveta	Visiting Faculty
Litvak, Ilya	Visiting Assistant in Research
Lobodin, Vladislav	Research Faculty I
Lu, Jie	Assistant in Research
Marshall, Alan	Professor, Chief Scientist for Ion Cyclotron Resonance (ICR) and Robert O. Lawton Distinguished Professor of Chemistry
McKenna, Amy	Research Faculty II

APPENDIX III – PERSONNEL

700 – CIMAR (cont.)	
Podgorski, David	Research Faculty I
Qin, Huajun	Associate in Research
Rodgers, Ryan	Research Faculty III, Research Faculty III
Rosenberg, Jens	Visiting Research Faculty I
Schepkin, Victor	Research Faculty II
Shekar, Srinivasan	Research Faculty I
Smith, Donald	Visiting Research Faculty I
Smith, James	Professor
Wi, Sungsool	Research Faculty II
Young, Nicolas	Research Faculty I
Zhang, Fengli	Research Faculty I
Zhou, Huan-Xiang	Associate Professor
800 - UF	
Abernathy, Cammy	Professor, Materials Science & Engineering, Dean, College of Engineering
Andraka, Bohdan	Associate Research Professor
Angerhofer, Alexander	Professor, Chemistry
Ashizawa, Tetsuo	Melvin Greer Professor and Chairman, Department of Neurology, Executive Director McKnight Brain Institute
Biswas, Amlan	Associate Professor of Physics
Blackband, Stephen	Professor, Neuroscience
Bowers, Clifford	Associate Professor, Chemistry
Brey, Wallace	Professor Emeritus, Chemistry
Butcher, Rebecca	Assistant Professor
Cheng, Hai Ping	Professor of Physics
Christou, George	Drago Professor
Douglas, Elliot	Associate Professor, Materials Science & Engineering
Edison, Arthur	Professor, Biochemistry & Molecular Biology, Director of the Southeast Center for Integrated Metabolomics at UF
Eyler, John	Professor Emeritus, Chemistry
Fanucci, Gail	Associate Professor
Febo, Marcelo	Assistant Professor
Fitzsimmons, Jeffrey	Professor, Radiology
Forder, John	Associate Professor of Radiology
Hagen, Stephen	Professor

APPENDIX III – PERSONNEL

800 – UF (cont.)	
Hamlin, James	Assistant Professor
Hebard, Arthur	Distinguished Professor of Physics
Hershfield, Selman	Professor
Hirschfeld, Peter	Professor
Ingersent, Kevin	Chair of UF Physics Department & Professor, Chair, UF Physics Dept.
Kumar, Pradeep	Professor
Labbe, Greg	Senior Engineer, Cryogenics Facility
Lai, Song	Associate Professor, Director, CTSI Human Imaging Core McKnight Brain Institute
Lee, Yoonseok	Professor
Long, Joanna	Associate Professor, NHMFL Director of AMRIS
Luesch, Hendrik	Associate Professor
Mareci, Thomas	Professor
Maslov, Dmitrii	Professor
Masuhara, Naoto	Senior Engineer, Microkelvin Laboratory
Meisel, Mark	Professor
Murray, Leslie	Assistant Professor
Muttalib, Khandker	Professor
Pearton, Stephen	Distinguished Professor, Alumni Professor of Materials Science & Engineering
Polfer, Nicolas	Assistant Professor
Rinzler, Andrew	Professor
Stanton, Christopher	Professor
Stewart, Gregory	Professor
Sullivan, Neil	Professor, Director of High B/T Facility
Takano, Yasumasa	Professor
Talham, Daniel	Professor
Tanner, David	Distinguished Professor of Physics
Vaillancourt, David	Associate Professor
Vandenborne, Krista	Professor
Vasenkov, Sergey	Associate Professor
Walter, Glenn	Associate Professor
Xia, Jian-Sheng	Associate Scientist
Zeng, Huadong	Specialist, Animal MRI/S Applications

APPENDIX III – PERSONNEL

1100 - ASC	
Abraimov, Dmytro	Research Faculty II
Griffin, Van	Associate In Research
Hellstrom, Eric	Professor
Jiang, Jianyi	Research Faculty II
Kametani, Fumitake	Research Faculty I
Kim, Youngjae	Research Faculty 1
Larbalestier, David	Chief Materials Scientist, Director, Applied Superconductivity Center
Lee, Peter	Research Faculty III
Pamidi, Sastry	Assistant Scholar / Scientist
Polyanskii, Anatolii	Research Faculty II
Starch, William	Associate in Research
Sung, Zu Hawn	Visiting Research Faculty I
Tarantini, Chiara	Research Faculty I
Trociewitz, Ulf	Research Faculty II
1200 - Director's Office	
Boebinger, Gregory	Director/Professor, Professor of Physics
Hughes, Roxanne	Assistant Scholar/Scientist, Director, Center for Integrating Research and Learning
Palm, Eric	Deputy Lab Director
Roberts, Kristin	Director of Public Affairs
1300 - Geochemistry	
Chanton, Jeff	Professor
Cooper, William	Professor
Froelich, Philip	Scholar / Scientist
Humayun, Munir	Professor
Landing, William	Professor
Morton, Peter	Visiting Assistant in
Odom, Leroy	Professor
Salters, Vincent	Professor, Director, Geochemistry
Spencer, Robert	Assistant Professor
Wang, Yang	Professor

