VOLUME 16 • NO. 3

NATIONAL HIGH MAGNETIC FIELD LABORATORY

MAG LAB REPORTS

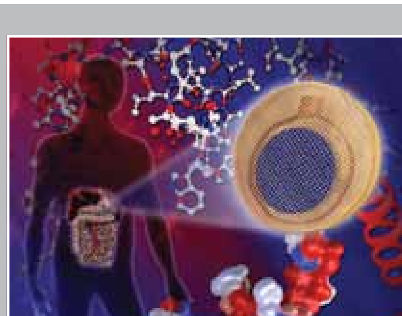
FLORIDA STATE UNIVERSITY · UNIVERSITY OF FLORIDA · LOS ALAMOS LAB

TABLE OF CONTENTS

Trying to reduce your carbon footprint? Sign up for an online subscription at http://www/mediacenter/publications/subscribe.aspx

Published by:
National High Magnetic Field Laboratory
1800 East Paul Dirac Drive
Tallahassee, FL 32310-3706

Tel: 850 644-0311
Fax: 850 644-8350
www.magnet.fsu.edu



On the cover:
Photo illustration by Kevin John.
See page 15 for the article that inspired the cover.

Director: GREG BOEBINGER
Associate Director for Management and Administration: BRIAN FAIRHURST
Director, Public Affairs: SUSAN RAY
Editor: AMY MAST
Art Direction and Production: SAVOY BROWN

Summertime brings budget relief, summer school

By Greg Beobinger

Bob Guertin will be missed. Bob, a member of the MagLab user community since Day One and career-long friend of Jack Crow, passed away June 12 after an extended battle with cancer. The next issue of *Mag Lab Reports* will feature tributes from several longtime colleagues and friends.

Greg Boebinger

LIGHT AT THE END OF THE BUDGET TUNNEL

With the increase in funding for scientific research at the Federal level, the MagLab and its user programs are emerging from the dark, poor, nasty, brutish and (thankfully) relatively short budget tunnel in pretty good shape to realize the potential articulated in the 2008-2012 renewal proposal. The 2008 National Science Foundation Site Visit Report added its voice to a wholehearted endorsement of the MagLab as a "unique and outstanding scientific resource" with a user program that is "maintaining its leading position in the world" in high magnetic field research. The advice in the report matches the budget planning of the MagLab in both general and specific terms … would that the Federal government and NSF and MagLab had the budget to address them.

But the good news is … In 2009, the NSF has been able to fund the MagLab at the level recommended back in 2007. We will use the much-needed budget increase almost entirely on updating our aging infrastructure and modernizing the user program instrumentation. (For more details, see the Director's Desk in Vol. 16, Issue 1 of *Mag Lab Reports*). Over half of the dollars in the increase will go toward replacing the core of our cryogenics plant, the ugly below-the-radar-screen nuts and bolts that keep the 45-tesla hybrid magnet, the many MagLab superconducting magnets, and a good fraction of the user program experimental samples cold. The new plant will increase our liquid helium capacity, our operating efficiency, and our contribution to the university metal recycling program.

The next biggest chunk, about one-quarter of the new dollars, will enable a steady parade of improvements in our Big-Dog generator-driven pulsed magnets. These magnets, the 60 T Controlled-Pulse and 85 T Multi-Shot Magnet, are the MagLab's flagship pulsed magnets, putting us on the road to reaching 100 T nondestructively and giving the MagLab's pulsed field user community unique opportunities to crank out great condensed matter science, even as the world of pulsed magnetic field research grows rapidly more competitive.

PRAISE FOR OUR DIVERSITY PROGRAMS

Accolades for the MagLab's programs to increase diversity in the nation's science, technology and engineering ranks have been coming from more places than one, a welcome improvement from the bumps and bruises we took in 2004. In addition to the 2008 NSF Site Visit Report, the outbrief from the NSF at the on-site Business Systems Review included strong praise for the MagLab's diversity Web site for effectively communicating and facilitating the MagLab's diversity programs. In the official MagLab response to the NSF Business Systems Review, I highlighted the contributions of MagLab Diversity Committee Chair Dragana Popovic, Human Resources Director Bettina Roberson, Diversity Committee members, and the many actively involved scientists here at the Magnet Lab. We're not yet where we want to be on diversity, but it's great to get an occasional "atta-boy/girl" as we work to address this long-standing and complex problem.

SUMMER SCHOOL A SUCCESS

The very first ever Annual MagLab Summer School drew to a close June 27 after a successful debut and an inaugural class of some 28 students. The summer school seeks to improve laboratory techniques, so roughly half of the agenda was spent in the laboratory, tracking down noise and making high-quality measurements that are most often employed by our users. The idea is to make sure fine techniques of experimental design will persist and continue to develop in this era of increasingly automated measurements.

We've got the confidence now to roughly double the size of the MagLab Summer School next year, which will join the 2010 Physical Phenomena in High Magnetic Fields Conference as a recurring event at a Mag Lab near you.

Gregory S. Boebinger

GREGORY S. BOEBINGER

Top, the MS&T team celebrates. The game winning shooter, Gavrilin, is on the bottom row, second from the right.

MAGNET, MATERIALS SCIENTISTS SQUARE OFF

Iain Dixon (right), a research associate in the Magnet Science & Technology division, tries to steal the ball from Morgan Poitevin, a research assistant at the Applied Superconductivity Center, during the first ever "Collaborative Departmental Soccer Challenge" between the two groups. The match took place June 24 in 93 degree heat and was scoreless until the last few minutes of the game when Andrey Gavrilin scored to give MS&T a 1-point lead, which it never lost. The loss, no doubt, will be avenged, as despite bumps, bruises and busted lips, the groups voted in favor of a rematch.

'Mag Lab is just down the hall'

By Paul C. Canfield & Sergey L. Bud'Ko
Ames Laboratory and Department of Physics, Iowa State University

The Magnet Lab is an integral part of our research effort and essentially is an extra part of our lab. It is, figuratively speaking, just down the hall. When we need to grow a specific sample we walk over to our labs in Spedding Hall; when we need to measure temperature dependent resistivity up to 70 kbar we walk to the basement of Zaffarano; when we want to measure samples in fields in excess of our own 9 tesla (or later 14 T) lab magnets we go to the Magnet Lab. Over the past decade we have been able to utilize the Magnet Lab facilities to perform a variety of measurements on systems ranging from highly anisotropic local moment systems[1,2], to field induced quantum criticality in YbAgGe[3-5], to the determination of $H_{c2}(T)$ in a variety of high field superconducting systems[6-9]. The $H_{c2}(T)$ work probably best summarizes how access to high fields has been vital to our research efforts.

In collaboration with Alex Lacerda, we were able to measure the full, upper $H_{c2}(T)$ curve (Figure 1) for high purity MgB_2 [6] within a few weeks of devising a simple synthetic route for the synthesis of dense wire segments[10]. These data also provided unambiguous evidence of the large, normal state magnetoresistance associated with high purity MgB_2. Given that 16 T was a rather low $H_{c2}(0)$, we devised a method of introducing C into our B precursor and synthesized a series of $Mg(B_{1-x}C_x)_2$ samples in the hopes of increasing the $H_{c2}(T)$ curves without too severely suppressing T_c. In collaboration with Scott Hannahs, we were able to determine the increasingly large $H_{c2}(T)$ curves [7] (Figure 2) and demonstrate that bulk, C-doped MgB_2 could manifest critical fields that exceeded those of Nb_3Sn.[11]

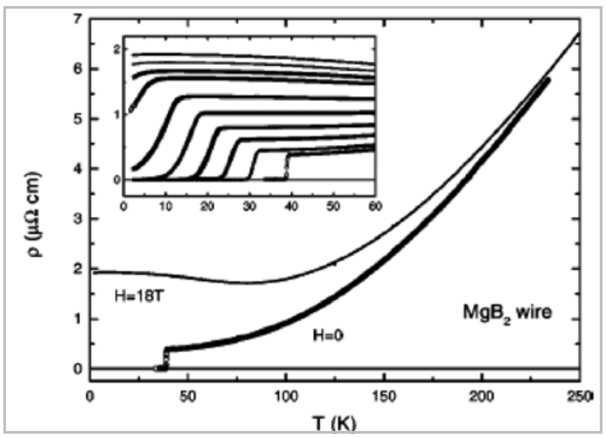


Figure 1a.
Temperature dependent resistivity of MgB_2 wire taken in applied fields of 0, 2.5, 5, 7.5, 10, 12.5, 15, 16, 17, 18 T. [6]

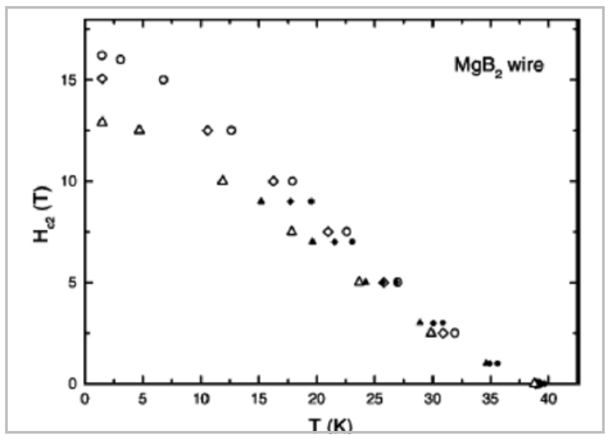


Figure 1b.
Upper critical field, H_{c2}, as a function of temperature inferred from onset, midpoint and offset criteria. [6]

