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NATIONAL HIGH MAGNETIC FIELD LABORATORY

NHMFL REPORTS

PREVIEWING THE 2002 NHMFL ANNUAL RESEARCH REVIEW

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Director: Jack Crow
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Editing and Writing: Kathy Hedick, Ceci Bell
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FROM THE CHIEF SCIENTIST'S DESK

J. Robert Schrieffer

PREVIEWING THE 2002 NHMFL *ANNUAL RESEARCH REVIEW*

The laboratory's major annual report of research is in the final stages of production and will be available on the Internet *(www.magnet.fsu.edu)* later this spring. As is our tradition, we devote the first issue of the year of this newsletter to highlighting some of the most outstanding research and engineering activities that are included in the latest *Annual Research Review.*

Following the precedent set during the last decade, the science program of the NHMFL continued to grow in strength and size in 2002. There was strong collaborative research by users and in-house scientists ensuring broad benefit to the scientific community of the unique facilities of the laboratory. This year 380 research reports were submitted in 16 areas of research, as compared to 322 reports in 2001. Thirty-seven reports were sponsored by the NHMFL In-House Research Program.

Category	2000	2001	2002	Total
Biology	47	49	54	150
Chemistry	27	31	39	97
Cryogenics	5	5	3	13
Engineering Materials	6	5	10	21
Geochemistry	13	10	13	36
Instrumentation	16	10	9	35
Kondo/Heavy Fermion Systems	19	21	26	66
Magnet Technology	6	7	17	30
Magnetic Resonance Techniques	19	24	24	67
Magnetism and Magnetic Materials	36	45	48	129
Molecular Conductors	19	24	27	70
Other Condensed Matter	10	13	15	38
Quantum Solids	3	6	4	13
Semiconductors	27	32	38	97
Superconductivity - Applied	16	11	32	59
Superconductivity - Basic	26	29	21	76
	295	**322**	**380**	**997**

In order to give a flavor of the overall research program, we are pleased to feature here one report from each category. In the case of Magnetic Resonance Techniques, two reports are presented. The task of determining which reports to highlight was extremely difficult, as many other research efforts are of comparable strength. I encourage all readers to check the Web site from time to time to take a look at the *Annual Research Review*. I am confident that you will be as impressed as the reviewers were by the depth, breadth, and interdisciplinary nature of NHMFL-related research.

BIOLOGY

Structure of the Inhibitory Region of the Cardiac TnI in the Ternary Complex by SDSL-EPR Spectroscopy

Brown, L., NHMFL/FSU, Biological Science, and Institute of Molecular Biophysics (IMB)
Sale, K., NHMFL/FSU, Biological Science, and IMB
Hills, R., NHMFL/FSU, Biological Science, and IMB
Rouviere, C., NHMFL/FSU, Biological Science, and IMB
Song, L., NHMFL/FSU, Biological Science, and IMB
Zhang, X., NHMFL/FSU, Biological Science, and IMB
Fajer, P., NHMFL/FSU, Biological Science, and IMB

Site Directed Spin Labeling EPR (SDSL-EPR) was used to determine the structure of the inhibitory region of TnI in the intact cardiac troponin ternary complex. Maeda and collaborators have modeled the inhibitory region of TnI (*skeletal 96-112*: the structural motif that communicates the Ca^{2+} signal to actin) as a kinked α-helix,[1] while Trewhella and collaborators have proposed the same region to be a flexible β-hairpin.[2] In order to distinguish between the two models, residues 129 to 145 of cardiac TnI were mutated sequentially to cysteines and labeled with the extrinsic spin probe, MTSSL. Sequence-dependent solvent accessibility was measured as a change in power saturation of the spin probe in the presence of the relaxant NiEDDA. In the ternary complex, the 129 to 137 region followed a pattern characteristic of a regular 3.6 residues/turn α-helix. The following region, residues 138 to 145 showed no regular pattern in solvent accessibility. Measurements of 4 intra-domain distances within the inhibitory sequence, using dipolar EPR, were consistent with an α–helical structure. The difference in sidechain mobility between the ternary (C·I·T) and binary (C·I) complexes revealed a region of interaction of TnT located at the N-terminal end of the inhibitory sequence, residues 130 to 135. The above findings for the troponin complex in solution do not support either of the computational models of the binary complex; however, they are in very good agreement with a preliminary report of the X-ray structure of the cardiac ternary complex.[3]

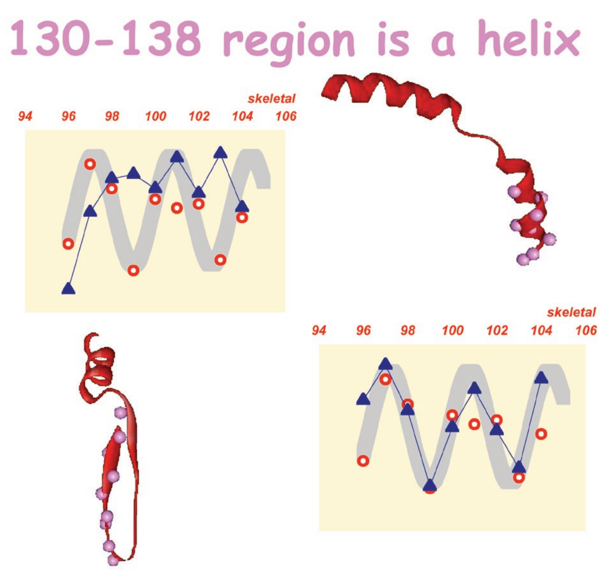

Figure 1. Observed (red) and simulated (blue) solvent accessibility areas for the two putative models. On the left: hairpin model; on the right helical model.

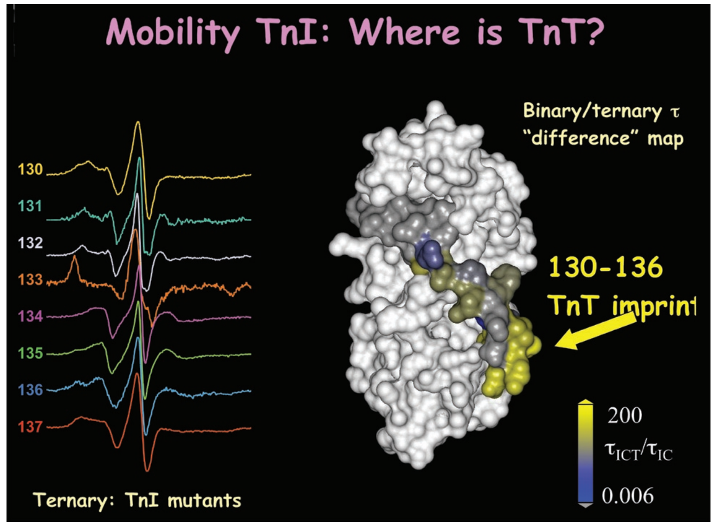

Figure 2. Sidechain mobility reveals the contact site between the subunits. On the left: the EPR spectra of the selected residues in the binary complex. On the right: model of the structure of the binary complex with the TnI residues colored according to the changes in the sidechain mobility induced by addition of the troponin T subunit.

1 Vassylyev, D., *et al.*, *Proc Natl Acad Sci U.S.A.*, **95**, 4847-52 (1998).
2 Tung, C., *et al.*, *Protein Science*, **9**, 1312-26 (2000).
3 Takeda, S., *et al.*, *Biophys J*, **82**, 832 (2002).

CHEMISTRY

Two-Dimensional EPR of a Novel Complex: (Corrolazinato)Manganese(III)

Krzystek, J., NHMFL
Zvyagin, S., NHMFL
Telser, J., Roosevelt Univ., Chemistry
Ramdhanie, B., Johns Hopkins Univ., Chemistry
Mandimutsira, B.S., Johns Hopkins Univ., Chemistry
Wang, H., Johns Hopkins Univ., Chemistry
Goldberg, D.P., Johns Hopkins Univ., Chemistry

Our group has developed a new class of metal tetrapyrrole complexes which are a hybrid of porphyrazines[1] and corroles, and which we have named corrolazines (Cz) (Figure 1).[2] A series of interesting cobalt corrolazine complexes has been recently described,[3] along with a remarkably stable Mn(V)-oxo complex.[4]

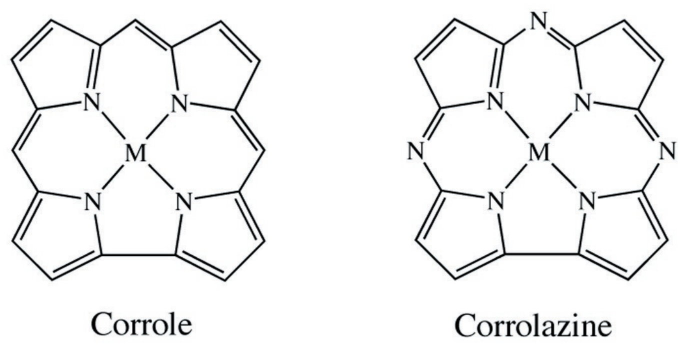

Figure 1. Structure of a corrolazine compared to a corrole.

We used the new mm and sub-mm facility at the NHMFL based on the Backward Wave Oscillators and the Keck 25-T resistive magnet to perform *two-dimensional (field vs. transition energy)* electron paramagnetic resonance (EPR) spectroscopy to characterize the electronic structural properties of a novel (Cz)Mn(III) complex. A typical individual spectrum, recorded at 503 GHz (transition energy 16.77 cm^{-1}) is presented as an inset to Figure 2. The full 2-D plot of magnetic resonances vs. the transition energy is shown in the main plot of Figure 2. This analysis allowed us to unequivocally attribute the observed resonances to particular transition branches in the S=2 spin manifold. From the simulations using the best-fit values it follows that the complex in the solid state is characterized by the following spin Hamiltonian parameters in the solid state: S=2, isotropic g=2.00(1), D=-2.60(2) cm^{-1}; and $|E|$=0.015(5) cm^{-1}.

