Quantum coherently-driven charge transport across two SQUIPTs coupled by a Coulomb island

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Actual research on the manipulation of quantum phenomena at the level of artificial atoms and qubits mainly focuses on nanostructured superconducting circuitry [1]. We will present a device concept based on the exploitation of quantum interference in short phase-biased superconducting nanowires implementing a superconducting quantum interference proximity transistor (SQUIPT) that leads to a tunable gap in the wire density of states (DOSs). A quantum-enhanced turnstile for single electrons based on SQUIPTs has been recently demonstrated exploiting analogous phenomena [2]. We will show how the flux dependence of the proximity gap induced in the weak link of a SQUIPT can be exploited as a phase-tunable energy barrier which enables quantum charge configurations with enhanced functionalities. Coupling two SQUIPTs with a metallic or superconducting Coulomb island we will present a novel single-electron superconducting transistor (called SQUISET) in which the charging landscape is coherently driven by an external magnetic field. Resuming, this device adds new perspectives to quantum electronics being an alternative building block in fields such as quantum metrology, coherent caloritronics, or quantum information technology.

[1]Y. Nakamura, Y. A. Pashkin, J. S. Tsai, Nature 398 , (1999)
[2]E. Enrico and F. Giazotto, Phys. Rev. Appl., Vol. 5, Issue 6, 064020, (2016)