More recently our work with the Magnet Lab has focused on the high field properties of the FeAs-based superconductors. After we synthesized the first single crystals[12] (Figure 3) of the $AEFe_2As_2$ materials (AE = Ba, Sr, Ca) we were able to determine the anisotropic $H_{c2}(T)$ of $(Ba_{0.55}K_{0.45})Fe_2As_2$ up to 14 T (Figure 3a).[12] It was clearly going to be a very high field superconductor, with what seemed to be a relatively small anisotropy, but higher field data were needed to either confirm or refute the long extrapolations required by our 14 T upper field limit. In collaboration with Chuck Mielke we were able to determine that $(Ba_{0.55}K_{0.45})Fe_2As_2$ has an impressively large H_{c2} (~ 40 T by 20 K!!) and an anisotropy that decreases from ~ 3 near T_c to ~1 below 20 K (Fig. 3b).[8] If wires, with good critical current density, can be made from this material it will have significant commercial potential. To that end it is worth noting that these data are robust, with a subsequently published report finding virtually identical results.[13]

When we performed a systematic study of the $Ba(Fe_{1-x}Co_x)_2As_2$ series[9] we again needed to use high fields to determine the anisotropic $H_{c2}(T)$ as a function of Co doping level (Figure 4). In collaboration with Scott Hannahs we found that there is a clear change in the temperature dependent anisotropy as the background that the superconducting state emerges from changes from orthorhombic / antiferromagnetic to tetragonal. In addition we can see that the general form of the anisotropy seen for the hole doped $(Ba_{0.55}K_{0.45})Fe_2As_2$ (roughly linear $H_{c2}(T)$ for H ||c and slightly higher, but non-linear $H_{c2}(T)$ for H || ab) is also found for electron doped $Ba(Fe_{1-x}Co_x)_2As_2$.

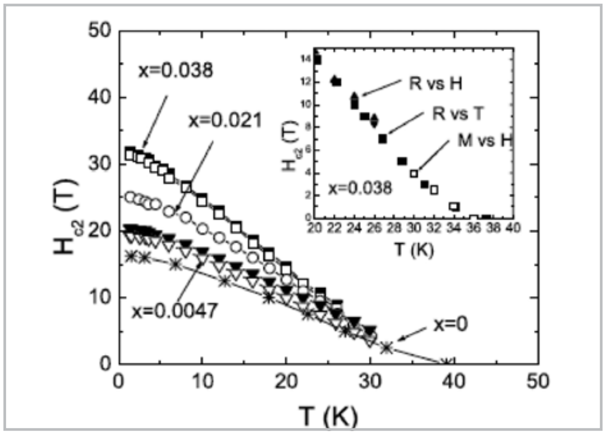


Figure 2.

H_{c2}(T) curves for Mg($B_{1-x}C_x$)$_2$ wire samples inferred from temperature dependent resistivity via onset criterion. 7

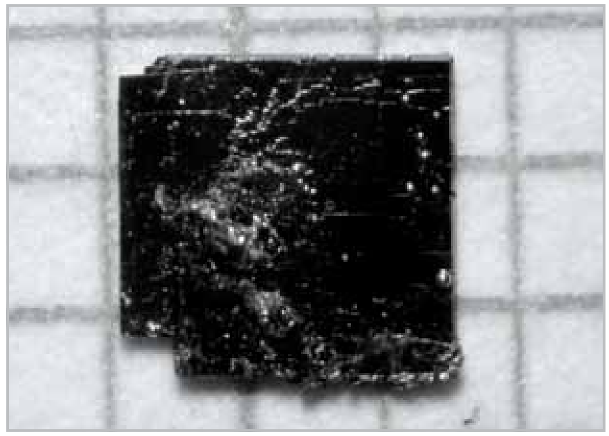


Figure 3.

First single crystal of ($Ba_{0.55}$ $K_{0.45}$)Fe_2As_2[12]

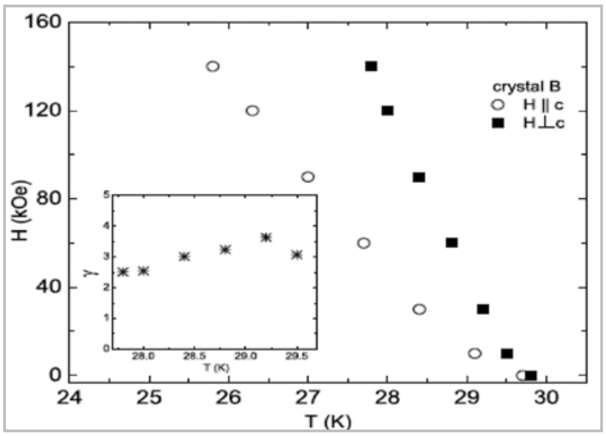


Figure 3a.

Anisotropic H_{c2}(T) data of ($Ba_{0.55}$ $K_{0.45}$)Fe_2As_2 for H < 14 T. Inset: H_{c2}(T) anisotropy. [12]

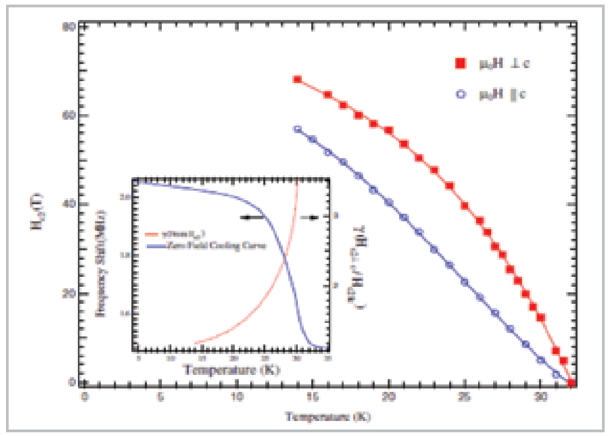


Figure 3b.

Anisotropic H_{c2}(T) data of ($Ba_{0.55}$ $K_{0.45}$)Fe_2As_2 from pulsed field data. Inset: H_{c2}(T) anisotropy. [8]

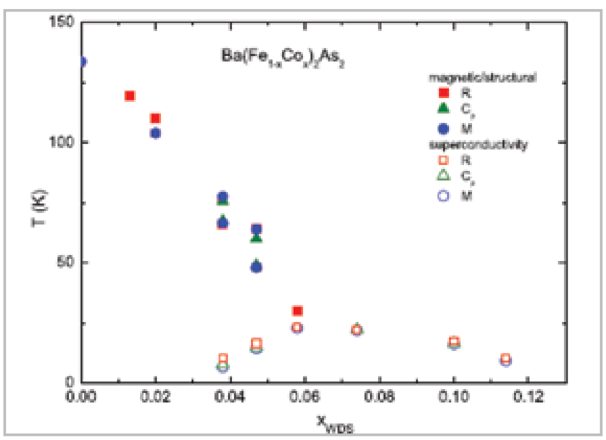


Figure 4a.

T- x phase diagram of Ba($Fe_{1-x}Co_x$)2As_2 showing suppression and splitting of tetragonal to orthorhombic / antiferromagnetic phase transitions as well as the lower temperature, superconducting dome. Note that superconductivity exists in both the lower-x antiferromagnetic / antiferromagnetic state as well as in the higher-x tetragonal state. [9]

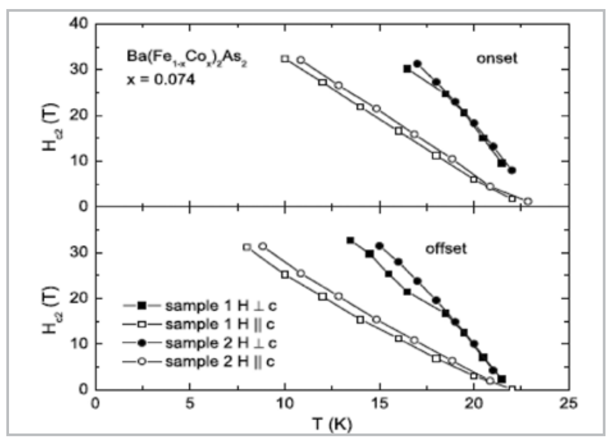


Figure 4b.

Anisotropic H_{c2}(T) data inferred from both onset and offset criteria on two samples of Ba(Fe_{1-x}Cox)$_2$$As_2$. [9]

In each of these cases, the Magnet Lab was readily accessible and staffed with eager, collegial and highly competent collaborators. This is what we want in our own labs and what we are always pleased to find in both Tallahassee and Los Alamos.

