MAR17-2016-020337

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

George E. Valley, Jr. Prize Talk: Quantum Frustrated Magnetism and its Expression in the Ground State Selection of Pyrochlore Magnets[1]

KATE ROSS, Colorado State University

In the search for novel quantum states of matter, such as highly entangled Quantum Spin Liquids, "geometrically frustrated" magnetic lattices are essential for suppressing conventional magnetic order. In three dimensions, the pyrochlore lattice is the canonical frustrated geometry. Magnetic materials with pyrochlore structures have the potential to realize unusual phases such as "quantum spin ice", which is predicted to host emergent magnetic monopoles, electrons, and photons as its fundamental excitations. Even in pyrochlores that form long range ordered phases, this often occurs through unusual routes such as "order by disorder", in which the fluctuation spectrum dictates the preferred ordered state. The rare earth-based pyrochlore series $R_2Ti_2O_7$ provides a fascinating variety of magnetic ground states. I will introduce the general anisotropic interaction Hamiltonian that has been successfully used to describe several materials in this series. Using inelastic neutron scattering, the relevant anisotropic interaction strengths can be extracted quantitatively. I will discuss this approach, and its application to two rare earth pyrochlore materials, $Er_2Ti_2O_7$ and $Yb_2Ti_2O_7$, whose ground state properties have long been enigmatic. From these studies, $Er_2Ti_2O_7$ and $Yb_2Ti_2O_7$ have been suggested to be realizations of "quantum order by disorder" and "quantum spin ice", respectively.

[1]This research was supported by NSERC of Canada and the National Science Foundation