NON-MARKOVIAN, STRONG COUPLING QUANTUM TRANSPORT: FLUCTUATION THEOREMS AND MEASUREMENT SCHEMES

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The possibility to extract full counting statistics (FCS) of transport processes in experimental settings exposes the necessity to upgrade existing simulation methods to gain access to environmental degrees of freedom. The techniques stemming from the theory of generating functions make it possible to encode all cumulants of the outcome of a specific measurement scheme in the form of a generalized density matrix. With this spirit we have developed a counting-field-resolved hierarchy of equations of motion (FCS-HEOM) which extends this ability to the case of strong-coupling, non-Markovian open quantum systems [1]. Exploiting the flexibility to define the underlying measurement scheme, we show that the comparison of two of them reveals transport coefficients which are the non-equilibrium generalization of energy or particle conductances. An alternative approach to the observation of environmental dynamics comes from the field of driven open systems. An analytical solution of the dynamics of both the system and the environment for a large class of systems is possible and can be interpreted as the effect of a static Hamiltonian on a continuous class of operators [2]. This novel perspective on the Floquet theory allows us to explore transient polaron dynamics in a straight-forward fashion. Both FCS results and Floquet simulation benefit strongly from the application of the transfer tensor method (TTM) [3], which is an approach to propose an optimized propagation alternative based on short time evolution samples. This extends the simulation power of existing exact approaches, like the chain-mapping DMRG-based simulation method known as TEDOPA [4]. This proposal departs from the traditional bottom-up approach of simulation method designs based on microscopic principles, and attempts to take a top-down perspective in placing the dynamical map as the central (and the only experimentally accessible) object.

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[3] J. Cerrillo, J. Cao, *Phys. Rev. Lett.* **112**, 110401 (2014).