Chez Pierre

Presents ...

Wednesday, April 30, 2014
12:00pm
MIT Room 4-331

Special Chez Pierre Seminar

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"From "Order By Disorder" to Emergent Electrodynamics in Geometrically Frustrated Pyrochlore Magnets"

In the search for novel quantum states of matter, such as the disordered yet entangled Quantum Spin Liquid, "geometrically frustrated" magnetic lattices are essential in preventing conventional long range order from developing. Though many examples of unusual frustrated magnets exist in the real world, often significant details are unknown about their microscopic descriptions. Using time-of-flight inelastic neutron scattering, the excitation spectra from frustrated magnets can be measured comprehensively. Under a strong magnetic field, the systems can be thought of as long range ordered, and support conventional spin wave excitations, thus allowing extraction of the exchange parameters. Then, analysis of the model Hamiltonian in the absence of a field reveals the details of the strange ground states in these quantum magnets. This approach has been taken with two effective spin-1/2 XY pyrochlore-type materials, Er2Ti2O7 and Yb2Ti2O7, whose ground state properties have, until this point, been enigmatic. From these studies, Er2Ti2O7 and Yb2Ti2O7 have been found to be realizations of "quantum order by disorder" and "quantum spin ice", respectively. Elucidation of these ground states has led to predictions of a small spin wave gap opened by quantum fluctuations (Er2Ti2O7; since confirmed) and emergent electrodynamics in a U(1) quantum spin liquid (Yb2Ti2O7). The latter prediction is still under intense debate, but it provides a distinct signature that can be observed experimentally, namely a linearly dispersing "emergent photon" mode. If found, this observation would make Yb2Ti2O7 the most convincing experimental realization of a Quantum Spin Liquid available to date.