NATIONAL HIGH MAGNETIC FIELD LABORATORY

REPORTS

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NHMFL REPORTS

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ON THE COVER:
The group of Mathias Doerr (University of Technology, Dresden; pictured top right) and Martin Rotter (University of Vienna) conducted magnetostriction experiments on rare earth materials in December 2005 using the 45 T Hybrid magnet. "We cannot get these measurements at home," said Doerr. "This laboratory is the only place where we can reach the very high fields necessary to see the magnetic phase transitions." Postdoc Duc Le, London University College, is pictured at top left.

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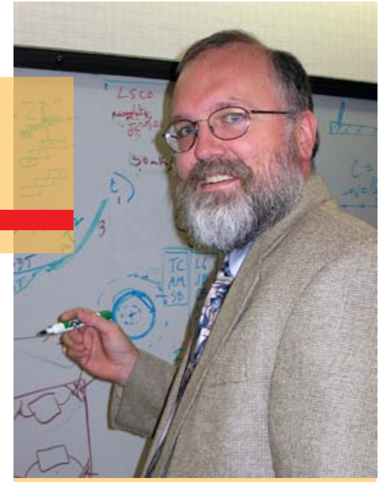
FROM THE DIRECTOR'S DESK



Greg Boebinger

An organization as large as the MagLab, like a well-lived life, has its victories and its tragedies. In this forum, I will be focusing on several recent highlights, but I want everyone in the MagLab community to know that we share your concern for **Bob Schrieffer** during this very difficult time. Our hearts go out to Bob, Anne, and to all others involved in this terrible human tragedy.

The Magnet Lab talent pool enjoys great breadth and depth: in place of a single Chief Scientist position, we are naming a Science Council whose expertise spans the MagLab research program. The Science Council will serve as a think tank to consider the global scientific mission and potential for the MagLab. The first MagLab Science Council will be chaired by **Lev Gor'kov** and will include **Rafael Brüschweiler**, **David Larbalestier**, **Albert Migliori**, **Jim Brooks**, **Carol Nilsson**, and **Glenn Walter**. As we approach the September 15, 2006, submission date for the MagLab's NSF Core Grant, the central scientific drivers underlying the MagLab's mission will be clearly articulated and will form the backbone of our renewal proposal. Our magnet and facilities infrastructure will directly support the science drivers and clear links will then identify supporting line items in the MagLab's budget request.

To get the ball rolling, discussions last summer among a group of five condensed matter physicists (myself, **Bill Halperin**, **David Larbalestier**, **Peter Littlewood,** and **Albert Migliori**) led to a draft list of five science drivers that make a clear and compelling case for the present and future impact of high magnetic field research. Because the bulk of MagLab funding from the NSF Core Grant goes to our DC and pulsed magnet user programs, the five science drivers reflect the materials science core of our research portfolio. The science drivers also convey the range of scientific excitement at the MagLab and the frontiers on which high magnetic fields will play a major role in the future. The chemistry and biology communities at the MagLab are now re-drafting several of the science drivers (the main reason we condensed matter physicists gave them a target at which to aim!).

Vlad Dobrosavljevic at FSU, **Dmitrii Maslov** at UF, and **Peter Littlewood** at Cambridge (a frequent visiting scientist at the MagLab) have agreed to help develop the condensed matter theory content for the renewal proposal. All aspects of the renewal proposal will become more public once the National Science Board decides whether to compete or renew our proposal, a decision we expect in February 2006.

I am pleased that MagLab's Magnet Science and Technology division continues to find great interest around the world from other laboratories, including neutron and X-ray sources, that are interested in exploring collaborations involving MagLab magnet technology.

Increasingly, future high-performance magnets will rely on new materials development, from conductors made from high-T_c cuprates and MgB_2 to ultra-strong nanocomposites that can serve as reinforcing materials in magnets. I am extremely excited that the **Applied Superconductivity Center** (ASC), now at the University of Wisconsin, will be moving to the National High Magnetic Field Laboratory in Tallahassee by next summer (see page 9 for further details).

David Larbalestier, Director of the ASC, will wear a second hat as the Chief Materials Scientist of the MagLab. Other key members of the ASC will be heading south as well: **Alex Gurevich** will be integrated into the MagLab's Condensed Matter Theory Group. **Peter Lee** will team up with MagLab folks to bring additional talent and instrumentation to a coordinated Electron Microscopy facility that serves both the ASC and MagLab.

The future is indeed very bright.

Greg

FROM THE MAGLAB SCIENCE COUNCIL

A collaboration between the groups of Martin Blackledge from the IBS in Grenoble, Stephan Grzesiek from the Biozentrum at the University Basel, and Rafael Brüschweiler at the NHMFL and the Department of Chemistry and Biochemistry at FSU resulted in a novel approach to characterize the slow time scale dynamics of proteins in solution by NMR spectroscopy.[1] Analysis of a very large set of magnetic dipolar spin couplings by a 3D axial fluctuation model reveals an intriguing pattern of standing waves across the β-sheet of protein G involved in binding to immunoglobulin G implying maximal conformational sampling at the interaction site. These findings suggest that dynamical information can be transmitted across a long-range network of hydrogen bonds in proteins. The work is featured in Editor's choice of the October 14 issue of *Science*.

Slow Correlated Motions in Proteins from NMR Dipolar Spin-Spin Couplings

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M. Blackledge, Institut de Biologie Structurale Jean-Pierre Ebel, CEA-CNRS-UJF, France

Molecular motions play a crucial role in protein stability and function. Slow time scale motions on nanosecond to milliseconds are of particular interest because biologically important processes, such as enzyme catalysis, signal transduction, ligand binding, and allosteric regulation are expected to occur in this time range.

Nuclear magnetic resonance (NMR) spectroscopy is uniquely suited to study such motions. When a protein is weakly aligned relative to the external magnetic field due to the presence of an alignment medium, for example a stretched gel, the magnetic dipolar spin-spin couplings of its atomic nuclei are not averaged to zero as they would be in isotropic solution. These residual dipolar couplings (RDCs) are unique probes of molecular motions occurring on a wide range of time scales that covers femtoseconds to milliseconds.[2,3]

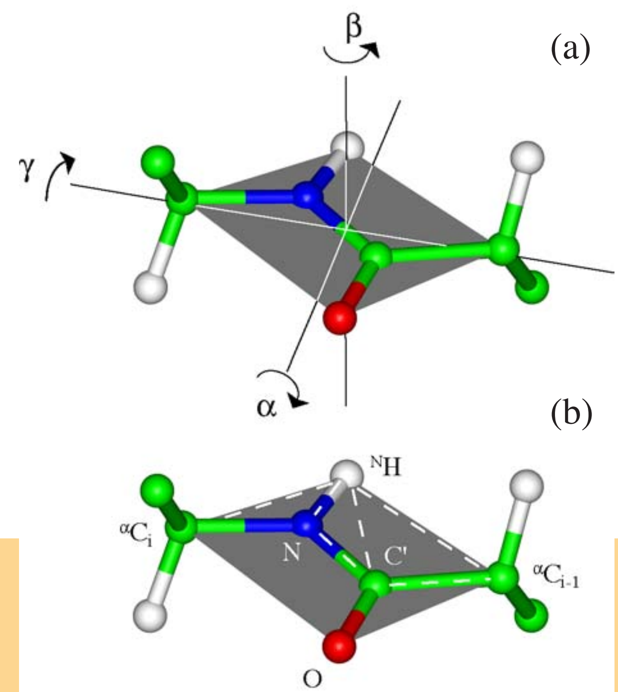

Figure 1. (a) 3D GAF motional model for peptide plane reorientational motion. (b) Depiction of the nuclear spin pairs in the peptide plane that exhibit the residual dipolar couplings (RDCs) that have been used to study the dynamics of the peptide planes in protein G. This figure and the following figures are adapted from Ref. 1.

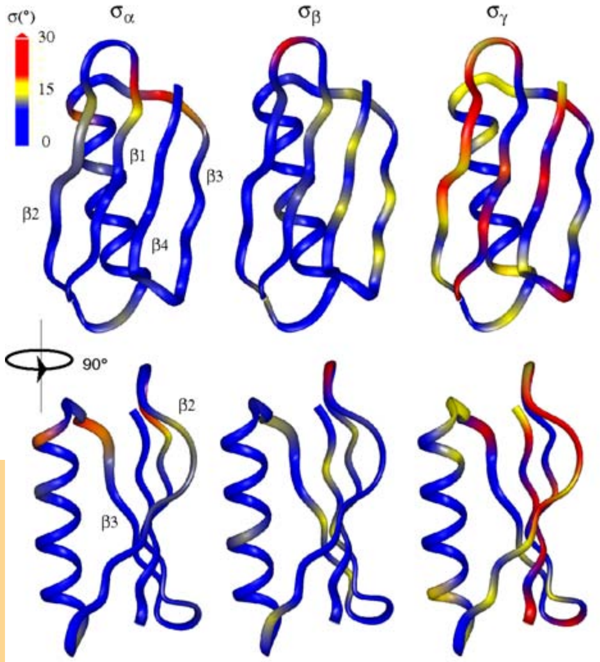

Figure 2. Distribution of motional amplitudes extracted from the 3D GAF analysis of backbone RDCs in protein G. Ribbon representations taken from two different orientations, showing the amplitudes σ of the 3D GAF motion (blue 0°-12°, yellow 12°-18°, red 18° and higher).

