Exploring structural correlations to design materials with new frustrated topologies

Magnetic materials are fundamental to the operation of our contemporary technological society and frustrated magnetic materials are a vibrant area of research at the fundamental and applied levels.
Geometric frustration arises when interactions between magnetic degrees of freedom are incompatible with the underlying crystal geometry. For example, in antiferromagnetic (AFM) materials, which exhibit triangular connectivity between magnetic species, each individual spin cannot satisfy all pairwise interactions. This *'frustration'* of the spins leads to ground state degeneracy, the realisation of unconventional magnetic properties (e.g. spin liquids, magnetic monopoles, incommensurate helical or cycloidal order) and typically short-range correlations.

Layered metal oxides are an important class of materials not only due to their compositional flexibility but also for their importance in battery technologies. By far the most widely studied family of materials are the Delafossite materials (ABO_2, where A is a cation such as Na^+ or Ca^{2+} and B is typically a transition metal). These materials exhibit triangular connectivity of the metal species within the BO_2 layer leading to frustration. Through control of synthetic procedures and exploiting compositional flexibility we can tune the connectivity of the magnetic species to design materials with new frustrated topologies.

In this seminar, we will present some of our recent work on $Ca_2Mn_3O_8$, which exhibits a bow-tie like lattice, $Mn_2Mo_3O_8$ which exhibits a *kagomé* type arrangement of the Mo and $Na_2Mn_3O_7$ which exhibits a Maple-Leaf like connectivity of the manganese. We will discuss the interrelationship between composition and structure and how this may be exploited for the design of new materials for all applications.