

Quantum Mpemba effect

Abstract: “The Mpemba effect is a striking and counterintuitive phenomenon in which, under certain conditions, hotter water cools more quickly than colder water. Although originally observed in classical systems, recent theoretical and experimental studies have uncovered an analogous effect in extended quantum systems. A specific manifestation of this quantum effect occurs when the system starts in a state that explicitly breaks a given symmetry, yet the time evolution leads to the eventual restoration of that symmetry, sometimes at an unexpectedly fast rate. To systematically investigate this phenomenon, we introduce the entanglement asymmetry, a quantity which quantifies the degree of symmetry breaking in a quantum state. This measure is inspired by concepts from entanglement theory in many-body systems and provides a powerful tool to track the restoration of symmetry over time. By leveraging entanglement asymmetry, we gain new insights into non-equilibrium quantum dynamics and the fundamental mechanisms governing symmetry restoration. This talk will explore the theoretical foundations of the quantum Mpemba effect, recent experimental observations, and the implications of entanglement asymmetry for understanding non-equilibrium processes in quantum many-body physics.”

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