In this study an extensive data set of RDCs was assembled, comprising up to 27 dipolar coupling interactions per peptide plane measured in 7 different alignments to uniquely define the nature and amplitude of protein backbone motion in protein G.[4] The peptide plane motions were modeled using the 3D Gaussian Axial Fluctuation Model (3D GAF) where the peptide plane undergoes reorientational Gaussian fluctuations about three orthogonal axes α, β, γ illustrated in Fig. 1.[5] As fitting parameters served the three Gaussian widths (amplitudes) σ_α,σ_β, and σ_γ about the three axes. The fitted values are color coded on the protein backbone in Fig. 2. The dominant motions generally occur about the γ-axis, which connects neighboring C^α atoms. A striking pattern is perceptible in the β-sheet where alternating large and small amplitude motions about the γ-axis can be observed in the hydrogen bonded strands β1, β3, and β4. Notably these motional modes appear to be coupled across the sheet, following chains of hydrogen bonded peptides that experience similar amplitude motions, and align orthogonal to the direction of the peptide backbone. This pattern is depicted in Fig. 3a, where the amplitudes of γ-motions are represented as conformational ensembles for each peptide plane.

These results were further corroborated and refined using a set of trans-hydrogen bond scalar couplings,[6] which previously were parametrized using quantum-chemical calculations as a function of the H^N-O distance, the H^N-O-C' angle, and the H^N-O-C'-N dihedral angle. Inclusion of motional averaging using the 3D GAF motional amplitudes results in significantly improved agreement with experiment. Moreover, positive motional correlations of hydrogen bonding partners in the β-sheet significantly improve the agreement over uncorrelated or negatively correlated motional behavior. The evidence that dynamical information is transmitted across hydrogen-bond networks carries important implications for understanding the mechanism of information transfer in proteins occurring in processes such as allosteric regulation.

The high stability of protein G is thought to be linked to the extensive interactions between buried hydrophobic sidechains. There is a striking similarity between the alternating nature of the observed dynamic modes and the presence of strongly hydrophobic sidechains that participate in the stabilization of the protein core (Y8, L10, I12, F57, and Y59) (Fig. 3b). These buried sidechains experience more restricted motions than those extending into the solvent, and it appears that this tethering of alternate sidechains anchors the collective backbone motions as they propagate across the β-sheet.

Due to the wide range of time scales relevant for RDC averaging, the dynamic information observed here is complementary to motional amplitudes derived from NMR spin relaxation measurements, which probe fs to ns motions. The 3D GAF model for RDC averaging allows determination of generalized order parameters that include motional contributions up to milliseconds. Detailed comparison reveals that most of the β-sheet motions must occur on time scales slower than nanoseconds and faster than milliseconds providing a lower and an upper bound for the dominant motional time scales manifested in the dipolar coupling data.

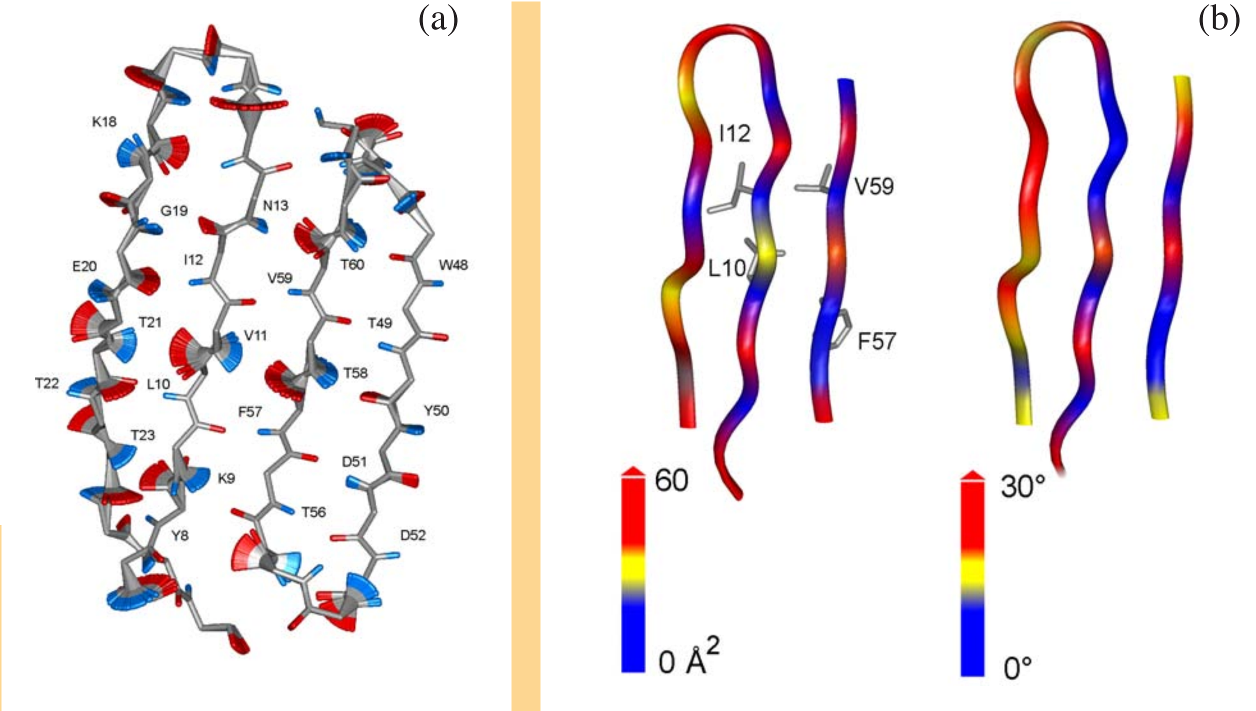

Figure 3. (a) Visualization of the distribution of γ-motions in the β-sheet. The peptide plane atoms H^N and O atoms are colored blue and red, respectively. (b) Comparison between surface accessibility calculated for the amino acids in β-strands 1, 2, and 4 and the amplitude of γ-motion. Left – Ribbon representation of β-strands 1, 2, and 4 colored to show the amino acid sidechain surface. Scale ranges from 0 to 60 $Å^2$. Right – Ribbon representation β-strands 1, 2, and 4 colored to show the amplitude of the γ-motion. Scale ranges from 0° to 30°.

The amplitudes of the collective motions increase across the β-sheet with the highest amplitude in strand β2. This may be relevant for the function of protein G: the residues exhibiting the highest level of flexibility coincide precisely with the sites participating in the interaction of protein G with its physiological partner, the antigen binding domain of immunoglobulin G. This interaction is mediated via a complete anti-parallel intermolecular β-sheet involving hydrogen bonds at residues 16, 18, and 20. The increased dynamics at these sites are almost uniquely γ-motions, perpendicular to the strand direction and implicating largest amplitude excursions for the N-H^N and C'-O bonds. These are the modes that offer maximum structural sampling for the hydrogen bond forming atoms to successfully locate the partner strand. Molecular interaction is thereby facilitated by the increased conformational sampling due to this type of collective mobility.

Acknowledgements

P.B. is grateful to the European Molecular Biology Organization (EMBO) for a long-term fellowship. This work was supported by the Commisariat à l'Energie Atomique, the CNRS, France and the Université Joseph Fourier, Grenoble, (to M.B.), by SNF grant 31-61'757.00 (to S.G.), and by the National Science Foundation (Grant MCB-0211512) (to R.B.).

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Attention Users
Users Committee Annual Meeting

October 28-29, 2005 at the University of Florida in Gainesville

Introduction

The 2005 Annual Meeting of the NHMFL Users Committee (UC) meeting took place as the NHMFL is planning its five-year renewal proposal to the NSF. The meeting included talks to and discussions with the entire UC on general issues affecting all users. More specialized issues were considered through meetings with the individual Users Advisory Committees (DC/Pulse, NMR, EMR, and ICR). Overall, the UC finds the NHMFL well positioned to make the technical developments and provide the user support necessary to continue leading the world in high magnetic field research.

Users Committee Structure

The Chair, James Valles, and Secretary, Ulrich Welp were reelected to serve until December 31, 2006. The bylaws were amended so that the UC now consists of all the members of the Advisory Committees for DC/Pulse, NMR, ICR, and EMR. The Users Executive Committee (UEC) was created to handle communications between the NHMFL and the UC between annual meetings. Lists of members of the various components of the UC can be seen at http://www.magnet.fsu.edu/users/committees/.

