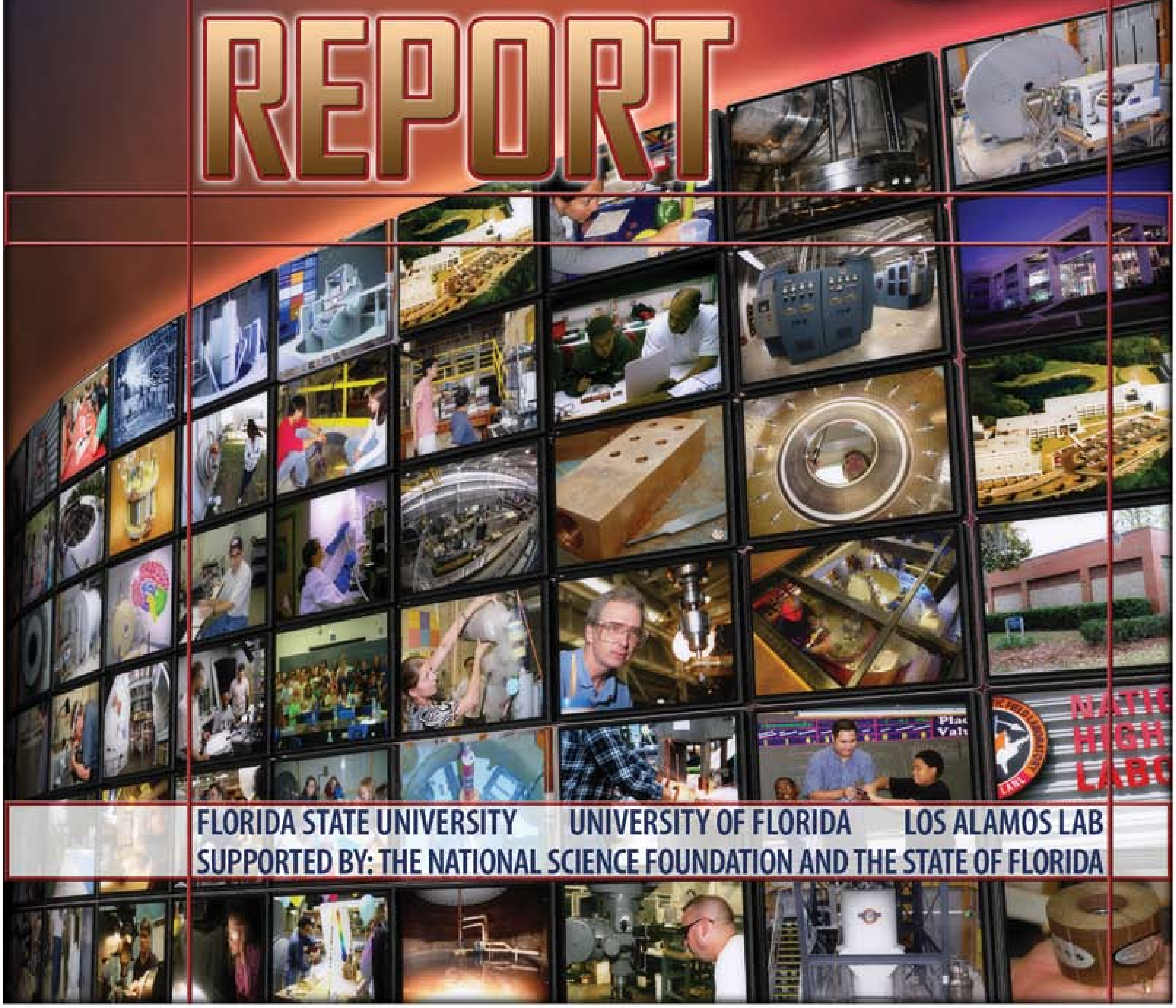
NATIONAL HIGH MAGNETIC FIELD LABORATORY

2007 ANNUAL REPORT



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CHAPTER 1: 2007 - YEAR IN REVIEW

This year began with the National Science Foundation (NSF) site review of our 2008-12 renewal proposal, held January 9-11 at the Tallahassee branch. All site reviews are important, but 2007 was the year in which the lab's level of funding under its renewal would be decided.

The NSF site review committee wrote an enthusiastic report to the National Science Board summarizing the excitement about the scientific vision for the Magnet Lab user programs for the coming five years and beyond. The site review panel, in its report, described the Magnet Lab as "truly a jewel in the crown of U.S. science."

In August the National Science Board recommended to the NSF that the National High Magnetic Field Laboratory be funded at a level "not exceeding" $162 million over the next five years. This was indeed very good news in a time of tight Federal budgets. Unfortunately, when the final fiscal year 2008 budget was resolved in December of 2007, the NSF increase of more than 8 percent had evaporated and the NSF and Magnet Lab were left essentially flat-funded.

The federal budget picture wasn't the only dark cloud looming in 2007; Florida's revenues fell far short of estimates, leading to additional blows to the state-supported portion of the Mag Lab budget. Despite it all, Magnet Lab management is confident that the high level of quality – if not occasionally the quantity – in its seven user programs will continue.

Certainly, 2007 was an excellent year for science in high magnetic fields, from new physics on the fractional quantum Hall effect and graphene to research that shed new light on superconductors and the structure and dynamics of proteins.

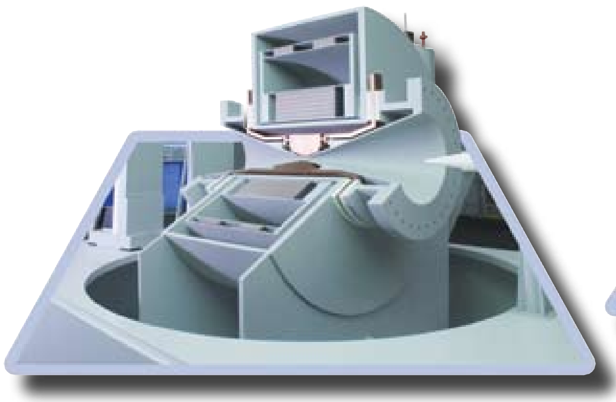

Graphene

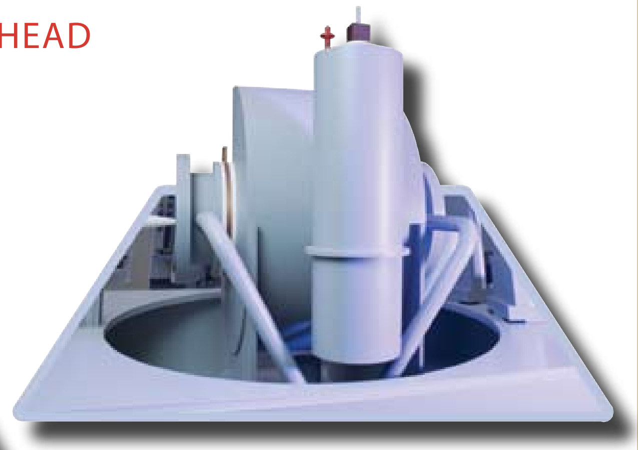
RESEARCH REPORTS SLIGHTLY UP

In 2007, 407 research reports were received in 17 categories, representing condensed matter physics, materials science, magnet science and technology, chemistry and the life sciences – slightly up from the number received in 2006. Of the reports:

- Sixteen percent of the research activities (64 reports) were already published in 2007, many in prominent journals.
- Six percent of the reports were accepted for publication; 11 percent were submitted for publication; and 40 percent had manuscripts in preparation.
- The majority of research projects were funded by theNSF, the Department of Energy, and the National Institutes of Health. Other funding organizations included: the American Chemical Society; American Heart Association, Engineering and Physical Sciences Research Council (UK), Human Frontiers Science Program, IBM, Japan Society for the Promotion of Science, Muscular Dystrophy Association, NASA, National Sciences and Engineering Research Council (Canada), Russian Academy of Science, U.S. Air Force Office of Scientific Research, U.S. Army, U.S. Geological Survey, U.S. Environmental Agency, and the U.S. Department of Veterans Affairs.
- The Magnet Lab's User Collaboration Grants Program (formerly called the In-HouseResearch Program) supported 48 of the 407 research activities and was the primary support for 24 projects. This grant program promotes collaborations between internal and external investigators, promotes bold but risky efforts, and provides initial seed money for new faculty and research staff and facility enhancements.

MAGNET PROJECTS FULL STEAM AHEAD

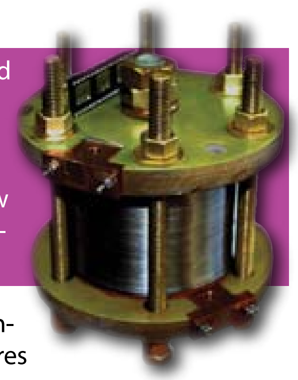




Full-scale models of the proposed magnet.

The lab in 2007 negotiated an $8.7-million contact with the Hahn Meitner Institute(HMI) in Berlin to build a version of the Series Connected Hybrid for neutron scattering. When finished in 2011, the new, high-field magnet will be housed at the Berlin Neutron Scattering Center and will produce a magnetic field between 25 tesla and 30 tesla (T). It will be the world's strongest magnet for neutron experiments, eclipsing the 15-T system presently at HMI.

In July, the Mag Lab and industry partner SuperPower achieved a new world record for magnetic field created by a superconducting magnet. The new record – 26.8 T – was reached with a test coil wound with SuperPower's yttrium barium copper oxide (YBCO) tape conductor. Based on bench-top measurements of this conductor, magnet engineers say this YBCO tape might go many teslas higher; one can now imagine matching the performance of DC resistive magnets using cost-effective all-superconducting magnets.



Also in 2007, researchers from Northwestern working at the lab identified the high-temperature superconductor bismuth-2212 as a material suitable for the new wires needed to build one of the scientific community's holy grails: A 30-tesla superconducting magnet. The team of researchers found that Bi-2212 could be operated at the same temperature as magnets made with niobium – 4 Kelvin – and also achieve the stable state necessary for a 30-T magnet.

In October, the 45-T Hybrid returned to user service with a new resistive insert that uses only three power supplies as opposed to four, which allowed the possibility of hosting two experiments simultaneously when the hybrid is running. The upgrade is a necessary step on the path to running the future Series Connected Hybrid in tandem with the existing hybrid.

LET THERE BE "BIG LIGHT"

As the design nears completion, the scientific community continues to grow in its support of co-locating a terahertz Free Electron Laser (FEL) with the Mag Lab DC magnets. The "Big Light" FEL would be a unique light source offering continuously tunable (0.3 THz to near infra-red) picosecond pulses featuring high power (>100 W) and brightness (>10 microjoules per pulse).

Why locate "Big Light" at Big Magnets? It's simple. The "Big Light" frequency range is commensurate with the energy scales (spin and orbital) probed by our magnetic fields, and terahertz beams can be beamed down the bore of our unique suite of magnets. Paring the two would lead to a revolutionary increase at the Mag Lab in the scope and impact of scientific research – the very definition of "transformational research."

Scientific applications will span the range of the Mag Lab's user programs, from condensed matter physics to chemistry and biology, using techniques as varied as diffraction-limited spectroscopy, multi-photon chemical bond breaking, and two-color pump-probe experiments on correlated electron systems featuring temporal resolution in the tens-of-femtoseconds.

NOTABLE STAFF CHANGES IN 2007

Stepping fully into the role he had already assumed in interim capacity, Mag Lab mechanical engineer **Mark Bird** was officially named director of lab's Magnet Science and Technology division in 2007. Bird, who has been a part of the lab since 1992, began his tenure in Tallahassee as an assistant scholar/scientist. He stepped into the interim director role in 2006 after **John Miller** left to head up the magnet system team for the U.S. International Thermonuclear Experimental Reactor (ITER) Project Office.

2007 was year of transition for the DC Field Facility. **Bruce Brandt**, who had directed the facility since its inception, retired in July. His position was split into two distinct positions: director of DC user program and director of DC instrumentation and facilities. **Eric Palm** and **Scott Hannahs** filled these positions, respectively, on an interim basis until the start of 2008, when both were made permanent.

Associate Laboratory Director for User Programs **Alex Lacerda** in October accepted a post as interim division leader of the Materials and Physics Applications Division at Los Alamos National Laboratory. In Lacerda's absence, Magnet Lab Director **Greg Boebinger** assumed the user program's position, and **Marcelo Jaime** of the Pulsed Field Facility became acting center leader at Los Alamos.

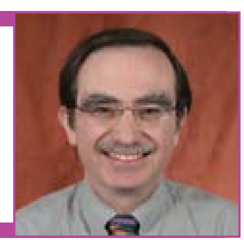
A YEAR OF MANY ACCOLADES

From lifetime achievement to early-career support, Magnet Lab scientists were honored in many different ways in 2007. Among them:

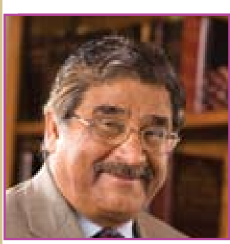
- **Gregory Boebinger**, director and professor of physics at both Florida State University (FSU) and the University of Florida, was elevated to the rank of Fellow by the American Association for the Advancement of Science (AAAS).

- **Irinel Chiorescu**, an assistant professor of physics at FSU and a member of the lab's Condensed Matter Science group, received a prestigious Faculty Early Career Development (CAREER) Grant from the NSF.

- **Scott Crooker**, a staff scientist in the Pulsed Magnet Field user program at Los Alamos National Lab, earned a 2007 LANL Fellows' Prize for Outstanding Research for his ground-breaking research in the development of magneto-optical spectroscopies and their applications.



- **Timothy A. Cross**, the Earl Frieden Professor of Chemistry and Biochemistry at FSU and director of the Magnet Lab's Nuclear Magnetic Resonance user program, was named a fellow of the Biophysical Society. Cross was one of only five scientists recognized in 2007 from a membership of 8,000.



- **Naresh S. Dalal**, the Dirac Professor of Chemistry and Biochemistry at FSU and a researcher with the Magnet Lab's Electron Magnetic Resonance user program, was selected to receive the 2007 Southern Chemist Award from the Memphis Section of the American Chemical Society.

- **David Larbalestier**, the director of Mag Lab's Applied Superconductivity Center, received the Cryogenic Materials Award for Lifetime Achievements 2007 from the International Cryogenic Materials Conference (ICMC).

- **Alan G. Marshall**, the Robert O. Lawton Professor of Chemistry and Biochemistry at FSU and director of the Mag Lab's Ion Cyclotron Resonance user program, received the 2007 Chemical Pioneer Award from the American Institute of Chemists.

- **Steven Van Sciver**, the John Gorrie Professor of Mechanical Engineering at the Florida A&M University-Florida State University College of Engineering, became just the fifth member of the Cryogenics Society of America to be named a fellow of that organization since its founding in 1964.

A complete list of 2007 awards can be found online at ***http://www.magnet.fsu.edu/mediacenter/factsheets/awards.html***

EDUCATION AND NON-TRADITIONAL OUTREACH

The lab's Center for Integrating Research & Learning received a major boost in 2007 with the addition of a Teacher in Residence. **Richard McHenry**, a chemistry teacher on special assignment from Leon County Schools, worked with CIRL to develop physical science workshops and professional development for elementary, middle and high school teachers. McHenry also began work on a "Science Coach" model to provide support for elementary educators teaching science.

Science was much on the mind of Floridians in 2007 as the state developed new science standards. Magnet Lab educators were involved at many levels: McHenry was a writer and reviewer, CIRL Director **Pat Dixon** served as a reviewer.

EDUCATION HIGHLIGHTS OF 2007 INCLUDE:

20 students from 15 universities participated in the Research Experiences for Undergraduates program.

12 teachers participated in the first summer of a 5-year NSF-funded research study on how teachers translate research experiences into changes in classroom practice.

32 girls from 6th to 10th grade participated in activities as diverse as digging up a skeleton to learn about forensic anthropology to making models of comets as part of year two of SciGirls summer camp.

Center educators reached 8,800 K-12 students in their classrooms with hands-on activities.

16 middle school students worked with 13 mentors as part of the lab's Middle School Mentorship program, completing research projects on subjects ranging from bridge design to java programming.

NONTRADITIONAL OUTREACH

The Magnet Lab's redesigned and content-enhanced Web site officially debuted in 2007. Growth to the Web site has been considerable since that time. This is best reflected in the total number of page requests made every month: Between January 2007 and January 2008, that number grew steadily, from 132,901 to 191,255, a growth of 44 percent.

The Education section was (and is) by far the most heavily visited section of the site, accounting as of January 2008 for 53 percent of all page requests. The electricity and magnetism educational content built for this site is considerable, making up 30 percent of all the pages in the Web site.

The Magnet Lab's two Florida branches were the subject of a 30-minute documentary that aired in January called "Attracting Science." Produced by the Florida Channel, a division of WFSU Public Broadcasting Service, the documentary looked at all facets of the lab and its impact on the state and science education.

The Mag Lab Open House continued to attract huge crowds in 2007, with 3,500 visitors passing through the doors between 10 a.m. and 3 p.m. on Saturday, Febuary 24. Open House has become one of the most well-attended community events in Tallahassee.

December welcomed the introduction of a new publication targeted at the general public. *Flux* is designed to help non-scientists – and in particular local, state and federal elected officials and administrators – gain a better understanding and appreciation of the Magnet Lab and the value of basic research to our communities and our country.

Flux was created to be the lab's ambassador to the outside world – a tool to initiate conversation between the Lab and the general public. Content for *Flux* includes:

- News about research conducted at the lab, written for the layperson;
- Profiles of scientists working with the magnets or building new ones;
- Educational resources, including projects parents can do with their children;
- Explanations of the tools, machines and concepts that keep the lab running; and
- Answers to questions we hear most often at the Magnet Lab.

Funding permitting, *Flux* will be published twice a year.

CHAPTER 2: RESEARCH HIGHLIGHTS

At the end of each year, Magnet Lab users and affiliated faculty submit brief abstracts that describe their scientific and R&D activities for the year. For 2007, we received 407 reports in 17 categories, and, following review and approval by user facility and department directors, all were presented on the Web at:

http://www.magnet.fsu.edu/mediacenter/publications/annualreport.aspx

In January, the Magnet Lab Science Council, comprising **Albert Migliori** (chair), **Rafael Bruschweiler**, **Mark Emmett**, **Lev Gor'kov**, **David Larbalestier**, **Denis Markiewicz**, **Dragana Popovic**, and **Glenn Walter**, conducted a second review to identify activities that were particularly noteworthy. The Council's recommendations were reviewed by Mag Lab Director **Greg Boebinger**, and 32 reports were selected and are published here as representative of the outstanding science begin conducted by users and staff across all three campuses of the laboratory.

	Reports Received	Highlights Selected
Life Sciences *including Biochemistry and Biology*	67	5
Chemistry *including Chemistry, Magnetic Resonance Techniques, Geochemistry*	90	7
Magnet Science & Technology *including Engineering Materials, Instrumentation, Magnet Technology, Superconductivity-Applied*	65	7
Condensed Matter *including Kondo/Heavy Fermion Systems; Magnetism and Magnetic Materials; Metal-Insulator Transitions; Molecular Conductors; Other Condensed Matter; Quantum Fluids and Solids; Semiconductors; Superconductivity—Basic*	185	13
Total	**407**	**32**

Research gets published. At the time of submission at the end of 2007, 16% of the research activities (64 reports) had already been published, many in prominent journals such as the *Analytical Chemistry, Energy & Fuels, Journal of the American Chemical Society, Magnetic Resonance Imaging, Nano Letters, Nature, Nature Physics, Physical Review B, Phys. Rev. Letters,* and *Science*. In addition, 6% of the results in the reports had been accepted for publication; 11% had been submitted; and 40% had manuscripts in preparation.

For more information on Magnet Lab publications, presentations, theses, and other scientific productivity, see Chapter 10 of this Annual Report or refer to the database online: ***www.magnet.fsu.edu/search/publications/search.aspx***

Broad funding support. While most research at laboratory is funded by the National Science Foundation, the Department of Energy, and the National Institutes of Health, a wide range of other agencies and organizations also support research projects and activities. Details are presented in the following table.

Funding Source	Total
American Chemical Society Petroleum Fund	1
American Heart Association	1
Australian Research Council	2
Canadian Institute for Advanced Research	1
Center for the Study of Advanced Materials - Chihuahua	1
Colby College Natural Science Division	1
Department of Energy	57
Deutsche Forschungsgemeinschaft	4
Engineering and Physical Sciences Research Council (UK)	2
European Commission (Marie Curie Fellowship)	1
Florida Sea Grant	1
Florida State University	5
Forschungszentrum Karlsruhe, Germany	1

Funding Source	Total
French research agencies	1
German Research Society (DFG)	1
Hahn Meitner Institute, Berlin Germany	1
Howard Hughes Medical Institute	2
Human Frontiers Science Program	3
IBM Research	1
Israel Science Foundation	1
James & Esther King Biomedical Research Foundation	2
Japan Society for the Promotion of Science (JSPS)	4
Korea Research Foundation	1
Korean National Research Lab Program	4
Korean Office of Science and Engineering Foundation	1
Lawson-Wilkins Pediatric Endocrine Society	1
Ministerio Español de Educación y Ciencia	1
Ministry of Education, Culture, Sports, Science and Technology of Japan	2
Ministry of Science and Technology (MOST) and the Korean Science and Engineering Foundation (KOSEF)	1
Ministry of Science, Korea	1
Muscular Dystrophy Association	2
Nanocem	1
NASA	5
National Council of Thailand	1
National Institutes of Health	42
National Science Council of Taiwan	2
National Science Foundation	119
National Sciences and Engineering Research Council of Canada	5
NHMFL	66
NHMFL User Collaborations Grants Program	24
NYSTAR	1
Principal Investigator funding	2
Research Corporation; Dreyfus Foundation	2
Russian Academy of Science	1
Tel Aviv University	1
Trinity College	1
U.S. Air Force Office of Scientific Research	3
U.S. Army	3
U.S. Department of Veterans Affairs	4
U.S. Environmental Protection Agency	4
U.S. Geological Survey	1
University of Akron	1
University of Colorado	1
University of Florida	5
University of South Alabama	1
US ITER team	1
Vanderbilt University	1
Warsaw University of Technology	1
TOTAL	407

International researchers from such diverse fields as ecology to neuroscience are exploiting the extremely high mass specific sensitivity of the Magnet Lab's 1-mm HTS cryogenic probe to characterize rare samples found in ecosystems ranging from tropical rainforests to the Florida Keys. Often these active compounds can only be isolated in submilligram quantities hampering structure elucidation. In the report by Matthew *et al.,* the sensitivity of this probe was exploited to identify novel active chemotypes and pharmacophores produced by cyanobacteria. They found that extracts of *Lyngbya confervoides* collected from Ft. Lauderdale and the Florida Keys yielded novel protease inhibitors that are potent inhibitors of elastase. The use of this HTS 1-mm probe is expected to play an increasing role in drugs discovered from rare samples.

This work was published in the ***Journal of Natural Products (2007).***

EXPLOITING FLORIDIAN MARINE CYANOBACTERIA FOR DRUG DISCOVERY

S. Matthew (UF, Medicinal Chemistry); K. Taori (UF, Medicinal Chemistry); J.C. Kwan (UF, Medicinal Chemistry); V.J. Paul (Smithsonian Marine Station); H. Luesch (UF, Medicinal Chemistry)

INTRODUCTION

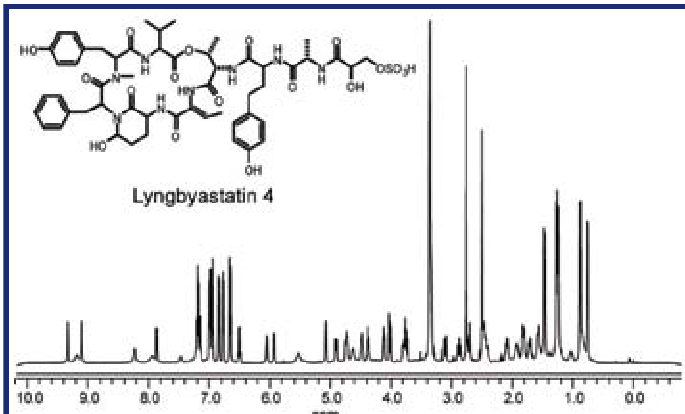
There is an urgent need to identify novel active chemotypes and pharmacophores as leads for effective drug development in many therapeutic areas. Our research is based on the hypothesis that marine cyanobacteria are a potential source of novel bioactive compounds. There is substantial evidence for the large biosynthetic capacity of cyanobacteria to produce chemically diverse secondary metabolites of biomedical utility. Florida harbors possibly the most marine biodiversity in the continental United States, and therefore there is a high probability of discovering novel and intriguing structures. One major problem is that oftentimes only submilligram quantities of active components can be isolated, hampering structure elucidation.

EXPERIMENTAL

^1H, ^{13}C, and 2D NMR spectra for cyanobacterial metabolites were recorded on Bruker Avance NMR spectrometers (500 MHz , 2.5 mm probe; 600 MHz warm bore, 5 mm probe; 750 MHz, 2.5 mm probe) or Bruker Avance II 600 MHz spectrometer equipped with National High Magnetic Field Laboratory's 1 mm triple-resonance high-temperature superconducting (HTS) cryogenic probe.

RESULTS AND DISCUSSION

Marine cyanobacteria of the genera *Symploca* and *Lyngbya* were collected off the coast of Florida, extracted and scrutinized for compounds with biomedical utility. Several extracts of *Lyngbya confervoides* collections from Ft. Lauderdale and the Florida Keys yielded novel protease inhibitors, lyngbyastatins 4–7 (Figure 1),[1,2] which displayed exceptional potency in inhibiting elastase. Active extract components were isolated by bioassay-guided fractionation and analyzed by NMR (Figure 1). Lyngbyastatins 5 and 6 were isolated in extremely low yield (0.47 and 0.17 mg, respectively), yet structure determination could be achieved thanks to the 1-mm HTS cryogenic probe.[2]



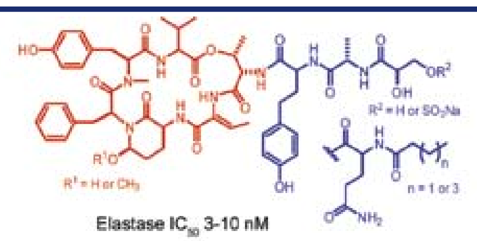


Figure 1.

^1H NMR and structure of lyngbyastatin 4 (left) and structures of all related metabolites, lyngbyastatins 4–7 (right).[1,2]

CONCLUSIONS

Cyanobacteria continue to yield new bioactive metabolites. The 1-mm probe was essential for the successful NMR analysis.

ACKNOWLEDGEMENTS

Florida Sea Grant College Program NA06OAR4170014, External User Program of NHMFL at AMRIS (NSF), and J. Rocca.

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[1] Matthew, S. *et al.*, Journal of Natural Products, **70,** 124-127 (2007).
[2] Taori, K. *et al.*, Journal of Natural Products, **70,** 1593-1600 (2007).

Multiply-labeled piscidin and HETCOR spectroscopy were successfully used to characterize the membrane-bound structure and tilt of piscidin 1 at high resolution. Access to high magnetic fields and low-E probes at the NHMFL enabled this work.

HIGH-RESOLUTION NMR STRUCTURE AND TILT OF AMPHIPATHIC PISCIDIN AT THE WATER-BILAYER INTERFACE

Riqiang Fu (NHMFL), Eric Gordon (Pacific Lutheran University, Chemistry), Milton Truong (NHMFL), Mallorie Taylor (PLU), Jeff Ditto (PLU) and Myriam Cotten (PLU)

INTRODUCTION

This research combines several solid-state NMR techniques to obtain the high-resolution structure of membrane-bound piscidin 1 (p1)[1] and help establish relationships between its structural motif, interactions with biological membranes, potency, and mechanisms of action. Piscidin[1], an amphipathic cationic antimicrobial peptide from fish, belongs to a large family of host-defense peptides that interact, at least initially, with cell membranes in order to perform their function. A bottleneck in this area of research is the lack of atomic level information on peptide-lipid interactions due to the challenges of performing traditional methods on physiologically relevant samples. Using solid-state NMR, we previously demonstrated that piscidin adopts an in-plane α-helical conformation in the presence of hydrated phospholipid bilayers.[2]

Here, we used 2D HETCOR (*Het*eronuclear *cor*relation) spectroscopy[3] to obtain the structure of membrane-bound piscidin. HETCOR correlates not only the orientation-dependent ^{15}N chemical shifts and ^{1}H-^{15}N heteronuclear dipolar couplings as in PISEMA (*P*olarization *i*nversion *s*pin *e*xchange at the *m*agic *a*ngle)[4], but also the ^{1}H chemical shift restraints from peptide planes. Similarly to PISEMA, HETCOR data can be directly analyzed to obtain tilt, polarity, and high-resolution structures of α-helices.

EXPERIMENTAL

HETCOR experiments were carried out on the ultra-wide bore 900 MHz and Bruker Avance 600 MHZ WB NMR spectrometers.

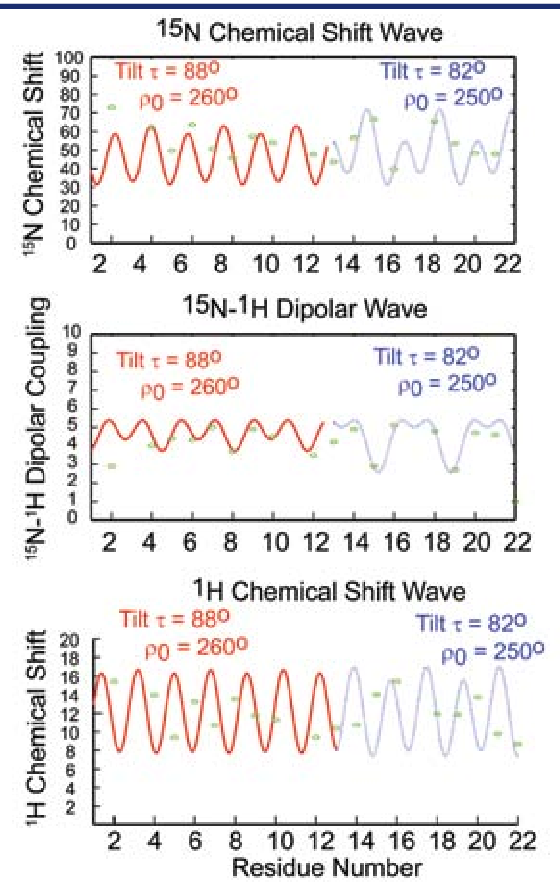

Figure 1.

Plots of experimental ^{15}N chemical shifts (top), ^{15}N-^{1}H dipolar couplings (middle), and ^{1}H chemical shifts (bottom) vs. residue number for p1-NH[2]. Simulated waves are provided in red and blue.

RESULTS AND DISCUSSION

High-resolution HETCOR spectra were obtained from multiply ^{15}N-backbone labeled amidated p1 ($p1\text{-}NH_2$) in the presence of aligned 3:1 phosphocholine/phosphoglycerate bilayers[5]. As shown in **Figure 1**, analysis of data from 18 sites of this 22-mer reveals the presence of two helical segments (tilts τ = 88 and 82°) separated by a kink (~6°) at Gly_{13}. This kink may help one portion of the peptide insert more deeply in the hydrophobic lipid bilayer and this may be related to the mechanism of membrane disruption.

CONCLUSIONS

Multiply-labeled piscidin and HETCOR spectroscopy were successfully used to characterize the membrane-bound structure and tilt of piscidin 1 at high resolution. Access to high magnetic fields and low-E probes at the NHMFL facilitated this work.

ACKNOWLEDGEMENTS

We acknowledge support from the Dreyfus Foundation, Research Corporation, and Cambridge Isotope Laboratories.

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2D HIMSELF spectra were recorded on bicelles containing uniformly ^{15}N-labeled cytochrome b_5 at 900 MHz with and without unlabeled cyt P450. Spectra are remarkably resolved and PISA wheels from the transmembrane region are well identifiable. Structural and dynamics changes in the rigid transmembrane region of cyt b_5 in the presence of cyt P450 are observed. These results will open new approaches to study the structure and dynamics of cyt b_5 as well as the cyt b_5-cyt P450 complex.

THE STRUCTURE AND DYNAMICS OF MEMBRANE-BOUND CYTOCHROME b_5 – CYTOCHROME P450 COMPLEX BY MEANS OF SOLID-STATE NMR SPECTROSCOPY

Kazutoshi Yamamoto, Jiadi Xu, Sang-Choul Im, Lucy Waskell, and Ayyalusamy Ramamoorthy (University of Michigan)

INTRODUCTION

Protein science in the post-genomic era is beginning to direct its course towards the elucidation of protein-protein interactions. Many biologically important protein-protein interactions, such as signal transduction, electron transport chain and photosynthesis, take place on the surface or across the lipid membrane of living cells. Despite their importance and ongoing investigative efforts, there have been very few reports on the protein structure determination of the complexes composed of protein-protein interactions and lipid bilayers. Practicable methods were deemed necessary to characterize the structure of complex protein systems due to the difficulties associated with membrane proteins in general and membrane protein-protein complexes in particular. We carried out the first studies

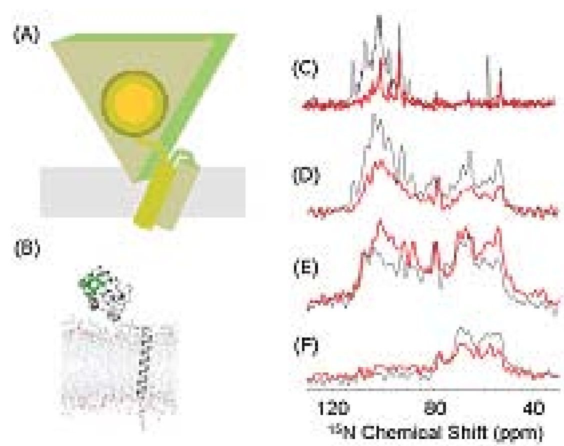

Figure 1.
Molecular model and ^{15}N NMR spectra of uniformly aligned DMPC/DHPC bicelles containing U-^{15}N-labeled cytb_5 (black) and U-^{15}N-labeled cyt b_5 with cyt P450 complex (red) at 37°C. The model (A) shows cyt b_5-cyt P450 complex and the model (B) shows cyt b_5 in the context of a DMPC bilayer; the transmembrane, linker, and heme-carrying soluble domains are evident. ^{15}N NMR spectra are absence (C-F, black) and presence (C-F, red) of cyt P450. Different spectral shapes are observed in (C) RINEPT experiments and cross-polarization (CP) experiments at contact times of (D) 3.0 ms, (E) 0.8 ms, and (F) 0.1 ms report on the different mobilities of the three domains of the cyt b_5 molecule. The ^{15}N RINEPT shows spectral intensity only in the 100-130 ppm region, consistent with a high mobility of the soluble domain. In the RINEPT sequence, 2.6 and 1.3 ms were used in the first (before the pair of 90° pulses) and second (after the pair of 90° pulses) delays, respectively.

on an intact mammalian membrane protein complex, rabbit cytochrome b_5 (cyt b_5) and cytochrome P450 2B4 (cyt P450), in a membrane bilayer environment by means of solid-state NMR at the atomic-level.[1] Cyt b_5 activates the enzymatic function of cyt P450 to oxidize a wide variety of pharmaceutical compounds.[2,2] Since the oxidation of pharmaceutical compounds is of great importance to understanding their *in vivo* efficiency, there is considerable interest in understanding the interaction and function of the cyt b_5-cyt P450 complex. Cyt b_5 is a 16.7 kDa protein consisting of three domains: a globular cytosolic domain consisting of a heme domain, a short linker region and a transmembrane domain. The transmembrane domain and linker region, which have been previously inaccessible to structural studies, are absolutely essential to activate cyt P450.

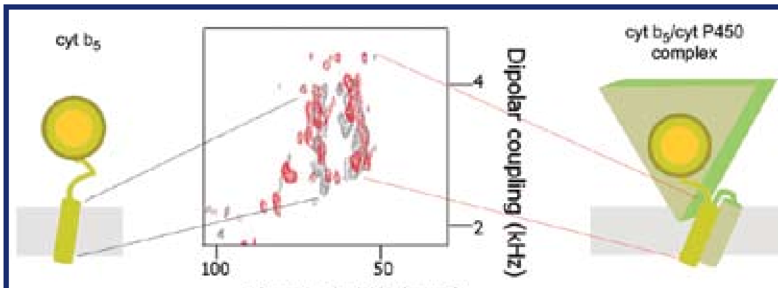

Figure 2
Two-dimensional static ^{15}N-HIMSELF spectra of TM region of a free U-15N-cytb5 (black) and the protein-protein complex U-15N-cyt b5 with cyt P450 (red) in bicelles.

EXPERIMENTAL

^{15}N NMR was performed on a UWB 900MHz NMR spectrometer (at NHMFL) equipped with an NHMFL Low-E probe. The Low-E probe and higher magnetic field were useful for this study because the intact cyt P450 protein is heat sensitive. Spectral acquisition time was 18 hours for two-dimensional static ^{15}N-HIMSELF[3] experiments at 30°C.

RESULTS AND DISCUSSION:

2D HIMSELF spectra were recorded on bicelles containing uniformly ^{15}N-labeled cyt b_5 with and without unlabeled cyt P450 (Figure 2). Spectra are remarkably resolved and PISA wheels[4] from the TM region are clearly seen. Here, we found structural and dynamics changes in the rigid transmembrane region of cyt b_5 in the presence of cyt P450. We expect these results will open new approaches to study the structure and dynamics of cyt b_5 as well as the cyt b_5-cyt P450 complex.

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It might come as a huge surprise that insect secretions could be the source of the next anti-cancer agent. In a report by the University of Florida Edison lab, that is exactly what they found. Using a highly sensitive HTS 1mm probe, they determined that the defensive secretion of *Parectatosoma mocquerysi*, a walkingstick insect from Madagascar, contains glucose, water, and a new monoterpene, parectadial, (4S)-(3-oxoprop-1-en-2-yl) cyclohex-1-enecarbaldehyde. Parectadial was also found to behave similarly to an anti-cancer agent, in that at a single concentration it inhibits the growth of several different established cancer cell lines. This study was made possible using the NHMFL's 1-mm HTS probe. This probe has proven to be an extremely efficient instrument for natural product discovery due to its high sensitivity when using extremely small amounts of material compared to conventional probes.

*This work was published in the **Journal of Natural Products** (2007).*

PARECTADIAL: A NOVEL MONOTERPENE FROM *PARECTATOSOMA MOCQUERYSI*

A. T. Dossey (UF, Biochemistry); S. S. Walse (USDA Laboratory); O. Conle (Bolsterlang, Germany); A. S. Edison (UF, Biochemistry)

INTRODUCTION

The NHMFL 1-mm HTS probe in AMRIS has been a great asset for natural product studies.[1] Using this probe, the defensive secretion of *Parectatosoma mocquerysi* Finot 1897, a walkingstick insect from Madagascar, was determined to contain glucose, water, and a new monoterpene, parectadial, (4*S*)- (3-oxoprop-1-en-2-yl) cyclohex-1-enecarbaldehyde. This work demonstrates the utility of the 1-mm HTS probe and the value of walkingstick insects as sources of new bioactive compounds, and provides an analytical framework for identifying such substances.[2]

Figure 1.
Adult male *Parectatosoma mocquerysi*.

EXPERIMENTAL, RESULTS AND DISCUSSION

P. mocquerysi was kept in culture by O. Conle (Figure 1), and the spray from 5 insects was collected and sent to the AMRIS facility for analysis. We used a variety of mass spectrometry, chromatography, and NMR techniques to show that the spray consists of glucose and a novel monoterpene that we named parectadial (Figure 2). We showed by chemical synthesis and enantioselective gas chromatography and circular dichroism that insect produces only the "S" isomer that is shown in Figure 2. *Anisomorpha buprestoides,* a walkingstick found in Florida, produces a variable mixture of monoterpenes that have a 5 membered ring[2,3] rather than the 6 membered ring of parectadial.[4]

Based on similarities to other chemicals that have been shown to kill cancer cells, we have tested parectadial for anti-cancer activity. At a single concentration it inhibits the growth of several different cancer cell lines at the National Cancer Institute's 60 cell line screen and is currently in the second round of testing to evaluate a dose response.

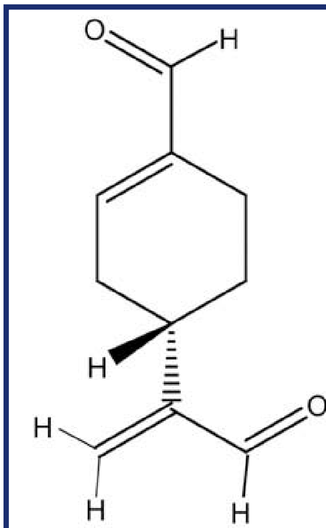

Figure 2.
Parectadial: (4*S*)- (3-oxoprop-1-en-2-yl)cyclohex-1-enecarbaldehyde.

CONCLUSIONS

The NHMFL 1-mm HTS probe is an extremely efficient instrument for natural product discovery, because much less material is needed than for conventional probes.

ACKNOWLEDGEMENTS

Bill Brey (NHMFL), Saikat Saha (NHMFL, now GE) Rich Withers (Bruker, now Varian), and Rob Nast (Bruker, now Varian) made the 1-mm HTS probe. Funding was from the HFSP, NIH, and NHMFL.

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By utilizing two low energy fragmentation techniques on peptides, it is now possible to assign the peptide fragments as originating from either the N-terminus or C-terminus of the peptide parent, which will greatly facilitate the sequencing of peptides/proteins in the gas phase.

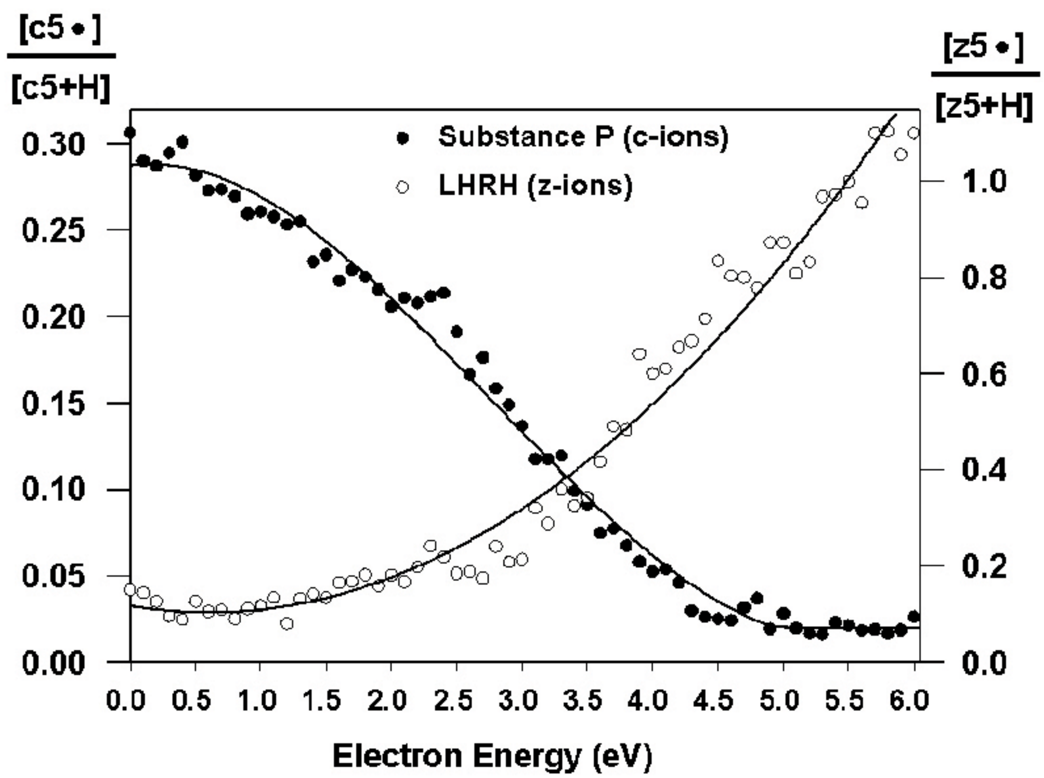
This work was published in ***Analytical Chemistry*** *(2007).*

BURNING THE CANDLE AT BOTH ENDS: PROTEIN SEQUENCING FROM THE N- AND C-TERMINI

Yury O. Tsybin (NHMFL Tallahassee), Mark R. Emmett (NHMFL Tallahassee; FSU Chemistry & Biochemistry), Christopher L. Hendrickson (NHMFL Tallahassee; FSU Chemistry & Biochemistry), and Alan G. Marshall (NHMFL Tallahassee; FSU Chemistry & Biochemistry)

INTRODUCTION

The most sensitive and informative way to determine the amino acid sequence of a protein is to slice it into segments with a suitable enzyme in solution, then "electrospray" it into the gas phase (i.e., remove all



surrounding water molecules and add positive charges in the form of protons), and finally break it at various backbone positions and weigh the product peptides with a mass spectrometer. The mass difference between product peptides resulting from cleavage at consecutive linkages then identifies the amino acid by which they differ. Until now, it has not been possible to determine which end of the original peptide is contained in the charged fragment, leading to ambiguous identification.

RESULTS AND DISCUSSION

NHMFL scientists have solved that problem by showing that a peptide breaks into two types of fragments, with relative abundances that depend on the energy of the electron "bullets" causing the fragmentation. Thus, by performing the fragmentation at each of two different electron energies, it is possible to determine whether the fragment ion is N- (amino-) terminal or C- (carboxyl-) terminal ("c" or "z" in the Figure). Protein identification is thus now twice as easy as before.

ACKNOWLEDGEMENTS

This work was supported by the NSF National High-Field FT-ICR Mass Spectrometry Facility (DMR 00-84173), Florida State U., and NHMFL.

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Iron (Fe) is the most important transition metal in biology. Oxygen molecules (O_2) bind to Fe in hemoglobin to be transported throughout the body via the bloodstream. Oxygen also is stored in muscle tissue by being bound to iron in myoglobin, another heme protein. In these cases, iron itself is not involved in chemical reactions. However, there also exist biomolecules, only recently discovered, known as non-heme iron enzymes. In these enzymes, oxygen molecules are activated by iron to create a highly reactive "ferryl" species, $[FeO]^{2+}$, which then reacts with various substrates to produce biologically important molecules. Very recently, stable small molecule analogs of this enzyme active species have been synthesized. We have now studied two of these molecules by high-frequency and high-field EPR (HFEPR) at NHMFL. HFEPR is uniquely suited for the study of these systems, due to their unusual electronic spin structure, and the best description to date of this aspect of the ferryl unit is now available. This information is of great importance to synthetic chemists in terms of helping them design better functional analogs to the enzymes. It is important also to biochemists in demonstrating the applicability of experimental methods present at NHMFL to the enzymes themselves. Lastly, the specific electronic structure information provided is important to computational chemists who are trying to understand the correlation between electronic structure and reactivity in both small molecules and in non-heme iron enzymes. Thus far, the enzymes are much more reactive than their synthetic analogs, but the basis for this is not well understood.

The work was supported by the ***User Collaboration Grants Program*** *and is currently in press in* ***Inorganic Chemistry*** *(2008).*

HFEPR STUDIES ON FERRYL COMPLEXES RELEVANT TO HEME AND NON-HEME IRON ENZYMES

K. Ray, J. England, L. Que, Jr. (U. of Minnesota, Chemistry); A. Ozarowski, D. Smirnov, J. Krzystek (NHMFL); J. Telser (Roosevelt U., Chemistry)

INTRODUCTION

Non-heme iron enzymes are widely found in biology and perform a broad range of functions, particularly activation of dioxygen and subsequent oxidative chemistry.[1] Considerable effort has been devoted to their spectroscopic characterization, by a variety of techniques including MCD and Mössbauer spectroscopies, as well as conventional EPR. In parallel, synthetic efforts have led to the isolation and characterization of model complexes for non-heme enzymes.[2]

The currently accepted model for the action of non-heme iron enzymes is via a ferryl ($[Fe^{IV}O]^{2+}$) intermediate.[1,2] The electronic spin ground state of ferryl species can be either $S = 2$, or intermediate spin $S = 1$. Model complexes have thus far exhibited $S = 1$ ground states;[2] however, surprisingly a $S = 2$ ground state has been observed for the reactive ferryl intermediate in a non-heme iron enzyme.[1] The basis for this difference between enzyme and model compounds is of great interest. As a step toward understanding this difference, we have applied High Frequency EPR to study two stable ferryl complexes in the solid state: $[FeO(tmc)(CH_3CN)](CF_3SO_3)_2$ (**1**) and $[FeO(N4py)(CH_3CN)](CF_3SO_3)_2$ (**2**), where tmc is tetramethylcyclam (1,4,8,11-tetramethyl-1,4,8,11-tetraazacyclotetradecane) and N4py is bis(2-pyridylmethyl)bis(2-pyridyl)methylamine).[2]

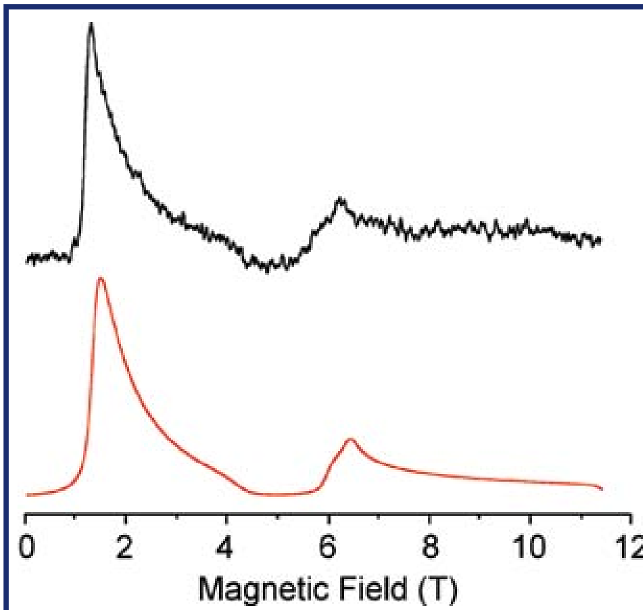

Figure 1.
HFEPR spectrum of **1** at 846 GHz and 5 K (black trace) with its powder-pattern simulation (red trace). Simulation parameters: $S = 1$, $D = +26.9$ cm^{-1}, $E = +0.095$ cm^{-1}; $g_{x,y} = 2.1$; $g_z = 2.04$.

EXPERIMENTAL

The NHMFL Mm- and Sub-mm Wave Facility with the resistive ("Keck") 25-T magnet, and the EMR Facility with the superconducting 17-T magnet were used to study polycrystalline samples of **1** and **2**.

RESULTS AND DISCUSSION

An HFEPR spectrum of **1** is shown in Figure 1. The field vs. frequency dependence of the observed resonances confirm the triplet ($S = 1$) ground spin state characterized by a zfs parameter $|D|$ of ~27 cm^{-1} and small rhombicity ($E \sim 0$). A computer fit of this entire dataset provided complete spin Hamiltonian parameters as given in Fig. 1 caption. Similar results were obtained for **2**, although the zfs was significantly smaller ($D = +22.0$ cm^{-1}).

CONCLUSIONS

This study is the first application of HFEPR to the ferryl ($[Fe^{IV}O]^{2+}$) ion, which is of great relevance to biological oxidation processes by iron-containing enzymes. From a technological and methodological point of view, the study is significant in that a new high value for zero-field splitting of the triplet spin state (nearly 30 cm^{-1}) has been directly measured by HFEPR.

ACKNOWLEDGEMENTS

We thank the NHMFL-IHRP Program, Roosevelt University, and NIH (GM-33162 to LQ) for support.

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Polymeric heterometallic compounds with properties potentially useful in the areas of magnetism, catalysis and electrical conductivity have been extensively studied in recent years. While important from a theoretial viewpoint, they may also give insight into the metal-metal interactions in biological systems like metalloenzymes that contain exchange-coupled paramagnetic metal ions. In this work, a supramolecular system containing infinite chains of binuclear anions $[Mn_2(succ)_2Cl_2]^{2-}$ (succ is the dianion of succinic acid) was synthesized. These chains are linked together by $[Cu(en)_2]^{2+}$ cations (en=ethylenediamine) to form an extended two-dimensional network.

Spectra expected for the anions and cations above were observed in high-field and –frequency EPR. However, additional weak signals were also seen that allowed to prove the presence of 8% of a 'swapped' system containing $[MnCu(succ)_2Cl_2]^{2-}$ anions and $[Mn(en)_2]^{2+}$ cations. These species eluded detection by x-ray crystallography. On the other hand, large zero-field splitting in binuclear Mn-Cu and Mn-Mn fragments rendered classical EPR useless. High-field and –frequency EPR is thus the only method indicating this interesting imperfectness of the synthetic method applied.

This work is currently in press in ***Inorganic Chemistry*** *(2008).*

DIRECT SYNTHESIS, CRYSTAL STRUCTURES, HIGH-FIELD EPR AND MAGNETIC STUDIES OF HETEROMETALLIC POLYMERS CONTAINING Mn(II) CARBOXYLATES INTERCONNECTED BY $[Cu(en)_2]^{2+}$

V. G. Makhankova, A. O. Beznischenko, V. N. Kokozay (Kiev U., Chemistry); R. I. Zubatyuk, O. V. Shishkin (National Academy of Sciences, Kharkiv, Ukraine); J. Jezierska (Wroclaw U., Poland, Chemistry); A. Ozarowski (NHMFL)

INTRODUCTION

A novel synthetic strategy has been developed to directly obtain heterometallic polymeric coordination complexes in a 'one-pot' reaction. In this work the magnetic properties and High-Field EPR spectra of the compound $[Cu(en)_2][Mn_2(succ)_2Cl_2]$ containing chains of dimeric $[Mn_2(succ)_2Cl_2]^{2+}$ anions linked by $[Cu(en)_2]^{2+}$ cations, (en = ethylene diamine), were studied.

EXPERIMENTAL

High-frequency EPR spectra up to 413 GHz were recorded on the transmission spectrometer at the EMR facility of the NHMFL. Magnetic susceptibility data of a powdered sample were measured with a SQUID magnetometer (Quantum Design MPMSXL-5) over the temperature range 1.8–300 K at the magnetic induction of 0.5 T.

RESULTS AND DISCUSSION

The dominant feature of the low-temperature high-field EPR spectra was an axially-symmetric spin-triplet (S=1) signal characterized by isotropic g factor equal to 2 and the zero-field splitting parameter D of -3.046 cm^{-1}. A D_{Mn} value for separate Mn(II) ions (S=5/2) of +0.38cm^{-1} was deducted from these data and satisfactorily reproduced by using a Density Functional Theory calculation[1] that resulted in D_{Mn} = +0.32 cm^{-1}. Additional signals seen in EPR spectra as well as magnetic susceptibility data allowed to conclude that the 'one-pot' synthetic method produced 92% of the intended complex $[Cu(en)_2][Mn_2(succ)_2Cl_2]$, while in the remaining 8% the Mn(II) and Cu(II) ions were 'swapped' to form a $[Mn(en)_2][MnCu\ (succ)_2Cl_2]$ system. The magnetic susceptibilities of the main complex (χ) and that of the 'swapped' system (χ^{sw}) were expressed as

$$\chi = \frac{Ng_{Mn}^2\beta^2}{3kT}\frac{\sum_{S=1}^{5}(2S+1)(S+1)S\exp(-J_{Mn-Mn}S(S+1)/2kT)}{\sum_{S=0}^{5}(2S+1)\exp(-J_{Mn-Mn}S(S+1)/2kT)} + \frac{Ng_{Cu}^2\beta^2}{3kT}\frac{3}{4} \qquad \chi^{sw} = \frac{N\beta^2}{3kT}\frac{30g_{S=2}^2 + 84g_{S=3}^2\exp(-3J_{Cu-Mn}/kT)}{5+7\exp(-3J_{Cu-Mn}/kT)} + \frac{N\beta^2 g_{Mn}^2}{3kT}\frac{35}{4}$$

and the exchange integral $J_{Mn\text{-}Mn}$ magnitude of 32 cm^{-1} was found from fitting procedures. The DFT calculation ('broken-symmetry' approach) resulted in $J_{Mn\text{-}Mn}$ = 44 cm^{-1}, in a reasonable agreement with experiment.

CONCLUSIONS

Magnetic susceptibility measurements and high-frequency EPR studies proved the absence of exchange interactions between $[Cu(en)_2]^{2+}$ units and Mn^{II}-carboxylate anions, while the manganese ions in the dimeric anion were found to be exchange-coupled. The single-ion D_{Mn} was satisfactorily reproduced by a DFT calculation using the ORCA software package,[1] as was the exchange integral magnitude $J_{Mn\text{-}Mn}$. The magnetic and EPR results indicate that the 'one-pot' synthesis was highly, but not perfectly efficient in putting manganese and copper ions in desired locations.

ACKNOWLEDGEMENTS

This work was supported in part by INTAS (project YS 05-109-4488) and by the NHMFL. The NHMFL is funded by the NSF through the Cooperative Agreement No. DMR-0084173 and the State of Florida.

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Instrumentation at the Magnet Lab is allowing for the study of diffusion on the nanoscale in model systems. Sanders and Vasenkov have performed non-invasive studies of lipid self-diffusion in membranes on the nanoscale using NMR spectroscopy combined with pulsed field gradients up to 35 T/m gradient amplitudes (see Report #123, http://www.magnet.fsu.edu/usershub/publications/researchreportsonline.aspx). Their studies demonstrate that it is possible to monitor anomalous diffusion in lipid bilayers deposited on oriented glass stacks at 750 MHz and over length scales as small as 100 nm. Using another approach, the Bowers lab has developed novel approaches to follow diffusion of hyperpolarized Xe atoms as they near the openings of self-assembled L-Alanyl-L-Valine dipeptide nanotubes. In the current report, Bowers *et al.* report a new method to provide greater accuracy in rate constant determination, and facilitate measurement of smaller exchange rate constants. This allows for the determination of slower exchange processes or longer diffusion time/length scales for in the depth characterization of nanotubes or nanoporous materials in general.

*This work was supported by the Magnet Lab's **User Collaboration Grants Program** and published in the **Journal of the American Chemical Society** (2007).*

INTERRUPTED GAS FLOW TO ENHANCE CROSS-PEAK NMR SIGNALS IN HYPERPOLARIZED XENON GAS: A NEW TECHNIQUE FOR STUDYING NANOSCALE DIFFUSION

C.-Y. Cheng, J.P. Pfeilsticker and C.R. Bowers, Department of Chemistry, University of Florida

INTRODUCTION

In our recent JACS article[1] we presented a study of the exchange kinetics of Xe atoms localized near the openings of self-assembled L-Alanyl-L-Valine (AV) dipeptide nanotubes[2,3] utilizing continuous-flow hyperpolarized 2D-EXSY NMR. In CFHP 2D-EXSY, hyperpolarized gas is transported from the optical pumping cell to the sample space at a constant flow rate, enabling the rapid acquisition of 2D spectra with enhanced sensitivity. In deriving the expressions for the cross-peak signals under flow conditions, we noted that the finite residence time of the hyperpolarized gas inside the sample space may suppress diagonal- and cross-peak signals, and we suggested that the undesired signal suppression could be mitigated simply by interrupting the gas flow during the mixing time of the 2D-EXSY pulse sequence.[1] Here we present the dramatic experimental confirmation of this effect in AV.

EXPERIMENTAL

A 15mg AV sample was evacuated in-situ to ~10^{-5}torr at 100ºC for 2-3 hours prior to experiments. The gas mixture consisted of 2% ^{129}Xe, 2% N_2 and 96% ^{4}He at a total pressure of 4600mbar. A fractional nanotube occupancy of $\theta = 0.047$ was inferred from the Xe shift tensor. The continuous-flow hyperpolarized ^{129}Xe NMR setup is the same as that described in Ref. 1, except for one modification: the outlet of the sample space was connected to a two-way solenoid valve. An auxiliary TTL gate on the Bruker spectrometer was used to switch the solenoid valve from the pulse program to stop the flow of gas.

RESULTS AND DISCUSSION

The CF and IF mode hyperpolarized ^{129}Xe 2D-EXSY spectra acquired in AV nanotubes at $\tau m = 1s$ are presented below. The continuous-flow sequence barely yielded any cross-peaks. In contrast, the IF mode spectrum exhibits intense gas phase diagonal and exchange cross-peak signals. Thus, by interrupting the gas flow during the EXSY pulse sequence, the cross-peak signals were enhanced by a factor of ~60.[4]

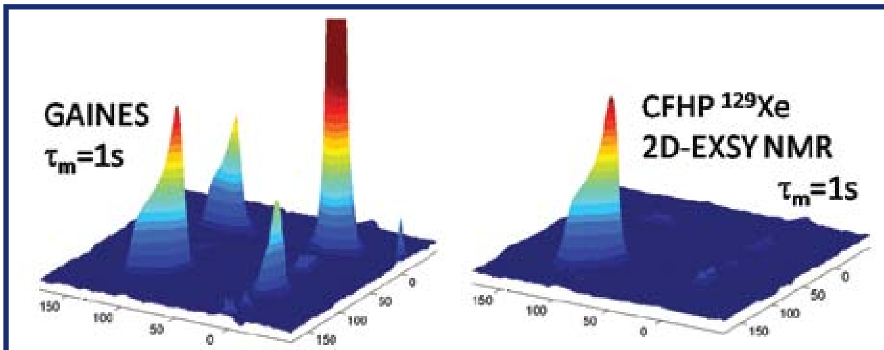

Figure 1.
Gas-flow attenvation intensifies NMR exchange signals (GAINES). Hyperpolarized xenon-129 EXSY spectra in AV nanotubes acquired under continuous (right) and interrupted gas flow conditions using a mixing time of 1s. Spectra were acquired at -10ºC at 9.4T.

CONCLUSIONS

Our new method will provide greater accuracy in rate constant determination, and facilitate measurement of smaller exchange rate constants. It may also be applicable to other hyperpolarized species such as ^{1}H or ^{13}C generated from parahydrogen or DNP. The ability to probe longer mixing times will facilitate extension of hyperpolarized 2D-EXSY to slower exchange processes or longer diffusion time/length scales for characterization of nanotubes or nanoporous materials in general.

ACKNOWLEDGEMENTS

Construction of the Xenon-129 polarizer was supported by the NHMFL In-House Research Program and UF.

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A significant and clever advance in MAS NMR: "The probe currently outperforms commercial probes we have tested as well as results published for other designs." This development adds a significant new capability to the user program and the field as well.

This work was supported by the User ***Collaboration Grants Program*** *and was published in* ***Magnetic Resonance in Chemistry*** *(2007).*

LOW-E MAGIC ANGLE SPINNING PROBE FOR BIOLOGICAL SOLID STATE NMR AT 750 MHZ

P.L. Gor'kov, W.W. Brey (NHMFL/FSU); S. McNeill (UF Electrical and Computer Engineering); J.R. Long (UF Biochemistry and Molecular Biology)

INTRODUCTION

Crossed-coil NMR probes are a useful tool for reducing sample heating for biological magic angle spinning (MAS) NMR. In a crossed-coil probe, the higher frequency ^{1}H field, which is the primary source of sample heating in conventional probes, is produced by a separate low-inductance resonator. Because a smaller driving voltage is required, the electric field across the sample and the resultant heating is reduced. In a commercial implementation, the ^{1}H coil is placed inside the low-frequency solenoid[1]. Last year we successfully developed a MAS probe based on the alternative approach of placing the ^{1}H resonator outside the solenoid (Figure 1). Because the solenoid can then be smaller and better separated from the ^{1}H resonator, we expect that this approach will give improved sensitivity and allow higher B_1 fields without arcing between the two coils. This dual resonator approach, named "Low-E," was originally developed to reduce heating in samples of mechanically aligned membranes[2], where it allowed the use of larger samples that were required to obtain sufficient NMR signal. The study of inherently dilute systems, such as proteins in lipid bilayers, via MAS techniques also requires large sample volumes at high field to obtain spectra with a sufficient signal to noise ratio under physiologically relevant conditions. This year we tested the probe under a variety of conditions, fine tuning design elements to improve proton decoupling fields. The probe currently outperforms commercial probes we have tested as well as results published for other designs. In particular, due to the larger volume of the rotor, we are able to examine structures in membrane associated peptides at physiologically relevant concentrations.

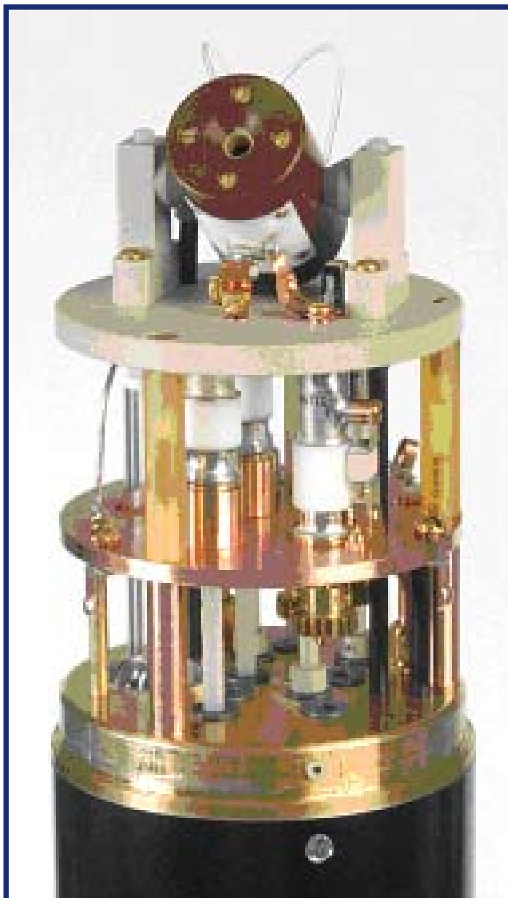

Figure 1.
Low E probe showing stator and tuning network.

METHODS

The probe was thoroughly characterized in order to determine maximum achievable B_1 fields, homogeneity of the B_1 fields, RF efficiencies, RF heating, frictional heating under MAS, spectral linewidths, and signal/noise on standard compounds. Working with Revolution NMR (Ft. Collins, CO), we were able to obtain rotors which have thinner walls and spin stably at 12 kHz, allowing us to pack more sample into the rotors. To increase robustness on the proton channel, capacitors were added in parallel to reduce voltages at individual points. This caused a small decrease in RF efficiency but allows us to operate for long periods of time with high proton decoupling.

RESULTS AND DISCUSSION

Under normal operating conditions, a ^{1}H B_1 field of 93 kHz and homogeneity (810°/90°) of 93% can be obtained with a sample length of 8.4mm corresponding to a volume of 80µl. With a higher power amplifier, we should be able to reach 110 kHz based on bench measurements. ^{13}C B_1 fields of > 71 kHz homogeneity (810°/90°) of 89% are routinely observed. Under full ^{1}H decoupling for long periods of time, sample heating due to the high RF field is minimal even for sample containing physiological levels of salt. The power handling characteristics, B_1 fields, and homogeneities make this an ideal probe for the full range of solid state NMR experiments, including sequences which use extended periods of continuous RF pulsing on both channels. We recently published a paper describing design considerations as well as some initial results[3]. A more detailed manuscript demonstrating the probe's capabilities with a variety of samples and pulse sequences is nearing completion.

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CHEMISTRY

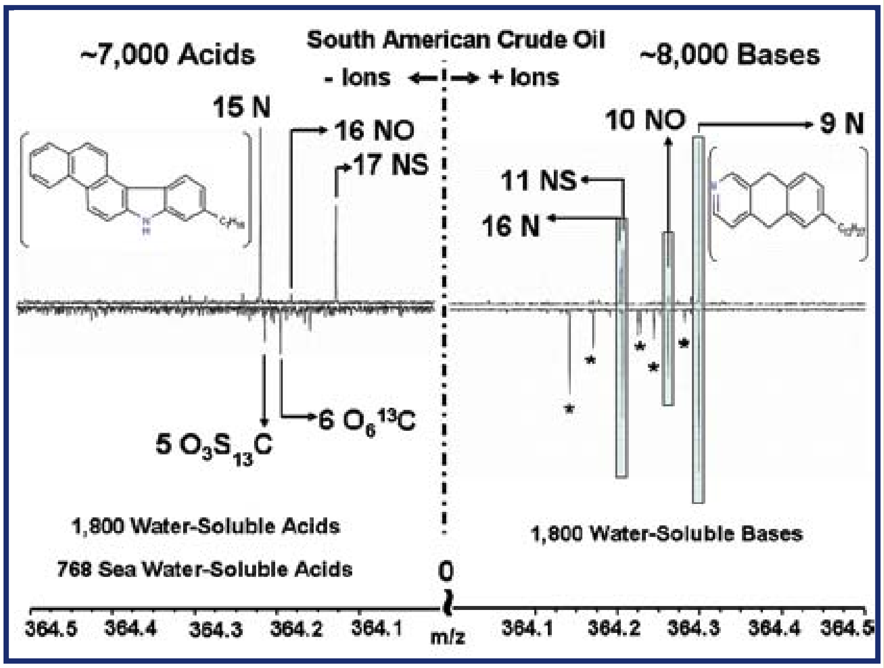
This report identifies the components of crude oil that readily dissolve in water (both fresh and salt water). This information is important in tracing the source and remediation of oil spills in the environment. This could be of great importance in spills that occur in the water table.

