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Manipulating the Quantum State of a Single Cooper Pair in a One-Atom Contact CRISTIAN URBINA, CAMILLE JANVIER, LEANDRO TOSI, ÇAĞLAR GIRIT, MICHAEL STERN, PATRICE BERTET, DENIS VION, PHILIPPE JOYEZ, DANIEL ESTEVE, MARCELO GOFFMAN, HUGUES POTHIER, Quantronics Group, CEA-Saclay — Superconducting qubits presently used in quantum information experiments are based on Josephson tunnel junctions. Nevertheless, these circuits exploit only partially the richness of the Josephson effect, as they overlook the existence of an internal, spin-like degree of freedom, inherent to all Josephson structures. Each conduction channel of a weak-link gives rise to a doublet of discrete subgap states (the Andreev bound states), which represents the two possible states of a localized Cooper pair. We spotlight these doublets with experiments on the simplest Josephson weak-link: a one-atom contact between two superconductors. The atomic contact is inserted in a superconducting loop coupled to a microwave resonator. This standard circuit-QED architecture allows performing single shot measurements of the state of a localized Cooper pair, and to manipulate coherently its quantum state, as illustrated by Rabi oscillations, Ramsey fringes and spin echoes.

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