

Results of research

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We showed that for special values of the coupling constant, the Hilbert space of the sine-Gordon model can be restricted consistently, and that the restricted theory has invariance under the higher spin $\mathcal{N} = 2$ supersymmetry (Publication List [1,2]).

Using the coordinate Bethe ansatz, we examined how the wave function for the ground state of the XXZ spin chain varies under twist of the boundary condition. Especially, for the finite size system, the behavior of the string solutions was studied in detail ([4]).

In the 90s, it was conjectured that the $3 + 1$ dimensional self-dual Yang-Mills (SDYM) equations and the Bethe ansatz method for the integrable models have deep connection with the special types of QCD scattering amplitudes with certain helicity states for the external gauge fields, called the Parke-Taylor amplitudes. Inspired by this conjecture, we obtained a new type of classical solutions for the $3 + 1$ dimensional SDYM equation. They are a non-linear sum of plane waves. This complex solution itself is not physical, but is interpreted as the generating function of the Parke-Taylor amplitudes ([5,6]).

For $1 + 1$ dimensional affine Toda field theories, I introduced the “quantum deformed Coxeter element of the Weyl group” and showed that the structure of the S-matrices can be explained by this element. As a byproduct, the universal form of integral representation of S-matrices is obtained ([7]).

For integrable models with diagonal S-matrices, the some of form factors and correlations functions are considered. The functional relations for the minimal form factors and the structure of poles of the form factors are determined ([3]).

In a massive perturbation of a series of the minimal conformal field theories, form factors of “off-critical” primary fields are determined and their correlation functions are analyzed. It was found that the two-point correlation functions of these fields have deep connection with the Fredholm determinant of certain operators ([8,9]).

In the low-energy effective theories of the type IIA/IIB superstring, we showed that a special combination of Ramond-Ramond gauge potentials with the NS-NS potentials transforms as a spinor representation under the T-duality group. ([10]).

The U-duality of the system of D-1 brane and D-5 brane is examined ([11]).

A free scalar field theory on a cylinder is considered under the non-trivial boundary conditions. The theory has close relation with the tachyon condensation of the string theory. The partition function is determined by using the off-shell boundary state and the zeta function regularization method. The boundary entropy is also determined. Moreover, using supersymmetric sine-Gordon model, we extended the theory to the supersymmetric cases ([12]).

I showed that for lattice nonlinear Schrödinger model and lattice sine-Gordon model, the form factors of certain local operators can be determined within the standard algebraic Bethe ansatz approach ([13]).