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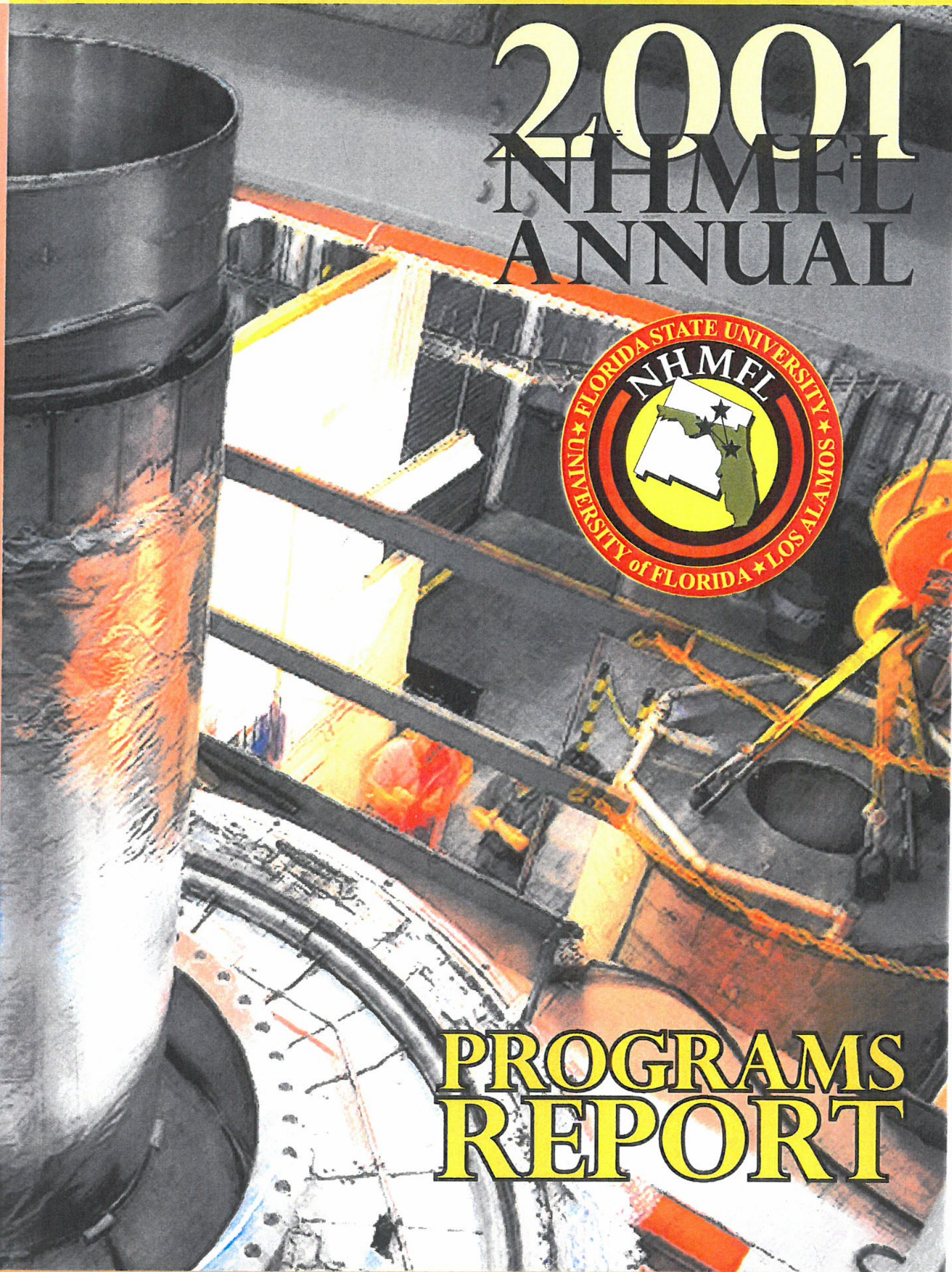
2001 NHMFL ANNUAL

FLORIDA STATE UNIVERSITY ★ NHMFL ★ UNIVERSITY of FLORIDA ★ LOS ALAMOS

PROGRAMS REPORT



2001 Annual Programs Report

of the

National High Magnetic Field Laboratory

1. Introduction

When frontier technologies and science merge, researchers and users produce exciting and new discoveries, and key scientific productivity measures suggest that the National High Magnetic Field Laboratory experienced an exceptional year in 2001. The number of research reports submitted by users increased by almost 10 percent, with strong increases in several areas of condensed matter physics. These reports are published in a separate document, the *2001 NHMFL Annual Research Review*, because of the volume.

NHMFL Research Reports	2000	2001
Biology	47	49
Chemistry	27	31
Cryogenics	5	5
Engineering Materials	6	5
Geochemistry	13	10
Instrumentation	16	10
Kondo/Heavy Fermion Systems	19	21
Magnet Technology	6	7
Magnetic Resonance Techniques	19	24
Magnetism and Magnetic Materials	36	45
Molecular Conductors	19	24
Other Condensed Matter	10	13
Quantum Solids	3	6
Semiconductors	27	32
Superconductivity - Applied	16	11
Superconductivity - Basic	26	29
Total	**295**	**322**

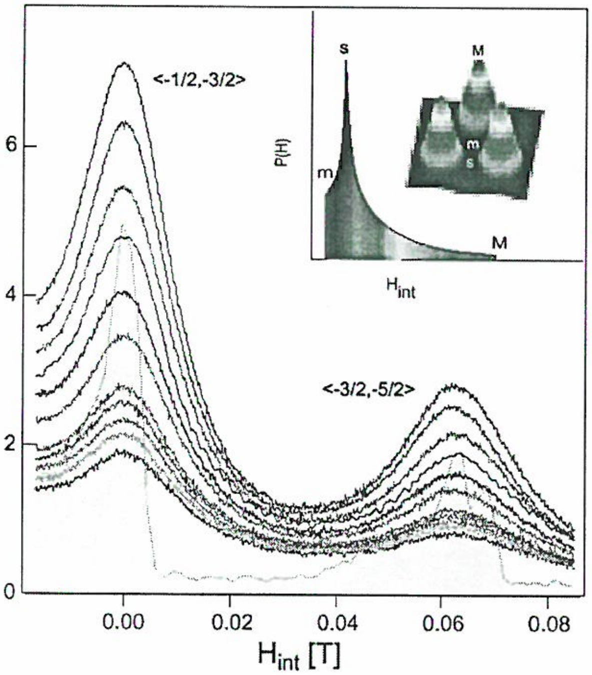
In addition, the number of publications increased by 21 percent (from 276 articles to 334), including 24 articles in *Physical Review Letters*, 5 in *Analytical Chemistry*, 4 in the *Journal of the American Chemical Society*, 2 in *Nature*, and 15 in other significant journals.

The laboratory is also particularly pleased to report that 22 graduate students affiliated with the NHMFL either directly or through our multi-disciplinary Users Program earned Ph.D.s in 2001. This number—anywhere from 20 to 25—has been fairly steady for a few years now and demonstrates the effectiveness of the laboratory's efforts in educating the next generation of scientists and engineers. The new doctors earned degrees in a several different disciplines, including Physics, Chemistry, Geological Sciences, Chemical Engineering, Molecular Biophysics, Biochemistry, and Biological Science.

The NHMFL Users Program. Users have routinely operated the **Hybrid magnet** at 45 T, and time on the magnet is through a very competitive proposal process. Although the 45 T Hybrid superconducting outsert experienced an unprotected quench in July of 2000 that compromised the maximum field, the Magnet Science & Technology group upgraded the resistive insert to restore the field to 45 T. The upgraded insert for higher-current/higher-field operation allows users access to 45 T, and there are plans to return the superconducting outsert to its full design field of 14 T in early 2002. At that time, it is likely that the laboratory will be able to offer continuous field approaching 50 T.

In February 2001, when the Hybrid returned to full field, John Singleton *et al.* ran an experiment examining the magnetoresistance of a prototype layered organic superconductor. There has been a vigorous debate about the nature of superconductivity and electron coherence perpendicular to the two-dimensional layered structures of this organic system. This experiment in the 45 T Hybrid indicated that the Fermi surface of this material is three-dimensional and that the electrical transport between the layers is coherent.

Gil Clarke *et al.* conducted one of the first proton NMR experiments in the 45 T Hybrid on spin density wave order and fluctuations associated with this low temperature phase of quasi one-dimensional conductors. This experiment was conducted with great precision. Bill Halperin *et al.* conducted an NMR experiment in the Hybrid on the vortex properties of a superconductor. This effort resulted in an article in *Nature*. For the first time, the dynamic fields were observed on a very detailed scale and show that inside the vortex the electronic states deviate from those found in superconductive behavior and may indicate the development of antiferromagnetism.

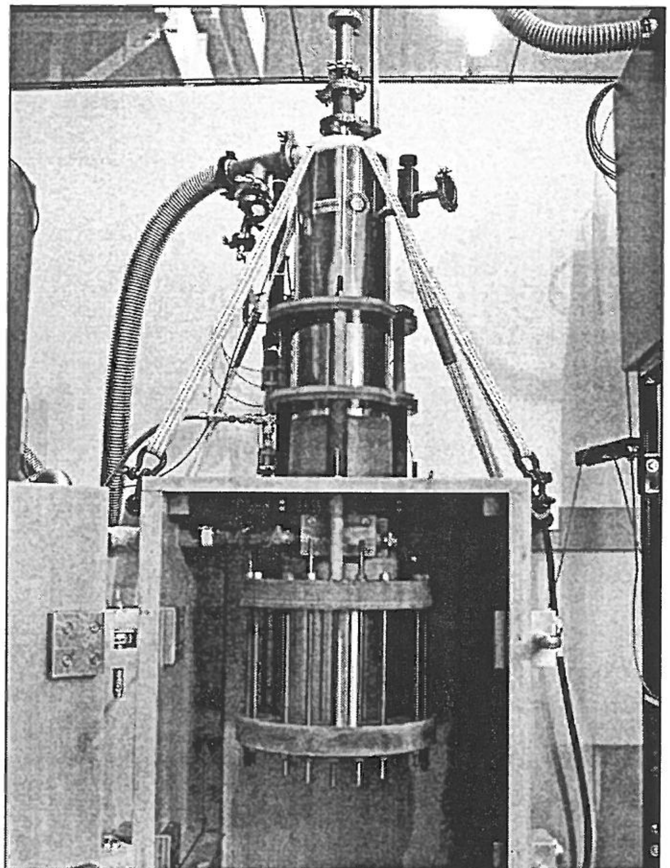


The energy spectrum of the electronic states of the vortices at various positions corresponding to the various internal fields as measured by the NMR. The inset is the spacial map of the magnetic field of the vortices generated from the spectra. —*Halperin, et al.*

In high fields only available in the Hybrid, James Brooks *et al.* probed a novel superconducting state that is induced by high magnetic fields. As the magnetic field is increased, the sample (an organic magnetic material) undergoes dramatic transformations at low temperatures from a magnetic insulator to a superconductor. It was discovered that fields in excess of 42 T were needed to destroy the superconducting state. Brooks *et al.* also conducted the highest steady state magnetic field experiment ever performed at 47.8 T to study the nearly two-dimensional electronic structure of an organic metal in a new regime.

Recently users at the **Pulsed Field Facility** at Los Alamos conducted the first biological experiment ever performed there in a 50 T short-pulse magnet. Researchers from Washington State University explored the effects of high magnetic fields on the growth of certain microorganisms. Their preliminary findings show an inactivation on these microorganisms when exposed to high intensity fields. In other user experiments, the recent discovery of the superconducting properties of MgB_2 prompted a flurry of activity at the NHMFL on "high-temperature" superconductivity in this non-oxide material. The NHMFL-Pulsed Field Facility played an important role in determining the high-magnetic-field properties of this newly discovered superconducting system. Several proposals were received almost immediately to do experiments at the Pulsed Field Facility. By scheduling experiments after 11:00 p.m., the rapid "spike" in user demand was accommodated without delay. S.L. Bud'ko and P.C. Canfield (*Phys. Rev. B, Rapid Comm.*, **63**, 220503-1 (2001)) from Ames National Laboratory utilized our facility to determine the upper critical field of superconducting wire made using boron fibers. M.H. Jung (NHMFL) collaborated with Prof. S.I. Lee's group at Pohang University in South Korea to determine that the upper critical field of MgB_2 thin films is as high as 29 T for fields applied perpendicular to the c-axis (*J. Chem. Phys, Lett.,* **343,** 447 (2001)).

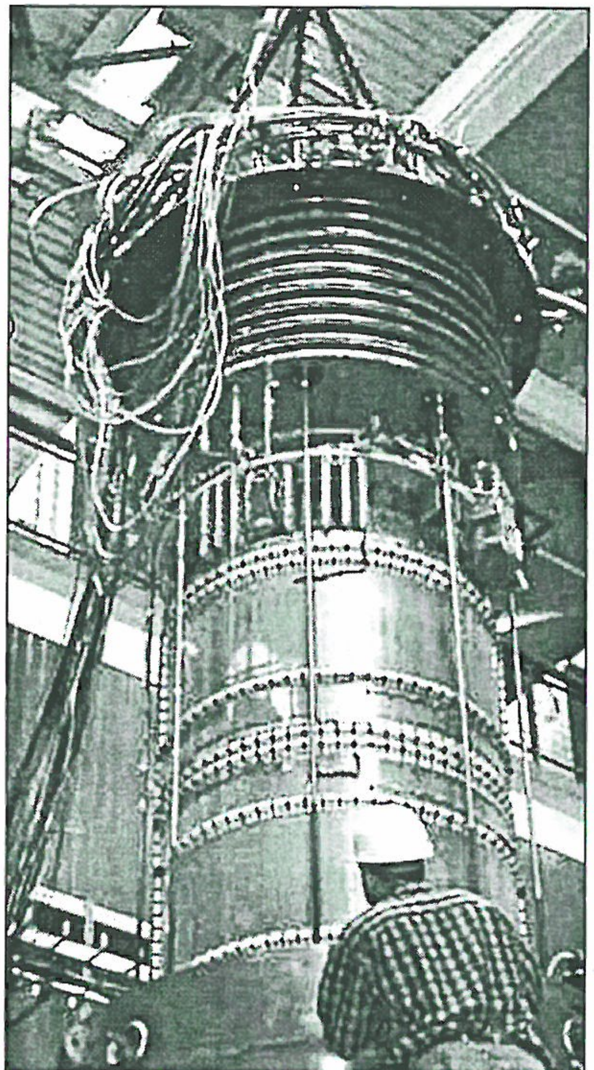
Neil Harrison, Chuck Mielke, Andy Christianson and Jim Brooks (NHMFL) collaborated with the Prof. Singleton group at Oxford University to discover the existence of persistent currents in certain molecular charge-density wave systems at high magnetic fields. The mechanism for these persistent currents is analogous to those that occur in the quantum Hall effect in two dimensional electron systems. The electric field is, however, offset by a charge-polarization field of the charge-density wave that is formed on another sheet of the Fermi surface. The currents are believed to obey a modified form of the London equations, thereby giving rise to effects similar to those observed in superconductors in very high magnetic fields (*Phys. Rev. Lett.*, **86**, 1586 (2002); *J. Phys. Cond. Mat.*, **13**, L389 (2001); and to be published).



50 T Mid-Pulse Magnet at LANL

Work is well underway on the rebuild of the **60 T Long-Pulse magnet** after a formal laboratory review of the incident and a technical review of the magnet. The 60 T Long-Pulse failure was caused by a reduced fracture toughness in the Nitronic-40 reinforcing shells in layers five through eight. Fabrication of the new magnet with follow the same design of the original 60 T with altered specifications, anneal schedules, and quality assurance tests of the Nitronic-40 shells. These steps should eliminate this particular materials weakness at the outset of the shell fabrication process and verify the required fracture toughness before the shells are built into the magnet. The 100 T project achieved significant progress over the past year and design of the outer coils is complete and prototyping is underway.

Magnet assembly of the **900 MHz ultra-wide bore magnet** was completed in 2001, and the magnet was inserted into the cryostat bucket for testing. Testing will be completed in early 2002. The object of the bucket test is to verify the basic operating parameters of the magnet in a cryostat that can be readily opened. This provides an opportunity to demonstrate magnet operation and go through the training period of the magnet in an operating environment that will allow relatively easy access to the magnet if trouble is detected. The 900 MHz console, a Bruker spectrometer, is 90 percent delivered. Since this is the first and only wide bore 900 MHz magnet ever built, no commercial probes are available. Consequently, the NHMFL probe development group is fabricating a single and double resonance probe for the 900 MHz. The team also received an In-House Research Program award to develop a more advanced triple resonance static and magic angle spinning NMR probe.



NHMFL 900 MHz Ultra-Wide Bore Magnet

In the fall of 2001, **NHMFL-NMR** Director Tim Cross was awarded an $8.1 million grant over five years from the National Institutes of Health to study the membrane proteins of *Mycobacterium tuberculosis*. These membrane proteins represent many potential drug targets in this bacillus that is needed to combat the #1 cause of worldwide infectious disease. It is estimated that a third of the world's population is infected with TB, and drug resistance is a major concern to treatment. New drugs are needed to combat TB and this project will facilitate this goal. Prof. Cross put together a broad group of researchers and institutions (thirteen collaborators from six states) to study these challenging membrane proteins for structural characterization.

The **Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility** is located within the McKnight Brain Institute at the University of Florida. AMRIS houses the NHMFL's MRI facilities and has performed some of the first single cell imaging. This unique laboratory is at the cutting edge of MRI research with its multi-disciplinary faculty in Biochemistry, Molecular Biology, Radiology, Medicine, and Physics, and its aggressive probe and instrumentation development focus. The NHMFL centerpiece of the MRI effort is the 11.7 T, 40 cm bore for imaging small animals. This commercially-built magnet experiences a challenging cryogenics leak, which leads to an ice build up in the magnet, but Magnex is confident about solving this impediment. The McKnight Brain Institute Director, Dr. Bill Luttge, recently was awarded a federal grant of almost a $1 million to purchase a human head scanner dedicated to research. This new magnet system will complement the AMRIS animal instruments.

The NSF supported NHMFL **National High-Field Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) Facility** is routinely using its 9.4 T mass spectrometry. The FT-ICR MS has on order a 15 T system that will be delivered from Magnex in summer 2002. ICR is being used more frequently in biology to do protein sequencing. ICR Director Alan Marshall has filed a patent on a new technique he developed to wire molecules together so that all the ions come into the ICR trap at the same time. There are also growing ICR opportunities in the forensic area where the complexity of the mixture is the signature of the compound. The group has also done work for a regional Air Force base to determine the sources of contaminated water and is exploring this unique mass spectroscopy technique to support the U.S. war on terrorism.

The NHMFL **In-House Research Program (IHRP)** established in 1996 has stimulated magnet and facility development and provides intellectual leadership for novel experimental and theoretical research in magnetic materials and phenomena. IHRP proposals generated by NHMFL researchers at all three sites and in collaboration with external users are submitted to the Research Program Committee. The IHRP review process was reorganized this year into three subcommittees to reflect the principal disciplines of condensed matter physics, biology and chemistry, and magnet and magnet materials development. Thirty-three pre-proposals were received; twelve P.I.s were asked to submit full proposals; and six projects were funded.

External magnet related **collaborations** continue to grow and expand with the private sector, other agencies and organizations, and international institutions. The Magnet, Science & Technology group is collaborating with similar laboratories at Tsukubu and Nijmegen to provide the Florida-Bitter 30+ T research magnets. The Center for Advanced Power Systems (CAPS) funded by the Office of Naval Research and being led by the NHMFL is actively working with industry to advance the all-electric ship for the next generation of naval sea power.

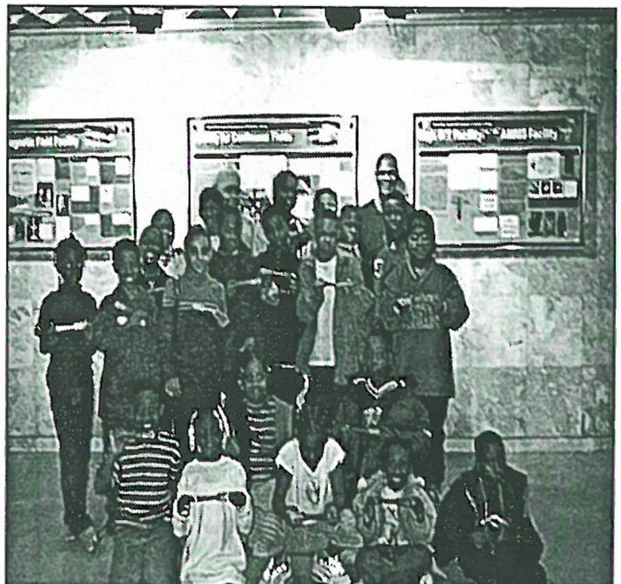
Education is the underpinning of all aspects of the NHMFL, but particular emphasis is directed to K-12 levels and outreach through the **Center for Integrating Research and Learning (CIRL)**. Three years ago the Center developed the curriculum resource, *Science, Tobacco & You* for the State of Florida to discourage 5th and 6th graders from smoking tobacco, while learning and discovering science. To date, the Center has conducted 61 training sessions with 2,780 teachers in five states, and oversees trainings in eleven additional states throughout the nation. The Center has been working with local school districts to begin "The NHMFL Classroom" experience for 4th grade students and their teachers.

Teachers developing new materials during *Science, Tobacco, and You* workshop in Connecticut.

In addition, the Center has targeted students and teachers at nine underserved local schools to spend a day at the NHMFL. The teachers enjoy a learning experience as well, and return to their classrooms with materials to continue the science experience. Over the summer months, the NHMFL hosted 17 undergraduates and 17 teachers in the REU and RET programs and it proved to be the best classes ever. Online submission of student and teacher applications is attracting a wider geographic base and very motivated applicants.

During 2001, the NHMFL hosted or sponsored **major meetings and conferences on magnet technology, ICR, NMR, EMR, condensed matter and materials physics.** The signature events honored two members of the NHMFL family: J. Robert Schrieffer and Zachary Fisk. A special one-day symposium to celebrate Bob's life long commitment and leadership to scientific research and education was held in conjunction with the fourth Physical Phenomena at High Magnetic Fields Conference, which he has guided since its inception in 1991. The commemorative event attracted nearly 150 participants, including five other Nobelists: Phil Anderson Alan Heeger, Walter Kohn, Bob Laughlin, and Horst Störmer. In mid-August, a 60th birthday celebration—The Future of Materials Physics: A Festschriff for Zachary Fisk—was held at Los Alamos. His colleagues at LANL organized interesting and distinguished speakers to explore the frontiers in theoretical and experimental research of the complexity of solids.

One of the NHMFL's newest Ph.Ds., Dr. Scott McCall (left), advises 8th grade student Will Fairhurst on a science fair project. Will won overall best project at his school earning him the opportunity to participate in the Florida Big Bend Regional Science Fair.



Tallahassee, Florida's Frenchtown Community After School Program participants learned about magnetism and optics as part of Governor Jeb Bush's Front Porch Initiative.

2. USERS PROGRAMS

The strength and success of NHMFL users programs and facilities are carefully built around the synergies of the highest field magnets, unique instrumentation, and strong supportive services of faculty and staff. All aspects of user facilities performed exceptionally well during 2001, producing robust science findings and opening new avenues for science. The tables in this chapter illustrate the amount of user activity and Appendix A shows the breadth of research activity by users of the NHMFL. In addition, the *2001 NHMFL Annual Research Review* to be available in March 2002 presents 322 brief abstracts by users, along with lists of publications and other scientific reports.

The 45 T Hybrid magnet was operated routinely by users throughout the year. Demand was high, so time on the magnet was determined through a very competitive proposal process. The science on the Hybrid magnet has been rich and there has been an explosion of interest by the NMR community. The Hybrid has opened a new frontier in NMR research and has led to advances in instrumentation and in signal processing. NMR research on a high temperature superconductor by V. F. Mitrovic *et. al.* was published in the October edition of *Nature*. G. Clark *et al.* conducted one of the first proton NMR experiments in the Hybrid on spin density wave order and fluctuations associated with this low temperature phase of quasi one-dimensional conductors.

An Oxford/LANL group used the 45 T Hybrid for research on molecular metals that required fields above 35 T and represents work that could not have been done in pulsed fields. An experiment by L. Balicas *et al.* explored a new superconducting state that results from competition between magnetism and superconductivity in materials with interlaced conducting and magnetic molecular layers. J. Brooks *et al.* also conducted the highest steady state magnetic field experiment ever performed, at 47.8 T, to study the nearly two-dimensional electronic structure of an organic metal in a new regime.

The NHMFL Pulsed Field Facility at Los Alamos continues to grow and attract new users, and it plays a leading international role in pulsed magnetic field research. During this review period, 77 publications were generated (6 *Phys. Rev. Lett.*, 1 *Chemical Physics Lett.*, and 13 *Phys. Rev. B*) and about 40 invited talks were published and presented. Since NHMFL magnets now define the state of the art, it is important to try to develop new measurement techniques for use in high magnetic field environments. Pulsed Field staff working through grants from the In-House Research Program and collaborations with users are developing capabilities so users can perform (1) micro-ohm-cm magneto-transport, (2) Terahertz spectroscopy, (3) specific heat to 45 T and 60 T, (4) contactless rf magneto-transport, (5) de Haas-van Alphen studies of heavy mass alloys, and (6) resonant cavity GHz spectroscopy.

The NHMFL High B/T Facility is operated by the University of Florida as a part of its Microkelvin Laboratory. Instrumentation is available to users for studies of magnetization, thermodynamic quantities, transport measurements, magnetic resonance, viscosity, diffusion and pressure. In the past year, the High B/T Facility completed implementation of pulsed UHF NMR techniques for applications at ultra-low temperatures.

Two new solid state NMR probes have been developed at the NHMFL that open up a range of solid state NMR experiments for use at high magnetic fields. The probes are used primarily in the superconducting 19.6 T magnet, but can also be used in resistive magnets and the 45 T Hybrid magnet when higher fields are necessary. High resolution solid state NMR requires rapid sample spinning at the magic angle to the magnetic field to average out the line broadening effect from chemical shift anisotropy, dipolar and quadrupolar couplings. Both probes are used by external users to the lab such as L. Butler (LSU), C. Grey (SUNY), G. Hoatson (William & Mary), F. Taulelle (Strasbourg), L. Alemany (Rice), D. Massiot (CNRS, France), S. Martin (ISU), and O. Han (Seoul).

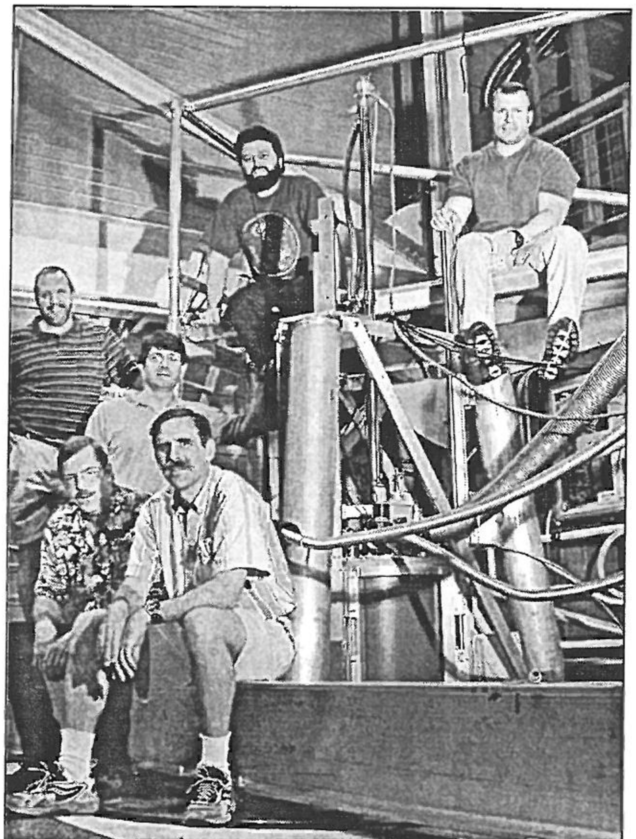
The Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR) facility had an active year with the installation of two new magnet systems—the 7 T and 9.4 T instruments. The 9.4 T magnet is initially being used for ICR instrumentation development. In collaboration with ExxonMobil, the 9.4 T instrument is being equipped with a field desorption ion source. Field desorption promises to add several thousand more compounds to the thousands already accessible by electrospray ionization, to resolve and identify chemically distinct constituents of complex mixtures such as petroleum heavy crude oil and liquefied coal. The 7 T instrument is primed for immediate impact in environmental analysis, where intractably complex volatile mixtures are common. The facility features directors for instrumentation, biological applications and environmental applications, as well as a machinist, technician, six rotating postdocs, and one permanent staff member, all of whom are available to collaborate or assist with projects.

The Electron Magnetic Resonance (EMR) spectroscopy program at the NHMFL is developing higher field and frequency ranges, which provide the advantage of the variety of applications for spin density systems. Initially, the EMR program studied highly concentrated spin systems common to materials science. Low spin density systems require high spectrometer sensitivity. The sensitivities of NHMFL spectrometers have recently been increased by orders of magnitude, thus allowing the EMR user program to expand to biology and chemistry, with an emphasis on physical chemistry and a clear trend toward biological science.

For the past two years **the Geochemistry program** has concentrated on using existing instrumentation for geochemical and environmental research, and they have been successful in obtaining external funding for these programs, primarily from the NSF Earth Science Directorate. This funded research studies the chemical evolution of the solid Earth through trace element and isotope analyses, as well as the use of isotopes to study several aspects of environmental geochemistry and global change. This year the Geochemistry group expanded its activities in the environmental science area. Researchers are pursuing speciation studies of metals with dissolved organic matter in natural waters using the unique NHMFL capabilities of FT-ICR, EPR, and ICP-MS instruments.

GENERAL PURPOSE DC FIELD FACILITIES–TALLAHASSEE

The DC magnetic field facility at the NHMFL's headquarters in Tallahassee provides the user community with the strongest, quietest, steadiest, constant or ramping magnetic fields in the world. The magnet systems are coupled with state-of-the-art instrumentation, experimental staff and technical expertise.



The dilution refrigerator in the 45 T Hybrid magnet and some of the people who make low temperatures at high fields accessible to users.

Several major systems provide a broad magnetic field-temperature-pressure-angle-frequency "parameter space" to researchers. Two dilution refrigerators offer 20 to 40 mK sample temperatures in fields up to 18 T in a superconducting magnet and up to 45 T in the Hybrid magnet. Diamond anvil high pressure cells and larger volume metallic piston cylinder cells permit optical and transport measurements to 20 GPa at temperatures from 18 mK to 350 K and to 2 GPa at temperatures to 40 mK. Magneto-optical measurements can cover wavelengths from the near ultraviolet to far infrared. Non-optical measurements of transport properties can be done at DC through audio frequency AC to millimeter and microwave frequencies. Magnetic properties of materials can be measured optically, by AC susceptibility, cantilever force and torque, and vibrating sample magnetometry. Nuclear Magnetic Resonance and Electron Magnetic Resonance (both spin and cyclotron resonance) provide unique insights into materials, including many of interest to biologists and chemists. Sample rotators allow researchers to vary not only the amplitude of the applied magnetic field but also its angle with respect to the sample. NHMFL staff often help visitors develop new instruments for unique experiments not possible with the general purpose instrumentation that is always available to all users.

The research in the DC General Purpose Facility is supported by magnet plant and cryogenic system operators and mechanical, electronic, and computer engineers and technicians. Eight scientists and an engineer whose specialties cover the kinds of measurements most frequently done at the NHMFL work directly with users. Other members of the NHMFL's scientific staff and faculty also support the user program by developing instrumentation and collaborating with visitors.

Computer hardware and software at the NHMFL allow any member of a research group to connect directly to the experimental areas at all three NHMFL sites. Collaborators far from the NHMFL facilities can view data and modify experimental strategies "live" during the magnet runs.

Further information on the facilities and services available to users of the continuous field, general purpose magnets may be obtained by contacting Bruce Brandt at brandt@nhmfl.gov or 850-644-4068 or by viewing http://www.magnet.fsu.edu/users/facilities/dcfield/.

Table 1. Magnet systems available to users at the Continuous Field Facility, Tallahassee, as of January 2002, and the kinds of experiments that can be done in them.

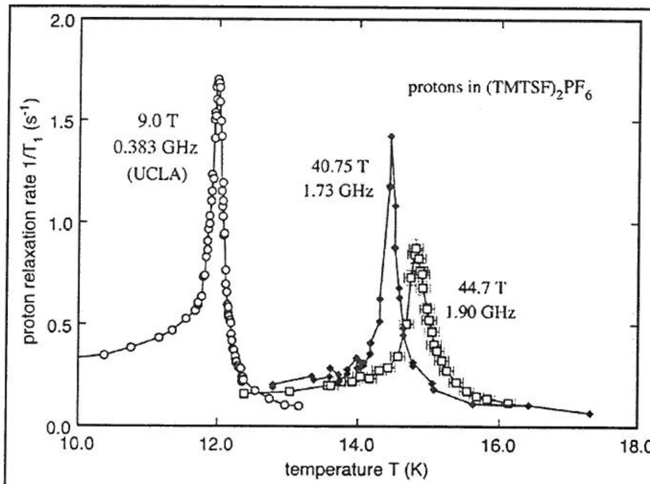
SUPERCONDUCTING MAGNETS		
FIELD (T), BORE (mm)	TEMPERATURE	SUPPORTED RESEARCH
18/20, 52	20 mK - 2 K	Magneto-optics (ultra-violet through far infrared), Magnetization, Specific heat, Transport (DC to microwaves), High pressure, Temperatures from 20 mK to 300 K, Dependence of optical and transport properties on field orientation, etc.
17.5/19.5, 52	0.4 - 300 K	
15, 45	10 mK - 1 K	
RESISTIVE and HYBRID MAGNETS		
FIELD (T), BORE (mm)	POWER (MW)	SUPPORTED RESEARCH
20, 195	20	Magneto-optics (ultra-violet through far infrared), Magnetization, Specific heat, Transport, High Pressure, Low to medium resolution NMR, Temperatures from 40 mK to 800 K, Dependence of optical and transport properties on field orientation, etc.
24.5, 32[1]	15	
25, 52[1]	19	
25, 32 to 50[2]	15	
30, 32	20	
33, 32	20	
45, 32	36	

1 High homogeneity magnet.
2 32 mm bore tube supports a coil for modulating the magnetic field.

Highlights of Research and New Instrumentation for Users of the Continuous Field General Purpose Magnets

The 45 T Hybrid magnet has come into its own as a research tool with many more techniques being used for more experiments than last year.

- A condensed matter NMR user group led by Gil Clark of UCLA set a new record for proton NMR at 1.90 GHz (44.7 T).
- V. Mitrovic and colleagues from Northwestern U. and the NHMFL used NMR to show that antiferromagnetic fluctuations exist inside vortex cores in high temperature superconductors. (V. F. Mitrovic, *et al.*, *Nature*, **413**, 501 (2001) and to be published.)
- J.S. Brooks and colleagues used DC magnetoresistance measurements to show that the field-induced superconducting state in a normally insulating organic material was suppressed by still higher magnetic fields. (Balicas, L., *et al.*, *Phys. Rev. Lett.*, **87**, 067002 (2001))

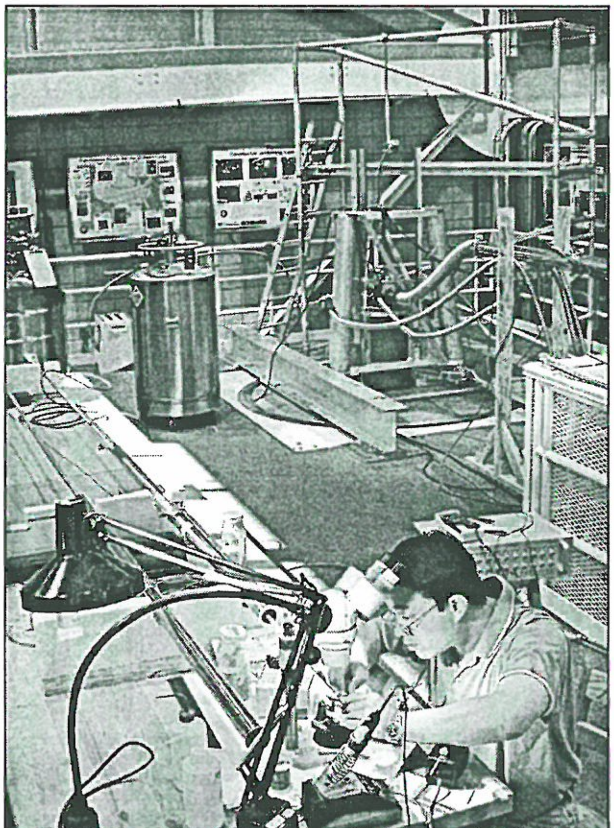


This figure is from an investigation of the order and fluctuations of the spin-density wave (SDW) phase in the organic quasi 1-d conductor $(TMTSF)_2PF_6$ up to very high magnetic fields using proton spin-lattice relaxation rate ($1/T_1$) measurements. The highest frequency measurements at f_{NMR} = 1.9 GHz using the Hybrid magnet at B = 44.7 T established a new record for high frequency proton NMR. The figure shows plots of $1/T_1$ for three values of $B \approx 30$ deg. from the c^*-axis in the b'-c^* plane. The values of B and f_{NMR} are: 44.7 T (1.90 GHz), 40.75 T (1.73 T), and 9.0 T (0.383 GHz). A sharp peak is seen where $1/T_1$ is dominated by critical fluctuations near T_{SDW}.
—*Clark, et al.*

J. Singleton and colleagues used DC and millimeter wave conductivity as functions of field-to-sample orientation to explore the fundamentals of superconductivity in low dimensional systems. (J. Singleton, *et al.*, *Phys. Rev. Lett.*, **88**, 037001 (2002))

The portable dilution refrigerator provides 45 mK at 45 T for transport and magnetic properties studies. The experimental phase space is further expanded by rotating the sample. Pan, Störmer, *et al.* used this combination to explore a new anisotropic state in the integer quantum hall regime. (Pan, W., *et al.*, *Phys Rev. B*, **64** 121305 (2001))

There was a broad attack on understanding heavy Fermion systems using various compounds of $ReMIn_5$, where Re=rare earth element, and M=a Group VIII metal. The Fermi surface was explored by changing the composition, temperature, pressure, applied magnetic field, and orientation of the samples. Transport, magnetic, and heat capacity measurements were done by several groups of NHMFL scientists and their collaborators. (see, for example, D. Hall *et al.*, *Phys. Rev. B*, **64** 212508 (2001) and J.-S. Kim, *et al.*, *Phys. Rev. B*, **64** 134524 (2001)).



Wei Pan mounting a sample on the rotating sample holder in preparation for an experiment at 40 mK in the Hybrid magnet.

Five university and industrial groups worked to develop **the next generation of practical superconducting wire** for higher field NMR and general purpose magnets. Their tests required the large bores and fields above 20 T provided by NHMFL magnets.

Several **sample rotators, one plastic, were heavily used for quantum well and Fermi surface studies**. The rotators can be driven continuously at millikelvin temperatures without heating the sample thanks to the design of the rotator and the stepping motor controller.

Incremental but important reductions in the noise floor for all measurements in the Bitter and Hybrid magnets were achieved by two changes to equipment. First, copper tails on all the cryostats shield experiments from field ripple. And second, cryostat mounting platforms installed in the 33 T Bitter and 45 T Hybrid magnet cells reduce sample vibration and thereby lower temperatures as well as measurement noise. They also reduce the amount of time that users must spend aligning the cryostat in the magnet.

Color LCD monitors replaced the monochrome video monitors on the data acquisition computers making it easier for users to follow multiple signals on a single graph and eliminating distortion of the image by the magnetic fringe field.

Planned Improvements

Helium 3 refrigerators for ≤350 mK will add to the low temperature capabilities of the lab. They will provide lower cost alternatives to the dilution refrigerators for users who do not need the lower temperatures provided by dilution refrigerators.

