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The mysteries of magnetism and structure in the layered magnet chromium triiodide

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Chromium triiodide (CrI3) was the first layered van der Waals material to demonstrate the persistence of a sizable ferromagnetic hysteresis down to the monolayer [1]. This observation was accompanied by a striking transition from a layered ferromagnetic to a layered antiferromagnetic order as the number of layers of the crystal approached the two-dimensional limit [2]. The discovery of layered-dependent magnetism in CrI3 motivated a wealth of fundamental studies seeking the origin of this phenomenon. Although this effect can be underpinned by the differences of the spin superexchange coupling in the distinct layer stacking alignments found in bulk and few-layer cystals [3, 4], CrI3 still hosts deep conundrums. First and foremost, a clear explanation of why bulk CrI3 exhibits a layer-stacking structural transition to a rhombohedral low-temperature phase whereas few-layer samples do not is still missing. Secondly, the exact crossover point in terms of the number of layers appears to be, surprisingly, in the mesoscopic scale, but is currently unknown. In addition, there exists other controversies regarding the presence of a peak at 50 K in the in-plane magnetization curve [5] and the coexistence of different structural phases in bulk single crystals of this material [6]. In this talk, I will provide experimental insights regarding the magnetic states and crystalline phases of CrI3 beyond the reported monoclinic/rhombohedral stacking dichotomy, showcasing a far more intricate scenario than the one currently understood.

References

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