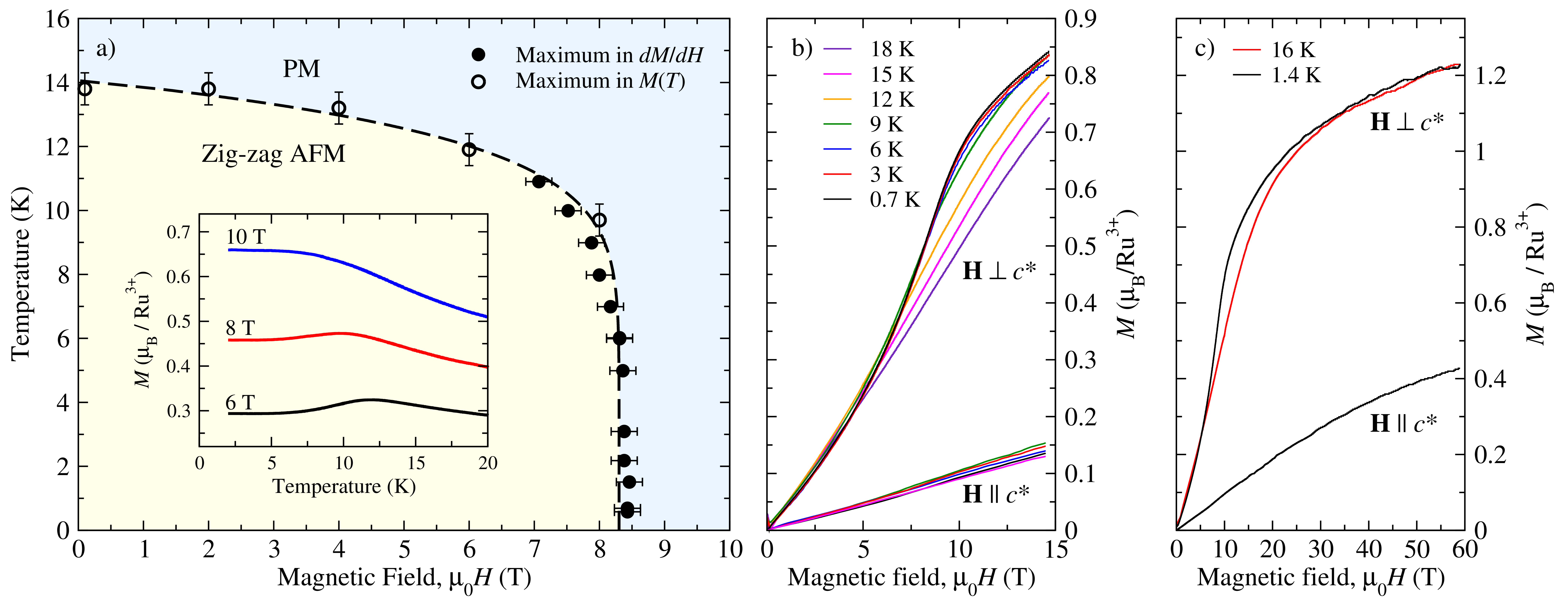
**Magnetometry of the Candidate Kitaev Honeycomb Magnet α-RuCl3**

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The layered honeycomb magnet α-RuCl3 has attracted much attention recently1-3 following the proposal4-6 that it could realize a Kitaev spin model7 with strongly frustrated, bond-dependent, anisotropic interactions between spin-orbit entangled jeff = 1/2 Ru4+ magnetic moments. Here we report detailed magnetometry studies on aligned crystal platelets of -RuCl3 in pulsed field up to 60 T to determine the shape of the magnetization curve and the phase diagram in magnetic field applied in the honeycomb layers and perpendicular.

Magnetometry measurements on a stack of aligned platelets were made using a 65 T short-pulse magnet at NHMFL at Los Alamos with an improved version of the experimental setup described in Ref. 9, in a 3He cryostat with a base temperature of 0.4 K; additional VSM measurements were performed at low field. Susceptibility data both for powders and for stacked crystals show a single magnetic transition upon cooling below *T*N ≃13 K, indicative of long-range antiferromagnetic ordering of the Ru magnetic moments. At lower temperatures, the steep rise in *M(H)* for pulsed-field measurements on single crystals suggests a field-induced phase transition near 8 T for field in the honeycomb plane (H ⊥ **c\***) followed by a gradual, asymptotic approach to magnetization saturation, as characteristic of strongly-anisotropic exchange interactions, of Kitaev10 or another form. For **H** ǁ **c\*** (out of plane), *M(H,T)* is around 5 times smaller, and the phase transition at 8 T is not observed. Using neutron diffraction we determined that the zero-field magnetic structure has antiferromagnetic order of zigzag ferromagnetic chains. The susceptibility measurements indicate that the zigzag phase is suppressed by relatively small magnetic fields (∼ 8 T) applied in the honeycomb layers, whereas it is robust in fields applied perpendicular to the honeycomb layers. Figure 1a) shows the magnetic phase diagram constructed from maxima in *M(T)* and d*M*/d*H*.



**Acknowledgements**

**Fig.1** a) Magnetic phase diagram for single crystals of α-RuCl3 in magnetic field **H** ⊥ **c\***. Solid points from maxima in d*M*/d*H* are from data in b) (upper traces). Open symbols are from maxima in *M(T)* VSM temperature sweeps (see inset). The dashed line is a guide-to-the-eye phase boundary between the zigzag antiferromagnetic phase (AFM, yellow shading) and paramagnetic (PM, blue shading). b) *M(H,T)* from rising part of 15 T pulses at constant temperatures c) *M(H,T)* from rising part of 60 T field pulses in both phases.

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**References**

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