- One that permits top loading of the sample into the liquid ^{3}He will increase the variety of experiments that can be done in our 17.5 T superconducting magnet.
- Another in which the sample is mounted in vacuum will allow low temperature heat capacity measurements, for example, in the 50 mm bore resistive magnet. Optional optical windows for that system will permit low temperature light scattering experiments.
- The third will provide temperatures down to 350 mK in the 32 mm bore Bitter and Hybrid magnets.

A direct optical access probe and other equipment for Raman spectroscopy is being developed. The cryostat and external optical components will also be used for other experiments that require fast pulses or polarized light. The first experiments are planned for the 50 mm bore magnets; experience and scientific results there will inform and drive the design of similar systems for the 32 mm bore magnets and the Hybrid.

Fast optical instrumentation for kinetics experiments is being developed as part of a project partially funded by the In-House Research Program (IHRP).

Variable temperature Far Infrared Spectroscopy will soon be possible thanks in part to another IHRP and assistance from a user group.

Two or three GPa piston cylinder pressure cells are being purchased or developed in-house.

Several microcalorimetry techniques and instrumentation are being developed in collaboration with users with funding from the State of Florida Visitors' Program and the IHRP.

Backward Wave Oscillators—180 to 720 GHz—will be used for Electron Spin Resonance studies and high frequency conductivity measurements at up to 25 T in the Keck magnet.

DC Facility Operation and User Statistics for 2001

	Total	Minority	Female
Number of Research Projects	104	NA	NA
Number of Senior Investigators, U.S.	72	1	5
Number of Senior Investigators, Overseas	16	NA	0
Number of Students, U.S.	46	2	7
Number of Students, Overseas	11	NA	3
Number of Postdocs, U.S.	6	0	0
Number of Postdocs, Overseas	1	NA	0
Number of Magnet-Days:	Resistive	Superconductor	Percent
NHMFL, UF, FSU, FAMU, LANL	240	212	31%
U.S. University	210	237	30%
U.S. Govt. Lab.	10	7	1%
Industry	34	3	3%
Overseas	213	112	22%
Test, Calibration, & Maintenance	24	52	5%
Idle	10	105	8%
Total: 1265	741	728	100%

PULSED FIELD FACILITY—LOS ALAMOS

The Pulsed Field Facility in Los Alamos continues to play a leading role world wide in pulsed magnetic field research. During 2001, 77 publications (among those: 6 *Phys. Rev. Lett.*, 1 *Chemical Physics Letter,* and 13 *Phys. Rev. B*), and around 40 invited talks were published and presented with research performed at the NHMFL–Pulsed Field Facility. The laboratory continues to attract new users and strives to accommodate experiments in all scientific disciplines, not only condensed matter physics.

Operation in the new experimental hall proved to be more efficient for users and local staff. With three fully operational short pulse experimental cells and the 20 T superconducting magnet, the lab can accommodate up to four groups of users a week. Around 88 percent of the available magnet time was filled with users during 2001.

The NHMFL–Los Alamos research staff and collaborators developed a wide variety of experimental capabilities utilizing the short pulse and long pulse magnets, which are summarized in Table 2. Research proposals to utilize the facility should be submitted through the laboratory's Web page (http://www.lanl.gov/mst/nhmfl/). Magnet time is scheduled following successful review of submitted proposals. Most commonly, users visit for one to two weeks of magnet time, although longer visits and sabbatical stays are also welcome. Additional information on magnets, instrumentation, and personnel, as well as Research Proposal Forms can be provided by contacting Alex H. Lacerda at lacerda@lanl.gov or 505-665-6504.

Table 2. Summary of scientific capabilities at NHMFL Pulsed Field Facility.

Field, Duration, Bore	**Supported Research**
Capacitor-bank-driven Cell#1: 50 T–Short Pulse, 25 msec, 24 mm Cell#2: 40 T–Mid-Pulse, 400 msec, 24 mm Cell#2: 50 T–Mid-Pulse, 400 msec, 15 mm Cell#3: 60 T–Short Pulse, 25 msec, 15 mm Cell#4: 60 T–Short Pulse, 25 msec, 15 mm	Magneto-optics (IR through UV), magnetization, and magneto-transport from 350 mK to 300 K Dilution refrigerator with 50 T, 24 mm Pressure from 10 kbar typical, up to100 kbar 60 T – Long Pulse Magnet *to return to service in early 2003. See the Magnet Science and Technology section for details*
Superconducting magnet 20 T magnet, 52 mm	Same as pulsed fields, plus thermal-expansion, specific heat, and 20 mK to 600 K temperatures.

The 100T Multi-Shot Magnet Project

The joint U.S. Department of Energy and U.S. National Science Foundation 100 T project is in its construction phase. The 100 T, 15 mm bore non-destructive magnet marries two pulsed magnet technologies: a ~47 T generator-driven outsert with a ~53 T capacitor-driven insert. Construction of the power supplies and infrastructure will continue through 2002, with the magnet scheduled for commissioning in mid 2003.

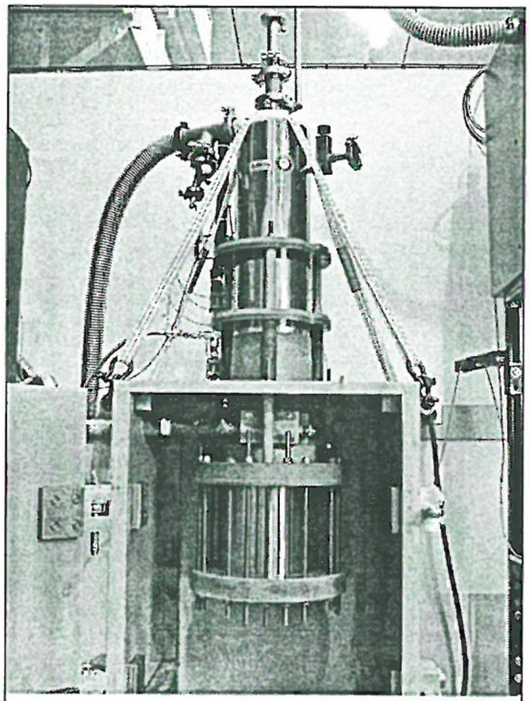
Capabilities of the Facility, Illustrated by Scientific Highlights

In an effort to measure high-frequency complex conductivity of correlated electron systems at high magnetic fields and low temperatures, S. A. Crooker and collaborators recently developed a method for performing time-domain terahertz (THz) spectroscopy in pulsed magnetic fields. Miniature fiber-coupled THZ emitters and receivers were developed for operation directly in the cryogenic bore of high-field magnets. Time-domain THz spectroscopy is a well-established technique for measurements of high-frequency conductivity in the range between 100 GHz and 3000 GHz (between microwave electronic methods, and far-infrared photonic techniques). The frequency range corresponds to energies between 0.4 meV and 12 meV, or alternatively, temperatures between 4 and 140 K and magnetic fields 8 to 200 T. This is precisely the energy scale relevant to many correlated-electron systems, including high T_c superconductors, Kondo insulators, Heavy-Fermions, Manganites, and other transition metal oxides.

F. Balakirev and collaborators from Tokyo University measured the Hall coefficient of one of the high T_c cuprates $Bi_2Sr_{2-x}La_xCuO_{2+\delta}$ down to 0.5 K using 60 T magnetic fields. This measurement was carried out using the in-house synchronous digital lock-in technique developed at the NHMFL. This technique allowed the extraction of the carrier concentration of each measured sample. The Hall number exhibited a sharp peak providing additional support for the existence of a phase boundary near optimal doping in the cuprates.

Development of radio frequency (RF) contactless conductivity measurements for pulsed magnetic fields was carried out by C. H. Mielke and his collaborator from Clark University, Charles Agosta. While great improvement has been made in resistivity measurements at the NHMFL Pulsed Facility, some very low resistivity systems are still extremely hard to measure in pulsed magnetic fields due to eddy current heating. The development of RF techniques, including the tunnel diode oscillator (TDO) technique, began as a technique used to measure RF penetration depth of superconductors in DC magnets. Software algorithms were written to process the TDO data: within 15 seconds of processing time, 600,000 data points are computed and the user is presented with the change in skin depth vs. magnetic field to 60 T. This technique is excellent for studying layered systems such as high temperature superconductors and organic compounds.

The recent discovery of the superconducting properties of MgB_2 revealed a great deal of interest in superconductivity, especially in non-oxide materials. The NHMFL Pulsed Facility played an important role determining the high-field properties of this material. S. L. Bud'ko and P. C. Canfield (*Phys. Rev. B, Rapid Comm.*, **63**, 220503-1 (2001)) utilized our facility to determine the upper critical field of wire made out of this material. M. H. Jung and collaborators from South Korea determined the upper critical field of MgB_2 thin films to be as high as 29 T for fields applied perpendicular to the c-axis (*J. Chem. Phys, Letters,* **343**, 447 (2001)). Another very important study, by K. H. Kim and collaborators, determined the role played by Mg in the magnetotransport properties of this compound.



50 T Mid-Pulse Magnet at LANL

B. K. Sarma, A. Suslov (University of Wisconsin, Milwaukee) and J. B. Ketterson (Northwestern University) and collaborators from the NHMFL Pulsed Field Facility developed ultrasonic velocity and attenuation measurements in pulsed magnetic fields. Ultrasound measurements are of paramount importance in trying to understand electron-lattice coupling of systems close to magnetic instabilities. Recent results by Sarma and Ketterson's group (*NHMFL Reports*, **8** (3), Summer 2001) in fields up to 50 T on the metamagnetic behavior of the heavy fermion system URu_2Si_2 showed the metamagnetic transition at 35 T and two extra transitions. These extra transitions additionally showed two softening modes at slightly higher fields. This new result is now under further investigation and this technique will be soon available for users.

Measuring thermodynamic quantities in high magnetic fields proved to be of great importance in condensed matter physics, especially when investigating new materials. With that purpose, M. Jaime and collaborators (NHMFL–Los Alamos) and S. McCall (NHMFL–Tallahassee) are developing user-friendly heat capacity measurements in the 45 T Hybrid magnet. Using a Si-crystal calorimeter and an experimental setup already tested in the 60 T Long Pulse Magnet, this group developed a non-metallic calorimeter to be used with a time-relaxation method in order to determine the heat capacity using the Hybrid magnet. As an example, the archetype Heavy Fermion compound, URu_2Si_2, has been measured. The magnetocaloric effect also shows a multi-step metamagnetic transition mirroring the NHMFL–Los Alamos ultrasound measurement. This measurement technique will be soon available for the 45 T Hybrid Users.

Neil Harrison (NHMFL–Los Alamos) and collaborators from Tallahassee and Oxford University observed the existence of persistent currents in certain molecular charge-density wave systems at high magnetic fields. The mechanism for these persistent currents is analogous to those that occur in the quantum Hall effect in two dimensional electron systems. The electric field is, however, offset by a charge-polarization field on the charge-density wave that is formed on another sheet of the Fermi surface. The currents are believed to obey a modified form of the London equations, thereby giving rise to effects similar to those observed in superconductors in very high magnetic fields.

NHMFL–Los Alamos, Facility Operation and User Statistics for 2001

	Total	Minority	Female
Number of Research Projects	117	NA	NA
Number of Senior Investigators, U.S.	44	6	4
Number of Senior Investigators, Overseas	16	NA	1
Number of Students, U.S.	19	1	2
Number of Students, Overseas	6	NA	2
Number of Post Docs, U.S.	10	0	1
Number of Post Docs, Overseas	2	NA	0

	20 T-SC	Cell 1	Cell 2	Cell 3,4	**Total**
User Affiliation	Number of Magnet Days				
NHMFL	20	32	14	24	90
LANL	21	10	22	0	53
Other Nat. Labs	10	0	5	0	15
U.S. University	117	96	19	151	383
Industry	12	0	14	16	42
Non-U.S.	93	17	53	78	241
Total	273	155	127	269	824

HIGH B/T FACILITY—GAINESVILLE

The **NHMFL High B/T Facility** at the University of Florida is operated as part of the Microkelvin Laboratory that is located in the Physics Department at the University of Florida. The Facility is designed to meet the needs of NHMFL users who wish to conduct experiments in high magnetic fields (up to 15.2 T) and at very low temperatures (down to 0.4 mK) simultaneously. Faculty members in the facility work with users in the design of experiments where needed. Instrumentation is available for studies of magnetization, thermodynamic quantities, transport measurements, magnetic resonance, viscosity, diffusion and pressure. The facility is housed in an ultra-quiet environment with "tempest" quality electromagnetic shielding and vibration isolation of the experimental station to permit high sensitivity measurements.

Applications for the use of the facility follow the procedures as for all NHMFL facilities. The use of the High B/T Facility is restricted to experiments that need the special low temperature and high field configurations. (Experimenters needing higher temperatures should contact Bruce Brandt at brandt@magnet.fsu.edu.) Many of the High B/T experiments require special assemblies and direct interaction with personnel on site, as well as having need for long running times. Prospective users should contact the facility manager and resident research scientists, Dr. J.S. Xia (352-392-8871, jsxia@phys.ufl.edu), Prof. E. Dwight Adams (adams@phys.ufl.edu) , or Prof. Neil S. Sullivan (sullivan@phys.ufl.edu), well in advance.

Instrumentation and Services Update

In the past year we completed a successful implementation of pulsed UHF NMR techniques for applications at ultra-low temperatures. This is the first time that high power pulsed experiments of this kind have been carried out in the mK to sub-mK temperature range. The techniques of Candela *et al.* used a reentrant microwave cavity that could function at relatively high temperatures (hundreds of mK) while the system under study was located in a cold finger at mK to sub-mK temperatures. This technique allowed users (Akimoto, Candela, and Mullin of the University of Massachusetts in collaboration with UF-Physics faculty) to carry out studies of the anisotropy of spin diffusion in dilute Fermi liquids. Studies in these dilute systems are of fundamental importance because the theoretical parameters can be calculated accurately (unlike the Fermi factors for high concentrations).

We have also completed the construction and testing of a vibrating wire viscometer for studies of viscosity in quantum fluids at very low temperatures. The instrument designed by Xia *et al.* has enabled the measurement of the dependence of the magnetization on spin polarization in Fermi fluids. The design could also have potential applications as a reliable secondary thermometer that could be attached via sintered silver heat links to experimental cells operated at very low temperatures.

Sintered silver heat exchangers continue to be extremely important for cooling samples and electrical leads. The high surface area of the sintered silver in contact with liquid ^{3}He provides the most reliable link to the nuclear cooling stage through large areas of sintered metal. This technique has been used for recent low temperature studies of non-Fermi liquids, such as $CeNi_2Ge_2$ (Stewart and Steglich).

Goals and Future Plans

Current capabilities allow experiments to be conducted to temperatures as low as 0.4 mK and for fields up to 16.5 T if the superconducting magnet is operated at 1.5 K. The highest priority for the Gainesville NHMFL facility in the near term is to replace this magnet with one capable of reaching 21 T. An RFP will be issued to procure this new high field capacity. Our long term goal is to achieve a 25 T capability that will include a 21 T conventional superconducting magnet with a 25 mm ID experimental volume, and a high-T_c insert capable of bringing the full field above 25 T with a 12.5 mm experimental access.

A small 5 T magnet that can operate in vacuum has been designed to make a second experimental volume available above the nuclear refrigerator. This volume will enable a variety of new measurements for users who need ultra-quiet and low temperature capabilities. These studies include transport and thermodynamic measurements in low fields but at temperatures down to 0.45 mK. This capability, if funded, could double the number of users that the High B/T facility could accommodate in each experimental cycle.

Table 3. New instrumentation available at the High B/T Facility in Gainesville.

Equipment	Features	Usage
Vibrating Wire Viscometer	Low Noise High Resolution	Transport and thermometry in high magnetic fields
Capacitance Thermometer	Low Noise High Resolution	Ultra-low temperatures in high magnetic fields

High B/T Facility Operation and User Statistics for 2001

	Total	Minority	Female
Number of Research Projects	2		
Number of Senior Investigators, U.S	8	1	
Number of Senior Investigators, Overseas	1		
Number of Students, U.S.	2		
Number of Students, Overseas			
Number of Post Docs, U.S.	2		
Number of Post Docs, Overseas			

Number of Magnet-Days:	Number for each category	Percent of total
NHMFL, UF, FSU, FAMU, LANL	37	
U.S. University	262	
U.S. Govt. Lab.		
Industry		
Overseas		
Experiment setup, & Maintenance	66	
Idle		
Total:	365	

CENTER FOR INTERDISCIPLINARY MAGNETIC RESONANCE (CIMAR)

The NHMFL's Center for Interdisciplinary Magnetic Resonance supports a broad range of research in the biological, chemical, and physical sciences, as well as cross-disciplinary programs in areas like environmental science. The techniques available to users include nuclear magnetic resonance (NMR), magnetic resonance imaging and spectroscopy (MRI/S), electron magnetic resonance (EMR), and Fourier transform ion cyclotron resonance mass spectrometry (ICR). Cross-fertilization among the four fields is a unique feature of the Center that is facilitated by broadly based external and internal users programs.

Table 4. CIMAR facilities in Tallahassee, January, 2002.

MAGNETIC RESONANCE SYSTEMS			
NMR FREQUENCY*	**FIELD (T), BORE (MM)**	**HOMOGENEITY**	**MEASUREMENTS**
	40, 32	10 ppm	Solid State NMR
1066 MHz	25, 52	1 ppm	Solid State and Solution NMR
900 MHz+	21.1, 100	1ppb	Solid State & Solution NMR, MRI
830 MHz	19.6, 31	100 ppb	Solid State and Solution NMR
720 MHz	16.9, 50	1 ppb	Solid State and Solution NMR
600 MHz	14, 89	1 ppb	MRI and Solid State NMR
600 MHz	14, 52	1 ppb	Solution State NMR
500 MHz	11.75, 50	1 ppb	Solution State NMR
400 MHz	11.75, 89	1 ppb	Solid State NMR
400 MHz	9.3, 50	1 ppb	Solution State NMR
300 MHz	7, 50	1 ppb	Solution State NMR
300 MHz	7, 89	1 ppb	Solid State NMR
EMR FREQUENCY	**FIELD (T), BORE (MM)**	**HOMOGENEITY**	**MEASUREMENTS**
Up to 7 THz	30, 32	100 ppm	ECR**
700 GHz+	25, 52	1 ppm	Multifrequency EMR
470 GHz	17, 61	3 ppm	Multifrequency EMR
400 GHz+	14, 88	3 ppm	Transient EMR
9 GHz			X-band EPR
ICR	**FIELD (T), BORE (MM)**	**HOMOGENEITY**	**MEASUREMENTS**
	9.4, 220	1 ppm	ESI FTICR
	9.4, 155+	1 ppm	EI, CI, FD, MALDI FTICR
	7, 155+	1 ppm	EI, CI, FTICR
	7, 150	1 ppm	ESI FTICR
	3, 150	10 ppm	Ion fluorescence, FTICR

+ Under development *Photon frequency for NMR/g=2 frequency for EMR **ECR: Electron Cyclotron Resonance

Table 5. CIMAR facilities at the University of Florida, January, 2002.

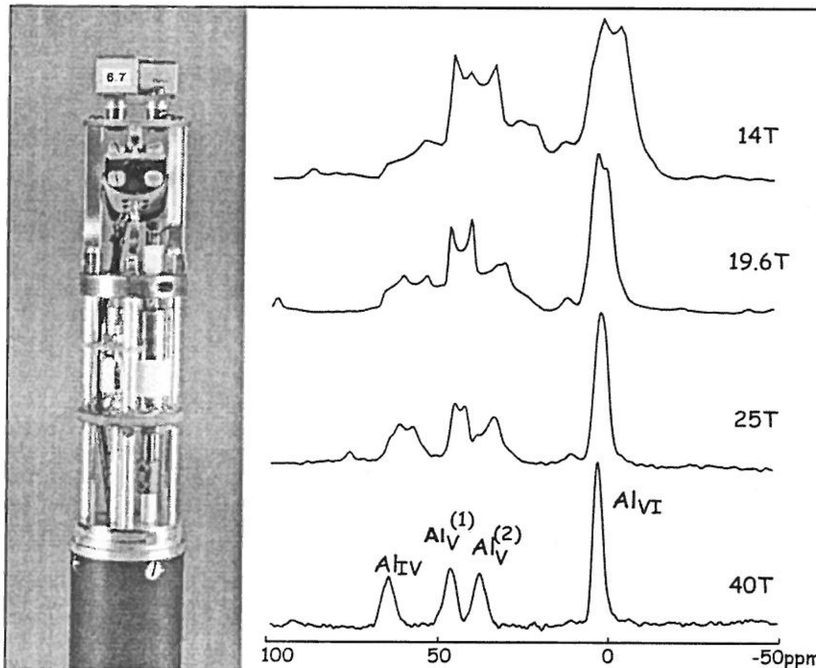
MAGNETIC RESONANCE SYSTEMS			
FREQUENCY	FIELD (T), BORE (MM)	HOMOGENEITY	MEASUREMENTS
750 MHz	17.5, 89	1 ppb	Solution state NMR & MRI
600 MHz	14, 50	1 ppb	Solution state NMR & MRI
500 MHz	11.75, 50	1 ppb	Solution state NMR
500 MHz+	11.7, 400	0.1 ppm	MRI & NMR of animals
200 MHz	4.7, 330	0.1 ppm	MRI & NMR of animals

+ Under development

The NMR Spectroscopy and Imaging Program

Timothy A. Cross is Director and Timothy M. Logan is Assistant Director of this program in Tallahassee. Three scientists in solid state and solution NMR are available to help users, as well as a substantial RF development group headed by William W. Brey and having an engineer, a machinist and a technician. In Gainesville Arthur S. Edison is the Director of the AMRIS (Advanced Magnetic Resonance Resonance Imaging and Spectroscopy) program that has three scientists, two engineers, and two managers. A total of 20 faculty participate in the NHMFL NMR Spectroscopy and Imaging program from these two institutions.

The NMR Spectroscopy and Imaging program has a mission to develop technology and applications at the highest magnetic fields through both in-house and external user

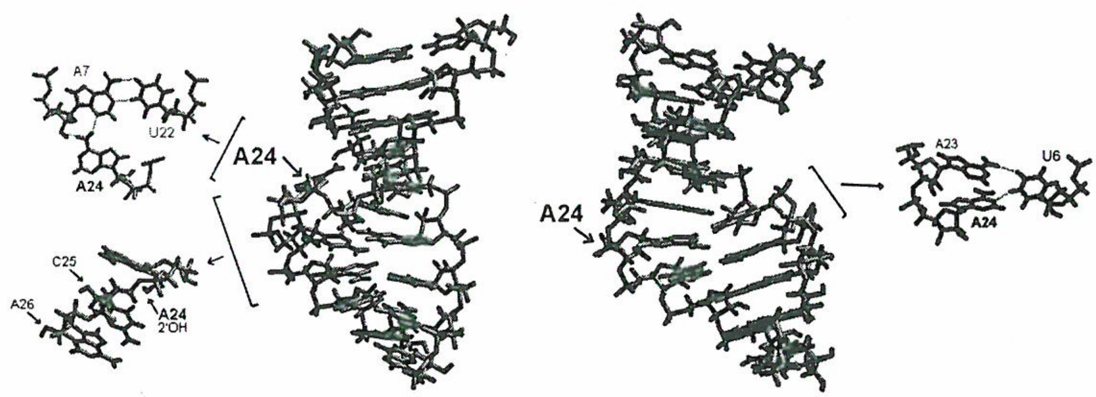


High magnetic fields can dramatically improve solid-state NMR spectral resolution of half-integer quadrupolar nuclei by reducing the second-order quadrupolar effect. The 45 T Hybrid magnet at the NHMFL offers a unique opportunity in this respect especially for samples with large quadrupolar couplings. The inhomogeneous field of the hybrid magnet can be reduced by magic-angle spinning and small sample volume. Small sample rotors also make high spinning rates possible for averaging large spin interactions. A 2 mm fast MAS probe with rotational rates up to 40 kHz has been developed in collaboration with **A. Samosan (NICBP/Estonia)**. It can reduce the field inhomogeneity to less than 50ppb with careful calibration of probe position and orientation in the hybrid magnet. The field dependence of ^{27}Al spectra (obtained in collaboration with **D. Massiot, CRMHT/CNRS, France**) of $^{9}Al_2O_3$+$2B_2O_3$ from 14 to 40 T is shown. Even with the additional ~3ppm line broadening from the magnetic field fluctuation, the spectrum at 40 T shows unique spectral resolution. All of these spectra were acquired at the NHMFL.

activities. This is a very broad mission in solution and solid-state NMR spectroscopy, as well as imaging and diffusion measurements.

2001 has been a particularly productive year for developing unique capabilities and probes to enable a wide variety of NMR experiments in superconducting magnets up to 19.6 T and in resistive/hybrid magnets to at least 40 T. The number of user magnet days on our high field instruments has increased by 24% over last year, and in addition, external users have consumed more than 150 days on lower field instruments.

Pseudouridine as a Conformational Switch in an RNA Helix: A curious mechanism devised by structural RNA molecules to expand the limited vocabulary of four bases is the chemical modification of selected bases, the most abundant of which involves the enzymatic rotation of uridine, with respect to its glycosidic linkage, to form pseudouridine (ψ). N. Greenbaum and M. Newby (FSU) have used solution NMR to characterize the role of a phylogenetically conserved ψ residue in the branch site helix of the eukaryotic spliceosome, an RNA duplex critical in the splicing of precursor mRNA. They find that the ψ residue induces a dramatically altered architectural landscape compared with that of its unmodified counterpart. Moreover, the ψ-induced structure explains recognition of the branch site by splicing factors and positioning of the nucleophile in the splicing reaction. This NMR-based structure determination provides the first demonstration in which a modified base functions as a major determinant of RNA structure, with significant implication for its activity.



Branch site duplex with ψ *vs.* Unmodified duplex

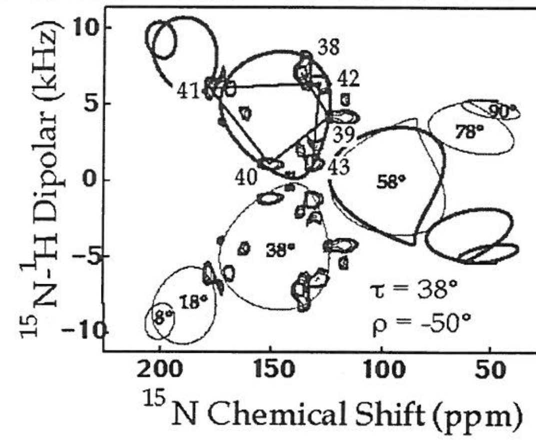
Solution structures of duplexes representing the eukaryotic pre-mRNA branch site helix from *S. Cerevisiae*. *Left*: the structure of the duplex including pseudouridine (ψ) in its conserved position on the U2 snRNA strand is characterized by the branch site residue (A24) extruded from the helix, and a sharply kinked backbone. A24 participates in a base triple with the A7-U22 Watson-Crick base pair (upper left). The kink in the backbone reverses orientation of the 2'OH of A24 and exposes it in the major groove, which may facilitate its nucleophilic function in splicing (lower left). *Right:* in contrast, the structure of the unmodified duplex displays regular helical geometry. Both A24 and A23 are stacked within the helix and form hydrogen bonds with U6 (far right).

The NMR program has established user programs around existing resources and magnets:

- The wide-bore 600 (Tallahassee) and wide-bore 750 MHz (Gainesville) systems have provided opportunities for developing imaging, diffusion, and solid state NMR technology and applications that require bore dimensions greater than 52 mm.

- The 720 and 830 MHz narrow bore systems provide opportunities for miniaturizing instrument hardware and performing experiments at higher field.
- The 11.7 T 40 cm bore system in Gainesville provides unique opportunities in the arena of animal imaging, diffusion studies, and *in vivo* spectroscopy.
- The resistive and hybrid magnets at the NHMFL provide a mechanism to look into the future when superconducting magnets will reach much higher fields. To do so, a great deal of technology and skills must be developed to achieve stable homogeneous fields or to compensate for instabilities and inhomogeneities. Recent results at 25 and 40 T from the NHMFL illustrate capabilities available nowhere else in the world.

The program is also committed to building technology and developing the science towards optimal utilization of future magnet systems at the NHMFL. The NHMFL and the NMR program await the commissioning of the 900 MHz 100 mm ultra-wide bore magnet system. This magnet is now in the test dewar phase in the hands of the NHMFL Magnet Science and Technology Group. The NMR Program is participating by conducting mapping and drift measurements of the magnet. Site preparation for this 24-ton superconducting magnet has been completed in the magnetic resonance wing of the laboratory. A special pit has been constructed to provide user access to the bottom of the 900 MHz magnet and a portion of the roof was raised to allow the upper instrument stack installation and removal. In addition a triple resonance console has been purchased from Bruker Instruments and is 90% delivered. While a few probes have been ordered with this system, most of the probes will be developed through the activities of the NHMFL RF engineering program and our collaborators around the world.



^{15}N PISEMA spectra that correlates the anisotropic ^{15}N chemical shift and ^{15}N-^{1}H dipolar interactions is shown for the transmembrane helix from the M2 protein of influenza A virus. The spectrum is the result of a number of single and multiple site labeled spectra superimposed. From the assignments it is clear that a resonance pattern analogous to a helical wheel is present. In fact, this observation results from the transformation of the laboratory frame of reference into the spectral frame. This resonance pattern and the resultant orientational restraints have led to a high resolution characterization of the backbone structure of this peptide in a fully hydrated lipid bilayer environment—a feat that has not been achieved by any other technology. The continuing work on M2 protein is in collaboration with Robert Lamb and Larry Pinto (Northwestern Univ.)

To achieve unique capabilities in this diverse range of spectroscopy and on a variety of magnet systems not normally used for NMR spectroscopy more resources are needed than those provided by the core grant. The program has been very successful in gaining such support:

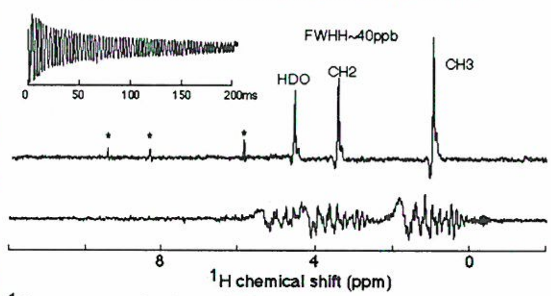
- W. Brey (NHMFL, NMR-RF Program) has been funded through an IHRP entitled "Aligned Sample and Magic Angle Sample Spinning Triple Resonance Solid-State Probes for the Wide-Bore 900". This project is a collaboration with **Stanley J. Opella (UCSD)** and **Robert G. Griffin (MIT)** two of the pioneers in the field of biological solid-state NMR.

- Z. Gan (NHMFL, NMR Program) has been funded through an IHRP entitled "High Resolution NMR Above 1 GHz Using the Keck Resistive Magnet". This project is a collaboration with **James H. Prestegard (Univ. of Georgia)** one of the pioneers in solution NMR spectroscopy.
- **Timothy Peck (MRM Corporation)** in partnership with the NHMFL has been funded ($1M) through an NCRR SBIR grant entitled "Microcoil NMR: Extending Field Limits of High Resolution". This effort in collaboration with **Piotr Starewicz (Resonance Research)** will develop high resolution capabilities on the 31 mm bore, 830 MHz magnet at the NHMFL.
- S. Blackband (NHMFL, AMRIS) has been funded ($5.2M) through an NCRR P41 Research Resource entitled "High Field Magnetic Resonance Research and Technology". In addition to other collaborators **Andrew Webb (Univ. Illinois), Stuart Crozier (Univ. Queensland)** and **Richard Bowtell (Nottingham Univ.)** and co-investigators.
- T. Cross (NHMFL, NMR Program) has been funded through an NIGMS P01 grant ($8.1M) for a project entitled "Membrane Protein Structural Genomics: *Mycobacterium tuberculosis*". This grant includes $400k for upgrading NHMFL NMR user facilities. Among the 12 co-investigators are three NMR spectroscopists: **Charles R. Sanders (Case Western Reserve Univ.), Frank Sönnichsen (CSRU)** and **Stanley J. Opella (UCSD).**

In addition, two grant proposals are pending:

- T. Cross (NHMFL, NMR Program) has submitted a proposal to the High End Technology Program at NCRR entitled "Wide Bore 800 MHz Spectrometer for Solid-State NMR Spectroscopy and Imaging" with **Martin Kushmerick (Univ. of Washington)** and **Gary Drobny (UW)** as co-investigators.
- **James H. Prestegard (Univ. Georgia)** has submitted a proposal to NIGMS for the purchase of a 900 MHz magnet to be located at the Univ. of Georgia. As a participant the NHMFL will have some access to this narrow bore solution NMR spectrometer system.

HENPEC (HEteroNuclear PhasE Correction)



^{1}H spectra of ethanol/$D_2$0 sample with (top) and without (bottom) HENPEC. Spectra were obtained on the Keck magnet operating at 19.6T using a 5 mm solid state NMR probe. The insert shows the simultaneously acquired ^{2}H FID for HENPEC and '*' indicates spinning sidebands. These preliminary spectra have been obtained by Gan in collaboration with Gor'kov and Brey. This program is continuing in collaboration with **James Prestegard (Univ. of Georgia).**

A range of capabilities are presently available to the user community:

- **NMR in Resistive (25 T) and Hybrid (40 T) magnets.** A new Tecmag Apollo console has been delivered to simultaneously acquire two independent frequencies so that HENPEC compensated spectroscopy can be fully available to users. The new console also has full pattern generation capability on the RF and 3 gradient channels to facilitate IZQC and NMR microscopy experiments. 40 kHz MAS is available for quadrupole nuclei.

- **Improving magnetic field homogeneity and stability for high-resolution NMR spectroscopy using resistive magnets.** Flux stabilization, ferromagnetic and active shims have been improved and optimized. Using the newly developed HENPEC method, residual magnetic field fluctuations have been corrected and 40 ppb ^{1}H line widths have been achieved on the Keck 25 T resistive magnet. Such line width is approaching the minimum requirement for high-resolution NMR spectroscopy of macromolecular solutions. This effort is continuing with a collaboration with Jeff Schiano (Penn State Univ.).
- **Intermolecular zero-quantum NMR spectroscopy**. Warren Warren (Princeton Univ.) has been improving the intermolecular zero-quantum approach to obtain high-resolution NMR spectra using the Keck resistive magnet at the NHMFL since first demonstration last year.
- **Double rotation (DOR) NMR probe.** The double axial (6 kHz and 1.5 kHz for inner and outer rotations) averages both the first and the second-order spin interactions for high resolution NMR spectroscopy of quadrupolar nuclei. (Ago Samosan, NICBP) The probe is compatible with the 25 T Keck, 720 MHz NB and 600 MHz WB magnets.
- **Satellite-Transition Magic-Angle Spinning.** The newly developed STMAS NMR experiment achieves high-resolution isotropic NMR spectra of quadrupolar nuclei. The experiment improves spectral sensitivity by an order of magnitude over the well-known multiple-quantum MAS experiment.
- **Triple-resonance NMR probes.** $^{1}H/^{19}F/X$ and $^{1}H/X/Y$ three-channel probes are available on the 600MHz wide bore magnet. Triple-resonance capability permits distance measurement among nuclei with different resonance frequencies.
- **Microcoils for solution NMR.** In collaboration with Andrew Webb (Univ. of Illinois at Champaign-Urbana), the NHMFL has been developing microcoil technology in both Tallahassee and in Gainesville using the 830 and 750 MHz instruments. This technology can minimize the amount of protein required for structural characterization.
- **Stray Field Imaging.** A STRAFI imaging probe has been built for the 19.6T superconducting magnet at the NHMFL in collaboration with Andrei Samoilenko (Chemical Physics Institute, Russian Academy of Sciences). The magnet has a stray field gradient about 75 T/m at 11.7 T and the STRAFI probe can achieve spatial resolution on the order of 10 μm. A second STRAFI probe with a floating probe head (a version of goniometer) has recently been completed, and enhances the spatial resolution.
- **Microimaging Probe.** A 25 mm clear access probe body is available for use with the 500, 600 and 750 MHz microimaging spectrometers. The clear access to the active volume is essential for some small animal and flow measurements.
- **Phased Array Hardware.** Both the 4.7 T, 33cm and 11.7 T, 40 cm have four channel phased array hardware installed (the first in the U.S. on animal imaging systems). Research is underway to develop the phased array RF coils required (not provided by the vendor).
- **Imaging/Spectroscopy RF Coil Development.** The new 11.7 T, 40 cm imager/spectrometer offers new challenges in rf coil design at high frequency over relatively large volumes, since conventional coil designs are inefficient. To this end novel volume coils (the ReCav coil) have been developed and tested at 200 and 400 MHz, and phased array coils have been constructed at 200MHz. These designs are being extended to 500 MHz.

- **Hyperpolarized ^{129}Xe and ^{3}He.** The construction of a spin exchange optical pumping system for the generation of hyperpolarized ^{129}Xe and ^{3}He is nearing completion. It is expected to be available as an NHMFL user resource in Spring 2002. The new polarized noble gas generator incorporates the highest power fiber coupled diode array laser system ever used for spin exchange optical pumping. The system has been designed to be self-contained for maximum functionality and portability to support a wide variety of hyperpolarized ^{129}Xe and ^{3}He NMR and MRI experiments at NHMFL sites. NMR applications already underway include studies of surfaces, binding sites in proteins, phase transitions and gas clathrate hydrates.

In addition there are a variety of capabilities that are under development or in the process of being purchased:

- **Cryoprobes.** Cryoprobes are being purchased for both 500 and 600 MHz solution NMR spectrometers. These probes will be used for high throughput structural genomics and for the characterization of high sensitivity kinetic and folding processes.
- **A new high performance Triple Resonance Solution Probe** is being purchased for the 720 MHz spectrometer to replace an outdated probe.
- **High Performance Flat Coil Probes** are being developed for aligned membrane protein systems. Double resonance designs achieved in house have far exceeded the performance of commercial probes even at 400 MHz. These designs are now being implemented for 600 MHz and will be the basis for the triple resonance IHRP effort described above.
- **Triple resonance MAS Probes** are being developed for the 900 MHz spectrometer system in collaboration with Robert G. Griffin (MIT). This capability will used for protein structural and dynamic characterizations.
- **A 7 mm MAS Single Resonance Probe** is being developed for the narrow bore 830 MHz spectrometer in collaboration with Ago Samosan (NICBP, Estonia) to increase the sample volume for low gamma and quadrupolar nuclei.
- **A 2 mm HX Indirect Detection 50 kHz MAS Probe** is being developed for the narrow bore 830 MHz spectrometer in collaboration with Ago Samosan (NICBP, Estonia) to broaden our capabilities with low gamma and quadrupolar nuclei.
- Superconducting RF Coils for ^{15}N NMR applications are being designed and developed in collaboration with Rich Withers (Bruker Instruments).

NMR Operation and User Statistics for 2001

		Minority	Women
Number of Projects	74		
Number of Research Groups	67		
Number of Users	153		
Number of Senior Investigators (U.S.)	50		7
Number of Senior Investigators (non-US)	22		1
Number of Postdoc (U.S.	10	1	3
Number of Postdoc (non-U.S.)	4		
Number of Students (U.S.)	29		3
Number of Students (non-U.S.)	6		

NMR Spectroscopy and Imaging Magnet Days for 2001

Magnet Day Statistics	833 NB	720 SB	600 WB
User Affiliation			
NHMFL	219	218	264
U.S. Universities	25	134	28
U.S. Government Labs	0	0	0
Industry	5	0	0
Overseas	78	11	37
Development & Maintenance	18	5	28
Idle	12	0	0

Note: More than 150 magnet days on lower field instruments have been used by external users.

Note: The number of user magnet days increased 24% over last year. These numbers will continue to increase as new unique capabilities continue to be added to our repertoire.

FOURIER TRANSFORM ION CYCLOTRON RESONANCE MASS SPECTROSCOPY

During the past year the ICR program continued instrument and technique development as well as pursuing novel applications of Fourier Transform Ion Cyclotron Resonance (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 directors for instrumentation, biological applications and environmental applications as well as a machinist, technician, five rotating postdocs, and one permanent staff member, all of whom are available to collaborate and/or assist with projects.

