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On the cover:
Graphene, up close and personal.
Art by Kevin John

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Lab Connection: Matching users with magnet time

By Greg Boebinger

This issue of Mag Lab Reports is all about relationships. On page 13 we present our new and online system for matching users with magnet time. We also highlight in this issue a few of the many relationships among MagLab users and in-house scientists.

To continue to provide competed access to our magnets that is fair and transparent to all, we launched in January of this year our Unified User Portal System (UUPS, pronounced 'oops'). UUPS is intended to be an easy-to-access point of entry for all of the MagLab’s user programs. All seems to be working smoothly, and we continue to welcome any ideas to further streamline the process for submitting and reviewing magnet time proposals.

One key feature of the UUPS system is that the scientific justification for requesting magnet time and the description of the specific experiment to be performed will be handled differently:

- The one to three-page scientific justification for requesting magnet time will be both internally and externally reviewed for scientific quality.

- However, the experimental details will be discussed only among in-house scientists who are knowledgeable about the relevant experimental techniques.

Thus external reviewers will not be asked to judge experimental feasibility and need not maintain a knowledge of the latest state-of-the-art capabilities at the MagLab. This system also recognizes that some experiments require multiple visits to the MagLab: while each visit requires a new magnet time request containing experimental details, users need not submit (and reviewers need not review!) a completely new scientific justification for every visit during a multi-visit experiment.

Scientific collaborations are near and dear to a successful user program and promoting serendipitous interactions is a major component of a vibrant scientific atmosphere. The lunchtime and coffee break crowd in the lobby of our main building continues to grow. The Starbucks menu is keeping pace, there is expanded seating (number of chairs, not surface area per chair), and the conversations that ensue could make a key contribution to your next publication. It happened in the Bell Labs cafeteria all the time.

Rock n’ roll,

Gregory S. Boebinger

GREGORY S. BOEBINGER
Graphene is an essentially two-dimensional material made entirely of carbon atoms. Its remarkable electronic properties place it at an intellectual frontier of condensed matter physics and also make it a potential material for novel technological applications. The subtle interference of the electron waves in the presence of the honeycomb potential lead, in the single atomic layer graphene, to an effective loss of the electron mass: near the Fermi level, the electrons disperse as massless Dirac particles in two spatial dimensions. Their velocity, which is therefore not necessarily proportional to their momentum, is experimentally found to be about 300 times smaller than speed of light in vacuum. This ultra-relativistic-like dispersion gives the system a certain degree of robustness with respect to (weak) electron-electron interactions.

A bilayer graphene is a system of two carbon honeycomb lattices stacked in the so-called A-B arrangement: Atoms in the first layer and belonging to one of the sublattices have atoms directly above them in the second layer, while the atoms of the second sublattice sit below (above) the honeycomb plaquettes. The massless Dirac dispersion in this case is modified and instead of two cones touching, two parabolic bands touch.

In the work published in PRB Rapid Communication and featured in the APS journal Physics, we argue that such a system is unstable even to infinitesimal electron-electron interactions. We then use renormalization group to identify the most likely broken symmetry ground state. In the parameter regime studied, an interesting new electronic phase, called nematic, was found to have the most divergent susceptibility. This phase is characterized by broken lattice rotational symmetry, but unbroken lattice translational symmetry and the authors propose ways to detect it. At the moment, experiments on the bilayers are underway to further explore this system.

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A pulsed EPR approach to studying HIV-1 Protease

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University of Florida

One of the projects in the Fanucci research lab at the University of Florida utilizes pulsed EPR to study HIV-1 Protease, a viral protein responsible for maturation of the HIV-1 virus.1-4 We started this project about three years ago and now have several graduate students dedicated solely to work on HIV-1 Protease (HIV-1Pr). We have gotten a lot of really exciting results and anticipate even more.

We utilize a technique called site-directed spin labeling (SDSL), which attaches a nitroxide spin-label to a specific cysteine amino acid at a chosen site within a biological molecule; in our case the biological molecule is the protein HIV-1Pr (Figure 1). When combined with EPR spectroscopy, a multitude of information can be obtained regarding the conformations and conformational changes of proteins. The nitroxide EPR spectrum reveals information about the local secondary structural elements, local dynamics, and conformational changes.5-9 The pulsed EPR technique we use is referred to as double electron-electron resonance (DEER), or also called pulsed electron double resonance (PELDOR). This form of spectroscopy allows for measurement of the dipolar electron-electron interaction, providing a means to measure the distance between two spin labels.10-12

The structure of HIV-1Pr is a dimer and has an active site comprised of an aspartic acid residue at positions D25 and D25′ (one residue per monomer). Accessibility of polypeptide substrates to the active site is mediated by the conformational change of two β-hairpins called “the flaps,” a concept supported by literature reports of nuclear magnetic resonance (NMR)13, 14 and isothermal titration calorimetry (ITC) studies,15 as well as molecular dynamics (MD) simulations16-18 among others. Given in Figure 2 are crystal structures of HIV-1Pr with the flaps in the “closed” and “semi-open” conformations. Note that as the flaps undergo a conformational change from “closed” (red) to “semi-open” (blue), the distance between the labels is predicted to change from approximately 33Å to approximately 36Å.
Figure 3.
DEER results of subtype B HIV-1Pr with (red) and without (blue) the FDA-approved inhibitor Ritonavir. (A) Dipolar modulated echo data and (B) resulting distance distribution profile. Note that the red profile (Ritonavir) is shifted by approximately 3 Å to a most probable distance of 33 Å when compared to the blue profile at 36 Å (no inhibitor present). Also note that the breadth of the red spectrum has decreased dramatically, inferring that the range of motion or flexibility of the flaps decreased upon addition of inhibitor.

When we started this project we did not have instrumentation capable of performing DEER measurements, and this is where our friends at the Magnet Lab came in. A former graduate student of ours, Luis Gallano, made regular trips to Tallahassee to work with Marco Bonora, a postdoctoral research fellow in the laboratory of Peter Fajer. Data were collected on the Bruker EleXsys E580/E680 equipped with the ER 4118X-MDS Dielectric Ring Resonator at X-band frequencies. With the first data collected at the Magnet Lab, and with very helpful discussions with both Peter and Marco, we demonstrated the power of DEER applied to the study of flap conformations in HIV-1Pr. Our first results showed clear differences in the conformations and flexibility of the flaps in the presence and absence of the protease inhibitor Ritonavir.2

The dipolar modulated echo data for the apo construct (Figure 3) is markedly different than that of the protease with ritonavir; accordingly, the resultant distance distribution profiles (Figure 3) report very different flap conformations and flexibility. Data shows that the average distance between the labeled sites on each flap shifted by about 3Å (from 36 Å to 33 Å) upon addition of Ritonavir and that the flaps possess much less flexibility, as indicated by the difference in breadth of the distance distribution profile. Concurrent in time with obtaining the first DEER data of flap conformational sampling in HIV-1Pr, we also applied to the National High Magnetic Field Laboratory In-House research Program (now called the User Collaboration Grants Program) to upgrade an older version E580 Bruker spectrometer at UF managed by Alex Angerhofer. We currently share this multi-user instrument with the Angerhofer group and are not only able to perform DEER experiments at UF, but also are expanding our collaborations and user base with X-band DEER capabilities at the Mag Lab at FSU.