*This work was published in **Environmental Science & Technology** (2007).*

WHICH COMPONENTS OF CRUDE OIL DISSOLVE IN WATER?

Lateefah Stanford (FSU Chemistry & Biochemistry), Sunghwan Kim (Korean Basic Science Institute, Korea), Geoffrey C. Klein (FSU Chemistry & Biochemistry), Donald F. Smith (FSU Chemistry & Biochemistry), Ryan P. Rodgers (NHMFL Tallahassee; FSU Chemistry & Biochemistry), and Alan G. Marshall (NHMFL Tallahassee; FSU Chemistry & Biochemistry)

RESULTS AND DISCUSSION



The first step in understanding petroleum crude oil spills is to identify which chemical components dissolve in water. Here, we use ultrahigh-resolution magnet-based mass spectrometry to resolve and identify, for the first time, thousands of different chemical components of crude oil and water exposed to that oil.[1] Of the 7,000+ acidic species identified in South American crude oil, surprisingly many are water-soluble, and many more in pure water than in seawater (see Figure. Top: crude oil. Bottom: water-soluble components). Water solubility depends on molecular weight, size, and heteroatom (nitrogen, oxygen, sulfur) content. Acidic oxygen-containing chemicals are most prevalent in the water-solubles, whereas acidic nitrogen-containing chemicals are least soluble. In contrast, basic nitrogen-containing chemicals are water-soluble. (Peaks noted with an asterisk in the distilled water-soluble bases portion of the Figure are nitrogen/oxygen/sulfur-containing compounds too dilute to be detected in the parent oil.) Possible structures are shown for two of the chemical components.

ACKNOWLEDGEMENTS

This work was supported by the NSF National High-Field FT-ICR Mass Spectrometry Facility (DMR 06-54118), Florida State U., and NHMFL.

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This report features technique development to improve both FT-ICR mass spectral signal-to-noise ratio (at fixed resolving power) and resolving power (at fixed signal-to-noise ratio). The time-domain signal duration increases by up to a factor of 2 or more. The mechanism is under investigation.

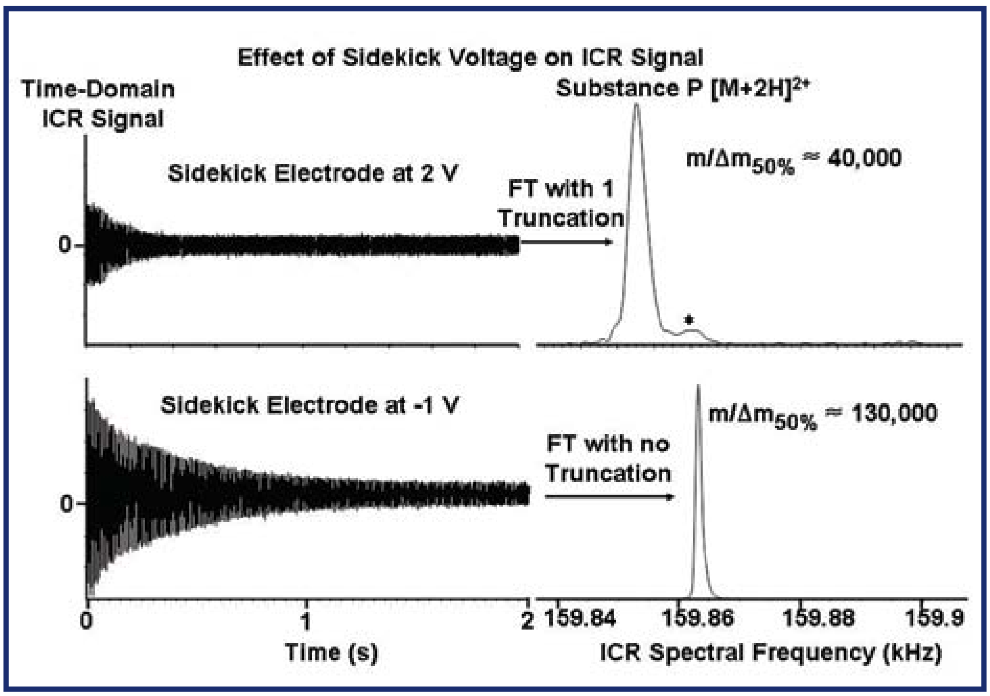
This work was published in ***Analytical Chemistry*** *(2007).*

MODIFICATION OF TRAPPING POTENTIAL BY INVERTED SIDEKICK ELECTRODE VOLTAGE DURING DETECTION EXTENDS TIME-DOMAIN SIGNAL DURATION FOR SIGNIFICANTLY ENHANCED FOURIER TRANFORM ION CYCLOTRON RESONANCE MASS RESOLUTION

Sunghwan Kim (Korean Basic Science Institute, Korea), Myoung Choul Choi (Korean Basic Science Institute, Korea), Seungyoung Kim (Korean Basic Science Institute, Korea), Manhoi Hu (Korean Basic Science Institute, Korea), Jong Shin Yoo (Korean Basic Science Institute, Korea), Hyun Sik Kim (Korean Basic Science Institute, Korea), Greg T. Blakney (NHMFL Tallahassee), Christopher L. Hendrickson (NHMFL Tallahassee; FSU Chemistry & Biochemistry), and Alan G. Marshall (NHMFL Tallahassee; FSU Chemistry & Biochemistry)

RESULTS AND DISCUSSION

Applying an inverted voltage to the "sidekick" electrodes during ion cyclotron resonance detection improves both Fourier transform ion cyclotron resonance (FT-ICR) mass spectral signal-to-noise ratio (at fixed resolving power) and resolving power (at fixed signal-to-noise ratio)[1]. The time-domain signal duration increases by up to a factor of 2 or more. The method has been applied to 7 T FT-ICR MS of electrosprayed positive ions from



substance P (see Figure) and human growth hormone protein (~22,000Da, $m/\Delta m_{50\%} \approx 200{,}000$), without the need for pulsed cooling gas inside the ICR trap. The modification can be easily adapted to any FT-ICR instrument equipped with sidekick electrodes. The present effects are shown to be comparable to electron field modification by injection of an electron beam during ICR detection, reported by Kaiser and Bruce[2]. Although the exact mechanism is not fully understood, computer simulations show that a flattening of the radial potential gradient along the magnetic field direction and formation of an inverted local potential gradient well in the ICR trap may contribute to the effects. This study provides not only a way to enhance the quality of FT-ICR mass spectra but also offers insight into understanding of ion motions inside an ICR ion trap.

CHEMISTRY

ACKNOWLEDGEMENTS
We thank John P. Quinn for help in interfacing the Predator data station to the Bruker FT-ICR mass spectrometer. We also thank Drs. Jung-Keun Suh and Young-Lan Jung for providing protein standard samples. This work was supported by the NSF National High-Field FT-ICR Mass Spectrometry Facility (DMR 06-54118), Florida State U., NHMFL, and the Korean Basic Science Institute.

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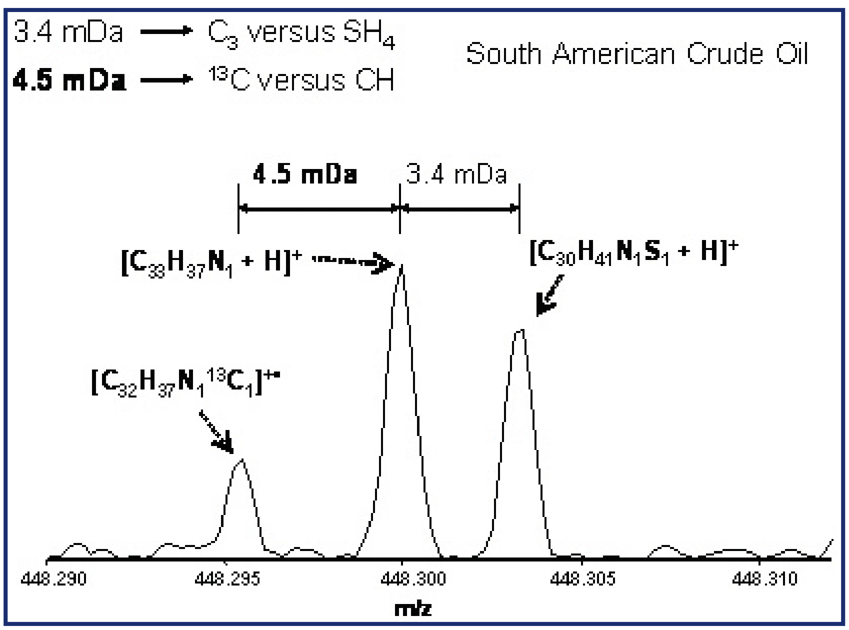
The combination of specific ionization techniques and accurate mass, high resolution Fourier transform ion cyclotron mass spectrometry permit the assignment of chemical composition and structure prediction based solely upon mass.

This work was published in the Journal of the ***American Society of Mass Spectrometry*** *(2007).*

MOLECULAR STRUCTURE FROM MOLECULAR MASS

Jeremiah M. Purcell (NHMFL Tallahassee; FSU Chemistry & Biochemistry), Ryan P. Rodgers (NHMFL Tallahassee; FSU Chemistry & Biochemistry), Christopher L. Hendrickson (NHMFL Tallahassee; FSU Chemistry & Biochemistry), and Alan G. Marshall (NHMFL Tallahassee; FSU Chemistry & Biochemistry)

RESULTS AND DISCUSSION
The smallest chemically distinct unit of matter is a molecule. High-resolution mass spectrometry can determine the chemical formula of a molecule: i.e., its number and types of constituent atoms, e.g., $C_cH_hN_nO_oS_s$. However, mass alone cannot usually determine how the atoms are linked together in the molecular structure. NHMFL/FSU researchers have recently shown that ultrahigh-resolution Fourier transform ion cyclotron resonance mass



spectrometry (FT-ICR MS) can differentiate molecules containing a nitrogen atom in a five-member vs. six-member aromatic ring (as in crude oil). Atmospheric pressure photoionization distinguishes the two kinds of rings in a single positive-ion mass spectrum (a five-member ring yields $M^{+\cdot}$ ions, whereas a six-member ring yields $(M+H)^+$ ions)[1]. High magnetic field FT-ICR MS is required, because it is necessary to resolve molecules differing in mass by less than 0.005 of the mass of the smallest atom (hydrogen)--see Figure.

ACKNOWLEDGEMENTS
This work was supported by the NSF National High-Field FT-ICR Mass Spectrometry Facility (DMR 06-54118), Florida State U., and NHMFL.

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This work pushes bulk-prepared MgB_2 to new limits, using ball milling as a means both to mix C into MgB_2 and to greatly refine the grain size of the MgB_2. Even after hot isostatic sintering at 1000° C, it is possible to obtain grain sizes of 20 nm or less. The strong scattering produced by the C and fine grain size mainly enhance the properties in the inferior H parallel to the c axis direction, where it is most useful to applications. The irreversibility field has thus been enhanced from about 11 to 17 T while the very fine grains also benefit flux pinning, generating the highest critical current densities yet reported in bulk MgB_2.

*This work was published in **Superconductivity Science and Technology** (2008). Another paper published on this work in 2007, "Understanding the route to high critical current density in mechanically alloyed $Mg(B_{1-x}C_x)_2$" was chosen for inclusion in the 'Superconductor Science and Technology' (SuST) 2007 highlights.*

IMPROVING PERFORMANCE IN BULK MAGNESIUM DIBORIDE BY IMPROVED PROCESSING

B.J. Senkowicz, J. Jiang, J. Zhou, P.J. Lee, E.E. Hellstrom, and D.C. Larbalestier (FSU-NHMFL Applied Superconductivity Center)

INTRODUCTION

Bulk form magnesium diboride (MgB_2) is a promising material for use in constructing superconducting magnets with operation temperatures up to 20 K, or mid-field magnets (< 10 T) operating at 4.2 K. The processing conditions leading to optimal properties are the object of much investigation. In this work, we examined the effects of carbon alloying, high energy ball milling, and heat treatment temperature on performance (critical current density) and used our results to describe a complex interaction between processing parameters and properties focusing on electron scattering, grain size, lattice composition, and electrical connectivity.

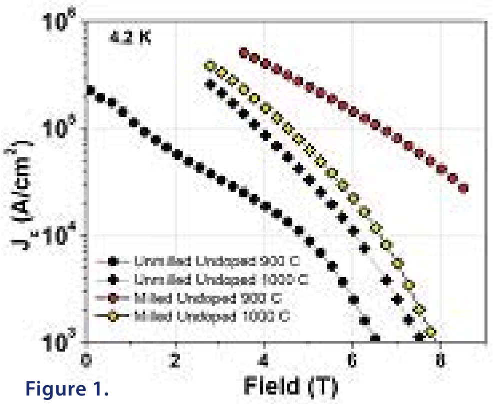

Figure 1.
Critical current density as a function of heat treatment temperature and milling status.

EXPERIMENTAL

Three sample sets (pellets) were synthesized with varying carbon content by a process involving mechanical alloying (in high energy ball mill) of pre-reacted MgB_2 powder with graphite powder (dopant), followed by hot isostatic pressing. Set A was unmilled and undoped. Set B was milled and undoped. Set C was both milled and doped. One sample from each set was HIP treated at 900°C, 950°C, 1000°C, 1150°C, and 1500°C. The sintered pellets were sectioned with a diamond saw, and their properties investigated. This experiment used the fabrication, characterization, and microscopy facilities located at the Applied Superconductivity Center, as well as the 33 T resistive magnet in the DC field user facility.

RESULTS AND DISCUSSION

We found that J_c(H,T) benefited strongly from fine grain sizes <50 nm, available by heat treating at 950°C or lower T. However, sintering was limited below 1000°C causing J_c to be limited by electrical connectivity. In this work we found that high energy ball milling reduced the T necessary to achieve ~50% of full connectivity from > 950°C to ~900°C in undoped samples. This advance enabled successful heat treatment at 900°C, resulting in an unprecedented combination of connectivity and fine grains Figure 1. When beneficial carbon was added to the material, we were able to achieve extremely high J_c (8 T, 4.2 K) > 5×10^4 A/cm^2. Further investigation revealed that the benefits of fine grain size are not limited to flux pinning improvement, but to changes in the electron scattering state of the material which result in improvement of the critically important performance-limiting H_{c2}(H//c-axis) with no significant change to H_{c2}(H//ab-plane).

CONCLUSIONS

This work simultaneously explored several processing variables and resolved their interrelated effects, resulting in excellent material performance and the knowledge necessary to tailor performance to the temperature and magnetic fields of applications by manipulating heat treatment schedules, mechano-chemical processing, and composition.

ACKNOWLEDGEMENTS

This work was financially supported by the US Department of Energy through the Division of High Energy Physics (DE-FG02-07ER41451) and Office of Fusion Energy Science (DE-FG02-06ER54881) and also our NSF focused research group DMR-0514592.

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Round wire Bi-2212 coil technology emerged during 2007 with a series of 12 coils in which many of the obstacles to immediate exploitation of the promise of Bi-2212 were identified. Along the path to a 7 Tesla insert coil aimed at surpassing the previous Bi-2212 coil record of 5T in a 20T background, the potential of RW Bi-2212 is now established. The tendency of the conductor to leak in the presence of the useful and widely used structural ceramic (Macor) means reliance on more complex insulations, as does the tendency to react with braided mullite insulations. Identification of these issues has led to better performance with all -metal coil forms such as Inconel 600. Extensive conductor evaluation has shown the need to sharpen the superconducting transition and to avoid degradation of the connectivity of the conductors by any step in the reaction process. This work lays out the key issues for making this new magnet technology viable.

Bi2212 CONDUCTOR AND COIL TECHNOLOGY FOR HIGH FIELD MAGNETS

U.P. Trociewitz, Y. Jiang, E.E. Hellstrom, W.D. Markiewicz, J. Schwartz, and D.C. Larbalestier (Applied Superconductivity Center); S. Hong, Y. Huang, H. Miao, M. Meinesz, B. Czabaj (Oxford Superconducting Technology Inc., NJ); I.H. Mutlu (Harran Üniversitesi, Turkey)

Development of $Bi_2Sr_2CaCu_2O_{8+x}$ (Bi2212) conductor for high-field magnet technology applications is a focus at the Applied Superconductivity Center (ASC)[1]. A design of a high field insert magnet manufactured using Bi2212 round wire in a wind and react (W&R) approach has been developed. In its current configuration the magnet will deliver 7 T in a background magnetic field of 18 T. The magnet design consists of four sub-shells with varying amount of external reinforcement on each shell and will have a bore size of 30 mm. The wire is Bi2212/Ag-alloy, 85 x 7 multifilament wire manufactured by Oxford Superconducting Technology (OST). It has a total diameter of 1.3 mm including a 0.15 mm thick $3Al_2O_3$-$2SiO_2$ mullite fiber braid[2]. To understand and

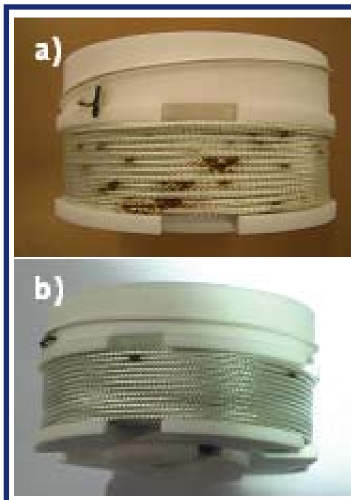

Figure 1.
Bi2212 coils on Macor coil forms heat treated with a) 0.5 l/min, and b) with 1 l/min O_2 gas flow.

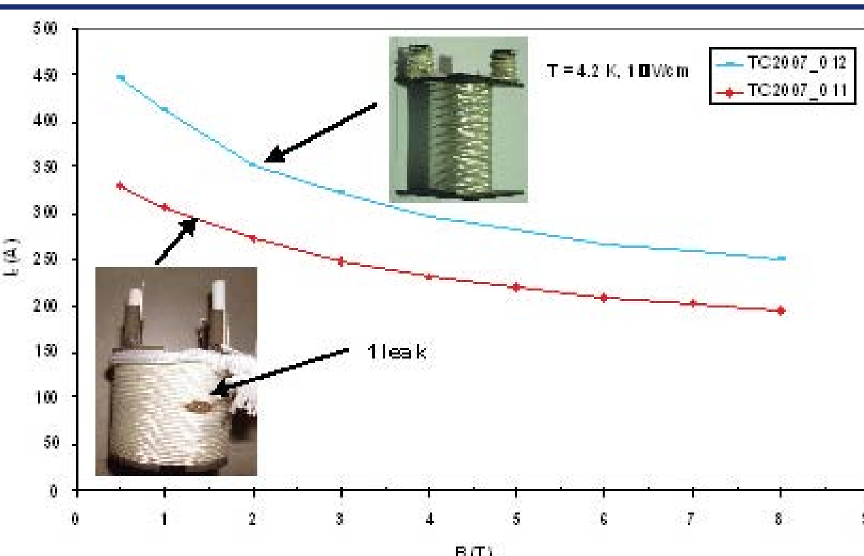

Figure 2.
Bi2212 coils wound on Inconel 600 coil forms and in- field transport data.

solve potential issues with thermo-processing of larger winding packs and other basic technology issues, a series of small sample-coils have been wound on mandrels made from Macor, a machinable glass-ceramic. They were heat-treated and studied regarding superconducting, and microstructural properties, as well as regarding chemical compatibility between conductor, electrical insulation and structural materials. The coils were heat-treated applying the typical three-step heat-treatment process in flowing O_2 including partial-melt, recrystallization, phase formation and phase refinery steps. Incompatibility issues were evident between the conductor, insulation braid and Macor. With all coils wound on Macor mandrels excessive leakage was found that could only be partially alleviated by changing heat treatment parameters and increase of gas flow, as shown in Figure 1. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) revealed that Macor decomposes as it reacts with the conductor releasing Mg and F. It also revealed reactions between the conductor and the insulation braid causing erosion of the Ag-alloy sheath and transformation of the mullite into a brittle glass that may also reduce O_2 diffusion into the conductor that is needed to complete Bi2212 phase formation. After replacing Macor coil forms with Inconel 600 coil forms leakage almost disappeared, as seen in Figure 2. This indicates that chemical reactions play a much stronger role in the cause of conductor leakage than other potential reasons that have been suggested previously like pre-existing defects, pin-holes, or internal pressure build up caused by the formation of CO_2 inside of the conductor. Comparison of transport data of short samples and coils show that though the conductor suffers from connectivity issues it is possible to manufacture W&R coils with decent performance. To increase packing density and hence the engineering critical current density, alternatives to the mullite braid insulation are being considered. Sol-gel coating with ZrO_2 has shown promising results in short samples and needs to be evaluated further.

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Work toward a conical bore high field magnet suitable for neutron scattering experiments made a significant advance with the test of the conical model coil. Here is an example of the further development of a core technology of the NHMFL allowing resistive magnets in new coil configurations, extending the range of magnet applications. The objective is to supply a conical magnet to the Spallation Neutron source (SNS) and thereby use the expertise of the NHMFL to meet critical instrumentation requirements of collaborating institutions.

THE DESIGN AND TEST OF THE CONICAL MODEL COIL

J. Chen, M.D. Bird, J. Toth, J.W. O'Reilly, S. Bole, Y. L. Viouchkov (FSU, NHMFL MS&T)

INTRODUCTION

In the autumn of 2006 a grant was awarded by the NSF for a Conceptual and Engineering Design (CED) of conical bore hybrid magnet suitable for neutron scattering experiments at the Spallation Neutron Source (SNS) in Oak Ridge, TN. The Conical Florida-Bitter (CFB) technology (pat. pend.) is the novel technology enabling for the design of this magnet. We have built a CFB model coil that has been tested to high current-density, power density, stress and field at the MagLab.

THE DESIGN OF THE CONICAL MODEL COIL

The basic design requirements include: 32mm bore, 15° half angle, 5mm sample diameter and dc power less than 8MW. The disks of a 30T magnet A coil are used to build the model coil. The unique feature in CFB technology is that the inner radii of the disks in different zones are different, as shown in Figure 1. Therefore the distribution of the current density, temperature and stresses are different for each zone and need to be calculated zone by zone. The main design parameters and the detailed zone parameters are listed in reference[1].

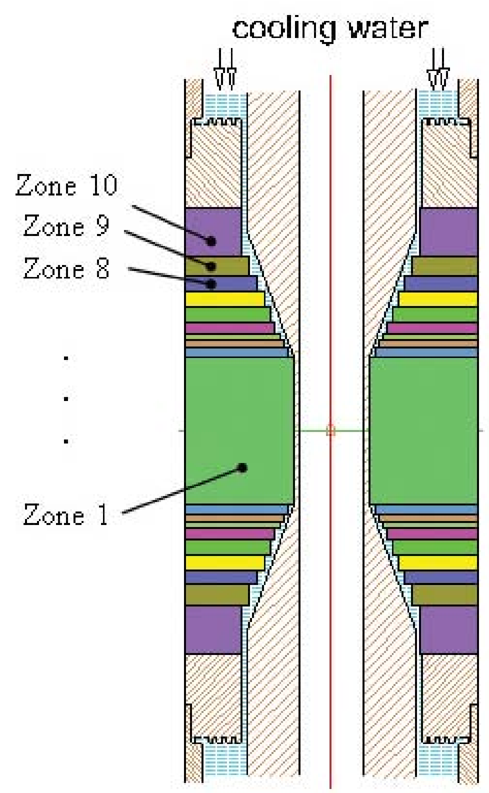

Figure 1.
Section of Conical Florida-Bitter model coil

EXPERIMENTAL

The conical model coil was installed in the housing, which was especially designed for the testing of varied coils, and the whole assembly was inserted in the existing 20-T 200-mm bore resistive magnet (large bore in cell 4). Four different tests were carried out, including high power testing (insert only), high stress testing (insert + outsert), cyclic testing and destructive testing. Water temperature at three different positions (close to zone 2, zone 9 and coil outer radius respectively) was measured in order to evaluate cooling performance.

RESULTS AND DISCUSSION

In general, the model coil worked very well. It generated 11.5 T at 15 kA and 14.1 T at 18 kA current. The power consumed was very close to the design value, implying that the cooling effect system performed as intended.

While designed for 15 kA, the coil worked at 18 kA current. In addition, the clamping force on the coil proved to be large enough to handle the electro-magnetic torque. The whole structure was very stable.

CONCLUSIONS

The design of the conical model coil is complete. It was reviewed by an international committee in November 2007. The model coil was tested in Dec. 20, 2007. It generated 14.1 T in a background field of 19.4T for a total of 33.5 T. The CFB technology, therefore, is proved to be suitable for the high-field neutron and photon scattering experiments. It will enable such experiments at higher fields than presently available.

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An essential step forward for ultra-high field NMR or MRI is the development of instrumentation that allows for the optimization of magnetic field homogeneity in high-field resistive and hybrid magnets. The challenge is to develop shims that can be adjusted to provide corrections throughout a large range of available background field enabling scientific users to study the field dependence of various scientific phenomena such as nuclear magnetic relaxation. With the goal in mind of obtaining a target of $1x10^{-6}$ field homogeneity in the future 36T Series-Connected Hybrid magnet system, Mag Lab scientists have developed a novel shimming technique that locates resistive shims on the inner bore of the resistive magnet to allow cooling of the shims from the pre-existing resistive-magnet cooling water supply. A complete working shim set has been built and will be installed in the 25 T Keck Magnet in 2008. The 25 T Keck Magnet will serve as a staging area for the development of shims to be used in the 36T Series-Connected Hybrid.

*This work has been accepted for publication in **IEEE Transactions of Applied Superconductivity**.*

RESISTIVE SHIMS FOR HIGH-FIELD RESISTIVE AND HYBRID MAGNETS

T. A. Painter, M. D. Bird, S. T. Bole, A. J. Trowell, K. K. Shetty, W. W. Brey (NHMFL), Jingping Chen

INTRODUCTION

The National High Magnetic Field Laboratory (NHMFL) has been funded by the National Science Foundation to construct a Series-Connected Hybrid (SCH) magnet system operated with a single 12 MW power supply which will produce 36 teslas and 10^{-6} field homogeneity and stability over a 1 cm diameter spherical volume[1]. The NHMFL presently operates a 25 T resistive magnet, referred to as the Keck magnet, which employs ferroshims that correct the field homogneity to 1.2×10^{-5} at 25 T over a 1 cm DSV[2]. The targeted SCH specification will extend the present boundary of the high-field, high-homogeneity experimental environment to 10^{-6} homogeneity at 36 T. As a first demonstration, a new shimming technique will be installed and operated in the Keck magnet to improve its homogeneity from 10^{-5} using ferroshims (10^{-4} unshimmed) to 10^{-6} at 25 T. Resistive shims have been selected for the SCH due to their operational flexibility. Unlike ferroshims, resistive shims can be adjusted to provide corrections throughout the range of available background field enabling scientific users to study the field dependence of various scientific phenomena such as nuclear magnetic relaxation. The resistive shims can also be adjusted as needed to optimize the field correction as resistive magnet coils are replaced over the system lifetime.

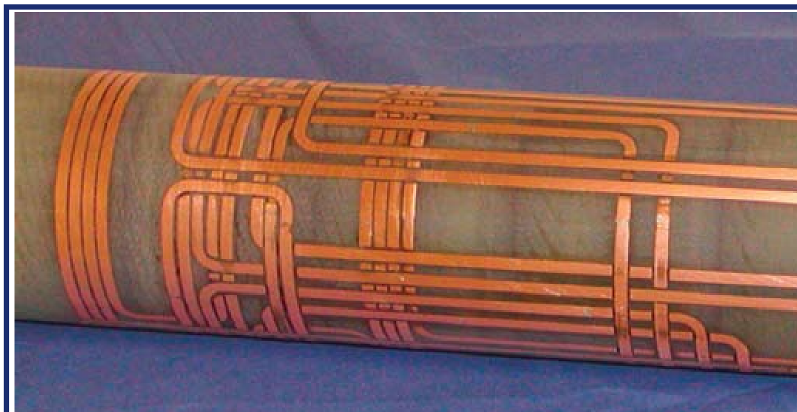

Figure 1.

The Keck Shims were produced by Advanced Magnet Lab to demonstrate and characterize performance and operation in a 25 T resistive magnet before integrating into the NHMFL SCH.

NOVEL SHIMMING TECHNIQUE

A novel shimming technique (patent application no. 60/854654) is proposed for the SCH that locates resistive shims on the inner bore of the resistive magnet to allow cooling of the shims from the pre-existing resistive-magnet cooling water supply. The novel technique employs single-turns capable of carrying 150 A as opposed to, for example, 150 turns at 1 amp to minimize the electrical insulation that impedes cooling from the water channel. The traditional conductor locations and circuits for the transverse shims have been modified to allow a single conductor in a novel circuitry for both the X and ZX (and Y and ZY) terms. The modified transverse shim circuits in combination with the optimized conductor axial location resulted in elimination of any lengthwise overlap and the associated increase in thermal impedance. In addition, a Z0 coil is fabricated into the shim set as part of the system to correct for temporal field instabilities in the magnetic field. The resultant radial build of the shim assembly is less than 5.0 mm – a key parameter at the inner bore of a high-field magnet. As an important developmental step, a fully operational shim set will be installed in the Keck magnet to allow the system to be demonstrated and characterized by regular user operation before being employed in the SCH.

CONCLUSIONS

A novel shimming technique has been conceptualized, designed and built (Figure 1) for correcting spatial inhomogeneities inside a high-field resistive or hybrid magnet system. The shimming technique uses resistive conductors located on the bore tube of the resistive magnet where (a) they can be cooled by a pre-existing flow of water required for the resistive magnet and (b) they require several orders of magnitude less ampere turns than superconducting shims traditionally located on the outer diameter of the superconducting magnet. A novel shim circuitry has been employed which allows the transverse shim terms to be divided and recombined to allow a minimum of turns. A complete working shim set with six terms has been built and will be installed in the 25 T Keck Magnet at the NHMFL in early 2008 to demonstrate the feasibility of this technique to meet the targeted objective of the SCH of 1×10^{-6} homogeneity in a 36 T central field region.

ACKNOWLEDGEMENTS

Many thanks to Rainer Meinke and Gerry Stelzer at Advanced Magnet Lab, Inc., Melbourne, FL (www.magnetlab.com) for the invaluable contributions regarding the fabrication processes for this resistive shimming technique.

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Angular dependent resistivity measurements of $YBa_2Cu_3O_7$ (YBCO) films, in pulsed magnetic fields (H) up to 50T, have settle a long-standing debate on the presence of a smectic phase in "lower anisotropy" high Tc superconductors. When H is aligned with the Cu-O layers, the rapid increase of the vortex melting line at low temperatures together with the critical exponent values, confirm the presence of a liquid-smectic transition. Also, up to 50T, correlated defects strongly reduce the motion of vortices well into the liquid phase.

This work was published in ***Physical Review Letters*** *(2008) and was supported by the Magnet Lab's* ***User Collaboration Grants Program***

ANGULAR DEPENDENCE OF THE MELTING LINE OF $YBa_2Cu_3O_7$+$BaZrO_3$ THIN FILMS

S. A. Baily, B. Maiorov (NHMFL/STC, LANL); F. F. Balakirev, M. Jaime (NHMFL, LANL); H. Zhou, S. R. Foltyn, L. Civale (STC, LANL)

INTRODUCTION

Deep inside the superconducting state when a magnetic field penetrates a superconductor, vortex matter can exist in solid or liquid phases. The nature of these phases is given by the nature of the pinning centers present.[1] Pinning centers make high temperature superconductors (HTS) useful by stabilizing the solid phase and enabling films to carry current without dissipation. When the magnetic field or temperature increases, the solid vortex lattice melts and electrical resistance increases. The most interesting case occurs when field is aligned with the copper oxide planes of HTS and many types of pinning centers are present.

EXPERIMENTAL

Electrical ac-transport was used to measure the vortex dissipation in the liquid phase as well as to determine the melting line (where dissipation goes to zero), as a function of angle for $YBa_2Cu_3O_7$ (YBCO) films in the 50 T short-pulse magnet using the newly rebuilt rotator probe. The effect of naturally grown defects on the melting line was studied.

RESULTS AND DISCUSSION

We find that near 80 K (H>40T), when the magnetic field is aligned with the layers, the melting line turns upward and the critical exponent that describes the rise in resistivity upon entering the liquid state becomes similar to that of a liquid crystal melting transition as predicted for layered superconductors.2 Also, we observe that up to the highest field measured (50 T) correlated defects arrest the motion of vortices well into the liquid phase. At intermediate angles, the complete vortex dissipation can be scaled using the mass anisotropy model.

CONCLUSION

A long-standing debate about the existence of a smectic vortex phase in "low anisotropy" HTS has been settled, with evidence for a smectic vortex phase in optimally doped YBCO at fields higher than 40 T.[3]

ACKNOWLEDGEMENTS

This work was supported by the NSF through the NHMFL and NHMFL UCGP, the State of Florida and the DOE.

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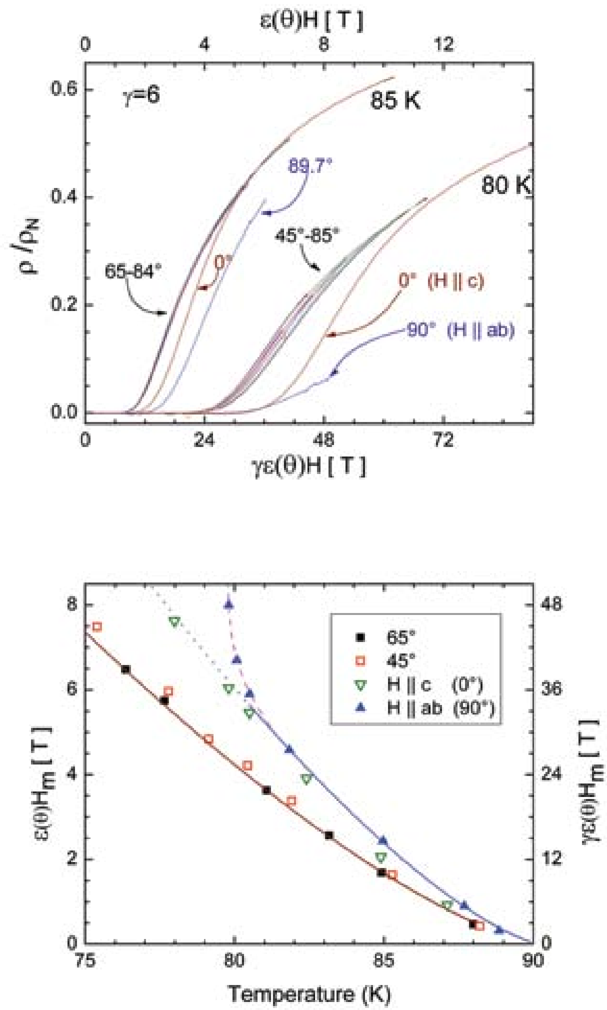

Figure 1.

Top: Normalized resistance vs. scaled field at two temperatures. Bottom: e(Θ))H vs. Temperature with the H applied at different orientations.

In spite of the vital advantages of round wire for magnet use, the emerging 2nd generation HTS wire using YBCO tapes is proving very attractive for applications. Thieme *et al.* present data on tapes made by the AMSC RaBITS technique in a form useful for very high field solenoid use. Current densities of almost 500 A/mm2 at 25 T make it clear that these materials are going to be very attractive for high field solenoids.

HIGH FIELD STABILITY EXPLORATION OF SECOND GENERATION HTS

C.L.H. Thieme, K. Gagnon, (American Superconductor - AMSC), Honghai Song, J. Schwartz (NHMFL/FSU)

INTRODUCTION

2G HTS wire is based on high performance thin film YBCO superconductor. AMSC uses a bi-axially textured substrate with a thin epitaxial oxide buffer layer (RABiTS™). The YBCO layer is grown using a solution-based coating process carried out on a 4 cm wide web. After completion of all coatings the conductor is slit to multiple 4 mm widths. These are laminated on both sides to a 4.4 mm copper foil[1], resulting in a so-called 344 superconductor. For ac applications a stainless laminate can be selected[2]. I_c improvements are obtained through improved chemistry and reactor conditions[3].

The main objective of this STTR Project is the exploration of the suitability of Second Generation HTS for high heat load, high radiation environment applications. The Phase I aimed at an extensive characterization of J_e (B, T, Θ) (where Θ is the angle between the field and surface of the conductor) and establishing the thermal limit in various stability experiments using small coils. The operating regime of interest is low temperatures (4.2-27 K) and fields up to 25 T. Previous measurements at the NHMFL demonstrated an engineering critical current of 225 A/mm^2 at 25 T, parallel field. We characterized short lengths of a new, thicker film conductor at 4.2 K and fields between 3 and 25 T. We then continued with the characterization of multiple 10m lengths. These were used to build various instrumental pancake coils, see Figure 1, intended for stability measurement at 4.2 k and fields of 6-7 T.

EXPERIMENTAL

The 344 superconductor for this STTR Project was made using a so-called double layer geometry, resulting in a 1.4 μm thick YBCO layer with different pinning characteristics for top and bottom layer. The 4.4x0.2 mm conductor (0.88 mm^2 area) has 50% copper stabilizer. The conductor showed a critical current exceeding 100 A at 77 K, SF. Lengths of this conductor were used for measurements at high magnetic field, with field orientations parallel and perpendicular to the face of the tape-like conductor. In parallel fields the conductor was measured using an adapted ITER probe. Two pair of voltage taps were placed at 40 and 60 cm distance, with a minimum distance of 15-20 cm between current leads and outer voltage taps. The sample was always under compression. This worked well except for very high fields (24-25 T) when the conductor could buckle.

Figure 1.
Epoxy impregnated pancake coil made of YBCO coated conductor. The coil is heavily instrumented for upcoming stability testing.

RESULTS AND DISCUSSION

In parallel fields the I_c reduction with field was gradual, as anticipated from earlier work. At 10, 15, 20 and 25 tesla the critical current was 643, 557, 486 and 418 A (or 1600, 1390, 1215 and 1045 A/cm-width), resulting in an overall critical current J_e (including copper stabilizer) of 670, 580, 506, and 435 A/mm^2. These values are roughly proportional to the layer thickness compared to earlier values in 0.8 μm thick YBCO films. In a perpendicular field the critical currents were much lower, again as expected based on earlier measurements, with J_e values of 208 (5 T), 133 (10 T), 101 (15 T), 83 (20 T) and 73 A/mm^2 (25 T). These values too were in line with what could be expected for the increased film thickness.

CONCLUSIONS

The high demonstrated engineering critical currents (475 A/mm^2 at 25 T) are of interest for those high field applications in which the HTS magnet section is placed in a background field with field parallel to the conductor. The measurements are the first and a good start in a series for a full characterization, before small pancake coils made of the same conductor will be tested for stability in a magnetic field.

ACKNOWLEDGEMENTS
This STTR Program is supported by the U.S. Department of Energy, Office of High Energy Physics.

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Controlling fusion energy, the source that drives the sun, is the objective of ITER, the International Thermonuclear Experimental Reactor. The NHMFL provides unique facilities for the testing of Nb_3Sn superconductor intended for use in the ITER machine. In earlier work, the very large degradation of critical current with bending strain in advanced high current density internal tin process conductors was revealed. These measurements are made on single strands in pure bending, and are therefore a fundamental aspect of the performance of cables under more complex load patterns. In the recent work reported here of an expanded study, the large degradation associated with high current density internal tin wires is confirmed, and compared with the much lower degradation characteristic of conventional bronze process wires. A clear tradeoff between available current density and strain sensitivity is shown. These measurements are essential in providing the information necessary to make design selections for the ITER conductors.

BENDING EFFECT ON Nb_3Sn SUPERCONDUCTING WIRES

Makoto Takayasu, Luisa Chiesa, Joel H. Schultz, Joseph V. Minervini (Massachusetts Institute of Technology, Plasma Science and Fusion Center), and John R. Miller (Oak Ridge National Laboratory)

INTRODUCTION
Bending effects on Nb_3Sn wires have been investigated to understand the critical current degradation of large Nb_3Sn superconducting cables, such as the ITER conductors. A variable-bending device has been constructed for characterizing the critical currents of Nb_3Sn superconducting strand under pure bending without unaxial tension or compression. This device has been successfully developed[1] and has been used to test several Nb_3Sn wires: ITER TF US wires of Luvata and Oxford internal-tin wires, and other ITER related Nb_3Sn wires (European EAS bronze and EM-LMI internal tin, and Japanese Furukawa bronze wires).

EXPERIMENTAL
Pure bending experiments for various Nb_3Sn wires were performed with our pure-bending device using the 20 T, 195 mm Bitter magnet at NHMFL. Our bending test device allowed applying pure bending strains to a strand during test operation in liquid helium[1]. The strand samples were placed on a support beam plate made of Ti-6Al-4V that was deformed through a series of pure bending states. This device can apply a large range of bending, up to 0.8% of the nominal bending strain at the wire surface. The actual peak bending strain of the filaments in the wires was about 65% of the nominal bending strain values, depending on copper/noncopper fraction. The critical currents were measured at every 0.1% increment of bending up to 0.8%. Irreversible degradation of the critical current due to bending was measured by releasing bending after each 0.1% increment.

Figure 1.
A pure bending device is shown in the figure. The superconducting strand is mounted on a support beam and a groove is placed on the neutral axis of the beam to produce pure bending effect on the strand.

RESULTS AND DISCUSSION
We tested five different Nb_3Sn wires which were developed by the ITER parties. Three were internal-tin wires of recently developed ITER TF US Oxford and Luvata wires and EU EM-LMI wire. Two of them were bronze wires of EU EAS and Japanese Furukawa designs. The critical currents degraded with increasing the bending strains. At 0.8% nominal bending strains the critical currents of the internal tin wires were degraded by 47% for Oxford wire, 40% for Luvata wire and 30% for EM-LMI wires. Higher current density wire such as the Oxford wire seems to degrade more than lower current density wires. On the other hand with the same 0.8% nominal bending, bronze wires made by Furukawa and EAS both degraded by only 10%. After 0.8% bending, Oxford and Luvata wires showed 13% and 1.3% irreversible permanent degradation of their initial critical current values, respectively. It is noted that some wires such as the Furukawa wire show small improvements of the critical currents with applied bending up to about 0.3%.

ACKNOWLEDGEMENTS

This work was supported by the U.S. Department of Energy, Office of Fusion Energy Science under Grant Number: DE-FC02-93ER54186 and the US ITER Project Office.

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Hall effect measurements in YBCO at 12% doping have been extended to high B up to 45 T. It is found that the Hall coefficient R_H is positive at high temperatures, but becomes strongly negative below ~70 K (T_C = 67.5 K). This is believed to reveal the presence of electron pockets in the Fermi surface, which would then give rise to the previously observed quantum oscillations at low temperatures. It is proposed that electron pockets arise from a reconstruction of the Fermi surface, but the mechanism remains unidentified.

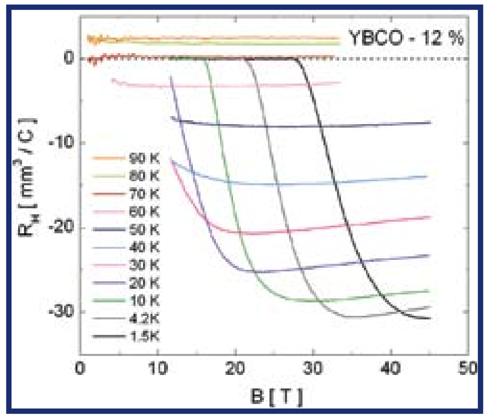
This work was published in ***Nature*** *(2007).*

NEGATIVE HALL COEFFICIENT IN THE NORMAL STATE OF HOLE-DOPED CUPRATE SUPERCONDUCTORS

N. Doiron-Leyraud, D. LeBoeuf, J.-B. Bonnemaison, L. Taillefer (Sherbrooke); C. Proust (LNCMP); R. Liang, D. Bonn, W. Hardy (UBC); L. Balicas (NHMFL)

INTRODUCTION

Earlier this year, quantum oscillations in the Hall resistance of the cuprate superconductor $YBa_2Cu_3O_y$ (YBCO) at 10% doping were observed[1], convincingly showing that there is a Fermi surface in underdoped cuprates. Yet, the large magnitude and negative sign of the Hall resistance remained a puzzling issue given that YBCO is a hole-doped material. To understand this problem, we carried out further high-field measurements of the Hall resistance of YBCO.



EXPERIMENTAL

The Hall and longitudinal resistances were measured using a 4-point lock-in method. The samples, grown at UBC, were detwinned chain-ordered YBCO platelets with dopings of 10 and 12%. Measurements were done in the 45 T hybrid magnet in Tallahassee during the week of March 26-30, 2007. The current was long the a-axis and the magnetic field along the *c*-axis.

RESULTS AND DISCUSSION

In the figure on the right we show the Hall coefficient R_H measured in YBCO at 12% doping as a function of magnetic field up to 45 T. We see that R_H is positive above 70 K, and strongly negative below. Strikingly, at 70 K R_H vanishes at all fields, showing that the sign change is field independent and occurs above the superconducting T_c of 67.5 K. While previous studies on cuprates (see, e.g.,[2]) limited to low field below 25 T attributed this sign change to a negative flux flow contribution, our high field data demonstrate that a negative R_H at low temperature is an intrinsic normal-state property. These results, obtained at the NHMFL, were published in *Nature* on 22 November 2007.[3]

CONCLUSIONS

In order to understand the pronounced temperature dependence and sign change of R_H, one must invoke a scenario where two types of carriers - electrons and holes – with different mobilities are present. Because the quantum oscillations are observed at low temperature when R_H is negative, we conclude that they come from small electron pockets in the Fermi surface of YBCO. This observation can be explained by a reconstruction of the large cylindrical hole Fermi surface into small hole and electron pockets[3], as is believed to occur in electron-doped cuprates because of antiferromagnetic ordering. The nature of the order causing the reconstruction in YBCO remains to be identified.

ACKNOWLEDGEMENTS

We acknowledge support from the Canadian Institute for Advanced Research, the NHMFL, and funding from the NSERC, the FQRNT, a Canada Research Chair, the NSF, and the State of Florida.

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Deviation from standard Fermi-liquid behavior is observed in the paramagnetic state of Na_xCoO_2 at x = 0.75, and as a result of the interplay between itinerancy and localized S = 1/2 moments on a triangular superlattice. The upturn in the low temperature specific heat and the anomalous scattering in the resistivity both point to the existence of a novel kind of low energy excitation. That these excitations appear to be suppressed by a magnetic field suggests that these are spin fluctuations. One suggestion is that the local moments form a spin liquid state which co-exists with itinerant electrons.

*This work is published in **Physical Review Letters** and was supported by the Magnet Lab's **User Collaboration Grants Program**.*

LOCAL MOMENT, ITINERANCY AND DEVIATION FROM FERMI LIQUID BEHAVIOR IN Na_XCoO_2 FOR 0.71 ≤• X ≤ 0.84

L. Balicas (NHMFL); Y. J. Jo (NHMFL); G. J. Shu (National Taiwan University); F. C. Chou (National Taiwan University); P. A. Lee (Physics-MIT)

INTRODUCTION

We report the observation of Fermi surface (FS) pockets via the Shubnikov de Haas (SdH) effect in Na_xCoO_2 for x = 0.71 and 0.84, respectively[1]. Our observations indicate that the FS expected for each compound intersects their corresponding Brillouin zones, as defined by the previously reported superlattice structures[1], leading to small reconstructed FS pockets, but only if a precise number of holes per unit cell is *localized*. For 0.71 ≤• x < 0.75 the coexistence of itinerant carriers and localized S = 1/2 spins on a paramagnetic triangular superlattice leads at low temperatures to the observation of a deviation from standard Fermi-liquid behavior in the electrical transport and heat capacity properties, suggesting the formation of some kind of quantum spin-liquid ground state.

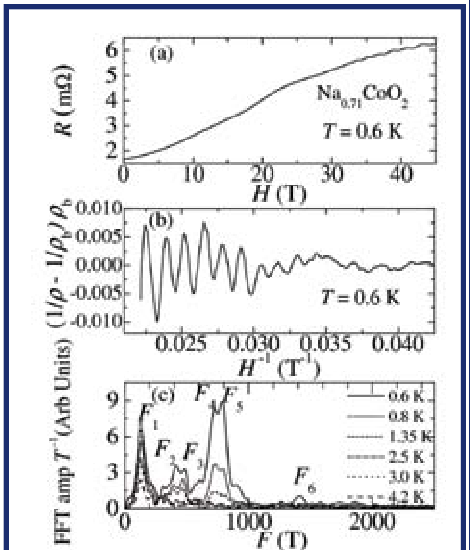
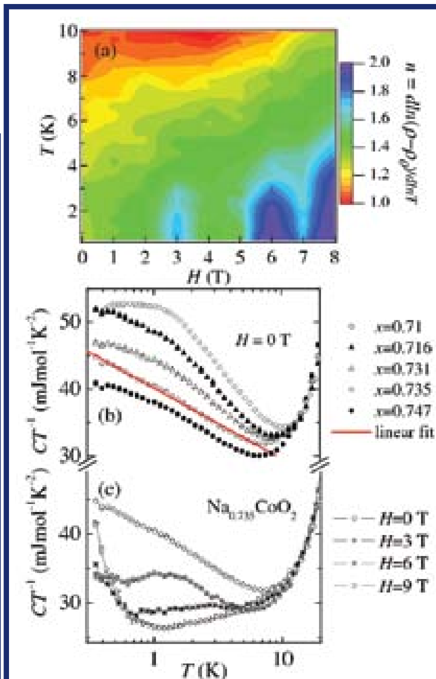


Figure 1.
(a) Resistance R as a function of field H for a $Na_{0.71}CoO_2$ single crystal at T = 0:6 K. (b) The SdH effect or the oscillatory component of R in (a) as a function of *Hj*1. (c) Amplitude of the fast Fourier transform normalized by temperature T for several values of T. At least six frequencies are detected: F_1 = 125 T, F_2 = 400 T, F_3 = 475 T, F_4 = 725 T, F_5 = 800 T, and F_6 = 1413 T.



(a) The evolution of the exponent of the resistivity as a function of field H for a $Na_{0.735}CoO_2$ single crystal. (b) Heat capacity normalized by temperature *C/T* as a function of T for several Na concentrations x in a semi-log scale. Straight line represents a linear fit to the x = 0.735 data over the temperature range 0:35 ≤• T ≤• 7 K. (b) *C=T* as a function of T for x = 0.735 and for several values of the field H.

EXPERIMENTAL

We performed electrical transport measurements in $Na_{0.71}CoO_2$ and $Na_{0.84}CoO_2$ using the hybrid magnet in conjunction with a ^{3}He refrigerator and a rotating sample holder in order to detect Shubnikov de Haas oscillations. Results for x = 0.71 are shown in Figure 1. While Heat capacity and resistivity measurements at low fields were performed by using a PPMS (Figure 2).

RESULTS AND DISCUSSION

The SdH oscillations can only be understood by the intersection of the original Fermi surface of these materials with the superlattice induced Brillouin zone, if for both concentrations at least one hole per superlattice unit cell is localized. Thus for x = 0.71 one has 2.5 itinerant holes coexisting with a localized moment per each 12 cobalts within the superlattice unit cell and 1 itinerant holes and one localized moment per 13 cobalts within the superlattice unit cell.

CONCLUSIONS

In summary, deviation from standard Fermi-liquid behavior is observed in the paramagnetic state of Na_xCoO_2 as $x = 0.75$, and as a result of the interplay between itinerancy and localized $S = 1/2$ moments on a triangular superlattice. The upturn in the low temperature specific heat and the anomalous scattering in the resistivity both point to the existence of a novel kind of low energy excitations. That these excitations appear to be suppressed by a magnetic field suggests that these are spin fluctuations. One suggestion[1] is that the local moments form a spin liquid state which co-exists with itinerant electrons. While our data does not allow us to draw any firm conclusion on the origin of the anomalous behavior, it is clear that the cobaltates offer a new window into possible novel ground states in a system with coupled local moments and itinerancy.

ACKNOWLEDGEMENTS

LB acknowledges support from the NHMFL in-house research program, and YJJ from the Schuller fellow program.

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The properties of graphene, a single atomic sheet of graphite, are currently a subject of intense research. Much of the interest in this truly two-dimensional (2D) system stems from its unusual, linear low-energy dispersion relation, where the low-energy electronic excitations are described in terms of massless, chiral, Dirac fermions. This particular dispersion is thus expected to give rise to many properties that are different from those exhibited by other 2D systems. The report by Z. Jiang *et al.* describes several interesting phenomena that are observed when graphene is subjected to high magnetic fields. They include the observation of the integer quantum Hall (QH) effect at room temperature and of the new QH phases at low temperatures. Furthermore, a cyclotron resonance (CR) study of both single and bilayer graphene reveals several departures from the conventional CR on 2D semiconductor heterostructures. Some of the differences are attributed to the interactions between Dirac quasiparticles.

*This research has been published in Science **315**, 1379 (2007), and Physical Review Letters: **98**, 197403 (2007); 99, 106802 (2007); **100**, 087403 (2008).*

LANDAU LEVEL SPECTROSCOPY OF GRAPHENE

Z. Jiang (Columbia University & NHMFL); E.A. Henriksen (Columbia University); K.I. Bolotin (Columbia University); Y. Zhang (Columbia University); L.-C. Tung (NHMFL); M.E. Schwartz (Columbia University); M. Takita (Barnard College); M.Y. Han (Columbia University); Y.-J. Wang (NHMFL); G.S. Boebinger (NHMFL); P. Kim (Columbia University), and H.L. Stormer (Columbia University & Bell Labs)

INTRODUCTION

Graphene, a single atomic sheet of graphite, is a monolayer of carbon atoms arranged in a hexagonal lattice. The unique electronic band structure of graphene exhibits an unusual *linear* low-energy dispersion relation, quite different from the parabolic bands common to all previous two-dimensional systems. Most interestingly, this dispersion results in the charge carriers that mimic relativistic, massless Dirac particles, leading to intriguing new phenomena. In particular, a very unusual half-integer quantum Hall effect and a non-zero Berry's phase have been discovered in graphene.

EXPERIMENT AND RESULTS

The Quantum Hall effect (QHE) is one example of a quantum phenomenon that occurs on a truly macroscopic scale. The signature of QHE is the quantization plateaus in the Hall resistance (R_{xy}) and a vanishing magnetoresistance (R_{xx}) in a strong magnetic field. The QHE, exclusive to two-dimensional metals, has led to the establishment of a new metrological standard, the resistance quantum, h/e^2 , that contains only fundamental constants. As with many other quantum phenomena, the observation of the QHE usually requires low temperatures (the previously reported highest temperature was 30 K). In graphene, however, we have observed a well-defined QHE at room temperature (see Figure 1.) owing to the unusual electronic band structure and the relativistic nature of the charge carriers of graphene[1]. In addition, we have observed new QH phases at filling factors $v = 0, \pm1$, and ±4 at low temperatures and in high magnetic fields (see Figure 2. for the $v = \pm1$ and -4 state), arising from the lifting of the spin and sublattice degeneracies of graphene Landau levels (LL)[2].

The phenomenon of cyclotron resonance (CR) results when incident infrared radiation is absorbed by the excitation of carriers between neighboring LLs, with the absorbed frequencies corresponding to the LL energy separation. Since the 1950s, CR has been a fundamental tool for the investigation of semiconductor bandstructures, which generally exhibit resonance energies that are linear in the magnetic field. Recently, we have made the first measurements of LL transitions via infrared transmission measurements in both single (Figure 3a, Ref.[3]) and bilayer (Figure 3b, Ref.[4]) graphene samples, in magnetic fields up to $B = 18$ T. We find that both systems present radical departures from the usual CR, exhibiting LL transition energies that are linear in √B for single layer graphene, and that for bilayers show a shift from a linear-in-B dependence at low energies to linear-in-√B at higher energies. In further departures from traditional CR, resonance energies in both systems show a dependence on the LL index, while in single layers we have also observed interband in addition to intraband transitions. Departures from the expected ratios of the transition energies are interpreted as indicating physics of interacting Dirac quasiparticles, beyond a simple single particle picture.

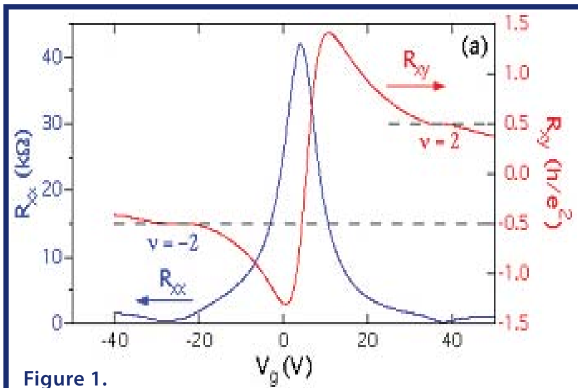

Figure 1.
Magnetoresistance (R_{xx}) and Hall resistance (R_{xy}) as a function of the back gate voltage (V_g) in a magnetic field of $B = 45$ T at room temperature.

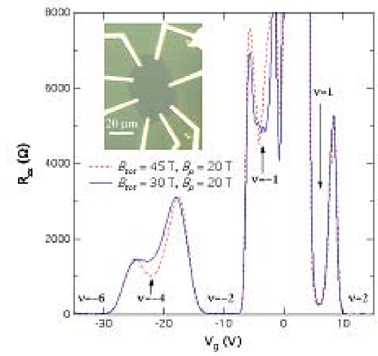

Figure 2 .
R_{xx} vs. V_g in tilted magnetic fields.

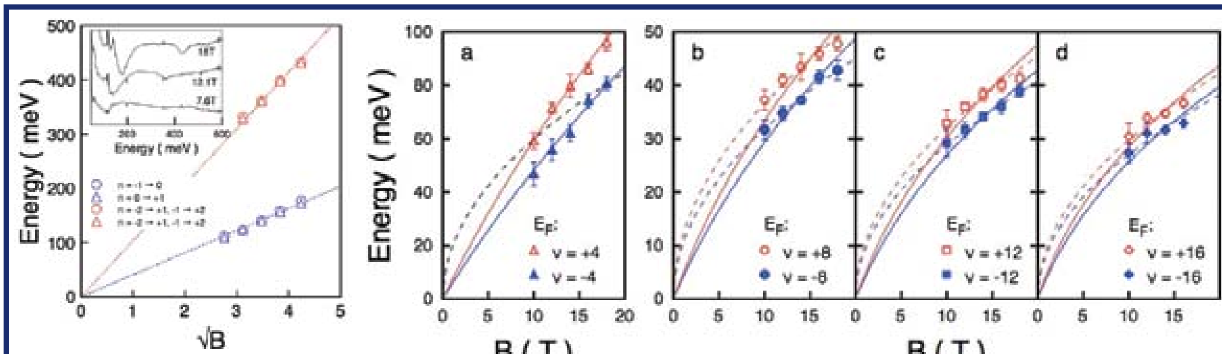

Figure 3.
(left) LL transitions in single layer graphene. Inset shows normalized transmission for three B fields. Dashed lines are best fit to √B. (right) LL transitions among the first nine LLs in bilayer graphene. Dashed lines are fit to √B; solid lines are fit to theory based on nearest-neighbor tight-binding approximation.

ACKNOWLEDGEMENTS
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This describes a study of the thermoelectric response of clean Bi beyond the quantum limit to probe for high field anomalies. Accepted by *Science*, the authors observed new anomalies in the field dependence of the Nernst coefficient. These anomalies occur in the ultraquantum limit. They appear to be beyond the one-particle picture that successfully describes the low-field peaks associated with quantum oscillations and may constitute the first detected signatures of electron fractionalization in a bulk metal.

This work was published in ***Science*** *(2007) and was supported by the Magnet Lab's* ***Visiting Scientist Program****.*

NERNST EFFECT IN ULTRAQUANTUM BISMUTH

Kamran Behnia (ESPCI-France), Luis Balicas (NHFML)

INTRODUCTION

The aim of this project was to study the thermoelectric response of a clean bulk metal beyond the quantum limit. A previous study detected giant quantum oscillations of the Nernst coefficient in elemental bismuth[1]. This experiment was set to probe any further anomaly at higher fields.

EXPERIMENTAL

We built a miniature probe to measure Nernst effect and used a He^3 refrigerator inside a resistive magnet yielding 33 T. Thermal conductivity in bismuth is field-independent. Therefore, a constant heat current yielded a constant temperature gradient along the sample. The signal-to-noise ratio in our DC voltage measurement was very satisfactory.

RESULTS AND DISCUSSION

We resolved three new anomalies in the field dependence of the Nernst coefficient beyond the quantum limit (see the figure). These anomalies occur in the ultraquantum limit. They appear to be beyond the one-particle picture that successfully describes the low-field peaks associated with quantum oscillations. They may constitute the first detected signatures of electron fractionalization in a bulk metal.

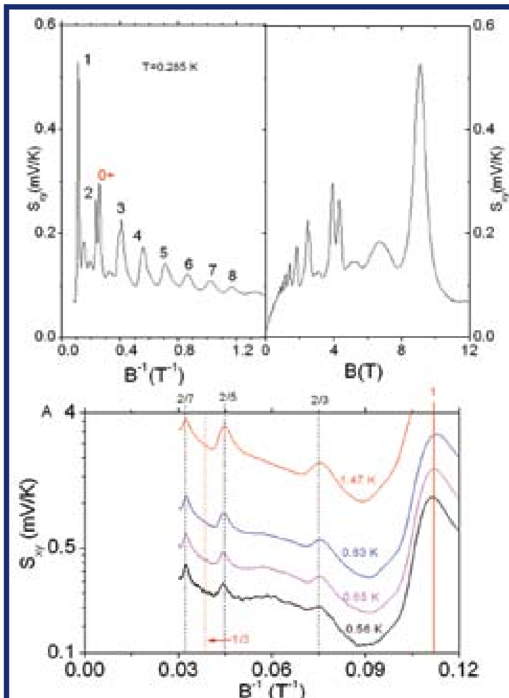

Figure. 1.

Nernst effect as a function of field below (upper panel) and above (lower panel) the quantum limit. Note the three additional peaks.

CONCLUSIONS

The results were published in *Science*.[2] We intend to pursue this investigation by studying the Nernst response of bismuth in the hybrid magnet up to 45 T next January.

ACKNOWLEDGEMENTS

KB is supported by DGA/D4S and ANR (ICENET project) and acknowledges a NHFML-VSP fellowship. LB is supported by the NHMFL in-house research program.

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Among the reports of the Magnetism & Magnetic Materials category, there were a number of reports that present incremental inputs into further understanding of properties of the specific materials. Two particularly interesting reports were:

The report by J. Musfeldt *et al.,* where the phase diagram and ac magnetodielectric effect were studied in the frustrated Kagome lattice $Ni_2V_2O_8$.

This work was published in ***Physical Review B*** (2007).

Also, the work of S. Hill, *et al.,* that describes the new technique to address the spin-dynamics in the so-called single-molecule magnet $[Mn_{12}O_{12}(CH_3COOH)_{16}(H_2O)_4]$ $2CH_3COOH{\bullet}4H_2O$.

This work was supported by the Magnet Lab's **User Collaboration Grants Program** *and has been accepted by* ***Physical Review B.***

CHEMICAL TUNING OF THE HIGH-ENERGY MAGNETO-DIELECTRIC EFFECT IN A FRUSTRATED KAGOME LATTICE MATERIAL

Musfeldt, J.L., Rai, R.C., Cao, J., Vergara, L.I., Brown, S. (Tennessee), Kasinathan, D. (Davis), Singh, D.J. (ORNL), Lawes, G. (Wayne State), Rogado, N., Cava, R.J. (Princeton), and McGill, S. (NHMFL)

INTRODUCTION

Magnetic frustration and competing interactions in Kagome lattice materials give rise to complex magnetic field - temperature phase diagrams in the $M_3V_2O_8$ system (M = Ni, Co, Mn). In $Ni_3V_2O_8$, the low temperature incommensurate state displays both ferromagnetism and a finite polarization. One manifestation of magneto-electric coupling is a large static magneto-dielectric contrast. Sizable magneto-dielectric effects can also extend to relatively high energy in complex oxides due to spin-lattice-charge coupling. This work was done using a combination of optical spectroscopy, first principles calculations, and energy dependent magneto-optical measurements to elucidate the electronic structure and to study the phase diagram of $Ni_3V_2O_8$. The variable field work was carried out at the NHMFL.

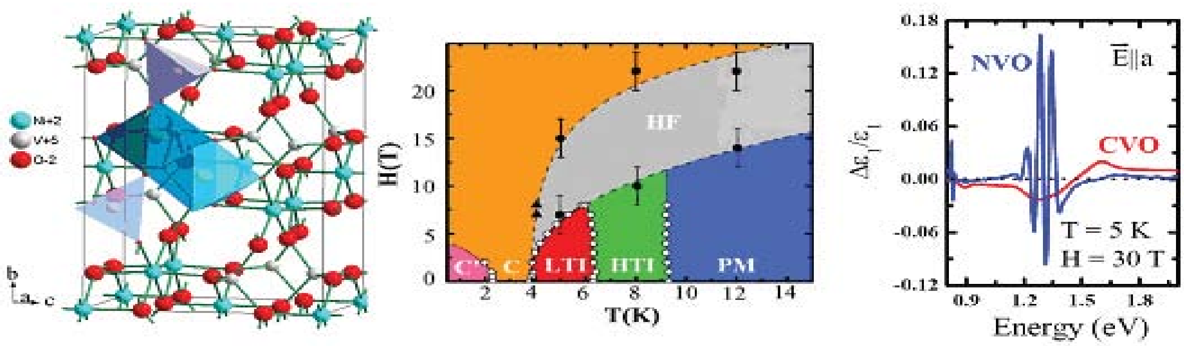

Figure 1.

Crystal structure, H-T phase diagram, and high energy magneto-dielectric contrast for $Ni_3V_2O_8$ compared with that of the Co analog, Refs. 1 and 2.

RESULTS AND DISCUSSION

We recently discovered that sizable magneto-dielectric contrast can extend to relatively high energy in complex oxides. The effect can be positive or negative depending on the energy (Figure 1). In $Ni_3V_2O_8$, the intermediate gap, local moment character favors the observed field-induced modification of local structure and resulting high-energy dielectric contrast. Since ac magnetodielectric effect is a spectroscopic rather than capacitance measurement, dead layer contact and "leaky" magneto-resistance issues are avoided. Structure-property trends in the M = Ni, Co, Mn isostructutral series are extremely interesting. The magneto-dielectric contrast is tunable depending on the chemical identify of the transition metal center (Figure 1), an effect that we attribute to a combination of lattice stiffness and hybridization effects. Complementary vibrational measurements on $Ni_3V_2O_8$ single crystals reveal changes in magneto-elastic coupling between the nearly degenerate magnetic ground states and pinpoint the lattice displacements that are important for establishing the state with magneto-electric cross-coupling. A softer lattice in the Co analog compound works to reduce the high energy magneto-dielectric contrast (because the lattice relaxes at high temperatures and does not couple to the low temperature magnetic transitions) and remove the interesting magneto-electric phase from H-T phase space.

ACKNOWLEDGEMENTS

We thank the U.S. Department of Energy for support of this work.

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PUMP-PROBE EPR STUDIES OF SPIN DYNAMICS IN SINGLE-MOLECULE MAGNETS

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INTRODUCTION

We have developed a novel experimental technique that integrates high frequency surface acoustic waves (SAWs) with high frequency electron paramagnetic resonance (HFEPR) spectroscopy (~300 GHz) in order to measure spin dynamics on fast time scales in single molecule magnets[1].

