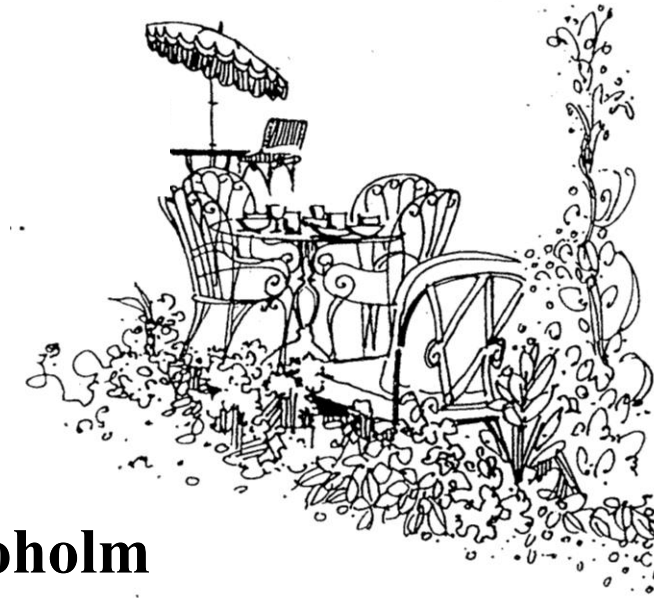
Chez Pierre



Presents ...

Monday, October 7, 2013
12:00pm
MIT Room 4-331

Collin Broholm
John Hopkins University

"Quantum fluctuations in spin-ice-like $Pr_2Zr_2O_7$*"

Spin ice is a magnetic analogue of H_2O ice that harbors dense static disorder. Dipolar interactions between classical spins yield a frozen frustrated state with residual Pauling entropy and emergent magnetic monopolar quasi-particles. Introducing quantum fluctuations is of great interest as this could melt spin ice and allow coherent propagation of monopoles.

Here we report experimental evidence for quantum dynamics of magnetic monopolar quasi-particles in a new class of spin ice based on exchange interactions, $Pr_2Zr_2O_7$ [1]. Narrow pinch-point features in otherwise diffuse elastic neutron scattering reflects adherence to a divergence free constraint for disordered spins on long time scales. Magnetic susceptibility and specific heat data correspondingly show activated dynamics and residual entropy below 0.1 K. In sharp contrast to conventional ice, however, more than 90% of the neutron scattering is inelastic and devoid of pinch points furnishing evidence for magnetic monopolar quantum fluctuations.

The spectrum of inelastic scattering persists to significantly higher energies than expected based on estimates of the exchange constant from thermomagnetic measurements. The absence of wave vector dependence in this scattering indicates it is associated with local physics of the non-Kramers doublet.

*Work at IQM was supported by DoE, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering under Award DE-FG02-08ER46544.

[1] "Quantum fluctuations in spin-ice-like $Pr_2Zr_2O_7$," K. Kimura, S. Nakatsuji, J.-J. Wen, C. Broholm, M. B. Stone, E. Nishibori, H. Sawa, Nature Communications **4**, 1934 (2013).