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Catch and Release of Microwave Photons

YI YIN, Zhejiang University

Quantum information is often encoded in photons, which can both propagate freely along transmission lines and be stored in cavity resonators. To store photons efficiently, the resonator should have negligible coupling with the outside world. On the other hand, the resonator should be strongly coupled to a transmission line through which photons can be transmitted and received. These contrary requirements can be resolved with adjustable coupling. We experimentally demonstrate a superconducting resonator with variable coupling to a measurement transmission line. The resonator coupling can be adjusted through zero to a photon emission rate 300 times the intrinsic resonator decay rate. We demonstrate the catch and shaped release of microwave photons as well as the control of nonclassical Fock states. We achieve a high-fidelity catch efficiency (99.4%) for a "time-reversed" shaped photon. These results will enable high fidelity quantum state transfer between distant cavities.