FT-ICR Magnet and Instrumentation Update

The **9.4 T, 220 mm bore system** continues to be the highest performance electrospray FT-ICR mass spectrometer in the world. It offers unrivaled mass resolving power ($m/\Delta m$ = 10,000,000 at mass 9,000 Da) and dynamic range (>10,000:1), as well as high mass range, mass accuracy, efficient tandem mass spectrometry (MS^n as high as MS^8), and long ion storage period. The magnet is passively shielded to allow proper function of all equipment and safety for users. This system has recently been upgraded with external mass selection prior to ion injection for further increase in dynamic range.

A **7 T electrospray FT-ICR instrument** has been dedicated to high sensitivity biological analysis. Nano-scale liquid chromatography (LC) and capillary electrophoresis (CE) interfaces are available. Picomolar concentration detection is the norm. Nano-LC sensitivity is demonstrated with repeatable detection limit of 300 attomoles loaded onto a column (in biological matrix). Absolute limits of 100 attomoles have repeatably been detected (*Anal. Chem.*, **73**, 1721-1725 (2001)). Recent upgrades include addition of a MIDAS data station and new high sensitivity tandem mass spectrometry options of electron capture dissociation (ECD) (*Anal. Chem.*, **73**, 3605-3610 (2001)) and infrared multiphoton dissociation (IRMPD). The instrument is currently available for use.

Additional 9.4 and 7 T magnets have been installed. The 9.4 T magnet is currently used for ICR instrumentation development. In collaboration with ExxonMobil, the 9.4 T instrument is initially being equipped with a field desorption ion source and should be available 1 February 2002. In addition, the instrument's design will focus on ionization source flexibility. The 9.4 T instrument will offer both electron impact and chemical ionization sources as well as field desorption/ionization and MALDI ionization sources. A similar instrument will be installed in the 7 T magnet. The 7 T magnet will be optimized for volatile mixture analysis. Samples will be volatilized in a heated silica coated inlet system (at 200-300 °C) and ionized by an electron beam (0-100 eV, 0.1-10 μA). The ions will be collected in a linear multipole trap and injected into the FTICR cell. Mass resolving power ($m/\Delta m$) greater than 10^5 and mass accuracy within 1 ppm have been achieved routinely in a similar (lower field) instrument. Hundreds of components in a complex mixture (e.g., petroleum distillates) can thus be resolved and identified. This instrument should be available 1 June 2002.

A **15 T, 110 mm bore superconducting magnet** is scheduled for delivery in July 2002.

ICR Applications

Biomolecular sequence verification continues to be in high demand. Protein and oligonucleotide masses can be determined with high sensitivity and ppm accuracy. Molecules can be fragmented (by collisions, photons, or electron capture by multiply-charged positive ions) to yield sequence-specific products. Sites and nature of post-translational modification (e.g., glycosylation, phosphorylation, etc.) have been demonstrated (*Anal. Chem.*, **73**, 4530-4536 (2001)). In-house software is constantly being modified to improve data analysis.

Hydrogen/deuterium exchange is used to determine tertiary structure in solution (biological) or the gas phase. The exchange (resulting in a mass increase) is monitored with the mass spectrometer. Details of biomolecular conformation and surface contact between molecules in a noncovalent complex can be deduced. Conformational changes induced by point mutation, inhibitor, ligand or cofactor binding can determined by H/D exchange and FT-ICR. Recent applications include assembly interaction of HIV capsid proteins and RNA binding protein complexes.

The 7 T instrument is primed for immediate impact in **environmental analysis**, where intractably complex mixtures are common. Several environmental applications of FT-ICR MS are underway. For example, diesel fuel is analyzed to evaluate removal of sulfur-containing organics that contribute to air pollution (*Anal. Chem.*, **70**, 4743-4750 (1998)). Initial characterization of a jet fuel (JP-8) contaminated site has been completed (*Anal. Chem.*, **71**, 5171-5176 (1999)). The site is now targeted for remediation, and FT-ICR will be used to monitor progress. Environmental work continues on the 9.4 T ESI instrument and concentrates on the resolution and identification of thousands of polar heteroaromatic species in crudes and commercial fuels (*Energy & Fuels,* **15**, 1186-93 (2001); *Energy & Fuels*, **15**(2), 492-498 (2001); *Can. J. Chem.*, **79**, 546-551 (2001)). These species poison catalysts and complicate the refining process, resulting in lost potential dollars for the crude/fuel producer and more environmentally harmful waste. This work will progress to include a collaborative project with the State of Florida Department of Environmental Protection that will seek to identify petrogenic contributions to the overall total extractable petroleum hydrocarbons at the recently discovered St. Marks refinery spill site. A similar project is being initiated with Eglin Air Force Base to identify contaminants at a pair of landfill sites. Work on the forensic applications of FT-ICR MS (initiated in 1999) continues with the identification of both active ingredients and filler agents in commercially available and military explosives.

ICR Operation and User Statistics for 2001

Number of Projects	67	
Number of Research Groups	46	
Number of visiting students	16	
Number of visiting postdocs	2	
Magnet	9.4 T, 220 mm	9.4, 155 mm
Affiliations	Number of Magnet Days	
NHMFL, UF, FSU, FAMU, LANL	259	120
U.S. University	31	180
U.S. Govt. Lab	0	
U.S. Industry	11	
Overseas	9	
Maintenance	10	
Idle	32	52
Total	352	352

ELECTRON MAGNETIC RESONANCE (EMR) PROGRAM

The continuing trend in the development of EMR spectroscopy toward higher field and frequency ranges is providing the advantages that can be gained from the increase in both these parameters for a broad variety of applications. The applications of high-field/high-frequency EMR can be roughly classified into two categories: The first one includes studies of highly concentrated spin systems, typical for material sciences. The second category of applications mainly concerns chemical, biochemical, and biological paramagnetic spin systems that are usually characterized by low spin concentrations. Low spin density systems require high spectrometer sensitivity. The high-field, multi-frequency spectrometers at the NHMFL were originally built for investigations of highly concentrated spin systems. The sensitivity of the spectrometers has recently been increased by orders of magnitude. Today the EMR users program spans biology, chemistry, and condensed matter physics, with an emphasis on physical chemistry and a clear trend toward more biological science.

There are two different regimes in the frequency domain for EMR spectroscopy, (a) from 1 to about 150 GHz, and (b) above 150 GHz. From 1 GHz up to about 150 GHz, the electromagnetic waves propagate in single-moded or over-moded waveguides, and one generally uses single mode cavities. Above 150 GHz, single mode cavities become less efficient and impracticable due to the extremely small size, and either a Fabry-Perot type cavity is used for small samples, or measurements are performed without cavity for larger samples. In EMR spectroscopy, increasing the frequency increases the absolute sensitivity in the case of single mode cavities, but as the sample size has to decrease at the same time, the concentration sensitivity is not significantly affected. Also it should be noted that pulsed techniques are only available up to 140 GHz, there are no pulse switches available for higher frequencies.

Very High Field EMR Spectrometers

The development of EMR spectrometers at the NHMFL has focused on **very high field/very high frequency** machines. All the instruments we have developed are **multifrequency.** Presently there are five high field EMR spectrometers; the first three are based on a 17 T superconducting magnet, the fourth is a Transient machine also with a superconducting magnet, the fifth one uses the 25 T resistive "Keck" magnet.

The first three spectrometers are built around a 17 T Teslatron magnet made by Oxford Instruments Inc. This magnet consists of a main 17 T coil with a +/- 0.1 T sweep coil.

- **Low sensitivity CW spectrometer.** We use different sources in the 23 GHz to 3 THz range. The detector is either a Schottky diode or a "hot electron" InSb bolometer. This instrument is a direct transmission system and has very broad band capabilities. The performance specifications are:

  Sensitivity: 10^{12} spins/gauss second at room temperature

  Averaging: up to about 100 spectra

  Field calibration: g determination error: +/- 3×10^{-5}

Resolution: 1 to 10 ppm

Sample temperature: 1.6 to 300 K.

- **High sensitivity CW Quasi Optical instrument.** The sources operate from 110 GHz up to 475 GHz for a g = 2 paramagnetic center. The system, optimized at 220 and 330 GHz, employs very low loss quasi optical (QO) techniques; these techniques allow for phase information. The detector is an InSb mixer. The sensitivity of the QO machine is 10^{10} spins/gauss second at room temperature, all others specifications are identical to the specifications of the low sensitivity spectrometer.
- **CW ENDOR spectrometer.** The high sensitivity QO machine is now equipped with a probe for CW Electron Nuclear DOuble Resonance. Concerning electron magnetic resonance, the machine operates at 220 and 330 GHz. For nuclear resonance, the RF is within the 0 to 1 GHZ range with 100 W power. The temperature of the sample is in the 4 to300 K range.
- **Transient EMR instrument.** The inherent timescale of an EMR experiment is inversely proportional to the measurement frequency, and allows faster measurements at higher frequencies. In time-resolved EMR this enables the measurement of systems with very short lifetimes and/or fast relaxation rates. This prompted the construction of a new high-field spectrometer with both fast detection as well as optical access for excitation of paramagnetic excited states and/or creation of paramagnetic reaction intermediates. The design of the spectrometer, which operates at 120, 240, and 360 GHz, combines quasi-optical techniques and a super-heterodyne detection scheme based on Schottky diode mixers and with a 1 GHz detection bandwidth. It features both sub-ns time-resolution and a high g-resolution. The room-temperature sensitivity in CW-mode is of the order of 10^{11} spins/gauss without cavity and $5x10^{8}$ spins/gauss in a Fabry-Perot cavity. The maximum time resolution is 600 ps. The magnet is a superconducting magnet
- **25 T "Keck" magnet spectrometer** is built around the 25 T, high homogeneity magnet. The "Keck" magnet is perfectly poised for EMR - fast ramping to the magnetic field of interest, very convenient sweepability, homogeneity better than 10 ppm over a typical sample size (a few mm^3), good field stability. It uses a far infrared laser for its source and an InSb "fast electron" bolometer detector with a magnetically extended response. The system performance specifications are:

  Frequency range: up to 700 GHz for a g=2 system

  Sensitivity: 10^{13} spins/gauss second at room temperature

  Field calibration: g determination error: +/- $3x10^{-5}$

  Resolution: better than 10 ppm

  Sample temperature: 1.6 - 400 K.

EMR Program Statistics

All the research projects of the EMR program involved measurements made with the spectrometer using the 17 T superconducting magnet. Some of them also made use of the Keck magnet. Those projects are indicated by **(K)** in the list of projects in the appendix.

EMR Facility Operation and User Statistics, 1/1/01 to 12/33/01

Research Projects/Groups	Total	U.S.	Overseas
Number of Research Projects	38	28	10
Number of Research Groups	47	32	15
Users	Total	Minority	Female
Numbers of Users	80	2	15
Number of Senior Investigators, U.S.	26	1	3
Number of Senior Investigators, Overseas	20		3
Number of Students, U.S.	17	1	4
Number of Students, Overseas	6		2
Number of Post Docs, U.S.	6		2
Number of Post Docs, Overseas	5		1
Number of Magnet-Days	17 T*	14 T	
NHMFL, UF, FSU, FAMU, LANL	60	82	
U.S. University	107	33	
U.S. Govt. Lab.	3		
Industry	10**		
Overseas	59	20	
Development	10	50	
Maintenance	20	15	
Idle	28	60	
Total	287	260	

* Number of magnet days were on for 11 months
** Industry magnet days were development

LARGE MAGNET COMPONENT TEST LABORATORY

To support the continued development of a variety of cryogenic/electrical components for large superconducting magnet systems, the Large Magnet Component Test Laboratory (LMCTL) has been established in Cell 16 of the DC Field Facility in Tallahassee. These facilities, which provide high current (up to 80 kA), high field, and low temperatures, have been essential in recent years to programs within the Magnet Science and Technology Group at NHMFL as well as to external groups from both the government and commercial sectors.

Table 6. Magnets available for use in the LMCTL.

Identifier	Type	Max. Field (T)	Bore (m)	Special Features
Oxford Split	Nb_3Sn/NbTi split solenoid, high-J, impregnated winding	14	0.150	30 x 70 mm^2 radial access
CWTX	NbTi split solenoid, low-J, ventilated winding	8	0.380	67-mm dia. radial access
TACL	NbTi cos(θ) dipole, high-J, ventilated winding	7	0.040	1-m long uniform field region
SMES CTA	NbTi simple solenoid, low-J, ventilated winding	4	2.0	Separate cryogenic test volume in bore

LMCTL Usage in 2001

- Tests by representatives of Fermi National Accelerator Laboratory of high-current conductors potentially applicable to future high-field dipole magnets.
- Test of the 900 MHz NMR Solenoid in an "open" cryostat prior to installation in its final cryostat.

GEOCHEMISTRY

The past two years the geochemistry program has concentrated on using existing instrumentation for geochemical and environmental research, and we have been successful in obtaining external funds for these programs. The majority of the funding for the Geochemistry program comes from the Earth Science Directorate at NSF. Presently there are three active NSF research grants to Salters, two NSF grants to Wang, and one grant to Odom. The research funded through these programs concerns the study of the chemical evolution of the solid Earth through trace element and isotope analyses as well as the use of isotopes to study several aspects of environmental geochemistry and global change. The solid Earth geochemistry research spends considerable effort on obtaining a better understanding of melting processes within the Earth and especially beneath ocean ridges. The Geochemistry program also receives funding from FSU through a Program Enhancement Grant (V. Salters, P.I.) and a Center of Excellence grant (Y. Wang, co-P.I.). This year two students successfully defended their Ph.D. theses, while one received a M.Sc.

The Geochemistry program continued this year its expansion of activities in the environmental science area. The relation with the rest of the NHMFL is especially in this area. We are pursuing speciation studies of metals with dissolved organic matter in natural waters in which we examine metal complexes using FT-ICR-MS, EPR and ICP-MS instruments. This research also involves a collaboration with researchers at the Analytical Chemistry Division at Oak Ridge National Laboratory. Two important new environmental research projects were funded through NSF, one project uses the natural variations in mercury isotopes to determine mercury cycling in the environment (R. Odom, P.I.) and the second involves the study of coastal wetland dynamics (Y. Wang, co-P.I.). This second study is funded through the NSF Biocomplexity program.

Instrumentation was maintained and improved without major new developments.

Table 7. Types and configuration of mass spectrometers for Geochemistry.

Name	Type of ionization	Mass analyzer configuration	Detection systems	Measurements	Sample introduction
Isolab	Thermal and Sputtering	E-M-D1-E-D2	D1: 4 faraday cups after M D2: Daly Ion counting and faraday cup	Isotope ratios: Th, Hf and Hg	Solids and chemical separates
262/RPQ	Thermal	M-D1-E-D2	D1: 7 faraday cups, 1 electron multiplier D2: Electron multiplier	Isotope ratios: Pb, Sr, Nd, Os	Chemical separates
ICP-MS	Thermal-Plasma	M-E-D	D: Electron multiplier	Concentrations and isotope ratios	Solutions

E = energy filter
M= Magnetic mass filter

Geochemistry Facility User Statistics for 2001

	Total	Minority	Female
Number of Research Projects	20		
Number of Senior Investigators (U.S.)	22	1	4
Number of senior investigators non-U.S.	4	0	1
Number of students U.S.	11	0	7
Number of students, non-U.S.	0	0	0
Number of post-docs U.S.	1	0	0
Number of post-docs non-U.S.	0	0	0

Geochemistry Magnet Day Statistics for 2001

Number of Magnet Days	Isolab	262/RPQ	ICP-MS	Total
NHMFL, UF, FSU, FAMU, LANL	140	143	204	487
U.S. University	10	25	40	75
U.S. Govt. Lab	0	0	0	0
U.S. Industry	0	0	0	0
Overseas	0	0	0	0
Maintenance	74	100	31	205
Total	224	268	275	767

Access to NHMFL Facilities

User access to the NSF-funded NHMFL Continuous and Pulsed Field Facilities is controlled by a two-step proposal and review process that is administered by the Directors of the Continuous and Pulsed Field User Programs. A brief initial proposal is reviewed by NHMFL staff and approved or denied by the Director of the NHMFL. Then, every year, a summary listing of all user programs is compiled and ranked in order of magnet use. Users who have consumed a significant portion of resources (about 1% to 2%) within the previous twelve months are required to submit a more extensive proposal based on their present and future work in high fields. Users in this category are the largest users and collectively account for at least 80% of the annual total facility use. In addition, all users of the 45 T hybrid and 60 T Long Pulse magnets will be required to submit such a proposal. Each major proposal is reviewed by a panel of scientists chosen for their familiarity with the fields of research commonly done at the NHMFL. The panel can also seek input in the form of mail reviews. A grade from A to C is given to each proposal with an A being required for heavy use of facilities, and especially, use of "expensive" or high demand facilities. A "C" grade means the user has access only after other demands are met. (Work that would merit a failing grade is blocked or stopped before it reaches the major proposal process.) The final decision for use of the High Field Facility rests with the Director of the NHMFL.

Access to The High B/T Facility is described in more detail in the "High B/T section" above.

The ICR Mass Spectrometry Facility is currently supported primarily as an NHMFL core activity by the Chemistry Division of NSF, with some State of Florida matching funds for personnel and visitor budget. Electron Magnetic Resonance facilities using the superconducting magnets and X-band spectrometer, isotope geochemistry facilities, and many of the magnetic resonance spectroscopy and imaging facilities are supported primarily by State of Florida funds, with additional support from the NHMFL Cooperative Agreement with the NSF. All of the above facilities are available to external users. Collaborative access to them is governed by the terms of the grants and the principal investigators.

Access to facilities at the NHMFL are moving to a common Web-based user proposal process that is currently being field tested by the DC Field User Program. The core package will be modified after testing to accommodate the NMR, EMR, ICR, and potentially other programs.

3. MAGNET SCIENCE AND TECHNOLOGY

The Magnet Science and Technology (MS&T) group has three main responsibilities within the NHMFL:

- Major magnet development projects supported by the NHMFL
- Research and development programs which advance magnet and magnet materials technology
- External activities such as magnet design and development in collaboration with other organizations.

The first and largest of these activities are major magnet development projects, which include both in-house magnet systems and those funded by external organizations. MS&T has developed this dual role to best utilize the human capital developed through the many magnet projects for the NHMFL. With the pending completion of major projects such as the Hybrid, 900 MHz and many of the resistive magnets, external activities are expected to increase as a fraction of the MS&T workload.

MS&T continues to work on a number of external programs and projects with outside agencies. This is part of the natural evolution of the organization and exemplifies the high regard that the MS&T group enjoys worldwide. A few examples of major external projects include:

- Magnet and cryogenic design for the DOE sponsored DuPont ore separation magnet
- Magnet design and construction for the Michigan State University, National Cyclotron Laboratory
- Design and construction of a radiography pulsed magnet system for Sandia National Laboratories
- Design of HTS current leads for the W7-X plasma physics experiment.

A significant amount of work has been accomplished over the past year. Highlights of achievements are presented below, followed by separate projects reports, including schedule and cost data for major projects.

Major Projects

The 45-T Hybrid superconducting outsert experienced an unprotected quench in June of 2000 that resulted in damage to the coil. The outsert now runs at 80% of design field, but the facility has been brought back to 45 T by upgrading the resistive insert. We have begun a project to rebuild the compromised A coil of the outsert, which should allow the Hybrid operating field to increase to at least 48 T.

DC resistive magnets have been maintained and successfully operated over the past year. A design effort is underway to upgrade six sites with higher field magnets. Also, preliminary conceptual work has been carried out on configurations for a DC resistive transverse field coil.

The 900 MHz project is progressing toward the ultimate goal of achieving 21 T in a 100 mm bore NMR spectrometer. The coil is in the bucket test, which will complete in early 2002. The design of the final cryostat is complete and the industrial vendor has begun fabrication of the components. The final test of the fully assembled magnet system is scheduled for summer 2002.

The 60 T quasi-continuous magnet at LANL, which was first operated as a user facility in November 1998, suffered a destructive failure in June 2000. A recovery plan is now in place, which combines the increased use of short pulse magnets and a rapid schedule for rebuilding the 60 T long pulse magnet.

The pulsed magnet group continues to deliver capacitively driven magnets for the LANL user facility. Improved lifetime of the 60 T, 15 mm bore magnets has been achieved. Also, a new 50 T, 15 mm bore mid-pulse magnet, which will replace some of the capability of the 60 T long pulse magnet, has been delivered.

The 100 T project achieved significant progress over the last year. The design for the outer coils is complete and prototyping is underway. A 75 T CuNb insert design is complete and prototyping is planned with testing as a potential user upgrade magnet.

Development Programs

The HTS magnets and materials group, in collaboration with Oxford Superconductor Technologies, are designing and building a **5 T high-field insert coil for the 20 T, 200 mm bore resistive magnet.**

HTS current leads are under development for replacing the main current leads in the Hybrid outsert. These leads will be installed during the coil A replacement and allow much more reliable and cost effective operation.

The High Strength/Conductivity materials group is investigating **strengthening of copper by cryogenic deformation**. Yield strengths in the range of 500 to 600 MPa have been achieved by this process.

External Activities

The MS&T group completed the design and construction of the cryogenic system for a **prototype HTS magnetic ore separator**. This activity is part of a cooperative development project supported by the Department of Energy.

With Michigan State University, MS&T has a grant to build a superconducting sweeper magnet for particle control at the MSU-National Superconducting Cyclotron Laboratory.

The MS&T group is under contract to Sandia National Laboratories to build a set of Radiography pulse magnets. These magnets utilize similar technology to the NHMFL short pulse user magnets.

Finally, MS&T staff participated in a variety of design and analysis activities in collaboration with other laboratories. Examples include, HTS current lead design for the W7-X magnet system for Germany, analysis of He II two phase flow for the TESLA project at DESY-Hamburg, and characterization of HTS materials for a variety of applications.

More details on these and other MS&T projects are described herein.

Major Projects

Project Title: **45 T Hybrid Magnet (Rebuild outsert Coil A)**

Report Date: **December 31, 2001**

Objective

This project goal is to return the superconducting outsert magnet to its full design field of 14 T (I = 10 kA) following the unprotected quench that damaged the coil in July 2000. Plans are in place to begin fabrication of a new Nb_3Sn coil to replace the damaged coil. The project also includes replacement of existing conventional high current leads with HTS leads to reduce refrigeration loading and improve reliability of the facility. Both of these modifications will require that the facility be taken out of service for approximately 9 months in 2003. The total cost of these modifications is $2,210K.

Status

Preparations to rebuild coil A of the superconducting outsert are underway:

- Nb_3Sn wire has been ordered for delivery by end of April 2002. This is a subcontract with a total estimated cost of $465K.
- Procurement of modified 316LN steel for the conductor jacket is also in place. Total cost of this procurement is a maximum of $174K (depending on quantity of material delivered).
- A plan for fabricating the cable-in-conduit conductor is being developed and we expect to have the rebuild project in full swing by early 2002.
- Dummy cables have been procured and will be used to settle critical issues.

During the extraction and repair of the superconducting outsert, the "normal" cryogenic current leads presently installed in the Hybrid cryostat will be replaced with HTS leads.

- R&D on the lead components is underway
- HTS material for the leads has been procured for a cost of $38K.

The conductor and coil-fabrication tasks presently slated to begin in Spring 2002 will consume approximately 2-years effort. Approximately 6 to 9 months prior to their completion, Hybrid operation will cease and the outsert will be extracted from the cryostat and disassembled, allowing reassembly to begin as soon as the new Coil A is completed. We expect to reassemble and replace the outsert within an additional 6 months, making the Hybrid repair complete and ready for cooldown in the third quarter of 2004.

45 T Hybrid Magnet (Rebuild Outsert Coil A): Project Schedule

Milestone	Current Schedule
Procure Nb_3Sn conductor	May 2002
Procure 316LN stainless steel strip	June 2002
Assemble CICC jacketing line at the NHMFL	July 2002
Conductor and coil A fabrication	July 2002 – July 2003
Complete and test HTS current leads	March 2003
Install coil A and HTS leads in Hybrid	March 2004
Modification complete, begin cooldown	August 2004

45 T Hybrid Magnet (Rebuild Outsert Coil A): Project Costs

	Expenses to date (2/4/02)	Remaining Costs to Complete	Total Costs
Personnel	39, 616	351,112	390,728
Equipment/Other	66,986	1,528,488	1,595,474
Indirect	25,718	197,639	223,357
Total	132,320	2,077,239	2,209,559

MAJOR PROJECTS

PROJECT TITLE: **RESISTIVE MAGNET PROGRAM**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The Resistive Magnet Program designs, builds and maintains high field DC magnets for the scientific user community. The scope of activity ranges from Hybrid inserts providing fields up to 45 T and consuming up to 30 MW of power to small wire-wound modulation or gradient coils that are inserted in the bore of high field magnets. The scientific community to whom we provide service consists primarily of the users of the Tallahassee facility but we also provide contract services to facilities in Tsukuba, Japan, and Nijmegen, The Netherlands, among others.

Status

Hybrid Insert Upgrade: The primary activity over the past year has been upgrading the Hybrid insert to provide 45 T DC with the reduced field from the superconducting outsert. By February 1, 2001 we had completed and installed an upgraded insert and again attained 45 T.

The following activities are funded under the core NSF grant and will be starting in earnest as shown. They are listed in priority order, with highest priority first. Priorities have been established in consultation with the NHMFL Users Committee at its November 2001 meeting. A schedule summary is given below.

1. The field in the 50 mm bore magnet will be upgraded from 25 T to 32 T by using a four coil system similar to our existing 32 mm bore magnets.
2. The field in the 50 ppm magnet will be upgraded from 23 T to 29 T also by using a four coil system similar to our existing 32 mm bore magnets.
3. Gradient Upgrade: a wire wound, water-cooled Helmholtz coil will be installed in the bore of the existing 25 T, 50 mm bore magnet. The gradient coil will be driven by either ac or dc for use in magnetometry experiments.
4. The field in our existing 32 mm bore magnets will be upgraded from 33 T to 35 T by introducing current density grading in the coils.
5. The field homogeneity of the 52 mm bore, 25 T magnet will be upgraded from 12 ppm to 1 ppm over a 10 mm diameter spherical volume by installing resistive shims coils in the bore of the existing magnet.
6. A transverse field magnet will be designed and built to provide field perpendicular to the access tube. The access tube will have a 32 mm inner diameter and the field provided will be in the range of 20 to 30 T. If we design the magnet to use two of our 10 megawatt power supplies, it will be capable of providing field around 20 T. If we design it for 40 MW, it will be in the 30 T range. Design specifications have been discussed with the NHMFL Users Committee and continued dialogue is anticipated as the specifications develop.

Resistive Magnet Program Schedule Overview

Magnet Cell #	Present				Future			Start Date	Finish Date
	Field	Bore	Other		Field	Bore	Other		
5	25 T	50 mm			32 T	50 mm		12/01	5/03
7	23 T	32 mm	50 ppm		29 T	32 mm	50 ppm	1/02	7/03
5					5 T/m	32 mm	gradient	6/02	11/02
8, 9, 12	33 T	32 mm			35 T	32 mm		8/02	11/03
6	25 T	52 mm	12 ppm		25 T	52 mm	1 ppm	11/01	12/02
10					20-30 T	32 mm	transverse	6/02	7/05

MAJOR PROJECTS

PROJECT TITLE: **HIGH FIELD MAGNETIC RESONANCE MAGNET SYSTEMS**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The 900 MHz magnet is a wide bore high resolution NMR magnet, with a central field of 21.1 T, a room temperature bore of 100 mm, and a temporal and spatial homogeneity objective of less than 1 part per billion in a 4 cm DSV. The magnet will operate in the persistent current mode at a reduced temperature of 1.8 K. The magnet employs epoxy impregnated coil technology, with coils fabricated from NbTi and Nb_3Sn metallic superconductors. The magnet system includes magnet, superconducting and room temperature shims, cryostat with JT refrigerator, and power supply.

Status

- All nine individual superconducting coil assemblies were complete by the beginning of 2001.
- All magnet components and interfaces, such as persistent current joints, superconducting switches, diode packs, shunt resistors, bucking coils, and other magnet assembly hardware are now complete.
- The quench detection and instrumentation and control has been completed including (1) the fuse boxes to isolate the operators from possible high voltages coming from the magnet assembly, (2) two quench detection systems, one main and one redundant, which detect unsafe, non-superconducting voltages and trigger the quench heaters to safely discharge the magnet, (3) various power supplies, including capacitive power supplies to power the quench heaters, and (4) the computers required to collect and record all the instrumentation on the magnet assembly.
- Hardware for the bucket test, which is to verify performance of the magnet assembly and allow for minor adjustments before placement into the final cryostat, was complete by September 2001.
- The final cryostat design is complete and its components will arrive in coordination with the end of the bucket test.
- The bucket test cooldown began on November 15, 2001.
- Low current operation of the magnet began on December 5, 2001.
- The NMR console has been purchased and 90% of the console components are on site.
- The facilities are being prepared for installation of the 900 MHz system into its final user location in the NMR building in room NM112.

The only remaining costs associated with this program include completion of the final cyrostat (approximately $150K), liquid helium for completing the bucket test ($100K) and final installation costs.

900 MHz Magnet: Project Schedule

Milestone	Schedule Start	Task Complete
Bucket test at 4.2 K	November 2001	January 2002
Bucket test at 2.2 K	February 2002	March 2002
Installation in final cryostat	April 2002	June 2001
Install complete assembly in NMR building	July 2002	August 2002
Magnet cooldown	September 2002	October 2002
Magnet testing	October 2002	November 2002
Begin operation as a user facility	December 2002	

900 MHz Magnet: Project Costs

	Expenses to date (1/1/02)	Remaining Costs to Complete	Total Costs
Personnel	4,221,638	494,193	4,715,831
Equipment/Other	4,736,089	399,720	5,135,809
Indirect	2,841,710	365,515	3,207,225
Total	11,799,436	1,259,428	13,058,865

MAJOR PROJECTS

PROJECT TITLE: **60 T LONG-PULSE MAGNET, "MARK II"**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The objective of this activity is to build and commission a new 60 T Long-Pulse magnet, the "Mark II," for the User Program at the Pulsed Field Facility of the NHMFL. This coil system will replace the original 60 T LP, which failed during normal operations in July 2000. The Engineering Recovery Plan in place will lead to a second-generation 60 T Long-Pulse magnet (the 60 T LP-II) available to users in two years (currently estimated at October 2003 in the magnet rebuild schedule). A magnet review has analyzed all aspects of the 60 T LP failure, seeking to determine the cause of failure and reduce the likelihood of a similar failure in the 60 T LP-II.

Status

- A formal laboratory review of the incident plus a laboratory technical review of the magnet was performed. The 60 T LP failure was caused by a reduced fracture toughness in the Nitronic-40 reinforcing shells in layers five through eight.
- The fabrication of the 60 T LP-II will follow the design of the 60 T LP with altered specifications, anneal schedules, and quality assurance tests for the Nitronic-40 shells. There will also be minor design improvements to shell mechanical features and the coil winding electrical insulation system.
- Conductor for the 60 T LP Mark II coils has been ordered and is currently being manufactured.
- Request for quotations for Nitronic-40 coil reinforcing shells have been sent to qualified vendors; the issues of increased quality assurance and metallurgical requirements for these shells are currently being discussed and negotiated with the vendors.
- Request for quotations for coil fabrication will be issued upon completion of the drawing revisions; this is currently estimated to occur in late November 2001.
- The magnet rebuild schedule is based upon past experience with the 60 T LP magnet and is scheduled to dovetail with the 100 T magnet project schedule.

60 T Long-Pulse Magnet: Project Schedule

Milestone	Current Schedule
Insulation of CuNb conductor	December 2001
Receipt & processing of MP35N	December 2001-March 2002
Development of transitions & leads	February 2001
Resolution of protection issues	February 2001
Construction/operation of 75T CuNb coil	March 2002
Materials testing protocol for high shot coils to access risk and design integrity	
Production of first insert	August 2002

60 T Long-Pulse Magnet: Project Costs

	Expenses to date (12/31/01)	Remaining Costs to Complete	Total Costs
Personnel	495,114	456,774	951,888
Equipment/Other	786,413	466,658	1,253,071
Total	1,281,527	923,432	2,204,959

MAJOR PROJECTS

PROJECT TITLE: **PULSED MAGNETS FOR USER FACILITY**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The project objective of this project is to develop and improve magnet technology to produce pulse coils that sustain physics research operations at the NHMFL Pulsed Field Facility at Los Alamos. This effort includes continual upgrading of user magnet performance in terms of field, reliability and pulse frequency. A significant materials effort is also required to advance the technology.

Status

- Significant effort has gone into improving shot lifetimes for the 60 T-ZM (zylon + MP35N) coil design. Development tasks entailed the understanding of the zylon and MP35N macro composite's 3D mechanics in the winding. The ZM design was revised to a "ZMC" designation to reflect a number of design revisions. These 60 T-ZMC magnets have been in service without incident since May, 2001.
- The first improved 50 T was shipped to the NHMFL Los Alamos facility in November 2000. This coil has operating as a user magnet with more than 250 full field shots. A second unit was delivered in August of 2001. We will continue production of the 50 T mid-pulse magnets in 2002 on an as required basis.
- We have developed ZM coil technology based on higher strength conductor, Glidcop AL-60, together with the improved zylon and MP35N reinforcement strategy. "AL60-ZM" technology designs for a 15 mm bore, 65 T coil and a 22 mm bore, 60 T coil are complete. Prototype production of the 65 T ZM coils will begin in February, 2002.
- We are developing a "CuNb-ZM" design for a 15 mm bore, 75 T user magnet. Production of the 75 T is targeted for March, 2002.
- Operationally, the time between shots has increased with the peak field. The 24 mm bore, 50 T coils require about 20 minutes to cool down. The 60 T ZMC coils require approximately 40 minutes to cool down. The 50 T mid-pulse coils cool down in about 120 minutes. A single annular gap within the coil, effectively creating two concentric coils, could reduce cool down times by a factor of 3. We have developed a design that incorporates this technology and plan to begin to introduce gap technology in pulse coils by summer of 2002.

Pulsed Magnets for User Facility: Project Schedule

Milestone	Current Schedule
Delivery of 65 T user coil	March 2002
Composite development	June 2002

Major Projects

Project Title: **100 T Insert Magnet Project**

Report Date: **December 31, 2001**

Objective

The objective of this activity is to design, construct, and test a 15 mm bore, capacitor powered insert coil for use with a long pulse outer coil set operated at the Los Alamos facility. Together, the two systems will be capable of producing a total field of 100 T. Design, development and production of the short pulse inner coil is the responsibility of MS&T in Tallahassee. The outer coil is sponsored by the Department of Energy and is being developed at Los Alamos.

Status

- We have reviewed four conceptual designs for the 100 T insert. The insert calculations have been made assuming an outer coil set field contribution of 44 T at peak field. The outer coil set generates a 47 T flattop and undergoes a 3 T field suppression to 44 T when the insert coil is fired. These designs are not all 100 T inserts.
- Design activity first focused on the development of the 75 T-ZM concept to fully evaluate the CuNb insert conductor under realistic fatigue conditions. The 75 T-ZM coil is a 75 T, 15 mm bore coil design that incorporates the Bochvar 100 T insert CuNb conductor into a "user" magnet design.
- An experimental effort is underway to provide a more cost effective and scientifically beneficial platform than the duplex coil. The coil is designed to operate at 75 T with a 15.2 mF capacitor bank. Our experience gained from the 75 T-ZM coils should guide us as to how aggressive we get in the 100 T during operation.

100 T Insert Magnet: Project Schedule

Milestone	Current Schedule
Insulation of CuNb conductor	December 2001
Receipt & processing of MP35N	December 2001–March 2002
Design & development of transitions & leads	February 2002
Resolution of protection issues	April 2002
Construction/operation of 75T CuNb coil	March 2002
Materials testing protocol for high shot coils to access risk and design integrity	January 2002 to June 2002
Production of first insert	August 2002

100 T Insert Magnet: Project Costs

	Expenses to date (2/5/02)	Remaining Costs to Complete	Total Costs
Personnel	91,137	180,000	271,137
Equipment/Other	114,633	100,000	214,633
Indirect	47,391	93,600	140,991
Total	253,161	373,600	626,761

RESEARCH & DEVELOPMENT ACTIVITIES

PROJECT TITLE: **HIGH FIELD HTS INSERT COILS AND COIL TECHNOLOGY**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The goal of this activity is the development of high field insert coils using high temperature superconductor (HTS) materials. The generation of 5 T in a 20 T background corresponds to a 1.1 GHz NMR system. Toward this end, the immediate objectives are:

- conductor development and characterization for improved electrical and mechanical behavior,
- coil winding studies for the development of suitable techniques for layer wound coils with co-wound reinforcement and improved packing factor,
- testing of double-pancake coils and prototypical inserts to better understand coil performance, leading to improved coil design,
- development of a 5 T pre-prototype insert for testing in the large bore resistive magnet in 2002, and
- development of insulation for layer-wound coils.

Accomplishments

In the past year we have begun winding double pancake coils for the pre-prototype 5 T insert. This project builds upon the successful testing in 1999 of a 3 T insert coil within the 19 T large bore resistive magnet. Both the previous 3 T and the present 5 T inserts are collaborative projects with Oxford Superconducting Technology (OST), Inc., and require the heat treatment of long-lengths of Bi-2212 conductor. Significant increases in the critical current density of this superconductor have been obtained. The design of the 5 T coil has been completed, and the double pancake coils for the innermost "A" stack and the middle "B" stack have been wound.

Last year, we developed a unique methodology for measuring the effects of axial compressive strain on short-samples of BSCCO conductor. Results from this activity indicated that, for applications below 77 K, low temperature compressive testing is necessary. Thus, in the past year we have developed a LNe facility that provides a steady-state 27 K environment for testing large HTS components in the large bore resistive magnet at 19 T. We have also designed a stress/strain/I_c probe that will operate within the liquid cryogen. This probe is presently being assembled.

Activities

With OST, we are studying the effects of varying the Bi-2212 conductor geometry on conductor performance. Further increases in J_c may be obtained for the 5 T coil. With OST, we are also studying conductors for wind-and-react double pancake coils and for react-and-wind double pancake and layer wound coils. Recent improvements in reacted conductor lengths and properties at OST have lead us to explore react-and-wind technology for the A-stack of the 5 T insert. Previously it was believed that this stack could only be constructed using the wind-and-react approach, resulting in a relatively low success rate for individual double pancakes. At present, we are addressing the manufacturing issues associated with winding small-diameter double pancakes with mechanically-sensitive conductor.

Development of the 5 T insert coil in continuing. It is anticipated that testing will occur in 2002.

In addition, with American Superconductor Corporation, Nordic Superconductor Technologies (NST), and the Korean Institute of Machinery and Materials (KIMM) we are evaluating Bi-2223 conductors for react-and-wind coils.

Also important for high field insert coils is the mechanical behavior of the HTS conductor. We are evaluating the stress-strain behavior at room temperature and low temperature, the effects of strain on J_c, and the effects of fatigue on J_c, of the various conductors under development. Furthermore, we are studying pancake coils of small radial build to determine the mechanical performance of coils under Lorentz forces. By using coils with large diameter and small radial build, Lorentz forces are maximized while maintaining a fairly uniform distribution of stress within the coil. This approach allows functional performance limits to be determined in realistic model coils.

RESEARCH & DEVELOPMENT ACTIVITIES

PROJECT TITLE: **CRYOGENIC COMPONENT DEVELOPMENT**

REPORT DATE: **DECEMBER 31, 2001**

Objective

The objectives of this program are to develop and better understand cryogenic systems in order to improve our ability to support superconducting magnet technology. To this end, the Cryogenic Component Development program has three main tasks:

- Develop cryogenic technology in support of large scale superconducting magnet systems.
- Conduct R&D to advance cryogenic technology for improved application.
- Collaborate with industry and other laboratories in development and application of cryogenic technology.

Status

Over the last year the Cryogenic Component Development (CCD) group has concentrated its efforts in two main projects. These are as follows:

- Continued to support the design and development of the 900 MHz NMR magnet cryostat. Fabrication is underway at Ability Engineering and Technology. Installation of the completed 900 MHz magnet is scheduled to begin in summer 2002.
- Design and development of the cryogenic system for a DOE-funded high temperature superconducting magnetic ore separator. This is an Industrial/Laboratory program supported by the Superconducting Partnership Initiative. The cryostat was shipped to Dupont Superconductivity in June 2001.