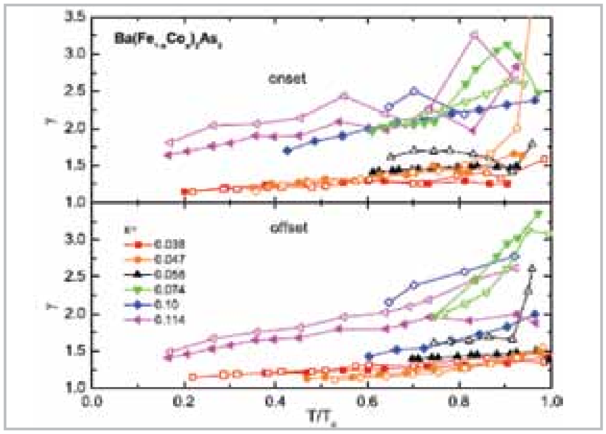


Figure 4c.

Temperature dependent H_{c2} anisotropy for $Ba(Fe_{1-x}Co_x)_2As_2$ series. [9]

ACKNOWLEDGEMENTS

Work at the Ames Laboratory was supported by the Department of Energy, Basic Energy Sciences under Contract No. DE-AC02-07CH11358.

REFERENCES

1. E Morosan *et al*., Journal of Magnetism and Magnetic Materials, **277** (3), 298-321 (2004).
2. E. Morosan *et al*., Physical Review B: Condensed Matter and Materials Physics, **71** (1), 014445/1-014445/20 (2005).
3. S.L. Bud'ko *et al*., Physical Review B: Condensed Matter and Materials Physics, **69** (1), 014415/1-014415/8 (2004).
4. S.L. Bud'ko *et al*., Physical Review B: Condensed Matter and Materials Physics, **72** (17), 172413/1-172413/4 (2005).
5. S.L. Bud'ko, P.C. Canfield, Physica B: Condensed Matter (Amsterdam, Netherlands), **403**(5-9), 1230-1232 (2008).
6. S.L. Bud'ko *et al*., Physical Review B: Condensed Matter and Materials Physics, **63** (22), 220503/1-220503/3 (2001).
7. R.H. Wilke *et al*., Physical Review Letters, **92** (21), 217003/1-217003/4 (2004).
8. M.M. Altarawneh *et al*., Physical Review B: Condensed Matter and Materials Physics, **78** (22), 220505/1-220505/3 (2008).
9. N. Ni *et al*., Physical Review B: Condensed Matter and Materials Physics, **78** (21), 214515/1-214515/9 (2008).
10. P.C. Canfield *et al*., Physical Review Letters, **86** (11), 2423-2426 (2001).
11. P.C. Canfield, S. Bud'Ko, Scientific American, **292** (4), 80-87 (2005).
12. N. Ni *et al*., Physical Review B: Condensed Matter and Materials Physics, **78** (1), 014507/1-014507/9 (2008).
13. H.Q. Yuan *et al*., Nature, **457** (7229), 565-568 (2009).

AMRIS looking to grow expertise, instrumentation, training

By Joanna Long

UF Associate professor Joanna Long has replaced Art Edison as Director of the Advanced Magnetic Resonance Imaging and Spectroscopy User Program. Glenn Walter is the new Associate Director.

Joanna Long

We are excited to be taking on the challenge of growing the programs in NMR and MRI/S at the Advanced Magnetic Resonance Imaging and Spectroscopy facility at the University of Florida branch of the Magnet Lab. Under the leadership of Art Edison, the facility has expanded to the point where we are pursuing new applications and research on multiple fronts in spectroscopy and imaging. Expanding the administrative structure of the facility to include two directors with complementary expertise will ensure we are able to continue to develop and utilize a wide array of magnetic resonance techniques. Currently the AMRIS facility supports an average of 60 research groups a year, with a third of them from outside the United States.

This year promises to bring more growth to the facility in both technical expertise and instrumentation. In particular, we are in the final stages of recruiting and hiring an imaging scientist to support both service applications within the facility and to develop collaborative research projects within UF and through the external users program. This is made possible by the generous support of the McKnight Brain Institute, which also provides our physical and administrative home at UF. The new staff member will be responsible for MRI/S applications development and support on the 4.7 T/30 cm, 11.1 T/40 cm, and 3 T/60 cm horizontal systems. He or she will also interface with staff responsible for RF coil development and higher field vertical systems for studies and technique development across magnetic field strengths.

Another promising development in the facility is the upgrade of our 11.1 T/40 cm system with a new console. This is made possible through an NIH Shared Instrumentation Grant with matching support from UF and the Magnet Lab. The upgrade will include multiple receiver channels as well as gradient coils with integrated shim systems and higher magnetic field gradients. The new system will serve as a platform for the development of our phased-array and multinuclear coils, yielding unprecedented animal imaging and spectroscopy capabilities. With the passing of the Recovery Act legislation, we have also submitted proposals to upgrade our 4.7 T/30 cm system and expand the NMR program through the acquisition of a 700 MHz system and are participating in a proposal to upgrade the helium recovery system at the University of Florida.

One of our top goals for the coming year will be to continue integrating the imaging and spectroscopy systems in the AMRIS facility with those housed in the NMR program in Tallahassee. Interactions between the RF, imaging, and spectroscopy groups of the two facilities have allowed the development of new technologies at multiple fields and with varying applications. These include the design and fabrication of a rat imaging probe for the 900 MHz ultra wide bore system in Tallahassee, with a complementary mouse imaging probe planned for the 750 MHz wide bore system in Gainesville, and the expansion of solid state NMR low-E coils to magic angle spinning applications on the 750 MHz wide bore system. Most recently, faculty affiliated with the Magnet Lab submitted a proposal through the NIH High End Instrumentation program to develop high temperature superconducting probes at 950 MHz. This effort was spearheaded by Art Edison in collaboration with the RF group in Tallahassee, Magnet Lab external users and a commercial partner, with the proposed installation of a 950 MHz NMR magnet at the lab in Tallahassee. We also look forward to developing further relationships with the University of Central Florida and the University of South Florida in the areas of developing nanoparticles as contrast agents and pursuing polarization enhancement methodologies.

Another goal this year is to continue expanding our training programs for students, postdoctoral fellows, and faculty in varied disciplines through both formal workshops as well as hands-on training provided within the facility. This year our users included 20 postdocs and 26 students, with several students successfully completing their thesis research through the AMRIS facility. External users are particularly encouraged to send students and postdocs for training, data acquisition, and to gain experience in coil design.

Faraday's cage to the rescue: RF noise reduction in the Millikelvin facility

By Ju-Hyun Park
Assistant Scholar / Scientist, Millikelvin Lab

Ju-Hyun Park

Situated at the entrance of DC field building at the Tallahassee Magnet Lab, the Millikelvin facility provides various low temperature experimental environments including Magneto-optics (ultra-violet through far infrared), magnetization, specific heat, transport, high pressure, low to medium resolution NMR, dependence of optical and transport properties on field orientation and more. In addition, use of superconducting magnets and programmable temperature control systems allow users to perform true 24/7 continuous scientific measurements.

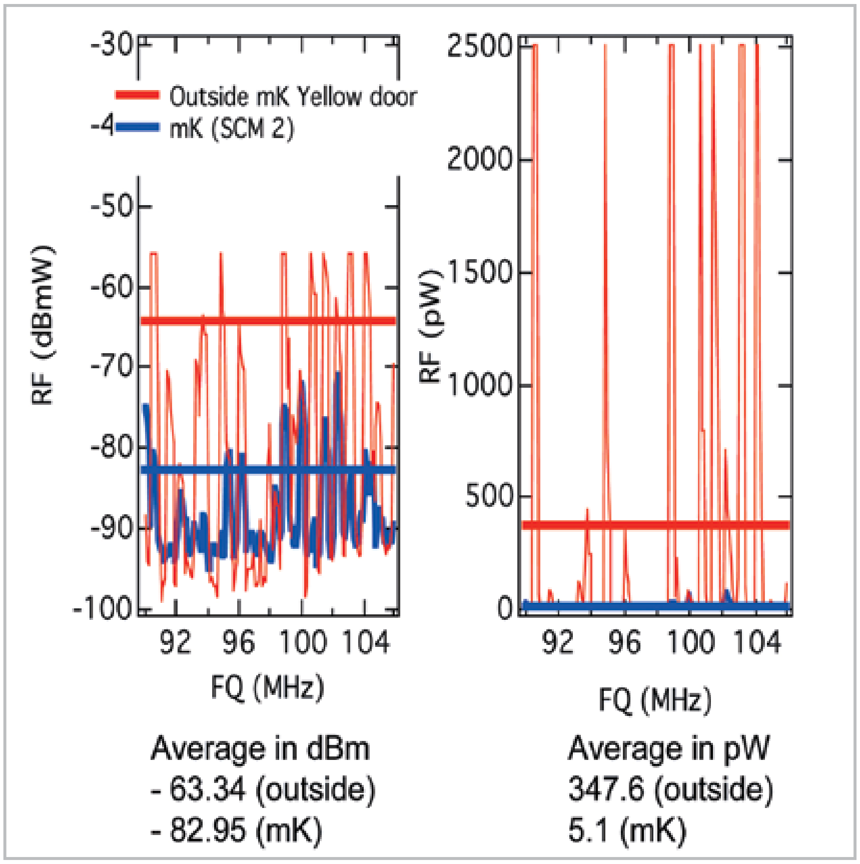
From the outside, the Millikelvin building sports a streamlined, modern look; flowers and palm trees, contrasting MagLab logo, nice reflecting windows, and occasional birds singing. The same is true from the inside. You can enjoy the nature of Florida through the big reflecting windows and it's quite soothing at the end of a hard working day.