Guided by discussions with two collaborators in the College of Medicine at UF, Ben Dunn and Maureen Goodenow, we next showed that drug-pressure selected mutations that arise in response to antiviral therapy alter the conformational sampling of the flaps.3 Two drug-resistant HIV-1Pr constructs, namely V6 and MDR769, were characterized by DEER distance measurements. An additional collaboration with Carlos Simmerling at Stony Brook University in New York resulted in demonstrating that the experimental results were consistent with molecular dynamic (MD) simulations of overall protein motion. The combined analyses demonstrated that the behavior of the flaps in drug-resistant constructs differ greatly in average flap conformation, range of flap opening and closing, and flexibility from that in drug-naïve constructs. These exciting results that provided structural insight into the mechanism of inhibitor resistance were featured in an issue of Chemical and Engineering News.19

Next we compared the distance distribution profiles and conformational ensembles of HIV-1Pr in the presence of nine current FDA-approved protease inhibitors; partial results are given in Figure 4.1 As a result, we were able to place the inhibitors into two groups, those that had a strong effect on flap closing, and those that had weak/moderate effect on flap closing. This data is in agreement with the number of non-water mediated hydrogen bonds between the inhibitor and the protease construct used in the study, suggesting a correlation regarding inhibitor effectiveness. When this paper came out, it was among the top 10 most accessed Biochemistry rapid reports in July-September 2009.
Figure 4.
DEER results of HIV-1Pr Subtype B in the apo form, and in the presence of the FDA-approved protease inhibitors Atazanavir (ATv) and Saquinavir (SQv). (A) Crystal structures of HIV-1Pr with the flaps in varying conformations, (B) dipolar modulated echo data for apo and inhibited samples, and (C) respective distance distribution profiles regenerated using a series of Gaussian-shaped functions representative of distinct flap conformations: closed (red), semi-open (blue), and wide-open (green). The black traces in C are the total distance distribution population.

Interesting insights gained from this work include the discovery that with a sufficiently large signal to noise ratio (SNR) in the dipolar evolution curve, we could extract information about the relative population distributions of the major flap conformations, namely, closed, semi-open and wide-open. This means that DEER can be used to characterize the energy landscapes of HIV-1Pr under various conditions, as illustrated in Figure 5. The energy landscape is essentially a multidimensional representation of the energy levels for the conformational states of a protein and the energy barriers between states. The energy landscapes are recognized as being very important tools for understanding dynamic signaling events within cells,20 allosteric mechanisms within proteins,21 and understanding how conformational changes are fundamentally important to a protein’s function. This was an important discovery because there are only a handful of techniques that can be used to characterize the energy landscape of a protein (that is the relative energy levels of the proteins conformations and the energy barriers between them) and most have a limited range of conditions, timescales (for which the pertinent motions should occur in), or protein sizes. The addition of another technique capable of characterizing energy landscapes, and one that is independent of protein size and timescale limitations, is potentially very beneficial.

Figure 5.
Pictorial representation of possible energy landscapes of flap conformations in HIV-1Pr in the absence and presence of inhibitor.

Again prompted by discussions with our collaborators Dunn and Goodenow, we then focused on the effects that natural polymorphisms have on HIV-1Pr flap flexibility. The viral genome mutates often, and the protein sequence found in North America and Europe (referred to as Subtype B) differs from that found in Sub-Saharan Africa (Subtype C) and other parts of the world. Our most recent publication focused on comparing the flap conformations and flexibility of six different apo HIV-1 protease constructs, including Subtypes B, C and F (Brazil), CRF01_A/E (Southeast Asia), and drug-resistant patient isolates V6 and MDR769.4 The dipolar modulated echo data and resulting distance distribution profiles differed greatly among these samples (Figure 6). From detailed analysis of the echo data, we reported differences in populations of four distinct flap conformations, namely wide-open, semi-open, closed, and tucked/curled. The DEER results demonstrated that variations in amino acid sequence, due to naturally occurring amino acid substitutions or drug pressure selected mutations, alter the average flap conformations and flexibility. These results, which may indicate how select mutations may play a role in viral fitness and drug resistance, were featured in an issue of AIDS Weekly.22
We in the Fanucci Lab are thankful to the National High Magnetic Field Lab at Tallahassee for assisting us with the means to start this project. We are very excited to continue our EPR studies of HIV-1Pr, and are beginning to expand our studies to several other proteins using the same type of analysis. DEER is a powerful technique capable of providing detailed information about protein conformational sampling, as we have demonstrated with HIV-1Pr.

ACKNOWLEDGEMENTS

This work was supported by NSF MBC-0746533 (to GEF) and MCB0346650 (to PF) and ARI DMR-9601864 (to AA), NIH R37 AI28571 (to BMD), AHA 0815102E (to JKL) and 0615135B (to LG), the UF Center for AIDS Research (to GEF and BMD), and Magnet Lab-UCGP (to GEF).

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Split magnet’s promise extends beyond optics

Eric Palm - National High Magnetic Field Laboratory

After the Magnet Lab was established and the work-horse, resistive magnets of the DC facility were in place, one of the first specialty magnets requested by users was a split bore magnet. This fact bears witness to the coming popularity and demand for the Split-Florida Helix being built this year. This unique magnet is different than any other split bore magnet built or conceived elsewhere. In addition to the much higher fields than other split bore magnets, this magnet has also been designed for maximum flexibility for users.

The first configuration of this magnet (the scattering configuration) will be ideal for optics users as described in this article. In addition to direct optics experiments that will make use of this system, we expect that it will be very useful for Fourier transform infrared resonance experiments (FTIR) as the light path into and out of the magnet can be shortened greatly decreasing lost light and improving signal to noise. We also expect other novel experiments such as EMR or x-rays will make use of this magnet in this configuration.

