

PROTON



PHYSICS REPORT ON THINGS OF NOTE

VOLUME 7 NUMBER 4

Outstanding Referees



Mark Meisel

The American Physical Society has named **Profs Mark Meisel** and **Richard Woodard** as "Outstanding Referees".

This is the first year of this recognition, so Mark and Richard are among 534 in the inaugural group. According to the APS, "The highly selective award program recognizes scientists who have been exceptionally helpful in assessing manuscripts for publication in the APS journals. The program will annually recognize approximately 130 of the 42,000 currently active referees, but in the inaugural year a larger group of 534 referees has been selected for the Outstanding Referee designation."

The full list of Outstanding Referees, along with details about the program, can be found at <http://publish.aps.org/outstandingreferees>.



Richard Woodard



Awards Received

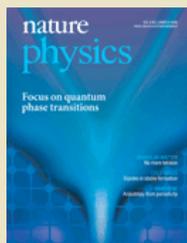
Pictured (l to r) are Robert Haddon (UC Riverside), Mildred Dresselhaus (MIT) and **Prof Art Hebard** (UF) shortly after the award ceremony at which Milli won the APS Oliver Buckley Prize and Art & Robert shared the James McGroddy Prize along with Jun Akimitsu (not present). The McGroddy prize was for the discovery of high temperature superconductivity in a non-oxide systems. *Photo taken by Prof Andrew Rinzler.*

RESEARCH NEWS

Physicists: After 30 years of study, rare particle confirms prediction

High-energy physicists devoted to recreating the conditions at the beginning of the universe have for the first time observed a new way to produce those basic particles of atoms, protons and neutrons.

Confirming a decades-old prediction, the physicists with the CLEO collaboration say they observed a rare and extremely short-lived subatomic particle with the unusual name of "charmed-strange meson" decay into a proton and anti-neutron. Detection of the event, which the collaboration made public recently at <http://arxiv.org/>, was attributed to **Prof John Yelton**, a physicist at the University of Florida, one of many institutions that are part of the CLEO collaboration. "It's the sort of thing that, for many years, people have known should happen," Yelton said. "What we have done is show that it does, and how often." Read full article at <http://news.ufl.edu/2008/03/10/particle-2/>



Collaborators' research featured in *Nature Physics*

Collaborators at the University of Central Florida (UCF), the University of California at San Diego (UCSD), and **Prof Stephen Hill's** group at the University of Florida (UF) report in *Nature Physics* a new dimeric molecular nanomagnet which reveals novel topological (Berry phase) effects in the quantum tunneling associated with interacting magnetic systems.

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Crystal bells stay silent as physicists look for dark matter

Fermilab - U.S. experiment retakes the lead in competitive race. Scientists of the Cryogenic Dark Matter Search experiment announced that they have regained the lead in the worldwide race to find the particles that make up dark matter. The CDMS experiment, conducted a half-mile underground in a mine in Minnesota, again sets the world's best constraints on the properties of dark matter candidates.

Read full press release at http://www.fnal.gov/pub/presspass/press_releases/cdms-result-2008.html

UPCOMING EVENTS:

ANNUAL SPRING PICNIC
presented by
The Society of Physics Students
Saturday, April 5
@ Lake Wauburg
12:00-4:00pm

OUTREACH ACTIVITY

As part of UF Library Read-a-thon 2008,
Prof Mark Meisel will be reading

"Whats wrong with this library?" in "Boojums All The Way Through: Communicating Science in a Prosaic Age"

by *N. David Mermin*
on Thursday, April 17, at 11:30-11:40, on the Plaza of the Americas for full schedule visit <http://www.uflib.ufl.edu/readathon/schedule.htm>

EDITORS

Alan Dorsey, Chair
Pam Marlin



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Physics Faculty, Students, and Postdocs attend APS Meeting

The March meeting of the American Physical Society (APS) was held March 10-14, in New Orleans, Louisiana. Over 7,000 physicists, students, educators, journalists, and researchers attended the meeting. There were several invited and contributed talks by our faculty, students and postdocs:



Photo: Brian Lane giving talk

Brian Lane, graduate student, (Prof Kevin Ingersent), "Conductance signatures of quantum phase transitions in asymmetric double quantum dots".