I thought these windows were ideal until we noticed very noisy data due to radio frequency (RF) electromagnetic wave interference. In our Fourier transformed spectrum, we could see considerable amounts of unwanted RF signals. These unwanted RF signals (typically ranged at the FM radio frequencies) not only give noisy data but also occasionally couple with thermometry in the dilution refrigerator and increase overall temperature while decreasing the stability of constant temperature. In the case of nuclear magnetic resonance (NMR) experimentation, the situation is more serious because when there is interesting physics at certain field and if the corresponding exciting frequency is in the range of unwanted RF noise, it is hard to interpret the true result.

Left: The Millikelvin facility is located behind the building sign. Below: Copper mesh covers the windows in the Millikelvin facility to sheild it from unwanted RF interference.

After some preliminary testing, we came to the conclusion that the RF noise in the Millikelvin facility is mainly coming through the nice big windows. In fact, the RF noise was so severe, there was not much of difference between the parking lot and the inside of the Millikelvin facility in RF noise level. So, we had to RF block our beautiful windows using copper mesh. Basically, the idea was to construct Faraday cage. Since the rest of the building walls (except the entrance side) are pretty much surrounded by conducting material, we decide to cover the windows with conducting mesh and connect to the existing conducting wall.

Specifically, we installed a single layer 100 / in^2 mesh copper (0.0045" wire diameter) over the windows of approximately 450 ft^2 area. The mesh was attached to wooden frames and bolted securely to the metal window frames of the Millkelvin building. The mesh was purchased from TWP Inc. in 3 ft and 4 ft wide, 100 ft long rolls. After the screen installation, the RF noise in the Millikelvin (mK) is ~ 1.5% of the outside noise level (see figure) and similar or less than the noise in the resistive magnet cell 10. The RF strength was measured using a handheld Protek 3290 RF Field Strength Analyzer in the frequency range between 90 and 106 MHz.



The NMR experiment also seems to benefit from this mesh installation. Philip Kuhns and Arneil Reyes, who are in charge of NMR user support, have tested their NMR related performance and left positive feedback.

"The CMPNMR group evaluated the shielding put in the Millikelvin building to eliminate the RF interference we saw in past NMR experiments. These noise measurements were made using the standard CMPNMR spectrometer and a loop antenna. NMR users in SCM1 are interested primarily in the reduction of the FM radio signals, 88-108 MHz, so particular attention was paid to the frequency band 60-120 MHz. The shielding of the windows achieved a worst case reduction of times 16 in power at 101 MHz, elsewhere the reduction was much better. We also looked at a wider frequency range 20-450 MHz and found that only low level signals were present outside the Millikelvin facility and found that the shielding eliminated those signals entirely."

So, everybody seems to be happy at low RF noise environment in the Millikelvin. Of course, there are some downsides too. From inside, the sky isn't blue anymore and it is hard to tell whether it's raining. On the other hand I've got a better excuse for my wife because my cell phone doesn't work in the Millikelvin anymore.

ACKNOWLEDGEMENTS

Ju-Hyun Park, Sean Coyne, Tim Murphy, Jan Jaroszynski, Philip Kuhns, Arneil Reyes, John Kynoch, Scott Hannahs, and Eric Palm contributed to this project.

Funding by NSF Facilities Renewal Grant (227000-520-022742).

Mag Lab establishes Mössbauer spectroscopy facility

Andrew Ozarowski, Magnet Lab, Yarilyn Cedeño-Mattei, Department of Chemistry-Chemistry of Materials, University of Puerto Rico-Mayaguez

A Mössbauer spectroscopy laboratory is under development at the Mag Lab. Made possible by a User Collaboration Grants Program (UCGP) award to Andrew Ozarowski, the lab will ultimately become part of the lab's user program.

The main instrument, delivered several weeks ago, can currently take spectra only at room temperature. The low-temperature equipment should be operational by the end of June and further development includes installation of a superconducting 9 tesla (T) magnet (that can be pushed to 12 T) to study magnetically perturbed spectra.

Since Mössbauer spectroscopy is not commonly known among Magnet Lab scientists, we will explain its principles and present the first practical results obtained by Yarilyn Cedeño-Mattei, a Ph.D. candidate from Puerto Rico, who is visiting the Magnet Lab.

THE PRINCIPLE

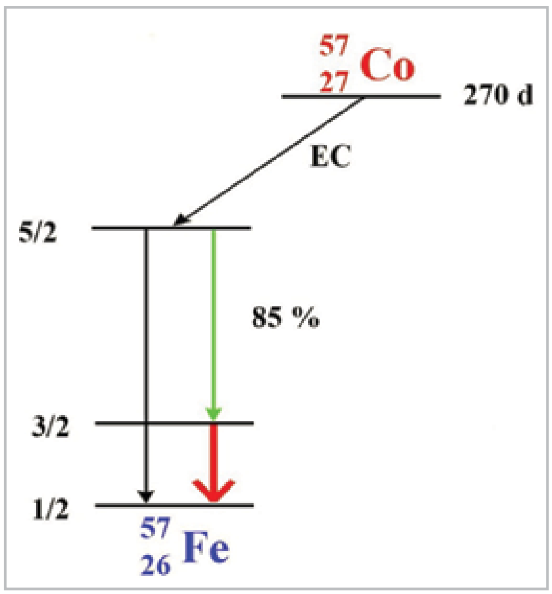


Figure 1.

Nuclear processes occurring in a Mössbauer source. The figure was taken from "Mössbauer Spectroscopy – Principles and Applications" by Philipp Gütlich, available at http://ak-guetlich.chemie.uni-mainz.de/Moessbauer_Lectures_web.pdf

In a radioactive source, Co-57 atoms undergo a nuclear "electron capture" process resulting in the formation of Fe-57 nuclei, which are born in their excited state with nuclear spin I=5/2. Next, the excited state energy is emitted in two steps, one from I=5/2 state to I=3/2 and finally from I=3/2 to I=1/2 state. In the latter step, a gamma quantum with energy of 14.4 keV is emitted

RECOIL-FREE GAMMA EMISSION

Emission of a gamma quantum by a free iron atom causes a recoil effect, according to the principle of the linear momentum conservation. As a result, an iron atom attains kinetic energy of

$$E_{recoil} = E_{\gamma} / 2m_{Fe}c^2$$

and the nuclear decay energy would be partitioned between E_{recoil} and E_{γ}. However, if the iron atoms are tightly bound in a crystal lattice, the recoil energy is not taken by the iron atom that undergoes gamma decay, but is rather transferred to the lattice phonons. A certain fraction (Debye-Waller factor) of the nuclear decay occurs without the lattice phonon excitation, which is essentially equivalent to the recoil momentum being absorbed by the entire crystal rather than by a single iron atom. Accordingly, the recoil energy becomes negligible resulting in unprecedentedly narrow emission band width of $4.6 \cdot 10^{-9}$ eV, some

13 orders of magnitude less than the gamma quantum energy itself. The Mössbauer effect relies on that extraordinarily monochromatic 14.4 keV radiation

GAMMA RAY ABSORPTION

When a sample containing iron is exposed to the 14.4 keV radiation, the quanta may be absorbed by Fe-57 nuclei (2.2% abundance in natural iron). But because iron atoms in the sample and in the source are in general in different environments, the Fe-57 nuclei in the sample require radiation frequency somewhat different from that emitted by the source. The frequency adjustment is accomplished by taking advantage of the Doppler effect. The radioactive source is moved versus an immobile sample and the plot of gamma absorption versus the source velocity is called a Mössbauer spectrum. Perhaps the most amazing aspect of the phenomenon is the required velocity – it is of the order of just millimeters per second.

An overwhelming majority of the Mössbauer studies are performed on iron, because of its abundance and importance in the living and non-living nature. However, the effect has been observed in more than 40 other elements including potassium, nickel, zinc, tin, gold and uranium.

IMPORTANT APPLICATIONS

- Iron detection, recognition of minerals containing iron
- Determination of the iron valence state, structure and bonding of compounds
- Magnetic properties of compounds and alloys, internal magnetic field detection and determination in ferromagnets.

Many branches of science take advantage of the Mössbauer spectroscopy, including chemistry, biochemistry and geology.

Figure 2.

