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Thermal Order-by-Disorder at Criticality in XY Pyrochlore Magnets MICHEL GINGRAS, BEHNAM JAVANPARAST, ALEXANDRE DAY, ZHIHAO HAO, University of Waterloo — We investigate analytically and numerically the problem of long-range order selection via thermal fluctuations close to the critical region of the paramagnetic phase to long-range order transition in a system of interacting XY spins on the pyrochlore lattice and for which we consider the most general bilinear anisotropic nearest-neighbor spin Hamiltonian. At the standard mean-field theory (s-MFT) level, in a certain region of the parameter space of this Hamiltonian, the ordered state displays an accidental $U(1)$ degeneracy. This degeneracy is lifted by fluctuations beyond s-MFT and a certain form of order-by-disorder near criticality is thus fund to be at play. We analytically explore this selection at the microscopic level by using an extension of the method originally developed by Thouless, Anderson and Palmer (TAP) to study the effect of fluctuations in spin glasses. These TAP calculations provide an insight into the long-range order fluctuation-induced selection mechanism in terms of the spin-spin coupling constants of the microscopic Hamiltonian. We also employ a cluster mean field theory (c-MFT) to further explore numerically this problem.

Michel J Gingras
Univ of Waterloo

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