

The Gervais–Neveu–Felder Equation and the Quantum Calogero–Moser Systems

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Received: 23 May 1995/Accepted: 20 September 1995

Abstract: We quantize the spin Calogero–Moser model in the *R*-matrix formalism. The quantum *R*-matrix of the model is dynamical. This *R*-matrix has already appeared in Gervais–Neveu's quantization of Toda field theory and in Felder's quantization of the Knizhnik–Zamolodchikov–Bernard equation.

1. Introduction

Integrable systems of N particles on a line with pairwise interaction have recently attracted much attention. After the famous works of Calogero and Moser [1], many generalizations have been proposed. These include the relativistic generalization of Ruijsenaars [2], the spin generalization of the non-relativistic models [3, 4] and finally the spin generalization of the relativistic models [5]. They have many relations to harmonic analysis [6], algebraic geometry [7], topological field theory [8], conformal field theory [9, 10], string field theory [11].

In this paper we consider yet another aspect of these models, i.e. their embedding into the *R*-matrix formalism, both at the classical and quantum levels. In this respect the essentially new feature which emerges is that the *R*-matrix turns out to be a dynamical one. At the classical level, the *r*-matrix was computed for the usual Calogero-Moser models in [12]. It was computed in [13] for their spin generalization, while it was calculated first in the Sine-Gordon soliton case [14], then in the general case [15] for the Ruijsenaars systems. We address here the issue of the quantum formulation of these models within an *R*-matrix framework. We are going to show that the quantum Yang-Baxter equation has to be generalized. At present this new equation stands at the crossroads of three seemingly distinct topics: quantization of Toda field theory, quantization of KZB equations, and quantization of Calogero-Moser-Ruijsenaars models.

In Sect. 2 we explain the above connections at the classical level. The classical r-matrix of the Calogero–Moser model, the KZB connection for the WZW model on the torus and the r-matrix of the exchange algebra in Toda field theory all satisfy the same generalized Yang–Baxter equation. In Sect. 3 we take advantage of these identifications to define the commutation relations obeyed by the quantum