Hysteresis in the random-field Ising model

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Abstract

The random-field Ising model (RFIM) is one of the simplest statistical-mechanical models that captures the anomalous irreversible collective response seen in a wide range of physical, biological, or socioeconomic situations in the presence of interactions and intrinsic heterogeneity or disorder. When slowly driven at zero temperature, it can display an out-of-equilibrium phase transition associated with critical scaling ("crackling noise"), while it undergoes at equilibrium, under either temperature or disorder-strength changes, a thermodynamic phase transition. Phase transitions in RFIM are characterized by a huge number of quasidegenrate metastable states. To fully capture the important physics we have used the Nonperturbative Renormalization Group (NPRG) approach. I will present our recent understanding of the hysteresis phase transition. We show that the fixed point describing hysteresis is different from the fixed point describing the equilibrium phase transition, despite several surprising indications that the two transitions were governed by the same fixed point. Our starting point is a dynamical formalism that we developed within the NPRG.

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