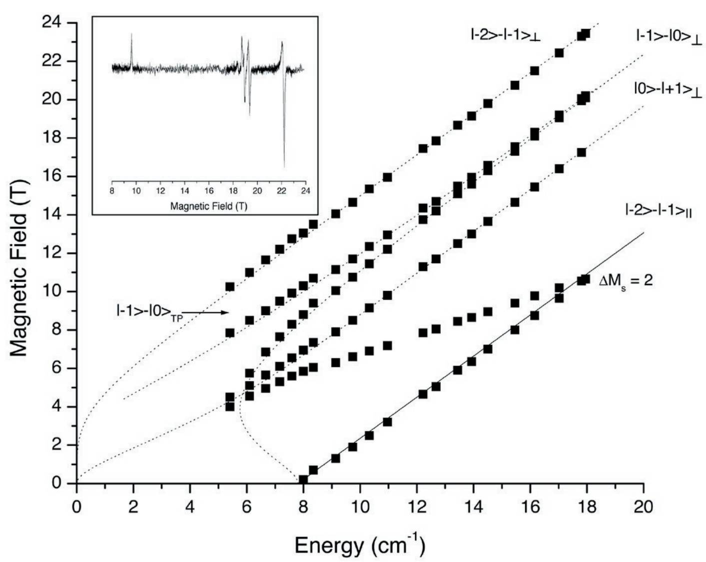

Figure 2. Field vs. transition energy dependence of EPR resonances (points), and simulations using spin Hamiltonian parameters as in text (curves). Individual transition branches are identified and labeled accordingly. The small splittings in the perpendicular transitions due to a non-zero E term are not shown for clarity. Inset: individual spectrum at 503 GHz and 10 K.

An isotropic g value of close to 2.00 is common to most complexes of Mn(III), and the zero-field splitting parameters appear to be very characteristic for corrolatomanganese(III) complexes.[5] In contrast to porphyrins and porphyrazines,[1] corrole and corrolazine complexes of Mn(III) are not rigorously axial spin systems. More importantly, the magnitude of D is larger for the latter class of complexes, indicating that triplet (S=1) excited states are closer in energy to the quintet (S=2) ground state in corrole/corrolazine complexes than in porphyrin/porphyrazine complexes.

Acknowledgements: D.P.G. is grateful for the support of this work from the NSF (NSF-0094095 (CAREER award) and CHE0089168), and from an Alfred P. Sloan Research Fellowship.

[1] Goldberg, D.P., *et al., J. Am. Chem. Soc.,* **119**, 8722-8723 (1997).
[2] Ramdhanie, B., *et al.*, *J. Am. Chem. Soc.,* **123**, 9447-9448 (2001).
[3] Ramdhanie, B., *et al., Inorg. Chem.*, **41**, 4105-4107 (2002).
[4] Mandimutsira, B.S., *et al., J. Am. Chem. Soc.* (2002).
[5] Krzystek, J., *et al.*, *J. Am. Chem. Soc.* **123**, 7890-7897 (2001).

CRYOGENICS

Transient Heat Transfer in He II Forced Flow at High Velocities

Fuzier, S., NHMFL/FAMU-FSU College of Engineering
Van Sciver, S.W., NHMFL/FAMU-FSU College of Engineering

The purpose of this experiment is to study transient heat transfer in forced flow He II, which can be used for the cooling of magnets. It aims especially at widening the experimental investigation of heat transfer in He II, which has been mostly studied so far in stagnant or low velocity flows. The present forced flow experiment can generate a uniquely wide range of flow velocities up to 22 m/s.

The experiment is composed of an 80 liter can/bellows pump assembly, which supplies and generates a flow of He II through an instrumented experimental loop. This experimental loop contains a 0.85 m long, 10 mm ID smooth stainless steel tube equipped with two heaters, nine thermometers and three pressure transducers. The two heaters are nicrome films epoxied to the inside surface of the tube and are 10 and 4 mm long in the direction of the flow. The thermometers are bare chip Cernox™ inserted in the tube wall in contact with the flow and at various distances from the heaters ranging from 5 to 50 cm mostly downstream.

Heat pulses of flux up to 40 W/cm^2 with durations between 1 and 20 ms were generated in the test section and the temperature profile was recorded at several locations as the pulses were transported by forced convection and their shape were modified by internal convection heat transfer.

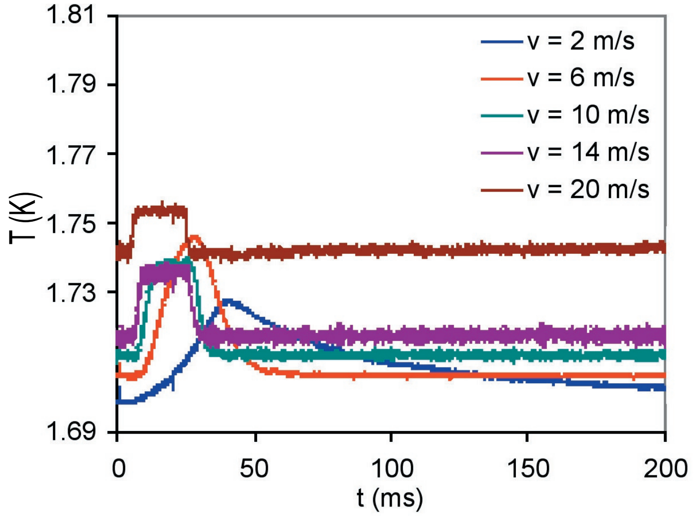

Figure 1. Temperature profiles obtained 9.3 cm downstream of the heater generating a 9.9 W/cm^2 and 20 ms long rectangular pulse for different flow velocities.

Figures 1 and 2 show typical transient results obtained. The heat pulses arrive faster at the measurement location when the flow velocities are higher as they are mainly carried by ordinary convection. The baseline for each pulse increases with the velocity and the distance downstream the heater. This is due to the Joule-Thomson effect: the pressure drop along the pipe leads to a raise in temperature. More importantly, for the highest flow velocities, the shape of the pulses is closer from the initial rectangular shape generated at the heater than for the lower velocities. This can be due to a modification of He II heat transfer due to the increase of the main flow velocity. A numerical model is in development to investigate that point.

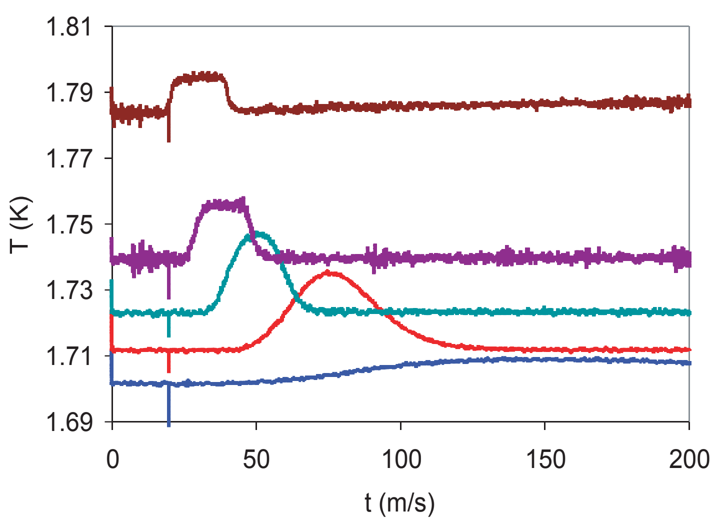

Figure 2. Temperature profiles obtained 39.3 cm downstream of the heater generating a 9.9 W/cm^2 and 20 ms long pulse for the same velocities as Figure 1.

Strengthening Mechanisms of Cu-Nb Microcomposites

Leprince-Wang, Y., Laboratoire de Physique des Matériaux Divisés et Interfaces, Université de Marne la Vallée, France

Han, K., NHMFL

Huang, Y., Laboratoire de Physique des Matériaux Divisés et Interfaces, Université de Marne la Vallée, France

Yu-Zhang, K., Dynamique des Transferts aux Interfaces, Université de Reims, France

Pantsyrnyi, V.I., A.A. Bochvar All-Russia Scientific Research Institute of Inorganic Materials, Russia

Two types of Cu-Nb microcomposites were studied to assess the potential applications of such composites in pulsed and resistive magnets. The *in-situ* composites were prepared by casting, followed by deformation, packing and deformation. The composites were formed by self-assembling and show strong textures and orientation relationship between Cu and Nb. The artificial composites were made by cladding Nb with Cu, packing and deformation, and they developed less pronounced texture than *in-situ* composites. In spite of the differences in the original orientation relationship and microstructure, both types of composites are composed of Nb ribbons or plates embedded in the copper matrix. A variation in the spacing between the Nb ribbons is observed, particularly in the *in-situ* composites. In Cu regions, very fine twins have been revealed. Various strain contrasts were observed in the interface regions and the lattice distortion occurred in both components. In the artificial Cu-Nb microcomposite, Nb ribbons have no regular characteristic shape and the $\{111\}_{Cu}$ // $\{110\}_{Nb}$ relationship is not as well established as in that of *in-situ* composite. In the *in-situ* Cu-Nb microcomposite, the orientation relationship is $\{111\}_{Cu}$ //$\{110\}_{Nb}$ with a deviation up to 9°.

Figure 1 shows an *in-situ* Cu-Nb composite. The lattices were indexed in the figures and the following interpretations are based on these indexes. The angle between $(11\bar{1})_{Cu}$ and $(110)_{Nb}$ is about 9°. Therefore, they are about 40 ± 10° with respect to the wire axis. Because the interface of Cu/Nb is about perpendicular to $<11\bar{1}>_{Cu}$ // $<101>_{Nb}$, or wire axes, as shown in the figure, the interface orientations are close to $(42\bar{2})_{Cu}$ // $(121)_{Nb}$. Apparently, those interfaces are not close-packed planes. Consequently, steps form at the interfaces and follow two sets of $\{101\}_{Nb}$ planes, one set of $\{111\}_{Cu}$ and one set of $\{002\}_{Cu}$, as illustrated in the figure. The average interface dislocation density estimated along $(1\bar{1}1)_{Cu}$ //$(110)_{Nb}$ revealed that misfit was 15 % of the $(110)_{Nb}$ atomic spacing. The misfit between Cu and Nb should be about 10 % under equilibrium conditions if the examination could be undertaken at $(1\bar{1}1)_{Cu}$ // $(101)_{Nb}$, and the lattice parameters of Cu and Nb are taken as 0.2087 nm and 0.2334 nm, respectively, for bulk samples. Therefore, the dislocations at the interfaces are generated due to the incompatibility of the plastic deformation between two phases and the tilting of the lattice and interfaces

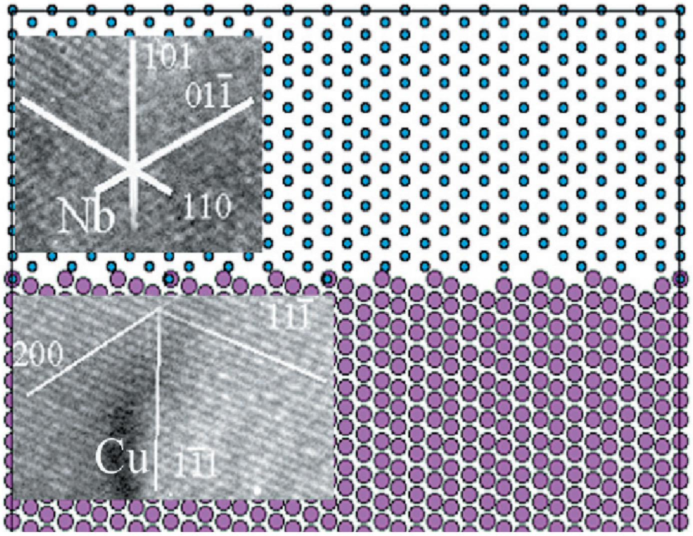

Figure 1. Schematic illustration and high resolution electron microscopy images of the Cu/Nb interface structure in an in situ Cu-Nb composite in the areas far away from the center of the wire. The sample zone axis is close to $[011]_{Cu}$ or $[\bar{1}11]_{Nb}$.

to compensate for the lattice misfit. The misfit between Cu and Nb adjacent to the interfaces is accommodated by both misfit dislocations and distortion of the lattices.

