Passive two-photon dissipation for bit-flip error correction of a cat code

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Bosonic codes offer a resource-efficient method to quantum error correction. Of particular interest, autonomous correction was successfully demonstrated for cat codes, where the logical |0⟩ and |1⟩ states are coherent states of opposite amplitudes |α⟩ and | − α⟩ in a superconducting resonator with single-photon loss rates κ1 as low as possible. They correct bit-flip errors by either using the non-linearity of the oscillator or parametrically pumping couplers to produce two-photon dissipation at a rate κ2. The bit-flip time increases exponentially with |α|^2 while the phase-flip rate only increases linearly with |α|^2. In this talk, we discuss superconducting circuits designed to correct for bit-flip errors of cat codes. We experimentally demonstrate unprecedented ratios κ2/κ1, which is key to leveraging cat codes for fault tolerant computation.