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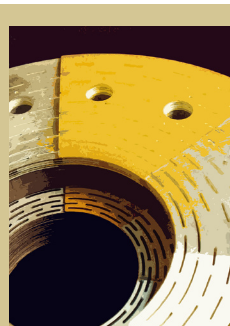
NATIONAL HIGH MAGNETIC FIELD LABORATORY

MAG LAB REPORTS

FLORIDA STATE UNIVERSITY • UNIVERSITY OF FLORIDA • LOS ALAMOS LAB



On the covers:
The front cover shows one of the copper Florida-Bitter plates that will be used to construct the insert of the Series Connected Hybrid the lab is building for the Berlin Neutron Scattering Center. The back cover shows a full-scale model of the magnet in what will be the magnet's permanent home. Both images courtesy of the Hahn Meitner Institute.

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Ch-ch-ch-Changes

GREG BOEBINGER

The MagLab is reaching a major milestone in its relatively young history. Bruce Brandt – the first and only director of the DC Magnetic Field Facility – will retire on Independence Day. Independence…retiring…apt timing, eh? As we mark this major milestone we reflect on the past by featuring Bruce in this issue (see page 19).

As the head of instrumentation and operations at the Francis Bitter Magnet Lab at MIT, Bruce was the all important bridge between the old and the new. Many scientists at the time were in a bit of a panic about what this new lab in North Florida would be able to accomplish. But when I learned Bruce would be moving to the new National High Magnetic Field Laboratory to run the user program, I felt a certain reassurance. The thing about Bruce is that nothing seems to rattle him. His calm-headedness moved smoothly from the old to the new magnet labs. The other major concern among scientists about the magnet lab was magnets – would this new lab be able to put together a team of engineers capable of pushing magnetic fields to new highs?

You already know the answer to that question. The lab went on to make and break several world records for strength of field. I'm pleased to announce that a key person who helped lead the magnet engineering team to world prominence no longer has the word "interim" in his job title. Effective in April, Mark Bird officially became the director of the Magnet Science & Technology group, as well as its chief engineer. In addition to keeping many balls in the air overseeing new magnet projects, he will continue to head up the resistive magnet engineering and design effort.

And MS&T has added another ball to its juggling act. On top of the recent $11.7-million grant from the National Science Foundation to build a Series Connected Hybrid, the lab recently signed an $8.7-million contract with the Hahn Meitner Institute to build a Berlin-bound SCH for neutron scattering (see page 8).

In every organization some transitions are extremely tragic. Yanni Constantinidis, a dear member of the MagLab family, passed away unexpectedly in April. You can read Steve Blackband's tribute to Yanni on page 24.

The MagLab Web Site

Our project to steadily build a better Web site continues. We recently rolled out changes designed to highlight the science and make requesting magnet time less intimidating, particularly for new users.

You can find all the information you need about the seven user programs and related services in the new **Users Hub**. Most noticeably, we've reduced the amount of reading and number of mouse clicks required to request magnet time. Information on the MagLab's Scientific Divisions is now merged into the Users Hub, reflecting that the users programs and the scientific divisions are greatly intertwined.

For similar reasons, we also merged magnets and materials on the Web site – so if you're looking for the Applied Superconductivity Center, you can find it as part of the Magnets & Materials tab.

Science Highlights

Science Highlights from the MagLab's user programs will continue to be highlighted on the home page, where a feature titled **"Science for Scientists"** will always remain in the features rotation. We urge our users to send us their latest publications for our database. And if you want your work to be considered as a MagLab scientific highlight on our Web site and in reports to the NSF, it will help greatly to add a few sentences that put your work in a broader context … in language understandable even by *<insert here an academic discipline other than your own>*.

The Web site improvements are an interim step. We need and value your feedback for further improvements. Please tell us what you do or don't like about the User's Hub. Is there information that you'd like to see more (or less)? Please send comments and suggestions to *webmaster@magnet.fsu.edu.*

Rock 'n' Roll,

Greg Boebinger

Wavelengths

Mag Lab getting new neighbor

Florida State University in May broke ground on a new Materials Research Building that will be located adjacent to Magnet Lab in Tallahassee's Innovation Park.

The $17-million building will be a two-story, 44,000-square-foot facility with 13 laboratories for the design, processing and characterization of advanced materials and systems. When completed in the fall of 2008, it will house FSU's Center of Excellence in Advanced Materials, which was established in November 2006 through a $4-million grant from the State University System's Board of Governors.

The Materials Research Building and its focus on composite materials will complement the other major research programs in Innovation Park, including programs at the Magnet Lab. In addition to providing high field analytical tools and methods, the Magnet Lab will be further developing its materials synthesis and characterization capabilities as part of its partnership with the Center. Already, a number of Magnet Lab research faculty are participating in Center initiatives in conjunction with FAMU/FSU College of Engineering's departments of industrial, mechanical, and chemical and biomedical engineering.

The Mag Lab's Applied Superconductivity Center will contribute microscopy expertise to the Center through its high resolution scanning electron microscopes, capable of examining complex materials down to the atomic level.

Working closely with industrial partners, research at the Center will benefit the aerospace, auto, defense, electronics and wind-energy industries by providing lightweight, safe, energy-efficient and cost-effective composite systems.

Magnet Lab Open House a success

The lab welcomed nearly 4,000 residents people to its annual Open House on Feb. 24. This much-anticipated, hands-on science blowout is the lab's biggest community outreach effort of the year. Open House is designed to get people excited about science by letting them try some "experiments" of their own.

This year, visitors had new exhibits to behold, including "Jello Optics" – which uses Jello to make continuously variable optic lenses – and the wildly popular Incredible Shrinking Quarter Machine. This exhibit literally packed the aisles of the Operations and Magnet Development end of the building, and with loud noises, bright flashes and shrinking quarters, it's not hard to see why. Created by research engineering support specialist Russell Wood, the machine uses a single shot pulse to shrink a quarter to about the size of a dime (only fatter).

Open House leads to lifelong learning

Depicted is an experiment where a kitchen battery powers a light emitting diode (LED). The Parkers found that an incandescent light bulb would not light, but that an LED would.

Sometimes, simple conversations at the Open House can lead to something larger. Take, for example, the Parker family, who has visited the Open House with their two young sons on several occasions. The Open House stimulated the older son, Mitch, then 6, and as a result, Jim Brooks, director of the lab's Condensed Matter Science-Experimental group, was invited to visit the boy's class at Medart Elementary School in nearby Crawfordville to discuss magnets and magnetism, and to do demonstrations.

Mitch continued to grow his interest in science, and when the recent book "Dangerous Book for Boys" by Gonn & Hal Iggulden was published, Brooks presented the book to the family. This book has the kinds of "hands on" projects that are accessible for backyard and kitchen science, further spurring the boy's interest in science.

Lab raises thousands for American Cancer Society

Once again, friends of the Magnet Lab turned out in droves to participate in the American Cancer Society's (ACS) Relay For Life, held March 16-17 at FSU's Mike Long track.

This is the fourth year that the lab has participated in Relay For Life, with three "Crow's Feet" teams established in memory of Jack Crow. In total, the three teams raised more than $5,600 this year, with Joan Crow serving as the Honorary Captain of the team.

Relay For Life TEAM CROW 2007

Relay For Life is the American Cancer Society's signature activity. It unites millions of people in thousands of communities nationwide each year to raise money to help prevent cancer, save lives, and diminish suffering from the disease.

Mag Lab collaboration … for peat's sake

Techniques and instruments developed at the Mag Lab will be used to study global climate change through collaboration with two Florida State University environmental scientists.

Jeffrey Chanton, an oceanography professor at FSU, and William T. Cooper, a professor of analytical and environmental chemistry in the department of chemistry and biochemistry, have received a nearly $500,000 research grant from the NSF to study the carbon balance in Minnesota's peatlands—a possible indicator of climate changes brought on by global warming.

Cooper is collaborating with Alan Marshall, an FSU chemistry professor and director of the lab's Ion Cyclotron Resonance program, and Vincent Salters, associate professor of geochemistry at FSU and director of the lab's Geochemistry group. The Mag Lab scientists pinpointed instrumentation and techniques that will help the team to understand the structure of peat and shed light on the cause of its resistance to decay.

Such instrumentation and techniques were already in existence, Salters explained recently, but needed to be verified as applicable to the team's work. The technique development was funded through an FSU Program Enhancement Grant and a South Florida Water Management District grant to Salters and Cooper.

Valdosta State undergraduates visit

The lab's Ion Cyclotron Resonance group continues to grow its relationship with nearby Valdosta State University. In April, the ICR group welcomed Tom Manning, chemistry professor, and nine VSU undergraduate chemistry majors. They worked with Jerry Purcell and acquired data on a bryostatin complex using FT-ICR. The data will be presented at the Southeastern Regional Meeting of the American Chemical Society to be held in October in Greenville, S.C.

The bryostatin complexes studied are isolated from a marine invertebrate and are being examined for anti-cancer activity. The Medical College of Georgia Cancer Center is testing one of Manning's bryostatin complexes, which was first identified at the Mag Lab.

Manning's work is part of a larger endeavor called Marine Microbes. For more information, visit *www.valdosta.edu/~obpatel/index.html*

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Charge density waves (CDWs) have been a central focus of Magnet Lab research for many years. In fact, some of the most comprehensively studied condensed matter physics systems are CDWs, and important parts of the overall body of work have come from the Mag Lab where DC and pulsed magnets have been used extensively to provide an increasingly more precise picture of their overall behavior.

In a recent sequence of transport and directionally dependent noise measurements at the Magnet Lab's Los Alamos facility, a model for the observation of charge stripes in manganites has been overturned, with the surprising result that these stripes were not in fact determined by the chemistry of, for example, $La_{0.5}Ca_{0.5}MnO_3$, but by the formation of a CDW. Key to this observation was the ability to grow manganite films that formed charge "stripes" in a uniform direction over the entire macroscopic thin film specimen. In what is described below, it is shown that most of the "exotic" explanations for charge order are really the result of simpler, more attractive physics clouded by the random orientations of charge order in previous work. *Al Migliori*

Sliding charge density wave in manganites

Susan Cox, J. Singleton, R.D. McDonald, A. Migliori, NHMFL, LANL

P.B. Littlewood, Cavendish Laboratory, Cambridge University

The manganites exhibit a variety of fascinating phases, including the so-called stripe phase. The stripe phase is a superstructure which appears at low temperatures, with a low-temperature wavevector of $\mathbf{q} \simeq (1-x)\mathbf{a}^*$ for $0.5 \leq x < 0.8$, where $\mathbf{a}^*$ is the reciprocal lattice vector [1]. Stripes of apparent charge order were originally observed in transmission electron microscopy (TEM) images, leading to the interpretation of the phase as the localisation of charge at atomic sites. Along with the insulating nature of these manganites at room temperature, this seemed to establish the stripe phase as a Mott-type insulator. However, this picture was clouded when theoretical work suggested a charge density wave (CDW) model[2], supported by the experimental observation that q/a^* is strongly temperature dependent[1,3], contradicting models in which the superstructure periodicity is derived from the sample stoichiometry. Nevertheless, the room temperature insulating behaviour of these manganites was still seen as an insuperable argument against a CDW picture.

