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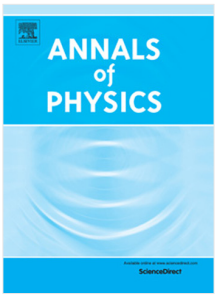

Hamiltonian formulation of systems with balanced loss-gain and exactly solvable models

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Hamiltonian formulation of systems with balanced loss-gain and exactly solvable models

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Abstract

A Hamiltonian formulation of generic many-body systems with balanced loss and gain is presented. It is shown that a Hamiltonian formulation is possible only if the balancing of loss and gain terms occur in a pairwise fashion. It is also shown that with the choice of a suitable co-ordinate, the Hamiltonian can always be reformulated in the background of a pseudo-Euclidean metric. If the equations of motion of some of the well-known many-body systems like Calogero models are generalized to include balanced loss and gain, it appears that the same may not be amenable to a Hamiltonian formulation. A few exactly solvable systems with balanced loss and gain, along with a set of integrals of motion is constructed. The examples include a coupled chain of nonlinear oscillators and a many-particle Calogero-type model with four-body inverse square plus two-body pair-wise harmonic interactions. For the case of nonlinear oscillators, stable solution exists even if the loss and gain parameter has unbounded upper range. Further, the range of the parameter for which the stable solutions are obtained is independent of the total number of the oscillators. The set of coupled nonlinear equations are solved exactly for the case when the values of all the constants of motions except the Hamiltonian are equal to zero. Exact, analytical classical solutions are presented for all the examples considered.

keywords: Hamiltonian formulation, Exactly solvable models, Dissipative system, Coupled nonlinear oscillators, Calogero-type model

Contents

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