Two miniature spectrometers designed in Prof. Philipp Gütlich's laboratory in Mainz, Germany were mounted on the rovers Spirit and Opportunity and sent to Mars where they identified some iron-containing minerals. Prof. Gütlich is a co-principal investigator in Ozarowski's UCGP grant. The picture was taken from http://ak-guetlich.chemie.uni-mainz.de/Moessbauer_Lectures_web.pdf

INTERACTIONS AFFECTING MÖSSBAUER SPECTRA

- Isomer shift – due to the electron density on a nucleus; provides information of the oxidation state, spin state, covalency and electronegativity. It shifts a resonance on the velocity scale without splitting it.
- Electric quadrupole interaction between the nuclear quadrupole moment and the electric field gradient on the nucleus – depends on oxidation and spin state and on the site symmetry. Splits a resonance line in two.
- Zeeman interaction between the nuclear spin and magnetic field – monitors magnetic properties like ferromagnetism. Causes six Mössbauer resonances to appear.

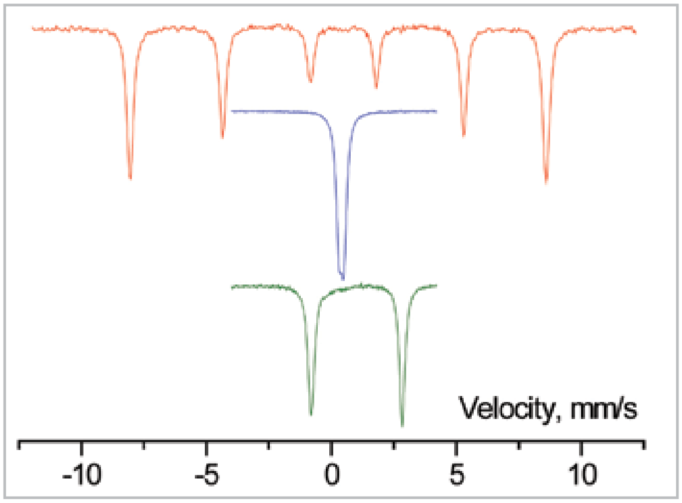


Figure 3.
Room-temperature Mössbauer spectra recorded at the Magnet Lab. Blue trace: A high-symmetry, low-spin iron(II) complex compound exhibiting a small isomer shift and very small quadrupole splitting. Green trace: a high-symmetry, high-spin iron(II) complex compound – higher isomer shift than in previous case and large quadrupole splitting. Red trace: iron(III) oxide Fe_2O_3 (hematite). Hematite is ferromagnetic and its internal magnetic field causes the Zeeman structure to appear.

PRELIMINARY RESULTS OBTAINED FOR FERRITE NANOCRYSTALS

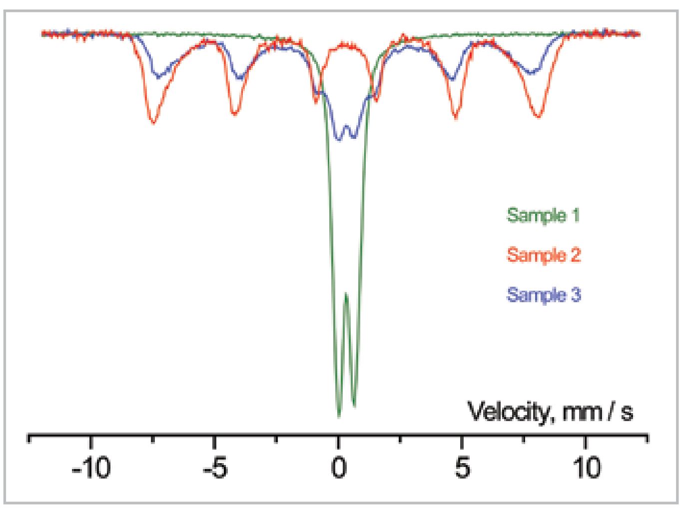


Figure 4.
Mössbauer spectra of cobalt ferrite $CoFe_2O_4$ nanocrystals produced by coprecipitation method under various preparative conditions to create different coercivities. Sample 1 appears to be a pure non-ferromagnetic substance, while sample 2 is a pure ferromagnetic material. Spectrum of Sample 3 is a sum of 15% of the non-ferromagnetic fraction, identical to Sample 1, and 85% of a ferromagnetic material, which is however different from Sample 2.

Yarilyn's research project titled "Composition- structure and size/shape-controlled synthesis and characterization of high coercivity ferrite nanocrystals" has as a main objective the determination of the single domain and multi-domain region limits as a function of the composition, structure, and crystal size in ferromagnetic ferrites.

The nanoparticles of cobalt-containing ferrite, $CoFe_2O_4$, display unusual properties making it a desirable material for advanced technological applications ranging from biomedical treatments to magnetic storage. High coercivity, strong uniaxial anisotropy, and a moderate magnetization, in addition to its high chemical stability and mechanical hardness make this ferrite a promising candidate for magnetic recording applications. Strong dependence of coercivity on crystal size is well known, and an increase of the crystal size within the single domain region limits causes coercivity enhancement. The coprecipitation method was employed in the production of these ferrites. Several synthesis parameters have been varied to control particle size, ion distribution, and hence, the magnetic properties.

Cobalt ferrite is an inverse spinel with Fe^{3+} ions in tetrahedral sites aligned anti-parallel to those from octahedral sites. The resultant saturation magnetization comes from Co^{2+} ions located in the octahedral sites. Some studies have shown that Co^{2+} ions can occupy both tetrahedral and octahedral sites, thus the spinel may be not completely inverse.

Mössbauer spectroscopy is a useful technique that helps in the determination of the magnetic structure of Fe ions and atomic re-arrangements (cation distribution within tetrahedral and octahedral sites) in the ferrite structures. It will also provide quantitative information related to the ferromagnetic and non-magnetic (superparamagnetic or paramagnetic) fractions in the sample.

The Mössbauer spectra of $CoFe_2O_4$ ferrite nanocrystals in Figure 4 show that ferromagnetic, non-ferromagnetic species as well as mixtures of both were created depending on the synthetic conditions. The internal field in the $CoFe_2O_4$ ferrites estimated from spectra in Figure 4 is about 48 T, compared to 51 T in hematite. Also, comparison of the spectra of the ferromagnetic ferrites with the hematite spectrum (Figure 3) indicates that the internal field in ferrites under study here is non-uniform, as judged from the large linewidth in their spectra. This may indicate a distribution of the crystallite sizes.

The results presented above are very preliminary and experiments will continue, particularly after our Mössbauer instrument enhancement. For now, the spectra in Figure 4 have confirmed that the synthetic methods were successful: sample 1, whose spectrum is plotted in green has been prepared under conditions restricting crystal growth and it was expected to be superparamagnetic rather than ferromagnetic. The presence of only the ferromagnetic phase in sample 2 spectrum indicates that all crystallites must be larger than 10 nm, while the spectrum of sample 3 suggests a wider size distribution with particles both smaller and larger than 10 nm.

ACKNOWLEDGMENTS

AO thanks the Magnet Lab for support in the form of a UCGP award. The Magnet Lab is funded by the National Science Foundation through the Cooperative Agreement No. DMR-0654118, the state of Florida and the Department of Energy. YCM thanks NHMFL and NSF-ESPCOR/IFN Fellowship for their support.

Selective wirelessly adjustable multiple-frequency probe (SWAMP) coil for MRI/S

B.L. Beck (UF, AMRIS Facility), B.S. Letzen (Johns Hopkins University, Biomed. Eng.), S. Wu (UF, Elect. Eng.), R. Bashirullah (UF, Elect. Eng.), N.A. Volland (UF, Biomed. Eng.), N.E. Simpson (UF, Medicine), and T. H. Mareci (UF, Biochemistry)

Approximately 7% of the U.S. population has diabetes, with 5-10% of these having Type-I diabetes. Diabetes is a pancreatic disorder in which insulin production is hindered[1] resulting in abnormal fluctuations in blood glucose levels. Although careful blood glucose monitoring and frequent insulin injections can give Type 1 diabetics a near-normal life, they are still greatly affected by this lifestyle. Moreover, this intensive therapy does not provide normal physiological control of blood glucose levels and can only delay the major health consequences of diabetes[2,3]. For direct and immediate regulation of blood glucose, an alternative therapy is the implantation of tissue-engineered pancreatic constructs[4,5] that produce insulin in response to the presence of glucose in a physiological manner.

Once implanted, these tissue-engineered constructs must be monitored to assess tissue viability and function. The most appropriate and non-invasive method to monitor function in such a construct is with NMR imaging and spectroscopy[6,7]. However, current NMR methods rely on external coils to monitor implanted tissue constructs. These measurements are sensitivity-limited and therefore hinder the evaluation of the construct function, performance and potential longevity. In addition, these evaluations require that multiple NMR-accessible nuclei, such as ^{1}H, ^{19}F, ^{31}P and ^{13}C, be measured from the tissue construct for a more complete characterization of the pancreatic substitute's function. However, conventional multiple-frequency coil tuning designs[8,9,10] significantly limit the NMR sensitivity and are very difficult to implement for more than two frequencies[11,12], particularly for an implanted coil, due to size constraints.

