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Reducing Thermal Photon Dephasing in Transmon Qubits: Qubit Measurements RUI ZHANG, JEN-HAO YEH, Laboratory for Physical Sciences, College Park, MD and Department of Physics, University of Maryland, College Park, MD, F. C. WELLSTOOD, Laboratory for Physical Sciences, College Park, MD and Joint Quantum Institute, University of Maryland, College Park, MD, B. S. PALMER, Laboratory for Physical Sciences, College Park, MD and Department of Physics, University of Maryland — With recent improvements in the energy relaxation times of superconducting transmon qubits, dephasing due to fluctuations in the number of photons in the cavity has become more noticeable. We have quantified the performance of custom-designed 20 dB and 30 dB microwave attenuators by measuring the coherence of a 3D $Al/AlO_x/Al$ transmon qubit as a function of temperature and as a function of dissipated power in the attenuator. Above a temperature of 50 mK, the coherence time T2 of the qubit begins to decrease due to an increase in the fluctuating number of thermal equilibrium photons in the cavity. We find the effective noise temperature T_n of the attenuator depends on the dissipated power P_d as $T_n \propto P_d^{1/5.4}$. Comparing our results with simulations, this behavior suggests that the hot electron effect (decoupling of the electrons from the phonons) is limiting the cooling power of the attenuator.

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