Flow equations approach to one dimensional quantum Ising model

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Abstract
One dimensional quantum Ising model with nearest neighbor interaction in transverse magnetic field is one of the simplest spin models which undergo quantum phase transition. This model has been precisely solved using different methods. In this paper, we solve this model in uniform magnetic field \( -J_g \sigma^x_n \) precisely using a new method called Continuous Unitary Transformations (CUT) or flow equations, and derive its expectation values \( \langle \sigma^x_n \rangle \), \( \langle \sigma^z_n \rangle \) and \( \langle \sigma^x_n \sigma^x_{n+1} \rangle \). Then, we apply this method on one dimensional quantum Ising model in staggered magnetic field \( (-\gamma)^n J_g \sigma^x_n \). Results show that both models have the same critical properties as expected, and it was also found that spontaneous symmetry breaking cannot be derived from CUT.

Keywords: continuous unitary transformations (CUT) method, flow equations method, one dimensional quantum Ising model, quantum phase transition (QPT)

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