MAR14-2013-020099

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Quantum fluctuations in spin-ice-like $Pr_2Zr_2O_7$

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Spin ice is a classical frustrated magnet in which ferromagnetic dipolar interactions stabilize a frozen disordered state with Pauling residual entropy and emergent magnetic monopolar quasi-particles [1]. A new class of spin ice has been recently proposed for Pr and Yb pyrochlores, in which quantum-mechanical exchange interactions predominately provides the ferromagnetic coupling between neighboring spins. The resultant strong quantum fluctuations were found to generate exotic quantum magnetism. For example, it has been demonstrated that the Pr-based metallic pyrochlore $Pr_2Ir_2O_7$ shows a novel chiral spin liquid phase, which may be explained by quantum melting of spin ice. In the talk, we report our recent experimental results on magnetic properties of the insulating analog $Pr_2Zr_2O_7$ [2]. Pinch-point features in quasi-elastic diffuse neutron scattering reflects adherence to a divergence free local constraint for disordered spins on long time scales. 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.

[1] S. T. Bramwell and M. J. P. Gingras, Science 294, 5546 (2001).
[2] K. Kimura *et al.*, Nat. Commun. 4, 1934-1-6 (2013).