TT 18: Transport: Fluctuations and Noise

Time: Monday 15:00–16:00 Location: HSZ 204

TT 18.1 Mon 15:00 HSZ 204

Energy noise in a voltage-driven quantum point contact — •Federica Haupt, Francesca Battista, and Janine Splettstösser — Institut für Theorie der Statistischen Physik, RWTH Aachen, Germany

Single electron sources are of key importance in research fields such as metrology and quantum electron optics [1]. Ideally, these time-periodically driven devices emit a controlled number of particles in each driving period. This is predicted to be reached when applying a series of Lorentzian-shaped pulses to the conductor [2]. In experimental realisations, the shot noise provides a tool to measure the precision with which particles are emitted. In particular, it is sensitive to extra electron-hole excitations induced by the driving itself [3,4].

In order to complement the investigations on the electron-hole pair creation based on the study of charge transport [5,6], we address the energy transport properties of a quantum point contact subject to a periodic driving. In particular, we discuss features of the driving in the energy current and the low-frequency energy noise, and show that the latter carries detailed informations on the energetics of the particle-like excitations transmitted through the conductor [7].

[1] J. P. Pekola et al., arxiv:1208.4030 (2012)
[2] J. Keeling et al., Phys. Rev. Lett. 97, 116403 (2006)
[3] J. Gabelli and B. Reulet, Phys. Rev. B 87, 075403 (2013)
[4]J. Dubois et al., Nature 502, 659 (2013)
[5] M. Vanevic Y. V. Nazarov, and W. Belzig, Phys. Rev. Lett. 99, 076601 (2007)
[6] M. Vanevic and W. Belzig, Phys. Rev. B 86, 241306 (2012)
[7] F. Battista, F. Haupt, J. Splesttoesser, in preparation.

TT 18.2 Mon 15:15 HSZ 204

Non-Gaussian noise- and plasmon-assisted over-bias light emission from tunnel contacts — •Fei Xu, Cecilia Holmqvist, and Wolfgang Belzig — Fachbereich Physik, Universität Konstanz, Konstanz, Germany

Understanding tunneling from an atomically sharp tip to a metallic surface requires to account for interactions on a nanoscopic scale. Inelastic tunneling of electrons gives rise to the emission of photons, whose energies should intuitively be limited by the applied bias voltage eV. However, experiments [1,2] indicate that more complex processes involving the interaction of electrons with plasmons lead to photon emission with over-bias energies. We propose a model of this observation in analogy to the dynamical Coulomb blockade, originally developed to treat the electronic environment in mesoscopic circuits. We explain the experimental finding quantitatively by correlated tunneling of two electrons interacting with an RCL circuit to model the local plasmon mode. We show that the non-Gaussian statistics of the tunneling dynamics of the electrons is essential to describe the over bias emission .

[1] G. Schull et al., PRL 102, 057401 (2009)
[2] N. L. Schneider et al., PRL 105, 026601 (2010)

TT 18.3 Mon 15:30 HSZ 204

Inverse counting statistics for stochastic and open quantum systems: the characteristic polynomial approach — •Martin Bruderer[1], Debora Contreras-Pulido[1], Maximilian Thaller[2], Lucia Sironi[3], Danail Obreschkow[4], and Martin B. Plenio[1] — [1]Institut für Theoretische Physik, Universität Ulm, Germany — [2]Fachbereich Physik, Universität Konstanz, Germany — [3]Department of Biology, Universität Konstanz, Germany — [4]University of Western Australia, ICRAR, Crawley, Australia

We consider stochastic and open quantum systems with a finite number of states, where a stochastic transition between two specific states is monitored by a detector. The long-time counting statistics of the observed realizations of the transition, parametrized by cumulants, is the only available information about the system. We present an analytical method for reconstructing generators of the time evolution of the system compatible with the observations. Moreover, we propose cumulant-based criteria for testing the non-classicality and non-Markovianity of the time evolution, and lower bounds for the system dimension. Our analytical results rely on the close connection between the cumulants of the counting statistics and the characteristic polynomial of the generator, which takes the role of the cumulant generating function.

[1] M. Bruderer et *al.*, arXiv:1311.2673

TT 18.4 Mon 15:45 HSZ 204

Floquet Theory of Electron Waiting Times in Quantum-Coherent Conductors — •David Dasenbrook, Christian Flindt, and Markus Büttiker — Département de Physique Théorique, Université de Genève, 1211 Genève, Switzerland

The distribution of waiting times between charge detection events has recently gained some interest in theoretical mesoscopic physics. As an alternative to full counting statistics (FCS), which is typically evaluated in the long time limit, it allows for a complementary characterization of electron transport on short and intermediate time scales. Waiting time distributions (WTD) can be used as a tool to investigate the interplay between extrinsic and intrinsic time scales in periodically driven systems.

However, while there have been results on waiting times in classical driven systems, a formalism for WTDs in phase coherent systems with an external time-dependence has so far been lacking. We present such a formalism for one-dimensional non-interacting systems based on a Floquet scattering approach.

We demonstrate the usefulness of our formalism by means of two examples: a quantum point contact (QPC) whose transmission is weakly and slowly modulated and the application of Lorentzian voltage pulses of integer charge to an ideal conductor.