EXPERIMENTAL

A single crystal of $[Mn_{12}O_{12}(CH_3COOH)_{16}(H_2O)_4]\cdot 2CH_3COOH{\bullet}4H_2O$, hereafter $Mn_{12}Ac$, was mounted on the surface of a piezoelectric $LiNbO_3$ substrate containing interdigital transducers (IDTs) for the production of SAWs. After pumping the system out of equilibrium, by triggering magnetic avalanches with short SAW pulses, the evolution of the spin population within a fixed energy level is measured using HFEPR spectroscopy in combination with fast data acquisition instrumentation. In addition to avalanche ignition, the SAWs can be used to perturb the system by merely heating it with a short pulse. The HFEPR is simultaneously used as a probe of the time evolution of the spins as they relax back to equilibrium.

RESULTS AND DISCUSSION

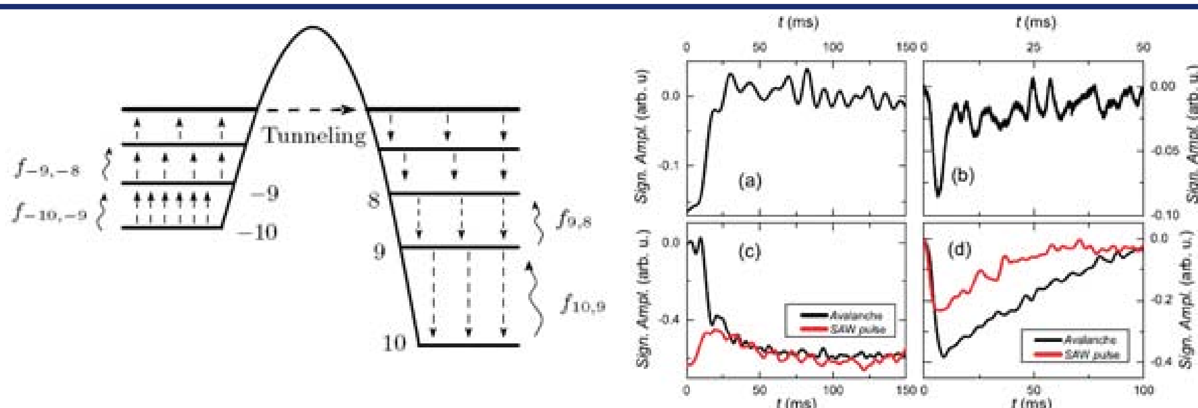

Figure 1.

(left) Double potential well diagram for $Mn_{12}Ac$ illustrating how spins relax during an avalanche. Spins in the right well relax to the ground state by emitting phonons, which result in heating of the system. This heating feeds back into the avalanche by exciting spins in the left well. (right) Evolution of the reflected microwave amplitude during an avalanche triggered via a SAW pulse. In (a), f = 270 GHz, B = 1.1 T & $m_S = -10$ to -9; in (b), f = 237 GHz, B = 0.58 T & $m_S = -9$ to -8; in (c) f = 320 GHz, B = 0.54 T & m_S = 10 to 9; and in (d), f = 268 GHz, B = 0.54 T & m_S = 9 to 8. In (c) and (d), the red traces correspond to microwave absorption during a SAW pulse after the occurrence of the avalanche.

CONCLUSIONS

Our results demonstrate how this new technique can be used to obtain energy resolved information about spin relaxation in single molecule magnets. In particular, we find that dynamics in the stable well are dominated by a phonon bottleneck effect, whereas the dynamics in the metastable well closely reflect the intrinsic spin-lattice driven magnetization dynamics.

ACKNOWLEDGEMENTS

This work was supported by the National Science Foundation (grant nos. DMR0239481 and DMR0414809).

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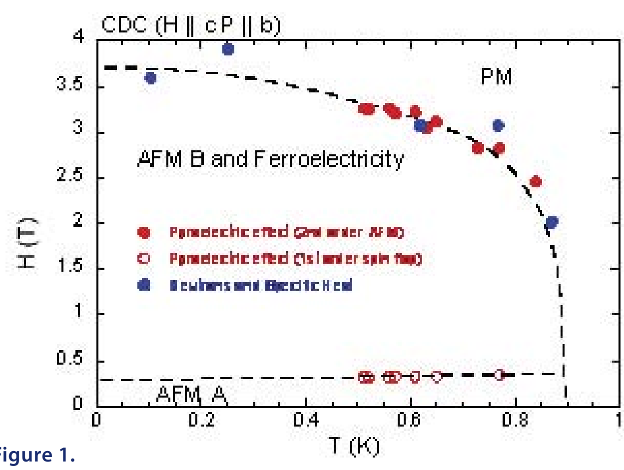
The magnetoelectric coupling between a magnetic order and an electric polarization, (a type of magnetoelectric coupling), has never been observed before in organic materials. The necessary provision for the phenomenon is the loss of the center of inversion symmetry. In this report, the authors study the orthorhombic compound CDC ($CuCl_2 \cdot 2(CH_3)_2SO$) in the antiferromagnetic state ($T_N = 0.93$ K). The loss of the inversion symmetry is occurs at the spin-flop transition in a low magnetic field along the c-axis. It is the first example of coupled multiferrotic behavior in an organic material.

FIELD-INDUCED FERROELECTRICITY IN AN ORGANIC QUANTUM MAGNET

V. S. Zapf (NHMFL - LANL), M. Kenzelmann (Paul Scherrer Institute, Zurich), F. Fabris (NHMFL - LANL), F. Balakirev (NHMFL - LANL), Y. Chen (NIST), C. Broholm (JHU)

INTRODUCTION

Magnetoelectric coupling is generally rare and has never been observed before in an organic quantum magnet. The compound CDC ($CuCl_2 \cdot 2(CH_3)_2SO$) however exhibits the necessary symmetry for certain applied magnetic fields H to allow an electric polarization P to coexist with antiferromagnetic (AFM) order. This compound contains chains of Cu S=1/2 spins[1] that are weakly coupled via superexchange and exhibit AFM order below $T_N = 0.93$ K, observed in specific heat and neutron diffraction measurements [2]. For H applied along the crystallographic a- and c-axes, the AFM order is suppressed, most probably due to a competition between interchain interactions and field-induced staggered fields[2]. For H along the orthorhombic c-axis, AFM order is suppressed by H ~ 4 T (see Figure 1). A spin-flop transition above $H_{sf} = 0.35$ T leads to a magnetically ordered state (AFM B) that breaks inversion symmetry along the b-axis for 0.35 T < H < 4 T.



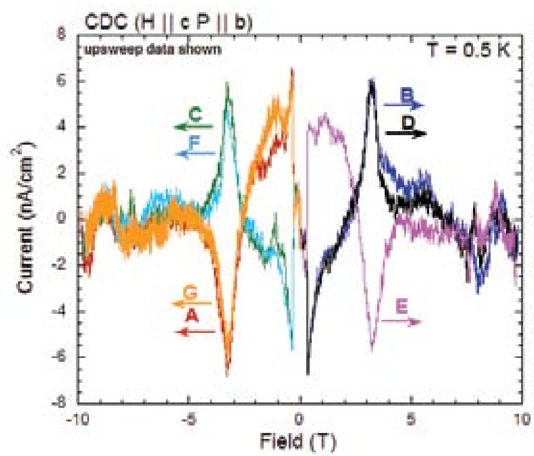


Figure 1.

Phase diagram of CDC showing regions of AFM with inversion symmetry (AFM A), AFM without inversion symmetry (AFM B) ferroelectric polarization, and paramagnetism (PM). Neutron and specific heat data is from Refs. 3,4.

Figure 2.

Magnetoelectric current measured on the upsweep of a 50 T short pulse magnet. Consecutive pulses A – F are shown, where the sign of P depends on whether the field sweep is in the same or opposite direction as the previous sweep.

EXPERIMENTAL

We have measured the magnetoelectric current of single crystals of CDC for H || c with the polarization P || b down to ^{3}He temperatures in the 50 T short pulse magnet at NHMFL-LANL. The rapid rise time of this magnet was necessary to increase the signal to noise of the magnetoelectric current in this sample.

RESULTS AND CONCLUSION

Our magnetoelectric measurements (Figure 2) indicate that ferroelectricity occurs in the same region of H-T space as the AFM B phase between 0.35 T < H < 4 T and below T = 0.93 K. Hysteresis is observed in the polarization depending on the direction of the previous two field sweeps. Interestingly, we find the same results with and without electrically poling the sample. The spin polarization calculated from the magnetoelectric current closely tracks the magnetic order parameter. While the magnetically-induced ferroelectricity in CDC is far from practical temperatures and fields, it nevertheless demonstrates that this phenomenon can occur in a whole new class of compounds.

ACKNOWLEDGEMENTS
This work was supported by the NSF, the DOE, and the state of Florida through the NHMFL and through V.S.Z.'s IHRP grant. Work at JHU was supported by the NSF through DMR-0086210 and DMR-9704257.

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The experiment is of the fundamental interest: The fully polarized ^{3}He has been discussed since the very old days, but the ^{3}He Bohr magneton smallness would demand huge magnetic fields for the complete polarization. In Rep 109 the solution of ^{3}He in ^{4}He formed the degenerate "Fermi gas" at very low temperatures; for a dilute gas the s-wave scattering is the prevailing interaction between ^{3}He-^{3}He atoms. Once a strong enough magnetic field orients all spins in one direction, the s-wave scattering is excluded due to the Pauli principle. This is the "trick" the authors use for the detection of the fully polarized state in the solution--the mean free path increases and this is seen as the drastic increase in the viscosity.

Fully polarized state dubbed as "the half-metallic" phase is assumed as the ferromagnetic phase of the cubic manganites and some other materials. In that case the proof of the 100% -polarization is far from being so straightforward and so elegant.

This work was published in ***Physical Review Letters*** *(2007) and supported by the Magnet Lab's* ***User Collaboration Grants Program.***

GIANT VISCOSITY ENHANCEMENT IN A SPIN-POLARIZED FERMI LIQUID

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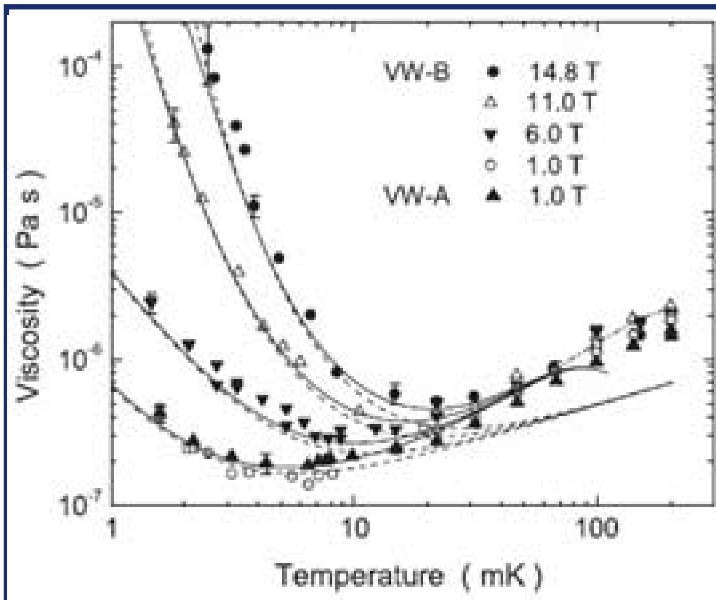
INTRODUCTION

At extremely high magnetic fields (B~ 14 T) and low temperatures (T~ 2 mK) the separation of the spin levels can become greater than the Fermi energy, and the nuclear spin polarization tends to unity. As a consequence the s-wave scattering is strongly suppressed because only antiparallel pairs can scatter in s-wave orbital states and the number of antiparallel pairs drops with increasing spin polarization. The viscosity along with other transport properties depends on the quasiparticle-quasiparticle scattering and its measurement can provide a sensitive test of the predicted suppression of s-wave scattering at very low temperatures. One expects a strong enhancement of the viscosity of Fermi systems for conditions of high B/T. Dilute ^{3}He in liquid ^{4}He is an almost ideal sample to test this prediction for experimentally accessible magnetic fields and temperatures.



Variation of temperature dependence of the viscosity of a dilute ^{3}He-^{4}He sample with applied fields in the range 1 to 14.8T.

EXPERIMENTAL

In a previous study[1] at the NHMFL High B/T facility, pulsed NMR was used to demonstrate the existence of a novel damping of spin currents in ^{3}He-^{4}He mixtures. In this new study[2] a special composite vibrating-wire was used to measure the momentum transport (viscosity) in ^{3}He-^{4}He mixtures under similar high B/T conditions. Here we summarize the reports of results for measurements of the viscosity using a vibrating wire at very low temperatures (2<T<100 mK)[2]. The required experimental conditions were met using the nuclear demagnetization refrigerators of the NHMFL High B/T facility.

Samples were prepared from gaseous mixtures to have 200ppm ^{3}He concentrations. Careful NMR calibration measurements at low temperatures established that the condensed samples in the low temperature cells contained 150 ppm ^{3}He, the difference with the gas concentration being attributed to surface absorption during the condensation process.

RESULTS AND DISCUSSION

The results of the viscosity measurements are shown in Figure 1. The data shows the exponential increase of the viscosity for high spin polarizations; i.e. for T<10 mK and B > 11 T. The results can be used to test theories of transport in degenerate, highly polarized Fermi liquids, and in particular test the current models for quasiparticle interactions in ^{3}He-^{4}He mixtures which are mediated by phonon exchange.

CONCLUSIONS

The giant enhancement of the viscosity of a prototype dilute Fermi system has been demonstrated experimentally for 150 ppm ^{3}He in liquid ^{4}He. The quantitative dependence is in good agreement with the expected dependence on polarization estimated from current models of quasiparticle-quasiparticle scattering at low temperatures.

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In samples of Ge implanted with Mn (concentrations of 3% and 6%) the authors have found huge magnetoresistance at temperatures around ~30K. The effect is so large that, according to the report, it can be described as a transition from a “metallic” state (below 10T) to an insulator-like state at higher fields in this temperature range. Interesting results were also found for the Hall effect. As it is known, the latter in a magnetic substance has two components: the normal Hall coefficient stands in front of the linear dependence on the applied magnetic field; the second component called as the Extraordinary Hall Effect (EHE) is proportional to the magnetization. Measurements in the broad enough range of magnetic field have revealed that the large magnetic field suppresses EHE. Therefore the Hall resistivity discloses the pronounced non-monotonic dependence on the field. The mechanisms responsible for this unique feature remain unknown.

This work was supported by the Magnet Lab’s ***Visiting Scientist Program.***

HIGH FIELD MAGNETOTRANSPORT IN Mn IMPLANTED Ge

A. Gerber, O. Riss (School of Physics, Tel Aviv University, Israel), and A. Suslov (NHMFL)

The giant and colossal magnetoresistivity (GMR/CMR) remains one of the hot topics in the condensed matter physics during the last two decades because of the great variety of potential and already realized applications (magnetic recording, magnetic field sensors, etc.) and due to many fundamental problems which arise in the course of the study of various aspects of this multifaceted phenomenon. There are three main classes of systems, in which the electrical resistivity changes by the order of magnitude or even more in an external magnetic field: (i) multilayered systems containing ferromagnetic layers separated by non-magnetic metallic layers (ii) granular nanocomposites containing magnetic granules; (iii) transition metal and rare-earth oxides, in which the electron transport is sensible to external magnetic field in the vicinity of structural, metal-insulator and magnetic field induced transitions as well as charge and orbital ordering phenomena. The mechanisms of the field enhancement or suppression of the magnetic scattering in these three systems are different, and one may anticipate that other mechanisms of (GMR/CMR) may act in other types of materials with nanoscale inhomogeneity.

This work is devoted to magnetotransport in germanium heavily doped by Mn. Magnetoresistance and Hall effect were measured in two samples with Mn concentration of 3% and 6% in fields up to 33 T and temperatures down to 4.2 K at the National High Magnetic Field Laboratory. Selection of magnetoresistance and Hall resistance at several temperatures is presented in Figures 1a and b.

Magnetoresistance depends strongly on temperature. It is relatively small at 4.2 K, but grows to thousands of percents around 30 K with the further reduction at higher temperatures. Magnetic field driven metal-insulator transition takes place at fields of about 10 T with metallic state at lower fields and insulator-like state at high fields. Magnetoresistance rise is very sharp below 20 K were the zero field metal-insulator transition takes place as a function of temperature.

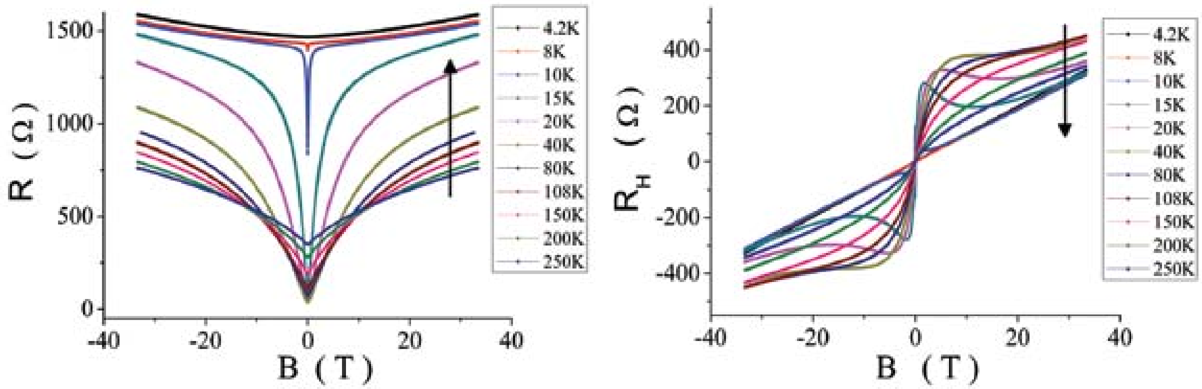

Figure 1.
Magnetoresistance (a) and Hall effect (b) of MnGe sample with 3% Mn at different temperatures. Arrows indicate the reduction of temperature.

Hall effect data is not less puzzling. Both the ordinary and the Extraordinary Hall effects (EHE) contribute to the shape and magnitude of the Hall resistance. The EHE component is usually generated by spin orbit scattering by magnetic impurities and ferromagnetic clusters embedded in a conducting matrix. The remarkable feature shown in the figure is suppression of the EHE by magnetic field, resulting in a non-monotonous field dependence. To the best of our knowledge this is the first observation of such phenomenon.

ACKNOWLEDGEMENTS
Experiments at NHMFL were supported in part by NHMFL Visiting Scientist Program.

The manipulation and extended study of the properties of one of nature's most interesting structures, the carbon nanotube, is rapidly becoming important to many areas of technology, not the least of which is energy. With many important energy related applications of carbon nanotubes requiring controlled, scalable production of large quantities, this Highlight provides a new tool for control of some properties of large quantities of carbon nanotubes based on NHMFL-level magnetic fields.

ELECTRICAL AND MECHANICAL PROPERTIES OF MAGNETIC-FIELD ALIGNED SINGLE-WALLED CARBON NANOTUBE BUCKYPAPERS

J.G. Park, X. Fan, S. Li, R. Liang, C. Zhang, B. Wang (FSU, HPMI); J.S. Brooks (FSU, Physics)

INTRODUCTION
Carbon nanotube (CNT) is fascinating lightweight material recognized for its low dimensionality with high electrical and thermal conductivity and excellent mechanical properties. Sheets of nanotubes or nanofibers, known as buckypaper (BP), provide a promising medium to control the properties of CNT. Several methods, such as alignment under magnetic[1] or electric fields, e-beam or ion beam irradiation[2], are under investigation to improve the electrical and mechanical properties of BP to produce high-performance nanocomposites. In this research, magnetically aligned BPs up to 10″ × 10″ were produced and tested to determine their electrical and mechanical properties as a function of magnetic field.

EXPERIMENTAL
Purified Hipco SWCNT (Carbon Nanotechnologies Inc., TX) was dispersed in an aqueous solution. To align the CNTs, BPs were produced under different magnetic fields up to 17.3 T. The aligned BP samples were cut in rectangular shapes for electrical and tensile tests. Polarized Raman with 785 nm excitation (0.5 mW) was used to check alignment. Electrical conductivity was measured using a conventional four-probe method. Tensile strength and modulus were measured in a dynamic mechanical analyzer (DMA 2980, TA instruments).

RESULTS AND DISCUSSION
Figure 1 shows normalized G band intensities of aligned BPs from polarized Raman indicating alignment increased as the magnetic field increased. As shown in Figure 2, electrical conductivity was enhanced by more than four times for BP produced in higher magnetic fields. Conductivity anisotropy, $\sigma_{\parallel}/\sigma_{\perp}$, also increased

along with magnetic field strength. Mechanical properties improved as a result of magnetic alignment. Figure 3 shows tensile modulus and strength of aligned BPs increased by more than factor of two.

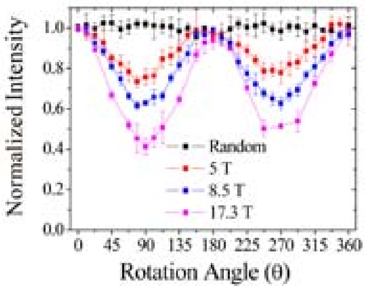

Figure 1.
Normalized G band polarized Raman intensity along with rotation angle.

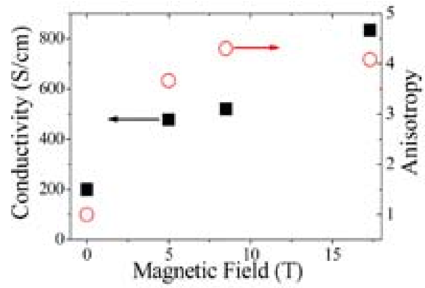

Figure 2.
Electrical conductivity and its anisotropy of aligned BP as a function of magnetic field.

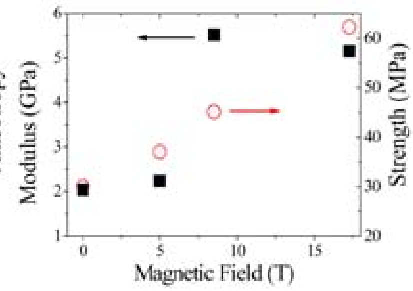

Figure 3.
Tensile modulus and strength of aligned BP as a function of magnetic field.

CONCLUSIONS

BP production under magnetic fields enhances the CNT alignment, which improves the electrical and mechanical properties. CNT alignment improves as a function of the magnetic field strength, enhancing electrical and mechanical properties of BP by more than factor of two-four. These improvements should facilitate producing high performance composites.

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Three-terminal devices with conduction channels formed by quasi-metallic carbon nanotubes (CNTs) are shown to operate as nanotube-based field-effect transistors under strong B (up to 30 T). An exponential decrease of the device off-state conductance is observed under high axial B up to room temperature, and it is attributed to the opening of an energy gap in the CNT electronic spectrum. Remarkably, under high axial B the devices operate as CNT FETs with the on/off conductance ratio exceeding 10^4.
The temperature dependent magnetotransport is also shown to be a new tool to determine the quasi-metallic nanotube chirality.

• *This work was published in* ***Nano Letters*** *(2007) and was supported by the Magnet Lab's* ***User Collaboration Grants Program****.*

EXPLORING THE MAGNETICALLY INDUCED FIELD EFFECT IN CARBON NANOTUBE BASED DEVICES

G. Fedorov (NHMFL), A. Tselev (Georgetown University), D. Jimenez (University of Barcelona, Spain), S. Latil (University of Namur, Belgium), N. Kalugin (New Mexico Tech), P. Barbara (Georgetown University), D. Smirnov (NHMFL) and S. Roche (CEA, France)

The exceptional low-dimensionality and symmetry of carbon nanotubes (CNT) are at the origin of their spectacular physical properties governed by quantum effects. Ajiki and Ando[1] predicted that an axial magnetic field would tune the band structure of a CNT between a metal and a semiconductor, owing to the modulation of the Aharonov-Bohm (AB) phase of the electronic wave functions. Here we report on a high magnetic field study of the AB-effect on transport properties of gated (quasi)-metallic single wall carbon nanotubes (SWCNTs)[2].

The magnetotransport measurements were conducted using devices made in the configuration of a standard CNT field-effect transistor (CNFET), as shown in Figure 1. The conductance characteristics G(Vg) were recorded at temperatures from 1.5 K to 290 K and in magnetic fields up to 30 T.

Figure. 2 shows the conductance of a CNFET device 1 made with a quasi-metallic CNT, measured at the coaxial magnetic field. Perpendicular magnetic fields do not significantly change the conductance. Suppression of the conductance around V_g* indicates the presence of the narrow gap in a quasi-metallic CNT at B=0. As the axial magnetic field increases, the gap decreases to reach a minimum value at B_0~6 T. Device 2 behaves as

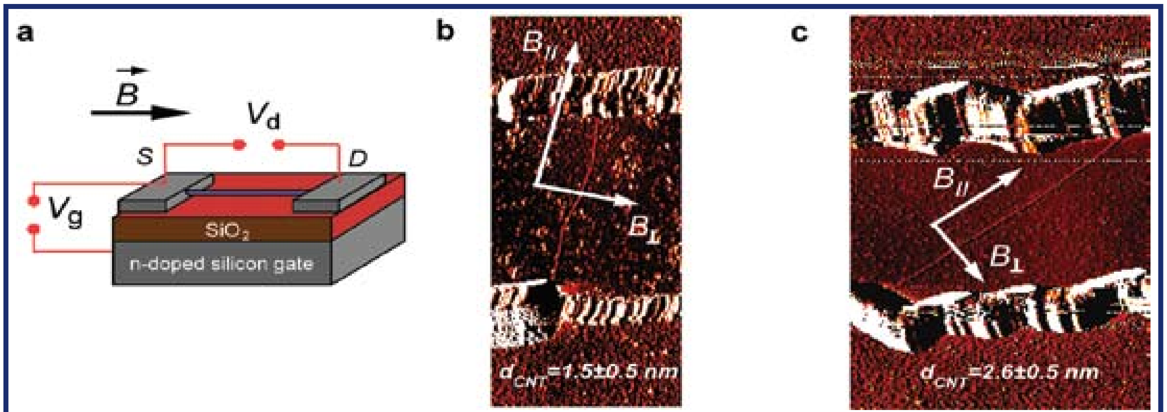

Figure 1.

(a) Schematic of a CNFET type device. (b), (c) AFM images of two studied CNFET devices. White arrows indicate direction of the magnetic field.

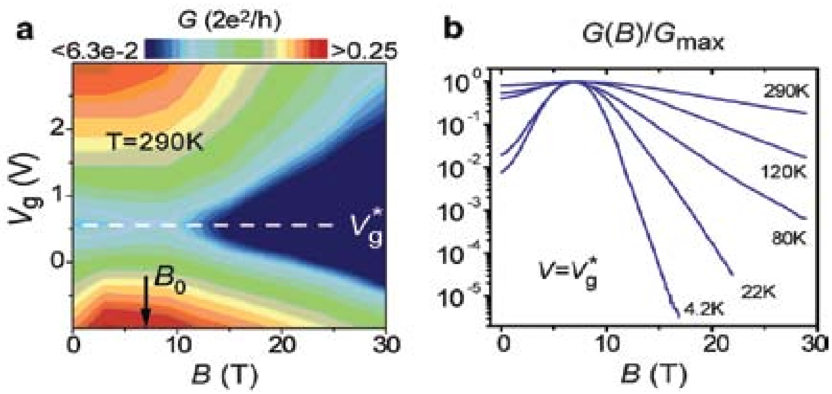

Figure 2.

(a) Plot of the sample 1 conductance versus the gate voltage and the axial magnetic field. A dark arrow indicates the value of B_0 , where ε_g(B) has a minimum. (b) Off-state magnetoconductance of sample 1.

a truly metallic nanotube with B_0~0 T. Above B_0, a region of suppressed conductance develops, indicating a monotonous increase of a band gap in both samples. Remarkably, under high axial magnetic fields the devices operate as CNFETs with the on/off conductance ratio exceeding 10^4.

Qualitatively, the experimental observations agree with the predicted ε_g (*B*) dependence, and therefore strongly favor the interpretation of our data in terms of the AB effect. A quantitative picture of CNFET magnetoconductance is achieved in the frames of a model incorporating both the AB effect on the bandstructure of the nanotubes and the AB effect on the barriers formed at the nanotube/contact interface

To summarize, we report on observation of a magnetic field induced conversion of initially metallic carbon nanotube devices into carbon nanotube field effect transistors. Strong exponential magnetoresistance observed up to room temperature is the ultimate consequence of the linear increase of the band gap with a magnetic field. The magnetic field controlled Schottky barriers significantly contribute to the CNT magnetoconductance, which may suggest new routes to engineer CNT-based devices characteristics. Moreover, this study reveals the temperature-dependent CNT magnetotransport as a new tool to explore the symmetries of carbon nanotubes.

ACKNOWLEDGMENTS

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Angular dependent resistivity measurements of optimally doped YBCO films in B pulsed up to 50 T provide the first evidence for the presence of the liquid-crystalline smectic phase predicted for layered superconductors. In particular, when B is aligned with the layers, the rapid increase of the vortex melting field at low temperatures and the critical exponent analysis confirm the presence of the smectic. They also observe that, up to the highest B applied (50 T), correlated defects arrest the motion of vortices well into the liquid phase.

*This work was published in **Physical Review Letters** (2007) and was supported by the Magnet Lab's **User Collaboration Grants Program**.*

SMECTIC VORTEX PHASE AT HIGH FIELDS IN OPTIMALLY DOPED HIGH-TEMPERATURE SUPERCONDUCTOR

S. A. Baily, B. Maiorov (NHMFL/STC, LANL); F. F. Balakirev, M. Jaime (NHMFL, LANL); H. Zhou, S. R. Foltyn, L. Civale (STC, LANL)

INTRODUCTION

Deep into the superconducting state when a magnetic field is applied it penetrates creating vortices, that can exist in solid, liquid, phases. The nature of these phases is given by the nature of pinning center present.[1] Also, pinning centers enable films to carry more current is an extremely important for applications of superconductivity. The most interesting case occurs along the copper oxide planes of HTS where all kinds of pinning centers are present.[2] When the magnetic field, or temperature increases the vortex lattice crosses the melting line and becomes a liquid with the concomitant increase of the electrical resistance.

EXPERIMENTAL

Electrical ac-transport was used to measure the vortex dissipation in the liquid phase as well as to determine the melting line (where dissipation goes to zero), as a function of angle for $YBa_2Cu_3O_7$ (YBCO) films in the 50 T short-pulse magnet using the newly rebuilt rotator probe. The effect of naturally grown defects on the melting line was studied, in particular for the defects along the ab-planes.

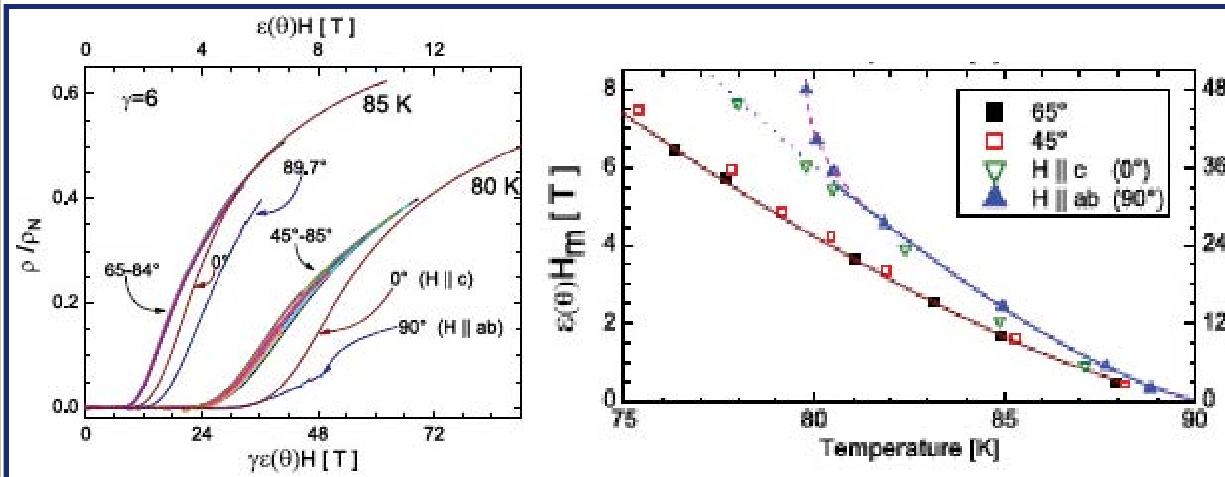

Figure 1.

Left: Normalized resistance vs. scaled field at two temperatures. Right: $\varepsilon(\theta)$H vs. Temperature with the magnetic field applied at different orientations.

RESULTS AND DISCUSSION

We find that near 80 K (H>40T), when the magnetic field is aligned with the layers, the melting line has an upward turn and the critical exponent that describes the rise in resistivity upon entering the liquid state becomes similar to that of the liquid crystal transition predicted for layered superconductors. Also we observe that up to the highest field measured (50 T) correlated defects arrest the motion of vortices well into the liquid phase.

CONCLUSION

A long-standing debate about the existence of a smectic vortex phase in "low anisotropy" high-temperature superconductor been settled, with the evidence for smectic vortex phase in optimally doped YBCO at fields higher than 40 T, available with pulsed field.[3]

ACKNOWLEDGEMENTS
This work was supported by the NSF through the NHMFL and NHMFL IHRP, the State of Florida and the DOE.

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$CeIn_3$ has the cubic structure. It is the f-electron antiferromagnet with a considerable hybridization. Changes in the Fermi surfaces' sizes under applied pressure or in high magnetic field seen by means of the dHvA experiment provide information about competition between itinerancy and the degree of localization of the Ce f-electrons. The electronic properties of $CeIn_3$ for the polarized phase that sets in at strong magnetic fields and the paramagnetic phase at the pressure above the critical pressure ~25kbar are different. In the magnetic fields above ~60 T the f-electrons do not contribute to the Fermi surfaces' volume. The effective masses get reduced to the values of few free electron masses and do not vary with the field increase. This research is the significant technical breakthrough in the use of the pulsed magnetic fields for the scientific experiments and contains interesting new results concerning $CeIn_3$.

*This work was published in **Physical Review Letters** (2007).*

MEASUREMENTS ON $CeIn_3$ IN NON-DESTRUCTIVE 100 TESLA MAGNET FIELDS

N. Harrison (NHMFL, LANL), C. H. Mielke (NHMFL, LANL), S. E. Sebastian (Cambridge U., Physics), T. Ebihara (Shizuoka Univ., Physics)

Scientists have long since been able to subject materials to the extremes of magnetic field beyond 100 tesla, utilizing explosive flux compression or singleturn coil techniques. The destruction of the sample by the explosively driven systems is not an option for many "one-of-a-kind" or otherwise "valuable" samples. For conductors, however, the rapid rates of change of magnetic flux brought on by their microsecond duration proves to be an additional experimental hurdle to conquer. If not addressed the Joule heating caused by the induced eddy currents will raise the temperature of the sample significantly. To counteract these problems, high magnetic field scientists around the world have for the past two decades been attempting to generate magnetic fields approaching 100 tesla in a controlled fashion, non-destructively, with millisecond duration. The demands on material strength and electrical energy have proven to be much more of a challenge than previously

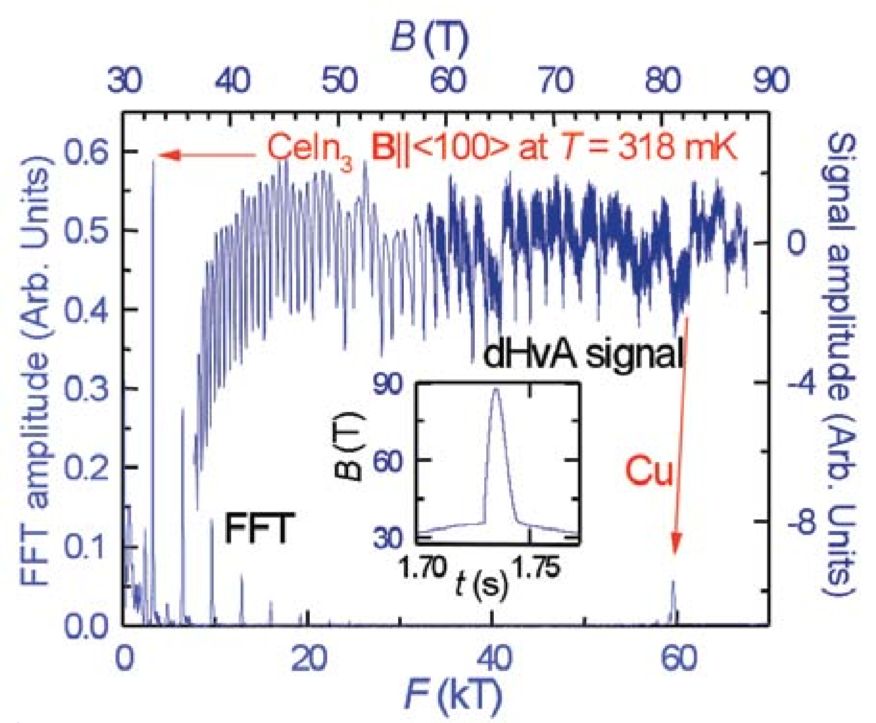


Figure 1
The raw dHvA signal in $CeIn_3$ and the spectral analysis. (Inset) The Magnetic Field pulse near peak field showing the ~35 tesla platform field.

anticipated. Only recently have controlled magnetic fields anywhere near 100 tesla become close to being realized. A team of scientists and engineers at the Los Alamos branch of the NHMFL have commissioning a 100 tesla multishot magnet with the intention of providing slightly reduced magnetic fields of ~90 T for experimental use in an interim period before the frontiers are finally pushed back to their ultimate goal. These World Record millisecond pulsed fields reach approximately 30 tesla beyond what was previously available for experiments in pulsed magnetic field laboratories— opening the door for countless new opportunities.

$CeIn_3$ provides the first example of a system, in which temperatures of ~318 mK (3/10 of a degree above absolute zero) enable observation of the quantum oscillations in the magnetization, better known as the de Haas van Alphen (dHvA) effect. Figure 1 shows an example of raw data of such oscillations measured in a pulse extending to 88 tesla. The Fourier transform of the oscillations in Figure 2 (done in reciprocal magnetic field) provides a reliable in-situ calibration of the magnetic field; the fundamental dHvA frequency F ~ 59.5 kT of Cu originates from the windings of the detection coil while that of F ~ 3.22 kT corresponds to a sample of $CeIn_3$ aligned with the field is parallel to its <100> axis.

$CeIn_3$ is of interest because it belongs to a small family of Ce-based antiferromagnets that become superconducting under the application of hydrostatic pressure, just at the point where antiferromagnetic order is suppressed[1]. Knowledge on the degree to which the f-electrons contribute to the electrical properties throughout is an essential prerequisite for understanding the origin of unconventional superconductivity. Strong magnetic fields assist in our pursuit of this understanding by changing the extent to which the f-electrons contribute to electrical conduction by polarizing their spin degrees of freedom. This polarization depletes the system of available spin degrees of freedom for ordering, causing the antiferromagnetic order to be suppressed (as under pressure). This then manifests itself by way of subtle changes in the electronic structure that can be observed as field-induced changes in the dHvA Fourier spectrum. This work was jointly supported by the NSF, DOE, and Florida State.

REFERENCES

[1] Harrison, N., *et al.*, Physical Review Letters 99, 056401 (2007).

CHAPTER 3: MAGNET LAB USER PROGRAMS

The strength of the user programs and facilities is built around the synergies of the highest field magnets, unique instrumentation, and exceptional support from highly qualified faculty and staff. In this chapter, each of the laboratory's user facilities—DC Field, Pulsed Field, High B/T, NMR, AMRIS, EMR, ICR, plus the Geochemistry that is affiliated—presents information about its research capabilities, developments, plans, productivity, and efforts to build the user community during 2007.

A concerted effort was made this year to standardize user reporting statistics: information about our users, their projects, and magnet usage. Considering the various types of magnet systems, different operational modes, and broad national and international user community, this was a challenging undertaking. Detailed user statistics for each facility are presented in **Appendix A**; lab-wide user statistics are presented in **Tables 1 and 2.**

Table 1. *Magnet Lab User Profile*[1]

	Total	Women	Minority	Internal Investigators[2]	University Users U.S.[3,5]	Industry Users U.S.[5]	National Lab Users U.S.[4,5]	Non-U.S. Users[5]
Senior Investigators	628	74	30	236	349	35	86	158
Postdocs	185	36	8	82	105	3	29	48
Students	323	81	19	127	229	0	18	76
Spt./Tech. Staff	8	2	1	8	5	0	0	3
Total Users	**1144**	**193**	**58**	**453**	**688**	**38**	**133**	**285**

1 The laboratory reports seven user facilities (DC Field, Pulsed Field, High B/T, NMR, AMRIS, ICR, EMR) and the Geochemistry Facility, which is affiliated. A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. Consequently, a researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users.

2 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

3 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

4 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

5 Four columns of users (university, industry, national lab, non-U.S.) will equal the Total.

Table 2. *Magnet Lab Facility Usage Profile*

	Number of Magnet Days[1] Allocated	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	4487	1357	1259	202	116	1553
U.S. University	2223	1069	460	57	17	620
U.S. Govt. Lab.	319	49	45	30	14	181
U.S. Industry	92	37	34	0	10	11
Non-U.S.	625	441	102	6	8	68
Total	**7746**	**2953**	**1900**	**295**	**165**	**2433**

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

2 "Internal" usage, as defined by NSF (Table 1. footnote 2.)

USER FACILITY: DC FIELD

2007 statistics on DC Field Facility users, projects, and magnet usage are presented in Appendix A.

The DC magnetic field facility at the Magnet Lab's headquarters in Tallahassee continues to provide the user community with the highest and quietest slowly varying magnetic fields in the world. The magnet systems are coupled with state-of-the-art instrumentation and expert experimental staff members provide users with scientific and technical support.

2007 was a year of transition for the DC Field Facility. Bruce Brandt, who had directed the facility since its inception, retired in July. His position was split into two distinct positions: Director of DC User Program and Director of DC Instrumentation and Facilities. Eric Palm and Scott Hannahs filled these positions, respectively, on an interim basis until the start of 2008, when both were made permanent.

Florida-Bitter and Hybrid Magnets at the DC Field Facility in Tallahassee

Field (T), Bore (mm)	Power (MW)	Supported Research
45, 32, (25 ppm/mm inhomogeneity)	29.3	Magneto-optics – ultra-violet through far infrared; Magnetization; Specific heat; Transport – DC to microwaves; High Pressure; Temperatures from 30 mK to 1500 K; Dependence of optical and transport properties on field, orientation, etc.; Materials processing; Wire, cable, and coil testing.
35, 32	19.2	
33, 32	17.2	
31, 32 to 50[1]	18.4	
29, 32 (~5 ppm/mm inhomogeneity[2])	19.1	
20, 195	18.8	Low to medium resolution NMR, EMR, and sub/millimeter wave spectroscopy.
25, 52, (1 ppm/mm inhomogeneity[2])	19	

Superconducting Magnets at the DC Field Facility in Tallahassee

Field (T), Bore (mm)	Sample 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.
18/20, 52	0.3 K – 300 K	
17.5, 47	4 K – 300 K	
	0.3 K – 300 K	
17.5, 34 (50 ppm/cm inhomogeneity[2])		

1 A coil for modulating the magnetic field and a coil for superimposing a gradient on the center portion of the main field are wound on 32 mm bore tubes.

2 Higher homogeneity magnet for magnetic resonance measurements.

FACILITY DEVELOPMENTS

The 17.5 T superconducting magnet that was installed in the optics facility last year has proven to be powerful workhorse that has been tremendously beneficial to the DC program optics users. This system is in a unique dewar that provides direct access from the top and bottom of the system through the bore of the magnet. Gate valves at the top and bottom allow different optical windows to be installed in either location without warming the magnet to replace the window. Samples in field center can be cooled via exchange gas or with fingers making contact with the sample space inner walls. This unique arrangement allows unprecedented flexibility in making measurements in both the UV and visible optics and in the infrared and can accommodate a wide range of experiments in both transmission and reflection mode.

Optical instrumentation that can be used in this system includes a streak camera that is magnetically shielded allowing flourescence lifetime measurements in the highest fields available. A regenerative amplified laser with optical parametric amplifier for complete tunability of frequencies for pump-probe measurements with a wide range of photon energies is available. This equipment has been optimized with probes developed for time-resolved reflectivity and time-resolved Kerr effect measurements. These systems have been made user friendly with turnkey operation using LabView routines developed in-house. A real advantage to this setup is all of the optical measurements can be optimized in the superconducting magnet then switched over to the 31 T resistive magnet in Cell 5. The data in **Figure 1** shows these capabilities.

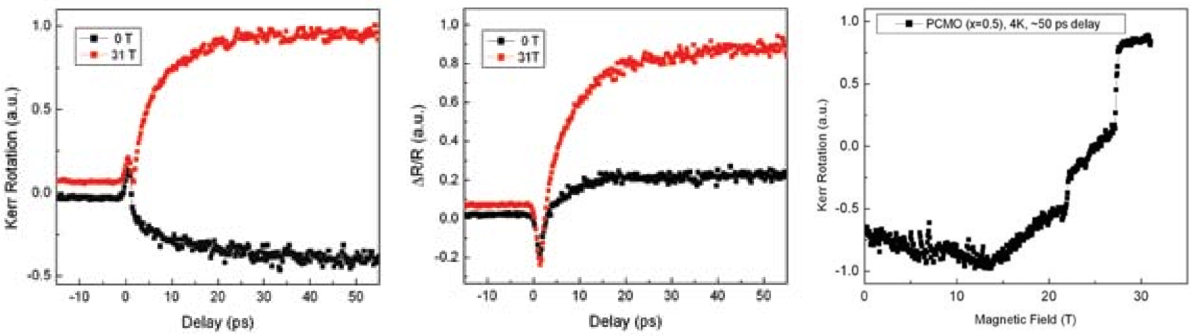


Figure 1.
(a) Transient Kerr rotation on PCMO (x~0.5) at 4K. (b) Transient reflectivity on PCMO (x~0.5) at 4K. (c) Transient Kerr rotation at fixed delay (50 ps) during continuous field sweep from 0T to 31T.

A new advanced cryogenic system was received from Oxford Instruments. This system is designed to go into all 32 mm bore resistive magnets (not including the Hybrid Magnet) and provides top-loading ease of use as well as liquid Helium hold times that exceed 48 hours. There are two inserts, one a charcoal pumped Helium-3 system has a base temperature of 300 mK and the other, a variable temperature insert (VTI), has a temperature range from 1.2 K to 300 K. This system will provide increased reliability, faster turnaround as well as improved temperature stability and less down time when waiting for the temperature to stabilize when changing set points. The top-loading probes are compatible with both systems providing easier maintenance and more flexibility for users.

The 45 T Hybrid was successfully redesigned and restacked to run on 3 power supplies. This has allowed high current conductor tests for internal and external users (including ITER) to be performed in parallel with the hybrid operation. Now these tests do not compete with other magnet users for power supply time and provide more experimental time for DC Field Facility magnet users.

FACILITY PLANS

DC Power and Cooling Systems Improvements. Power supply upgrades were initiated in 2006 and have continued throughout 2007 and will continue into the next year. The large number of upgrades to the power supplies increased the number of trips that the power supplies experienced. In order to diagnose the cause of these trips, a current and voltage monitoring system was installed into the power supplies that allowed key parts of the system to be recorded with sub-millisecond temporal resolution. This system has been essential to finding problems in the power supplies and engineering solutions to those problems.

New Interphase transformers that will dramatically reduce the ripple in the delivered current have been designed and purchase order issued. These transformers are scheduled to be delivered and installed late in 2008. The transistors used in the main power supplies are no longer made and the MagLab's supply of spares has dwindled to nothing. Transformer modules using modern MOSFETs were purchased and delivered. One of these modules has been installed in a power supply replacing the first bank of transformers and allowing them to be used as spares for the other banks. The other transformer banks will be installed in the August-September 2008 shutdown.

Cryogenic Infrastructure Upgrades. Major upgrades of the cryogenic liquification and recovery infrastructure are being planned and implemented. During the past year the Millikelvin Facility was used as a test bed for a system utilizing distributed gas bags and blowers to collect gas and return it to the central liquefication facility more efficiently. This system has proven to be a resounding success both in terms of the amount of gas collected and also the isolation of the experimental stations from vibrations generated in the rest of the facility and thus reducing the noise caused by those vibrations in user experiments.

A two-phase upgrade is planned for the storage and liquefiers in the main liquefiers. Plans for phase one are nearing completion. These include upgrading medium pressure storage capabilities and installing a helium gas purifier, which will greatly increase the capacity of the system as well as its reliability. This is very important for users as these liquefiers directly feed the 45 T Hybrid Magnet. Currently, the Hybrid Magnet is scheduled for 6 weeks of users with 2 weeks scheduled for maintenance on the liquefiers. This upgrade could allow us to schedule more users in the Hybrid. Long range planning for the second phase, which involves replacing the liquefiers with modern high capacity units, is also underway.

SCIENCE PRODUCTIVITY

In the past year a number of high profile experiments in high magnetic fields brought new understanding to mechanism for superconductivity in the cuprates. In one of those experiments, the **Taillefer** group from the University of Sherbrooke measured the Hall effect in hole doped YBCO. The temperature dependence of R_H, must be due to the presence of electrons and holes with different mobilities. Because the quantum oscillations are observed at low temperature when R_H is negative, we conclude that they come from small electron pockets in the Fermi surface of YBCO. This can be explained by a reconstruction of the large cylindrical hole Fermi surface into small hole and electron pockets, as is believed to occur in electron-doped cuprates because of antiferromagnetic ordering. The nature of the order causing the reconstruction in YBCO remains to be identified. See **Figure 2**. [Ref.: Doiron-Leyraud, N. *et al*., Nature, **447**, 565 (2007)]

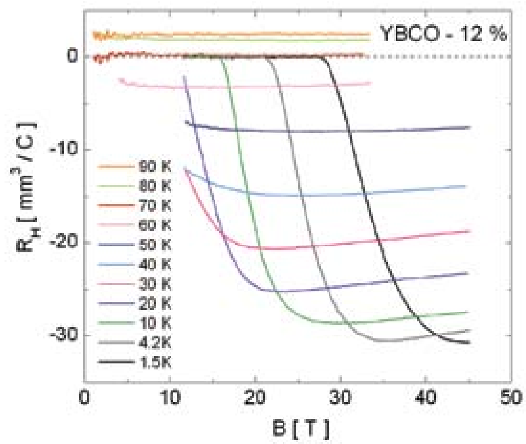


Figure 2.
Negative Hall effect in hole doped YBCO.

In the past year scientists at the NHMFL have worked closely with **George Schmeideshoff** at Occidental College to modify his design for a dilatometer for use at very low temperatures and high magnetic fields. The titanium dilatometer produced by this fruitful collaboration has produced a number of successful results. For example, it has been used to probe the collinear up-up-down phase that occurs in the geometrically frustrated S=1/2 antiferromagnet Cs_2CuBr_4 at fields of 14 T. The transitions between the up-up-down phase and the adjacent, incommensurate phases are highly hysteretic, with the transition fields differing by as much as 29% of the entire width of the up-up-down phase between upward and downward field sweeps. The hysteresis, as well as a step-like jump in the lattice dimension at each transition, confirms that the transitions are first order. The step size ΔL is only about 10^{-7} of the lattice dimension L and scales with the magnetization step, suggesting that the jumps in the lattice dimension at the transitions are merely a consequence, not the cause, of the transitions being first order. See **Figure 3**.

[Ref.: Tsujii, H. *et al*., Phys. Rev. B, **76**, 060406 (R) (2007); Schmiedeshoff, G.M. *et al*., Rev. Sci. Instrum., **77**, 123907 (2006)]

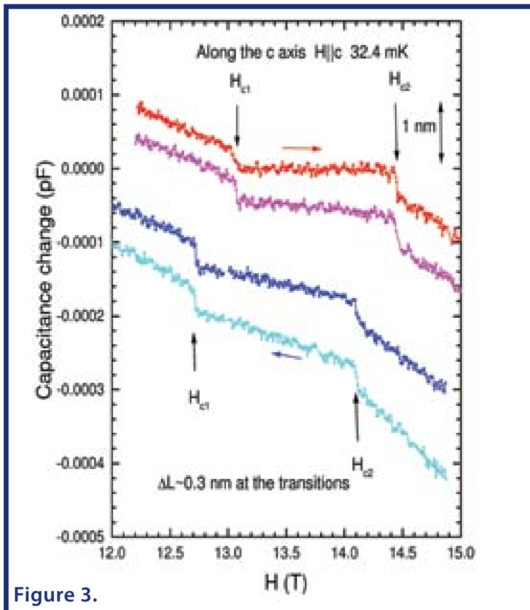


Figure 3.
Dilatometer signal in the field region of the collinear up-up-down phase of Cs_2CuBr_4. The magnetic field was along the c axis of the crystal, parallel to the planes of the triangular lattice.

PROGRESS ON STEM AND BUILDING THE USER COMMUNITY

The scientific project shown above is an excellent example of collaborations between scientists at the Magnet Lab and professors at smaller, primarily undergraduate teaching institutions. **Prof. Schmeideshoff** of Occidental College allowed his designs to be modified for use at wider range of field and temperature than he has access to at Occidental; and, by using the NHMFL machine shop, the design could be iterated through several versions and debugged much faster than would have been possible for him working alone. Once this instrument was working and calibrated, **Prof. Nathanial Fortune** of Smith College was able to utilize it to push his research project forward. The resources available at the Magnet Lab allow professors at smaller institutions to participate in the research project in ways that would not be possible using the resources at their home institutions alone.

The Open Doors Lab is another example of the resources in the DC program at the NHMFL providing opportunities for those who would not otherwise be able to participate fully. This laboratory was originally funded through the NNSA/DOE in collaboration with Prairie View A&M and North Carolina A&T Universities to do extreme conditions research on the actinides. This laboratory has a fully automated 16 T PPMS system from Quantum Design that allows researchers from universities serving underrepresented groups to base preliminary measurements out of this system. When these measurements show the need for higher fields, the experiments can be moved to the rest of the DC Field Facility.

USER FACILITY: PULSED FIELD FACILITY

2007 statistics on Pulsed Field Facility users, projects, and magnet usage are presented in Appendix A.

The Pulsed Field Facility (PFF) and the Los Alamos branch of the NHMFL are located in Los Alamos, New Mexico, at the Los Alamos National Laboratory (LANL). The pulsed field users program is designed to provide researchers with a balance of the highest research magnetic fields and robust scientific diagnostics specifically designed to operate in pulsed magnets. The connection with the DC Field Facility is strong and complementary in expertise. Achieving the highest magnetic fields possible is not what this facility is focused on. Instead, we strive to create the very best high-field research environment possible and to provide users with assistance from some of the world's leading experts in science conducted in pulsed magnets. All of the user support scientists are active researchers and collaborate with multiple users per year. A fully multiplexed and computer controlled, 6-position 1.6 mega-Joule (32 mF @ 10 kV) capacitor bank system is at the heart of the pulsed field activities. Some 4000 shots per year are fired for the users program, which accommodates approximately 100 different user groups.

Capacitor-Bank-Driven Magnets at the Pulsed Field Facility at Los Alamos

Field (T), Duration, Bore (mm)	Supported Research
Cell#1: 50 T Mid-Pulse, 400 msec, 15 mm Cell#2: 50 T Short Pulse, 25 msec, 24 mm Cell#3: 65 T Short Pulse, 25 msec, 15 mm Cell#4: 65 T Short Pulse, 25 msec, 15 mm Cell#5: 60 T Short Pulse, 40 msec, 9.8 mm Cell#6: Test Cell 100 kA peak current 60 T Long Pulse Magnet, ~3 sec, 32 mm 100T Multi-Shot, 10 msec, 15 mm Single Turn (to 240 T), 0.06 msec, 10 mm	Magneto-optics (IR through UV), magnetization, and magneto-transport from 350 mK to 300 K. Pressure from 10 kbar typical, up to 100 kbar. GHz conductivity, MHz conductivity, Pulse Echo Ultra-sound spectroscopy.

Superconducting Magnets at the Pulsed Field Facility at Los Alamos

Field (T), Duration, Bore (mm)	Supported Research
20 T magnet, 52 mm 17 T magnet 52 mm 15 T magnet, 52 mm 15 T magnet 52 mm 14 T-PPMS magnet	Same as pulsed fields, plus thermal-expansion, specific heat, and 20 mK to 600 K temperatures. Heat Capacity, THz Resistivity, Heat Capacity, Magnetometry.

FACILITY DEVELOPMENTS

The 100 T multi-shot magnet operated in 2007 for over 100 magnet days and delivered magnetic field pulses to 85 T on a routine basis. Scientific research was pursued on a collaborative level as techniques that were developed for millisecond duration pulsed magnets (to 65 T) were ported to the new platform. Contactless resistivity via the tunnel diode oscillator (TDO) technique paid off quickly as resolution of quantum oscillations were discovered in the high temperature superconductor $YBa_2Cu_4O_8$ with user **Ed Yelland** and **John Cooper** of Bristol University and Cambridge University in the U.K (recently published in *Phys. Rev. Letters*). Other successful measurements in the 100 T MS included magnetic susceptibility of $CeIn_3$ which also resulted in a *Phys Rev. Letter* by **N. Harrison** and co-authors. In mid July the magnet was taken off-line for maintenance of the outer platform field coils. The system is expected to be back on-line in 2008.

The single-turn magnet system continues to provide the Magnet Lab with the highest research fields available in the United States. In July of 2007 a peak magnetic field of 240 T was recorded as part of systems check by utilizing a 6 mm inside diameter magnet coil and a 40 kV charge on the capacitor bank. The magnetic field measured was within a couple of percent of calculated values and indicates that the system can produce what it was designed for. An infrared cyclotron resonance diagnostic capability was also demonstrated in 2007 as well as a magnetic susceptibility technique, developed in collaboration with researchers from LNCMP.

The 60 T Long Pulse magnet returned to regular operation in 2007. Nearly 80 magnet days for the Long Pulse were recorded for the year. By taking advantage of the relatively slow magnetic fields pulse in conjunction with the TDO technique, users have been able to collect very high quality data on high T_c superconductors as well as more traditional condensed matter systems. Publications are in progress.

FACILITY PLANS

A new 4 megaJoule (MJ) capacitor bank is being completed and is expected to be operational by the summer of 2008. The new system will not only replace the aging 1.6 MJ system but raise the maximum voltage by more than 60% and allow for multi-plexed magnet designs. New magnets are designed and may be available to users by the end of 2008.

SCIENCE PRODUCTIVITY

Users and scientists at the Pulsed Field Facility published 59 papers in peer-reviewed journals in 2007.

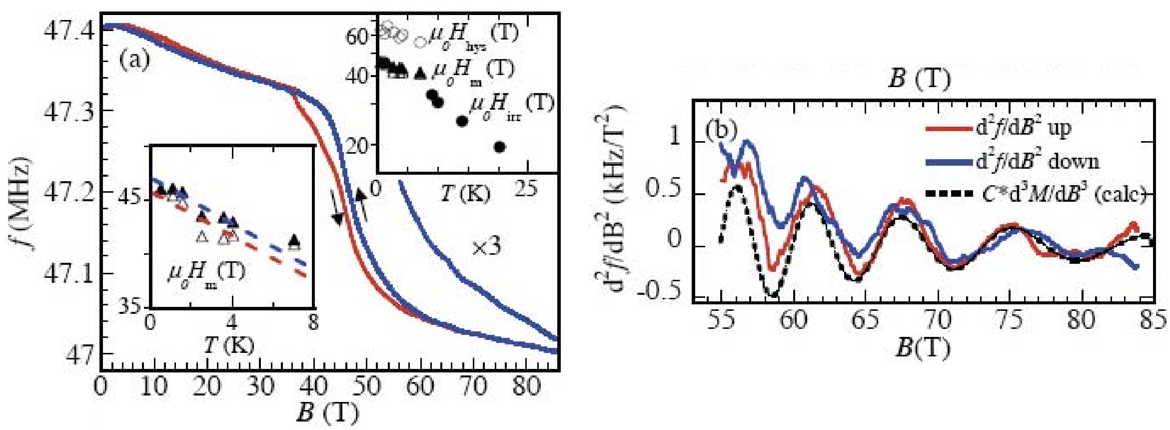


Figure 4.

(a) Resonant frequency f of the TDO versus magnetic field B recorded during an 85T pulse at T = 0.53K. Upper inset: $\mu_o H_{hys}$ (o) and $\mu_o H_m$ (rising - △, falling - ▲) from this work and $\mu_o H_{irr}$ (•) from previous work. Lower inset shows expanded view of the $\mu_o H_m$ data at low T. The dashed lines are guides to the eye. (b) Second derivative d^2f/dB^2 of1.6K data (solid lines). The dashed line is given by LK theory assuming $\Delta f \approx dM/dB$, and using a suitable scale factor. [Phys. Rev. Lett. **100**, 047003 (2008)]

A recent example of the high quality science being conducted at the PFF utilizing the 100 T Multi-Shot magnet is well represented by the recent *Phys. Rev. Letter* by Yelland and co-authors. **Figure 4** shows the quantum oscillatory phenomena of the high temperature superconductor $YBa_2Cu_4O_8$ measured for the first time. The quantum oscillations define an extreme orbit of the electronic carriers (i.e. electrons or holes) of the normal state metal. The magnetic field extending to 85 T was used to suppress the superconductivity while the TDO technique was used to precisely probe changes in the electrical resistivity. The quantum oscillations manifest themselves in subtle changes in the electrical resistivity, also known as the Shubnikov de Haas effect.

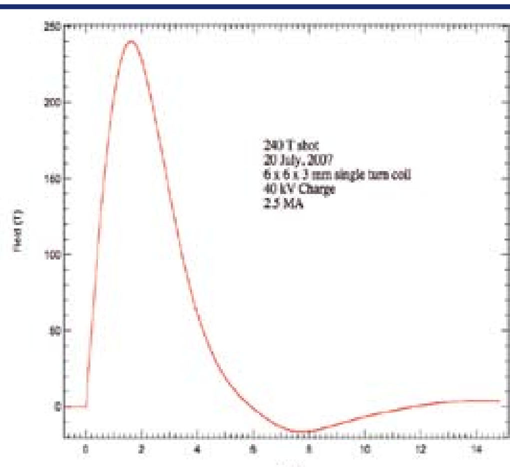


Figure 5.

The maximum magnetic field achieved at the NHMFL is 240 T, which is delivered from the Single Turn Magnet system.

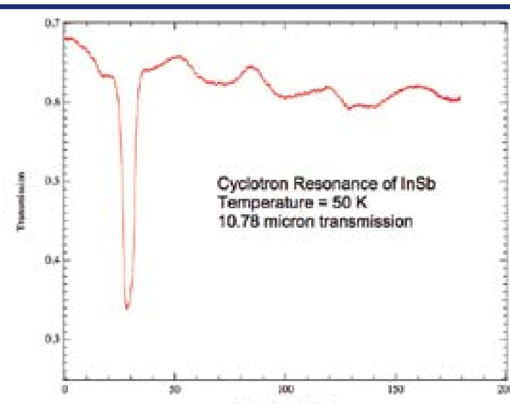


Figure 6.

The cyclotron resonance of InSb taken at 50 K in the Single Turn Magnet System at the NHMFL. The applied magnetic field extends to 178 T. The sample, probe and cryostat all survive the shot completely intact. Data taken by **C. H. Mielke** and **N. Miura**.

Significant developments of user instrumentation for the Single Turn magnet system occurred in 2007. Addition of an IR cyclotron resonance capability was implemented in the spring. Test case samples of InSb were measured at cryogenic temperatures and exhibit an exceptional signal to noise ratio that complements the ultra-high magnetic field capability extending to 240 T thus far for the system. **Figure 5** shows a magnetic field profile to 240 T. An example of the cyclotron resonance in InSb at 50 K is shown in **Figure 6**. A high power (Class IV) CO_2 laser at 10.78 micron wavelength was used for the experiment. Professor **N. Miura** graciously lent his expertise in installation and development of the new NHMFL capability.

PROGRESS ON STEM AND BUILDING THE USER COMMUNITY

The REU program from the NSF has given the PFF an excellent opportunity to extend the impact of the facility onto underrepresented groups in the scientific community, particularly with the student community. Several students from underrepresented groups were involved in the program this year providing mutual benefits to the students and the PFF mentors. Projects included resonant ultra-sound spectroscopy, sample growth of inter-metallic compounds, ultra-high field measurement techniques, and specific heat of low dimensional quantum-magnets.

The recent goal for the PFF is to increase the user base by attracting 10 new users each year. The goal was surpassed this year and a marked increase in magnet days shows the impact of the effort. Some travel support is granted to the new users, which has been helpful in growing the effort considering the relatively remote location of the PFF in Los Alamos.

The staff members of the PFF continue to make considerable efforts toward outreach. In February 2007, four PFF members participated in the E for Engineering Expo at the Los Alamos High School, which attracted 500 students, and taught local students about the wonders of magnetism and pulsed magnetic fields. Students used very strong permanent magnets to pick up small grains of iron fortified breakfast cereal as well as launch diamagnetic objects into the air. Several other staff members gave lectures at local high schools and the University of New Mexico.

USER FACILITY: HIGH B/T

2007 statistics on High B/T Facility users, projects, and magnet usage are presented in Appendix A.

The High B/T facility meets the needs of all qualified users who seek to conduct experiments at high magnetic fields (currently up to 16 T) and very low temperatures (down to 0.3 mK) simultaneously. The facilities include Bay 3 of the UF Microkelvin Laboratory and part-time use of Bay 2 of the Microkelvin Laboratory. Bay 3 employs a $PrNi_5$ nuclear demagnetization stage (0.3 mK minimum temperature) and Bay 2 uses a copper nuclear demagnetization stage capable of reaching 0.1 mK. The full use of time on Bay 2 is limited by staffing and we plan to add a new associate in 2009. The facility is housed in an ultra-quiet environment with electromagnetic shielding and vibration isolation of the experimental station to permit high sensitivity measurements.

Potential users submit a brief proposal for first-time use and repeat users submit a full proposal following the guidelines of the DC Facility. Following a review involving representatives from Tallahassee and LANL, successful proposals are assigned a time slot for their experiment pending initial design and set-up considerations.

FACILITY DEVELOPMENTS

The High B/T Facility has developed an expanded activity to include the second bay of the Microkelvin Facility for NHMFL users who need ultra-low temperature and high field capabilities. The facility has the capability of adding 3 or 4 additional users, depending on the time needed for experiments. The times range from 2 to 3 months per experiment.

In addition, the facility has placed an order with Cryomagnetics Inc. for a 20 T superconducting magnet and the associated magnetic systems for adiabatic nuclear demagnetization and field compensation to extend the field capability to 20 T. The new system is expected to be delivered in January 2009. It will have moderate homogeneity to permit physics NMR experiments in addition to the regular array of experiments. A new postdoctoral associate has been appointed to assist the scientific staff to operate Bay 3 (the original High B/T facility) operations.

FACILITY PLANS

In addition to the upgrades described above, the High B/T Facility has acquired (1) a fast turn-around dilution refrigerator (10 mK capability) with a 10 T superconducting magnet, and (2) a helium-three refrigerator.

These systems are in the process of being commissioned, and are housed in the Williamson Hall annex of the Microkelvin Laboratory. These systems are designed to test experimental configurations before lengthy use in the Microkelvin Laboratory, as well as for experiments needing lower magnetic fields. In addition the small field demagnetization refrigerator developed by Dwight Adams can be used in special cases.

SCIENCE PRODUCTIVITY

The High B/T Facility reported 6 peer reviewed publication for 2007, including two significant publications. (The UF Physics faculty reported 37 NHMFL-related publications.)

Two examples of the exceptional science include:

- **Akimoto, H.** *et al*., Giant viscosity enhancement in a spin-polarized Fermi liquid, Phys. Rev. Lett., **99**, 095301 (2007)

The viscosity of very dilute ^3He-^4He mixtures was measured for extremely high magnetic field/temperature conditions (B ~ 15 T, T ~ 2 mk) for which the spin polarization attains values greater than 99%. Vibrating wire measurements were used to complement high-frequency pulsed NMR measurements of the diffusion. The viscosity was found to increase by a factor of more than 500 over its low field value. At these magnetic fields, the Fermi energy is less than the splitting of the spin states, the polarization tends exponentially to unity as the temperature is lowered, and as a result, the s-wave scattering decreases and the viscosity increases.

