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Landau-Zener Physics in a Quantum Electron Turnstile

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Abstract:

A quantum turnstile is a nano-electronic device which transfers electrons one by one between two superconducting electrodes [1]. The key element of the device is a small normal metal island sandwiched between the electrodes, which effectively has a single electronic level (due to strong confinement) whose double occupation is prohibited by the Coulomb blockade. By applying a time-dependent gate voltage to the island, one can move the position of the level periodically, so that each time it picks up one electron from one electrode and then delivers it to the other one (a voltage bias between the electrodes is necessary to introduce an asymmetry). The key process here is the ejection of an electron or a hole into one of the electrodes. We show that the coupling between the level on the island and the coherence peak in the quasiparticle density of states in the superconductor may significantly affect the electron dynamics and impose a fundamental limit on the device operation.

[1] J. P. Pekola, J. J. Vartiainen, M. Möttönen, O.-P. Saira, M. Meschke, and D. V. Averin, *Nature Phys*. **4**, 120 (2008).