Commun. Math. Phys. 94, 67–92 (1984)

Communications in Mathematical Physics

The Quantum Inverse Scattering Method Approach to Correlation Functions

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Abstract. The inverse scattering method approach is developed for calculation of correlation functions in completely integrable quantum models with the R-matrix of XXX-type. These models include the one-dimensional Bose-gas and the Heisenberg XXX-model. The algebraic questions of the problem are considered.

1. Introduction

The quantum inverse scattering method (QISM) [1] is extremely useful for analysis of completely integrable systems. In this paper we formulate the problem of calculation of correlation functions for these models in the frame of QISM. Our approach is essentially different from the one based on the quantum Gelfand–Levitan equation [2, 3]. We use results of papers [4, 5] where the generalized integrable model was introduced. This model depends on an arbitrary functional parameter. Concrete models such as one-dimensional Bose-gas and the Heisenberg XXX-model can be obtained as special cases at particular values of this parameter. The crucial point is a simple dependence of the generalized model on this functional parameter. We call this generalized model the "one-site" model. By means of this model the simple formula for norms of Bethe wave functions was proved.

In this paper we introduce the "two-site" generalized model which permits us to give a natural formulation of a problem of calculation of correlation functions. This approach can be applied to any model with the R-matrix of XXX or XXZ models. Here we restrict ourselves to the XXX-case only.

We deal in this paper with algebraic aspects of the problem, but to clarify the statement of the problem turn now to the one-dimensional Bose-gas with repulsion which is described by the quantum nonlinear Schrödinger equation (so we call this