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Ferromagnetism with Continuum Excitations in the Geometrically Frustrated Pyrochlore $Yb_2Ti_2O_7$

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In the frustrated pyrochlore magnet $Yb_2Ti_2O_7$, Yb^{3+} forms (effective) S=1/2 moments that are subject to anisotropic exchange interactions. The ground state of this material is rather perplexing and controversial; one proposal is that $Yb_2Ti_2O_7$ behaves as a quantum version of "spin ice", where quantum fluctuations enable tunneling between different ice-rules obeying spin states. This model includes a quantum spin liquid ground state hosting three exotic quasi-particle excitations that are analogs of magnetic monopoles, electric monopoles, and photons; i.e., it would host a full "emergent electrodynamics". However, there are varying reports about the true nature of the ground state in $Yb_2Ti_2O_7$, in part due to a known sample-dependence involving non-stoichiometry on the 1% level, which is particularly prevalent in single crystal samples. After introducing the key prior measurements on $Yb_2Ti_2O_7$, I will present neutron scattering results from a polycrystalline sample which is known to be stoichiometric. This sample was found to develop magnetic Bragg peaks at low temperatures, consistent with moments forming a long range ordered ferromagnetic state. Despite this signature of a long range ordered ground state, the spin excitations remain gapless and continuum-like (unlike the expectation for conventional magnons), and are generally insensitive to the first order transition at 260 mK which is observed via specific heat measurements.