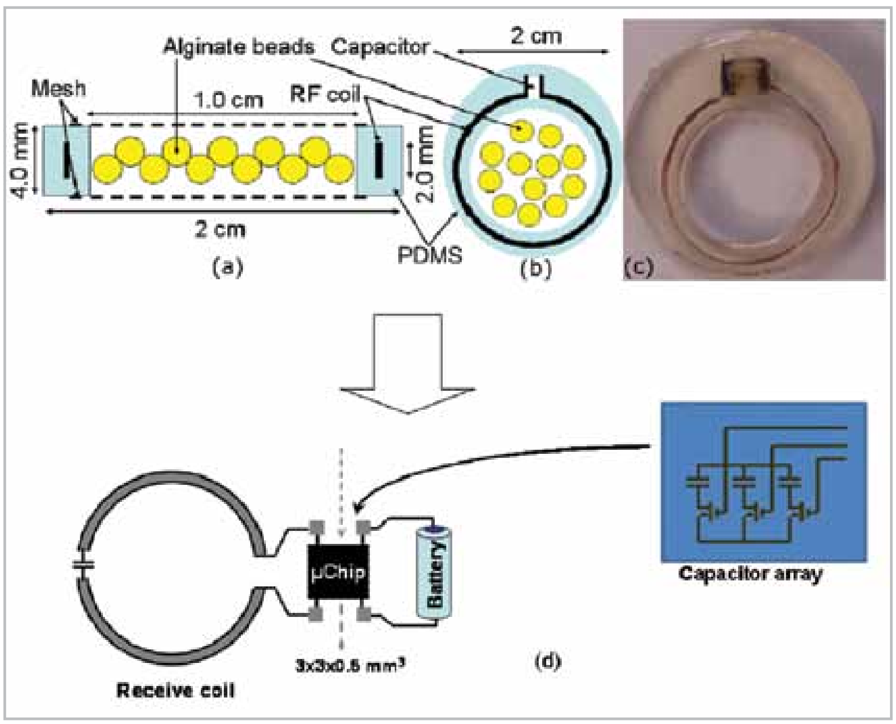


Figure 1.
Bioartificial construct, implantable coil assembly: (a) transverse view, (b) coronal view, and (c) a polydimethylsiloxane-coated coil used to create the assembly. The tissue containing alginate beads are contained in the cylindrical cavity created by the PDMS-coated implanted coil and the mesh screens. Part (d) is future implementation with microchip.

To overcome the sensitivity limitations of current NMR methods, we have developed an NMR coil[13] that is included with the implantable bioartificial pancreas (Figure 1). NMR measurements are performed by inductively coupling this implanted coil to an external coil, which is connected to the NMR instrument. In addition, we have developed a multiple-frequency implantable coil design (NIH R21EB009555, T. H. Mareci, PI) that involves a "single resonant" approach (Figure 2). This design uses an array of capacitors embedded within a microchip that is remotely switched (via an embedded microcontroller) to resonate with the inherent coil inductance at the desired NMR frequency. To switch the microchip to the desired frequency, standard NMR console pulse sequencing capability is used to transmit a sequence of low-power triggering pulses that communicate with the microcontroller. Therefore, the coil essentially behaves like a single-frequency resonant coil and this approach significantly improves the detection sensitivity.

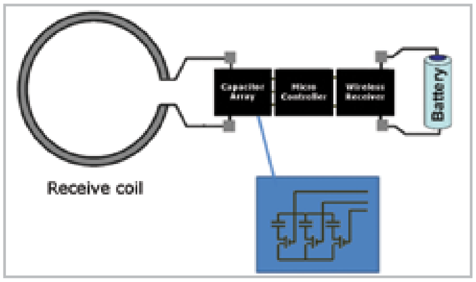


Figure 2.
Diagram of implantable NMR receiver coil with wirelessly controlled microchip. The blue box shows the capacitor array schematic diagram.

With a wirelessly adjustable multiple-frequency implantable coil, the external coil must also be tuned and matched to multiple frequencies for efficient inductive coupling for NMR measurement. To accomplish this goal, we are developing an automatic impedance matching (AIM) system (Figure 3) that allows the implanted and external coil system to be remotely controlled and automatically tuned and matched. The AIM system uses a microprocessor-controlled feedback loop consisting of a Voltage Controlled Oscillator, a directional coupler to measure the reflected signal of the external coil (coupled to the implanted coil), and voltage controlled varactors for tuning and matching. This combination of remote control of both the implanted and external coils allows the SWAMP coil system to be optimally turned to a single NMR frequency for the nucleus of interest.

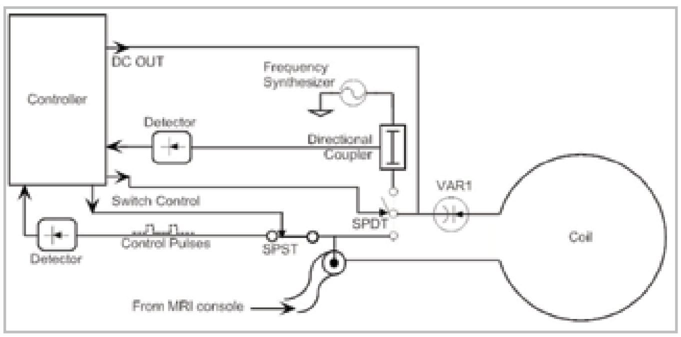


Figure 3.
Conceptual diagram of the automatic impedance matching system for the external NMR coil.

The design concepts developed for the SWAMP coil system can be used for other NMR measurements. For example, the AIM system provides an efficient and convenient way to tune and match NMR coils for the exact electrical environment inside a magnet and the electrical loading conditions of the sample. Since tuning and matching is required for all high sensitivity NMR measurements, this procedure is particularly important at the high NMR frequencies of advanced magnet systems, like those of the Magnet Lab.

ACKNOWLEDGEMENTS

This work was supported through the National High Magnetic Field Laboratory and the data obtained at the Advanced Magnetic Resonance Imaging and Spectroscopy Facility in the McKnight Brain Institute of the University of Florida. The project described was supported by award number R21EB009555 from the National Institute of Biomedical Imaging and Bioengineering. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Biomedical Imaging and Bioengineering or the National Institutes of Health.

REFERENCES

1. J.W. Yoon and H.S. Jun, Am J Ther., **12**(6), 580-591 (2005).
2. R.P. Robertson, N Engl J Med., **327**(26), 1861-1868 (1992).
3. D.E. Sutherland, Transplant Proc, **28**(4), 2131-2133 (1996).
4. F. Lim, A.M. Sun, Science, **210**(4472), 908-910 (1980).
5. A. Sun, *et al.*, Artificial Organs, **4**(4), 275-278 (1980).
6. C.L. Stabler, *et al.*, Cell Transplantation, **14**(2-3), 139-149 (2005).
7. C.L. Stabler *et al.*, Tissue Eng, **11**(3-4), 404-414 (2005).
8. M.D. Schnall, *et al.*, Journal of Magnetic Resonance, **65**, 122-129 (1985).
9. J.R. Fitzsimmons, *et al.*, Magnetic Resonance in Medicine, **5**:471-477 (1987).
10. T.M. Grist, *et al.*, Magn Reson Med, **6**(3), 253-264 (1988).
11. S.M. Eleff, *et al.*, Magnetic Resonance in Medicine, **7**(4), 412-424 (1988).
12. J.R. Fitzsimmons, *et al.*, Magnetic Resonance in Medicine, **10**(3), 302-309 (1989).
13. N.A. Volland, *et al.*, Magnetic Resonance in Medicine, 2009; submitted.

Center expands its research agenda

Research on two Center for Integrating Research & Learning (CIRL) programs – SciGirls summer camp and Research Experience for Teachers – were presented at major conferences this spring and generated a great deal of interest.

Roxanne Hughes, graduate research assistant in CIRL, presented her data from two years of research on the girls in science program at the American Educational Research Association annual meeting. Margareta Pop, a former graduate research assistant and now faculty member at North Carolina State University, presented a paper co-authored by CIRL Director Pat Dixon, on the RET program at the American Educational Research Association and the National Association for Research in Science Teaching. In late March Carlos R. Villa, outreach coordinator, presented a session on magnet-based activities in New Orleans, Louisiana, at the National Science Teachers Association (NSTA) conference. The session was aimed at elementary through high school teachers and covered basic and advanced topics in magnetism. In addition, Jose Sanchez, CIRL assistant director, attended the annual National Research Centers Education Network (NRCEN) meeting to share best practices in educational outreach from NSF-funded facilities.

SUMMER PROGRAMS UNDERWAY

Summer programs include Research Experiences for Undergraduates (REU), RET, SciGirls, teacher workshops for 36 local teachers, and Operation Filmmaker Goes Science for students to produce documentary films related to science. This year's REU program received 150 quality applications. Students came to Tallahassee and Gainesville, Florida, and Los Alamos, New Mexico, from universities as far as Sacramento, California, and University of Puerto Rico Mayaguez. Likewise, the RET program received its largest number of applications, 78, since its inception in 1999. In addition, CIRL is working with the Center for Advanced Power Systems' (CAPS) ERC FREEDM project to provide oversight for five high school students and two teachers who will work with CAPS engineers in a five-week research internship. Brandon Nzekwe, graduate research assistant, will oversee student activities for the five weeks introducing them to science and engineering topics on sustainable energy.

