# The Ising spin glass: new methods for old models and old methods for new models

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The Ising spin glass in 2D exhibits rich behavior with subtle differences in the scaling for different coupling distributions. We use combinatorial optimization methods to determine exact ground states for systems with up to 10 000 × 10 000 spins. A combination of new algorithms al low us to treat samples with fully periodic boundaries and to sample uniformly from degenerate ground states for the ±J model. To establish a unified framework for studying both discrete and continuous coupling distributions in arbitrary dimensions, we introduce the binomial spin glass. In this model, the couplings are the sum of m identically distributed Bernoulli random variables. In the continuum limit $m \to \infty$, this system reduces to the Edwards-Anderson model with Gaussian couplings, while m = 1 corresponds to the ±J spin glass. Using this model, we derive a rigorous bound for the degeneracy of any energy level. Studying the defect energies in this model, we uncover intriguing subtleties in the behavior of the model with respect to the order in which the thermodynamic ($N \to \infty$) and continuum ($m \to \infty$) limits are taken.

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