Tunable superconducting single electron transistors: from weak to strong-coupling regime

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An island coupled to two leads and a gate forms a single electron transistor (SET) that shows Coulomb blockade (CB). All-superconducting SETs have shown to enable a multitude of possible charge transport processes, not all of them are well understood [1], in particular in the strong- coupling regime [2]. The conceptually simpler SSN-SET reduces the number of possible pro- cesses. We study a device consisting of a S island coupled to a N lead via an oxide tunnel barrier, and to a S lead with a mechanically controlled break junction (MCBJ). Via the MCBJ, different coupling regimes can be studied from a tunnel contact to a point contact [2]. For weak coupling, our experimental findings in the N state can be understood in terms of the Orthodox Theory of CB [3,4]. For stronger coupling, we observe Andreev and Josephson transport as well as, in the N state, a renormalization of the charging energy [5,6]. We describe our experimental results in the S state with simulations based on a generalized master equation approach [7].

References:

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