PS24

Exact Correlation Functions of Spin-1/2 Heisenberg XXZ Chain

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The spin-1/2 antiferromagnetic Heisenberg XXZ chain is one of the most fundamental models for one-dimensional quantum magnetism. The exact eigenvalues and eigenvectors of this model can be obtained by the Bethe ansatz method. Many physical quantities in the thermodynamic limit such as specific heat, magnetic susceptibility, elementary excitations, etc..., have been exactly evaluated even at finite temperature by this method.

The exact calculation of the correlation functions, however, is still a difficult problem even in the simplest case for static correlation functions at zero temperature. The exceptional case is $\Delta = 0$, where the system reduces to a lattice free-fermion model by the Jordan-Wigner transformation. In this case, we can calculate arbitrary correlation functions by means of Wick's theorem.

However, there have been rapid developments recently in the exact evaluations of correlation functions for $\Delta \neq 0$ case also. We would like to present our recent results for them, concentrating mainly on the static correlation functions of the XXX model $\Delta = 1$ at zero temperature.