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Transport properties of a superconducting single-electron transistor coupled to a nanomechanical oscillator VERENA KOERTING, T.L. SCHMIDT, C.B. DOIRON, C. BRUDER, Department of Physics, University of Basel, CH-4056 Basel, Switzerland, B. TRAUZETTEL, Institute for Theoretical Physics and Astrophysics, University of Würzburg, D-97074 Würzburg, Germany — Superconducting single-electron transistors (SSETs) are known to constitute a very sensitive probe for the position measurement of a nanomechanical resonator (NR) which can provide near quantum-limited accuracy. The laws of quantum mechanics, however, also require a backaction of the SSET on the resonator, which limits the sensitivity. Recent experiments have confirmed that the backaction gives rise to an effective thermal bath which has the potential to cool or drive the resonator. Our research attempts to gain a better understanding of this system by examining the action of the NR on the SSET. In particular, we investigate the effect on transport properties of the SSET. We focus on the double Josephson quasiparticle (DJQP) resonance where an especially strong back-action can be observed due to the appearance of two coherent Cooper pair tunneling events. We argue that a measurement of for example the current, the charge noise and the shot noise (Fano factor) provides a direct way of gaining information on the state of the NR. In addition to an analytical discussion of the linear response regime we discuss results of higher order approximation schemes and a full numerical solution.

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