

Abstract Submitted
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Multiple mode circuit QED with engineered photon lifetimes M. BAUR, P. J. LEEK, A. WALLRAFF, ETH Zurich, ETH QUANTUM DEVICE TEAM — We present the realization of a cavity quantum electrodynamics setup in which photons of strongly different lifetimes are engineered in different harmonic modes of the same cavity. We achieve this in a superconducting transmission line resonator with superconducting qubits strongly coupled to the different resonator modes. We use a short lifetime externally coupled mode for dispersive readout of the qubits, while simultaneously performing experiments with maximized photon coherence in an adjacent long lifetime mode of the multiple quality factor resonator. We demonstrate sideband based generation of n photon Fock states and the scaling of the sideband Rabi frequency with \sqrt{n} using schemes that may be extended to realize sideband based two-qubit logic gates.

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