The dislocation density in both phases is markedly lower than that in single phase materials exposed to similar magnitude of deformation strain. Plastic deformation and refinement of the structure introduce dislocations, which are accumulated at the interfaces and in Cu. The high strength of the Cu-Nb microcomposites is attributed to (1) the large interface areas in the unit volume, (2) the lattice distortions induced by the deformations, and (3) the refinement of the structures.

GEOCHEMISTRY

Hafnium and Neodymium Isotopes in Ocean Island Basalts

Salters, V., NHMFL/FSU, Geological Sciences
Hart, S., Woods Hole Oceanographic Institution
Blichert-Toft, J., Ecole Normale Superieure de Lyon, France

We have measured Hf and Nd isotopes in basalts from Koolau, Hawaii, as well as from basalts from the Samoa hot spot chain. The Hawaiian samples, from the Koolau drillhole, show limited variation in Hf or Nd isotope composition (epsilon Nd varies from 4.2 to 7.3 and epsilon Hf varies from 8 to 12.2). The correlated variation, based on 38 samples, has an R-squared of 0.86. The data results in a slope of 1.23 on a Hf-Nd isotope correlation diagram (epsilon notation). This slope is shallower than the mantle array defined by ocean island basalts, which is 1.5.

Contrary to previous work, the Hf-Nd–isotope correlation for Samoa shows an even shallower slope than the Hawaiian samples. The Samoan samples are surface samples as well as samples from the recently dredged samples of the youngest extension of the Samoan hot spot.[1] The samples show a large range in Sr-Nd and Hf compositions with epsilon-Nd ranging from –2.2 to 3.5 and epsilon-Hf ranging from 2.2 to 7.5 and extreme Sr-isotopic composition with values up to 0.7088. Hf-isotopic composition is well correlated with both Sr and Nd isotopic composition (R-squared is 0.93 and 0.95 respectively). The slope of the correlated isotope variation on an epsilon Hf-Nd isotope diagram is 0.97, which is shallower than any Hf-Nd-isotope correlation measured before.

The shallow slope of the Hawaiian basalts on a Hf-Nd isotope correlation diagram has been interpreted as being distinctive of a contribution of recycled pelagic sediments.[2] For Samoa, however, the influence of pelagic sediments was thought to be limited as EMII basalts were thought to find its source in either a mixture of recycled oceanic crust with terrigenous sediments, or carbonatite metasomatism as an EMII-like component has been recognized in xenoliths affected by carbonatite metasomatism with Sr-isotopic compositions up to 0.7128.[3] Our new Hf-isotope data seem to rule out a recycled terrigenous sediment component for the Samoan basalts, while the Pb - and Sr-isotopes seem to rule out a pelagic sediment component.

We propose that the shallow slope on a Hf-Nd isotope correlation diagram can also explained a component from the recycled oceanic lithosphere. Because melt extraction beneath mid-ocean ridges starts in the garnet stability field the Lu/Hf ratio of the residue is more fractionated than the Sm/Nd ratio. This, in time, will result in more radiogenic Hf-isotopic compositions and a deviation of from the terrestrial array. Concentrations of most elements in the oceanic lithosphere are low, suggesting that mixing of solids is unlikely as even for a 2 Ga old lithosphere more than 80% of residual lithosphere is required to “move” the Hf-isotope composition significantly above the mantle array. Therefore, it is more likely that melts derived from ancient oceanic lithosphere, or melts that interacted with ancient lithosphere were a component of the Samoan basalts.

1 Hart, S.R., *et al*., *Geochem. Geophys. Geosys*., 2000GC000108 (2000).
2 Blichert-Toft, J., *et al*., *Science*, **285**, 879-882 (1999).
3 Hauri, E., *et al*., *Nature*, **365**, 221-227 (1993).

INSTRUMENTATION

Development of High Frequency Phased Array Rf Coils and Large Volume Coils

Beck, B., McKnight Brain Institute, UF/NHMFL
Duensing, R., Applied Resonance Technology
Fitzsimmons, J., McKnight Brain Institute, UF
Jenkins, K., McKnight Brain Institute, UF/NHMFL
Crozier, S., Univ. of Queensland, Australia
Smith, M., Pennsylvania State Univ., College of Medicine
Collins, C., Pennsylvania State Univ., College of Medicine
Blackband, S., McKnight Brain Institute, UF/NHMFL

Last year we describe the construction of the first phased array coil at 4.7 T (200 MHz) used successfully to image cat spines. Additional coils, particularly a rat brain sized phased array have also been constructed. We also described a novel large volume coil for use at high frequencies—our so-called ReCav (reentrant cavity) coil. A short account of both coils has now been published.[1]

Using the ReCav coil we have obtained images of moderately large biological samples at 11.1 T. The images show large signal voids (inhomogeneities) at these high frequencies, representative of coil/sample interactions on dielectric samples. With our colleagues in Hershey and Australia, we are now modeling these effects and investigating ways of reducing or eliminating them. If they cannot be practically mediated, this has significant implications for the future development of high field proton imaging on large biological samples. A manuscript has been submitted.[2]

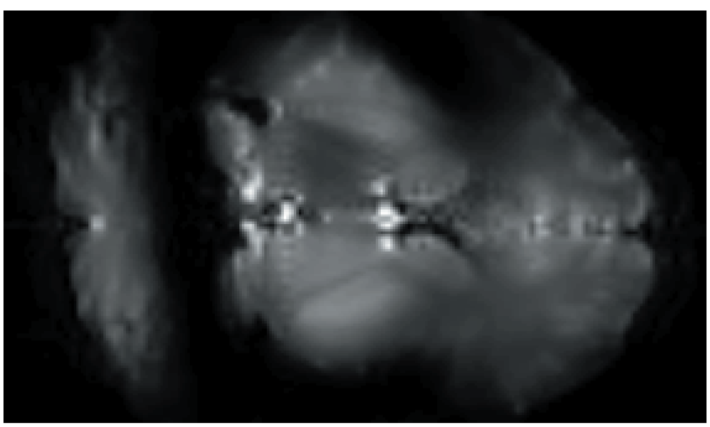

Figure 1. Axial image of an isolated fixed human brain at 11.1 T showing a large signal void (dark band) across the image.

Acknowledgements: This research is funded by the NHMFL, the UF McKnight Brain Institute, and NIH (P41 RR16105).

1 Beck, B., *et al.*, *MAGMA*, **13**, 152-157 (2002).
2 Beck, B.L., *et al.*, "Observation of Significant Signal Voids on Large Biological Samples at 11.1 Tesla," submitted, *Magn. Reson. Med.* (2002).

KONDO/HEAVY FERMION SYSTEMS

Magnetic Properties of URu_2Si_2 in Pulsed Magnetic Fields

Harrison, N., NHMFL/LANL
Jaime, M., NHMFL/LANL
Mydosh, J.A., Max-Planck Institut for Chemical Physics of Solids, Germany

Following the recent resurgence of interest in the hidden order phase of URu_2Si_2, that was recently suggested to involve orbital antiferromagnetism,[1] one important question that needed to be asked is whether one can learn anything about the hidden order from its behavior in a magnetic field. For a long time, it has been known that this material undergoes three very abrupt magnetic transitions between 35 and 39 T that were thought to be caused by field-induced ferromagnetic frustration.[2] Support for this scenario had come from the near temperature-independence of the transition fields up to temperatures as large as ~17 K. It was never understood how these three transitions were connected with the low temperature order phase.

From the magnetocaloric measurements recently made by Jaime *et al.* in the 45 T Hybrid magnet, it has become clear to us that magnetization measurements in pulsed magnetic fields can be seriously affected by this effect.[3] In fact, this can be so severe in this material that a sample that starts out at being ~16 K at zero field ends up being at less than 1 K at 50 T. This provides an explanation for the apparent temperature-independence of the three magnetic transitions: because each time the sample reaches 50 T is below 1 K regardless of the starting temperature.

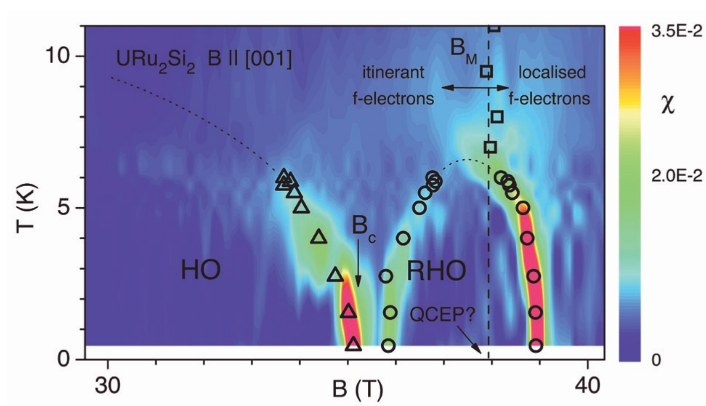

Figure 1. The high magnetic field low temperature phase diagram of URu_2Si_2 combined with a color intensity plot of the susceptibility measured at many different temperatures. Square, triangle, and circle symbols mark the high temperature metamagnetic transition field and transitions into and out of the hidden order and re-entrant hidden order phases respectively. The curved dotted lines depict the continuation of the phase boundaries revealed by specific heat and transport studies.

To remedy this problem, it is important to use very small samples in a long pulse magnet so that the sample is able to acquire thermal equilibrium with the bath. By doing this we found the transition temperatures to be strongly dependent on temperature, thereby requiring a revision of what had been accepted models. Figure 1 shows an example of the phase diagram we obtain, combined with an intensity plot of the susceptibility. One important thing we can see is that the two uppermost transitions correspond to the creation and destruction of a new high magnetic field-induced phase created in the vicinity of a single metamagnetic transition that is visible at higher temperatures. This suggests that the high magnetic field phase is created in the vicinity of a metamagnetic quantum critical end point.[4]

1 Chandra, P., *et al.*, *Nature*, **417**, 881-884 (1998).
2 Sugiyama, K., *et al.*, *J. Phys. Soc. Japan*, **68**, 3394-3401 (1999).
3 Jaime, M., *et al.*, *Phys. Rev. Lett.*, **89**, 287201 (2002).
4 Harrison, N., *et al.*, *Phys. Rev. Lett.* (in press 2003).

