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Novel approach to the dynamics of a dissipative two-state system
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A two-state system in contact with a harmonic oscillator bath is frequently used to describe the process of decoherence in physical systems, such as a spin in a solid-state environment or a qubit coupled to external and uncontrolled degrees of freedom. The problem in general cannot be solved exactly, and several approximative methods have been devised such as Bloch-Redfield master equations, which are limited to weak-coupling, or the Non-Interacting Blip Approximation (NIBA), that neglects the system's backaction onto the bath. We study the dissipative two-state dynamics in a novel way, rephrasing the problem as that of (non-)unitary time evolution of a quantum state vector exposed to a random Gaussian perturbation Hamiltonian. Our formalism goes beyond the NIBA and is particularly well suited to study the case of time-dependent system parameters. We compare it to common approaches such as the (extended)-NIBA, or stochastic wave-function methods. Furthermore, we investigate dissipative Landau-Zener tunneling in the so-called scaling limit.

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