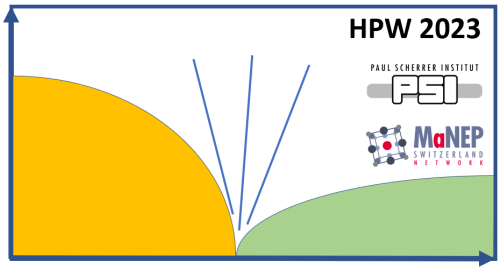

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Resolving spin reorientation of CrCl3 induced by high-pressure with MuSR and neutron diffraction

Wednesday 22 November 2023 14:15 (15 minutes)

Researches on two-dimensional (2D) materials have attracted tremendous attention both from fundamental and applied sciences since accelerated by the discovery of graphene. Among a large number of 2D materials, chromium trihalides CrX3 (X = Cl, Br, I) van der Waals (vdW) magnets have also raised a large interest due to the existence of many magnetic subtleties that cannot be explained by their magnetic and/or structural transitions.
Numerous studies were performed on CrI3, but only a few have been reported so far on its analogue CrCl3. The 2D vdW CrCl3 compound is stabilized under a rhombohedral symmetry, consisting of 2D Cr layers arranged in a honeycomb web fashion and surrounded by octahedrally coordinated Cl, with weak vdW inter-layer coupling. This makes CrCl3 an ideal system to study under external stimuli such as pressure or magnetic field, where new intriguing states can be unveiled. Expectantly, studies of CrCl3 under high pressure and room temperature have been reported. [1] However, its spin dynamics at low-temperature and high-pressure regimes remain unexplored. Motivated by the variability of the spin degree of freedom and spin dynamics under such conditions, we performed muon spin rotation (MuSR) and neutron powder diffractions (NPD) on ambient and hydrostatically pressured CrCl3 up to 23 kbar down to 2 K. [2,3]
In this study, by incorporating the two techniques and high-pressure, we resolved a suppression of the magnetic ground state and a stronger relaxation rate by MuSR. Within the magnetically ordered states, a spin reorientation was also observed by NPD at high pressure. A linear extrapolation points toward the suppression of magnetism at about pc= 30 kbar indicating the possible existence of a critical point at pc. [3]
[1] Ahmad, A., et al. Nanoscale 12.45 (2020): 22935-22944.
[2] Forslund, O., et al. arXiv:2111.06246 (2021).
[3] Ge, Y., et al., in preparation.

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