In addition, the CCD group is pursuing several R&D activities. These are mostly funded by outside grants as indicated:

- Liquid Helium Flow Visualization Studies: This program is supported by a grant from the National Science Foundation. The work involves experimental application of modern particle imaging techniques to flow states in liquid He II. Current activities include establishing the facility for particle imaging and generating neutral density particles in liquid helium.
- Liquid Helium Fluid Dynamics Studies: This program is supported by a grant from the Department of Energy. The work focuses on cryogenics issues of future particle accelerators. Current studies include: (1) propagation of intense thermal shock and second sound attenuation; and (2) High Reynold's number forced flow He II and instrumentation development using the Cryogenic Helium Experimental Facility.

Research & Development Activities

Project Title: **High Strength Materials**

Report Date: **December 31, 2001**

Objective

The high strength material program supports the development of the high field magnets. This program focuses on:

- development of various fabrication routes for different conductors and reinforcement materials for various magnets in collaboration with industrial partners;
- understanding of the relationship among the properties, microstructure and phase transformation in both materials developed by various fabrication routes; and
- exploration of new materials which have the potential to be used for next generation magnets. The program emphasizes the nanostructure impact on the material properties.

Accomplishments

The study of fabrication routes and properties of the conductors has taken an approach to relate the properties both to design requirements and to the service life of the magnets. Fabrication of Cu-Ag, and Cu-Nb aims to make high strength conductors with nanostructures and appropriate sizes required for the magnets. The system stores excessive energy because of the nanostructure and defects accumulated by fabrication. The stored energy and atomic structure distortion are related to both the elastic-plastic transition and the mechanical instability of heavily deformed conductors. The measurements were made on the energy stored during the fabrication.

An attempt has been made to relate the energy to the apparent Young's modulus, yield stress and conductivity of the materials at room temperature and 77 K. In both Cu-Ag and Cu-Nb conductors, the strain hardening introduces both the crystallographic lattice distortion and accumulation of energies that are related. In addition, an effort has been made to relate the stored energy to the interface areas. As the distance between the second phase (Ag or Nb fibers) reaches nanoscales due to the deformation, the system reaches a stage with high internal energy that includes the lattice distortion energy, interface energy and dislocation energy. Consequently no sharp elastic-plastic transition can be observed and the system is unstable. Annealing and cyclic deformations, such as mechanical fatigue, may change the amount of the stored energy and the effect of the lattice distortion on the mechanical properties of the materials so that a sharper elastic to plastic transition may be observed. More severe lattice distortions were found in Cu-Nb than Cu-Ag conductors and therefore, it was expected that more energy was stored in Cu-Nb system.

The effort on exploration of new conductors for the future magnets is distributed between cryogenic deformation of Cu and Cu+Al_2O_3 and fabrication of various macro-composite. The assessment of the microstructure and properties of cryogenic deformed pure Cu indicates that the structure and strength formed by 77 K deformation need to be stabilized. Therefore, low temperature rolling and drawing have been undertaken on Cu+Al_2O_3 conductors. The preliminary results indicate that the low temperature deformation indeed introduces more strain hardening in $Cu+Al_2O_3$ conductors at low strain levels.

Macro-composites that were studied at the NHMFL are continuous fiber reinforced Cu and Al materials. The continuous fiber reinforced Cu tape reaches a strength level of 1350 MPa at room temperature with the conductivity of 68% IACS. Currently, an effort has been made to bond the tape in order to achieve the size requirement for the high field pulsed magnets. The continuous fiber reinforced Al conductor with woven architecture reaches a strength level of 1200 MPa with the conductivity of 19% IACS. The preliminary results indicate that the conductors may have higher fatigue endurance than aluminum alloys and have the potential to be used in a high magnetic field with neutron diffraction.

The reinforcement materials investigated are cobalt-nickel alloys and pearlite. The cobalt-nickel alloys are strengthened mainly by dislocations and coherent defects that are only a few atomic layers thick. The pearlitic steels (ferrite + carbides) have a nanostructure and thus may have a high fracture toughness value than conventional high strength steels. A systematic investigation and survey have been undertaken on the thermo-mechanical processing variables and their effect on the anisotropy, strength, ductility and fatigue life of both materials. The properties are related to the structure and texture of the materials. Currently, the relationships between the strength and both the deformation and heat treatment conditions were established. These properties meet the various requirements of the current pulse magnet designs.

REPORT DATE: DECEMBER 31, 2001

Big Horn Valve

Big Horn Valve of Sheridan, Wyoming, has teamed with the NHMFL to develop of a magnetic actuator for a linear valve under development at BHV. The project is funded through a NSF STTR phase I grant. In this one-year project, the NHMFL designed and built a pulse coil driven magnetic actuator. In Phase II, the actuator will be integrated into a complete prototype valve that will be used in the process industry.

Physikalisches Institut, Johann-Wolfgang-Goethe Universität, Frankfurt, Germany

In cooperation with the Physikalisches Institut of the Johann-Wolfgang-Goethe Universität, the Pulsed Magnet Group has delivered one 50 T, 24 mm bore pulse magnet for its pulse field facility. Additionally we have developed a site-specific coil design for the Frankfurt facility. The new magnet design is a 60 T, 22 mm bore pulse magnet.

HTS Reciprocating Magnetic Ore Separator

The magnetic ore separator project is being conducted in collaboration with DuPont Superconductivity and Outokumpu-Carpco, and is funded by the Department of Energy. When complete, the system will be a quarter-scale, working prototype in operation at one of DuPont's demonstration facilities. The magnet system consists of a 2^{+} T, 200 mm warm bore Ag/BSCCO conductor HTS magnet with a room temperature iron shield. The magnet, which is being built by American Superconductor, will be conductively cooled and operate at approximately 30 K. The goal is to provide a robust, industrial unit that is competitive with existing LTS superconducting separators. During Phase I of this project (until December 1999), the NHMFL is conducted a magnet and cryogenic system design. The magnet will have a 250 mm cold bore and an overall length of 300 mm. During Phase II in CY 2000, the NHMFL began fabrication of the cryogenic system. The cryostat was shipped to DuPont Superconductivity in June 2001 and is in the process of installation in the test laboratory.

NIMS/Tsukuba Laboratory: High Field Florida-Bitter Magnets

We are presently working through EURUS Technologies to provide DC Bitter magnets to the National Research Institute for Metals of Tsukuba, Japan. A 30 T, 32 mm bore magnet is complete and is scheduled for shipment to NIMS.

NSCL: Sweeper Magnet

The National Superconducting Cyclotron Laboratory at Michigan State University has contracted with the NHMFL to build a 4 T superconducting sweeper magnet. The magnet is referred to as a sweeper because it "sweeps" charged particles out of a neutron beam and into a mass spectrometer. It is required to bend beams of 4 T/m rigidity though 40° on a one meter radius. The magnet consists of 2 D shaped coils with a split of 140 mm. The conductor is epoxy impregnated niobium titanium operating at 4.2 K. There is a yoke of approximately 16 tons to enhance the peak field and reduce the fringe field.

Although 4 T is not a tremendously high field, attaining 4 T in a gap of 140 mm with a D-shaped magnet leads to high stresses and requires substantial analytical work in the design process to ensure reliable operation. The design of this magnet system is complete and fabrication of subcomponents has begun. The complete coil system is scheduled for delivery to MSU in mid-2002.

High Field Magnet Laboratory, University of Nijmegen, The Netherlands

The NHMFL is currently building a 33 T, 32 mm bore DC resistive Florida Bitter magnet for the High Field Laboratory at Nijmegen. The magnet, which is similar to NHMFL user magnets, is under construction and will be delivered in spring of 2002. The NHMFL is also training support personnel from the High Field Laboratory at Nijmegen in the design and fabrication of Florida Bitter DC magnets. The University of Nijmegen has been funded to develop a new 20 MW, DC magnet laboratory. Construction has started and completion of the new laboratory is anticipated early in 2003.

Institute of Solid State and Materials Research Dresden (IFW Dresden)/Research Centre Rossendorf (FZ Rossendorf), Germany

The NHMFL has an Agreement of Cooperation with IFW Dresden and FZ Rossendorf for the design and construction of pulse magnets for the non-destructive generation of the highest magnetic fields possible. Among other contributions, the German partner will develop and provide high-strength micro- and macro-composite conductors, their characterization, and offers the use of their facilities. The NHMFL will provide magnet design, access to its materials database, and at-cost supply of high field pulse magnets. In 2001, two 60 T, 15 mm bore magnets were delivered to this facility. We are also reviewing pulse coil concepts for the magnetization of T_c puck magnets.

Sandia National Laboratories, Albuquerque, New Mexico

The pulsed field group of the MS&T is developing a pulsed high magnetic field system for the advanced hydrodynamic radiography program at Sandia National Laboratories to generate intensive electron beams. The magnetic field profile along the axis of the system is required to be a gradient from 30 T at the center of a 110 mm bore pulsed magnet to 60 T at the center of a 45 mm bore pulse magnet. The two magnets will be energized with independent banks. The total energy of the system will be about 5 MJ. The materials required for construction have been received. We developed the coil designs based on the properties of the CuNb and Glidcop AL15. Coil geometry, dimensions, and the reinforcing materials have been determined. We have completed the prototyping of the initial lead designs and delivered the first coil in March 2001. We are in production as of the last quarter of 2001.

4. NHMFL In-House Research Program

The National Science Foundation charged the National High Magnetic Field Laboratory (NHMFL) with developing an in-house research 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.

To this end, the NHMFL established in 1996 an in-house research program that stimulates magnet and facility development and provides intellectual leadership for experimental and theoretical research in magnetic materials and phenomena. The NHMFL In-House Research Program (IHRP) 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 IHRP strongly encourages collaboration across host-institutional boundaries; between internal and external investigators in academia, national laboratories and industry; and interaction between theory and experiment. Some projects are also supported to drive new or unique research, that is, to 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.

Six IHRP solicitations have now been completed with a total of 247 proposals being submitted for review. Of the 247 proposals, 122 were selected to advance to the second phase of review, and 51 were funded (21% of the total number of submitted proposals).

2001 Solicitation and Awards

The NHMFL IHRP has been highly successful as a mechanism for supporting outstanding projects in the various areas of research pursued at the laboratory. Two enhancements were made for the 2001 solicitation that significantly improved program management.

The first dealt with the proposal review process. In the past the in-house component of the review of the proposals was carried out by a single committee comprised of scientists from all areas of research. In order to improve the quality of the review given each proposal, subcommittees were formed that reviewed only proposals in their area of expertise. The other major enhancement was the development and use of an online system for the submission, review, and management of the solicitation process. All proposals were submitted electronically; all reviewers (internal and external) had access to the IHRP Web site and performed their reviews online. Adopting the new technology saved money, saved time, and significantly enhanced program management and communications. The IHRP online management system will be expanded in the future to support the submission of the semi-annual reports as well.

Of the 33 pre-proposals received, the committee recommended that 12 pre-proposals be moved to the full proposal stage. Of the 12 full proposals 6 proposals were awarded. A breakdown of the review results is presented in the following tables.

Table 1. 2001 IHRP Overview.

Research Area	# Pre-Proposals Submitted	# Proceeding to Full Proposal Status	# of Projects Funded
Condensed Matter Science	11	4	2
Biological & Chemical Sciences	14	5	2
Magnet & Magnet Materials Technology	8	3	2
TOTAL	**33**	**12**	**6**

Table 2. Funded projects for 2001 (2-year durations).

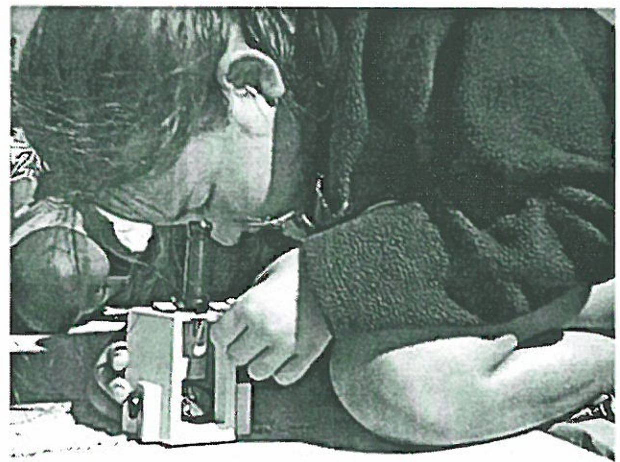
Lead P.I.	NHMFL Institution	Project Title	Funding
William Brey	NHMFL	*900 MHz NMR Probe Development*	229,601
Zhehong Gan	NHMFL	*High Resolution NMR above 1GHz using Keck Resistive Magnet*	147,581
Ke Han	NHMFL	*Development of High Strength Dispersion Strengthened Conductors for Magnets*	290,018
William Markiewicz	NHMFL	*High Strength Superconductor for High Field NMR Magnets/Enhanced Bronze High Strength Nb_3Sn Superconductor*	166,700
Christopher Stanton	UF	*Ultrafast Optics of Excitons in High Magnetic Fields*	162,238
Stanley Tozer	NHMFL	*Exploring the Interplay Between Magnetism and Superconductivity in the Heavy Fermions*	187,715

2002 Solicitation

The 2002 Solicitation Announcement will be released in May, 2002. Awards will be announced by the end of the year.

5. EDUCATION PROGRAMS

The *Center for Integrating Research and Learning* (Center) at the NHMFL has aggressively pursued ways to enhance science for students, teachers, and the general public. More than ever before, the Center is devoting time, energy, and resources to supporting and promoting science education in both public and private schools with the goal of establishing the Center as a major resource nationwide and assisting schools and school districts in their pursuit of excellence in science programs.



NHMFL educational programs and activities are more and more influenced by state and national policy and are emerging as an important influence in how science is being conducted in the classroom. This focus has provided an environment in which the Center can play a major role in restructuring how science is perceived by educators and the general public—a responsibility that is taken seriously through the educational mission of the NHMFL. The Center's organization around seven areas of educational significance continues to provide structure for the diverse programs that have evolved in the past year. This continuity of focus for the Center has allowed for maintenance of successful programs, expansion of pilot programs, development of new programs, expanded curriculum development, addition of education and private industry partners with whom the Center works closely, and closer ties to the university community. Areas of focus are Student Education, Teacher Education, General Public Awareness, Curriculum Materials Development, Educational Research, Educational Resource Laboratory, and Partnerships.

One of the challenges that CIRL faces is increasing involvement with populations that are historically underrepresented in the sciences. This challenge is being met through new and proposed programs and through refocusing existing programs to encourage participation by rural communities, underserved schools, and underserved teacher populations (in-service and pre-service) in both informal and formal settings. In addition, CIRL takes seriously its dedication to providing opportunities for girls and women in science. "As the economy in the United States and the world grows more and more reliant on a technologically literate workforce, the nation cannot afford to overlook the talent and potential contributions of half the population. Women and girls and others underrepresented in the sciences offer valuable new perspectives that will affect both the goals and practices of technological work and research" (*Balancing the Equation*, Executive Summary, 2001). CIRL is tackling these challenges with characteristic enthusiasm and commitment.

This report summarizes recent advances and the current status of existing programs in the educational programs at the NHMFL. Features of CIRL programs for this reporting period are outlined below.

STUDENT EDUCATION

The **2001 Research Experiences for Undergraduates** hosted **17 students from 11 universities** representing Massachusetts, New York, Florida, Kentucky, Virginia, Iowa, and Washington. Of the 17 students, 13 completed mentorships at the NHMFL in Tallahassee, 3 worked with scientists at the University of Florida in Gainesville, and 1 student completed an internship at LANL (see Table 1). Student projects and papers can be seen at *http://education.magnet.fsu.edu.*

NHMFL scientists and researchers in concert with the Center supported **40 middle school students and 25 high school students in mentorships** at the laboratory in Tallahassee during this reporting period. We expect another 20 middle school students in spring 2002. Mentors at the laboratory give freely of their time and energy in their continued commitment of educational programs.

Most classes that come to the NHMFL combine hands-on classroom-type experiences with a tour. In an effort to make the experience more meaningful and more rigorous relative to science content, the Center has developed new outreach materials that are more closely linked to research at the laboratory. For example, the newest outreach emphasizes ICR and NMR by giving students the opportunity to "observe the unobservable" and then take a tour of these areas with demonstrations conducted by researchers. In addition to in-house outreach, Center educators continue a program of school visits providing activities and materials for teachers and students at their home locations. **The Center has provided outreach for 1700 people, representing 6000 contact hours.**

The newly established NHMFL classroom provides a daylong experience at the laboratory and includes hands-on science activities, a technology component, and an expanded tour of the laboratory with demonstrations. The NHMFL classroom not only affords students an exciting remote classroom, but models for teachers effective techniques for teaching science. Teachers take back to their classrooms equipment and activities to continue the excitement. After only three months in existence, the NHMFL classroom has worked with **140 fourth graders**.

With more and more students attending both formal and informal after school programs, the Center has turned its attention to the **Frenchtown After School Project**, targeting underserved community centers. The NHMFL will host up to **60 students** from a local community center for an expanded outreach during their after school experience. This program is part of an ongoing effort to revitalize an area of Tallahassee that has traditionally received few resources.

Table 1. Research Experiences for Undergraduates Class of 2001.

Tallahassee Participants			
Name	**Home Institution**	**Area of Research**	**Mentor**
Adam Abate	Harvard University	High Pressure Laboratory	Stan Tozer
Jiawen Chen	Cornell University	A Python Interface to the GAMMA Magnetic Resonance Library	Scott Smith
Rick Clinite	Cornell University	Photoconductivity in Pentacene	James Brooks
Alisha Elsebough	Florida State University	Chemical Analysis of Spanish Moss	Roy Odom
Michael Fanous	Columbia University	Positron Confinement: Magnetic Bottle Design	Cesar Luongo
Stephanie Howse	Florida A&M University	Chemical Analysis of Spanish Moss	Roy Odom
Kristen Johannessen	New College of University of South Florida	Responses to n-amylacetate in Normosmics	Martin Kendal-Reed
Misha Lipatov	Harvard University	Investigation of Sintering & Metal-Coating Techniques of Magnesium Diboride	Justin Schwartz
Kenneth Purcell	Western Kentucky University	The Effect of NA Doping on $SrRuO_3$	Jack Crow, Scott McCall
Shelly Ann Ramrattan	Columbia University	Chemical Analysis of Spanish Moss	Roy Odom
Haley Showman	William & Mary	Oxygen Exchange in $SrRuO_3$	Jack Crow, Gang Cao
Corinne Teeter	University of Washington	Energy Deposition in Helium Superfluid	Steven Van Sciver
University of Florida Participants			
Jill Adcox	University of Florida	Inductively Coupled Fourier Transform Ion Cyclotron Resonance	John Eyler
Joshua Alwood	University of Florida	Low Temperature Physics	Gregory Stewart
Tom Bemben	University of Florida	The Effects of Bond Length on g-Factors with Liganded *Chlorophyll a* and *Bacteriochlorophyll*	Alex Angerhofer
Los Alamos Participant			
Norman Anderson	Iowa State University	Experimental Techniques in Low Temperature Physics	Alex Lacerda

TEACHER EDUCATION

The NHMFL **Research Experiences for Teachers Summer Program** has become a signature project that expanded in 2001, with **17 teachers representing Florida, Illinois, Connecticut, and Kentucky** participating. Four pre-service teachers, 6 elementary teachers, 3 middle school teachers, and 4 high school teachers (see Table 2) worked with mentors at the Tallahassee site of the NHMFL on research projects that were then translated into materials for their students. It is estimated that **over 1,200 students** are directly affected by one group of participants. In addition to students, teachers become science advocates at their schools and districts making a real and effective impact on classroom science education.

Table 2. Research Experiences for Teachers Class of 2001.

Teacher Name	Grade Level	Area of Research	Mentor(s)
Logan Chalfant	High School Physics	Construction and Testing of Superconductor Y-123	Jack Crow, Gang Cao, Scott McCall
Patricia Cramer	Middle School	Olfaction Makes Sense	Holly Bennett
Kristina Dugger	Pre-service	2001 RET Web Site	Pat Dixon
Alison Gerry	Pre-service	Macroscopic Model of Nuclear Spin	Arneil Reyes, Phil Kuhns
Susan Goracke	Elementary School	Crystalline & Chemical Structure of Cans	Bob Goddard
Matt Guyton	Middle School	Properties of Superconducting Tape	Justin Schwartz
Thomas Hawkins	Elementary School	Granular Physics	James Brooks
Robert Hoffman	High School Physics	Granular Physics	James Brooks
Toyka Holden	Secondary	Crystalline & Chemical Structure of Cans	Bob Goddard
Dawn Housser	Pre-service	Spanish Moss as an Atmospheric Indicator	Roy Odom
Rich McHenry	High School Chemistry	Developing Cantilevers from Chemical Etching Process	Donovan Hall
Dan Nelson	Elementary School	Granular Physics	James Brooks
David Rodriguez	Middle School	Spanish Moss as an Atmospheric Indicator	Roy Odom
Lynn Sapp	Middle School	Spanish Moss as an Atmospheric indicator	Roy Odom
Alan Turner	Elementary School	Properties of Superconducting Tape	Justin Schwartz
Bailey White	Pre-service	Olfaction Makes Sense	Holly Bennett
Linda Wolters	Elementary School	Macroscopic Model of Nuclear Spin	Arneil Reyes, Phil Kuhns

During 2001, Center educators have provided **teacher workshops for over 300 teachers**. These workshops include sessions on *Science, Tobacco & You,* Magnets and Magnetism, Forces and Motion (done in conjunction with the Florida State University Physics Department), Light and Optics, States of Matter, Literature in the Science Classroom, and Writing in Science. In addition to workshops conducted for practicing teachers, the Center conducted a workshop for pre-service teachers at the University of Florida Science Education Department.

The NHMFL Ambassador Program has expanded its membership to **103 K-12 teachers and community organizations**. This group continues to be a strong force in determining the direction for educational programs. Responding to the real-world needs of teachers of science occurs because of the close relationship the Center continues to have with its cadre of science education advocates.

Center educators continue to offer undergraduate level courses for prospective teachers through Flagler College, Tallahassee campus. Courses taught include General Methods in Education and Methods of Elementary Science.

General Public Awareness

There continues to be a significant number of visitors to the NHMFL from the local community and surrounding areas and from as far away as Shanghai, China. NHMFL scientists, researchers, educators, faculty and staff toured approximately 2000 people in addition to the 2000 people who attended the NHMFL Annual Open House in Spring 2001. Tours remain an important aspect of the laboratory's mission to expand awareness of the work done at the NHMFL as well as to expand the general public's understanding of real-world science.

Our outreach to the general public has expanded to include work with the Girl Scouts of America, participation in many diverse community events, co-developing programs with the Rotary Club, and work with the Frenchtown Project.

Curriculum Development

Science, Tobacco & You: The Center continues to be actively involved in facilitating teacher workshops designed to disseminate *Science, Tobacco & You*, an integrated, standards-based program designed for grades 3-6. We are currently fulfilling the terms of the most recent Florida Department of Health contract, conducting five regional training sessions across the state. In addition to dissemination in Florida, *Science, Tobacco & You* has been adopted in Wisconsin, California, South Carolina, West Virginia, Kentucky, Oklahoma, Washington, and Oregon (as well as Illinois and Connecticut as previously reported). In addition, **15 other states** have made plans to look at incorporating *Science, Tobacco & You* into their health/science plans.

Science, Optics & You, Science, Magnets & You, and MagLab: Alpha continue to be the basis for teacher workshops conducted at the NHMFL and in workshops and summer institutes in other areas of the state. Each curriculum package includes equipment as well as at least 25 activities through which students explore science and learn to ask and answer questions. All curriculum materials are used to model science teaching and learning through expanded outreach to schools as well.

Center educators are currently working in partnership with I^4 Learning, a private curriculum development company, to build on the success of *Science, Tobacco & You* and develop science materials for grades 6-9. The present effort is directed at developing critical thinking skills through inquiry-based science activities.

EDUCATIONAL RESEARCH

Data collection continues on all CIRL programs. Center educators are currently tracking Research Experiences for Undergraduates participants to determine the impact that the summer internship has on their career choices and decisions for graduate school. Teachers who participated in the Research Experiences for Teachers program are being surveyed to determine how the experience changed their practice and how they plan to disseminate what they learned.

Two publications were completed in 2001:

Dixon, P., LaFrazza-Hickey, G., & Spiegel, S. *Looking, Thinking, Asking...How Your Body Works,* a resource for teachers and students. Not only does the book provide in-depth information including detailed drawings, photographs and diagrams, it is closely aligned with Center curriculum materials. This close connection to the real-world processes of science make this a very popular resource among teachers and students alike.

Dixon, P., & Whyte, A. "Eroding Brick and Bureaucratic Walls," *Journal for the Art of Teaching*. This article explores the challenges presented when dealing with pre-service teachers, their attempts to visualize themselves as teachers, and their ability to blend practice, theory, and deeply-held beliefs about teaching and teachers.

EDUCATIONAL RESOURCE LABORATORY

Teachers, students, NHMFL scientists, researchers, and staff, and parents are taking advantage of the state-of-the-art equipment currently housed in our Educational Resource Laboratory. Students who participate in the NHMFL classroom work on laptop computers that enable them to have hands-on experience with educational technology. Students from nearby counties take advantage of the on-line hookups to create materials for community outreach and school projects.

Web-based materials are a major resource for teachers as they integrate technology into their classrooms. The Center maintains *http://education.magnet.fsu.edu*, a site at which teachers, students, and the general public can access information about programs, events, and activities for K12 students. Teachers can keep up with special events at the laboratory such as our ***Science in My Community* Contest** that is part of the Annual Open House; parents can access the Web site to find help with science projects; and students can use the Web site as a resource for studying magnets, magnetism, and related concepts.

The Educational Resource Laboratory is an integral part of teacher and student workshops conducted at the NHMFL. Teachers work with laptop computers, printers, and scanners to develop curriculum materials and use Internet access to research science activities for use in the classroom. In addition, schools can request assistance in creating and maintaining their own web pages for their schools and classrooms. The ERL is also a curriculum preview center where teachers and students can take advantage of the extensive library of curriculum products, professional journals and books, and literature books related to science (fiction and nonfiction) for grades K-adult.

Partnerships And Community Activities

The Center continues its efforts to establish and maintain community and private industry partnerships that enhance science teaching and learning. Partnerships have helped the Center fulfill its mission while tapping into other resources that help the Center expand its outreach. Private industry partnerships to market NHMFL products to a wider educational audience have proven to be both profitable and educationally sound. Partnerships within the university community are helping to institutionalize Center programs and demonstrate that the Center is a viable resource for the university.

Training Solutions Interactive, Inc. (TSI) continues its aggressive marketing of *Science, Tobacco & You* to states other than Florida. Through this effort, Center educators participate in teacher workshops, expanding our programs to include teachers and students nationwide. TSI is active in 20 states through its own efforts and the work of United Learning/AGC.

I^4 Learning, Inc., a curriculum development company, is currently partnering with the Center to create an innovative science and health curriculum product that builds upon the success of *Science, Tobacco & You.* The Center will continue to be an active participant in future curriculum development efforts.

Community Classroom Consortium (CCC) is comprised of approximately 35 community non-profit educational organizations that work to support member groups, the north Florida/south Georgia community, and educational institutions in their efforts to enhance science in the community. Through the CCC, the Center has developed important partnerships with Girl Scouts of America, the Department of Environmental Protection, and the Mary Brogan Museum of Art and Science. Joint workshops are planned for the future and member organizations support the Center's summer programs with resources and opportunities for participants.

Women in Math, Science & Engineering Honors Living Community and Bryan Hall Living Community are two science-oriented student groups at Florida State University that are taking advantage of the rich resources the Center can offer. Center educators work with faculty advisors to plan and present lectures and seminars that specifically target undergraduates in the sciences.

Florida Agricultural and Mechanical University (FAMU) and the Florida/Georgia Alliance for Minority Participation (FGAMP) are local resources that the Center supports through its Research Experiences for Undergraduates Summer Internship Program. The Center also provides enrichment activities and experiences for high school students and pre-service teachers participating in FGAMP programs.

The Center represents the NHMFL on the Board of the **Leon Association for Science Teaching (LAST)**. Through LAST, the Center conducts community-wide outreach activities as well as supporting students and teachers through Science Fair scholarships and a rewards program that honors new teachers of science and teachers who have provided mentorship and inspiration to students.

The Center maintains formal and active partnerships with two local schools: The **Sealey Magnet School for Science and Mathematics and the School for the Arts and Sciences**. The Center provides experiences, activities, and equipment for classroom science as well as technology that enables both students and teachers to incorporate computer-based resources into their learning.

Leon County Schools has endorsed several Center programs and is requiring participation by fourth graders from Tallahassee's Southside Schools in the **NHMFL Classroom** Program. Southside Schools are typically underserved schools with a high percentage of students who receive free or reduced lunch. The NHMFL Classroom encourages teachers and students to look at science in new ways and provides materials with which teachers can continue the NHMFL-based experience.

6. COLLABORATIONS

In accordance with one of the laboratory's mission objectives "to engage in the development of future magnet technology," NHMFL researchers and staff work aggressively to engage the private sector, other federal agencies and institutions, and international organizations to advance a wide variety of magnet-related technologies and projects. These important external collaborations are an excellent means of fulfilling this laboratory's mission to advance magnet related technologies and promote U.S. economic competitiveness while enhancing user facilities. The NHMFL collaborations continue to grow and expand in both breath and scope as reflected by the summaries below.

PRIVATE SECTOR ACTIVITIES

ABB, Raleigh, NC and American Superconductor, Westborough, MA. At the Pulsed Field Facility at Los Alamos, NHMFL researchers are collaborating on a DOE Superconductivity Partnership Initiative for transformer projects. The team is designing and setting up experimental equipment for measuring current limiting characteristics of high temperature superconducting tapes for high currents under variable conduction times. A special coil is being designed to do the measurements in a background field, thus simulating the short circuit behavior of an HTS transformer.

American Superconductor Corporation (AMSC), Westborough, MA. As part of the ONR-supported HTS motor program, the NHMFL has characterized AMSC conductors. In particular, the NHMFL has focused on the effects of mechanical stress and strain (both tensile and compressive). The NHMFL has developed special facilities to extend testing of these AMSC conductors to a temperature of 27 K. In addition, we are working with AMSC through a DOE-funded program to investigate the stability and quench propagation behavior of Y-Ba-Cu-O coated conductors.

Austral Von Roll Inc., Douglasville, GA. This collaboration involves the evaluation of the heat sensitivity of CuNb conductor during insulation with the TEFLON®FEP fluorocarbon resin system. This experiment answered questions about heat sensitivity and insulation performance allowing further development of the 100 T insert.

Big Horn Valve, Sheridan, WY. The NHMFL and Big Horn Valve are working together on an NSF STTR grant funded project to develop a magnetic actuated fluid handling valve that could have wide applications in the fluid processing industry. The potential outcome from this project is a valve that is completely sealed, and thus will not leak to the environment. The prototype actuator was developed in 2001 and a Phase II effort to develop a complete valve system should begin in 2002.

Bruker Instruments, Billerica, MA. The NHMFL is partnering with Bruker Instruments on the development of a high temperature superconducting probe for liquid-state NMR applications. The probe will be used in the NHMFL's 750 MHz wide bore magnet at the McKnight Brain Institute at the University of Florida. The work is supported by NIH through grant number 1P41RR016105-01. This collaboration has successfully completed an NSF Phase I SBIR grant with the characterization of HTS probe coils in the 25 T Keck magnet. These coils were made from thin films of $YBa_2Cu_3O_{7-\Delta}$, patterned using designs. Q values dropped by less than 12% between zero field and 21.1 T and only an additional 12% in going up to 25 T. These numbers demonstrate the feasibility of using YBCO coils at very high fields for high sensitivity NMR probes.

BWX Technologies, Inc. (BWXT), Lynchburg, VA. The Center for Advanced Power Systems (CAPS), through the Office of Naval Research program, is collaborating with BWXT to establish a SMES demonstration project. This project will be based on a 100 MJ SMES magnet developed by BWXT with Department of Energy and DARPA funding. CAPS will be the host site for the SMES demonstration and will provide installation of the system and conduct an extensive research program with the device.

Cryogenic Materials Inc. (CMI), Boulder, CO. Materials scientists at CMI are collaborating with the NHMFL to evaluate the structural integrity of high strength weldments at cryogenic temperatures. NHMFL is conducting mechanical tests to evaluate the tensile, fatigue, and fracture properties of the welds and heat affected zones in Inconel 718 and 304 Stainless Steel.

DuPont Superconductivity, Wilmington, DE, and Outokumpu-Carpco, Jacksonville, FL. The NHMFL is working with DuPont Superconductivity and Outokumpu-Carpco to develop a quarter-scale high temperature superconducting magnetic ore separation system. The NHMFL is responsible for the magnet design and building the cryogenic system. Carpco is building the ore separator equipment. The working prototype system will be assembled and tested at the NHMFL and then shipped to DuPont for process engineering studies. This $6 million project is funded under the Department of Energy's Superconductivity Partnership Initiative (SPI) program.

Everson Electric Company, Bethlehem, PA. This continuing collaboration between Everson and the NHMFL Pulsed Field program at Los Alamos has the goal of further developing the methods of fabricating large, high strength, high field long pulse magnet coils. This work is essential to the 100 T multi-shot (MS) magnet project and helpful to the 60 T long-pulse (LP) Mark II magnet rebuild project. Accomplishments include the successful fabrication of the 100 T MS magnet prototype wrapped stainless steel shells, the investigation of alternate epoxy impregnation procedures for large coils, and the exploration of the fabrication issues of co-axial high field magnet coil leads.

ExxonMobil Corporation, Irving, TX. The National High Field FT-ICR Facility at the NHMFL has an ongoing collaboration with this oil company to analyze the mass resolution of a variety of different crude oils. Dr. Alan Marshall has achieved a world record in mass spectroscopy and mass accuracy with 5000 chemically distinct components and 55 elemental compositions at a single nominal mass of South American crude oil. Collaborators are working together to develop the potential of various ionization methods (electrospray, field desorption, field ionization, electron ionization, and chemical ionization) combined with FT-ICR mass analysis.

Fischer Custom Communications, Torrance, CA and EMCO Products, Austin, TX. The Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility within the McKnight Brain Institute at the University of Florida has established a new state-of-the-art rf laboratory. Faculty and staff are working with these companies to develop specialized current injection and monitor probes and near field probe sets.

H.C. Starck/CSM Industries Inc., Cleveland, OH. The collaboration with H.C. Starck is concentrated on producing high strength $MP^{35}N$ sheets as a reinforcement for high field pulsed magnets. Different fabrication routes have been assessed in order to achieve the properties that are reproducible.

Honeywell, Kansas City, MO. This collaboration of the NHMFL Pulsed Field program at Los Alamos, DC Fields program in Tallahassee, and Honeywell is based on a common interest in development and evaluation of the stainless-steel-clad copper conductors produced by the **A.A. Bochvar Institute in Moscow, Russia.** The collaboration has included the sharing of conductor fabrication specifications and conductor testing results. This type of conductor is of importance to the 100 T multi-shot (MS) magnet project (outsert coils) and other high field user magnet systems with long decay times.

Hyper Tech Research Inc, OH. The NHMFL is collaborating with Hyper Tech Research Inc. to coat single RE-Oxide buffer layers and YBCO on Ni/Ni-alloy tape substrates and fine wires using NHMFL proprietary sol-gel process. The fine wire activity is also supported by an SBIR. The development of a long-length HTS power transmission cable, using the sol-gel, all non-vacuum coated conductors, as a mutual venture to illustrate the cost effectiveness and problem solving capacity of HTS materials. The development of second generation YBCO tape that will reshape the cost of HTS materials and will offer significant advantages on HTS coil design and fabrication.

I^4 Learning, Tallahassee, FL. I^4 Learning, a subsidiary of TSI, Inc., is a health and science curriculum development partner with the Center for Integrating Research & Learning (CIRL) at the NHMFL. CIRL faculty members and I^4 Learning are currently developing a new curriculum project that builds upon the many successes of the *Science, Tobacco & You.* Like *Science, Tobacco & You*, the new product will be marketed nationwide.

Interface Welding, Inc., Carson, CA. The NHMFL in conjunction with Interface Welding is developing patentable welding procedures between thick sections of aluminum alloys and high strength, high conductivity copper alloys. The welding technology will be used as part of the Repetitively Pulsed Magnet project for neutron scattering.

Intermagnetics General Corporation (IGC), Latham, NY. The IGC-NHMFL collaboration on the cutting edge, wide bore 900 MHz NMR magnet system was completed in 2001. IGC delivered five NbTi coils and a NbTi shim set in summer and the coils are now at the NHMFL in preparation for installation in the final magnet assembly. The collaboration was an excellent example of industry-laboratory partnership leading to a significant technical breakthrough.

LGK Corporation, Albuquerque, NM. Researchers at the Pulsed Field Facility in Los Alamos are working on a contract to develop the PC boards for the basic building blocks of the Digital Lock-In system. The collaboration is an outgrowth of some of the very specialized instrumentation developed for users of the Pulsed Field Laboratory.

Magnetic Resonance Microsensors (MRM), Savoy, IL. In a program supported by an NIH grant, the NHMFL is collaborating with MRM to extend the high field limits of NMR spectroscopy using high sensitivity microcoils in very narrow bore magnets. At the NHMFL, this technology will be adapted for the 32 mm bore, 19.6 T superconducting magnet. This unique magnet and probe technology will not only lead to increased NMR sensitivity, but also to inherent cost advantages associated with narrow bore magnets.

Minnesota Mining and Manufacturing Company (3M), Saint Paul, MN. The NHMFL is collaborating with 3M to produce an ultra high strength, high conductivity composite electrical conductor by means of 3M's proprietary composite fabrication processes. This composite conductor has demonstrated a very significant increase in tensile strength as compared to present high performance conductors such as CuNb or CuAg. In addition, it has better electrical conductivity. This conductor may have applications in pulsed high field magnets and in high current, high frequency AC coil applications. Basic fabrication trials were made by 3M, then the NHMFL sponsored a pilot production run of 120 meters (currently in progress) of this very promising conductor. This collaboration occurred as a result of the NHMFL's experience with materials and high field pulsed magnets and knowledge of the fabrication process capabilities in the private sector.

In addition, the NHMFL Repetitively Pulsed Magnet program in collaboration with 3M is attempting to produce a high strength composite conductor having higher fatigue endurance than aluminum alloys with low neutron cross-sections. Samples produced by 3M have arrived in Tallahassee for testing, where the properties of the composite will be assessed.

Finally, a collaboration agreement with 3M has been signed to facilitate studies of the stability and quench propagation behavior of Y-Ba-Cu-O coated conductors.

Nikon USA, Melville, NY. The NHMFL maintains close ties with Nikon on the development of an educational and technical support microscopy Web site, including the latest innovations in digital imaging technology. As part of the collaboration, the NHMFL is field-testing new Nikon equipment and developing new methods of fluorescence microscopy.

Nordic Superconductor Technologies (NST), Denmark. The NHMFL is collaborating with NST on the development of wind-and-react double pancake coils that could ultimately play a role in a 1 GHz NMR magnet system. The NHMFL has evaluated the conductor in terms of the effects of high magnetic fields and mechanical strain on the critical current density. Furthermore, double pancake coils have been wound and tested in self-field and validate the NHMFL's capability to form wind-and-react coils. This double pancake was subsequently tested in the 19 T, large bore, resistive magnet.

Olympus America, Melville, NY. The NHMFL is developing an education/technical Web site centered around Olympus products and will be collaborating with the firm on the development of a new tissue culture facility at the NHMFL in Tallahassee. This activity will involve biologists at the NHMFL and will feature Total Internal Reflection Fluorescence microscopy.

OMG Americas, Research Triangle Park, NC and IGC-Advanced Superconductors, Waterbury, CT. The NHMFL Pulsed Field program at Los Alamos and the DC Facility in Tallahassee continue development of high performance magnet conductors in collaboration with these companies. This work includes developing methods to increase the strength, length, and size of production quantities of high performance aluminum oxide strengthened copper and micro-composite copper silver conductors. These conductors are essential to the 100 T multi-shot (MS) magnet project and the 60 T (long-pulse) LP Mark II magnet rebuild project.