David McPherson conducts research with Jim Cao.

Jose Sanchez and Pat Dixon have been invited to facilitate full-day workshops on magnetism and electricity at Florida Atlantic University for 70 teachers. In addition, the lab and CIRL support statewide initiatives for teachers to address the new Florida science standards by hosting 35 third through eighth grade teachers for a two-week workshop at the Magnet Lab.

Alicia Calero worked with the NMR group this summer.

Brandon Nzekwe and Pat Dixon traveled to the University of Central Florida in Orlando for a workshop as part of Engineering Education Day further expanding CIRL's outreach. Monthly workshops for teachers concluded for the 2008-2009 academic year with plans to continue providing professional development for local elementary teachers at two schools for the 2009-2010 academic year. Carlos Villa, Jose Sanchez and Pat Dixon continue their active and enthusiastic participation with local science organizations that enhance classroom science and engage and excite students.

August Larson analyzes a sample.

Nicholas Bembridge, a research assistant in MS&T, works with a middle school student.

MIDDLE SCHOOL MENTORSHIP PROGRAM WRAPS UP

Fourteen middle school students participated in the spring mentorship program that culminated in a public presentation of their research. The PowerPoint presentations ranged in subject from the sinking of the Titanic and a study of meteorites, to the strength of rolled copper and creating a fluidyne sterling engine. Working with middle school students every Friday for 10 weeks takes time, commitment, patience and an understanding of just how bright these students are. Mentors included Nicholas Bembridge, Lloyd Engel, Afi Sachi-Kocher, Nicole Tibbetts, Hans Van Tol, Philip Kuhns, Arneil Reyes, Vince Toplosky and Bob Walsh.

The CIRL research agenda includes the continuation of REU Tracking with the addition of additional surveys of former participants and surveys of mentors who have worked with students 1999-2009. Brandon Nzekwe is starting the second year of this project and is expanding it to include a study of who mentors students and why. Currently we are constructing a survey that will examine the REU program from 1999–2009, and seek to understand participant expectations, motivations, and learning outcomes as a result of the REU program. Additionally, we are examining the REU applicant data from 1999-2009, which shows a number of interesting trends and offers data on the types of students that apply to the REU program. The majority of students who apply are juniors (41.0%), are male (56.2%), are Black or African American, Non-Hispanic or Latino (22.5%), and from 2001-2009, 11.6% of the REU applicants were from historically black colleges or universities.

RET research continues as part of the grant that funds the program with preliminary results on how teachers translate their experiences to the classroom having already been presented at national conferences. A separate RET study resulted in the publication in *Professional Development in Education* of *Research Experiences for Teachers: Influences Related to Expectancy and Value of Changes to Practice in the American Classroom,* co-authored by Crissie Grove, Pat Dixon and Margareta Pop.

Science Fair research is in the final stages; program evaluation of outreach and workshops is currently being conducted; and Roxanne Hughes is conducting a longitudinal study of SciGirls participants. Kristen Molyneaux joins the research team this summer, facilitating data collection for the ERC FREEDM project, and planning further research on informal science education beginning in Fall 2009.

Intrepid science fair judges were busy during the spring semester, encouraging elementary students to pursue their questions about a wide variety of science topics. Pat Dixon, Jose Sanchez, Eric Hellstrom, Afi Sachi-Kocher, Todd Adkins, Stephen McGill, Bill Brey, George Bou-Assaf, Iain Dixon, Bob Walsh and others listened to students explaining their theories about ice melting, planes flying, water quality, and health and safety issues of biphenol-A. All agree that it is exciting to talk with very young students who are learning about how scientists work and how we learn about the world around us.

In a climate of renewed interest in science, CIRL is privileged to bring the excitement of science to a diverse audience. Ira Flatow, host of NPR's Science Friday, visited the FSU campus and WFSU-TV, the Magnet Lab's partner in the SciGirls program. During a talk, he stressed the need for communicating science to the broad audience of students, teachers, and the general public and to encouraging their enthusiasm by finding new and inventive ways to translate the sometimes complex and misunderstood world of science research. CIRL's mission is to do just that.

People

CONDENSED MATTER SCIENCE

Associate Scholar/Scientist **Luis Balicas** will be returning to the country where he received his doctorate; he has accepted a position at the Grenoble High Magnetic Field Laboratory.

Kristen Collar, an undergraduate physics major working with **Stan Tozer**, took first place in The Florida State University Physics Department's undergraduate poster symposium, for which she received the Lannutti Award for Undergraduate Research and $750. The award is named for Joseph E. Lannutti, who was a pioneering professor of physics at FSU. Collar, who will be a junior in the fall, first came to the Magnet Lab as a freshman through FSU's Women in Math, Science and Engineering program. She conducts research on the flux growth of crystals and their characterization, an effort funded by U.S. Department of Energy/National Nuclear Security Administration (NNSA).

Vladimir Dobrosavljevic, right, director of the Magnet Lab's Condensed Matter Theory group and a physics professor at FSU, received the 2009 Marko V. Jaric Prize for Outstanding Scientific Achievement in Physics. The award, the highest honor in the field of physical science in the scientist's native Serbia, recognized Dobrosavljevic's contribution to the development of the theory of correlated disordered electronic systems.

Alex Gurevich

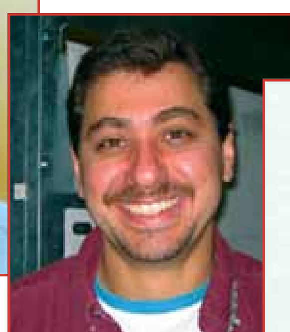
Pedro Schlottmann

The American Physical Society (APS) has honored two Magnet Lab-affiliated FSU physicists — **Alex Gurevich** and **Pedro Schlottmann** — as "Outstanding Referees" for 2009. Gurevich, an APS fellow, is a scholar/scientist and principal investigator in the Applied Superconductivity Center (ASC) at the Mag Lab; Schlottmann, a physics professor and member of the lab's Condensed Matter Science group, was a Heisenberg fellow of the German National Science Foundation. The Outstanding Referee award is designed to recognize scientists who have been exceptionally helpful in assessing manuscripts for APS journals. The honorees, who come from 35 countries, were chosen for the quality, number and timeliness of their reports, whether or not the scientists were members of the APS.

Art Hebard, Distinguished Professor of Physics at the University of Florida and affiliate with the Magnet Lab condensed matter science group at UF, is co-winner of the James C. McGroddy Prize for New Materials bestowed by the APS.

Matt Jewell (Ph.D. 2008), affiliated with the Mag Lab's ASC division, was one of four scientists chosen from a field of 28 applicants to be ITER Monaco Postdoctoral Fellows, a fellowship funded by the Principality of Monaco. Jewell was congratulated by HSH Prince Albert II during a February lunch hosted by the prince in the Palais Princier. He is currently working on understanding, specifying and procuring the superconductor for the ITER magnets at the ITER Organization in Cadarache, France.

Alex Lacerda



Chuck Mielke

Jonathan Betts

Former Mag Lab Director of User Programs and Pulsed Field Facility (PFF) Center Leader **Alex Lacerda** has been named director of the Los Alamos Neutron Science Center. **Chuck Mielke** has been named interim center leader, and **Jon Betts** has been named interim director of the pulsed field users program.

Akiyasu Yamamoto, Japan Science and Technology Association post-doctoral fellow in the ASC, is among an elite group studying iron oxypnictides, a promising class of high-temperature superconductors that has been called "the hottest thing in superconductivity." Research published by Yamamoto working with **David Larbalestier** and colleagues in Superconductor Science and Technology was named one of the journal's top papers of 2008. The article, "Evidence for two distinct scales of current flow in polycrystalline Sm and Nd iron oxypnictides," was widely read and praised in the scientific community.

A former Magnet Lab REU student has been awarded a Fulbright Scholarship to build solar-powered water-filtration systems in Ghana this summer. **Amanda Lounsbury**, a senior physics major at Occidental College in Los Angeles, participated in the 2008 summer research program at the Magnet Lab's Tallahassee headquarters, where she was supported by the DOE/NNSA. Lounsbury worked with **Eric Palm** on helium mixtures and fabricated capacitive thermometers to extend measurements to the highest fields.

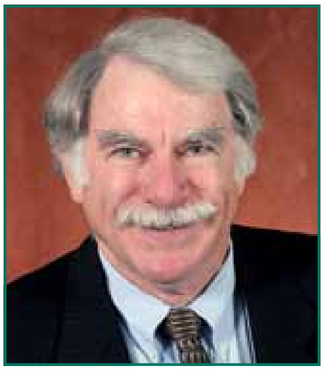
FSU physics undergraduate student **Alison Pawlicki** received the Lynn Shannon Proctor Fellowship for outstanding research by a student in a group that is underrepresented in the field of physics. The award is given in honor of Ms. Proctor, who was majoring in physics at FSU at the time of her death. Pawlicki was also inducted into the Sigma Pi Sigma honor society and took second place in the physics department's undergraduate poster symposium. A junior, Pawlicki works with physics professor and Magnet Lab experimentalist **Chris Wiebe** on the synthesis of new magnetic oxides.

