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Mathematical Physics

Inherited structures in deformations of Poisson pencils

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In this paper we study some properties of bi-Hamiltonian deformations of Poisson pencils of hydrodynamic type. More specifically, we are interested in determining those structures of the fully deformed pencils that are inherited through the interaction between structural properties of the dispersionless pencils (in particular exactness or homogeneity) and suitable finiteness conditions on the central invariants (like polynomiality). This approach enables us to gain some information about each term of the deformation to all orders in ϵ. Concretely, we show that deformations of exact Poisson pencils of hydrodynamic type with polynomial central invariants can be put, via a Miura transformation, in a special form, that provides us with a tool to map a fully deformed Poisson pencil with polynomial central invariants of a given degree to a fully deformed Poisson pencil with constant central invariants to all orders in ϵ. In particular, this construction is applied to the so called r-KdV-CH hierarchy that encompasses all known examples with non-constant central invariants. As far as homogeneous Poisson pencils of hydrodynamic type is concerned, we prove that they can also be put in a special form, if the central invariants are homogeneous polynomials. Through this we can compute the homogeneity degree about the tensorial component appearing in each order in ϵ, namely the coefficient of the highest order derivative of the δ.

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