A PHYSICS DEPARTMENT PUBLICATION

MARCH 2008

PROTON

PHYSICS REPORT ON THINGS OF NOTE

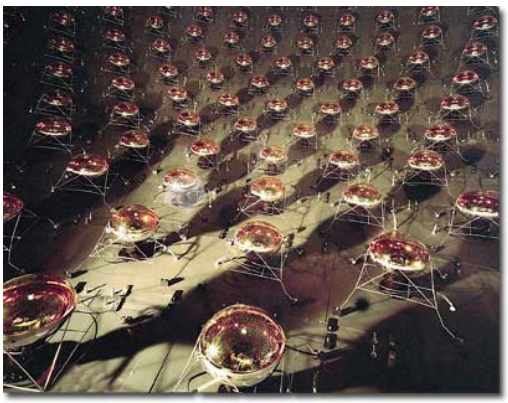
VOLUME 7 NUMBER 3

MINIBOONE @ UF

Contributed by Heather Ray

There are three types of neutrinos in the Standard Model of Physics: the electron neutrino, the muon neutrino, and the tau neutrino. Neutrinos are believed to oscillate, or change from one type to another. In the long list of experiments which have claimed an observation of neutrino oscillations, one stands apart: LSND. The LSND result doesn't fit the picture of oscillations formed by other experiments, and as such is highly controversial. The MiniBooNE experiment was designed to explore the LSND result, to conclusively prove or disprove the claimed oscillations.

MiniBooNE is an accelerator-based experiment located at Fermi National Laboratory. MiniBooNE searches for oscillations using a neutrino beam created by pions and kaons decaying in flight. Neutrinos enter the detector where their interactions with the mineral oil produce Cerenkov and scintillation light. The pattern of light observed in the detector indicates which type of neutrino (electron or muon) is engaged in the interaction. In March 2007 MiniBooNE reported results of the oscillation search using a neutrino data set. MiniBooNE did not see evidence for the LSND-style oscillations, but did see an unexplained excess of events in the low energy region. This excess is not consistent with having come from oscillations. In the past year MiniBooNE has focused on understanding the low energy events. The excess is still present, and still a mystery. MiniBooNE is currently collecting anti-neutrino data, and hopes to release preliminary results for this analysis in the next few months.



A close-up of the interior of the MiniBooNE tank (Courtesy BooNE website)

The MiniBooNE group at Physics currently consists of **Professor Heather Ray**, **Postdoctoral Fellow Bari Osmanov,** and undergraduates **Bryce Bolin**, **Matt Fisher**, and **Rainey Lund**. The group is involved in a wide range of analyses: verifying the detector stability using a sample of electrons from cosmic ray muon decays, making predictions for the anti-neutrino data set assuming varying oscillation scenarios, improving the sensitivity of the oscillation analysis, and searching for signs of supernova. The group will be expanding to include one to two graduate students in the next few months.

Visit BooNE Booster Neutrino Experiment at http://www-boone.fnal.gov/

A VISIT TO THE MICROKELVIN LABORATORY

Contributed by Neil Sullivan

UNIVERSITY OF FLORIDA
Microkelvin Lab

http://www.phys.ufl.edu/~mkelvin/

The Microkelvin Laboratory was created following an NSF award to Principal Investigators: **Dwight Adams**, **Gary Ihas** and **Neil Sullivan** in 1984. The NSF provided funds for the scientific equipment and the University matched the support by providing funds for the building. The NSF funds were only sufficient to properly equip two of the three bays in the Laboratory. Each of the first two bay consists of a nuclear demagnetization refrigerator that consist of a 20 mole copper that are pre-cooled to a few tens of millikelvins in a magnetic field of 10 Tesla. The copper is then demagnetized to a small value and the temperature to a few tens of Microkelvin for a copper stage. Each of these bays is housed in a special shielded room to exclude electromagnetic (radio and radar) noise and sits atop a 15 foot concrete tripod with special isolation units to reduce vibration to a very low level. The unique features of the facility is the ultra-quite environment and the high cooling power of the refrigerators which can in some cases allow one to stay cold for 1 to 2 months. *See Microkelvin and Photos on Page 4*

Spring 2008 SEMINAR Schedule

Astrophysics
Fridays @ 4:00pm in Room 2165 NPB

Condensed Matter Physics
Mondays @ 4:05pm in Room 2205 NPB

Physics Colloquium
Thursdays @ 4:05 in Room 1002 NPB

High Energy Physics
Tuesdays @ 2:00pm and Fridays @ 2:00pm in Room 2165 NPB

Quantum Theory
Wednesdays @ 4:05pm in Room 2205 NPB

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FACULTY NEWS

Congratulations to **Professor Steven Detweiler** who has been elected as Vice-Chair of the Topical Group on Gravitation of the American Physical Society.

The Camille and Henry Dreyfus Foundation has selected **Professor David Micha** for an award within its Senior Scientist Mentor Program, stating that it is "based in part on your distinguished research and pedagogical career accomplishments and your commitment to advising and mentoring undergraduate student participants". The award includes $ 20,000 to cover expenses of the mentored students for two years. The funds are being used for theoretical and computational research on optical properties of surfaces relevant to capture and conversion of solar energy.

