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Yb_2Pt_2Pb: Emergent Criticality on the Frustrated Shastry-Sutherland Lattice[1]

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Metallic Yb_2Pt_2Pb forms in the U_2Pt_2Sn structure, with layers of Yb ions forming the orthogonal dimers of the Shastry-Sutherland lattice (SSL). The Yb^{3+} moments are strongly Ising-like, with an energetically isolated doublet ground state. Fits to the temperature dependent susceptibility confirm that dimerization occurs, and that the B=0 energy separation of the singlet ground state and the triplet excited state $\Delta \sim$ 4-5 K. Yb_2Pt_2Pb orders antiferromagnetically at 2.06 K, with a striped modulation of the dimer moments in the SSL planes with two wave vectors q_{AF} =(0.2,$\pm$ 0.2,0) rlu. The Yb moments are oriented perpendicular to the (1,$\pm$ 1,0) dimer bond directions, and the dimers form the rungs of two orthogonal spin ladders along the c-axis. A nondispersing and inelastic excitation with energy $\sim$ 0.4 meV is found for wave vectors in the SSL plane, in good agreement with the singlet-triplet gap Δ inferred from susceptibility measurements. The dispersion of the excitations along (00l) closely resembles that of a spinon continuum, such as those found in spin chain compounds, with an effective c-axis exchange of $\sim$ 0.12 meV. Yb_2Pt_2Pb is a unique system, where strong quantum fluctuations related to the spin-ladder or SSL characters of this compound may lead to unusual correlations in this excellent metallic host.

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