- **Pan, W.** *et al*., Experimental studies of the fractional quantum Hall effect: High field-Low temperature studies, Phys. Rev. B, **77**, 075307 (2008)

A well-developed even-denominator fractional quantum Hall effect for quantum number ν=5/2 has been observed at very low temperatures for a high conductivity 2D electron spin system. This state does not follow the odd-denominator rule set by the initial Laughlin wave function, and is believed to result from pairing of composite fermions. In analogy to the formation of Cooper pairs in superconductivity, this pairing creates a gapped, BCS-like ground state at ν=5/2. No evidence of a 13/5 state, the particle-hole conjugate at ν = 12/5 has been observed. This breaking of particle-hole symmetry is contrary to previous trends where both fractions have been observed for conjugate pairs with equal strength The absence of the 13/5 state in the high mobility samples may be associated with a transition from a spin unpolarized state at small B to a spin-polarized state at higher B.

PROGRESS ON STEM AND BUILDING THE USER COMMUNITY

The High B/T Facility served as host on two occasions for the UF Science Quest program that brings science majors and their teachers from all over central Florida to UF for a special summer program. Students receive lectures and visit the facility. Microkelvin faculty members also serve as hosts to students supported by the UF and NHMFL REU programs.

Three new users (Gao, Zapf, and Luhmann) have applied for time at the High B/T Facility. Zapf for a new series of experiments on quantum magnets, Gao for studies of metal-insulator transitions, and Luhmann for studies of 2D electron systems near MI transitions. Preliminary results have been obtained for Zapf, and Gao's experiment is scheduled for March 2008. Luhmann is scheduled for use in the Williamson Hall Annex in June-July 2008.

USER FACILITY: NMR IN TALLAHASSEE

2007 statistics on NMR Facility users, projects, and magnet usage are presented in Appendix A.

This program is a joint effort between the NHMFL in Tallahassee and Gainesville through collaboration with the AMRIS (Advanced Magnetic Resonance Imaging and Spectroscopy) program in the McKnight Brain Institute at the University of Florida. The Magnet Lab's NMR program has a mission to develop technology, methodology, and applications at the highest magnetic fields through both in-house and external user activities. This is a very broad mission in solution and solid-state NMR spectroscopy, as well as imaging and diffusion measurements. Both locations have experienced research faculty, engineers, and technicians spanning these disciplines who are available to facilitate user activities on a wide range of unique instrumentation and to develop novel experiments and new instrumentation.

NMR Systems at the Magnet Lab in Tallahassee			
NMR Frequency	Field (T), Bore (mm)	Homogeneity	Measurements
1.7 GHz	40, 32	10 ppm	Solid State NMR
1066 MHz	25, 52	1 ppm	Solid State/Solution NMR
900 MHz	21.1, 105	1 ppb	Solid State/Solution NMR, MRI
830 MHz	19.6, 31	100 ppb	Solid State NMR
800 MHz	18.7, 52	1 ppb	Solution NMR, Cryoprobe
720 MHz	16.9, 52	1 ppb	Solution NMR
600 MHz	14, 89	1 ppb	MRI and Solid State NMR
600 MHz	14, 89	1 ppb	Solid State NMR
600 MHz	14, 52	1 ppb	Solution NMR
500 MHz	11.75, 52	1 ppb	Solution NMR, Cryoprobe
400 MHz	9.4, 89	1 ppb	Solid State NMR
300 MHz	7, 52	1 ppb	Developmental NMR
300 MHz	7, 89	1 ppb	Solid State NMR

FACILITY DEVELOPMENTS

The flagship instrument of the NMR program is the Magnet Lab's ultra-wide bore (UWB) 900 MHz magnet with a Bruker console that is being used for imaging and solid-state spectroscopy. The development of RF probes for 900 MHz spectroscopy and imaging to make optimal use of high fields is a world-wide endeavor. Unique NHMFL-developed probes for solid state NMR and magnetic resonance imaging are attracting users to the laboratory. Enhanced low-electric field probes that minimize sample heating from the RF irradiation are having a dramatic impact on the biological solid state NMR spectroscopy. Unique high sensitivity probes for the characterization of quadrupole nuclei continue to attract an international user community of the very narrow bore 830 MHz spectrometer. Most of the development activities, however, have been centered on the UWB 900.

FACILITY PLANS

Compact gradient coils that will permit *in vivo* imaging of rats have been ordered and resources have been secured for upgrading the NHMFL animal facility for our internal and external users. With the strong support of the NMR advisory committee, a high priority for the NMR Program is the upgrading of the spectrometer consoles as soon as possible.

SCIENCE PRODUCTIVITY

Victor Schepkin, in collaboration with the RF development group, has achieved the first *in vivo* ^{23}Na images of a mouse in the UWB900 (**Figure 7**). This activity takes optimal advantage of both the high field and wide bore. The sensitivity and resolution of quadrupole signals increase dramatically with field strength while the *in vivo* animal studies require the large bore. The unique resolution for sodium MR imaging of 0.5 x 0.5 x 0.5 mm was achieved in just 55 minutes of data acquisition.

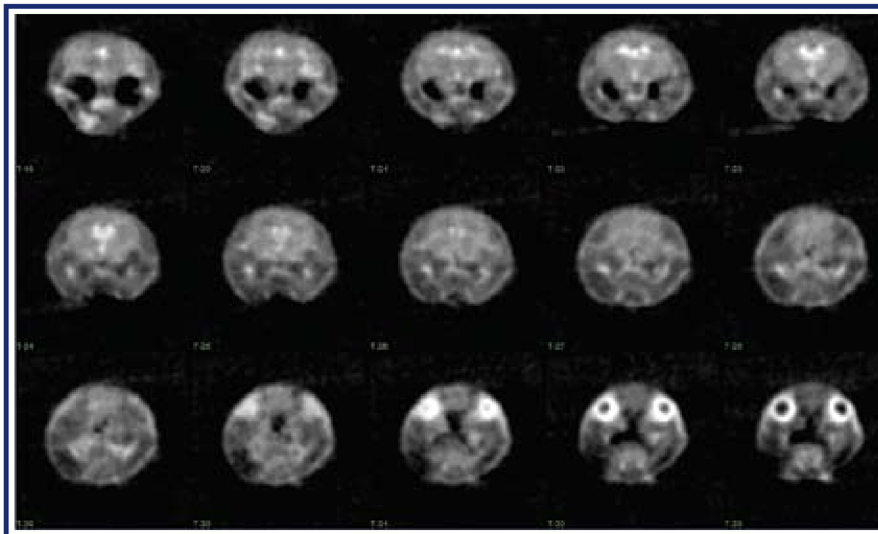


Figure 7.
Sodium image slices of the mouse head with a resolution of 0.125 µl. High signal intensity in cortex areas of the brain is observed.

Biological solid state NMR of aligned samples of membrane proteins for structural characterization is coming of age, in large part because of the low-E probes mentioned above. **Ayyalusamy Ramamoorthy** from the University of Michigan has characterized the transmembrane domain of cytochrome b5 both by itself and in complex with its biological partner cytochrome P450 (**Figure 8**). Cytochromes are proteins that carry a heme group, such as that present in hemoglobin. For the cytochromes studied here the hemes do not carry oxygen, but the P450 heme is involved in the oxidation of a wide variety of pharmaceuticals and for it to be active Cytochrome b5 is required. It is shown that only subtle differences in the structure and dynamics of the transmembrane domain of cytochrome b5 take place upon complex formation with cytochrome P450.

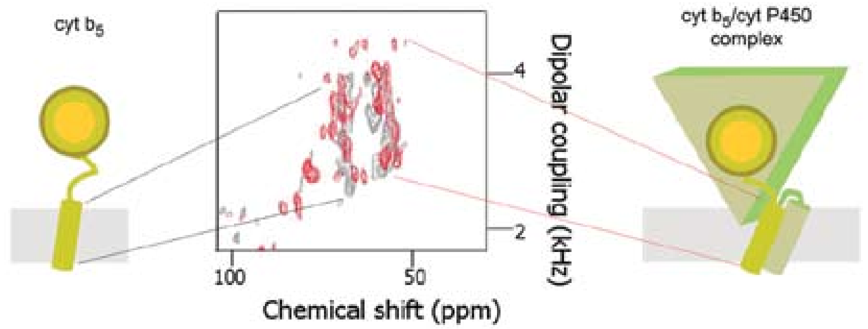


Figure 8.

Solid-state NMR spectra of the transmembrane domain of uniformly ^{15}N labeled cytochrome b_5 (black) and in complex with cytochrome P450 (red). The circular pattern of resonances reflects the helical structure of the transmembrane domain of cytochrome b_5.

Covariance NMR is an important technique developed by **Fengli Zhang** and **Rafael Bruschweiler** that allows the indirect dimension to achieve the same nominal resolution and spectral width as the direct dimension multi-dimensional NMR spectra. Recent work has demonstrated the applicability of covariance NMR to four dimensional (4D) NOESY spectra. Shared-evolution NOESY experiments allow ^{15}N-edited and ^{13}C-edited NOESY data to be collected in a single experiment (**Figure 9**). The application of covariance NMR to a shared evolution NOESY experiment in collaboration with Drs. **Xu** and **Yang** from the National University of Singapore yields a 4D spectrum displaying all the correlations available from a 2D experiment and with resolution surpassing that typically obtained in 4D experiments. The resolution enhancement afforded by 4D-covariance NMR allows identification and assignment of more peaks, including ones reporting on long-range protein distances. For each dimension in an NMR spectrum data sets must be recorded as a function of an incremented time interval. A two-dimensional spectrum requires incrementing one interval while 3D and 4D spectra require two and three time intervals to be incremented, respectively. To achieve high resolution many increments are required resulting in spectra that can take many days to record. By enhancing the resolution without having to increase the number of increments permits much more rapid data acquisition.

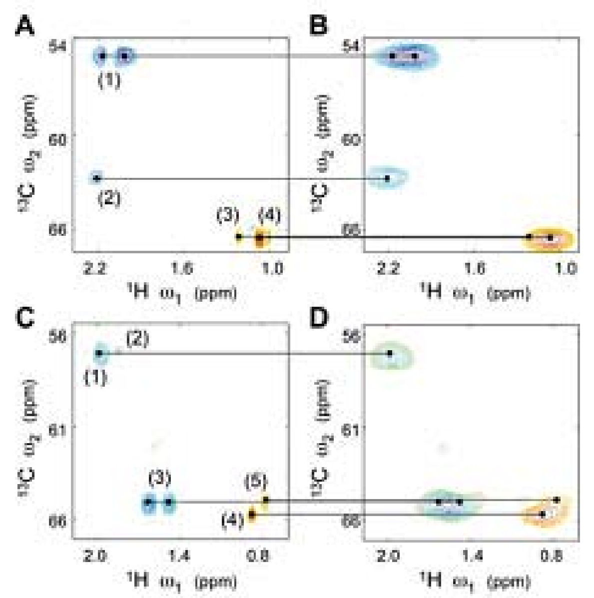


Figure 9.

Comparison between shared evolution 4D $^{13}C/^{15}N$-edited NOESY donor planes of ubiquitin before (B,D) and after (A,C) covariance processing.

USER FACILITY: ADVANCED MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY (AMRIS)

2007 statistics on AMRIS Facility users, projects, and magnet usage are presented in Appendix A.

The AMRIS facility at the University of Florida supports biological magnetic resonance studies of chemicals, tissues, small animals, large animals, and humans. We currently offer 7 vertical or horizontal systems to users, and AMRIS has 10 professional staff members to assist users, maintain instrumentation, build new coils and probes, and help with administration. Several of the AMRIS instruments offer users unique capabilities: the 600 MHz 1-mm HTS cryoprobe is the most mass-sensitive NMR probe in the world and is ideal for natural products;

the 750 MHz wide bore provides outstanding high-field microimaging for excised tissues and mice; the 11.1 T horizontal MRI is the largest field strength magnet in the world with a 400 mm bore; the 3 T human whole body has 16 channels for rapid parallel imaging and is the only whole body instrument in the state of Florida dedicated to research. These systems support a broad range of users from natural product identification to solid-state membrane protein NMR in lipids to cardiac studies in animals and humans to tracking stem cells and gene therapy *in vivo* to functional MRI in humans.

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

Frequency	Field (T), Bore (mm)	Homogeneity	Measurements
750 MHz	17.6, 89	1 ppb	Solution/solid state NMR and MRI
600 MHz	14, 52	1 ppb	Solution state NMR and MRI
600 MHz	14, 52	1 ppb	1-mm HTS cryoprobe
500 MHz	11.7, 52	1 ppb	Solution/solid state NMR
500 MHz	11.1, 400	0.1 ppm	MRI and NMR of animals
200 MHz	4.7, 330	0.1 ppm	MRI and NMR of animals
130 MHz	3, 900 (600 mm useable bore)	0.1 ppm	MRI of whole body humans and large animals

FACILITY DEVELOPMENTS

We added no new instrumentation during 2007. The major development during the year was establishing the new 3 T whole body as a research instrument. We hired Joy Kidder as our full-time 3 T MRI operator; she is a trained and licensed radiology technician and can assist users both in data collection and patient safety. Many user groups are now expanding their research in human imaging in response to the new system.

On a personal note, the AMRIS facility lost one of our major users this year. **Professor Yanni Constantinidis** died unexpectedly in April. He was a friend to all of us, and his death leaves a very big hole in our program. We miss him greatly, and his loss reminds us that facilities are much more than instruments.

FACILITY PLANS

For 2008, we are hoping to obtain funding to upgrade the 11.1 T console, which is about 10 years old and unable to be updated to the latest imaging software. The 11.1 T magnet is working perfectly, so the console upgrade will significantly enhance the science that can be done on this magnet and allow users to use modern parallel imaging methods for improved speed and sensitivity.

For the NHMFL user program, we will continue to offer services to all qualified users. In addition, through generous matching funds to AMRIS from the University of Florida, we are establishing three new technology cores to help build the Magnet Lab user program. These cores represent areas of unique strength in AMRIS in both hardware and in faculty expertise. **Glenn Walter** will lead a core in molecular imaging. This utilizes special nanoparticles that are designed and made in the UF College of Engineering. Glenn is developing optimal methods to use these particles to generate tissue and cellular contrast at high magnetic field strengths. **Steve Blackband** is leading a core on microimaging. Through work on the AMRIS 750 MHz wide bore, Steve and colleagues at Brookhaven National Labs have developed a detailed digital mouse brain atlas. The microimaging core will support similar efforts and continue to push the resolution in MRI to smaller and smaller scales. **Art Edison** will lead a core on high sensitivity NMR. The 1-mm HTS probe is the foundation of this effort, but AMRIS has several other commercial and home-built small volume NMR probes. The emphasis is on natural product discovery or other complex biological samples that are available in small quantities.

SCIENCE PRODUCTIVITY

The AMRIS facility users reported 32 peer-reviewed publications for 2007. One of our major users, **Krista Vandenborne**, was named UFRF Professor by the University of Florida Research Foundation. This is one of the highest research honors at UF, and it is great for the facility and Magnet Lab user program to have people like Krista. Some of the more notable research highlights from 2007 include:

- **Liu, M.; Walter, G.A.; Pathare, N.C.; Forster, R.E. and Vandenborne, K.**, A quantitative study of bioenergetics in skeletal muscle lacking carbonic anhydrase III using ^{31}P magnetic resonance spectroscopy, P. Natl. Acad. Sci. U.S.A., **104**, 371-376 (2007)

The **Vandenborne** and **Walter** laboratories collaborate on projects on muscle regeneration. They develop new *in vivo* tools such as MRI and *in vivo* NMR spectroscopy to monitor therapies for muscle damage and disease. This study utilizes the AMRIS 11 T MRI system to look at ^{31}P spectroscopy in leg muscles of live mice. Skeletal muscle contains at least four isozymes of carbonic anhydrase: CA II, CA III, CA IV, and CA V. CA III is present in the highest concentration of any of the carbonic anhydrases, as much as 2% of wet weight in slow oxidative muscle, but its function is unknown. In this study, they measured the intracellular pH and energy phosphates in hind limb muscles of wild-type and CA III knockout mice during and after ischemia and intense exercise (electrical stimulation). Thirty minutes of ischemia caused phosphocreatine (PCr) to fall and Pi to rise while pH and ATP remained constant in both strains of mice. PCr and Pi kinetics during ischemia and recovery were not significantly different between the two genotypes. From this we conclude that under neutral pH conditions resting muscle anaerobic metabolism, the rate of the creatine kinase reaction, intracellular buffering of protons, and phosphorylation of creatine by mitochondrial oxygen metabolism are not influenced by the lack of CA III. Two minutes of intense stimulation of the mouse gastrocnemius caused PCr, ATP, and pH to fall and ADP and Pi to rise, and these changes, with the exception of ATP, were all significantly larger in the CA III knockouts. The rate of return of pH and ADP to control values was the same in wild-type and mutant mice, but in the mutants PCr and Pi recovery were delayed in the first minute after stimulation. Because the tension decrease during fatigue is known to be the same in the two genotypes, we conclude that a lack of CA III impairs mitochondrial ATP synthesis.

- **Mathew, S.; Ross, C.; Rocca, J.R.; Paul, V.J. and Luesch, H.**, Lyngbyastatin 4, a dolastatin 13 analogue with elastase and chymotrypsin inhibitory activity from the marine cyanobacterium Lyngbya confervoides, J. Natural Products, **70**, (1), 124-127 (2007)

The **Luesch** laboratory at UF collaborates extensively with **Valerie Paul**'s laboratory at Smithsonian Marine Station. The focus of their research is on identification and characterization of biologically active marine natural products. They utilize all vertical AMRIS NMR instruments, including the 1-mm HTS cryoprobe. Marine cyanobacteria are prolific sources of bioactive secondary metabolites with intriguing structures, mostly modified peptides and hybrid peptides-polyketides. Natural products with such cyanobacterial biosynthetic signatures have also been isolated from sea hares, including from Dolabella auricularia, the original source of anticancer dolastatins. Within the past decade, several dolastatins and related analogues have been discovered in marine cyanobacteria and in much higher yield, supporting the suspicion that many dolastatins are derived from a cyanobacterial diet. We have initiated biological screening and chemical investigation of largely unexplored cyanobacteria from Florida and discovered a new dolastatin analogue.

Figure 10.
Lyngbya confervoides, Ft. Lauderdale

- **Dossey, A.T.; Walse, S.S.; Conle, O.V. and Edison, A.S.**, Parectadial: A Monoterpene Produced by a Madagascar Walkingstick Insect, J. Natural Products, **70**, 1335-1338 (2007)

This work was an application of the NHMFL/AMRIS 1-mm HTS cryoprobe. In this study, material *Parectatosoma mocquerysi*, a walkingstick insect from Madagascar (**Figure 11**), was sent to us by

Figure 11.
Parectatosoma mocquerysi female. Photo by Oskar Conle.

external user and collaborator, Oskar Conle. These samples are always difficult to isolate in large quantities, and for this study we used just 5-6 individuals. The spray contained a novel monoterpene that we named parectadial. This compound showed activity against cancer cells and was submitted for testing against an extensive set of 60 cancer cell lines at the National Cancer Institute. This is a nice example of the utility of the 1-mm HTS probe for discovering new chemicals from nature that might have important applications. This work was highlighted by the *Journal of Natural Products* as one of only two "Hot Articles" for 2007.

PROGRESS ON STEM AND BUILDING THE USER COMMUNITY

Art Edison, professor and director of AMRIS, travels to underrepresented colleges and universities as part of the NHMFL College Outreach-Workforce Initiative (which is part of the lab's Diversity Program). In 2007 he visited the University of Texas-El Paso, Southern University in Baton Rouge, LA, and Pontificia Universidad Católica Del Perú (PUCP) in Lima, Peru. The Peruvian connection is part of a bigger effort to develop new projects with the NHMFL in natural product discovery with Peruvian scientists.

USER FACILITY: ELECTRON MAGNETIC RESONANCE

2007 statistics on EMR Facility users, projects, and magnet usage are presented in Appendix A.

The Electron Magnetic Resonance (EMR) facilities at the NHMFL provide users with several home built, high field and high frequency instruments in the frequency range of 23-900 GHz. In addition to standard transmission instruments, two quasi-optical (QO) spectrometers are available. Also, a commercial Bruker Elexsys 680 operating at 9.7 and 95 GHz is available to outside users. There is a large range of applications from the study of cyclotron resonance, paramagnetic impurities, molecular clusters, anti-ferromagnetic and ferromagnetic compounds and thin films, optically excited paramagnetic states, etc.

In the general science building, two superconducting magnets serve three spectrometers, as presented in the table. EMR staff members also assist users in the DC facility with the Keck spectrometer, using broadband tunable Backward Wave Oscillators (BWO) as sources.

EMR Systems at the Magnet Lab in Tallahassee

Spectrometer	Frequency (GHz)	Field range (T)	CW-EPR	Pulsed	TR-EPR	ENDOR	Rotation	Absolute Sensitivity[2] at 290 K (spins/mT)	Concentration Sensitivity at 290 K (spin/cm^3·mT)	Max. sample size (μl)
Transmission	23-660	0-17	■					10^{13}	5×10^{13}	200
Homodyne QO	190-475	0-17	■			■		5×10^{11}	2×10^{13}	10
Heterodyne QO	120, 240, 336	0-12.5	■	■	■	■	■	10^{9} (in cavity) 2×10^{11}	5×10^{13} 2×10^{12}	0.1 100
Keck (DC-field)[1]	150-900	0-25(33)	■					10^{13}	$5x10^{13}$	200
Bruker X-band	9.7	0-1.5	■	■		■	■	10^{11}	10^{12}	70
Bruker W-band	95	0-6	■	■		■	■	$5x10^{8}$	10^{12}	0.4

1 The absolute sensitivity is the minimum number of detectable spins per mT linewidth and a 1 Hz bandwidth at room temperature.

2 In combination with a far-infrared laser, selected frequencies up to 2500 GHz are available

FACILITY DEVELOPMENTS

Frequency extensions. In 2007, a new BWO tube was acquired that raises the maximum frequency available in the DC facility to 900 GHz, which thereby extends the range of coupings and zero-field splittings that can be investigated. Also an additional 150 and 600 GHz multiplier for the transmission and homodyne spectrometer has extended the frequency range available in the 17 T magnet. These extensions have already proved their worth in a number of experiments.

Pulsed EPR. The pulsed EPR on the heterodyne spectrometer has now been commissioned and is available to outside users. It has also pulsed ENDOR capability, and enables a multifrequency study of relaxation parameters and 336 GHz is now the highest frequency available for pulsed EPR in the country (see **Figure12**). (**Morley, G.W.** *et al.*, arXiv: 0803.3054v2 [quant-ph])

Probe for 45 T Hybrid Magnet. A student in the group developed a probe that can be used for measurements in the 45 T Hybrid that incorporates single crystal rotation. This probe has been successfully used in the Hybrid magnet with a Far-Infrared Laser as the high frequency source.

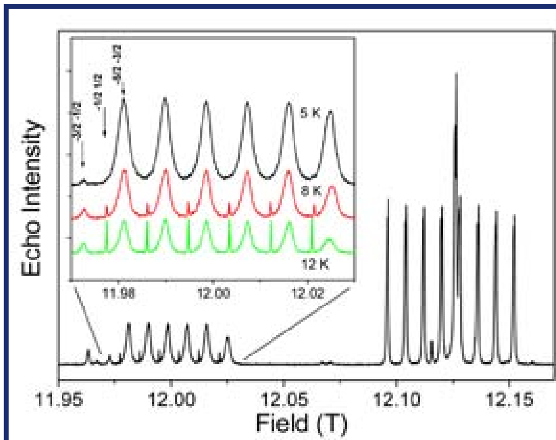


Figure 12.
Pulsed EPR spectrum at 336 GHz of impurities in MgO at 8 K. The inset shows the temperature dependence of the S=5/2 Mn^{2+} signals.

FACILITY PLANS

Extension to lower temperatures. Measurements at 1.2 K will be made standard on the heterodyne instrument, while a new probe is in development that will enable operation at ^3He temperatures. This is especially important for antiferromagnetic resonance and molecular magnetic systems.

Vector magnet. A vector magnet allows users to rotate the orientation of the magnetic field without changing sample orientation or microwave intensity. This is crucial for samples with string orientation dependence, or *e.g.* the study of crossings/anti-crossings of spin levels.

Pulsed EPR development. The sensitivity and time-resolution of pulsed EPR can be significantly improved by higher microwave-fields at the sample. This can be achieved by more powerful sources and more efficient resonators. Dedicated holders for pulsed ENDOR and pulsed EPR of optically excited states are developed.

Quasi-optical components for DC-field experiments. The quasi-optical components currently used in the spectrometers have enhanced the sensitivity significantly. Application of these techniques in the DC field facilities will increase sensitivity and decrease measurement time.

Further extension of BWO frequency range. Up to 1.2 THz.

Construction of a frequency domain magnetic resonance spectrometer. A new instrument is being setup with a very broad frequency range (70-1500 GHz), initially for zero-field experiments and later for operation in the split coil magnet.

SCIENCE PRODUCTIVITY

In 2007 a large number of research groups and projects were accommodated by the EMR group, resulting in 37 peer-reviewed publications and numerous presentations. The projects spanned a range of disciplines from applied materials research to metalproteins. A few examples are given below.

Electrically-Detected Magnetic Resonance at the SiO_2-Si interface. In a collaboration between the group of **Christian Boehme** at the University of Utah, and the NHMFL EMR group, a study was made of the spin-dependent conductivity at the Si:SiO_2 interface. Instead of a detection of the absorption of the microwaves, the magnetic resonance was detected through changes in the conduction. An understanding of the spin-dependent processes is crucial for applications in spin-dependent electronics (spintronics) and Quantum Information Processing. At conventional frequencies a recombination between the surface Pb centers and the bulk phosphorus donors dominates. The spin-dependent processes at measurements at the Magnet Lab were performed at a much higher frequency (240 GHz) than had been reported so far, and the spin-dependent processes behave very different, and show no correlation between the Pb center and the phosphorus centers (**Figure 13**). Spin-dependent tunneling between neighboring Pb states seems the dominant recombination process for the Pb center. The phosphorus response corresponds to either a

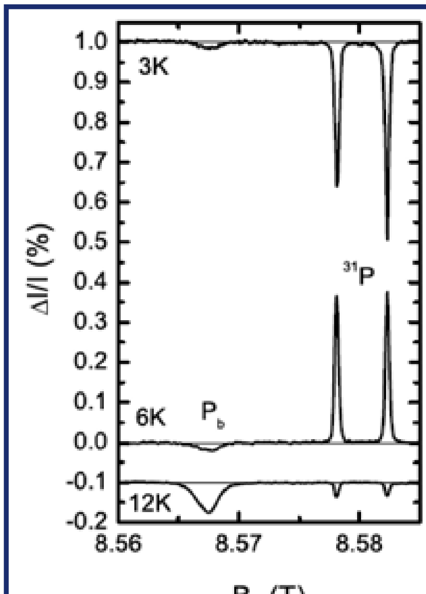


Figure 13.
EDMR spectra of the SiO_2-Si interface at 240 GHz and 3 K, 6 K, and 12 K.

current increase or a current decrease, dependent of temperature, and its mechanism is still under investigation (**McCamey** *et al.* arXiv:0802.0230v1 [cond-mat.other]).

Zero-Field Splitting and Exchange Interactions in a Ni(II) Dimer.

In an international collaboration involving the Palacký University in the Czeck Republic, the Slovak Technical University in Slovakia, the University of Stuttgart in Germany, and the NHMFL, a di-nickel complex was studied by high field EPR and magnetization. Understanding the origin of zero-field splitting (ZFS) in molecular magnets is of great importance, because the ZFS determines many of their fundamental properties. The aim of this work has thus been to elucidate the microscopic origin of ZFS in dinuclear exchange coupled systems with large anisotropies exemplified by a classic complex bis(μ-chloro)tetrakis(ethylenediamine) dinickel(II) dichloride, $[Ni_2(en)_4Cl_2]Cl_2$ (see **Figure 14**, inset). In this class of complexes the single-ion anisotropy is comparable with exchange coupling constants.

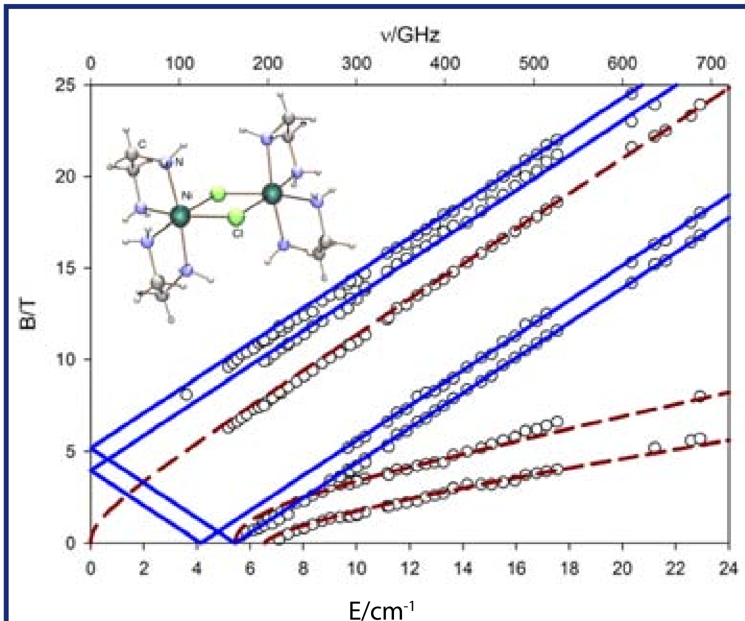


Figure 14.
The 2-D field vs. frequency map of EPR resonances.

We developed a model that allowed us to take into account simultaneously the single-ion anisotropy, isotropic and asymmetric exchange in calculating the ZFS. Calculations using this model very successfully reproduced the experimental data set (**Figures 13 and 14**). Our results point to the importance of asymmetric exchange, which is often neglected in similar systems. **Herchel** *et al.*, J. Am. Chem. Soc.**, 129**, 10306 (2007).

Multifrequency EPR Studies on the Mn(II) Centers of Oxalate Decarboxylase.

Oxalate decarboxylase (OxDC) is an enzyme catalyzing the cleavage of the carbon-carbon bond in oxalic acid. Its presence in gut bacteria helps prevent the formation of kidney stones. It contains a Mn(II) ion coordinated by four identical conserved residues in each of its two cupin domains. The similarity between the two Mn(II) sites has precluded attempts in the past to distinguish them spectroscopically and complicated efforts to understand the catalytic mechanism. We have shown through a multifrequency electron paramagnetic resonance (EPR) approach that the two Mn ions differ in their magnetic properties. This made it possible to observe that only one of the two sites is solvent-exposed and presumed to be catalytically active. Based on comparison with recent X-ray structures, that site was identified as the Mn ion in the N-terminal site. This research is a collaboration of groups at the University of Florida, the ETH in Zurich, Switzerland, and the NHMFL. **Angerhofer** *et al.,* J. Phys. Chem., **B 111**, 5043 (2007).

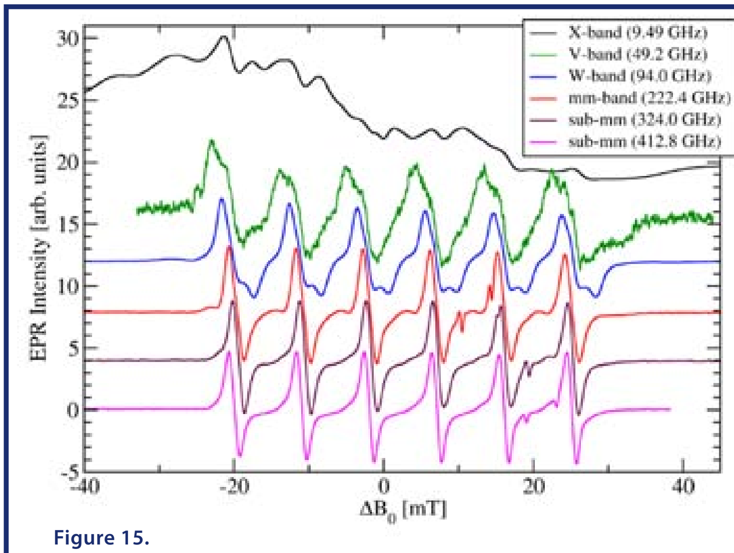


Figure 15.
Frequency dependence of the EPR spectra of OxDC in storage buffer. Field positions in teslas at the zero-points: 0.3340 (X-band), 1.7490 (V-band), 3.3545 (W-band), 7.9427 (222 GHz), 11.567 (324 GHz), and 14.730 (413 GHz).

BUILDING THE USER COMMUNITY

This year a total of 13 new groups joined the EMR user base—9 from the United States (Britt-UC/Davis, Han-UCSB, Manson-EWU, Brynda-UC Davis, Sherwin-UCSB, Boehme-Univ. Utah, Zvanut-UAB, Chiorescu-FSU, Hoch-NHMFL); 3 from Poland (Drabent-Wroclaw U, Wojcichowski-Warsaw U. of

Techn., Szymanska - Nicolai Copernicus U, Torun); and 1 from Great Britain (Stoneham, UCL, London)—coupled to a total of 12 requests for magnet time from first time users. All the magnet time requests were approved. Five of the new users were provided $500 toward travel costs. In addition, travel costs for the students/postdocs of one new user (Boehme) was provided via an award from the Visiting Scientist Program.

This year, out of the 128 researchers, 24 were women, and 28 were minorities, a slight increase with respect to last year.

USER FACILITY: ION CYCLOTRON RESONANCE

2007 statistics on ICR Facility users, projects, and magnet usage are presented in Appendix A.

During 2007, the Fourier Transform Ion Cyclotron Resonance (ICR) Mass Spectrometry program continued instrument and technique development as well as pursuing novel applications of FT-ICR mass spectrometry. These methods are made available to external users through the NSF National High-Field FT-ICR Mass Spectrometry Facility. The facility features five staff scientists who support instrumentation, software, biological applications, petrochemical and environmental applications, and user services as well as a machinist, technician, and several rotating postdocs who are available to collaborate and/or assist with projects.

ICR Systems at the Magnet Lab in Tallahassee

Field (T), Bore (mm)	Homogeneity	Measurements
14.5, 104	1 ppm	ESI FT-ICR
9.4, 220	1 ppm	ESI, APPI FT-ICR
9.4, 155	1 ppm	FD, MALDI FT-ICR
7, 155	1 ppm	EI, CI, FT-ICR
7, 150	1 ppm	ESI FT-ICR

FACILITY DEVELOPMENTS

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

The 9.4 T, 220 mm bore system offers a unique combination of mass resolving power ($m/\Delta m$ = 8,000,000 at mass 9,000 Da) and dynamic range (>10,000:1), as well as high mass range, mass accuracy, dual-electrospray source for accurate internal mass calibration, efficient tandem mass spectrometry (as high as MS^8), and long ion storage period. The magnet is passively shielded to allow proper function of all equipment and safety for users. The system features external mass selection prior to ion injection for further increase in dynamic range and rapid (~100 ms timescale) MS/MS (Anal. Chem., **75**, 3256-3262 (2003). Available dissociation techniques include collisional (CAD), photon-induced (IRMPD), and electron-induced (ECD). A robotic sample-handling system allows unattended and geographically remote operation. An APPI source can be used for analysis of nonpolar analytes. HPLC and CE interfaces are also available.

The 9.4 and 7 T actively shielded FT-ICR instruments are available for analysis of complex nonpolar mixtures and instrumentation development. The 9.4 T magnet is currently used for field desorption (Anal. Chem., **77**, 1317-1324 (2005)) and elemental cluster analysis. The 7 T magnet is optimized for volatile mixture analysis (Rev. Sci. Instrum., **77**, 025102 (2006)) and can be used to develop ion optics and ICR ion traps. Samples are volatilized in a heated glass inlet system (at 200-300 °C) and externally ionized by an electron beam (0-100 eV, 0.1-10 µA). The ions are collected in a linear multipole ion trap and injected into the FT-ICR cell. Mass resolving power ($m/\Delta m$) greater than 10^5 and mass accuracy within 1 ppm have been achieved with both systems. Thousands of components in a complex mixture (*e.g.*, petroleum distillates) can thus be resolved and identified.

SCIENCE PRODUCTIVITY

Biomolecular sequence verification continues to be in high demand. Protein and oligonucleotide masses can be determined with ppm accuracy. Molecules can be fragmented (by collisions, photons, or electron capture by multiply-charged positive ions) to yield sequence-specific products (Anal. Chem., **77**, 7163-7171 (2005)). Sites and nature of post-translational modification (*e.g.*, glycosylation, phosphorylation, etc.) are readily determined (Proteomics, **4**, 970-981 (2004)). In-house software has been developed for rapid data analysis. We devised a method to distinguish N-terminal from C-terminal peptides by use of electron capture dissociation MS/MS (Anal. Chem., **79**, 7596-7602 (2007)), as well as the first large-scale characterization of hundreds of membrane lipids from cell cultures (Anal. Chem., **79**, 8423-8430 (2007)).

Tertiary and quaternary structure can also be probed. Automated **hydrogen/deuterium exchange** can be carried out (Anal. Chem., **78**, 1005-1014 (2006)) and monitored with the mass spectrometer. Details of biomolecular conformation and surface contact between molecules in a noncovalent complex can be deduced. For example, we were able to characterize the nature of the interaction of a biological "motor" that injects single-stranded RNA into the capsid (shell) of a bacteriophage virus (Virology, **351**, 73-79 (2006)).

The 7 and 9.4 T instruments are primed for immediate impact in **environmental, petrochemical, and forensic analysis**, where intractably complex mixtures are common. For example, post-blast soil samples can be extracted and compared with a library of commercial and military explosives to identify the active agent and the source of the product (Anal. Chem., **74**, 1879-1883 (2002)). Further, fossil fuel samples can be analyzed and components resolved without chromatographic separation. In a recent study more than 12,000 distinct chemical components were resolved and identified (elemental formulas) in a single atmospheric pressure photoionization FT-ICR mass spectrum of crude oil (Anal. Chem., **78**, 5906-5912 (2006)).

USER FACILITY: GEOCHEMISTRY

2007 statistics on Geochemistry Facility users, projects, and magnet usage are presented in Appendix A.

The geochemistry facility has six mass spectrometers of which four are available to outside users.

- One instrument is a multi collector thermal ionization instrument (Finnegan MAT 262/RPQ) that is used for measurements of isotopes of elements with low first ionization potential.
- The second instrument is a single collector inductively coupled plasma mass spectrometer (ICP-MS), ELEMENT, which is used for trace metal abundance determinations. A separate laser ablation system can be interfaced for *in-situ* trace element analyses on solid materials.
- The third instrument is a multi-collector inductively coupled plasma mass spectrometer (NEPTUNE) that is used for determination of isotopic abundances of metals.
- The fourth instrument is a mass spectrometer designed for the measurement of the light stable isotopes (C, N O, S).

The facility is run off of external grants, and, in the last year, individual principal investigators had funding from NSF (several divisions of the GEO directorate), NASA, and EPA.

FACILITY DEVELOPMENTS

In 2006 we built the plasma facility—a semi clean room that houses the NEPTUNE and a new second generation ELEMENT. These instruments were delivered in December of 2006 and met specifications in early April of 2007. Since then we have developed protocols for the analyses of osmium, hafnium, neodymium, and mercury. The sample throughput of the new ICP-MS is far higher than that of the thermal ionization instrument, thus considerable effort was spent on increasing the throughput of the chemical preparations of the samples.

FACILITY PLANS

Plans this year are not related to further facility improvement, but rather to diversifying funding. In addition to submission of proposals to our traditional funding sources, we are trying new avenues. Some of these efforts are toward combining some of the analytical techniques available in our program with high magnetic field techniques. We are planning to submit a User Collaboration Grants Program proposal this year for proof-of-concept studies. The results of those studies are expected to attract new users.

SCIENCE PRODUCTIVITY

The first results of these new analytical techniques associated with the new instrumentation were presented at the December 2007 Fall meeting of the American Geophysical Union, which we attended with a record number of twelve persons (including 6 students) and made twelve presentations. One very significant discovery was the first recognition of natural occurrence of mass independent fractionation of the mercury isotopes. Mass independent fractionation has two known causes: non-linear variation in the nuclear volume and difference of magnetic moment of the nucleus of the odd isotopes. Mercury cycling through the environment can occur along different pathways and the fractionation of mercury isotopes will be different along those different paths. The mercury isotopes are expected to become an extremely important new tool for understanding mercury cycling in the environment. A manuscript with the first results from our group is in press.

Detailed investigations of the isotopic compositions of mid-ocean ridge basalts have revealed for the first time two different length scales of heterogeneities in the mantle. The small length scale (100s of km) is related to a component that resembles ancient melt enrichment and the larger length scale component (1000s of km) is related to an ancient component that is melt depleted.

The total number of 2007 publications for the Geochemistry group is eleven and total number of presentations at conferences is 19. One PhD thesis was defended.

PROGRESS ON STEM AND BUILDING THE USER COMMUNITY

Non-Magnet Lab use (i.e., external users) has increased somewhat over the last year. The facility is open to users of all kind. During the summer we hosted a teacher in the Research Experiences for Teachers program; during the fall semester we supported an undergraduate student enrolled in the WIMSE program and two female students enrolled in the FSU Young Scholars Program. We also participated in the annual open house.

CHAPTER 4: MAGNETS & MATERIALS

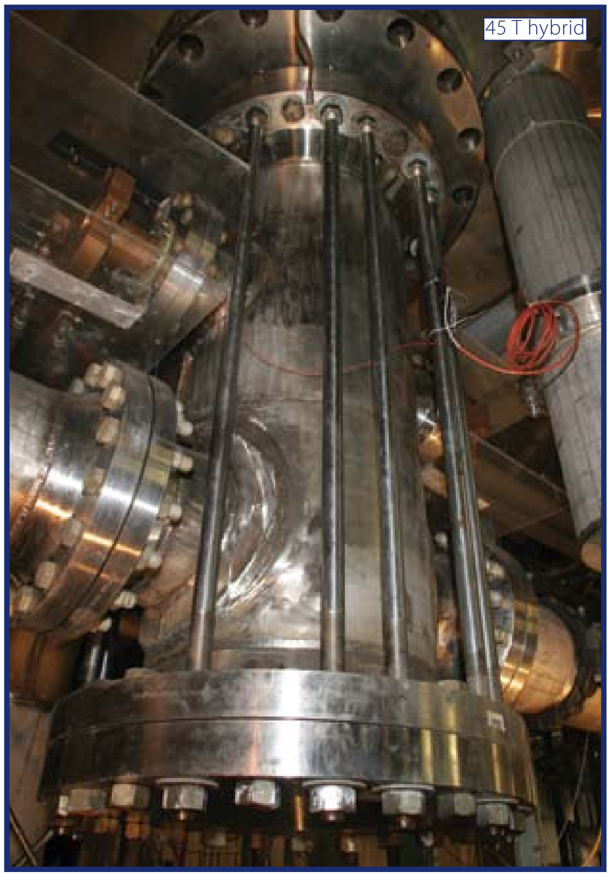
A central enabling feature of the NHMFL's success to-date and its prospects for success in the future is the availability of unique high-performance magnet systems that exploit the latest materials and magnet design and construction developments. As we move forward, pursuing ever higher fields while controlling costs, continued hand-in-glove developments on these fronts will be essential for success.

2007 was another year of breakthroughs in magnet technology and materials development at the Magnet Lab. In the superconducting magnet arena, SuperPower and the NHMFL developed a YBCO-based superconducting coil that reached a record field of 26.8 T during testing at the NHMFL in July 2007. This new coil is the culmination of 10 years of development of YBCO-coated conductors. Such conductors appear to be commercially viable for many electric utility applications. We are very pleased that their first implementation for high-field magnets occurred at the NHMFL. YBCO conductors are being produced by two American manufacturers.

In the resistive magnet facility we continued to provide world-record magnetic fields in various bore sizes and various levels of homogeneity, modulation, gradient, etc. We also demonstrated two new technologies suitable for neutron and photon-scattering experiments: one for split magnet configurations and one for conical magnet configurations. Both technologies show tremendous potential for widespread application and patent applications have been filed for both.

In the pulsed magnet facility we provide the highest field repeatable pulsed magnets worldwide with 75 T available in a capacitor-driven system and 85 T available from the combination of a capacitor bank and a motor-generator. We continue to develop better technology to employ the new 4MJ capacitor bank to its fullest potential and anticipate providing 85 T to the user community without use of the motor-generator.

The NHMFL has the world's highest-field dc magnet, the 45 T hybrid, which consists of a 30 MW resistive insert magnet and a 100 MJ superconducting outsert magnet. The laboratory is now developing three new hybrid magnets: one for the NHMFL, one for the Hahn-Meitner Institute in Berlin Germany, one for the Spallation Neutron Source in Oak Ridge, Tennessee. The NHMFL magnet will be used for NMR experiments and the HMI and SNS magnets will be used for neutron scattering experiments. In November 2007 we held a major design review of all three systems with three different external review committees. Purchase orders for the Nb_3Sn strand for the magnets are expected to be issued in 2008.


45 T hybrid

Development of superconducting materials at the NHMFL has increased in intensity with the relocation of the Applied Superconductivity Center from Wisconsin to Tallahassee in 2006. During 2007 an extensive collaboration effort with the U.S. high energy physics community to broaden the NHMFL program to develop multifilament round wire Bi-2212 conductors with application to new machines like a Muon Collider, which require solenoidal fields up to ~50T, was initiated. Significant advances in the understanding of the behavior of YBCO, BSCCO, Nb_3Sn, NbTi, and MgB_2 were also developed.

Ultimately, the fields available from the dc and pulsed resistive magnets are limited by the strength and electrical conductivity of the materials available for their construction. The NHMFL team of metallurgists and materials scientists continues to demonstrate concepts for developing practical materials with better combinations of strength and conductivity than are presently available.

PULSED MAGNETS

100 T. The 100 Tesla Multi-Pulse Magnet System completed its first six-month operation cycle in June 2007. The system provided over 80 science pulses at 85 T. This system established the world record field for pulsed magnets operating in a repeatable manner. Two magnet systems comprise the 100 T assembly: (1) a large generator-powered outer magnet assembly called the "outsert", and (2) a capacitor-driven inner magnet called the "insert." The outsert magnet-system entered a maintenance and upgrade cycle in July 2007. Improved diagnostics will be implemented on the outsert-magnet assembly. We anticipate resuming 85 T operations in January 2009. The first generation insert-magnet was upgraded in March 2007 to improve dielectric insulation. (See **Figure 1A**) Present design development is focused on a new insert magnet upgrade to extend science operations to the 95 T - 100 T range. Upgrade of the insert magnets is relatively easy since inserts are designed to be replaceable.

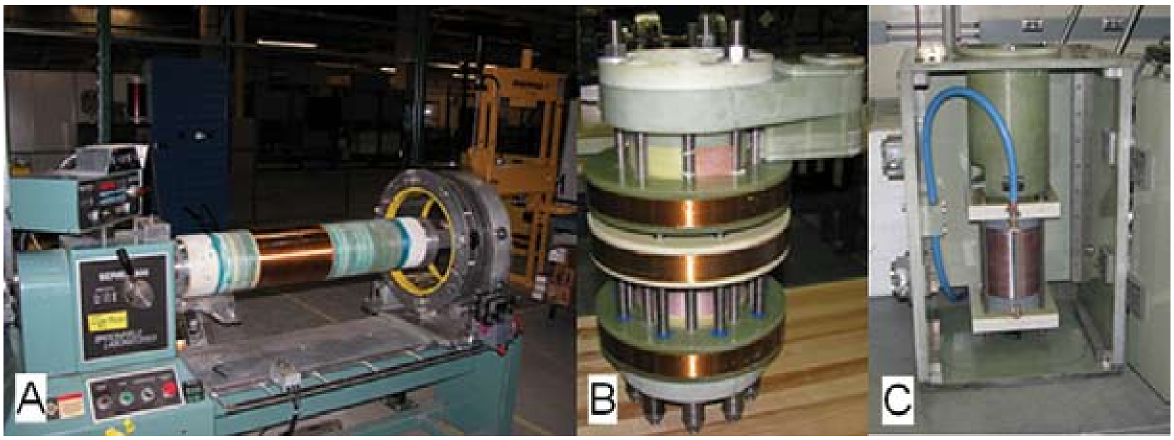


Figure 1.
2007 Work projects at NHMFL Pulsed Magnet Facility: (A) Insert magnet assembly during dielectric upgrade, (B) Upgraded 75 T magnet, (C) 144 mm bore room-temperature 10 T magnet.

60 T Long Pulse. The 60 Tesla Long-Pulse Mark II magnet has operated since August 2006. The magnet provides a 100 ms flat-top field. Science operations have been limited to 55 T since commissioning. Presently the magnet is under review to extend operations to 60 T. Development work is presently underway to reduce noise in the magnet. Noise reduction strategies experimentally examined thus far entail conductive damping tubes.

Capacitor-Driven Magnets. Capacitor-driven magnet work in 2007 initially focused on improving and replacing production tooling in the facility. Additionally a mature and efficient logistical supply-chain for components and materials was developed. Four 65 T magnet-assemblies were produced for the NSF user program in 2007. A new high-energy magnet user cell was installed in the facility. The cell functions as a stand alone high-field staging magnet to allow refinement of experimental measurements prior to insertion in the 100 T multi-pulse magnet. An upgraded 15 mm bore 75 T magnet assembly was installed in the new user cell. (See **Figure 1B**) Magnet performance has thus far been acceptable. The first magnet has been pulsed between 70-73 T more than 225 times since installation. 75 T pulses are generated if the science requires the additional field.

Work is now underway developing magnets for the new high-energy magnet user cell. The planning entails the introduction of a new generation of duplex powered magnets. Two synchronized pulsed circuits energize a duplex magnet assembly. Duplex designs utilize the new NHMFL 4 MJ capacitor bank now completing construction. Duplex operations will allow development of stand alone peak fields to 85 T, and magnetic fields beyond 100 T for the DOE-NSF multishot program.

A 144 mm bore room-temperature 10 T pulsed magnet was also commissioned in 2007. (See **Figure 1C**) The magnet has a 10.1 ms rise time and a "1/*e*" decay time of 14 ms. A 1500 cc volume is available for pulsed experiments. The magnet structure is designed to contain 70 kN axial loads from large samples.

RESISTIVE MAGNETS

Split Magnet Test Coil. To date, all high field resistive magnets at the NHMFL have been solenoids with cylindrical bores. We have undertaken the design of a magnet with four large ports at the mid-plane as shown in **Figure 2**. The magnet would be able to be operated in two configurations. In the first, the field would be vertical and the ports in a horizontal plane. A sample could be installed from above and photons introduced via one of the mid-plane ports and diffraction and scattering experiments could be performed. In the second configuration, the magnet could be rotated to make its bore horizontal and the mid-plane ports lie in a vertical plane. In this configuration a cryostat could be installed from above (perpendicular to the field) and rotated about a vertical axis for measuring material anisotropy. A new magnet technology, the Split Florida-Helix, is being patented in support of this magnet. In August 2007 a model coil was tested that reached 32.1 T in a 32 mm bore. The test was performed by installing 2 new coils inside the 20 cm bore, 20 T resistive magnet. Of the 2 new coils, the innermost (assembly process shown in **Figure 3**) had a split in the mid-plane that was very similar to what would be included in the real user magnet. The test coil reached current densities, power densities, and stress levels that met or exceeded what will be experienced in the user magnet system. Based on the results of this testing, we expect the user magnet to provide a field in the range of 24-26 T. At this point the project has been placed on hold due to the recent budget challenges. The user magnet will be operational no earlier than 2011.

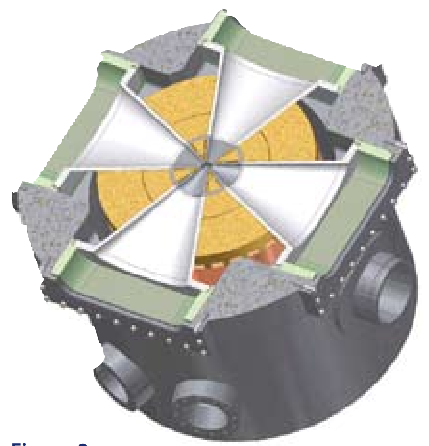


Figure 2.
Mid-plane of split user-magnet with four ports for photon scattering.

Figure 3.
Assembly of test coil for split magnet technology.

Conical Magnet Test Coil. The NHMFL is developing a hybrid magnet suitable for neutron-scattering experiments either at the Spallation Neutron Source in Oak Ridge, Tennessee, or the Hahn-Meitner Institute in Berlin, Germany. To attain a high field with a large scattering-angle, a new magnet technology is required for the resistive insert: Conical Florida-Bitter, which is being patented. A model coil was successfully tested in December 2007. The test coil produced 14.1 T using 4.9 MW of power in a background field of 19.1 T for a total of 33.5 T with a conical angle of 30°. The test coil operated at current densities and power densities higher than those used in the 45 T hybrid and successfully demonstrated the technology needed for this new magnet type. **Figure 4** shows the coil after testing.

Figure 4.
Conical Florida-Bitter model coil after testing.

45 T Hybrid Insert Upgrade. In November 2007 the resistive insert of the 45 T hybrid magnet was upgraded to operate on three power supplies instead of the four that were previously required. This development was possible as the power supplies were upgraded in 2006 from 500 to 600 volts. Upgrading the hybrid insert was necessary to allow the Series-Connected Hybrid to eventually operate on a single power supply at the same time as the 45 T hybrid. In the mean-time, it should allow users to continue to reach full field, even if one of the power supplies is malfunctioning and anytime the 45 T hybrid is operating, there is a power supply available for such things as testing cable-in-conduit-conductors (CICCs) for the Series-Connected Hybrids.

CICC MAGNETS

The NHMFL is working on three Series-Connected Hybrid (SCH) magnet projects in parallel. Two have just entered a construction phase and one is in a Conceptual Engineering Design (CED) phase. The principal application for the system at the NHMFL will be high field NMR, but it will also be available for general-purpose use as part of the DC Field Facility. The systems for the Hahn-Meitner Institut (HMI) in Berlin and the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory will be dedicated to neutron-scattering experiments.

The SCH for the NHMFL is a powered magnet system that will provide at least 36 T in a 40 mm warm-bore with a uniformity over 1 cm DSV of 1 ppm. Two types of coils are powered in series with an operating current of 20 kA and a stored energy of 63 MJ. The SCH consists of five Florida-Bitter resistive coils (insert magnet) and two cable-in-conduit conductor coils (outsert magnet). The insert, as it is designed for this application, produces 23.1 T at 20 kA and 12 MW. The insert is graded by varying the current density along its axis to produce a central field whose homogeneity is higher than is typical with resistive magnets, which are usually designed for maximum field with the available power. The outsert has one primary coil made from Nb_3Sn cable-in-conduit conductor (CICC) and one shield coil made with Nb-Ti CICC.

The SCH for HMI, presently under construction, will use a 4 MW resistive insert and produce a magnetic field between 25 T and 30 T. The SCH for SNS (funded by NSF in a CED phase) will use a 12 MW resistive insert to produce a central field greater than 30 T. The orientation of the magnet system is such that the axis of the magnet is horizontal, to align with a neutron beam. The bore of this magnet system is conical to provide a scattering path for neutrons, thus restricting the size of the resistive insert. A new resistive magnet technology has been developed to serve in this application, as explained above.

Benefits are realized when commonalities exist between magnet projects, even though their field requirements differ. The flexibility of the hybrid design allows for similar features, the largest being the Nb_3Sn coil, which will have the same design. Customization of the resistive insert accounts for differences in the field requirements. The hybrids for neutron scattering experiments have additional common features with their structure and cryostat since they both have horizontal configurations. **Figure 5** shows the systems for the NHMFL and neutron scattering facilities.

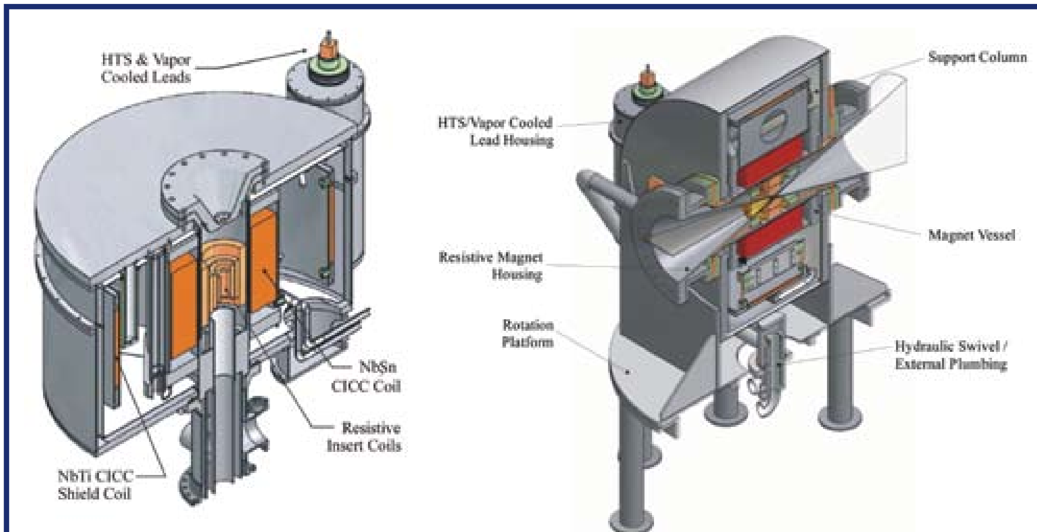


Figure 5.

Sectioned views of the SCH magnets. The left image is configured for NMR at the NHMFL; the right image is configured for neutron scattering experiments at the HMI and SNS.

At the heart of the Nb_3Sn coil is the CICC. In 2007 there was a large push to complete its design, study the impact on variations in CICC design parameters, and prepare for verification tests on full-size sample CICCs. Recent tests conducted in Europe show that CICC can suffer from degradation in their current-carrying capacity due to strain cycling if careful attention to the CICC design parameters is not made. The NHMFL faced this issue on two fronts. One activity was the development of a new numerical model that predicts the current degradation of CICC from thermal and electromagnetic loads. The code has been benchmarked against existing measurements with excellent agreement. **Figure 6** demonstrates this correlation. A second direction that was taken was to quantitatively determine the impact on cable design variations through the measurements of critical current sharing temperature as a function of magnetic field, strain, and load cycling. For this, cables of different twist pitches, void fractions, and core cable patterns were studied. The results of the measurements and analysis went into the final CICC design. The procurement of superconductor and fabrication of full-scale CICC was initiated in 2007 to obtain samples that will be used in measurements for the final verification of performance.

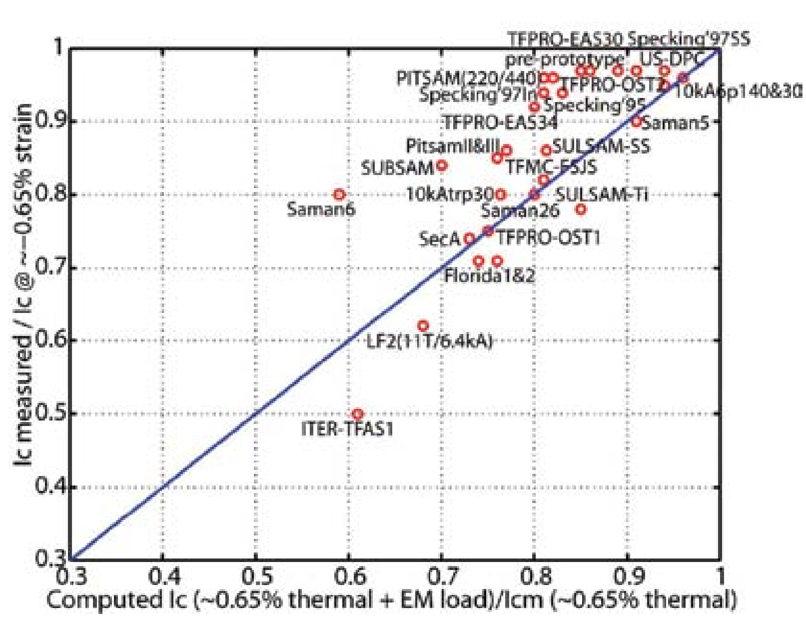


Figure 6.
Correlation of CICC Test Measurements with FEMCAM Calculations

In preparation for future coil fabrication, two model coils are planned: a reduced-scale coil and a full-diameter/short length coil. The design of the reduced-scale model coil was completed and procurement of hardware was initiated. The main purposes of this coil, which will be wound, heat treated, and epoxy impregnated, are to develop fabrication and quality control procedures, identify and build required tooling, and to continue the investigation of alternative materials for the conduit. In 2004 we identified a new candidate material for use in the conduit of the CICC. Haynes 242 is a nickel-chrome-molybdenum based superalloy, which has a thermal contraction upon cooldown from 900 K to 4 K that nearly matches that of Nb_3Sn wire. The reduced-scale model coil utilizes Haynes 242 and surplus copper cable from the original 45 T hybrid magnet. It will be the first time a significant quantity of this material will be used throughout the full magnet construction process.

Progress in the fabrication of model coils and verification measurements of CICC will continue through 2008. Additionally the designs for the cryostat, external cryogenics, and Nb-Ti shield coil will near completion and be the focus of an external design review at the end of the year.

Nb_3Sn UNDULATOR

Argonne National Laboratory plans to upgrade the beam line of the Advanced Photon Source (APS), for which higher-performance undulators are desired that perform beyond the capabilities of state-of-the-art permanent-magnet-based technology. In 2005 a project was started to demonstrate the feasibility of superconducting Nb_3Sn undulators. Early work focused on assembly technology by investigating both a fully modular and single-piece yoke approach. An approach in which each 2.5-m long yoke of a user magnet is subdivided into a limited number of segments connected by near-superconducting joints appears to be the most viable. A quarter-length model with one joint per jaw was designed in 2006 and was built in 2007 (**Figure 7**). Some

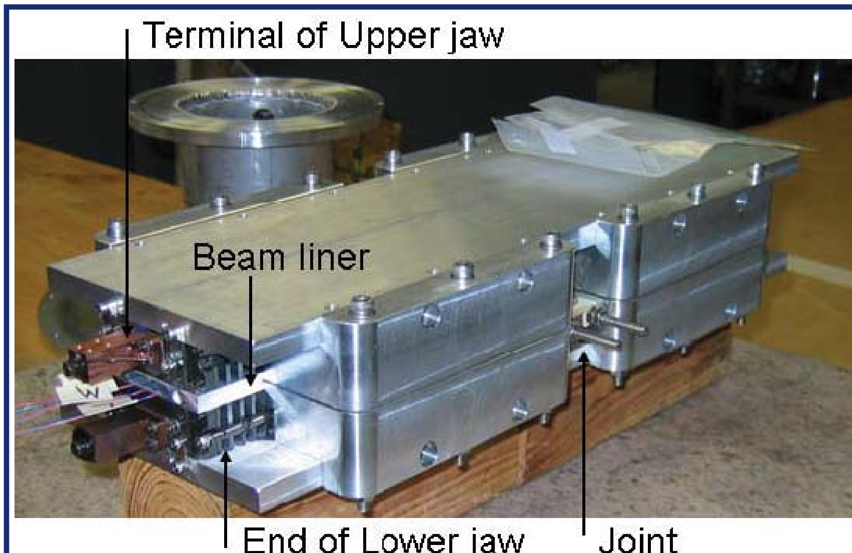


Figure 7.
The model coil prepared for the helium bath test.

minor design changes were implemented, including a change from round to rectangular helium reservoirs for improved ease of fabrication and better ability to maintain dimensional tolerances. The number of conductor turns in windings near the end of the magnet was optimized to minimize beam deflection. At the end of 2007, the model coil was in the final stages of preparation for a test of its current carrying capability in a helium bath providing direct cooling of the windings. In a follow-up experiment the helium tanks will be installed and the coil configured for testing in conduction cooled mode.

HIGH-FIELD SUPERCONDUCTING COILS

The NHMFL intends to continue to lead the world in high-field superconducting magnet technology both for our own user facilities and for others. This is occurring by combining the skills of the Magnet Science and Technology division, which developed the 900 MHz ultra-wide bore NMR magnet, and the Applied Superconductivity Center, which has been working on high-temperature superconductors for twenty years.

YBCO. The progress that has been achieved in the development of YBCO conductor, including long lengths with uniform properties and high critical currents, was dramatically demonstrated in 2007 with the test of a YBCO coil designed and fabricated by SuperPower Inc. in collaboration with the NHMFL. The coil contained approximately 500 m of YBCO tape conductor, and reached a record high field of 26.8 T while tested in the 19 T background field of the large-bore resistive magnet (**Figure 8**). This result was a powerful indication of the progress in the development of YBCO conductors and the suitability of the conductor for the production of very high field superconducting magnets. The test result motivated the establishment of an in-house program for the further development of YBCO conductors and magnet technology with the objective of eventually producing very high field all superconducting user magnets. An initial NHMFL development coil was designed based on available information on the mechanical and electromagnetic characteristics of YBCO tape. A coil and conductor development program was organized. A length of 850 m of conductor was ordered for characterization and fabrication of a development coil. Facilities suitable for tape magnet fabrication were designed and are being made, including coil winding and assembly, and conductor insulation. An analysis was begun of high-field magnets that would employ inner YBCO coils to achieve fields in the neighborhood of 30 T and that might initially be suitable for installation in the micro-Kelvin facility.

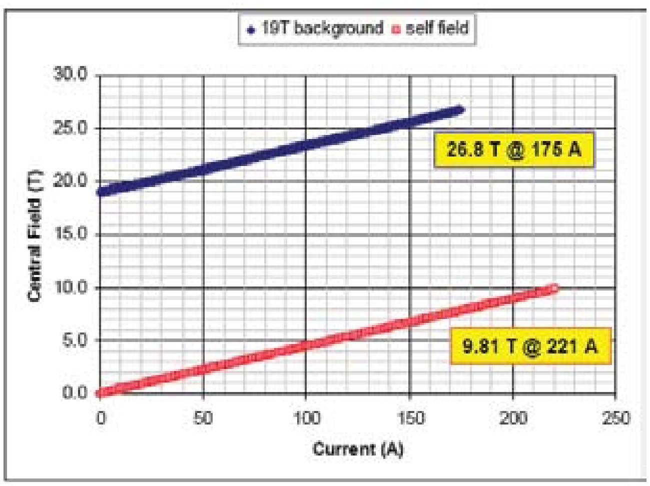


Figure 8.
Performance characteristics of a 12 pancake coil made from SuperPower YBCO coated conductor that operated to new benchmarks of field for a superconducting magnet in July 2007.

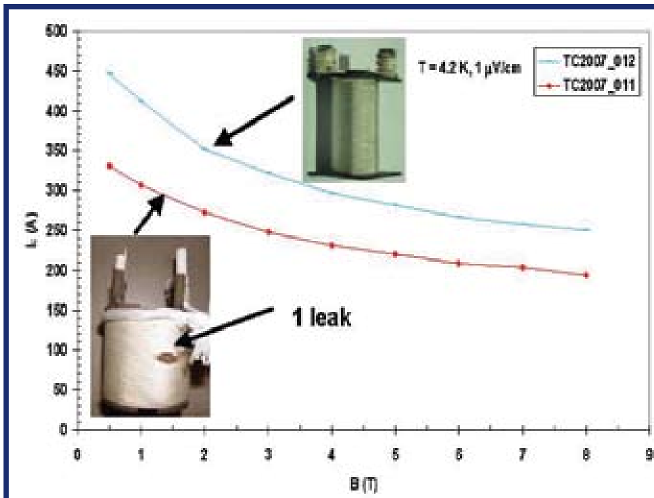


Figure 9.
Performance of two Bi-2212 coils wound on Inconel 600 coil forms. The coil shown in the upper image had no apparent leaks whereas the coil in the lower image had only one leak.

BSCCO. Bi2212 has important technical advantages compared with YBCO that make it appealing for high-field applications, including availability in long length and in a round wire geometry that is electromagnetically isotropic and retains high transport currents at the highest fields. The maximum in the pinning force is reached at around 45 T (at 4.2 K) and a conservative estimate of the irreversibility field is at least 85 T. A layer-wound insert magnet with a 30 mm free bore using Bi2212 round wire, manufactured with the wind and react (W&R) approach, has been designed. In its current configuration, the magnet should generate 7 T in an 18 T background magnetic field. The conductor is Bi2212/Ag-alloy, 85 x 7 multifilament wire manufactured by Oxford Superconducting Technology (OST). It has an outer diameter of 1.3 mm including a 0.15 mm thick alumino-silicate fiber braid. To explore and understand potential issues with thermal processing of larger winding packs and solve other basic technology issues, fourteen small sample-coils have been wound, heat-treated and studied regarding superconducting, and microstructural properties, as well as chemical compatibility properties between conductor, electrical insulation and structural materials. The W&R coils were processed using a standard heat treatment in which we investigated how slight variations in T_{max}, and time at T_{max} affected the coil properties.