APPENDIX III – PERSONNEL

Postdoctoral Associates at FSU, UF & LANL (52)

Name	Position Title
400 - Magnet Science & Technology	
Niu, Rongmei	Postdoctoral Associate
500 - Condensed Matter Science	
Besara, Tiglet	Postdoctoral Associate
Bishop, Michael	Postdoctoral Associate
Breshike, Christopher	Postdoctoral Associate
Chen, Zhiguo	Postdoctoral Associate
Dubroca, Thierry	Postdoctoral Associate
Grockowiak, Audrey	Postdoctoral Associate
Hatke, Anthony	Postdoctoral Associate
Lai, Hsin-Hua	Postdoctoral Associate
Louis, Golda	Postdoctoral Associate
Maiti, Saurabh	Postdoctoral Associate
Murray, James	Postdoctoral Associate
Park, Jin Gyu	Postdoctoral Associate
Pradhan, Nihar	Postdoctoral Associate
Pramudya, Yohanes	Postdoctoral Associate
Saraswat, Garima	Postdoctoral Associate
Shi, Zhenzhong	Postdoctoral Associate
Steven, Eden	Postdoctoral Associate
Stoian, Sebastian	Postdoctoral Associate
Thirunavukkuarasu, Komalavalli	Postdoctoral Associate
Wang, Shengyu	Postdoctoral Associate
Wildeboer, Julia	Postdoctoral Associate
Zeng, Bin	Postdoctoral Associate
600 - LANL	
Beedle, Christopher	Postdoctoral Research Associate
Chikara, Shalinee	Postdoc Research Associate
Ramshaw, Brad	Postdoctoral Research Associate
Rice, Bill	Postdoctoral Research Associate
Stier, Andreas	Postdoc Research Associate
Yang, Luyi	Postdoctoral Associate

APPENDIX III – PERSONNEL

700 – CIMAR	
Brownstein, Naomi	Postdoctoral Associate
Chen, Huan	Postdoctoral Associate
Dai, Jian	Postdoctoral Associate
Dunk, Paul	Postdoctoral Associate
Guan, Xiaoyan	Postdoctoral Associate
Guo, Cong	Postdoctoral Associate
He, Huan	Postdoctoral Associate
Hooker, Jerris	Postdoctoral Associate
Jarvis, Jacqueline	Postdoctoral Associate
Kweon, Jin Jung	Postdoctoral Associate
Lalli, Priscila	Postdoctoral Associate
Mooney, Victoria	Postdoctoral Associate
Tang, Tzu-chun	Postdoctoral Associate
800 - UF	
Serafin, Alessandro	Postdoctoral Associate
1100 - ASC	
Bosque, Ernesto	Postdoctoral Research Associate
Constantinescu, Anca-Monia	Postdoctoral Associate
Kandel, Hom	Postdoctoral Associate
Zhang, Zili	Postdoctoral Associate
1200 - Director's Office	
Kemper, Jonathon	Postdoctoral Associate
1300 - Geochemistry	
Mayer, Bernhard	Postdoctoral Associate
Perrot, Vincent	Postdoctoral Associate
Waeselmann, Naemi	Postdoctoral Associate
Wyatt, Neil	Postdoctoral Associate

APPENDIX III – PERSONNEL

Other Professionals at FSU, UF & LANL (83)