We have probed the nature of the manganite stripe phase using orientation-dependent resistivity measurements. This was made possible by the discovery that an $La_{0.5}Ca_{0.5}MnO_3$ thin film can be grown so that the stripe phase orders in the same direction over the entire film[5] (see Figure 1a). Our resistance measurements demonstrate that the stripe phase is in fact a prototypical charge density wave (CDW) which undergoes collective transport. The high levels of disorder typical of manganite samples explain the lack of a clear transition in the temperature dependence of the resistivity, because similar behavior is seen in disordered CDW systems.

Figure 1b shows the differential resistivity as a function of DC bias applied parallel (along the lattice vector $\mathbf{a}$) and perpendicular to (along the lattice vector $\mathbf{c}$) the superlattice direction. At 100 K, the differential resistivity undergoes a sharp drop when the bias is applied in the $\mathbf{a}$ direction; the effect is very much less marked with the bias in the $\mathbf{c}$ direction (Figure 1(b)). Accompanying this is a large hysteresis between the differential resistance recorded when the bias is first applied in the $\mathbf{a}$ direction after cooling from 300 K, and that measured on subsequent sweeps; the area enclosed by the hysteresis loop increases rapidly as the temperature falls. The hysteretic resistivity features are typical of CDWs[7]. As the sample is cooled, the CDW settles into a minimum-free-energy pinned configuration, corresponding to maximum electrical resistivity[7]. On the application of electric field, the CDW initially undergoes local distortions that occur over longer and longer lengthscales as the field increases; eventually, the threshold field is reached and the CDW starts to slide. As the field is reduced again, the CDW freezes into a distorted state, characterized by a lower resistivity; the initial, minimum energy state cannot be regained without thermally cycling the sample[7], explaining the hysteresis we observe.

Another distinguishing feature of CDWs is that they exhibit broadband noise with an amplitude proportional to $f^{-\alpha}$, where f is frequency[8]. Using a low-noise current source, we found that significant broadband noise is observed in $La_{0.5}Ca_{0.5}MnO_3$ when DC bias is applied in the superstructure direction (see Figure 2a). By contrast, the noise amplitude is much smaller with bias in the non-superstructure direction (see Figure 2b). The magnitude of the broadband noise in $La_{0.5}Ca_{0.5}MnO_3$ is much larger than that observed in clean CDW systems, because the extensive disorder present in $La_{0.5}Ca_{0.5}MnO_3$[6] produces many more pinning-depinning events than in a clean system. Figures 1c and 1d show variation of broadband noise amplitude with applied bias between the first bias sweep after cooling from 300 K and on a subsequent sweep. On first biasing, the noise amplitude shows a large peak at the same electric field as the large fall in differential resistance (Figure 1c). On subsequent bias sweeps, noise increases more slowly with bias (Figure 1d). The large peak during the first bias sweep is caused by a high level of random telegraph noise that occurs in CDW systems as they switch from pinned to depinned states and back again when close to the threshold field.

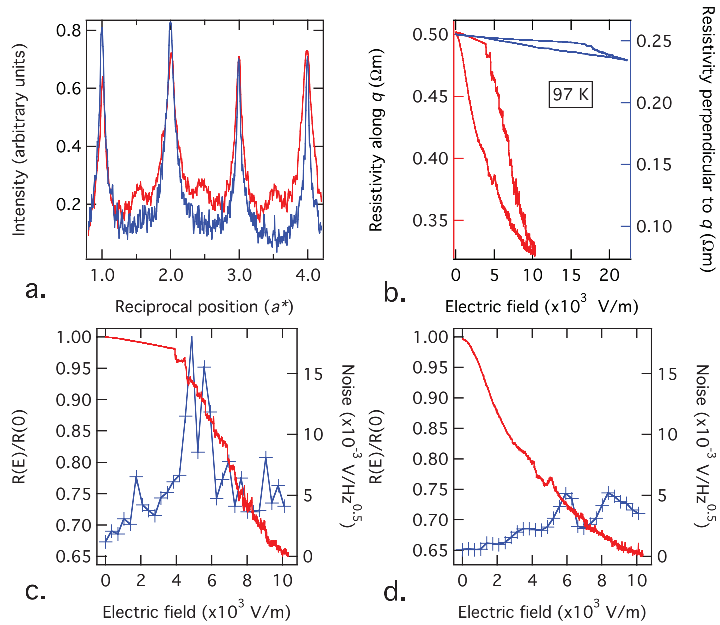

Figure 1.
(a) Linescan of TEM image in a (red) and c (blue) directions showing the superstructure reflections present in only the **a** direction. (b) Differential resistivity of $La_{0.5}Ca_{0.5}MnO_3$ versus DC bias with bias applied in the **a** (red) and **c** (blue) directions at 97 K. In each case the upper curve is the differential resistivity obtained after cycling the temperature to 300 K, and the lower curve is the path followed by subsequent bias sweeps. (c) Resistivity displayed as *R(E)/R*(0) (red), and noise signal at 300 Hz (blue) for the first time current is passed parallel to the superstructure after cooling from 300 K. (d) Resistivity (red) and noise (blue) for the second time current is passed.

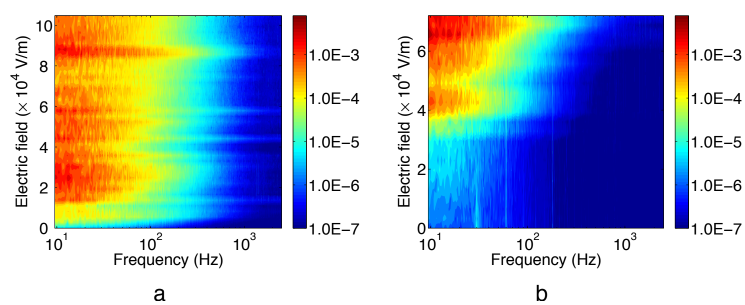

Figure 2.
Variation of noise amplitude (color scale in units of V^2/Hz) with applied electric field and frequency when the current is passed (a) parallel to the superstructure and (b) perpendicular to the superstructure.

These measurements demonstrate that the superstructure in the stripe phase of manganites is a CDW which slides in the presence of an electric field. The manganite CDW is a fully-gapped system with no screening electrons, previously observed only in extremely clean organic materials[9]. Unlike the organics, manganite CDW exists even with a high impurity density, leading to dramatic hysteresis effects in resistivity. Our discovery that the manganite superstructure is a CDW calls into doubt the seemingly accepted conceptQ that the spectacular properties of complex oxides are caused by exotic physics; on the contrary, these unusual properties can emerge when a well-understood phase (the CDW) coexists with disorder.

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Magnet Lab to build magnet for neutron scattering experiments

By Susan Ray and Mark Bird

The Hahn-Meitner Institute in Berlin has contracted with the Magnet Lab and with Florida State University to build an $8.7-million hybrid magnet for neutron scattering experiments.

When finished in 2011, the new, high-field magnet, which is based on the Magnet Lab's Series Connected Hybrid (SCH) concept, will be housed at the Berlin Neutron Scattering Center. The magnet will produce a magnetic field between 25 tesla and 30 tesla – more than half a million times stronger than the Earth's magnetic field. It will be the world's strongest magnet for neutron experiments, eclipsing the 15-tesla system presently at the Hahn-Meitner Institute (HMI).

The Magnet Lab's Magnet Science & Technology (MS&T) division has been working with Hahn-Meitner since the summer of 2005, recently completing a design study. The results of that study were strong enough to convince the review committee of the German Helmholtz Association and the Federal Ministry of Education and Research that the investment in the new technology was worth the cost.

"Part of the challenge in science is figuring out how to maximize resources," said Mark Bird, chief engineer and director of the Magnet Science & Technology division. "We can't always afford to bring the tools and techniques to the magnets; sometimes we have to bring the magnets to the tools to advance the science."

MS&T has already been working on the design of an SCH for the NHMFL. The HMI magnet will be the second of this new generation of hybrids. The two hybrids will use the same outer coil design to save time and money, specifically a Nb_3Sn Cable-in-Conduit-Conductor (CICC) technology operating at 4.5 K using forced-flow supercritical helium. The cryostats for the two magnets will be significantly different as the Magnet Lab version will have a vertical field while the HMI version will be horizontal.

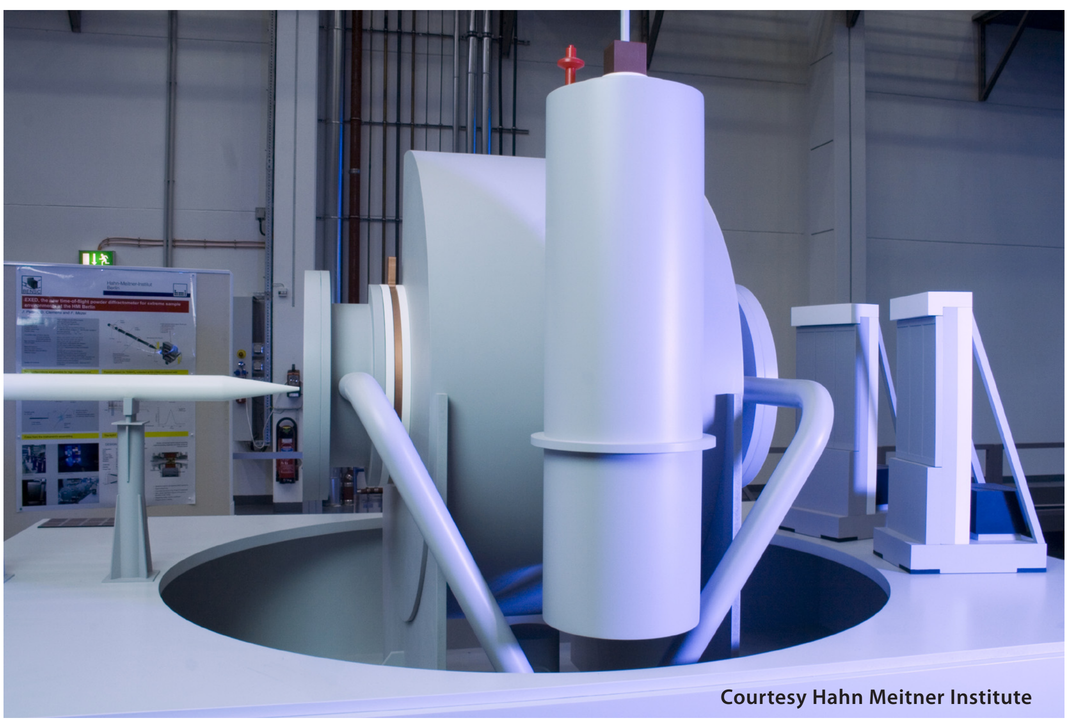
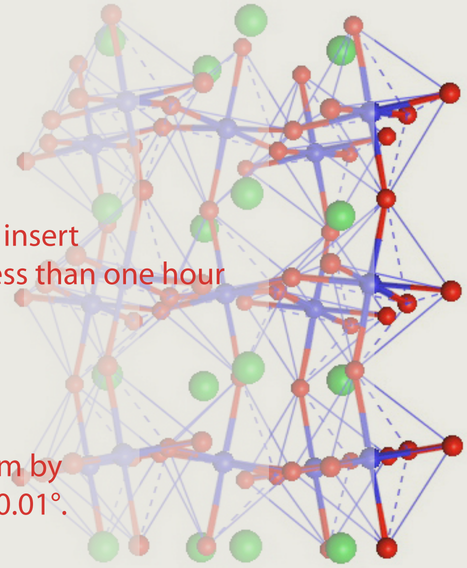


Figure 1.
This model of the hybrid magnet shows the neutron leader, at left, and two detectors on the right.

