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Discovery and Characterization of New Frustrated Magnetic Systems

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Magnetic frustration occurs when a material's lattice geometry prevents it from finding the classical ground state which minimizes pairwise magnetic interaction energies. In such situations, novel ground states with exotic properties can emerge: examples include classical and quantum spin ice and classical and quantum spin liquids. Many different states and excitations have been predicted theoretically, but the study of their physical properties requires real physical realizations of these models.

We have been searching for new geometrically frustrated magnetic materials to broaden the range of materials that can be studied to identify new ground states and novel excitations. I will describe our work to synthesis a stacked triangular system $ErMgGaO_4$ and the related garnet $Er_3Ga_5O_{12}$, which we have characterized with magnetic susceptibility, specific heat, muon spin relaxation and neutron scattering. We find that the spins in remain dynamic down to our lowest temperatures (50mK), making this system a candidate spin liquid.

I will also describe our ongoing work on new materials whose lattice is derived from the highly frustrated pyrochlore and kagome lattices where we have successfully synthesized single crystal and polycrystalline specimens of several new compounds.

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