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Quasiparticle Poisoning in a Cooper-Pair Box B. S. PALMER, C. A. SANCHEZ, A. NAIK, M. A. MANHEIMER, Laboratory for Physical Sciences, J. F. SCHNEIDERMAN, Department of Physics, University of Southern California, P. M. ECHTERNACH, Jet Propulsion Laboratory, F. C. WELLSTOOD, Center for Superconductivity Research, Department of Physics, University of Maryland —
We have used a single-electron transistor (SET) to measure the Coulomb staircase of a single Cooper-pair box (CPB) from a temperature of 30 mK to 300 mK. At the lowest temperature, the data shows that the CPB, which is fabricated from $Al/AlO_x/Al$ tunnel junctions, is poisoned by nonequilibrium quasiparticles. As the temperature is increased from 30 to 150 mK, the width of the odd step in the staircase, which corresponds to a quasiparticle on the island of the box, decreases linearly with temperature. Above 180 mK, the width of the odd step increases, eventually producing a staircase with $1e$ steps. The low-temperature poisoning is consistent with the assumptions of Aumentado *et al.* that quasiparticles are spontaneously generated in the leads.[1] For particular gate voltages it is energetically favorable to have a nonequilbrium quasiparticle occupy a state on the island; hence poisoning the pure $2e$ staircase. The data above 180 mK is consistent with the quasiparticle states of the island being thermally populated.

[1]J. Aumentado, M. Keller, J. Martinis, & M. Devoret, Phys. Rev. Lett. **92**, 066802 (2004).

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