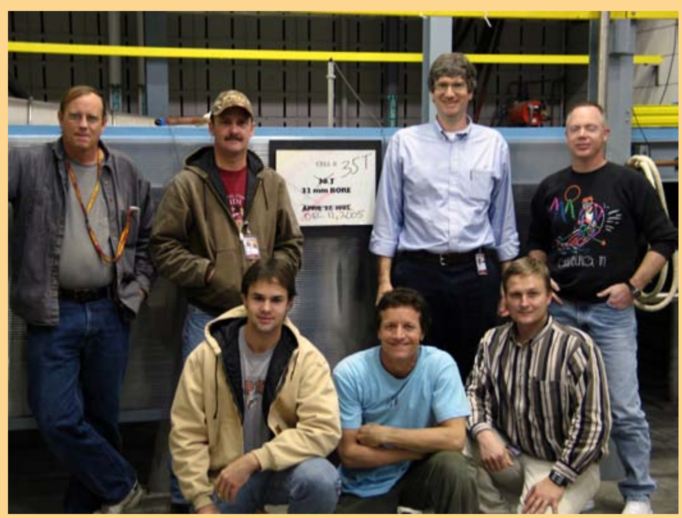
Recent Progress, New Developments, and UC Recommendations

900 MHz NMR: The major achievement in magnetic resonance over the past year has been the commissioning of the 900 MHz instrument. The initial results in the areas of micro-imaging, solution, and solid-state NMR are very impressive. The NMR committee recommends that the 900 MHz instrument be the centerpiece of a national resource for NMR spectroscopy and imaging at the NHMFL. The UC recommends increased funding to support novel probe development and the imaging capabilities of the facility. The UC also recommends a more proactive approach to expanding the external users community for this facility.

Magnetic Resonance at UF: Increased support from the NHMFL has catalyzed exciting new research. New faculty in physics and chemistry have nucleated a group in structural biology that complements the strong imaging community. Molecular imaging is one of several areas of research that would benefit from a resident Scholar/Scientist.

Opening of Bay 2 of the High B/T Facility to Users: This facility will expand the High B/T user base by providing users with magnetic fields up to 8 T and temperatures <1 mK.

Split Gap Magnet: The MS&T group has created a Split Gap Magnet design that can be switched between a "scattering" geometry and a "rotator" geometry by changing inserts. The UC recommends building one magnet with the two inserts.



Users of the DC Field Facility have a new world-record magnet! Members of the Resistive Magnet Development team tested the "35 T" on December 12. It met all expectations by reaching a field of 35.1 T! See the next issue of *NHMFL Reports* for complete story.

Series Connected Hybrid Magnets: The UC continues to view the SCH as the next generation workhorse for high field magnets. Its energy efficiency will allow more user hours and higher continuous fields. The SCH design has impacts on the use and design of the experimental probes used within. Restrictions on magnetic field sweeping need to be addressed soon through close cooperation of magnet designers and instrumentation designers.

21 T Superconducting Magnet for ICR: The UC is excited about the additional resolution, higher throughput, ability to analyze high mass ions, and sophisticated automation offered by the NHMFL/Korea Basic Science Institute/Pacific Northwest National Laboratory joint project to build an ICR instrument based on a 21 T persistent superconducting magnet.

New DC Magnet Cryostats: The UC likes the new cryostats designed for use in the DC magnets. The design appears to be likely to facilitate more efficient use of magnet time.

Users Instrumentation Proposals: A "consortia" model of teaming outside users with common interests to develop new high magnetic field instrumentation was briefly discussed and frequently revisited during the meeting. The UC finds this concept attractive and recommends that the Magnet Lab develop it further.

Advertisement of EMR User Facilities: Each instrument should be listed on the NHMFL Web site with its available field range, frequency range, temperature range, source type, and the classes of compatible sample types.

Housing:

1. Tallahassee - The four bedroom condominium in Tallahassee has been a very popular housing solution for users and other visitors, and often does not have enough rooms. We encourage the NHMFL to consider leasing a second condominium.
2. Gainesville - The UC applauds the declaration by Director Greg Boebinger and Professor Neil Sullivan at UF that housing will soon be available for scientists visiting the High B/T facility for experiments that last a month or more.

Facility managers and members of the Users Committee welcome comments and suggestions from users. See the Web site for contact information and other materials.

Editor's Note: *Thanks to Bruce Brandt, director of DC Field Facilities, for providing this summary.*

Special Notice

Magnet Lab Users and Affiliated Faculty

The National Science Foundation requires that the Magnet Lab collect and report the scientific activities of the laboratory each year. We do this in two ways: by one-page research reports and by the reporting of scholarly activities, such as NHMFL-related publications, presentations, theses, patents, etc.

Research Reports & Activities … Due Now!

Research Reports Deadline: Saturday, December 17, 2005

Information & Submissions: *http://reporting.magnet.fsu.edu/*

Questions: Kathy Hedick, *hedick@magnet.fsu.edu*, 850-644-6392

The Magnet Lab & Florida State University Lure Applied Superconductivity Center from Wisconsin

In a major coup for Florida State University, the Applied Superconductivity Center (ASC) led by David C. Larbalestier will be setting up shop next year in Tallahassee's Innovation Park, near the Florida A&M University-FSU College of Engineering and across the street from the National High Magnetic Field Laboratory, with which it will join forces.

ASC has been headquartered at the University of Wisconsin in Madison for more than two decades, but FSU administrators made a successful push to lure it to FSU. The Center will become a materials research division of the Magnet Lab.

"This will increase our capabilities even more in terms of materials science," said Kirby Kemper, FSU's vice president for research. "Researchers at the Magnet Lab, for instance, are hoping to build the next generation of superconducting magnets. The Applied Superconductivity Center will develop the new materials so that they can do that.

"We're also excited about the development of new materials for instruments for medical science," Kemper added. The ASC will "build on top of what we already have" in terms of materials science research at FSU's Center for Materials Research and Technology and at several programs within the College of Engineering."

FSU President T.K. Wetherell shared Kemper's excitement over the ASC's selection of FSU as its new home.

"This is frontier instrumentation that will be shared by researchers from a number of disciplines," Wetherell said. The Center's relocation to FSU is "a major step forward in our move toward recognition as one of the top research universities in the nation," he added.

ASC's mission is to advance the science and technology of superconductivity and particularly superconductivity applications. They have an impressive record of attaining research grants for investigations of low-temperature and high-temperature materials and for developing and maintaining collaborations with other universities, national laboratories, and industry. They also fully integrate postdoctoral fellows, graduate students, and undergraduates into their research and are actively engaged in numerous public outreach activities.

David C. Larbalestier

Ching-Jen "Marty" Chen, dean of the FAMU-FSU College of Engineering, and Chiang Shih, chairman of the college's department of mechanical engineering, were also heavily involved in negotiations to bring ASC to FSU. Chen said, "this is an excellent example of multidisciplinary collaboration between the sciences and engineering."

In addition to ASC Director David C. Larbalestier, three other researchers will begin relocating to Tallahassee by January 2006. They will be followed over the next six months by eight postdoctoral researchers, several highly skilled machinists, and a few graduate students. In all, ASC may bring as many as 30 researchers to Florida's capital city, along with about $2 million in research grants and another $2.5 million worth of precision laboratory equipment.

Larbalestier is viewed by many of his peers as the leading researcher in the United States, and possibly the world, in the basic research of practical superconducting materials for magnets and power applications. Over a 35-year career, he has profoundly influenced the development of high-field magnets for high-energy physics and other applications, such as magnetic resonance imaging, that have evolved from them. Among the highlights of his career is his election in 2003 to the prestigious National Academy of Engineering.

"We anticipate that the leadership of Dr. Larbalestier and his colleagues will enhance our visibility as the center for material engineering research both nationally and internationally," Chen said.

Magnet Lab Director Gregory S. Boebinger expressed his enthusiasm over the prospect of making significant advances in magnet research with the help of ASC.

"All superconducting technologies, from levitating train projects to next-generation power lines to the construction of research magnets such as the powerful superconducting magnets at our own Magnet Lab, owe a debt to the research of David Larbalestier and the Applied Superconductivity Center," Boebinger said. "So the future is bright for FSU as we work to pioneer the development of new materials."

Editor's note: Barry Ray, FSU Media Relations, contributed to this article.

NEWS FROM EMR

FT-EMR Structural Investigation of Bio-Molecules: *The High-Frequency DEER Approach*

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E. Hustedt, Center for Structural Biology, Vanderbilt University, Nashville, TN, USA
J. van Tol, NHMFL
L.-C. Brunel, NHMFL

It is probably not possible to overestimate the utility of magnetic resonance in biophysical studies. NMR and EMR techniques help to understand structural and dynamical details of bio-molecules and, hence, to expand our present knowledge of the mechanisms that make life possible.

It is well known[1] that paramagnetic centers can be covalently attached to selected positions in the sequence of a protein. More precisely, mutants of the protein are produced where cysteines are replacing other amino acids in certain molecular sites. Nitroxide spin labels are then easily and quantitatively bonded to the sulfhydryl groups of the cysteines, giving an EMR-active molecule. If more than one paramagnetic center is inserted in the molecule, we can use EMR techniques to quantify the dipolar interaction and to extract the distance between the centers.

