Title: Quantum Mpemba Effect: An Anomalous Thermal Relaxation Process in quantum matter

abstract:
Mpemba effect refers to the counter-intuitive phenomenon where a hotter object can cool down faster than a colder copy of the same object. Despite some theoretical as well as experimental advances in the classical domain, the quantum counterpart of the Mpemba effect, specifically in temperature, has remained unexplored. In this talk, we demonstrate the quantum Mpemba effect by showing that temperatures of two copies of a quantum system, one initially hotter than the other, can cross each other after some time and thereafter reverse them identities, i.e. hotter becomes colder and vice versa, before reaching the same final temperature. We show such a crossing of trajectories characterizing the quantum Mpemba effect, which can occur in several other observables including energy, entropy, etc. Our theoretical results on the quantum Mpemba effect are primarily based on a quantum dot connected to two reservoirs [1]. In the later part of the talk, we discuss how exceptional points and complex eigenvalue spectrum can lead to multiple quantum Mpemba effect (where crossing occurs multiple times) in a two-level driven dissipative system [2].

Reference:
[1] A. K. Chatterjee, S. Takada, and H. Hayakawa, Phys. Rev. Lett. 131, 080402 (2023).
[2] A. K. Chatterjee, S. Takada, and H. Hayakawa, arXiv:2311.01347 (to be published in PRA).