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Quantum phase slips in a resonant Josephson junction

In superconducting circuits with highly transparent junctions, the amplitude for quantum tunneling under the Josephson potential barrier is modified by the Landau-Zener probability to excite an Andreev bound state, resulting in the suppression of 2π quantum phase slips. We investigate the consequences of this process on the observable properties of transmon and fluxonium circuits. In particular, in a transmon circuit, we determine the residual charge dispersion of the energy levels that persists even at perfect transparency, due to the occurrence of 4π phase slips. We determine parameters to observe these effects with present-day circuits.