Dynamics of a driven quantum dot interacting with finite reservoirs

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I'll discuss the kinetic regimes of a linearly driven quantum system connected to a finite reservoir. When the reservoir is large (dense), we require a strong mixing [1] between the reservoir and the system for the Redfield-type kinetic description to hold, which is similar to the autonomous case. In the other extreme, where the reservoir is sparse we find that the Landau-Zener (LZ) physics plays a crucial role. Here, we develop a kinetic description [2] that in the diabatic limit has the same mathematical form as the Redfield-type description [3]. This implies that a driving could compensate for the sparseness of the reservoir and mimic an effective kinetic description, which is traditionally valid for an infinite reservoir. Importantly, the underlying physical assumptions on the validity of these descriptions are distinct and can be characterized by the various timescales of the problem. The existence of these kinetic regimes persists even if the system is connected to multiple reservoirs and in all cases we can systematically build thermodynamic first and second laws that are consistent in the full Hilbert space and the kinetic description [4].

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