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The physics of coupled spin-orbital degrees of freedom and Fe pnictides CHENG-CHIEN CHEN, BRIAN MORITZ, THOMAS DEVEREAUX, Stanford Institute for Materials and Energy Science, SLAC National Accelerator Laboratory and Stanford University, JEROEN VAN DEN BRINK, Institute Lorentz for Theoretical Physics, Leiden University, RAJIV SINGH, Universityof California, Davis — Motivated by neutron scattering experiments on Fe pnictides, we study the thermodynamic properties and finite-temperature spin dynamics of a model Hamiltonian with coupled quantum Heisenberg-spin and Ising-orbital degrees of freedom. The model system undergoes a phase transition to an orbitally ordered state at a temperature set by short-range magnetic order. The behavior of the specific heat and the order-parameter suggests that the transition is continuous and of second order, belonging to the 2D Ising universality class. The onset of orbital excitations and fluctuations causes a rapid scrambling of the spin spectral weight away from coherent spin-waves, leading to a sharp increase in uniform magnetic susceptibility just below the phase transition. The experimental consequences of this model are in qualitatively good agreement with the observed behavior in the Fe-pnictide materials.

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