

T_CSUH Special Seminar

Texas Center for Superconductivity at the University of Houston

Prof. H. A. Mook

Oak Ridge National Laboratory
Oak Ridge, Tennessee

Friday, September 23, 2011

Room 102, University of Houston Science Center
12:00 noon - 1:00 p.m.

Discovery of a New Magnetic Mode in YBa₂Cu₃O_{6.6}

Abstract

Although it has been over 25 years since the discovery of the high temperature cuprate superconductors they remain one of the most interesting and challenging problems in condensed matter physics. YBa₂Cu₃O_{6+x} (YBCO) is arguably the most studied cuprate system where extensive studies of the magnetic excitations have been completed, yet we have used inelastic neutron scattering to discover a new excitation quite distinct from the magnetic excitations observed in the material so far. In particular, the excitation is essentially dispersionless rather than strongly dispersive, with an intensity completely independent of the Cu-O bilayers of the YBCO structure that the conventional spin excitations obey. Polarized neutron measurements unambiguously confirm the origin of the excitation as magnetic, but it breaks translational symmetry and so is fundamentally different than the scattering recently found in HgBa₂CuO_{4+d}. The temperature scale is intermediate between superconductivity ($T_C = 60$ K for this oxygen doping) and the very high temperature scale of the conventional spin excitations. Overall the new scattering is consistent with expectations for the pseudogap phase stemming from theoretical models of circulating currents in the unit cell, offering an answer to the nature of the long-sought hidden order of the pseudogap phase, a new state of matter that controls the phase diagram via a quantum critical point.

Bio

Dr. Herbert A. Mook Jr. received his master's and doctorate degrees from Harvard University. His neutron science career at ORNL began in 1965. His experiments have employed neutron beams from the Oak Ridge Research Reactor, now decommissioned, and the more powerful High Flux Isotope Reactor (HFIR), which was recently upgraded with new beam lines and a cold neutron source. He served as the first scientific director of the Spallation Neutron Source (1995-2000) and the director of the Center for Neutron Science (2000-2004) at ORNL. Dr. Mook has received numerous awards, among them the DOE Award for Outstanding Scientific Accomplishments in Solid State Physics (twice, 1982 and 1998) and the 2010 Clifford E. Shull Prize. He holds several patents for neutron instrumentation he has developed, two of which received R&D 100 Awards. Herbert Mook has been elected a Fellow of the American Association for the Advancement of Science, the American Physical Society, and the Neutron Scattering Society of America.

Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.



TEXAS CENTER FOR
SUPERCONDUCTIVITY