Computational Study of Quantum Coupled Chaotic Systems

Project Report

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PHY F376 Design Project

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Chapter 1

Introduction

1.1 Classical Kicked Rotor

In the classical picture, we can write the Hamiltonian of single kicked top as

$$H = \frac{J^2}{2I} + \sum_n V\delta(t - nT) \tag{1.1}$$

where J is the angular momentum of the top, I is the moment of inertia, and V is the kicked potential.

If we try to construct a system having two kicked tops coupled to each other, the corresponding Hamiltonian of the system can be written as

$$H = \frac{{J_1}^2}{2I_1} + \frac{{J_2}^2}{2I_2} + \sum_n (V_1 + V_2 + V_{12})\delta(t - nT) \tag{1.2}$$

where V_{12} is an interaction potential that couples the dynamics of the system.

1.2 Quantum Kicked Rotor

In the quantum picture, we replace the angular momentum J's by the corresponding angular momentum operators $\hat{J}$, and the Hamiltonian for coupled tops can be written as follows

$$H = \frac{p_1}{2j}{J_1}^2 + \frac{p_2}{2j}{J_2}^2 + \frac{\epsilon}{j}J_{z_1}J_{z_2} \tag{1.3}$$

where ϵ is the coupling strength, and j are the eigenvalues of the J^2 operator. The value of ϵ determines the entaglement properties of this coupled system.

1.3 Measures of Entaglement

Entaglement can be defined as the non classical correlation between two spatially separated subsystems jnbbig. Entaglement can be measured calculating the von Neumann entropy of the Reduced Density Matrix of the Hamiltonian. The von Neumann entropy S_v is given by

$$S_v = -\sum_n \lambda_i \log \lambda_i \tag{1.4}$$

Bibliography

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