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A new integrable symplectic map by the binary nonlinearization to the super AKNS system

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Abstract

Based on the constructed new Lie super-algebra from OSP(2,2), the super bi-Hamiltonian structure of a new super AKNS hierarchy is obtained by making use of super-trace identity. For the new super AKNS system, an explicit symmetry constraint between the potentials and the eigenfunctions is proposed. Moreover, the super AKNS system is decomposed into two compatible finite-dimensional super integrable systems and the obtained super systems are proved to be finite-dimensional super integrable Hamiltonian systems in the super-symmetry manifold $R^{4N|4N}$.

Keywords

Orthosymplectic Lie superalgebras; Super AKNS hierarchy; Explicit symmetry constraint; Binary nonlinearization.

MSC Codes: 35Q51, 37J10, 37K10, 37K30

1 Introduction

Recent years, more attention has been paid to the construction of finite-dimensional integrable systems from soliton equations by using symmetry constraints[1]. The technique of nonlinearization of Lax pairs, including mono-nonlinearization, which is proposed by Prof. Cao [2] and binary nonlinearization, which is proposed by Prof. Ma [3], has attracted a lot of interest recently. The method of nonlinearization of Lax pairs is one of effective ways to obtain finite-dimensional integrable Hamiltonian systems and it can help us to find algebro-geometric solutions [4] of soliton equations. The theory of nonlinearization has been successfully applied to many well-known soliton equations, such as the KP system [5], the c-KdV system [6], super KdV [7] and c-KdV hierarchy [8] and the higher order constraints [9] were widely studied. The crucial idea of nonlinearization is to find a constraint between the potentials and the eigenfunctions of the spectral problem associated with the soliton equation. Then, the soliton equation can be decomposed into a finite-dimensional integrable Hamiltonian system by means of the above-mentioned symmetry constraint.

In [11-13], super AKNS hierarchy was proposed using different Lie superalgebras [14-16] and the super-Hamiltonian structures of the resulting hierarchies were discussed by the super variational identity [17-19]. By using of an explicit constraint, nonlinearization of the super AKNS system has been discussed in [20]. An implicit symmetry constraint between the potentials and the eigenfunctions is proposed in [21]. Its worth noting that the super AKNS systems of these two papers were derived from the same Lie superalgebra based

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