MAGNET TECHNOLOGY

Cooling Design Evolution of a 65 T Capacitor Driven Pulse Coil Assembly

Swenson, C.A., NHMFL
Gavrilin, A.V., NHMFL

Requirements imposed on cooling time of multi-shot coils of capacitor driven pulse high field magnets are rather exacting—time interval between shots should be sufficiently short (from several minutes to some few tens of minutes). Design of a 65 T multi-shot coil of 15 mm diameter bore has been significantly corrected and optimized to decrease the cooling time down to 20 to 30 minutes and provide a more uniform temperature distribution over the coil. The coil parameters are given in Table I. The coil winding, pool-cooled with liquid nitrogen at 77 K (over the interface—inner and outer surfaces, and from the ends), is closely packed and has strong inner, inter-layer reinforcement comprised of thermally thick shells wound with zylon fiber and MP35N tape.

Table 1. Characteristics of the ZM Gap 66 Coil (ultimate design).

Total number of winding layers	12
Coil height (mm)	120
Coil inner radius (mm)	7.75
Coil outer radius w/support shell (mm)	73.56
Conductor	AL60 2.50mm x 4.80mm, 83.9% copper IACS
Conductor insulation	Kapton, 0.1 mm
Winding layer shells (inter-layer insulation)	Zylon / MP35N, 0.7 – 2.2 mm
Peak current (kA)	28.2
Voltage (V)	8900
Bank energy (MJ)	0.961
Peak central field (T)	65.00
Coil inductance (mH)	1.57
Max. temperature after shot (K)	310
Cooling gap inside of the coil (mm)	3.0

To significantly reduce the cold propagation time over the coil, a 3 mm gap is between the 6th and 7th winding layers. The gap is filled with G10 composite with a number of axial cooling channels at the gap's outer perimeter, the void fraction is <55%. A cool-down to 94 K instead of 77 K has been assumed to be sufficient, based on the analysis of the successful NHMFL built 60 T ZM coil design which can withstood a tremendous number of full field shots having temperature of only 94 K on average before each next shot (Figure 1). The "ZM" designation refers to our use of zylon fiber and MP35N alloy as reinforcement materials.

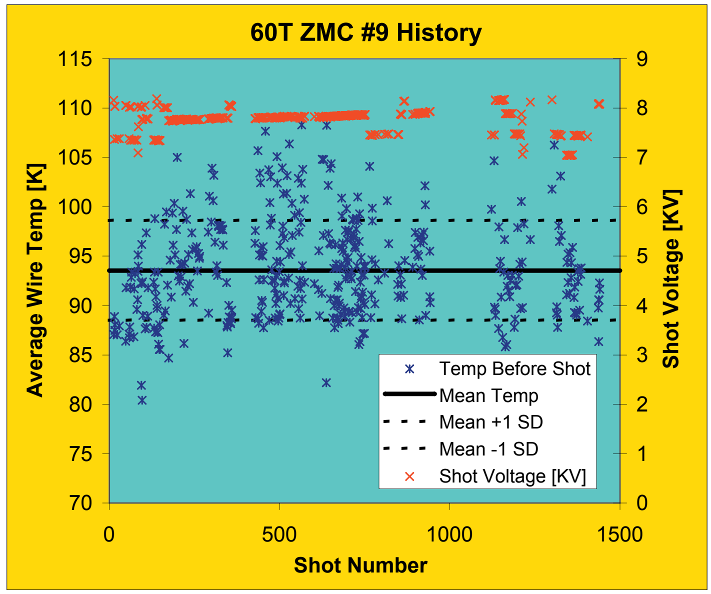

Figure 1. Statistics of the 60 T ZM coil temperature before shots.

A Fortran optimization code has been prepared to model the transient cool-down process of the coil. The interface temperature dependence of the coolant heat removal is experimentlly measured in its own right and is input data to the code.Temperature dependencies of properties (specific heat and thermal conductivity) of all materials were used in this model. The optimization parameters that we varied to reach a desirable 20 to 30 minutes of cooling down to 94 K have been: the gap width and void fraction, thickness of the ZM shell of each layer, fraction ratio between zylon and MP35N in each shell (thickness of each component), thickness of the kapton insulation of the conductor, and the coil height. In fact, an inverse problem for the coil configuration has been solved in several iterations. In the ultimate configuration, the cooling time does not exceed 30 minutes and suitably uniform temperature distribution is reached. The approach developed is a basic one and can be used in R&D of other pulse coils.

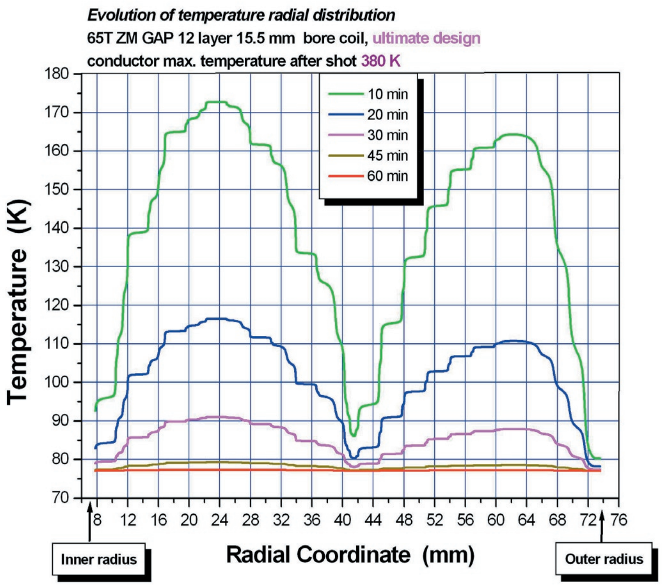

Figure 2. Evolution of temperature radial distribution over the 65 T ZM coil (calculated), the ultimate configuration of the coil.

MAGNETIC RESONANCE TECHNIQUES

High Field-Gradient Translational Diffusion Measurements in a Bitter Magnet

Sigmund, E.E., Northwestern Univ., Physics and Astronomy
Halperin, W.P., Northwestern Univ., Physics and Astronomy
Reyes, A.P., NHMFL
Kuhns, P.L., NHMFL
Moulton, W.G., NHMFL

We have performed nuclear magnetic resonance (NMR) measurements of slow translational diffusion in glycerol with an applied magnetic field gradient in the stray field of the Cell 9 resistive Bitter magnet. With the magnet center field set at 28.5 T, this gradient is 216 T/m. The timescales involved for this phase-sensitive measurement required a stabilization scheme for the applied field in this resistive magnet. Previously, we described a method of inductive shielding with a helium cooled aluminum shield that significantly suppressed the 60 Hz field ripple.[1] The same scheme was employed for these diffusion measurements, and its efficacy was confirmed.

Two experiment types were employed for diffusion measurement: stimulated echo decay and hole-burning. The latter involves the time-resolved imaging by NMR of a micron-thick slice of spins as they diffuse along the field gradient. The temperature dependences of the diffusion measurements we performed on doubly carbon-labeled glycerol (glycerol-$^{13}C_2$) are shown in Figure 1, along with ^{1}H diffusion measurements in a stable superconducting magnet fringe-field. The Bitter magnet experiments were primarily performed on the ^{13}C resonance at $^{13}\nu$ = 226 MHz, H_0 = 21.1 T, G = 216 T/m, but also included ^{1}H NMR at $^1\nu$ = 226 MHz, H_0 = 5.3 T, G = 54 T/m. The low-inductance resistive magnet allowed the field to be easily changed, between experiments, between these resonant fields for the same probe frequency. Note that the high gradients have allowed diffusivities well below 10^{-9} cm^2/s to be resolved. The ^{13}C signal-to-noise level was sufficiently low that the stimulated echo experiments required frequency jumping and signal averaging. This was accomplished with the MagRes2000 spectrometer system designed by A. P. Reyes.[2] Conversely,

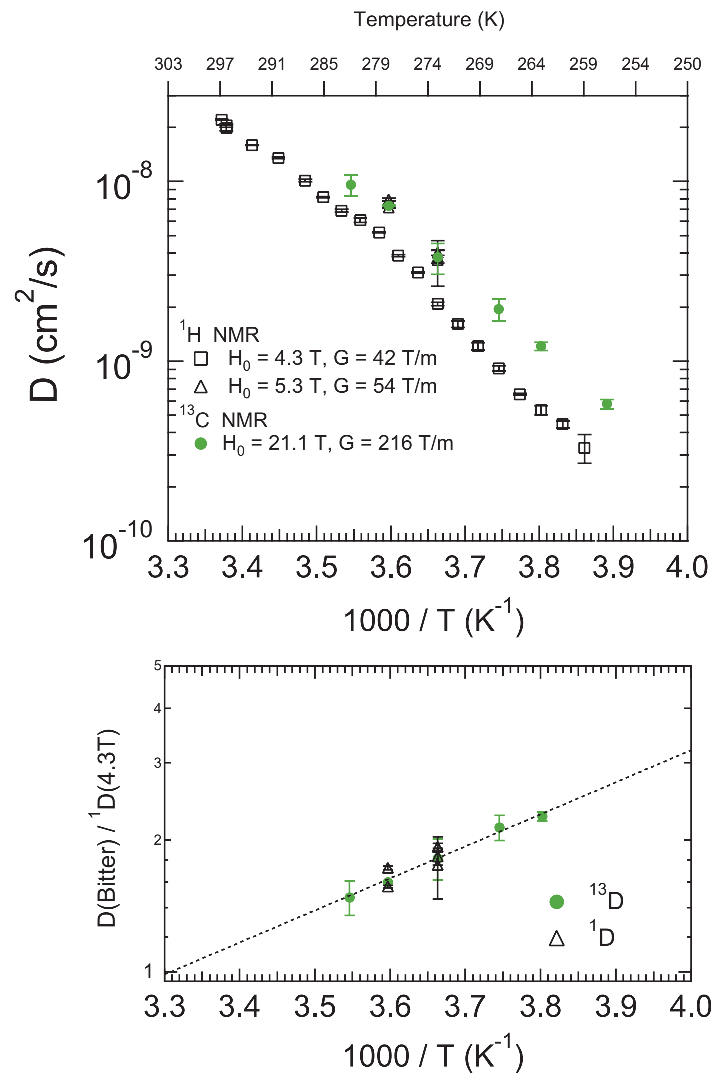

Figure 1. NMR Diffusion experiments on glycerol-$^{13}C_2$. ^{13}C stimulated echo data were taken at H_0 = 21.1 T, G = 216 T/m. ^{1}H experiments, including stimulated echo (with and without signal averaging) and hole-burning measurements, were acquired at H_0 = 5.3 T, G = 54 T/m in the Bitter magnet. These data are compared with ^{1}H data taken in a superconducting magnet at H_0 = 4.3 T, G = 42 T/m. Lower panel: Diffusivities measured in the Bitter magnet normalized to those found in the superconducting magnet.

the higher sensitivity of the ^{1}H signal, even at lower field, was sufficient to perform stimulated echo experiments with and without signal averaging as well as a hole-burning experiment. Interestingly, in all cases, consistent results were obtained that are higher than the diffusivities obtained in the superconducting magnet by as much as factor of 2. The temperature dependence of this discrepancy is shown in the lower panel of Figure 1. It shows that the temperature dependence of the diffusion coefficients measured in the Bitter magnet case is slightly weaker than the superconducting magnet case.