Study of the linewidth in CW-EMR can be used when the distance between the two centers is relatively small (up to 25 Å). For longer distances this is no more a practical method, since the magnitude of the dipolar interaction is smaller than 3 MHz. The contribution of it to the spectral linewidth is then not clearly distinguishable, and we must use pulsed methods.[2]

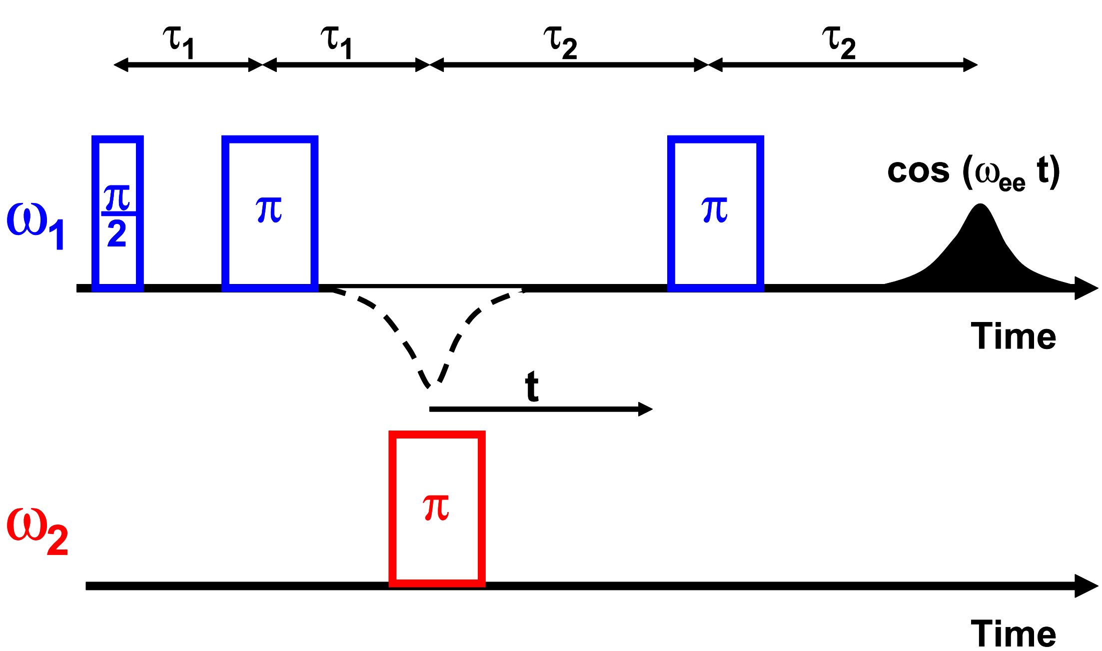
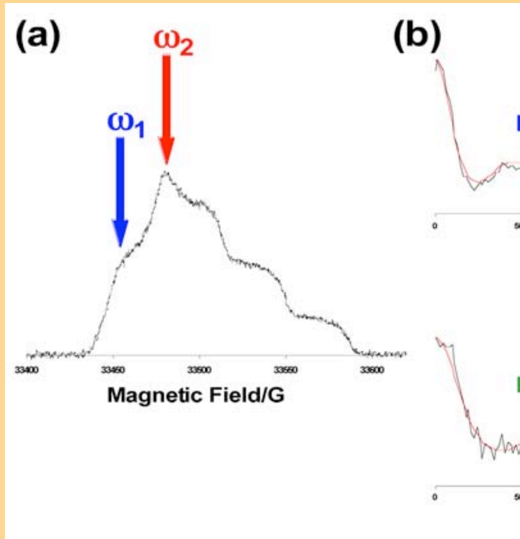


Figure 1. The DEER sequence is shown. The first two pulses with frequency ω_1 produce a spin echo at the time $2\tau_1$ that is refocused by the third π pulse at the time $(2\tau_1 + 2\tau_2)$. A fourth π pulse with frequency ω_2 is swept for a time t and the echo intensity is modulated according to $[\cos(\omega_{ee} t)]$, where ω_{ee} is the electron-electron dipolar frequency.

Figure 2. (a) An echo-detected EMR spectrum of the T4-lysozyme mutant spin-labeled at the cysteines 65 and 89 is shown. It was recorded at 94 GHz and T=60 K in frozen solution. The three z hyperfine components are clearly resolved. The spectral positions of the DEER pulses excitation are shown. (b) The 94 GHz DEER spectra (black) and their simulations (red) are shown for two different protein mutants. The cartoons in the inset show the T4 lysozyme mutants, and the spin-labeled cysteines are highlighted. The distance between the paramagnetic centers given by the analysis of DEER data is, respectively, 28 and 33 Å.



One of the most widely used pulsed experiments is the dead-time free Double Electron-Electron Resonance (DEER).[3] It can measure reliably inter-spin distances in the range 2.5 to 7 nm (3000 to 150 kHz), and it has been applied to the structural study of several biomolecules.[4,5] A scheme of the dead-time free DEER sequence is shown in Fig. 1. So far, DEER has been generally performed in X-band, that is ~10 GHz. The X-band g and hyperfine components of the nitroxide spectra are mostly unresolved. Increasing the frequency gives EMR spectra with enhanced g-dispersion, where the spectral details can be more clearly identified.[6]

The two nitroxides do not generally adopt a single relative distance and orientation. That is, they retain partial ordering with respect to each other. The orientationally selective DEER experiment, if performed at high frequency, can then take advantage of the improved resolution and can be able to answer questions connected to the partial ordering effects. This will help to verify the reliability of structural models of bio-molecules and the consistency of the distribution of distances obtained from DEER. In Fig. 2 we show DEER spectra obtained with the NHMFL Bruker E680 W-band FT-EMR spectrometer at 94 GHz on frozen solutions of two different bi-labeled mutants of the bacteriophage T4 lysozyme. The solutions of the spin-labeled protein (300 μM) were prepared in the Center for Structural Biology of the Vanderbilt University in Nashville. The volume of the samples was ~0.7 μl and the spectra were collected in 2h 50′ (cys65-cys89 mutant) and 4h 40′ (cys65-cys109 mutant). We also measured a distance of (46 ± 1) Å on a third T4 bi-labeled mutant (data not shown). We are now performing these experiments changing systematically the frequencies ω_1 and ω_2 to observe variations of the intensity of the DEER modulation due to orientational effects.

While we show that 94 GHz DEER is feasible with commercial instrumentation, we are planning to increase the frequency up to 240 GHz to completely resolve the g- and hyperfine components of the EMR spectra. Pulses of the desired length and power will be obtained at this frequency using a free-electron laser source[7] in collaboration with the University of California, Santa Barbara. This collaboration is founded by the NSF grant DMR 0520481, P.I. J. (Hans) van Tol.

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EDUCATION NEWS

The Center for Integrating Research and Learning (CIRL) welcomed **Jose Sanchez**, who assumed the position of Assistant Director in September. Sanchez is a former Research Experiences for Teachers participant, having worked with CIRL in the RET inaugural year, 1999, and again in summer 2005. After graduating in 1996 with a B.S. in Physics Education, he went on to receive a Master's in Science Education in 2001. Sanchez taught high school mathematics and physics for nine years in Miami, kept in touch with CIRL activities, and assisted with teacher workshops. Sanchez will have primary responsibility for CIRL's signature programs—Research Experiences for Undergraduates (REU), Research Experiences for Teachers (RET), the NHMFL Ambassador Program—as well as new program and Web-based resources development.

Jose Sanchez

The first Pan-REU Workshop took place at NSF Headquarters in September 2005. **Pat Dixon**, director of CIRL, was a member of the Steering Committee as well as a participant in the first REU workshop that included representatives from all NSF directorates. The event hosted 70 REU program managers and guests and included a "Posters on the Hill" session that was co-sponsored by the AAAS. Remarks were provided by Arden Bement, Jr., director of NSF; the Honorable Sherwood Boehlert, chairman of the House Science Committee; and Shirley Malcolm, director of Education and Human Resources Programs, AAAS.

Issues discussed at the workshop included REU and the national need; the impact of REU at the national level; the impact of the REU program on students; REU and underrepresented minorities, adding to the student experience; optimizing scientific productivity and student environment; alternative models for REU sites; and measuring REU impact on individual students. The resulting paper will be presented to NSF with recommendations.

CIRL continues its activities in the local area, providing a full-day workshop for the science department from a nearby county and expanding partnerships with underserved schools and counties. In addition, NHMFL staff is coming together to restock a school library destroyed by Hurricane Katrina in Pascagoula, Mississippi. In partnership with a local school, the NHMFL contributed 800 new and "gently used" books to show the children of that devastated area that we care.

The current research project on the effects of the RET program once teachers return to the classroom is coming to a close with results to be presented at the Association for Science Teacher Education conference in January 2006 and the National Association for Research in Science Teaching conference in April. Three case studies reveal subtle changes made by teachers after exposure to real world science research at the lab.

Outreach

The 2005-2006 school year has gotten off to a flying start! In addition to our tried and tested outreach activities, we have begun to offer four new outreach programs that are becoming immensely popular and successful in less than a year of classroom use. In early November, **Carlos R. Villa** presented his magnet-based activities in Orlando, Florida at the Florida Association of Science Teachers (FAST) conference. Villa presented twice, the first being aimed at elementary school teachers, and the second covering advanced topics in magnetism for middle and high school teachers. Both sessions were attended by over 40 teachers.

On October 31, 2005, the lab held its annual Tour Guide Appreciation Breakfast at which certificates were distributed. Greg Boebinger, director of the Magnet Lab, thanked all who have contributed to the lab's outreach program over the past year. A tour guide training session was held after breakfast for faculty and staff interested in touring and learning more about the lab.

