Saptarshi Mandal

International Centre for Theoretical Sciences of Tata Institute of Fundamental Research, Bengaluru

Title: Partial Projected Ensemble and Spatiotemporal Structure of Information Scrambling

Abstract

Understanding how quantum information spreads and entangles in many-body systems is crucial for characterizing different dynamical phases of matter. The Projected Ensemble framework provides a powerful tool to study information dynamics by incorporating measurement-induced effects into entanglement evolution. Here, we introduce the Partial Projected Ensemble (PPE)—a refined approach that selectively applies projective measurements to subsystems while preserving coherent quantum evolution elsewhere. This enables a more fine-grained analysis of scrambling beyond traditional averaged quantities. We apply PPE to various dynamical settings, including ergodic, many-body localized (MBL) systems in a floquet circuit setup, revealing distinct spatiotemporal structures of information flow. We also relate the spatiotemporal structure of scrambling to experimentally realisable quantities like local bit-string probabilities. We also highlight the late time fate of such local measurement based construction for probing information scrambling in quantum dynamics.