Renormalization Group Approach to Weakly Interacting Spin and Fermion Chains

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The properties of many real materials are dominated by the presence of weakly coupled chains. We propose a method based on the real space renormalization group transformation which can be used to study critical behavior and thermodynamics of a broad class of the weakly interacting classical and quantum spin chains with $S \geq 1/2$ in an magnetic field as well as fermion chains. The method is presented and examined for the standard Ising model on a rectangular lattice and then applied to the weakly interacting quantum anisotropic Heisenberg model and spinless fermion system. We discuss a dimensional crossover in coupled spin chains. We also show that the characteristic feature of a strongly correlated spinless fermion chain is a double peak structure of the specific heat as a function of temperature and a small interchain (transverse) hopping leads to a phase transition from a metallic to a charged ordered phase.

9.7 cm

13.4 cm

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