Oxford Superconductor Technologies (OST), Carteret, NJ. The NHMFL and OST successfully developed an HTS insert coil that generated 3 T in the 19 T large bore resistive magnet, generating 22 T in total. This insert coil, which required approximately 1.5 kilometer of HTS conductor, is an important development on the path toward a 1 GHz NMR magnet system.

OST is providing all powder-in-tube BSCCO 2212 conductor for the program. After OST fabricated the unreacted conductor, the NHMFL then insulates it using an internally developed sol-gel approach, and subsequently winds the double pancake coils. Approximately half of the coils are stacked at the NHMFL and electrically joined. Building upon this success, the NHMFL and OST are now collaborating on a 5 T insert coil that will include wind-and-react and react-and-wind coils. It will also include both layer wound and double-pancake wound coils. Testing of this coil is planned for 2002.

Oxford Instruments Superconductivity, Oxford, England. A Memorandum of Understanding has been signed. The cooperation will focus on the development of components, testing of materials, and development of high field NMR magnet systems.

Pirelli Cable and American Superconductor, Detroit Edison. Researchers at the Pulsed Field Facility have designed and set up experimental equipment for measuring the AC losses in a high temperature superconducting cable at variable frequencies under external field conditions. This collaboration is being conducted under the auspices of a DOE Superconductivity Partnership Initiative.

Resonance Research Inc., Billerica, MA. The NHMFL is partnering with Resonance Research on the development of shim systems for the 25 T Keck magnet. The present goal is to achieve 1 ppm homogeneity over a spherical volume of 1 cm in this 52 mm bore resistive magnet. Without shims the peak to peak homogeneity is approximately 50 ppm. The approach that has been taken is to use a combination of ferroshims and resistive coils. The first attempt with ferroshims mounted on the outside of the bore tube improved the homogeneity by a factor of 4. Currently, the next generation of ferroshims is being developed as well as the first generation of resistive shims.

Scientific Instruments, Inc., West Palm Beach, FL, and National Academy of Sciences of the Ukraine. Thermometers are being developed for use in high magnetic fields and at cryogenic temperatures. These devices are based on doped Germanium resistors constructed on GaAs substrates using computer-chip construction techniques. The chips are made in the Ukraine, packed for low temperature use at Scientific Instruments, and tested at the University of Florida and the National High Magnetic Field Laboratory.

Sentricon, USA. Sentricon is the most commonly used baiting system for termite control and was developed by University of Florida (UF) researchers. Little is known about termite tunneling behavior because the tunnels are constructed of termite saliva, feces, and soil particles and readily break apart when excavated. UF researchers are developing three-dimensional models of termite tunneling using MRI to hopefully better understand the tunneling behavior and improve termite control.

Southern California Edison, General Atomics, and Intermagnetics General Corporation-Superpower. NHMFL researchers at the Pulsed Field Facility at Los Alamos are leading a DOE-supported program to repair and operate a state-of-the-art fault current controller, which is capable of reducing short circuit currents in a medium voltage utility system. The fault current controller uses large high temperature superconducting (HTS) magnets. The work includes the design of a high voltage lead for the HTS coil that operates in a vacuum at cryogenic temperatures and power system tests at the Los Alamos substation. Intermagnetics General Cooperation-Superpower has licensed a LANL HTS fault current controller patent.

Spalding Worldwide Sports. The NHMFL Material Development and Characterization Group is currently involved in a materials research program with Spalding R&D. The NHMFL scientists in collaboration with Spalding Engineers have developed a test apparatus to conduct dynamic impact experiments on elastomeric materials used in golf ball construction. The experiments require high-speed, sensitive measurement techniques that capture the material's response characteristics during microsecond events. Spalding's design engineers utilize the dynamic materials properties data to assist in the design of new materials.

Stereotaxis, St. Louis, MO. The NHMFL has developed, in a collaboration with Stereotaxis, several designs of a superconducting magnet system for catheter guidance through the human body. The requirements for this magnet system include a variable direction and constant amplitude magnetic vector that can be generated in the body for steering a magnetic catheter. The ultimate goal is a low cost magnet system that can be installed in hospitals to assist with diagnosis, microsurgery, and delivery of medical treatment. It has been proposed that the NHMFL will design and build the first prototype.

Thomas Keating Ltd., and QMC Ltd. The collaboration between the NHMFL and two British companies, Thomas Keating Ltd., and QMC Ltd., led to the formation of Kyospin, a company dedicated to the production of devices and spectrometers for High Frequency Electron Magnetic Resonance. Thomas Keating Ltd. builds quasi optical components, while QMC manufactures detectors. The FSU Research Foundation issued Kyospin a license to market the components developed at the NHMFL by the EMR group. Kyospin has been quite successful in 2001 and had customers from Berlin, Cornell, Grenoble, Leiden, Manchester, MIT, and Northeastern University.

TSI, Inc., Atlanta, GA, Washington, D.C., and Tallahassee, FL. TSI is a leader in the development of innovative interactive programs for education and training. TSI specializes in the implementation of programs, systems, and strategies to improve efficiency and productivity for a wide variety of applications in business, industry, and education. TSI is a key partner to the NHMFL's Center for Integrating Research and Learning in the *Science, Tobacco & You* curriculum program. In the past year alone, TSI has expanded marketing of *Science, Tobacco & You* to 11 additional states. Training programs by NHMFL and TSI personnel continue nationwide.

Vacuumschmelze, Hanau, Germany. In the framework of the 900 MHz ultra wide bore NMR magnet, the NHMFL has initiated a cooperation with Vacuumschmelze to evaluate different approaches to high strength Nb_3Sn conductors. Vacuumschmelze has further offered to send some lengths of HTS conductors to the NHMFL to be characterized and wound into high field insert coils.

INTER-AGENCY & INTER-INSTITUTIONAL ACTIVITIES

Air Force Research Laboratory (AFRL), OH. The NHMFL is collaborating with AFRL to deposit highly textured, high Jc YBCO layers by Pulsed Laser Ablation (PLD) on the Ni/Ni-alloy tape substrates with sol-gel buffer layer/layers. This is to provide high quality, sol-gel inexpensive buffer layered substrates to the working vacuum deposition technology, as well as to double check the suitability of the NHMFL sol-gel buffered Ni/Ni-alloy substrates.

Brookhaven National Laboratory (BNL), Upton, NY. The NHMFL is collaborating with the BNL in achieving a high degree of texture in thick, sol-gel coated YBCO conductors by a proprietary processing method developed by the BNL. By achieving the biaxial texture in the thick YBCO layer of the second generation HTS conductors, the much awaited use of HTS in practical industrial applications will be not only possible, but also be in high demand.

Center for Advanced Power Systems (CAPS), Florida State University. CAPS has been established by Florida State University as a direct result of NHMFL efforts to develop research relationships focused on applications of superconductivity to power system applications. CAPS is focused on research in power systems interactions, power system controls, and applications of high temperature superconductors in power systems. CAPS superconductivity research activities are closely coordinated with the NHMFL activities in HTS. The CAPS program is funded by institutional funds and a major three-year grant from the **Department of the Navy, Office of Naval Research (ONR).** In addition, CAPS has developed collaborations with other universities and industry. CAPS has taken a leadership role in forming the Electric Ship Research and Development Consortium with **Mississippi State University, the University of South Carolina, and the University of Texas at Austin.** The Electric Ship R&D Consortium is developing with ONR a comprehensive research and development program focused on a broad range of electric ship technology issues. In addition, CAPS is collaborating with several private sector organizations reported in the previous section.

DOE High-Energy Physics, Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA, and Fermi National Accelerator Laboratory (Fermilab), Batavia, IL. Programs at both LBNL and Fermilab for the development of high field dipole magnets for future generation accelerators have involved collaborations with the Magnet Science and Technology group of the NHMFL. The primary objective of these programs has been the characterization of the Nb_3Sn-based, Rutherford-style, superconducting cables that will be needed for the dipole magnets in these future machines. The unique facilities of the NHMFL Large Magnet Component Test Laboratory allow testing these conductors with the simultaneous application of high current, high magnetic field, and either longitudinal or transverse compressive loading.

Gulf Coast Alliance for Technology Transfer (GCATT). As a founding member of GCATT, the laboratory continues to serve on its Board of Directors. The consortium consists of nine federal and defense laboratories, five universities, and one community college. GCATT provides an important vehicle to network and exchange technologies and support among its members. Its principle mission, however, is to promote technology transfer among the laboratories and universities and to look for shelf technologies that are good candidates for commercialization.

Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA. The laboratory continues to support LBNL's high field, dipole development program through operation of a specially designed facility that allows simultaneous application of high field, high current, and high transverse load to large test conductors. The facility is based on our superconducting split-pair solenoid, produced by Oxford Instruments, Inc., and is located in the NHMFL Large Magnet Component Test Laboratory. At present, the facility is capable of applying up to 13 T, 19.5 kA, and 250 kN to a test conductor fitting into the 30 x 70 mm^2 radial-access port of the Oxford magnet. A variety of large Rutherford-style cables based on multifilamentary Nb_3Sn/copper composite wires have been tested already and have provided insight to the performance of an experimental model dipole magnet tested at LBNL. Future test plans include cables fabricated with high temperature superconductor wires based on Ag-matrix Bi-2212.

Los Alamos National Laboratory, Los Alamos, NM. The objective of the Los Alamos Neutron Science Experiment (LANSCE) high frequency split-pair pulsed magnet, funded by the Department of Energy and the NHMFL, is to supply the LANSCE with the highest field repeating pulsed magnet for neutron scattering experiments in the world. The present target is 30 T for 10 million cycles. The construction of the first and second prototypes has started. The first prototype should be tested in the first quarter of 2002. These high repetition pulsed magnets will be pulsed at 1 Hz in the LANSCE facility to provide a high magnetic field and neutron beam scattering capability unique in the world. This magnet is being designed and fabricated by the NHMFL's Magnet Science and Technology group.

In addition, a materials test program has been performed on high purity niobium by the NHMFL in collaboration with the Engineering Sciences and Applications Division of LANL. The research was conducted to generate low temperature mechanical properties data for niobium that can be confidently used for the design and construction of Superconducting-Radio Frequency (SCRF) cavities. Microstructural and fractographic analyses were also conducted to further characterize the materials. The results of the test program have been accepted for publication in *Advances in Cryogenic Engineering*, Vol. 48.

MAGLEV 2000, Brevard County, FL. The NHMFL is a contributing partner to this project in east central Florida. MAGLEV 2000 is supported by Florida industry, academic, and the Florida Department of Transportation. For a decade the State of Florida has had an ongoing interest in maglev technology as the next-generation alternative to high-speed rail in congested central and south Florida. A recently adopted state constitutional amendment mandates that the state develop a high-speed rail project.

Mary Brogan Museum of Arts & Sciences, Tallahassee, FL. The Center for Integrating Research and Learning at the NHMFL has developed a working relationship with the Mary Brogan Museum of Arts & Sciences, the capital city's newest museum. The Museum and the Center are currently in the process of developing educational programs and exhibits that feature the NHMFL and magnet science and technology. In the plans are permanent exhibits at the Tallahassee museum, traveling exhibits that will be featured at the state's other science museums, and collaborative educational programs for students, teachers, and the general public.

National Museum of American History, Smithsonian Institution, Washington, D.C. The NHMFL has been working with this Smithsonian museum for some time on a special Information Age Exhibit that opened later last year. The laboratory contributed a collection of computer chips that features microscopic graffiti placed on the surface of computer chips by their designers. The collection uncovered the once-hidden practice of etching art on integrated circuit development. The exhibition features contributions from chip designers at Intel, Hewlett-Packard, MIPS, Analog Devices, Dallas Semiconductor, VLSI, Texas Instruments, Advance Micro Devices, Cyix, National Semiconductor, and NCR.

National Superconducting Cyclotron Laboratory (NSCL), Michigan State University, East Lansing, MI. The Magnet Science and Technology group of the NHMFL were contacted by the NSCL to build a 4 T superconducting sweeper magnet. The magnet is referred to as a sweeper because it "sweeps" charged particles out of a neutron beam and into a mass spectrometer. It is required to bend beams of high rigidity 4 Tm on a 1-meter radius. The magnet consists of 2 D shaped coils with a split of 140 mm. The conductor is epoxy-impregnated niobium titanium operating at 4.5 K. There is a yoke of approximately 20 tons to enhance the peak field and reduce the fringe field. Although 4 T is not a tremendously high field, attaining 4 T in a gap of 140 mm with a D-shaped magnet leads to high stresses and requires substantial analytical work in the design process to ensure reliable operation. Fabrication of the magnet is underway.

Ohio State University, Columbus, OH. The NHMFL is collaborating with Ohio State University to characterize the magnetic field dependence of the critical current density of "jelly rolled" Nb_3Al conductors at 4.2 K and up to 26 T. Ohio State, IGC, and NRIM have been developing the conductors by various processing approaches like Ohmic heating and quenching. The aim of this collaboration is to evaluate the capacity of conductors as possible candidate conductor for high field NMR applications due to the high B_{c2} of Nb_3Al.

Pacific Northwest National Laboratory (PNNL), Richland, WA. This collaboration between the Pacific Northwest National Laboratory Materials Processing and Performance Group and the Los Alamos NHMFL pulsed field mechanical engineering team entails doing a survey and report on existing materials for pulsed magnet coils and pulsed magnet coil technology for possible use in more robust pulsed magnet coils for use in metal forming. Also included in this collaboration was the definition of a typical metal forming pulsed coil design incorporating proposed features to permit longer coil life and increased duty cycle. In addition, the NHMFL at Los Alamos, provided PNNL continued technical assistance with the capacitor based power supply previously designed and built for PNNL by the Los Alamos Pulsed Field Magnet Laboratory.

Princeton Plasma Physics Laboratory, Princeton, NJ. One of the future options for the next generation of fusion experiments will involve resistive field coils. The NHMFL is participating in a cooperation with the Princeton Laboratory on optimizing the choice of conductor materials, insulators, and magnet design for the Fusion Ignition Research Experiment (FIRE). With the limitations on energy sources, the utilization of high strength, high conductivity materials, combined with a magnet design that reduces stress concentrations, will allow FIRE to extend the pulse length of plasma experiments.

Sandia National Laboratories (SNL) and Lockheed Martin Corporation, Albuquerque, NM. This collaboration between the SNL Magnetic Propulsion and Particle Beam Applications Department and the Los Alamos NHMFL pulsed field mechanical engineering team includes providing mechanical design, engineering and analyses to an electromagnetic coil gun project. The work includes the re-establishment and migration of an existing coil gun design to a 3-D CAD model, mechanical stress analysis of the coil, and designing improvements to eliminate known coil and launcher problems. Many of the coil gun coil mechanical, structural, and fabrication issues are similar to those faced by the NHMFL in the design and building of pulsed high field research magnets.

The pulsed field group of Magnet Science and Technology is developing a pulsed high magnetic field system for the advanced hydrodynamic radiography program at SNL to generate intensive electron beams. The magnetic field profile along the axis of the system is required to be a gradient from 30 T at the center of a 110 mm bore pulsed magnet to 60 T at the center of a 45 mm bore pulse magnet. The two magnets will be energized with independent banks. The total energy of the system will be about 5 MJ. The materials required for construction have been received. We developed the coil designs based on the properties of the CuNb and Glidcop AL_{15}. Coil geometry, dimensions, and the reinforcing materials have been determined. We have completed the prototyping of the initial lead designs and delivered the first coil in March 2001. We are in production as of the last quarter of 2001.

Also, the Pulsed Field Facility at Los Alamos is providing information on pulsed magnet coil materials to the Electromagnetic Coil Gun program at Sandia. The goal of this collaboration is to evaluate high field pulsed magnet and coil gun materials, plus fabrication and engineering experience for possible use in improving the performance of high field magnets and coil gun systems. The results of this collaboration could have potential application to very high field pulsed magnets and high repetition rate pulsed magnets.

Texas Tech University, Pulsed Power Laboratory. NHMFL researchers are cooperating with personnel of the Texas Tech Pulsed Power Laboratory to determine the electrical surface flashover voltage of insulation material in a vacuum at cryogenic temperatures. This project is in support of the DOE HTS fault current controller project.

University of Illinois, Department of Electrical Engineering, Urbana, IL. The NHMFL and the Advanced Magnetic Resonance Imaging Spectroscopy (AMRIS) facility at UF are working with the group at the University of Illinois to develop multifrequency microcoils and arrays of microcoils for biomolecular spectroscopy. The enhanced sensitivity of solenoidal microcoils for low sample-volume NMR applications makes them attractive options for a variety of problems. The collaborators involved in this effort are developing the circuitry for triple-resonance, pulsed-field gradient enhanced rf probes that can be used singly or in multi-coil arrays. Multi-coil arrays optimize the use of large bore volumes in imaging magnets to increase sample throughput, and provide novel detection devices for monitoring time-dependent reactions via magnetic resonance. This work is supported by the NIH and was supported previously by an NHMFL In-House Research Program grant.

U.S. Army Research Laboratory, Aberdeen, MD, and Air Force Research Laboratory, Kirkland, NM. The NHMFL Pulsed Field program at Los Alamos is sharing information on pulsed magnet coil materials and providing material samples to these laboratories. The goals of these collaborations are to provide useful materials information to both parties: The defense laboratory applications are related to the use of high field magnetics for military purposes while NHMFL applications relate to high field short pulse and repetitively pulsed magnets for basic research purposes.

INTERNATIONAL ACTIVITIES

A.A. Bochvar Institute, Moscow, Russia. Scientists at the NHMFL's Pulsed Field Facility and the materials development program at Tallahassee have maintained a long-standing relationship with the Bochvar Institute. As a result, high quality Cu-Nb micro-composite wires with outstanding characteristics (strength, conductivity, and resistive ratio) were developed and are now available for use in the construction of high field coils. The materials were further characterized in Tallahassee for pulsed magnets. Another activity concerns the development of stainless-steel-clad copper conductors in long lengths with small and large cross sections. Both types of conductors are of great importance to the 100 T development project (outsert and inner coils) and other high field user magnet systems with long decay times.

Catholic University of Nijmegen, Nijmegen, The Netherlands. The Catholic University of Nijmegen is developing high field resistive magnets in collaboration with the NHMFL's resistive magnet program. One 33 T magnet is being built by the NHMFL. The rights to use the NHMFL's drawings have been sold and the Nijmegen lab will be building two additional 33 T magnets using the drawings. Collaboration is underway on development of high field resistive magnets suitable for low-resolution NMR and hybrid inserts in the 40 T range.

Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany. The NHMFL is collaborating with the DESY laboratory on cryogenic problems relating to the future of the TESLA electron accelerator. DESY is developing the TESLA Test Facility for He II cooling of RF cavities The NHMFL is providing components to study the flow characteristics of two-phase He II for the test facility and measurements of the Kapitza conductance of the niobium cavity material.

Free Electron Laser Facility, University of Nijmegen, The Netherlands. The National High Field FT-ICR Facility at the NHMFL is collaborating with the Dutch facility to build a 4.7 T FT-ICR instrument. The special magnet system is being built by John Elyer at the University of Florida, where it will be tested and shipped in 2002. The Free Electron Laser Facility is the world leader in producing intense radiation conveniently tunable in the infrared spectral range that spans typical chemical bond vibrational frequencies. This FT-ICR instrument will provide a unique capability in the world for the determination of the infrared absorption spectra of mass-selected ions.

Institut für Experimentalphysik, Technische Universität, Wien, Austria. The NHMFL Pulsed Magnet Group made a first design of a magnet that will match the new quasistationary energy source (10 MW, 1 s) of the Institut für Experimentalphysik. Magnets to generate a 100 ms flat top at 35 T and a peak field of 35 T for a triangular 1 second pulse shape are feasible. The two partners are identifying funding sources for this new and exciting facility. The development of ultra-low noise magnets for magnetization measurements also will be further pursued. Delivery of standard magnets is being evaluated.

Institut für Plasmaphysik, Greifwald, Germany. The NHMFL Magnet Science and Technology group carried out a study of the high current leads for the superconducting magnets of the Wendelstein 7-X plasma physics experiment. The study compared conventional leads with HTS leads for reliability, cost, and availability. The NHMFL also recommended acquisition and testing program for the final lead design.

Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia. The NMR program and Dr. Andrei Samoilenko have developed Stray Field Imaging (STRAFI) capability for the 19.6 T, 32 mm superconductive NMR magnet. Initial demonstrations of the system obtained a resolution of approximately 10 mm. This represents the highest field and highest field gradient stray field imaging achieved in the world. The instrumentation is being developed to further improve the spatial resolution.

Institute of Low Temperature Physics, University of Sao Paulo, Brazil. The NHMFL Pulsed Field Facility has an ongoing collaboration with the group at the University of Sao Paulo to investigate colossal magnetoresistance materials at very high magnetic fields.

Institute of Materials Research, Charles University, Prague, Czech Republic. Researchers at Charles University and the Pulsed Field Facility at Los Alamos are collaborating on the investigation of correlated metals at the facility's sophisticated low temperature and very high pressure instrumentation.

Institute of Physics, University of Campinas, Brazil. A new dialogue has been established with this institute on planning and establishing a new high magnetic field laboratory in South America.

Institute of Solid State and Materials Research Dresden (IFW Dresden)/Research Centre Rossendorf (FZ Rossendorf), Germany. The NHMFL has an Agreement of Cooperation with IFW Dresden and FZ Rossendorf for the design and construction of pulse magnets for the non-destructive generation of the highest magnetic fields possible. Among other contributions, the German partner will develop and provide high-strength micro- and macro-composite conductors and their characterization, and offers the use of their facilities. The NHMFL delivered several 15 mm bore, 60 T ZM pulse magnets for physics research to the institute in Dresden Germany. The magnets have expanded the user magnet capability at the facility. We are also reviewing pulse coil concepts for the magnetization of T_c puck magnets.

Laboratoire National des Champs Magnétiques Pulsés, Toulouse, France. Extending the successful cooperation with the pulsed high field laboratory of Toulouse, the Pulsed Magnet Group has agreed to wind a 150 kg magnet for use as an external coil of a duplex 80 T system. It will generate 48 T in a bore of 70 mm with an energy of 8 MJ. As a first step, the NHMFL has received copper-stainless steel conductor to develop and produce a long-pulse 50 T coil for physics research. In addition, the NHMFL Pulsed Field program at Los Alamos has been providing advice and information to assist CNRS in Toulouse in ensuring their high energy, high field magnet systems are configured and operated in a safe manner. The goals of this aspect of the collaboration are safer high field magnet systems.

Korean Institute of Machinery and Materials (KIMM), Changwan, South Korea. The NHMFL and KIMM are collaborating on the development of Bi-2223 based HTS insert coils. KIMM has provided conductor for the winding of a double pancake coil that was successfully tested in the 19 T large-bore resistive magnet.

McMaster University, Canada. This collaboration effort is related to the deformation mechanisms of high strength conductors that have very high internal energy due to the existence of very high volumes of the interface areas and very high internal stresses. The energies of the interfaces and the internal stresses were measured and will be related to the performance of the high strength conductors in the magnets and the reliefs of the internal energies are being studied.

Ministry of Science and Technology of Korea. The Multinational Cooperation Project on Quantum Transport in Synthetic Metals is funded by Seoul National University and the overall direction of the project is under Professor Yung Woo Park. The NHMFL portion is directed by Prof. James Brooks. Its aim is to investigate the effects of high magnetic fields on quantum transport in conducting polymers, charge transfer salts, and high T_c materials. Two of Prof. Brooks' students have worked at the Seoul National University in Korea; Prof. Park and several of his students have used the NHMFL's DC High Field Facility.

National Institute of Chemical Physics and Biophysics, Tallinn, Estonia. High resolution solids NMR in high magnetic fields requires fast magic angle spinning (MAS), and Dr. Ago Samosan makes the fastest MAS bearings in the world. In the NMR instrumentation workshop at the NHMFL, two NMR probes for the highest field NMR magnets in the world have been built around his precision-machined ceramic air bearings. Two more probes are under development. Dr. Samosan is also a world leader in the development of Double Rotation (DOR) spectroscopy in which samples spin about two independent axes simultaneously. He also collaborates with Dr. Zhehong Gan on solids NMR applications and MAS below the temperature of liquid nitrogen.

National Research Institute for Metals (NRIM), Tsukuba, Japan. The Japanese NRIM purchased a 30 T resistive magnet from the NHMFL in 1996 that was delivered in 1997. We are presently working on a long-term collaboration to provide magnets to the NRIM. In late 1998, a contract was signed for a replacement "A" coil that was delivered in 2000. A contract for a replacement "B" coil has been signed and construction is underway. We expect to sign a contract for a replacement "C" coil within the next few months. Preliminary discussions have begun regarding a new insert for their 40 T class hybrid magnet.

Physics and Engineering Research Institute (PERI), Ruppin Institute for Solid State Physics Applications, Ruppin, Israel. A Memorandum of Understanding has been signed with the PERI of the Ruppin Institute for Solid State Physics Applications. It is planning to install a pulsed magnetic field facility in cooperation with the NHMFL. Scientific applications of high pulsed magnetic fields, the development of new technologies using magnetic fields, and the development of new and advanced methods for the generation of high fields will be part of the program.

Physikalisches Institut, Johann-Wolfgang-Goethe Universität, Frankfurt, Germany. In cooperation with the Physikalisches Institut of the Johann-Wolfgang-Goethe Universität, the Pulsed Magnet Group has delivered one 50 T, 24 mm bore pulse magnet for its pulse field facility. Additionally, we have developed a site-specific coil design for the Frankfurt facility. The new magnet design is a 60 T, 22 mm bore pulse magnet.

Université de Reims, France. The collaboration between the NHMFL and the Université de Reims is related to the characterization of nano-structure materials. The materials include Cu-Nb used for pulsed magnets, Pb nano single crystals, and Fe-Pt multi-layers that have unique magnetic properties.

University of Nottingham, England. Researchers at the AMRIS facility at the University of Florida and the University of Nottingham have been collaborating to design and fabricate novel multi-layer transverse gradient coils for high field microimaging, even to the single cell level. Gradient strength is an important criterion in NMR and MRI studies of a variety of tissues and systems.

Van der Waals-Zeeman Institut, Amsterdam, The Netherlands. The NHMFL Pulsed Field program at Los Alamos and Tallahassee and the Van der Waals-Zeeman Institut have shared information on pulsed magnet coil materials. The NHMFL has provided material specimens for evaluation and testing by the Institute. In addition, the NHMFL Pulsed Field program at Los Alamos has been providing advice and information to assist the institute in ensuring their high energy, high field magnet systems are configured and operated in a safe manner. The goals of this collaboration are better characterization of materials for high field magnets and safer high field magnet systems.

The Versaille Project on Advanced Materials and Standards (VAMAS). VAMAS is an international collaboration of laboratories that is organized into Technical Working Areas. The NHMFL's Materials Development and Characterization Group participates in pre-standards measurement research to foster the development of internationally acceptable standards for advanced materials. This year's research was related to the development of a new low-temperature, fracture-toughness test method for structural alloys used in cryogenic and magnet applications.

7. CONFERENCES AND WORKSHOPS

NHMFL conference activity ebbs and flows from year to year as many events are held only every two or three years. In 1998-99, for example, the NHMFL sponsored, hosted, or supported nearly a dozen significant events. The VIIIth International Conference on Megagauss Magnetic Field Generation and Related Topics, Physical Phenomena at High Magnetic Fields-III, the Second North American FT-ICR Mass Spectrometry Conference, and additional workshops attracted thousands of visitors from all over the world. We were kept extremely busy developing quality conference programs, engaging the broad science communities, and showcasing the laboratory's world-class facilities.

A brief respite from major events during 2000 allowed us to hold smaller meetings focused on specific science topics and user needs. These gatherings were attended by members of the NHMFL Users' and External Advisory Committees (and others) and were critically important to the development of the laboratory's successful renewal proposal and for charting the laboratory's course for the next five years. This year, 2001, conferences and workshops were again the focus of much attention and effort.

Pan-American Workshop on Molecular and Materials Sciences: Theoretical and Computational Aspects
February 21-23, 2001
University of Florida

This workshop was the fifth event in a series of meetings held to review recent developments in the theoretical and computational aspects of molecular and materials sciences. Advanced doctoral students, research scientists and teaching faculty from institutions in the United States, Latin America, Canada, and the Caribbean reported on current work, challenges, and opportunities for collaboration.

Third North American FT-ICR Conference
March 22-24, 2001
Austin, Texas

The NHMFL ICR Program initiated this biennial conference in Tallahassee in 1997. Attended by approximately 100 scientists, the program featured 24 invited speakers from the United States, Sweden, England, Germany, Switzerland, Canada, and Denmark, including a feature lecture by Professor Fred McLafferty of Cornell University. Thirty-six posters, mostly contributed by graduate students and postdoctoral fellows, were also presented. The conference was organized by Drs. Mark Emmett and Chris Hendrickson of the NHMFL and sponsored by NSF, Bruker Daltonics, IonSpec, Finnigan-Thermo, and Oxford Instruments.

Fifth MRS/ISTEC Joint Workshop on High Tc Superconductivity
June 24-27, 2001
Honolulu, Hawaii

The NHMFL was a partial sponsor for this workshop, along with Oak Ridge National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory, and the University of Wisconsin. The general theme was Processing and Applications of High Tc Conductors, with a special focus on HTS Coated Conductors. ISTEC is a Japanese organization; MRS is the Materials Research Society.

24th International EPR Symposium
NMR Symposium
July 29-August 2, 2001
Denver, Colorado

The 24th International EPR Symposium and NMR Symposium were held in conjunction with the 43rd Annual Rocky Mountain Conference and the NHMFL provided support for both events. About 150 people participated in the EPR meeting that covered all aspects of EPR spectroscopy and included a special session on industrial applications. Sessions emphasized the wide range of frequencies at which EPR is now performed including, for example, *in vivo* experiments at 250 MHz and high field EPR. The NHMFL co-sponsored the high field sessions.

The NMR Symposium featured sessions on *in-situ* NMR, nanoparticles and interfaces, obtaining structure from multiple-spin systems, theory, polymers and dynamics, quadrupolar nuclei, and inorganics.

Workshop on Superconductivity Applications in the Electric Power Industry
July 31, 2001
NHMFL, Tallahassee

This workshop was held by the FSU Center for Advanced Power Systems and co-sponsored by the Electric Power Research Institute. It examined the present status and future prospects of superconductivity in the electric power sector and included discussion on the issues and benefits associated with incorporating superconducting equipment into the utility grid and power systems in general.

CAPS is an academic-industrial-government consortium that focuses on recent advances in power system technologies, power electronics, materials, advanced controls, and superconductivity that have utility, industrial, defense, and transportation applications. It is forging new alliances between a wide range of research organizations, end users, and equipment and system manufacturers. CAPS builds on the expertise of NHMFL in materials, superconductivity, and high-field electromagnets and the faculty and students at FSU and the FAMU-FSU College of Engineering.

The Future of Materials Physics: A Festschrift for Zachary Fisk
August 13-15, 2001
Los Alamos National Laboratory

This workshop, held as a celebration of Zachary Fisk's 60th birthday, brought together international leaders in materials physics to explore the frontiers in theoretical and experimental research of the complexity of solids. Dr. Fisk is an NHMFL faculty member, a LANL and APS Fellow, a member of the National Academy of Sciences, and served as chair of the In-House Research Program for two years.

Fifth Latin American Workshop on Magnetism and Magnetic Materials and Their Applications
September 3-7, 2001
San Carlos de Bariloche, Argentina

The NHMFL was pleased to support this first LAW3M meeting of the new millennium. It was the fifth of a series initiated in La Habana, Cuba in 1991; other workshops were held in Guanajuato, Mexico (1993), Merida, Venezuela (1995), and Sao Paulo, Brazil (1998). LAW3M was designed to bring together the Latin American community of scientists and engineers interested in recent developments in both fundamental and applied magnetism, on topics such as thin films, giant magnetoresistance and magnetoimpedance, nanocrystalline materials, superconducting oxides, and magneto-optics. The program consisted of invited and contributed papers, tutorial in nature, as well as reviews of recent work in specialized fields.

6th International Symposium on Magnetic Suspension Technology
October 7-11, 2001
Turin, Italy

The 6th ISMST was hosted by the Technical University of Turin with support from the NHMFL. This biannual meeting covered a wide range of industrial applications including magnetic bearings for high-speed rotating machinery, levitated trains, vibration isolation, pointing and control, guiding systems, electromagnetic launchers, power and control systems, and wind tunnel model suspensions. The topics addressed scientific, technological, and economic aspects, as well as interdisciplinary and specialized theoretical issues and applications. An exciting new area discussed was materials processing and biological studies in low or zero gravity by magnetic suspension.

Over 100 people registered for ISMST6, which was a significant increase from previous years that reflects the growing interest in magnetic suspension-related technologies. Interestingly, 25 percent of the early registrants were from Japan. There were 85 papers and invited speakers included Bjarni Trggvason (Canadian Space Agency), Gennady A. Shvetsov (Laurentyev Institute of Hydrodynamics), Hannes Bleuler (Ecole Polytechnique), Eric Maslen (University of Virginia), Jan van Eijk (Philips CFT and Delft University of the Netherlands), and Pascale Gillon (CNRS). Conference co-chairs were Giancarlo Genta of the Technical University of Turin and NHMFL Deputy Director Hans Schneider-Muntau.

J. Robert Schrieffer Anniversary Symposium
October 19, 2001
Santa Fe, NM

The signature event for the year was a special one-day symposium in honor of NHMFL Chief Scientist and Nobel Laureate Robert Schrieffer, in recognition of his 70th birthday and his enormous contributions to condensed matter physics. The symposium preceded the Physical Phenomena at High Magnetic Fields IV conference that Dr. Schrieffer founded in 1991 at the NHMFL. The symposium featured Nobel laureates and other distinguished scientists with a focus on the theory of high temperature superconductivity and magnetism in condensed matter systems. The program committee was chaired by Steve Kivelson and included Nicholas Bonesteel, James Davenport, Ted Einstein, Douglas Scalapino, and John Wilkins.

Schrieffer's life-long dedication to science, his leadership within the physics community, and his commitment to the laboratory have been extraordinary. Schrieffer was the first faculty appointment of the NHMFL, and his early affiliation helped shape the laboratory and attract numerous other senior scientists in various disciplines. Under his leadership, the NHMFL has established and nurtured a world-class multi-disciplinary research program with a highly collegial spirit. The evening banquet attracted nearly 150 people, including five other Nobelists: Phil Anderson, Alan Heeger, Walter Kohn, Bob Laughlin, and Horst Störmer.

Physical Phenomena at High Magnetic Fields (PPHMF-IV)
October 19-25, 2001
Santa Fe, New Mexico

The PPHMF conference is held every three years and represents an opportunity for the global community of researchers to come together to discuss advancements, share results, and plan for future collaborations in the areas of physics at high magnetic fields; as well as showcase the NHMFL as a user facility open to the international community of researchers in all disciplines of science. Topics included: semiconductors, magnetic materials, superconductivity, organic solids, the quantum Hall effect, chemical and biological systems, and the technological use of high magnetic fields. Attendees were offered a tour of the NHMFL Pulsed Field Facility, including the New Experimental Hall, the 1.4 GVA motor generator, and other outstanding user facilities.

2001 Southeast Magnetic Resonance Conference (SEMRC)
October 26-28, 2001
UF McKnight Brain Institute, Gainesville, Florida

This two-day meeting provided an ideal opportunity for scientists in all areas of magnetic resonance to come together and share new applications and technique developments. The Southeast has had tremendous growth in magnetic resonance research over the recent years, and some of the major national and international centers are now located in this region of the country. A banquet was held on Saturday, October 27 in memory of Dr. Raymond Andrew. Two plenary speakers included Lewis Kay and James Hyde. Other scientific talks were picked from submitted abstracts.

8. BUDGET AND STAFFING

Introduction

The National High Magnetic Field Laboratory (NHMFL) operates with funding provided by federal, state, local, and industry sources. The laboratory staff has been successful in securing individual research grant funding for specific areas of research from federal, state, and local agencies. The additional awards offset the operating costs by shifting costs during the periods of time in which staff is engaged in individual research activities. The lab has also actively pursued opportunities for industry support through collaborative efforts. While the lab receives funding from numerous sources, the primary funding source for operation of the NHMFL remains the National Science Foundation (NSF) and the State of Florida.

NSF Core Budget

The National Science Board approved the NHMFL renewal award of the third five-year research grant , in the amount of $117,500,000, at its meeting on October 19, 2000. The renewal period is from January 1, 2001 through December 31, 2005. Due to the scheduling of activities, including the unscheduled repair of the 45 T, rebuild of the 60 T Long-Pulse, continued development of the 900 MHz, and increased electric cost, FY2001 NSF funding is actually less than the amount required for the current expenses. The deficit position levels out in years 2003 through 2005. The NHMFL is utilizing institutional funds and prior year surplus to offset this funding deficit. The following table presents the NSF Funding* for the five-year period.

Division/Program	FY2001	FY2002	FY2003	FY2004	FY2005	Total
Director	622,080	498,135	507,670	517,485	527,595	2,672,965
CIRL	244,965	247,165	251,090	255,135	259,300	1,257,655
Reserve	-2,524,820	-999,275	693,075	2,493,865	2,232,370	1,895,215
Facilities & Admin	1,821,475	1,628,100	1,651,255	1,675,105	1,699,670	8,475,605
Instruments & Operations	7,099,455	7,223,760	7,319,205	7,417,515	7,518,770	36,578,705
Magnet Science & Technology	4,716,225	6,345,840	4,126,440	3,292,905	3,351,990	21,833,400
Science	1,575,255	1,556,460	1,551,825	1,555,695	1,559,690	7,798,925
LANL ***	5,372,655	5,709,835	5,982,790	5,727,770	5,877,600	28,670,650
CIMAR	538,435	747,260	557,645	568,345	579,365	2,991,050
ICR NHMFL	48,640	42,445	43,720	465,440	1,346,980	1,947,225
ICR Facilities **	1,236,495	1,266,064	1,056,780	994,880		4,554,219
UF – Hi B/T ***	182,525	188,070	993,715	199,525	205,515	1,769,350
UF – ARMIS***	303,110	312,205	321,570	331,215	341,155	1,609,255
Total	**21,236,495**	**24,766,064**	**25,056,780**	**25,494,880**	**25,500,000**	**122,054,219**

* Budget amounts are inclusive of overhead distribution by program.

** ICR Facilities represents the NSF Chemistry Division award in the amount of $1,236,496 (FY2001), $1,266,064 (FY2002), $1,056,779 (FY2003), and $994,881 (FY2004).

*** LANL and UF funding is distributed through subcontracts.

The following table provides the cumulative NSF budget and expenses by expense classification through 12/31/01.*

Expense Classification	Total Budget Dollars	*Dollars Expended & Encumbered	*Total Budget Balance $
Salaries, Wages, & Benefits	5,371,601	**5,643,089	-271,488
Capital Equipment	1,827,101	3,252,346	-1,425,245
Other Direct Expenses	9,386,297	8,635,554	750,743
Total Direct Cost	**16,584,999**	**17,530,989**	**-945,990**
Indirect Cost	3,574,919	3,444,925	129,994
Total Cost	**20,159,918**	**20,975,914**	**-815,996**
Program Income	183,653		183,653

* Data was compiled from NHMFL internal financial records and represent unaudited financial estimates
** Salaries, Wages, & Benefits includes actual expenses through 12/31/01.

NHMFL Matching Commitment

The NSF grant includes a matching commitment by the State of Florida. For FY 2001, the State of Florida matching commitment for the NSF grant is $6,783,400. The State of Florida provides additional institutional funds to the laboratory above the NSF matching requirement. The NHMFL utilizes these additional state resources as available cost sharing funds for other funding opportunities, as well as to help support some of the NSF core activities.

The following table presents the current State of Florida matching requirements for FY2001:

	FY 2001 State Matching ($)	FY2001 State Contributed ($)
State of Florida recurring funds cost sharing	4,462,765	1,797,503
Indirect Cost (52%)	2,320,635	934,701
Total State Matching Commitment	**6,783,400**	**2,732,204**

NHMFL Contributed Funds*

Organization/Program	Institutional Contributed ($)
LANL	3,648,400
E & G funding (State of Florida)	3,104,698
Program Income	183,653
Total Contributed Funding	**6,936,751**

* Support not included in the NSF matching commitment includes committed funds to other federal sources.