It was found that materials in contact with the conductor during heat treatment must be chosen carefully due to potentially severe chemical interactions causing conductor leakage that degrades coil properties. For the W&R route, the wire is covered with insulation prior to the heat treatment, so it must withstand the high-temperature processing conditions and be an electrical insulator at cryogenic temperatures. During heat treatment, leaks can occur, apparently due to holes in the Ag sheath through which Bi2212 melt can flow. These leaks can be minor, causing slight discoloration of the insulation, or they can be major, provoking severe reaction with the insulation and lowering the local critical current in the vicinity of the leak. During 2007 we started a systematic attack to understand the multiple causes of this leakage.

SUPERCONDUCTING MATERIALS

YBCO. The main thrusts of our work are to understand the current limiting mechanisms operating in YBCO, to minimize AC loss and to open up the technology of very high magnetic field magnets. We made significant progress on all facets of the work in 2007.

The principal current limiting mechanisms in YBCO are vortex depinning within grains and the current blocking effects of misaligned grain boundaries. Concerning grain boundary (GB) engineering, we have been exploiting the understanding obtained in our 2005 *Nature Materials* paper [Song *et al.*] on the effects of Ca-doping on the YBCO grain boundary atomic structure, chemistry and electromagnetic properties. In 2007, we extended the segregation study by using our model to design a series of RE-alloyed grain boundaries using the size of the RE ion as the variable. We were particularly interested in the use of small and large RE ions such as Yb (small) and Nd (large). The essential issue of grain boundaries in pure YBCO is that they are under-doped with respect to the grains due to the local GB strain produced by the distorted GB lattice structure, one of whose consequences is to kick out chain-layer O near the GB. The under-doped nature of the GB can be fixed by *over-doping* or *strain relief*, which can be achieved by a combination of partial Ca substitution, or other cation substitution.

An extensive array of individual grain boundary studies performed by isolating individual grain boundaries within coated conductors were published in 2007. A key feature of these studies is that meandered grain boundaries pass significantly higher current densities than planar grain boundaries of the type almost universally used for scientific study and that the critical angle of 2-3° established so clearly by Dimos *et al.* is delayed until at least 6°. Moreover the important factor that the GB becomes progressively weaker as H and T increase also holds up well for the case of meandered GBs too. Particularly valuable to YBCO is the fact that very strong intra-grain flux pinning is possible since this allows the vortex segments that lie in the grains (the overwhelming length) to pin the short segments that lie in the GBs. Thus the intergrain J_c of GBs becomes a much less well defined quantity than hitherto thought.

Important studies of the thickness dependence of the critical current density were also completed in 2007. In the search for a broad and systematic understanding, milling studies were performed on MOD coated conductors grown on RABiTS, on MOCVD coated conductors grown on IBAD substrates, on a high J_c multilayer PLD film with strong pinning 211 particles, and the latest two-layer MOD RABiTS coated conductor. In all cases we found that there was a varying degradation of J_c with increasing thickness *t* that was connected not to any fundamental vortex physics dimensionality but to individual degradation mechanisms that varied from film to film. The key point of these studies of 4 films of 3 different types (MOD, MOCVD and PLD) is that when strong pinning precipitates are present with separations much smaller than the film thickness, then the pinning is essentially 3 dimensional and independent of film thickness. This behavior is significantly different than occurs in most nominal single phase YBCO films grown by PLD in which dislocations and other natural defects form the pinning landscape. Although J_c *(self field 77 K)* is almost independent of the method of growth, the in-field properties are quite different and broad range, in-field measurements are needed to bring up the full flux pinning properties, including the through-thickness properties.

Theoretical studies of ultimate pinning limits and the optimum density of vortex pinning nanoparticles were also performed. This work pointed out the important roles of multiscale pinning mechanisms and the crystalline anisotropy as one of the key limiting factors for both J_c and the irreversibility field of high-T_c superconductors. In particular, this model enabled us to establish some rather restrictive conditions under which (for now) imaginary superconductors with critical temperatures > 300 K can carry currents in magnetic fields at room temperatures.

Nb_3Sn. Nb_3Sn remains an important superconductor for 11-22 T applications such as plasma confinement for fusion reactors, NMR and research magnets such as the Series-Connected Hybrid magnets to be built at NHMFL. At high fields huge Lorentz forces are generated on the superconducting strand and potential breakage of the brittle Nb_3Sn compound is of great concern. A detailed review of ways in which the current density of modern wires have developed J_c was made last year, but major experimental effort turned to the analysis of filament cracking in Nb_3Sn composites of interest to ITER. We have advanced two techniques for imaging fracture events in brittle Nb_3Sn filaments embedded in composite wires. The first is a traditional metallographic technique, and the second is a novel deep etching technique that provides a 3-D view of the damaged structure. We can image (by SEM or laser confocal microscopy (**Figure 10**)) the distribution of fracture events produced by testing in the TARSIS apparatus at the University of Twente, or by pure strand bending or microindentation. We have shown that strands with different filament architectures produce different filament fracture patterns after mechanical testing in TARSIS or microindentation. Filaments under compression show almost no fracture behavior, regardless of the Nb_3Sn to Cu volume fraction. Filaments under tension always show some crack propagation, the effect being most severe with highly agglomerated filament structures, such as the high J_c prototype strand shown in **Figure 10**, where, because there is very little interfilamentary Cu, the cracks induced by micro-indentation propagate over 100 μm. The local stress environment and the amount of interfilamentary Cu present in Nb_3Sn composite strands play key roles in determining the extent to which nucleated cracks will propagate across multiple filaments. The clear implication is that crack propagation can be arrested by maintaining a compressive stress state and introducing more Cu. Such conditions make the strand much more tolerant of large Lorentz forces and less likely to experience critical current degradation during magnet operation, but at the expense of lowering the J_c of the whole conductor. Understanding this tradeoff of performance with composite design is ongoing into 2008.

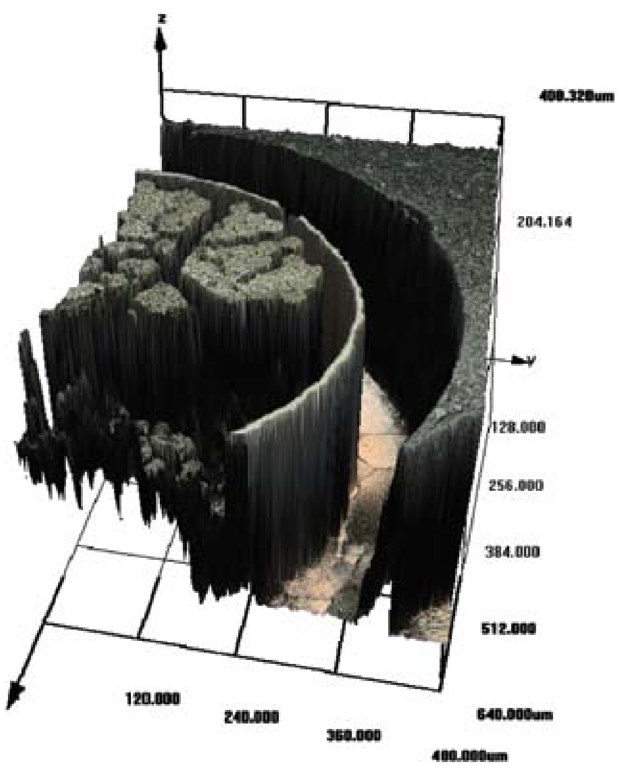


Figure 10.
Scanning Laser Confocal Microscope image of deep etched post-mortem TARSIS 5 mm bend sample (EAS Bronze process) revealing distribution of broken filaments and the residual strain induced redistribution of the filaments in the cross-section.

MgB_2. Work on MgB_2 in both bulk and thin film form continued in the year. Under NSF Focused Research Group support that unites efforts at Penn State, Arizona State, the University of Wisconsin, the University of Puerto Rico-Mayaguez, and Florida State, we were able to address several key issues. In a collaboration between UW, PSU and FSU, we were able to view the structural changes that occur in the highest (60 T plus) H_{c2} films. Using analytical TEM it was shown that the very high C contents of the HPCVD films occur very inhomogeneously, most of the C depositing as an amorphous layer between MgB_2 crystallites, consistent with the reduced connectivity of such films. The exceptional H_{c2} of such films may be explained by extensive nanoscale disorder of the MgB_2 grains, especially plane rumpling and many rotations that provide new ways to inject strong scattering into MgB_2. An additional FSU-UW collaboration with NIMS Japan has revealed some of the key features of SiC-doped bulk forms of MgB_2 in which exceptional (for bulk forms that normally do not exceed 35 T) H_{c2} values of almost 50 T were measured. In this case great disorder was also seen in the MgB_2 and strong O segregation occurred around precipitate reactions of the SiC with MgB_2. Extensive study was also made of the effects of ball milling C into MgB_2. This method of alloying is reproducible and effective, particularly in enhancing the irreversibility field of MgB_2 from ~10 T at 4.2 K to 17 T. The dominant structural change produced by the milling is intense refinement of the grain size to below 20 nm, even after hot isostatic pressing at 1000°C. We have found that such milling has generated the highest current densities and irreversibility fields yet seen in bulk form MgB_2.

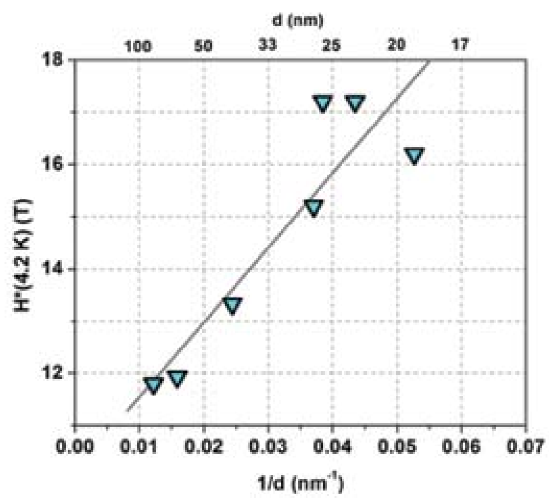


Figure 11.
Linear relationship between the irreversibility field H*(4.2 K) and the inverse grain size of ball milled C-doped MgB_2.

Nb for Superconducting Radio Frequency Cavities. Quenching below the critical field H_c is common in practical cavities. Experimental study of vortex penetration at Nb surfaces and grain boundaries (GBs) is underway. In 2007 we developed a technique to image the flux entering individual GBs, to measure the electromagnetic properties of an individual GB, and to obtain an atomic resolution view of the structure of that GB under conditions characteristic of optimal polishing of SRF cavities. An important finding was that vortex penetration appears to occur only at some GBs and, so far, only under conditions when the magnetic field is parallel to the plane of the GB. Buffered chemical polishing leads to extensive differential grain etching and thus to steps at GBs that may produce field enhancements at the GB or deleterious depression of the superconducting order parameter at the GB. Discrimination between such possibilities is the goal of ongoing work in 2008. In parallel with the experimental effort, extensive theoretical study of the nonlinear dynamics of a single vortex under a strong RF magnetic field $B(t)=B_0\sin\omega t$, particularly the dissipated power $Q(B_0, \omega)$, and the transient time scales characteristic of hypersound velocities of vortices penetrating through the oscillating surface barrier at RF fields B_0 near the thermodynamic critical field H_c have been made. Penetration of a single vortex through the ac surface barrier always involves penetration of an antivortex and subsequent annihilation of the vortex antivortex pairs. The nonlinear Larkin-Ovchinnikov (LO) viscous drag force at higher vortex velocities v(t) results in a jump-wise vortex penetration through the surface barrier and a significant increase of the dissipated power. The effect of dissipation on nonlinear vortex viscosity $\eta(v)$ and the rf vortex dynamics can also result in LO-type behavior, instabilities, and thermal localization of the penetrating vortex channels. A thermal/diffusion feedback model, which not only results in the LO dependence of $\eta(v)$ for a steady-state motion, but also takes into account retardation of temperature or quasiparticle fields around rapidly accelerating vortex, and its long-range interaction with the surface, was developed. The model also addresses the effect of pinning on the nonlinear rf vortex dynamics and the effect of trapped magnetic flux on the surface resistance R_s. Trapped flux can result in a temperature-independent residual resistance R_i at low T, and a hysteretic low-field dependence of $R_i(B_0)$, which can *decrease* as B_0 is increased, reaching a minimum at B_0 much smaller than the thermodynamic critical field B_c. This work addresses key aspects of cavity performance from both experimental and theoretical points of view.

HIGH STRENGTH MATERIALS

The large stresses generated by high-field magnets frequently exceed the strength of most of the existing normal conductors, superconductors, and structural materials. Therefore, higher-strength materials are required if higher field magnets to be developed. In 2007, we addressed the urgency for the requirement of the high strength materials for high field magnets in our renewal proposal, and we started some preliminary work that was promised in the proposal.

The efforts on high strength conductor developments focus on both pure Cu and Cu composite conductors. In pure Cu, we proposed to make Cu with high densities of twins to enhance the mechanical strength but maintain low electric resistance. Our previous work indicates that it is feasible to achieve both high strength (up to 580 MPa) and high electrical conductivity (95% IACS) in Cu with refined twins and high density of dislocation cells. In 2007, we showed that we were able to make high density twinned Cu by pulsed electrodeposition (PED) technique, as shown in **Figure 12**. The PED has been shown by Lu *et al.* to have a potential for production of pure Cu with strength up to 1 GPa [Lu, L. *et al.*, Science, **304**, 422 (2004)]. However, the authors stated that current density up to 100 A/cm^2 was required to make the nanotwinned Cu with high strength. With such a high current density, it is impractical to make the conductors for high field magnets. We systematically studied the influence of peak current densities (PCDs), substrates on crystallographic textures; twin densities; electrical transport and mechanical properties of the PED Cu films. Textured and twinned Cu films were obtained, and the material properties of the Cu can be manipulated by engineering the textures and twin densities rather than grain sizes, with maximum PCD as low as 2 A/cm^2 [Cui, B.Z. *et al.*, Acta Mater., **55**, 4429 (2007)]. This current density is about 1/50 of the one used by previous authors and makes it possible to make the conductors for high field magnets with such a technology. In this way, both the ultimate tensile strength and the ductility are simultaneously improved without increasing the electrical resistivity. For composite conductors, we have published our new fabrication routes for making CuNb [Cui, B.Z. *et al.*, Scripta Mater., **56**, 879 (2007)] / CuAg [Shen, T.D. *et al.*, J. Materials Science, **42** (5), 1638 (2007)] normal conductors and high strength Nb_3Sn superconductors [Chen, J. *et al.*, IEEE Trans. Appl. Supercond., **17** (2), 2584 (2007)].

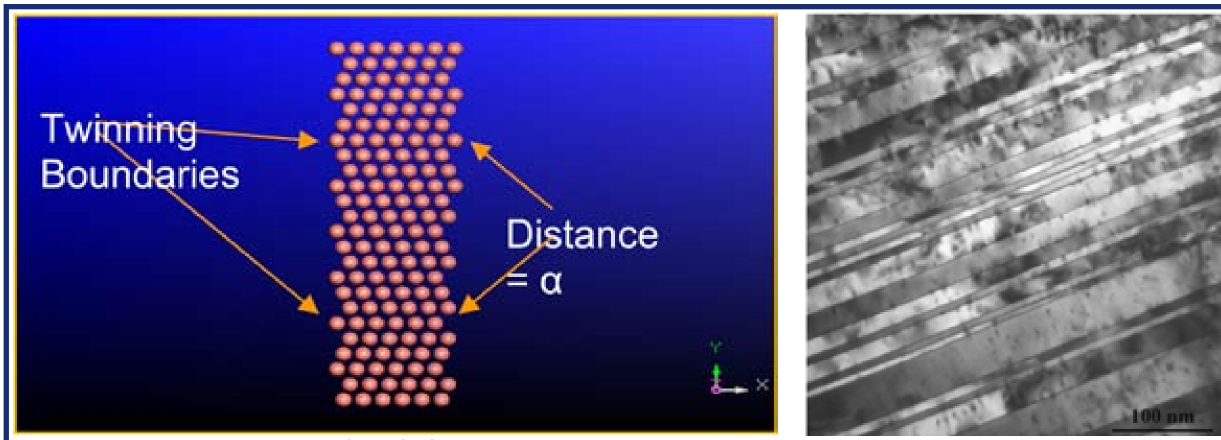


Figure 12. **Twinned Cu Block (a = nm)**

(a) Schematic pictures show twinning in Cu. (b) Transmission electron microscopy image showing nanotwinned Cu.

In 2007, we made efforts in understanding the cryogenic physical properties of various high strength magnet materials using our new physical property measurement system. A typical example is the characterization of Haynes 242, a nickel-based high strength superalloy for series-connected hybrid magnets applications [Lu, J. *et al.*, J. Appl. Phys. **101**, 123710 (2007)]. In this work, physical properties of Haynes 242 including magnetization, specific heat, electrical resistivity, thermal conductivity, and Seebeck coefficient were measured from 2 to 300 K. We found that Haynes 242 is weakly paramagnetic at 4.2 K. Its thermal transport properties at cryogenic temperatures are similar to that of stainless steel. Our results suggest that Haynes 242 is suitable for many cryogenic applications including conduit for cable-in-conduit conductor of large superconducting magnets.

CHAPTER 5: USER COLLABORATION GRANTS PROGRAM

PREVIOUSLY, THE IN-HOUSE RESEARCH PROGRAM

The National Science Foundation charged the National High Magnetic Field Laboratory (NHMFL) with developing an internal grants program that ***utilizes*** the laboratory's facilities to carry out high quality research at the forefront of science and engineering and ***advances*** the facilities and their scientific and technical capabilities. Established for this purpose in 1996, this program was called the In-House Research Program (IHRP). To reflect the large amount of collaboration with external users that the program generates, the program was renamed this year, to the User Collaboration Grants Program (UCGP).

The User Collaboration Grants Program seeks to stimulate magnet and facility development and to provide intellectual leadership for experimental and theoretical research in magnetic materials and phenomena. It funds 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 UCGP 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 Magnet Lab cannot fund clinical studies.

Twelve UCGP solicitations have now been completed with a total of 395 pre-proposals being submitted for review. Of the 395 proposals, 196 were selected to advance to the second phase of review, and 85 were funded (21.5% of the total number of submitted proposals).

2007 SOLICITATION AND AWARDS

The User Collaboration Grants Program has been highly successful as a mechanism for supporting outstanding projects in the various areas of research pursued at the laboratory. Since 2001, submission and proposal review (including two review stages) have been conducted and managed via a web-based system.

Of the 22 pre-proposals received in 2007, the committee recommended that 10 pre-proposals be moved to the full proposal stage. Of the 10 full proposals, 5 grants were awarded. A breakdown of the review results is presented in Tables **1 and 2**.

Table 1. *User Collaboration Grants Program Solicitation Results, 2007*

Research Area	Pre-Proposals Submitted	Pre-Proposals Proceeding to Full Proposal	Projects Funded
Condensed Matter Science	6	4	2
Biological & Chemical Sciences	11	5	3
Magnet & Magnet Materials Technology	5	1	0
Total	22	10	5

Table 2. *User Collaboration Grants Program, Funded Projects, 2007 Solicitation*

Lead P.I.	NHMFL Institution	Project Title	Funding
Neil Sullivan	UF	NMR Studies of Superfluidity in Solid ^{4}He	$166,485
Dimitry Smirnov	FSU	Carbon Nanotube Based Devices in High Magnetic Fields	$180,740
Samuel Grant	FSU	An Integrated *in vivo* System for 21.1 T: Novel RF Technology for Rodent MRI	$178,260
William Brey	FSU	Instrumentation and Techniques to Use ^{14}N NMR to Probe the Structure of Biomolecules	$179,921
Peter Fajer	FSU	From EPR to Molecular Structure: Simulations of the Nitroxide Label Behavior	$178,994

2008 SOLICITATION

The 2008 Solicitation Announcement will be released on April 1, 2008. Awards will be announced by the end of the year.

RESULTS REPORTING

To assess the success of the User Collaboration Grants Program, reports were requested in January 2008, on grants issued from the solicitations held in the years 2003 through 2006, which had start dates respectively near the beginnings of years 2004 through 2007. At the time of the reporting, some of these grants were in progress, and some had been completed. For this "retrospective" reporting, PIs were asked to include external grants, Magnet Lab facilities enhancements, and publications that were generated by UCGP funding. Since the UCGP is intended to seed new research through high risk initial study or facility enhancements, PIs were allowed and encouraged to report results that their UCGP grant had made possible, even if these were obtained after the term of the UCGP grant was complete.

Reports on a total of 31 grants were received, and the results are summarized in **Tables 3 and 4**. The success of the program is evident from the wide-ranging enhancements produced and from the production of peer-reviewed publications, many in high impact journals. These include 1 article in *Nature*, 5 in *Nature Physics*, 30 in *Physical Review Letters*, and 5 in the *Journal of the American Chemical Society*. A significant positive impact on education is also evident from the reporting, since almost all grants were reported to have supported one or more students, at least partially or through supplies.

Information on collaborations with external users was also gathered this year and showed collaborations with 23 separate external groups.

Table 3. *New Facility Enhancements Reported, 2003-2006 UCGP Solicitations*

NMR spectrometer, cryostats and ^{3}He probe
Instrumentation for resistively detected NMR
Rotator to perform pulsed critical currents at different temperatures
Instrumentation for Double Electron-Electron Resonance (DEER) Spectroscopy
Ultrafast spectroscopy capability, to 150 fs
^{3}He system probe for simultaneous infrared transmission and electric transport measurement
Probe for dielectric constant and dielectric polarization measurements
Contribution to establishment of new crystal growth program at the NHMFL
350 and 700 GHz quasioptical superheterodyne spectrometers for resistive magnets
Point contact spectroscopy set up for resistive magnets
^{3}He system automated rotator probe with special temperature control for resistive magnets and hybrid
Design of a helical strain probe to examine validity of General Invariant Stain Analysis predictions
Quartz dilatometer, for thermal expansion and magnetostriction measurements
Two-axis rotator used in the hybrid magnet
Instrumentation for pulse echo transmission and resonant ultrasound spectroscopy
Capability for pulse echo ultrasound with high hydrostatic pressure
Low E magic angle spinning probe for biological solid state NMR at 750 MHz
Microwave connected rotating stages for dilution fridges
Capability for specific heat and magnetocaloric effect measurements at dilution fridge temperature
Capability for specific heat and magnetocaloric effect measurements in pulsed magnetic fields

Table 4. *New Publications Reported, 2003-2006 UCGP Solicitations**

App. Phys. Lett.	2
Inorg. Chem.	2
J. Am. Chem. Soc.	5
J. Biomol. NMR	1
J. Exp. and Theor. Phy.	1
J. Low Temp. Phys.	5
J. Mag. Mag. Matter	1
J. Magn. Reson.	2
J. Mod. Optics	1
J. Mod. Phys. B	4
J. Phys.–Chemistry	1
J. Phys. – Condens. Mat.	4
J. Phys. – Conference Series	1
Magnet. Reson. Chem.	1
Nanotechnology	3
Nature	1
Nature Physics	5
Physica B	3
Physica E	3
Phys. Rev. B	38
Phys. Rev. Lett.	30
Polyhedron	3
Rev. Sci. Instru.	3
Conference Proc.	42

* High impact journals appear in bold.

CHAPTER 6: EDUCATION

After over a decade of programming for students, teachers, and the general public, the **Center for Integrating Research and Learning** (CIRL) continues to serve as a local, regional and national resource. In 2007, amid much debate, the State of Florida developed new science standards. CIRL educators were involved at many levels: the Magnet Lab Teacher in Residence, Richard McHenry, was a writer and reviewer, and Pat Dixon, Director of CIRL, served as a reviewer, illustrating how education at the Magnet Lab interacts with the education community.

Educational outreach has many layers, from web-based resources to face-to-face outreach. CIRL group members work independently and together to provide quality programming for schoolchildren, undergraduates, teachers, and the public.

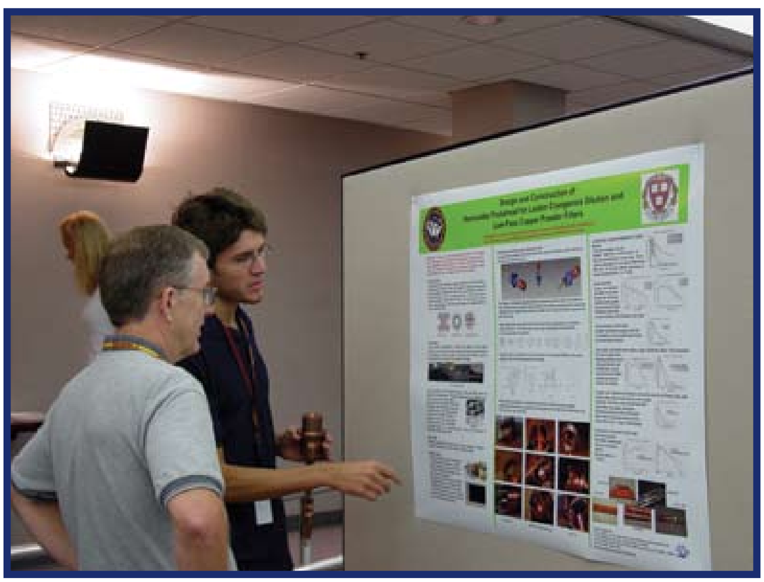
- Carlos Villa, full-time outreach coordinator, maintains a steady schedule of classroom and community outreach;

- Jose Sanchez, assistant director, administers three signature programs, Research Experiences for Undergraduates, Research Experiences for Teachers, and the Magnet Lab Ambassador Program, as well as classroom and community outreach;

- Pat Dixon, director, facilitates the Magnet Lab SciGirls program, creates partnerships with other educational outreach entities as well as with private industry partners, works with pre-service teachers, and participates in classroom and community outreach; and

- Felicia Chavez, administrative support, in 2007, assumed all outreach and tour scheduling as well as overall support for all programs administered by CIRL.

The CIRL team is committed to enhancing science education at all levels—a commitment that has grown with the lab and with increasing media and public attention to science in our schools.



RESEARCH EXPERIENCES FOR UNDERGRADUATES

Twenty students from 15 universities conducted research in Tallahassee, Gainesville, and Los Alamos (see **Table 1**). Steven Robinette attending the University of Florida worked at the Tallahassee site with Rafael P. Bruschweiler and will continue the work started at the Magnet Lab at Imperial College in London. Steven's work was presented at the 16th International *C. Elegans* Meeting and is being published in the *Journal of Chemical Physics*. This is a prime example of how support for talented undergraduates provides the impetus for future successes. Many of the Magnet Lab's undergraduates have gone on to high level jobs in government and industry and advanced degrees at the country's most prestigious universities. A number of REU participants have either stayed on or returned to Florida State University and the Magnet Lab to pursue research careers and Ph.D. degrees.

Table 1. *Research Experiences for Undergraduates, Class of 2007*

Florida State University, Tallahassee

REU Participant	School	Research Area	Mentor
Rebecca Altman	Florida State University	Rocket Car Driven by the Vaporization of Liquid Nitrogen	Sylvie Fuzier
Mary Bauman	Florida State University	Magneto-elastic Distortions in Single Crystal MgV_2O_4	Chris Wiebe
Courtney Bennett	Florida State University	Wild-type p53-transfected Glioblastoma Cells	Carol Nilsson
Jaime Calderon	University of Turabo Puerto Rico	Electrical Engineering Approaches to Physical Measurements in Condensed Matter	James Brooks
Shalton Evans	Prairie View A&M University	Heat Capacity of Heavy Fermion $CeCoIn_5$:Fe	Kevin Storr
Elliot Hawkes	Harvard University	Design and Construction of Removable Probehead for Leiden Cryogenics Dilution and Low-Pass Copper Powder Filters	Irinel Chiorescu
Rebecca Shea Kelly	University of Alabama at Huntsville	Physical Characterization of Novel Organic Materials	James Brooks
Anthony Kuhns	McGill University	Dynamic Modeling of Deformation of Twinned Copper Samples Using Parallel Process Computing	Ke Han
Julia Luongo	Swarthmore College	Thermal-hydraulic Analysis of the Series Connected Hybrid Magnet Outsert Using the Computer Program "FLOWER"	Iain Dixon
Nivia Medina	University of Puerto Rico Mayaguez	Painting the Nuclear Envelope: Fluorescent Protein-Lamin B1 Fusions	Mike Davidson
Suchandan Pal	Florida State University	Exact Diagonalization of the Quadrupole Hamiltonian in Nuclear Magnetic Resonance Spectroscopy	Arneil Reyes
Steve Robinette	University of Florida	Automated Profiling of Metabolics Mixtures by NMR Spectral TOCSY Traces	Rafael Bruschweiler
Mark Wartenbe	Florida State University	Electron-Phonon Coupling in Ni Thin Film	Jim Cao

Los Alamos National Laboratory, New Mexico

REU Participant	School	Research Area	Mentor
Isiah Helm	Montana State University	Hydrostatic Pressure Cell Design for Cryogenic Operation in Pulsed Magnetic Fields	Chuck Swenson
Sean Miller	International University Bremen	60-110 GHz Resonance Chambers for Low Temperature ESR Probes	Chuck Mielke
Jose Negrete	University of Texas El Paso	Anomalous Hall Effect in AuFe at 8%	Alex Lacerda
Sally June Tracy	Occidental College	Cyclotron Resonance of Semiconductors in Ultra-High Magnetic Fields	Chuck Mielke
Anna Trugman	Stanford University	Implementation of the Next-generation Resonant Ultrasound Spectroscopy System for the User Program at NHMFL-LANL, including hardware assemble and testing, and software development	Albert Migliori

University of Florida, Gainesville

REU Participant	School	Research Area	Mentor
Gabriela Sanz-Douglass	Sonoma State University	Magnetic Susceptibility Studies of Heterostructures of Prussian Blue Analogs	Mark Meisel
Justin Cohen	University of Florida	Neutron Scattering Simulation on an S = 1=2 Quantum Spin Ladder	Mark Meisel

RESEARCH EXPERIENCES FOR TEACHERS

In summer 2007, 12 teachers participated in the first summer of a 5-year NSF-funded research study on how teachers translate research experiences into changes in classroom practice (see **Table 2**). One returning teacher also participated and, for the first time, an international participant was part of the Magnet Lab RET program. Funded by the American Jewish Federation and other sources, Zehorit Kapach, a high school physics teacher from Ramat Hasharon, Israel, worked with Chris Wiebe, assistant professor in condensed matter physics. A recent "Where Are They Now?" study of RET participants 1999-2006 conducted by CIRL researcher Margareta Pop, Ph.D., provides evidence that the real-world research experience provided by RET and RET-like programs generates long-term lasting effects on teachers.

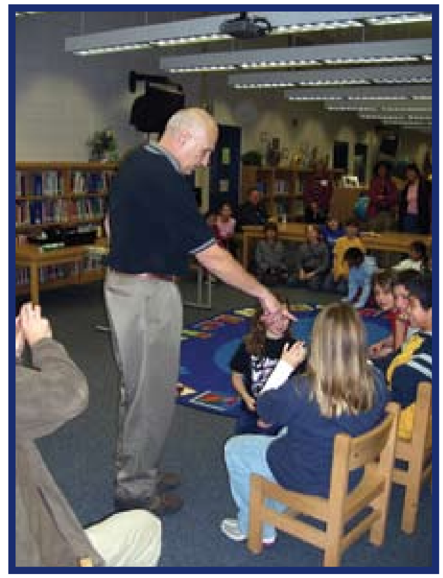
Table 2. *Research Experiences for Teachers, Class of 2007*

RET Participant	Home Town	Research Area	Mentor
Beth Button	Tallahassee, FL	Plasmid & Fluorescent Protein Replication for Cell Imaging	Mike Davidson
Charles Carpenter	Monticello, FL	Proteomic Analysis of Brain Tumor Cells by Use of FT-ICR MS	Carol Nilsson
Betsy Cunningham	Tallahassee, FL	Heat Treatment and Analyzing of High Temperature Superconductor $Bi_2 Sr_2 CaCu_2 O_x$ (BSCCO 2212)	David Larbalestier
Charles Cutler	Tallahassee, FL	NMR Microscopy Analysis of the Zebra Finch Neural Pathway Following Exposure to Nicotine or Ecstasy	Sam Grant
Gary Davis	Tallahassee, FL	Synthesis of a $CeCoIn_5$ Single Crystal	Tesafaye Gebre
Richard Frey	Atlanta, GA	Structural, Mechanical and Electrical Properties of Highly Textured and Twinned Cu Film Fabricated by Pulsed Electrodeposition	Ke Han
Candace Gautney	Tallahassee, FL	Heat Treatment and Analyzing of High Temperature Superconductor $Bi_2 Sr_2 CaCu_2 O_x$ (BSCCO 2212)	David Larbalestier
Mark Johnson	Ocala, FL	NMR Microscopy Analysis of the Zebra Finch Neural Pathway Following Exposure to Nicotine or Ecstasy	Sam Grant
Zehorit Kapach	Tel Aviv, Israel	Order-Disorder Transitions in the s=1/2 Chromate $(NH_4)_3 CrO_8$	Chris Wiebe
Tynica Lewis	High Point, NC	Metallographic Sample Preparation	Bob Goddard
Marcia Martin	Pembroke Pines, FL	Electron-Phonon Coupling in Ni Thin Film	Jim Cao
William Millard	Tallahassee, FL	Determining the Ni Content in St. Helena Olivines	Vincent Salters
Mary Patrick	Tallahassee, FL	Plasmid & Fluorescent Protein Replication for Cell Imaging	Mike Davidson
Melissa Olson	Tallahassee, FL	On-chip Deposition for Local Control of Nanomagnets	Irinel Chiorescu
Brooks Spelling	Tallahassee, FL	Metallographic Sample Preparation	Bob Goddard

CIRL again partnered with WFSU-TV and the Tallahassee Museum in 2007 to provide a 2-week opportunity for girls to experience hands-on science during the SciGirls I and SciGirls II camps. Thirty-two girls from sixth to tenth grade participated in activities as diverse as digging up a skeleton to learn about forensic anthropology to making models of comets. In an era when more girls look to Paris Hilton as a role model, there is a need for educational outreach professionals to look for ways to engage young women in STEM fields. Funded by Dragonfly TV, the SciGirls received attention in two articles in *Cold Facts*, the journal of the American Cryogenics Society, from Florida State University's Headline News, and from local news media. Watching 32 teenage girls learn about a wide variety of science careers, as well as how real-world science is done, points up the need for more such programs for boys and girls.

OUTREACH

In 2007, over 8,800 K12 students received visits by CIRL educators, the vast majority by Outreach Coordinator Carlos Villa. Each year, the challenge is to engage students at all levels with new and exciting activities that translate complex science concepts. The Center has accepted the challenge extended by No Child Left Behind's legacy of high stakes tests by modeling strategies for covering detailed standards through inquiry. While classroom outreach requests are at an all-time high, CIRL is increasing its efforts to involve parents and specifically parents and children at underserved schools. Consequently, CIRL educators are participating in an increased number of "Science Nights" and "Science Days" through which we typically reach between 200-400 parents and children. In spring 2007, 16 middle school students worked with 13 Magnet Lab mentors (Bob Walsh, Michael Bizimis, Afi Sachi-Kocher, Steve Downey, Peter Kalu, Matthew J. Party-Hill, Lloyd Engel, Arneil Reyes, Phil Kuhns, Robert Smith, Scott Bole, Todd Adkins, and Bob Goddard) to complete research projects on subjects ranging from bridge design to java programming. The public presentation of their work exemplifies the ability of motivated seventh grade students to produce quality research. Middle school students have returned as REU participants and as interns through university programs.



In addition to formal programming for students, there are many other outreach activities that are supported by lab scientists and CIRL educators. In 2007, more than 12 local school-wide science fairs were supported. The hundreds of students that participate in such activities are assisted, encouraged, and inspired by lab scientists. Many Magnet Lab scientists and graduate students assist schools in this effort. A core group of volunteers from the scientific staff at the lab is routinely asked to participate and they rarely refuse: Matt Jewell, Eric Hellstrom, Dragana Popovic, Afi Sachi-Kocher, Maartje van Agthoven, Vlad Dobrosavljevic, Stephen McGill, and Bill Brey.

CIRL, through two contracts negotiated by Jose Sanchez and Pat Dixon, formalized a partnership with the **Panhandle Area Educational Consortium** (PAEC), which serves 21 North Florida school districts. PAEC provides educational programs, professional development, and overall support for rural counties that are typically underserved because of their remote locations. CIRL is providing materials, facilitating professional development through regional workshops, and working with PAEC to provide quality programming and curriculum materials to up to 200 area middle and high school science and math teachers.

The Center for Integrating Research & Learning has, since 1996, taken the Magnet Lab's mission for educational outreach that capitalizes on the unique resources of the lab to the highest level. While CIRL provides educational expertise and creative programming, lab scientists, graduate students, and administrative staff provide the support necessary to implement the vision.

CHAPTER 7: COLLABORATIONS

Magnet Lab researchers and staff work hard to develop partnerships and collaborations with the private sector, federal agencies and institutions, and international organizations to develop a wide variety of magnet-related technologies and to advance other projects that bring technologies closer to the marketplace. Indeed, engaging in these kinds of R&D activities is part of the National Science Foundation's charge to the Magnet Lab.

PRIVATE SECTOR ACTIVITIES IN THE UNITED STATES

ALABAMA CRYOGENIC ENGINEERING, INC., HUNTSVILLE, AL

Alabama Cryogenic Engineering, Inc. is a small business specializing in fabrication of materials via hydrostatic extrusion. The company and the laboratory have undertaken a joint research project on fabrication of high critical current density low-temperature superconductors for next-generation superconducting magnets. Because of the high efficiency of the fabrication approach, conductors can be fabricated in an inexpensive manner.
(Magnet Lab contact: Ke Han, MS&T)

B&B MICROSCOPES, PITTSBURGH, PA

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

BAKERPETROLITE, SUGARLAND, TX

Deposits formed in petroleum production equipment pose major obstacles to safe, economical production of heavy oils in both terrestrial and deep offshore production environments. With the help of BakerPetrolite, the FT-ICR facility has provided detailed compositional analysis for commonly encountered production deposits for oil reserves all over the globe. The compositional information is vital to the design of the next generation of chemical dispersants and inhibitors to reduce deposition in the transport of heavy petroleum reserves. Another concern is that many species in oil that are soluble under reservoir conditions (high temperature and pressure) become unstable when oil production starts. Their precipitation poses significant problems in oil production. The FT-ICR facility has begun the compositional analysis of pressure-induced and temperature-induced precipitants from live oil samples. The results show that specific classes (chemical functionality) preferably precipitate when either the temperature or pressure is dropped from reservoir conditions.
(Magnet Lab contact: Ryan Rodgers, ICR)

BIOPTECHS, BUTLER, PA

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

BRUKER BIOSPIN CORP., BILLERICA, MA

The Magnet Lab's NMR instrumentation program and Bruker Biospin collaborate on the development of low-E probes for solid-state NMR in heat sensitive biological samples, such as proteins.
(Magnet Lab contacts: William Brey and Peter Gor'kov, NMR)

CHARACTER AND HERITAGE INSTITUTE (FORMERLY ROSSIER PRODUCTIONS INC.), TALLAHASSEE, FL

The Center works with President and CEO Gail Rossier to create innovative science programs for middle school students. Operation Filmmaker, Science Style premieres in summer 2008.
(Magnet Lab contact: Pat Dixon, Educational Programs)

CHROMA, ROCKINGHAM, VT

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

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

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

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

EVERSON-TESLA INC., NAZARETH, PA
This collaboration entails the production of large-scale coils for the 100 T Multi-pulse Magnet Program.
(Magnet Lab contact: Chuck Swenson, LANL)

EXXONMOBIL CORP., IRVING, TX
The FT-ICR facility has an ongoing collaboration with this oil company to explore new mass spectrometric techniques for characterization of petroleum crude oil and its products. Current efforts involve application of field desorption/field ionization (FD), atmospheric pressure photoionization (APPI), electron ionization, and chemical ionization. FD and APPI provide access to non-polar components (e.g., hydrocarbons, thiophenes, etc.) not accessible by conventional electrospray ionization.
(Magnet Lab contact: Ryan Rodgers, ICR)

FOVEON, SANTA CLARA, CA
An innovative corporation exploring true color "complementary metal-oxide semiconductor" (CMOS) image sensor technology, Foveon is involved with developing educational tutorials with the Magnet Lab that explain its cutting-edge technology in image sensor design. Scientists at the lab are developing image galleries using a variety of optical contrast enhancing techniques in the microscope.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

H.C. STARCK, INC., CLEVELAND, OH
H.C. Starck produces an assortment of refractory metal powders and super-alloys that is unique. This collaboration focuses on production of high strength MP35N nickel cobalt alloy sheet for reinforcement in support of the pulsed magnet program.
(Magnet Lab contact: Chuck Swenson, LANL)

H.R. TEXTRON, ASC RESEARCH GROUP, SANTA CLARITA, CA
This collaboration entails the reliability evaluation of circuit components, control systems, and machinery in pulsed magnetic fields.
(Magnet Lab contact: Chuck Swenson, LANL)

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

HAYNES INTERNATIONAL, INC., KOKOMO, IN

This manufacturer of specialty alloys is collaborating with the laboratory's Materials Development and Characterization Group in researching one of their superalloys (Haynes 242) for use in Cable-in-Conduit Conductor (CICC) superconducting magnets. The company has supplied samples of Haynes 242 in production form that can be directly processed into conduit for CICC magnets being built at the Magnet Lab. Metallurgists from the company are assisting our materials scientist in the selection of processing variables and the analysis of performance tests. The alloy's superior properties make it likely to be a direct replacement for conventional 316LN. The improved properties will allow increased superconductor performance along with a decrease in overall magnet size and cost.
(Magnet Lab contact: Bob Walsh, MS&T)

LUVATA OHIO, DELAWARE, OH

Luvata is a multi-national corporation engaged in the production of copper and copper alloy products. Our collaboration with Luvata entails the drawing of high-strength Glidcop alloys and the production of large cross-section CDA-107 conductors for our pulsed magnet programs.
(Magnet Lab contact: Chuck Swenson, LANL)

MBL INTERNATIONAL, WOBURN, MA

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

MEDIA CYBERNETICS, SILVER SPRING, MD

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

MOLECULAR PROBES/INVITROGEN, EUGENE, OR

A major supplier of fluorophores for confocal and widefield microscopy, Molecular Probes is collaborating with the laboratory to develop educational tutorials on the use of fluorescent probes in optical microscopy.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

N.I. TEJIN SHOJI INC., NEW YORK, NY

N.I. Tejin Shoji supplies ultra-high-strength fiber and sample materials for composite development in support of the pulsed magnet programs.
(Magnet Lab contact: Chuck Swenson, LANL)

NIKON USA, MELVILLE, NY

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

OLYMPUS AMERICA, CENTER VALLEY, PA

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

OMEGA OPTICAL, BRATTLEBORO, VT

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

OXFORD SUPERCONDUCTOR TECHNOLOGIES (OST) CARTERET, NJ

The manufacturer of Nb_3Sn superconducting wire is collaborating with laboratory's Materials Development and Characterization Group in researching their latest advanced low temperature superconductors. The lab's superconductor wire test facility is designed for tests of the critical current versus strain behavior of low temperature Nb_3Sn superconductors. Materials scientists at Oxford are assisting by providing the latest high performance superconductors and consultation with respect to test methodology and data analysis.
(Magnet Lab contact: Bob Walsh, MS&T)

PFIZER GLOBAL RESEARCH & DEVELOPMENT, SAN DIEGO, CA

Dr. Michael Greig at Pfizer is collaborating with the ICR program in a novel application of supercritical fluid chromatography (SFC) to separate peptides following hydrogen-deuterium exchange experiments, thereby essentially eliminating deuterium-hydrogen back-exchange, which had been the primary drawback to such analyses. This idea was a specific aim of the recently funded NIH project for which Greig is a contributor.
(Magnet Lab contact: Mark Emmett, ICR)

PHOTOMETRICS (ROPER SCIENTIFIC, INC.), TUCSON, AZ

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

PHOTONICS INSTRUMENTS, PITTSFIELD, MA

The lab's microscopy research team is collaborating with engineers at Photonics Instruments to develop photoactivation techniques for widefield and spinning disk confocal microscopy. This collaboration involves live-cell imaging techniques.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

PRIOR SCIENTIFIC, INC., ROCKLAND, MA

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

SCHLUMBERGER-DOLL RESEARCH, RIDGEFIELD, CT

This research focuses on the correlation between downhole fluid behavior and composition determined by FT-ICR mass spectrometry. Additional research projects aim at compositional variations in reservoir fluids that reveal compartmentalization (i.e. multiple isolated compartments present in a single reservoir). Both projects address the biggest current problems in reservoir risk management.
(Magnet Lab contact: Ryan Rodgers, ICR)

SEMROCK, ROCHESTER, NY

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

TRAINING SOLUTIONS INTERACTIVE, INC., I4LEARNING, ATLANTA, GA & TALLAHASSEE, FL

TSI and the Center for Integrating Research & Learning (CIRL) have been collaborating since 1998 to bring Science, Tobacco & You to more than 20 states. TSI specializes in the implementation of programs, systems, and strategies to improve efficiency and productivity in business, industry, and education. Because of the overwhelming success of Science, Tobacco & You, TSI and the Center continue to maintain an active and dynamic business relationship. Anticipated projects include an update of Science, Tobacco & You and physics curriculum materials for high school students and teachers.
(Magnet Lab contact: Pat Dixon, Educational Programs)

INTER-AGENCY AND INTER-INSTITUTIONAL ACTIVITIES

ADVANCED PHOTON SOURCE AT ARGONNE NATIONAL LABORATORY, ARGONNE, IL

The lab is under contract to develop and test a Nb_3Sn undulator demonstration magnet, with the intent of developing magnet technology for a planar Nb_3Sn undulator at the IXS beam line of the Advanced Photon Source.

(Magnet Lab contact: H. Weijers, MS&T)

COLUMBIA UNIVERSITY, STANFORD UNIVERSITY, UNIVERSITY OF CALIFORNIA SANTA BARBARA, UNIVERSITY OF RHODE ISLAND

The Center for Integrating Research & Learning continues its collaboration with other institutions that conduct educational outreach with teachers. Through the Research Experiences for Teachers (RET) Network, the Center maintains a national presence among other laboratories, centers, and universities that conduct RET and other teacher enhancement programs. Current projects include expansion of the current RET Network web site to include input from additional sites and an interactive component to share best practices. In addition, the RET Network will be a comprehensive site that compiles lists of RET programs across the country.

(Magnet Lab contact: Pat Dixon, Educational Programs)

FALK CENTER FOR MOLECULAR THERAPEUTICS, NORTHWESTERN UNIVERSITY, EVANSTON, IL

Joseph R. Moskal and Roger A. Kroes are collaborating with the FT-ICR facility on the inhibition of invasion of glioblastoma brain tumors through gene therapy. Drs. Moskal and Kroes bring their unique glyco-gene array technology and expertise in the field of Glycomics to the collaboration which permits a Systems Biology approach (proteomics, lipidomics, glycomics, transcriptomics and phenotypic response) to the search for therapeutic targets for treatment of glioblastoma brain tumors.

(Magnet Lab contact: Mark R. Emmett, ICR)

INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR (ITER), OAK RIDGE, TN

The United States is part of an international collaboration to construct and operate ITER, a full-scale experimental device designed to demonstrate the feasibility of fusion energy. The U.S. ITER project office at Oak Ridge National Laboratory has enlisted the Magnet Lab's Magnet Science and Technology Div. to assist in the design and R&D of the large superconducting magnetic device (TOKAMAK) that is essential for plasma confinement during the fusion reaction. Engineers in MS&T are collaborating on magnet design topics such as stress analysis, component tests, and materials characterization.

(Magnet Lab contact: Bob Walsh, MS&T)

LEON COUNTY SCHOOLS, TALLAHASSEE, FL

The Center for Integrating Research & Learning facilitates science workshops and summer institutes for Leon County Schools. With high stakes testing in science now part of school accountability, the Center has responded to the call of teachers and schools to provide quality professional development. The Center currently maintains formal partnerships with two elementary schools, three middle schools, and two high schools. In 2006, Leon County Schools funded a full-time Teacher in Residence at the Magnet Lab in an effort to further solidify the partnership and to assist teachers with science instruction.

(Magnet Lab contact: Pat Dixon, Educational Programs)

LOS ALAMOS NATIONAL LABORATORY, APPLIED MODERN PHYSICS GROUP, LOS ALAMOS, NM

This collaboration entails the investigation of pulsed magnet pre-polarization coils for low-field magnetic-resonance imaging systems.

(Magnet Lab contact: Chuck Swenson, LANL)

LOS ALAMOS NATIONAL LABORATORY, PLASMA PHYSICS GROUP, LOS ALAMOS, NM

The laboratory's collaboration with the Plasma Physics Group involves the investigation of plasma confinement geometries using pulsed magnetic fields.

(Magnet Lab contact: Chuck Swenson, LANL)

LOS ALAMOS NATIONAL LABORATORY, SUPERCONDUCTING TECHNOLOGY GROUP, LOS ALAMOS, NM

Magnet Lab and LANL engineers and scientists are collaborating on a proposal for constriction of pilot HTS SMES.

(Magnet Lab contact: Chuck Swenson, LANL)

M.D. ANDERSON CANCER CENTER, HOUSTON, TX

This collaboration with Charles A. Conrad, M.D., associate professor of neuro-oncology and medical director of the Anne C. Brooks Neuro Center, involves the study of a protein (galectin-1) as a therapeutic target in the progression of glioblastoma multiforme brain tumors. The galectin target was discovered in previous collaborations between Conrad, Carol L. Nilsson (then of Göteborg University), and Mark R. Emmett of the FT-ICR program. The initial collaboration was primarily funded by a Swedish STINT grant. Recently, Mike Davidson, director of the Magnet Lab's Optical Microscopy group, joined the collaboration to provide high resolution fluorescent photomicroscopy of the live glioblastoma cell lines.
(Magnet Lab contacts: Mark Emmett, ICR, and Mike Davidson, Optical Microscopy)

MARY BROGAN MUSEUM OF ART AND SCIENCE, TALLAHASSEE, FL

The lab's Center for Integrating Research and Learning currently partners with The Brogan to create an interactive exhibit that translates complex science concepts for the general public.
(Magnet Lab contact: Pat Dixon, Educational Programs)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, PLASMA SCIENCE AND FUSION CENTER, CAMBRIDGE, MA

The Magnet Lab collaborates in the measurement of the critical current of Nb_3Sn strands and cables under transverse pressure at 4.2 K and in magnetic fields up to 14 T, on candidate conductors for fusion magnets (ITER).
(Magnet Lab contact: H. Weijers, MS&T)

MIAMI UNIVERSITY, OXFORD, OH

The Magnet Lab completed a contract to provide a low-E RF probe for solid-state NMR of aligned proteins. The instrument is used by the research group of Professor Gary Lorrigan.
(Magnet Lab contact: Peter Gor'kov, NMR)

SANDIA NATIONAL LABORATORY, ALBUQUERQUE, NM

Magnet Lab engineers at the Pulsed Field Facility are collaborating with Sandia colleagues on the development of the design for electromagnetically driven shutters.
(Magnet Lab contact: Chuck Swenson, LANL)

SPALLATION NEUTRON SOURCE, OAK RIDGE, TN

In late 2006 the National Science Foundation awarded funding to a team including researchers at Johns Hopkins University, the NHMFL, the SNS, and MIT for a Conceptual Engineering Design of a conical Series-Connected Hybrid magnet suitable for neutron scattering at the SNS. The 2-year study includes development of a conical resistive magnet. This model coil was successfully tested in December 2007.
(Magnet Lab contact: Mark D. Bird, MS&T)

UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MN

The lab has a contract with Professor Gianluigi Veglia of the University of Minnesota to develop low-E RF technology for solid-state NMR of aligned proteins.
(Magnet Lab contact: Peter Gor'kov, NMR)

UNIVERSITY OF NEBRASKA-LINCOLN, LINCOLN, NE

In collaboration with Diandra Leslie-Pelecky, Department of Astronomy and Physics, the Center is working to assist scientists and researchers with meeting NSF Criterion II, Broader Impacts. The effort, with support from NSF, expands the role of the educational outreach professional.
(Magnet Lab contact: Pat Dixon, Educational Programs)

UNIVERSITY OF NEW MEXICO, ALBUQUERQUE, NM

A 1-year non-disclosure agreement between Los Alamos National Laboratory and Professor Claudia D. Tesche of the Department of Psychology of the University of New Mexico in Albuquerque regarding a miniature pulsed coil for transcranial magnetic stimulation was negotiated and put in effect April 10, 2007. Following this, James R. Sims, Josef B. Schillig, and Curtt N. Ammerman of Los Alamos National Laboratory/NHMFL jointly submitted a NHMFL User Collaboration Grants Program (UCGP, formerly the In-House Research Program) Pre-proposal with Professor Tesche to build a prototype of such a transcranial stimulation coil and test it on a phantom (emulates a human head). This pre-proposal was not selected for further consideration. In August 2007, the U.S. Department of Energy elected to proceed to apply for a patent for this miniature pulsed coil; the application

for this patent has been filed. Further consideration is being given to attempting to obtain funding to build a prototype coil; DARPA may be solicited for this funding.
(Magnet Lab contact: Jim Sims, LANL)

INTERNATIONAL ACTIVITIES

A.A. BOCHVAR INSTITUTE OF INORGANIC MATERIALS, MOSCOW, RUSSIA
The lab collaborates with the institute on the development of a high-strength high-conductivity conductor in support of the NSF 100 T insert and other pulsed magnet programs.
(Magnet Lab Contact: Chuck Swenson, LANL)

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

FORSCHUNGSZENTRUM KARLSRUHE, KARLSRUHE, GERMANY
The lab completed a contract to develop a low-E RF probe for solid-state NMR of aligned proteins. The instrument is used by the research group of Professor Anna Ulrich.
(Magnet Lab contact: Peter Gor'kov, NMR)

HAHN-MEITNER INSTITUTE, BERLIN, GERMANY
In March 2007 HMI signed an agreement with Florida State University Magnet Research and Development (FSUMRD) to develop a Series-Connected Hybrid magnet suitable for neutron scattering experiments and install it at HMI. The magnet is intended to provide 25 T on-axis using 4 MW of dc power and have upstream and downstream scattering angles of 30 degrees. A design review of the magnet system was held at the Magnet Lab in November 2007.
(Magnet Lab contact: Mark D. Bird, MS&T)

ITER ORGANIZATION, CADARACHE, FRANCE
The International Thermonuclear Experimental Reactor is being built in France and will employ Cable-In-Conduit Conductor similar to the conductors used in the NHMFL's hybrid magnets. ITER has contracted with the laboratory to develop a numerical model that predicts the critical current of these conductors including thermal compression, thermal bending, electromagnetic bending, and other effects.
(Magnet Lab contact: Mark D. Bird, MS&T)

KOREA BASIC SCIENCE INSTITUTE, DAEJEON, SOUTH KOREA
The lab's Magnet Science and Technology group is collaborating with the Korea Basic Science Institute (KBSI) to advance very high field superconducting solenoid technology through collaborative technology development. The present collaboration includes development of 1.8 K cryogenic technology with the goal of minimizing or eliminating cryogen refills. The 1.8 K operational temperature enables the use of higher superconducting current carrying capacities available at the lower temperature. The higher current capacities are used to create higher fields and/or higher operating margins, which in turn reduce risk.
(Magnet Lab contact: Tom Painter, MS&T)

KOREA BASIC SCIENCE INSTITUTE, DAEJEON, SOUTH KOREA
Dr. Hyun Sik Kim headed a group of KBSI scientists who spent two years at the Magnet Lab with the ICR group to modify a commercial 7 T FT-ICR mass spectrometer for installation with a 15 T superconducting magnet at KBSI. In the first stage, we replaced the commercial data system with a Magnet Lab home-built system that controls data acquisition and data reduction and display. In the recently completed second stage, we modified the modules for ion introduction, ion accumulation, ion transmission, ion trapping, and excitation/detection of the ICR signal. The project was funded by KBSI (separately from the project mentioned above) and completed in 2007 with the successful installation of the mass spectrometer.
(Magnet Lab contact: Christopher Hendrickson, ICR)

LINKAM, SURREY, UNITED KINGDOM

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

OLYMPUS CORP., TOKYO, JAPAN

Investigators at the Magnet Lab have been collaborating with engineers at Olympus, Tokyo, to develop and test new optical microscopy systems for education and research. In addition to pacing the microscope prototypes through basic protocols, the lab is developing technical support and educational web sites as part of the partnership.
(Magnet Lab contact: Mike Davidson, Optical Microscopy)

QIMAGING, BURNABY, BRITISH COLUMBIA, CANADA

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

SYNCRUDE RESEARCH, EDMONTON, ALBERTA, CANADA

The largest petroleum reserve in North America rests in Alberta, Canada. With proven recoverable reserves approaching those of Saudi Arabia, Alberta will be an important supplier of petroleum crude oil to the United States in the near future. Although abundant, the Alberta reserves are heavily biodegraded and take the form of oil-soaked sand. The sand is mined with conventional mining equipment, and the oil is extracted by water to yield a petroleum product called bitumen. Bitumen is further refined and upgraded to produce synthetic crude oil ("syncrude"). Water extraction can form stable emulsions that significantly reduce the amount of recoverable oil. Furthermore, the large volumes of emulsion (oil) laden water must be recycled to limit the water consumed in production. Recycling the water discharges large amounts of oil (in the form of emulsions) and other water soluble oil components into the environment. In collaboration with Syncrude Research, we have analyzed the interfacial material responsible for the stable emulsion formation. The analysis identified chemical compound classes that preferentially accumulate in the interfacial material and stabilize the emulsion. Work is underway to design chemicals that interfere with those specific classes of compounds to prevent stable emulsion formation.
(Magnet Lab contact: Ryan Rodgers, ICR)

UNIVERSITÉ DE REIMS, FRANCE

The collaboration between the lab and the Université de Reims is related to the characterization of nanostructure materials. The materials are mainly Cu-Nb multilayers with both high hardness and good conductivities.
(Magnet Lab contact: Ke Han, MS&T)

UNIVERSITY OF CALGARY, CALGARY, ALBERTA, CANADA

In-reservoir biodegradation can alter the composition of a parent petroleum fluid and cause problems in production and refining. In collaboration with Steve Larter and Barry Bennett in the Petroleum Geochemistry group at the University of Calgary, we have analyzed a series of samples collected at different vertical and horizontal sampling locations within a single reservoir. The mass spectral results serve as a compositional map of the reservoir and indicate areas of increased microbial activity. The compositional information from the acidic species has been shown to provide a useful indicator for the degree of biodegradation in the reservoir.
(Magnet Lab contact: Ryan Rodgers, ICR)

CHAPTER 8: CONFERENCE & WORKSHOP INVOLVEMENT

Conference and workshop involvement is essential to disseminating the Magnet Lab community's knowledge and research. Whether it is a huge conference or a small technical workshop, Magnet Lab staff and users are deeply involved in information sharing on both the scientific research and magnet technology fronts. A sampling of the lab's conference and workshop involvement follows below.

10TH JOINT MAGNETISM AND MAGNETIC MATERIALS / INTERMAG CONFERENCE
January 7-11, 2007
Baltimore, Maryland

The MMM/Intermag Conference was held at the Baltimore Marriott Waterfront Hotel in Baltimore, Maryland. Members of the international scientific and engineering communities interested in recent developments in magnetism and associated technologies attended the conference and contributed to its technical sessions. The Magnet Lab's **Marcelo Jaime** was a member of the conference's program committee, and **Vivien Zapf** gave an invited talk.

DESIGN AND APPLICATIONS OF FREE ELECTRON LASERS (FELS) FOR RESEARCH WITH HIGH MAGNETIC FIELDS WORKSHOP
January 21-23, 2007
Newport News, VA

This workshop was the fourth in a series intended both to optimize the output parameters of the NHMFL Light Source and to develop and enhance the science drivers for the project. The invited lecturers comprised potential users of the facility, users, designers, and instrument scientists from other light-source projects in the United States and Europe, the young scientists associated with the current NHMFL light source grant, and the design team from the Jefferson Laboratory.

The Newport News workshop complemented the Baltimore Workshop (March 2006), which chiefly concerned soft condensed matter physics and biophysics. Science speakers were therefore drawn chiefly from the semiconductor physics, superconductivity, magnetism, chemistry, and magnetic resonance communities; facility speakers included representatives from Brookhaven, UCSB, Dresden (Germany), and 4GLS (UK). The latter two projects are very relevant to the NHMFL Light Source, as they involve some related technical challenges; in some ways, their current efforts can be regarded as technology demonstrators for the NHMFL Light Source.

6TH NORTH AMERICAN FT-ICR CONFERENCE
April 1-5, 2007
Lake Tahoe City, CA

This biennial conference has become a primary forum for presentations of the latest and best developments in FT-ICR. The conference was initiated by the Magnet Lab's FT-ICR Program in 1997 and continues to be organized and hosted by the laboratory. The 2007 meeting attracted 95 leading researchers from the United States, Germany, Austria, Czech Republic, The Netherlands, France, Sweden, and Switzerland. The technical program featured 30 posters and 24 invited speakers, concluding with a plenary lecture by **Gerald Gabrielse**, Leverett Professor of Physics at Harvard University on "Lunatic Fringe ICR: A New Measurement of the Electron Magnetic Moment and the Fine Structure Constant." The invited presentations ranged from instrumentation to technique development in the biological/biomedical sciences ranging from pharmaceutical metabolism to proteomics, environmental analysis, and petroleomics, with special emphasis on new developments.

Generous sponsorship by Thermo Electron Corporation, Bruker Daltonics, Advion BioScience, Varian, Oxford Instruments, Florida State University Department of Chemistry and Biochemistry, the National High Magnetic Field Laboratory, and ExxonMobil made it possible to provide registration and lodging for all invited speakers as well as 17 student awards for poster presentations.

2007 BIG LIGHT WORKSHOP
May 23-24, 2007
Tallahassee, FL

The Big Light IV Workshop was designed for discussion of chemistry and biology applications for the proposed Free Electron Laser at the NHMFL. The workshop was geared toward collecting a broad range of potential experiments and techniques to help inform who should guide the project as it moves forward. The workshop was attended by about 60 guests.

2007 CRYOGENIC ENGINEERING CONFERENCE AND INTERNATIONAL CRYOGENIC MATERIALS CONFERENCE
July 16- 20, 2007
Chattanooga, TN

The 2007 Cryogenic Engineering Conference (CEC) and International Cryogenic Materials Conference (ICMC) were held jointly at the Chattanooga Convention Center. The conference program format consisted of plenary, focused, and special sessions with oral and poster presentations covering all aspects of cryogenic engineering and materials. In addition, an extensive exhibit showcased the most up-to-date products and technologies in the cryogenic field.

In addition to the participation of Magnet Lab faculty and staff (including **Steve Van Sciver** who is on the CEC Board), the laboratory also partially sponsored the event. At the meeting, **David C. Larbalestier**, Director of the NHMFL Applied Superconductivity Center, was awarded the ICMC Lifetime Achievement Award, and Van Sciver was presented with the Fellow of the Cryogenic Society of America Award.

30TH ANNUAL SOLID-STATE NMR SYMPOSIUM OF THE 49TH ANNUAL ROCKY MOUNTAIN CONFERENCE ON ANALYTICAL CHEMISTRY
July 22-26, 2007
Breckenridge, CO

The conference features symposia on solid-state NMR, electron paramagnetic resonance, pharmaceutical analysis, luminescence and advances in LC/MS analysis, MALDI analysis, and separations science.

The Magnet Lab provided a travel grant to this event. The Jack E. Crow Travel Grant was established in memory of Jack Crow, founding director of the National High Magnetic Field Laboratory, in recognition of his long-time support of the NMR Symposium at the Rocky Mountain Conference.

5TH ANNUAL WORKSHOP ON MECHANICAL AND ELECTROMAGNETIC PROPERTIES OF COMPOSITE SUPERCONDUCTORS — MEM '07
August 21-24, 2007
Princeton, NJ

The annual MEM conference was sponsored by the NEDO International Joint Research Program and National High Magnetic Field Laboratory Applied Superconductivity Center. Discussions focused on several broad areas:

- Electromagnetic Properties: Critical current, irreversibility field, AC losses and other electromagnetic phenomena and their dependence on external stimuli like bending, compressive and tensile stresses, electromagnetic forces, mechanical, and thermal cycling

- Mechanical Properties: Tensile and compressive properties, fatigue characteristics and fracture behavior

- Thermal Properties: Thermal conductivity, thermal expansion, and thermal strain

- Test Methods: International cooperative research work to establish test methods for assessing mechano- and electromagnetic properties based on the activities of IEC/TC90 and VAMAS/TWA-16

- FEA and HPC modeling of superconducting properties. Predictions of critical current and mechanical properties of composite superconductors through statistical analysis, finite element analysis and HPC.

20TH INTERNATIONAL CONFERENCE ON MAGNET TECHNOLOGY
August 27-31, 2007
Philadelphia, PA

The International Conference on Magnet Technology is the major international forum for scientists and engineers to present and discuss the latest research results, ideas, and developments in every aspect of the science, technology, and applications of magnets. MT-20, the 20th conference of this biennial series, was hosted by the IEEE Council on Superconductivity.

MT-20 included plenary and invited talks, and contributed oral and poster presentations, focusing on all types of magnets and their applications. Superconducting, normal conducting, permanent, hybrid, high field, and pulsed techniques were discussed in terms of systems, components, materials, and processes. Emphasis was given to industrial applications and new developments in research areas. Computation, design, stress analysis, superconductor stability and protection, heat transfer, cryogen-free, measurements, and analysis were part of the conference program.

The conference was attended by at least ten members of the Magnet Lab community and featured a plenary talk by **Justin Schwartz** and an invited talk by **David Larbalestier**.

EUROPEAN CONFERENCE ON APPLIED SUPERCONDUCTIVITY
Brussels, Belgium
September 16-20, 2007

EUCAS is the major European conference devoted to applications of superconductivity. Although initially founded as an exchange Forum mainly for European scientists, it has gradually developed into a truly international meeting. The scientific aims of EUCAS were focused on the interplay between the most recent developments in superconductor research and the positioning of applications of superconductivity on the market place.

EUCAS is held every two years in different venues in Europe. The 2007 meeting included a plenary talk by **David Larbalestier** and an invited talk by **Justin Schwartz**.

2007 LOW TEMPERATURE SUPERCONDUCTING MATERIALS WORKSHOP IN LAKE TAHOE
October 30-November 1, 2007
Lake Tahoe, CA

This workshop, sponsored by the U.S. Department of Energy's Office of High Energy Physics, brings together leaders from government, academia, national labs, and industry for the purpose of advancing the development of high-field superconducting materials and magnet systems. In recent years, the LTSW community has played a key role in achieving the DOE-HEP goal of 3,000 A/mm^2 in superconducting Nb_3Sn wire, and has also begun to turn its attention to higher-field material systems such as MgB_2 and Bi-2212.

The Applied Superconductivity Center (ASC) has supported the LTSW for 25 years, and co-organized this meeting in Lake Tahoe. This year's workshop featured seven presenters and eight attendees from the Magnet Lab, including ASC director David Larbalestier, who was the workshop organizer.

CHAPTER 9: MANAGEMENT & ADMINISTRATION

The National High Magnetic Field Laboratory is jointly operated for the National Science Foundation by Florida State University, the University of Florida, and Los Alamos National Laboratory (with user programs at each of those locations) under a cooperative agreement that establishes the lab's goals and objectives.

FSU, as the signatory of the agreement, is responsible for establishing and maintaining administrative and financial oversight of the lab, and ensuring that the operations are in line with the objectives outlined in the cooperative agreement.

In 2007, the Florida State University Magnet Research and Development Co. (FSU-MRD), a nonprofit direct support organization of the Magnet Lab, was created to promote and encourage the work of faculty, staff, and students through income from contracts, grants, and other sources. Specifically, FSU-MRD will design, develop, build, and test magnet systems. As part of that mission, FSU-MRD entered into an agreement in 2007 with the Hahn-Meitner Institute of Berlin to build an ultra-high field magnet for neutron scattering. The organization is governed by a board of directors. More information about FSU-MRD can be found online at ***www.fsumrd.magnet.fsu.edu.***

MANAGEMENT

Gregory Boebinger serves as director and principal investigator of the Magnet Lab. He oversees the Magnet Science and Technology Program, the activities of the Applied Superconductivity Center, as well as the associate director.

