DY 19: Transport: Fluctuation and Noise (Joint session of DY and TT organized by TT)

Time: Tuesday 14:00–15:45 Location: H23

DY 19.1 Tue 14:00 H23

Super-Poissonian shot noise of squeezed-magnon mediated spin transport — •Akashdeep Kamra and Wolfgang Belzig — Fachbereich Physik, Universität Konstanz, D-78457 Konstanz, Germany

The magnetization of a ferromagnet (F) driven out of equilibrium injects pure spin current into an adjacent conductor (N). Such F|N bilayers have become basic building blocks in a wide variety of spin based devices. We evaluate the shot noise of the spin current traversing the F|N interface when F is subjected to a coherent microwave drive. We find that the noise spectrum is frequency independent up to the drive frequency, and increases linearly with frequency thereafter. The low frequency noise indicates super-Poissonian spin transfer understood in terms of dipolar interaction mediated squeezing of F eigenmodes, which results in quasi-particles with effective spin $\hbar^* = \hbar(1+\delta)$. For experimentally relevant parameters, we estimate $\delta \approx 0.4$ for yttrium iron garnet and $\delta \approx 3.0$ for iron thin films. The spontaneous squeezing of F eigenmodes suggests novel possibilities for their applications in quantum optics and related fields.

DY 19.2 Tue 14:15 H23

Statistics of transmission eigenvalues in diffusive star-shaped multi-terminal structures — •Sven Essert, Viktor Krueckl, and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg, Germany

We study transport in diffusive star-shaped devices with more than two leads. We find that the eigenvalue distribution $p(t)$ of the transmission matrix between any pair of terminals is typically not showing the bimodal distribution that is found in two-lead devices. Instead, the distribution displays a cutoff t_c, i. e., $p(t) = 0$ for $1 \geq t \geq t_c$. We explain the origin of this cutoff by deriving analytical expressions in the limit of low transmission for fully symmetric stars and for some limiting cases of extreme asymmetry. Using numerical calculations we probe the validity of these results away from the low-transmission limit.

In addition, we note that the bimodal distribution can be recovered when combining the leads of the star into meta leads in such a way that the total number of such meta leads is two. Then the transport between these is again bimodal, thus showing "open channels" with transmissions close to 1. Related to this, we propose the study of a new observable, which we call eigenvector splitting, that quantifies the distribution of outgoing flux among the constituent leads of the meta lead. This quantity becomes particularly interesting, when studying devices in the low-transmission limit, where it directly relates to the eigenvalue distribution. We present analytical solutions for the eigenvector splitting in some limiting geometries and supplement them by numerical calculations.

DY 19.3 Tue 14:30 H23

Detection of interactions via generalized factorial cumulants in systems in and out of equilibrium — •Philipp Stegmann[1], Björn Sothmann[2], Alfred Hucht[1], and Jürgen König[1] — [1]Theoretische Physik, Universität Duisburg-Essen and CENIDE, 47048 Duisburg, Germany — [2]Département de Physique Théorique, Université de Genève, CH-1211 Genève 4, Switzerland

We introduce time-dependent, generalized factorial cumulants $C_s^m(t)$ of the full counting statistics of electron transfer as a tool to detect interactions in nanostructures [1]. The violation of the sign criterion $(-1)^{m-1}C_s^m(t) \geq 0$ for *any* time t, order m, and parameter s proves the presence of interactions. For given system parameters, there is a minimal time span $t_{\min}$ and a minimal order m to observe the violation of the sign criterion. We demonstrate that generalized factorial cumulants are more sensitive to interactions than ordinary ones [2, 3] and can detect interactions even in regimes where ordinary factorial cumulants fail. We illustrate our findings with the example of a quantum dot tunnel coupled to electronic reservoirs either in or out of equilibrium.

