Switching Current of a Superconducting Single Electron Transistor in a Tunable Dissipative Environment

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The switching current (I_{SW}) of a superconducting single electron transistor (sSET) is investigated under the influence of a tunable dissipation as a function of gate charge and temperature. A two-dimensional electron gas (2DEG) located 100 nm below the surface of a GaAs/AlGaAs hetorostruncture substrate is capacitively coupled to the sSET and provides a frequency dependent dissipative environment. The sSET has a SQUID configuration allowing a fully controllable Josephson coupling energy (E_J) via a small magnetic field. This device has a well-defined Hamiltonian with competing E_J and charging energy (E_C). The measured I_{SW} exhibits a 1e periodicity with the charge number on the central island, showing its charging nature. By increasing the dissipation, the quantum fluctuations of the phase across the sSET is compressed, resulting in an enhanced I_{SW} and effective E_J. The effect of thermal fluctuations on the quantum phase fluctuation and phase diffusion in the sSET will also be presented.