**Annealed Ising model on hierarchical structures: A transfer matrix approach**

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Spin systems in the presence of disorder are described by two sets of degrees of freedom, associated with orientational (spin) and disorder variables, which may be characterized by two distinct relaxation times. Disordered spin models have been mostly investigated in the quenched regime, which is the usual situation in solid state physics, and in which the relaxation time of the disorder variables is much larger than the typical measurement times. In this quenched regime, disorder variables are fixed, and only the orientational variables are duly thermalized. Recent studies in the context of lattice statistical models for the phase diagrams of nematic liquid-crystalline systems have stimulated the interest of going beyond the quenched regime. The phase diagrams predicted by these calculations for a simple Maier-Saupe model turn out to be qualitative different from the quenched case if the two sets of degrees of freedom are allowed to reach thermal equilibrium during the experimental time, which is known as the fully annealed regime. In this work, we develop a transfer matrix formalism to investigate annealed disordered Ising models on two hierarchical structures, the diamond hierarchical lattice (DHL) and the Apollonian network (AN). The calculations follow the same steps used for the analysis of simple uniform systems, which amounts to deriving proper recurrence maps for the thermodynamic and magnetic variables in terms of the generations of the construction of the hierarchical structures. In this context, we may consider different kinds of disorder, and different types of ferromagnetic and anti-ferromagnetic interactions. In the present work, we analyze the effects of dilution, which are produced by the removal of some magnetic ions. The system is treated in a "grand canonical" ensemble. The introduction of two extra fields, related to the concentration of two different types of particles, leads to higher-rank transfer matrices as compared with the formalism for the usual uniform models. Preliminary calculations on a DHL indicate that there is a phase transition for a wide range of dilution concentrations. Ising spin systems on the AN are known to be ferromagnetically ordered at all temperatures; in the presence of dilution, however, there are indications of a disordered (paramagnetic) phase at low concentrations of magnetic ions.