The second configuration has the magnet rotated as 90 degrees to the original orientation so that the field direction is parallel to the floor. Two of the scattering ports will be opened up to a minimum diameter of 32 mm. This will allow us to place a conventional dewar in this magnet so that the tails of the dewar are at right angles to the field. Thus when the dewar (or probe) is rotated about its axis, a sample in field center is rotated with respect to the magnetic field. This rotation configuration will enable angular dependent experiments with instrumentation that are not compatible with our current rotators, such as wave guides, high frequency rigid coax, or large heat capacity cells.

We fully expect that the Split-Florida Helix magnet will enable revolutionary science with a wide variety of techniques. One of the biggest problems after the magnet is in place may be scheduling the many users who will be queued up to use it.

The Split-Florida Helix being built this year is very different from any other high-field resistive magnet at the Magnet Lab. The Split-Florida Helix will permit close, free-space optical access to samples at 25 tesla through four windows spaced evenly around the mid-plane of the magnet. Though there are a variety of expected uses for this magnet, its design is certainly revolutionary for optical spectroscopy at high magnetic fields. Where optical fibers have been necessary in the past to solve the problems of light delivery and collection inside resistive magnets, it is now possible to design and build experiments in which one is no longer limited by the performance characteristics of those optical fibers. This means that it is now possible to begin developing a variety of state-of-the-art optical techniques for use at high magnetic fields. The side-access to samples also allows light to enter the magnet perpendicular to the applied field, which further creates new experimental possibilities.

Optical magneto-spectroscopy, from UV to THz wavelengths, is a powerful tool used to reveal details of electronic transitions between size-quantized states in low-dimensional structures. These optical experiments at very high magnetic fields are mostly performed in the optical-Faraday configuration (i.e. the incident light propagates parallel to the magnetic field). However, the Split-Florida Helix will also permit experiments in the optical-Voigt geometry (i.e. the incident light propagates perpendicular to the magnetic field) opening up opportunities to explore transitions governed by different selection rules. This permits new experimental possibilities that merit attention. For example, in doped quantum well structures, the incident light couples directly to intersubband transitions if it is polarized in the direction of confinement and in the direction of applied magnetic field when exploring the effects of orbital (Landau) quantization. Another important case is found in the spectroscopy of carbon nanotubes. An axially applied magnetic field can be used to control the nanotube’s electronic structure through the Aharonov-Bohm effect. Since in the Faraday geometry the light polarized perpendicular to the nanotube axis is not absorbed, the Voigt configuration is therefore required to explore magneto-optical effects associated with intersubband transitions.

Raman spectroscopy requires one to gather light scattered inelastically from a sample. The intensity of this scattered light is typically weaker than the incident excitation by about six orders of magnitude. The large windows and close access to samples through the side of the Split-Florida Helix make it perfectly suited for passing along as much of this weakly scattered light as possible. Raman spectroscopy is a versatile technique because of its ability to provide detailed information on collective excitations in the charge, spin, orbital, and lattice degrees of freedom. The study of these low-energy excitations is at the forefront of condensed matter science, and so information on the energy, lifetime, and symmetry of these excitations is of great value. Raman scattering, as a tool for vibrational analysis, is complementary to infrared spectroscopy as it is sensitive to changes in polarizability, whereas infrared techniques monitor changes in dipole moment. These methods
access modes of different symmetry because the transitions are governed by separate selection rules. Raman is also complementary with neutron scattering in the study of ordered spin states since photons can, with very high resolution, probe excitations that cannot be accessed with neutrons. Raman spectroscopy reveals details such as magnetic and structural symmetries, spin and orbital dynamics, changes in magnetoelastic couplings, and energies of electronic, magnetic and lattice excitations. Many interesting research applications will be found among graphene, carbon nanotubes, multiferroics, and other spin- and orbitally frustrated materials to name a few prospects.

The Split-Florida Helix is also the first resistive magnet to make it possible for users to perform a wide array of time-resolved and non-linear optical spectroscopies. To describe all the possibilities goes beyond the scope of any single article. Many of these techniques are not just new to the Magnet Lab, but are also utilized in cutting-edge optical research at universities and laboratories around the world. Therefore, this magnet will provide these researchers a chance to perform their exciting experiments in high magnetic fields. The addition of a short pulse (<25 femtosecond duration), high-energy ultrafast laser to instrumentation surrounding the Split-Florida Helix will be a key to enabling this coupling of magnet and research.

With such an asset at the Magnet Lab, external researchers are planning to implement broadband, ultrafast terahertz spectroscopy, four-wave mixing and optical 2-D Fourier transform spectroscopies, and polarization-resolved luminescence and circular dichroism spectroscopies. These experiments will enable optical research at high magnetic fields on magneto-excitons and exciton fine-structure, inter-Landau level excitations, magneto-plasmons, spin dynamics, magnetoconductivities, and cyclotron resonance linewidths. Of course, this is only just the beginning.

A test version of the innovative split-magnet coil.

Announcement of coming vacancy

The Magnet Lab is anticipating a scholar-scientist opening in the field of far-infrared spectroscopy in DC magnetic fields. This position combines independent research with support for our broad-based user program, offering opportunities for collaboration with world-class researchers. For more information, contact Eric Palm at palm@magnet.fsu.edu.
FT-ICR joint projects offer guidance during oil exploration

Ryan Rodgers
Ion Cyclotron Resonance Program

The world’s current and future dependence on fossil fuels shift the types of materials slated for production. Light, sweet crude oils will diminish as their reserves approach exhaustion and the production of heavier, more heteroatom rich crudes will increase. Ultra-deep-water reserves will be tapped along with previously undesirable terrestrial and offshore reserves to meet world energy demands — a trend that has already begun in many parts of the world.

Canada has continuously ramped up oil sand mining operations in Alberta over the past 20 years to become the primary supplier of crude oil for the United States. Saudi Arabia and most other countries in the Middle East have plans to, or have already begun, production of medium and heavy crude oils. Acid-laden reservoirs off the coast of Africa and in Asia have been in production for nearly a decade. Deep-water reservoirs are in production in many parts of the world including the North Sea and the Gulf of Mexico. In fact, one of the world’s largest deepwater drilling projects recently began off the coast of Brazil. Known as the Tupi field, it is estimated to contain between 5 and 8 billion barrels of recoverable oil. However, production is complicated by the water depth (7000 feet), overburden thickness (16,000 feet) and a thick salt cap (6800 feet).

