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Engineering the parity lifetime of NbTiN Cooper-pair transistors
ATTILA GERESDI, DAVID VAN WOERKOM, TAMAS KRIVACHY, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands, SEBASTIAN RUBBERT, ANTON R. AKHMEROV, Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands, LEO P. KOUWENHOVEN, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands — Controlling the quasiparticle occupation of a superconducting island is of fundamental importance for superconducting circuits as single electron tunneling results in decoherence. Thus far, engineering superconducting tunnel junctions for quantum bits was done exclusively based on aluminum, which limits integration with systems requiring finite magnetic field, such as topological superconductors based on spin-orbit coupled nanowires or spin ensembles. Here we present parity modulation of the switching current of a niobium titanium nitride (NbTiN) Cooper-pair transistor coupled to aluminum (Al) leads for the first time. Owing to the gap profile $\Delta_{island} >> \Delta_{leads}$, we observe a parity lifetime exceeding 1 minute in combination with a Josephson energy of 50 μeV. We link this value to the finite subgap density of states of NbTiN, which is consistent with the subgap conductance measured by DC transport. We discuss our design of quasiparticle trapping and radiation shielding techniques, which resulted in a non-saturated parity lifetime down to a fridge temperature of 12 mK. Finally, we show that this circuit is compatible with magnetic fields in the range of 100 mT.

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