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(I) Spin-Ice Thin Films: The Effect of Strain and Disorder

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Geometrically frustrated systems have an inherent incompatibility between the lattice geometry and the magnetic interactions, resulting in macroscopically degenerate ground-state manifolds. The single-ion anisotropy in these systems gives rise to unusual noncollinear spin textures [1,2], such as a spin ice state that hosts emergent quasiparticle excitations equivalent to magnetic monopoles. There is an enticing potential of using these monopoles for the development of new quantum information applications. To realize this, thin films are required. The thin films in my group are grown using pulsed laser deposition and characterized using capacitive torque magnetometry and neutron measurements. I will show that epitaxial strain and the amount of disorder in the films play important roles in determining their magnetic properties. Furthermore, capacitive torque magnetometry can be used to characterize the transitions between noncollinear spin textures in highly anisotropic systems, such as spin ices. Studying these magnetic-field-induced phase transitions allows extraction of the energy scales associated with the magnetic interactions in the material. I will benchmark the technique using measurements on bulk single crystals, and I will show that thin films of the same spin ice grown on yttria-stabilized zirconia substrates [1] show modified spin ice physics depending on the growth conditions used.

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