Assistant Professor Ivan Furic has been named an Alfred P. Sloan Research Fellow. These extraordinarily competitive awards are designed to "stimulate fundamental research by young scholars of outstanding promise". Ivan will receive $50,000 over a two year period in support of his research. For the full list of recipients, see http://www.sloan.org/programs/fellowshiplist.shtml. Congratulations Ivan!

Professor Pierre Ramond gave the inaugural talk of the S. Goldman Lectures in Mathematical Physics at the University of Central Florida on March 1. These lectures were launched in Spring 2008. http://heplectures.physics.ucf.edu/

48TH ANNUAL SANIBEL SYMPOSIUM

Contributed by Sam Trickey

Five "Focused Sessions on Cuprates and Electronic Structure Methods" got the 48th Sanibel Symposium off to an intense start. Fourteen invited speakers presented aspects of strongly correlated systems and methods for treating them. There was strong inter-specialty discussion with participants expert in quantum chemistry methods and applications. These sessions were organized by **Professors Hai-Ping Cheng** and **Peter Hirschfeld**.

Peta-scale computers present great challenges as well as opportunities to treat more realistically sized systems, so there was a Workshop on Parallelization of Coupled-Cluster Methods. These are the most sophisticated many-body methods in quantum chemistry. This was organized by **Professor Rod Bartlett**. This thematic emphasis within the Symposium continues a pattern begun last year. Materials and chemical physics problems are the major theme in even-numbered years, biomolecular and pharmaceutical problems in odd-numbered years. Other threads this year included two thematic sessions on Optical Properties at Surfaces, and sessions on Theoretical and Computational Methods, Complex Spectra, and Metals in Biology.

This was the fourth meeting at the King and Prince Hotel on St. Simons Island, Georgia, February 21-26. The similarity of the St. Simons beach-front location to the original site continues to be popular with participants. (The meeting left Sanibel Island after the hotel was sold and razed in 1977.) Attendance remains strong, though representation from Latin America was off, apparently because of the cost and hassle of obtaining visas.

The Cuprates Theme was supported by the U.S. Department of Energy, Oak Ridge National Laboratory, the National High Magnetic Field Laboratory, UF's Center for Condensed Matter Sciences, and the Department of Physics. The Coupled-Cluster Work-shop was supported by the U.S. National Science Foundation and the Department of Energy. General support was received from the Office of Naval Research, Taylor and Francis Publishers, John Wiley and Son, and UF's Office for Research and Graduate Programs.

The 49th Symposium will take place beginning on Thursday, February 19, and end at noon on Tuesday, February 24, 2009. Detailed information on the program and arrangements will be at http://www.qtp.ufl.edu/sanibel.

UPCOMING SEMINARS

FOR TIMES PLEASE SEE PAGE 1

ASTROPHYSICS

MARCH 28, GEORGE FULLER

Neutrinos: nature's stealthy agents of disorder and creation

COLLOQUIUM

MARCH 6, VUK MANDIC

Searching for Stochastic Gravitational Radiation with LIGO: New Results and Implications

MARCH 20, KEN MERZ

Is Biology Quantum Mechanical?

MARCH 27, JOEL SHAPIRO

CONDENSED MATTER

MARCH 3, EUGENE MISHCHENKO

Intrinsic Spin-Hall Effect in 2D Electron Systems

MARCH 17, ANNA KOEHLER

Controlling exciton diffusion for white light emission

MARCH 24, MICHAEL MACKAY

Dynamics and thermodynamics on the nanoscale

HIGH ENERGY

MARCH 21, MARTIN KRUCZENSKI

MARCH 25, HYE-SUNG LEE

QTP

MARCH 5, ERIC FORD

Searching for Extrasolar Planetary Systems

MARCH 19, EIRIK DA SILVA

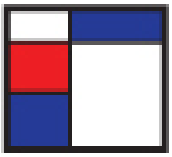
MARCH 26, DIMITRI KILIN

Photovoltage for Adsorbants on Silicon Surface

SEMINAR SCHEDULES ARE LISTED AT
http://www.phys.ufl.edu/seminars

CCMS 2008 Summer Lecture Series

The Preparation and Characterization of (Real) Materials for Research – a University of Florida Perspective These lectures will introduce students to both various methods of how to prepare samples (including examples from each lab in the Physics department plus an overview of the work on campus) *and* how to characterize their samples and some of the tricks/pitfalls/opportunities of these methods. The lectures will also provide the faculty attending with an overview of what their colleagues are doing and a review of a broad range of characterization methods, with a focus on those done in-house and at the Major Analysis Instrumentation Center in the materials science department. The 75 minute lectures will begin July 21, 2008 and will be given by **Professor Greg Stewart**. For more information on the lectures please visit http://www.phys.ufl.edu/ccms/lecture.



