Time-dependent single impurity Fano-Anderson Model

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ABSTRACT

The interest in quantum devices out of equilibrium has attracted attention to the time-dependent properties of strongly coupled electrons. Accurate computation of such properties is nonetheless challenging in impurity-metal systems, such as those modeled by the Anderson Hamiltonian, because the number of low-energy particle-hole excitations driving the dynamics grows without bounds at long times. To face this difficulty, the Numerical Renormalization Group (NRG) method seems promising since it yields essentially exact equilibrium properties. Unfortunately, the standard procedure applied to time-dependent properties gives lackluster results. Deviations arise, which stem from the logarithmic discretization of the conduction band, the heart of NRG construction. The differences between energies in the discrete spectrum give rise to unphysical oscillations. To eliminate such artificial effects, we have adopted a recently developed smoothing procedure based on a real-space formulation of the NRG method [1, 2] to study the time-dependent response of a quantum wire coupled to a quantum dot following the sudden application of a gate potential to the dot. We have computed the time-dependent dot occupation and fidelity of the ground state with respect to the initial one for the Fano-Anderson model representing the system [3]. At short times, the smoothed curves show good agreement with time-dependent DMRG results. At long times, as expected, the fidelity follows the pertinent Doniach-Sunjic power law [4].

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