TT 26: TR: Fluctuations and Noise

Time: Tuesday 14:00–15:30 Location: HSZ 301

Invited Talk TT 26.1 Tue 14:00 HSZ 301

Quantum paradoxes in quantum transport — •Wolfgang Belzig[1] and Adam Bednorz[1,2] — [1]Fachbereich Physik, Universiät Konstanz, D-78457 Konstanz, Germany — [2]Institute of Theoretical Physics, University of Warsaw, Hoza 69, PL-00681 Warsaw, Poland

The impossibility of measuring non-commuting quantum mechanical observables is one of the most fascinating consequences of the quantum mechanical postulates, relevant for correlation measurements of the electric current [1]. Hence, to date the investigation of quantum measurement and projection is a fundamentally interesting topic. We propose to test the concept of weak measurement of non-commuting observables in mesoscopic transport experiments, using a quasiprobablistic description [2]. As first example of a paradox, we derive an inequality for current correlators, which is satisfied by every classical probability but violated by high-frequency fourth-order cumulants in the quantum regime for experimentally feasible parameters [3]. Further paradoxes can be used to detect nonlocal quantum correlations (entanglement) in mesoscopic junctions far beyond the regime covered by the usual Bell inequalities.

[1] A. Bednorz and W. Belzig, Phys. Rev. Lett. 101, 206803 (2008).
[2] A. Bednorz and W. Belzig, Phys. Rev. B 81, 125112 (2010).
[3] A. Bednorz and W. Belzig, Phys. Rev. Lett. 105, 106803 (2010).

TT 26.2 Tue 14:30 HSZ 301

A Full Counting Statistics with the 2nd-order-von-Neumann approach — •Philipp Zedler[1], Tomáš Novotný[2], Clive Emary[1], and Tobias Brandes[1] — [1]Technische Universität Berlin — [2]Univerzita Karlova v Praze

We formulate a (Non-Markovian) master equation with counting fields which generalizes the 2nd-order-von-Neumann approximation. The approach can also be considered as a resonant tunneling approximation in real time diagramatics or can be derived using Liouvillian perturbation theory. We apply the formalism to the well-understood single resonant level model to make statements about its accuracy in the presence of counting fields.

TT 26.3 Tue 14:45 HSZ 301

Semiclassical dynamics of a NEMS oscillator — •Anja Metelmann and Tobias Brandes — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, Berlin D-10623, Germany

We investigate the dynamics of a single phonon (oscillator) mode linearly coupled to an electronic few–level system in contact with external particle reservoirs (leads). A stationary electronic current through the system generates non–trivial dynamical behaviour of the oscillator [1]. Using Feynman–Vernon influence functional theory, we derive a Langevin equation for the oscillator trajectory that is non–perturbative in the system–leads coupling. For the case of two coupled electronic levels, we discuss various regimes of the oscillator dynamics.

[1] R. Hussein, A. Metelmann, P. Zedler, and T. Brandes, Phys. Rev. B **82**, 165406 (2010).

TT 26.4 Tue 15:00 HSZ 301

Factorial cumulants reveal interactions in counting statistics — •Dania Kambly, Christian Flindt, and Markus Büttiker — Département de Physique Théorique, Université de Genève, CH-1211 Genève, Switzerland

Full counting statistics concerns the stochastic transport of electrons in mesoscopic structures. Recently it has been shown that the charge transport statistics for non-interacting electrons in a two-terminal system is always generalized binomial: it can be decomposed into independent single-particle events and the zeros of the generating function are real and negative. Here we investigate how the zeros of the generating function move into the complex plane due to interactions and demonstrate that the positions of the zeros can be detected using high-order factorial cumulants. As an illustrative example we consider electron transport through a Coulomb blockade quantum dot for which we show that the interactions on the quantum dot are clearly visible in the high-order factorial cumulants. Our findings are important for understanding the influence of interactions on counting statistics and the characterization in terms of zeros of the generating function provides us with a simple interpretation of recent experiments, where high-order statistics have been measured.

TT 26.5 Tue 15:15 HSZ 301

Thermal noise due to electron interactions in networks of disordered wires — •Maximilian Treiber[1], Christophe Texier[2], Oleg M. Yevtushenko[1], Jan von Delft[1], and Igor V. Lerner[3] — [1]Ludwig-Maximilians-Universität, Physics Department, ASC, CeNS, Theresienstrasse 37, D-80333 Munich, Germany — [2]Université Paris-Sud, CNRS, LPTMS, UMR 8626, Bat. 100, F-91405 Orsay, France — [3]University of Birmingham, School of Physics and Astronomy, Birmingham, B15 2TT, UK

At sufficiently low temperatures, electron interactions govern dephasing in mesoscopic samples. Thus, a theory of dephasing requires the knowledge of the correlation function of Johnson-Nyquist (electronic) noise. This function is well-known, for example, for quasi-1d wires. Recent experiments address dephasing in substantially inhomogeneous systems consisting of multiply-connected wires, such as metallic grids or connected rings. Motivated by these experiments, we study the spatial dependence of the noise correlation function in networks of disordered wires with arbitrary boundary conditions.

Using the fluctuation-dissipation theorem and the random-phase approximation, we derive a real-space integro-differential equation for the correlation function. In the case of sufficiently strong screening, this equation reduces to a time-integrated diffusion equation which has to be solved for the given boundary conditions (such as connections to leads). We show how a solution can be found efficiently for networks of wires, by using a method based on the spectral determinant.