JOINT MATHEMATICS - IFT COLLOQUIUM

Professor Bert Kostant (MIT) will be speaking on "Some of the mathematics in Garrett Lisi's E(8) Theory of Everything" Monday, March 17, at 4:00pm in LIT 339. Refreshments will be served at 3:30pm. A physicist, Garrett Lisi, has published a highly controversial, but fascinating, paper purporting to go beyond the standard model in that it unifies all four forces of nature by using as gauge group the exceptional Lie group E(8). My talk, strictly mathematical, will be about an elabloration of the mathematics of E(8) which Lisi relies on to construct his theory.

PHYSICS STUDENTS...

First year graduate students, **Rashid Hamdan** (**Prof Hai-Ping Cheng**) and **Mohammed Zakaria** (**Prof Stephen Hagen**) have been selected as recipients of the CCMS Graduate Fellowship for summer 2008. The fellowship will provide full financial support including the stipend, tuition, and insurance.

Ranjani Narayanan has won a graduate student travel award (from the APS Division of Biological Physics) to attend the March Meeting in New Orleans.

STAFF NEWS

Congratulations to **Darlene Latimer** and **Bill Malphurs** who both received Division Three 2007-2008 Superior Accomplishment Awards. They were recognized at the official awards ceremony in February at Emerson Alumni Hall. According to the award announcement, "Superior Accomplishment Awards recognize efforts that go the extra mile beyond your normal assigned duties." Congratulations, Darlene and Bill!

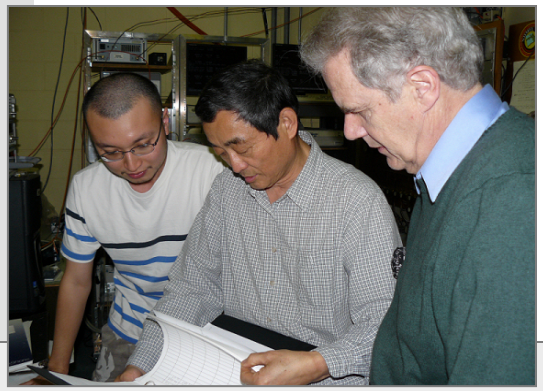
Unfortunately, Bill Malphurs was unable to attend the award ceremony due to surgery the same week. Everything went well and Bill is now recovering. Get well soon!

Photo at left: Darlene Latimer with award nominator, Professor Andrew Rinzler

MICROKELVIN *cont'd from page 1*

In 1990 with the NSF award to establish a new National Magnet Laboratory in Florida, it was decided to equip bay three as a specialized high magnetic field --ultra-low temperature facility which today is unique worldwide and attracts many scientists, including two Nobel prize winners, who wish to conduct experiments at high magnetic fields and low temperatures simultaneously. The success of the facility has lead the local scientists to extend operations to include bay 2. In 2007 a state award of 41.3M allowed the facility to place an order for a 20 T magnet to extend field capabilities, and to place a rapid turn around cooling station (10 Tesla and 10 millikelvin) in the Williamson Hall Annex that consists of part of the original laboratories of the founding faculty members (Adams, Ihas, Meisel, Sullivan and Takano) when Physics was housed in Williamson.

View of one of the super-conducting magnets used for demagnetization of nuclear coolants (copper metal or PrNi5) used to produce sub-millikelvin temperatures with record achieving cooling powers in the UF Microkelvin Laboratory.



Group in Bay 3 of the Microkelvin Laboratory, site of the NHMFL High B/T facility (from left, **Liang Yin**, Postdoctoral Associate recently appointed after graduating from Oxford University, **Jian-sheng Xia**, UF-NHMFL Research Scientist, and **Neil Sullivan**, UF Co-principal Investigator for the NHMFL) review recent results from studies of an experiment lead by **Vivien Zapf** (Los Alamos) to study critical field behavior in quantum organic magnets.

John Graham, UF-Physics Cryogenics Engineer, delivers a 250 liter liquid helium dewar to provide operating cryostats in the Microkelvin Laboratory with liquid helium. Cooling down for the first time can consume more than 500 liters and each cryostat boils helium at a rate of about 20 liters per day -- 24/7/360. Annual consumption can exceed 20,000 liquid liters, depending on the rate at which experiments are changed. Fortunately, the department's cryogenic staff, thanks to helium gas installations designed by **Greg Labbe**, are able to recover 95% of the helium and send it to a central liquefier in the New Physics Building. This service is critical for the operation of the Microkelvin laboratory and the High B/T facility, and indeed provides a campus-wide service to Chemistry, Materials Science, the Physics Williamson Hall Annex and the McKnight Brain Institute. It is the envy of other low temperature laboratories around the world.

Liang Yin, Postdoctoral Associate in the High B/T Facility adjusts equipment for a measurement of the magnetization of a quantum magnet at very low temperatures, using the nuclear demagnetization capability of Bay 3 of the Microkelvin Laboratory.

Byung Hee Moon (L) with advisor, **Professor Yoonseok Lee**, conduct an experiment investigating disordered superfluid 3He.