The explanation for the enhanced diffusivities obtained in the Bitter magnet is not clear. First order estimates of residual phase noise contributions[3] to the echo decay from either field fluctuations or vibrations fail to explain the result, and the equivalence of results with and without signal averaging seems to rule out phase noise entirely. Other possible explanations, although also not quantitatively promising to first order, are molecular alignment in the ambient field of 21.1 T or convective effects in the fluid motion. In any case, the shield has apparently successfully suppressed phase noise contributions to the spin echo decay since the single-shot and signal averaged results are identical. This shielding technique allows diffusivity measurements to be performed in the Bitter magnet environment. The precise values found and their comparison with lower field experiments remain open questions that further high-field diffusion experiments might address.

Acknowledgements: This work was supported by NSF-MRSEC through the Materials Research Center at Northwestern University, grant DMR-0076097.

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Stabilization of Ultra High Magnetic Fields by Iterative Control of Spin Chaos

Lin, Y.-Y., Univ. of California at Los Angeles, Chemistry
Huang, S.Y., Univ. of California at Los Angeles, Chemistry
Warren, W.S., Princeton Univ., Chemistry
Brey, W., NHMFL

Recent investigations in high-resolution NMR spectroscopy have revealed that two readily observed interactions in solution, radiation damping, and the distant dipolar field, combine to produce spatial-temporal chaos in routine experiments.[1] The resulting aperiodic turbulent spin dynamics amplify intrinsic spin noise and magnetization nonuniformities to render measurements in gradient-based high-field solution NMR applications virtually irreproducible.[2] To suppress such unwanted signal fluctuations, we have developed a novel approach to control chaotic spin dynamics through the application of external periodic perturbations. Integrating this iterative control strategy with detection of intermolecular zero-quantum coherences (iZQCs),[3] experiments at very high fields show that chaotic spin systems may be desensitized to variations in the experimental conditions, providing a means to stabilize fluctuating electroresistive ultra high-field magnets.

Measurements of translational diffusion coefficients by the pulsed gradient spin echo (PGSE) experiment reveal that the amplitudes and phases of the echo signals fluctuate significantly under well-controlled experimental conditions. To tame the underlying chaotic dynamics, weak harmonic perturbations in the form of RF pulses were applied to a solution of 95% water in the 25 T Keck electromagnet (1 kHz/s drift, 3 kHz linewidth over 1 cm^3). Preliminary experimental results show that the external magnetic field can be effectively homogenized through a suppressor pulse scheme applied in conjunction with detection of intermolecular zero-quantum coherences to generate reproducible PGSE echo tops. The exceedingly large number of spin degrees of freedom necessitates such an iterative approach since the observed fluctuations in the macroscopic magnetization arise from instability in individual spin trajectories, which cannot be directly observed or manipulated.

Numerical simulations indicate that our suppressor pulse sequence decreases the leading Lyapunov exponent, in effect taming the chaotic evolution and reducing the observed echo distributions. Optimization of the pulse sequence through adjusting the spacing and phase cycling of successively applied RF perturbations promises to enable the acquisition of reproducible signals even in the presence of a highly fluctuating external magnetic field, lending spatial homogeneity and temporal stability to future high-resolution applications.

Acknowledgements: This work was supported by the NHMFL, NIH (CA88683, WSW), Camille and Henry Dreyfus Foundation (YYL), Research Corporation (YYL), and NSF (SYH).

1 Lin, Y.-Y., *et al.*, *Science*, **290,** 118-121 (2000).
2 Huang, S.Y., *et al.*, *J. Chem. Phys.*, **116**, 10325-10337 (2002).
3 Lin, Y.-Y., *et al.*, *Phys. Rev. Lett.*, **85**, 3732-3735 (2000).

MAGNETISM & MAGNETIC MATERIALS

Physics in Some Novel Magnetic Systems

Dzero, M., NHMFL/FSU, Physics
Gor'kov, L.P., NHMFL
Kresin, V.Z., Lawrence Berkeley Lab
Krotkov, P.L., NHMFL
Zvezdin, A.K., NHMFL/Institute for General Physics, Russia

During the past year, our group has been working on two major topics: (I) GMR phenomena in manganites and ferromagnetic nanowires, and (II) Mechanisms responsible for spins relaxation in n-doped semiconductors.

(I) As for manganites, we concentrated on the study of $La_{1-x}Sr_{x}$-MnO_3 in the concentration range of existence of the A-phase. The latter is built up as an array of ferromagnetic metallic planes ordered alternatively in the perpendicular-to-layer direction. Thus, the A-phase presents an example of a natural spin-valve system in frameworks of the double exchange mechanism.

We derived expressions of the in-plane and out-of plane conductivity and magnetoconductivity to disclose large magnetoresistance effects there. An intimate relation between resistivity and the doping level is emphasized. Contacts between ferro-and the A-phases, and heterostructures constructed from these two components were also considered.

For ferromagnetic nanowires spin accumulation on the domain walls was studied. As a new feature, we added to the commonly used approach allowance for difference in densities of states between the spin-majority and spin-minority bands, which resulted in the voltage discontinuity at a single wall and other pronounced new effects.

(II) Exceedingly slow spin relaxation times observed in n-doped GaAs have prompted hopes for computer applications, they have also posed a question regarding the mechanisms governing relaxation. We derived for the first time the asymptotically correct expression for the Dzyaloshinskii-Moriya interaction for which estimates show that it may be at the origin of the effect.

Acknowledgements: The work of M. Dzero and P.L. Krotkov was supported by DARPA through the Naval Research Laboratory Grant No. N00173-00-1-6005.

MOLECULAR CONDUCTORS

Observation of the Fermi Surface in a Single Component Molecular Material

Tanaka, H., National Institute of Advanced Industrial Science and Technology, JST CREST
Tokumoto, M., National Institute of Advanced Industrial Science and Technology, JST CREST
Kobayashi, H., Institute for Molecular Science, JST CREST
Kobayashi, A., Univ. of Tokyo, Research Center for Spectrochemistry, Graduate School of Science, Japan
Graf, D., FSU, Physics/NHMFL
Choi, E.S., NHMFL
Brooks, J.S., FSU, Physics/NHMFL
Uji, S., National Institute for Materials Science, Japan
Yazuzuka, S., National Institute for Materials Science, Japan

Recently, Tanaka and co-workers[1] described a new type of single component molecular metal $Ni(tmdt)_2$ that exhibited metallic behavior in the resistivity from room to helium temperatures, and band structure calculations indicated the presence of small electron and hole pockets. This is due to the highly optimized stacking of the extremely flat $Ni(tmdt)_2$ molecules. The purpose of this investigation was to explore the resistivity and magnetization (de Haas van Alphen – dHvA) in high magnetic fields to see if the material had evidence for a Fermi surface, which is a

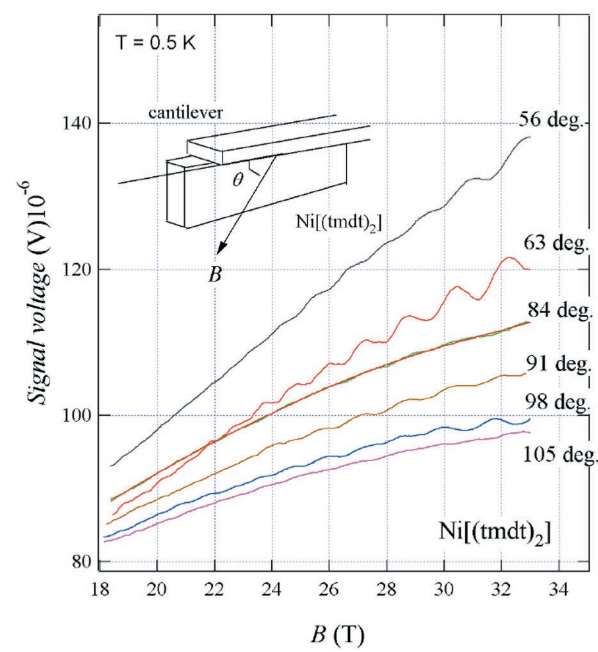

Figure 1. Torque signal of a $Ni(tmdt)_2$ single crystal from an AFM-type piezo resistive cantilever.

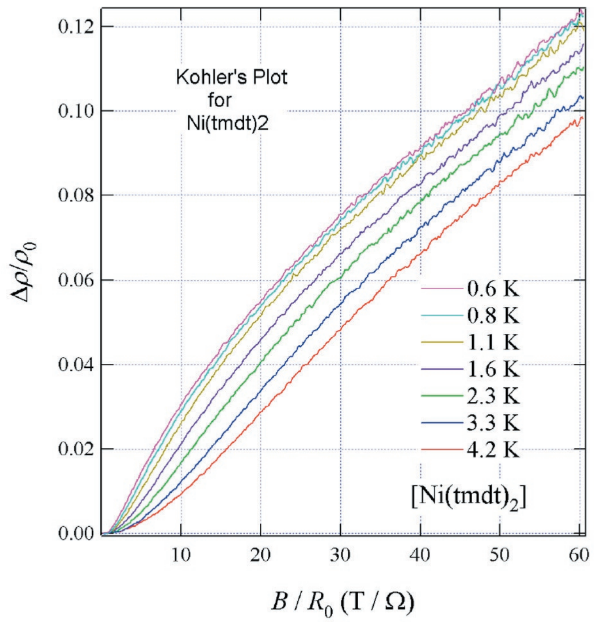

Figure 2. Kohler Plot of the resistivity of a Ni(tmdt)$_2$ single crystal in the field range 0 to 33 T.

defining character of a metal. High field torque magnetization and magnetoresistance measurements were carried out as a function of field direction, and temperature. The magnetization measurements employed a piezo-resistive cantilever method.

The results of this study showed, for the first time, that this material is indeed a metal, based on the observation of dHvA oscillations at high fields. The angular dependence of the dHvA oscillations revealed evidence for several, perhaps 3D, carrier pockets in the dHvA signal. The temperature dependence of the dHvA amplitudes was non-monotonic, indicating anomalous behavior of the low temperature ground state. Further evidence for unconventional metallic character came from the deviations from Kohler's rule, which were observed in the temperature dependent magnetoresistance. Work is underway in the 45 T hybrid magnet at the NHMFL to extend the dHvA studies to higher fields.

