Continuous Degeneracy and Magnetization Process in the 3D FCC Kagome Lattice with the Dipole-Dipole Interaction

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ABSTRACT: Results are presented on analytic and computational analyses of the spin states associated with ABC stacked kagome planes of magnetic ions with only long-range dipole-dipole interactions. Extending previous work on the 2D kagome system, where six-fold discrete degeneracy of the ground state was revealed [1], we show that the 3D FCC kagome lattice exhibits a continuous degeneracy characterized by just six sub-lattice spin vectors and two spherical angles. Thermal fluctuations are shown to lift this degeneracy in an order-by-disorder process. Degaussing the lattice with a magnetic field applied along directions of high symmetry also results in lifting the continuous degeneracy to a subset of states from the original set of ground states, characterized by a single parameter. This lattice type is a model for the magnetic Mn ions in IrMn3, the most popular compound used as the antiferromagnetic pinning layer in hard-drive spin valve structures [2]. Analysis of these spin states is relevant for a deeper understanding of magnetic and thermal stability at surfaces and in thin films of IrMn3.

[1] M. S. Holden, M. L. Plumer, I. Saika-Voivod, and B. W. Southern , Phys. Rev. B 91, 224425 (2015); M. Maksymenko, V. R. Chandra, R. Moessner, Phys. Rev. B 91, 184407 (2015).
[2] M.D. LeBlanc, M.L. Plumer, J.P. Whitehead, and B.W. Southern, Phys. Rev. B 88, 094406 (2013).

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