Saiti Datta, graduate student, (Prof Stephen Hill) "Looking for higher anisotropy barriers in single-molecule magnets".

Prof Art Hebard, (invited talk, McGroddy Prize), "Superconductivity in alkali-metal doped Carbon-60". From Prof Hebard's group: **Rajiv Misra**, graduate student, "Observation of spin-wave mediated Altshuler-Aronov and weak localization corrections to conductivity in thin films of gadolinium".

From **Prof Yasumasa Takano's** group: **Yasuo Yoshida**, post doc, "Magnetic field versus temperature phase diagram of the spin-1/2 bond-alternating-chain antiferromagnet F5PNN"; **Younghak Kim**, graduate student, "Specific heat and magnetocaloric effect of the $S=1/2$ spin-ladder compound $(\text{CH}_3)_2\text{CHNH}_3\text{CuCl}_3$ "; **Travis Miller**, undergraduate student, "Low-temperature calorimeter for magnetocaloric-effect measurements in high magnetic fields" (supported in part by the University Scholars Program).

Prof Peter Hirschfeld, "Structure of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ supermodulation from ab initio calculations". From Prof Hirschfeld's group: **Siegfried Graser**, post doc, "Local quasiparticle lifetimes in a d-wave superconductor"; **Greg Boyd**, graduate student, "Reversal of specific heat oscillations with planar magnetic field in 2D d-wave superconductors: Doppler shift beyond the nodal approximation"; **Vivek Mishra**, graduate student, "Sublattice Model of Atomic Scale Pairing Inhomogeneity in a Superconductor"; **Wei Chen**, graduate student, "Magnetic Correlations on the Full Chains of Ortho-II $\text{YBCO}_{6.5}$ " and "Disorder Induced Resistivity Upturns in Metallic Cuprates".



Photo: New Orleans paddle boat



All photos contributed by Brian Lane, (pictured right in New Orleans)

Ranjani Narayanan, graduate student, (Prof Stephen Hagen), "Coupled folding and binding kinetics in the intrinsically isordered peptide IA3". Ranjani also attended the workshop on Opportunities in biological physics".



Prof Ho Bun Chan, "Activation barrier scaling and switching path distribution in a micromechanical parametric oscillator". From Prof Ho Bun Chan's group: **Yiliang Bao**, graduate student, "Measurements of the Casimir interaction between a sphere and a rectangular corrugated plate"; **Konstantinos Ninos**, graduate student, "Micromechanical force detectors for measuring magnetization at high magnetic fields and the magnetic response of $\text{Ba}_3\text{Cr}_2\text{O}_8$ "; **Corey Stambaugh**, graduate student, "Fluctuation relations in a micromechanical oscillator driven far from thermal equilibrium"; **Zsolt Marcet**, graduate student, "Controllable evanescent field coupling between metallic bilayers of subwavelength apertures".

From **Prof Mark Meisel's** group: **Daniel Pajerowski**, graduate student, "Angular Dependent Magnetic Susceptibility with Photoexcitation Studies on Prussian Blue Analog Thin Films"; **Justin Cohen**, undergraduate student, "UnderQuantum Criticality and Neutron Scattering Solutions for a Spin-1/2 Ladder Model". To attend this meeting, Justin Cohen was the recipient of a \$500 Wentworth Travel Scholarship administered by the UF Honors Program.

Byoung Hee Moon, graduate student, (Prof Yoonseok Lee) "Direct Sound Propagation in Superfluid $^3\text{He-A}$ in 98% Aerogel".

Lex Kemper, graduate student, (Prof Hai-Ping Cheng) "Electronic structure of graphene in the presence of disorder" and "Influence of oxygen orbitals on impurity states in superconducting cuprates".

UF was well represented at the "Student Lunch with the Experts" Session, where, at tables of 8 people, interested students enjoyed complimentary box-lunches while participating in an informal discussion with an expert on a topic of interest to them. Participating UF "experts" and their topics were **Alan Dorsey** (Supersolids), **Stephen Hill** (Molecular Magnets), and **Mark Meisel** (Magnetism: Molecule-Based Systems Where Physics Meets Chemistry).



