Reconstruction of the influence matrix from Keldysh correlation functions

Julian Thoenniss, Alessio Lerose, Michael Sonner, and Dmitry Abanin

University of Geneva

In the study of quantum thermalisation in isolated quantum many-body systems, the recently developed influence matrix (IM) approach has opened new doors for the efficient simulation of quantum many-body dynamics [1-4]. This approach is inspired by the Feynman–Vernon influence functional which encodes the dynamical influence of a many-body bath on a local subsystem [5]. While a self-consistent approach to the computation of the IM has been proven extremely versatile for the efficient application of MPS algorithms, this technique is not applicable to arbitrary initial states. I will present a complementary perspective in which the IM is viewed as generating functional for Keldysh correlation functions in the bath. By computing these correlation functions explicitly, the IM can be reconstructed for a large range of initial states and certain types of Floquet dynamics. Moreover, this perspective can serve as useful starting point for approximations and renormalisation group approaches which may help to shed new light on the mechanisms governing out-of-equilibrium quantum many-body dynamics.

[1] Influence matrix approach to many-body Floquet dynamics (Lerose, Sonner, Abanin), Phys. Rev. X 11, 021040 (2021).

[2] Characterizing many-body localization via exact disorder-averaged quantum noise (Sonner, Lerose, Abanin), arXiv:2012.00777 (2020).

[3] Influence functional of many-body systems: temporal entanglement and matrix-product state representation (Sonner, Lerose, Abanin), Annals of Physics 431, 168552 (2021).

[4] Scaling of temporal entanglement in proximity to integrability (Lerose, Sonner, Abanin), Phys. Rev. B 104, 035137 (2021).

[5] The theory of a general quantum system interacting with a linear dissipative system (Feynman, Vernon), Annals of Physics 24, 118-173 (1963).