Acknowledgements: Work at FSU is supported by NSF-DMR 99-71474 and 0203532.

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Study of the Ground State of $Ca_{1.7}Sr_{0.3}RuO_4$

Jin, R., Oak Ridge National Laboratory
He, J., Univ. of Tennessee, Physics & Astronomy
Mandrus, D., Oak Ridge National Laboratory, and Univ. of Tennessee, Physics

It is known that Sr_2RuO_4 is an unconventional superconductor, whereas the isoelectronic relative Ca_2RuO_4 is a Mott insulator. A systematic study on the substituted $Ca_{2-x}Sr_xRuO_4$ yielded a very interesting phase diagram, showing a quantum critical phenomenon at $x = x_c = 0.5$.[1] Theoretically, the Fermi-liquid ground state is expected to resume when x is slightly away from the critical point. As shown in Figure 1a, our resistivity measurements on $Ca_{1.7}Sr_{0.3}RuO_4$ (x = 0.3) reveal T^2-dependence below ~ 0.5 K, consistent with the Fermi-liquid picture. By applying magnetic field (H) along the current (I) direction (H//I), we further investigated the longitudinal magnetoresistance (Δρ/ρ) at low temperatures. Figure 1b presents the magnetic field dependence of the longitudinal (H//I) magnetoresistance $\Delta\rho_i/\rho_i$ (i = ab, c) at T = 20 mK. The large longitudinal magnetoresistance in both the ab-plane and c-direction suggests that the Fermi-liquid ground state is close to magnetic instability. Moreover, the apparent nonmonotonic H-dependence of Δρ/ρ may result from the competition between antiferromagnetic and ferromagnetic correlations, consistent with the metamagnetic behavior seen in this material.

Acknowledgements: This work is supported in part by NSF DMR-0072998. Oak Ridge National Laboratory is managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00R22725.

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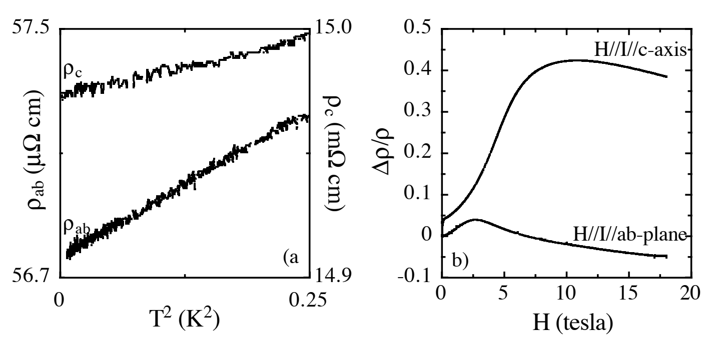

Figure 1. (a) Temperature dependence of the electrical resistivity along ab-plane (ρab) and c-axis (ρc) below 0.5 K plotted as ρ vs. T2; (b) Magnetic field dependence of the longitudinal (H//I) magnetoresistance Δρi/ρi (i = ab, c) at T = 20 mK.

QUANTUM SOLIDS

Non-Trivial Temperature-Dependent Resistance in Oriented Graphite in High Magnetic Fields

Hebard, A.F., UF, Physics
Maslov, D.L., UF, Physics
Du, X., UF, Physics

We have been investigating magnetotransport in HOPG graphite (<2º mosaic spread) at temperatures as low as 25 mK and fields as high as 18 T. Two samples cut from the same piece having a Dingle temperature of 5 K are studied with the magnetic field parallel to the c-axis. In the "basal plane" sample the transport current is applied in the basal plane and in the "c-axis" sample the current is applied perpendicular to the basal plane along the c-axis.

In magnetic fields above the ultra-quantum limit (~8 T), where all carriers are in the lowest Landau level, the temperature-dependent resistivity R(T) of the basal plane sample shows a peak with metallic behavior at low temperatures (Figure 1, left panel) whereas the c-axis sample (Figure 1, right panel) shows a constantly rising resistance with decreasing temperature. Such a behavior cannot be explained within the free electron model and in the absence of strong localization effects but is qualitatively consistent with the "magnetic-field-induced Luttinger liquid" model,[1] which predicts insulating- and metallic-like T-dependences for transport along and perpendicular to the magnetic field, respectively. This behavior, however, is also consistent with the predictions of the localization theory for the ultra-quantum limit. In the latter case, the T-dependences arise due to dephasing, which destroys the strongly (but not completely) localized state at T=0.[2]

Analysis of these data with the extraction of power-law exponents is expected to distinguish between magnetic field induced Luttinger liquid behavior, where the exponent is field dependent, and dephasing, where the exponent is independent of field.

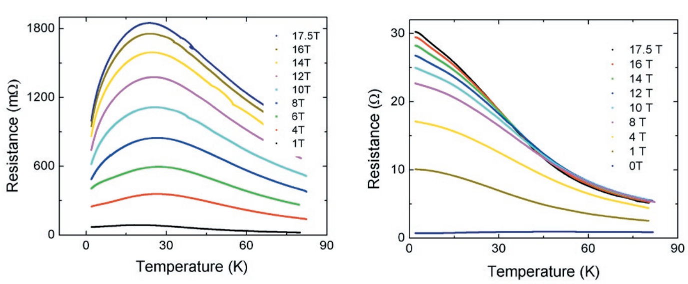

Figure 1. Temperature dependent resistance at the indicated fields of the "basal plane" sample (left panel) and the c-axis sample (right panel).

Acknowledgements: This research was supported by the NHMFL In-House Research Program.

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SEMICONDUCTORS

Quantum Hall Ferromagnetism in Diluted Magnetic Semiconductors

Jaroszyński, J., NHMFL
Stringer, E.A., NHMFL and The University of the South, Physics
Popović, D., NHMFL

A giant Zeeman splitting in diluted magnetic semiconductors (DMS) offers a unique opportunity to examine quantum Hall ferromagnetism[1] (QHF) since crossing of Landau levels (LL) can be achieved in moderately strong total magnetic fields (B ≥ 1 T). This makes it possible to study QHF in a wide range of tilt angles θ. We carried out studies of $Cd_{1-x}Mn_xTe$ quantum wells (QW) with a similar average content of Mn, but with either digital or uniform Mn distribution in the QW. Figure 1 shows that QHF peaks that occur at LL crossings shift toward lower $B_\perp$ as θ increases, due to a decrease[1] of the Zeeman gap with increasing B when B>1 T. At the same time, the behavior of the "normal" Shubnikov-de Haas peaks is more complicated, stemming from the redistribution of carriers between overlapping LL and the corresponding shift of the Fermi level. The amplitude of QHF spikes decreases as θ increases, indicating that ferromagnetic domain walls become shorter in a tilted field configuration, with no substantial difference between digitally and evenly doped QW.

The height of the QHF spikes depends dramatically on the history of the sample, shows hysteresis, stretched-exponential time evolution characteristic of glassy systems, and Barkhausen noise reflecting the dynamics of ferromagnetic domains. Our study indicates that these metastabilities stem from the electronic systems itself,[2] while the changes in the nuclear spin polarization[3] play only a minor role. Our results thus corroborate a transition from a stable QHF to a quantum Hall spin glass phase predicted for a sufficiently high disorder.[4]

Acknowledgements: This work was supported by NSF grant DMR-0071668 and the NHMFL. We are grateful to T. Murphy and E. Palm for cryogenic expertise.

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[2] Piazza, V., *et al*., cond-mat/0207234.
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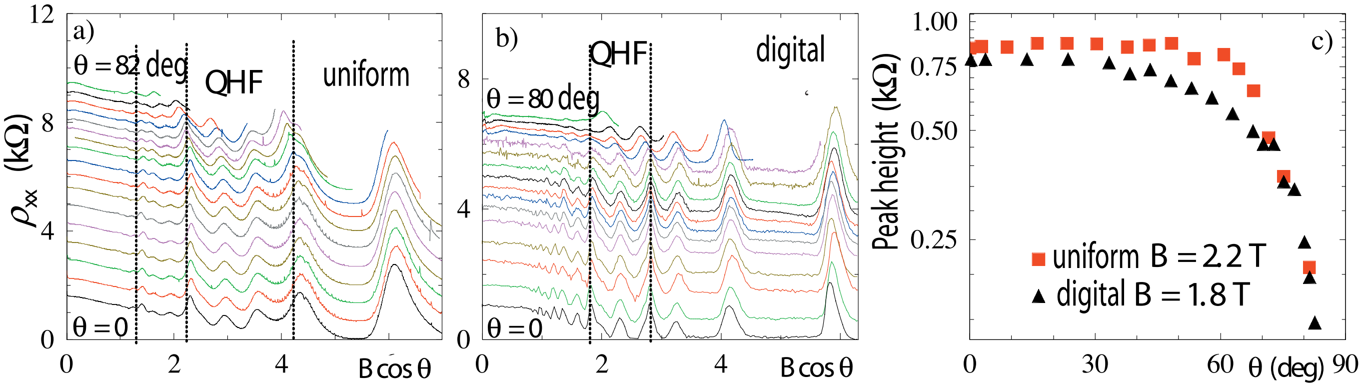

Figure 1. ρxx resistances at T=0.330 K as a function of Bcos(θ) at different tilt angles θ for a uniform (a) and a digital (b) Mn ion distribution. Vertical dotted lines show positions of the QHF peaks. (c) Amplitudes of the QHF spikes as a function of θ.

SUPERCONDUCTIVITY- APPLIED

The Effects of Conductor Anisotropy on the Design of High Field BSCCO Insert Magnets

Weijers, H.W., NHMFL
Schwartz, J., NHMFL/FAMU-FSU College of Engineering

$Bi_2Sr_2Ca_1Cu_2O$ and $Bi_2Sr_2Ca_2Cu_3O$ tape conductors (BSCCO) are prime candidates for application in the inner sections of 25 T superconducting magnets considering their current carrying capability in the field range of 20 to 25 T and their commercial availability in long lengths (>100 m). BSCCO tape conductors show a strong anisotropy in the field dependence of the critical current (I_c) with respect to the orientation of the magnetic field vector ***B***. This anisotropy varies between conductors depending on the distribution of grain misalignment angles and is characterized by the average grain misalignment angle (α^*). For commercial BSCCO conductors, α^* ranges from 3 to 12º relative to the flat surface of the tape. An effective magnetic field, B_{eff}, resulting in the same I_c as a field perpendicular to the tape surface, is defined as the product of |**B**| and a scaling function that depends on α^* and the field angle. The resulting $I_c(B_{eff})$ is then a scalar relation.