Alex Lacerda, associate director for User Programs, accepted a post as interim division leader of the Materials and Physics Applications Division at Los Alamos National Laboratory in October of 2007. Upon Lacerda's departure, Boebinger became acting director for User Programs, overseeing user operations and facilities, and the User Collaboration Grants (previously referred to as In-House Research Program) and Visiting Scientist programs. Marcelo Jaime of the Pulsed Field Facility was named acting center leader at Los Alamos.

Brian Fairhurst serves as associate director for Management and Administration. He oversees public affairs, education, facilities, safety, human resources, Web outreach, computer support, budgeting and other administrative functions.

As 2007 began, five senior faculty members served as co-principal investigators on the NSF grant. After the departure of Lacerda, remaining co-PIs are:

- Tim Cross (FSU), Nuclear Magnetic Resonance program director
- Arthur Edison (UF), Advanced Magnetic Resonance Imaging and Spectroscopy program director
- Alan Marshall (FSU), Ion Cyclotron Resonance program director
- Neil Sullivan (UF), High B/T program director.

The lab's scientific direction is overseen by the **Science Council**, a multidisciplinary group of distinguished faculty from all three sites that serves as a think tank to consider and help guide the lab's scientific mission. Members are: Albert Migliori (chair), Rafael Brüschweiler, Mark Emmett, Lev Gor'kov, David Larbalestier, Denis Markiewicz, Dragana Popovic, and Glenn Walter.

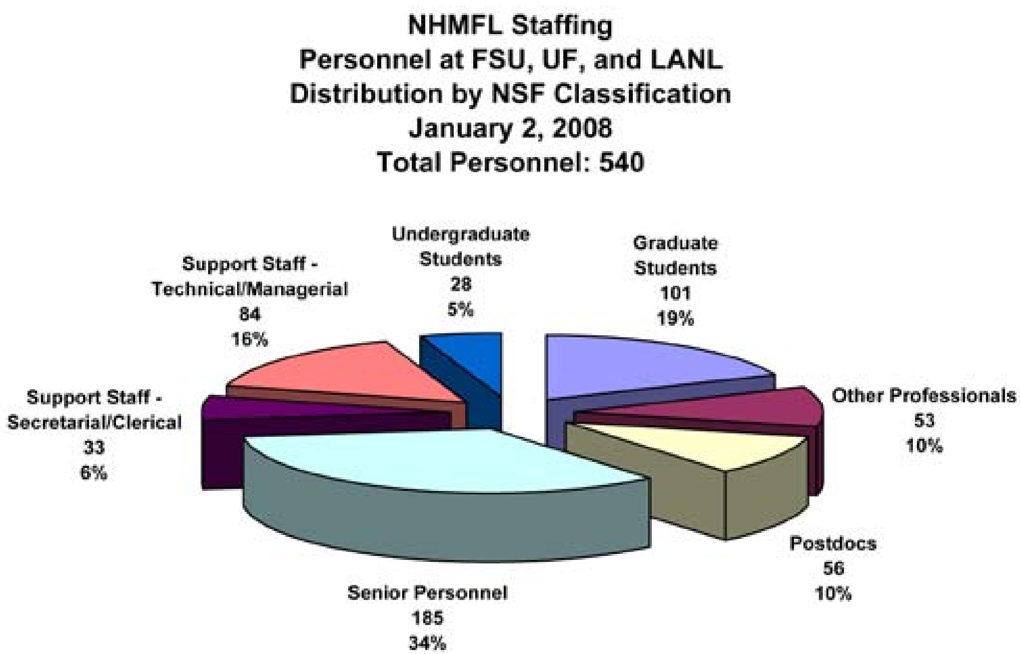
Two external committees meet regularly to provide critical advice on important issues. Reflecting the broad range of scientists who conduct research at the lab, the **Users Committee** provides guidance on the development and use of facilities and services in support of the work of those scientists. The **External Advisory Committee**, made up of representatives from academia, government and industry, offers advice on matters critical to the successful management of the lab.

PERSONNEL AND STAFFING

Mag Lab veteran Mark Bird was officially named director of the lab's Magnet Science and Technology division in 2007. Bird began his tenure in Tallahassee in 1992 as an assistant scholar/scientist. He stepped into the interim director role in 2006 after John Miller left to head up the magnet system team for the U.S. International Thermonuclear Experimental Reactor (ITER) Project Office.

2007 was year of transition for the DC Field Facility. Bruce Brandt, who had directed the facility since its inception, retired in July. His position was split into two distinct positions: director of DC user program and director of DC instrumentation and facilities. Eric Palm and Scott Hannahs filled these positions, respectively, on an interim basis until the start of 2008, when both were made permanent.

Approximately 540 people worked for or were affiliated with the Magnet Lab at its three sites in 2007. Thirty-four percent were classified as senior personnel; students (graduate and undergraduate) make up 24 percent.



DIVERSITY

Since the adoption of the formal diversity plan in 2004, the Magnet Lab has pursued a multitude of activities and efforts to increase the participation of underrepresented groups in science, engineering and mathematics.

The Magnet Lab aspires to become a nationally recognized leader in the diversity of its scientific, technical, and engineering staff, much the same way it is already recognized for its education and outreach programs. With this goal in mind, the lab in 2007 enhanced its recruiting policies by including at least one member of the Magnet Lab Diversity Committee on each search committee for scientific and technical staff, and advertised job openings in venues that target women and minorities.

The lab strives to provide an environment for success for members of underrepresented groups by providing mentors and opportunities to network within and beyond the Magnet Lab. For example, Ivana Raičević, a physics Ph.D. student, received an I2CAM Junior Scientist Travel Award, Society of Photographic Instrumentation Engineers (SPIE) Student Travel Grant, and FSU Congress of Graduate Students Conference Presentation Grant to present her research and paper at SPIE's Fourth International Symposium on Fluctuations and Noise, in Florence, Italy, May 2007.

The lab continued its efforts to develop and cultivate individually crafted early career opportunities for members of underrepresented groups at the undergraduate level and above. In 2007, those efforts included the following:

- A continuation of the successful diversity lecture series, "College Outreach – Workforce Initiative Program" (CO-WIN) that sends Magnet Lab scientists and engineers to women's colleges, and historically black and minority-serving colleges and universities. The 2007 effort also included an international component to complement existing scientific collaboration. The following lectures were presented:
  1. Arthur Edison, Jan. 24, Southern University, LA
  2. Arthur Edison, Feb. 9, The University of Texas at El Paso, TX
  3. Eric Palm, March 13, Darton College and Albany State University, GA (This visit took place jointly with Nancy Marcus, dean of graduate studies at Florida State University, in order to advertise and promote graduate school opportunities at FSU.)
  4. Arthur Edison, Oct. 18, Pontificia Universidad Católica Del Perú in Lima, Peru.
- The Magnet Lab provided support to two 2007 REU students: Jose Negrete (University of Texas at El Paso) and Gabriela Sanz-Douglass (Sonoma State University).
- Partial travel support was provided to Jordyn Detwiler, an undergraduate student in the physics department at Kent State University, to help users (PIs: Jim Gleeson and Sam Sprunt) with experiments during their magnet time in the DC facility.
- Alex Lacerda's visit to North Carolina A&T (spring 2007) attracted the first Native American student (Terrell D. Dial) to study at the Pulsed Field Facility for summer 2007.
- Natanette Craig, a Florida A&M University graduate student in engineering, was hired half-time into the Applied Superconductivity Center (ASC). With the guidance of new supervisors, she is making good progress toward Ph.D.
- Matching funds were awarded to several postdoctoral research associates: Frank Hunte and Abdallah Mbaruku, for research with the ASC; Saritha Nellutla, for EMR research; and Eugene Mananga for NMR research.
- James Dickerson (Vanderbilt University) received a Magnet Lab letter of support for his grant application to NSF's CAREER program. Dickerson, who conducts research in the Open Doors Lab (see below), is a new user and building ties with the Magnet Lab and FSU. Dickerson serves as the chair of the American Physical Society Committee on Minorities.
- The Open Doors Lab, which was completed in 2007, provides space for underrepresented students, postdocs and young faculty to do research in collaboration with the Magnet Lab's Extreme Conditions Group. In addition to Dickerson (see above), other users include Kevin Storr (Prairie View A&M University) and Susan Latturner (FSU).
- As a result of Eric Palm's 2005 CO-WIN visit to Alabama A&M, Tesfaye Gebre was recruited and hired as a postdoc to work with Eric Palm in the Open Doors Lab.
- Palm attended the 2007 Joint Annual Conference of the National Society of Black Physicists and Black Physics Students and the National Society of Hispanic Physicists held Feb. 21-25, 2007 in Boston, MA as an exhibitor and a recruiter.
- The lab's Center for Integrating Research and Learning (CIRL) continued to work with the FSU Women in Math, Science and Engineering (WIMSE) program, typically providing four tours every semester. One of the 2007 REU participants was a WIMSE student.
- The Magnet Lab provided research opportunities to three WIMSE engineering students in the fall 2007 semester.
- A tour of the Magnet Lab was given to the local chapter of Society of Hispanic Professional Engineers. About 15 engineering students (all minorities, all majors) came for the 1½-hour tour, during which research opportunities at the lab, including the REU program, were promoted.
- LANL hosted the 2007 McDermott Scholars for lecture and tour. At least two female students requested consideration for an internship for summer 2008.

From SciGirls to SciPals, CIRL expanded its educational outreach to target still more diverse groups, with special emphasis on reaching very young children and middle-school-aged students. In particular, CIRL partnered with two Leon County schools that serve mostly minority students. The partnership with Ruediger Elementary School provides science professional development by conducting teacher workshops. In the Nims Middle School science enhancement partnership, CIRL and the Magnet Lab provide outreach, tours and professional development for science teachers. For more information about CIRL's diversity outreach, see page Chapter 6.

Several lectures were presented to the general public in 2007:

- Eric Palm was a mentor at the Youth Leadership Forum, put on by the Able Trust. The Able Trust provides career and educational encouragement, opportunities and tools for youths with disabilities. Palm represented a career in "Science".

- Vivien Zapf gave a lecture as part of the Los Alamos Women in Sciences (LAWIS) program to the general public at the Bradbury Science Museum, and a radio interview about the Magnet Lab and science in high magnetic fields.

- Izabela Stroe served as a panelist for "Career Paths for Women in the Sciences and Science-Related Fields" as part of the LAWIS program.

Finally, a special section of the ***magnet.fsu.edu*** Web site was devoted to careers and diversity at the lab. This section is accessible from the home page.

BUDGET

The National High Magnetic Field Laboratory operates with funding provided by federal, institutional, and industry sources. In addition, the Magnet Lab faculty and staff have been very successful in securing individual research funding for specific areas of research from a variety of sources, including federal and private sectors. Although the lab receives funding from numerous sources, the National Science Foundation (NSF) is its primary funding source for operations.

NSF CORE BUDGET

The National Science Board approved the Magnet Lab renewal award of the third five-year research grant in the amount of $117,500,000 at its meeting Oct. 19, 2000, plus subsequent amendments.[1] The renewal period is from Jan. 1, 2001 through Dec. 31, 2007 (in 2004 the NSF approved two additional years of funding). **Table 1** provides a comparison of the current seven-year NSF award with the previous five-year award:

Table 1. *NHMFL NSF Budget Comparison (with Indirect Distributed to Programs)*

Division/Program	1996 - 2000 5-Yr NSF Summary	% of BGT	2001 - 2007 7-Yr NSF Summary	% of BGT
Director	$2,912,811	3.33%	$7,101,829	4.13%
Unassigned Budget	0	0.00%	(0)	0.0%
Facilities & Admin	5,698,737	6.51%	13,060,842	7.60%
Instruments & Operations	18,366,654	20.99%	30,263,658	17.61%
Instruments & Operations - Electrical Power for DC Facility	7,918,471	9.05%	21,864,076	12.72%
Magnet Science & Technology	22,122,487	25.28%	31,217,337	18.16%
FSU – UCGP [formerly IHRP]	7,343,739	8.39%	6,314,127	3.67%
LANL	20,838,959	23.82%	37,765,159	21.97%
LANL – UCGP[2] [formerly IHRP]			989,599	0.58%
CIMAR – NMR -FSU	361,550	0.41%	6,077,217	3.54%
CIMAR - EMR	248,902	0.28%	1,765,984	1.03%
CIMAR – ICR[3]	175,650	0.20%	6,785,253	3.94%
CIMAR –NMR -UF - AMRIS	812,414	0.94%	3,127,359	1.82%
UF - High B/T	699,626	0.80%	1,591,393	0.93%
UF – UCGP[2] [formerly IHRP]			2,440,845	1.42%
Applied Superconductivity			1,518,568	0.88%
Total NSF Cooperative Agreement[1]	**$87,500,000**	**100.00%**	**$171,883,246**	**100.00%**

[1] Baseline budget 2001 - 2005	$117,500,000
Amendments:	
Eglin AFB	49,917
Electricity	1,470,000
RET Program	623,329
Additional 2 years funding (2006 – 2007)	52,500,000
Less 2006 NSF budget reduction	(260,000)
Amended Budget	$171,883,246

[2] UCGP (User Collaboration Grants Program), formerly the IHRP - In-House Research Program, for LANL and UF is now being reported separately instead of including it in the Science Department's budget as has been done in the past.

[3] ICR Facilities budget does not include the NSF Chemistry Division award in the amount of $5,808,433, which was for 1/1/2000 through 12/31/2004.

Table 2 presents the NSF Funding for the seven-year period. The material variations in the actual budget for 2007 from the estimated 2007 budget in preceding years are a result of requesting the various departments to conserve spending to allow the lab to react to unforeseen circumstances. Some significant equipment orders were not able to be delivered in a timely manner because of vendor issues, which resulted in a re-allocation of the budget to accommodate other pressing needs. The Magnet Lab also adjusted the budget in 2007 to agree with actual expenditures for the entire seven years.

We have also included in **Table 2** the first year of the five-year (2008-2012) NSF Renewal Grant. The total grant from NSF for 2008 was $29,500,000, however, NSF then reduced the funding for the first year of the Renewal Grant by $3,000,000, resulting in the actual award for 2008 in the amount of $26,500,000.

Table 2. *NHMFL - NSF Budget by Program (with Indirect Separate from Programs)*

Division/Program	2001	2002	2003	2004	2005	2006	2007	Total Budget	NSF Renewal Grant 2008
Director	$407,208	$313,320	$115,223	$478,672	$686,216	$796,882	$810,027	$3,607,548	$656,661
CIRL[1]	225,379	198,611	142,872	329,769	161,213	300,914	165,229	1,523,987	197,153
Unassigned Budget	(2,780,994)	(596,653)	2,071,302	1,441,535	714,162	(819,691)	(29,661)	0	69,000
Facilities & Admin	1,374,631	1,253,506	960,122	1,314,968	1,392,666	1,384,990	1,343,959	9,024,842	1,065,203
DC Field Facility Instruments & Operations	2,771,403	3,888,227	2,326,974	2,913,482	2,962,497	3,098,024	3,517,673	21,478,280	3,277,813
Electricity for the DC Field Facility	1,900,000	1,600,000	3,020,000	3,074,000	3,606,809	3,901,225	4,760,564	21,862,598	3,397,840
Magnet Science & Technology[2]	4,130,929	4,906,176	3,650,610	3,312,840	1,469,308	2,962,568	2,732,748	23,165,179	2,364,613
Condensed Matter Science	880,889	1,037,627	813,047	874,041	968,710	1,232,868	(1,203,387)	4,603,795	906,509
LANL[2]	4,575,655	6,436,905	5,083,545	5,164,502	5,382,012	5,129,415	5,993,125	37,765,159	5,369,940
LANL UCGP[3] [IHRP]	397,107		209,802	92,000	90,000	14,490	186,200	989,599	186,200
CIMAR – NMR – FSU	338,597	595,990	501,271	832,097	902,429	924,683	291,754	4,386,821	826,577
CIMAR - EMR	81,473	95,650	135,388	221,880	244,347	234,768	268,832	1,282,338	263,577
CIMAR – ICR[4]	1,533,358	49,248	46,311	370,541	1,084,812	1,077,706	1,091,536	5,253,512	955,070
CIMAR – NMR-UF-AMRIS	303,110	312,202	320,288	291,161	628,890	586,115	685,592	3,127,358	717,046
UF – High B/T[2]	182,527	188,003	597,352	(147,833)	218,879	267,151	285,315	1,591,394	287,371
UF UCGP[3] [IHRP]	148,199	219,090	434,810	572,470	547,963	297,291	221,022	2,440,845	158,892
Applied Superconductivity	0	0	0	0	0	36,654	1,315,597	1,352,251	477,658
Indirect	3,686,446	4,578,098	3,677,083	3,547,147	4,439,087	4,436,004	4,063,875	28,427,739	5,322,877
Total	$20,155,917	$25,076,000	$24,106,000	$24,683,272	$25,500,000	$25,862,057	$26,500,000	$171,883,246	$26,500,000

[1] CIRL includes RET funding as follows: $106k in 2001, $106k in 2002, $106k in 2003, $183k in 2004, and $122,057 in 2006.

[2] LANL and UF funding is distributed through subcontracts. LANL also contributes funds to the Pulsed Magnet Program, in the amount of $3.6 million in 2001, $3.8 million in 2002, $3.6 million in 2003, $5 million in 2004, $2.6 million in 2005, $3,628.5K in 2006, and 4.070M in 2007. UF contributes funds to the High B/T Magnet and the AMRIS Program; the High B/T contributions were $60 K in 2001, $131K in 2002, $195K in 2003, $494K in 2004, $923K in 2005, $193.8 in 2006, and $257K in 2007; and the AMRIS contributions were $895 K in 2003, $321K in 2004, and $166K in 2005, $1.555 million in 2006, and $380K in 2007 (2001 and 2002 AMRIS contributions are not available).

[3] LANL and UF UCGP User Collaboration Grants Program (formerly IHRP - In-House Research Program) funding is distributed from the Science Program.

[4] ICR Facilities budget does not include the NSF Chemistry Division awarded through the Chemistry Department in the amount of $5,808,433, which was for 1/1/2000 through 12/31/2004 (although all of the funding was received by 12/31/2003).

MATCHING COMMITMENT

The NSF grant includes a matching commitment by the State of Florida through Florida State University, which is $6,783,400 annually. In addition to this, the State of Florida also provides institutional funds to the laboratory above the NSF matching requirement. The Magnet Lab utilizes these additional state resources as cost-sharing funds for other funding opportunities, as well as to help support some of the NSF core activities. **Table 3** presents the State of Florida matching requirements and contribution provided through FSU.

Table 3. *Fiscal Year 2007/2008 State of Florida Matching and Contribution*

	State Matching	State Contribution	Total State Funding
State of Florida recurring funds cost sharing	$4,492,318	5,878,806	$10,371,124
Indirect Cost (51%)	2,291,082	2,998,191	5,289,273
Total	**$6,783,400**	**8,876,997**	**$15,660,397**

PROGRAM BUDGET DISCUSSION

Calendar year 2007 is the final year of the current grant awarded by the National Science Foundation, in the amount of $26,500,000. This includes the National Science Board approved allocation of $25,000,000 plus $1,500,000 for ICR that was formerly granted through the Chemistry Division of NSF. The lab also receives an annual operating budget from the State of Florida through FSU. In fiscal year 2006/2007, the state funding was $7,754,478, and was $10,371,124 for fiscal year 2007/2008 (excluding indirect). The increase in state funding between the two fiscal years (excluding indirect cost) is attributable to a net increase in State Education and General funding of $1,040,846 in 07/08 (which includes $816,892 of recurring budget); also, for 07/08 we are including the funding for professors (with Magnet-Lab-related research) through the physics, chemistry, and engineering departments, whereas in past fiscal years we just reported the funding for professors that was provided directly to the Magnet Lab. The 2007/2008 funding for professors provided through other FSU departments amounts to $1,280,782.

Table4. *NHMFL Program Budget by Source (budget allocation by program)*

Program	NSF Budget Calendar Year 2007	State Matching Fiscal Year 2007/2008	State Contributed Fiscal Year 2007/2008	Total Budget
Director	$810,027	$1,299,790	$1,135,508	$3,245,325
CIRL	165,229	123,236	70,561	359,026
Unassigned Budget	(29,661)			(29,661)
Facilities & Admin	1,343,959	360,929	206,658	1,911,546
Instruments & Operations	3,517,673	203,251	116,376	3,837,300
Instruments & Operations - Electrical Power for DC Facility	4,760,564		845,323	5,605,887
M S & T	2,732,748	392,675	445,957	3,571,380
Condensed Matter Science	(1,203,387)	965,232	1,509,974	1,271,819
LANL (Subcontract)[1]	5,996,125			5,996,125
LANL UCGP (formerly IHRP)	186,200			186,200
CIMAR – Administration		40,591	23,241	63,832
CIMAR – NMR	291,754	314,339	433,636	1,039,729
CIMAR – EMR	268,832	250,756	155,503	675,091
CIMAR – ICR Facilities	1,091,536	260,030	357,025	1,708,591
CIMAR – Geochemistry		69,118	52,810	121,928
CIMAR – NMR @ UF – AMRIS[2]	685,592			685,592
UF- High B/T[3]	285,315			285,315
UF UCGP (formerly IHRP)	221,022			221,022
ASC	1,315,597	212,371	526,235	2,054,203
Indirect[4]	4,063,875	2,291,082	2,998,191	9,353,148
Total	**$26,500,000**	**$6,783,400**	**$8,876,998**	**$42,160,398**

[1]LANL's contribution to the Pulsed Magnet Program was $4.070 million in 2007.

[2]UF's contribution to AMRIS was $0.380 million in 2007.

[3]UF's contribution to the High B/T program was $0.257 million in 2007.

[4]The NSF Budget includes indirect (Indirect), and the equivalent indirect is included in the state budget to reflect the total State of Florida support. FSU's federally negotiated Indirect rate is 51%.

Table 5 summarizes the Magnet Lab's budget position as of Dec. 31, 2007. The budget balance represents deferred capital and expense items, such as resistive magnets maintenance and upgrade, split magnet equipment purchases, User Collaboration Grants Program (formerly IHRP) time lag between 2006 awards and actual incurred expenses, and equipment for the 900 MHz.

Table 5. *Cumulative NSF Budget and Expenses (1/1/2001 – 12/31/2007)*

Expense Classification	Budget	Spent and Encumbered	Balance 12/31/2007
Salaries, Wages & Benefits	$40,812,856	$40,812,856	$0
Subcontracts	46,482,038	46,482,038	0
Capital Equipment	16,800,294	16,800,294	0
Other Direct Cost	39,376,078	39,376,078	0
Subtotal	**143,471,266**	**143,471,266**	**0**
Indirect	28,411,980	28,411,980	0
Total before indirect on encumbrances	**$171,883,246**	**$171,883,246**	**$0**
Estimated Indirect on Encumbrances			0
Adjusted Total	**$171,883,246**	**$171,883,246**	**$0**
Program Income	$336,048		

These expenses are best effort estimates and were prepared before FSU made final adjustments, officially closed the grant, and provided the final report to the NSF. There may, therefore, be a minor variance between these expenses and FSU's final report to the NSF.

PROGRAM BUDGETS

DIRECTOR'S OFFICE

The Director's Office includes the director, associate director, budget administration, public affairs, computer support, human resources, Web-site development, and the Visiting Scientist Program. The Budget Administration Office is responsible for budget, accounting, and financial analyses functions for the lab. The development and maintenance of an internal budget management system provides greater cost accounting and control over the many different funding sources and projects supported by those funds. The Office of Public Affairs is responsible for the Magnet Lab's media and public relations, for development and oversight of the lab's publications and its Web site. The Visiting Scientist Program provides funding for scientists to conduct research at the Magnet Lab. Proposals requesting support through the program are internally peer reviewed, and awards are based on input during the review process.

Table 6. *Director's Office Program Budget*

Director's Office		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Director - Admin	494,647	845,888
Budget Administration	76,793	170,371
Visitor's Program	0	137,301
Director's Research	(470)	75,705
Computer Services	239,058	0
Unassigned NHMFL Budget	(29,661)	0
Total	**780,367**	**1,229,265**
State Contribution		1,095,127

CENTER FOR INTEGRATING RESEARCH AND LEARNING (CIRL) AND OPTICAL MICROSCOPY RESOURCE CENTER (OMRC)

CIRL supports programs that translate research conducted at the Magnet Lab to students, teachers and the general public. Curriculum development and teacher education are supported by CIRL to enhance science education at all levels and promote public awareness. CIRL administers two signature programs: the Research Experiences for Undergraduates (REU) and the Research Experiences for Teachers (RET) programs. Both are successful and the RET has become a national model. The REU has been administered at the lab since 1994. CIRL took over administration of the program in 1999. The RET program continues to fit very effectively with the summer REU students. All mentorships for middle school and high school students are organized by CIRL, as are school, classroom, and community outreach and tours. CIRL maintains an educational research agenda that includes program development, and develops partnerships to expand the breadth of programming.

The Optical Microscopy Resource Center is another program operated as part of the lab's research and learning efforts. The OMRC has been hugely successful in its educational efforts and continues to receive world-wide recognition. In addition to establishing an in-house Magneto-Optical Imaging Facility, the OMRC has developed a state-of-the-art live-cell imaging center that collaborates with outside users and is available to scientists who wish to study the dynamics of living organisms in magnetic fields. Distance learning efforts of the OMRC are highlighted by the international use of the educational Web sites in middle school, high school, undergraduate, and graduate curricula around the world. The OMRC is responsible for web application development and upgrades, and print graphics

Table 7. *Center for Integrating Research and Learning (CIRL) and Optical Microscopy Resource Center (OMRC) Program Budget*

Center for Integrating Research and Learning and Optical Microscopy Resource Center		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
CIRL Education	99,151	123,236
REU Program	66,078	
Optical Microscopy RC	0	70,525
Total	**165,229**	**193,761**
State Contribution		110,942

FACILITIES AND FISCAL ADMINISTRATION

Facilities and fiscal administration provide general administrative functions for the lab including the University Business Administrators (UBA) Program. The UBA is responsible for accounts payable, accounts receivable, travel, payroll, procurement, receiving, and other accounting activities. The facilities staff has responsibility for maintenance of the Magnet Lab facilities including magnet power supplies and cooling systems, helium systems, and the remainder of the facilities except buildings, grounds, janitorial, and some HVAC and plumbing preventative maintenance. The facilities group also handles small interior renovations and modifications needed to support research activities. Funding for the facilities group is split between NSF and institutional funds. NSF funding is used for core-related activities, while institutional funds are used for general facility maintenance and modifications required to support research and other activities related to the lab's mission.

Table 8. *Facilities and Administration Program Budget*

Facilities and Administration		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
UBA	639,078	105,368
Facilities	573,334	207,958
Safety	131,546	47,602
Total	**1,343,958**	**360,928**
State Contribution		206,658

DC FIELD FACILITY INSTRUMENTATION AND OPERATIONS

This unit is responsible for the operation of the DC magnet systems in Tallahassee, including the MilliKelvin facility. It provides machine shop, electronics shop, and cryogenic systems support. Two thirds of the staff is dedicated to supporting user activities, and the other third provides mechanical and electronic instruments for all the groups in Tallahassee. This group focuses on keeping abreast of cutting-edge instrumentation specialties, improving the performance of user instrumentation, and developing new measurements. The Instrumentation and Operations group also helps coordinate annual meetings of the Magnet Lab Users Committee.

Table 9. *DC Field Facility Instrumentation and Operations Program Budget*

DC Field Facility Instrumentation and Operations		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Administration	228,132	19,077
Cryogenics	367,726	
Electronics	431,444	
Magnet Operations	345,602	
Electrical Power for DC Magnets	4,760,564	
Mechanical Operations	305,766	
User Services	1,839,003	184,174
Total	**8,278,237**	**203,251**
State Contribution		961,699

MAGNET SCIENCE & TECHNOLOGY

The Magnet Science and Technology (MS&T) group is responsible for the design, engineering, fabrication and maintenance of a broad variety of powered-dc and advanced superconducting magnets, along with the development of the advanced materials, components, and subsystems critical for all high-performance magnet applications. MS&T has broad interactions with the private sector, with other national laboratories, and with the international community involved in high-field magnet research and development. Future advances in magnet technology are heavily dependent on advancements made in materials, especially high-strength, high-conductivity conductors; high-strength, high-performance superconductors; high-temperature superconductors; and high-strength, high-modulus reinforcement materials, which are critical to overcoming the enormous forces intrinsic to high-field magnet design.

Table 10. *Magnet Science & Technology Program Budget*

Magnet Science & Technology		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Admin/Operations	1,183,410	392,675
Pulsed Magnets	(68,731)	
Powered Magnets	1,574,871	
Persistent Magnets	43,198	
Total	**2,732,748**	**392,675**
State Contribution		445,957

CONDENSED MATTER SCIENCE PROGRAM

The NSF funding for the science and facilities development program are primarily distributed through the User Collaboration Grants Program (UCGP), previously call the In-House Research Program. Funding also is utilized to cover the administration of the program, travel by reviewers, visitors and speakers, and to provide assistance for the director of the UCGP. The director of the UCGP typically serves a two-year term, with the position rotating among the three institutions. During the current period, the program is headed by Dr. Lloyd Engel at the FSU branch. UCGP proposals must include a principal investigator from one of the three participating institutions and participation from external users as co-principal investigators are strongly encouraged by the NSF and the Magnet Lab. 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.

Table 11. *Condensed Matter Science Program Budget*

Condensed Matter Science		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Administration	201,517	80,033
User Collaboration Grants Program	(1,567,873)	
Condensed Matter Theory		306,917
Condensed Matter Experimental	162,969	578,282
Total	**(1,203,387)**	**965,232**
State Contribution		1,509,974

PULSED FIELD FACILITY - LOS ALAMOS NATIONAL LABORATORY

The Pulsed Field Facility is located at Los Alamos National Laboratory (LANL) and operated under a subcontract agreement between Florida State University and the U.S. Department of Energy. The mission of the Pulsed Field Facility is to provide state of the art pulsed magnetic fields and technical and instrumentation support to qualified users. The staff, in close cooperation with users, also devotes considerable attention to the development of new research tools, instrumentation, and capabilities responding to the unique requirements imposed by the electromagnetic and vibrational characteristic of resistive pulsed magnets. Pulsed magnet development and construction is also a central activity of the Pulsed Field Facility, as is the construction and maintenance of 1.6 MJ, 2.1 MJ, 4 MJ, 0.26 MJ/4 MJ capacitor banks, and a 1.4 GVA inertial storage motor generator used to power pulsed magnets. Essential support to pulsed-field-centered research in condensed matter and semiconductor physics is provided with a state-of-the-art 20-tesla superconducting magnet.

Table 12. *Pulsed Field Facility Program Budget*

Pulsed Field Facility - Los Alamos National Laboratory		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Facilities & Admin	363,144	
User Operations	3,658,558	
Pulsed Magnets	1,971,424	
UCGP [previously IHRP]	186,200	
Total	**6,179,326**	
LANL Contribution		4,069,779

CENTER FOR INTERDISCIPLINARY MAGNETIC RESONANCE

CIMAR represents all areas of magnetic resonance techniques and 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 (ICR) mass spectroscopy, and magnetic resonance imaging and spectroscopy. A portion of the NMR spectroscopy and imaging activities are 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.

Table 13. *Center for Interdisciplinary Magnetic Resonance Program Budget*

Center for Interdisciplinary Magnetic Resonance		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
Administration		40,591
NMR Program	291,754	314,339
ICR Program	1,091,536	260,030
EMR Program	268,833	250,756
Geochemistry		69,118
AMRIS (UF)	685,592	
Total	**2,337,715**	**934,834**
State Contribution		1,022,215
UF-AMRIS Contribution		380,000

HIGH B/T FACILITY – UNIVERSITY OF FLORIDA

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 Lab, using a specially designed $PrNi_5$ nuclear refrigerator and a separate 14/15.5-T magnet to conduct experiments at both high magnetic fields and low temperatures simultaneously. Additionally, users may request access to Bay #2 in the Microkelvin Laboratory that uses copper nuclear demagnetization refrigerators and can reach below 100 mk.

This specialized facility is operated as a user facility and is open to all qualified users who wish to explore new phenomena that require experimental conditions of high spin polarization or high initial magnetization, and thus a high ratio of applied magnetic field to temperature.

Specialized instrumentation is available for thermometry, pressure measurements and heat capacity studies, pulsed NMR techniques up to UHF frequencies, electrical conductivity, and transport studies. The facility is enclosed in a *tempest* quality ultra-quiet environment. A state allocation in 2005-2006 provided funds to upgrade the magnetic field system of the facility to provide fields up to 20 T. This upgrade is expected to be completed in 2008-2009.

Table 14. *High B/T Program Budget*

High B/T Facility - University of Florida		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
High B/T User Support	285,315	
UCGP – Total for UF	221,022	
Total	**506,337**	**0**
UF-High B/T Contribution		193,773

APPLIED SUPERCONDUCTIVITY CENTER (ASC)

The NSF funding for work in ASC is for the development of a new generation of high field superconducting magnets using Bi-2212 and YBCO conductors. This research and development effort is presently in the conductor understanding, evaluation and small-coil-development phase. It is collaborative with Magnet Science and Technology and with industry both in and outside the United States.

Table 15. *Applied Superconductivity Center Program Budget*

Applied Superconductivity Center		
Program	**NSF Budget 2007**	**State Matching Budget 2007/2008**
ASC	1,315,597	212,371
State Contribution		526,235

PROGRAM BUDGET

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

Budget Units: The NSF and Institutional budgets are allocated to the Magnet Lab programs. There are subcontracts for facilities and activities at Los Alamos National Laboratory, as well as at the University of Florida in Gainesville. The Executive Committee governs the overall operations of the lab and is responsible for 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.

Indirect Rates: The Florida State University's federally negotiated indirect rate is 51% for 2007. The institutional indirect rate used at the University of Florida is 46.5%.

Indirect Base: At FSU and UF, indirect is applied to modified direct costs, which include payroll, payroll fringe benefits, materials and supplies, services, travel, and the first $25,000 of subcontracts. The following categories of expenditures are excluded from the indirect base:

- Permanent Equipment (equipment in excess of $1,000)
- Undergraduate, Graduate, and Ph.D. Programs (CIRL)
- Electric Power for magnet operations
- Subcontracts in excess of $25,000
- Tuition Waivers and Student Fees

UF also excludes charges for patient care, rental costs for off-site facilities, scholarships, and fellowships from the indirect base.

Fringe Benefits: Fringe benefits for Florida personnel are based on actual costs of fringe benefits for permanent employees (averaging 29.6%) and temporary employees (1.45% for non-students and 0.1% for students).

LANL Indirect Rate Structure:

Permanent Salary Personnel

- Salary related fringe benefits – 26.5%
- Infrastructure Support charged on labor costs, including fringe benefits, related to infrastructure – 23.0%
- Organizational Support – 37.5%
- New Mexico Gross Receipts Tax, which is applied to all direct and indirect costs - 5.5%
- General and Administrative costs for non-construction programs, charged on all costs (direct and indirect charges) - 35.5%

Post Doctoral personnel

- Salary related fringe benefits – 26.5%
- Infrastructure Support – 23.0%
- New Mexico Gross Receipts Tax, applied to all direct and indirect costs – 5.5%

Construction (pulsed magnet design and construction)

- General and Administrative costs for equipment – 5%
- General and Administrative charges on non-equipment construction costs – 35.5%
- New Mexico Gross Receipts Tax, applied to all direct and indirect costs – 5.5%

LANL Indirect Rates include the cost of electricity for the NHMFL Pulsed Field Facility

CHAPTER 10: SCIENCE & RESEARCH PRODUCTIVITY

The laboratory continued its strong record of publishing, giving conference presentations, and educating the next generation of scientists and engineers. **Table 1** summarizes these activities, and the citations follow in this chapter. For additional information, refer to the Magnet Lab's Web site: ***www.magnet.fsu.edu*** (/search/publications/search.aspx), where you can search the laboratory's publication database and read many articles online. Grant information, received from Florida State University and the University of Florida's respective offices of sponsored research, is also presented in this chapter beginning on page **141**.

Table 1. *2007 Magnet Lab Activities Summary*

	Number Reported	Page Number for Citations
Publications in Peer-Reviewed Journals	371	113
Presentations, Posters & Other Publications	353	126
Books & Book Chapters	6	139
Internet Disseminations	3	139
Awards	28	139
Dissertations, Ph.D.	12	140
Theses, Master	3	140

Of the over 370 publications reported by Magnet Lab faculty and users, 214 appeared in some of the most prominent science and major disciplinary journals (**Table 2**). The percentage of significant journal articles continues a steady increase: 46% in 2005, 56% in 2006 and 58% in 2007.

Table 2. *2007 Prominent Journal Articles*

Acta Materialia	1
Analytical Chemistry	3
Angewandte Chemie International Edition	1
Applied Physics Letters	4
Biochemistry	1
Biochimica et Biophysica Acta	1
Biophysical Journal	4
Chemistry of Materials	2
Cryogenics	2
Energy & Fuels	4
Environmental Science & Technology	1
IEEE Transactions on Applied Superconductivity	16
Inorganic Chemistry	7
Journal of Applied Physics	10
Journal of Biomolecular NMR	3
Journal of Magnetic Resonance	7
Journal of Medicinal Chemistry	1
Journal of Molecular Biology	1
Journal of Physical Chemistry A	2
Journal of Physical Chemistry B	3
Journal of Physics-Condensed Matter	5
Journal of Proteome Research	2

Journal of the American Chemical Society	13
Journal of the American Society for Mass Spectrometry	2
Macromolecules	1
Magnetic Resonance Imaging	1
Magnetic Resonance in Chemistry	3
Magnetic Resonance in Medicine	1
Nano Letters	2
Nature	4
Nature Physics	6
Neuroimage	1
Physical Review B	41
Physical Review B Rapid Communications	2
Physical Review Letters	42
Proceedings of the National Academy of Sciences of the United States of America	3
Protein Science	2
Science	2
Solid State Nuclear Magnetic Resonance	1
Superconductor Science and Technology	6
Total	214

2007 PEER-REVIEWED PUBLICATIONS

This section lists over 370 articles that appeared in print in referred journals and conference proceedings in 2007. Journal titles appearing in **red boldface** are regarded by the laboratory as prominent or major disciplinary publications.

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2007 PRESENTATIONS, POSTERS & ABSTRACTS

This section lists invited and contributed talks and papers at conferences; papers in conference proceedings that were not peer-reviewed; posters; abstracts; and presentations at universities and public forums in 2007. Over 350 activities were reported this year.

Alamo, R.G.; Jeon, K.; Boz, E.; Nemeth, A.J. and Wagener, K.B., *Crystallization of Polyethylenes Containing Halogens: Precise vs. Random Placement*, ACS National Meeting. Division of Polymeric Materials Science and Engineering, Boston, MA, August 19-24 (2007)

Andraka, B.; Rotundu, C.R.; Ingersent, K. and Schlottmann, P., *Resistivity and magnetoresistance of La-doped CeOs$_4$Sb$_{12}$ and PrOs$_4$Sb$_{12}$*, New Quantum Phenomena in Skutterudite and Related Systems, Kobe, Japan, September 26-30 (2007)

Andrearczyk, T.; Zaleszczyk, W.; Wiater, M.; Wojtowicz, T.; Dietl, T.; Karczewski, G.; Popowic, D. and Jaroszynski, J., *Colossal Magnetoresistance in (Cd,Mn)Te heterostructures*, The 13th Int. Conf. on II-VI Compounds, Jeju, Korea, September, 10-14 (2007)

Baek, S-H.; Choi, K-Y; Reyes, A. P.; Kuhns, P; Dalal, N.; Zhou, H. and Wiebe, C., *Coexistence of a long-range and short-range ordered state in MnV$_2$O$_4$*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

Baily, S.A.; Maiorov, B.; Hunte, F.; Zhou, H.; Foltyn, S.R.; Jia, Q.X.; Balakirev, F.F.; Jaime, M. and Civale, L., *Irreversibility line of YBa$_2$Cu$_3$O$_7$ films as a function of angle and field up to 50 Tesla*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

Balicas, L., *Fermi surface of Na$_x$CoO$_2$ as a function of x as seen via the Shubnikov–de Haas effect (contributed talk)*, Orbital Physics Conf., Stuttgart, Germany, October 10-12 (2007)

Barzykin, V. and Gor'kov, L.P., *On the (T,B)-phase diagram of Q2D multi-band superconductors*, April, 20 (2007)

Betts, J.B.; Migliori, A. and Stroe, I., *Making resonant ultrasound spectroscopy measurements from Millikelvin temperatures to well above room temperature*, Acoustical Society of America, Annual Conf., New Orleans, LA, November 27-December 1 (2007)

Betts, J.B.; Migliori, A.I; Stroe, I. and Riggs, S., *A new approach to the measurement of relaxation heat capacity*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

Beu, S.C.; Hendrickson, C.L. and Marshall, A.G., *SIMION Modeling of Ion Transfer in RF-Only Multipole Ion Guides Immersed in Strong Magnetic Field Gradients*, 55th Amer. Soc. Mass Spectrom. Ann. Conf. on Mass Spectrometry, Indianapolis, IN, June 3-7 (2007)

Bhaumik, S.; Molodova, X.; Molodov, D.A. and Gottstein, G., *Recrystallization Behaviour of Cold Rolled Aluminum Alloy AA 3103 in a Magnetic Field*, Recrystallization and Grain Growth III, Jeju Island, Korea, June 10-15 (2007)

Biasatti, D.; Wang, Y. and Deng, T., *Reconstruction of paleoecologies and paleoclimates of Cenozoic mammals from northwest China based on stable isotopes*, Society of Vertebrate Paleontology annual meeting, Austin, TX, October 17-20 (2007); Published in Journal of Vertebrate Paleontology Abstracts of Papers, **27** (3), 48 (2007)

Bizimis, M., *The composition of the Hawaiian plume from the mantle xenolith perspective*, University of South Carolina, Department of Geological Sciences, Columbia, SC, January 23 (2007)

Blakney, G.T.; Hendrickson, C.L. and Marshall, A.G., *Improved Data Acquisition System for Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*, 55th Amer. Soc. Mass Spectrom. Ann. Conf. on Mass Spectrometry, Indianapolis, IN, June 3-7 (2007)

Boebinger, G.S., *'Big Light': A proposed THz-IR Free Electron Laser at the MagLab*, Workshop on National Academy of Sciences decadal study: "Condensed Matter and Materials Physics 2010", University of California at Irvine, CA, January (2007)

Boebinger, G.S., *MagLab Futures: The Vision for High Magnetic Field Research at the National High Magnetic Field Laboratory*, Workshop on "Design and Applications of Free-Electron Lasers for Research with High Magnetic Fields", Jefferson Laboratory, Newport News, VA, January (2007)

Boebinger, G.S., *MagLab Futures: The Vision for High Magnetic Field Research at the National High Magnetic Field Laboratory*, Workshop on National Academy of Sciences decadal study: "Condensed Matter and Materials Physics 2010", University of California at Irvine, CA, January (2007)

Boebinger, G.S., *The Case for a Quantum Phase Transition at Optimum Doping in High-Tc Superconductors*, Colloquium, Argonne National Laboratory, Argonne, IL, August (2007)

Boebinger, G.S., *The Case for a Quantum Phase Transition at Optimum Doping in High-Tc Superconductors*, Stanford University, Physics Department, Palo Alto, CA, February (2007)

Bonesteel, N.E., *Finding Braids for Non-Abelian Particles (Invited Talk)*, Topological Quantum Computation, Institute for Pure and Applied Mathematics, UCLA, Los Angeles, CA, February 26-March 2 (2007)

Bonesteel, N.E., *Finding Braids for Topological Quantum Computation (Seminar)*, California Institute of Technology, Pasadena, CA, May 15 (2007)

Bonesteel, N.E., *Quantum Computing with Braids (Colloquium)*, Tufts University, Department of Physics, Medford, MA, April 6 (2007)

Bonesteel, N.E., *Quantum Computing with Braids (Seminar)*, Boston College, Boston, MA, November 6 (2007)

Bonesteel, N.E., *Quantum Computing with Braids (Seminar)*, Purdue University, Department of Physics, West Lafayette, IN, October 12 (2007)

Bonesteel, N.E., *Quantum Computing with Braids (Seminar)*, University of Central Florida, Department of Physics, Orlando, FL, March 19 (2007)

Bonesteel, N.E., *Quantum Computing with Braids*, Aspen Colloquium, Aspen, CO, July 12 (2007)

Bonesteel, N.E., *Random Chains of Interacting Non-Abelian Quasiparticles (Invited Talk)*, Hamilton Mathematics Institute, Trinity College Dublin, Dublin, Ireland, September 10-14 (2007)

Bonito-Oliva, A.; Bird, M.D.; Bole, S.T.; Cantrell, K.R.; Gavrilin, A.V.; Luongo, C.A.; Dixon, I.R.; Han, K.; Lu, J.; Miller, G.E.; Noyes, P.D.; Painter, T.A.; Weijers, H.W.; Walsh, R.P. and Zhai, Y., *Development of the Superconducting Outserts for the Series-Connected-Hybrid Program at the National High Magnetic Field Laboratory*, 20th Biennial Int. Conf. on Magnet Technology (MT-20), Philadelphia, PA, August 27-31 (2007)

Bowers, C.R., *Hyperpolarized NMR Studies of Diffusion and Gas Exchange in Single-File Nanotubes*, Max Planck Institute for Polymer Research, Mainz, Germany, November 28 (2007)

Bowers, C.R., *Resistively Detected NMR Studies at nu=1 in GaAs Quantum Wells*, Physics Department: Condensed Matter Seminar, University of Florida, Gainesville, FL, April 16 (2007)

Bowers, C.R., *Universal dynamics in one-dimensional diffusive systems: from traffic jams to single file diffusion*, Physics Department Colloquium, University of Florida, Gainesville, FL, November 15 (2007)

Capan, C.; Goodrich, R.G.; DiTusa, J.F.; Balicas, L.; Jo, Y.J.; Murphy, T.P.; Palm, E.C.; Movshovich, R.; Bauer, E.D.; Hundley, M.F.; Thompson, J.D.; Sarrao, J.L.; Hall, D. and Tozer, S.W., *Metamagnetism in $CeIrIn_5$: Investigation of magnetoresistance and the de-Haas-van-Alphen Effect*, Strongly Correlated Electron Systems Conf., Houston TX, May 13-18 (2007)

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Cappendijk, S.L.T.; James, J.R. and Grant, S.C., *Acute Effects of Systemic Nicotine Administration in the Zebra Finch*, Society for Nicotine and Tobacco Research: 13th Annual Meeting, Austin, TX, February 21-24 (2007)

Chase, R.A.; Li, C.; Gao, P.F. and Cross, T.A., *Characterization of Membrane Proteins from M. tuberculosis Using Solution and Solid State NMR*, Biophysical Society 51st Annual Meeting, Baltimore, MD, February (2007)

Chen, Y.; Zhang, F.; Bermer, W.; Snyder, D.; Gan, Z.; Bruschweiler-Li, L. and Brüschweiler, R., *Quantitative Covariance NMR with Minimal Datasets and Regularization*, 48th ENC, Daytona Beach, FL, April 22-27 (2007)

Chen, Z.; Kametani, F.; Kim, S.I.; Gurevich, A. and Larbalestier, D.C., *Pushing the Vortex Pinning In a $YBa_2Cu_3O_{7-x}$ Coated Conductor to the Three Dimensional Limit*, EUCAS 07, Brussels, Belgium, September 16-20 (2007)

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Cheng, C.-Y. and Bowers, C.R., *Gas Adsorption in Peptide Nanotubes: A Laser-Polarized Xe-129 NMR Study*, 48th Experimental NMR Conf., Daytona Beach, FL, April 22-27 (2007); Published in 48th ENC Conference Abstracts (0)

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Chiari, Y.L.; Jeon, K. and Alamo, R.G., *Sequence Distribution and Crystallization Kinetics of Random Propylene Ethylene Copolymers up to 25 mol% Ethylene*, ACS National Meeting--Division of Polymer Chemistry, Chicago, IL, March 25-29 (2007); Published in Polymer Preprints, **48** (1), 966 (2007)

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Conrad, C.; Ji, Y.; Emmett, M.R.; Puchades, M.; Sheng, X.; Aldape, K.; Liu, T.-J. and Nilsson, C.L., *Galectin-1 Expression in Glioblastoma Cell Lines is Associated with p53 Expression: Implications with Cell Survival, Invasive Phenotype, Chemotherapy Resistance and Poor Patient Survival*, American Association for Cancer Research, Los Angeles, CA, April 14-18 (2007)

Cornnell, H.H.; Grant, S.C.; Rosenberg, J.; Foroutan, P.; Sherry, A.D.; Edison, A. and Walter, G.A., *Characterization of Paramagnetic Lanthanide Ion Complexes as MRI Contrast Agents as a Function of Magnetic Field Strength*, 48th Experimental NMR Conf., Daytona, FL, April 22-28 (2007)

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Cotten, M.; Vollmar, B.S.; Saager, R.J.; Gordon, E.D. and Fu, R., *Structural and Dynamic Characterization of Antimicrobial Piscidins Using High Field Solid-State NMR and Multiply-Labeled Peptides in Hydrated Lipid Bilayers*, 62nd Northwest Regional Meeting, Boise, ID, June (2007)

Crooker, S.A., *Imaging spin flows in Fe/GaAs electrical spin detectors*, 2007 Materials Research Society (MRS), Fall Meeting, Boston, MA, November 26-27 (2007)

Crooker, S.A., *Imaging spin flows in Fe/GaAs electrical spin injection and detection*, 2007 Materials Research Society (MRS) Fall Meeting, Boston, MA, November 26-27 (2007)

Crooker, S.A., *Imaging spin injection and spin transport in lateral Fe/GaAs devices*, Optical Properties of Low Dimensional Semiconductors (OPLDS2007), Ottawa, Canada, May (2007)

Crooker, S.A., *Imaging spin injection in ferromagnet/semiconductor spin transport devices*, Experimental Condensed Matter Physics Seminar, Ohio State University, Columbus, OH, February 8 (2007)

Crooker, S.A., *Imaging spin injection in semiconductors*, University of Pennsylvania, Philadelphia, PA, March 28 (2007)

Crooker, S.A., *Imaging the injection /flow of spin polarized electrons in ferromagnet-semiconductor devices*, Sandia National Lab, Albuquerque, NM, March 21 (2007)

Crooker, S.A., *Imaging the injection and flow of spin polarized electrons in ferromagnet-semiconductor devices*, Condensed Matter Physics Seminar, Princeton, NJ, March 26 (2007)

Crooker, S.A., *Spin injection, transport, and imaging in epitaxial Fe/GaAs devices*, 35th Conf. on the Physics and Chemistry of Semiconductor Interfaces (PCSI-35), Santa Fe, NM, January 13-17 (2007)

Crooker, S.A., *Tuning the sign and sensitivity of Fe/GaAs electrical spin detectors*, SPINTECH-IV, Maui, Wailea, Maui, June 20-22 (2007)

Crosson, B., *An Intention Manipulation in the Treatment of Aphasia: Can Left-Hand Movement and Gesture Relateralize Language Production in Nonfluent Aphasia*, Max Planck Institute for Psycholinguistics, Nijmegen, Holland, October 10 (2007)

Crosson, B., *Cognitive and Neural Substrates in Rehabilitation: Awareness and Intention*, Conference in Cognitive Rehabilitation, Zeist, Holland, October 9 (2007)

Crosson, B., *Functional Neuroimaging in Rehabilitation and Aphasia*, Meeting of the International Neuropsychological Society, Portland, OR, February 7 (2007)

Crosson, B., *Targeting Neuroplastic Change in Cognitive Rehabilitation: Can an Intention Manipulation in Aphasia Treatment Affect Lateralization?*, Emory University, Atlanta, GA, November 6 (2007)

Crosson, B., McGregor, K., Benjamin, M., Chang, Y.-L., Bacon Moore, A., Gopinath, K., Peck, K., Wierenga, C., Wabnitz, A., Gaiefsky, M., Soltysik, D., Cavanagh, C., Gonzalez Rothi, L., Briggs, R., White, K., *Can manipulating intention change frontal lateralization for word production during aphasia treatment?*, Cognitive Neuroscience Society, New York, NY, May 5-8 (2007); Published in Journal of Cognitive Neuroscience, **suppl**, 255 (2007)

Das, R. and Odom, A.L., *Fractionated Mercury Isotopes in Fish: The Effects of Nuclear Mass, Spin, and Volume*, AGU, Fall 2007, San Francisco, CA, December 16 (2007)

Datta, S.; Hill, S.; Waldmann, O.; Milway, V. and Thompson, L.K., *High Frequency EPR studies of an antiferromagnetic supramolecular grid*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

Datta, S.; Milios, C.J.; Brechin, E. and Hill, S., *HFEPR studies of new manganese-based single-molecule magnets*, 52nd Magnetism and Magnetic Materials (MMM) Conference, Tampa, FL, November 5-9 (2007)

Datta, S.; Waldmann, O.; Kent, A.; Milway, V.; Thompson, L.K. and Hill, S., *An antiferromagnetic supramolecular grid: a high frequency EPR overview*, Florida Inorganic Mini-Symposium (FIMS), Gainesville, FL, September 22 (2007)

Dias da Silva, L.G.G.V.; Sandler, N.P.; Ingersent, K. and Ulloa, S.E., *Conductance signatures of a quantum-critical transition and a Kondo filtered resonance in double quantum dots*, American Physical Society March Meeting, Denver, CO, March 8 (2007)

Dias da Silva, L.G.G.V.; Sandler, N.P.; Ingersent, K. and Ulloa, S.E., *Quantum-critical transitions and interference effects: conductance in double quantum dots in the Kondo regime*, 17th Int. Conf. on Electronic Properties of Two-Dimensional Systems (EP2DS-17), Genova, Italy, July 17 (2007)

Dixon, P., *Essential Features of an RET Program: Teachers as Scientists, Scientists as Teachers*, American Physical Society Jacksonville Meeting, Hyatt Regency Jacksonville, April 16 (2007)

Dobrosavljevic, V., *Coulomb-Frustrated Phase Separation in a Magnetically-Doped 2DEG*, Condensed Matter Seminar at the Department of Physics, CCNY, New York, NY, May 19 (2007)

Dobrosavljevic, V., *Coulomb-Frustrated Phase Separation in a Magnetically-Doped 2DEG*, invited talk at the conference "Frontiers of Condensed Matter", Rutgers University, Piscataway, NJ, May 20 (2007)

Dobrosavljevic, V., *Coulomb-Frustrated Phase Separation in a Magnetically-Doped 2DEG*, invited talk, SFKM XVII Symposium on Condensed Matter Physics, Vrsac, Serbia, September 17-20 (2007)

Dobrosavljevic, V., *Quantum Critical Behavior of the Cluster Glass Phase*, invited talk, Daniel Grempel Memorial Conference, CEA-Saclay (Paris, France), June 14-15 (2007)

Dobrosavljevic, V., *Wigner-Mott Scenario for the 2D-MIT*, invited talk, International Workshop on Disorder and Interactions in Low Dimensions, National Chiao Tung University, Hsinchu, Taiwan, June 6-9 (2007)

Dorsey, A.T., *Phenomenology of Supersolids*, LANL Condensed Matter Sciences Colloquium, Los Alamos National Laboratory, Los Alamos, NM, May 23 (2007)

Dorsey, A.T., *Squeezing Superfluid from a Stone: Coupling Elasticity and Superfluidity in a Supersolid*, American Physical Society March Meeting, Denver, CO, March 8 (2007)

Dorsey, A.T., *Supersolid Phenomenology*, Supersolid State of Matter, Stillwater, MN, July 23-27 (2007)

Dozier, C.; Waryoba, D.; Kalu, P.N. and Kalu, E.E., *Supported Bimetallic Zerovalent Metal Nanoparticles in the Remediation of Chlorinated Organic Contaminated Water*, 211th ECS Meeting, Chicago, IL, May 6-10 (2007)

Drichko, I.L.; Diakonov, A.M.; Smirnov, I.Yu.; Suslov, A.V.; Mironov, M.; Mironov, O.A.; Whall, T.M. and Vinokur, V.M., *Low-temperature conductance mechanisms in p-Si/SiGe heterostructures in high magnetic fields*, Int. Conf. on Transport in Interacting Disordered Systems TIDS12, Marburg, Germany, August 6-10 (2007); Published in Abstract Booklet (2007)

Drichko, I.L.; Dyakonov, A.M.; Smirnov, I.Yu.; Suslov, A.V.; Mironov, M.; Mironov, O.A.; Whall, T.E. and Vinokur, V.M., *Mechanisms of Low-Temperature Conductivity in the p-Si/SiGe Heterostructures in Strong Magnetic Field*, VIII Russian Conf. on the Physics of Semiconductors, Ekaterinburg, Russia, September 30-October 5 (2007); Published in Book of Abstracts, 185 (2007)

Drichko, I.L.; Smirnov, I.Yu.; Suslov, A.V.; Mironov, M.; Mironov, O.A.; Whall, T.E.; Galperin, Yu.M. and Vinokur, V. M., *Transport Properties of p-Si/SiGe Heterostructures in the Ultraquantum Limit*, The XI Annual Symposium of "Nanophysics and Nanoelectronics", Nizhny Novgorod, Russia, 10-14 March (2007); Published in Proceedings, **1**, 293-294 (2007)

Ehrmann, B.M.; Rodgers, R.P. and Marshall, A.G., *Combined High and Low Resolution Mass Spectrometry for Determination of Molecular Structures of Asphaltene Compounds*, 6th N. Amer. FT-ICR MS Conf., Tahoe City, CA, April 1-6 (2007)

Ehrmann, B.M.; Schaub, T.M.; Rodgers, R.P. and Marshall, A.G., *Combined High and Low Resolution Mass Spectrometry for Determination of Asphaltene Molecular Structures*, 55th Amer. Soc. Mass Spectrom. Ann. Conf. on Mass Spectrometry, Indianapolis, IN, June 3-7 (2007)

Eyler, J.R., *Infrared Spectra of Gaseous Ions*, Moffitt Symp. on Mass Spectrometry (MS/MS), Tampa, FL, April 12-13 (2007)

Fabris, F.; Zapf, V.S., Lacerda, A.H.; Pureur, P.; Schaf, J.; Vieira, V. and Campbell, I., *The Chiral anomalous Hall Effect in re-entrant Au-Fe alloys*, American Physical Society March Meeting, Denver, CO, March 5-7 (2007); Published in Bulletin of the American Physical Society, **52** (1) (0)

Foroutan, P.; Simpson, N.E.; Oca-Cossio, J.A.; Sweeney, C.A.; Blackband, S.J.; Grant, S.C. and Constantinidis, I., *MR Microscopy of Alginate Stability in a Novel Design for a Bioartificial Pancreas*, 48th Experimental NMR Conf., Daytona Beach, FL, April 22-28 (2007)

Fu, R., *High field MAS NMR study of phase transitions in model H-bonded solids and lithium rechargeable batteries*, Invited presentation in Department of Physics, Xiamen University, Xiamen, P. R. China, October 24 (2007)

Fu, R.; Sen, O.G. and Dalal, N.S., *Unexpectedly Large Resolution and Sensitivity Enhancement at 900 MHz (21.1 T) in MAS NMR of Spin-1/2 in Solids, Oral presentation*, 2nd Asia-Pacific NMR Meeting, Taiwan, October 12-14 (2007)

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Suslov, A., *Magnetoacoustic studies as a probe of electron system (Invited talk)*, 153rd Meeting of the Acoustical Society of America, Salt Lake City, UT, USA, June 4-8 (2007); Published in The Journal of the Acoustical Society of America, **121** (5), 3089 (2007)

Suslov, A., *Ultrasound study on Sr_2RuO_4 in high magnetic fields*, Laboratory of Kinetic Phenomena in Solids at Low Temperatures (Seminar), A.F. Ioffe Physical-Technical Institute, St. Petersburg, Russia, June 29 (2007)

Szymanska, I.B. and Ozarowski, A., *High-Field, High-Frequency EPR Studies on Dimeric Copper(II) Perfluorocarboxylates and Silylcarboxylates*, 36th Southeastern Magnetic Resonance Conf., Tuscaloosa, AL, November 9-11 (2007); Published in Conference Proceedings, 73 (2007)

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Tecimer, M., *FIR FEL Conceptual Design*, NHMFL FEL Design Proposal Review, Jefferson Lab., Newport News, VA, July 13 (2007)

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Tokumoto, T.; van Tol, J.; Brunel, L.-C.; Choi, E.S.; Brooks, J.S.; Kaihatsu, T.; Akutsu, H. and Yamada, J., *High field ESR study of the pi-d interaction effect in beta-$(BDA\text{-}TTP)_2MCl_4$ (M=Fe, Ga)*, American Physical Society March Meeting, Denver, CO, March 6 (2007)

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Tsybin, Y.O.; He, H.; Hamidane, H.B.; Tsybin, O.Y.; Emmett, M.R.; Hendrickson, C.L. and Marshall, A.G., *Biological FT-ICR MS: A Glycocentric View*, 6th N. Amer. FT-ICR MS Conf., Tahoe City, CA, April 1-5 (2007)

Vachon, M.-A.; Koutroulakis, G.; Mitrovic, V.; Reyes, A.P.; Kuhns, P.L. and Coldea, R., *Anisotropic Interactions in a Quantum Antiferromagnet Cs_2CuCl_4 as revealed by NMR*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

van Agthoven, M., *Etude et optimisation de l'optique d'entrée d'un spectromètre de masse FTICR*, Laboratoire d'Analyse Spectroscopique d'Ions et Molécules, Université Claude Bernard Lyon, Lyon, France, December 21 (2007)

van Agthoven, M., *Etude et optimisation de l'optique d'entrée d'un spectromètre de masse FTICR*, Laboratoire de Chimie Organique et Macromoléculaire, Université des Sciences et Technologies Lille 1 in Lille, Lille, France, December 18 (2007)

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van Agthoven, M.A.; Beu. S.C.; Blakney, G.T.; Hendrickson, C.L. and Marshall, A.G., *Minimization of Mass Discrimination due to Time-of-Flight Dispersion in External Source Fourier Transform Ion Cyclotron Resonance Mass Spectrometry*, 6th N. Amer. FT-ICR MS Conf., Tahoe City, CA, April 1-5 (2007)

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Van Sciver, S.W., *Particle Image Velocimetry (PIV) techniques applied to turbulence studies in helium II*, American Physical Society March Meeting, Denver, CO, March (2007)

Van Sciver, S.W., *PIV Techniques in Superfluid Helium*, European Workshop on Turbulence in Cryogenic Helium, CERN, Geneva, Switzerland, April 23-25 (2007)

Van Sciver, S.W., *The Fundamentals of Superconductivity for Applications*, United Technologies Research Center, Hartford, CT, May 17 (2007)

van Tol, J.; Nellutla, S. and Landee, C. P., *High frequency ESR study of the two-dimensional Heisenberg antiferromagnet copper pyrazine perchlorate*, American Physical Society March Meeting, March 5-9 (2007); Published in Bulletin of the American Physical Society, **57** (12007) (0)

van Tol, J.; Nellutla, S.; Pati, M. and Dalal, N.S., *^{39}K Hyperfine and Quadrupole Interaction in K_3NbO_8:Cr(V) Studied by Pulsed ENDOR at 240 GHz*, 49th Annual Rocky Mountain Conf. on Analytical Chemistry, Breckenridge, CO, July 22-26 (2007)

Verhaert, P.D.; Emmett, M.R.; Schaub, T.M.; Pinkse, M.; Nilsson, C.L. and Marshall, A.G., *Top-down Insect Neuropeptide Analysis with Nano-LC and a 14.5 T FT-ICR Mass Spectrometer*, 55th Amer. Soc. Mass Spectrom. Ann. Conf. on Mass Spectrometry, Indianapolis, IN, June 3-7 (2007)

Vollmar, B.S.; Cotten, M. and Fu, R., *Structure and dynamics of the antimicrobial peptide piscidin*, Undergraduate Program, 233rd ACS National Meeting, Chicago, IL, March 25-26 (2007)

Walsh, R.; Han, K.; Toplosky, V. and Goddard, R., *Fracture Toughness Measurements and Assessment of Thin Walled Conduit Alloys in a CICC Application*, 2007 CEC/ICMC, Chattanooga, TN, July 16-20 (2007)

Waryoba, D. R.; Kalu, P. N. and Crooks, R., *Grain Boundary Structure in Severe Plastic Deformed OFHC Cu Wires*, TMS 2007, 136th Annual Meeting & Exhibition, Orlando, FL, February 25-March 1 (2007)

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Weijers, H.W., *Second order polynomial fit of BSCCO room temperature stress-strain curves*, VAMAS-IEC Work Group 4 meeting at the ISS 2007, Tsukuba. Japan, November 7 (2007)

Weijers, H.W.; Gavrilin, A.V.; Cantrell, K.R.; Kenney, S.J. and Miller, G.E., *Binary Nitrogen-Vapor Cooled 10 kA Leads*, 20th Biennial Int. Conf. on Magnet Technology (MT-20), Philadelphia, PA, August 27-31 (2007)

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Wiebe, C.R.; Zhou, H.; Vogt, B.; Janik, J.; Jo, Y.-J.; Balicas, L. and Gardner, J., *Freezing the 2D distorted kagome spin liquid $Nd_3Ga_5SiO_{14}$*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

Witter, R.; Gor'kov, P.L.; Schmitt, M.; Gauder, D.; Heinzmann, R.; Brey, W.W. and Ulrich, A.S., *$^{19}F/^{1}H$ double Efree Probe for Biological Applications*, BRUKER user meeting, Ettlingen, Germany, November 6-7 (2007)

Witter, R.; Sternberg, U.; Klipfel, M.; Heinzmann, R.; Gor'kov, P.; Nozirov, F.; Li, C.; Fu, R.; Cross, T.A. and Ulrich A.S., *Structure and Dynamics Investigations with Solid State ^{13}C-, ^{15}N- and ^{19}F-NMR Chemical Shift Tensors*, 48th ENC, Experimental Nuclear Magnetic Resonance Conf., Daytona Beach, FL, April 22-27 (2007)

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Xiao, F.; Landee, C.P. and Turnbull, M.M., *Field-induced anisotropy crossover in copper pyrazine perchlorate $Cu(pz)_2(ClO_4)_2$*, American Physical Society March Meeting, March 5-9 (2007); Published in Bulletin of the American Physical Society, **521** (2007)

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Yi, M.; Li, C.; Cross, T.A. and Zhou, H.-X., *Molecular Dynamics Study of Amantadine Inhibition of the M2 Ion Channel of Influenza A in Phospholipid Bilayers*, Biophysical Society 51st Annual Meeting, Baltimore, MD, February (2007)

Yoshida, Y.; Andraka, B.; Takano, Y.; Tsujii, H.; Inagaki, Y. and Kikuchi, H., *Specific-heat and magnetocaloric-effect study of the S=1/2 frustrated-chain antiferromagnet $Cu_3(CO_3)_2(OH)_2$*, American Physical Society March Meeting, Denver, CO, March 5-9 (2007)

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Yoshida, Y.; Tsujii, H.; Inagaki, Y., Masaoka, S., Kikuchi, H., Craciun, V.; Kim, Y.; Andraka, B. and Takano, Y., *Angle-dependent magnetic phase diagram of the quasi-one-dimensional antiferromagnet* $Cu_3(CO_3)_2(OH)_2$, Meeting of the Physical Society of Japan, Sapporo, Japan, September (2007)

Zapf, V.S., *A new approach to magnetostriction in a quantum magnet*, Int. Conf. on Strongly Correlated Electron Systems, Houston, TX, May (2007)

Zapf, V.S., *Bose-Einstein condensation in Quantum magnets*, Institute for Solid State Physics, Tokyo, Japan, February (2007)

Zapf, V.S., *Bose-Einstein condensation in quantum magnets*, Magnetism and Magnetic Materials Conf., Baltimore, MD, January (2007)

Zapf, V.S., *Bose-Einstein condensation in Quantum magnets*, University of Southern California Colloquium, Los Angeles, CA, March (2007)

Zapf, V.S., *Large magnets and new science at the National High Magnetic Field Lab*, Bradbury Science Museum Public Lecture Series, Los Alamos, NM, June (2007)

Zapf, V.S., *Quantum magnetism and possible BEC in an organic Nickel compound*, American Physical Society March Meeting, Denver, CO, March 5-7 (2007); Published in Bulletin of the American Physical Society, **52** (1) (2007)

Zapf, V.S., *Quantum magnetism, an introduction*, Los Alamos Summer School, Los Alamos, NM, June (2007)