Two "Teachers in Residence" at the Magnet Lab, Richard McHenry, a chemistry teacher from Tallahassee, and David Rodriguez, an earth/space science teacher from Tallahassee, facilitated the Geophysical Information for Teachers (GIFT) workshop at the annual American Geophysical Union conference in San Francisco in December. The workshop theme, "Journey to the Center of the Earth" provided the context for newly developed activities that were shared with teachers from all over the country. For the first time, the AGU had to limit participation since travel scholarships were offered to accommodate teachers from outside of the Bay Area. The workshop was a huge success and another way that the laboratory reaches teachers nationwide.

Continuing its tradition of teachers providing valuable input to Center programs, the fall Ambassador Program meeting had an attendance of 70 teachers and educators from a five-county area. Guest speakers Richard McHenry, Jonathan Hamilton, Sandy Beck, Brian McClain, Marcy Steele, Judy King, Jane Storm, and Amanda Witters represented a wide range of experiences including the RET. They shared their excitement for real world science with other teachers and provided an overview of the many and varied resources available in the north Florida and south Georgia area. The Ambassador Program continues to be a signature program that provides a conduit to area elementary, middle, and high schools.

Participants of the Pan-REU Workshop at the poster session.

Steering Committee of the Pan-REU Workshop in front of the Rayburn Building. CIRL Director Pat Dixon, pictured at left.

Upgrade of University of Florida Magnet Lab Facilities

In order to keep the core infrastructure of the National High Magnetic Field User Facilities at or beyond the state-of-the-art, the State of Florida awarded the laboratory $10 million in equipment funding in 2004. As reported in the last issue of *NHMFL Reports*, $7.5 million is being used to upgrade DC Field Facilities at Florida State University. The remaining $2.5 million was awarded to the two University of Florida NHMFL User Facilities: the Advanced Magnetic Resonance Imaging and Spectroscopy Facility directed by Art Edison and the High B/T Facility at the UF Microkelvin Laboratory directed by Yasu Takano.

The upgrade to the AMRIS Facility will address the serious overbooking of their facilities and provide the opportunity to dramatically increase the number of user hours. The upgrade will consist of the following additions:

1. Acquisition of a new 600 MHz magnet and console for high-resolution magnetic resonance studies. This will provide two significant improvements in AMRIS. First, we have recently completed and tested a completely novel 600 MHz 1-mm high temperature superconducting probe through the UF NIH/NCRR High Field Magnetic Resonance (HiFiMR) resource grant. This probe appears to have the highest mass sensitivity of any NMR probe at any field strength. This probe is already providing data on extremely mass-limited natural product and metabolic samples that could not be previously studied by NMR. The current 600 MHz system has some of the best microimaging capabilities available and is being equipped to provide solid-state NMR capabilities. The new 600 will enhance the new applications with the 1-mm HTS probe and allow more extensive use of the current 600 for imaging and solid-state studies. A new Linux operating system and additional NMR probes are also being purchased as upgrades to the existing 600.
2. A major upgrade of the current 750 MHz system with a new console upgrade that will include a 4-channel phased array capability, and more powerful 300 G/cm pulsed field gradients. We recently received a new magnet from Bruker for this system after the original one had problems. The current console is nearly 7 years old, however, and has many limitations that prevent it from doing some of the most advanced imaging and spectroscopy experiments. The 4-channel phased array will provide better sensitivity for animal imaging studies, and the improved gradients will allow much better detail in diffusion studies that can identify lesions such as spinal cord injuries or strokes in mice. The upgraded console will keep this instrument capable of some of the finest high-field imaging available anywhere and will increase its utility as a staging instrument for 900 MHz imaging studies at the MagLab in Tallahassee.
3. Finally, a special 150 G/cm 11 T gradient set is being acquired for imaging rodents. This gradient set will improve the resolution and quality of images on rodents on this unique 11 T/40 cm bore instrument. The current gradients are not as powerful and have a diameter that is too large for optimal rodent studies. The older gradients will still be used for larger animals, but the new gradients will provide significantly enhanced capabilities for rodents.

The upgrade for the High B/T Facility will be the acquisition of a 20+ T superconducting magnet system integrated with a demagnetization magnet for nuclear cooling using the current $PrNi_5$ nuclear refrigerator. This addition will increase the current capability from 15+ T to the higher field that is critical for a number of proposed experiments, notably the exploration of the high field phase diagram of solid helium three. The 20+ T system will have moderate homogeneity in order to allow for experiments that use nuclear magnetic resonance as a probe.

The design will include an additional small cryogen-free 5 T magnet for users who need the ultra-low temperature capability but only modest fields. This addition will be located in the existing space above the nuclear refrigerator, and will allow the facility to provide services for two types of users without the time consuming need to warm up the system and add new experimental cells for each user. The 5 T addition will be especially useful for researchers studying the quantum Hall effect in high conductivity semiconductor heterostructures.

The design of the complete system requires a three component superconducting system to operate during the demagnetization: the 20+ T magnet, the demagnetization magnet and a compensation magnet to reduce the field perturbation at the experimental sites to a minimum during demagnetization.

The design of the system is being approached through a competitive process with potential manufacturers in which awards have been made for design studies before a final design selection is made. The final design is expected to be selected by November.

Editor's Note: *Thanks to Neil Sullivan, NHMFL Principal Investigator at UF, for contributing this article.*

Van Sciver Explores Commercial Applications of Liquid Helium

Steven Van Sciver

Picture a teaspoon of powdered sugar. As fine a substance as it is, there still are tremendous differences in the sizes of its individual particles. Some are so small, they move around randomly and are invisible to the naked eye. Now, let's say you wanted to choose only particles of a certain size from those in the spoon. Traditional technology and scientific techniques can separate quantities of particles of different sizes down to a few microns, but beyond that, it's not currently possible to perform this operation at the submicron level. How small is that? Consider that a micron is a mere 0.00004 of an inch. Yet unlocking the mystery of how to manipulate, measure, and separate very tiny particles has tremendous applications for the pharmaceutical industry, and could change how some medications are delivered and how effective they are.

That's the backdrop for the research of Steven Van Sciver, an engineering professor and cryogenics expert at the National High Magnetic Field Laboratory in Tallahassee. Van Sciver is working with technology company Oxford Instruments on the first phase of a grant to help prove the concept behind a patent pending cryogenic technique for particle separation from a few microns down to submicrons.

With funding from Oxford Instruments, Van Sciver is performing the basic science behind how particles behave in liquid helium. Helium turns into liquid only at very low temperatures (-452 F where virtually everything else is frozen solid). If helium is cooled to even lower temperatures, it becomes "superfluid," meaning that if placed in a closed loop, it can flow endlessly without friction.

"Superfluid helium has extraordinary properties," said Van Sciver. "Because of its unique viscosity and heat conductivity its flow can be controlled to a degree you can't get with other fluid, it has lots of potential for commercial applications."

In a letter published in a recent issue of *Nature Physics (Vol. 1, pages 36-38, 2005)*, Van Sciver wrote that when superfluid helium flows toward and then around a relatively large object, say the size of a small stone, it has a tendency to create whirlpools not just in the back, as would be expected, but also in the front. So a portion is flowing "counterflow," or in an opposite direction. This is a unique observation and a link in the chain of science that Van Sciver hopes ultimately will lead to development of a cryogenic technique for particle separation. (To view the abstract of Van Sciver's letter, see *www.nature.com/nphys/journal/v1/n1/full/nphys114.html*.)

Toward this end, Van Sciver is moving forward on a research-and-development program funded by Oxford Instruments to establish the operating principles behind a device to separate particles. Proper sizing of particles is critically important for effective "aspiration" delivery of medication; some medications are much better tolerated when absorbed through the lungs rather than through the bloodstream.

"In order to deliver respiratory medications to the deep lung efficiently, careful engineering of the size and density of the microparticles in the drug is essential," said Neal Kalechofsky, Technology Development Manager with Oxford Instruments, a global, hi-tech company providing tools and systems for the physical science and bioscience sectors. "Through our partnership with FSU, we are exploring the extension of low temperature technology to new applications in microparticle classification."

Center for Advanced Power Systems Receives Major DOE Grant

Tree limbs brush against an Ohio power line, causing it to short-circuit. Soon, a nearby power plant is knocked off-line. A giant cascading effect then occurs, ultimately forcing the shutdown of more than 100 power plants in the northeastern United States and Canada and leaving 50 million people without power. Such was the chain of events leading up to the Great Blackout of August 2003, which caused widespread problems with communication, drinking-water, transportation, and other systems throughout the region for several days.

To help address and improve issues with the North American power grid, including some of those brought to the fore during the August 2003 blackout and in the investigations that followed, Florida State University's Center for Advanced Power Systems (CAPS), with support from the U.S. Department of Energy (DOE), is beginning work to improve the reliability and security of the nation's electric power grid.

This effort got a huge boost in September when the DOE Office of Electricity Delivery and Energy Reliability announced a $4.77 million award and the start of an enhanced research project that will help researchers better understand, improve, safeguard, protect, and modernize the nation's electric power infrastructure.

"The Department of Energy is pleased and excited to partner with the Center for Advanced Power Systems," said William Parks, deputy director of research and development. "It is paramount that the United States put some of its best talent at universities and national laboratories like Sandia to work on modernizing the electric grid. Grid modernization—targeting reliability, resiliency, and restoration—is a major key to U.S. competitiveness over the next century. This partnership will allow us to enhance research in superconductivity, transmission reliability, and cybersecurity."