HMI SERIES CONNECTED HYBRID SPECS



- Horizontal field orientation
- Down-the-bore beam
- 50-mm clear bore
- Conical entry and exit
- 30° total view angle (15° half angle)
- 25 to 30 T central field using 4 to 8 MW power in resistive insert
- Capability of ramping from zero field to full field within less than one hour
- Capability to reverse polarity
- Spatial uniformity, better than 0.5% over 20-mm DSV
- Temporal stability, better than 0.01% to 0.05%
- Actively shielded
- Capability for varying the magnet axis relative to the beam by ±15°, with continuous change, and setting precision of ±0.01°.
- Full computer control for all drives and encoders
- Magnet bore and cones are a vacuum container with seals at both ends

The inner magnets for the two hybrids will be different. The Magnet Lab's version will use Florida-Bitter technology and will provide 1-ppm homogeneity in a 40-mm cylindrical bore. The HMI version will employ a new technology: Conical Florida-Bitter. That is, the bore of the magnet will be 50 mm at the sample but will diverge in both directions to allow small-angle scattering in both the downstream and upstream directions. The HMI hybrid should have both lower capital and operating costs than an all-resistive magnet as it uses only 1/3 the power of such a system.

The combination of horizontal field and conical bore and low power make the magnet ideal for neutron scattering experiments, which are among the best methods for probing molecules to better understand the structure of materials.

"With this major piece of equipment, Hahn-Meitner Institute itself becomes a magnet, pulling in researchers from around the world to Berlin," said Thomas Rachel, parliamentary state secretary of the Federal Ministry of Education and Research.

Neutrons are remarkable probes of phenomena within solids. With this new magnet, scientists from around the world will be able to carry out experiments that aren't currently possible. Presently, one of the greatest challenges in condensed matter physics is to develop a comprehensive theory describing high-temperature superconductors. The combination of neutrons and high magnetic fields will allow scientists to study the normal state of high-temperature superconductors in the low-temperature limit. In addition, it will be possible to probe hydrogen structure in both biological and hydrogen-storage materials.

The project is funded primarily through the German Federal Ministry for Education and Research. In addition to the $8.7-million magnet, the Germans are putting $14.4 million into infrastructure, such as cooling and current supplies, needed to run a high-field magnet. The agreement will be administered by the FSU Magnet Research and Development Co., a not-for-profit direct support organization of the Magnet Lab.

The announcement comes just six months after the National Science Foundation awarded the Magnet Lab an $11.7-million grant to build a 36-tesla SCH, expected to come online in 2011, for the Tallahassee facility. Together with Johns Hopkins University, the lab also is conducting an NSF-funded engineering design of a split-gap SCH for the Spallation Neutron Source, a neutron facility in Oak Ridge, Tenn.

For more information about this project, contact Mark Bird at *bird@magnet.fsu.edu.*

Unexpectedly Large Resolution and Sensitivity Enhancement at 900 MHz (21.1 T) in Magic Angle Spinning NMR of Spin-1/2 Nuclei in Solids

By Riqiang Fu, Ozge Gunaydin-Sen, and Naresh S. Dalal
National High Magnetic Field Laboratory and Department of Chemistry and Biochemistry, Florida State University

Advantages of very high fields in nuclear magnetic resonance (NMR) include the improved sensitivity, increased chemical shift dispersion, reduced second-order quadrupolar interactions, improved relaxation properties, and many others. Such advantages have been well demonstrated for liquids and for aligned samples. For quadrupolar nuclei in solids, the line-narrowing effects are at least quadratic with the static magnetic field, B_0, because of the combination of the chemical shift dispersion and the reduction of the second-order line broadening at high fields. However, the situation is less clear for spin-1/2 nuclei in solids, related in part to bulk magnetic susceptibility line broadening effects[1], which also scale with B_0. One technique that is proving highly useful for minimizing the magnetic susceptibility effects in solids is magic angle spinning (MAS) of a single crystal[2], especially as applied to the study of solid-solid phase transitions in which the resolution enhancement is crucial[3]. Our recent results[4] indicate that high fields up to 21.1 T (shown in Figure1) yield unexpectedly large resolution and sensitivity enhancement in MAS NMR measurements of spin-1/2 nuclei.

Enhanced by cross polarization (CP) from protons, the ^{15}N CP/MAS NMR spectra of a $NH_4H_2AsO_4$ crystal (henceforth, ADA, with 9% ^{15}N labeling[4]) were recorded at different static fields (7.0, 14.1, and 21.1 T) with efficient ^{1}H decoupling [5]. Temperatures were controlled within ±0.1 K by a Bruker BVT-2000 unit.

Figure 2 shows the ^{15}N CP/MAS NMR spectra recorded at different static fields. Clearly, as listed in Table I, the observed line-width, $\Delta\nu^*$, of the ^{15}N ADA resonance greatly decreases from 0.260 to 0.071 ppm with the increase of the static fields from 7.0 to 21.1 T, i.e. the spectral resolution improved by 366%. It is worth noting that the resolution enhancement is not linearly proportional to the magnetic field strength. From 7.0 to 21.1 T, the resolution is improved by 260%, while it improves only 140% from 14.1 to 21.1 T.

Figure 1.
The Magnet Lab's 900 MHz magnet.

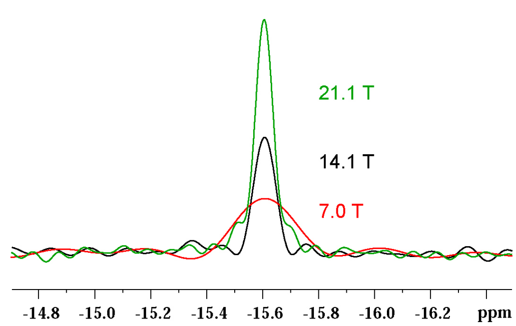


Figure 2.
Field dependence of ^{15}N CP/MAS spectra of an ADA single crystal at 300K at a spinning rate of 2.5 kHz, recorded on Bruker DMX300 (red), DRX600 (black), and the ultra-wide bore 900 NMR spectrometer (green). The signals were normalized to 32 scans. No linebroadening was applied in these spectra.

In order to understand the mechanism underlying the resolution enhancement, we measured the T_2 values at the various fields. The T_2 measurements were carried out using the standard spin-echo sequence in which a π pulse is placed in the middle of the ^{15}N spin echo period, τ, to refocus the ^{15}N magnetization generated by CP. The ^{1}H decoupling during the evolution and acquisition periods was achieved by the efficient ^{1}H decoupling [5]. Fig. 3 shows the plots of the signal intensities versus the spin echo time τ measured on the 7.0 and 21.1 T NMR spectrometers. Apparently, the ^{15}N signal intensities decay mono-exponentially as a function of τ, yielding transverse relaxation times T_2 of 138 and 163 ms for 7.0 and 21.1 T, respectively. These relaxation times translate into natural line-widths, $\Delta\nu$, of 2.31 and 1.95 Hz, which are generally smaller than the observed ones owing to the refocusing of shift distributions (e.g. B_0 inhomogeneity) in the T_2 measurements[6]. Table 1 lists the T_2 values measured at different fields and their respective natural line-widths. As can be seen from Table 1, the natural line-width decreases by 14% from 7.0 to 14.1 T while remains almost constant from 14.1 to 21.1 T. However, by taking into account the chemical shift dispersion at different fields, the spectral resolution enhancement improves by 233% from 7.0 to 14.1 T and 150% from 14.1 to 21.1 T, which is similar to the observed line-widths (c.f. Figure 2).

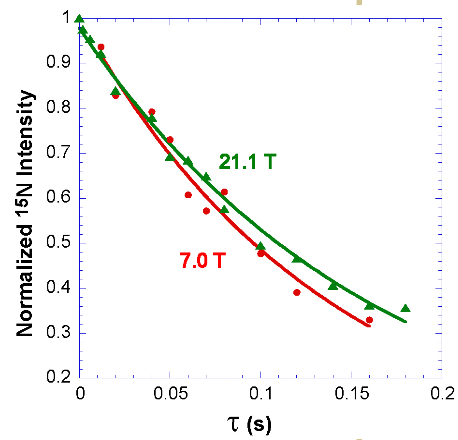


Figure 3.
Normalized ^{15}N signal intensities of ADA as a function of spin echo time τ, recorded from 300 (red) and 900 (green) MHz. Mono-exponential fittings yield the transverse relaxation times of 138 and 163 ms for 300 and 900 MHz, respectively.

For relaxation mechanisms induced by spin interactions, the line-width $\Delta\nu$ is proportional to the spectral densities, SDs.[7] As an example, for dipolar interactions SDs can be rationalized by

$$SDs = 3\tau_C + \frac{5\tau_C}{1+\omega_0^2\tau_C^2} + \frac{2\tau_C}{1+4\omega_0^2\tau_C^2} , \quad (1)$$

where, ω_0 is the Lamor frequency and τ_C characterizes the lattice motion. For the extremely fast (i.e. $\omega_0\tau_C$ <<1) and extremely slow (i.e. $\omega_0\tau_C$ >>1) motions, the SDs are independent of B_0. However, for $\omega_0\tau_C \sim 1$, the SDs greatly depend on B_0. Although the SDs steadily increase as the motion slows down, for any given correlation time τ_C higher static fields always give rise to smaller SDs thus resulting in narrower line-widths (or longer T_2 values). Such an increase in T_2 values at high fields was observed in solution NMR[8]. It is found that the most pronounced high field line-narrowing effect occurs at $\tau_C \sim 10^{-8}$ s. However, this field dependence of the line-width is much more difficult to predict in solids in the presence of other significant line-broadening effects such as bulk magnetic susceptibilities and chemical shift anisotropies at high fields[1].