Name	Position Title
100 - Management and Administration	
Brooks, Richard	Facilities Superintendent
Clark, Eric	Application Developer/Designer
Greenlee, Reshaye	Accounting Specialist
Kynoch, John	Assistant Director
McCrory, Marcia	Budget Analyst
McEachern, Judy	Assistant Director, Business Systems
Mook, Bradley	Budget Analyst
Payne, Jimmy	Scientific Research Specialist
Wood, Marshall	Facilities Electrical Supervisor
300 - DC Instrumentation	
Barrios, Matthew	Research Engineer
Berhalter, James	Technology Specialist
Billings, Jonathan	Scientific Research Specialist
Boenig, Heinrich	Engineer
Brooks, Erica	Technology Specialist
Dalton, Bryon	Scientific Research Specialist
Jensen, Peter	Network Administrator
Jones, Glover	Scientific Research Specialist
Maier, Scott	Scientific Research Specialist
Powell, James	Research Engineer
Rubes, Edward	Scientific Research Specialist
Schwartz, Robert	Scientific Research Specialist
Schwerin, John	Technology Specialist
Semenov, Dmitry	Scientific Research Specialist
Stiers, Eric	Research Engineer
Williams, Vaughan	Research Engineer
400 - Magnet Science & Technology	
Adkins, Todd	Research Engineer
Bole, Scott	Research Engineer
Cantrell, Kurtis	Research Engineer
Cherisol, Daphnee	Accounting Specialist
Goddard, Robert	Scientific Research Specialist

APPENDIX III – PERSONNEL

400 - Magnet Science & Technology (cont.)	
Gundlach, Scott	Research Engineer
Jarvis, Brent	Research Engineer
Johnson, Zachary	Research Engineer
Lucia, Joseph	Technical/Research Designer
Marks, Emsley	Research Engineer
McRae, Dustin	Research Engineer
Mellow, Amy	Administrative Specialist
Miller, George	Research Engineer
Noyes, Patrick	Associate in Research
O'Reilly, James	Research Engineer
Richardson, Donald	Research Engineer
Sheppard, William	Research Engineer
Stanton, Robert	Research Engineer
Su, Yi-Feng	Research Specialist
Toplosky, Vince	Scientific Research Specialist
Viouchkov, Youri	Research Engineer
Voran, Adam	Research Engineer
White, James	Research Engineer
500 - Condensed Matter Science	
Javed, Arshad	Grants Compliance Analyst
Luallen, Renee	Program Coordinator
Shehter, Arkady	Visiting Research Faculty I
Trociewitz, Bianca	Research Engineer
Wood, Ryan	Visiting Scientist/Researcher
700 - CIMAR	
Beu, Steven	Visiting Scientist/Researcher
Bickett, Karol	Administrative Specialist
Hodges, Kurt	Coordinator, Animal Welfare Compliance
Kitchen, Jason	NMR Engineer
McIntosh, Daniel	Scientific Research Specialist
Quinn, John	Research Engineer
Ranner, Steven	Research Engineer
Schiano, Jeffrey	Visiting Scientist/Researcher
800 - UF	
Elumalai, Malathy	RF Engineer

APPENDIX III – PERSONNEL

800 – UF (cont.)	
Jenkins, Kelly	RF Coil Engineer
Nicholson, Tammy	Certified Radiology Technology Mgr. (3T Imaging Applications)
Plant, Daniel	Coordinator
Rocca, James	Senior Chemist & NMR Applications Specialist
1100 - ASC	
Linville, Connie	Administrative Specialist
1200 - Director's Office	
Coyne, Kristen	Media Specialist
Laufenberg, Kathleen	Media Specialist
McNiel, Caroline	Media Specialist
Orth, William	Asst Dir, Environmental, Safety, Health & Security Services
Richerson, Lezlee	Administrative Specialist
Roberson, Bettina	Assistant Director, Administrative Services
Roberts, Kari	Program Coordinator
Rodman, Christopher	Industrial Safety & Health Eng.
Sanchez, Jose	Program Coordinator
Tabtimtong, Nilubon	Media Specialist
Toth, Anke	Program Coordinator
Villa, Carlos	Training Specialist
Wackes, Christina	Administrative Specialist
1300 - Geochemistry	
Barnett, Bruce	Research Assistant
Sachi-Kocher, Afi	Scientific Research Specialist
White, Gary	Scientific Research Specialist

APPENDIX III – PERSONNEL

Graduate Students at FSU, UF & LANL (166)

Name	Position Title
400 - Magnet Science & Technology	
Brown, Daniel	Graduate Research Assistant
Dhuley, Ram	Graduate Research Assistant
Gao, Jian	Graduate Research Assistant
Gordon, Renee	Research Assistant
Mastracci, Brian	Graduate Research Assistant
Scott, Valesha	Graduate Research Assistant
Vanderlaan, Mark	Graduate Research Assistant
Wray, Andrew	Graduate Research Assistant
Zhao, Congcong	Research Assistant
500 - Condensed Matter Science	
Akinfaderin, Adewale Abiodun	Graduate Research Assistant
Amouzandeh, Ghoncheh	Graduate Research Assistant
Bade, Sri Ganesh Rohit	Graduate Research Assistant
Bahadur, Divya	Graduate Research Assistant
Baity, Paul	Graduate Research Assistant
Barrett, Ryan	Graduate Research Assistant
Barry, Kevin	Graduate Research Assistant
Benjamin, Shermane	Graduate Research Assistant
Bindra, Jasleen Kaur	Graduate Research Assistant
Chakraborty, Shantanu	Graduate Research Assistant
Chen, Kuan-Wen	Graduate Research Assistant
Christian, Jonathan	Graduate Research Assistant
Coulter, John	Graduate Research Assistant
Das, Suvadip	Graduate Research Assistant
Dong, Lianyang	Graduate Research Assistant
Ellanson, Garrett	Graduate Research Assistant
Feng, Weibo	Graduate Research Assistant
Gallagher, Andrew	Graduate Research Assistant
Ghosh, Soham	Graduate Research Assistant
Gorfien, Matthew	Graduate Research Assistant
Greer, Samuel	Graduate Research Assistant
Hayati, Zahra	Graduate Research Assistant