Program Budget Discussion

FY2001 is the first year of the current grant award for funding from the National Science Foundation. The total NSF budgetary allocation for FY2001 was $20,000,000. The NHMFL also receives an annual operating budget from the State of Florida. In FY2001, the State budget was $6,260,240 (exclusive of overhead) in direct expenses. The total state budget for FY2001, inclusive of overhead, is $9,515,540. The NHMFL internally allocates the annual budgets by program area.

For FY2001, the following table details the budget allocations and actual expenditures by program for both NSF and State E & G funding:(1)

(Dollars in 000's)

Program	NSF Budget	State Budget	Total Budget		NSF Actual(2)	State Actual(2)	Total Actual
Director	622.1	1,886.5	2,508.6		248.4	1,465.1	1,713.5
CIRL	244.9	161.9	406.8		99.6	106.4	206.0
Reserve	-2,525.1	228.6	-2,296.5			0	0
Facilities & Admin	1,821.5	78.7	1,900.2		1,226.2	63.5	1,289.7
Instruments & Operations	7,099.5	387.3	7,486.8		3,667.9	248.6	3,916.5
M S & T	4,716.2	909.7	5,625.9		3,915.0	757.4	4,672.4
Science	1,575.3	1,230.6	2,805.9		545.2	915.7	1,460.9
LANL (Subcontract)	5,372.6	0	5,372.6		4,572.6	9.0	4,581.6
CIMAR	538.4	1,043.4	1,581.8		416.5	1,048.1	1,464.6
ICR Facilities (3)	1,285.0	333.5	1,618.6		1,450.3	119.7	1,570.0
ICR Magnet					1,500.0		1,500.0
UF (Subcontract)	485.6	0	485.6		879.8	0	879.8
Unallocated (4)						3,345.8	3,345.8
Overhead (5)		3,255.3	3,255.3		3,444.9	3,739.5	7,184.4
Total	**21,236.0**	**9,515.5**	**30,751.5**		**21,966.4**	**11,818.8**	**33,785.2**

(1) Data was compiled from NHMFL internal financial records and represent unaudited financial estimates. State funding includes State of Florida E & G budget allocation only (Ref: 502401002).

(2) NSF Actual includes actual expense and encumbrances (excluding payroll encumbrances) through 12/31/01. State Actual includes actual expenditures 11/1/00 through 6/30/01, and, expenditures and encumbrances for 7/1/01 through 10/31/01.

(3) For FY2001, the ICR facilities were supported primarily by a NSF Chemistry Division award (Ref: 502460922).

(4) State Unallocated includes encumbered salaries and prior year (certified-forward) expenses funded from the State budget.

(5) The NSF budget includes overhead, while actual expenses are not allocated overhead by program. The overhead budget is not distributed to programs within the state budget. The state actual overhead represents 52% of the direct expenses.

Director's Office

The Director's Office includes the Director, Deputy Director, and their administrative assistants. In FY2001, all of the budget, accounting, and financial analysis functions were consolidated in the Director's Office with the Chief Administrative Officer and Chief Budget Officer. These two positions provide the Director with greater cost accounting and budget control over the many different funding sources and programs. In addition, the Office of Government and Public Relations is included in the Director's Office. Government and Public Relations has been realigned to include a new laboratory Information Management group that is a consolidation of the functions of publications, web master, graphics and publication support that were carried out in other units. The Visiting Scientist's program provides funding for scientists to conduct research utilizing the NHMFL facilities. Proposals are internally peer reviewed and awards are made based on input provided through the internal review process.

DIRECTOR'S OFFICE FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Director	109,405	507,180
Deputy Director	15,200	305,080
Budget Administration	145,160	202,235
Government & Public Relations	352,315	358,640
Visitor's Program		415,835
Director's Research		74,515
Reserve		247,790
Total	**622,080**	**2,111,275**
*Institutional Contributed $		850,380

Center for Integrating Research and Learning (CIRL)

This unit was formerly included in the Director's Office, but as the program has expanded, it has been set up as a separate cost center. CIRL supports programs in curriculum development, distance learning and teacher education with the primary focus on enhancing science education at all levels and promoting public awareness. CIRL administers the Research Experience for Undergraduates (REU) program that has been extremely successful over eight years. The Research Experience for Teachers (RET) is also coordinated and run by the Center. In FY2001, the NSF provided a supplemental allocation, in the amount of $108,000 (which is not reflected in the NSF budget table), for the RET program. The RET program has fit very effectively with the summer REU students. All mentorships for middle school students are organized by CIRL, which is also the focal point for the organization of the NHMFL Annual Open House and other tour activities for K-12 groups and the public. The Optical Microscopy Resource Center (OMRC) is another program operated as part of the NHMFL research and learning efforts. The OMRC has been hugely successful and received national recognition. The costs associated with the microscopy research program are offset with funding from other sources.

CENTER FOR INTEGRATING RESEARCH AND LEARNING FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Education	179,964	175,380
REU Program	65,000	
Optical Microscopy		180,680
Total	**244,964**	**356,060**
*Institutional Contributed $		143,415

Facilities and Administration

Facilities and Administration includes general administrative functions for the lab including accounting, payroll, procurement, accounts payable, grant administration, and media activities. Facilities include maintenance of the magnet power supplies and cooling systems, helium system, and the remainder of the facilities with the exception of the grounds, janitorial, and some HVAC and plumbing preventative maintenance which are provided separately by FSU. The Facilities group also handles small interior renovations and modifications needed to support research activities. Funding for the facilities group is split between NSF, state and institutional funds. NSF funding is used for core-related activities while state and institutional funds are used for general facility maintenance and modifications required to support research and other activities related to the mission of the NHMFL. Additional institutional funding, in the amount of $700,000 (and not included in the Institutional contribution above), was provided for the facilities operation in FY2001.

FACILITIES AND ADMINISTRATION FY 2001		
Program	**NSF Budget $**	**State Matching Budget $**
ABA	825,240	48,760
Facilities	751,600	36,470
Safety	244,635	
Total	**1,821,475**	**85,230**
*Institutional Contributed $		34,329

Instrumentation and Operations

This unit, headed by the Director of DC Fields Operations, is responsible for the operation of the DC magnet systems at Tallahassee, as well as the Millikelvin facility. This unit also provides operational machine shop, electronics, cryogenic system support, and computer networking support for the entire laboratory. Most of the staff is dedicated to supporting user activities from the technical level to assistance from instrumentation scientists. This group focuses on keeping abreast of the cutting edge instrumentation specialties and improving the performance level of the user instrumentation through the development of new approaches to measurements. The Instrumentation and Operations group also helps coordinate annual meetings of the NHMFL Users Committee and other interface activities with the user community.

INSTRUMENTATION AND OPERATIONS FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Administration	441,090	86,480
Computer Services	400,815	22,925
Cryogenics	964,160	
Electronics	383,375	
Magnet Operations	2,984,041	
Mechanical Instruments	416,715	
User Services	1,509,260	310,285
Total	**7,099,456**	**419,690**
*Institutional Contributed $		169,043

Magnet Science and Technology

The Magnet Science and Technology (MS&T) group is responsible for the design, engineering, fabrication and maintenance of the DC, pulsed, and advanced superconducting magnets, such as the wide-bore 900 MHz NMR magnet. This group has brought together some of the best and brightest talent ever assembled to advance magnet technology and magnet materials. MS&T has broad interactions with the private sector, other national laboratories, and international institutions involved in high field magnet research and development. Future advances in magnet technology will be heavily dependent on advances in materials, specifically high strength, high conductivity normal conductors and high strength, high performance superconductors; high transition temperature superconducting conductors and reinforcement materials that are critical to overcome the enormous forces reflected in high field magnet design. The specific programs in MS&T include Administration (which includes general management, administrative, and some engineering staff and supplies), Resistive Magnets, High Field Systems (which includes NMR and Hybrid systems), Materials Development and Characterization, Pulsed Magnets, Cryogenics Operations and In-house Research and Development, HTS Magnets and Materials Development, and MS&T analysis.

MAGNET SCIENCE & TECHNOLOGY FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Administration	356,320	39,985
Personnel	3,052,400	945,685
Resistive Magnets	439,000	
High Field Systems	613,500	
Materials Development	65,000	
Pulsed Magnets	120,000	
Cryogenics	25,000	
HTS Magnets	25,000	
Analysis	20,000	
Total	**4,716,220**	**985,670**
*Institutional Contributed $		397,008

Science Program

The NSF funding for the science and facilities development program are primarily distributed through the In-House Research Program (IHRP). A small amount of funding is utilized to cover the administration of the program, fund travel by reviewers and to provide assistance for the Director of the IHRP. The Director of the IHRP serves for two-year terms and rotates among the three institutions. During the current period, the program is headed by Dr. Al Migliori from the NHMFL Pulsed Field Facility at Los Alamos National Laboratory. The Condensed Matter & Theory group in Tallahassee assists and provides administrative support with proposal

SCIENCE FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Administration	48,030	484,595
In-House Research Program	1,527,225	
Condensed Matter Theory		274,260
Condensed Matter Experimental		401,860
Total	**1,575,255**	**1,160,715**
*Institutional Contributed $		467,513

solicitations and reviews. IHRP proposals must include an internal investigator from one of the three participating institutions as Principal Investigator but participation from external users as Co-Principal Investigators is strongly encouraged by the NSF and NHMFL. The proposed research work must utilize and advance facilities and support is restricted to two years or less. Proposals that support young scientists and/or support bold new research areas that have the possibility of opening new frontiers are strongly encouraged.

Pulsed Field Facility - Los Alamos

The NHMFL Pulsed Field Facility is sited at Los Alamos National Laboratory (LANL) and operated under a subcontract agreement between Florida State University and the Department of Energy. Funding for the NHMFL Pulsed Field Facilities and Administration includes the facility overhead charges. The Pulsed Field Facility provides technical and instrumentation support for the user community. The staff of the NHMFL Pulsed Field Facility, in cooperation with the user community, also devotes considerable attention to the development of new research capabilities and instrumentation responding to the unique requirements imposed by the rapidly changing magnetic fields and vibrations characteristic of these systems. The NHMFL Pulsed Field Facility staff works closely with members of the NHMFL Magnet Science and Technology group in Tallahassee to advance pulsed magnet technology and materials for these unique systems. Special staffing is also required to maintain the 4.0 MJ capacitor bank and the 1.4 GVA generator used to power the magnets available at this facility.

PULSED FIELD FACILITY–LOS ALAMOS FY 2001		
Program	**NSF Budget $**	**State Matching Budget $**
Facilities & Admin	2,416,350	0
User Operations	1,807,245	0
Pulsed Magnets	1,149,060	0
Total	**5,372,655**	**0**
*Institutional Contribution $		3,648,400

Center for Interdisciplinary Magnetic Resonance

CIMAR represents all areas of magnetic resonance techniques and has made has made significant advances in building a user program that involves interdisciplinary activities with Physics, Geochemistry, Chemistry, Biology and engineering. The program focuses on nuclear magnetic resonance (NMR), electron magnetic resonance (EMR), ion cyclotron resonance mass spectroscopy (ICR-MS), and magnetic resonance imaging and spectroscopy (MRI/S). CIMAR has received only modest support from the NSF core grant, which is exclusively used to support user activities. Most of the program activities have been

CENTER FOR INTERDISCIPLINARY MAGNETIC RESONANCE–FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Administration	0	58,775
NMR Program	413,800	306,350
SSNMR Program	0	211,925
ICR Program*	1,285,135	361,315
ESR Program	124,640	458,660
GAMMA		94,970
Geochemistry		172,720
AMRIS (at UF)	303,110	
Total	**2,126,685**	**1,664,715**
*Institutional Contributed $		983,010

*The ICR-MS facilities are primarily supported by a separate award from the Chemistry Division of NSF.

supported with state and institutional funds. A portion of the NMR spectroscopy and imaging activities is pursued at the Advanced Magnetic Resonance Imaging and Spectroscopy Facility (AMRIS) located at the McKnight Brain Institute at the University of Florida. The facilities within CIMAR provide unique instrumentation and capabilities to support a wide variety of research areas and are open to all qualified users.

High B/T Facility

The High B/T Facility is located at the University of Florida and is housed in the existing Microkelvin facility. A special bay has been retrofitted in the Microkelvin laboratory with a 15/18 T magnet designed for ultra-low temperature research, i.e. research at a few 100's microkelvin.

HIGH B/T FACILITY, UNIVERSITY OF FLORIDA FY2001		
Program	**NSF Budget $**	**State Matching Budget $**
Administration		
Hi B/T User Support	182,525	
Total	**182,525**	
*Institutional Contributed $		60,000

* State funding for one position was transferred to UF for 2001.

Basis of Estimate of Program Budget

The program budgets were prepared in accordance with the following criteria:

Budget Units: The NSF and State budgets are allocated to the NHMFL programs. There is one subcontract for facilities and activities at Los Alamos National Laboratory, Los Alamos, NM. The overall operations of the NHMFL are governed by the Executive Committees, which is responsible developing recommendations to the Director for allocation of budget dollars to programs.

Wage and Salary Rates: Where possible, actual salary rates have been used in the cost calculation. In some instances, the average salary rate may have been used for vacant and OPS positions.

Overhead Rates: The Florida State University current approved overhead rate of 52% has been used for all costs at Tallahassee. Current approved institutional overhead rates have been used for costs at University of Florida (44.5%) and Los Alamos (49.4%).

Overhead Base: At FSU and UF, overhead is applied to all costs except the following:

- Permanent Equipment
- Undergraduate, Graduate, and Ph.D. Programs (CIRL)
- Electric Power for magnet operations
- Subcontracts (excluding the first $25,000 of each subcontract).

At LANL, full overhead is applied to all costs except for projects designated as capital projects where a reduced overhead (10%) is applied to all costs.

Fringe Benefits: Fringe benefits for Florida personnel are based on average actual costs of fringe benefits for permanent employees (28%) and temporary employees (8%). Fringe benefit costs for LANL employees are included in the average salary rates for each class.

Administrative and Facility Maintenance Costs: Certain administrative and facility maintenance costs are accrued solely for the benefit and function of the NHMFL. These costs are included as direct costs in the budget estimates as allowed by the OMB regulations.

In-House Research Program Awards: The designated budget for the IHRP is inclusive of institution overhead. Since the actual overheads vary depending on the nature of the program and the institution involved, actual overheads are determined at the time of award within the total IHRP budget.

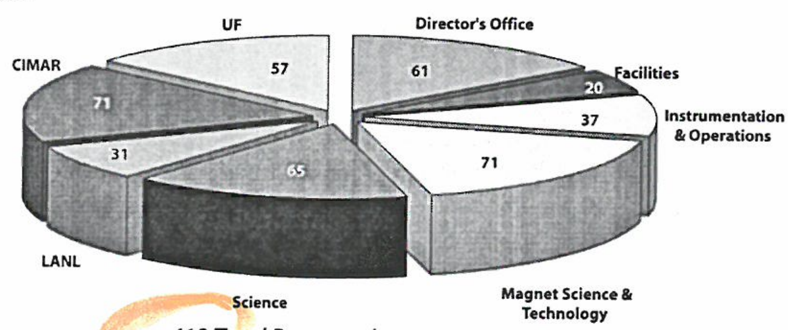
NHMFL Staffing

The NHMFL has added several positions to its staff and user support activities. Much of the increased funding has gone to enhance user support. The most significant addition has been a senior position in the MS&T group to help provide support and leadership in project cost and schedule areas. This position was filled with an individual with extensive private sector experience. In addition, the user programs have been strengthened in several critical areas.

In addition, Florida State University and the University of Florida have aggressively pursued both intermediate and senior faculty hires to strengthen our science leadership in functional imaging and solution NMR. UF has added a new position in functional imaging and FSU has an ongoing search for a senior NMR spectroscopist in solution NMR. These searches will continue.

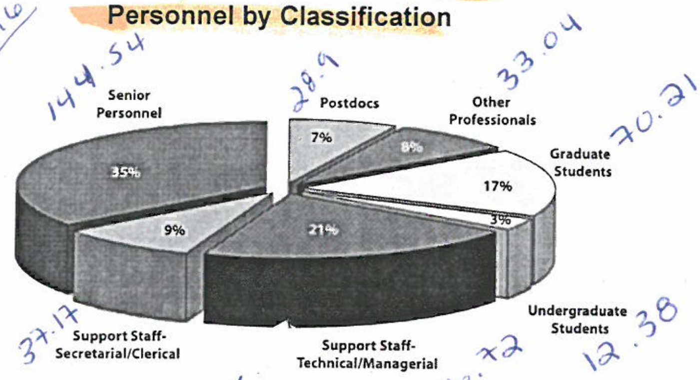
After expected growth during the laboratory's first decade, the NHMFL personnel profile appears to have stabilized during 2000 and for the current reporting year, 2001. The laboratory is organized and operates in a multi-institutional and highly collaborative environment. Because of this, the nature of personnel affiliations ranges from (1) directly and wholly supported by the NHMFL (either by NSF Core Grant or State funding) to (2) long-term visiting users, scientists, or postdocs paid by their home institutions to (3) key members of the extended NHMFL family at UF, and so on. All of these individuals contribute to the laboratory's mission as a user facility, its operational effectiveness, and its intellectual capital. Shown graphically below are statistics on the distribution, classification, and demographic makeup of NHMFL-affiliated faculty and staff located at FSU, UF, and LANL, as of November 26, 2001.

Personnel Distribution

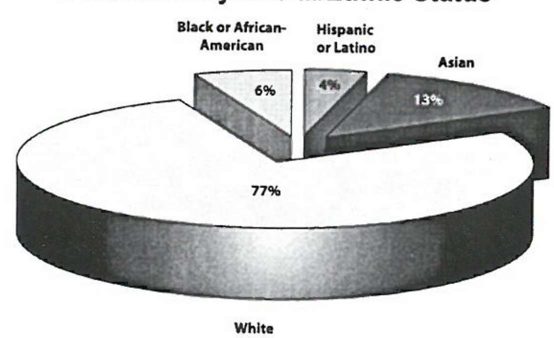


413 Total Personal

Personnel by Classification



Personnel by Racial/Ethnic Status



Note: Gender distribution: 78% male, 22% female.

To support the laboratory's personnel data collection and reporting needs, the NHMFL developed and operates an online information system that serves all three sites to varying degrees. It provides comprehensive, electronic personnel management services and data collection for all FSU-affiliated positions. Since positions at UF and LANL are managed principally by the respective institutions, the system captures and manages mainly demographic data and contact information for these positions.

A closer look at the people working at FSU, however, illustrates the diversity and complex nature of the laboratory's personnel profile:

- 68% of the 325 people at NHMFL-FSU are U.S. citizens; 9% are permanent residents; 23% are other non-U.S. citizens
- * At least 33 different countries are represented
- Support for FSU-affiliated faculty and staff members comes from a variety of sources:
- 29% (95 people) are paid through the NHMFL-NSF Core Grant
- 26% (83 people) are paid through NHMFL-State of Florida funding
- 45% (147 people) are paid by over 25 different individual investigator grants, the partner institutions, or external sources.
- Among the 45% in the "paid by others" category are two of the laboratory's principal investigators (Chief Scientist Bob Schrieffer and Dr. Alan Marshall), several department heads, and many of its senior faculty.

The critical mass of science and engineering knowledge and expertise brought together over the last decade at FSU, UF, and LANL through the NHMFL exists nowhere else in the world.

Σ [Visa + Perm Residents]

70-80% graduate students and postdocs are non U.S. born scientists

* Need to make sure FSU only searches will include UF + LANL!

APPENDIX A: USERS AND PROJECTS

USERS AND PROJECTS: DC FIELD FACILITY

+ Postdoc, * Student, (f) female

User	Institution	Funding	Project
Agosta, Charles Coffey, Tom* Martin, Catalin*	Clark U. Clark U. Clark U.	NSF	Critical Field in Parallel and Perpendicular Directions via RF Penetration Depth Measurements.
Bauer, Pierre Imbasciati, Linda (f)	Fermilab Fermilab	DOE	Critical Current of Superconducting ITER Nb_3Sn Cables in High Magnetic Fields with Transverse Pressure
Bowers, C. Russ Olshanetsky, Eugene	UF UF	NSF	GHz Quantum Hall Effect
Brey, William Gor'kov, Peter Gan, Zhehang Murali, Nagajaran Bird, Mark	NHMFL NHMFL NHMFL NHMFL NHMFL	NSF	Refine Flux Stabilization of Keck Magnet
Brooks, James Balicas, Luis Molinuevo Storr, Kevin Pappavasiliou, George Terashima, Taichi	FSU Venezuela Inst. of Tech. FSU Inst. for Chemistry, Greece NRIM	NSF	Electrical Transport in CeNiSn, Organic t Phase and dHvA in κ-$(BEDT\text{-}TTF)_2I_3$
Brooks, James Kobayashi, A Storr, Kevin* Graf, David* Rutel, Isaac* Balicas, Luis Molinuevo Uji, Shinya Choi, Eun Sang+	FSU Inst. for Molecular Science FSU FSU FSU Venezuela Inst. of Tech. NRIM NHMFL	NSF	Electronic and Magnetic Properties in Low Dimensional Materials
Butler, Les Gan, Zhehong Mrse, Anthony*	Louisiana State U. NHMFL Louisiana State U.	NSF	^{2}H, ^{27}Al High Resolution Major-Angle Spinning NMR in Zeolites
Cao, Gang Crow, Jack	NHMFL NHMFL	NHMFL	Novel Quantum Phenomena in $Ca_3Rh_2O_7$
Carnahan, Blake Hassain, Aftab	Lockheed Martin Lockheed Martin	U.S. Navy	Magnetization of Drivestacks
Chen, Ching-Jen Haik, Yousef Badisa, Ramesh* Cordovez, Manuel* Zowlinski, Andrew*	FAMU-FSU College of Eng. FAMU-FSU CoE FAMU-FSU CoE FAMU-FSU CoE FAMU-FSU CoE	NSF	Effects of Magnetic Fields on Cancer Cells
Chen, Chih-Yung (f) Oliver, Trevor*	Harvey Mudd College Harvey Mudd College	Harvey Mudd College	Study of Subband Structures in Si-d Doped GaAs Before and After Illumination
Clark, W. Gilbert Gavilano, Jorge Kuhns, Phil Moulton, Bill Reyes, Arneil Vonlanthen, Patrik Goto, Atsushi	UCLA Lab. Fur Festkorperphysik, Zurich NHMFL FSU NHMFL UCLA NRIM	NSF	NMR Investigation of the Antiferromagnetic State of $LiVGe_2O_6$

Clark, Gilbert Moulton, Bill Voulautheu, Patrik* Kuhns, Phil Reyes, Arneil	UCLA FSU UCLA NHMFL NHMFL	NSF, NHMFL	Phase Fluctuations of the Charge Density Wave in $Rb_{0.3}MoO_3$
Crabtree, George Kwok, Wai-Kwong Moulton, William Karapetrov, Goran Paulis, Lisa (f) Cenat, Christophe	Argonne Natl. Lab. Argonne Natl. lab. NHMFL Argonne Natl. Lab Western Michigan U. Grenoble		Tests of High Tc Superconductors
Crow, Jack Cao, Gang McCall, Scott+ Alexander, Scott*	NHMFL NHMFL NHMFL NHMFL	NSF	Investigation of Fermi Surface of $Ca_3Ru_2O_3$
Douglas, Elliot P. Kim, Dongsik*	UF UF	NSF	Materials Orientation in Magnetic Fields: Collagen
Douglas, Elliot Cho, Seunghyun* Castell, Pere*	UF UF UF	NSF	Materials Processing in Magnetic Fields: High Strength Polymers
Du, Rui Rui Zhang, Jian+ Simmons, Jerry	U. Utah U. Utah Sandia Natl. Labs.	NSF	Heat Capacity and Microwave Photoconductivity Studies of the FQHE State
Dynes, Robert Hellman, Frances Teizer, Winfried+	U. California, San Diego UCSD UCSD	NSF	Metal Insulator Transition in Amorphous Si Gd
Engel, Lloyd Lewis, Rupert Ye, Peide Tsui, Dan Pfieffer, Lauren West, Ken	NHMFL NHMFL NHMFL Princeton U. Lucent Lucent	NHMFL	Microwave Conductivity of the Fractional Quantum Hall States and Studies of the Wigner Crystalline State
Fisk, Zachary Jones, Glover Nakatsuji, Satoru+ Hall, Donavan Maeno Yoshiteru	FSU NHMFL NHMFL NHMFL Kyoto U.	NSF	Magnetic Field - Temperature Phase Diagram of $Ca_{2-x}Sr_xRuO_x$ and $YbInCu_4$
Fortune, Nathanael Hannahs, Scott LaRue, Anna* (f)	Smith College NHMFL Smith College	Smith College	Thermometry for Heat Capacity Measurements in Miniature Cells
Garmestani, Hamid Cheikh - Ali Askar*	FAMU-FSU College of Eng. FAMU	NSF	Effect of Magnetic Field on Recrystallization and Grain Growth in Some Ferro and Paramagnetic Materials
Garmestani, Hamid Meda, Lamartine*	FAMU-FSU College of Eng. FAMU-FSU College of Eng.	NSF	High Temperature Texturing of $Nd_2Fe_{14}B$
Goodrich, Roy Alver, U.* Harrison, Neil Hall, Donavan Palm, Eric Murphy, Tim Tozer, Stan Pagliuso. P.G.+ Sarrao, John Moreno, J.L. Fisk, Zachary	Louisiana State U. Louisiana State U. NHMFL - LANL NHMFL NHMFL NHMFL NHMFL LANL - MST10 LANL - MST10 LANL FSU	NSF	Localized f Electrons in $Ce_xLa_{1-x}RhIn_5$: dHvA Measurements

Goodrich, Roy G. Hall, Donavan Fisk, Zachary Hebard, Arthur F. Maslov, Dmitri Sarrao, John	Louisiana State U. NHMFL FSU UF UF LANL	NSF	Magnetization Above the Quantum Limit
Guillot, Maurice Ostorero, Jean Long, Gary	Grenoble Magnet Lab. CNRS, Grenoble U. Missouri, Rolla	NSF	Magnetic Properties of Different Compounds under High Magnetic Fields
Hall, Donavan Palm, Eric Murphy, Tim Tozer, Stan Fisk, Zach Alver, U.* Goodrich, Roy Sarrao, John Pagliuso. P.G.+ Ebihra, Takao	NHMFL NHMFL NHMFL NHMFL FSU Louisiana State U. Louisiana State U. LANL - MST10 LANL - MST10 U.C. Irvine	NSF	The Fermi Surface of $CeCoIn_5$: dHvA
Hall, Donavan Fisk, Zach Petrovic, C.* Movshovich, Roman Hundley, M.F. Sarrao, John Pagliuso. P.G.+ Thompson, J.D.	NHMFL FSU FSU LANL - K764 LANL - MST10 LANL - MST10 LANL - MST10 LANL - MST10	NSF	Coexistence of Magnetism and Superconductivity in $CeRh_{1-x}Ir_xIn_5$
Hall, Donavan Palm, Eric Murphy, Tim Tozer, Stan Fisk, Zach Alver, U.* Goodrich, Roy Sarrao, John Pagliuso. P.G.+ Miller-Ricci, Elizabeth* Peabody, Lydia* Wills, J.M. Li, Charis Quay Huei*	NHMFL NHMFL NHMFL NHMFL FSU Louisiana State U. Louisiana State U. LANL - MST10 LANL - MST10 Middlebury College Smith College LANL Mount Holyoke College	NSF	Electronic Structure of $CeRhIn_5$: dHvA and Energy Band Calculations
Halperin, William Moulton, Bill Mitrovic, Vesna* (f) Sigmund, Eric* Lee, Moohee Kuhns, Phil Reyes, Arneil	Northwestern U. FSU Northwestern U. Northwestern U. Northwestern U. NHMFL NHMFL	NSF	Diffusion Glass-Forming Liquids
Halperin, William Moulton, Bill Kuhns, Phil Mitrovic, Vesna* (f) Reyes, Arneil Calder, Ned* Thomas, Will	Northwestern U. FSU NHMFL Northwestern U. NHMFL Northwestern U. Northwestern U.	NSF	Vortex Microscopy by NMR

Hammer, Bruce Conroy, Mark Turner, Russell	U. Minnesota U. Minnesota Mayo Clinic	U. Minnesota	Analysis of Osteoblasts Where Gravitational Forces are Counterbalanced by Magnetic Forces
Hari, Parmeswar Moulton, Bill Taylor, Craig Caldwell, Tod* Reyes, Arneil	California State U. - Fresno FSU U. Utah FSU NHMFL	NHMFL, Research Corp.	Photodarkening in As_2S_3 NMR Lineshape Mapping
Hellman, Frances (f) Dynes, Robert Teizer, Winfried+ Zink, Barry* Queen, Daniel*	U. California, San Diego UCSD UCSD UCSD UCSD	NSF	Magnetic Properties of Amorphous Magnetic Superconductors
Hentges, Rob Field, Mike Hong, Seung Zhang, Youshu Parrell, Jeff	Oxford Superconducting Technology OST OST OST OST	Oxford Superconducting Technology	High Field Current Density of Nb_3Sn Wire Reacted with Different Heat Treatment Parameters
Hill, Stephen Kovalev, Alexey* Negusse, Ezana*	UF UF Montana State U.	NSF	Search for Melting Field of Vortex Lattice by Cantilever Magnetometry
Houpt, Thomas Smith, James Goodner, Drew Kwan, Bumsup Lockwood, Denesa* (f) Cassell, Jennifer* (f) Golden, Glen	FSU FSU FSU FSU FSU FSU FSU	NIH	Behavioral and Neural Effects of High Strength Magnetic Fields
Huber, Tito Graf, Michael J. Celestine, Kizi (f)*	Howard U. Boston College Howard U.	NSF	Angle-Dependent Resistance of Bismuth Wires
Hussey, Nigel McBrien, Matthew Horii, Shigeru* Balicas, Luis	U. Bristol U. Bristol U. Tokyo Venezuela Inst. of Tech.	EPSRC (UK)	Angular Magnetoresistance Oscillations in $PrBa_2Cu_4O_8$
Hwang, Sung-Woo Son, Maeng-Ho Engel, Lloyd Jun, Myung-Sim	U. Seoul U. Seoul NHMFL U. Seoul	Korean Government Ministry of Science	I-V Characteristics (Tunneling) of Stacked InAs Quantum Dots
Iwasa, Yukikazu Takayasu, Makoto	Massachusetts Inst. of Technology MIT	DOE	Low Cost, High Performance HTS Magnets for NMR
Jaime, Marcelo Mydosh, John Movshovich, Roman	LANL U. California, Santa Barbara LANL	NHMFL	Specific Heat in High Fields of URu_2Si_2
Jones, Eric D. Wei, Xing Reno, John Bajaj, Krishman K. Crooker, Scott Tozer, Stan	Sandia Natl. Labs. NHMFL Sandia Natl. Labs. Emory U. NHMFL - LANL NHMFL	DOE	Band Structure Studies of Semiconductor Alloys
Kang, Woun Balicas, Luis Kang, Haeyong (f)* Jo, Younjung (f)*	Ewha Womans U. Venezuela Inst. of Tech. Ewha Womans U. Ewha Womans U.	Korean Research Foundation	Electrical Resistivity and Hall Resistivity Measurement of Bechgaard Salts
Kang, Woowon Young, Joseph* Nelson, Jeffrey	U. Chicago U. Chicago U. Chicago	Packard Foundation	Sonoluminescence at High Magnetic Fields

Kantser, Valeriu Condrea, Elena P. Grozav, Anatol	Academy of Sciences of Moldova Academy of Sciences of Moldova Academy of Sciences of Moldova		Temperature Dependence and Magnetoresistance of Bismuth Nanowires
Khokhlov, Dmitriy	Moscow State U.	IHRP	Transport and Susceptibility Measurements of Doped PbTI Based Semiconductors
Krasovitsky, Vitaly Hannahs, Scott	B. Verkin Inst. for Low Temp. Phys. & Eng. NHMFL	NSF	High Temperature Oscillations in the Conductivity of Bismuth
Krusin-Elbaum, Lia Shibauchi, Takasada+ Maley, Martin Latyskev, Yuri Suzuki, Minorv	IBM Research IBM LANL Tohoku U. Kyoto U.	NSF	Intrinsic Tunneling Spectroscopy of Bi-2212 Superconductor
Lacerda, Alex Christianson, Andrew Hundley, Mike Pagliuso, Pascal + Sarrao, John Kern, Sandy Jung, Myung-Hwa	LANL LANL LANL LANL LANL Colorado State U. Hiroshima U.	NSF	Magnetotransport at High Fields and Low Temperatures of $CeRhIn_5$
Landee, Chris Turnbull, Mark* Galeriu, Calin*	Clark U. Clark U. Clark U.	NSF	Magnetization Studies of Molecular based S= 1/2 Spin Ladders
Lewis, Roger Wang, Yong-Jie	U. Wollongong NHMFL	Australian Research Council	Resolving Outstanding Questions in the Acceptor Spectra of III-V and II-VI Semiconductors and the Appearance of Metamagnetism in Cobaltite/manganite Perovskites
Maple, Brian Indrakanti, S.S Maley, Martin Nesterenko, V.F. Taylor, Ben Li, Shi*	U. California at San Diego UCSD LANL UCSD UCSD UCSD	NSF	Upper Critical Field, Hc_2, of High T Superconductors
Markiewicz, Denis Swenson, Chuck Hall, Donavan Brey, William Jones, Glover	NHMFL NHMFL NHMFL NHMFL NHMFL	NSF	Permeability Measurement of Candidate 900 MHz Bore Tube Materials
Meisel, Mark Morgan, Nicole* (f) Ferl, Robert Paul, Anna-Lisa (f) Brooks, James	UF UF UF UF FSU	NSF	Magnetic Field Effects and Levitation of Transgenic Plants
Molodov, Dmitri Konijnenberg, Peter	Inst. Phys. Metal and Metal Physics, Germany Inst. Phys. Metal and Metal Physics, Germany	Deutsche Forschungsgemeinschaft	Magnetically Induced Planar Grain Boundary Motion in Zinc Bicrystals

Moulton, Bill Caldwell, Tod* Kuhns, Phil Abdelrazek, Margie* (f) Reyes, Arneil	FSU FSU NHMFL FSU NHMFL	NSF	1. ^{17}O NMR Study 2. Phase Mapping 3. Low Temperature State Study
Moulton, Bill Kuhns, Phil Reyes, Arneil Caldwell, Tod* Herceg, Tomi* Achey, Randall*	FSU NHMFL NHMFL FSU Peddie High School FSU	NSF	^{23}Na NMR Studies of the New Spin-Peierls System, NaV_2O_5 at High Field
Murata, Keizo Balicas, Luis Molinuevo Brooks, James Graf, David* Storr, Kevin* Rutal, Isaac*	Osaka City U. Venezuela Inst. of Tech. FSU FSU FSU FSU	NSF, Osaka U.	Examination of: 1. Phase Transitions, such as Spin Density Wave Under Uniaxial Pressure 2. Fermi Surface Transition
Murphy, Tim Hall, Donavan Palm, Eric Tozer, Stan Petrovic, C.* Fisk, Zachary Goodrich, Roy Pagliuso. P.G.+ Sarrao, John Thompson, J.D.	NHMFL NHMFL NHMFL NHMFL FSU FSU Louisiana State U. LANL - MST10 LANL - MST10 LANL - MST10	NSF	Anomalous Superconducting Properties and Field Induced Magnetism in $CeCoIn_5$
Musfeldt, Janice (f) Wang, Yong-Jie Sushkor, Andrei*	U. Tennessee NHMFL U. Tennessee	NSF, DOE	Far Infrared of Mn_{12} - Acetate
Musfeldt, Janice (f) Sushkov, Andrei* Wei, Xing	U. Tennessee U. Tennessee NHMFL	DOE	Spectroscopic Studies of Oxide Based Solids at High Magnetic Fields
Ng, Hon-Kie Leem, Young-Ahn+	FSU FSU	NSF	Cyclotron Resonance for Modulation Doped II-VI Quantum Well
Noh, Tae Won Lee, Haeja* Wang, Yong-jie Kim, Myung	Seoul Natl. U. Seoul Natl. U. NHMFL Seoul Natl. U.	NSF	IR Reflectance Measurements of (La.Pr,Ca) MnO_3, $Sm_2Mo_2O_7$, and other Manganese Oxides
Noh, Tae Won Choi, Eun Sang Moritomo, Y Jung, Jong Lee, Haeja* Wang, Yong-Jie Wei, Xing	Seoul Natl. U. Seoul Natl. U. Nagoya U. Seoul Natl. U. Seoul Natl. U. NHMFL NHMFL	Korea - MS &T	Melting of Charge Ordering in $(Nd,Pr)_{1/2}Sr_{1/2}MnO_3$ and other Manganese Oxides
Ong, Nai-Phuan Wang, Yayu	Princeton U. Princeton U.	NSF	Nernst Effect in Cuprates in High Fields
Palm, Eric Murphy, Tim	NHMFL NHMFL	NHMFL	Coulomb Blockade Thermometry Tests
Park, Yung Woo Suh, Dong-Seok* Shirakawa, H. Akagi, K. Brooks, James Kim, Jun Sung*	Seoul Natl. U. Seoul Natl. U. U. Tsukuba U. Tsukuba NHMFL/FSU Seoul Natl. U.	Korea Sci. & Eng. Foundation	Magnetoresistance and Hall Effect. Studies of Conducting Polymers

Park, Yung Woo Yu, Han Young* Shirakawa, H. Aleshin, A. N.	Seoul Natl. U. Seoul Natl. U. U. Tsukuba Seoul Natl. U.	Korea Sci. & Eng. Foundation	The Effect of High Magnetic Fields on Synthetic Nanowires
Parrell, Jeff Hentges, Rob Field, Mike Hong, Seung Zhang, Youzhu	Oxford Superconducting Technology OST OST OST OST	Oxford Superconducting Technology	VSM Measurements of B_{c2} of Nb_3Sn Wire
Pekarek, Thomas Miotkowski, Irek Ramads, A	U. North Florida Purdue U. Purdue U.	Research Corp.	Cantilever Measurements of CdCCoTe, II-VI DMS, III-VI DMS
Petrou, Athos Wei, Xing Furis, Madalina* Itskos, Grigorios*	SUNY at Buffalo NHMFL SUNY at Buffalo SUNY at Buffalo	NSF	Magneto-optical Studies of Spintronic Materials and Devices
Pourrahimi, Shahin Williams, John McNiff, Edward	Superconducting Systems Inc. Superconducting Systems Inc. Superconducting Systems Inc	Superconducting Systems Inc.	JC vs. B of Nb_3Sn Wire
Qualls, Jeremy Lachgar, Abdessadek Duraisamy, Thirumalai+	Wake Forest U. Wake Forest U. Wake Forest U.	Wake Forest U.	Novel Transport Phenomena in low Dimensional Metals
Reyes, Arneil Moulton, Bill Kuhns, Phil Caldwell, Tod* Abdelrazek, Margie* (f)	NHMFL FSU NHMFL FSU FSU	NSF	1. NMR Studies at High Field. 2. NMR Studies of Nd Fluctuations and Pseudogap. 3. T1 and Knightshift at High Field in $NdBa_2Cu_3O_7$
Rõõm, Toomas Wang, Yong-Jie Kageyama, Hiroshi Nagel, Urmas Timusk, Tom	Natl. Inst. of Chem. Phys. & Biophy. NHMFL U. Tokyo Natl. Inst. of Chem. Phys. & Biophy. McMaster U.	Estonian Science Foundation, NHMFL	FIR Spectroscopy of $S_2Cu_2(BO_3)_2$
Rosenbaum, Ralph Pullum, Bobby Joe Hannahs, Scott Habekem, Roland	Tel Aviv U. NHMFL NHMFL Technical Inst. of Chemistry	Tel Aviv U., NHMFL	Magnetoresistance Measurements and Zero-Field Resistance Measurements of Metallic Amorphous and Quasicrystalline Thin Films
Rosenbaum, Ralph Brandt, Bruce Chen, Y.Y.* Ihas, Gary G. Zink, Barry*	Tel Aviv U. NHMFL Sinica Acedemia UF UCSD, La Jolla	Tel Aviv U., NHMFL	Testing Various Temperature Sensors
Schwartz, Justin Weijers, Huub Marken, Ken Thompson, Hill Meinesz, Maarten	FAMU-FSU College of Eng. NHMFL Oxford Superconducting Technology NHMFL NHMFL	NSF	HTSC Coil Development-Stress Test Combined with T_c Measurements of Double Pancake

