Pseudomode treatment of strong-coupling quantum thermodynamics

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Abstract: Quantum thermodynamics beyond weak coupling requires nonperturbative approaches and heavy simulations. We derive expressions for thermodynamic quantities using bath autocorrelation functions and system operators, employing pseudomodes for efficient numerical evaluation. Applications include entropy production and work extraction in two paradigmatic systems.

The treatment of quantum thermodynamic systems beyond weak coupling and Markovian regimes is of increasing relevance, yet extremely challenging. The evaluation of thermodynamic quantities in these regimes requires a nonperturbative knowledge of the bath dynamics, which in turn typically relies on heavy numerical simulations. To tame these difficulties, considering thermal bosonic baths linearly coupled to the open system, one can consider expressions for heat, work, and average system-bath interaction energy that only involve the autocorrelation function of the bath and two-time expectation values of system operators. In [1] this perspective has been combined with the pseudomode approach, to numerically evaluate these relevant thermodynamic quantities. It was shown in particular that this method allows for an efficient numerical evaluation of thermodynamic quantities in terms of one-time expectation values of the open system and the pseudomodes.

Example References

[1] F. Albarelli, B. Vacchini and A. Smirne,
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