Measuring heat and a non-equilibrium quantum Landauer principle

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Landauer was the first to observe a connection between thermodynamics heat and information theoretic entropy. We will show that thermodynamics heat can be measured by an interference experiment, the scheme is given in Figure 1. Moreover, using the operational framework of completely positive, trace preserving operations and thermodynamic fluctuation relations, we derive a lower bound for the heat exchange in a Landauer erasure process on a quantum system. Our bound comes from a non-phenomenological derivation of the Landauer principle which holds for generic non-equilibrium dynamics.

J. Goold and K. Modi. arXiv:1401.4088 (2014)
J. Goold, M. Paternostro, and K. Modi. arXiv:1402.4499 (2014)

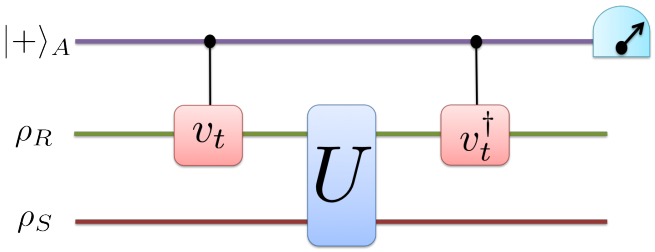

FIG. 1. The quantum circuit which maybe used to measure the heat of a quantum process. The ancilla qubit in the upper branch is prepared in a $|+\rangle$ state, the system of interest is prepared in an arbitrary initial state whereas the reservoir state ρ_R defined in the text is a thermal state. First a controlled operation $v^\dagger = e^{iH_R t}$ is applied on the reservoir, next the protocol unitary U is applied and then another controlled operation v is performed on the reservoir and the qubit is measured in the $x-y$ plane.