In describing the need for a better understanding of the nation's power system, CAPS Director Steinar J. Dale said that "the electric power grids in place today are being used in ways that were never intended." He cited capacity limitations combined with bulk-power transfers of electricity across large distances, which the system wasn't designed to handle.

"We have to operate the grids smarter than we have in the past," Dale added. "With the DOE's grant, CAPS is well-positioned to work toward solutions to the reliability and capacity problems that plague the current system."

The groundwork for CAPS was laid in the late 1990s at the Magnet Lab, in collaboration with FSU and the FAMU-FSU College of Engineering. It was officially established in July 2000 with a $10.9 million award from the U.S. Department of the Navy. John Miller, director of the Magnet Lab's Magnet Science and Technology Department, congratulated CAPS on its new funding. "We in the NHMFL continue to have strong ties to CAPS and the synergies among the technologies we employ to accomplish our separate missions are clearly evident. We look forward to a continued cooperation."

Dale stated that the DOE grant will help fund research in four keys areas:

- Advanced Simulation Development - CAPS is home to the most powerful university-based dynamic digital power system simulator in the nation. Using this real-time simulator, which will be further expanded with the DOE funding, scientists and engineers will be able to gain new insights into the behavior of the nation's electric power infrastructure.
- New-Technology Insertion - Research will help investigate and resolve issues with applying new technologies such as power-electronics-based reactive power and power-flow control devices and new approaches such as distributed generation and microgrids. This includes helping power companies determine how new technologies will work when integrated into the system, which is key to minimizing risk and ensuring the reliability of the system.
- High-Temperature Superconductivity - Superconducting materials have the potential to improve the reliability and increase the capacity of power systems. However, the nation's alternating-current (AC) power supply hinders their effectiveness. By performing research at cryogenic temperatures - more than 300 degrees below zero Fahrenheit - CAPS will work to improve the understanding of AC losses and electric insulation behavior, ultimately helping to enable widespread application of superconducting devices in power systems.
- System Security, Protection and Control - Working with New Mexico-based Sandia National Laboratories, CAPS research will lead to improved security of the computer control systems critical to operating the nation's power system.

In addition to its collaboration with Sandia, CAPS will lead a consortium of several other Florida universities in this research project.

Editor's note: Thanks to Barry Ray, FSU Media Relations, for contributing this article.

Magnet Lab Hosts International Photomicrography Competition

It's a small world, after all. A really, *really* small world. And much of what we know about it is learned through the ever advancing technology of microscopes.

That microscopic world was celebrated in October 2005 when Nikon announced the winners of the "Small World Competition," which recognizes excellence in photography though the microscope. The Magnet Lab hosted the international competition, serving as the focal point for 875 entries from 58 countries.

Mike Davidson, director of the lab's Optical and Magneto-Optical Imaging Center, has served as the contest's organizer and a consultant to the judges since 2001, during which time participation in the contest has grown more than 10-fold.

The Small World Competition, founded in 1975, is the leading forum for showcasing the beauty and complexity of objects seen through the light microscope. This year's competition was judged by a distinguished panel comprising the country's leading microscopists and photo editors, including: Jennifer Waters, Ph.D., director of the Nikon Imaging Center at Harvard Medical School; Todd James, illustrations editor for *National Geographic* magazine; Emily Harrison, photography editor of *Scientific American* magazine; and Alexey Khodjakov, research scientist at the Wadsworth Center for the New York Department of Health.

"Contestants are taking ordinary objects and looking at them in extraordinary ways," said Davidson, a two-time Grand Prize winner of the Polaroid International Microscopy contest and multiple winner of the Nikon Small World competition. "Once you've seen some of these images, it's hard to look at everyday objects the same way again."

Take, for example, the common house fly. Bristling with sharp, sensitive antennae, bulbous eyes with 4,000 lenses, and a mouth that sucks up food through a pump in its head, a photomicrograph of the housefly placed first in the 2005 competition. The image, taken by Charles Krebs of Issaquah, Washington, using reflected light microscopy, was one of hundreds of entries.

While the photomicrograph of a common house fly might seem whimsical, photomicrographs are technical documents that can be of great significance to science and industry. Photomicrographers make critically important scientific contributions to life sciences, bio-research, and materials science. Their work often also results in objects of beauty that non-scientists can appreciate. Davidson views it as another avenue for interesting young people in careers in science, which is one of the Magnet Lab's core missions.

A list of all current and previous winners along with a gallery of their work, and information on how to enter the 2006 competition can be found online at *www.nikonsmallworld.com*. Entry deadline is April 28.

Ars Magna Gallery at the Lab

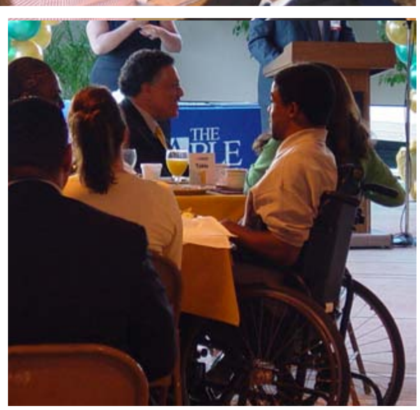
The Magnet Lab ventured into the local art world on October 7 when it participated in the Tallahassee Cultural Resources Commission's First Friday Gallery Hop. On these evenings, every month museums and galleries open free-of-charge to the public. More than 80 people stopped by for the debut of *Ars Magna* (Latin for "Great Art").

The initial idea for the Ars Magna Gallery in the lab's atrium was suggested by John Janik, a graduate research assistant in the Condensed Matter Physics group. Janik's wife is an artist. The gallery, which features local 2-D, 3-D, and mixed media, showcases to a general audience that science is beautiful and that there is a relationship between science and art. The art, with titles like "Embryonic Rat Thoracic Aorta Smooth

Muscle Fibrolast Cell" and "DNA-God's Puzzle," as well as paintings that depict hard, cold metal objects like magnet probes in a warm, artistic light have prompted questions about science. The next exhibit will be February 3, 2006.

NHMFL Participates in Florida Disability Mentoring Day

The Magnet Lab hosted the Florida Disability Mentoring Day National Kickoff Celebration and press conference on October 19, 2005. National Disability Mentoring Day (NDMD) began in 1999 as part of a White House effort to increase the profile of National Disability Employment Awareness Month. Patterned after other school-to-work activities, students and job seekers with disabilities are matched with workplace mentors according to career interests. The Florida DMD is organized by a collaborative partnership between the Able Trust, the Division of Vocational Rehabilitation, and Volunteer Florida. Florida's governor, Jeb Bush, was the honorary chair of the day. He says that "mentoring activities help build confidence, lead to lasting relationships with employers, and even result in permanent employment for participants."



The lab's director, Gregory Boebinger, gave opening remarks at the breakfast. He commended the event organizers for their efforts to promote diversity—especially in a state like Florida with very diverse, international communities — because science benefits from diversity. He likened groups such as the Able Trust and their mission to push back barriers to Thomas Edison's attempts at producing the first light bulb, in which Edison stated that he had not failed 10,000 times, but had found 10,000 ways that did not work.

More than 600 students are mentored in over 30 cities in the state of Florida. The lab is a mentor, along with 38 other local businesses. Nick Ivory, a local Tallahassee high school senior, was mentored by Boebinger, along with Chris Hendrickson, Mike Davidson, and Susan Ray, all employed at the lab.

UF Chemistry Alumnus Receives Nobel Prize

Robert H. Grubbs

Robert H. Grubbs, who earned degrees in chemistry from UF, has received the 2005 Nobel Prize in Chemistry. An organic chemist whose work on catalysis has led to a wide variety of applications in medicine and industry, Grubbs is currently the Victor and Elizabeth Atkins Professor of Chemistry at the California Institute of Technology in Pasadena. He shares the award with Yves Chauvin, a professor at the Institut Français du Pétrole in Rueil-Malmaison, France, and Richard Schrock, a professor of chemistry at the Massachusetts Institute of Technology. The winners will share a $1.3 million prize, which will be presented in December at a ceremony in Stockholm, Sweden.

The trio was cited specifically for "the development of the metathesis method in organic synthesis." Metathesis is an organic reaction in which chemists selectively strip out certain atoms in a compound and replace them with atoms that were previously part of another compound. The end result is a custom-built molecule that has specialized properties that can lead to better drugs for the treatment of disease, or better electrical conducting properties for specialized plastics, for example.

In particular, Grubbs has worked on olefin metathesis. Prior to his work, metathesis was poorly understood and of limited value to scientists. Grubbs developed powerful new catalysts for metathesis that enabled custom synthesis of valuable molecules, such as pharmaceuticals and new polymers with novel materials properties.

Grubbs earned his bachelor's and master's degrees in chemistry from UF in 1963 and 1965, respectively. After completing his Ph.D. in chemistry at Columbia University, he spent a year at Stanford University as a postdoctoral fellow, and then joined the Michigan State University faculty in 1969. He has taught at Caltech since 1978.

As a UF student, Grubbs was convinced by a friend to work with Chemistry Professor Merle Battiste. To Grubbs' surprise, he enjoyed working in a chemistry lab. "I liked the mechanical aspects of working in the lab and the combination of physical and intellectual challenges," he says. Battiste, who is now a professor emeritus of chemistry, became Grubbs' advisor.

