Cooling a nanomechanical resonator using spin-dependent transport and noise interference in Andreev reflections

PASCAL STADLER, WOLFGANG BELZIG, GIANLUCA RASTELLI, University of Constance — Nano-electromechanical systems promise to manipulate mechanical motion in the quantum regime using electron transport. For such a goal, a necessary condition is the ability of cooling the resonator into or near to its quantum ground state. A still open challenge in this field is the achievement of active cooling using purely electron transport in, for instance, suspended carbon nanotube quantum dots. We consider the quantum transport in a carbon nanotube quantum dot suspended between two electric nanocontacts. Due to the interaction between electrons and flexural mechanical modes, the electron transport results in inelastic vibration-assisted tunneling processes. These give rise to a mechanical damping and to a steady nonequilibrium phonon occupation of the resonator. We discuss these effects for two different coherent transport regimes: (i) spin-polarized current between two ferromagnets [1,2] and (ii) subgap Andreev current between a superconductor and normal metal [3].