Ground-state cooling a mechanical oscillator by spin-dependent transport and Andreev reflection

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Abstract

We study the ground-state cooling of a mechanical oscillator coupled to the charge or the spin of a quantum dot inserted between spin-polarized or a normal metal and a superconducting contact. Such a system can be realized e.g. by a suspended carbon nanotube quantum dot with a suitable coupling between a vibrational mode and the charge or spin. We show that ground-state cooling of the mechanical oscillator can be achieved for many oscillator modes simultaneously [3] as well as selectively for single modes [1]. We discuss different modes of operation which also include single mode cooling by resonance, which is tunable by a magnetic field [1,2]. We finally discuss how the oscillator's state can be detected in the current-voltage characteristic [2,3] and how quasiparticles can be used as alternative cooling mechanism [4]. [1] P. Stadler, W. Belzig, and G. Rastelli, Phys. Rev. Lett. **113**, 047201 (2014).

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