The two will have the chance to see each other again soon. Grubbs received 15 tickets to the Nobel awards dinner in Stockholm, and Battiste will be among his guests. Grubbs has been a member of the National Academy of Sciences since 1989, and was the 2000 recipient of the Benjamin Franklin Medal.

Editor's Note: *This article was contributed by Allyson A. Beutke, News and Publications Coordinator, College of Liberal Arts and Sciences, University of Florida.*

People in the News

Marco Bonora

Matthew Case

Michael S. Chapman

Sam Grant

Arthur Hebard

Marco Bonora is a new postdoc in the EMR program. Between 1997 and 1999 he was a Ph.D. student at the Department of Physical Chemistry of the University of Padova, Italy, in the EMR group of Professor Marina Brustolon. He studied the properties of inclusion compounds and, particularly, of catalytic materials like clays and zeolites. In 1999 he moved to Sweden, in the Department of Physics, Measurement Technology, Biology and Chemistry of the University of Linkoeping to join the chemical physics group of Professor Anders Lund, where he was mainly interested in the application of pulsed EMR to the characterization of new materials suitable for radiation dosimetry. Between 2002 and 2005 he was a postdoc in the EMR group of Professor Sunil Saxena, in the Department of Chemistry of the University of Pittsburgh (PA). In Pittsburgh he was especially involved in the development and refinement of pulsed EMR experiments for the determination of inter-spin distances applied to the solution of structural problems in biophysics. In August, 2005 he joined the EMR group of Professor Louis-Claude Brunel at the Magnet Lab in Tallahassee. His project focuses on the use of high-frequency pulsed EMR to structural and dynamical studies of biomolecules.

Matthew Case is a new postdoc in the Condensed Matter/Theory program. He received his B.Sc. at Memorial University of Newfoundland in St. John's, Newfoundland (Canada) and completed his Ph.D. this past August at Simon Fraser University in Vancouver, British Columbia under the supervision of Dr. Igor Herbut. His thesis was on the study of the superfluid density in theories of high temperature superconductivity, charge confinement in QED^3 and two-dimensional dirty bosons. Case's research interests are in strongly correlated systems, critical phenomena, and disordered systems.

Michael S. Chapman, FSU professor of chemistry and biochemistry, has been selected as a fellow in the American Association for the Advancement of Science (AAAS). The AAAS is the publisher of the journal *Science*. According to Naresh Dalal, chairman of the department of chemistry and biochemistry and Magnet Lab faculty member, "Michael Chapman is one of the world leaders in the field of structure and function of large and complex biological systems such as that of a virus. He is a rare example of someone with exceptionally good insight into both the theoretical and experimental aspects of structural biology." The AAAS cited Chapman "for fundamental studies of the structural biochemistry of large biomolecular complexes, relating to enzyme mechanism, and viral-host interactions relevant to vectors for gene therapy." Chapman received is B.Sc. in cellular and molecular biology from the University of London and his Ph.D. in biochemistry from the University of California in Los Angeles. He won a First Year Assistant Professor Award and Developing Scholar Award from FSU in 1994 and 2000, respectively.

We are pleased to announce that **Samuel C. Grant** has agreed to join the FAMU-FSU College of Engineering as an NHMFL-affiliated faculty member in Chemical and Biomedical Engineering as of January 1, 2006. Grant, who is currently a postdoc with Stephen Blackband at the University of Florida, is an expert in magnetic resonance (MR) microscopy. His Ph.D. thesis work with Richard Magin and Andrew Webb at the University of Illinois involved applying microcoil solenoids to the MR microscopy and localized spectroscopy of single cells. His research interests have grown to include the effects of diffusion and compartmentalization in neuronal tissue, neurodegenerative disorders such as ALS and Alzheimer's Disease, and MR contrast mechanisms at high field. Grant has made extensive use of the 750 MHz wide bore NMR system at UF. His research in Tallahassee will involve animal and tissue studies on the NHMFL's new 900 MHz ultra-wide bore NMR User Facility. Grant's initial studies on rodent brain tissue have already indicated that there is excellent and interesting susceptibility contrast in gradient echo images at 21.1 T (Fu, *et al*., Ultra-Wide Bore 900 MHz High-Resolution NMR at the National High Magnetic Field Laboratory, *J. Magn. Reson*., **177**, 1-8 (2005).

Arthur Hebard, UF physics professor, has been selected as a fellow in the American Association for the Advancement of Science (AAAS). The AAAS is the world's largest general scientific society. Hebard has been at UF since 1996 and has a Research Foundation Professorship from 2004-06. He specializes in condensed matter and his research interests include: magnetism, dilute magnetic semiconductors, fullerenes, superconductivity, and thin-film physics (his work in thin-film physics was done at the Magnet Lab facility in Tallahassee). He graduated magna cum laude with a B.A. in physics from Yale University and received his Ph.D. in physics from Stanford University. He was elected a fellow of the American Physical Society in 1995.

Shichun Huang

Shichun Huang is a new postdoc in the Geochemistry group. He joined the NHMFL in September and is working with Munir Humayun to analyze isotopic composition of meteorites and returned samples of captured solar wind particles from NASA's GENESIS mission. He earned his B.S. in Geochemistry at the University of Science & Technology of China and completed his Ph.D. in Geochemistry at Massachusetts Institute of Technology in 2005. His research interests include examining trace element distribution during igneous processes, investigating mantle composition and geochemical evidences of mantle convection, and studying hotspot-related volcanism.

The Office of the Dean of the Faculties at FSU has announced this year's non-ranked faculty promotions and continuing contracts, effective for the fall 2005 semester.

For promotion to scholar scientist/engineer:

Mark R. Emmett, director of Biological Applications for the FT-ICR program, received his BS in biology and M.S. in molecular biology from Texas A&M University. After several years in the pharmaceutical industry, he returned to school and received his Ph.D. in biochemistry/neuropharmacology in 1995 from the University of Texas Medical School-Houston. He is currently applying Nano-scale Liquid Chromatography, Microelectrospray Mass Spectrometry to Fourier Transform Ion Cyclotron Resonance Mass Spectrometry for the high sensitivity analysis of endogenous biological compounds post-translational modifications and biological structure analysis with H/D exchange in relation to neurological disease and oncology. He is a member of the Society for Neuroscience and the American Society for Mass Spectrometry and has taught at Texas A&M University, Miami University of Ohio, and Florida State University.

Lloyd W. Engel, a member of the Condensed Matter Physics Group, earned his bachelor's degree in physics from Yale and his Ph.D. from Princeton. He joined the faculty of FSU in 1995 and is an experimentalist at the Magnet Lab. He has an active program in microwave and rf study of quantum Hall effect systems, with recent publications in *Physics Review B*, *Physics Review B Rapid Communications*, and *Physics Review Letters.*

Christopher L. Hendrickson, associate director of the Ion Cyclotron Resonance Program and courtesy professor of chemistry at Florida State University, received a B.A. in chemistry from the University of Northern Iowa and a Ph.D. in analytical chemistry from the University of Texas at Austin. He was appointed to the A-page Advisory Board of *Analytical Chemistry* in 2003. His research interests are instrumentation, technique development, and applications of FT-ICR mass spectrometry.

For promotion to associate scholar scientist/engineer:

Ryan P. Rodgers, a member of the ICR Group, received a B.S. in chemistry from the University of Florida in 1995, and Ph.D. in analytical chemistry from Florida State University under the direction of Alan G. Marshall in 1999. Following a postdoctoral appointment in aerosol mass spectrometry at Oak Ridge National Laboratory, he joined the Ion Cyclotron Resonance Program at the Magnet Lab as an Assistant Scholar-Scientist and a courtesy faculty member of the Department of Chemistry and Biochemistry at Florida State University. He is the director of environmental, petrochemical, and forensic applications of FT-ICR mass spectrometry at the lab. His primary research interests are in the characterization of crude oil and its associated production deposits and fractions in both upstream (production) and downstream (refining) areas.

Johan Van Tol, a member of the EMR group, received his B.S. in physics and in chemistry from Leiden University in the Netherlands, and completed his Ph.D. in experimental physics in 1991. At the Grenoble High Magnetic Field Lab he became interested in Far-Infrared Spectroscopy and high-frequency Electron Magnetic Resonance techniques. When he joined the NHMFL in 1998, he became especially involved in transient and time-resolved magnetic resonance on a large variety of materials and biological systems. Currently, he is involved in the design of a Free Electron Laser system for high field research with high-power, electromagnetic radiation in the 1 mm-2 μm wavelength range.

For promotion to associate in engineering:

Peter L. Gor'kov, a member of the NMR Group, has research interests in novel solid state NMR probe designs for lossy and hydrated biological samples. Elimination of destructive internal RF heating is of particular importance when salts are present in biological samples. Before coming to the Magnet Lab, Gor'kov had primary responsibility to design imaging hardware at Biomedical Magnetic Resonance Laboratory at the University of Illinois at Urbana-Champaign, which included microimaging probes and gradients, animal imaging probes, tissue-stimulating devices, etc.

