PULSED FIELD MAGNETIZATION IN RARE EARTH KAGOME SYSTEMS

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Low temperature (450 mK – 4 K) pulsed field magnetization measurements made on single crystals of the rare earth kagome systems $R_3Ga_5SiO_{14}$ (R = Nd or Pr), designated NGS and PGS respectively, reveal contrasting behavior in these quasi-2D weakly frustrated antiferromagnets. Evidence for field-dependent correlated spin clusters in these materials has previously been obtained from neutron scattering and magnetic resonance measurements. For PGS ($J = 4$) the transient magnetization, M, is reversible for 60 T pulsed fields (25 ms) while for NGS ($J = 9/2$) M shows dramatic hysteresis as seen in Fig. 1. This difference in the responses of PGS and NGS is linked to differences in the crystal field states and spin dynamics in the two systems. A simple criterion involving the field sweep rate can explain the contrasting M behaviors.

Plateau features in the 450 mK M vs. $\mu_0 H$ curves for NGS at low applied fields, shown in Fig. 2, are compared with available theoretical predictions based on the antiferromagnetic Heisenberg model for spins $S \geq 3/2$ with the assumption that single ion anisotropy D is much larger than the exchange coupling J between neighbor spins [1]. While theory and experiment display certain common features, the experiments do not show the predicted 1/3 plateau in M. This finding suggests that the assumption $D >> J$ is not valid for NGS. In the case of PGS it is not possible to compare the results with theoretical predictions for $S = 1$ kagome systems since no plateau features are observed under the conditions used in the experiments. This absence of a plateau suggests that for PGS the nearest-neighbor exchange coupling $J < 1$ K.

[1] A.Sen, K. Damle and A. Vishwanath, Phys. Rev. Lett. **100**, 097202 (2008).

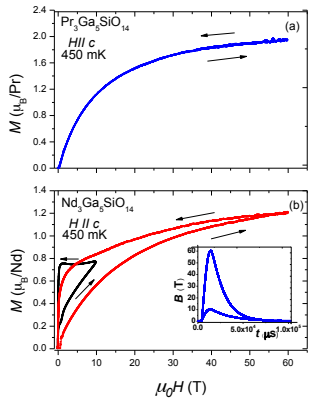

Figure 1. Pulsed field magnetization curves for (a) PGS and (b) NGS at 450 mK

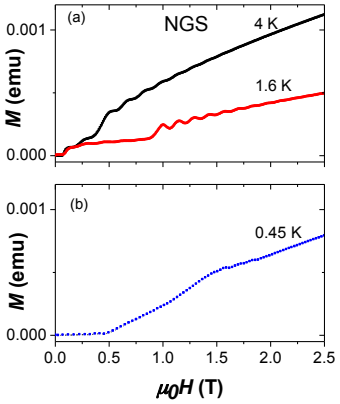

Figure 2. Low field magnetization plateau features for NGS at (a) 1.6 K and 4 K and (b) 450 mK

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