Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Internal Webinar

Quantum Speed limits for CPTP dynamics

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How fast can a quantum system evolve from one state to another? For over sixty years, the celebrated Mandelstam–Tamm bound has given a precise answer for perfectly isolated systems, but an equally fundamental version for open systems, where noise and dissipation are unavoidable, was missing. Here we establish that missing result. By reformulating quantum dynamics in an enlarged Liouville space, we derive a true Mandelstam–Tamm type bound that applies universally to open quantum processes. This geometric bound identifies the shortest possible time for a noisy quantum system to evolve, and we show that it can in fact be attained. The results provide sharper and more practical limits than before, with immediate implications for current research areas such as quantum chaos, operator growth, and unusual thermalisation effects like the quantum Mpemba effect, where hotter systems can cool faster than colder ones. Beyond technical improvements, the work deepens our conceptual understanding of what really drives change in the quantum world.

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11:30 Hrs