Abstract

Among all conceivable materials, there are tremendous more disordered materials than ordered ones. For ordered physical systems, there has been a rich spectrum of well-defined theories, models, and methods; while disordered systems have more questions that are unclear. In this work, we study 3 disordered systems in finite dimensional lattice-like structures, which may contribute new insights comparing to a large amount of work in mean-field-like models. First, we apply a lattice glass model proposed and discover the evidence of a jamming transition with no phase transition. Secondly, the antiferromagnetic Ising model in hierarchical networks shows glassy dynamics and an infinite-order transition characterized by a super-critical Hopf-bifurcation in coupling-space to chaotic behavior for low temperatures. Thirdly, the random field Ising model is studied to understand the aging in an experimental system, a thin-film ferromagnet/antiferromagnet bilayer. The Monte Carlo simulations agree well with experiments in terms of the relaxation scaling and exponent magnitude, which helps understand the extremely slow cooperative relaxation in experiments.