National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Diagnosis of Quantum Chaos in Perturbed Quantum Wells and Billiards
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Venue	: MC 126
Date and Time	: 18 Jul 2025 (16:00)
Abstract	: The predictable world we observe is a simplified, coarse-grained version of the probabilistic quantum reality. Yet, the quantum world is by definition linear, while the classical world with nonlinearity can be chaotic. Thus, the real challenge is how to connect our classical intuitions with the counter-intuitive quantum theories. There the diagnostic tools come in as help. In recent years, Out-of-Time-Order-Correlator (OTOC) has emerged as diagnostic tool for quantum mechanical signatures of chaos. Previous studies have concluded that OTOCs show false positive of chaos in the neighbourhood of a local maximum in the potential. Though, it is necessary, but it is not the only condition. In this thesis, by applying a symmetry-breaking perturbations (linear and nonlinear), we notice that the exponential behaviour of the OTOCs remains remarkably resilient even in the absence of a local maximum. Therefore, the critical factor lies not in the presence of a local maximum, but in the dynamic nature of the density of states in the broken symmetry regions where he slope of the potential is an extrema. Our examination, including one dimensional potentials with linear perturbation and two dimensional harmonic potential with nonlinear perturbations, reveal that the universality of this phenomenon. The latter part of the thesis focusses on the crucial role of curvature of the billiard boundary on the particle dynamics. In this study, we introduce two geometrically distinct billiards: a bean- and a peanut-shaped billiard. These systems incorporate both focusing and defocusing walls with no neutral segments. Our study reveals a strong correlation between classical and quantum dynamics.