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Phase diagram and spin dynamics of the frustrated pyrochlore magnet $Yb_2Ti_2O_7$ in applied field

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The frustrated pyrochlore magnet $Yb_2Ti_2O_7$ has been proposed as a candidate "quantum spin ice" material. Here we report single-crystal inelastic neutron scattering measurements of the spin dynamics and complementary specific heat data to map the phase diagram in magnetic fields applied along a cubic [001] direction, not explored experimentally in detail before. At the highest magnetic fields probed (9 T) we observe in addition to dominant one-magnon excitations also a broad scattering continuum at higher energies, attributed to two-magnon excitations, not detected in previous neutron scattering studies. We characterize how the spectrum evolves upon lowering field and observe how high-energy magnons decay when they overlap with the high-energy continuum and the low-energy magnons have their dispersion bandwidth suppressed and in zero field disappear altogether over a wide range of the Brillouin zone where the inelastic signal is dominated by a scattering continuum extended over a broad energy range. Through fits of the dispersion relations at high fields we propose a re-evaluation of the spin Hamiltonian to consistently explain all existing spin dynamics data for different field directions and propose a phenomenological model of the evolution of the spin dynamics in applied field [1]. We acknowledge support from EPSRC (UK). [1] J. D. Thompson, P. McClarty, D. Prabhakaran, I. Cabrera, T. Guidi and R. Coldea, in preparation.