Shayegan, Mansour Tutuc, Emanuel * Shkolnikov, Yakov* De Poortere, Etienne *	Princeton U. Princeton U. Princeton U. Princeton U.	NSF	Magnetotransport in High-Mobility Electrons in AlAs Quantum Wells
Singleton, John Tozer, Stan Edwards, Rachel* (f) Goddard, Paul* Narduzzo, Alessandro*	U. Oxford NHMFL U. Oxford U. Oxford U. Oxford	Eng. & Phys. Sci. Research Council	1. Transport Studies of Conductivity in Low-D Materials Using Two Axis Rotation and High Pressure 2. mm-Wave Impedance Measurements
Singleton, John Harrison, Neil Mielke, Charles H. Goddard, Paul* Ardavan, Arzhang+ Narduzzo, Alessandro*	U. Oxford NHMFL - LANL NHMFL - LANL U. Oxford U. Oxford U. Oxford	Eng. & Phys. Sci. Research Council	The Use of Quantum Oscillations in Probing Strongly Correlated Electron Systems
Stewart, Greg Kim, Jung Soo Sarrao, John Thompson, Joe	UF UF LANL LANL	NSF	Magnetization of URu_2Si_2 up to 37 T
Stewart, Greg Kim, Jung Soo Sarrao, John Thompson, Joe	UF UF LANL LANL	DOE	Non-Fermi Liquid Behavior in High magnetic Fields
Stewart, Greg Kim, Jung Soo Sato, Noriaki	UF UF Nagoya	DOE	Specific Heat of UPd_2Al_3 up to 22 T and $\rho(H, T)$ in Au-Ge up to 33 T
Störmer, Horst L. Tsui, Daniel C. Pan, Wei+ Pfeiffer, Loren Baldwin, Kirk West, Ken	Columbia U. Princeton U. Princeton U. Bell Labs / Lucent Bell Labs / Lucent Bell Labs / Lucent	Bell Labs	Fractional Quantum Hall Effects Study the ν=6 Anisotropy Under Very High In-Plane Magnetic Field
Störmer, Horst L. Syed, Sheyum* Pan, Wei+	Columbia U. Columbia U. Princeton	Columbia U.	g-Factor of 2DEG
Storr, Kevin Brooks, James Balicas, Luis Molinuevo	Florida A & M U. FSU Venezuela Inst. of Tech.	FAMU - Physics Dept	Fermi Surface Studies of the Asymmetric Donor τ-(P-r-DMEDT-TF$)_2(AuBr_2)(AuBr_2)_y$
Sumption, Michael Buta, Florin Hascicek, Yusuf Aslanoglu, Ziya	Ohio State U. Ohio State U. NHMFL NHMFL	NSF	Critical Current Measurements of Multifilamentary Wires
Teitel'baum, Gregory Vavilova, Evgenia Kukovitskiy, Evgeniy Talanov, Yuriy Kuhns, Phil	KPTI-Russian Academy of Sciences KPTI-Russian Academy of Sciences KPTI-Russian Academy of Sciences KPTI-Russian Academy of Sciences NHMFL	NSF	NMR of La_{2-x} Sr_x Cu O_y - Superconductor
Thomann, Hans Ling, Shiun Tindall, Paul Luton, Michael	Exxon Corporate Res. Lab ExxonMobil Res. & Eng. Co. Experimental Equip. Design ExxonMobil Res. & Eng. Co.	Exxon Mobil	Magnetic Effects on Ferrous Alloy Phase Stability at High Temperature

Tozer, Stan Hall, Donavan Goodrich, Roy G. Fisk, Zachary Sarrao, John Palm, Eric	NHMFL NHMFL Louisiana State U. FSU LANL NHMFL	NHMFL	Fermi Surface Studies at High Pressure of $CeRhIn_5$
Tyson, Trevor A. Cui, Congwu Croft, Mark Cheong, Sang Wook Woicik, Joe	New Jersey Inst. of Tech. New Jersey Inst. of Tech. Rutgers U. Lucent Tech./Bell Labs NIST	DOE	Correlations Between Magnetic and Structural Properties of Ca Doped $BiMnO_3$
Uji, Shinya Tokumoto, Madoka Balicas, Luis Molinuevo Brooks, James	Natl. Inst. Material Science, Japan Electro-Technical Inst., Japan Venezuela Inst. of Tech. FSU	NIMS	Magnetoresistance of λ–$(BETS)_2Fe_xGa_{1-x}Cl_4$
Wang, Yong-Jie Zhang, Yong Tu, CW Wei, Xing	NHMFL Natl. Renewable Energy Laboratory U. California, San Diego NHMFL	NSF	Optical Study of GaAsN Giant Band Gap Reduction
Warren, Warren	Princeton U.	NSF	Resolution Enhancement Using Homogenized Detection of Solution State NMR on the Keck Magnet
Wei, Xing Vardeny, Zeev	NHMFL U. Utah	NSF	Organic Molecular Crystals
Yuen, Tan Hall, Donavan Li, Jing LIn, Chyanlong	Temple U. NHMFL Rutgers U. Temple U.	NSF	Magnetization vs. Field Magnetization vs. Temperature of 1.) M(ox)(bpy) 2.) MCl_2(bpy) 3.) $(MCN_3)_2$(bpy) M=Fe,Co,Ni; ox=$C_2O_4^{2-}$; bpy=4, 4-bypyridine 4.)[Co(bpde)$(H_2O)_2$] H_2O bpde= $C_{14}O_4H_6$
Zeitlin, Bruce Palm, Eric	Supergenics LLC NHMFL	Supergenics LLC	H_{c2}, J_c Measurements on Short Coiled Samples
Zheng, Guo-Qing Caldwell, Tod* Kuhns, Phil Abdelrazek, Margie* (f) Reyes, Arneil	Osaka U. NHMFL NHMFL NHMFL NHMFL	NSF	^{63}Cn NMR Study of High-Tc Superconductor YBCO (T_1 Measurement)
Zheng, Jim Wei, Xing	FAMU-FSU College of Eng. NHMFL	FSU CRCP	Optical Spectra of Porous Silicon at High Magnetic Fields

Users and Projects: Pulsed Field Facility

+ Postdoc, *Student, (f) female

User	Institution	Funding	Project
Agosta, Charles Mielke, Chuck Tokumoto, Madoka Mihut, Izabela* (f)	Clark U. NHMFL - LANL ETL - Japan Clark U.	NSF	TDO Experiments in Organic Conductors
Ando, Yoichi Kim, Kee-Hoon+ Ono, Shimpei* Balakirev, Fedor Boebinger, Greg	CRIEPI - Japan NHMFL - LANL CRIEPI - Japan NHMFL - LANL NHMFL - LANL	Industry	Searching for a Quantum Critical Point in High Tc Cuprates
Aronson, Meigan Balakirev, Fedor Fisk, Zach Bennett, Marcus*	U. Michigan NHMFL - LANL FSU U. Michigan	NSF	Magnetoresistance in Low Carrier Density Magnets
Balicas, Luis Brooks, James Graf, David* Papavassiliou, G. Kobayashi, H. Mielke, Chuck Harrison, Neil	Venezuela Inst. of Tech. FSU FSU NHRF, Athens-Greece IMS - Japan NHMFL - LANL NHMFL - LANL	NSF	Field Induced Superconductivity of $(BETS)_2FeCl_4$
Baxter, David Mielke, Chuck Ruzmetov, Dmitry* Furdyna, Jack Sasaki, Yuji Liu, Xinyu Scherschlgt, Julia* (f)	Indiana U. NHMFL - LANL Indiana U. Notre Dame U. Notre Dame U. Notre Dame U. Indiana U.	NSF	Magnetotransport in GaMnAs
Bekeris, Victoria Jaime, Marcelo Tokura, Y. Jorge, Guillermo*	U. Buenos Aires NHMFL - LANL U. Tokyo U. Buenos Aires	Other	High Field Hall Effect in Manganites
Broholm, Collin Stone, Matthew* Harrison, Neil	Johns Hopkins U. Johns Hopkins U. NHMFL - LANL	NSF	Quantum Disorder Magnet
Brown, Stuart Betts, Jon Boebinger, Greg Hillman, Chris* Mielke, Chuck	UCLA NHMFL - LANL NHMFL - LANL UCLA NHMFL - LANL	NSF	Pulsed Field Studies of RF Capacitance Probes for Mechanical Micromagnetometers
Canfield, Paul Bud'ko, Sergey Lacerda, Alex Jung, Myung-Hwa+	Ames Laboratory Ames Laboratory NHMFL - LANL New Mexico State U.	U.	Hc_2 Diagram of MgB_2 Wires
Canfield, Paul Bud'ko, Sergey Lacerda, Alex Anderson, Norman* Christianson, Andrew*	Ames Laboratory Ames Laboratory NHMFL - LANL Iowa State U. Colorado State U.	DOE	High Field Magnetotransport Measurements of $CeBi_2$

Cava, Robert Ramirez, Art Harrison, Neil	Princeton U. LANL - MST10 NHMFL - LANL	NSF	High Field Fermi Surface Investigation of $Ca_2Ru_3O_7$
Cheong, Sang-Wook Yew-San, Hor* Jaime, Marcelo	Rutgers U. Rutgers U. NHMFL - LANL	NSF	High Field Magnetotransport in Manganites and Spinels
Cheong, Sang-Wook Kim, Kee-Hoon+ Jaime, Marcelo Boebinger, Greg Jung, Myung-Hwa+ Lacerda, Alex	Rutgers U. NHMFL - LANL NHMFL - LANL NHMFL - LANL New Mexico State U. NHMFL - LANL	NSF	High Field Magnetotransport Properties of Pyrochlore Ruthenates
Cheong, Sang-Wook Kim, Kee-Hoon+ Jaime, Marcelo Hor, Yew-San* Boebinger, Greg	Rutgers U. NHMFL - LANL NHMFL - LANL Rutgers U. NHMFL - LANL	NSF	High Magnetic Field Study of Transition Metal Disulfide: $Ni_{1-x}Co_xS_2$ and $Fe_{1-x}Co_xS_2$
Cornelius, Andrew Lawrence, Jon Sarrao, John Ebihara, Takao Harrison, Neil	U. Nevada UC - Irvine LANL - MST10 Shzuoka U. - Japan NHMFL - LANL	NSF	Fermi Surface Studies of $YbAl_3$
Crooker, Scott Klimov, Victor Hollingsworth, Jennifer (f)	NHMFL - LANL LANL - CST6 LANL - CST6	NSF	Semiconductor Nanocrystals in Pulsed Fields
Crooker, Scott Efros, Sasha Klimov, Victor Hollingsworth, Jennifer (f)	NHMFL - LANL Naval Research Laboratory LANL - CST6 LANL - CST6	DOE	Time-Resolved PL Decays in Wurtzite and Cubic Nanocrystals
Goodrich, Roy Uimit, H.* Hall, Donavan Palm, Eric Murphy, Tim Tozer, Stan Sarrao, John Fisk, Zach	Louisana State U. Louisana State U. NHMFL NHMFL NHMFL NHMFL LANL - MST10 FSU	NSF	High Field Fermi Surface Studies of La-$CeRhIn_5$ Alloys
Goodrich, Roy Rickel, Dwight	Louisana State U. NHMFL - LANL	NSF	Aluminum Coil Test
Goodrich, Roy Macaluso, Robin* Sarrao, John Fisk, Zach Harrison, Neil	Louisana State U. Louisana State U. LANL - MST10 FSU NHMFL - LANL	NSF	dHvA in $La_{1-x}Ce_xMIn_5$
Guertin, Robert Crow, Jack Cao, Gang Alexander, Scott* McCall, Scott+ Mielke, Chuck	Tufts U. NHMFL NHMFL NHMFL NHMFL NHMFL - LANL	NSF	Magnetic, Transport and Structural Properties of Ruthenates and Iridates in High Magnetic Fields
Guy, Phillipe Migliori, Albert Harrison, Neil Singleton, John Mielke, Chuck Rickel, Dwight	ABB - France NHMFL - LANL NHMFL - LANL Oxford U.-UK NHMFL - LANL NHMFL - LANL	Industry	Millimeter Wave Vector Network Analyzer
Harrison, Neil	NHMFL - LANL	DOE	Magnetization Probe Test

Hellman, Frances Jaime, Marcelo Kim, Kee-Hoon+ Jorge, Gillermo*	UC - San Diego NHMFL - LANL NHMFL - LANL U. Buenos Aires	NSF	Thermometry Calibration
Hollingsworth, Jennifer (f) Klimov, Victor Efros, Sasha Crooker, Scott	LANL - CST6 LANL - CST6 Naval Research Laboratory NHMFL - LANL	DOE	Polarization of Cubic and Wurtzite Semiconductor Nanocrystals
Inoue, Isao Jung, Myung-Hwa+ Nakotte, Heinz Lacerda, Alex	Electrotechnical Lab. - Japan New Mexico State U. New Mexico State U. NHMFL - LANL	Other	Fermi Surface Investigation of $CaSrVo_3$
Jia, Quanxi Trugman, Stuart Taylor, Toni Crooker, Scott	LANL - STC LANL - T11 LANL - MST10 NHMFL - LANL	DOE	High-Field THz Spectroscopy of YBCO
Jones, Eric Crooker, Scott Bajaj, Krishan	Sandia Natl. Labs. NHMFL - LANL Emory U.	DOE	Magneto-Excitons in Semiconductor Alloys
Jones, Eric Crooker, Scott Bajaj, Krishan Waldrip, Karen (f)	Sandia Natl. Labs. NHMFL - LANL Emory U. Sandia Natl. Labs.	DOE	High Field Diamagnetic Shifts and FWHM Linewidths in Semiconductors
Karczewski, Grzegorz Crooker, Scott Negre, Nicolas+	Inst. of Physics - Polish Academy of Science NHMFL - LANL NHMFL - LANL	NSF	Photoluminescence Study of Charged Exciton in $CdTe_2$DEGs with Varying Carrier Density
Kastner, Marc Boebinger, Greg Matan, K.* Lee, Young Wakimoto, S. Birgeneau, Robert Khaykovich, Boris+ Balakirev, Fedor	MIT NHMFL - LANL MIT NIST MIT U. Toronto MIT NHMFL - LANL	NSF	Upper Critical Field and Hall Effect in La_2CuO_{4+y}
Klimov, Victor Crooker, Scott Hollongsworth, Jennifer (f) Efros, Sasha	LANL - CST6 NHMFL - LANL LANL - CST6 Naval research Laboratory	DOE	Electron Spins in Cubic Nanocrystals
Klimov, Victor Crooker, Scott Hollongsworth, Jennifer (f) Efros, Sasha Barrick, Todd* Treitak, Sergei McCulloch, Quinn*	LANL - CST6 NHMFL - LANL LANL - CST6 Naval research Laboratory U. New Mexico LANL - T11 New Mexico Tech	DOE	Spin Structure of Oriented Nanocrystallites
Lacerda, Alex Christianson, Andy* Sarrao, John Paglioso, P.	NHMFL - LANL Colorado State U. LANL - MST10 LANL - MST10	NSF	Fermi Surface Investigation of $Ce_{1-x}La_xRhIn_5$
Lacerda, Alex Jung, Myung-Hwa+ Jaime, Marcelo Boebinger, Greg Kim, K. Kang, W. Lee, S.	NHMFL - LANL New Mexico State U. NHMFL - LANL NHMFL - LANL Pohang U. - S. Korea Pohang U. - S. Korea Pohang U. - S. Korea	NSF	Magnetoresistance Measurements of MgB_2 Single Crystals

Lacerda, Alex Christianson, Andrew* Sarrao, John Anderson, Norman*	NHMFL - LANL Colorado State U. LANL - MST10 Iowa State U.	NSF	High Field Magnetotransport of $CeRhIn_5$ and Related Alloys
Lacerda, Alex Harrison, Neil Sarrao, John Paglioso, P. Jung, Myung-Hwa+	NHMFL - LANL NHMFL - LANL LANL - MST10 LANL - MST10 New Mexico State U.	NSF	High Field Fermi Surface Measurements of $CeNiGe_2$
Lander, Gerry Harrison, Neil Kern, Sandy Christianson, Andrew*	ILL - Grenoble NHMFL - LANL Colorado State U. Colorado State U.	Other	Magnetization Study of Uranium Sulfide
Lawrence, Jon Egihara, T. Lacerda, Alex Thompson, Joe Jung, Myung-Hwa+	UC Irvine Japan NHMFL - LANL LANL - MST10 New Mexico State U.	NSF	High Field Scaling Laws of $YbAl_3$
Lee, S. Jaime, Marcelo Kim, H. Choi, E. Kang, W. Boebinger, Greg Jung, Myung-Hwa+ Lacerda, Alex	Pohang U. - S Korea NHMFL - LANL Pohang U. - S Korea Pohang U. - S Korea Pohang U. - S Korea NHMFL - LANL New Mexico State U. NHMFL - LANL	Other	Anisotropic Superconductivity in MgB_2 Epitaxial Flms
Lee, H. Kwon, Y. Jung, Myung-Hwa+ Lacerda, Alex	Sung Kyun U. - S. Korea Sung Kyun U. - S. Korea New Mexico State U. NHMFL - LANL	Other	High Field Magnetotransport Measurements of $Ce_3Pd_4Ge_3$
Mielke, Chuck Harrison, Neil Montgomery, Michael	NHMFL - LANL NHMFL - LANL Indiana U.	NSF	High Field Complex Conductivity in Organic Metals
Mielke, Chuck Harrison, Neil Montgomery, Michael Singleton, John	NHMFL - LANL NHMFL - LANL Indiana U. Oxford U. - UK	NSF	Depinning the CDW in α-$ET_2MHg(SCN)_4$
Mielke, Chuck Rickel, Dwight Montgomery, Michael Migliori, Albert	NHMFL - LANL NHMFL - LANL Indiana U. NHMFL - LANL	DOE	Thermodynamic Investigation of X-$BETS_2MCl_4$ Salts
Movshovich, Roman Betts, Jon Lacerda, Alex Bianchi, Andreas+	LANL - MST10 NHMFL - LANL NHMFL - LANL LANL - MST10	DOE	Development of Heat Capacity Measurements: 20 T - SC
Mueller, Fred Mielke, Chuck Drymiotis, Fivos* Fisk, Zach	LANL -MST6 NHMFL - LANL FSU FSU	NSF	Anisotropy of MgB_2 Aligned Powder
Mydosh, John Jaime, Marcelo Boogaard, Geerten* Harrison, Neil	Leiden U. NHMFL - LANL Leiden U. NHMFL - LANL	Other	Investigation of Quantum Phase Transition in $CeNi_2Ge_2$
Mydosh, John Jaime, Marcelo Boogaard, Geerten*	Leiden U. NHMFL - LANL Leiden U.	Other	Study of CDW in Local Moment Magnets on $Re_5Ir_4Si_{10}$

Nakotte, Neinz Mielke, Chuck Bruck, E. Lacerda, Alex Chang, Sung*	New Mexico State U. NHMFL - LANL WZL - Amsterdam NHMFL - LANL New Mexico State U.	NSF	High Field Complex Conductivity of UNiGe
Nakotte, Neinz Prokes, K. Bruck, E. Lacerda, Alex Chang, Sung* Alsmadi, Abdel* Jung, Myung-Hwa+	New Mexico State U. Prague - Czech Republic WZL - Amsterdam NHMFL - LANL New Mexico State U. New Mexico State U. New Mexico State U.	U.	Magnetoresistance of UIrGe Under High Pressure
Norris, David McCulloch, Quinn* Crooker, Scott	NEC Research Inst. New Mexico Tech NHMFL - LANL	NSF	Magnetic Quantum Dots in Pulsed Magnetic Fields
Perez, Florent Negre, Nicolas+ Jusserand, Bernard Etienne, Bernard	CNRS-INSA, Toulouse- France NHMFL - LANL Lab. de Photonique et Nano-Fr Lab. de Photonique et Nano-Fr	Other	Photoluminescence of Quantum Wires Array
Ramirez, Art Boebinger, Greg Lacerda, Alex Cava, Bob Jung, Myung-Hwa+	LANL - MST10 NHMFL - LANL NHMFL - LANL Princeton U. New Mexico State U.	DOE	Upper Critical Field in MgB_2
Ramirez, Art Boebinger, Greg Subramariam, Mas Harrison, Neil Kim, Kee-Hoon+	LANL - MST10 NHMFL - LANL Exxon NHMFL - LANL NHMFL - LANL	DOE	High Field Geometrical Frustration: Y_2MoO_7
Rickel, Dwight Heller, Ed	NHMFL - LANL Sandia Natl. Labs.	DOE	Testing Sandia Magnetometer
Sarma, Bimal Migliori, Albert Ketterson, John Souslov, Alexei+ Gaffney, Ron* Jaime, Marcelo	U. Wisconsin NHMFL - LANL Northwestern U. U. Wisconsin U. Wisconsin NHMFL - LANL	NSF	Ultrasonic Measurements in the Vicinity of the Metamagnetic Transition in URu_2Si_2
Sarrao, John Jung, Myung-Hwa+ Paglioso, P. Lacerda, Alex	NHMFL - LANL New Mexico State U. LANL - MST10 NHMFL - LANL	DOE	High Field Magnetotransport Measurements of $CeNiGe_2$
Sarrao, John Harrison, Neil Goodrich, Roy	LANL - MST10 NHMFL - LANL Louisiana State U.	DOE	High Field Fermi Surface Studies of UGa_3 and $CeMIn_5$
Schiffer, Peter Ramanathan, Mahendiran Smarth, Nitin Jaime, Marcelo Potashnik, Steve*	Penn State U. Penn State U. Penn State U. NHMFL - LANL Penn State U.	NSF	High Field Magnetotransport Studies of $Ga_{1-x}Mn_xAs$
Sechovsky, Vladimir Nakotte, Heinz Honda, Fumi Alsmadi, Abdel* Chang, Sang Lacerda, Alex	Charles U. - Czech Republic New Mexico State U. Charles U. - Czech Republic New Mexico State U. NHMFL - LANL NHMFL - LANL	NSF	High Pressure - High Field Magnetotransport of UPdSn

Singleton, John Schluerter, John Goddard, Paul* Symington, Jane* Harrison, Neil	U. Oxford - UK Argonne Natl. Lab. U. Oxford - UK U. Oxford - UK NHMFL - LANL	Other	Anomalous Angle-Dependent Magnetic-Quantum-Oscillation Damping in Layered Metals
Singleton, John Harrison, Neil Mielke, Chuck Tukumoto, M.	U. Oxford - UK NHMFL - LANL NHMFL - LANL ETL / Tsukuba - Japan	Other	High Field Fermiology Studies of ET_2-RbGh$(SCN)_4$
Singleton, John Maeno, Yoshi Mielke, Chuck Edwards, Rachel* Narduzzo, Alessandro*	U. Oxford - UK Kyoto U. NHMFL - LANL U. Oxford - UK U. Oxford - UK	Other	High-Frequency Probes of Anisotropic Superconductors
Steglich, Frank Trovarelli, Octavio+ Deppe, M. Geibel, C. Tegus, O. Mydosh, J. Gegenwart, Philipp	Max-Planck Dresden-Germany Max-Planck Dresden-Germany Max-Planck Dresden-Germany Max-Planck Dresden-Germany Leiden U. - Holland Leiden U. - Holland Max-Planck Dresden-Germany	Other	Fermi Surface Investigation of $CeNi_2Ge_2$ Single-Crystals
Steglich, Frank Trovarelli, Octavio+ Cichorek, T. Jaime, Marcelo Aoki, H. Ochiai, A. Gegenwart, Philipp	Max-Planck Dresden-Germany Max-Planck Dresden-Germany Max-Planck Dresden-Germany NHMFL - LANL Tohoku U. - Japan Tohoku U. - Japan Max-Planck Dresden-Germany	Other	High Field Study of the 1D S = 1/2 AFM Heisenberg Chain: $YbAs_3$
Tessema, G. Skove, Malcom Nevitt, Michael Gamble, Brian* Canfield, Paul Lacerda, Alex	Clemson U. Clemson U. Clemson U. Clemson U. Ames Laboratory NHMFL - LANL	NSF	High Field Transport Phenomena of $SmSb_2$
Tessema, G. Skove, Malcom Nevitt, Michael Gamble, Brian* Canfield, Paul Bud'ko, S. Lacerda, Alex	Clemson U. Clemson U. Clemson U. Clemson U. Ames Laboratory Ames Laboratory NHMFL - LANL	NSF	Hall Effect of Light Rare-Earth Diantimonides
Torikachvili, Milton Jardim, Renato Bossi, Ilaria* Nakotte, Heinz Lacerda, Alex Borges, H.	San Diego State U. USP - Brazil San Diego State U. New Mexico State U. NHMFL - LANL LANL - MST10	NSF	High Field Magnetotransport of CePtSn
Tyson, Trevor Qin, Yuhai* Jaime, Marcelo	New Jersey Inst. of Tech. New Jersey Inst. of Tech. NHMFL - LANL	NSF	High Magnetic Field Studies of Ca Doped $BiMnO_3$

von Molnar, Stephan Watts, Steven* Jaime, Marcelo	FSU FSU NHMFL - LANL	NSF	High-Field Effect in CrO_2 Films
Yakovlev, Dimitri McCulloch, Quinn* Crooker, Scott	Ioffe Russian Acad. of Sciences New Mexico Tech NHMFL - LANL	NSF	Trions in II-VI 2D Electron Gases
Yakovlev, Dimitri McCulloch, Quinn* Crooker, Scott Barrick, Todd* Astakhov, G. Wolfgang, Ossau	Ioffe Russian Acad. of Sciences New Mexico Tech NHMFL - LANL U. New Mexico U. Wuerzburg-Germany U. Wuerzburg-Germany	Other	High Field Reflectivity of II-VI 2D Electron Gasses

USERS AND PROJECTS: HIGH B/T FACILITY

+Postdoc, *Student

User	Institution	Funding	Project
Candela, D.	U. Mass. Amherst	NSF	Spin Diffusion in Dilute ^3He
Mullin, W.J.	U. Mass. Amherst		
Akimoto, H.+	U. Mass. Amherst		
Sullivan, N.S.	UF, NHMFL		
Adams, E.D.	UF		
Xia, J.S.	UF, NHMFL		
Shvarts, V.A.+	UF, NHMFL		
Kless, K.J.*	UF		
Caffery, J.*	UF		
Stewart, Greg	UF	NSF	Study of a Non-Fermi Liquid System
Ihas, G.G.	UF		
Kim, J.S.	UF		
Sullivan, N.S.	UF, NHMFL		
Adams, E.D.	UF		
Xia, J.S.	UF, NHMFL		
Shvarts, V.A.+	UF, NHMFL		
Kless, K.J.*	UF		
Caffery, J.*	UF		

Users and Projects: NMR Spectroscopy and Imaging Facilities

User	Institution	Funding	Project
Alamo, R.G. Blanco, J.A. Carrilero, I. Fu, R.	FAMU-FSU College of Engineering, NHMFL	NSF	Measurement of ^{13}C Relaxation of Polymers
Beck, B. Blackband, S.J. Fitzsimmons, J. Crozier, S. Smith, Mike Collins, Chris	MBI, UF, NHMFL, U. Queensland, Australia, Hershey	NHMFL, UFBI	Development of Large Volume High Frequency RF Coils
Beck, B. Duensing, R. Fitzsimmons, J. Blackband, S. Smith, Mike Collins, Chris	UF, NHMFL, MBI, Hershey	NHMFL, UFBI	Development of High Frequency Phased Array RF Coils
Benveniste, H. Grant, Sam Blackband, S.	Brookhaven Laboratories, MBI, NHMFL, UF	NIH, NHMFL, UFBI	MR Microimaging Studies of Mouse Brains for Generation of a Web-Based Atlas
Blackband, S.J. Grant, S. Thelwall, P. Sheperd, T. Roper. S. Phillips, I. Stanisz, G. Webb, A. Buckley, D.	MBI, UF, NHMFL, U. Toronto, Canada, U. Illinois, U. Manchester, England	IHRP, NIH, UFBI	NMR Microscopy and Spectroscopy of Single Cells, Blood Cell Ghosts and Brain Slices
Bowtell, R. Crozier, S. Beck, B. Blackband, S.J.	U. Nottingham, England, U. Queensland, Australia, MBI, NHMFL, UF	NIH	Development of Novel Multi-Layer Transverse Gradient Coils
Brey, W. Gor'kov, P. Fu, R. Tian, C.	NHMFL	NHMFL	RF Homogeneity of Large Sample Solenoids due to Wavelength Effects, and Its Improvement Based on Balanced Tuning Circuit
Brey, W. Gor'kov, P. Tian, C.	NHMFL	NHMFL	Improved Filling Factor for Oriented Samples: Special Packaging and RF Coil Design Techniques
Busath, D.D. Gowen, J.A. Morrison, S.E. Cross, T.A. Mapes, E.J. Schumaker, M.F.	Brigham Young U., NHMFL, Washington State U.	NIH	The Role of Tryptophan in Gramicidin Proton Conductance

Bussmann-Holder, Annette Dalal, Naresh Fu, Riqiang Migoni, Ricardo	Max-Planck-Institut, NHMFL, FSU, Instituto di Fisica Rosario	NHMFL	High-Precision ^{31}P Chemical Shift Measurements on KH_2PO_4-Type Crystals: Role of Electronic Instability in the Ferroelectric Transition Mechanism
Butler, L. Morse, A.	Louisiana State U.		^{27}Al MAS NMR at High Fields
Constantinidis, Ioannis Simpson, Nicholas Blackband, S. Rocca, James	UF, NHMFL, MBI	NSF-NHMFL External Users Program	Study of Insulin Production in Various Cell Lines
Cross, T.A. Kim, S.	NHMFL, FSU	NSF	Continuing Development of PISA Wheel Analysis
Cross, T.A. Gao, F. Mo, Y.	NHMFL, FSU	NIH	Expression of Membrane Proteins from M. tuberculosis
Cross, T.A. Mo, Y. Nerdal, W.	NHMFL, U. Begen	NSF, U. Bergen	Structural Studies of Gramicidin in Long Chain Lipids by Solid State NMR
Cross, T.A. Tian, C. Tobbler, J. Lamb, R.A. Pinto, L.	NHMFL, FSU, Northwestern U.	NSF, NIH	Backbond Structure of the M2 Protein from Influenza A Virus
Cross, T.A. Nishimura, K. Kim, S.	NHMFL, FSU, Yokohama Natl. U.	NSF	Tetrameric Structure of the M2 Transmembrane Peptide
Cross, T.A. Tian, C. Hu, J.	NHMFL, FSU	NIH	Binding of Amantadine to the M2 Transmembrane Peptide
Cross, T.A. Wang, J. Kim, S. Kovacs, F.	NHMFL, FSU	NSF	Monomeric Structure Refinement of the M2 Transmembrane Peptide
Cross, T.A. Kim, S.	NHMFL, FSU	NSF	Uniformity, Ideality and H-Bonds in Transmembrane Helices
Edison, A.S. Thomas, Steve Zachariah, Cherian Cottrell, Glen Price, David Price, Becky	UF, St. Andrews U., Whitney Laboratory	NSF	NMR Structure of FMRFamide Bound to FaNaCh
Fanucci, Gail E. Backov, Renal Fu, Riqiang Talham, Daniel R.	UF, NHMFL	NSF, NASA	Multiple Bilayer Dipalmitoylphosphat-idylserine LB Films Stabilized with Transition Metal Ions
Forder, J. Hsu, E. Buckley, D.L. Blackband, S.	Birmingham, Alabama, Duke U., U. Manchester, England, MBI, UF, NHMFL	NIH, UFBI, NHMFL	MR Biexponential Diffusion Tensor Imaging of Isolated Rat Hearts

Forder, John Blackband, S. Rocca, James Zachariah, Cherian	U. Alabama, UF, NHMFL, MBI	NSF-NHMFL External Users Program	^{13}C NMR of Metabolites from Heart Extracts
Fu, R. Tian, C. Cross, T.A.	NHMFL, FSU	NSF	NMR Spinlock at FSLG
Fu, R. Nishimura, K. Gao, F. Kim, S. Hu, J.	NHMFL, Yokohama Natl. U.	NIH	^{19}F NMR of Membrane Proteins
Fu, R. Ma, Z Zheng, J.P.	NHMFL, College of Engineering	FSU	^{1}H NHMR of Hydrous Ruthenium Oxide
Fu, R. Ma, Z. Zheng, J.P. Brey, W. Gor'kov, P.	NHMFL, College of Engineering	FSU	STRAFI of the Li Batteries
Fu, R. Brey, W. Samoilenko, A.	NHMFL, Russian Academy of Science	NHMFL	Multi-Echo, Slice-Interleaved STRAFI for Improved Sensitivity
Gamscik, M. McDonald, Jeffrey Grant, S. Blackband, S.	Duke U., U. North Carolina, MBI, UF	NSF-NHMFL External Users Program	Decoupled and Spatially Localized ^{13}C Spectroscopy of Glutathione in Tumors
Gan, Z. King, B.F. Cross, T.A.	NHMFL	NSF	$^{17}0$ NMR of Humic Acids
Gan, Z. Gorkov, P. Brey, W. Prestegrad, J.	NHMFL, U. Georgia	NHMFL	High Resolution NMR above 1 GHz using Keck Magnet
Gan, Z. Steuernagel, S.	Bruker, NHMFL	NHMFL, Bruker	Ultra Precise Magic-Angle Calibration
Gilboa, Joseph K. Edison, Arthur S. Rocca, James Zachariah, Cherian	Weizmann Inst. of Science, UF, MBI	NSF-NHMFL External Users Program	Conformational Studies of Furanosides
Gor'kov, P. Gan, Z.	NHMFL	NHMFL	Microphonics in Low-Gamma Probes
Gorkov, P. Gan, Z. Fu, R. Samoson, A. Samoilenko, A.	NHMFL, NICBP, Estonia Inst. of Chemical Physics, Russia	Russian Visitor	Probe Development for 19.6 T Magnet at NHMFL
Grandinetti, P. Gan, Z.	Ohio State U., NHMFL	NSF, NHMFL	Theory for Rotary Resonance in MQMAS Experiment
Han, O. Gan, Z.	Korean Inst. of Basic Science, NHMFL	Korean Government	^{109}Ag NMR of Electric Materials using High Fields
Hargrave, Paul Smith, Clay McDowell, Hugh Rocca, Jim Edison, A.S. Shilton, Brian	UF, MBI, NHMFL, U. Western Ontario	NSF-NHMFL External Users Program	NMR Studies of the Arrestin/Rhodopsin Complex

Hedges, K. Blackband, S. Rodier, P.	MBI, UF, NHMFL, U. Rochester	NIH	High Resolution MRI of Isolated Fixed Autistic Human Brains
Hilbelind, Don Mareci, Tom	U. South Florida	NIH	MRI of Fetal Pig
Hoatson, Gina L. Zhou, Donghua	College of William & Mary	NHMFL, College of William & Mary	^{93}Nb, ^{45}Sc NMR of PMN using 830 MHz NMR
Houpt, T.A. Smith, J.C. Jahng, J.W. Pittman, D. Barranco, J.M.	FSU, Yonsei College of Medicine, Korea	NIH, Yonsei, Korea	Behavioral and Neural Effects of Static High Magnetic Fields
Kim, K.S. Park, E.K. Lee, C.H. Oh, D.K. Lee, Cheol Eui Fu, R. Dalal, N.S.	Korea U., FSU, NHMFL	Korea Science & Engineering Foundation, NSF	Cr^{3+}-Doping Effects on $KTiOPO_4$ Studied by ^{31}P Nuclear Magnetic Resonance
Lee, C.E. Fu, R. Dalal, N.S.	Korea U., NHMFL, FSU	NHMFL, Korea U.	^{31}P NMR Studies of KTP
Lockett, Elizabeth Noe, Adrianne Mareci, Tom	Natl. Museum of Health & Medicine of the Armed Forces Inst. of Pathology	NIH	MRI of Human Fetal Development
Logan, T.M. Korepanova, A. Marin, V.	NHMFL, FSU	NIH	Non-Random Unfolded States and Protein Stability
Logan, T.M. Wylie, G.	NHMFL, FSU	AHA	Peptide Binding in Prokaryotic SH3-like Domains
Logan, T.M. Murphy, J. Caspar, D. Twigg, P.	NHMFL, FSU, Boston U.	NIH	Disorder-to-Order Transition in DtxR
Logan, T.M. Chapman, M. Clark, S.	NHMFL, FSU	NIH	Catalysis in Arginine Kinase
Logan, T.M. Edison, A. Dunn, B.	NHMFL, FSU, UF	NIH	Structure of IA3 Peptide
Ma, Ding Deng, Feng Fu, Riqiang Han, Xiuwen Bao, Xinhe	State Key Laboratory of Catalysis, Dalian Inst. of Chemical Physics, Chinese Academy of Sciences, NHMFL	NSF	MAS NMR Studies on the Dealumination of Zeolite MCM-22
Moerland, T.S. Vanderlinde, O.H. Erickson, J.	FSU, NHMFL	NSF	Effects of Temperature and Ultrastructure on Solute Diffusion in Muscle
Morrison, Paul Sarntinoranont, Malisa Mareci, Tom	Natl. Institutes of Health	NIH	MRI of Excised Spinal Cords

Newby, Meredith Greenbaum, Nancy	FSU, NHMFL	NIH	A Conserved Pseudouridine Modification in Eukaryotic U2 snRNA Induces a Change in Branch Site Architecture
Newby, Meredith Greenbaum, Nancy	FSU, NHMFL	NIH	Solution Structure of the Branch Site Recognition Motif
Past	NICBP, Estonia	Russian Visitor Program	830 CPMAS probe
Pikov, Victor Mareci, Tom	Huntington Medical Research Inst.	NIH	MRI of Spinal Cords
Randall, E.W. Samoilenko, A. Fu, R. Brey, W. Gor'kov, P.	Queen Mary & Westfield College, Russian Academy of Science, NHMFL	NSF, NHMFL	STRAFI Imaging of Paramagnetic Solids
Samoilenko, A. Gor'kov, P.	Russian Academy of Science, NHMFL	NHMFL	A Test of Fourier Transform STRAFI Technique for Ultra-High Resolution Solids Imaging
Samoson, A. Gan, Z. Cross, T.A.	NICBP, Estonia, NHMFL	NICBP, Estonia	DOR NMR at 720 MHz
Schiano, J. Brey, W.	NHMFL	NHMFL	Feedback Stabilization of the Keck Magnet
Srinivasan, P. Quine, J. Gan, Z.	FSU, NHMFL	NHMFL	Mathematical Tools in NMR Spectroscopy
Stemmler, Timothy	Wayne State U., NHMFL	American Heart Association Scientist Development Grant	The Solution Structure of the 123 Amino Acid Yeast Frataxin Homologue Protein "Yfhlp"
Stemmler, Timothy	Wayne State U., NHMFL	Wayne State U.	Active Site Characterization and Solution Dynamic Study of TEM-1 Beta-Lactamase
Sven, Ferdinand Edison, Arthur	Mt. Sinai School of Medicine, UF, NHMFL	NSF-NHMFL External Users Program	Conformation and Dynamics of a New Group of Neuropeptides
Taulelle, Francis	U. Strasbourg	CNRS, France	Optimizing STMAS
Tzou, Der-Lii Gan, Z.	Inst. of Chemistry, Taipei, NHMFL	Academia Sinica	^{27}Al Solid State NMR of Porous Zeolite Materials
Walkenhorstt, William Edison, Arthur S. Thirumoorthy, Ramanan	Loyola U., UF, NHMFL	NSF-NHMFL External Users Program	NMR Structure and Stability of Modified Ovomucoid
Waschek, James Grant, S. Blackband, S.	U. California, Los Angeles, MBI, NHMFL, UF	NSF-NHMFL External Users Program	MR Microimaging of Genetically Modified Mice
Williams, David F. Koehler, Philip G. Silver, Xeve	USDA, UF, AMRIS	NSF-NHMFL External Users Program	MRI Elucidation of the 3-D Structure of Subterranean Termite Habitats
Withers, S. Brey, W.	NHMFL Bruker Instruments	NIH	Design of Superconductive Coils for ^{15}N NMR Applications
Zujovic, Z. Gan, Z.	U. Belgrade, NHMFL	NHMFL	Development of New PISEMA Sequence

