

Domain Wall Renormalization Group Analysis of the 2-dimensional Square Lattice Ising Model

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abstract

We apply a tensor renormalization group method to the 2-dimensional square lattice Ising model. We represent the spin configuration by a domain wall configuration and formulated the domain wall renormalization group (DWRG), by introducing the notion of coarse grained domain wall. We calculate the effective domain wall interactions among the coarse grained domain walls and write down analytically the renormalization group equation in 3-dimensional interaction space. We analyze the flow structure of the renormalization group (see Fig. 1) and derive the 2-phase structure, existence of a fixed point (as a root of a fifth order algebraic equation), and single relevant operator around that. Numerical analysis gives the critical temperature, critical exponents of the correlation length and the specific heat. These results are very good compared to the known exact values.

We enlarge the number of states of the domain wall and worked out with 25-dimensional effective interaction space. The obtained physical quantities at the criticality are improved much to give almost exact values within a few %. Magnetization analysis, physical meanings of multi-state domain walls, adding long range interactions of 2-state domain walls, domain wall condensation, higher space dimension, etc. are also to be discussed.

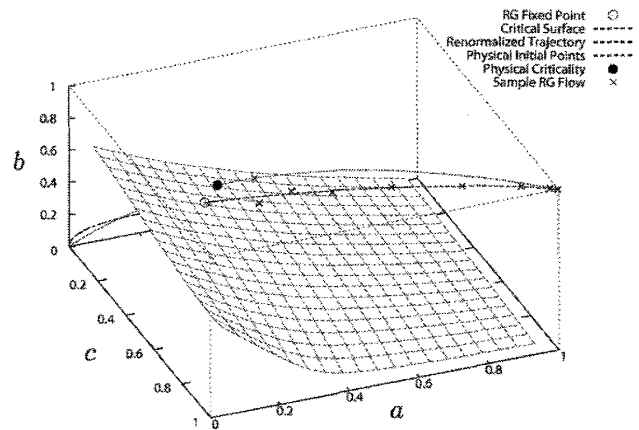


Figure 1: Phase structure of DWRGT

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