The production costs associated with current and future reserves are enormous. Additionally, the oils range from light sweet to highly acidic, heteroatom rich and viscous and can present significant upstream and downstream production issues. In the case of deep-water production, the behavior of the crude oil must be studied in great detail, as its journey from the hot, pressurized reservoir to the cold, atmospheric pressure storage vessel results in significant changes in temperature and pressure. Specifically, pressure or thermally induced precipitation (flocculation) can plug production equipment and devastate an offshore operation (Figure 1).

Thus, detailed information on oil composition is paramount to understanding its reactivity and production behavior. Simply, oil companies sell molecules and an oil’s composition determines its behavior (and worth). However, the inherent complexity of crude oil makes it difficult to provide compositional information on the crude itself or even the most likely culprits in common production and refining problems. In fact many of the most common characterization techniques are based on bulk properties or solubility. The Fourier transform ion cyclotron resonance mass spectrometers at the Magnet Lab provide the high resolving power (> 400,000 at mass-to-charge ratio 500) required to resolve the masses of tens of thousands of different species in petroleum as well as the high mass accuracy (< 500 ppb) necessary to provide elemental composition assignment for all species. It is currently the only analytical technique that can provide the detailed compositional characterization of heavy crude oil or high boiling distillates.

The FT-ICR MS Facility petroleum subgroup provides user services for many academic and government research groups worldwide. We have also partnered with industry in sponsored projects that support post doctoral, graduate, undergraduate and high-school research. The industrial contacts are essential and enable access to difficult to obtain and unique samples. In fact, we just finished the analysis of a uniquely blue crude oil with offshore production issues (Figure 2).
In the petroleum subgroup, we employ the latest analytical technology along with high field FT-ICR mass spectrometry for the characterization of petroleum and biofuels. The detailed compositional analysis of heavy crude oil distillate fractions has revealed a compositional continuum in heteroatom content, (N,S, and O) carbon number (molecular weight) and aromaticity (double bond equivalents, DBE) (See Figure 3). It has provided the first detailed test of the controversial Boduszynski model, now almost 20 years old, which postulated that oil was a compositional continuum and that the continuum extended into the nondistillables. The implication of the continuity model was that the nondistillables were not high molecular weight species. We show that the model accurately reflects the composition of all distillable species and demonstrate how the compositional continuum proceeds in nondistillable petroleum species. The compositional information casts serious doubts on decades of prior reports that suggested the nondistillable fraction of petroleum was composed of high molecular weight (>2000 Da) species. We have provided the first detailed compositional analysis of nondistillable materials and shown that they occupy compositional space that is more aromatic, (higher DBE or number of rings plus double bonds) not higher molecular weight (higher carbon number).

Furthermore, mass spectrometry provides definitive proof that most of the nondistillable materials are not monomeric and exist as nanoaggregates in solution. The molecular weight of the nanoaggregates is shown to be concentration dependent and in addition, may be shifted to lower m/z by gentle nozzle-skimmer dissociation of the nanoaggregates prior to mass analysis. The results strongly suggest that prior attempts to characterize the molecular weight of nondistillable materials were compromised by the presence of noncovalent aggregates. Thus, the methods employed measured the molecular weights of the aggregates and not that of the monomeric species. Combined, the detailed compositional information provided by FT-ICR MS and the high mass characterization of the nanoaggregates by time-of-flight MS significantly advance the understanding of the fundamental compositional bounds of petroleum materials. The boundaries and richness of compositional information provided by FT-ICR MS are currently unavailable by any other analytical method.

Work supported by NSF DMR-0654118, the state of Florida and Shell Global Solutions, Houston TX.
Attention all users and prospective users

Kathy Hedick
User Programs Chief of Staff

One-stop “shopping”— that is, centralized requests for magnet time—has come to the Magnet Lab.

As of January 4, access to all of the laboratory’s facilities—whether located at Florida State University in Tallahassee, Los Alamos National Laboratory (LANL) in New Mexico, or at the University of Florida in Gainesville—is through one unified user portal: https://users.magnet.fsu.edu/.

This is a big change. In the laboratory’s first decade, 1990-2000, the seven user programs—DC Field, Nuclear Magnetic Resonance (NMR), Ion Cyclotron Resonance (ICR), and Electron Magnetic Resonance (EMR) in Tallahassee; Pulsed Field at LANL; High B/T and the Advanced Magnetic Resonance Imaging and Spectroscopy program (AMRIS) at the UF—were starting up, getting established, attracting users to new sites and providing them with state-of-the-art facilities and expertise. The number of users from 2001 to 2005 nearly doubled: from 547 to 1019. During this period, and through the second decade, user program managers were operating with modestly different procedures and data “tools”—everything from paper logs, to e-mail chains, to Word tables, to Excel spreadsheets, to a first-generation online system.

If a DC Field user wanted to use the Pulse Field Facility, he/she went through a completely different process. The same was true of an AMRIS user who wanted to use NMR facilities in Tallahassee. And if that AMRIS user wanted to use ICR facilities in Tallahassee, the process was different yet again.

Time to get on one page!

In addition to improving user access and convenience, the Magnet Lab wanted to:

- standardize policies across all facilities;
- institute common practices in the content, review, and management of all proposals;
- implement efficient external review for all proposals;
- ensure transparency of the magnet-time assignment process.

See the Magnet Lab User Proposal Policy on the next page for complete details.

The redesigned User Magnet Time Request system builds on the system used extensively by the DC Field and NMR Facilities since 2003. In addition to now supporting all seven user programs, it features:

- more intuitive on-screen workflow
- more feedback to users both on-screen and via e-mail messaging
- access by the PI to anonymous reviews of his/her proposal
- a user option for requesting Rapid Access, a way to respond to extraordinary science opportunities where access to magnet time is needed ASAP
- automated workflow for managers
- enhanced data collection for reporting and review purposes.

Assignment of all magnet time is the responsibility of Magnet Lab Director Greg Boebinger. While he may delegate to the seven facility directors, the buck ultimately stops at his desk.

No account of this effort would be complete without recognizing the exceptional re-development and re-programming work accomplished by Bo Flynn and the Web Applications group. Online systems always can be improved; if you have suggestions please send them to IMsystems@magnet.fsu.edu.
NHMFL User Proposal Policy
Finalized Feb. 10, 2010

The National High Magnetic Field Laboratory User Proposal Policy is printed here as a service to users and potential users. The policy is posted online at https://users.magnet.fsu.edu/, where you also can find the lab’s User Policy Statement on Confidentiality and Ethics, and the User Operations & Governance section of the NSF Cooperative Agreement.

