Ground states of random-field Ising magnets around the upper critical dimension

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We consider the random-field Ising magnet (RFIM) around the upper critical dimension which is predicted to be \( d_u = 6 \). The RFIM consists of ferromagnetically coupled Ising spins with an additional quenched local random field. To ensure unique ground-states it is chosen to be distributed according to a Gaussian with zero mean and a tuneable standard deviation. To obtain the ground state for each realisation of the disorder we map the random field to a graph with suitable chosen edge capacities [Picard and Ratliff, Networks 5, 357 (1975)]. For these graphs we calculate the maximum flow using a fast max-flow/min-cut algorithm, recently developed in algorithmic graph theory. Therein the minimum cut corresponds to a ground-state configuration of the system.

We obtain critical scaling exponents out of energy, magnetisation and susceptibility, using finite-size scaling. The results for \( d = 5, 6, 7 \) are compared with the mean-field exponents of the RFIM, since from \( d_u = 6 \) on the mean-field exponents are expected to hold.