Considering an initial design for a 3-section, 5 T BSCCO insert in a 19 T outsert (*i.e.* background magnet), the value of B_{eff} is calculated for the two key locations: the maxima in the axial (B_z) and radial (B_r) field components. As seen in Figure 1, the analysis reveals 3 distinct regimes. In Regime I, the maximum in B_{eff} is practically equal to $B_{r,max}$, and the insert is radial field limited. In Regime II, the maximum in B_{eff} is at the location of $B_{r,max}$ but significantly higher in value. Thus neither radial or axial field, but a combination thereof limits the magnet. In Regime III the maximum in B_{eff} is at the location of $B_{z,max}$, with a value of $\sin(\alpha^*)B_{z,max}$, so the magnet is axial field limited. $B_{z,max}$ is practically equal to the central field value B_{CF}, *i.e.* ~25 T.

Since the limiting factor in Regime I ($B_{r,max}$) is determined by the geometry and current densities of insert and outsert, it can be affected by design changes. The limiting factors in Regime III (α^* and B_{CF}) are a conductor property and the target field value. So the parameters most relevant in the design optimization process depend on regime and therefore on α^*.

The pattern of three regimes is typical for BSCCO inserts in 25 T systems; only the crossover values between regimes vary. To understand and optimize the design of such an insert, α^* must be known or specified.

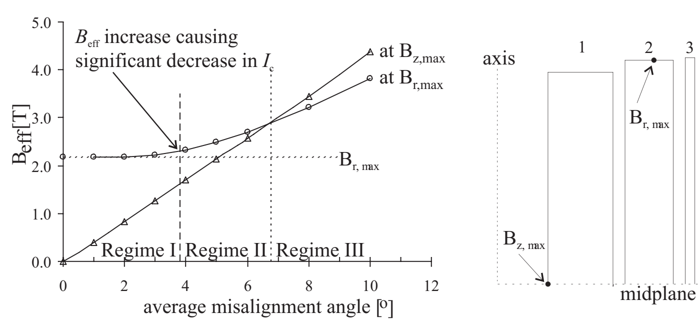

Figure 1. The effective field versus grain misalignment angle in a 3-section, 5 T BSCCO insert.

Lack of Orbital Frustration in the Formation of the Pseudogap in $Bi_2Sr_2CaCu_2O_{8+y}$

Krusin-Elbaum, L., IBM T.J. Watson Research Center
Shibauchi, T., Kyoto Univ., Electronic Science and Engineering
Mielke, C.H., NHMFL/LANL

In high temperature (T_c) superconductors, over a wide range of charge carrier (hole) doping, the pseudogap phenomenon is the dominant feature of the phase diagram. Its connection to superconductivity, however, remains controversial, and it has been viewed either as a form of a "precursor" or as a "competitor" to high T_c. In a precursor pairing scenarios, the characteristic pseudogap temperature $T^* > T_c$ may characterize the onset of some sort of pairing correlations, while the overall phase coherence is set at T_c. Indeed, there have been reports of vortex-like excitations in cuprates well above T_c. The magnetic field response is a good candidate to help sort this out, since the superconducting upper critical field H_{c2} is determined by the coherence length, and not directly by the superconducting gap, for the magnetic field strongly couples to the orbital motion of Cooper pairs.

A different sensitivity of T^* and T_c to magnetic fields has been known for some time, although the doping dependence was not well studied and the field range was not sufficient to fully understand the field effect on the pseudogap. Recently, by applying magnetic fields up to 60 T along the *c*-axis of $Bi_2Sr_2CaCu_2O_{8+y}$ and measuring its intrinsic tunneling resistivity ρ_c, we mapped the pseudogap closing field H_{pg} in the temperature and doping level phase space.[1] We found $H_{pg}^{\parallel c}$ and T^* related through a simple Zeeman energy relation as $g^{\parallel c}\mu_B H_{pg}^{\parallel c} \approx k_B T^*$ with the *g*-factor $g^{\parallel c} = 2.0$, suggesting the predominant role of the spin degrees of freedom in the formation of the pseudogap.

Our finding inspired a number of the "precursor" proponents to suggest that, at least within the framework of an intermediate coupling- and a BCS-Bose Einstein crossover models of cuprate superconductors, the Zeeman scaling may be argued as still possibly compatible with a superconducting origin of the pseudogap. For the case of a precursor (charge) pairing, however, one would also expect an orbital frustration of the pseudogap closing field. Thus, the key test of the relative importance of the Zeeman and orbital effects on H_{pg} lies in its field anisotropy in response to a magnetic field applied in the direction parallel and normal to the CuO_2 planes, since—by analogy to H_{c2}—when the field is parallel to the planes the orbital contribution should be suppressed.

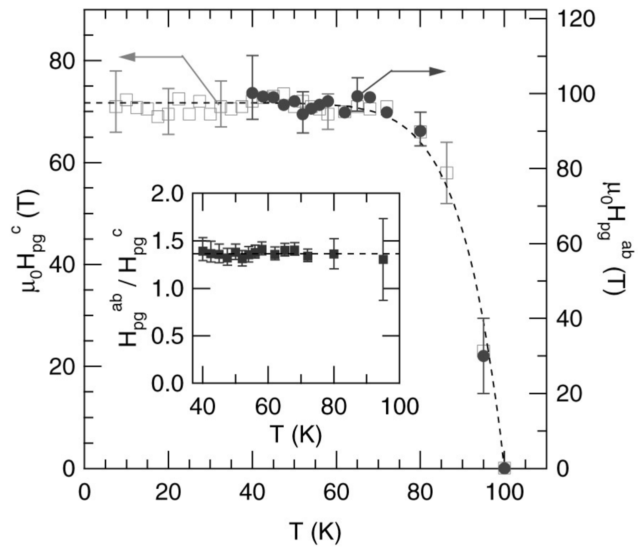

Figure 1. *H-T* diagram showing the pseudogap closing field $H_{pg}(T)$ of $Bi_2Sr_2CaCu_2O_{8+y}$ with a zero-field T_c = 60 K and $T^* \sim 100$ K for the magnetic field applied along the *c*-axis (open squares) and in the ab-plane (solid dots). Up to 60 T, H_{pg}(T) was directly determined from the down-shifting upturn of $\rho_c(T)$, see Reference 1. At lower temperatures, H_{pg}(T) was obtained by extrapolating the excess resistivity due to the pseudogap $\Delta\rho_c(H)$ to zero, with the error bars shown in the figure. Inset: The obtained ratio $H_{pg}^{\parallel ab}/H_{pg}^{\parallel c} = 1.35\pm0.1$ corresponds to the *g*-factor anisotropy as determined from the susceptibility measurements.

Using a rotational probe and a lock-in technique at 100 kHz in a 60 ms pulse magnet at NHMFL in Los Alamos, we performed measurements of ρ_c in $Bi_2Sr_2CaCu_2O_{8+y}$ in magnetic fields up to 60 T applied parallel to the *c*-axis[2] and parallel to the *ab*-plane. This allowed us to make a detailed comparison of the field anisotropy of both the superconducting and the pseudogap states. In contrast to the observed expectedly large (it can be as high as a factor of 30 at temperatures in the vicinity of ~ 0.5 T_c, for example) orientational anisotropy of the characteristic fields in the superconducting state, we find that the Zeeman relation still holds for $H_{pg}^{\parallel ab}$ (see Figure 1), namely, $g^{\parallel c}\mu_B H_{pg}^{\parallel c} = g^{\parallel ab}\mu_B H_{pg}^{\parallel ab} \approx k_B T^*$, with only a small anisotropy of the *g*-factor,[3] which is independently known from the measurements of magnetic susceptibility $\chi(T)$. Our observation appears to rule out the orbital contribution to the pseudogap closing field.

Acknowledgements: We are most appreciative of the technical assistance given to us by F.F. Balakirev and J. Betts.

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[3] Krusin-Elbaum, L., *et al*., manuscript in preparation (2002).

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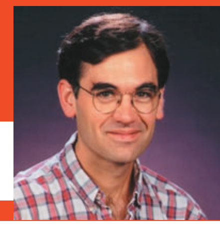
PEOPLE IN THE NEWS

G.Boebinger

A.Dorsey



A. Edison

A. Moreo

Greg Boebinger, NHMFL Center Leader at LANL, has been invited to speak before the National Academy of Sciences on April 25 in Washington, D.C. High magnetic field science is of particular interest to the Board because they anticipate conducting a study of high magnetic field science for the National Science Foundation in the near future. In addition to discussing his own work on the normal state of high-Tc superconductors, he has been asked to give a broad overview of the field, from the point-of-view of the science forefronts and also the various means of achieving high magnetic fields.

Alan Dorsey, NHMFL-UF physics faculty member, is the new chair of the UF Department of Physics. His term began on November 30, 2002 when he took the reins from interim chair Jack Sabin, who had held the position since mid-August. Dorsey earned his Ph.D. in physics from the University of Illinois at Urbana-Champaign in 1987 and was a postdoctoral fellow at Cornell University. He served on the faculty at the University of Virginia before coming to UF in 1997. Dorsey was recently elected a Fellow of the American Physical Society (APS). (see sidebar for more details).

Art Edison, Director of the Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility in the UF McKnight Brain Institute and UF assistant professor of biochemistry and molecular biology has been chosen as the Adult Volunteer of the Year for Prairie View Elementary School in Gainesville, Florida. Dr. Edison has been running a weekly science club in the after-school program for the last two years. Prairie View has the largest number of disadvantaged students in the Alachua County School District. Prairie View's total enrollment last year was 298 students (K-5), and 276 of those students (93%) were economically disadvantaged and received school lunch subsidies. 274 of the Prairie View students are African American (92% of the total), 18 are white (6%), 4 are Hispanic (1%), and 2 are Asian (1%). The club's activities are simple hands-on experiments (including things like magnetism and electricity), tours of UF labs, math activities, demonstrations, and regular math tutoring. According to Professor Bert Flanegan, chairman of the UF Department of Biochemistry and Molecular Biology, Edison is a rising star, "very energetic and a very enthusiastic teacher. He's always bubbling over with ideas and enthusiasm. [Volunteering] is something that should be applauded and supported. In the long term, it's going to pay off in the sense that you're getting kids really involved in science."

2002 APS Fellows

American Physical Society Fellowships recognize members who make "outstanding contributions to physics." The APS Fellowship Program was created to recognize members who have made advances in knowledge through original research and significant contributions to the application of physics to science and technology.

Alan Dorsey, NHMFL-UF physics faculty member and the new chair of the UF Department of Physics, is recognized "for seminal contributions to the theory of magnetic flux dynamics and non-equilibrum pattern formation in superconductors." (For more on Dorsey, see left).

