Magnetic field effect on quasiparticle dynamics in hybrid superconducting turnstiles

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We report on our recent experimental and theoretical studies of the effect of magnetic field on charge transport through the hybrid superconducting turnstiles. By applying an external magnetic field one can conveniently suppress or redistribute the population of excess quasiparticles in a mesoscopic superconductor in a NISIN turnstile. We present an experimental demonstration and theoretical analysis of such effective control of quasiparticles, resulting in electron cooling both in the Meissner and vortex states of a mesoscopic superconductor. We introduce a theoretical model of quasiparticle dynamics in the presence of the traps introduced by magnetic field, which appears to give a reasonable agreement with the experimental data. We also consider possible realizations of the collective dynamics of vorticity and electric charge via the charge pumping effect caused by alternating vortex entry and exit controlled by periodic magnetic field.