MS19-02 | Torque Magnetometry, a Tool for Magnetic Crystallography in Thin Films of Frustrated Magnets

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Geometrically frustrated systems have an incompatibility between the lattice geometry and the magnetic interactions, resulting in macroscopically degenerate ground-state manifolds. In pyrochlore titanates (such as Ho2Ti2O7), large single ion anisotropy leads to a highly degenerate two-in/two-out spin ice state. Degeneracy is lifted when magnetic fields are applied, leading to transitions between various spin textures that depend on the direction of the field, and to emergent excitations equivalent to magnetic monopoles. There is an enticing potential of harnessing these monopoles, as information carriers; to realize these thin films are required. I will demonstrate the applicability of torque magnetometry in probing specific spin textures hosted by the spin ice state, and the transient states associated with transitions between them. High quality single crystals and thin films have been measured at temperatures down to 20 mK in applied fields up to 11 T. Sample rotation allowed for application of magnetic fields along various crystallographic directions of the samples. Utilizing reported results from neutron scattering as a starting point I have developed a phenomenological model that describes the anisotropic magnetic phase diagram of the bulk spin ice. This sensitive technique is highly suitable for thin film characterization; hence, this paves the way to compiling temperature-field phase diagrams, detailing thin film spin ice physics as a function of film thickness and strain.

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