



ICTS Colloquium

Title : Breaking Thermalization in Quantum Many-Body Systems: Scars, Fragmentation, and Novel Symmetries

Speaker : Sanjay Moudgalya (Technical University of Munich, Germany)

Date : Tuesday, 11 February 2025

Time : 3:30 PM (IST)

Abstract : Classical and quantum systems composed of many interacting particles typically exhibit complex dynamics that are not analytically tractable. Yet, such systems almost universally thermalize over time, with their late-time behavior well described by simple thermodynamic ensembles. Understanding the microscopic origins of this universality has been a long-standing effort. In quantum many-body systems, thermalization is guaranteed by a widely studied conjecture on the eigenstates of any quantum Hamiltonian, known as the Eigenstate Thermalization Hypothesis (ETH). While this conjecture has been numerically verified in numerous physical Hamiltonians, recent discoveries have identified a broad class of systems where certain eigenstates violate ETH, leading to an interesting breakdown of thermalization. In this talk, I will discuss two such mechanisms --- quantum many-body scars and Hilbert space fragmentation --- where certain initial states evade thermalization, resulting in a "weak" breaking of ergodicity. From a physical perspective, these effects lead to a host of interesting dynamical phenomena and are crucial for explaining recent results in cold atom experiments. From a mathematical perspective, they motivate a broader definition of "symmetry" in quantum many-body systems, revealing unconventional symmetries that challenge traditional frameworks. I will conclude with an overview of open questions and future directions in this field.

Venue : Madhava Lecture Hall

Zoom Link: <https://icts-res-in.zoom.us/j/97611276085?pwd=4fH1WZvvJtFpFym4cEx1uPQwvpD5mu.1>

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