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Conjugate Field and Fluctuation-Dissipation Relation for the Dynamic Phase Transition in the Two-dimensional Kinetic Ising Model

D.T. ROBB, Clarkson University, P.A. RIKVOLD, Florida State University, A. BERGER, Hitachi Global Storage Technologies, M.A. NOVOTNY, Mississippi State University — The two-dimensional kinetic Ising model, when exposed to an oscillating magnetic field with zero time-average, has been shown to exhibit a nonequilibrium, second-order dynamic phase transition (DPT), whose order parameter Q is the period-averaged magnetization. It has been established that this DPT falls in the same universality class as the equilibrium phase transition in the two-dimensional Ising model in zero applied field. Here we apply a square-wave field with (for the first time) a non-zero period-averaged magnetic field, H_b, and study the scaling of the dynamic order parameter with respect to H_b. We find evidence that the field scaling exponent, δ_{d}, at the critical period of the DPT is equal to the exponent for the critical isotherm, δ_{e}, in the equilibrium Ising model. A finite-size scaling analysis of the dynamic order parameter in the critical region provides further support for this result. We also demonstrate numerically that a fluctuation-dissipation relation (FDR), with an effective temperature $T_{\mathrm{eff}}\,(T, P, H_0)$ depending on the period, and possibly the temperature and field amplitude, holds for the dynamic order parameter and its conjugate field. This FDR justifies our use of the scaled variance of Q as a proxy for the nonequilibrium susceptibility, $\partial\langle Q\rangle/\partial H_b$.

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