APPENDIX III – PERSONNEL

500 - Condensed Matter Science (cont.)	
Javan Mard, Hossein	Graduate Research Assistant
Jiang, Yuxuan	Research Assistant
Kinyon, Jared	Graduate Research Assistant
Kiswandhi, Andhika	Graduate Research Assistant
Komijani, Dorsa	Graduate Research Assistant
Kreth, Phillip	Graduate Research Assistant
Lai, You	Graduate Research Assistant
Lakshmi Bhaskaran, FNU	Graduate Research Assistant
Lan, Wangwei	Graduate Research Assistant
Lee, Minseong	Graduate Research Assistant
Lee, Tsung-Han	Graduate Research Assistant
Li, Dong	Graduate Research Assistant
Liou, Shiuan-Fan	Graduate Research Assistant
Liu, Teng	Graduate Research Assistant
Liu, Tianhan	Graduate Research Assistant
Lu, Zhengguang	Graduate Research Assistant
Ludwig, Jonathan	Graduate Research Assistant
Mahmoudian, Samiyeh	Graduate Research Assistant
Marbey, Jonathan	Graduate Research Assistant
Martens, Mathew	Graduate Research Assistant
Memaran, Shahriar	Graduate Research Assistant
Mendez, Joshua	Graduate Research Assistant
Moench, Michael	Research Assistant
Muhammed, Faheem	Graduate Research Assistant
Nelson, william	Graduate Research Assistant
Pavanjeet Kaur, FNU	Graduate Research Assistant
Pouranvari, Mohammad	Graduate Research Assistant
Rahmani, Hamidreza	Graduate Research Assistant
Ramirez, Daniel	Graduate Research Assistant
Rhodes, Daniel	Graduate Research Assistant
Riner, Lauren	Research Assistant
Shiddiq, Muhandis	Graduate Research Assistant
Siddique, Sabrina	Graduate Research Assistant
Siegrist, David	Research Assistant
Smith, Adam	Visiting Scientist/Researcher

APPENDIX III – PERSONNEL

500 - Condensed Matter Science (cont.)	
Stanley, Lily	Graduate Research Assistant
Stritzinger, Jared	Research Assistant
Suarez, Daniel	Graduate Research Assistant
Sun, Jifeng	Graduate Research Assistant
Tada, Ryota	Graduate Research Assistant
Tang, Shao	Graduate Research Assistant
Tran Hoang, Phong	Graduate Research Assistant
Vakil, Parth	Research Assistant
Wang, Ying	Graduate Research Assistant
Wilson, Douglas	Graduate Research Assistant
Winter, Laurel	Graduate Research Assistant
Yuan, Shaojie	Graduate Research Assistant
Yue, Guang	Graduate Research Assistant
Zabalo, Aidan	Graduate Research Assistant
Zeuch, Daniel	Graduate Research Assistant
Zhang, Biwen	Graduate Research Assistant
Zhang, Qiu	Graduate Research Assistant
Zhang, Yuhui	Graduate Research Assistant
Zhou, Jun	Graduate Research Assistant
Zhou, Qiong	Graduate Research Assistant
600 - LANL	
Martinez, Nicholas	Graduate Research Assistant
Modic, Kimberly	Graduate Student
700 - CIMAR	
Abad, Nastaren	Graduate Research Assistant
Beasley, Rebecca	Graduate Research Assistant
Bradshaw, Miles	Graduate Research Assistant
Chen, Tong	Graduate Research Assistant
Chen, Xuejian	Graduate Research Assistant
Chien, Po-Hsiu	Graduate Research Assistant
Clingenpeel, Amy	Graduate Research Assistant
Dang, Xibei	Graduate Research Assistant
Das, Nabanita	Research Assistant
Ekanayake, E	Research Assistant
Escobar Bravo, Cristian	Graduate Research Assistant