[1] P. Stegmann, B. Sothmann, A. Hucht, and J. König, PRB **92**, 155413 (2015)
[2] D. Kambly, C. Flindt, and M. Büttiker, PRB **83**, 075432 (2011)
[3] D. Kambly and C. Flindt, J. Comput. Electron. **12**, 331 (2013)

DY 19.4 Tue 14:45 H23

Time-resolved statistics of entangled photon pairs in Josephson photonics — •Simon Dambach, Björn Kubala, and Joachim Ankerhold — Institute for Complex Quantum Systems and IQST, Ulm University, Ulm, Germany

The interplay of the tunneling transfer of charges and the emission and absorption of light can be investigated in a setup where a voltage-biased Josephson junction is placed in series to a microwave resonator. Such circuits combine phenomena and observational tools originally known from the fields of charge transfer physics and quantum optics (Josephson photonics). Due to the inherent nonlinearity of the Josephson junction, tunneling Cooper pairs can create a variety of nonclassical states of light. This is reflected in form of characteristic signatures in the second-order correlation function $g^{(2)}(\tau)$ and the waiting-time distribution $w(\tau)$. We find that this device represents a versatile source of nonconventional light which can be tuned from photon-pair creation and strong bunching to single-photon creation and complete antibunching [1].

In this talk, we will investigate theoretically the simultaneous creation of two photons within different modes and, in particular, address the question of intermode entanglement by means of different entanglement witnesses.

[1] S. Dambach et al., PRB **92**, 054508 (2015).

Invited Talk DY 19.5 Tue 15:00 H23

Dynamical Coulomb Blockade theory of resonantly enhanced light emission from a tunnel junction — •Wolfgang Belzig[1], Fei Xu[1], and Cecilia Holmqvist[2] — [1]Fachbereich Physik, Universität Konstanz, D-78457 Konstanz, Germany — [2]Department of Physics, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway

Inelastic tunneling of electrons generates emission of photons, whose energies intuitively should be limited by the applied bias voltage. However, experiments indicate that more complex processes involving the interaction of electrons with plasmon polaritons lead to photon emission characterized by over-bias energies. We have proposed a model of this observation [1] in analogy to the dynamical Coulomb blockade, originally developed for treating the electronic environment in mesoscopic circuits, and explained the experimental finding quantitatively by the correlated tunnelling of two electrons interacting with an LRC circuit modelling the local plasmon-polariton mode. Furthermore, we calculate the over-bias emission at finite temperature and discuss the possibility of non-classical light emission.

[1] F. Xu, C. Holmqvist, W. Belzig, PRL **113**, 066801 (2014).

DY 19.6 Tue 15:30 H23

Correlations of weak quantum measurements in a non-Markovian detection scheme — •Johannes Bülte[1], Adam Bednorz[2], Christoph Bruder[3], and Wolfgang Belzig[1] — [1]Fachbereich Physik, Universität Konstanz, D-78457 Konstanz, Germany — [2]Faculty of Physics, University of Warsaw, PL02-093 Warsaw, Poland — [3]Department of Physics, University of Basel, CH-4056 Basel, Switzerland

Generalized quantum measurement schemes are described by positive operator-valued measures that go beyond the projection postulate, i.e., the instantaneous collapse of the systems' wave function by the measurement. They allow to consider the noninvasive limit of so-called weak measurements, and, in particular, to investigate the correlations of several such measurements which permits the tracking of non-commuting observables. We propose a scheme in which the detectors are coupled to the measured system for a finite time which leads to non-Markovian effects [1]. We derive microscopic expressions for the memory functions which are related to the Kubo linear-response formalism. The deviations from the standard Markovian measurement with symmetrized operator order (Keldysh ordering) can be traced back to a detector-detector interaction mediated by the measured system. Finally, we discuss different detector types, and show that an appropriate choice enables e.g. the proof of the non-classical nature of a system by second-order correlation functions.

[1] A. Bednorz, C. Bruder, B. Reulet, and W. Belzig, PRL **110**, 250404 (2013)