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Phase diagram of a geometrically frustrated dipolar Heisenberg pyrochlore antiferromagnet MATTHEW ENJALRAN, Southern CT State University — Rare-earth pyrochlore oxide materials of general chemical formula $A_2B_2O_7$ (A^{3+}= rare-earth, B^{4+}= transition metal) have attracted a great deal of attention because the combination of chemical composition and lattice geometry produces a plethora of interesting physical phenomena in these materials. In insulating systems, rare-earth ions with large magnetic moments reside on the corners of a geometrically frustrated network of corner sharing tetrahedra and interact via exchange and long-range dipole-dipole interactions. Experiments have observed spin liquid, spin glass, spin ice, and magnetically ordered phases. In the gadolinium titanate pyrochlore, $Gd_2Ti_2O_7$, an excellent realization of a Heisenberg antiferromagnet, experiments reveal a two step transition sequence to a partially ordered magnetic phase at 50 mK in zero applied field. In finite magnetic fields, a rich phase diagram of multiple field driven transitions is observed for magnetic fields applied along the high symmetry directions of the lattice. We study a model of classical Heisenberg spins (O(3) symmetry) on a pyrochlore lattice with exchange and dipolar interactions within mean-field theory. Using parameters relevant to the material system, we develop phase diagrams in zero and finite magnetic fields. Our results our compared to recent experiments on $Gd_2Ti_2O_7$ and $Gd_2Sn_2O_7$.

Matthew Enjalran
Southern CT State University

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