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Cavity state manipulation using a dispersively coupled qubit REINIER HEERES, BRIAN VLASTAKIS, ERIC HOLLAND, STEFAN KRASTANOV, VICTOR V. ALBERT, CHAO SHEN, LIANG JIANG, ROBERT SCHOELKOPF, Yale University — The large available Hilbert space and high coherence of cavity resonators makes them an interesting resource in quantum information processing. For example, several schemes exist to encode a logical qubit in such a harmonic oscillator in a way that would be protected against certain kinds of errors. Here we demonstrate a method to manipulate a cavity state using a far off-resonantly coupled qubit, using only linear controls and a gate we call the Selective Number Arbitrary Phase (SNAP) gate. This gate allows to impart an arbitrary phase on each Fock-state component of the cavity. We show how we can use these tools to correct for the effects of Kerr-evolution as well as how to create a single-photon Fock state. Our scheme can be generalized to arbitrary cavity state creation and even allows to construct arbitrary unitary operators to give universal control of the oscillator.

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