the pair of independent Volterra models corresponding to different time directions:

\[ S_n^\pm = \pm S_n^\pm (S_{n+1}^\pm - S_{n-1}^\pm), \]

were reduced to integrable models, which are massless limits of the SG model. These limits correspond to two choices of spirality for a massless relativistic particle.

Thus the Volterra model falls into the general class of models, integrable by the R-matrix method. The existing rich attempt to quantize such models [7] suggests a path for passing to the quantum formulation of our model. In this connection we recall the following achievements: a general formalism for the construction of local Hamiltonians [8], a propagation scheme for the construction of R-matrices of highest spin [9] and its generalization to the trigonometric case [10], and also a formulation of the analytic Bethe Ansatz [11, 12]. At the present time work is going on in this direction.

LITERATURE CITED

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FIELD CORRELATION FUNCTIONS IN A ONE-DIMENSIONAL BOSE GAS

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Multifield correlation functions are calculated in the Bose gas model. It is shown that the multifield correlation functions like the correlator of currents previously calculated can be expressed in terms of the irreducible parts of the form factors and the solutions of nonlinear integral equations.

1. Introduction

At the present time there is no longer any doubt that the quantum method of the inverse problem (QMIP) [1] is the most natural foundation for calculating correlation functions in integrable models of quantum field theory and statistical physics in two-dimensional space-time [2-6]. The simplest of them is the model of one-dimensional Bose gas with point paired interaction of particles [7]. It is equivalent to the quantum field theory of a canonical boson field \( \psi(x) \) [8]. The equation of motion of this field is a nonlinear Schrödinger equation (NS). The Hamiltonian model has the following form.

Here $\hbar$ is the chemical potential; the sign of the constant of interaction corresponds to repulsion between particles.

In [2-5] the correlation function of two currents in this model, which is the simplest from the point of view of the QMIP was calculated. The present paper is devoted to the generalization of the methods of these papers in two directions: firstly, correlators of fields $\psi(x)$ and $\psi^*(x)$ are included in the scheme of the method, and secondly, multifield correlators are considered. By multifield correlators here we shall mean averages of the following product of local and nonlocal operators:

$$\langle \phi_{a_0}^<(0) \phi^a_{a_1}(x_1) \phi^b_{a_2}(x_2) \cdots \phi^d_{a_N}(x_N) \rangle,$$

where $a = \pm 1, 0 < x_1 < \cdots < x_N \leq L$.

$$\phi^<_{a_0}(x) = \psi^<_{a_0}(x), \quad \phi^b_{a_1}(x) = \psi^b_{a_1}(x), \quad \phi^c_{a_2}(x) = \psi^c_{a_2}(x),$$

$$\phi^d_{a_N}(x) = \psi^d_{a_N}(x).$$

The regularization used in (1.4) leads to the following commutation relations

$$[\psi(x), \phi_{a}(y)] = \phi_{a}(x) \delta(x-y),$$

$$[\phi_{a}(x), \phi_{b}(y)] = \phi_{a}(x) \delta(x-y).$$

Where possible we shall use the notation of [2, 3].

The rest of the content of the paper is the following. In Sec. 2 we describe the multinodal model needed for the calculation of the averages of operators of the form (1.2). In Sec. 3 we study the form-factors of these operators. Section 4 is devoted to the calculation of averages of the operators (1.2). In the following section we give an expression for the multifield correlators (1.2) in the thermodynamic limit, an expression for the correlator of two fields is given separately.

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2. Multinodal Generalized Model

The multinodal model is the direct generalization of the binodal model introduced in [2]. Below we give a description of the model and the basic formulas needed for the later construction of a representation for the correlation functions are given.

The basic object in the QMIP is the quantum monodromy matrix (QMM). The models NS correspond to QMM of size $2 \times 2$:

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

Its matrix elements $A$, $B$, $C$, and $D$ are operator-valued functions of the complex spectral parameter $\lambda$, which satisfy the commutation relations:

$$R(\lambda - \mu) T(\lambda) \otimes T(\mu) = T(\mu) \otimes T(\lambda) R(\lambda - \mu), \quad (2.2)$$

where the R-matrix $R(\lambda) = \mathbb{P} + i \lambda \mathbb{I}$ is a matrix in $\mathfrak{g}^* \otimes \mathfrak{g}^*; \mathbb{P}$ is the permutation operator $\mathbb{P} \otimes g = g \otimes f$; the tensor product in (2.2) relates only to the matrix structure.

In each concrete model, including the model NS, the elements of the WMM are operators whose structure is determined by an auxiliary linear problem of the model considered [1]. These operators act in the corresponding space of states.

We shall interpret the QMM differently. The elements $A$, $B$, $C$, and $D$ in (2.1) will be considered as generators of an associative algebra $\mathfrak{A}$, and (2.2) as a relation between them. In such an interpretation each concrete realization of the commutation relations (2.2) is a representation of the algebra $\mathfrak{A}$. 

$$H = \int_0^L dx (\psi^*_x \psi_x + c \psi^*_x \psi_x - \hbar \psi^*_x \psi_x), \quad \hbar, c > 0 \quad (1.1)$$