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Participant	Title	Abstract
Mohammad H. Ansari	Noise in critical current of Josephson junction induced by Kondo trap states	We extend previous studies of noninteracting traps in Josephson junctions to traps with on-site electron repulsion inside one ballistic channel. This repulsion allows the control of coupling between the computational qubit and spurious two-level systems inside the oxide dielectric. We use second order perturbation theory which allows to obtain analytical formulae for the interacting bound states and spectral weights, limited to small and intermediate repulsions. Remarkably, it still reproduces the main features of the model as identified from the Numerical Renormalization Group. Analytical formulations for the subgap bound state energies are given and the singlet-doublet phase boundary and spectral weights are extracted. We show that interactions can reverse the supercurrent across each trap. Finally, we derive the spectrum of junction resonators for qubits as a function of repulsion and analyze its dependence on microscopic parameters that may be controlled by fabrication.
Julien Basset	Coupling of a semiconductor double quantum dot to a microwave resonator	In this project we aim at realizing a hybrid solid-state quantum device, in which a semiconductor double quantum dot, acting as a quantum bit at the charge degeneracy point, strongly couples to the quantized voltage oscillations of a nearby superconducting transmission line resonator [1]. This hybrid structure, making use of mesa edge structured double dot and aluminum coplanar waveguide, has already been investigated and showed promising results [2]. However, an important issue of such previous work was that the coupling with the many electrons dwelling into the dot (typical for mesa edge confined dots) enhances the energy relaxation (100MHz) together with the dephasing rate (1-3 GHz) of the qubit. As a result, decoherence is faster than the achieved coupling (50MHz) with the resonator. In order to overcome this difficulty and study the influences of the number of electrons residing in the dot on qubit decoherence, we have strongly modified the double dot design. A fully gated system is now used in addition to a charge detector. With this new design, one can empty the dots, count electrons and will hopefully reduce decoherence. Ideally, electron spin physics will be studied. [1] L.Childress, A.S. Sorensen and M.D. Lukin Phys. Rev. A 69, 042302 (2004) [2] T.Frey et al. Phys. Rev. Lett. 108, 046807 (2012)
Christian Bergenfeldt	Microwave Quantum Optics and Electron Transport: Transport through two DQD:s resonantly coupled to a transmission line cavity	Motivated by recent experimental success in coupling mesoscopic conductors to transmissionline cavities we investigate theoretically the electronic transport properties in a system consisting of two Double Quantum Dots (DQD:s) resonantly coupled to a transmission line cavity. Working within the framework of Circuit-QED we derive a Tavis-Cummings Hamiltonian for the system. The dynamics of the system is described by a quantum master equation, accounting for the electronic transport as well as the coherent, non-equilibrium properties of the photon state. Focusing our investigations on the non-local transport properties in the deep quantum, few photon regime, several interesting results are obtained. We find sizable non-local conductances and current cross-correlations, resulting from a non-equilibrium, transport-induced, photon state From the full statistical description of the electron transport we further show that the tunneling electrons affect each other by exchanging single photons through the cavity. Moreover, entanglement between electrons in the two DQDs is investigated. The concurrence of the stationary reduced two-particle state is found to be considerable.
Tim Botzem	Towards high-fidelity gates in GaAs S-T0 spin qubits	Decoherence, due to random charge noise and fluctuations in the nuclear spin bath limit the accuracy of qubit control pulses significantly. Current estimates of the errors introduced by residual nuclear fluctuations are on the order of the error threshold [1], achieving single-qubit gate fidelities greater than this threshold is an important requirement for further development of spin qubits. I present first steps towards implementing low-noise high-fidelity gates, the set up of a rf-readout cryogenic experiment and proof-of-principal simulations. [1] Bluhm et al., Physical Review Letters 105, 216803
Alessandro Braggio	Quasiparticle agglomerates and noise effects in the fractional quantum Hall edge states	We propose[1] a general mechanism for renormalization of the tunneling exponents in edge states of the fractional quantum Hall effect in the low energy limit. Mutual effects of the coupling with out-of-equilibrium 1/f noise and dissipation[2] are considered both for the Laughlin sequence and for composite co- and counter-propagating edge states with Abelian or non-Abelian statistics. For states with counter-propagating modes we demonstrate the robustness of the proposed mechanism in the so called disorder-dominated phase. We give a clear explanation of the renormalization mechanism not only for the charged modes but also, more intriguingly, for the neutral ones - very recently observed experimentally. Detailed comparisons with the experimental observations are re- ported[3] for all the cases considered. In particular we discuss the anti-Pfaffian model for = 5/2 where, at low temperatures, the dominance of Abelian agglomerates, with charge e/2, over the non- Abelian single quasiparticles of charge e/4 is experimentally observed. Relevant consequences in quantum point contact transport properties (current and noise) at zero and finite frequency are finally discussed[4]. [1] A. Braggio, D. Ferraro, M. Carrega, N. Magnoli, and M. Sassetti, submitted Phys. Rev. B, arXiv:1203 [2] E. G. Dalla Torre, E. Damler, T. Giamarchi, and E. Altman, Nature Physics 6, 806 (2010); E. G. Dalla Torre, E. Demler, T. Giamarchi, and E. Altman, arXiv: 1110.3678 [3] D. Ferraro, A. Braggio, M. Merlo, N. Magnoli, and M. Sassetti, Phys. Rev. Lett. 101, 166805 (2008); D. Ferraro, A. Braggio, N. Magnoli, and M. Sassetti, Phys. Rev. B 82, 085323 (2010); M. Carrega, D. Ferraro, A. Braggio, N. Magnoli, and M. Sassetti, Phys. Rev. Lett. 107, 146404 (2011) [4]M. Carrega, D. Ferraro, A. Braggio, N. Magnoli, and M. Sassetti, New J. Phys. 14, 023017 (2012)