Table 1.
Resolution and sensitivity enhancement factors of ^{15}N CP/MAS signals for $NH_4H_2AsO_4$ at various static fields.

Field (T)	Δυ* (ppm)	T_2 (ms)	Δυ=1/πT_2 (ppm) (Hz)	S/N (obs)	S/N observed over $(B_0)^{3/2}$
7.0	0.260	138	0.077 2.31	1	1
14.1	0.100	160	0.033 1.98	4.44	1.6
21.1	0.071	163	0.022 1.95	18.22	2.7

This high field line-narrowing effect not only results in spectral resolution enhancement but also leads to an improvement of the sensitivity beyond what is expected from the $(B_0)^{3/2}$ effect. The signal-to-noise ratio (S/N) measured from the spectra in Figure 2 was 9, 20, and 41 for 300, 600, and 900 MHz, respectively. Figure 4 shows the S/N and resolution enhancement versus B_0. Detailed analyses of the measured S/N estimate an extra enhancement of a factor of 1.6 and 2.7 by going from 7.0 to 14.1 and to 21.1 T.

The enhanced resolution and sensitivity at 900 MHz enabled us to study the temperature dependences of the ^{15}N isotropic chemical shift and spin dynamics through the antiferroelectric phase transition of ADA at 215 K. This study was undertaken to understand the role of the NH_4^+ ion in the transition mechanism, since the substitution of NH_4^+ ion in place of K^+ in KH_2AsO_4 switches the latter compound from a ferroelectric to an antiferroelectric one. Fig. 5 shows the ^{15}N CP/MAS spectra recorded on 900 MHz in the close vicinity of the phase transition at T_N~215 K. As the temperature approaches T_N, the paraelectric phase steadily disappears while the antiferroelectric phase gradually merges. The two phases, whose ^{15}N isotropic chemical shifts are just 0.3 ppm apart, coexist within 1.5 K. Such a small isotropic chemical shift difference can be hardly identified at lower fields. The sharp change in the isotropic chemical shift, δ_{iso}, at T_N implies that the NH_4^+ group takes part in the charge renormalization at the phase transition, and thus it is not just a spectator ion. Earlier theories of the ferroelectric (or antiferroelectric) behavior of this family of compounds have stressed the order-disorder role of the O-H···O protons in the transition mechanism. Specifically, the observation of the anomaly in δ_{iso} implies that the transition has a displacive character, since δ_{iso} is invariant to any translational or rotational symmetry change (i.e., order-disorder effects). This aspect has not been appreciated in any earlier theory of transition in ADA and related antiferroelectrics.[2,3]

Figure 6 shows the ^{15}N spin-lattice relaxation time, T_1, as a function of temperature. A clear discontinuity appears in the figure near the phase transition temperature T_N ~ 215K, implying that the two phases have distinguishable

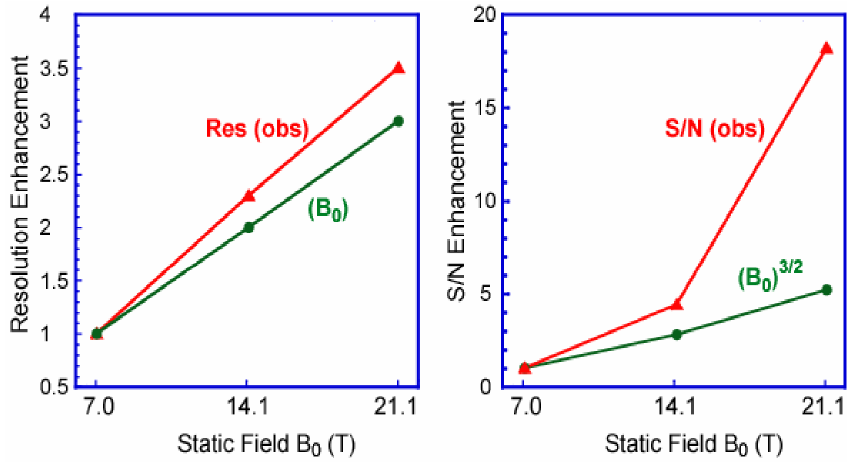


Figure 4.
Expected (red) and observed (green) resolution and sensitivity enhancement at various static fields B_0 after normalizing to the same number of scans.

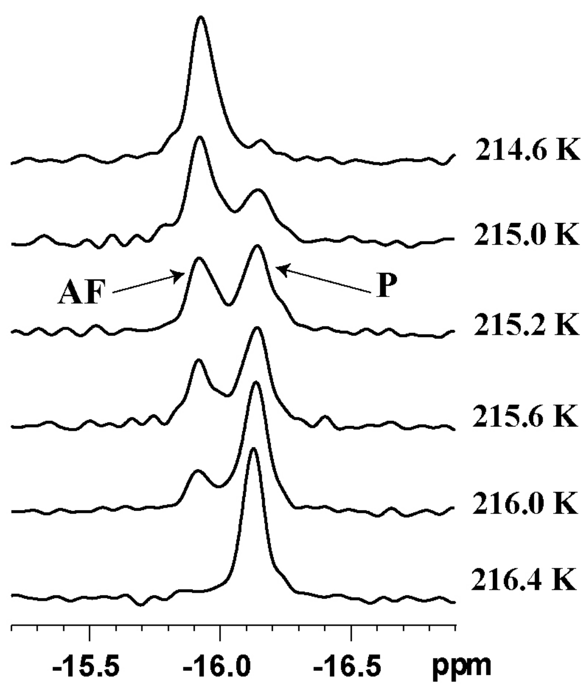


Figure 5.
Temperature dependence of the ^{15}N CP/MAS NMR spectra of ADA in the close vicinity of the antiferroelectric phase transition recorded on the ultra-wide bore 900 MHz NMR spectrometer. The peaks corresponding to the paraelectric and antiferroelectric phases are labeled by P and AF, respectively.

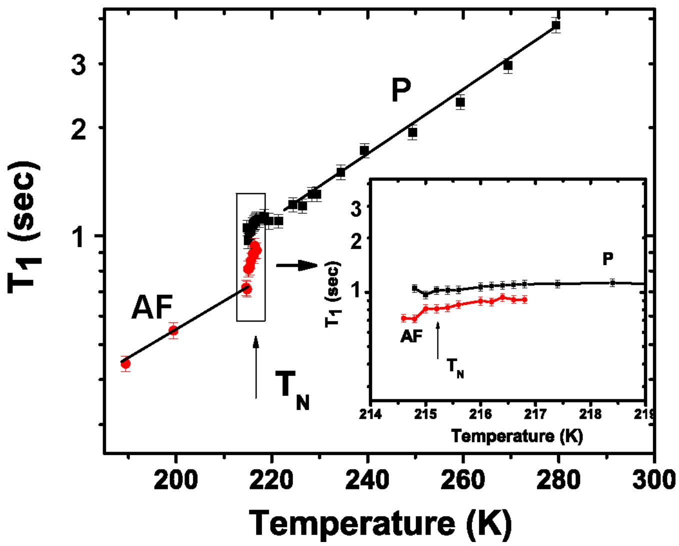


Figure 6.
The [15]N spin-lattice relaxation time T_1 of ADA as a function of temperature recorded on the 900 MHz NMR spectrometer. The paraelectric and antiferroelectric phases are labeled by P and AF, respectively. Inset: the T_1 values measured from the paraelectric and antiferroelectric phases in the close vicinity of the phase transition.

motional behavior. The fittings, as indicated by solid lines in the figure, show the correlation times of 100 and 500 ps for the paraelectric and antiferroelectric clusters, respectively, in the close vicinity of T_N. During the phase transition, the two coexisting clusters have different spin-lattice relaxation behaviors, as shown in the inset of Figure 6. To our knowledge, such detailed information has not been previously observed in the hydrogen-bonded compounds. Currently, we are carrying out further investigations in order to understand how the conversion between the paraelectric and ferroelectric clusters takes place during the transition.

CONCLUSION

The above data demonstrate that for ^{15}N CP/MAS NMR experiments, the sensitivity enhancement is a factor of 18.2, as opposed to 6.75 expected from the $(B_0)^{3/2}$ effect, in going from 7.0 to 21.1 T. This enhancement seems to have its origin in the T_2 increase at higher fields. The enhanced resolution and sensitivity have enabled us to probe the nature of the antiferroelectric transition in ADA to a depth not possible at lower fields. These findings should open up new areas of investigations in NMR spectroscopy of solids, as well as its applications to new phenomenon in materials science.

ACKNOWLEDGEMENT

This work was supported in part by the National High Magnetic Field Laboratory supported by the NSF Cooperative Agreement DMR-0084173 and the State of Florida. We thank Dr. Bill Brey, Kiran Shetty, and Ashley Blue for assistance in setting up variable temperature MAS experiments on the ultra-wide bore 900 MHz NMR spectrometer and Drs. Alan Marshall and Tim Cross for helpful discussions.

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Lyngbyastatin 4, a New Protease Inhibitor from the Floridian Marine Cyanobacterium *Lyngbya confervoides*

S. Matthew (UF, Medicinal Chemistry), C. Ross (Smithsonian Marine Station), J.R. Rocca (UF, McKnight Brain Institute), V.J. Paul (Smithsonian Marine Station), and H. Luesch (UF, Medicinal Chemistry)

INTRODUCTION

Marine cyanobacteria are prolific sources of bioactive secondary metabolites with intriguing structures, mostly modified peptides and hybrid peptides-polyketides. Natural products with such cyanobacterial biosynthetic signatures have also been isolated from sea hares, including from *Dolabella auricularia*, the original source of anticancer dolastatins. Within the past decade, several dolastatins and related analogues have been discovered in marine cyanobacteria and in much higher yield, supporting the suspicion that many dolastatins are derived from a cyanobacterial diet.[1] We have initiated biological screening and chemical investigation of largely unexplored cyanobacteria from Florida and encountered a new dolastatin 13 analogue.[2]

EXPERIMENTAL

1D and 2D NMR data (^{1}H, ^{13}C, COSY, TOCSY, ROESY, HMQC, and HMBC) were acquired on a Bruker Avance 500 or 600 MHz spectrometer using DMSO-d_6 as the solvent.

