清华大学高等研究院
Institute for Advanced Study, Tsinghua University
物理学术报告
Physics Seminars (biweekly)

Title： Quantum 'spin-metal' phase in an organic Mott insulator with two-dimensional triangular lattice

Speaker: Dr. Takasada Shibauchi
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Time：3:15 pm, Wednesday, Sept 26, 2012
(2:45~3:15pm, Tea, Coffee, and Cookie)

Venue: Conference Hall 322, Science Building, Tsinghua University

Abstract:

In Mott insulators, the strong electron-electron Coulomb repulsion prevents metallicity and charge excitations are gapped. In dimensions greater than one, their spins are usually ordered antiferromagnetically at low temperatures. Geometrical frustrations can destroy this long-range order, leading to exotic quantum spin liquid (QSL) states. However, their magnetic ground states have been a long-standing mystery. We have shown from the thermal conductivity measurements that a QSL state in the organic Mott insulator EtMe3Sb[Pd(dmit)2]2 with two-dimensional triangular lattice has gapless excitations, which are highly mobile with long mean free path [1]. However, whether the excitations are magnetic or nonmagnetic had remained unsolved. Here we show that the QSL state exhibits Pauli-paramagnetic-like low-energy excitations, which are a hallmark of itinerant fermions [2]. Our torque magnetometry down to low temperatures (30 mK) up to high fields (32 T) reveal distinct residual paramagnetic susceptibility comparable to that in a half-filled two-dimensional metal. This demonstrates that the system is in a magnetically gapless ground state, a critical state with infinite magnetic correlation length. Moreover,
our results are robust against deuteration, pointing toward the emergence of an extended quantum `spin-metal' phase, in which low-energy spin excitations behave as in paramagnetic metals with Fermi surface, despite the frozen charge degree of freedom.

[1] M. Yamashita et al., Science 328, 1246-1248 (2010).
[2] D. Watanabe et al., Nature Commun. (in press).