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Engineering non-linear resonator mode interactions in circuit QED by continuous driving: Introduction WOLFGANG PFAFF, MATTHEW REAGOR, REINIER HEERES, NISSIM OFEK, KEVIN CHOU, JACOB BLUMOFF, ZAKI LEGHTAS, STEVEN TOUZARD, KATRINA SLIWA, ERIC HOLLAND, STEFAN KRASTANOV, LUIGI FRUNZIO, MICHEL DEVORET, LIANG JIANG, ROBERT SCHOELKOPF, Yale Univ — High-Q microwave resonators show great promise for storing and manipulating quantum states in circuit QED. Using resonator modes as such a resource in quantum information processing applications requires the ability to manipulate the state of a resonator efficiently. Further, one must engineer appropriate coupling channels without spoiling the coherence properties of the resonator. We present an architecture that combines millisecond lifetimes for photonic quantum states stored in a linear resonator with fast measurement provided by a low-Q readout resonator. We demonstrate experimentally how a continuous drive on a transmon can be utilized to generate highly non-classical photonic states inside the high-Q resonator via effective nonlinear resonator mode interactions. Our approach opens new avenues for using modes of long-lived linear resonators in the circuit QED platform for quantum information processing tasks.

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