RESULTS AND DISCUSSION

Samples from a cyanobacterial bloom of *Lyngbya confervoides* were collected in August 2005 from reef habitats near Fort Lauderdale, Fla.[3] Following extraction, several chromatographic steps and finally reversed-phase HPLC, we isolated a new cyclodepsipeptide, which we termed lyngbyastatin 4.[2] Its gross structure was deduced by standard 1D and 2D NMR spectroscopy in combination with high-resolution ESI mass spectrometry, which established the presence of standard as well as unusual and modified amino acid units (Figure 1). The absolute configuration was determined by chiral HPLC analysis of the amino acids and hydroxy acid liberated by chemical degradation. While non-cytotoxic (unlike many dolastatins), lyngbyastatin 4 potently inhibited elastase and chymotrypsin with IC_{50} values of 0.03 and 0.30 μM but had no effect on other serine proteases tested (trypsin, thrombin, plasmin).

CONCLUSIONS

Cyanobacteria continue to yield new structures with activities of biomedical interest. The protease selectivity profile of lyngbyastatin 4 is remarkable. The isolation of yet another dolastatin analogue from a marine cyanobacterium provides more circumstantial evidence that dolastatins are actually acquired by sea hares through cyanobacteria-containing diet.

Figure 1.
Structure and ^{1}H NMR spectrum of lyngbyastatin 4 (500 MHz in DMSO-d_6).

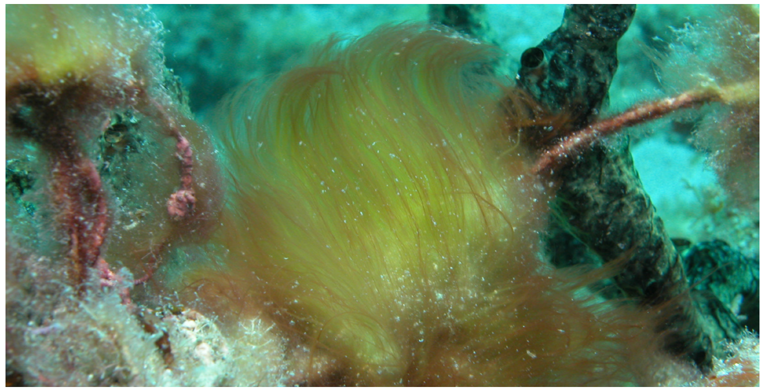
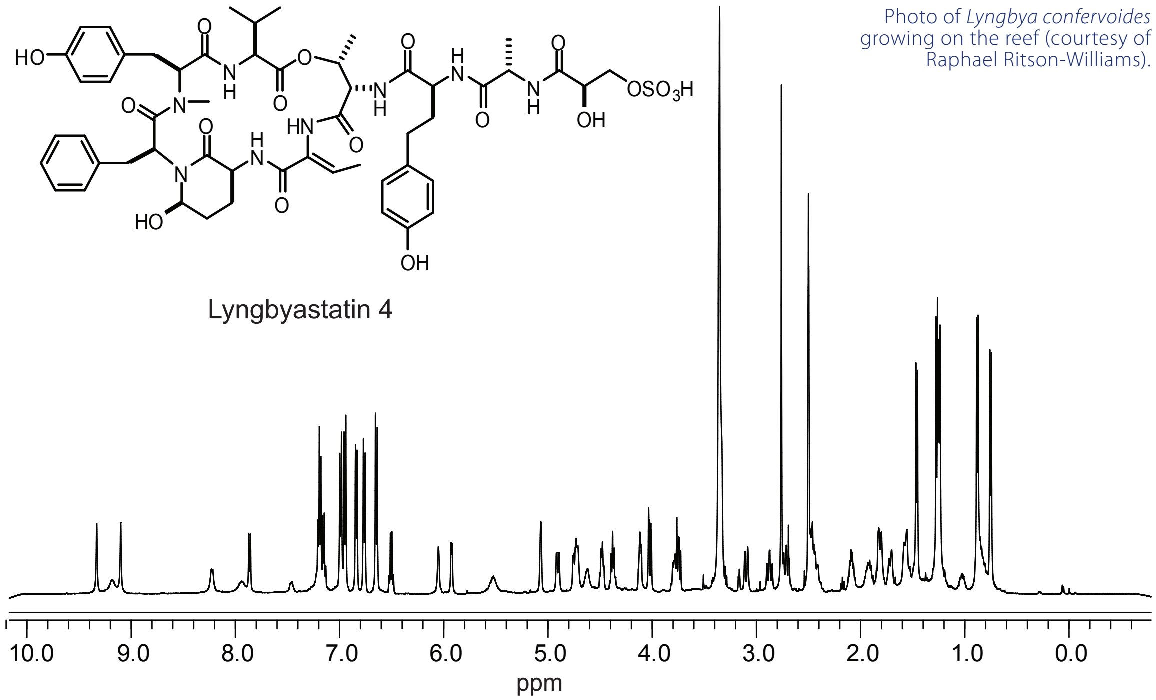


Photo of *Lyngbya confervoides* growing on the reef (courtesy of Raphael Ritson-Williams).



ACKNOWLEDGEMENT

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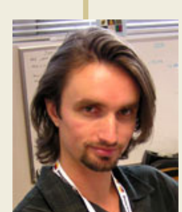


Hendrik Luesch joined the Department of Medicinal Chemistry at the University of Florida as an assistant professor in 2005. Since his arrival, Hendrik has established a vibrant program in the identification and functional characterization of natural product chemicals made by marine organisms. The Luesch lab at UF (*www.cop.ufl.edu/departments/mc/luesch/luesch.htm*) combines his interest in marine natural products chemistry with systems biology approaches for the discovery and characterization of potential drugs and molecular drug targets.

Luesch received his *Diplom* in chemistry at the University of Siegen (Germany) in 1997. He attended the University of Hawaii at Manoa to study marine natural products chemistry and obtained his Ph.D. in chemistry under the supervision of Richard E. Moore in 2002. He then undertook three years of postdoctoral studies as an Irving S. Sigal Fellow at The Scripps Research Institute in La Jolla under the guidance of Peter G. Schultz in the area of functional genomics.

Summer science programs sizzle at Mag Lab

By Pat Dixon

Summers in the lab's Center for Integrating Research & Learning (CIRL) are high- energy, busy, and exciting, and this year promises to be no exception. The Research Experiences for Undergraduates (REU) program, after months of preparation, is welcoming 18 students from around the country to match with 16 lab mentors from Tallahassee, Gainesville, and Los Alamos. In addition, the Research Experiences for Teachers (RET) program will host 16 K-12 science educators in Tallahassee who will work with nine mentors.

Mentors commit a great deal of time to make the experience at the Magnet Lab a sought-after program that is the ultimate professional development for teachers. The overwhelming support for these two programs provided by lab scientists demonstrates their commitment to increasing science literacy and to encouraging young people to pursue science careers.

Jose Sanchez, assistant director of CIRL, has a full schedule planned for students and teachers that includes lectures, seminars and workshops, on top of participants' time in the labs with mentors. For more on the research experiences programs, visit magnet.fsu.edu/education.

REU Class of 2007

Name	School	Mentor
Anna Trugman	Stanford University	Albert Migliori
Jose Negrete	University of Texas El Paso	Alex Lacerda
Sally June Tracy	Occidental College	Chuck Mielke
Sean Miller	Jacobs University, Bremen, Germany	Ross McDonald
Isaiah Helm	Montana State University Bozeman	Chuck Swenson
Anthony Kuhns	McGill University Montreal	Ke Han
Courtney Bennett	Florida State University	Carol Nilsson
Elliot Hawkes	Harvard Cambridge Mass	Irinel Chiorescu
Julia Luongo	Swarthmore College	Iain Dixon
Mark Wartenbe	Florida State University	Jim Cao
Mary Bauman	Florida State University	Chris Wiebe
Nivia Medina	University of Puerto Rico	Mike Davidson
Rebecca Altman	Florida State University	Sylvie Fuzier
Steve Robinette	University of Florida	Rafael Bruschweiler
Suchandan Pal	Florida State University	Arneil Reyes
Gabriela Sanz-Douglass	Sonoma State University	Mark Meisel
Justin Cohen	University of Florida	Mark Meisel
Jaime Calderon	University of Turabo, Puerto Rico	Jim Brooks

RET Class of 2007

Name	School	Location	Mentor
Richard Frey	J.E. Richards Middle School	Atlanta, GA	Ke Han
William Millard	W.T. Moore Elementary School	Tallahassee, FL	Vincent Salters
Elizabeth Cunningham	Maclay School	Tallahassee, FL	David Larbalestier
Zehorit Kapach	Alon High School	Tel Aviv, Israel	Chris Wiebe
Gary Davis	Gilchrist Elementary School	Tallahassee, FL	Tesasaye Gegbre
Candace Gautney	Ruediger Elementary School	Tallahassee, FL	David Larbalestier
Charles Carpenter	Lawton Chiles High School	Tallahassee, FL	Carol Nilsson
Mark Johnson	Lake Weir High School	Ocala, FL	Sam Grant
Charles Cutler	Lake Brantley High School	Longwood, FL	Sam Grant
Brooks Sperling	Springwood Elementary School	Tallahassee, FL	Bob Goddard
Tynica Lewis	Montlieu Academy	High Point, NC	Bob Goddard
Marcia Martin	Everglades Elementary School	Pembroke Pines, FL	Jim Cao
Mary Patrick	Cobb Middle School	Tallahassee, FL	Mike Davidson
Elizabeth Button	Swift Creek Middle School	Tallahassee, FL	Mike Davidson
Melissa Olson	Ruediger Elementary School	Tallahassee, FL	Irinel Chiorescu

SUMMER PARTNERSHIPS UNDERWAY

The first semester of the Teacher in Residence program further supports the concept that we can make a big difference in K12 education with the Magnet Lab behind us. Richard McHenry, the first Magnet Lab Teacher in Residence, designed and will facilitate two workshops for elementary, middle and high school teachers. McHenry has brought expertise, enthusiasm, and new ideas for enhancing science education to CIRL.

Young scientists float and sink.

Carlos Villa, outreach coordinator, finished up the 2006-2007 school year with a series of school visits to rural Florida counties, south Georgia, and Tallahassee-area schools. In addition, Villa coordinated the middle-school mentorship for 15 students. Their outstanding presentations remind us of the talent pool out there waiting to be tapped. The presentations were featured on *FSU Headlines*, which airs on the local public radio station, reaching thousands in Tallahassee and surrounding areas.

