Chez Pierre

Presents ...

Friday, March 1, 2013
10:00am
MIT Room 4-331

SPECIAL CHEZ PIERRE SEMINAR

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"Visualizing Heavy Fermions Emerging in a Quantum Critical Kondo Lattice"

In compounds containing partially occupied f-orbitals, the entanglement of the rather localized f-electrons with surrounding itinerant electrons leads to the development of low-energy composite quasiparticles with a heavy effective mass. These excitations are fundamental to the appearance of unconventional superconductivity and non-Fermi-liquid behavior observed in actinide- and lanthanide-based compounds. Recently, there has been a major breakthrough in the application of scanning tunneling microscopy (STM) techniques to the study of heavy fermions [1-2]. In this talk, I will review these recent developments and will describe how we used the STM techniques to detect, for the first time, the emergence of heavy fermions with lowering of temperature in a prototypical family of heavy-electron materials [2]. I will address how these experiments demonstrate the composite nature of these heavy quasiparticles, resolve their energy–momentum structure, and probe the lifetime of these emergent quasiparticles in proximity to a quantum phase transition. Our experiments open a new window to explore the apparent non-Fermi liquid behavior in heavy fermion compounds as well as decades-old puzzles of superconductivity and other complex ordering phenomena involving
heavy electrons.

[1] P. Aynajian, E. H. da Silva Neto, C. V. Parker, Y. Huang, A. Pasupathy, J. Mydosh, and A. Yazdani, Proc. Nat'l. Acad. Sci USA 107, 10383 (2010).
[2] P. Aynajian, E. H. da Silva Neto, A. Gyenis, R. E. Baumbach, J. D. Thompson, Z. Fisk, E. D. Bauer and A. Yazdani, Nature 486, 201 (2012).