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Influence matrix approach to ergodic and non-ergodic quantum dynamics

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Dynamical properties of a many-body system are determined by its properties as a quantum bath: the systems that thermalize act as an efficient bath, while integrable and many-body localized (MBL) systems fail to do so. I will describe a new approach to quantum many-body dynamics, inspired by the notion of the Feynman-Vernon influence functional (IF). I will consider interacting spin systems, and formulate an equation satisfied by their influence functionals. While difficult in general, this equation can be solved exactly for a class of many-body systems –perfect dephasers –which act as Markovian baths on their subsystems. More generally, I will show that, viewed as a fictitious wave function in the temporal domain, influence functional can be described by tensor-network methods. The efficiency of this approach is based on the behavior of temporal entanglement of the IF, which surprisingly remains relatively low in very different physical regimes, including fast thermalization, integrability, and many-body localization. IF approach offers a new lens on many-body non-equilibrium phenomena, both in ergodic and non-ergodic regimes, connecting the theory of open quantum systems to quantum statistical physics.

Based on: [1] Lerose, Sonner, Abanin, Phys. Rev. X 11, 021040 (2021); arXiv:2012.00777; arXiv:2104.07607

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