Poster 2

Exact finite-time correlation functions for multi-terminal setups: Connecting theoretical frameworks for quantum transport and thermodynamics

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The dynamics of a quantum system in contact with one or more environments can be explored by using different theoretical frameworks, such as master equation, scattering-matrix, Green's functions and Heisenberg equation of motion. The choice of analyzing the quantum dynamics within a given framework takes into account several factors, for instance the presence of interactions within the quantum system, the coupling strength between the system and environment, and the focus on either the steady state or the transient regime. In general, it is challenging to provide a unified perspective on these frameworks. In this work we clarify the role and status of these approaches by considering a minimal single-level quantum dot in a two-terminal setup, subject to voltage and temperature biases. We provide analytical expressions of the particle and energy currents and their associated current fluctuations, both in the steady-state and transient regimes. Exact results are obtained from the Heisenberg equation, which we then show to be consistent with the ones obtained within the scattering-matrix and master equation approaches in their respective regimes of validity.