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Title: Signature of Liouvillian exceptional point in stationary current noise

Abstract: Open quantum systems coupled to thermal reservoirs naturally exhibit non-Hermitian physics; their time evolution can be described by quantum master equations characterized by Liouvillian superoperators, accounting for both free Hamiltonian evolution and dissipation due to coupling to the reservoirs, the latter being inherently non-Hermitian. An interesting feature of non-Hermitian physics is the presence of exceptional points (EPs), which can also be found in dissipative open quantum systems as Liouvillian EPs[1-3]. At an EP, the operator exhibits a singularity where eigenvalues and corresponding eigenvectors coincide, rendering the operator non-diagonalizable and only transformable into the Jordan block form.

Investigating physical signatures of Hamiltonian and Liouvillian EPs in state-of-the-art physical platforms, particularly in the quantum regime, is an active research area. A recent study on Liouvillian EPs in a quantum thermal machine, consisting of two interacting qubits each in contact with its own thermal reservoir, revealed that the dynamical signature manifests in the transient relaxation process as critical decay towards the steady state[4].

In this talk, we explore an alternative approach to capture physical signatures of Liouvillian EPs in quantum thermal machines, focusing on the steady state noise of the heat current between two thermal reservoirs. By formulating the power spectrum of the two-time autocorrelation function of the heat current using full counting statistics (FCS) and the quantum master equation, we analyze the noise of the steady state heat current at Liouvillian EPs. As a result, we show that the Jordan block structure at Liouvillian EPs leads to a non-Lorentzian line shape in the noise spectrum.

References:

1. K. Hashimoto, K. Kanki, H. Hayakawa, and T. Petrosky, Prog. Theor. Exp. Phys. **2015**, 023A02(2015).

2. F. Minganti, A. Miranowicz, R. W. Chhajlany, and F. Nori, Phys. Rev. A **98**, 062131(2019).

3. N. Hatano, Molecular Phys. **117**, 2121(2019).

4. S. Khandelwal, N. Brunner, and G. Haack, PRX Quantum **2**, 040346(2021).