Condensed Matter Physics Seminar Series

Observation of Pines' Demon in Sr_2RuO_4 with Momentum-Resolved EELS

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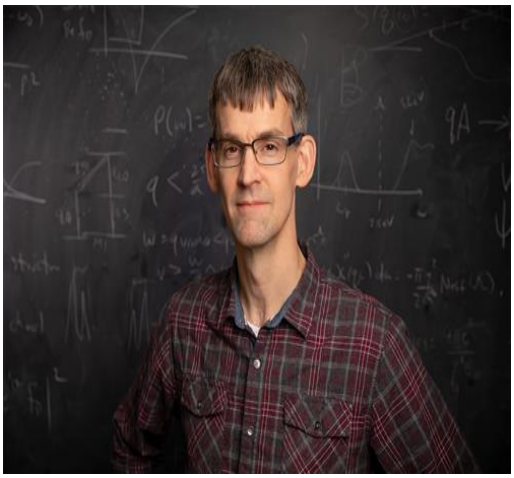
Friday, January 27th at 1:00 PM
4-330 PAB



The characteristic excitation of a metal is its plasmon, which is a quantized collective oscillation of its electron density. In 1965, David Pines predicted that distinct type of plasmon, dubbed a "demon," could exist in multiband metals containing more than one species of charge carrier. Consisting of out-of-phase movement of electrons in different bands, demons are acoustic, electrically neutral, and do not couple to light, so have never been detected in an equilibrium metal. Nevertheless, demons are believed to be responsible for a wide range of phenomena such as "soundarons" in Weyl semimetals, phase transitions in mixed-valence materials, optical properties of metal nanoparticles, and high temperature superconductivity in, for example, metal hydrides. In this talk I will present evidence for a demon in the multiband metal Sr_2RuO_4 from momentum-resolved electron energy-loss spectroscopy (M-EELS). Formed of electrons in the β and γ bands, the demon is gapless with critical momentum q_c = 0.08 reciprocal lattice units and room temperature velocity v = $1.065(120)\times10^5$ m/s, which undergoes a 14% renormalization upon cooling due to coupling to the particle-hole continuum. Our study confirms a 66-year old prediction and suggests that demons may be a pervasive feature of multiband metals.

Prof. Abbamonte received his Ph.D. in Physics from the University of Illinois at Urbana-Champaign in 1999 having done his research with Eric Isaacs and Phil Platzman in the Materials Physics Department at Bell Laboratories. He joined the scientific staff at Brookhaven National Laboratory in 2003, and was recruited to the University of Illinois in 2005, where he is currently the Fox Family Professor of Engineering in the Department of Physics and an affiliate of the Seitz Materials Research Laboratory.