Zhai, Y. and Bird, M.D., *Modeling of the Performance of* Nb_3Sn *CICCs for High Field Magnet Design*, 20th Biennial Int. Conf. on Magnet Technology (MT-20), Philadelphia, PA, August 27-31 (2007)

Zhang, F.; Bruschweiler, R.; Kaplan, F.; Zachariah, C.; Sippel, K.; Dossey, A.T. and Edison, A.S., *NMR and Mixtures: New Developments for Natural Products and Metabolomics*, 48th ENC, Daytona Beach, FL, April 22-27 (2007)

Zhang, H.; Emmett, M.R.; Kazazic, S. and Marshall, A.G., *Use of Multiple Proteases to Improve Resolution and Accuracy in Hydrogen/Deuterium Exchange Monitored by FT-ICR Mass Spectrometry*, 55th Amer. Soc. Mass Spectrom. Ann. Conf. on Mass Spectrometry, Indianapolis, IN, June 3-7 (2007)

Zhang, H.; Emmett, M.R.; Kazazic, S.; Schaub, T.M. and Marshall, A.G., *Use of Multiple Proteases in Hydrogen/Deuterium Exchange Monitored by High-Field FT-ICR Mass Spectrometry*, 6th N. Amer. FT-ICR MS Conf., Tahoe City, CA, April 1-5 (2007)

Zhou, H.D.; Conner, B.S.; Balicas, L. and Wiebe, C.R., *Orbital-ordering transition in* Sr_2VO_4, Orbital Physics Conf. 2007, Stuttgart, Germany, October 10-12 (2007)

BOOKS, CHAPTERS, REVIEWS & OTHER ONE-TIME PUBLICATIONS

Alamo, R.G., "Polyethylene, Linear High-Density", *Polymer Data Handbook, 2nd Ed. Oxford University Press*, 2007

Carlsohn, E. and Nilsson, C.L., "Proteomic Approaches to the Functional Identification of Bacterial Adhesins", *Lectins: Analytical Technologies (C.L. Nilsson, Ed.)*, 2007

Nilsson, C.L., "Lectins: Analytical Tools from Nature [chapter]", *Lectins: Analytical Technologies (C. L. Nilsson, Ed.)*, 2007

Nilsson, C.L., Editor, "Lectins: Analytical Technologies (Elsevier)", 2007

Novotny, M.A.; Robb, D.T.; Stinnett, S.M.; Brown, G. and Rikvold, P.A., "Finite-temperature Simulations for Magnetic Nanostructures", *Magnetic Nanostructures, edited by B. Aktas, L. R. Tagirov, and F. Mikailov. Springer Series in Materials Science Vol. 94 (Springer-Verlag, Berlin, 2007), pp. 97-120.*, 97-120, 2007

Walter, G.A.; Santra, S.; Thattaliyath, B.; and Grant, S.C., "of (Para)magnetic nanoparticles for labeling and tracking of stem cells and progenitors", *Nanoparticles in Biomedical Imaging: Emerging Technologies and Applications*, 2007

INTERNET DISSEMINATIONS

Petrik, M.S.; Wilson, J.M.B.; Grant, S.C.; Blackband, S.J.; Tabata, R.C.; Shan, X.; Krieger, C. and Shaw, C.A., *MR microscopy of the central nervous system of a mutant SOD model of ALS, MagLab Reports*, **http://www.magnet.fsu.edu/mediacenter/publications/reports/maglabreports-2007-v14-i1.pdf**, (2007)

Schepkin, V.D.; Grant, S.C. and Cross, T.A., *In vivo MR Imaging at 21.1 T, MagLab Reports*, **http://www.magnet.fsu.edu/mediacenter/publications/reports/maglabreports-2007-v14-i4.pdf**, (2007)

Zhou, S. and Wang, Z., *Nodal d+id pairing and topological phases on the triangular lattice: unconventional superconducting state of* $Na_xCoO_{2y}H_2O$, **http://arxiv.org/abs/0712.1042**, (2007)

AWARDS, HONORS & SERVICE

Bartlett, Rodney J., American Chemical Society Award in Theoretical Chemistry (2007)

Boebinger, Gregory S., Fellow of the American Association for the Advancement of Science (AAAS) (2007)

Bowers, Clifford Russell, Elected to the Executive Committee, Center for Condensed Matter Sciences, University of Florida (2007)

Cheng, C.-Y. and **Bowers, Clifford Russell**, Particle Engineering Research Center IAB Meeting Poster Competition, Florida Hilton Hotel, Gainesville, 2nd Place, "Characterization" (2007)

Chiorescu, Irinel, NSF Career Award (2007-2011)

Crooker, Scott, Los Alamos National Laboratory Fellows' Prize for Outstanding Research (2007)

Cross, Timothy A., Fellow of the Biophysical Society (2007)

Dalal, Naresh, 2007 Florida Award from the American Chemical Society (2007)

Dalal, Naresh, 2007 Southern Chemist Award from the Memphis Section of the American Chemical Society (2007)

Dorsey, Alan T., Selection Committee for the Southeastern Section of the American Physical Society (SESAPS) Jesse W. Beams Award: Vice-Chair (2007), Chair (2008). (2007-2008)

Grant, Samuel C., 2nd Place Poster Award: Other Applications and Techniques, 15th Annual Meeting of the International Society for Magnetic Resonance in Medicine, "High Resolution Sodium Imaging of Isolated Neurons." (2007)

Harrison, Neil, American Physical Society (Division of Condensed Matter Physics) Fellow (2007)

Hirschfeld, Peter, Named UFRF Professor by the University of Florida Research Foundation (2007-2010)

Jaime, Marcelo, James J. Christensen Award for Innovations in Calorimetry by the Calorimetry Conference (2007)

Larbalestier, David, Cryogenic Materials Award for Lifetime Achievements 2007 from the International Cryogenic Materials Conference (2007)

Marshall, Alan, Chemical Pioneer Award from the American Institute of Chemists (2007)

Nguyen, Hau Thi B., ISOTEC Student Sponsorship (2007)

Page, Richard C., Joseph M. Schor Fellowship in Biochemistry, Florida State University (2007-2008)

Page, Richard C., National Institutes of Health National Graduate Student Research Festival, Participant (2007)

Pfeilsticker, Jessica, Best Undergraduate Honors Thesis, University of Florida Department of Chemistry: Resistively Detected NMR Studies (2007)

Reitze, David, Elected spokesperson for the Laser Interferometer Gravitational Wave Observatory (LIGO) Scientific Collaboration (2007)

Richards, Nigel J., Named UF Distinguished Teaching Scholar (2007)

Schwartz, Justin, Special Award for Exceptional Service, FAMU-FSU College of Engineering (2007)

Sebastian, Suchitra E., Lee-Osheroff-Richardson Prize (2007-2007)

Van Sciver, Steven, Fellow, Cryogenics Society of America (2007)

Vandenborne, Krista, Named UFRF Professor by the University of Florida Research Foundation (2007-2010)

Wiant, David B., Otto Lehmann Award for 2007 (2007)

Yang, Kun, FSU Developing Scholar Award (2007)

PH.D. DISSERTATIONS

Bhatia, Mohit, *"MgB_2 Superconductors: Processing, Characterization and Enhancements of Critical Fields"*, The Ohio State University, Materials Science Department, advisor: Mike Sumption (2007)

Bhattacharya, Nilakshee, *"Backbone Dynamics in an Intramolecular Prolylpeptide-SH3 Complex from Diphtheria Toxin Repressor, DtxR"*, Florida State University, Chemistry & Biochemistry, advisor: Timothy Logan (2007)

Hormozi, Layla, *"Topological Quantum Compiling"*, Florida State University, Department of Physics, advisor: N.E. Bonesteel (2007)

Kim, Il, Sang, *"The Critical Current Density of $YBa_2Cu_30_{7-x}$ Coated Conductors"*, University of Wisconsin-Madison, Materials Science, advisor: David Larbalestier (2007)

Lawrence, Jonathan, *"Comprehensive High Frequency Electron Paramagnetic Resonance Studies of Single Molecule Magnets"*, University of Florida, Physics, advisor: Stephen Hill (2007)

Lee, Hyun Jung, *"One-Dimensional Charge Transport in Conducting Polymer Nanofibers"*, Seoul National University, School of Physics, advisor: Yung Woo Park (2007)

Nguyen, Doan Ngoc, *"Alternating Current Loss Characteristics in $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10}$ and $YBa_2Cu_3O_{7-d}$ Superconducting Tapes"*, Florida State University, Physics, advisors: Justin Schwartz and Greg Boebinger (2007)

Pop, Margareta, *"Teaching in the eyes of Beholders: Preservice Teachers' Reasons for Teaching and their Beliefs about Teaching"*, FSU Educational Psychology, advisor: Alysia Roehrig (2007)

Senkowicz, Ben James, *"Optimizing Critical Current Density through Composition and Microstructure in Mechanically Alloyed Magnesium Diboride"*, University of Wisconsin-Madison, Materials Science, advisors: Eric E. Hellstrom and David Larbalestier (2007)

Wang, Xiaorong, *"Quench Behavior of $YBa_2Cu_3O_{7-d}$ Coated Conductors"*, Florida State University, Electrical Engineering, advisor: Justin Schwartz (2007)

Wiant, David, *"Pattern Formation and Phase Transitions in Bent-Core Liquid Crystals"*, Kent State University, Physics, advisor: J.T. Gleeson (2007)

Zhou, Sen, *"Electronic Correlation and Geometric Frustration in Na_xCoO_2"*, Boston College, Physics, advisor: Ziqiang Wang (2007)

MASTER THESES

Chiari, Ysela L., *"NMR Characterization and Isothermal Crystallization of Random Iso-propylene Copolymers with Ethylene and 1-Octene Co-units"*, Florida State University, Chemical and Biomedical Engineering, advisor: Rufina G. Alamo (2007)

Dhaka, Rakesh, *"Sn and Ti Diffusion, Phase Formation, Stoichiometry, and Superconducting Properties of Internal-Sn-Type Nb_3Sn Conductors"*, The Ohio State University, Materials Science Department, advisors: M.D. Sumption and E.W. Collings (2007)

Oliver, Anita, *"Mechanical and Electrical Properties of Carbon Nanotube Reinforced Polycarbonate at Liquid Nitrogen Temperature"*, Florida State University, Mechanical Engineering, advisor: Justin Schwartz (2007)

GRANTS AWARDED TO NHMFL-AFFILIATED FACULTY AT FLORIDA STATE UNIVERSITY

As reported by the FSU Office of Sponsored Research for calendar year 2007

PI: Alamo, Rufina
Grant Title: FRG:GOALI: Collaborative Research: The Role of Polymer…
Agency: National Science Foundation
Project Dates: 7/15/07 - 6/30/08
Award: $90,000

PI: Bird, Mark
Grant Title: Hahn-Meitner-Institut Educational Research Agreement
Agency: FSU Magnet Rsch. & Dev. Inc.
Project Dates: 3/1/07 - 2/28/11
Award: $1,130,000.00

PI: Bird, Mark
Grant Title: Series Connected Hybrid Construction Phase…
Agency: National Science Foundation
Project Dates: 8/25/06 - 8/31/11
Award: $3,000,000

PI: Bird, Mark
Grant Title: CED of Conical SCH for SNS
Agency: Johns Hopkins University
Project Dates: 9/15/06 - 4/30/08
Award: $337,117

PI: Bizimis, Michael
Grant Title: Kaua'i Xenoliths
Agency: National Science Foundation
Project Dates: 10/1/06 - 9/30/08
Award: $72,073

PI: Boebinger, Gregory
Grant Title: National High Magnetic Field Laboratory
Agency: National Science Foundation
Project Dates: 1/1/01 - 12/31/07
Award: $26,500,000

PI: Brey, William
Grant Title: Unrestricted Grant for Support of Postdoctoral Associate
Agency: Bruker BioSpin Corporation
Project Dates: 6/1/07 - 5/31/09
Award: $100,000

PI: Brooks, James
Grant Title: Properties of Molecular Solids
Agency: National Science Foundation
Project Dates: 7/15/06 - 6/30/08
Award: $123,740

PI: Bruschweiler, Rafael
Grant Title: *In Vivo* Elucidation of Drug Targets
Agency: American Heart Association
Project Dates: 7/1/07 - 6/30/09
Award: $41,476

PI: Bruschweiler, Rafael
Grant Title: *In Vivo* Elucidation of Drug Targets
Agency: American Heart Association
Project Dates: 7/1/07 - 6/30/09
Award: $45,796

PI: Bruschweiler, Rafael
Grant Title: NMR/MD Studies of Human MDM2 Interaction with P53
Agency: National Cancer Institute
Project Dates: 7/1/05 - 6/30/08
Award: $48,796

PI: Bruschweiler, Rafael
Grant Title: Direct NMR Methods for Protein Structures and Assignment…
Agency: National Institute of General
Project Dates: 1/1/05 - 4/30/08
Award: $173,044

PI: Bruschweiler, Rafael
Grant Title: New Methods and Applications
Agency: National Science Foundation
Project Dates: 1/1/05 - 6/30/06
Award: $148,242

PI: Bruschweiler, Rafael
Grant Title: Correlated Protein Motions
Agency: National Science Foundation
Project Dates: 7/1/06 - 6/30/08
Award: $137,008

PI: Bruschweiler, Rafael
Grant Title: Functional Dynamics during Induced-Fit...
Agency: Oregon Health Sciences University
Project Dates: 2/1/07 - 1/31/08
Award: $66,134

PI: Cao, Jianming
Grant Title: Ultrafast Structural Dynamics in Solids and Nanoparticle…
Agency: National Science Foundation
Project Dates: 6/1/06 - 5/31/08
Award: $110,000

PI: Chanton, Jeffrey
Grant Title: Phase II of Manatee Springs Study
Agency: Florida Department of Health
Project Dates: 5/2/05 - 9/30/07
Award: $41,041

PI: Chanton, Jeffrey
Grant Title: Fate of Nitrogen and Organic Wastewater Compounds
Agency: Florida Dept Environ Protection
Project Dates: 5/1/07 - 4/30/08
Award: $52,406

PI: Chanton, Jeffrey
Grant Title: Groundwater Carbon Flux Coupling
Agency: National Science Foundation
Project Dates: 2/1/07 - 1/31/12
Award: $493,448

PI: Chanton, Jeffrey
Grant Title: Coupling of Continuous
Agency: University of Mississippi
Project Dates: 7/1/06 - 6/30/08
Award: $112,520

PI: Chanton, Jeffrey
Grant Title: Methane Emissions and Oxidation Testing and Modeling…
Agency: Waste Management, Inc.
Project Dates: 1/30/07 - 2/28/09
Award: $110,000

PI: Chanton, Jeffrey
Grant Title: Los Gatos
Agency: Los Gatos Research, Inc.
Project Dates: 9/4/07 - 3/19/08
Award: $25,033

PI: Chiorescu, Irinel
Grant Title: Quantum Optics with Magnetic Molecular Spins
Agency: National Science Foundation
Project Dates: 2/15/07 - 1/31/09
Award: $100,000

PI: Chiorescu, Irinel
Grant Title: Probe the Quantum Spin Dynamics in Novel Magnetic...
Agency: University of New Orleans
Project Dates: 9/1/07 - 3/4/08
Award: $19,359

PI: Cross, Timothy
Grant Title: Correlations: Structure-Dynamics-Functions in Channels
Agency: National Institute of Allergy
Project Dates: 3/1/05 - 5/31/08
Award: $339,547

PI: Cross, Timothy
Grant Title: Four MTB Membrane Proteins: Structure and Function
Agency: National Institute of Allergy
Project Dates: 12/1/07 - 11/30/08
Award: $413,511

PI: Dalal, Nar
Grant Title: Thermodynamic and Spectroscopic Studies on Ammonia Boran
Agency: Battelle Memorial Institute
Project Dates: 4/16/07 - 2/29/08
Award: $36,500

PI: Dalal, Nar
Grant Title: Undergraduate Education in Chemistry
Agency: Various DFPO
Project Dates: 6/13/95 - 6/30/10
Award: $2,166

PI: Davidson, Michael
Grant Title: Construction of Interactive Tutorials
Agency: Olympus America
Project Dates: 4/1/00 - 8/31/11
Award: $150,000

PI: Dixon, Patricia
Grant Title: PAEC Fame Project
Agency: Panhandle Area Educational Consortium
Project Dates: 5/1/07 - 7/31/07
Award: $7,500

PI: Dixon, Patricia
Grant Title: Science, Tobacco & You Update and Revision
Agency: TSI Management Corporation
Project Dates: 8/1/07 - 5/31/08
Award: $39,999

PI: El-Azab, Anter
Grant Title: Multiscale Simulation of Thermo-Mechanical Processes…
Agency: U. S. Department of Energy
Project Dates: 5/1/07 - 5/7/08
Award: $29,633

PI: El-Azab, Anter
Grant Title: Deformation Simulation and Analysis
Agency: UT-Battelle LLC
Project Dates: 4/19/07 - 1/31/08
Award: $50,000

PI: Fajer, Piotr
Grant Title: EPR Studies of Protein-Protein Interactions: Distances…
Agency: National Science Foundation
Project Dates: 3/1/04 - 2/29/08
Award: $210,584

PI: Gaffney, Betty
Grant Title: Effect of Vascular Protectants on Lipoxygenase
Agency: AtheroGenics, Inc
Project Dates: 9/20/05 - 9/19/06
Award: $2,000

PI: Gor'kov, Petr
Grant Title: Construction of 700 NB Bicelle NMR Probe
Agency: University of Minnesota
Project Dates: 8/10/07 - 6/30/08
Award: $16,060

PI: Gurevich, Alexander
Grant Title: AFOSR Phase II STTRYBCO Coated Conductors with Reduced…
Agency: American Superconductor
Project Dates: 12/18/06 - 12/31/07
Award: $115,000

PI: Han, Ke
Grant Title: Fabrication of Anisotropic Magnets via High Magnetic…
Agency: Toyota Motor Eng. & Mfg. North America
Project Dates: 12/3/07 - 12/2/08
Award: $158,494

PI: Humayun, Munir
Grant Title: Siderophile Element Analysis by ICP-MS
Agency: National Aeronautics & Space Administration
Project Dates: 8/15/06 - 8/14/09
Award: $80,000

PI: Humayun, Munir
Grant Title: Analysis of GENESIS Wafers by ICP-MS
Agency: National Aeronautics & Space Administration
Project Dates: 2/16/05 - 2/15/10
Award: $129,000

PI: Humayun, Munir
Grant Title: Siderophile Element Analysis by ICP-MS
Agency: National Aeronautics & Space Administration
Project Dates: 8/15/06 - 8/14/09
Award: $14,999

PI: Landing, William
Grant Title: NSF CLIVAR 2006
Agency: National Science Foundation
Project Dates: 12/16/06 - 2/28/10
Award: $5,000

PI: Landing, William
Grant Title: NSF CLIVAR 2006
Agency: National Science Foundation
Project Dates: 12/16/06 - 2/28/10
Award: $391,711

PI: Landing, William
Grant Title: Assessment of Environmental Pollution
Agency: University of West Florida
Project Dates: 5/1/05 - 6/30/08
Award: $29,085

PI: Larbalestier, David
Grant Title: AFOSR Phase II STTR High Critical Current in Metal…
Agency: American Superconductor
Project Dates: 2/1/07 - 1/31/09
Award: $250,000

PI: Larbalestier, David
Grant Title: Applied Superconductivity
Agency: New Energy and Industrial Development
Project Dates: 10/1/06 - 9/30/07
Award: $40,900

PI: Larbalestier, David
Grant Title: Characterization of Superpower Coated Conductors
Agency: SuperPower Inc.
Project Dates: 2/13/07 - 2/12/08
Award: $60,000

PI: Larbalestier, David
Grant Title: High Field Superconductor Development and Understanding
Agency: U. S. Department of Energy
Project Dates: 4/1/07 - 3/31/08
Award: $25,000

PI: Larbalestier, David
Grant Title: High Field Superconductor Development and Understanding
Agency: U. S. Department of Energy
Project Dates: 4/1/07 - 3/31/08
Award: $530,000

PI: Larbalestier, David
Grant Title: Buffer Layer Growth, the Thickness Dependence of Jc...
Agency: University of Wisconsin
Project Dates: 7/1/07 - 6/30/08
Award: $132,000

PI: Lee, Peter
Grant Title: Experimental and Modelling Studies of the ITER Strand…
Agency: ITER (Int'l Fusion Energy Org) Org.
Project Dates: 8/7/07 - 2/6/08
Award: $100,000

PI: Lee, Peter
Grant Title: Understanding & Development of High Field SCS for Fusion
Agency: U. S. Department of Energy
Project Dates: 7/1/06 - 6/30/08
Award: $90,000

PI: Lee, Peter
Grant Title: Magnetic Investigation of High Purity Niobium
Agency: U. S. Department of Energy
Project Dates: 9/1/06 - 8/31/08
Award: $64,000

PI: Liang, Zhiyong
Grant Title: Fabrication of Buckypaper Samples
Agency: Goodrich Aerostructures Group
Project Dates: 12/22/06 - 2/28/07
Award: $14,774

PI: Liang, Zhiyong
Grant Title: Fabrication of Randomly Oriented Buckypaper Samples
Agency: National Composite Center
Project Dates: 4/18/07 - 5/30/07
Award: $95,350

PI: Liang, Zhiyong
Grant Title: Innovative Process for Continuous Fabrication of Carbon
Agency: National Composite Center
Project Dates: 8/1/07 - 4/30/08
Award: $260,000

PI: Liang, Zhiyong
Grant Title: Fabrication of Randomly Oriented Buckypaper
Agency: Spirit Aerosystems, Inc.
Project Dates: 5/2/07 - 7/31/07
Award: $42,250

PI: Logan, Timothy
Grant Title: Purchase AUC for IMB
Agency: National Center for Research Resources
Project Dates: 6/1/07 - 5/31/08
Award: $308,578

PI: Logan, Timothy
Grant Title: Non-Metal Ion Activators
Agency: Boston Medical Center
Project Dates: 2/1/07 - 1/31/08
Award: $141,328

PI: Logan, Timothy
Grant Title: Renovations of the Molecular Biophysics Building
Agency: National Ctr. for Research Resources
Project Dates: 8/1/00 - 7/31/23
Award: $1,999,999

PI: Marshall, Alan
Grant Title: Structural Mapping of Protein Complexes
Agency: National Institute of General
Project Dates: 8/1/06 - 7/31/08
Award: $305,380

PI: Marshall, Alan
Grant Title: FT-ICR Mass Spectral Research
Agency: Baker Petrolite
Project Dates: 7/1/07 - 6/30/08
Award: $99,999

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $344

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $12,000

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $25,000

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $26,000

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $50,000

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $65,000

PI: Marshall, Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $307,500

PI: Marshall. Alan
Grant Title: FT-ICR ANALYSIS
Agency: Various Sources (Business/ Industry)
Project Dates: 11/23/03 - 7/20/07
Award: $8,000

PI: Moerland, Timothy
Grant Title: Investigations of Environmentally Induced Myosatellite
Agency: American Heart Association
Project Dates: 7/1/07 - 6/30/09
Award: $21,770

PI: Moerland, Timothy
Grant Title: High Field Magnetic Resonance Research and Technology
Agency: University of Florida
Project Dates: 5/1/06 - 4/30/08
Award: $41,000

PI: Painter, Thomas
Grant Title: High-Field Magnet Technology Development Activities
Agency: Korea Basic Science Institute
Project Dates: 8/1/07 - 7/31/08
Award: $70,040

PI: Polyanskii, Anatolii
Grant Title: Method of Visualization of Superconducting Properties
Agency: U. S. Civilian Research & Development
Project Dates: 5/1/07 - 2/29/08
Award: $5,500

PI: Rikvold, Per
Grant Title: Computational Studies
Agency: Mississippi State University
Project Dates: 4/1/05 - 3/31/08
Award: $49,401

PI: Salters, Vincent
Grant Title: Hafnium Isotope Constraints of Normal MORB
Agency: National Science Foundation
Project Dates: 4/1/07 - 3/31/08
Award: $109,660

PI: Sanchez, Jose
Grant Title: Science: Optimizing Academic Returns (SOAR)
Agency: Panhandle Area Educational Consortium
Project Dates: 6/1/07 - 8/31/08
Award: $69,300

PI: Schepkin, Victor
Grant Title: Dual Sodium MRI and Proton ADC Assessment
Agency: National Cancer Institute
Project Dates: 8/21/06 - 3/31/08
Award: $139,694

PI: Schlottmann, Pedro
Grant Title: Strongly Correlated Electron Systems
Agency: U. S. Department of Energy
Project Dates: 8/15/98 - 8/14/08
Award: $55,000

PI: Schlottmann, Pedro
Grant Title: Strongly Correlated Electrons
Agency: U. S. Department of Energy
Project Dates: 8/15/07 - 8/14/08
Award: $55,000

PI: Schwartz, Justin
Grant Title: High Field Stability Exploration of Second Generation HTS
Agency: American Superconductor
Project Dates: 6/20/07 - 3/19/08
Award: $35,050

PI: Schwartz, Justin
Grant Title: React-Wind-Sinter Technology for $Bi_2Sr_2CaCu_2O_x$
Agency: Supercon Inc.
Project Dates: 9/5/07 - 3/19/08
Award: $59,908

PI: Schwartz, Justin
Grant Title: Continuation of High Field Magnets for MRI Applications
Agency: Supercon Inc.
Project Dates: 9/1/07 - 8/31/08
Award: $255,952

PI: Schwartz, Justin
Grant Title: Quench Behavior of YBCO Coated Conductors
Agency: University of Wisconsin
Project Dates: 7/1/04 - 6/30/06
Award: $29,164

PI: Tozer, Stanley
Grant Title: Electron Interactions in Actinides and Related Systems
Agency: U. S. Department of Energy
Project Dates: 5/1/06 - 4/30/08
Award: $600,000

PI: Sam Grant
Grant Title: Effects of Nicotine in the Zebra Finch
Agency: Florida Department of Health
Project Dates: 7/1/06 - 6/30/08
Award: $156,541

PI: Van Sciver, Steven
Grant Title: Visualization Studies of Forced Flow Liquid Helium
Agency: National Science Foundation
Project Dates: 7/15/07 - 6/30/10
Award: $300,000

PI: Van Sciver, Steven
Grant Title: Liquid Helium Fluid Dynamics Studies
Agency: U. S. Department of Energy
Project Dates: 1/1/96 - 3/31/08
Award: $50,000

PI: Van Sciver, Steven
Grant Title: Liquid Helium Fluid Dynamics Studies
Agency: U. S. Department of Energy
Project Dates: 1/1/96 - 3/31/08
Award: $205,000

PI: Walsh, Robert
Grant Title: ITER-NHMFL 2007 Materials Characterization Program
Agency: UT-Battelle LLC
Project Dates: 6/1/07 - 5/31/08
Award: $271,252

PI: Wang, Yang
Grant Title: Technician Support for the Stable Isotope Laboratory…
Agency: National Science Foundation
Project Dates: 12/15/05 - 11/30/08
Award: $74,770

PI: Wang, Yang
Grant Title: Tibetan Uplift and Climate Change
Agency: National Science Foundation
Project Dates: 1/15/08 - 12/31/08
Award: $25,230

PI: Wang, Yongjie
Grant Title: Infrared Optical Study of Graphene - High Magnetic Fields
Agency: U. S. Department of Energy
Project Dates: 8/15/07 - 8/14/08
Award: $130,014

PI: Yang, Kun
Grant Title: Unconventional Phases and Phase Transitions in Strongly…
Agency: National Science Foundation
Project Dates: 12/15/07 - 11/30/08
Award: $85,000

GRANTS AWARDED TO NHMFL-AFFILIATED FACULTY AT THE UNIVERSITY OF FLORIDA

As reported by the UF Office of Sponsored Research for calendar year 2007

PI: Abernathy, C.
Grant Title: 20 GHz Gan Wide-Band Receiver
Agency: U.S. Navy
Project Dates: 12/11/06 - 6/30/08
Award: $120,000.00

PI: Abernathy, C.
Grant Title: Magneto-Optical Behavior of II-TM-N Materials & Devices
Agency: U.S. Army
Project Dates: 10/1/04 - 12/31/07
Award: $80,000.00

PI: Andraka, B.
Grant Title: Investigation of Novel Strongly Correlated Electron States with the Emphasis on Pr-Based Systems
Agency: U.S. Department of Energy
Project Dates: 2/1/99 - 1/31/08
Award: $90,001.00

PI: Blackband, S. J.
Grant Title: Noninvasive Monitoring Glutathione Metabolism in Tumors
Agency: Duke University
Project Dates: 3/17/06 - 1/31/08
Award: $53,301.00

PI: Blackband, S. J.
Grant Title: Noninvasive Monitoring Glutathione Metabolism in Tumors
Agency: Duke University
Project Dates: 3/17/06 - 11/30/07
Award: $11,393.00

PI: Blackband, S. J.
Grant Title: Hippocampal Shape Recovery & Analysis in Epileptics
Agency: National Institutes of Health
Project Dates: 5/1/05 - 4/30/09
Award: $10,573.00

PI: Blackband, S. J.
Grant Title: Spectroscopic Imaging of Antioxidant Metabolism in the Brain
Agency: North Carolina State University
Project Dates: 9/15/07 - 5/30/08
Award: $97,228.00

PI: Blackband, S. J.
Grant Title: A Study of Model B-Cells in Diabetes Treatment
Agency: National Institutes of Health
Project Dates: 5/15/02 - 8/31/11
Award: $14,011.00

PI: Christou, G.
Grant Title: Transition Metal Clusters as Single-Molecule Magnets
Agency: National Science Foundation
Project Dates: 8/1/04 - 7/31/09
Award: $373,000.00

PI: Dorsey, A. T.
Grant Title: Theoretical Condensed Matter Physics
Agency: National Science Foundation
Project Dates: 12/15/07 - 11/30/10
Award: $86,000.00

PI: Edison, A. S.
Grant Title: National High Magnetic Field Laboratory
Agency: Florida State University
Project Dates: 1/1/06 - 12/31/07
Award: $685,592.00

PI: Edison, A. S.
Grant Title: DPOLT - Synthesized NiSiN A
Agency: Oragenics
Project Dates: 1/18/07 - 7/1/07
Award: $5,000.00

PI: Edison, A. S.
Grant Title: Core 3: High Field Magnetic Resonance Research and Technology
Agency: National Institutes of Health
Project Dates: 5/1/01 - 4/30/08
Award: $43,650.00

PI: Edison, A. S.
Grant Title: Discovery of *Caenorhabditis Elegans* Chemical Ecology
Agency: Human Frontier Science Program Org.
Project Dates: 7/1/05 - 6/30/08
Award: $190,000.00

PI: Eyler, J. R.
Grant Title: Differentiating Oligosaccharide Isomers via Infrared Spectra of Gaseous…
Agency: National Science Foundation
Project Dates: 9/1/07 - 8/31/09
Award: $361,530.00

PI: Eyler, J. R.
Grant Title: PIRE: A US-Dutch Mass Spectrometry Consortium for Advanced Modeling and Biological Structure and Imaging Applications
Agency: Wayne State University
Project Dates: 10/1/07 - 9/30/08
Award: $65,262.00

PI: Fanucci, G. E.
Grant Title: Membrane Binding Properties of the GM2 Activator Protein
Agency: National Institutes of Health
Project Dates: 5/5/06 - 4/30/11
Award: $242,211.00

PI: Fanucci, G. E.
Grant Title: Site-Directed Spin Labeling EPR Studies of Conformational Dynamics in the Flap Region in HIV Protease
Agency: American Heart Assoc. Florida
Project Dates: 7/1/06 - 6/30/08
Award: $21,770.00

PI: Fitzsimmons, J. R.
Grant Title: Core 1: High Field Magnetic Resonance Research and Technology
Agency: National Institutes of Health
Project Dates: 5/1/01 - 4/30/08
Award: $85,000.00

PI: Forder, J. R.
Grant Title: UFCC for Cardiovascular Cell Therapy Research Network
Agency: National Institutes of Health
Project Dates: 1/1/07 - 12/31/11
Award: $23,145.00

PI: Forder, J. R.
Grant Title: Application of MR Technology to Improve Prognostic and Diagnostic Capabilities for Combat Effectiveness
Agency: U.S. Army
Project Dates: 9/6/07 - 9/5/09
Award: $842,000.00

PI: Forder, J. R.
Grant Title: Novel Mechanisms and Therapies Targeting Dysfunctional Endothelium (Project 4)
Agency: Juvenile Diabetes Foundation
Project Dates: 7/1/07 - 6/30/08
Award: $40,000.00

PI: Forder, J. R.
Grant Title: MRI Signal Validation and Evaluation of Pathogenic Iron Compounds as an Early Biomarker in Alzheimer's
Agency: National Institutes of Health
Project Dates: 7/1/07 - 6/30/09
Award: $11,721.00

PI: Hebard, A. F.
Grant Title: Magnetoimpedance of Ultrathin Films and Thin-Film Interfaces
Agency: National Science Foundation
Project Dates: 9/1/07 - 8/31/08
Award: $125,000.00

PI: Hebard, A. F.
Grant Title: Center for Sensor Materials and Technologies
Agency: U.S. Navy
Project Dates: 5/14/07 - 5/13/08
Award: $100,000.00

PI: Hebard, A. F.
Grant Title: Synthesis and Characterization of Self-Assembled Ordered Nano Arrays for Magnetic & Superconducting Applications
Agency: North Carolina A&T University
Project Dates: 7/15/04 - 6/30/08
Award: $19,997.00

PI: Hill, S. O.
Grant Title: Career: Magnetic Resonance - From Materials Research to Science Education
Agency: National Science Foundation
Project Dates: 5/1/03 - 4/30/08
Award: $90,000.00

PI: Hirschfeld, P. J.
Grant Title: Grains, Wires and Interfaces of Cuprate Superconductors
Agency: U.S. Department of Energy
Project Dates: 9/1/05 - 8/31/08
Award: $99,810.00

PI: Ihas, G. G.
Grant Title: Materials World Network: Collaborative Experimental Investigation of Pure Quantum Turbulence in Superfluid ^{4}He…
Agency: National Science Foundation
Project Dates: 5/1/06 - 5/31/08
Award: $135,000.00

PI: Ingersent, J. K.
Grant Title: Materials World Network - Collaborative Research: Decoherence, Correlations and Spin Effects In Nanostructured Materials
Agency: National Science Foundation
Project Dates: 9/1/07 - 8/31/09
Award: $182,000.00

PI: Ingersent, J. K.
Grant Title: REU Site: Materials Physics at the University of Florida
Agency: National Science Foundation
Project Dates: 4/1/06 - 3/31/08
Award: $104,000.00

PI: Lee, Y.
Grant Title: Nature of Pure & Dirty Liquid ^{3}He-Fundamental Investigations and Educational Activities
Agency: National Science Foundation
Project Dates: 2/15/03 - 1/31/08
Award: $92,640.00

PI: Liu, Y.
Grant Title: Diffusion Tensor Imaging in Autism
Agency: National Institutes of Health
Project Dates: 9/22/06 - 8/31/08
Award: $73,250.00

PI: Liu, Y.
Grant Title: Diffusion Tensor Imaging in Autism
Agency: National Institutes of Health
Project Dates: 9/22/06 - 8/31/08
Award: $71,126.00

PI: Long, J. R.
Grant Title: Solid State NMR Studies of a Membrane-Associate Peptide: The Role of Membrane Composition on Ion Channel Structure...
Agency: American Heart Association
Project Dates: 1/1/04 - 12/31/07
Award: $65,000.00

PI: Long, J. R.
Grant Title: Protein Structure-Function Relationships in Lung Surfactants
Agency: National Institutes of Health
Project Dates: 1/7/05 - 12/31/08
Award: $47,984.00

PI: Long, J. R.
Grant Title: Materials World Network: Liquid Precursor Formation and Crystallization at Interfaces: Fundamentals Toward Applications
Agency: National Science Foundation
Project Dates: 8/15/07 - 7/31/10
Award: $15,711.00

PI: Long, J. R.
Grant Title: Materials World Network: Liquid Precursor Formation and Crystallization at Interfaces: Fundamentals Toward Applications
Agency: National Science Foundation
Project Dates: 8/15/07 - 7/31/10
Award: $15,711.00

PI: Mareci, T. H.
Grant Title: Convective Drug Transport in the Spinal Cord
Agency: National Institutes of Health
Project Dates: 4/15/06 - 1/31/08
Award: $51,386.00

PI: Mareci, T. H.
Grant Title: CRCNS: Evolution into Epilepsy
Agency: National Institutes of Health
Project Dates: 9/1/04 - 6/30/08
Award: $82,239.00

PI: Mareci, T. H.
Grant Title: CRCNS: Automatic Prediction of the Onset of Epilepsy via Analysis of High Angular Resolution Diffusion Weighted MRI
Agency: National Institutes of Health
Project Dates: 8/1/06 - 5/31/10
Award: $85,925.00

PI: Mareci, T. H.
Grant Title: A Study of Model B-Cells in Diabetes Treatment
Agency: National Institutes of Health
Project Dates: 5/15/02 - 8/31/11
Award: $11,834.00

PI: Meisel, M. W.
Grant Title: Magnetism of Molecule-Based Thin Films, Nanoparticles and Frustrated Systems
Agency: National Science Foundation
Project Dates: 8/15/07 - 7/31/10
Award: $110,000.00

PI: Merz, K. M.
Grant Title: Validation of the Quantum Mechanical NMR Pose Scoring Method- Phase 1
Agency: Quantumbio
Project Dates: 9/1/06 - 2/28/08
Award: $46,123.00

PI: Merz, K. M.
Grant Title: Quantum Chemical Evaluation of NMR Chemical Shifts in Proteins
Agency: National Science Foundation
Project Dates: 8/15/05 - 7/31/10
Award: $156,499.00

PI: Merz, K. M.
Grant Title: The Bioinorganic Chemistry of Nickel…
Agency: National Institutes of Health
Project Dates: 6/1/03 - 5/31/08
Award: $71,529.00

PI: Pearton, S. J.
Grant Title: Wide Bandgap Semiconductor Nanowires for Electronic, Photonic and Sensing Devices
Agency: U.S. Army
Project Dates: 8/1/07 - 1/31/08
Award: $53,000.00

PI: Pearton, S. J.
Grant Title: P-Type Doping of ZnO Using Ion Implantation
Agency: National Science Foundation
Project Dates: 5/15/07 - 4/30/10
Award: $240,000.00

PI: Pearton, S. J.
Grant Title: ZnO Pn Junctions for Highly-Efficient, Low-Cost Light Emitting Diodes
Agency: U.S. Department of Energy
Project Dates: 10/1/04 - 9/30/07
Award: $15,395.00

PI: Pearton, S. J.
Grant Title: 1.55 UM Sub-Micron Finger, Interdigitated MSM Photodetector Arrays with Low Dark Current
Agency: U.S. Army
Project Dates: 8/1/05 - 7/31/08
Award: $35,000.00

PI: Pearton, S. J.
Grant Title: ZnO Pn Junctions for Highly-Efficient, Low-Cost Light Emitting Diodes
Agency: U.S. Department of Energy
Project Dates: 10/1/04 - 9/30/07
Award: $68,259.00

PI: Pearton, S. J.
Grant Title: High Density Three-Dimensional Packaging Technology for RF Devices
Agency: International Technology Corp.
Project Dates: 5/18/04 - 6/30/08
Award: $100,000.00

PI: Pearton, S. J.
Grant Title: Revenue for Alumni / Endowed Professorship
Agency: UF Foundation
Project Dates: 9/1/05 - 6/30/10
Award: $19,533.00

PI: Pearton, S. J.
Grant Title: 1.55 UM Sub-Micron Finger, Interdigitated MSM Photodetector Arrays with Low Dark Current
Agency: U.S. Army
Project Dates: 8/1/05 - 7/31/08
Award: $15,000.00

PI: Reitze, D. H.
Grant Title: Ultrafast Coherent Control in High Magnetic Fields
Agency: Fl State University
Project Dates: 1/1/05 - 12/31/07
Award: $60,000.00

PI: Reitze, D. H.
Grant Title: Prototype Advanced LIGO Diagnostics and Optical Components: *In situ* Measurements and Control of Thermo-Optical Effects
Agency: National Science Foundation
Project Dates: 7/1/05 - 6/30/08
Award: $120,000.00

PI: Rinzler, A. G.
Grant Title: Sticky Polymer Charge Transfer Nanotube Doping
Agency: Nanoholdings
Project Dates: 5/1/07 - 10/31/09
Award: $190,864.00

PI: Rinzler, A. G.
Grant Title: Carbon Nanotube-Based Transparent Electrodes for Polymer Emitting, Electro…
Agency: NRADIANCE
Project Dates: 7/15/05 - 10/5/08
Award: $181,181.00

PI: Rinzler, A. G.
Grant Title: Carbon Nanotube-Based Transparent Electrodes for Polymer Emitting, Electro…
Agency: Nradiance
Project Dates: 7/15/05 - 10/5/08
Award: $3,857.00

PI: Stanton, C. J.
Grant Title: Optical Control in Semiconductors for Spintronics and Quantum Information Processing
Agency: National Science Foundation
Project Dates: 9/15/03 - 7/31/08
Award: $201,586.00

PI: Stanton, C. J.
Grant Title: Optical Control in Semiconductors for Spintronics and Quantum Information Processing
Agency: National Science Foundation
Project Dates: 9/15/03 - 7/31/08
Award: $26,508.00

PI: Steindler, D.
Grant Title: A Stem/Progenitor Cell Protection for Parkinson's Disease
Agency: National Institutes of Health
Project Dates: 7/1/07 - 3/31/08
Award: $310,596.00

PI: Steindler, D.
Grant Title: AMBI-UF Santa Fe Healthcare Alzheimer's Research Center Project
Agency: Florida Department of Elder Affairs
Project Dates: 4/1/07 - 6/30/07
Award: $300,000.00

PI: Steindler, D.
Grant Title: A Florida Center for Brain Tumor Research
Agency: Florida Department of Health
Project Dates: 7/1/06 - 11/6/07
Award: $135,302.00

PI: Steindler, D.
Grant Title: A Brain and Spinal Cord Injury Research
Agency: Florida Department of Health
Project Dates: 7/1/06 - 6/30/11
Award: $500,000.00

PI: Stewart, G. R.
Grant Title: Novel Strongly Correlated (Primarily F-) Electron Behavior
Agency: U.S. Department of Energy
Project Dates: 12/1/06 - 11/30/09
Award: $125,000.00

PI: Sullivan, N. S.
Grant Title: History of Science Society Project
Agency: History of Science Society
Project Dates: 1/1/05 - 12/31/10
Award: $15,000.00

PI: Sullivan, N. S.
Grant Title: History of Science Society Project
Agency: History of Science Society
Project Dates: 1/1/05 - 12/31/10
Award: $8,000.00

PI: Sullivan, N. S.
Grant Title: The National High Magnetic Field Laboratory
Agency: Florida State University
Project Dates: 1/1/06 - 12/31/07
Award: $285,315.00

PI: Talham, D. R.
Grant Title: Fabrication and Magnetism of Coordinate Covalent Networks Assembled at Interfaces
Agency: National Science Foundation
Project Dates: 4/1/05 - 3/31/08
Award: $125,000.00

PI: Talham, D. R.
Grant Title: Metal Phosphonate Surfaces for Bioarray Applications
Agency: National Science Foundation
Project Dates: 8/15/05 - 7/31/08
Award: $110,000.00

PI: Tanner, D. B.
Grant Title: Task D: UF Participation in ADMX, The Axion Dark-Matter Experiment
Agency: U.S. Department of Energy
Project Dates: 3/1/07 - 2/28/10
Award: $58,000.00

PI: Tanner, D. B.
Grant Title: Submillimeter Wave Schottky Diode Circuits in Silicon Technology
Agency: IBM Corp.
Project Dates: 12/12/06 - 2/6/07
Award: $12,989.00

PI: Tanner, D. B.
Grant Title: Time-Resolved Far-Infrared Experiments: Implications for Nanotechnology
Agency: U.S. Department of Energy
Project Dates: 5/15/02 - 5/14/09
Award: $125,000.00

PI: Tanner, D. B.
Grant Title: IMR-MIP: Concept and Engineering Design of a Free Electron Laser Light Source for High Magnetic Field Research
Agency: Florida State University
Project Dates: 1/1/06 - 8/31/08
Award: $17,302.00

PI: Tanner, D. B.
Grant Title: Extreme Light Sources
Agency: U.S. Department of Defense
Project Dates: 11/13/07 - 11/12/08
Award: $65,000.00

PI: Vandenborne, K. H.
Grant Title: Rehabilitation Research Career Development Program
Agency: University of Texas
Project Dates: 9/25/07 - 8/31/08
Award: $176,835.00

PI: Vandenborne, K. H.
Grant Title: Interdisciplinary Training in Rehabilitation and Neuromuscular Plasticity
Agency: National Institutes of Health
Project Dates: 6/11/03 - 4/30/08
Award: $184,092.00

PI: Vandenborne, K. H.
Grant Title: Molecular Signatures of Muscle Rehabilitation after Limb Disuse
Agency: National Institutes of Health
Project Dates: 9/28/04 - 7/31/09
Award: $304,808.00

PI: Vandenborne, K. H.
Grant Title: Noninvasive Monitoring and Tracking of Muscle Stem Cells
Agency: National Institutes of Health
Project Dates: 9/22/04 - 8/31/08
Award: $28,517.00

PI: Vandenborne, K. H.
Grant Title: Musculoskeletal Pain and Muscle Dysfunction in Soldiers with Traumatic Injuries
Agency: U.S. Department of Veterans Affairs
Project Dates: 9/1/07 - 8/31/08
Award: $50,000.00

PI: Vandenborne, K. H.
Grant Title: Modulation of Muscle Growth for Muscle Dystrophies
Agency: University of Pennsylvania
Project Dates: 6/1/07 - 5/31/08
Award: $32,086.00

APPENDIX A: 2007 USER FACILITY STATISTICS

DC FIELD FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. DC Field Facility: *User Demographics, Calendar Year 2007*

DC Field Facility	Users	Female	Minority[1]	On-site[2] Users[6]	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	189	9	8	185	0	4
Number of Senior Investigators, non-U.S.	64	7	3	58	0	6
Number of Postdocs, U.S.	42	7	1	42	0	0
Number of Postdocs, non-U.S.	11	2	0	10	0	1
Number of Students[5], U.S.	72	10	5	69	0	3
Number of Students[5], non-U.S.	26	3	0	25	0	1
TOTAL	404	38	17	389	0	15

1 Minority status includes American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status excludes Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. DC Field Facility: *User Affiliations, CY 2007*

DC Field Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	189	94	150	18	21
Number of Senior Investigators, non-U.S.	64	N/A	40	5	19
Number of Postdocs, U.S.	42	21	39	1	2
Number of Postdocs, non-U.S.	11	N/A	8	1	2
Number of Students, U.S.	72	32	72	0	0
Number of Students, non-U.S.	26	N/A	25	0	1
TOTAL	404	147	334	25	45

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the Total.

Table 3. ***DC Field Facility:*** *Users by Discipline, CY 2007*

DC Field Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	189	143	24	10	12	0
Number of Senior Investigators, non-U.S.	64	62	2	0	0	0
Number of Postdocs, U.S.	42	37	4	1	0	0
Number of Postdocs, non-U.S.	11	10	1	0	0	0
Number of Students, U.S.	72	60	5	7	0	0
Number of Students, non-U.S.	26	26	0	0	0	0
TOTAL	**404**	**338**	**36**	**18**	**12**	**0**

DC FIELD FACILITY

By the numbers: *About our projects*

Table 4. ***DC Field Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
374	293 / 78%	81 / 23%	0

Table 5. ***DC Field Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

DC Field Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Biophys.	Biology, Biochem., Biophys.
Number of Projects	185	1	8	150	14	9	12	0

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

USER FACILITY STATISTICS

DC FIELD FACILITY

By the numbers: *About our magnet usage*

Table 6. ***DC Field Facility:*** *Operations Statistics, CY 2007*

DC Field Facility	Resistive Magnets & Hybrid	Superconducting Magnets	Total Days Allocated / User Affil.	Percentage Allocated/User Affil.
Number of Magnet Days[1]				
NHMFL, UF, FSU, FAMU, LANL[2]	312.98	379	691.98	44%
U.S. University	162.39	195	357.39	23%
U.S. Govt. Lab.	24.91	30	54.91	3%
U.S. Industry	36.22	0	36.22	2%
Non-U.S.	119.18	111	230.18	14%
Test, Calibration, Set-up, Maintenance	87.3	101	188.3	12%
Idle	4.66	22	26.66	2%
TOTAL	**747.64**	**838**	**1585.64**	**100%**

1 User Units are defined as magnet days. For the DC Field Facility, one magnet day is defined as 7 hours in a water-cooled resistive or hybrid magnet. Using this definition, a typical 24-hour day in the DC Field Facility contains three or four "magnet days". For experiments in the superconducting magnets, one "magnet day" is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

Table 7. ***DC Field Facility:*** *Operations by Discipline, CY 2007*

DC Field Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	691.98	570.13	52.13	0	69.72	0
U.S. University	357.39	328.43	25.96	0	3.00	0
U.S. Govt. Lab.	54.91	41.04	0	0	13.87	0
U.S. Industry	36.22	25.52	0	0	10.70	0
Non-U.S.	230.18	222.06	0	0	8.12	0
Test, Calibration, Set-up, Maintenance	188.3	---	---	---	---	---
Idle	26.66	---	---	---	---	---
TOTAL	**1585.64**	**1187.18**	**78.09**	**0**	**105.41**	**0**

1 User Units are defined as magnet days. For the DC Field Facility, one magnet day is defined as 7 hours in a water-cooled resistive or hybrid magnet. Using this definition, a typical 24-hour day in the DC Field Facility contains three or four "magnet days". For experiments in the superconducting magnets, one "magnet day" is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

PULSED FIELD FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. Pulsed Field Facility: *User Demographics, Calendar Year 2007*

Pulsed Field Facility	Users	Female	Minority[1]	On-site[2] Users[6]	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	49	8	5	46	0	3
Number of Senior Investigators, non-U.S.	13	1	1	11	0	2
Number of Postdocs, U.S.	31	3	0	31	0	0
Number of Postdocs, non-U.S.	8	0	0	8	0	0
Number of Students[5], U.S.	34	2	1	34	0	0
Number of Students[5], non-U.S.	6	0	0	6	0	0
TOTAL	141	14	7	136	0	5

1 Minority status includes American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status excludes Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. Pulsed Field Facility: *User Affiliations, CY 2007*

Pulsed Field Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	49	27	19	2	28
Number of Senior Investigators, non-U.S.	13	N/A	12	0	1
Number of Postdocs, U.S.	31	20	11	0	20
Number of Postdocs, non-U.S.	8	N/A	7	0	1
Number of Students, U.S.	34	13	18	0	16
Number of Students, non-U.S.	6	N/A	6	0	0
TOTAL	141	60	73	2	66

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the Total.

Table 3. ***Pulsed Field Facility:*** *Users by Discipline, CY 2007*

Pulsed Field Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	49	41	4	1	3	0
Number of Senior Investigators, non-U.S.	13	13	0	0	0	0
Number of Postdocs, U.S.	31	25	4	0	2	0
Number of Postdocs, non-U.S.	8	8	0	0	0	0
Number of Students, U.S.	34	32	2	0	0	0
Number of Students, non-U.S.	6	6	0	0	0	0
TOTAL	**141**	**125**	**10**	**1**	**5**	**0**

PULSED FIELD FACILITY

By the numbers: *About our projects*

Table 4. ***Pulsed Field Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
132	125, 95%	0	7, 5%

Table 5. ***Pulsed Field Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

Pulsed Field Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Biophys.	Biology, Biochem., Biophys.
Number of Projects	88	5	19	80	4	1	3	0

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

PULSED FIELD FACILITY

By the numbers: *About our magnet usage*

Table 6. Pulsed Field Facility: *Operations Statistics, CY 2007*

Pulsed Field Facility	Super-cond.	Short Pulse	Mid Pulse	Long Pulse	100T	Single Turn	Other	Total Days Allocated / User Affil.	Percentage Allocated / User Affil.
	Number of Magnet Days[1]								
NHMFL, UF, FSU, FAMU, LANL[2]	385	101	51	19	4	50	52	662	53%
U.S. University	246	76	24	13	3	20	26	408	33%
U.S. Govt. Lab.	0	8	0	0	0	0	0	8	<1%
U.S. Industry	7	0	0	0	0	0	4	11	<1%
Non-U.S.	56	27	22	0	22	29	0	156	13%
Test, Calibration, Set-up, Maintenance									
Idle									
TOTAL	**694**	**212**	**97**	**32**	**29**	**99**	**82**	**1245**	**100%**

1 User Units are defined as magnet days. For the Pulsed Field Facility, one magnet day is defined as 12 hours in any pulsed magnet system. For experiments in the superconducting magnets, one "magnet day" is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

Table 7. Pulsed Field Facility: *Operations by Discipline, CY 2007*

Pulsed Field Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	662	598	50	3	11	0
U.S. University	408	304	100	0	4	0
U.S. Govt. Lab.	8	8	0	0	0	0
U.S. Industry	11	11	0	0	0	0
Non-U.S.	156	156	0	0	0	0
Test, Calibration, Set-up, Maintenance						
Idle						
TOTAL	**1245**	**1077**	**150**	**3**	**15**	**0**

1 User Units are defined as magnet days. For the Pulsed Field Facility, one magnet day is defined as 12 hours in any pulsed magnet system. For experiments in the superconducting magnets, one "magnet day" is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

USER FACILITY STATISTICS

HIGH B/T FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. High B/T Facility: *User Demographics, Calendar Year 2007*

High B/T Facility	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	12	1		10		2
Number of Senior Investigators, non-U.S.	1			1		
Number of Postdocs, U.S.	2			2		
Number of Postdocs, non-U.S.	2			2		
Number of Students[5], U.S.						
Number of Students[5], non-U.S.	2			2		
TOTAL	19	1		17		2

1 Minority status <u>includes</u> American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status <u>excludes</u> Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. High B/T Facility: *User Affiliations, CY 2007*

High B/T Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	12	5	9	1	2
Number of Senior Investigators, non-U.S.	1	N/A	1		
Number of Postdocs, U.S.	2	2	3		
Number of Postdocs, non-U.S.	2	N/A	1		
Number of Students, U.S.		0			
Number of Students, non-U.S.	2	N/A	2		
TOTAL	19	7	16	1	2

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 <u>In addition</u> to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 <u>In addition</u> to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

Table 3. ***High B/T Facility:*** *Users by Discipline, CY 2007*

High B/T Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	12	11		1		
Number of Senior Investigators, non-U.S.	1	1				
Number of Postdocs, U.S.	2	2				
Number of Postdocs, non-U.S.	2	2				
Number of Students[5], U.S.						
Number of Students[5], non-U.S.	2	2				
TOTAL	19	18		1		

HIGH B/T FACILITY

By the numbers: *About our projects*

Table 4. ***High B/T Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
7	5, 71%	1, 16%	1, 15%

Table 5. ***High B/T Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

High B/T Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Biophys.	Biology, Biochem., Biophys.
Number of Projects	8		1	8				

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

HIGH B/T FACILITY

By the numbers: *About our magnet usage*

Table 6. High B/T Facility: *Operations Statistics, CY 2007*

High B/T Facility	Total Days Allocated / User Affil.	Percentage Allocated / User Affil.
	Number of Magnet Days[1]	
NHMFL, UF, FSU, FAMU, LANL[2]	132	21%
U.S. University	395	63%
U.S. Govt. Lab.	30	5%
U.S. Industry		
Non-U.S.		
Test, Calibration, Set-up, Maintenance	70	11%
Idle		
TOTAL	**627**	**100%**

1 User Units are defined as magnet days. For the High B/T Facility, one magnet day is defined 24 hours in the superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

Table 7. High B/T Facility: *Operations by Discipline, CY 2007*

High B/T Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	132	132				
U.S. University	395	395				
U.S. Govt. Lab.	30			30		
U.S. Industry						
Non-U.S.						
Test, Calibration, Set-up, Maintenance	70				70	
Idle						
TOTAL	**627**	**527**		**30**	**70**	

1 User Units are defined as magnet days. For the High B/T Facility, one magnet day is defined 24 hours in the superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

NUCLEAR MAGNETIC RESONANCE (NMR) FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. NMR Facility: *User Demographics, Calendar Year 2007*

NMR Facility	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	77	14	4	59	4	14
Number of Senior Investigators, non-U.S.	13	2	0	7	0	6
Number of Postdocs, U.S.	22	3	2	22	0	0
Number of Postdocs, non-U.S.	1	0	0	1	0	0
Number of Students[5], U.S.	47	12	7	43	4	0
Number of Students[5], non-U.S.	14	3	1	14	0	0
TOTAL	174	34	14	146	8	20

1 Minority status includes American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status excludes Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. NMR Facility: *User Affiliations, CY 2007*

NMR Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	77	42	65	1	11
Number of Senior Investigators, non-U.S.	13	N/A	11	1	1
Number of Postdocs, U.S.	22	16	18	0	4
Number of Postdocs, non-U.S.	1	N/A	0	0	1
Number of Students, U.S.	47	28	47	0	0
Number of Students, non-U.S.	14	N/A	13	0	1
TOTAL	174	86	154	2	18

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

Table 3. ***NMR Facility:*** *Users by Discipline, CY 2007*

NMR Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Geochemistry	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	77	3	14	14	1	45
Number of Senior Investigators, non-U.S.	13	0	4	0	0	9
Number of Postdocs, U.S.	22	1	5	2	0	14
Number of Postdocs, non-U.S.	1	0	1	0	0	0
Number of Students[5], U.S.	47	0	13	2	0	32
Number of Students[5], non-U.S.	14	0	3	4	0	7
TOTAL	174	4	40	22	1	107

NMR FACILITY

By the numbers: *About our projects*

Table 4. ***NMR Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
2,521	1,845, 73%	0	676, 27%

Table 5. ***NMR Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

NMR Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Instrum.	Biology, Biochem., Biophys.
Number of Projects	91	4	21	1	21	8	0	61

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

NMR FACILITY

By the numbers: *About our magnet usage*

***Table 6. NMR Facility:** Operations Statistics, CY 2007*

NMR Facility	900	830	720	600	600WB	600WB2	Total Days Allocated / User Affil.	Percentage Allocated / User Affil.
	Number of Magnet Days[1]							
NHMFL, UF, FSU, FAMU, LANL[2]	223	19	214	187	208	205	1056	53%
U.S. University	109	52	137	157	135	120	710	36%
U.S. Govt. Lab.	0	0	0	0	0	0	0	0
U.S. Industry	0	0	0	0	0	0	0	0
Non-U.S.	9	17	0	19	0	0	45	2%
Test, Calibration, Set-up, Maintenance	15	16	11	0	12	20	74	4%
Idle	9	46	3	2	10	20	90	5%
TOTAL	**365**	**150**	**365**	**365**	**365**	**365**	**1975**	**100%**

1 User Units are defined as magnet days. For the NMR Facility in Tallahassee, one magnet day is 24 hours in the superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

***Table 7. NMR Facility:** Operations by Discipline, CY 2007*

NMR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	1056	21	201	179	0	655
U.S. University	710	21	192	57	0	440
U.S. Govt. Lab.	0	0	0	0	0	0
U.S. Industry	0	0	0	0	0	0
Non-U.S.	45	0	14	6	0	25
Test, Calibration, Set-up, Maintenance	74	0	48	0	15	11
Idle	90	-	-	-	-	-
TOTAL	**1975**	**42**	**455**	**242**	**15**	**1131**

1 User Units are defined as magnet days. For the NMR Facility in Tallahassee, one magnet day is 24 hours in the superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

ADVANCED MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY (AMRIS) FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. AMRIS Facility: *User Demographics, Calendar Year 2007*

AMRIS	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	36	10	2	25		11
Number of Senior Investigators, non-U.S.	14	2		7	3	4
Number of Postdocs, U.S.	9	1	1	7		2
Number of Postdocs, non-U.S.	10	6	3	9		1
Number of Students[5], U.S.	15	6	2	14		1
Number of Students[5], non-U.S.	10	6	2	9		1
Support and Technical staff, U.S.	5	2	1	5		
Support and Technical staff, non-U.S.	3					3
TOTAL	102	33	11	76	3	23

1 Minority status includes American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status excludes Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. AMRIS Facility: *User Affiliations, CY 2007*

AMRIS	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	36	34	34	1	1
Number of Senior Investigators, non-U.S.	14	N/A	11	2	1
Number of Postdocs, U.S.	9	8	8		1
Number of Postdocs, non-U.S.	10	N/A	9	1	
Number of Students, U.S.	15	15	15		
Number of Students, non-U.S.	10	N/A	10		
Support and Technical staff, U.S.	5	5	5		
Support and Technical staff, non-U.S.	3	3	3		
TOTAL	102	65	95	4	3

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

Table 3. AMRIS Facility: *Users by Discipline, CY 2007*

AMRIS	Users	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	36		2		3	31
Number of Senior Investigators, non-U.S.	14					14
Number of Postdocs, U.S.	9				2	7
Number of Postdocs, non-U.S.	10					10
Number of Students, U.S.	15		2		1	12
Number of Students, non-U.S.	10					10
Support and Technical staff, U.S.	5					5
Support and Technical staff, non-U.S.	3					3
TOTAL	102		4		6	92

AMRIS FACILITY

By the numbers: *About our projects*

Table 4. AMRIS Facility: *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
~1200	1,200	About 10-20% of requests get deferred to the following month, and some requests are reduced by up to about 20% in over subscribed months	0

Table 5. AMRIS Facility: *Research Projects[1] Profile, with magnet time in CY 2007*

AMRIS	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Instrum.	Biology, Biochem., Biophys.
Number of Projects	37	11	33		2	3		32

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

AMRIS FACILITY

By the numbers: *About our magnet usage*

Table 6. ***AMRIS Facility:*** *Operations Statistics, CY 2007*

AMRIS	500 MHz NMR	600 MHz NMR / MRI	600 MHz cryo	750 MHz wb	4.7 T / 33 cm	11.1 T / 40 cm	3T whole body	Total Days Allocated / User Affil.	Percentage Allocated / User Affil.
Number of Magnet Days[1]									
NHMFL, UF, FSU, FAMU, LANL[2]	159	116	92	123	65	203	55	813	32%
UF Pilot study[3]	0	6	11	0	8	11	6	42	2%
U.S. University	16	25	42	8	2	0	0	93	4%
U.S. Govt. Lab.	52	7	122					181	7%
U.S. Industry								0	0
Non-U.S.			29	4				33	1%
Development[4]	58	97	37	122	69	38	27	448	17%
Test, Calibration, Set-up, Maintenance[5]	15	15	15	15	45	45	45	195	8%
Idle[6]	65	99	17	93	176	68	232	750	29%
TOTAL	**365**	**365**	**365**	**365**	**365**	**365**	**365**	**2555**	**100%**

1 User Units are defined as magnet days. Magnet-day definitions for AMRIS instruments:

- Verticals (500, 600s, & 750 MHz), 1 magnet day = 24 hours (7 days/week).
- Horizontals (4.7, 11.1, and 3T), 1 magnet day = 8 hours (5 days/week). This accounts for the difficulty in running animal or human studies overnight. Thus, horizontal instruments can exceed 365 days use with this definition.

Magnet days were calculated by adding the total number of real hours used for each instrument and dividing by 24 (vertical) or 8 (horizontal).

Note: due to the nature of the 4.7 T, 11 T and 3 T studies, almost all studies with external users were collaborative with UF investigators.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution. **Note: All of the use in this category was paid by individual investigator grants and not the NHMFL.**

3 Pilot studies are awarded to UF investigators from NHMFL funds. **For merging with other NHMFL user tables it will be added to the FSU/UF/FAMU/LANL category.**

4 Development was used for several purposes, primarily for establishing new capabilities such as building and testing coils, implementing new pulse sequences, and developing new protocols such as cardiac gating for animal studies. In some cases it was also used to help external and internal users start new projects by optimizing protocols. The 97 and 122 days on the 600 and 750, respectively, represent console and computer/software upgrades and swaps and extensive testing and trouble-shooting on each instrument. **For merging with other NHMFL user tables it will be merged with Test, Calibration, Set-up, Maintenance.**

5 Note that each instrument has approximately the same number of hours for maintenance/testing and days are different due to definitions of magnet days on the different instruments.

6 The idle time also reflects the 750 upgrade and the new installation of the 3T January, 2007. The 3T took several months of development and testing before it was routinely used by users.

Table 7. ***AMRIS Facility:*** *Operations by Discipline, CY 2007*

AMRIS	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	855		100	20	35	700
U.S. University	93					93
U.S. Govt. Lab.	181					181
U.S. Industry	0					0
Non-U.S.	33					33
Test, Calibration, Set-up, Maintenance[3]	643				448	195
Idle	750					
TOTAL	**2555**		**100**	**20**	**483**	**1202**

1 User Units are defined as magnet days. Refer to Table 6, Footnote 1 (above) for complete definition.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

3 Refer to Table 6, Footnote 4 (above) for further information.

USER FACILITY STATISTICS

ELECTRON MAGNETIC RESONANCE (EMR) FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. EMR Facility: *User Demographics, Calendar Year 2007*

EMR Facility	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	44	2	0	24	0	20
Number of Senior Investigators, non-U.S.	28	3	0	3	0	25
Number of Postdocs, U.S.	12	5	0	5	0	8
Number of Postdocs, non-U.S.	14	3	0	2	0	12
Number of Students[5], U.S.	20	7	0	8	0	11
Number of Students[5], non-U.S.	10	7	0	3	0	7
TOTAL	**128**	**27**	**0**	**45**	**0**	**83**

1 Minority status <u>includes</u> American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status <u>excludes</u> Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. EMR Facility: *User Affiliations, CY 2007*

EMR Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	44	13	29	0	15
Number of Senior Investigators, non-U.S.	28	N/A	27	0	1
Number of Postdocs, U.S.	12	4	10	0	2
Number of Postdocs, non-U.S.	14	N/A	12	0	2
Number of Students, U.S.	20	2	18	0	2
Number of Students, non-U.S.	10	N/A	10	0	0
TOTAL	**128**	**19**	**106**	**0**	**22**

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 <u>In addition</u> to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 <u>In addition</u> to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

Table 3. ***EMR Facility:*** *Users by Discipline, CY 2007*

EMR Facility	Users	Condensed Matter Physics	Chemistry, Geochemistry	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	44	9	28	0	0	7
Number of Senior Investigators, non-U.S.	28	4	23	0	0	1
Number of Postdocs, U.S.	12	2	8	0	0	2
Number of Postdocs, non-U.S.	14	2	11	0	0	1
Number of Students, U.S.	20	2	17	0	0	1
Number of Students, non-U.S.	10	2	8	0	0	0
TOTAL	**128**	**21**	**95**	**0**	**0**	**12**

EMR FACILITY

By the numbers: *About our projects*

Table 4. ***EMR Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
31	31,100%	0,0	0,0

Table 5. ***EMR Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

EMR Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Instrum.	Biology, Biochem., Biophys.
Number of Projects	47	0	4	9	33	0	0	5

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

EMR FACILITY

By the numbers: *About our magnet usage*

Table 6. EMR Facility: *Operations Statistics, CY 2007*

EMR Facility	17T	12T	Total Days Allocated / User Affil.	Percentage Allocated/User Affil.
Number of Magnet Days[1]				
NHMFL, UF, FSU, FAMU, LANL[2]	87	75	162	36%
U.S. University	31	33	64	14%
U.S. Govt. Lab.	0	0	0	0
U.S. Industry	0	0	0	0
Non-U.S.	93	41	134	30%
Test, Calibration, Set-up, Maintenance	20	33	53	12%
Idle	14	20	34	8%
TOTAL	**245**	**202**	**447**	**100%**

1 User Units are defined as magnet days. For the EMR Facility, one magnet day is defined as 24 hours in superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

Table 7. EMR Facility: *Operations by Discipline, CY 2007*

EMR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	162	36	99	0	0	27
U.S. University	64	21	30	0	0	13
U.S. Govt. Lab.	0	0	0	0	0	0
U.S. Industry	0	0	0	0	0	0
Non-U.S.	134	63	71	0	0	0
Test, Calibration, Set-up, Maintenance	53	20	33	0	0	0
Idle	34			0	0	0
TOTAL	**447**	**140**	**233**	**0**	**0**	**40**

1 User Units are defined as magnet days. For the EMR Facility, one magnet day is defined as 24 hours in superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

ION CYCLOTRON RESONANCE (ICR) FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. ICR Facility: *User Demographics, Calendar Year 2007*

ICR Facility	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	42	6	1	17		25
Number of Senior Investigators, non-U.S.	25	5	5	6		19
Number of Postdocs, U.S.	12	3	0	2	4	6
Number of Postdocs, non-U.S.	2	0	1	1		1
Number of Students[5], U.S.	35	10	1	25	4	6
Number of Students[5], non-U.S.	8	1	0	4		4
TOTAL	124	25	8	55	8	61

1 Minority status includes American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status excludes Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. ICR Field Facility: *User Affiliations, CY 2007*

ICR Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	42	9	27	12	3
Number of Senior Investigators, non-U.S.	25	N/A	11	9	5
Number of Postdocs, U.S.	12	6	10	2	0
Number of Postdocs, non-U.S.	2	N/A	2	0	0
Number of Students, U.S.	35	15	35	0	0
Number of Students, non-U.S.	8	N/A	8	0	0
TOTAL	124	30	93	23	8

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 In addition to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 In addition to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

USER FACILITY STATISTICS

Table 3. ***ICR Field Facility:*** *Users by Discipline, CY 2007*

ICR Facility	Users	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.[1]
Number of Senior Investigators, U.S.	42		20			22
Number of Senior Investigators, non-U.S.	25		19			6
Number of Postdocs, U.S.	12		6			6
Number of Postdocs, non-U.S.	2		0			2
Number of Students, U.S.	35		26			9
Number of Students, non-U.S.	8		1			7
TOTAL	**124**		**72**			**52**

1 ICR projects were in Biology and Biochemistry; none were in Biophysics.

ICR FACILITY

By the numbers: *About our projects*

Table 4. ***ICR Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
221	221, 100%	0, 0%	0, 0%

1 Number of days (for all ICR magnets) that users or user's projects were allocated. Number does not include ICR research group projects.