Adriana Moreo, FSU professor of physics and member of the NHMFL Condensed Matter/Theory Group, is recognized "for important contributions to computational techniques and their application to the manganites, d-wave superconductors, and other correlated electronic systems." Her research interests include condensed matter physics, materials science, computational physics, high T_C superconductors, strongly correlated electronic systems, manganites and colossal magnetoresistance, and magnetism. She received her Ph.D. in physics in 1985 from the Instituto Balseiro in Argentina. Previous awards include a 1998 FSU COFRS Award, 1997 FSU Developing Scholar Award, 1993 FSU Summer Assistant Professor Research Award, and 1984-85 Fellowship of Comision Nacional de Energia Atomica at the Centro Atomico Bariloche, Argentine Atomic Energy Commission.

CONFERENCE & WORKSHOP ACTIVITY

4th N. American FT-ICR Conference
April 3-6, 2003
Marconi Conference Center, Coastal Lodge, and Retreat
Greater San Francisco, CA
http://www.magnet.fsu.edu/news/events/icr4.html

Organized by the NHMFL ICR Program, the 4th North American Fourier Transform Ion Cyclotron Resonance Mass Spectrometry Conference will feature 24 invited plenary lectures in four general areas (Instrumentation, Biomolecules, MS/MS, and Other Applications), plus posters and a feature lecture by Prof. Helmut Schwarz from Berlin. Partial support for a number of graduate student/postdoc posters will again be available. Local arrangements are being organized by: Professor Evan R. Williams of the Department of Chemistry, University of California, Berkeley, CA. Further details about the program, registration, and lodging is available on the Web site. Interested participants may contact members of the organizing committee: NHMFL/FSU (Alan G. Marshall, Christopher L. Hendrickson, Mark R. Emmett) or NHMFL/UF (John R. Eyler).

VI Latin American Workshop on Magnetism, Magnetic Materials and Their Applications (LAW3M)
April 7-11, 2003
Chihuahua, Mexico
Advanced Materials Research Center (CIMAV)
http://www.law3m.org.mx/

This biennial meeting initiated in La Habana, Cuba in 1991 is designed to support scientific exchanges in the Americas. The LAW3M is a great forum to support scientific exchanges among researchers and institutions interested in recent developments in all branches of fundamental and applied magnetism. The NHMFL is assisting in organizing the workshop.

A primary goal during the 2003 LAW3M will be to provide an open forum that promotes exchanges among researchers (including students and postdocs) and discussions of new concepts and developments in materials research and magnetic applications. Workshop proceedings will be published as a special issue of the Elsevier Science B.V. journal, Journal of Alloys and Compounds.

SPIE's First International Symposium on Fluctuations and Noise
June 1-4, 2003
La Fonda Hotel
Sante Fe, New Mexico
http://spie.org/conferences/calls/03/fn/

The use of noise techniques to study materials has grown steadily over the last few decades, and the goal of this symposium is to bring together people from around the world working on the most exciting applications of noise to serious material problems.

The first meeting on Fluctuations and Noise (FaN) comprises six parallel conferences: FaN in Biological, Biophysical, and Biomedical Systems, FaN in Photonics and Quantum Optics, Noise as a Tool for Studying Materials, Noise in Devices and Circuits, Noise in Complex Systems and Stochastic Dynamics, Noise and Information and Nano-electronics, Sensors, and Standards. The NHMFL is pleased to support the conference on Noise as a Tool for Studying Materials (Conference Chair: Michael B. Weissman, University of Illinois/Urbana-Champaign, mbw@uiuc.edu, 217-333-7897). For complete symposium information, see the Web site.

XIIth International Quantum Atomic and Molecular Tunneling in Solids Workshop (QAMTS)
June 22-25, 2003
Gainesville, Florida
Hotel Headquarters: Reitz Union Hotel and UF Hotel & Conference Center
Abstract Deadline: March 22, 2003
http://www.clas.ufl.edu/QAMTS/

This important international meeting will be held on the campus of the University of Florida in Gainesville. NHMFL Principal Investigator and UF Dean of the College of Liberal Arts and Sciences Neil Sullivan and Juergen Eckert of Los Alamos National Laboratory are the principal organizers of the workshop. Topics will include: Macroscopic Tunneling in Nanomagnets and Related Molecular Systems; Rotational Tunneling of Symmetrical Groups; Proton Tunneling in Hydrogen Bonds; Molecular Dynamics Simulations; Coupled Rotors; Tunneling in Life Sciences; Tunneling in Glasses and Amorphous Systems; and others.

Sponsors include the NHMFL, LANL, Spallation Neutron Source, National Institute of Standards and Technology, and UF. For further information, contact Carol Binello at the conference office, cbinello@clas.ufl.edu; (352) 392-0780; fax (352) 392-3584.

33rd Southeast Magnetic Resonance Conference and Symposium (SEMRC)
October 17-19, 2003
Ramada Inn & Conference Center
Tallahassee, FL

The SEMRC provides an ideal opportunity for scientists in all areas of magnetic resonance to come together and share new applications and technique developments. The NHMFL is pleased to sponsor the 33rd SEMRC. Registration information and further details will be available soon on the conference Web site.

Future Conference Dates

5th Magnetic Microsphere Meeting
May 20-22, 2004
Lyon, France
http://www.magneticmicrosphere.com

16th International Conference on High Magnetic Fields in Semiconductor Physics
August 2-6, 2004
Tallahassee, Florida
http://SemiMag16.magnet.fsu.edu

This prestigious conference has been held every other year alternatively in Europe, North America, and Asia (mainly in Japan). The main focus of SemiMag 16 will be up-to-date highlights of semiconductor research in high magnetic fields with specific emphasis on magneto optical and transport studies on different semiconductor systems. The local organizing committee which consists of seven people from three sites include: Yong-Jie Wang (Chair, SemiMag16@magnet.fsu.edu), Lloyd Engel, and Dragana Popovic (Tallahassee), John Singleton and Scott Crooker (LANL), Chris Stanton and Russ Bowers (UF).

Applied Superconductivity Conference (ASC04)
October 4-8, 2004
Jacksonville, Florida
Hotel Headquarters: Adam's Mark

This important international conference is held every two years and typically attracts approximately 1,800 participants. Dr. Justin Schwartz of NHMFL's Magnet Science and Technology program is the conference chair. Additionally, Cesar Luongo and Ysonde Jensen both of NHMFL/MST will serve as program chair and local chair, respectively. For information, contact Justin Schwartz at 850-644-0874; fax 850-644-0867; or *ASC04ConfChair@magnet.fsu.edu.*

15th Conference of the International Society of Magnetic Resonance (ISMAR 2004)
October 24-29, 2004
Jacksonville, Florida
Hotel Headquarters: Sawgrass Marriott Resort
http://www.ismar.org/

The scientific program of this major triennial program encompasses lectures and posters representing the various fields of magnetic resonance, showing its breadth and interdisciplinary nature. The program reflects the progress and exciting developments of new techniques, theory, and applications in chemistry, physics, biology, medicine, and material science. Junior scientists are particularly encouraged to participate.

A preconference summer school will be held at the NHMFL in Tallahassee focusing on modern methodology in magnetic resonance. Buses will be available to transport attendees to the Sawgrass Resort on Sunday, October 24.

The conference Chairman is Timothy A. Cross, NHMFL/FSU NMR Spectroscopy and Imaging Program Director/Professor. For complete details, see the conference Web site.

Physical Phenomena at High Magnetic Fields - V
August 2005 (tentative)
Tallahassee, Florida

PPHMF-V has been held triennially since its inception in May, 1991, and would normally be held next in the fall, 2004. In August 2005, however, NHMFL colleagues at the University of Florida will be hosting the prestigious 24th Low Temperature Physics Conference in Orlando, Florida. Because attendees may be interested in topics at both conferences, the laboratory has decided to shift PPHMF-V to summer, 2005, and hold it as a satellite to the 24th LTP conference. Planning is underway; for information, contact Mary Layne, *layne@magnet.fsu.edu,* 850-644-3203.

24th Low Temperature Physics Conference
August 10-17, 2005
Orlando Hyatt Conference Center
Orlando, Florida

The daily program schedule will include plenary talks in the morning, five parallel sessions during late morning and early afternoon, and posters in late afternoon until 7 p.m. Parallel session topics include: quantum gases, fluids, and solids; properties of solids (magnetic, mechanical, and thermal properties, phase transitions); superconductivity, conduction electronics in condensed matter (localization, electron transport, mesoscopics); and materials, techniques and applications (refrigeration, detectors, superconducting devices, etc.). Several satellite conferences will be run in various parts of Florida before and after the conference. For more information, contact Conference Chairman Gary Ihas at *ihas@phys.ufl.edu*

Other Conferences of Interest

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7th International Symposium on Research in High Magnetic Fields
July 20-23, 2003
Institut National des Sciences Appliquées
Toulouse, France
Abstract Deadline: February 28, 2003
http://www.lncmp.org/ENG/

This symposium, a satellite of the International Conference on Magnetism ICM 2003, aims to cover recent highlights in research in high magnetic fields, in areas like magnetism, magneto-transport, and magneto-optics of condensed and dilute matter, developments in high magnetic field generation, and new high magnetic field measurement techniques.

GRANTS

The National Science Foundation (NSF) has awarded two UF assistant physics professors with a $450,000 grant through the organization's CAREER program. Yoonseok Lee and Stephen Hill each will receive $90,000 a year for the next five years to support their research. Both Hill and Lee came to UF in 2001.

Stephen Hill, a former postdoc at the NHMFL in Tallahassee, is a UF-NHMFL faculty member. Hill received his B.A. and Ph.D. degrees in physics from the University of Oxford, where his Ph.D. adviser was John Singleton, a prominent user of the NHMFL. In Tallahassee, Hill worked as a postdoc for two years with Jim Brooks before taking a faculty position at Montana State University. Hill's research focuses on the use of electron magnetic resonance spectroscopy to study the characteristics of molecule based materials. He will work closely with chemistry professor George Christou during the project. "It is hard to describe how overjoyed I feel," Hill says. "This grant rewards many years of incredibly hard work and is a tremendous help. It will provide student salaries, materials and supplies, and fund a much needed summer salary for the next five years so that I may focus on research and research-oriented education."

Yoonseok Lee is a low temperature physicist and new member of the Microkelvin Research Laboratory. Lee has started new experiments using the NHMFL High B/T Facility at UF to study superfluid helium three in high magnetic fields. Lee's award was based on his research proposal: Nature of Pure and Dirty Liquid 3He. "This award supports our research on the fundamental nature of pure and dirty liquid helium three," Lee says. "This unique property allows us to study the property of liquids at extremely low temperatures." He will work with colleagues at Northwestern University.

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www.magnet.fsu.edu

The major focus of the High Resolution NMR program at the NHMFL is the NMR spectroscopy of biological macromolecules, including proteins and RNA, in solution.