

Title: Novel ground states and excitations in quantum spin liquids

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Description: Quantum frustrated magnets are important materials in which a competition between energy terms in the Hamiltonian (frustration) destabilises familiar magnetic behaviour and creates opportunities for quantum mechanics to drive exotic electronic states. Theory and experiment have shown that one of the most likely classes of materials to show these new effects are quantum kagome magnets, where the magnetic ions make up a kagome lattice of vertex-sharing triangles, and the small spin quantum numbers allow the influence of quantum mechanical effects to be greatest. These frustrated magnets commonly show remarkable effects such as robust entanglement and tunable balance points between different exotic responses.

This project is based on the synthesis and physical characterization of new quantum kagome magnets ($S = 1/2$ and 1), and the study of the unconventional physics that they display. This class of magnets has already shown that the richness of possible magnetic responses greatly exceeds our current expectations and understanding. Consequentially, the experimental work will be quite broad and will include synthesis, crystal structure characterization (by X-ray and neutron diffraction) and studies by a variety of experimental techniques, including SQUID magnetometry, specific heat and inelastic neutron scattering.