Exploring quantum thermodynamics with superconducting qubits

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Superconducting circuits offer an interesting platform with which to explore thermodynamics at the quantum level. In particular, the ability to perform high efficiency quantum measurements and track quantum evolution enables novel experiments in measurement and feedback which form the basis of Maxwell's Demon. These experiments elucidate the role of quantum information in thermodynamics. Furthermore, the quantum dynamics associated with continuous measurement allow us to characterize the arrow of time by examining the statistical likelihood of certain measurement processes. By experimentally tracking individual weak measurement trajectories, we compare the path probabilities of forward and backward-in-time evolution to develop an arrow of time statistic associated with measurement dynamics. We show that the arrow of time statistic obeys both detailed and integral fluctuation theorems thus establishing the consistency between microscopic and macroscopic measurement dynamics.