Quantum heat transport through a multi-level system coupled to bosonic reservoirs

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Heat transport in nanoscale objects has been a central topic in condensed matter physics from both aspects of fundamental physics and the application for heat devices. Recently, various quantum heat devices, e.g., a quantum heat rectifier and a quantum heat valve, were suggested theoretically, and a part of them has been realized in superconducting circuits, which are the main platform to investigate quantum heat transport. The rapid development of techniques for the fabrication and the measurement in superconducting circuits allows us to observe heat transport with high accuracy and then motivates us to compare the experimental data with the theoretical model in detail.

In this poster, we consider heat transport in the quantum Rabi model, which is one of the most typical multi-level systems in the superconducting circuit [1]. Since the quantum Rabi model is more flexible and complex due to more degrees of freedom compared to a two-level system, it is expected to show characteristic transport properties reflected from multiple levels. In this work, we found that the thermal conductance has two peaks in its temperature dependence when tuning parameters to a specific region. At the poster discussion, we will talk about the reason for the double-peak structure in the thermal conductance and its possibility of application for quantum heat devices.

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