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Frustrated and Satisfied Ground States in Pyrochlore Antiferromagnet $Tb_2Ti_2O_7$[1]

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The Rare-Earth Titanates have been a playground for the physics of geometrical frustration, as magnetic rare earth sites can be arranged on the pyrochlore lattice, a network of corner-sharing tetrahedra, and different rare earth elements display differing exchange interactions and anisotropies. $Tb_2Ti_2O_7$ is a particularly enigmatic pyrochlore antiferromagnet. It is reasonably well understood in terms of local Ising-like anisotropy, such that the Tb^3+ magnetic moments should point either directly into or out of the tetrahedra. The moments are antiferromagnetically coupled, and theory expects a phase transition to an ordered state at $\sim$ 1 K. However, in the abnsence of an external perturbation, it remains in a spin liquid state to very low temperatures, $<$ 0.05 K. We report new neutron scattering measurements on $Tb_2Ti_2O_7$ using new time-of-flight techniques at NIST, which show the spin liquid state can be brought to order in the presence of relatively weak [110] magnetic fields. We'll also discuss high resolution x-ray scattering results which show that the lattice is not a passive observe to the physics of frustration, but that it displays fluctuation effects typical of Jahn Teller physics, albeit at very low temperatures.

[1]In collaboration with S. Dunsiger, J. Gardner, K. Rule, J. Ruff, P. Clancy, J. Copley, Y. Qiu