Photo: New Orleans



UPCOMING SEMINARS

FOR TIMES PLEASE VISIT
<http://www.phys.ufl.edu/seminars>

ASTROPHYSICS

April 18, Larry Price,
Stochastic background of gravitational waves from cosmological sources

COLLOQUIUM

April 3, Gary Steigman,
Cosmological nucleosynthesis
 April 10, Sebastien Balibar,
Supersolidity and disorder
 April 17, Myriam Sarahik,
Molecular nanomagnets

CONDENSED MATTER

April 14, Juergen Eckert
 April 21, Takao Mizusaki

HIGH ENERGY

April 1, Gabriella Sciolla
 April 4, Robert Napora,
An introduction to neutrino physics and the Sci BooNE experiment
 April 8, Deepak Kar, *Using drell-yan production to study the underlying event at CDF*
 April 11, Paolo Gondolo,
Dark matter and the first stars
 April 15, Heather Ray
 April 18, Seung Joon Lee
 April 22, David Morrissey

QTP

April 16, Hai Lin
 April 23, Nico Stolterfoht



On a recent trip to Titusville, **Deepak Kar**, physics student, snaps a picture of the launch of the space shuttle Endeavor.

STUDENT NEWS



Ian Vega, physics graduate student (**Prof Steven Detweiler**), received a Student Travel Grant from the Topical Group in Gravitation of the American Physical Society. With the grant, Ian will attend the APS April Meeting in St. Louis, Missouri. The amount of the award was \$300. Ian also won the Blue Apple Award for Best Student Talk at the 4th Gulf Coast Gravity Meeting, held at the University of Mississippi in Oxford. Again, this comes from the Topical Group in Gravitation of the American Physical Society. The Blue Apple is given to four students each year, one in each of the four gravity meetings across the US (Pacific Coast, Eastern, Midwest, and Gulf Coast). The Gulf Coast contingent includes the universities from Texas all the way to Florida. The award included a plaque and Blue Apple trophy, and a \$200 cash prize.

The most recent issue of *New Scientist* features a two column discussion with physics graduate student, **Emre Kahya** (**Prof Richard Woodard**), on "Acid test for alternative to dark matter". The full article can be read at <http://space.newscientist.com/article/mg19726464.300-supernova-race-could-settle-dark-matter-debate.html>.

Acid test for alternative to dark matter



The Road Less Traveled

Professors Lee and Meisel organized a camping road trip to the APS meeting in New Orleans. Leaving on Saturday morning, Lee's van carrying six and Meisel's compact SUV carrying four, plus massive quantities of gear, left the Physics building loading dock and took the back roads to Steinhatchee, where the group lunched at the famous Roy's Restaurant on the banks of the Steinhatchee River.

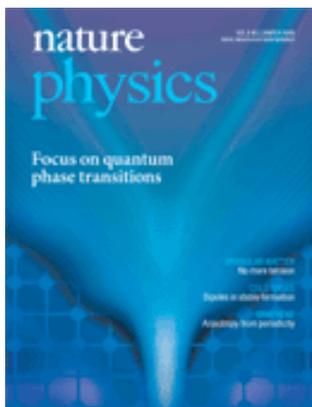
The trip continued along US 19 and 98 to St. Joseph Peninsula State Park, where two camp sites were shared. The blustery and cool weather was enjoyed by everyone, and the group included **Professors Biswas, Lee, Meisel**; graduate students **Pradeep Bhupathi, Evan Donoghue, Miguel Gonzalez, Byoung Hee Moon, Dan Pajerowski**; and undergraduates **Justin Cohen and Jaymin Jhaveri**. After breaking camp on Sunday morning, the rest of the trip to New Orleans seemed almost endless.



STAFF NEWS

Bill Malphurs receives the 2007 Superior Accomplishment Award. Bill was unable to receive the award at the February awards ceremony due to illness. Welcome back and congratulations, Bill!

Photo l to r, Prof Andrew Rinzler (accepted the award for Bill at the ceremony), Prof Stephen Hill (award nominator) and Bill Malphurs (award recipient).