APPENDIX III – PERSONNEL

700 – CIMAR (cont.)	
Evans, Kimberly	Graduate Research Assistant
Gao, Yuan	Graduate Research Assistant
Huang, Danting	Graduate Research Assistant
Hudson, Benjamin	Graduate Research Assistant
Jiang, Tingting	Graduate Research Assistant
Kavuluri, Nandita Bhanu	Graduate Research Assistant
Krajewski, Logan	Graduate Research Assistant
Li, Xiang	Graduate Research Assistant
Liu, Peilu	Graduate Research Assistant
Miao, Yimin	Graduate Research Assistant
Morris, David	Graduate Research Assistant
Morris, Deborah	Graduate Research Assistant
Muniz, Jose	Graduate Research Assistant
Murray, Dylan	Graduate Research Assistant
Ogden, Sarah	Graduate Research Assistant
Oparaji, Onyekachi	Graduate Research Assistant
Ould Ismail, Abdol Aziz	Graduate Research Assistant
Paulino, Joana	Graduate Research Assistant
Ramaswamy, Vijaykumar	Graduate Research Assistant
Rose, Alyssa	Graduate Research Assistant
Rowland, Steven	Graduate Research Assistant
Sahanggamu, Paula	Graduate Research Assistant
Shellikeri, Annadanesh	Graduate Research Assistant
Shin, Yiseul	Graduate Research Assistant
Shomo, Alan	Graduate Research Assistant
Tao, Yeqing	Graduate Research Assistant
Viravanallur Venkataraman, Avinash Poornan	Graduate Research Assistant
Wright, Anna	Graduate Research Assistant
Yang, Guang	Graduate Research Assistant
1100 - ASC	
Brown, Michael	Graduate Research Assistant
Chen, Peng	Graduate Research Assistant
Chetri, Santosh	Graduate Research Assistant
Collantes, Yesusa	Graduate Research Assistant
Collins, Justin	Graduate Research Assistant

APPENDIX III – PERSONNEL

1100 – ASC (cont.)	
Davis, Daniel	Graduate Research Assistant
Hu, Xinbo	Graduate Research Assistant
Matras, Maxime	Graduate Research Assistant
Oz, Yavuz	Graduate Research Assistant
Pan, Yanjun	Graduate Student
Sanabria, Carlos	Graduate Research Assistant
Segal, Christopher	Graduate Research Assistant
Weiss, Jeremy	Graduate Research Assistant
1200 - Director's Office	
Bremer, Martin	Graduate Research Assistant
Moir, Camilla	Graduate Research Assistant
Stegen, Zachary	Graduate Research Assistant
Wartenbe, Mark	Graduate Research Assistant
1300 - Geochemistry	
Aljahdali, Mohammed	Graduate Research Assistant
Bosman, Samantha	Graduate Research Assistant
Bowman, Chelsie	Research Assistant
Dial, Angela	Graduate Research Assistant
Ebling, Alina	Graduate Research Assistant
Eller, Virginia	Research Assistant
Harper, Alexandra	Graduate Research Assistant
Henrick, Stevie	Research Assistant
Hodgkins, Suzanne	Graduate Research Assistant
Imhoff, Johanna	Graduate Research Assistant
Krishnamurthy, Nishanth	Graduate Research Assistant
Landing, Alexandra	Laboratory Assistant / Technician
Liu, Rui	Graduate Research Assistant
Mauney, Michael	Graduate Research Assistant
Mickle, Alejandra	Graduate Research Assistant
Olsen, Lauren	Research Assistant
Rogers, Kelsey	Graduate Research Assistant
Roy, Rupsa	Graduate Research Assistant
Stacklyn, Shannon	Graduate Research Assistant
Tremaine, Darrel	Graduate Research Assistant
Yang, Shuying	Graduate Research Assistant

APPENDIX III – PERSONNEL

Undergraduate Students at FSU, UF & LANL (74)

Name	Position Title
100 - Management and Administration	
Kujawa, Karoline	Programmer
400 - Magnet Science & Technology	
Arroyo, Erick	Technician
Etienne, Ernest	Undergraduate Research Assistant
Joyner, Rachel	Research Assistant
Kiefer, Michael	Technician
Levin, Talya	Undergraduate Research Assistant
Rodriguez, Julian	Laboratory Assistant
500 - Condensed Matter Science	
Bernier, Jacob	Research Assistant
Brown, Jhanielle	Research Assistant
Burke, Jamie	Laboratory Assistant / Technician
Catt, Sarah	Research Assistant
Cherrier-Vickers, Samuel	Research Assistant
Chown, Amanda	Research Assistant
Chu, Winston	Research Assistant
Colbert, Ashlee	Research Assistant
deTorres, Fernando	Laboratory Assistant / Technician
Ellis, Andrew	Research Assistant
Estry, Emily	Laboratory Assistant / Technician
Ferrari, Anthony	Research Assistant
Fryer II, Algene	Research Assistant
Gonzalez, Jorge	Laboratory Assistant / Technician
Gordon, Andrew	Research Assistant
Gutalj, Stanko	Research Assistant
Holt, Hannah	Research Assistant
Jarrett, Jeremy	Laboratory Assistant / Technician
Jeter, Emily	Research Assistant
Johansen, Cody	Research Assistant
Johnson, Hayden	Research Assistant
Krehl, Jessey	Laboratory Assistant / Technician