USERS AND PROJECTS: ICR FACILITIES

v.P.I. = a principal investigator that came to the facility
v.g.s. = a graduate student that came to the facility
v.p.d. = a post doc. that came to the facility
User = sent samples for ICR analysis
Collaborator = grants are either active or in progress for these projects

Users	Institution	Funding	Project
Andren, Per (Collaborator)	Uppsala U.		Drug Analysis, Endogenous Release of Dynorphins
Ben, Rob (User)	SUNY Binghamton		Antifreeze Glycoproteins
Bitler, Cathy (Collaborator)	Elan Pharmaceuticals		H/D Exchange of NGF Receptor and NGF
Blair, Ian (v.P.I.)	U. Pennsylvania		Vitamin D Analysis
Cargile, Ben (v.g.s)	U. Illinois		Automation of a High Performance ESI 9.4T FT-ICR
Chalmer, Michael (v.g.s.)	UMIST (United Kingdom)		ESI of Peptide and Protein Phosphorylation
Charlebois, Jay (v.g.s)	U. Illinois		H/D Exchange of Proteins
Conrad, Charles (Collaborator)	Kansas City Cancer Center		Cytokines Associated with Gliablastoma Brain Tumors
Cooper, Bill (P.I.)	FSU		ESI of Humic Substances
Cross, Tim (User)	FSU		Peptide Sequence Analysis
Dahl, Gerhard (User)	Miami U. Medical School		ESI of Oocyte Metabolites
Dahmen, Klaus (User)	FSU		Synthetic Chemical Analysis
Duan, Jin (v.g.s.)	Ohio State U.		H/D Exchange of Peptides
Eschgfäller, Bernd (User)	NOXXON Pharma AG, Berlin		ESI of a Antwort: PEG-Spiegelmer Conjugate
Evans, Sarah (v.g.s.)	Grinnell U.		Gas Phase H/D Exchange
Eyler, John (v.P.I.)	U. Florida		ICP/ICR, Ion Solvation
Fisher, Andrew (v.g.s.)	U. California		Preliminary Analysis of Caspase Inhibitor
Fitzgerald, Michael (User)	Duke U.		Analysis of Cancer Cell Lysate Protein
Green, John (User)	Dow Chemicals		ESI of Polymers
Goli, Omesh (User)	FSU		Peptide Lab, Verification of Peptide Structure
Greenbaum, Nancy (User)	FSU		FT-ICR of RNA
Hare, Joan (Collaborator)	FSU		Magnetic Assisted Transformation, Gliablastoma and Microglia
Hendricks, Hank (User)	FSU		Peptide Lab, Verification of Peptide Structure

USERS AND PROJECTS: EMR FACILITIES

Users	Institution	Funding	Project
Allen, J.P. Lo Brutto R. van Tol, H. Brunel, L.-C.	Arizona State U. Arizona State U. NHMFL NHMFL	NSF	HF EPR in Modified Reaction Centers from *Rhodobacter sphaeroides*
Angerhofer, A. Zvyagin, S. Kamenev, K Paul, D.McK. Balakrishnan, D.G. Brunel, L.-C.	NHMFL/UF NHMFL/UF-FSU U. Edinburgh U. Warwick U. Warwick NHMFL/FSU	NSF	Microwave Properties of $Nd_{0.5}Sr_{0.5}MnO_3$: the Key Role of Orbital Effects
Arcon, D. Lappas A. Giapintzakis, J. Zorko A. Saylor C.	Ljubljana Heraklion Heraklion Ljubljana NHMFL	NSF	HF ESR Study of Haldane System $PbNi_2V_2O$
Arcon, D. Lappas, A. Giapintzakis, J. Zorko, A. Saylor, C.	Ljubljana Heraklion Heraklion Ljubljana NHMFL	NSF	HF ESR Study of a 2D Dimmer System: $SrCu_2(BO_3)_2$
Budil, D. Zeng, R. van Tol, J.	Northeastern U. Northeastern U. NHMFL	NSF	EPR of Triplet States in Photosynthetic Reaction Centers
Budil, D. Smith, S. Khairy, K. Fajer, P.	Northeastern U. NHMFL NHMFL/Northeastern U NHMFL/FSU	NSF	The Stochastic Liouville Equation in Magnetic Resonance. An Object Oriented Implementation
Dolinsek, J. Arcon, D. Zorko, A. Klanjsek, M. Saylor, C. Brunel, L.-C. Brunet, P. Dubois, J.M.	Ljublana Ljublana Ljublana Ljublana NHMFL NHMFL Nancy Nancy	NHMFL	ESR of Quasi Crystals
Fajer, P. Li, H.	NHMFL/FSU NHMFL	NSF & American Heart Association	Domain Dynamics of Smooth Muscle Myosin
Fajer, P. Brown, L. Klonis, N. Sawyer, W. Hambly, B.	NHMFL/FSU U. Sydney, Australia U. Melbourne, Australia U. Melbourne, Australia U. Sydney, Australia	NSF	Independent Movement of Regulatory and Catalytic Domains of Myosin Heads Revealed by Phosphorescence Anisotropy
Hambly, B. Baumann, B. Fajer, P. Hideg, K.	U. Sydney, Australia NHMFL NHMFL/FSU U. Pecs, Hungary	NSF	The Regulatory Domain of the Myosin Head Behaves as a Rigid Lever
Hambly, B. Brown, L. Singh, L. Sale, K. Yu, B. Trent, R. Fajer, P.	U. Sydney, Australia U. Sydney, Australia U. Sydney, Australia NHMFL U. Sydney, Australia U. Sydney, Australia NHMFL/FSU	NSF	Functional and Spectroscopic Studies of an FHC Mutation in Motif X of Cardiac Myosin Binding Protein-C
Heiman D. van Tol, J.	Northeastern U. NHMFL	NSF	HF ESR of GaAs (Mn)

Hendrickson, D. Christou, G. Nakano, M. Yoo, J. Saylor, C.	UC, San Diego U. Indiana U. Osaka, Japan UC, San Diego NHMFL	NSF	High Frequency Electron Paramagnetic Resonance Spectroscopy Study of a Series of Polynuclear Transition Metal Complexes
Hoffman, B.M. Krzystek, J. Telser, J. Brunel, L.-C. Licoccia, S.	Northwestern U. NHMFL Roosevelt U. NHMFL U. Rome, Italy	NSF	Investigations of Manganese(III) Corrole Complexes as Solids and in Glasses
Hoffman, B.M. Telser, J. Smoukov, S. Bernat, B.A. Armstrong, R.N. Krzystek, J. Brunel, L.-C.	Northwestern U. Roosevelt U. Northwestern U. Vanderbilt U. Vanderbilt U. NHMFL NHMFL	NSF	High Frequency and Field EPR Spectroscopy of a Mononuclear Manganese(II) Enzyme, FosA, Involved in Bacterial Drug Resistance
Kispert, L. Konovalova, T. van Tol, J. Brunel, L.-C.	U. Alabama U. Alabama NHMFL NHMFL	DOE	HF EPR Study of the Structure and Redox properties of Heterogeneous Catalysts
Kispert, L. Konovalova, T. Saylor, C.	U. Alabama U. Alabama NHMFL	DOE	High-Field EPR Study of Carotenoid Radical Cations in Mesoporous Metal-Silicate MCM-41 Molecular Sieves
Klinman, J.P. Knapp, M. Evans, J. Thrower, J. van Tol, J.	UC, Berkeley UC, Berkeley UC, Berkeley UC, Berkeley NHMFL	NSF	HF EPR of $Fe^{2+/3+}$ and Cu^{1+} in Metalloenzymes
Krzystek, J. Brunel, L.-C. Cao, G.	NHMFL NHMFL NHMFL	NHMFL	EPR from "EPR-Silent" Species: High Frequency and Field EPR and Magnetic Studies of Nickel(II) Molecular Complexes
Lenahan, P. Saylor, C.	Pennsylvania State U. NHMFL	NSF	High Field Spin Dependent Recombination Measurements in Si
Long, J. Sokkol, J. van Tol, J.	UC, Berkeley UC, Berkeley NHMFL	NSF	High-Spin Metal-Cyanide Clusters
Maniero, A. Saylor, C. van Tol, J. Brunel, L-C.	U. Padova, Italy NHMFL NHMFL NHMFL NHMFL	NHMFL & CNR, Italy	High Frequency, 330 GHz, CW ENDOR of a Nitroxide Radical with Delocalized Spin Density
McCombe, B. van Tol, J.	SUNY-Buffalo NHMFL	NSF	Transient Effects in the Cyclotron Resonance of a 2D Quantum Well
Meisel, M. Ward, B. Jolicoeur, Th. Talham, D. van Tol, J.	UF UF CEN Saclay, France UF NHMFL	NSF	High Frequency EMR of Mn^{3+} Low Dimensional Organic Complexes
Pasimeni, L. van Tol, J. Maniero, A.-L. Brunel, L.-C.	U. Padova NHMFL U. Padova NHMFL	NHMFL & CNR Italy	High-Field Transient EPR of Bisadducts of Fullerene C60

Pogni, R. Maniero, A. Brunel, L.-C.	U. Siena, Italy U. Padova, Italy NHMFL	CNR Italy	High Field EPR Study of *Heme* Proteins Radical Intermediates
Redding, K. Gu, F. vanTol, J.	U. Alabama U. Alabama NHMFL	DOE	The Cofactor Branches of Photosystem I
Reyerse, E. van Tol, J. Brunel, L.-C.	Nijmegen NHMFL NHMFL	NHMFL	HF EPR of Bioinorganics
Saylor, C.A. van Tol, J. Brunel, L.-C.	NHMFL NHMFL NHMFL	NSF	High-Frequency Source Stabilization and Control for EPR Spectroscopy
Sharma, V. Burnett, C. Smith, T. Saylor, C. van Tol, J.	FL Inst. of Technology FL Inst. of Technology FL Inst. of Technology NHMFL NHMFL	NHMFL	High Frequency and High Field Electron Paramagnetic Resonance Studies of Ferrate Species
Smirnov, A. Saylor, C.	North Carolina State U. NHMFL	NSF	HF EPR of Spin Labels
Smirnova, T. van Tol, J.	North Carolina State U. NHMFL	NIH	HF EPR of Gd(III) Complexes
Telser, J. Krzystek, J. Brunel, L.-C.	Roosevelt U. NHMFL NHMFL	NHMFL	EPR from "EPR-Silent" Species: High Frequency and Field EPR Spectroscopy of a Catalytically Relevant Cobalt (I) Molecular Complex
Telser, J. Krzystek, J. van Tol, J. Brunel, L.-C.	Roosevelt U. NHMFL NHMFL NHMFL	NHMFL	EPR from "EPR-Silent" Species: High Frequency and Field EPR Spectroscopy of Vanadium(III) Molecular Complexes
Thurnauer, M. Poluektov, O. Brunel, L.-C. Zvyagin, S. Boyce, C. Walker, L. Angerhofer, A.	Argonne Nat. Lab. Argonne Nat. Lab. NHMFL NHMFL U. South Carolina NHMFL/UF NHMFL/UF	DOE	The *G*-Factor Anisotropy of Bacteriochlorophyll $a^{\bullet +}$
van Tol, J. Brunel, L.-C.	NHMFL NHMFL	NHMFL	Detection of Spin Labels in Aqueous Solutions by HFEPR
van Tol, J. Brunel, L.-C.	NHMFL NHMFL	NSF	A High-Field Transient Electron Magnetic Resonance Spectrometer
van Tol, J. Angerhofer, A. Brunel, L.-C.	NHMFL UF NHMFL	NSF	The Lowest Excited Triplet State in Porphyrins Studied by High Field Transient EMR
Volodin, A. van Tol, J.	Novossibisrk NHMFL	NSF	Spin Design of Metal Complexes in Zeolite Matrices
Zvyagin, S. Cao, G. Brunel, L.-C. Crow, J.	NHMFL/UF-FSU NHMFL NHMFL NHMFL	NHMFL	Electron-Spin Resonance Investigation of the Spin-Chain System $LiCu_2O_2$

USERS AND PROJECTS: GEOCHEMISTRY FACILITIES

USERS	INSTITUTION	FUNDING	PROJECT
Choppin, G.	FSU	DOE	Stability of Uranium-Thorium Complexes in Aqueous Solutions
Furbish, D. Hussaini, Y. Wang, Y. Schmeeckle, M.	FSU FSU NHMFL/FSU FSU	FSU/CoE	Earth Surface Processes
Furbish, D. Wang, Y. Hsieh, P.	FSU NHMFL/FSU FAMU	NSF	Biocomplexity Incubation: An Integrated Approach Towards a Quantitative Model of Salt Marsh Biocomplexity and Morphodynamics
Hames, W.E.	Auburn U.	NSF	Trace Element Characteristics of Clubhouse Crossroads Basalts
Hickey, R.	Florida International U.	NSF	Isotopic Investigation of Island-Arc Basalts
Landing, W.M.	FSU		Trace Elements in Atmospheric Dust
Landing, W.M.	FSU	NSF	Fe by Isotope Dilution ICP-MS
Odom, A.L. Salters, V. Landing, W.M.	NHMFL/FSU NHMFL FSU	NSF	Mercury Isotope Investigations of Pre-and Post-Industrial Atmospheric Deposition
Salters, V. Dick, H. Zindler, A.	NHMFL WHOI NHMFL/FSU	NSF	Determining the Mineralogy of the Source of Mid-Ocean Ridge Basalts through Nd-Isotopes in Abyssal Peridotites
Salters, V. Blichert-Toft, J. Patchett, P.J.	NHMFL ENS-Lyon U. Arizona	NSF	The Composition of Bulk Earth Inferred from Primitive Chondrites
Salters, V. Longhi, J.	NHMFL LDEO-Columbia U.	NSF	Trace Element Partitioning and Phase Equilibria at P,T and X relevant to Mid-Ocean Ridge Basalt Genesis
Salters, V.	NHMFL	NSF	Constraints on the Origin of Mantle Endmembers through Hf-Isotope Analyses on Ocean Island Basalts
Salters, V. Landing, W. Cooper, W. Marshall, A.	NHMFL FSU FSU NHMFL	FSU/PEG	The Speciation of Metals and Nutrients with Dissolved Organic Matter
Sen, G.	Florida International U.	NSF	Isotopic Investigations of Hawaiian Xenoliths
Udin, A.	Auburn U.	American Chemical Society	Isotopic Constraints on Provenance of Miocene Sediments from the Bengal Basin, Bangladesh

Wang, Y.	NHMFL/FSU	NSF	Tracing the Source of Phosphorus using Oxygen Isotopic Ratios
Wang, Y.	NHMFL/FSU	NSF	Isotopic Evidence for Late Cenozoic Ecosystem and Climate Changes in Southwest China
Wang, Y.	NHMFL/FSU		Coastal Wetland Formation and Its Significance to Carbon Sequestration
Wolf, M. Wolf, U. Baumgartner, St. Thurneysen, A. Heusser, P.	U. Bern	Swiss NIH	Investigation of Homeopathic Potencies with Physical Methods: Nuclear Magnetic Resonance Spectroscopy, Ultraviolet Spectroscopy and Inductive Coupled Plasma Mass Spectroscopy
Zindler, A.	NHMFL/FSU	NSF	Melting Processes Beneath Iceland

APPENDIX B: SEMINARS

NHMFL SEMINARS AT THE NHMFL IN TALLAHASSEE

January 5, 2001
John D. Dow
Arizona State University
The Nature of High Temperature Superconductivity

January 12, 2001
Victor Barzykin
NHMFL-CM/T
New Superconducting States From BCS

January 19, 2001
Mark Reed
Yale University
The Design and Measurement of Molecular-Scale Devices

January 26, 2001
A. H. Castro-Neto
Boston University
Stripes and High Temperature Superconductivity

January 29, 2001
Michael John Nilles
BWX Technologies
Heat Exchangers to Magnets—A Superconducting Link

January 30, 2001
Cheol Eui Lee
Korea University
Phase Transitions in Model Biomembranes

February 1, 2001
Eva Meirovitch
Bar-Ilan University
A Structural Mode-Coupling Approach to NMR Relaxation in Proteins

February 5, 2001
Ibrahim Mutlu
NHMFL-MS&T
YBCO Coated Conductor Development by Non-Vacuum Processes

February 7-8, 2001
Syd Gordon
Battelle Laboratories
Chemistry of Exhaled Breath

February 9, 2001
Gabriel Aeppli
NEC Research Institute
Internal Structure of Vortices In High Tc Superconductors

February 9, 2001
J. Michael Ramsey
Oak Ridge National Laboratories
Lab-on-a-Chip Devices: A New Approach to Chemical and Biochemical Experimentation

February 16, 2001
Sudip Chakravarty
UCLA
Hidden Order in the Cuprates

February 22, 2001
Kurt Zilm
Yale University
Design and Construction of High Field Triple Resonance CPMAS NMR Probes

February 23, 2001
Jack Toth
FSU-FAMU College of Engineering
Computational Analysis in Transportation Problems

February 23, 2001
Claudio Chamon
Boston University
Interplay between Disorder and Interactions in 2-D

February 27, 2001
Marc Verdier
CNRS-LTPCM, Domaine Universitaire
Effects of Length Scale on Mechanical Properties: Metallic Multilayers as Model Materials

March 1, 2001
Jeffrey L. Schiano
Pennsylvania State University
Feedback Stabilization of a High Field Resistive Magnet for NMR

March 9, 2001
Lucia Banci
University of Florence
NMR in Structural Genomics

March 9, 2001
Ole Sorensen
Carlsberg Laboratory, Copenhagen, Denmark
New Liquid-State NMR Experiments with Some Aimed at the Highest Fields

March 12, 2001
Ziya Aslanoglu
NHMFL-MS&T
Effects of Powder Preparation Methods on the Properties of W-35Ag Electrical Contact Material

March 19, 2001
Francis Taulelle
University of Strasbourg
NMR Crystallography of Inorganic Materials and the Need for High Fields

March 19, 2001
Niels Nielsen
University of Aarhus
Numerical Simulations for Evaluation and Design of Experiments In Biological Solid-State NMR

April 3, 2001
Jack J. Skalicky
State University of New York at Buffalo
Structure and Dynamics of Designed Proteins

April 5, 2001
Thomas L. Chester
The Procter & Gamble Company
Optimizing HPLC Methods

April 6, 2001
John Mitchell
Argonne National Laboratory
Structural and Magnetic States in Layered CMR Manganites

April 6, 2001
Ignacio Tinoco
University of California, Berkeley
Unfolding Single RNA Molecules by Force

April 9, 2001
Marlene C. Richter
IMRIS Winnipeg, Manitoba, Canada
Four Contemporary Issues in NMR

April 10, 2001
Rieko Ishima
National Institue of Dental & Craniofacial Research
Protein Dynamics Study Using NMR: Flexibility of the Dimer Interface in HIV-1 Protease

April 11, 2001
Steve Bohlen
Joint Oceanographic Institutions, Inc
The Future of Geosciences and the Future of the Ocean Drilling Program

April 11, 2001
Steve Simon
Lucent Technologies
Cell Phones, Information Theory, and Mesoscopic Physics, or How to Make Money with Diffusions and Replicas

April 11, 2001
Wayne Tuohig
Federal Manufacturing and Technologies
Honeywell Federal Manufacturing and Technologies and the Kansas City Plant

April 13, 2001
Toshio Ogata
National Research Institute for Metals
The VAMAS Cryogenic Structural Materials Program

April 13, 2001
S. Das Sarma
University of Maryland
Spin Electronics and Spin Computation

April 16, 2001
Gina L. Hoatson
College of William and Mary
Solid State Multinuclear NMR Studies of Relaxor Ferroelectrics (1-x) PMN: x PSN

April 20, 2001
Shivaji Sondhi
Princeton University
Short Ranged RVB, Quantum Dimer Models and Ising Gauge Theories

April 27, 2001
John Tranquada
Brookhaven National Laboratory
Recent Results on Stripe Phases in Doped Antiferromagnets

May 2, 2001
Ashish Arora
University of Virginia
Refolding, Structure and Function of Outer Membrane Protein A of E Coli

May 2, 2001
Edward Rezayi
California State University
Paired States, Stripe Order and Fermi Liquid in High Landau Levels

May 4, 2001
Marc Gabay
Laboratoire de Physique des Solides, Universite Paris-Sud
Surprises in One Dimensional Physics: Laughlin-Like Fractional Excitations in the Luttinger Liquid

May 10, 2001
Florin Buta
Ohio State University
Progress in High Temperature Process Nb_3Al

May 22, 2001
J. J. Quinn
University of Tennessee, Knoxville
Composite Fermions in Fractional Quantum Hall Systems

May 25, 2001
Francisco DeLeon
Plitron Manufacturing
An Engineering Approach to Power Factor and Power Definitions Under Unbalanced and Nonsinusoidal Conditions

May 25, 2001
Chris B. Effiong
University of Tennessee
Stabilization of Multi-Area Electric Power System by Sensitivity-Based Control Reconfiguration

May 29, 2001
Bernard Lesieutre
Massachusetts Institute of Technology
Power System Uncertainty Analysis: Will the Lights Stay On?

June 8, 2001
Sergey Lyshevski
Purdue University
High Performance Power and Electromechanical Systems

June 12, 2001
David Snoeyenbos
Cameca Instruments Inc.
The Cameca SX100 Electron Microprobe

July 9, 2001
Wojciech Suski
Institute of Low Temperature and Structural Research, Wroclaw, Poland
Structure and Properties of the Uranium Intermetallics with the $ThMn_{12}$ Type Structure: What We Can Learn from High Field Research

July 9, 2001
Michael Chalmers
Michael Barber Centre for Mass Spectrometry, University of Manchester, UK
Mass Spectrometric Approaches to the Characterization of Sites of Phosphorylation within Mitogen Activated Protein Kinases

July 13, 2001
N.E. Hussey
University of Bristol
Nodal Quasi-Particle Transport in High-Tc Cuprates

July 16, 2001
Karina Chattah
Universidad Nacional Cordoba
Breaking Anderson Localization with Dynamical Disorder

July 26, 2001
Jack Skalicky
State University of New York
Biological NMR in Supercooled Water

August 3, 2001
E.V. Sampathkumaran
Tata Institute of Fundamental Research, Mumbai India
Magnetic Anomalies In New Class of Ternary Rare-Earth Compounds and Oxides

August 20, 2001
Chuck Swenson
NHMFL-MS&T
Design Evolution of Pulse Magnets with High Strength Materials

September 7, 2001
Herb Fertig
University of Kentucky
Crystal in the Liquid vs. Liquid Crystal Stripes in Quantum Hall Systems

September 7, 2001
David Gilbert
Binghamton University
Electron Spin Echo Envelope Modulation Studies of NOS-Model Compounds

September 17, 2001
John Miller
NHMFL-MS&T
Cryogenic Current Leads

September 19, 2001
Vesna Mitrovic
Northwestern University
High Magnetic Field NMR Microscopy of Vortices in High-Tc Superconductors

September 21, 2001
Piers Coleman
Rutgers University
Does the Heavy Electron Fall Apart at a Quantum Critical Point

October 1, 2001
Sylvie Fuzier
NHMFL-MS&T
Heat Transfer and Pressure Drop in Forced Flow Helium II

October 5, 2001
Alan G. Marshall
NHMFL-ICR
Accurate Mass Measurement: Taking Full Advantage of Nature's Isotopic Complexity

October 8, 2001
Zein Heiba
Visiting Associate of Crystallography, NHMFL-MS&T
Structural and Microstructural Investigations of Rare-Earth Borides, Chalcopyrite, ... Applying X-Ray Line Profile Analysis

October 8, 2001
David Eaton
University of Kentucky
Recent Developments in Soluble Pentacenes

October 12, 2001
Zvi Ovadyahu
Hebrew University
Experimenting with an Electron Glass

October 15, 2001
Jim P. Zheng
FAMU-FSU College of Engineering
Ruthenium Oxide Prepared at Low Temperatures for Capacitor Applications

October 29, 2001
Mark Bird
NHMFL-MS&T
Recent Developments in Magnet Technology: Repetitively Pulsed Sweeper NMR above 25 T Transverse Field

October 30, 2001
Xiao Ping Tang
University of North Carolina
An NMR Study of Slow Motion in Bulk Metallic Glasses and Supercooled Liquids

October 31, 2001
Dr. Michael Meissner
Hahn-Meitner-Institut, Berlin, Germany
Magnetism Research at the Berlin Neutron Scattering Center: Using High Magnetic Fields up to 17 T and Low Temperatures down to 25 mK

November 6, 2001
Zhendong Jin
University of Iowa
Total Synthesis of the Anticancer Natural Produce OSW-1

November 15, 2001
Dwight Adams
University of Florida
Nuclear Magnetism in Solid 3-He

November 16, 2001
James Eisenstein
California Institute of Technology
Tunneling and Drag in a Bilayer Quantum Hall Excitonic Condensate

November 19, 2001
Hiroshi Maeda
NHMFL-MS&T and Kitami Institute of Technology
Texture Development and Critical Current Density of Bi-oxide Superconducting Bulks and Tapes Grown in High Magnetic Field

November 28, 2001
T.W. Wright
Army Research Laboratory
High Rate Damage in Ductile Materials: Shear Bands and Voids

November 29, 2001
Kathleen P. Howard
Swarthmore College
Transmembrane Interface of the M2 Protein from Influenza A Virus: An Analytical Ultracentrifugation Study

November 29, 2001
Arneil P. Reyes
NHMFL
High Field Oxygen and Copper NMR in $NdBa_2Cu_3O_7$: Anomalous Magnetism in High Temperature Superconductors

November 30, 2001
Anuvrat Joshi
NHMFL
Spin and Orbital Physics in Insulating Vanadium Oxide

December 5, 2001
Yue Wu
University of North Carolina
The Nano-World of Nanofluids and Nanotubes: A View Through Nuclear Magnetic Resonance

December 6, 2001
Denis Dalidovich
NHMFL
Charge Transport near Melting of the Electron Glass

December 6, 2001
Vikram D. Kodibagkar
Washington University
NMR Studies of the Layered Metal-Hydride $ZrBe_2(H/D)_x$

December 7, 2001
Joerg Schmalian
Iowa State University
Self Generated Randomness in Strongly Correlated Systems

December 10, 2001
E.W. Collings
Ohio State University
Science and Technology of MGB2—Materials, Strands and Applications

December 11, 2001
Ian Blair
University of Pennsylvania
Vitamin C-Induced Decomposition of Lipid Hydropeptides to Endogenous Genotoxins

December 13, 2001
Shane Hritz, Joe Yeager
Lake Shore Cryotronics
Demonstration of Lake Shore Cryotronics Model 370 AC Resistance Bridge with Temperature Control

December 14, 2001
Collin Broholm
Johns Hopkins University and NIST Center for Neutron Research
Quantum Phase Transition in Quasi-Two-Dimensional Frustrated Magnet

December 17, 2001
Judy Wu
University of Kansas
Hg-Based Cuprate Superconductors: Their Challenges and Promises

NHMFL Seminars at Los Alamos National Laboratory

January 12, 2001
John Singleton
Oxford University, UK
Millimetre-Wave and High-Magnetic Field Measurements of Quasi-Two-Dimensional Metals

January 19, 2001
Vladimir Sechovsky
Charles University, Prague, Czech Republic
Crystal Field Paramagnetism in High Magnetic Fields

January 26, 2001
Mike Zhitomirsky
University of Paris, France
Highly Frustrated Magnets in a Strong Magnetic Field

February 2, 2001
Arek Wojs
University of Paris, France
Fractionally Charged Magneto-Excitons

February 9, 2001
Yew-San Hor
Rutgers University
Metal-Insulator Mixture in $CuIr_{2-x}Cr_xS_4$

February 16, 2001
Jim Sims
Los Alamos National Laboratory
The 60 Tesla Long Pulse Magnet Failure and Plans for the 60 Tesla Long Pulse Magnet Mark II

February 23, 2001
Jon Lawrence
University of California, Irvine
Two Energy Scales and Slow Crossover in Intermediate Valence Compounds

March 3, 2001
Cristian Batista
Los Alamos National Laboratory
Itinerant Ferromagnetism in Intermediate Valence Systems

March 9, 2001
Raymond Laflamme
Los Alamos National Laboratory
Quantum Computation

March 23, 2001
Octavio Trovarelli
Max Planck, Dresden, Germany
$YbRh_2Si_2$*: A New Non-Fermi-Liquid with Linear Resistivity*

March 30, 2001
John Singleton
Oxford University, UK
Lawbreakers? Emission by Superluminal Sources in the Laboratory

April 6, 2001
Helen Fretwel
University of Wales, Swansea, Australia
Many Body Effects in High Tc Superconductors

April 13, 2001
Jean Leotin
LNCMP, Toulouse, France
Magneto-Subband Effect in Quantum Cascade Lasers

April 20, 2001
Allan McDonall
University of Texas
Is There a d.c. Josephson Effect in Quantum Hall Bilayers?

April 27, 2001
Myung-Hwa Jung
New Mexico State University, Las Cruces
Anisotropic Superconductivity in MgB_2 *Epitaxial Films*

May 4, 2001
Robert Thorne
Cornell University
Pinning, Plasticity and Creep in Charge-Density-Wave Conductors

May 11, 2001
Jack Harris
Massachusetts Institute of Technology
Micromechanical Studies of Level Crossings, the Quantum Hall Effect, and Single Spins in Semiconductor Heterostructures

June 1, 2001
Bryan Pivovar
Los Alamos National Laboratory
Fuel Cells: What They Are, How They Work, and the Research Developments Necessary To Make Them Part of Our Every Day Lives

June 8, 2001
Luis Balicas
NHMFL–Tallahassee
Superconductivity in an Organic Insulator at Very High Magnetic Fields

June 15, 2001
Lev Boulaevskii
Los Alamos National Laboratory
Optical Properties of Crystal with Spatial Dispersion—Beyond the Fresnel Approach

June 22, 2001
Dennis Drew
University of Maryland
IR Hall Effect in High Tc Superconductors

June 29, 2001
Nick Curro
Los Alamos National Laboratory
NMR and NQR in the $CeMIn_5$ *Heavy Fermion*

July 6, 2001
Ken Ahn
Los Alamos National Laboratory
Effects of In-Plane Strain on Orbital Ordering and Magnetism in $LaMnO_3$ *Thin Film*

July 13, 2001
Roderich Moessner
Princeton University
Theory of Geometrical Frustration in Magnets

July 20, 2001
Pascoal Pagliuso
Los Alamos National Laboratory
Evolution of Magnetic Properties in the Homologous Series RmMnIn{3m+2n} (R=Ce, Pr, Nd, Sm, Gd; M=Rh,Ir; m=1,2; n=0,1)

July 27, 2001
John Mydosh
Leiden University, The Netherlands
Coexisting CDW's and Magnetism in Ternary Intermetallic Compounds

August 3, 2001
Chuck Mielke
NHMFL–Los Alamos
Radio Frequency Probing of Layered Superconductors in High Magnetic Fields

August 21, 2001
R. Mahendiran
Penn State University
Instability of Metal-Insulator Transition Against Thermal Cycling: an Unusual Phenomena in Manganites

August 28, 2001
Stephen R. Foltyn
Los Alamos National Laboratory
Progress in Coated Conductor Development in the Superconductivity Technology Center

September 5, 2001
Ana Lobett-Mejías
Los Alamos National Laboratory
Phase Diagram of Manganites

September 12, 2001
Michael Wanke
Sandia National Laboratories
Quantum Cascade Lasers

November 2, 2001
Ying Liu
Penn State University
Tunneling Studies of Sr_2RuO_4*: Unconventional Superconductivity in the Bulk and the 3-K Phases*

November 9, 2001
Mattias Graf
Los Alamos National Laboratory
Antiferromagnetic Domains and Superconductivity in UPt_3

November 16, 2001
Myron Salamon
University of Illinois
Colossal Magnetoresistance is a Griffiths

November 30, 2001
Diego Casa
Argonne National Laboratory
X-Ray Induced Metal Insulator Transition in Manganites

December 7, 2001
Ricardo Decca
Indiana University
Photo-Exited Josephson Junctions in High Tc Superconductors

December 7, 2001
Roy Goodrich
Louisiana State University
The Kondo Effect to Heavy Fermions Studied Using the de Haas-van Alphen Effect

NHMFL Seminars at the University of Florida

January 31, 2001
Mark Villoria
University of Florida
Functional Magnetic Resonance Imaging: Fundamentals and Applications

May 2, 2001
Todd Huml
University of Florida
Cavity Ring Down Spectroscopy

September 6, 2001
David Reitze
University of Florida
Doing Physics with Lasers in the New Millennium: Superstrong Fields, Superhigh Resolution

September 11, 2001
Hiro Munekata
Tokyo Institute of Technology
Photo-Magnetic Effects in Magnetic Semiconductors and Related Structures

September 17, 2001
Steve Pearton
University of Florida
New Uses for GaN: High Power Electronics and High Temperature Ferromagnetism

September 20, 2001
Art Hebard
University of Florida
Magnetic Bits, Giant Magnetoresistance and Spin Glasses

September 24, 2001
Olga Drozdova
University of Florida
Spectroscopic Study of the [0110] Charge Ordering in $(EDO\text{-}TTF)_2PF_6$

October 4, 2001
Edward Trifonov
Weizmann Institute
Life: Definition and Early Evolution

October 8, 2001
Boris Narozhny
University of New York, Stony Brook
Interaction Corrections to Transport Coefficients in Two-Dimensional Electron Gas at Intermediate Temperatures

October 15, 2001
Doug Natelson
Rice University
Quantum Coherence in Sub-10-nm-Wide Metal Structures

October 24, 2001
Stefan Fau
University of Florida
New Basis Sets for ESR Hyperfine Coupling Constrants

October 31, 2001
Andrew Kolchin
University of Florida
Hydrolytic Weakening in Amorphous Silica and Electronic Structure of Metallic Clusters

November 5, 2001
Luis Balicas
NHMFL
Field-Induced Superconductivity in $\lambda\text{-}(BETS)_2FeCl_4$

November 15, 2001
Bruce Taggart
National Science Foundation
Nanoscience and Materials Science

Appendix C: Key Personnel & Committees

NHMFL Key Personnel

Principal Investigator
Jack E. Crow, Director

Co-Principal Investigators
Greg Boebinger, LANL
Alan Marshall, FSU
J. Robert Schrieffer, Chief Scientist
Neil Sullivan, UF

Deputy Director
Hans Schneider-Muntau

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Magnet Science and Technology Program
http://www.magnet.fsu.edu/magtech/
Steven Van Sciver
Phone: 850-644-0998
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Tallahassee, FL
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MAGNETIC RESONANCE FACILITIES

Tallahassee, FL
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Tim Cross (NMR)
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Alan Marshall (ICR)
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MAGNETIC RESONANCE IMAGING/SPECTROSCOPY FACILITIES

Gainesville, FL
http://www.ufbi.ufl.edu/
http://csbnmr.health.ufl.edu/
Art Edison
Phone: 352-392-4535
Fax: 352-392-3422
art@ascaris.ufbi.ufl.edu

NHMFL Committees

External Advisory Committee

The External Advisory Committee reviews and evaluates overall NHMFL performance and provides advice and guidance to the NHMFL Oversight Committee on matters critical to the success and management of the laboratory. Members of the NHMFL External Advisory Committee represent academic, government, and industrial organizations, as well as the NHMFL user community. Committee members are appointed by the Chair of the NHMFL Oversight Committee, with the concurrence of the Oversight Committee.

George W. Crabtree, Chair
Argonne National Laboratory

Chuck Agosta
Clark University
Chair, NHMFL Users' Committee
(through mid-2000)

W. Gilbert Clark
University of California at Los Angeles

Donald U. Gubser
Naval Research Laboratory

Lynn W. Jelinski
Louisiana State University

Eric Jones
Sandia National Laboratories

Brian Maple
University of California at San Diego

Eric Oldfield
University of Illinois at Urbana-Champaign

Raymond Orbach
University of California at Riverside

Charles Reed
California State University

Carl H. Rosner
Intermagnetics General Corporation

Ray Shaw
Varian Associates, Inc.

USERS' COMMITTEE

Members of the NHMFL Users' Committee are nominated and elected by the user community. The committee provides guidance on the equipment and policies needed for the development and utilization of the laboratory's facilities.

Ward P. Beyermann
University of California, Riverside
Department of Physics

Stuart Brown
University of California, Los Angeles
Department of Physics

Michelle Buchanan
Oak Ridge National Laboratory
Analytical Chemistry Division

Nathanael Fortune
Smith College
Department of Physics

Roy Goodrich
Louisiana State University
Department of Physics & Astronomy

Bill Halperin, Committee Chair
Northwestern University
Department of Physics & Astronomy

Steve Hill
University of Florida
Department of Physics

Martin Kushmerick
University of Washington
Radiology, Physiology & Biophysics,
Bioengineering

Jim Prestegard
University of Georgia
Complex Carbohydrate Research Center

Larry Rubin
Francis Bitter Magnet Laboratory
MIT

George Schmiedeshoff
Occidental College
Department of Physics

Marion Thurnauer
Argonne National Laboratory
Chemistry Division

Tom Timusk
MacMaster University
Department of Physics & Astronomy

RESEARCH PROGRAM COMMITTEE

The NHMFL Research Program Committee is charged with promoting the laboratory's In-House Research Program (IHRP) and with ensuring the development of the highest quality facilities for the laboratory's research communities. The committee evaluates research opportunities and facilities enhancements available to the NHMFL and recommends programs for the use and enhancement of NHMFL facilities and resources. It oversees the IHRP, encourages the formation of collaborative research efforts, establishes worldwide channels for communication, and identifies cutting-edge high magnetic field research programs. The committee, through its chair, administers the funding of the IHRP. Members of the RPC also participate in the Users' Program proposal review and evaluation.

Chair
Albert Migliori

Condensed Matter Sciences Subcommittee
Lev Gor'kov
Dragana Popovic
Kevin Ingersent
Mark Meisel
Marty Maley
Neil Harrison
*Craig Taylor
*Dimitri Basov
*Steve Hill

Biological and Chemical Sciences Subcommittee
Alan Marshall
Tim Logan
Alex Angerhofer
Steve Blackband
Tom Terwilliger
Clifford Unkefer
*Warren Warren
*Les Butler
*Sandra Eaton

Magnet and Magnet Materials Technology Subcommittee
Hamid Garmestani
Anthony Brennan
James Sims
Steve Van Sciver
Hans Schneider-Muntau

*External Committee Members

Executive Committee

The NHMFL Executive Committee reviews and advises on a broad range of issues including organization, staffing, resource allocation, budgeting, and interactions with external agencies and private organizations. Members take into account the objectives and mission of the laboratory, external reviews, and internal evaluations of the overall program.

Jack E. Crow
Director and Co-Principal Investigator, FSU

Greg Boebinger
Co-Principal Investigator, LANL

Alan Marshall
Co-Principal Investigator, FSU, and Director, ICR Program

J. Robert Schrieffer
Co-Principal Investigator, FSU, and Chief Scientist

Neil Sullivan
Co-Principal Investigator, UF

Reza Abbaschian
NHMFL-University of Florida Representative

Bruce Brandt
Director, Continuous Fields Facility

Tim Cross
Center for Interdisciplinary Magnetic Resonance Representative

Alex Lacerda
Director, Pulsed Field User Programs

William G. Luttge
Director, University of Florida McKnight Brain Institute

Albert Migliori
Chair, Research Program Committee

Janet Patten
Director, Public and Governmental Relations

Dwight Rickel
NHMFL-Los Alamos National Laboratory Representative

Hans Schneider-Muntau
Deputy Director

Steven Van Sciver
Director, Magnet Science and Technology

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