Collaborators' at UCF, UF and UCSD report in *Nature Physics* a new dimeric molecular nanomagnet which reveals novel topological (Berry phase) effects in the quantum tunneling of interacting magnetic systems

(contributed by Prof Stephen Hill)

Tunable electron spins in solid media are among the most promising candidates for qubits in quantum computing. The synthetic flexibility of molecular nanomagnets allows one to systematically produce samples with desirable properties such as those with entangled spin states for implementation in quantum logic gates. A new molecular *nanowheel*, composed of two coupled halves with the same spin value, represents an advance in this direction. A magnetic field modulates the coupling between states of different spin length leading to the observation of quantum interference—an effect that can be used to tune the entanglement of a prototypical molecular quantum device.

Berry phase and magnetic quantum tunneling

In nanoscale magnets, such as single-molecule magnets (SMMs), the magnetic moment (spin) can switch between opposite projections without following a *classical* precession path in real space via a quantum mechanical tunneling process. From this perspective, the spin can also acquire a topological phase (Berry's phase) during its quantum mechanical switching. The novelty is that, under certain conditions and due to the quantum mechanical nature of the system, different quantum tunneling trajectories can combine and give rise to interference effects that may lead to a vanishing of the quantum tunneling in the destructive case. This was predicted in 1992 separately by theorists Daniel Loss and J. von Delft and first observed experimentally in the Fe_8 SMM by Wernsdorfer and Sessoli in 1999.

The effect of topology on the dynamics of two interacting spins is of great interest in different disciplines. Sjöqvist was the first to study this phenomenon in 2000 assuming two entangled spins precessing around a fixed magnetic field. It was shown that the topological phase acquired by the entangled system could not be trivially reduced to the sum of the Berry phases acquired by each individual spin.

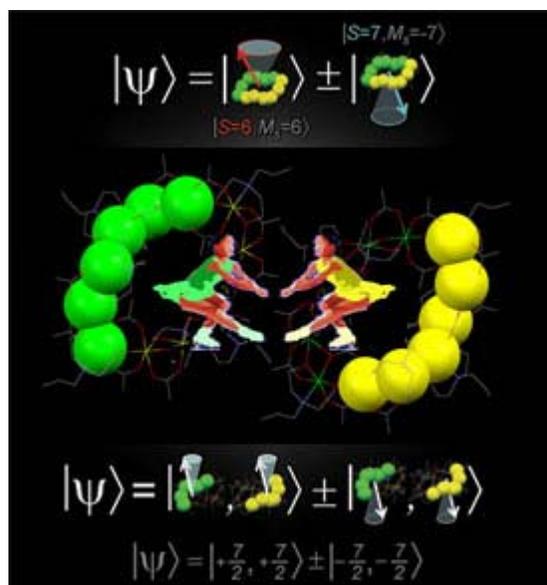
Interestingly, one can trace an equivalence between two interacting magnetic moments switching directions via quantum mechanical tunneling and the situation described by Sjöqvist. Along these lines, the UCF/UF/UCSD collaboration have provided the first experimental observation of quantum interference effects associated with the quantum mechanical tunneling of two exchange-coupled spins associated with a SMM. This behavior is a consequence of the unique characteristics of a molecular Mn_{12} wheel which behaves as a (weak) ferromagnetically exchange-coupled molecular dimer. The molecule is composed of 12 manganese ions arranged in an annular structure (wheel) giving rise to a ground spin state $S=7$ that points along the direction of the wheel axis. The total spin results from ferromagnetic coupling between the two spin $S=7/2$ halves of the wheel.

The observations reveal how the interaction between the two wheel halves causes their tunneling trajectories to interfere and, under certain conditions, the tunneling probability vanishes. This work, which is published in *Nature Physics*, is timely in that a number of theoretical groups have recently discussed the possibility of utilizing the spin states of molecular magnets to realize a quantum logic device (e.g. Leuenberger and Loss, *Nature* 2000). In particular, *quantum interference could be employed to turn on and off the entanglement between two qubits* in a future molecular quantum device.

To read full article please visit: http://physics.ucf.edu/~delbarco/html/topology_effects.html

Reference

C. M. Ramsey, E. del Barco, S. Hill, S. J. Shah, C. Beedle and D. N. Hendrickson, "Quantum Interference of Tunnel Trajectories between States of Different Spin Length in a Dimeric Molecular Nanomagnet" <http://www.nature.com/nphys/index.html> *Nature Physics* Advance online publication (2 March 2008): DOI: 10.1038/nphys886.



A quantum dance involving the two molecular wheel halves.