APPENDIX III – PERSONNEL

500 - Condensed Matter Science (cont.)	
Lipscomb, Crystal	Research Assistant
Luscuskie, Lauren	Research Assistant
Murray, Andy	Research Assistant
Pamic, Damir	Research Assistant
Pawlak, Kelly	Research Assistant
Rodenbach, Linsey	Laboratory Assistant / Technician
Saff, David	Research Assistant
Sanchez, Lorena	Research Assistant
Smith, Brandon	Research Assistant
Swanson, Samuel	Research Assistant
Thomas, Danica	Research Assistant
Trujillo Jr, Francisco	Research Assistant
Velasquez, Ever	Research Assistant
Wagler, Sarah	Laboratory Assistant / Technician
Washington, Herbert	Research Assistant
Woods, Michael	Laboratory Assistant / Technician
Yannakopoulos, Anna	Laboratory Assistant / Technician
600 - LANL	
Schneider, Kim	Undergraduate Student
700 - CIMAR	
Bartges, Tessa	Undergraduate Research Assistant
Brooks, Gabrielle	Undergraduate Research Assistant
Chrzanowski, Grace	Research Assistant
Davenport, Nicholas	Undergraduate Research Assistant
Franklin, Robert	Undergraduate Research Assistant
Griffith, Lauren	Undergraduate Research Assistant
Jones, Natalie	Graduate Research Assistant
Rausch, Alexander	Research Assistant
Schevers, Justin	Undergraduate Research Assistant
1100 - ASC	
Boebinger, Matthew	Laboratory Assistant-Level 2
Chew, Brandon	Laboratory Assistant - Level 3
Dickey, Jermaine	Laboratory Assistant Level 2
Flagler, Erin	Laboratory Assistant- Level 2
Freeman, Stephen	Laboratory Assistant-Level 1

APPENDIX III – PERSONNEL

1100 – ASC (cont.)	
McCallister, Jeremiah	Laboratory Assistant-Level 2
Mcneely, Justin	Laboratory Assistant - Level 2
Miller, Steven	Laboratory Assistant-Level 1
Nwodu, Arriana	Laboratory Assistant- Level 2
Richardson, Ross	Laboratory Assistant-Level 1
Velasquez, Julian	Laboratory Assistant - Level 2
1300 - Geochemistry	
Giambalvo, Janine	Undergraduate Laboratory Assistant
Leverone, Randy	Undergraduate Research Assistant
McColaugh, Stephanie	Undergraduate Research Assistant
Oulton, Jonathan	Undergraduate Research Assistant
Sutton, John	Undergraduate Research Assistant
Weisend, Rachel	Undergraduate Research Assistant
Westberry, Shelby	Undergraduate Research Assistant

APPENDIX III – PERSONNEL

Facility Participants & Staff in Diversity Classification

Parameter / Category	Senior Personnel	Postdoc	Other Professional	Graduate Student	Undergraduate Student	Support Staff - Technical/ Managerial	Support Staff - Secretarial/ Clerical	Total	%
Gender									
Male	194	33	60	106	42	78	12	**525**	**72.3%**
Female	27	19	23	60	32	11	29	**201**	**27.7%**
Race									
White	163	26	74	80	64	78	30	**515**	**70.9%**
Male	144	19	56	53	37	68	7	**384**	**52.9%**
Female	19	7	18	27	27	10	23	**131**	**18.0%**
Black or African	1	1	5	9	8	10	4	**38**	**5.2%**
Male	1	1	2	5	4	9	0	**22**	**3.0%**
Female	0	0	3	4	4	1	4	**16**	**2.2%**
Native Hawaiian or	0	0	0	0	1	0	0	**1**	**0.1%**
Male	0	0	0	0	1	0	0	**1**	**0.1%**
Female	0	0	0	0	0	0	0	**0**	**0.0%**
Asian	57	24	4	77	0	0	5	**167**	**23.0%**
Male	49	13	2	48	0	0	4	**116**	**16.0%**
Female	8	11	2	29	0	0	1	**51**	**7.0%**
American Indian or Alaska Native	0	1	0	0	1	1	2	**5**	**0.7%**
Male	0	0	0	0	0	1	1	**2**	**0.3%**
Female	0	1	0	0	1	0	1	**3**	**0.4%**
Ethnicity									
Hispanic or Latino	4	1	2	10	6	9	3	**35**	**4.8%**
Male	3	1	2	7	5	9	0	**27**	**3.7%**
Female	1	0	0	3	1	0	3	**8**	**1.1%**
Not Hispanic or Latino	217	51	81	156	68	80	38	**691**	**95.2%**
Male	191	32	58	99	37	69	12	**498**	**68.6%**
Female	26	19	23	57	31	11	26	**193**	**26.6%**
Total:	**221**	**52**	**83**	**166**	**74**	**89**	**41**	**726**	**100.0%**
%	**30.4%**	**7.2%**	**11.4%**	**22.9%**	**10.2%**	**12.3%**	**5.6%**	**100.0%**	

