College of Science
Department of Physics & Astronomy

WEEKLY CALENDAR

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Louisiana State University
Baton Rouge, Louisiana 70803-4001

WEEKLY CALENDAR

October 14-18, 2013

DEPARTMENTAL COLLOQUIUM

"Black Hole Battery"

3:30 PM October 17, 2013
109 Nicholson Hall

Janna Levin
Columbia University

Host: Gabriela Gonzalez

• Refreshments served at 3:10 PM in 232 (Library) Nicholson Hall •

Black holes are dark dead stars. Neutron stars are monstrous magnets. Together they can form a giant electronic circuit that outshines an entire galaxy for a few minutes before the black hole swallows the neutron star and the circuit with it. A black hole battery is expensive but powerful. I'll tell you how to make one.

Saturday Science at LSU

October 19, 2013
10:00 A.M.
130 Nicholson Hall, LSU

Suniti Karunatillake
LSU Dept. of Geology and Geophysics

"What may chemically bind water in Martian soil?"

LA-SiGMA

Louisiana Alliance for Simulation-Guided Materials Applications

Fall Seminar
3:30pm - 4:30pm, Wednesday, October 16, 2013
1008B, Digital Media Center, Louisiana State University

What role does nematicity play in the high-temperature superconductivity of the iron pnictides?

By

Rafael M. Fernandes

University of Minnesota

Five years after their discovery, much of the interest in the iron pnictides remains in understanding not only their high-temperature superconducting phase, but also the nature of their normal state. In this context, recent experiments have provided strong evidence for the existence of an unusual correlated state in the phase diagram of these materials, dubbed electronic nematic. Below the nematic transition temperature, the tetragonal symmetry of the system is broken down to orthorhombic not by lattice vibrations, but by electronic degrees of freedom. However, two questions remain open: What is the origin of this nematic state? What is its relationship to the superconducting state? In this talk we will explore these two issues via a microscopic theoretical model in which the nematic instability is caused by magnetic fluctuations arising from a degenerate ground state. A key consequence of this model is that lattice fluctuations and magnetic fluctuations are not independent. Instead, they follow a simple scaling relation, which we will show to be satisfied by elastic modulus and NMR experimental data. We will also demonstrate that, in general, nematic order competes with the unconventional sign-changing s^{+-} superconducting state. However, when the s^{+-} instability is in close competition with a d-wave instability – as it has been suggested in several iron pnictides – we find that nematic and superconducting degrees of freedom are strongly coupled. As a result, not only T_c can be significantly enhanced by nematic order, but also nematicity itself can be used as a diagnostic tool to search for novel unconventional superconducting states.

Rafael M. Fernandes - received his Bachelor degree (2003) and my PhD in Physics (2008) from the State University of Campinas, in Brazil. Before joining the University of Minnesota, he was a postdoc in Ames Laboratory and a joint postdoc in Columbia University/Los Alamos National Lab.

His research areas are strongly correlated electron systems, unconventional superconductivity, competing phases and emergent order, and disorder effects in quantum phase transitions.

His current research activities are in theoretical condensed matter physics, particularly in strongly correlated electronic many-body systems. Dr. Fernandes is interested in clean and disordered systems in which the collective behavior of the electrons give rise to ordered states that break different symmetries of the system, such as superconductivity, magnetism, nematic ordering, and orbital ordering. His aim is to understand not only the impact of these individual phases on the electronic structure and macroscopic properties of the system, but also how they interact with each other. To achieve this goal, he relies not only on the theoretical methods from quantum statistical mechanics and many-body theory, but also on the invaluable empirical information obtained from a variety of experimental techniques, such as x-ray diffraction, neutron scattering, optical spectroscopy, thermodynamic measurements, and angle-resolved photo-emission spectroscopy.

Here are some of the topics I have been working on:
•Unconventional superconductivity (iron-based materials)
•Emergent phases in magnetic systems (nematics, smectics)
•Transport in strongly correlated systems
•Quantum criticality in disordered systems
•Phase diagram of doped graphene
•Finite temperature Mott transition