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**Measurement of Microwave Resonators for Improved $T_1$ in Josephson Qubits** MATTHEW NEELEY, M. ANSMANN, R. BIALCZAK, N. KATZ, E. LUCERO, R. MCDERMOTT, M. STEFFEN, E. WEIG, A. CLELAND, J. M. MARTINIS, UC Santa Barbara — To realize a quantum computer with Josephson qubits, the energy relaxation time $T_1$ must be increased by an order of magnitude or more over current qubits. One of the dominant sources of energy decoherence is dielectric loss due to two-level defect states in the Josephson junction and in wiring crossovers. Easily-fabricated microwave resonators provide a convenient way to measure the dielectric loss of candidate materials before incorporating them into qubits. We describe the measurement process and the results for several candidate dielectric materials. The loss tangents have been observed to vary with applied magnetic field. This variation is explained by a simple model of flux vortex trapping in the type I superconducting aluminum films of the resonators.

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