Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **4368** Type: **Oral not-in-competition (Graduate Student) / Orale non-compétitive (Étudiant(e) du 2e ou 3e cycle)**

(G) Non-linearity and chaos in the kicked top.

Tuesday 28 May 2024 14:15 (15 minutes)

Classical chaos arises from the inherent non-linearity of dynamical systems. However, quantum maps are linear; therefore, the definition of chaos is not straightforward. To address this, we study a quantum system that exhibit chaotic behavior in their classical limits. One such system of interest is the kicked top model Haake, Ku´s, and Scharf, Z. Phys. B 65, 381 (1987), where classical dynamics are governed by Hamilton's equations on phase space, while quantum dynamics are described by the Schr¨odinger equation in Hilbert space. In the kicked top model, non-linearity is introduced through the exponent of the angular momentum term, denoted as J^p. Notably, when p = 1, the system remains integrable. Extensive research has focused on the case where p = 2. In this study, we investigate the critical degree of non-linearity necessary for a system to exhibit chaotic behavior. This is done by modifying the original Hamiltonian such that a non-integer value of p is allowed. We categorize the modified kicked top into two regimes: $1 \le p \le 2$ and $p > 2$, and analyze their distinct behaviors. Our findings reveal that the system loses integrability for any $p > 1$, leading to the emergence of chaos. Moreover, we observe that the intensity of chaos amplifies with increasing non-linearity. However, as we further increase p (> 2), we observe unexpected behavior, where chaos is suppressed, and regions of chaotic sea are confined to a small region in phase space. This study sheds light on the complex interplay between non-linearity and chaos, offering valuable insights into their dynamic behavior.

Keyword-1

Chaos

Keyword-2

non-linear

Keyword-3

dynamical systems

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Session Classification: (DQI) T2-5 Chaos and Entanglement | Chaos et intrication (DIQ)

Track Classification: Technical Sessions / Sessions techniques: Theoretical Physics / Physique théorique (DTP-DPT)