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Experimental realization of random-field Ising ferromagnetism in a molecular magnet[1]

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The longitudinal magnetic susceptibility of single crystals of the molecular magnet Mn_{12}-acetate obeys a Curie-Weiss law, indicating a transition to a ferromagnetic phase at ~ 0.9 K [1,2]. With increasing magnetic field applied transverse to the easy axis, a marked change is observed in the temperature dependence of the susceptibility, with a considerably more rapid suppression of the Curie-Weiss temperature than predicted by mean-field theory for an ordered single crystal. Our results can instead be fit by a Hamiltonian for a random-field Ising ferromagnet in a transverse magnetic field, where the randomness derives from the intrinsic distribution of locally tilted magnetic easy axes known to exist in Mn_{12}-acetate crystals. Mn_{12}-ac and other single molecule magnets may thus serve as clean model systems for the study of random field ferromagnetism where the random fields are controllable and considerably larger than typical hyperfine fields. This discovery promises to enable widespread and convenient experimental study of magnetism in a random field in a broad class of new materials.

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[1] B. Wen et al., Phys. Rev. B 82, 014406 (2010).
[2] Luis, et al., Phys. Rev. Lett. 95, 227202 (2005).

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