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The magnetic ground state and relationship to Kitaev physics in α-$RuCl_3$[1]

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The 2D Kitaev candidate alpha-$RuCl_3$ consists of stacked honeycomb layers weakly coupled by Van der Waals interactions. Here we report the measurements of bulk properties and neutron diffraction in both powder and single crystal samples. Our results show that the full three dimensional magnetic ground state is highly pliable with at least two dominant phases corresponding to two different out-of-plane magnetic orders. They have different Neel temperatures dependent on the stacking of the 2D layers, such as a broad magnetic transition at $T_N = 14$ K as observed in phase-pure powder samples, or a sharp magnetic transition at a lower $T_N = 7$ K as observed in homogeneous single crystals with no evidence for stacking faults. The magnetic refinements of the neutron scattering data [1] will be discussed, which in all cases shows the in-plane magnetic ground state is the zigzag phase common in Kitaev related materials including the honeycomb lattice Iridates. Inelastic neutron scattering in all cases shows that this material consistently exhibit strong two-dimensional magnetic fluctuations leading to a break-down of the classical spin-wave picture [2]. [1] H.B. Cao, A. Banerjee, J-Q. Yan, C.B. Bridges, M. Lumsden, B.C. Chakoumakos, D.G. Mandrus, D.A. Tennant, S.E. Nagler, *Low-temperature crystal and magnetic structure of alpha-$RuCl_3$*, (manuscript in preparation). [2] A. Banerjee *et al., arxiv:*1504.08037 (2015);

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