Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Engineering non-linear resonator mode interactions in circuit QED by continuous driving: Manipulation of a photonic quantum memory MATTHEW REAGOR, WOLFGANG PFAFF, REINIER HEERES, NISSIM OFEK, KEVIN CHOU, JACOB BLUMOFF, ZAKI LEGHTAS, STEVEN TOUZARD, KATRINA SLIWA, ERIC HOLLAND, VICTOR V. ALBERT, LUIGI FRUNZIO, MICHEL H. DEVORET, LIANG JIANG, ROBERT J. SCHOELKOPF, Departments of Applied Physics and Physics, Yale University — Recent advances in circuit QED have shown great potential for using microwave resonators as quantum memories. In particular, it is possible to encode the state of a quantum bit in non-classical photonic states inside a high-Q linear resonator. An outstanding challenge is to perform controlled operations on such a photonic state. We demonstrate experimentally how a continuous drive on a transmon qubit coupled to a high-Q storage resonator can be used to induce non-linear dynamics of the resonator. Tailoring the drive properties allows us to cancel or enhance non-linearities in the system such that we can manipulate the state stored in the cavity. This approach can be used to either counteract undesirable evolution due to the bare Hamiltonian of the system or, ultimately, to perform logical operations on the state encoded in the cavity field. Our method provides a promising pathway towards performing universal control for quantum states stored in high-coherence resonators in the circuit QED platform.

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Date submitted: 13 Nov 2014 Electronic form version 1.4