Magnetic Phase diagram of α-$RuCl_3$

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The material α-$RuCl_3$ has been the subject of intense study for the past few years owing to the expectation that it exhibits competing uniaxial exchange interactions characteristic of what are now termed Kitaev materials [1]. coordinated Ru^{3+} ions form a honeycomb lattice with layers weakly bonded via van der Waals interactions. The ease of formation of stacking faults and domains has made a definitive determination of the low temperature crystallographic space group difficult since many possible arrangements of the layers are energetically similar. In the absence of a magnetic field single crystals with few stacking faults show a phase transition near a Neel temperature T_N = 7 K to an antiferromagnetic structure that has zigzag order in a single plane and a 3-fold out of plane periodicity [2,3]. The introduction of stacking faults results in a structure with a 2-layer periodicity with T_N = 14 K [2,3]. The phase diagram in the presence of external in-plane magnetic field perpendicular to a Ru-Ru bond has not been fully resolved, but some features are clear, including a transition to an ordered state with a different layered periodicity near 6 Tesla and the complete suppression of zigzag order above roughly 7.5 Tesla [4,5,6]. Substitution of non-magnetic Ir4+ for Ru3+ also suppresses the zigzag order [7].This talk discusses these results in the context of measurements of the magnetic excitations, and the possible presence of a quantized thermal Hall effect and other interesting phenomena.

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