Transport properties of mesoscopic systems driven by harmonically time-dependent fields

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Electronic quantum transport through mesoscopic systems has been traditionally analyzed as a response to dc-voltages. The paradigmatic setup corresponds to the system under consideration placed between two reservoirs with a chemical potential difference that represents an external voltage.

There are, however, alternative possibilities to induce net charge and spin transport, using time-dependent fields as generating sources. Several interesting examples of this kind have been recently realized experimentally. In particular, charge and spin directed currents were induced in quantum dots operating with out-of-phase oscillating gates. In addition, dc electronic current has been generated in carbon nanotubes under the action of surface acustic waves, as well as in mesoscopic ratchet systems, where an asymmetric semiconductor structure is rocked by ac voltages. The striking feature of these devices is that directed transport is generated in the absence of a dc driving force.

In this talk, a formalism based in Keldysh non-equilibrium Green's functions to treat this type of systems will be briefly presented and the behavior of the quantum particle and energy transport will be discussed in the context of several devices of interest.