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Exact solution of the six-vertex model with domain wall boundary conditions

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Abstract

The six-vertex model, or the square ice model, with domain wall boundary conditions (DWBC) has been introduced and solved for finite N by Korepin and Izergin. The solution is based on the Yang–Baxter equations and it represents the partition function in terms of an $N \times N$ Hankel determinant. Paul Zinn–Justin observed that the Izergin–Korepin formula can be re-expressed in terms of the partition function of a random matrix model with a nonpolynomial interaction. We use this observation to obtain the large N asymptotics of the free energy in the six-vertex model with DWBC. The solution is based on the Riemann–Hilbert approach. We obtain the leading and subleading terms in the asymptotics of the partition function in the disordered and ferroelectric phases, and also on the critical line between these two phases.