Anomally low tunneling escape rates from the excited states of an inductively–isolated current–biased Josephson junction phase qubit

University of Maryland — We present measurements of an inductively-isolated current-biased Nb/AlOx/Nb Josephson junction quantum bit at 20 mK. Density matrix fits of Rabi oscillations in our system suggest that the tunneling rate ($\Gamma_1$) from the first excited state is an order of magnitude lower than expected from a single current-biased junction. Furthermore, measurements of the energy relaxation time, $T_1$, through both pulse/decay and thermal population techniques only agree if $\Gamma_1$ is approximately an order of magnitude lower than our single junction model predicts. To test for low $\Gamma_1$, we use a fast-ramp technique ($\alpha = d(ln\Gamma)/dt > 1/T_1$) to directly measure $\Gamma_1$. We propose that an increase in the Josephson inductance of the qubit junction when in the excited state causes this effective reduction in $\Gamma_1$.

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