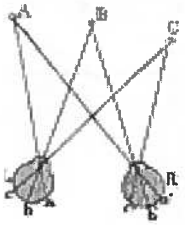

WEEKLY CALENDAR

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April 23, 2007

GENERAL SEMINAR

"Tidbits About Qubits: Spin Computation in Nanostructures"

3:40PM / Thursday, 26 April 2007 / Room 109

[Refreshments served at 3:15 PM in Room 229 Nicholson]

Host: Dr. John DiTusa

Sankar Das Sarma, Ph.D.

University of Maryland

I will provide an introduction to the emerging field of spintronics and spin qubits in this talk. Active control of carrier spin in nanostructures of semiconductors and other electronic materials is projected to lead to new device functionalities in the future. In particular, it may be possible to envision memory and logic operations being carried out on the same 'spintronic' chip. I will discuss various aspects of fundamental physics related to this new research area of spin electronics with the particular emphasis on localized electron spins in semiconductor nanostructures, such as GaAs quantum dots and P donors in Si. A revolutionary possibility in the (perhaps, far) future is using the natural two-level quantum dynamics of electron spin to create robust quantum bits ('qubits') which could be used to carry out solid state quantum information processing or quantum computation. I will discuss in details the questions of entanglement, decoherence, quantum error correction, and quantum gates in semiconductor nanostructure-based solid state spin quantum computer architectures, critically discussing from a theoretical perspective the current status of the field and the prospects for carrying out large-scale quantum computation using solid state spin qubits. If time permits, I will discuss an even more revolutionary idea involving fault tolerant topological quantum computation, where the underlying non-Abelian physics provides quantum immunity from errors, and quantum computation arises from intricate braiding of the space-time paths of the anyonic quasiparticles.

Material Science and Engineering Seminar

"On the Status of a Possible Fulde-Ferrel-Larkin-Ovchinnikov State in Heavy Fermion CeCoIn5"

3:40PM / Wednesday, 25 April 2007 / Room 109

Host: Dr. Ilya Vekhter

Roman Movshovich, Ph.D.

Los Alamos National Laboratory

CeCoIn5 exhibits several features which can be related to interplay between superconductivity and magnetism. At the superconducting critical field Hc2 this material displays Non-Fermi liquid behavior, pointing to a Quantum critical point at Hc2, and hinting to a presence of magnetic fluctuations, probably due to an AFM order superceded by superconductivity. Within 10-20% below Hc2 additional phase appears within the superconducting phase, and the normal-to--superconducting transition itself becomes first order. This behavior is consistent with a strong Pauli limited superconductivity, and the low temperature – high field phase being an inhomogeneous superconducting (FFLO) phase. Recent NMR experiments, however, point to a distribution of magnetic field on a scale of a crystallographic unit cell, and not on a scale of a superconducting coherence length expected of an FFLO order. Additional experiments on CeRhIn5 show magnetic field enhancement effects of AFM order, with some similarities to the phase diagram of CeCoIn5. Could the low temperature high field phase transition be due to magnetic order? We might need a picture of magnetism enhanced by superconductivity.

Special Seminar

Physics and Astronomy and CCT

"Hubbard Model with Phonons: Superconductivity, Polaron Formation and Isotope Effect"

1:40PM/Thursday, 26 April 2007/Room 435

Host: Dr. John DiTusa

Alexandru Macridin, Ph.D.
University of Cincinnati

A large body of experimental evidence shows strong interaction between electrons and lattice vibrations in high Tc superconductors. Motivated by this we investigate the effect of dynamical Holstein, buckling and breathing phonons on the physics of the 2D Hubbard model at small doping using a cluster meanfield approximation. The interplay of the antiferromagnetic correlations present in the system and the electronphonon coupling results in a synergistic enhancement of both polaron formation and antiferromagnetism. We find that phonons cause an apparent enhancement of the effective pairing interaction but in spite of that the strong renormalization of the charge carriers mobility associated with polaron formation leads to a suppression of superconductivity in the region of parameter space relevant for cuprate superconductors.

Special Seminar

Physics and Astronomy and CCT

"Do Spin Glasses Order in a Field?"

2:40PM / Monday, 30 April 2007 / Room 435

Host: Dr. John DiTusa

Helmut G. Katzgraber, Ph.D.
ETH Zurich, Switzerland

Spin glasses are paradigmatic models that deliver concepts relevant for a variety of systems. However, despite ongoing research spanning several decades in the area of glassy systems, there remain many fundamental open questions. Rigorous analytical results are difficult to obtain for spin-glass models, in particular for realistic short-range models. Therefore large-scale numerical simulations are the tool of choice. Concepts from the solution of the mean-field model, such as ergodicity breaking, aging, ultrametricity, and the existence of an instability line at finite magnetic fields known as the Almeida-Thouless line, have been applied to realistic short-range spin-glass models as well as to fields as diverse as structural biology, geology, computer science and even financial analysis. After presenting a brief overview of the properties of spin glasses, I discuss the existence of the Almeida-Thouless line, i.e. the existence of a spin-glass state in a field. Our results on a one-dimensional long-range spin-glass model with power-law interactions, where one can tune effectively the space dimension, show that the spin-glass state is not stable in a field for short-range systems below the upper critical dimension

Publications:

"Improvement of field matching in segmented-field electron conformal therapy using a variable-SCD applicator." **John D. Richert, Kenneth R. Hogstrom, Robert S. Fields, Kenneth L. Matthews II and Robert A. Boyd**, Phys. Med. Biol. 52, pp. 2459-2481 (2007).

"The Central Laser Facility at the Pierre Auger Observatory," **J. Matthews, R. Meyhandan,** et.al., Institute of Physics Publishing and SISSA, (2006), http//www.iop.org/EJ/jinst.

"An upper limit to the photon fraction in cosmic rays above 10^{19} eV from the Pierre Auger Observatory," **A. Dorofeev, J. Matthews, R.R. McNeil, M. McEwen, R. Meyhandan, T.A. Porter**, et.al., Astroparticle Physics 27 (2007) 155-168.

"Anisotropy studies around the galactic centre at EeV energies with the Auger Observatory," **A. Dorofeev, J. Matthews, R.R. McNeil, M. McEwen, R. Meyhandan, T.A. Porter**, Astroparticle Physics 27 (2007) 244-253.

G.W. Ford and **R.F. O'Connell**, "Free Electron Motion in an Electromagnetic Field at Zero Temperature and the Dependence on Its Rest Mass," Laser Physics, Vol. 17, No. 4, 2007.