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Investigating Long-range Magnetic Ordering in $\text{Li}_3\text{Co}_2\text{SbO}_6$ a layered oxide honeycomb lattice

Over the last decade layered-honeycomb oxides have come to increasing prominence as materials that exhibit an array of interesting properties, including use as electrodes for Li-ion batteries, high electrical conductivity, low temperature magnetic phases, and spin-glass transitions. Layered oxides with the general formula AxM_2XO_6 ($\text{A} = \text{Li}, \text{Na}$; $\text{M} = \text{transition metals eg. Co, Cu, Ni}$; $\text{X} = \text{Bi, Sb, Te}$; $0 < x < 3$) are a form of 'honeycomb' lattice where one third of the transition metal sites are doped with high charge cations such as Sb^{5+} and Te^{6+} . More recently honeycomb lattices have been investigated as Kitaev lattices and potential Quantum Spin Liquids (QSL).(1)

My project involves the conventional solid-state synthesis of $\text{Li}_3\text{Co}_2\text{SbO}_6$ and the $\text{Na}_{3-x}\text{Li}_x\text{Co}_2\text{SbO}_6$ solid solution. The focus is on investigating the magnetic behaviour of these systems, including antiferromagnetism below the Néel temperature(T_N) and magnetic frustration within the 2D honeycomb layers. In addition, the Na analogue $\text{Na}_3\text{Co}_2\text{SbO}_6$, possible QSL properties, as is predicted to be a material which is a QSL.

Low-temperature neutron powder diffraction provides the means to investigate the structure of these materials and the magnetic lattice below T_N . The spins are predicted to align in an antiferromagnetic 'zig-zag' arrangement.(2) Inelastic neutron scattering provides a means to verify if these materials do in fact become the unusual QSL as some have predicted.

References:

1. Banerjee, A., Bridges, C., Nagler, S., et al. (2016). Nature Materials, 15(7), pp.733-740.
2. Wong, C., Avdeev, M. and Ling, C. (2016). Journal of Solid State Chemistry, 243, pp.18-22.

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