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Correlation Function of Fields in One-Dimensional Bose-Gas

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Abstract. Correlation function of fields is presented as a Fredholm minor, at finite coupling constant in one-dimensional Bose gas.

1. Introduction

We discuss correlation function of fields in the quantum nonlinear Schrödinger equation model (NS-model). The Hamiltonian of this model is equal to

$$\mathscr{H} = \int_0^L dx(\partial_x\psi^+\partial_x\psi + c\psi^+\psi^+\psi\psi - h\psi^+\psi)\,. \tag{1.1}$$

Here $c > 0$ is a coupling constant, $h > 0$: chemical potential; L: a length of a box; $\psi(x)$: a canonical Bose-field:

$$\begin{gathered}[\psi(x),\, \psi^+(y)] = \delta(x-y)\,,\\ \psi(x)\,|0\rangle = 0\,.\end{gathered} \tag{1.2}$$

In the limit $c = \infty$ (free fermions) the correlator was calculated by Lenard [1] in terms of a Fredholm minor. This representation was used for writing differential equations for the correlator [2, 3]. In the present paper we consider the case of the finite coupling constant c. Using the method of algebraic anzats Bethe we present the correlator as a minor of an integral operator, which depends on auxiliary quantum fields. Such a representation can be used for writing the system of integro-differential equations for the correlation function.

2. Algebraic Anzats Bethe

The main object of algebraic anzats Bethe is the monodromy matrix $T(\lambda)$. In the case of NS-model it is 2×2 matrix:

$$T(\lambda) = \begin{pmatrix} A(\lambda) & B(\lambda) \\ C(\lambda) & D(\lambda) \end{pmatrix}\,. \tag{2.1}$$