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Additional Symmetries of Supersymmetric KP Hierarchies

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Abstract: We investigate the additional symmetries of several supersymmetric KP hierarchies: the SKP hierarchy of Manin and Radul, the SKP_2 hierarchy, and the Jacobian SKP hierarchy. In all three cases we find that the algebra of symmetries is isomorphic to the algebra of superdifferential operators, or equivalently $\mathbf{SW}_{1+\infty}$. These results seem to suggest that despite their realization depending on the dynamics, the additional symmetries are kinematical in nature.

1. Introduction

The aim of this paper is to study the additional symmetries of the following supersymmetric extensions of the KP hierarchy: the SKP hierarchy of Manin and Radul [1], the SKP_2 hierarchy [2], and the Jacobian SKP hierarchy of Mulase [3] and Rabin [4]. The additional symmetries of the KP hierarchy were first studied in [5] (although see [6]) and their algebraic structure has been recently identified with the algebra **DOP** of differential operators [7, 8]. The additional symmetries of the supersymmetric KP hierarchy defined by Manin and Radul have been previously studied in [9].

Let us first briefly review what is known about the additional symmetries of the KP hierarchy. The KP hierarchy can be thought of as a dynamical system defined on a space whose functions are given by a subring of the ring $k[[x]]$ of formal power series in the variable x with coefficients in the field k. It is defined as the universal family of isospectral deformations of a pseudodifferential operator $L = \partial + \sum_{i\geq 1} u_i \partial^{1-i}$. The evolution of L is specified by a commuting family of flows ∂_i in terms of which

$$\partial_i L = -[L_-^i, L] = [L_+^i, L]\,. \tag{1.1}$$

If one restricts oneself to operators satisfying $u_1 = 0$, then one can lift the KP flows to the Volterra group G. The Volterra group acts naturally via dressing transformations

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