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Qubit Reset Based on a Quantum Absorption Refrigerator

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***Abstract*— Absorption refrigerators are autonomous machines that utilize the natural flow of heat across a thermal gradient to cool objects. Here, we implement a quantum absorption refrigerator based on superconducting circuits and demonstrate its use to autonomously reset the state of a transmon qubit below its residual thermal occupation. The refrigerator is fueled by an engineered four-wave-mixing interaction between the target qubit and two auxiliary qubits coupled to thermal baths. The baths are realized as microwave waveguides populated with a synthesized thermal occupation. Our proof-of-concept refrigerator shows that quantum thermal machines can be seamlessly integrated with quantum processing units to perform useful tasks. It also initiates a path to experimental studies of quantum thermodynamics using superconducting quantum circuits coupled to propagating thermal microwave fields.**

***Keywords (Index Terms)*—Superconducting circuits; circuit quantum electrodynamics; qubit reset; quantum thermodynamics**

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