APPENDIX IV
Postdoctoral Mentoring Plan

APPENDIX IV – POSTDOCTORAL MENTORING PLAN

NATIONAL HIGH MAGNETIC FIELD LABORATORY POSTDOCTORAL MENTORING PLAN

The goal of the Postdoctoral Mentoring Plan at the National High Magnetic Field Laboratory (NHMFL) is to provide NHMFL postdoctoral associates with a complete skill set that addresses the modern challenges of a career in science, technology, engineering and mathematics (STEM). A key component of the plan is full immersion in the interdisciplinary culture of the NHMFL and in the surrounding communities of one of the NHMFL's three partner institutions - the Florida State University (FSU), the University of Florida (UF), and Los Alamos National Laboratory (LANL). The Center for Integrating Research and Learning (CIRL) housed within the NHMFL will facilitate this Postdoctoral Mentoring Plan.

Currently, NHMFL postdoctoral researchers are required by their supervisors and research groups to participate in the preparation of publications, and to make presentations at group meetings and conferences. Postdoctoral researchers are also required to play active roles in STEM-strengthening programs, such as the NHMFL Diversity Action Plan, the Research Experiences for Undergraduates program, the Research Experiences for Teachers program, and other CIRL outreach programs, through which they can provide significant STEM mentorship to students, early career scientists and the teachers of the next generation of scientists. Finally, NHMFL postdoctoral associates are required to provide service to the laboratory through participation in the NHMFL Annual Open House or other events designed specifically to translate and communicate research in the NHMFL user community to members of the general public.

The key components of the Postdoctoral Mentoring Plan are:

- **Orientation.** Each new postdoctoral associate will meet with the NHMFL Human Resources Director who can address questions they may have related to their new position.
Orientation materials, including a "Welcome to the MagLab" document are available online to augment face-to-face orientation and best accommodate the different individual start dates of NHMFL postdoctoral associates. Orientation includes an overview of the three sites of the NHMFL, the breadth of scientific research in the NHMFL user program, particularly interdisciplinary research, and practical institutional information (including but not limited to performance expectations, salary information, the ordering and delivery of materials, as well as information about local housing, schools, health care resources, and links to special interest groups at the local partner institution).

- **Professional Development.** Professional development classes, workshops, and online materials will cover grant writing, ethical conduct of research, organizing data, writing manuscripts, giving effective scientific presentations, mentoring other scientists and communicating scientific research to non-scientists. Workshops will be facilitated by CIRL and involve faculty from the NHMFL, the FSU Career Center and librarians from the FSU Dirac Science and Engineering.

- **Career Counseling.** Sometimes postdoctoral associates may have career questions that their assigned mentor cannot speak to (e.g. careers in industry, networking opportunities for underrepresented minority students). Therefore, the NHMFL Postdoctoral Mentoring Plan includes a list of additional volunteer mentors who are willing to answer questions that postdoctoral associates may have. Postdoctoral associates may choose to contact volunteers from this list if they feel they need additional advice not exclusively from their direct supervisor. Possible forms of advice include: providing guidance, encouragement, and information on opportunities for networking, contributed and invited talks, and travel funds to attend conferences, including the NHMFL's Dependent Care Travel Grant Program [https://nationalmaglab.org/user-resources/funding-opportunities].

- **Assessment.** Assessment will be conducted by the Center for Integrating Research & Learning through annual evaluation surveys to determine topics of interest to postdoctoral researchers and to ensure that postdoctoral researchers' mentoring needs are being met.

