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Parity conservation in a Cooper-pair transistor DAVID VAN WOERKOM, ATTILA GERESDI, SEBASTIAN RUBBERT, ANTON AKHMEROV, LEO KOUWENHOVEN, Delft Univ of Tech — In a small superconducting island, hosting an even number of electrons, all charge carriers form Cooper pairs, defining the ground state of the Cooper-pair transistor (CPT). An additional, unpaired electron can only occupy a higher energy level, determined by the superconducting order parameter. This even-odd (parity) energy difference makes the CPT a very sensitive charge detector as well as a prototype superconducting qubit, whose coherence relies on the conservation of the parity of the island. Here we report parity conservation in a niobium-based superconductor, NbTiN, for the first time. NbTiN is a popular superconductor since it can sustain high parallel and perpendicular magnetic fields which is often a requirement for hybrid devices. The parity conversation resulted in the first 2e-periodicity measurements in a non-Aluminium CPT. The highest reported parity lifetime ever, which was longer than one minute, was measured. The parity lifetime didn't saturate down to a base temperature of 12mK, showing state-of-the-art device shielding of thermal photons. We show that our CPT is magnetic field compatible, opening new possibilities for coupling spin degrees of freedom to superconducting circuits and qubits and for topological superconductivity, enabling qubits based on Majorana fermions.

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