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Non-equilibrium dynamics of dissipative strongly-correlated quantum matter

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How interacting quantum systems relax toward equilibrium is a fundamental question in modern physics, especially when such systems are influenced by their surroundings. While isolated many-body systems can thermalize through their own interactions, realistic systems are often coupled to environments that introduce memory effects and modify their dynamics. Understanding how strong interactions and environmental coupling compete is crucial for both fundamental insights and emerging quantum technologies.

In this work, we investigate these questions using an open Sachdev–Ye–Kitaev (SYK) model coupled to a fermionic bath with a pseudogapped density of states. Using the Schwinger–Keldysh path-integral formalism and the large-N limit, we derive self-consistent Schwinger–Dyson equations governing the system's dynamics. Solving these equations, we identify distinct relaxation regimes: pseudogapped environments lead to universal algebraic relaxation, while flat or strongly suppressed baths produce exponential decay controlled by dissipation or intrinsic many-body chaos. These results demonstrate that non-Markovian dissipation can qualitatively alter relaxation beyond the Lindblad description.

Field of Research/Work

Condensed Matter and Materials

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