A. Proposal review and magnet time assignment

The NHMFL operates seven user facilities (DC Field, Electron Magnetic Resonance-EMR, Ion Cyclotron Resonance-ICR, and Nuclear Magnetic Resonance-NMR in Tallahassee; Pulsed Field Facility at LANL; High B/T and Advanced Magnetic Resonance Imaging and Spectroscopy-AMRIS at UF). Each facility is managed by a Director of User Program (DUP) who is an NHMFL-employed scientist. This document contains the specific NHMFL policy for proposal review, magnet time assignment, and appeal of magnet time assignment decisions.

1. Proposals for magnet time at any of the facilities are submitted online at the same user portal (http://users.magnet.fsu.edu). All proposals must include:
   • Up to 3 page description of the proposed science and/or technology development, including broader impacts of the work (http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf)
   • Up to 1 page description of previous relevant work
   • 2-page biographic sketch, including up to 5 publications related to the proposed project.

   In addition to the proposal, details of the experiment must also be submitted: specific magnet system requested, funding source information, sample information, experimental plan, and schedule request. Access to systems in the DC Field Facility requires an additional report of prior results at lower fields to demonstrate the need for high fields. In limited cases, the NHMFL director may give a waiver of this requirement.

2. Each of the seven user programs has a User Proposal Review Committee (UPRC) that is responsible for selection and recommendation of user proposals to the applicable DUP.

   The DUPs recommend the members of the UPRCs to the NHMFL director. The NHMFL director, in consultation with the cognizant NSF program director, appoints the members of the UPRC. Each committee consists of NHMFL-affiliated staff members/users and external users or other members of the scientific community at large. “External” is defined for this purpose as not affiliated with the NHMFL, FSU, UF, or LANL. The UPRC will have at least seven members and have more external members than internal. Due to the breadth of the proposed science conducted at Magnet Lab facilities, the DUP may seek additional external or staff-written reviews on a proposal-by-proposal basis to ensure a comprehensive and high quality review process.

   To preserve confidentiality, the membership of the UPRCs is available for review by NSF and NHMFL advisory committees, but it is not posted publicly.

3. Proposal reviews are based on two criteria per NSF policy (NSF Grant Proposal Guide, Section A. Review Criteria), (http://www.nsf.gov/pubs/policydocs/pappguide/nsf09_1/gpg_3.jsp): (1) the scientific and/or technological merit of the proposed research and (2) the “broader impacts” of the proposed work. Proposals are graded online using the following scale:
   A – Proposal is high quality and magnet time must be given a high priority
   B – Proposal is good quality and magnet time should be granted
   C – Proposal is acceptable and magnet time should be granted at NHMFL discretion
   D – Proposal has minimal merit and granting magnet time should be a low priority
   F – Proposal has little/no merit and magnet time should not be granted.
4. Reviews are conducted in strict confidence. UPRC members are allowed to submit proposals, but they will not be used as reviewers for any proposal for which they are cited as the PI or collaborator. Obvious conflicts of interest are removed when the facility director selects reviewers; and reviewers will be required to certify that they have no conflict of interest with the proposal under review. Following NSF guidelines (http://www.nsf.gov/od/ogc/panelists_conflict_of_interest_training.jsp), conflict of interest occurs in situations such as: present or past Ph.D. advisor/student; a collaborator within the past 48 months; a co-editor within the past 24 months; or any other circumstance where impartiality could be questioned.

The NHMFL is careful not to discourage review committee members from submitting proposals and/or from being NHMFL users.

5. The DUPs, with inputs from the UPRC and facility staff, recommend magnet time allocations to the NHMFL director. The director is responsible for final decisions on scheduling of magnet time based on these recommendations. Anonymous reviews are provided to the PI via the online system.

6. Each year, the four Magnet Lab User Committees (DC/Pulsed/BT; NMR; ICR; EMR) will review the NHMFL proposal review process for quality and fairness. These committees will also serve as external reviewers of last resort for any proposals that did not receive adequate review during the previous year. Examples of situations that may occur include:

   (a) a proposal was not fully reviewed because a minimum number of external reviews was not available,

   (b) a new user was awarded discretionary magnet time by the director prior to the full review of a formal proposal

   (c) discretionary magnet time was awarded by the NHMFL director prior to a full review of a formal proposal. These “Rapid Access” requests allow NHMFL users to quickly respond to extraordinary scientific opportunities, e.g., pnictide research in 2008; a breakthrough circumstance in energy research, or a transformative development in biochemistry. To request Rapid Access, the user/submitter checks a box during the online process that, upon submission, triggers an e-mail notification to the director and applicable DUP. Rapid Access requests will only rarely be approved.

7. Once during the 5-year funding cycle, the NHMFL will convene a Committee of Visitors (COV) to review the proper implementation of these proposal review procedures. In the event any appeals have occurred, the COV will also review the appeal process and procedures, described in section B below. The NHMFL will be responsible for providing all review information to the COV.

B. Appeal of magnet time assignment decision

A scientist who is denied magnet time has the right to appeal the decision. The Magnet Time Appeals Committee is chaired by the director of the NHMFL and includes the chair of the NHMFL User Committee (or his/her designee) and one additional member of the NHMFL User Committee selected by the NHMFL director on an ad hoc basis.

The appeals committee will review the unsuccessful proposal in the context of competing proposals, both accepted and rejected, as well as the total amount of magnet time distributed to users in the relevant user program(s). The director will make a final decision and inform the appealing scientist and the relevant DUP. A summary of the appeal and decision will be provided at the next NHMFL Users Committee meeting.

The appeals committee has wide latitude in developing its recommendation. It can endorse the denial of magnet time, recommend that magnet time be granted as a high priority at the earliest possible date (potentially displacing a lower priority user), or recommend that the proposal receive magnet time in the next allocation of magnet time. If the NHMFL director overturns a denial of magnet time, the NHMFL director will inform the relevant DUP and explicitly consider whether to provide him/her feedback regarding any perceived bias in assigning magnet time.
Depth of volunteer corps at Mag Lab shows scientists’ commitment to education

Pat Dixon
Director, Center for Integrating Research & Learning

Volunteerism and mentorship are crucial to the success of educational programs at the Magnet Lab. The Center for Integrating Research & Learning provides a wide variety of opportunities for graduate students, postdocs and scientists to make significant contributions to helping students, teachers and the general public understand more about the world of science research. By exciting students about science, encouraging undergraduates to enter STEM fields, and providing teachers with the challenge of real-world science research, mentors at the lab are contributing to scientific literacy. The relationship between CIRL and scientists at all three sites is beneficial to both those conducting research and those gaining a window into the world of experimental science.

