Coherent states of the Pöschl–Teller potential and their revival dynamics

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Abstract
A recently developed algebraic approach for constructing coherent states for solvable potentials is used to obtain the displacement operator coherent state of the Pöschl–Teller potential. We establish the connection between this and the annihilation operator coherent state and compare their properties. We study the details of the revival structure arising from different time scales underlying the quadratic energy spectrum of this system.

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1. Introduction
Since its introduction by Schrödinger [1], coherent states (CSs) have attracted considerable attention in the literature [2–7]. A variety of coherent states, e.g., minimum uncertainty coherent state (MUCS), annihilation operator coherent state (AOCS), displacement operator coherent state (DOCS) and recently Klauder-type CS [4], possessing temporal stability, have been constructed and applied to diverse physical phenomena [3]. Coherent states of systems possessing nonlinear energy spectra are of particular interest as their temporal evolution can lead to revival and fractional revival, leading to the formation of Schrödinger cat and cat-like states [8–10]. A celebrated example in quantum optics of the aforementioned phenomenon is the coherent state in a Kerr-type nonlinear medium [11]. In quantum mechanical potential problems, Hamiltonians for potentials such as Pöschl–Teller, Morse and Rosen–Morse (RM) lead to nonlinear spectra. Time evolution of the CSs for these potentials, a subject of considerable current interest [12–22], can produce the above type of states.

The simplest way to construct CSs is a symmetry-based approach [5]. It is well known that making use of the Heisenberg algebra \([a, a^\dagger] = 1\), one can construct all the above type of CSs for the Harmonic oscillator, which are identical to each other. In many physical problems, groups like SU(2) and SU(1,1) manifest naturally, enabling a straightforward construction of CSs. For the identification of the symmetry structure of quantum mechanical