Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Tuesday, December 13th 2016 - 14:00
CFEL Seminar room I (Bldg. 99)

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Partition-free theory of time-dependent current correlations in nanojunctions in response to an arbitrary time-dependent bias

Working within the Nonequilibrium Green's Function formalism, a formula for the two-time current correlation function is derived for the case of transport through a nanojunction in response to an arbitrary time-dependent bias. The one-particle Hamiltonian and the wide band limit approximation are assumed, enabling us to extract all necessary Green's functions and self-energies for the system, extending the analytic work presented previously [Ridley et al. Phys. Rev. B (2015)].

We show that our new expression for the two-time correlation function generalises the Büttiker theory of shot and thermal noise on the current through a nanojunction to the time-dependent bias case including the transient regime following the switch-on. Transient terms in the correlation function arise from an initial state that does not assume (as is usually done) that the system is initially uncoupled, i.e. our approach is partition-free. We show that when the bias loses its time-dependence, the long time-limit of the current correlation function depends on the time difference only, as in this case an ideal steady state is reached. This enables derivation of known results for the single frequency power spectrum and for the zero frequency limit of this power spectrum. In addition, we present a technique which for the first time facilitates fast calculations of the transient quantum noise, valid for arbitrary temperature, time and voltage scales. We apply this to the quantum dot and molecular wire systems for both DC and AC biases, and find a novel signature of the traversal time for electrons crossing the wire in the time-dependent cross-lead current correlations.

Host: Angel Rubio

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