Proposal writing today requires an understanding of how one can communicate complex research to a broader audience of students, teachers and the general public. The infrastructure created by CIRL provides a menu of activities that principal investigators can draw from to meet educational outreach requirements. In addition, for graduate students and postdocs, mentoring is a chance to provide time and expertise as a way of giving back and recognizing the mentors who made a difference in their own lives. Educational outreach is a valued component for curriculum vitae and demonstrates to others that a researcher has the skill to take his or her research and distill it in a way that is understandable to the general public. For CIRL, the willingness of Magnet Lab staff and faculty to give of their time enables us to make a contribution to science education at the K-12 level, as well as at the undergraduate and graduate levels.

Here are some ways that Magnet Lab scientists give of their time to express their commitment to increasing the number of men and women entering the STEM fields.

Research Experiences for Undergraduates: In summer 2009, 20 mentors from all three sites of the lab worked with 21 undergraduates from 13 different colleges and universities. Over the past decade, an impressive 75 scientists have mentored REU participants at all three sites. A cadre of scientists will be starting their second decade of mentoring undergraduates: Stan Tozer, Eric Palm, Roy Odom, Jim Brooks, Mark Meisel and Charles Meilke. Any mentorship requires a significant time commitment, but the 8-week REU mentorship is unique in that there is the expectation that students will become immersed in the culture of the Magnet Lab and become a part of a research team. Magnet Lab scientists exemplify the benefits of mentorship and volunteerism that encourage many REU participants to become mentors as they begin their careers.

Research Experiences for Teachers: In summer 2009, 13 teachers were mentored by 11 scientists over 6 weeks. Recent research conducted by CIRL indicates that teachers’ experiences are directly related to their thinking and planning for science instruction once they return to their classrooms. In many cases, the mentorship that scientists provide translates into volunteerism in the schools and in the teacher’s classroom and is a relationship that extends well beyond the summer. Even in cases that do not go beyond the initial experience, teachers report an increase in confidence for teaching science and an increased understanding of the nature and process of science. CIRL provides supporting activities that help teachers translate their experiences for the classroom as well as support for scientists to accommodate their busy schedules. Jim Brooks, Bob Goddard and Roy Odom started mentoring teachers in 1999 and continue to do so. The National Science Education Standards and other National Academies...
publications reinforce the value of providing such activities for teachers K-12, involving them in the enterprise of doing science and challenging them to find ways to bring a renewed excitement for science to their students.

**High School and Middle School Mentorships:** Each year, students come to the lab to learn more about conducting scientific research and to learn about careers in science. Some middle-school students who have gone on to pursue science in college report that the experience was one that reinforced their determination to go into a science career. Others who pursued unrelated careers said the experience helped them develop interests beyond their chosen fields. High-school students who participate in Magnet Lab internships typically have an interest in pursuing science or engineering and are focused on learning more about different areas of research. For the 2009-2010 academic year, Ryan Rodgers, Iain Dixon, Steve VanSciver and Mike Davidson are each working with a talented student. The middle-school mentors have volunteered year after year: Lloyd Engel, Hans Van Tol, Afi Sachi-Kocher, Bob Walsh and Vince Toplosky have consistently been there for these young scientists.

**School and Classroom Outreach:** CIRL provides demonstrations, materials, activities and advice to Magnet Lab scientists who are interested in visiting K-12 classrooms. Many scientists judge school and regional science fairs, provide advice to science clubs, give classroom lectures, and provide demonstrations and activities for K-12 students. This academic year alone more than 20 Magnet Lab scientists and staff volunteered at school science fairs. Even more participate in judging school winners from area middle and high schools at the Regional Science Fair from which state competitors are chosen.

How can the user community take advantage of the opportunities available through CIRL? In the past, visiting scientists have brought undergraduate students with them, and those students become part of the Research Experiences for Undergraduates Program activities. This enables the user to provide for the students the option of meeting other undergraduates with like interests and taking part in social events, lectures, and educational activities that are part of the REU program.

Beyond the opportunities mentioned above, scientists provide a rich resource for the development of new materials, programs and information for the Web site. Take a look at the education Web site's archives of mentors and students. It is an impressive list that illustrates the commitment Magnet Lab scientists at all three sites have toward their profession and their communities.
We are deeply sorry to report that Dr. Yong-Jie Wang, 52, died on December 12, 2009 from cardiac arrest. Those who knew Yong-Jie know that he was an enthusiastic participant in every aspect of the life of the Magnet Lab since joining it in 1993. Yong-Jie was an expert in high-field infrared spectroscopy in the Mag Lab's DC Magnet user program, providing unique capabilities to his many collaborations with visiting scientists from all over the world. Yong-Jie's recent collaborations with Mag Lab users included work on magneto-elastic interactions in magnetic systems, cyclotron resonance in graphene, and infrared spectroscopy in heavy fermions and semiconductors. Yong-Jie also provided valuable links with the scientific community and new magnet laboratories in China. Last summer, Yong-Jie helped to plan and host a trip to China by lab director Greg Boebinger, a trip that provided a wonderful “Yong-Jie balance” of work in Hefei and Wuhan with play in Xian and Beijing.

Wang was born on January 16, 1957, in Hefei, China, to the late Hongji Wang and Yunqin Wu. He received his B.S. in Physics from Beijing University in 1982 and Ph.D. from the State University of New York at Buffalo in 1993. Yong-Jie was a true sports fan and enjoyed the outdoors. He had a large circle of friends around the world and will be sorely missed.

-Yong-Jie when the food arrives at the table. Photo taken by Janice Musfeldt during her recent trip to China.
People

**Rafael Brüschweiler**, Magnet Lab associate director for biophysics, recently received a four-year research grant from the National Institutes of Health in the amount of $1,055,476. Shortly afterward, he received a second four-year grant valued at $608,782, from the National Science Foundation. For the NIH project, Brüschweiler will use a precise analytical technique developed in his laboratory, known as covariance NMR, to produce high-resolution spectra of both proteins and of small biomolecules known as metabolites, which play a critical role in essentially all biological processes that happen in an organism. While the NSF project also involves biomolecules, it has a somewhat different focus: to understand the relationship between protein structure and dynamics and to document the interactions of proteins with each other and with smaller molecules.

