
The square lattice Ising model on the rectangle

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Abstract

The partition function of the square lattice Ising model on the rectangle is calculated exactly for arbitrary system size $L \times M$ and temperature. We start with the dimer method of Kasteleyn, McCoy & Wu, construct a highly symmetric block transfer matrix and derive a factorization of the involved determinant, effectively decomposing the free energy of the system into two parts, where the subleading residual part contains the nontrivial finite- L contributions for fixed M . It is given by the determinant of a $M/2 \times M/2$ matrix and can be mapped onto an effective spin model with M Ising spins and long-range interactions. While the residual part becomes exponentially small for large L/M or off-critical temperatures, it leads to important finite-size effects such as the critical Casimir force near criticality.

In the finite-size scaling limit, the involved expressions simplify and lead to the scaling functions of the Casimir potential and of the Casimir force. At criticality, a prediction from conformal field theory is confirmed.

Alfred Hucht, "The square lattice Ising model on the rectangle I: Finite systems", J Phys A: Math. Theo., 2016, arXiv:1609.01963, accepted

Alfred Hucht, "The square lattice Ising model on the rectangle II: Finite-size scaling limit", in preparation

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