Table 5. ***ICR Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

ICR Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Instrum.	Biology, Biochem., Biophys.[4]
Number of Projects	101	5	18		52			49

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

4 ICR projects were in Biology and Biochemistry; none were in Biophysics.

ICR FACILITY

By the numbers: *About our magnet usage*

Table 6. ICR Facility: *Operations Statistics, CY 2007*

ICR Facility	14.5 T Hybrid[3]	9.4 T Passive	Total Days Allocated / User Affil.	Percentage Allocated/User Affil.
	Number of Magnet Days[1]			
NHMFL, UF, FSU, FAMU, LANL[2]	207	144	351	48%
U.S. University	70	69	139	19%
U.S. Govt. Lab.	0	0	0	
U.S. Industry	16	29	45	6%
Non-U.S.	4	18	22	3%
Test, Calibration, Set-up, Maintenance	54	8	62	9%
Idle	14	97	111	15%
TOTAL	**365**	**365**	**730**	**100%**

1 For the ICR Facility, one magnet day is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

3 The instrument is a hybrid between a commercial Thermo LTQ ion trap mated to an ICR in a 14.5 T superconducting magnet.

Table 7. ICR Facility: *Operations by Discipline, CY 2007*

ICR Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.[3]
NHMFL, UF, FSU, FAMU, LANL[2]	351		180			171
U.S. University	139		65			74
U.S. Govt. Lab.	0		0			0
U.S. Industry	45		34			11
Non-U.S.	22		12			10
Test, Calibration, Set-up, Maintenance	62					
Idle	111					
TOTAL	**730**		**291**			**266**

1 User Unites are defined as magnet days. For the ICR Facility, one magnet day is defined as 24 hours of use.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

3 ICR projects were in Biology and Biochemistry; none were in Biophysics.

GEOCHEMISTRY FACILITY

By the numbers: *About our users*

A user is an individual or a member of a research group that is allocated magnet time. The user does not have to be "on site" for the experiment. A researcher who sends samples for analysis; a scientist who uses new lab technologies to conduct experiments remotely; or a PI who sends students to the Magnet Lab, are all considered users. All user numbers reflect distinct individuals, i.e. if a user has multiple projects (different scientific thrusts) or is allocated magnet time more than once during the year, he/she is counted only once.

Table 1. ***Geochemistry Facility:*** *User Demographics, Calendar Year 2007*

Geochemistry Facility	Users	Female	Minority[1]	On-site[2,6] Users	Remote Users[3,6]	Users Sending Sample[4,6]
Number of Senior Investigators, U.S.	21	4	1	18		3
Number of Senior Investigators, non-U.S.						
Number of Postdocs, U.S.	6	3		6		
Number of Postdocs, non-U.S.	1			1		
Number of Students[5], U.S.	24	14		23		1
Number of Students[5], non-U.S.						
TOTAL	**52**	**21**	**1**	**48**		**4**

1 Minority status <u>includes</u> American Indian, Alaska Native, Black or African American, Hispanic, Native Hawaiian or other Pacific Islander. Minority status <u>excludes</u> Asian and White-Not of Hispanic Origin

2 Users at the Magnet Lab facility operating the magnet. Not all users on the project must physically come to the lab; if one or more come, then all members of the group are counted in this category.

3 Users conducting the experiment remotely.

4 Experiments in which the sample was sent by an external PI and the experiment was conducted by in-house user support personnel in service mode. No member of the group comes to the lab, and all are counted in this category.

5 "Students" generally refers to graduate students, but may include a few undergraduate students.

6 The total of on-site users, remote users, and users sending samples will equal the total number of users.

Table 2. ***Geochemistry Facility:*** *User Affiliations, CY 2007*

Geochemistry Facility	Users	Internal Investigators[1]	University Users[2,4]	Industry Users[4]	National Lab Users[3,4]
Number of Senior Investigators, U.S.	21	12	16		5
Number of Senior Investigators, non-U.S.		N/A			
Number of Postdocs, U.S.	6	5	6		
Number of Postdocs, non-U.S.	1	N/A			1
Number of Students, U.S.	24	22	24		
Number of Students, non-U.S.		N/A			
TOTAL	52	39	46		6

1 "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

2 <u>In addition</u> to external users, all users with primary affiliations at FSU, UF, or FAMU are reported in this category, even if they are also NHMFL associates.

3 <u>In addition</u> to external users, users with primary affiliations at NHMFL/LANL are reported in this category.

4 Three columns of users (university, industry, national lab) will equal the total.

Table 3. ***Geochemistry Facility:*** *Users by Discipline, CY 2007*

Geochemistry Facility	Users	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
Number of Senior Investigators, U.S.	21		20		1	
Number of Senior Investigators, non-U.S.						
Number of Postdocs, U.S.	6		6			
Number of Postdocs, non-U.S.	1		1			
Number of Students, U.S.	24		23		1	
Number of Students, non-U.S.						
TOTAL	**52**		**50**		**2**	

GEOCHEMISTRY FACILITY

By the numbers: *About our projects*

Table 4. ***Geochemistry Facility:*** *Requests for Magnet Time, CY 2007*

Requests for Magnet Time	Requests Granted	Requests Deferred	Requests Declined
23	100%	0	0

Table 5. ***Geochemistry Facility:*** *Research Projects[1] Profile, with magnet time in CY 2007*

Geochemistry Facility	Total	Minority[2]	Female[3]	Cond. Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls, Testing, Instrum.	Biology, Biochem., Biophys.
Number of Projects	23	2	13		22		1	

1 A "project" may have associated with it a single experiment or a group of closely related experiments. A PI may have more than one project.

2 The number of projects satisfying one of the following two conditions: (a) the PI is a minority OR (b) the PI is a non-minority working at a minority-serving college or university AND the project includes minority participants.

3 The number of projects satisfying one of the following two conditions: (a) the PI is a female OR (b) the PI is a male working at a college or university for women AND the project includes female participants.

USER FACILITY STATISTICS

GEOCHEMISTRY FACILITY

By the numbers: *About our magnet usage*

Table 6. Geochemistry Facility: *Operations Statistics, CY 2007*

Geochemistry Facility	262/RPQ	MC-ICP-MS Neptune	ELEMENT	Delta XP	Total Days Allocated / User Affil.	Percentage Allocated / User Affil.
			Number of Magnet Days[1]			
NHMFL, UF, FSU, FAMU, LANL[2]	160	142	135	140	577	68%
U.S. University	11		35	11	57	7%
U.S. Govt. Lab.			15	30	45	5%
U.S. Industry						
Non-U.S.			5		5	>0%
Test, Calibration, Set-up, Maintenance	10	90	40	30	170	20%
Idle						
TOTAL	**181**	**232**	**230**	**211**	**854**	**100%**

1 User Units are defined as magnet days. For the Geochemistry Facility, one magnet day is defined as 24 hours in superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

Table 7. Geochemistry Facility: *Operations by Discipline, CY 2007*

Geochemistry Facility	Total Days[1] Allocated / User Affil.	Condensed Matter Physics	Chemistry, Geochem.	Engineering	Magnets, Matls., Testing, Instrum.	Biology, Biochem., Biophys.
NHMFL, UF, FSU, FAMU, LANL[2]	577		577			
U.S. University	57		47		10	
U.S. Govt. Lab.	45		45			
U.S. Industry						
Non-U.S.	5		5			
Test, Calibration, Set-up, Maintenance	170		170			
Idle						
TOTAL	**854**		**844**		**10**	

1 User Units are defined as magnet days. For the Geochemistry Facility, one magnet day is defined as 24 hours in superconducting magnets.

2 This data accounts for "internal" usage as defined by NSF/MagLab agreement: "Internal Investigator" is defined by NSF/MagLab agreement as a researcher originating from ANY of the institutions in proximity to the MagLab sites (i.e. MagLab employees as well as employees of FSU, UF, FAMU, or LANL), EVEN IF that researcher travels to a different MagLab campus than his/her home institution.

APPENDIX B: RESEARCH REPORTS BY CATEGORY

At the end of each year, Magnet Lab users and faculty at FSU, UF, and LANL submit brief abstracts of their experiments, research, and scholarly endeavors. In 2007, 407 research reports were approved and all are published online: **http://www.magnet.fsu.edu/usershub/publications/researchreportsonline.aspx**. The reports are searchable by facility, category, first author, PI, and keywords.

BIOCHEMISTRY – 41 REPORTS

FACILITY	PI NAME	REPORT TITLE
EMR Facility	Angerhofer, A.	High-Field EPR on the Mn-Centers in Oxalate Decarboxylase – pH Dependence
EMR Facility	Redding, K.E.	Investigating the Effect of Loss of Hydrogen-Bonds upon the G-Tensor of the Chlorophyll Anion Radical, A0–, The Reduced Primary Electron Acceptor of Photosystem I
ICR Facility	Emmett, M.	Proteomics of Malignant Cells: Discovery of a Clinical Biomarker of Brain Tumor Invasivity
ICR Facility	Eyler, J.R.	Identification of Single and Double Sites of Phosphorylation in Peptides Related to the Phosphorylation Site Domain of the Myristoylated Alanine-Rich C Kinase Protein
ICR Facility	Marshall, A.G.	Analysis of O-glycan Heterogeneity in IgA1 Myeloma Proteins by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry: Implications for IgA Nephropathy
ICR Facility	Marshall, A.G.	Burning the Candle at Both Ends: Protein Sequencing from the N- and C-Termini
ICR Facility	Marshall, A.G.	Method for Lipidomic Analysis: p53 Expression Modulates Sulfatide, Ganglioside, and Phospholipid Composition of U87 Glioblastoma Cells
ICR Facility	Marshall, A.G.	Molecular Characterization of Dissolved Organic Matter in a North Brazilian Mangrove Porewater and Mangrove-Fringed Estuary by Ultrahigh Resolution Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry and Excitation/Emission Spectroscopy
MBI-UF AMRIS	Long, J.R.	Structural Studies of the Lung Surfactant Peptide KI4 Using MAS ssNMR
MBI-UF AMRIS	Long, J.R.	Structural Studies of the M2 Helix of nAChR in Varying Lipid Environments
MBI-UF AMRIS	Long, J.R.	The Effects of Pulmonary Surfactant Peptides on Lipid Properties
MBI-UF AMRIS	Molinski, T. F.	Metabolites from Marine Organisms
MBI-UF AMRIS	Simpson, N.E.	Studying Metabolic Pathways in Native Human Islets by 13C NMR Spectroscopic Techniques Using a Microcoil Apparatus
MBI-UF AMRIS	Turner, B.L.	Forms and Stability of Organic Phosphorus in Wetlands
MBI-UF AMRIS	Vasenkov, S.	Heterogeneity of Polyelectrolyte Diffusion in Polyelectrolyte-Protein Coacervates: A 1H Pulsed Field Gradient NMR Study
MBI-UF AMRIS	Vasenkov, S.	Lateral Diffusion in Lipid Membranes on Nanoscale by High Gradient PFG NMR
NMR Facility	Bruschweiler, R.	Structure and Dynamics of Ca2+-Binding Domain 1 of the Na+/Ca2+ Exchanger in the Presence and Absence of Ca2+
NMR Facility	Bruschweiler, R.	Toward Quantitative Interpretation of Methyl Side-Chain Dynamics from NMR by Molecular Dynamics Simulations
NMR Facility	Brüschweiler, R.	Complex Mixture Analysis by NMR (COLMAR) Metabolomics Web Portal at NHMFL
NMR Facility	Brüschweiler, R.	Covariance Enhancement of 4D 15N/13C NOESY Data
NMR Facility	Cotten, M.	High-Resolution NMR Structure and Tilt of Amphipathic Piscidin at the Water-Bilayer Interface
NMR Facility	Cotten, M.	Using Solid-State NMR to Map the Environment of Amphipathic Piscidin at the Water-Bilayer Interface
NMR Facility	Cross, T.A.	Conformational Heterogeneity of ChiZ, a Natively Disordered Membrane Protein from Mycobacterium tuberculosis

FACILITY	PI NAME	REPORT TITLE
NMR Facility	Cross, T.A.	Construction of a Ligation Independent Cloning Based Platform for High Throughput Cloning and Expression Screening of Membrane Proteins from Mycobacterium tuberculosis
NMR Facility	Cross, T.A.	Examining the Adverse Effect of Detergent Upon the Soluble Domain of KdpC
NMR Facility	Cross, T.A.	Ion Binding to Gramicidin A Studied by High Resolution Heteronuclear Correlation Spectroscopy
NMR Facility	Cross, T.A.	Ligand Binding in the Conserved Interhelical Loop of CorA, a Magnesium Transporter from Mycobacterium tuberculosis
NMR Facility	Cross, T.A.	M2 Proton Channel from Influenza A Virus Studied by Solid State NMR Spectroscopy in Magnetically Aligned Bicelle
NMR Facility	Cross, T.A.	Solid State NMR Studies of Uniformly Aligned Full-length Membrane Proteins
NMR Facility	Cross, T.A.	Structural Biology of Transmembrane Domains: Efficient Production and Characterization of Transmembrane Peptides by NMR
NMR Facility	Cross, T.A.	Transmembrane Helix Uniformity Examined by Spectral Mapping of Torsion Angles
NMR Facility	Crosss, T.A.	Backbone Structure of a Helical Integral Membrane Protein in the Absence of NOEs
NMR Facility	Eisenmesser, Z.	Structural and Dynamic Studies of Endonuclease V-DNA Interactions
NMR Facility	Kern, D.	Binding of Homer1a Shifts cis/trans Equilibrium of Phosphorylated mGluR5
NMR Facility	Kern, D.	Loss of Hydrogen Bond in the Transition State of NtrCR Leads to Altered Dynamics
NMR Facility	Logan, T.M.	Backbone Dynamics in an Intramolecular Protein-Peptide Ligand Complex
NMR Facility	Logan, T.M.	Isotope Enrichment of Recombinant Glycoproteins Produced in Cultured Mammalian Cells
NMR Facility	Ramamoorthy, A.	Bicelles Enable Magic Angle Spinning Solid-State NMR Structural Studies on a Large Soluble Domain Containing Membrane Protein, Cytochrome B5
NMR Facility	Ramamoorthy, A.	The Structure and Dynamics of Membrane-bound Cytochrome b5 – Cytochrome P450 Complex by Means of Solid-State NMR Spectroscopy
NMR Facility	Smirnov, A.	Macroscopic Alignment and Leaflet Solvent Accessibility of Nanopore-confined Lipid Bilayer Arrays as a Function of Lipid Composition
NMR Facility	Zhou, H.-X.	A Secondary Gate as a Mechanism for Inhibition of the M2 Proton Channel by Amandatine

BIOLOGY - 26 REPORTS

FACILITY	PI NAME	REPORT TITLE
MBI-UF AMRIS	Benveniste, H.	In Vivo Digital Mouse Brain Atlas Using MR Microscopy
MBI-UF AMRIS	Blackband, S.J.	MR Microscopy of Brain Tissue Using Microsurface Coils: Correlation with Histology
MBI-UF AMRIS	Blackband, S.J.	Temperature Dependant Diffusion Measurements on Single Neurons
MBI-UF AMRIS	Bui, J.D.	Diffusion Weighted MRI of Rat Brain In Vivo at High B Values
MBI-UF AMRIS	Carter, S.	ACE Inhibition and Angiotensin Receptor Blocker Treatment on Skeletal Muscle Fat Content in Aged Rats
MBI-UF AMRIS	Crosson, B.	Treatment of Intention in Aphasia: Neuroplastic Substrates
MBI-UF AMRIS	Crosson, B.	VA RR&D Brain Rehabilitation Research Center: fMRI for the Upper Extremity Initiative
MBI-UF AMRIS	Crosson, B.	VA RR&D Brain Rehabilitation Research Center: fMRI for the Upper Extremity Initiative
MBI-UF AMRIS	Davenport, P.	Activation of Neural Projections from the Amygdala and Agranular Insular Cortex during Tracheal Obstruction in the Rat using ME-MRI

FACILITY	PI NAME	REPORT TITLE
MBI-UF AMRIS	Davenport, P.D.	Cortical Activations to Transient Tracheal Obstruction in the Rat Using BOLD fMRI
MBI-UF AMRIS	Edison, A.S.	Caenorhabditis elegans Metabolomics
MBI-UF AMRIS	Edison, A.S.	Magnetic Resonance Imaging as a Potential Tool to Image Worms in Native Environments
MBI-UF AMRIS	Edison, A.S.	Parectadial: A Novel Monoterpene from Parectatosoma mocquerysi
MBI-UF AMRIS	FitzGerald, D.B.	Asymmetrical Alien Hands in Corticobasal Degeneration
MBI-UF AMRIS	Gamcsik, M.P.	Correlative 2D HPLC Maps of Glutathione for 13C Spectroscopy
MBI-UF AMRIS	Kaan, E.	Discourse Processing in the Brain: Setting up new discourse referents
MBI-UF AMRIS	Peter, G.	MR Microscopy of Wood Chip Digestion: Utility for Biofuels
MBI-UF AMRIS	Peter, G.	MR Microscopy of Wood Chips Using Microsurface Coils
MBI-UF AMRIS	Robinson, M.E.	Placebo Analgesia Accompanies Large Reductions in Pain-Related Brain Activity in Irritable Bowel Syndrome Patients
MBI-UF AMRIS	Vandenborne, K.	In Vivo Quantification of Soleus Muscle Changes from Fat Infiltration using Magnetic Resonance Imaging and Spectroscopy in Children with Duchenne Muscular Dystrophy
MBI-UF AMRIS	Vandenborne, K.	Muscle Damage Assessed Using MRI and Spectroscopy in Children with Muscular Dystrophy
MBI-UF AMRIS	Walter, G.A.	A Gene Reporter System for the Detection of Cellular LacZ Expression by MRI
MBI-UF AMRIS	Walter, G.A.	High Resolution MRI of Arterially Delivered Mesoangioblasts
NMR Facility	Grant, S.C.	MR Analysis of Structural Contrast in Rodent Models of Attention Deficit Hyperactivity Disorder as a Function of Magnetic Field
NMR Facility	Ulrich, A.S.	19F/1H Solid State NMR Probe for Small Volumes of Mechanically Aligned Proteins
NMR Facility	Veglia, G.	Structure and Topology Studies of the Integral Membrane Protein Phospholamban

CHEMISTRY – 37 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Krzystek, J.	Multifrequency EPR Study of S = 1 Vanadium (III) Complexes with Nitrogen Containing Ligands
DC Field Facility	Telser, J.	HFEPR Studies on Dinuclear Complexes Relevant to Purple Acid Phosphatase (PAP) Enzymes
EMR Facility	Broering, M.	High-Frequency and -Field EPR of Open Chain Mn(III) Porphyrinoid Complexes
EMR Facility	Cao, Y.C.	A High-Frequency EPR Study on Nanocrystals with Position-Controlled Dopants
EMR Facility	Dalal, N.	High-field Measurements on Molecular Clusters with Very Large Spin: Mn25 with S = 51/2, 61/2 and 65/2
EMR Facility	Dinse, K.-P.	High Frequency EPR Investigation of Vanadium Supported on SBA-15 and gamma-Alumina
EMR Facility	Drabent, K	X-ray Crystal Structures, EPR and Magnetic Studies on Strongly Antiferromagnetically Coupled Mixed μ-Hydroxo-μ-N1,N2-Triazole-Bridged 1D Linear Chain Copper(II) Complexes
EMR Facility	Hsu, H.-F.	HFEPR Studies on Vanadium(III) Complexes with Aminocarboxylate Ligands
EMR Facility	Kokozay, V.N.	Direct Synthesis, Crystal Structures, High-Field EPR and Magnetic Studies of Heterometallic Polymers Containing Mn(II) Carboxylates Interconnected by [Cu(en)$_2$]$^{2+}$
EMR Facility	Kokozay, V.N.	Structural, Magnetic, High-Frequency and High-Field EPR Studies on a Double-Stranded Heterometallic [{Ni(en)2}2(μ–NCS)4Cd(NCS)2]n•nCH3CN Polymer
EMR Facility	Krzystek, J.	High-Frequency and -Field EPR Studies on Nitrogen Oxide Complexes of Manganese

RESEARCH REPORTS BY CATEGORY

FACILITY	PI NAME	REPORT TITLE
EMR Facility	Meejoo, S.	High-Frequency and -Field EPR of Natural, and Beryllium-Treated Sapphires
EMR Facility	Ozarowski, A.	High-Field EPR Studies on Binuclear Oxygen-Bridged Iron(III) Complexes
EMR Facility	Sharma, V	High-Frequency and High-Field Electron Paramagnetic Resonance Studies of Ferrate(VI) Species
EMR Facility	Sharma, V.	Electron Paramagnetic Resonance Investigation of Peroxo Species in Fe(III)EDTA-Hydrogen Peroxide System
EMR Facility	Smith, J.M.	HFEPR Studies on Nickel(II) Complexes with a Novel Carbene "Scorpionate" Ligand
EMR Facility	Szymanska, I.B.	High-Field, High-Frequency EPR Studies on Dimeric Copper(II) Perfluorocarboxylates and Silylcarboxylates
EMR Facility	Telser, J.	HFEPR Studies on Ferryl Complexes Relevant to Heme and Non-Heme Iron Enzymes
EMR Facility	Wojciechowski, K.W.	Studies of Magnetic Properties of 1-D Polymeric Cu(II)-fatty Acid-azacrown Ether Complex
Geochemistry Facility	Canfield, G.M.	Zeolite Ion Exchange in Ethylene Oxide Oligomer Solutions
ICR Facility	Marshall, A.G.	Compositional Characterization of Bitumen/Water Emulsion Films by Negative- and Positive-ion Electrospray Ionization and Field Desorption/Ionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometry
ICR Facility	Marshall, A.G.	Detailed Elemental Compositions of Emulsion Interfacial Material vs. Parent Oil for Nine Geographically Distinct Light, Medium, and Heavy Crude Oils, Detected by Negative- and Positive-Ion Electrospray Ionization Fourier Transform Ion Cyclotron Resonance M
ICR Facility	Marshall, A.G.	Heat Exchanger Deposits in an Inverted Steam Assisted Gravity Drainage Operation. Organic Acid Analysis by Electrospray Ionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometry
ICR Facility	Marshall, A.G.	Molecular Characterization of Dissolved Organic Matter in a North Brazilian Mangrove Porewater and Mangrove-Fringed Estuary by Ultrahigh Resolution Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry and Excitation/Emission Spectroscopy
ICR Facility	Marshall, A.G.	Molecular Structure from Molecular Mass
ICR Facility	Marshall, A.G.	Self-Association of Organic Acids in Petroleum and Canadian Bitumen, Characterized by Low- and High- Resolution Mass Spectrometry
ICR Facility	Marshall, A.G.	Sulfur Speciation in Petroleum: Atmospheric Pressure Photoionization or Chemical Derivatization and Electrospray Ionization Fourier Transform Ion Cyclotron Resonance Mass Spectrometry
ICR Facility	Marshall, A.G.	Which Components of Crude Oil Dissolve in Water?
MBI-UF AMRIS	Luesch, H.	Exploiting Floridian Marine Cyanobacteria for Drug Discovery
MBI-UF AMRIS	Luesch, H.	Secondary Metabolite Profiles of Cyanobacteria from Guam
NMR Facility	d'Espinose de LaCaillerie	High Field 33S MAS NMR of Sulphate Mineralogy in Cement-Related Chemical Systems
NMR Facility	Duxson, P.	17O MAS-NMR Investigation of Geopolymer Binder Structure
NMR Facility	Fu, R.	15N MAS-NMR of Antiferroelectric Phase Transition in a Single Crystal of Ammonium Dihydrogen Arsenate, $NH_4H_2AsO_4$ at 900 MHz
NMR Facility	Fu, R.	Solid State 15N MAS-NMR of Ammonia Borane at 900 MHz
NMR Facility	Grey, C.P.	25Mg MQMAS Studies of Mg-Al Layered Double Hydroxides
NMR Facility	Ramamoorthy, A.	Structure of Cortical Bone Studied by 43Ca Solid-State NMR
UF Physics	Bowers, C.R.	Backbone Dynamics in a Precisely Displaced Deuterated-Methyl Branch Polyethylene by Solid State Deuterium Quadrupole Echo Spectroscopy and Deuterium Motion Simulations

ENGINEERING MATERIALS – 12 REPORTS

FACILITY	PI NAME	REPORT TITLE
CMT/E	Brooks, J.S.	Resistivity Measurements of SWNT Polymers with isotactic polypropylene (iPP), propylene-ethylene (PE) co-polymers
DC Field Facility	Ludtka, G.M.	Ambient Temperature High Magnetic Field Processing Conversion of Retained Austenite (%RA) in SAE 52100 Steel
DC Field Facility	Molodov, D.A.	In Situ-Grain Boundary Velocity Measurements in High Purity-Zinc
DC Field Facility	Molodov, D.A.	Magnetic Annealing of Cold-rolled Aluminium Sheet
DC Field Facility	Walsh, R.P.	Fracture Toughness of Thin Walled Conduit Alloys in a CICC Application
DC Field Facility	Wang, B.	Electrical and Mechanical Properties of Magnetic-Field Aligned Single-Walled Carbon Nanotube Buckypapers
EMR Facility	Eichel, R.A.	High-Frequency EPR Studies on Co-Doped Ferroelectric Ceramics
EMR Facility	Zvanut, M E	Identification of Pair Defects in SiC
MBI-UF AMRIS	Simpson, N.E.	Towards Monitoring the Function of Implantable Pancreatic Constructs Through NMR Methods
MS & T	Han, K.	Examinations of Cu-Ag Composite Conductors in Sheet Forms
MS & T	Han, K.	Highly Textured and Twinned Cu Conductors
MS & T	Han, K.	Thermodynamic Assessment of the Mo-Re Binary System

GEOCHEMISTRY – 20 REPORTS

FACILITY	PI NAME	REPORT TITLE
Geochemistry Facility	Bizimis, M.	Scales of Heterogeneities in the Hawaiian Plume
Geochemistry Facility	Cable, J. E.	Evaluating the Role of the Subterranean Estuary on the Redox Cycling of Uranium
Geochemistry Facility	Froelich, P.N.	High-Precision Low-Blank Lithium Isotope Ratios in Forams
Geochemistry Facility	Froelich, P.N.	Speleoclimatology of Florida Caves: Proxy Calibrations of Climate
Geochemistry Facility	Gu, B.	Stable Isotopes Reveal Diet Overlap between Invasive Asian Carps and Native Filter-Feeding Fishes in the Lower Missouri River, USA
Geochemistry Facility	Humayun, M.	Osmium Isotope Anomalies in Group IVB Irons: Cosmogenic or Nucleosynthetic Contributions
Geochemistry Facility	Humayun, M.	Recycled Carbonate-Rich Sediments in the Hawaiian Plume: Evidence from Mahukona Seamount
Geochemistry Facility	Landing, W.M.	Trace Element Analysis of Rainfall Samples from the Pensacola Airshed
Geochemistry Facility	Landing, W.M.	Trace Element Analysis of Seawater Samples from the 2002 Intergovernmental Oceanographic Committee (IOC) Intercalibration Cruise in the Northwestern Pacific Ocean
Geochemistry Facility	Landing, W.M.	Trace Element and Isotope Analysis of Aerosol Samples from the CLIVAR/Repeat Hydrography Program
Geochemistry Facility	Odom, A.L.	A Distinct Magnetic Isotope Effect Measured in Atmospheric Mercury in Epiphytes
Geochemistry Facility	Odom, A.L.	Fractionated Mercury Isotopes in Fish: The Effects of Nuclear Mass, Spin, and Volume
Geochemistry Facility	Odom, A.L.	Mass Independent Fractionation of Mercury Isotopes Archived in a Peat Core
Geochemistry Facility	Righter, K.	High Pressure and Temperature Partitioning of Palladium: No Late Veneer
Geochemistry Facility	Salters, V.J.M.	Determining Melt Flow at the East Pacific Rise through Hf and Nd Isotopes
Geochemistry Facility	Salters, V.J.M.	Mixing Systematics in the Mantle beneath Mid-Ocean Ridges
Geochemistry Facility	Salters, V.J.M.	Relationship between Abyssal Peridotites and Mid-Ocean Ridge Basalts through Nd Isotopes
Geochemistry Facility	Sen, G.	In-situ Analyses of Highly Siderophile Elements in Sulfides from Hawaiian Garnet Pyroxenite Xenoliths

RESEARCH REPORTS BY CATEGORY

FACILITY	PI NAME	REPORT TITLE
Geochemistry Facility	Wang, Y.	Stable Isotopes in Fossil Mammals, Fish and Shells from Kunlun Pass Basin, Tibetan Plateau: Paleoclimatic and Paleoelevation Implications
Geochemistry Facility	Wang, Y.	Stable Isotopic Variations in Modern Herbivore Tooth Enamel, Plants and Water on the Tibetan Plateau: Implications for Paleoclimate and Paleoelevation Reconstructions

INSTRUMENTATION – 14 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Balicas, L.	Ultrasensitive Micromachined Si Magnetometers for Magnetization Measurements at Very Low Temperatures and Very High Magnetic Fields
DC Field Facility	Bednar, N.A.	Measurement of Large DC Currents with an Optical Magnetometer
DC Field Facility	Suslov, A.	Development of a Two-Axis Rotator
DC Field Facility	Suslov, A.	Resonant Ultrasound Spectroscopy on Conductive Materials in High Magnetic Fields
DC Field Facility	Wang, Y.J.	Test of Our New Transmittance and Reflectance Probes in Conjunction with the Bruker 113 Spectrometer in SCM 3
EMR Facility	van Tol, J.	Status of the FSU FIR FEL Design Study
ICR Facility	Marshall, A.G.	Atmospheric Pressure Photoionization Proton Transfer for Complex Organic Mixtures Investigated by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry
ICR Facility	Marshall, A.G.	Modification of Trapping Potential by Inverted Sidekick Electrode Voltage during Detection Extends Time-Domain Signal Duration for Significantly Enhanced Fourier Transform Ion Cyclotron Resonance Mass Resolution
MBI-UF AMRIS	Long, J.R.	Low-E Magic Angle Spinning Probe for Biological Solid State NMR at 750 MHz
NMR Facility	Brey, W.W.	Applications of Low-E Coils to High Field SS NMR of Proteins Aligned in Bicelles
NMR Facility	Grant, S.C.	Design of a 1H/31P Surface Coil for in vivo Spectroscopy and Imaging of Skeletal Muscle in the Mouse Leg at 11.75 T
Pulsed Field Facility at LANL	Mielke, C.H.	Magnetic Susceptibility Probe for Beyond 100 Tesla
Pulsed Field Facility at LANL	Rickel, D.G.	A Case Study of the 60 T Long Pulse Magnet: Sample Heating
Pulsed Field Facility at LANL	Zapf, V.S.	Testing of a Prototype Faraday Magnetometer

KONDO/HEAVY FERMION SYSTEMS – 20 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Andraka, B.	High Field Magnetoresistance of La-doped PrOs4Sb12
DC Field Facility	Ditusa, J.F.	Angular Dependence of Magnetoresistance in CeCo(In,Cd)5 at High Magnetic Fields
DC Field Facility	Francoual, S.	Magnetostriction Investigation of the 4% Rh Doped URu2Si2 Heavy Fermion Compound Near the Quantum Critical Point
DC Field Facility	Goodrich, R.G.	Fermi Surface Evolution in $CeCoIn_5$ and LaCoIn5 with Cd Substitution
DC Field Facility	Julian, S.R.	Magnetic Field-Angle Study of CePb3
DC Field Facility	Sarma, B.K.	Study of Acoustic de Haas - van Alphen Phenomena in URu2Si2
DC Field Facility	Stewart, G.R.	Low Temperature Specific Heat of New Heavy Fermion Materials and of Micro-Particles of Ce(Ru0.4Rh0.6)2Si2
DC Field Facility	Young, B.L.	NMR Investigation of the High-Field Phase in YbInCu4
Pulsed Field Facility at LANL	Alsmadi, A.M.	Complex Conductivity of UTX Compounds in High Magnetic Fields
Pulsed Field Facility at LANL	Alsmadi, A.M.	Pressure and Magnetic Field Effects in Heavy-Fermion UCu3.5Al1.5

FACILITY	PI NAME	REPORT TITLE
Pulsed Field Facility at LANL	Canfield, P.C.	High Magnetic Field de Haas-van Alphen Measurements of RT2Zn20(R=Yb and Lu, T=Fe, Co and Rh)
Pulsed Field Facility at LANL	Harrison, N.	Measurements on CeIn3 in Non-Destructive 100 Tesla Magnet Fields
Pulsed Field Facility at LANL	Harrison, N.	Resistivity of CeIn3 Single-Crystals Down to 400 mK
Pulsed Field Facility at LANL	Lawrence, J.M.	Specific Heat and Magneto-caloric Effect in Polycrystalline Pr3In
Pulsed Field Facility at LANL	Maple, M.B.	Investigation of the Low-Temperature High-Magnetic-Field Phase Diagram of URu2-xRexSi2, x = 0.30
Pulsed Field Facility at LANL	McDonald, R.D.	Tracking the Conduction Electron Spin Resonance Signal in the Heavy Fermion Metal YbRh2Si2
Pulsed Field Facility at LANL	Mielke, C.H.	Contactless Conductivity of a-U to 143 Tesla
Pulsed Field Facility at LANL	Takagi, H.	Specific Heat of LiV2O4 up to 15T
Pulsed Field Facility at LANL	Wolff Fabris, F.	The Specific Heat of CeIn3 at Low Temperatures
UF Physics	Ingersent, K.	Magnetic Quantum Phase Transition in an Anisotropic Kondo Lattice

MAGNET TECHNOLOGY – 19 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Dixon, I.	Subscale Cable-in-Conduit Conductor Measurements of TCS(B, I, e) for the Series-Connected Hybrid Magnets
DC Field Facility	Lu, J.	Critical Current Irreversibility Strain of ITER High Jc Nb3Sn Strands
DC Field Facility	Lu, J.	Critical Current Longitudinal and Transverse Strain Sensitivities of High Jc Nb3Sn Wires
DC Field Facility	Miller, J.	Bending Effect on Nb3Sn Superconducting Wires
DC Field Facility	Minervini, J.	Transverse Stress Effect on Nb3Sn Superconducting Cables
DC Field Facility	Schwartz, J.	React-Wind-Sinter Magnet Fabrication for Bi-2212 Round Wire
DC Field Facility	Weijers, H.W.	HTS Current Lead Development
DC Field Facility	Weijers, H.W.	HTS Inserts: Test of a YBCO Coated-Conductor Magnet
MS & T	Bird, M.D.	The Design and Test of the Conical Model Coil
MS & T	Bird, M.D.	Design and Test of a Working Model of a Split Florida-Helix Magnet
MS & T	Bird, M.D.	Transient Stability Analysis of the Superconducting Outsert of the NHMFL Series Connected Hybrid Magnet System
MS & T	Bonito Oliva, A.	Development of the Superconducting Outserts for the Series-Connected-Hybrid Program at the National High Magnetic Field Laboratory
MS & T	Goddard, R.E.	Examinations Of Haynes 242 Superalloy Using Electron Backscatter Patterns (EBSP)
MS & T	Lu, J.	Physical Properties of Hastelloy® C-276™ at Cryogenic Temperatures
MS & T	Lu, J.	The Interstrand Contact Resistance of a Nb3Sn Cable for the 45 T Hybrid Upgrade
MS & T	Markiewicz, W.D.	Finite Element Analysis of Helical Spring Probe for Strain Dependence Measurements of Nb3Sn
MS & T	Markiewicz, W.D.	Quench Protection of HTS Coils with Distributed Protection Heaters
MS & T	Markiewicz, W.D.	The Invariant Strain Scaling Function for the Strain Dependence of Composite Nb3Sn Superconductors
MS & T	Weijers, H.W.	Short-period Nb3Sn Undulator Development

RESEARCH REPORTS BY CATEGORY

MAGNETIC RESONANCE TECHNIQUES – 33 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Brey, W.W.	Feedback Reduction of Temporal Field Fluctuations for Resistive Magnets
EMR Facility	Boehme, C.	Demonstration of the Electrical Detection of Spin Coherence of Phosphorous Donor Electron States in Isotopically Pure Crystalline 28Si
EMR Facility	Stoneham, A.M.	High-Field Pulsed EPR of Nitrogen Donors in Diamond
MBI-UF AMRIS	Beck, B.L.	Noise Parameter Extraction in the Design of Low Noise Amplifiers (LNA) for MRI
MBI-UF AMRIS	Bolch, W.E.	Advances in Skeletal Dosimetry through Microimaging: Bone-Specific Assessment of Marrow Cellularity by H-NMR Spectroscopy. Aim 2-Validation of H-MRS Method In Vivo
MBI-UF AMRIS	Bolch, W.E.	Advances in Skeletal Dosimetry through Microimaging: Bone-Specific Assessment of Marrow Cellularity by H-NMR Spectroscopy. Aim 4-Human Adult H-MRS Cellularity Study
MBI-UF AMRIS	Conway, T.W.	Reliability and Variability of Repeated fMRI of Language in Aphasic Adults
MBI-UF AMRIS	Dobson, J.	Imaging and Characterizing Brain Iron via MRI and Synchrotron X-Ray Analysis: Implications for Neurodegenerative Disease Research & MRI Signal Validation
MBI-UF AMRIS	Eyler, F.D.	Diffusion Tensor Imaging of Frontal White Matter and Executive Functioning in Cocaine-Exposed Children
MBI-UF AMRIS	Mareci, T.H.	Wireless Control of an Implantable Coil System for MRI/S
MBI-UF AMRIS	Miller, J.	Effects of Growth Hormone on Metabolism and Satiation in Prader-Willi Syndrome: Translational Research in Prader-Willi Syndrome and Obesity – Part 3.
MBI-UF AMRIS	Vandenborne, K.	In Vivo Bioenergetics of Rat Hindlimb Muscle After Moderate Spinal Cord Contusion
NMR Facility	Bird, M.D.	Resistive Shims for High-Field Resistive and Hybrid Magnets
NMR Facility	Brey, W.W.	1H and 23Na Mouse Imaging Coils for the NHMFL 900 MHz Ultra-Wide Bore Magnet
NMR Facility	Cappendijk, S.L.	In vivo Imaging of Nicotine-Exposed Adult Male Zebra Finches
NMR Facility	Chaw, C.A.	Magnetic Resonance Microscopy and Immunohistochemistry of the CNS of the Mutant SOD Murine Model of ALS Reveals Widespread Neural Deficits
NMR Facility	Cross, T.A.	Solution NMR Structural Restraints for Rv0008c, an Integral Membrane Protein from Mycobacterium tuberculosis
NMR Facility	Fu, R.	Dipolar-Encoded HETCOR Spectroscopy in NMR of Aligned Samples
NMR Facility	Gan, Z.	Indirect Detected 14N Wide Line NMR under MAS
NMR Facility	Grant, S.C.	Assessment of Cellular Growth in a Double Microbead Alginate Construct via MR Microscopy
NMR Facility	Grant, S.C.	Bimodal Intracellular Nanoparticles Based on Quantum Dots for High Field MRI at 21.1 Tesla
NMR Facility	Grant, S.C.	Field Dependence of Paramagnetic Lanthanide Ion Complexes as MRI Contrast Agents
NMR Facility	Grant, S.C.	Neuroprotective Effects of Alpha Lipoic Acid on Ecstasy-exposed Zebra Finches: An MRI Study
NMR Facility	Grant, S.C.	Use of Magnetic Nanoparticles to Monitor Alginate Encapsulated Cells
NMR Facility	Jakobsen, H.J.	Techniques for Very Wide Bandwidth Solid State NMR of Low-Gamma Quadrupolar Nuclei
NMR Facility	Schepkin, V.D.	In vivo Diffusion MRI of Mouse Brain with Motion Compensation
NMR Facility	Schepkin, V.D.	In vivo High Resolution Proton MR Imaging of Mice at 21.1 T
NMR Facility	Schepkin, V.D.	In vivo High Resolution Sodium MR Imaging of Mouse Brain at 21.1 T

FACILITY	PI NAME	REPORT TITLE
NMR Facility	Schurko, R.W.	Application of Solid-State 35Cl NMR Spectroscopy for the Detection of Polymorphism in Hydrochloride Anaesthetic Pharmaceuticals
NMR Facility	Witter, R.	19F-2D-CPMG NMR on 5F-Trp41-M2TMD Reveals a Participation of Trp41 in the Gating Mechanism of the M2 Proton Channel of Influenca A Virus
NMR Facility	Witter, R.	19F-RAI-CODEX Investigation on Gramicidin A
UF Physics	Bowers, C.R.	Dramatic Enhancement of Cross-Peak Signals in Hyperpolarized NMR Exchange Spectroscopy by Interruption of the Gas Flow
UF Physics	Bowers, C.R.	Hyperpolarized NMR Studies of Gas Exchange and Diffusion in Dipeptide Nanotubes

MAGNETISM AND MAGNETIC MATERIALS – 53 REPORTS

FACILITY	PI NAME	REPORT TITLE
CMT/E	Chiorescu, I.	Detection of Quantum Spin Dynamics Using Mesoscopic Devices
CMT/E	Guertin, R.P.	Magnetic Characterization and Pressure Dependence of Newly Synthesized Inter-lanthanide Chalcogenides
CMT/E	Smith, R.S	Phase Separation and Giant Magnetoresistance in a Perovskite Oxide
DC Field Facility	Brooks, J.S.	Terahertz ESR above 40T: Exploring Exotic Magnetic Field-Induced Phases in a Tau Phase Organic Conductor
DC Field Facility	Dalal, N.S.	55 Mn NMR Study of the {Mn12-Ac} Single Molecule Magnet
DC Field Facility	Dickerson, J.H.	Magnetization Measurements of Multi-Layer Thin Films of Fe3O4 Nanocrystals
DC Field Facility	Dickerson, J.H.	Magnetization Studies of Europium Chalcogenide Nanocrystalline Materials
DC Field Facility	Epstein, A.J.	Linear Anomalous Magnetoresistance (up to highest field 45 T) of High-temperature Organic-based Magnetic Semiconductor V(TCNE)x (x~2)
DC Field Facility	Fisher, I.R.	Multiple Magnetic Phases in the Frustrated Spin-Dimer Compound Ba3Mn2O8
DC Field Facility	Gerber, A.	High Field Magnetotransport in Mn Implanted Ge
DC Field Facility	Harrison, N.	Dilution Fridge Temperature Measurements of the Magnetic Torque of SrCu2(BO3)2 Extended to 45 T
DC Field Facility	Hill, S.	High-Field EPR Studies of the Spin-1 Dimer Compound Ba3Mn2O8
DC Field Facility	Imai, T.	High Field NMR Study of Charge Ordering in Na0.5CoO2
DC Field Facility	Kim, K.H.	High Field Phase Diagram of Multiferroic LiCu2O2
DC Field Facility	Kim, K.H.	Specific Heat Study of Multiferroic BiMn2O5
DC Field Facility	Kuehne, H.K.	Quantum Critical Spin Dynamics of a Cu(II) S=1/2 Antiferromagnetic Heisenberg Chain Studied by High-Field NMR Spectroscopy
DC Field Facility	Landee, C.P.	Critical Magnetic Fields for a 3D Spin-Singlet Antiferromagnet: (5FAP)2CuCl4
DC Field Facility	Leighton, C.	High Field Studies of Magnetoelectronic Phase Separation in the Doped Perovskite Cobaltites
DC Field Facility	Luke, G.M.	dc-Magnetization of Ba3Cr2O8
DC Field Facility	Mitrovic, V.F.	133Cs NMR Spin-Lattice Relaxation Rate in the Frustated Quantum Antiferromagnet Cs2CuCl4
DC Field Facility	Musfeldt, J.L.	Chemical Tuning of the High-Energy Magneto-Dielectric Effect in a Frustrated Kagome Lattice Material
DC Field Facility	Musfeldt, J.L.	Spin-lattice Interactions Mediated by Magnetic Field
DC Field Facility	Nakatsuji, S.	Metamagnetic Transition and Anomalous Hall Effect of the Metallic Pyrochlore Oxide Pr2Ir2O7
DC Field Facility	Palm, E.C.	Magnetic Properties of $CeCoIn_5$ Studied in a New Top-Loading Dilution Refrigerator (XCF)

RESEARCH REPORTS BY CATEGORY

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Parkin, S.S.	Probing the Field Induced Splitting of Kondo Resonance in Magnetic Double Tunnel Junctions
DC Field Facility	Reyes, A.P.	51V NMR Study of a Single Crystal MnV_2O_4
DC Field Facility	Reyes, A.P.	Nuclear Spin-Lattice Relaxation in the {Cu3} Spin Triangle
DC Field Facility	Strouse, G.F.	Field Dependence of Photoluminescence Lifetime in CdSe Nanocrystals
DC Field Facility	Strouse, G.F.	Field Dependence of Photoluminescence Lifetime in Manganese Doped CdSe Nanocrystals
DC Field Facility	Takano, Y.	High-Field Magnetic Phases of Cs_2CuBr_4
DC Field Facility	Takano, Y.	Quantum Critical Behavior of Spin-1/2 Two-Leg Spin-Ladder Compound IPA-CuCl3
DC Field Facility	Tanner, D.	Infrared Study of Phase Separation in (La1-yPry)0.67Ca0.33MnO3 Thin Films
DC Field Facility	Wiebe, C.R.	Orbital Ordering Transition in Sr_2VO_4
DC Field Facility	Wolff-Fabris, F.	Volume Dependence of the Magnetostriction Effects in the 1D Quantum Spin System Azurite
EMR Facility	Chiorescu, I.	Development of a Pulsed Network Analyzer for Studies on Molecular Magnets and Organic Conductors
EMR Facility	Dalal, N.S.	Magnetic and EPR Studies on an Iron Wheel Containing Tungstophosphate
EMR Facility	Julve, M.	High-Frequency and -Field EPR of Mono- and Poly-Nuclear Complexes of Rhenium(IV)
EMR Facility	van Tol, H.	Spin State Transition in LaCoO3 Using Low Temperature EPR
EMR Facility	van Tol, J.	Antiferromagnetic d-Electron Exchange via a Spin-Singlet π-Electron Ground State in an Organic Conductor
EMR Facility	Zorko, A	ESR Study of the Spin-1/2 Kagome Antiferromagnet $ZnCu_3(OH)_6Cl_2$
Pulsed Field Facility at LANL	Alsmadi, Abdel	Magnetic Behavior of PAN-based Nickel Coated Carbon Fiber/ Nylone66 Composite
Pulsed Field Facility at LANL	Bao, W	Magnetization and Electron Paramagnetic Resonance Studies of Kagomé Lattice Compounds
Pulsed Field Facility at LANL	Fanelli, V.	Specific Heat of BaCuSi2O6 at Field-Induced Quantum Critical Point
Pulsed Field Facility at LANL	Francoual, S.	Magnetostriction and Thermal Expansion Measurements in Azurite in Vacuum at Dilution Fridge Temperatures in Magnetic Fields Up to 18 T
Pulsed Field Facility at LANL	Kim, K.H.	High Field Phase Diagram of a New Multiferroic $Ba_2CoGe_2O_7$
Pulsed Field Facility at LANL	Kim, K.H.	Magnetization Study of Multiferroic BiMn2O5 at High Magnetic Fields
Pulsed Field Facility at LANL	Maple, B.	de Haas-van Alphen Studies of NdOs4Sb12 Skutterudites
Pulsed Field Facility at LANL	May, I.	Electron Paramagnetic Resonance Studies of a Plutonyl Polyoxometalate Complex
Pulsed Field Facility at LANL	McDonald, R.D.	Electron Paramagnetic Resonance Measurements of Low Dimensional Quantum Magnet Systems
Pulsed Field Facility at LANL	Schlueter, J.	Pulsed-Field Studies of Quasi-One- and Quasi-Two-Dimensional Organic Magnets
Pulsed Field Facility at LANL	Wolff Fabris, F.	Anomalous Hall Effect on AuFe Compounds
UF Physics	Hill, S.	Pump-probe EPR Studies of Spin Dynamics in Single-Molecule Magnets
UF Physics	Meisel, M.W.	Exact Solutions for Correlations in a S = 1/2 Spin Ladder Model having Two- and Four-Spin Exchange Interactions with Application to Inelastic Neutron Scattering

METAL-INSULATOR TRANSITIONS – 6 REPORTS

FACILITY	PI NAME	REPORT TITLE
CMT/E	Dobrosavljevic, V.	RKKY Interactions in the Regime of Strong Localization
CMT/E	Popovic, D.	Aging Effects across the Metal-Insulator Transition in Two Dimensions
DC Field Facility	Drichko, I.L.	High-Frequency Conductance in the p-type Si/SiGe Heterostructures in Parallel Magnetic Field: Acoustic Study
DC Field Facility	Heeger, A.J.	Properties of the Metallic Phase in Conjugated Polymer Field-Effect Transistors: Dependence on Temperature and Magnetic Field
DC Field Facility	McGill, S.A.	Time-resolved Studies of Coupled Dynamics in Manganites
UF Physics	Hebard, A. F.	Simultaneous Measurement of In-Plane and Out-of-Plane Magnetotransport in Anisotropic Thin Films

MOLECULAR CONDUCTORS – 9 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Brooks, J.S.	High Field Study of the CDW Ground States of (Per)2M(mnt) (where M = Ni, Pt)
DC Field Facility	Brooks, J.S.	High Pressure Angular Dependent Magnetoresistance Measurements at 31 tesla of (Per)2Au(mnt)2
DC Field Facility	Brooks, J.S.	Investigation of Possible Field-Induced Superconductivity in beta-(BDA-TTP)$_2$FeCl$_4$
DC Field Facility	Brooks, J.S.	Simultaneous 77Se NMR and Electrical Transport Investigation of the Field-Induced Spin Density Wave Phases in the Organic Conductor (TMTSF)$_2$ClO$_4$
DC Field Facility	Kang, W.	Magnetic Torque Measurements of the Organic Superconductor (TMTSF)$_2$ClO$_4$ with a Piezoelectric Cantilever
DC Field Facility	Kawamoto, T.	High Field Angle Dependence of the Magnetoresistance in the Layered Organic Superconductor
DC Field Facility	McDonald, R.D.	Thermoelectric Studies of Non-Thermal Equilibrium Charge Density Wave Dynamics
DC Field Facility	Park, Y.W.	Magnetotransport of Polymer Nanofibers in High Magnetic and Electric Fields
Pulsed Field Facility at LANL	Naughton, M.J.	Pulsed Field Study of Interference Commensurate Effect in (DMET)2I3

OTHER CONDENSED MATTER – 23 REPORTS

FACILITY	PI NAME	REPORT TITLE
CMT/E	Bonesteel, N.E.	Monte Carlo Study of Chains of Non-Abelian Quasiparticles
CMT/E	Cao, J.	Coherent Atomic Motion in Nano-crystal Film
CMT/E	Cao, J.	Electronic Thermal Expansion in Ferromagnetic Transition Metals
CMT/E	Yang, K.	Strong Correlation Physics in Trapped Cold Atom Systems
DC Field Facility	Balicas, L.	Local Moment, Itinerancy and Deviation from Fermi Liquid Behavior in Na$_x$CoO$_2$ for 0.71 less equal to • x less equal to • 0.84
DC Field Facility	Behnia, K.	Nernst Effect in Ultraquantum Bismuth
DC Field Facility	Cheong, S.W.	Evidence for Field-Induced Recovery of Inversion Symmetry in a Ferroelectric Ising Chain Magnet
DC Field Facility	Choi, E.S.	Quantum Criticality of Sr$_3$Ru$_2$O$_7$ Probed by Magnetothermopower
DC Field Facility	Dalal, N.S.	Specific Heat and Magnetocaloric-effect Measurements On K$_2$NaCrO$_8$
DC Field Facility	Gleeson, J.T.	High Field Magneto-Optical Studies of Liquid Crystals and Complex Fluids
DC Field Facility	Kono, J.	Magneto-Photoluminescence Spectroscopy of Carbon Nanotube Films
DC Field Facility	Long, V.C.	Magnetic Field-Induced Energy Shifts in Electronic Bands of Ni(II) Coordination Compounds

RESEARCH REPORTS BY CATEGORY

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Neumeier, J.J.	Electrical Resistance of Quasi-1D $Li_{0.9}Mo_6O_{17}$ at Very High Magnetic Field
DC Field Facility	Noh, Tae Won	Investigation on Magneto-optical Properties of Epitaxial-stabilized Hexagonal $RMnO_3$ (R=Dy, Tb, Gd) Thin Films
DC Field Facility	Rosenbaum, R. L.	Electronic Transport in Al-Pd-Re Quasicrystalline Multigrain Samples
DC Field Facility	Suslov, A.	Ultrasonic Studies on Aluminum Bicrystals
NMR Facility	Wu, Y.	High-Resolution 13C Solid-State NMR Study of Phenols Adsorption in Titania Nanotubes
Pulsed Field Facility at LANL	Bhansali, S.	Magnetic Properties of Ni-Fe Nanowire Arrays: Effect of Template Material and Deposition Conditions
Pulsed Field Facility at LANL	Kono, J.	Electron Paramagnetic Resonance of Single-Walled Carbon Nanotubes
Pulsed Field Facility at LANL	Kono, J.	Geometry Dependence of Magnetic Brightening in Stretch - Aligned SWNT Films
Pulsed Field Facility at LANL	Kono, J.	Megagauss Absorption Spectroscopy of Single-walled Carbon Nanotubes
Pulsed Field Facility at LANL	Lima Sharma, A.L.	Magnetism in the Ternary $CaMn_2Sb_2$ System
Pulsed Field Facility at LANL	Maich, A.	Magnetoresistance and Resonant Ultrasound Spectroscopy Study of the Shape Memory Alloy AuZn

QUANTUM FLUIDS AND SOLIDS – 14 REPORTS

FACILITY	PI NAME	REPORT TITLE
CMT/E	Vafek, O.V.	Coulomb Interaction, Ripples, and the Minimal Conductivity of Graphene
DC Field Facility	Lacerda, A.H.	Magnetostriction and Thermal Expansion on 1D Chain Azurite Compound
DC Field Facility	Tanaka, H.	Ultrasound Studies on Cs_2CuBr_2
DC Field Facility	Wiebe, C.R.	Field-induced Magnetic Order in the Spin-liquid Kagomé $Nd_3Ga_5SiO_{14}$
DC Field Facility	Zvyagin, S.A.	Excitation Hierarchy in the Spin-1 Large-D System $NiCl_2$-$4SC(NH_2)_2$
High B/T Facility at UF	Lee, Y.	Gapless Superfluid ^3He in High Porosity Aerogel
High B/T Facility at UF	Sullivan, N.S.	Experimental Studies of the Fractional Quantum Hall Effect in the First Excited Landau Level
High B/T Facility at UF	Sullivan, N.S.	Giant Viscosity Enhancement in a Spin-polarized Fermi Liquid
High B/T Facility at UF	Sullivan, N.S.	Kapton Capacitance Thermometry at Low Temperatures and in High Magnetic Fields
Pulsed Field Facility at LANL	Zapf, V.S.	Dielectric Constant and Dilatometry in the Organic Quantum Magnet CDC
Pulsed Field Facility at LANL	Zapf, V.S.	Field-induced Ferroelectricity in an Organic Quantum Magnet
UF Physics	Sullivan, N. S.	Pulsed NMR Studies of ^3He Exchange on Atomically Smooth Surfaces
UF Physics	Sullivan, N. S.	Random Ordering in Solid Hydrogen Films: NMR studies.
UF Physics	Sullivan, N.S.	Thermal Hysteresis in Magnetic Phase Changes in Solid Oxygen

SEMICONDUCTORS – 33 REPORTS

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Bowers, C.R.	Tilted Magnetic Field NMR Spin Relaxation Study of the nu=1 Quantum Hall State
DC Field Facility	Dobrowolska, M.	Scaling of the Anomalous Hall Effect in Low Mn Concentration (Ga,Mn)As Films
DC Field Facility	Engel, L.W.	Higher Order Peaks in the WIgner Crystal Resonances of 2D Hole Systems
DC Field Facility	Engel, L.W.	In-plane Field Effect on the Stripe and Bubble Resonances of 2D Electron System in High Landau Levels

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Grayson, M.	Evidence of Momentum Resolved Quantum Hall Edge Spectroscopy in a Bent Quantum Well Junction
DC Field Facility	Karczewski, G.	Spin Dependent Transport in Diluted Magnetic Heterostructure
DC Field Facility	Kim, P.	Quantum Hall Effect in Graphene
DC Field Facility	Latturner, S.E.	Flux Growth and Electronic Properties of $Ba_2In_5Pn_5$ (Pn = P, As): Zintl Phases Exhibiting Metallic Behavior
DC Field Facility	Leotin, J.	Effective Masses and Valley-Symmetry in AlP Quantum Wells
DC Field Facility	Lewis, R.A.	Far-infrared Spectroscopy of Electronic Materials
DC Field Facility	Pan, W.	A Study of Phase Transitions in Wide High-Quality GaAs Quantum Wells at Higher Landau Levels
DC Field Facility	Pan, W.	Search for Pfaffian Quantum Hall States in High Quality Wide GaAs Quantum Wells
DC Field Facility	Reitze, D.H.	Ultrafast Emission From Highly Excited Magneto-Plasmas: First Results On Dynamics Of The Emission Process
DC Field Facility	Shayegan, M.	Effective Mass Suppression in Fully Spin-polarized 2D Electron System
DC Field Facility	Sirtori, C.	Magneto-Transport and Magneto-Spectroscopy of MOCVD Mid-Infrared Quantum Cascade Lasers
DC Field Facility	Smirnov, D.	Exploring the Magnetically Induced Field Effect in Carbon Nanotube Based Devices
DC Field Facility	Smirnov, D.	Study of the Angular Dependence of the Emission Intensity of Mid-IR Quantum Cascade Lasers
DC Field Facility	Smirnov, D.	Sub-THz Multi-Wavelength Emission in Quantum Cascade Lasers
DC Field Facility	Stormer, H.L.	Infrared Measurements of Landau Level Transitions in Single and Bilayer Graphene
DC Field Facility	Su, T.	High-Field 121Sb NMR in Amorphous Ge2Sb2Tex (x = 4, 5, 7) Thin Films
DC Field Facility	Swartz, C.H.	Variable Magnetic Field Hall Effect Measurements in ZnO and InN
DC Field Facility	Tsui, D.C.	In-Plane Magnetoresistance of Dilute Two-Dimensional Electrons in Si/SiGe Heterostructures
DC Field Facility	Wang, Y.J.	The Study of Sub-millimeter Wave Induced Zero Resistance Effect at ^{3}He Temperatures
DC Field Facility	Wang, Y.J.	Unusual Magneto-infrared Modes in CdMnTe/CdMgTe Quantum Well Structures
DC Field Facility	Woo, J.C.	Anisotropic Effect of III-V Semiconductor Nanostructures by the Experiments of Magneto-Photoluminescence
Pulsed Field Facility at LANL	Crone, B.	Magneto-Photoluminescence from Platinum Porphyrin in n-octane Crystals
Pulsed Field Facility at LANL	Crooker, S.A.	Imaging Spin Drift and Diffusion in Lateral Fe/GaAs Spin Transport Devices
Pulsed Field Facility at LANL	Crooker, S.A.	Measuring the Stochastic Spin Noise of Free Electrons in Semiconductors
Pulsed Field Facility at LANL	Crooker, S.A.	Tuning the Sign and Magnitude of the Spin Detection Sensitivity in Fe/GaAs Spin Detectors
Pulsed Field Facility at LANL	Hayes, S.	Low Temperature Optical Absorption Studies on Semi-Insulating GaAs: Implications for Optically-Pumped NMR
Pulsed Field Facility at LANL	Klimov, V.	Control of sp-d Exchange Interactions in Pseudo-type II Mn: ZnSe/CdSe Core-Shell Nanocrystal Quantum Dots
Pulsed Field Facility at LANL	Mielke, C.H.	Mid-Infrared Transmission of InSb to 175 Tesla
Pulsed Field Facility at LANL	Schaller, R.D.	Time-Resolved Magneto-Photoluminescence Measurements Determine the Role of Dark Exciton States in Semiconductor Nanocrystals

RESEARCH REPORTS BY CATEGORY

SUPERCONDUCTIVITY – APPLIED – 20 REPORTS

FACILITY	PI NAME	REPORT TITLE
Applied Superconductivity Center	Jiang, J.	Superconductor Bi-2212 Wire for Very High Magnetic Field Magnets
Applied Superconductivity Superconductivity Center	Larbalestier, D.C.	Bi2212 Conductor and Coil Technology for High Field Magnets
Applied Superconductivity Superconductivity Center	Larbalestier, D.C.	Magneto-Optical Study of Effect of Deformation In Nb3Sn Multifilamentary Strands
Applied Superconductivity Center	Lee, P.J.	An Investigation of the Influence of Grain Boundaries on Flux Penetration in High Purity Large Grain Niobium for Particle Accelerators
Applied Superconductivity Center	Lee, P.J.	The Effect of Filament Architecture on the Fracture Behavior of Nb3Sn Composite Strands
Applied Superconductivity Center	Schwartz, J.	Magnetic Processing of Low Aspect Ratio $Bi_2Sr_2CaCu_2O_x$/ AgMg Wire
Applied Superconductivity Center	Schwartz, J.	Split Processing of High Superconductor Fraction $Bi_2Sr_2CaCu_2O_x$/AgMg Round Wire
DC Field Facility	Canfield, P.C.	Performance of Carbon and Titanium Doped Magnesium Diboride Wire
DC Field Facility	Hong, S.	Characterization of Superconducting Strands for High Field Magnet Applications over 25 T
DC Field Facility	Jiang, J.	Irreversibility Field of High Temperature Superconductor Bi-2212
DC Field Facility	Larbalestier, D.C.	Enhancement of H_{c2} in c-Doped MgB_2 by Precipitation
DC Field Facility	Larbalestier, D.C.	Improving Performance in Bulk Magnesium Diboride by Improved Processing
DC Field Facility	Larbalestier, D.C.	Strong Vortex Pinning in Sm-doped $YBa_2Cu_3O_{7-x}$ Films Made by MOCVD
DC Field Facility	Larbalestier, D.C.	Upper Critical Field Study of Alloyed MgB_2
DC Field Facility	Pyon, T.	Development of Internal-Tin Processed Nb3Sn Superconducting Wire for Fusion Application
DC Field Facility	Sumption, M.D.	Influence of Stoichiometry (Mg level) on Birr and Bc_2 in MgB_2
DC Field Facility	Thieme, C.	High Field Stability Exploration of Second Generation HTS
High B/T Facility at UF	Larbalestier, D.	Study of Local Dissipation in MOD Coated Conductors
MS & T	Bird, M. D.	Modeling of the Performance of Nb3Sn CICCs for High Field Magnet Design
Pulsed Field Facility at LANL	Maiorov, B.	Angular Dependence of the Melting Line of YBCO+BZO Thin Films

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CMT/E	Brooks, J.	High Frequency Probes of Superconductivity and Magnetism in Anisotropic Materials
CMT/E	Gor'kov, L.P.	Mobility and its Temperature Dependence in LSCO: Dissipative Motion?
DC Field Facility	Boebinger, G.S.	H_{c2} of High Temperature Superconductivity at a Hetero-junction between two Non-superconducting Cuprates
DC Field Facility	Dordevic, S.V.	Magnetic Field Dependence of the Mid-Infrared Transmission in Underdoped $La_{2-x}Sr_xCuO_4$ Thin Films
DC Field Facility	Gapud, A.A.	Driving Vortices in Weak-pinning V3Si at High Currents and Fields While in Liquid Helium
DC Field Facility	Greene, R.L.	High Pressure Low Temperature Magnetoresistance and Hall Effect of $Pr_{2-x}Ce_xCuO_{4-\&\#948;}$ for Doping Close to x=0.17
DC Field Facility	Halperin, W.P.	17O NMR Study of Single Crystal and Aligned Powders of $Bi_2Sr_2CaCu_2O_{8+d}$ (Bi-2212)

FACILITY	PI NAME	REPORT TITLE
DC Field Facility	Huecker, M.	Anisotropic Spin Magnetism and Diamagnetic Response in Stripe Ordered $La_{1.875}Ba_{0.125}CuO_4$
DC Field Facility	Hussey, N.E.	Temperature and Doping Dependent Study of Polar AMRO in Tl2201
DC Field Facility	Lonzarich, G.G.	Observation of de Haas van Alphen Oscillations in the Underdoped High Temperature Superconductor $YBa_2Cu_3O_{6.51}$
DC Field Facility	Maple, M.B.	Evolution Towards a Conventional Vortex-Solid to Vortex-Liquid Phase Boundary with Oxygen Doping in $Y_{0.8}Ca_{0.2}Ba_2Cu_3O_x$ Films
DC Field Facility	Ong, N.P.	Unusual Magnetization in Superconducting State of Sr_2RuO_4 with H||c
DC Field Facility	Panagopoulos, C.	Magnetotransport in Lightly Doped $La_{2-x}Sr_xCuO_4$ and La2Cu1-xLixO4
DC Field Facility	Suslov, A.	On Electron Coherence Length in Sr_2RuO_4
DC Field Facility	Taillefer, L.	Negative Hall Coefficient in the Normal State of Hole-doped Cuprate Superconductors
DC Field Facility	Wang, Y.J.	The Investigation of the Two Gap Superconductor --- MgB_2 Thin Films
DC Field Facility	Zheng, G.Q.	Finite Fermi Surface in the Zero-Temperature Pseudogap State of High-Tc Superconductors
High B/T Facility at UF	Biswas, A.	Point Contact Spectroscopy of $Pr_{2-x}Ce_xCuO_4$ in High Magnetic Fields
MS & T	Larbalestier, D.	Atomic Structural Analysis of YBCO Bicrystal Grain Boundary by Aberration Corrected STEM
Pulsed Field Facility at LANL	Cooper, J.	Shubnikov-de Haas Oscillations up to 85 T in the Underdoped Cuprate Superconductors: Understanding the Fermi Surface
Pulsed Field Facility at LANL	Maiorov, B.	Smectic Vortex Phase at High Fields in Optimally Doped High-Temperature Superconductor
Pulsed Field Facility at LANL	Matutes-Aquino, J.	Field, Temperature and Composition Dependence of Electrical Resistance in the Superconducting Ferromagnetic Rutheno-Cuprates (Ru1-xNbx)Sr2(Eu1.5Ce0.5)Cu2O10, [Ru,Nb)-1222]
Pulsed Field Facility at LANL	Taillefer, L.	Quantum Oscillations in Underdoped YBa_2Cu_3Oy
Pulsed Field Facility at LANL	Tozer, S.W.	High Pressure Studies of CeIn3 in High Magnetic Fields
Pulsed Field Facility at LANL	Yeh, N.C.	Quantum Fluctuations and Competing Orders in the Hg-1245 High-Tc Cuprate
UF Physics	Hirschfeld, P.J.	Disorder-Induced Static Antiferromagnetism in Cuprate Superconductors
UF Physics	Hirschfeld, P.J.	Structure of $Bi_2Sr_2CaCu_2O_{8+x}$ Supermodulation from ab initio Calculations

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