Antiferromagnetic Ising Model in Hierarchical Networks †

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The antiferromagnetic Ising model in complex networks can introduce geometric frustrations and lead to disordered states. The disorderedness may give rise to spin glass properties and phases at low temperature[1]. We apply the antiferromagnetic Ising model to 3 hierarchical networks which share features of both small world networks and regular lattices. Their recursive and fixed structures make them suitable for exact renormalization group as well as numerical simulations. We first explore the dynamical behaviors using the simulated annealing simulation and discover an extremely slow aging at low temperature. Then we employ Wang-Landau algorithm to investigate the energy landscape and the corresponding equilibrium behaviors for different system sizes. Also, renormalization group[2] is used to study the equilibrium properties and phase diagram in thermodynamic limit. The result from renormalization group is also an insightful reference for the results from simulated annealing and Wang-Landau sampling.

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[1]C. P. Herrero, Phys. Rev. E. **77**, 04112 (2008)
[2]V. Singh, C. T. Brunson, S. Boettcher, arXiv:1408.0669 (2014)
[1]

[1]Option 1: 2.6: Disordered and Glassy Systems (non-polymeric); 3.1.10: Fluctuations and Correlations far from Equilibrum (GSNP); Option 3: 3.6: Statistical Mechanics of Frustrated Systems.