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Nota di contenuto	Part 1: Key concepts and contributions -- Chapter 1: Introduction -- Chapter 2: Andreev levels -- Chapter 3: Probing Andreev levels with cQED -- Chapter 4: Unlocking the spin of a quasiparticle -- Chapter 5: Future directions -- Part 2 The beautiful, messy details -- Chapter 6: BCS superconductivity -- Chapter 7: Andreev reflection, Andreev levels, and the Josephson effect -- Chapter 8: Andreev levels in Josephson nanowires -- Chapter 9: What would happen in a topological weak link? -- Chapter 10: The device -- Chapter 11: Spectroscopy and dispersive shifts -- Chapter 12: Raman transitions of the quasiparticle spin -- Chapter 13: Interactions of Andreev levels with the environment -- Chapter 14: Unexplained observations.
Sommario/riassunto	The thesis gives the first experimental demonstration of a new quantum bit (“qubit”) that fuses two promising physical implementations for the storage and manipulation of quantum

information – the electromagnetic modes of superconducting circuits, and the spins of electrons trapped in semiconductor quantum dots – and has the potential to inherit beneficial aspects of both. This new qubit consists of the spin of an individual superconducting quasiparticle trapped in a Josephson junction made from a semiconductor nanowire. Due to spin-orbit coupling in the nanowire, the supercurrent flowing through the nanowire depends on the quasiparticle spin state. This thesis shows how to harness this spin-dependent supercurrent to achieve both spin detection and coherent spin manipulation. This thesis also represents a significant advancement to our understanding and control of Andreev levels and thus of superconductivity. Andreev levels, microscopic fermionic modes that exist in all Josephson junctions, are the microscopic origin of the famous Josephson effect, and are also the parent states of Majorana modes in the nanowire junctions investigated in this thesis. The results in this thesis are therefore crucial for the development of Majorana-based topological information processing.