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Quantum decoherence in the Caldeira-Leggett model by the real-time path integral on a computer

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概　要

We propose first-principle calculations of an open system based on the real-time path integral formalism, treating the environment as well as the system of interest together on a computer. We focus on the Caldeira-Leggett model, which is well known, in particular, as a model of quantum decoherence. The calculation simplifies for typical initial conditions, and the relevant complex saddle point can be determined by solving a linear equation. The integration over the saddles can be performed analytically, and the reduced density matrix can be obtained by tracing out a large number of harmonic oscillators in the environment. In particular, we confirm the dependence of the decoherence time on the coupling constant and the temperature that has been predicted from the Lindblad-type master equation in a certain parameter regime. If time allows, we also discuss how to extend this framework to general models, e.g., by using the generalized Lefschetz thimble method to overcome the sign problem.

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