Magnet Lab affiliate **Naresh Dalal**, Dirac Professor of Chemistry and Biochemistry at FSU, has been selected to receive the 2010 Silver Medal for Physics/Materials Science from the International Electron Paramagnetic Resonance Society. This elite award has been bestowed only six times previously, and only twice in the preceding seven years. It recognizes his “three decades of pioneering research in electron paramagnetic resonance, its novel application to a wide range of problems from studies of free radicals in toxicology and carcinogenesis to ferroelectric and magnetic phase transitions in quantum solids and high-temperature superconductivity, and for developments of new techniques particularly at very high frequencies and magnetic fields.” The award will be presented at the Worldwide Magnetic Resonance Conference in Florence, Italy in July 2010.

Magnet Lab DC Facilities and Instrumentation Director **Scott Hannahs** has been named a fellow of the American Physical Society. Hannahs was recognized “for contributions to instrumentation and measurements in high magnetic fields and for scientific contributions to many fields including quantum fluids, organic superconductors, heavy fermions, quantum Hall effect, and Heisenberg spin systems.”

“Though we receive various acknowledgments of our work during our careers, it is a particular honor to have my work recognized by my colleagues and peers,” said Hannahs. “To be recognized in the company of so many our users and collaborators is a gratifying recognition of the Tallahassee lab as a world-class scientific instrument.”

Magnet Lab-affiliated scientists from the University of Florida branch named APS Fellows include:

**Kevin Ingersent**, “for contributions to the theory of strongly correlated electron systems.”

**Dmitry Maslov**, “for contributions to the theory of quantum transport in one-dimensional systems.”

**Mark Meisel**, “for contributions to magnetic and magneto-optical properties of low-dimensional and nanoscale materials.”

New APS Fellows who are users of Magnet Lab facilities include:

**Raymond Ashoori**, Massachusetts Institute of Technology, “for the development of imaging techniques that reveal the physical properties of reduced-dimensional electronic systems.”

**Sergey Bud’ko**, Iowa State University/Ames Laboratory, “for significant contributions to the study of superconducting, magnetic transport properties of metals, such as field-induced quantum criticality in heavy fermions and superconductivity in layered cuprate, rare earth nickel borocarbide, magnesium diboride, and iron arsenide-based compounds.”

Magnet Lab alum **Gang Cao**, University of Kentucky, “for experimental studies of electric and magnetic single-crystal transition-metal oxides.”
Junichiro Kono, Rice University, “for contributions to optical processes in semiconductor nanostructures, including magneto-optical studies of Aharonov-Bohm physics in carbon nanotubes.”

Jeremy Levy, University of Pittsburgh, “for contributions to the understanding of complex oxides, semiconductor spintronics, and their application to quantum information science.”

Yung Woo Park, Seoul National University, “for contributions to the synthesis and transport in conducting polymers, carbon nanotubes, organic crystals, and highly-correlated materials.”

Chuck Mielke, deputy group leader (acting) and interim director of the Pulsed Field Facility at Los Alamos National Lab, has been invited to join the board of directors of the Megagauss Institute Inc., a not-for-profit, scientific and educational organization incorporated in the state of New Mexico. The Megagauss Institute has provided the organizational, legal and financial continuity for the Megagauss Conferences since 1979, and now shares that responsibility for continuity with the IEEE Nuclear and Plasma Sciences Society.

Steve Robinette, a senior at the University of Florida, has been awarded a prestigious Marshall Scholarship. Robinette is currently conducting research in Mag Lab Director of BioChem Applications Art Edison’s lab and worked with Rafael Brüscheiler as a Research Experiences for Undergraduates participant in 2007. Says Brüscheiler, “Since then, Steve has been a valuable link in the collaboration between Art’s lab and my own on complex natural product mixture analysis and metabolomics. Steve is a co-author of more than a half-dozen publications in high-quality journals. Steve’s accomplishments are truly impressive and he has not even graduated yet.”

The AMRIS user program at the University of Florida welcomes Dr. Huadong Zeng, a new specialist for animal imaging and spectroscopy on the 4.7 and 11.1 tesla systems. Huadong received his Ph.D. from Emory University with a specialization in NMR spectroscopy. He has spent the last nine years overseeing MRI/S and NMR facilities at the University of Alabama. Huadong’s main research interests are developing in vivo MRI/S applications and techniques for studying cancer and neurodegenerative disorders. In his previous position he was responsible for the daily operation of a small animal MRI facility that housed two (9.4 T/20 mm and 140 mm) MRI/S animal systems at the Comprehensive Cancer Center at UAB. He has also participated in translational research using a Philips 3 T scanner. Huadong is looking forward to working with research groups in a broad range of areas and assisting them in developing MRI/S applications for their studies. His office is next to the AMRIS Facility, room LG-126.

Vivien Zapf, a longtime collaborator with the National High Magnetic Field Lab (NHMFL) High B/T Facility in the Microkelvin Laboratory at UF, a staff member at the Pulsed Field Laboratory, and a major user of other Magnet Lab facilities at all three campuses, has been named as the winner of the 2010 Lee-Osheroff-Richardson Prize. The prize, sponsored by Oxford Instruments Inc., is intended to promote and recognize the work of young scientists working in the field of low temperature/high magnetic fields.

Vivien was cited “for notable achievements in making the definitive experimental verification of the applicability of the Bose-Einstein condensation universality class to magnetic field-induced phases in quantum magnets, requiring the development of novel experimental techniques at ultra-low temperatures.”

Dr. Vivien Zapf received her Ph.D. from the University of California in San Diego, and is a principal member of the Scientific Staff at Los Alamos National Laboratory.
NAME:  
Paul Cadden-Zimansky

POSITION:  
Postdoctoral fellow, jointly at Columbia University and the Magnet Lab, 2008-present

CURRENT WORK:  
We take the world’s thinnest material, one-atom-thick sheets of carbon known as graphene, and place it in the Magnet Lab’s most powerful magnets. Electrons moving in graphene behave very differently than those flowing through most materials. While we have a good idea of how to understand the motion of individual electrons in graphene, we don’t yet have a good grasp of all the possible collective electronic states that can exist as they interact with each other. By subjecting graphene to magnetic fields we can localize its electrons in nanometer-sized circular orbits; the higher the field, the smaller the orbits, the more closely packed the electrons become, and the more they interact.

HOW DO YOU THINK YOUR EXPERIENCE AT THE LAB HAS SHAPED YOUR SCIENTIFIC CAREER?  
Research facilities open to external users are a relatively new concept, and my experience at the Magnet Lab has helped to make me realize their potential. While I might previously have viewed my work as wedded to a particular lab, I’m now much more aware of the tools that are available at off-site institutions.