APPENDIX V
Budget

APPENDIX V – BUDGET

STATEMENT OF EXPENSES AND ENCUMBRANCES
January 2013 thru December 2014

		CUMULATIVE	As of 12/31/14	
		2013-2014 EXPENSED	ENCUMBERED	TOTAL COSTS 2013-2014
TOTAL SALARIES, WAGES AND FRINGE BENEFITS		16,870,599	3,013,213	**19,883,812**
TOTAL EQUIPMENT		1,457,471	1,701,492	**3,158,963**
TRAVEL	1. DOMESTIC	435,064	8,743	**443,807**
	2. FOREIGN	113,149	19,324	**132,473**
PARTICIPANT SUPPORT				
	1. STIPENDS	241,826	-	
	2. TRAVEL	100,943	-	
	3. SUBSISTENCE	38,310	-	
	4. OTHER	-	-	
TOTAL PARTICIPANT COSTS		381,079	-	**381,079**
OTHER DIRECT COSTS				
1. MATERIALS AND SUPPLIES		4,326,680	798,998	**5,125,678**
2. PUBLICATION/DOCUMENTATION/DISSEMINATION		-	-	**-**
3. CONSULTANT SERVICES		-	-	**-**
4. COMPUTER SERVICES		-	-	**-**
5. SUBAWARDS		16,698,887	628,184	**17,327,071**
6. OTHER		3,651,803	-	**3,651,803**
TOTAL OTHER DIRECT COSTS		24,677,371	1,427,182	**26,104,552**
TOTAL DIRECT COSTS (A THROUGH G)		43,934,733	6,169,954	**50,104,687**
INDIRECT COSTS (F&A)	Base	21,820,493	3,840,278	25,660,771
	Rate: %	52%	52%	52%
TOTAL INDIRECT COSTS (F&A)		11,344,524	1,996,945	**13,341,469**
TOTAL DIRECT AND INDIRECT COSTS		**55,279,257**	**8,166,899**	**63,446,156**

APPENDIX V – BUDGET

	2014	As of 12/31/14			2013
	EXPENSED	ENCUM-BERED	TOTAL COSTS for 2014		2013 EXPENSED
TOTAL SALARIES, WAGES AND FRINGE BENEFITS	9,503,976	3,013,213	**12,517,189**		7,366,623
TOTAL EQUIPMENT	1,268,563	1,701,492	**2,970,056**		188,907
TRAVEL 1. DOMESTIC	247,483	8,743	**256,226**		187,581
2. FOREIGN	72,004	19,324	**91,328**		41,145
PARTICIPANT SUPPORT					
1. STIPENDS	140,400				101,426
2. TRAVEL	92,222				8,721
3. SUBSISTENCE	25,926				12,384
4. OTHER	-				-
TOTAL PARTICIPANT COSTS	258,548	-	**258,548**		122,531
OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES	2,510,777	798,998	**3,309,775**		1,815,903
2. PUBLICATION/DOCUMENTATION/DISSEMINATION	-		**-**		-
3. CONSULTANT SERVICES	-		**-**		-
4. COMPUTER SERVICES	-		**-**		-
5. SUBAWARDS	9,108,934	628,184	**9,737,118**		7,589,953
6. OTHER	2,877,436	-	**2,877,436**		774,367
TOTAL OTHER DIRECT COSTS	14,497,148	1,427,182	**15,924,329**		10,180,223
TOTAL DIRECT COSTS (A THROUGH G)	25,847,722	6,169,954	**32,017,676**		18,087,011
INDIRECT COSTS (F&A) Base	12,334,241	3,840,278	16,174,519		9,486,253
Rate: %	52%	52%	52%		52%
TOTAL INDIRECT COSTS (F&A)	6,415,312	1,996,945	**8,412,257**		4,929,211
TOTAL DIRECT AND INDIRECT COSTS	**32,263,034**	**8,166,899**	**40,429,934**		**23,016,222**

APPENDIX V – BUDGET

STATEMENT OF RESIDUAL FUNDS – FY 2014

32,630,000	NSF Budget Allocation for FY 2014
(40,345,934)	Expensed and encumbered
Reconciliations	
4,580,084	Personnel and indirect funds encumbered on Dec 31, 2014 for personnel costs from Jan 1, 2015 – April 30, 2015. Costs were encumbered in 2014 but budgeted and paid with FY 2015 funds.
Obligations	
(576,046)	UCGP grants obligated to PI's to be expensed over the next year
Residual Funds	
(3,711,896)	

Accounting standards dictate that all encumbered funds be reported at FY end.

Advanced funding for FY 2015 was received in September 2014. These funds were encumbered in FY 2014 for personnel cost and the related indirect cost for the period of January 1, 2015 through April 30, 2015.

The negative residual funds balance is a result of unencumbered purchase obligations reported in FY 2013 being finalized and expensed in FY 2014.

Rebudgeting to increase Indirect Cost Rate to 70% did not occur until FY 2015.

2014

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