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Anomalous Avoided Level Crossings in a Cooper-Pair Box Spectrum[1] ZAEILL KIM, V. ZARETSKEY, Y. YOON, Department of Physics, University of Maryland, J.F. SCHNEIDERMAN, M.D. SHAW, Department of Physics and Astronomy, University of Southern California, P.M. ECHTERNACH, Jet Propulsion Laboratory, California Institute of Technology, F.C. WELLSTOOD, JQI, CNAM, Department of Physics, University of Maryland, B.S. PALMER, Laboratory for Physical Sciences — We have used a radio-frequency superconducting single-electron transistor to measure the detailed spectrum of an $Al/AlO_X/Al$ Cooper-pair box (CPB) qubit. The CPB had a charging energy $E_C/k_B = 0.58$ K and a Josephson energy E_J/k_B, which can be tuned by an external magnetic flux, between 0.1 and 1 K. From 15 to 50 GHz we have found four anomalous avoided level crossings in the excited state spectrum of the CPB. We note the splitting size has a strong dependence on the Josephson energy and the location of the splitting depends on the gate voltage of the CPB, evidence that the CPB is coupled to other quantum systems that are charged. We compare our results to a model Hamiltonian that describes a charge fluctuator coupled to a CPB and extract fit parameters that provide microscopic information about the charge fluctuators.

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