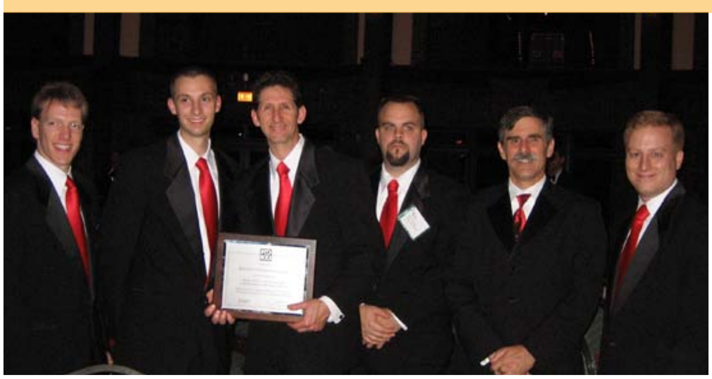
The Magnet Lab and Sealey Elementary School Host Book Drive for Hurricane Survivors

Ann Nucatola, a reporter for Tallahassee television news station WCTV, interviews one of a group of 12 girls who combined their personal money to buy $123.65 worth of books, which they donated to the book drive.

Sealey Elementary Math and Science Magnet School and the Magnet Lab, Leon County Schools Partners in Excellence, organized and executed a book drive for Beach Elementary and the Pascagoula, Miss., school district. More than 2,000 books were collected from Sealey students, parents and teachers, and Magnet Lab employees and their families. The books were hand-delivered to the school district Monday, Nov. 21. The book drive took place over about a three week period.

The book drive was organized by Ysonde Jensen, Sealey PTO president and coordinator of administrative services for the Magnet Lab's Magnet Science & Technology Group. She, along with Magnet Lab Director Greg Boebinger; Leon County Superintendent of Schools Bill Montford; Sealey Principal Tom Inserra; Vice Principal Michele Prescott; and Pat Dixon, the Lab's director of the Center for Integrating Research & Learning, helped load the van of books. As parts of its effort to help with the book drive, the Lab donated graphics services, printed posters and flyers for the book drive, and collected nearly 1,000 books from its employees and their families.

Jensen is originally from and still has family in the Pascagoula area, and knows first-hand the devastation in the region. She organized the book drive to help address the remaining schools' need for books for young children. Beach Elementary was so damaged by the hurricane that its students currently attend Central Elementary School. The books will be given to the Pascagoula School District—earmarked for Beach school, but housed initially at Central. The books will go to Beach if it is ever rebuilt, or to wherever the Beach children end up going to school permanently.



NHMFL instrumentation guru **Scott Hannahs** (picture second from right) and Keithley representatives **Adam Daire, Brian Frackelton, Stuart Meyer, Ben Yurick** and **Chris Armstrong** accept a prestigious R&D 100 Award in Chicago in October 2005. These awards are presented by R&D Magazine and recognize the 100 most innovative and technologically significant products of the year. This was the 19th time Keithley Instruments has won this award, this time for special functions that are possible by combining Keithley's new model 6221 Precision AC/DC Current Source and a Model 2182A Nanovoltmeter. For more on the "Oscars of Invention", see the last issue of *NHMFL Reports*, **12** (4), 7, (2005).

ISCOM-2005: Focusing on Interdisciplinary Science and Education

The Sixth International Symposium on Crystalline Organic Metals, Superconductors, and Ferromagnets (ISCOM) was held in Key West, Florida, September 11 to 16, 2005. The venue was the beautiful Wyndham Casa Marina Resort. Nearly 200 participants from 17 countries attended.

ISCOM is the pre-eminent forum for interdisciplinary discussions of the Chemistry, Physics, Materials Science, and Technology of crystalline molecular solids, including: Synthesis of New Molecules; Molecular Materials and Crystal Engineering; Molecular Magnetism; Physics of Low Dimensional Metals and Superconductors; Magnetic Field-Induced Phenomena; Organic Thin Films and Devices; Phase Transitions and Charge Ordering; Theory, Modeling, and Computation; and Organic Molecular Nanoscience.

High magnetic fields continue to reveal new, fundamental phenomena in organic metals, insulators, magnets, and superconductors. Theoretical and computational methods have also advanced considerably, giving new insight into subjects such as low dimensional superconductors and magnetic systems. The topic of single molecule magnets made a strong debut in the ISCOM program, and the areas of charge ordering, electron correlations, and coherent/incoherent electrical transport in organic materials were well represented.

The program was divided into 83 oral, 4 tutorial, and 119 poster presentations. An effort was made to highlight younger researchers and also underrepresented groups for oral presentations. We note that women speakers included S. Brown and W. Kaneko, S. Ohira, A. Coldea, C. Hotta, N. Drichko, R. Lusar, and H. Ha, and A. Kobayashi, C. Rovira, N. Spitsina, N. Kirova, L. Valade, A. Bussmann-Holder, and D. Roberts.

An interdisciplinary theme was emphasized with synthesis, devices, theory, measurement, and materials systems intertwined as much as possible in the program. Some highlights of the conference deserve special mention:

Tutorials. After each lunch period a senior researcher gave a tutorial to advance student understanding in important ISCOM areas. Marc Fourmigue discussed chemical design and synthesis, Ross McKenzie presented a theoretical perspective, Marshal Luban gave an overview of molecular magnets, and Janice Musfeldt discussed optical probes of molecular systems. Sergei Brazovskii provided a prospective of the impressive professional career and fine personality of Prof. Anatoly Larkin, who passed away earlier in the year. Patric Batail and Ross McKenzie closed the conference with perspectives on the importance of interdisciplinary collaborations in this equally interdisciplinary field of science.

Teacher and Undergraduate Research. The NSF support allowed the invitation of NSF-Funded Research Experience for Teachers-RET (2) and Research Experience for Undergraduates-REU (6) participants to attend the conference and to present posters of their work done this summer at their host institutions in the Thursday evening poster session. These included RETs Johnathan Hamilton (Tallahassee 5th grade) and Mel Figeroua (Ft. Lauderdale High); and REUs Catherine Yeh (UF), Lindsey Channels (Bowling Green), Emmett Thompson (UF), Kim Wadelton (UF), Mariannna Worczak (Sweet Briar), and Francisco Luongo (Stanford). According to Worczak, the opportunity to listen to talks from renowned scientists, in addition to presenting her poster, was enlightening and she "was amazed at the number of scientists there who offered encouraging words . . . they were very eager to encourage young minds to enter research."

CONTINUED ON BACK COVER

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Banquet Address and Crow Prize. At the banquet on Thursday night, Prof. Diane Roberts, Professor of English from the University of Alabama, well-known author, National Public Radio Commentator, and 8th generation Floridian, gave perspectives of the history of Florida and the arrival of Jack Crow and the National High Magnetic Field Laboratory in Tallahassee.

Madoka Tokumoto

After the banquet, **Dr. Madoka Tokumoto was awarded the first Crow Prize** for his many contributions to the careers of young researchers working in the area of high magnetic field studies of organic conductors. Tokumoto is from the National Institute of Advanced Industrial Science and Technology (AIST), Japan. As a result of long-term collaborations for over 15 years, Tokumoto has published over 80 joint papers and additional proceedings papers with many Ph.D. students, postdocs, and young researchers, both within and outside Japan. **The prize is given in honor of the late Jack E. Crow, the founding director of the National High Magnetic Field Laboratory.**

The meeting was supported in part by the National Science Foundation through DMR-0508574. The National High Magnetic Field Laboratory, the Florida State University through the Dean of Arts and Sciences, the Vice President for Research, and its Departments of Physics and Chemistry also provided partial support. The Crow Prize was supported by the Florida State Chapter of the Scientific Research Organization Sigma Xi. ISCOM would like to thank Alice Hobbs, Diane Nakasone, James Berhalter, Janet Patten, Kirill Tchourioukanov, Kathy Hedick, and Andrea Durham, for their invaluable assistance in managing the program, Web site, publication activities, etc. before, during, and after the Symposium. The next ISCOM will be held in Spain in 2007.

This article was contributed by ISCOM Chair, James S. Brooks. He may be reached by e-mail (*brooks@magnet.fsu.edu*) or phone (850-644-2836).

***Editor's Note*:** ISCOM presentations are available on the Web at *http://iscom.magnet.fsu.edu/info/program.html*.

CONFERENCES & WORKSHOPS

9th Annual Southeast Ultrafast and High Resolution Spectroscopy Conference

http://www.magnet.fsu.edu/news/events/conferences.html
January 19-20, 2006
Site: Magnet Lab, Tallahassee, Florida
Sponsor: Coherent Inc.

The Magnet Lab and the FSU Departments of Physics and Chemistry & Biochemistry are pleased to host the 9th Annual SEUFC, which is being sponsored as always by Coherent, Inc. This meeting offers the significant opportunity for researchers and representatives of the commercial sector to communicate and share new ideas and goals and to set the stage for more collaboration, both formal and informal, between the distinguished research institutions in the Southeast and industry.

The 2006 Plenary Speaker will be Sir Harold W. Kroto, Francis Eppes Professor, Department of Chemistry and Biochemistry from Florida State University. Kroto is a co-recipient of the 1996 Nobel Prize, based on the co-discovery of the buckminsterfullerine better known as "buckyballs." Kroto will be speaking on Thursday morning, January 19, and conference registrants will have priority seating.

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