Contribution ID: **13** Type: **not specified**

Quantum speed limit for perturbed open systems

Thursday, August 29, 2024 11:45 AM (30 minutes)

Quantum speed limits provide upper bounds on the rate with which a quantum system can move away from its initial state. Here, we provide a different kind of speed limit, describing the divergence of a perturbed open system from its unperturbed trajectory. In the case of weak coupling, we show that the divergence speed is bounded by the quantum Fisher information under a perturbing Hamiltonian, up to an error which can be estimated from system and bath timescales. We give three applications of our speed limit. First, it enables experimental estimation of quantum Fisher information in the presence of decoherence that is not fully characterized. Second, it implies that large quantum work fluctuations are necessary for a thermal system to be driven quickly out of equilibrium under a quench. Moreover, it can be used to bound the response to perturbations of expectation values of observables in open systems.

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