Spin-wave investigation in the layered hybrid organic-inorganic perovskite $(C_6H_5CH_2CH_2NH_3)_2MnCl_4$

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Low-dimensional magnetism (LDM) has been shown to have links with various phenomena like high temperature superconductivity, fractional excitations, spin liquids and multiferroicity, which are on the forefront of world wide solid state research. Metal-organic compounds (MOC) serve as an essentially infinite toolbox to build model systems exhibiting LDM. The hybrid perovskite $(C_6H_5CH_2CH_2NH_3)_2MnCl_4$ (*in short* Mn-PEA) without inversion symmetry is known to support Dzyaloshinsky-Moriya interaction (DMI) [1], which has never been quantified in Mn-PEA and related systems. That is because the details of the magnetic interactions as investigated by neutron experiments suffer from small samples and the incoherent background of hydrogen.

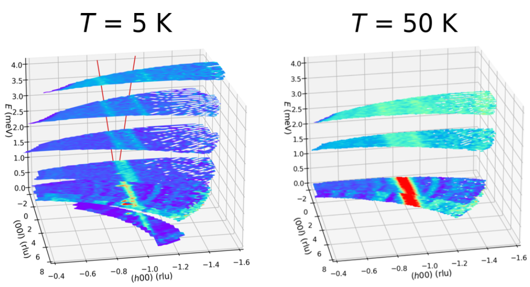

FIG. 1: INS spectra at various E positions below T_N (Left) and above T_N (Right) measured with HODACA. L-independent spin excitations are clearly visible at both Ts, but 50 K data show weaker and broader features of spin fluctuations.

By co-aligning several single crystals, we managed to successfully conduct inelastic neutron scattering (INS) studies on Mn-PEA using the multiplexing secondary spectrometer HODACA setup at C1-1, JRR-3. Low-temperature environment was provided by a GM cryostat and standard sample can.

The magnetic ordering temperature T_N was confirmed to be 45 K and several magnetic Bragg peaks (1 0 *L*) have been tracked above T_N. The appearance of a signal at (1 0 1) provides first direct evidence of a canted magnetic moment possible originating from DMI. Reciprocal space maps at constant energies up to 4 meV have been recorded at 5 K [FIG. 1 (left)] and 50 K [FIG. 1 (right)]. At both temperatures, spin wave scattering intensities are completely *L* independent, proving the 2D nature of magnetic interactions in this system. In the AFM state, the strong magnetic Bragg peak is formed at the elastic position followed by the tiny spin-gap (smaller than 0.25 meV). Those fluctuations become weaker and broader above T_N but still do not vanish at 50K. The dispersion data provides an excellent starting point to refine a magnetic Hamiltonian including DMI.

[1] S.-H. Park et al., Dalton Trans. 41, 1237 (2012).