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Spin Liquid Properties of a Spin 1/2 Kagome Metal-OrganicFframework Compound

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The metal-organic-framework compound $Cu_3(HOTP)_2$ is a small-gap semiconductor containing a kagome lattice of antiferromagnetically coupled S=1/2 Cu^{II} spins with intra-layer nearest-neighbour exchange coupling $J \sim 2$ K. The intra-layer J value obtained from calculations using density functional theory is shown to match with the experimental value for reasonable values of the Hubbard U parameter. Muon spin relaxation confirms no magnetic ordering down to 50 mK and sees spin fluctuations diffusing on a 2D lattice. These properties are consistent with the hypothesis of a quantum spin liquid ground state being present within highly decoupled kagome layers. Reduction of the spin diffusion rate on cooling from the paramagnetic region to the low-temperature region reflects quantum entanglement, one of the key properties of a quantum spin liquid. It is also found that the layers become more strongly decoupled in the low-temperature region. Comparison of results for the spin diffusion, magnetic susceptibility and specific heat in the low temperature region suggests close proximity to a quantum critical point and a large density of low energy spinless electronic excitations. A Z_2-linear Dirac model for the low energy spin excitations of the putative quantum spin liquid ground state is found to provide the best match with experiment [1].
1. F. L. Pratt et al, Phys. Rev. Res. 7, 023007 (2025).

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