Jack Crow Professor of Engineering and Applied Superconductivity Center group member **Justin Schwartz** has accepted a position as department head of Material Science and Engineering at North Carolina State University. Schwartz will be the Kobe Steel Distinguished Professor.

A paper by physicist **Suchitra Sebastian**, the Trinity College Research Fellow at the University of Cambridge, was selected by editors of *Journal of Physics: Condensed Matter* as one of the year's best. The article, "Quantum oscillations in the parent magnetic phase of an iron arsenide high temperature superconductor," was based on research done in the Mag Lab's world-record hybrid magnet. Sebastian travels frequently to the lab and has published numerous papers on experiments conducted here.

Chris Wiebe, an assistant professor of physics at Florida State University and member of the lab's Condensed Matter Science-Experimental group since 2005, is heading home: He has accepted an associate professor position at his alma mater, the University of Winnipeg/ University of Manitoba.

ION CYCLOTRON RESONANCE



Alan G. Marshall, director of the Ion Cyclotron Resonance program and the Robert O. Lawton Professor of Chemistry and Biochemistry at FSU, in March was officially named the co-recipient of the 2009 New Frontiers in Hydrocarbons Award, sponsored by Eni, an Italian energy company. The prize recognizes "internationally significant results in the development of technologies for the efficient use of hydrocarbons with particular reference to the activities of exploration, production, transport, distribution and transformation." It consists of a gold medal specially minted by Italy's Zecco di Stato (State Mint) and a monetary award in the amount of 300,000 euros (about $409,000).

George M. Bou-Assaf, a Ph.D. candidate in Marshall's ICR group, has been awarded an American Heart Association Predoctoral Fellowship, for "research broadly related to cardiovascular function and disease and stroke, or to related clinical, basic science, bioengineering or biotechnology, and public health problems." The fellowship provides a stipend of $21,770/year for two years, and will support George's research on the solution-phase structure of troponin, a key element for muscle contraction.

Christine Hughey, 2002 Ph.D. from the ICR program and associate professor of chemistry at Chapman University, won first place in the Undergraduate Analytical Research Program from the Society of Analytical Chemists of Pittsburgh. Her proposal, "Effect of Mobile Phase Modifiers on Chromatographic Separation and Negative Ion Electrospray Ionization (ESI) Response," was recognized at the SACP 2009 Awards Meeting at Duquesne University in May. The award comes with a $10,000 grant designed to "promote high-quality, innovative research, training, and development of undergraduate students in the field of analytical chemistry."

Amy McKenna

Hui-Min Zhang

Two Ph.D. students working in the ICR program recently won awards. **Amy McKenna** collected the American Chemical Society Petroleum Chemistry Student Award, while **Hui-Min Zhang** received a 2008-2009 FSU Graduate Student Research and Creativity Award. Additionally, Zhang, who completed her Ph.D. in molecular biophysics at FSU this spring, received that program's 14th Annual Kasha Award. This award recognizes a molecular biophysics graduate student for authoring the best scientific manuscript for the previous two years. The award, which includes a $500 honorarium, was presented at a ceremony in June. In her prize-winning paper (*Analytical Chemistry* 2008, 80, 9034-9041), Zhang established "protease XIII" from Aspergillus as the proteolytic enzyme of choice (replacing pepsin, the previous universal standard) to greatly improve characterization of protein conformational changes on binding of drugs or other proteins, based on hydrogen/deuterium exchanged monitored by high-resolution mass spectrometry.

The 7th North American Fourier Transform Mass Spectrometry Conference was held in Key West, Florida, April 18-22, 2009. Organized by the Magnet Lab, this biennial conference has become a primary forum for presentations of the latest and best developments in FT MS. In spite of cutbacks from the recent worldwide recession, the 2009 meeting attracted 84 leading researchers from around the world. The technical program featured 41 posters (including 20 presented by graduate students) and 24 invited speakers, including a closing lecture by **Jack Beauchamp**, Mary and Charles Ferkel Professor of Chemistry, Caltech. The invited presentations ranged from instrumentation to technique development in the biological/biomedical sciences from pharmaceutical metabolism to proteomics, environmental analysis, and petroleomics, with special emphasis on new developments. Sponsorship by Bruker-Daltonics, Eksigent, ExxonMobil, FSU Department of Chemistry & Biochemistry, Proxeon, and Thermo Fisher Scientific made it possible to provide registration and four nights lodging for all invited speakers as well as registration/lodging awards for student poster presentations.

NMR/MRI

Undergraduates sponsored by **Bill Brey** and **Peter Gor'kov** of the Mag Lab's Nuclear Magnetic Resonance group tied for best project in the 2008-2009 FAMU-FSU College of Mechanical Engineering Capstone program, a yearlong course encompassing product design and implementation with real-world engineering issues.

Left to Right: Kitchen, Vanterpool, Altman, Stevenson

The team – composed of **Rebecca Altman**, **Jason Kitchen**, **Zac Stevenson** and **Jessica Vanterpool** – developed a method of maintaining the required temperature of a sample for the duration of an experiment in the lab's flagship 900 MHz magnet. The project made a meaningful contribution to the NMR user program by improving sample temperature stability in the 900. To learn more about the project, visit: www.eng.fsu.edu/ME_senior_design/2009/team2/.

Joanna Long

Glenn Walter

University of Florida Biochemistry & Molecular Biology Associate Professor **Joanna Long** is the new director of the lab's Advanced Magnetic Resonance Imaging and Spectroscopy user program. Long replaces **Art Edison**, who is now director of the lab's chemistry and biology programs. **Glenn Walter** will be Associate Director. Read about Long's goals for AMRIS on page 8.

Huan-Xiang Zhou, associate professor of physics at FSU and member of the lab's NMR program, was elected a fellow of the American Association for the Advancement of Science.

Science Starts Here

Nakamae with her family — her husband, Bertrand Baudouy , was a postdoc with Steven Van Sciver.

NAME:

Sawako (Saco) Nakamae, 37

POSITION:

Researcher, Condensed Matter Physics (French Atomic Energy Research Center)

TIME AND ROLE AT THE MAGNET LAB:

1993 to 1999, graduate research assistant

CURRENT WORK:

Saco Nakamae is an experimental condensed matter physicist who investigates magnetism of nanostructured objects including magnetic nanoparticles, biomolecules and biologically inspired materials.

IN HER OWN WORDS:

I arrived to the Mag Lab shortly after its construction. Nearly all of the labs/research groups had not been finished (or not even started). Therefore, I have witnessed start-up labs from their birth to operation. This was a unique and valuable experience that has helped me decide how to (or how not to, for that matter) start my own research group.

I keep reminding myself and my students that in research, every effort, including failed experiments, leads to the advancement of our knowledge.

HOW MENTORS MAKE A DIFFERENCE:

I did not "meet" Justin Schwartz at the Magnet Lab. I started working in Justin's group initially as a Japanese-English translator of scientific articles on MAGLEV (magnetically levitated vehicles) during my undergraduate years at University of Illinois in Urbana, Illinois. I became quickly interested in the contents of what I was translating more than in the translation itself. Noticing this, Justin suggested that I join his research group to see "what it is like to do research."

Professor Schwartz thinks fast and wide. At times I felt as if his brain was a 10-lane highway (each lane representing his project, course, etc.) with 10 cars driving at 100 miles per hour, switching lanes, without anybody having an accident. But what impressed me more than such super-human scientific ability, was his very human personality. On the contrary to the sterotypical image of a brainy professor, he can tell jokes (and sometimes, they were even funny!!) and always treated his graduate and undergraduate students with respect.

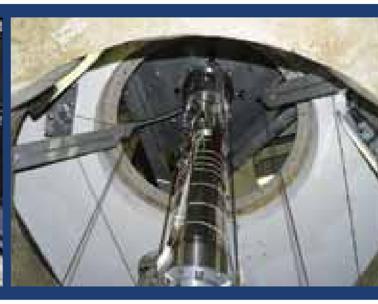
WHAT MADE THE MAGNET LAB SPECIAL:

The Magnet Lab was full of researchers who had recently arrived to build (or re-locate) their own research groups. They were VERY ambitious scientists. Needless to say, this created an exciting environment for research as well as for the surrounding community. Since then I have worked at many different labs in the world and I am yet to find a research institution and as dynamic as the Magnet Lab.

NATIONAL HIGH MAGNE

MAGNET LAB





TIC FIELD LABORATORY

User Programs

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





VOLUME 16 • NO. 3

SUPPORTED BY: THE NATIONAL SCIENCE FOUNDATION

1800 E. PAUL DIRAC DRIVE
TALLAHASSEE, FL 32310-3706

TEL: 850-644-0311
FAX: 850-644-8350
www.magnet.fsu.edu

Non-Profit
Organization
U.S. Postage
PAID
Tallahassee, FL
Permit No. 55

SUPPORTED BY: THE STATE OF FLORIDA