Nonlinear optics quantum computing with circuit QED$^1$ PRABIN ADHIKARI, MOHAMMAD HAFEZI, Joint Quantum Institute at UMD, JACOB TAYLOR, Joint Quantum Institute at UMD and NIST — One approach to quantum information processing is to use photons as quantum bits and rely on linear optical elements for most operations. However, some optical non-linearity is necessary to enable universal quantum computing. We consider a circuit-QED approach to linear optics quantum computing in the microwave regime, including a deterministic two-photon phase gate. Our model is a hybrid quantum system comprising an LC resonator coupled to a flux or phase superconducting qubit, which will be used to implement a non-linear two photon phase shift operation. Using this model, we show how fast, low-noise two-qubit gates between photons are possible, and discuss limitations of these ideas based on current technology.

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