Exploring a New Family of $S = \frac{1}{2}$ Kagomé Antiferromagnets

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Materials constructed from kagomé layers of antiferromagnetically coupled $S = \frac{1}{2}$ moments are highly prized as they offer a unique opportunity to explore the elusive quantum spin liquid state (QSL).[1] Recently, the Cu$^{2+}$-based mineral known as Zn-doped barlowite, ZnCu$_3$(OH)$_6$FBr, has shown promise as a new realisation of the QSL state.[2] Despite this interest, the crystal and magnetic structures of the parent material barlowite, Cu$_4$(OH)$_6$FBr, are poorly understood with several conflicting reports in the literature.[3-5] In this seminar, I will introduce these developments in the field of highly frustrated magnetism before presenting our comprehensive neutron diffraction studies of barlowite. In doing so, I will discuss the intriguing structural phase transition we observe in this material at $T = 250$ K, and clarify the nature of the magnetic ground state below $T_N = 15$ K.[6] I will also discuss our efforts to control the nature of the structural phase transition within a new family compounds through exchange of the halide ions in barlowite. In addition, I will show that we can tune the magnetic ground state of barlowite from antiferromagnetic order to quantum disorder upon Zn-doping though muon spectroscopy measurements supported by density-functional theory.[7]