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A Four-wave Mixing Toolbox For Photon State Manipulation in Superconducting Resonators[1] A.V. SHARYPOV, XIUHAO DENG, LIN TIAN, University of California, Merced — We present a circuit scheme to generate quantum operations on superconducting resonators by engineering effective interaction Hamiltonians. We show that both the linear Bogoliubov transformations, including the beam-splitter operation, the squeezing operation, and the phase shifter, and the nonlinear interactions such as the cross-Kerr interaction can be realized with one single circuit. Our circuit is composed of two superconducting qubits coupled with each other to form a quantum four-level system. Each qubit interacts directly with one superconducting resonator. We exploit the four-wave mixing (FWM) approach and use the circuit as a toolbox to generate the above-mentioned quantum operations by controlling circuit parameters with external sources. Using numerical simulations to study the error rates, we show that the transformations can be realized with high fidelity. Arbitrary quantum operations on the microwave photons can be realized by combining these effective interactions.

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