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### **Transverse Field and Random-Field Ising Ferromagnetism in Mn<sub>12</sub>-acetates<sup>1</sup>**

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Single molecule magnets (SMMs) single crystals can exhibit long range ferromagnetic order associated with intermolecular interactions, principally magnetic dipole interactions. With their high spin ( $S \sim 10$ ) and strong Ising-like magnetic anisotropy, they are model materials to the study of physics associated with Transverse-Field Ising Ferromagnet Model (TFIFM). We have measured magnetic susceptibility of single crystals of the prototype SMM, Mn<sub>12</sub>-acetate, and of a new high-symmetry variant, Mn<sub>12</sub>-ac-MeOH. At zero transverse field the inverse susceptibility of both SMMs is found to accurately follow a Curie-Weiss law with an intercept at a non-zero temperature  $T_{cw} \sim 0.9$  K, indicating a transition to a ferromagnetic phase due to dipolar interactions. With increasing transverse field, the susceptibility and the Curie-Weiss temperature decreases due to increase in spin fluctuations but the nature of the decrease is very different in the two materials. We find that in Mn<sub>12</sub>-ac-MeOH, the suppression of ferromagnetism by the transverse field is consistent with TFIFM, while the suppression of ferromagnetism by the transverse field is considerably more rapid in Mn<sub>12</sub>-acetate. Previous studies show that due to solvent disorder Mn<sub>12</sub>-acetate has an intrinsic distribution of discrete tilts of the molecular magnetic easy axis from the global easy axis of the crystal. Thus with the application of transverse field, the molecules with tilted easy axis experience an additional field along their easy axis and give rise to a distribution of random-fields that further destroys the long-range order, suggesting that this prototypical molecular magnet is a realization of Random-Field Ising Ferromagnet (RFIFM).

[1] *Phys. Rev. B* **85**, 013441 (2012).

[2] *Phys. Rev. B* **82**, 014406 (2010).

[3] *Phys. Rev. B* **82**, 174405(2010)

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