More than any other university or national lab I’ve worked at, I think the magnet lab has a very open environment. This openness is manifested in a hospitality that is extended to all the visitors who come through, from the high-powered researchers who arrive to do experiments to the members of the public who want to check out the magnets. I think trying to establish a similar openness at whatever institution I end up next will be something I take with me.

WHAT MAKES THE MAGNET LAB SPECIAL?  
I often describe the user experience at the Magnet Lab as being like going to kindergarten. There are lots of toys and supplies and many friendly people around to help you out, but who also make sure you don’t do anything dangerous. You use whatever you need for a week to work on your project, and then put all the toys away and go home.
Access to all Magnet Lab magnets is open to all scientists via a competitive proposal process. Go to www.magnet.fsu.edu and click on “Request Magnet Time” to get started!

This issue’s highlighted magnets:

The Pulsed Field Facility

Proposals for magnet time at the Pulsed Field Facility are accepted throughout the year. Magnet time is also scheduled year round except for the 60T Long Pulse and 85T Multi-Shot magnets, which are scheduled 2 times per year. Proposals for summer 2010 magnet time should be submitted by May 1.

85 TESLA MULTI-SHOT MAGNET

- 85 tesla non-destructive
- 8mm sample space
- 300mK – 300K
- Transport
- Magnetometry
- Contactless conductivity
- Optics and more!

60 T LONG PULSE MAGNET

- 60 tesla controlled waveform
- 15mm sample space
- 300mK - 300K
- Heat capacity
- Transport
- Magnetometry
- Contactless conductivity
- Optics and more!

For detailed info on the resources available at the Pulsed Field Facility, visit http://www.magnet.fsu.edu/usershub/scientificdivisions/pulsedfield-current/proposals2010.html
The Magnet Lab is continually accepting proposals from interested potential users. Explore our user programs virtually at http://www.magnet.fsu.edu/usershub/

The National High Magnetic Field Laboratory is a national resource that centralizes the country’s greatest magnet-related research tools, resources, and expertise. This approach is efficient and cost-effective, and encourages fruitful, collaborative research — across disciplines — at the highest level. The Magnet Lab's flagship magnets, designed and built in-house, are unrivaled anywhere in the world, and lab engineers are constantly striving to push fields higher still. But it’s not only the magnets that pull in upwards of 1,000 researchers each year; it’s also the world-class scientific support available at the Magnet Lab. The lab’s scientists and technicians develop the experimental instrumentation and techniques.

To learn more about a specific program of interest, contact one of the following:

**Advanced Magnetic Resonance Imaging and Spectroscopy**
Gainesville
Joanna Long
jrlong@mbi.ufl.edu

**DC Field**
Tallahassee
Eric Palm
palm@magnet.fsu.edu

**Electron Magnetic Resonance**
Tallahassee
Stephen Hill
hill@phys.ufl.edu

**High B/T**
Gainesville
Neil Sullivan
sullivan@phys.ufl.edu

**Ion Cyclotron Resonance**
Tallahassee
Alan Marshall
marshall@magnet.fsu.edu

**Nuclear Magnetic Resonance**
Tallahassee
Tim Cross
cross@magnet.fsu.edu

**Pulsed Field**
Los Alamos
Jonathan Betts
jbbetts@lanl.gov
The National High Magnetic Field Laboratory (NHMFL) seeks a visionary leader as the Chief Scientist in Chemistry and Biology. The successful candidate will have a broad understanding of the most important problems in chemistry, biology, biomedicine, and biomedical engineering.

The NHMFL is the world’s leading magnet laboratory, providing unique high-magnetic-field user facilities and hosting the research of approximately one thousand scientists annually. User research at the NHMFL spans condensed matter physics, materials research, chemistry, biology, biomedicine, and biomedical engineering. The NHMFL consists of three campuses: Florida State University, the University of Florida, and Los Alamos National Laboratory. It operates seven vibrant user programs: DC Magnetic Fields, Pulsed Magnetic Fields, High B/T (ultralow temperatures), Ion Cyclotron Resonance (ICR), Electron Magnetic Resonance (EMR), Nuclear Magnetic Resonance, and the Advanced Magnetic Resonance Imaging and Spectroscopy Center (AMRIS). Each of these seven user programs is well established with strong leadership and staff. Major existing instrumentation of particular interest to Chem/Bio includes (1) a 900 MHz ultra wide bore (105mm) instrument for MRI and NMR; (2) an 11 T/40 cm MRI instrument; (3) a 36 T hybrid magnet designed for 1.5 GHz NMR and 1000 GHz EMR (to be completed in 2012), and (4) a recently funded 21 T / 105mm ICR horizontal bore magnet.

The NHMFL is presently leading a world-wide advance in superconducting magnet technology. The NHMFL has exploited major advances in high temperature superconducting (HTS) materials over the last two years to demonstrate the feasibility of superconducting magnets that will exceed 30T. The NHMFL is making additional investments to realize high-homogeneity capabilities for HTS superconducting magnets. This represents a real revolution in magnet technology with the potential to transform Chem/Bio applications of high magnetic fields in ICR, EMR, NMR, and MRI.

Another major initiative under development at the NHMFL is the proposed construction of “Big Light”, a high-intensity light source that will provide bright, picosecond pulses of light that are tunable over the entire terahertz-to-infrared (THIR) frequency regime. This light source will be unique in the world and will be well matched to the energy and time scales relevant to much of the research conducted at the NHMFL. Consequently, high-field spectroscopy in the THIR regime represents another area with tremendous new opportunities for Chem/Bio research in the NHMFL user programs.

The NHMFL is looking for leadership to help broaden the operations and infrastructure funding base for the Chem/Bio user programs. The Chief Scientist in Chem/Bio will have a strong understanding of MRI, NMR, EMR, and ICR and will be an internationally recognized expert in at least one of these areas of technology. He/she will be expected to provide an expanded vision for the integrated use of existing and planned technologies to make a major impact in solving critical problems in chemistry & biology.

The successful candidate will have faculty appointments at both the University of Florida in Gainesville and Florida State University in Tallahassee. The primary institution and department are negotiable and will depend on the successful candidate’s particular area of major research emphasis.

To apply, please attach your curriculum vitae, cover letter describing your experience, and names and contact information of three references to Dr. Gregory Boebinger, Chair, Chief Scientist in Chemistry and Biology Search Committee, National High Magnetic Field Laboratory, Florida State University, 1800 E. Paul Dirac Drive, Tallahassee, FL 32310-2740, (850) 644-0851, fax (850) 644-9462. Florida State University is an Equal Opportunity/Access/Affirmative Action Employer.