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Quantum Dynamics of a Nonlinear Kicked Oscillator

S. Mukhopadhyay [1], B. Demircioglu [2] and A. Chatterjee [3*]

[1] *Dr. V. R. K. Women's College of Engineering and Technology, Aziznagar, Moinabad, Hyderabad, India*
[2] *Saraykoy Nukleer Arastirma ve Egitim Merkezi Saray Mahallesi, Atom Caddesi, No:27, 06983 Saray-Kazan-Ankara, Turkey*
[3] *School of Physics, University of Hyderabad, Hyderabad, India*

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Abstract: The quantum dynamics of a nonlinear kicked oscillator is studied by a recently proposed complex non-hermitian Hamiltonian technique. It is shown that the probability density and the energy function display either a growing or a decaying exponential time dependence characteristic of absorption or dissipation. It is furthermore shown that though a decrease in the kicking period increases the diffusive motion leading to the ballistic spreading, increasing its value does not apparently favour any localization. The anharmonicity also enhances the dissipative dynamics but with time gives rise to energy crossings typical of a quantum chaos. The variation in the spatial periodicity of the delta-function kicking however exhibits a more complex behaviour showing diffusive character to super-diffusion leading to ballistic motion on the one side and the quantum localization on the other.

Keywords: *nonlinear kicked oscillator; quantum diffusion; dissipation; localization*

Mathematics Subject Classification (2000): 35Q72, 81Q50, 37L50.

1 Introduction

Recent years have witnessed a flurry of investigations in the area of quantum chaos and dynamical quantum localization and in this context the quantum dynamics of area preserving maps has attracted a particular attention [1, 2]. The kicked harmonic oscillator is an example that belongs to this class and has been studied quite extensively in the last two decades [3, 4, 5, 6]. The kicked harmonic oscillator however has generated some renewed interest in recent times for it simulates some interesting low-dimensional systems like quantum wires, semiconductor superlattices [7] or trapped ions [8] periodically

* Corresponding author: mailto:acsp@uohyd.ernet.in