In partnership with the Leon County Public Library, Center Director Pat Dixon conducted a workshop for parents and their children ages 3-8. More than 50 people attended the workshop on sharing science with your children. Children had a wonderful time making predictions about floating and sinking, testing fruits and vegetables, recording data, and discussing their conclusions. Parents were encouraged to “think like scientists” to help their children become critical thinkers and questioners. CIRL hopes to continue the series.

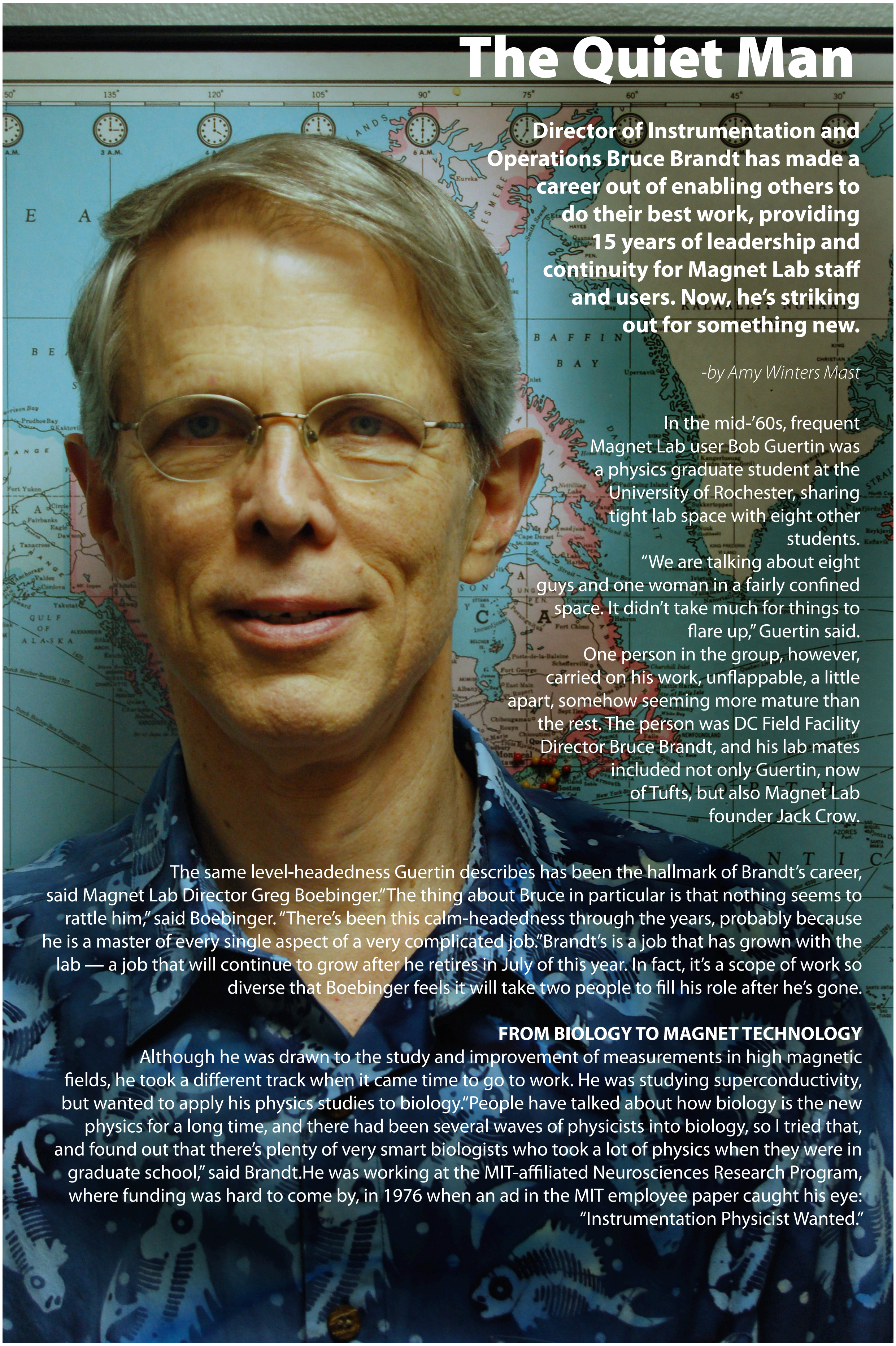
SCIGIRLS EXPANDS FOR YEAR TWO

SciGirls campers visited the Magnet Lab to learn about Tesla coils. This year, the SciGirls camp is open to more girls.

Summer science camps for middle- and high-school girls are gearing up. SciGirls I and SciGirls II will see an expanded two-week experience for girls with an interest in science. Last year's program proved so successful that the Magnet Lab, in partnership with WFSU-TV, a Public Broadcasting Service station, and the Tallahassee Museum, received funding from Dragonfly TV to provide quality experiences for 32 young women. Mabry Gaboardi and Nicole Tibbetts from the lab's Geochemistry group will be working with the girls to answer the question, "Where does the water on Earth come from?" In addition, SciGirls will be shadowing this summer's REU students to see what life is like in a real-world science research laboratory. Featured in Cold Facts, the SciGirls program has gained a great deal of attention as a model program. For more information about SciGirls, visit *www.magnet.fsu.edu/education/students/programs/girlsinscience.html.*

ICAM'S SUPERNET PROJECT

In partnership with the Institute for Complex Adaptive Matter's SuperNet Project, CIRL worked with scientists at the Lab and Brian McClain from Godby High School in Tallahassee to present two workshops for secondary teachers on superconductivity. Under the direction of Vlad Dobrosavljevic, workshops featured lectures and participation by Greg Boebinger, David Larbalestier, Chris Wiebe, Irinel Chiorescu, and Nick Bonesteel. Teachers were provided with activities with which to introduce their students to the concept of superconductivity and the world of science at low temperatures. We anticipate more workshops and continued work with Fermi Lab and Ohio State University to establish SuperNet as a national resource for secondary teachers. (See ***www.magnet.fsu.edu/education/teachers/resources/supernet/index.html***.)



The Quiet Man

Director of Instrumentation and Operations Bruce Brandt has made a career out of enabling others to do their best work, providing 15 years of leadership and continuity for Magnet Lab staff and users. Now, he's striking out for something new.

-by Amy Winters Mast

In the mid-'60s, frequent Magnet Lab user Bob Guertin was a physics graduate student at the University of Rochester, sharing tight lab space with eight other students.

"We are talking about eight guys and one woman in a fairly confined space. It didn't take much for things to flare up," Guertin said.

One person in the group, however, carried on his work, unflappable, a little apart, somehow seeming more mature than the rest. The person was DC Field Facility Director Bruce Brandt, and his lab mates included not only Guertin, now of Tufts, but also Magnet Lab founder Jack Crow.

The same level-headedness Guertin describes has been the hallmark of Brandt's career, said Magnet Lab Director Greg Boebinger."The thing about Bruce in particular is that nothing seems to rattle him," said Boebinger. "There's been this calm-headedness through the years, probably because he is a master of every single aspect of a very complicated job."Brandt's is a job that has grown with the lab — a job that will continue to grow after he retires in July of this year. In fact, it's a scope of work so diverse that Boebinger feels it will take two people to fill his role after he's gone.

FROM BIOLOGY TO MAGNET TECHNOLOGY

Although he was drawn to the study and improvement of measurements in high magnetic fields, he took a different track when it came time to go to work. He was studying superconductivity, but wanted to apply his physics studies to biology."People have talked about how biology is the new physics for a long time, and there had been several waves of physicists into biology, so I tried that, and found out that there's plenty of very smart biologists who took a lot of physics when they were in graduate school," said Brandt.He was working at the MIT-affiliated Neurosciences Research Program, where funding was hard to come by, in 1976 when an ad in the MIT employee paper caught his eye: "Instrumentation Physicist Wanted."


With a position at MIT Brandt combined his physics background and his rapport with machines.

"Always, from graduate school onward, my strength was with instrumentation — sort of a natural rapport with machines. I thought, gee, if there's anything I am, that might be it," Brandt said.

So in 1977, he began working at MIT's Francis Bitter National Magnet Laboratory.

Brandt settled into full-time magnet work at MIT, where he and his colleagues worked to balance user demand for magnet time, the need for innovation, and increasing budget pressure with mixed success. During its final years, Brandt explained, Bitter Lab's budget hovered around $6 million per year.

"MIT is a private university; it's not like having state money. Very, very slowly, the budget began to decrease. People at the Bitter Lab were really good at producing the highest fields in the world on a tight budget," said Brandt. "But we could see there were things we might have done that we weren't able to do."

THE JOURNEY FROM MIT TO FSU

By the late 1980s, the Francis Bitter National Magnet Lab faced a new challenge: competition. In 1989, Crow and partners at the University of Florida and Los Alamos National Lab submitted a joint proposal to the National Science Foundation to establish a new national magnet lab. After a stringent peer-review competition, the National Science Board rocked the science establishment by awarding the National High Magnetic Field Laboratory to Florida State University in 1990.

"When FSU won, there was a lot of disbelief. How could this football school beat out MIT? There was some wounded arrogance. But when the final decision came down that this is what it was going to be, I started looking for a job, thinking about what would be next."

What came next was a call from Crow. He wanted Brandt to move to Tallahassee and run the new user program.

"When he asked if I would be interested in going to FSU, I was a little concerned as to whether this new lab would be viable," Brandt recalled. "Would they have the magnet designers and other people they needed to make it go? My wife and I decided that it was worth the chance, that it seemed like an opportunity to do what I really loved doing. So I took it."

Brandt wasn't the only one with initial concerns. Guertin, based in the Northeast, thought his work could be adversely affected and Boebinger worried his career "would go up in smoke."

"I was very frightened about whether this new magnet lab would be a success," said Boebinger. "So I was pleased to hear that Bruce was moving to Florida, because he would help ensure that the DC magnet program would carry on without skipping a beat."

Although Brandt had seen the plans on paper, he still had some reservations when he began visiting Florida in 1991. By early 1992, however, he was sold, and the Brandt family moved to Florida full time in August of that year.

"When I got here (in 1992), I think there were about 17 people up on the third floor in the A wing. By that time, the foundation of the Magnet Lab had been poured and the conversion of this building was beginning. As soon as I saw what was going to be possible, then it became very exciting," Brandt said.

Once the lab's construction was complete, it fell to Brandt to reprise his role at MIT on a grander scale. His colleagues say the even keel that served him so well in grad school is what made him so successful building the


Construction of the Magnet Lab.

user program from the ground up. His hiring connected the old lab to the new, bringing much needed continuity. His new job also proved a perfect match of his skills and interests.

"I like the challenge of trying to solve somebody's noise problem so that they can get decent data," said Brandt. "While it's not as though Mother Nature is trying to thwart us, it requires a high level of suspiciousness to make sure that what you're seeing is valid data."

