LSU LOUISIANA STATE UNIVERSITY

PHYSICS & ASTRONOMY
WEEKLY CALENDAR

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202 NICHOLSON HALL
Louisiana State University
Baton Rouge, Louisiana 70803-4001

WEEKLY CALENDAR

March 12-16, 2012

DEPARTMENTAL COLLOQUIUM

"Antihydrogen Trapped"

3:40 PM, March 15, 2012
109 Nicholson Hall

Francis Robicheaux
Auburn University

Host: Ravi Rau

• Refreshments served at 3:15 PM in 232 (Library) Nicholson Hall •

Atoms made of a particle and an antiparticle are unstable, usually surviving less than a microsecond. Antihydrogen, the bound state of an antiproton and a positron, is made entirely of antiparticles and is believed to be stable. It is this longevity that holds the promise of precision studies of matter-antimatter symmetry. Low energy (Kelvin scale) antihydrogen has been produced at CERN since 2002. I will describe the experiment which has recently succeeded in trapping antihydrogen in a cryogenic Penning trap for times up to approximately 15 minutes.

SPECIAL SEMINAR

"Recent Advances in Quantitative Dynamic Positron Emission Tomography"

1:30 – 3:00 PM, MARCH 12, 2012
119 Nicholson Hall

You Zhou
Johns Hopkins University School of Medicine
Host: Wayne Newhauser

Positron emission tomography (PET) is a main molecular imaging modality used to in vivo measure biochemical and physiological activities at molecular levels in human beings and laboratory animals. Dynamic PET is now considered as a standard imaging technique to measure physiological and biochemical parameters such as blood flow, glucose metabolism, receptor density, and drug occupancy in living subjects. The validated tracer kinetic modeling methods for quantification of dynamic PET image data are adapted by dynamic MRI, CT, and SPECT. The talk will start with a few examples of quantitative PET applications in basic science research, clinical oncology, Alzheimer's disease, and drug development. The basic principals and main techniques of PET kinetic modeling for those applications will be briefly reviewed. Recent advances in quantitative PET including noninvasive kinetic modeling and parametric imaging will be presented. Finally, the main anticipated challenge for scientists in molecular imaging research, i.e. how to integrate and extract signals reliably and efficiently from multi-function, multi-tracer, and multi-modality PET/CT/MRI studies, will be described. Discussion to address the challenge is welcome during and after the presentation.

SPECIAL SEMINAR

"Magnetic Interactions and Anisotropies in Iron Superconductors"

3:30 PM, March 13, 2012
435 Nicholson Hall

Elena Bascones
Department of Theory and Simulation of Materials
Instituto de Ciencia de Materiales de Madrid

Host: Ilya Vekhter

A major breakthrough took place in 2008 with the discovery of high temperature superconductivity in iron pnictides. The basic structure of these materials are FeAs layers. In these materials superconductivity emerges when doping or applying pressure to an antiferromagnetic compound. Most iron pnictides order with (pi,0) momentum, antiferromagnetic in the x direction and ferromagnetic in the y direction. The magnetic state of iron pnictides is metallic and presents unusual magnetic moment and resistivity anisotropy [1].

The origin of magnetism in iron superconductors is still unsettled. At the heart of the debate are the itinerant (weak coupling) versus localized (strong coupling) nature of magnetism, the role played by the orbital degree of freedom and Hund's coupling and a possible nematic phase. The itinerant picture relies on the metallicity of the magnetic state and an approximate (pi,0) nesting of the Fermi surface. In the strong coupling picture localized moments interact with AF exchange constants J1 and J2 with their first and second nearest neighbors respectively. (pi,0) state can be stabilized with J1< 2 J2, but little is known on the actual value of these constants. Orbital

In this talk I will present our recent calculations which try to make connection between the itinerant and localized picture. We have analyzed the magnetic interactions of iron superconductors on the basis of a five orbital model treated both within Hartree-Fock and Heisenberg approximations [2]. We show that the exchange constants depend on charge and orbital filling and on Hund's coupling with unexpected consequences on the phase diagram [2]. We have also studied the dc and optical conductivities and separated the effect of magnetism and of orbital ordering on the anisotropic properties [3].

[1] For a review see, J. Paglione and R.L. Greene, Nature Phys. 6, 645 (2010).
[2] M.J. Calderón, G. León, B. Valenzuela and E. Bascones, arXiv:1107.2279. E. Bascones, M.J. Calderón, B. Valenzuela, PRL 104, 227201 (2010).
[3] B. Valenzuela, E. Bascones, M.J. Calderón, PRL 105, 207202 (2010).

SPECIAL SEMINAR

"New Cine PET/CT Imaging for Quantification and Tumor Delineation in Radiotherapy of NSCLC"

3:30 – 4:30 PM, March 16, 2012

435 Nicholson Hall

Tinsu Pan
University of Texas, M. D. Anderson Cancer Center

Host: Wayne Newhauser

• Refreshments served at 3:15 PM in 232 (Library) Nicholson Hall •

Positron Emission Tomography/Computed Tomography (PET/CT) is used increasingly in radiation therapy planning of non-small cell lung cancer (NSCLC) patients, in particular for patients who have local-regionally confined disease. Most patients undergo a F18-fluorodeoxyglucose (F18-FDG) PET/CT study for diagnosis and tumor staging before radiation therapy. Incorporation of functional PET in tumor delineation can contribute to consistency of target delineation, avoidance of geographical miss of the tumor, and decrease of radiation exposure to normal tissues. However, the influence of respiratory motion combined with the limited resolution of PET imaging poses a challenge to quantification of the functional PET data. Without adequate quantification, treatment response assessment and standardization of tumor delineation cannot be achieved. Limited PET resolution induces the partial volume effects (PVE) and affects the quantification of the small tumors of less than 2-3 times the PET imaging resolution. Respiratory motion can also cause misregistration between the CT and the PET data, introducing uncertainty in the treatment planning. The traditional approach to combat tumor motion is the four-dimensional PET/CT imaging, which requires respiratory gating on both PET and CT, resulting to a long imaging time and poor patient compliance. We propose a new cine PET/CT imaging technique without gating to achieve most of the benefits provided by 4DPET/CT. The new technique adds < 1 min of acquisition time to the conventional PET/CT and < 1 mSv of radiation dose to the patient. It has a great potential to become a clinical procedure on the existing PET/CT scanners.

PUBLICATIONS:

1. "Dedicated phantom materials for spectral radiography and CT", **P.M.Shikhaliev**, Physics in Medicine and Biology, v.57, (2012), pp.1575-1593.

2. "Photon counting spectral CT: improved material decomposition with K-edge filtered x-rays", **P.M.Shikhaliev**, Physics in Medicine and Biology, v.57, (2012), pp.1595-1615.