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Parametric Resonators for Quantum Information Applications
C.M. WILSON, M. SANDBERG, F. PERSSON, I. HOI, G. JOHANSSON, V. SHUMEIKO, P. DELSING, Chalmers University, T. DUTY, U. Queensland — We have fabricated and characterized tunable superconducting transmission line resonators. To change the resonance frequency, we modify the boundary condition at one end of the resonator through the tunable Josephson inductance of a SQUID. We demonstrate a large tuning range, high quality factors and that we can change the frequency of a few-photon field on a time scale orders of magnitude faster than the photon lifetime. When parametrically pumped at twice their resonance frequency, the devices can act as parametric amplifiers. When pumped strongly, a threshold is crossed where the resonators oscillate spontaneously. Within this regime of parametric oscillations, the devices can exist in a variety of dynamical states. We observe a rich pattern in the dynamics of switching between these states. We study the possibility of using this dynamical bifurcation for qubit readout. Finally, recent theoretical work has suggested that it may be easier to observe dynamical tunneling in this system than in the Duffing oscillator.

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