Brandt said he's always been more interested in measurement problems than in science.

"One of my problems as a scientist was having enough confidence or feeling that whatever scientific problem I was working on was important enough to require my time," said Brandt. "At the Magnet Lab, I don't have that problem, because I get to work on a whole raft of things and some of that is going to be useful or important somehow. That makes it worthwhile."

'A MARVELOUS ADVENTURE'

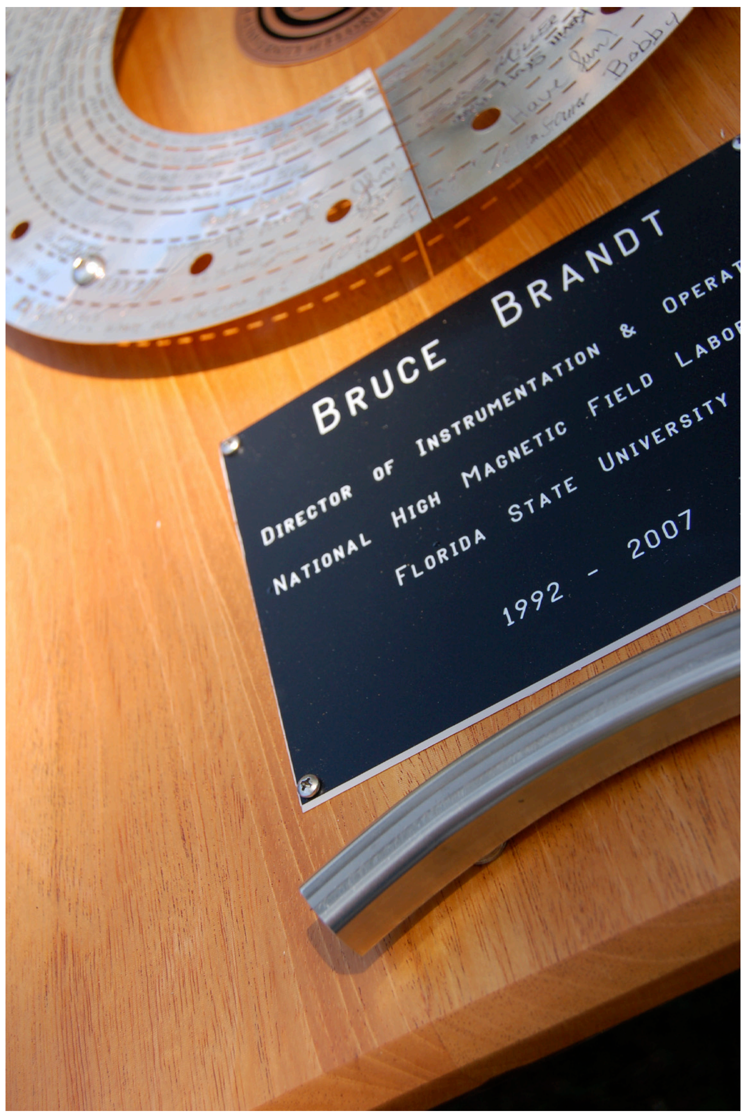
As magnet technology has allowed for fewer bumps in the road and more magnet time for users, Brandt's responsibilities have expanded over time to what he describes as "part troubleshooting, part planning, and part hotel management."

The administrative work of his position, Brandt said, means he has less contact with users than he used to.

"Because I don't get to work with people, I don't get to know people like I used to, when students come through and so forth. My user buddies tend to be people who were graduate students when I was at MIT, along with other folks I've worked with over many years," he said.

Brandt, who's 65, is ready to exchange some of his trademark deliberateness for impulsivity, to pass the responsibility that goes with his work along to someone else who's ready for it, he said, adding that he and his wife, Junelle, are ready to take risks they weren't equipped for during the heart of their working years. Brandt has thought about "a marvelous adventure" working with a Chinese magnet lab that's in the planning stages, getting Red Cross training to help in emergencies, or traveling for a while with Junelle.

"Part of it is just that I've been doing this for a long time. I am ready to do something else. What it will be, I'm not sure. Some of it might be in this same general area, but the important thing is that we will have some more freedom."



A LASTING LEGACY

Brandt said that he feels the key to lab's success has been a combination of "the scientific growth, the imagination, the sheer chutzpah and hard work to say we're going to do this new thing, it's going to work, and we're not afraid to spend the money."

How does the Magnet Lab now, 15 years after Brandt's family moved to Tallahassee, compare to Crow's initial vision for the project?

"It's fulfilled everything I was thinking of then and more," Brandt said. "Jack Crow did a really good job in terms of just keeping the place growing in ways I don't think he had even thought of at first. The fact is that at each five year renewal, the NSF budget has gone way up each time. It is concrete evidence of what he's been able to do and what it looks like Greg is going to be able to do."

Jack Crow's widow and active Magnet Lab volunteer Joan Crow wrote an open letter on Bruce's decision to retire, one in which she emphasized the friendship that formed the basis of Crow and Brandt's longstanding working relationship.

"What drew them together in graduate school – their pure love of science and desire to make a mark on the scientific world – was the protective cushion that cradled our friendship over many years and miles," she wrote.

Brandt has chosen early July - appropriately the week of Independence Day - to take his first steps into the next phase of his life, leaving an imprint more subtle but perhaps just as permanent as that of his old friend.

PHYSICS' CHANGING CULTURE

Though the basic physical quantities measured in the MagLab's DC magnets haven't changed much during Bruce Brandt's career, he noted a shift in the people using those magnets - a widening gap between people who design and build the experimental instrumentation, and the scientists who conduct experiments using that instrumentation.

"It's a change that's more subtle. I'm not sure if it's real. Students are changing a bit," Brandt said.

"It used to be that most physicists were people who, in my generation, a lot of them had HAM radio sets that they built themselves, or they built Heath kit televisions and so forth. They came to physics already handy.

"Now more and more people are coming from a society in which everything is inaccessible. You can't fix your computer because it's just plug-in stuff. You can't fix your cell phone, because how do you figure out how that works? About all that's left that you can work on is your bicycle.

"More and more, physicists are focusing only on the science, and they sort of expect the instrumentation to be taken care of by somebody else. They want all of these measurement problems to have been solved so they can just come in and program their experiment into the computer and out comes the result."

This change, he added, means that it will be increasingly important to groom young scientists and engineers with a knack for instrumentation to address the specialty work that drives ever-more sophisticated experiments in the MagLab's high field magnets.

People

Stepping fully into the role he assumed in interim capacity, Mag Lab veteran **Mark Bird** has been officially named director of the Magnet Science and Technology (MS&T) division.
Bird, who has been a part of the lab since its inception, began his tenure in Tallahassee as an assistant scholar/scientist. By 1999, he was MS&T's head of engineering services, and in 2003, he became the department's head of engineering analysis. He stepped into the interim director role last year after **John Miller** left to head up the magnet system team for the U.S. International Thermonuclear Experimental Reactor (ITER) Project Office.

During his time at the lab, Bird has created the resistive magnet group and led the development of the high field resistive magnets and the "Florida-Bitter" magnet technology. With more than 100 coils built to date, Florida-Bitter magnets have become the international standard for high field resistive magnets and are in place or being installed at four laboratories on three continents.

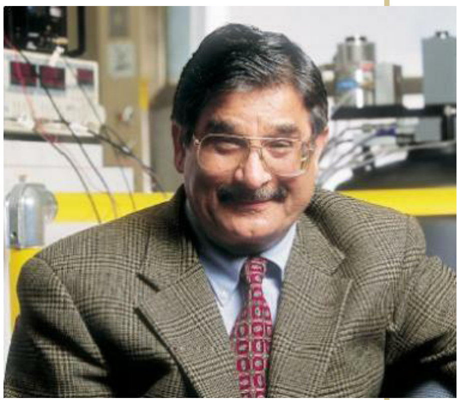
"Mark has excelled in his engineering prowess, and over the past nine months as interim director of MS&T, he's shown equal talent in managing a very complicated organization," said Lab Director **Greg Boebinger** of Bird's appointment. "We're pleased that he's accepted this invitation and I look forward to years of continued great achievements from the Magnet Science and Technology division." In addition to the director title, Bird also has been named chief engineer.

Irinel Chiorescu, an assistant professor of physics at Florida State University and a researcher at the Magnet Lab, has been selected to receive a prestigious Career Grant from the National Science Foundation. The NSF offers the awards "in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization."

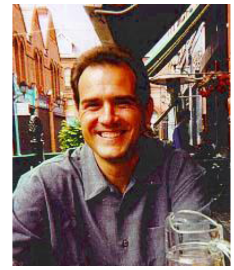
Chiorescu, an experimental physicist and leader of the Magnet Lab's Quantum Spin Dynamics group, will receive $100,000 a year over five years to support his research. Chiorescu studies the quantum behavior of condensed matter at extremely low temperatures. His studies focus on quantum magnetic spins in interaction with probe photons and random environments.

"I am honored to be entrusted with the Career Award, and am very grateful to the NSF, Magnet Lab, FSU, and my students," said Chiorescu. "With this grant I can lead the research in my group with installments of Research Assistantships for graduate students. Education-wise, it gives increased support for related activities in the physics department and for the newly established and Magnet Lab-led SuperNet program." For more information about SuperNet, visit *magnet.fsu.edu/education*.

Magnet Lab scientist and former chair of the FSU department of chemistry and biochemistry **Naresh Dalal** has been selected to receive the American Chemical Society's 2007 Florida Award. One Florida Award has been presented each year since 1952 to recognize the significant and meritorious achievements of prominent chemists working in the Southeast. Dalal was formally recognized at the Florida Annual Meeting and Exposition in Orlando on May 11 with a symposium in his honor. "This award is special because it is decided by the people who know you the best ... in this case my scientific colleagues in Florida," Dalal said.



Mike Davidson was cited as an expert in the May 10, 2007 *Nature* article titled, "The Good, the Bad, and the Ugly," a piece about how the images created by today's microscopes and techniques- beautiful though they may be- can be fraught with inaccuracy when the microscope is in inexperienced hands. The article closes with his quote: "In competitive biology, you don't necessarily need to be a mechanic but you need to be able to operate the machine. If you don't know how it works, you'll get creamed in the race."



The University of Florida Research Foundation has named 33 faculty members as UFRF Professors for 2007-2010. Among them are Mag Lab-affiliated scientists **Peter Hirschfeld**, professor of physics, and **Krista Vandenborne**, associate professor physical therapy. The recognition goes to faculty members who have a distinguished current record of research and a strong research agenda that is likely to lead to continuing distinction in their fields. The UFRF professors were recommended by their college deans based on nominations from their department chairs, a personal statement and an evaluation of their recent research accomplishments as evidenced by publications in scholarly journals, external funding, honors and awards, development of intellectual property and other measures appropriate to their field of expertise. The three-year award includes a $5,000 annual salary supplement and a one-time $3,000 grant.

