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Confirming the phase diagram of the Shastry-Sutherland model with μ^+SR

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One famous model for a two-dimensional magnetic system is the Shastry-Sutherland (SS) model, which considers an orthogonal dimer network of spin S = 1/2 [1]. The model predicts a dimer ground state for J/J'< 0.5, and a 2D antiferromagnetic (AFM) phase with significant quantum fluctuations is expected for J/J'> 1 [2]. However, the ground state of the intermediate region (0.5 < J/J'< 1) has been debated and various grounds states have been suggested: AFM order [3], helical order [1] or even columnar dimer [4]. The only known realisation of SS model is SrCu2(BO3)2 (SCBO). In order to confirm and determine the intermediate state of the SS model, series of hydrostatic pressure studies were initiated [5,6] and an intermediate frustrated plaquette phase above 21.5 kbar was determined by inelastic neutron scattering. [5]
We have initiated a ^+SR study to investigate the temperature/pressure dependency of the magnetic properties of SCBO [7]. Measurements in zero field and transverse field confirms the absence of long rang magnetic order at high pressures and low temperatures. These measurements suggest changes in the Cu spin fluctuation characteristics above 20 kbar, consistent with the formation of a plaquette phase. Therefore, the ground state of the SS model for the intermediate region is confirmed to be a plaquette state.

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