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Detailed Study of the Excited State Lifetime of a Cooper-Pair Box[1] VITALEY ZARETSKEY, Z. KIM, Y. YOON, Department of Physics, UMD, J. F. SCHNEIDERMAN, M. D. SHAW, Department of Physics and Astronomy, USC, P. M. ECHTERNACH, JPL, Caltech, F. C. WELLSTOOD, JQI, CNAM, Department of Physics, UMD, B. S. PALMER, LPS — We have used a radio-frequency superconducting single-electron transistor (rf-SET) to measure the lifetime of the excited state (T_1) of an Al/AlO_x/Al Cooper-pair box (CPB) qubit with a charging energy $E_C/k_B = 0.58$ K. We measured the lifetime by continuously measuring the decay of the qubit from a mixed state. By effectively decreasing E_J/k_B from 1 K to 0.1 K we could increase T_1 from 50 ns to 5 μs which indicates that charge is the dominant noise source. Additionally we noted that the decay rate as a function of transition frequency had several narrow peaks in the range 15 to 50 GHz. These peaks correlated with the locations of anomalous avoided level crossings we observed in the excited state spectrum of the CPB[2], suggesting that interaction with microstates is a source of dissipation for these qubits.

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[2]**Anomalous Avoided Level Crossings in a Cooper-Pair Box Spectrum**, ZAEILL KIM *et al.*, BAPS (March 2008)

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