Professor Ioannis (Yanni) Constantinidis, 1961-2007

It is with great sadness that we report the passing of a dear member of the Magnet Lab family. **Professor Ioannis (Yanni) Constantinidis** died unexpectedly April 16, 2007 at the unjustly young age of 46. He leaves behind his wife, Jenny, and children, Alex (8) and Zoe (6).

Ioannis obtained his Ph.D at the University of New Mexico and developed his career at Johns Hopkins University and Emory University before joining the University of Florida in 2001 as associate professor. He worked on issues related to diabetes, and among many techniques, employed MR in the development of an artificial pancreas. With respect to the Magnet Lab and its mission, Ioannis was most recently investigating the utility of high field MRI for the examination of alginate beads, cell constructs and tissue islets. Some of this work was featured in recent *NHMFL Reports* with colleagues at UF and Florida State University. Ioannis was funded by the National Institutes of Health, and in recognition of his world-leading studies, was recently awarded full professorship and tenure at UF.

Yanni was one of the most caring and gregarious people you could ever hope to meet. His enthusiasm for science took second place only to that for his family. His infectious personality will be sorely missed. Yanni's close personal and professional friend, Dr. Nick Simpson, has agreed to help continue Yanni's research programs and take over leadership of his grants. I hope you will join us all in supporting Nick as he moves Yanni's visions forward. I know for sure that Yanni, most especially, would want that.

Of my friend, I cannot find the words. But I know for sure that he would want us to continue forward with the mission of the Magnet Lab and wish us all the best in that endeavor. Sleep well Yanni, and relax. I hear that the funding levels in heaven are 100 percent.

Steve Blackband

Pulsed Field Facility staff member **Marcelo Jaime** has been named the 2007 recipient of the James J. Christensen Award for Innovations in Calorimetry. The award is presented by the Calorimetry Conference (CalCon) annually for outstanding innovative contributions to the development and use of calorimetric instrumentation. Jaime will be a featured speaker at the 62nd CalCon in Hawaii this August, where he will also be honored with an award ceremony and a $1,000 check.

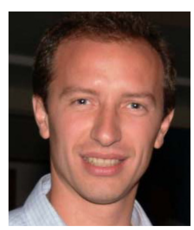
Alan G. Marshall, director of the Ion Cyclotron Resonance program and the Robert O. Lawton professor of chemistry and biochemistry at FSU, has been selected to receive the 2007 Chemical Pioneer Award from the American Institute of Chemists. The award recognizes "chemists and chemical engineers who have made outstanding contributions advancing the science of chemistry or impacting the chemical industry or the chemical profession."

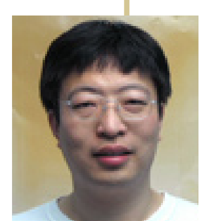
The Chemical Pioneer Award is based on Marshall's co-invention and pioneering development of Fourier transform ion cyclotron resonance (FT-ICR) mass spectrometry. Since its invention, more than 700 FT-ICR instruments, with a replacement value of approximately $400 million, have been installed in laboratories worldwide.

"Not every new scientific technique turns out to be useful," Marshall said. "The most satisfying thing to me is that the developments cited for this award turned out to be good for solving all sorts of problems that weren't even imagined when we started."

In addition to the Chemical Pioneer Award, Marshall has been granted Fellow status in the American Institute of Chemists. He was recognized May 18 during a symposium at the Chemical Heritage Foundation in Philadelphia.

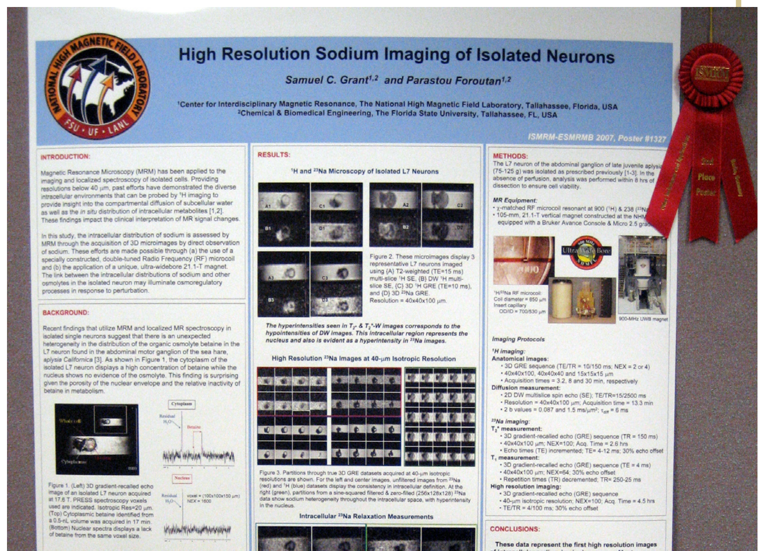
The Chemical Pioneer Award is highly esteemed; 11 previous recipients have received the Nobel Prize in chemistry.





A paper produced by a fruitful Mag Lab collaboration ranks in the top 10 percent of Institute of Physics journal dowloads for the first quarter of 2007. The paper, "Theoretical explanation of non-equipotential quench behavior in Y-Ba-Cu-O coated conductors," by M. Breschi, P.L. Ribani, X. Wang and J. Schwartz, published in Superconductor Science and Technology, was downloaded 250 times during the first quarter of 2007. First author **Marco Breschi** from the University of Bologna has an ongoing collaboration with **Justin Schwartz**, leader of the lab's HTS Magnets and Materials group, and **Xiaoming Wang**, a postdoc in the group. Read the article online at ***stacks.iop.org/0953-2048/20/L9*** .

Adriana Serquis, a former LANL postdoc and current user of the Pulsed Field Facility, was featured on nanotechweb.org in March for her work on MgB2. The article's introductory paragraph states: "Physicists in Argentina and the U.S. have improved the superconducting properties of magnesium diboride by chemically doping it with double-walled carbon nanotubes. Adriana Serquis of the Centro Atomico Bariloche-Instituto Balseiro and co-workers at the Los Alamos National Lab showed that the doping can significantly enhance magnesium diboride's upper critical field and its critical current density – two parameters that are essential for using the material in practical applications." You can read the full article online at ***/nanotechweb.org/articles/news/6/3/21/1.***

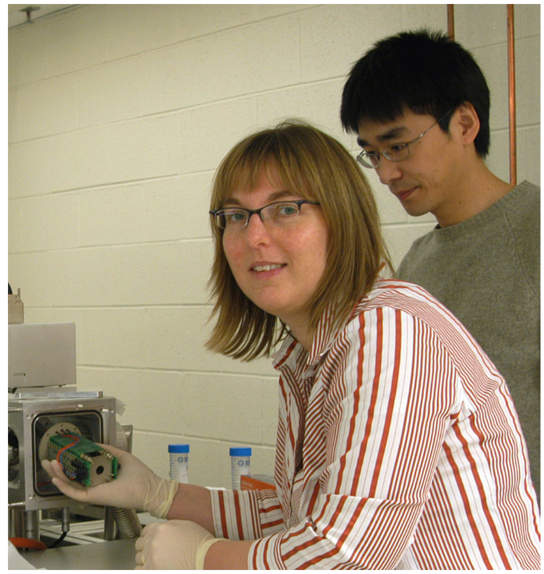


Sam Grant, an assistant professor of chemical and biomedical engineering and a researcher with the lab's Nuclear Magnetic Resonance group, received a poster award at the 2007 Joint Annual Meeting of the International Society for Magnetic Resonance in Medicine and the European Society for Magnetic Resonance in Medicine and Biology in Berlin, Germany. He received 2nd place in the category of "Other Techniques and Applications" for his poster entitled "High Resolution Sodium Imaging of Isolated Neurons." In total, there were 3880 oral and poster presentations at the conference, with 2893 posters (electronic and traditional) eligible for awards. Forty poster awards were given in 10 categories.

Neil Harrison, a senior staff member of the lab's pulsed field facility at LANL, was elected as a fellow of the American Physical Society's Division of Condensed Matter Physics. He was honored for "pioneering experimentation on the electronic structure and magnetism of strongly correlated electron systems in strong magnetic fields." He came to the Los Alamos Pulsed Field Facility as a postdoctoral researcher in 1996. Harrison earned his bachelor's and doctoral degrees in physics from the University of Bristol and received the Laboratory Fellow's Prize for Research in 2005.

Science Starts Here

KRISTINA HÅKANSSON, 34



POSITION:
Dow Corning Assistant Professor of Chemistry
University of Michigan

TIME AND ROLE AT THE MAGNET LAB:
June 2000-June 2003, postdoc in Alan Marshall's lab

CURRENT WORK:

Using reactions between free electrons and gaseous biological molecules, e.g. proteins, nucleic acids (DNA and RNA), and carbohydrates (sugars), to probe their structure. Hakansson's group is exploring the use of metal ions (e.g., calcium, manganese, cobalt, etc.) as charge carriers and has found that the dissociation of gaseous metal-biomolecule complexes can provide additional information, not available from other methods. The group utilizes these strategies to characterize binding between DNA/RNA and drug molecules and is embarking on an exciting project in which team members will use these methods to determine differences in the sugar molecules on the surface of cancer cells as compared to healthy controls. These experiments, performed in collaboration with a pancreatic cancer surgeon at the U-M Medical School, will allow researchers to gain further understanding of the molecular level changes that occur in cancer and to seek molecular targets of diagnostic and therapeutic importance.

IN HER OWN WORDS:

"My three years at the Magnet Lab have totally shaped my scientific career. Without the guidance of Prof. Alan Marshall, I would not have pursued an academic position in the United States. In fact, I had not even considered it until he encouraged me to apply."

"The (lab's) active users' program … meant that I had an opportunity to meet and work with outstanding scientists from all over the world. This opportunity was personally rewarding but it also resulted in me developing a set of skills that would have been difficult to gain at any other place."

"I truly enjoyed being part of a large research enterprise comprising several research directions where I would learn something new from every group meeting."

HOW MENTORS MAKE A DIFFERENCE

"A key word in Alan's group was freedom. He did not tell me what to do and I was free to explore new scientific directions with all the tremendous resources that were available … Since starting my position here, Alan has continuously supported my career and provided invaluable guidance any time I asked for it."

"Science Starts Here" showcases young Scientists whose career paths have been greatly shaped by their experiences at the Magnet Lab.

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