Contribution ID: **408** Type: **Poster**

Characterization of the low-dimensional antiferromagnet [Cu(H2O)2(pyz)2]Cr2O7

Tuesday, 21 March 2023 16:00 (2 hours)

Metal organic magnets (MOM) have enormous potential to host a variety of electronic and magnetic phases that originate from a strong interplay between the spin, orbital, and lattice degrees of freedom. Due to the unique possibility of controlling interatomic distances and magnetic exchange pathways by coordination chemistry, a plethora of MOM have been reported. This way, 0D to 3D magnetic structures can be realized. In $[Cu(H_2O)_2(pyz)_2]Cr_2O_7$ (Cu-pyz), the magnetically active Cu^{2+} ions exhibit a nearest-neighbour exchange coupling in a 2D square lattice, with no out-of-plane coupling.

We have used static susceptibility, magnetization and neutron scattering (NS) measurements to characterize Cu-pyz single crystals. Our data supports the proposed model of a 2D isotropic quantum Heisenberg antiferromagnet (2D QHAF) model. Thus, magnetization curves show the characteristic upward bending with increasing external field. Likewise, the susceptibility displays a broad maximum at $T \approx 4.5\,\mathrm{K}$, which corresponds to the emergence of long range spin correlations within the individual planes.

Usually, the spin wave excitations are mapped out from within the ordered state, however, neither in bulk measurements down to $T = 2\,\mathrm{K}$ nor in elastic NS down to $T = 38\,\mathrm{mK}$ a transition to 3D long range order was observed. Nevertheless, we were able to measure the in-plane spin wave dispersion of the 2D correlations above T_N and determine the exchange coupling $J_{2\mathrm{D}} = 5.2(3)\,\mathrm{meV}$.

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Session Classification: Poster session TUESDAY

Track Classification: Magnetism, Superconductivity, Topological Systems, Magnetic Thin Films an other electronic phenomena