Sibylle Braungardt	Particle-counting statistics of time- and space-dependent fields	The full counting statistics has been used widely to characterize the properties of quantum states of light. The theoretical description of photon counting was derived in the 1960s and was extended to massive particles more recently. Typically, the interaction between each particle and the detector is assumed to be limited to short time intervals, and the probability of counting particles in one interval is independent of the measurements in previous intervals. In our work, we derive a fully time- and space-dependent description of the counting process for linear quantum many-body systems, taking into account the back-action of the detector on the field. We apply our formalism to an expanding Bose-Einstein condensate of ultracold atoms, and show that it describes the process correctly, whereas the standard approach gives unphysical results in some limits. The example illustrates that, in certain situations, the back-action of the detector cannot be neglected and has to be included in the description.
Iurii Chernii	Direct access to quantum fluctuations through cross-correlation measurements	It is difficult to measure the properties of quantum fluctuations in a straight-forward way, since that requires high-frequency measurements. Moreover, quantum fluctuations are normally dominated by the classical noise and are further obstructed by such effects as the detector backaction and the environment noise. In the present work, we propose an experiment designed to bypass these difficulties by performing the cross-correlation measurements. We propose to use a pair of two-level detectors, weakly coupled to a collective mode of an electric circuit. Fluctuations of the source current, accumulated as the collective mode charge, induce stochastic transitions in the detectors. The transitions are then read off by the quantum-point contact (QPC) electrometers and translated into a pair of telegraph processes in the QPC currents. Correlations in the detectors' transitions are fingerprinted by the cross correlator of the telegraph processes, that can be measured at zero frequency, i.e., with a long-time measurements. In the dependance of the cross correlator on the detectors' energy splittings 1 and 2, the most interesting region is at the degeneracy points 1=±2, where it exhibits a sharp nonlocal resonance, that stems from higher-order processes. We determine the conditions, at which the main contribution to this resonance comes from the quantum fluctuations. Namely, while the resonance line shape is weakly broadened by the classical noise, the height of the peak is directly proportional to the square of the quantum component of the noise spectral function.

Daniel Dominguez	Tailoring population inversion in Landau-Zener-St\"uckelberg interferometry of flux qubits	We distinguish different mechanisms for population inversion in flux qubits driven by dc+ac magnetic fields. We show that for driving amplitudes such that there are Landau-Zener-St\"uckelberg interferences, it is possible to have population inversion solely mediated by the environmental bath. Furthermore, we find that the degree of population inversion can be controlled by tailoring a resonant frequency Ω_p in the environmental bath. To observe these effects experiments should be performed for long driving times after full relaxation.
Christopher Eichler	Experimental characterization of quantum microwave radiation and its entanglement with a superconducting qubit	
Michael Hell	Coherent Backaction by Charge Sensing of Quantum Dots	The readout of the charge state of a quantum dot is a key ingredient for realizing qubits based on quantum dots. Thus, backaction effects of charge sensing will become an important issue for the qubit performance in the future. One of the most sensitive charge sensing methods is a conductivity measurement through a proximal sensor quantum dot (SQD) [1], instead of a quantum-point contact. In this poster, we investigate the ensemble measurement of the position of an electron in a double quantum dot by such a SQD, in particular, the backaction of the SQD on this charge qubit. Besides introducing dissipation, the sensing also modifies the internal unitary evolution of the charge qubit, an effect that has received little attention in the literature so far. The latter considerably alters the evolution of the qubit in the experimentally relevant regime where the tunneling rate within the double quantum dot is comparable to the Coulomb energy difference used by the SQD to probe the qubit. We show that the mixed state of the qubit can only be represented using two Bloch spheres, one for each detector charge state: the individual dynamics of these (detector) charge-conditioned isospins strongly resembles the spin dynamics of a quantum dot in a non-collinear spin-valve structure [2]. Furthermore, Coulomb interaction generates non-collinear effective “magnetic” fields acting on the charge-conditioned isospins. Strikingly, the signal current through the SQD couples non-trivially to these charge-conditioned isospins and not to the total qubit isospin. Our results extend also to singlet-triplet qubits in which the readout is based on spin-to-charge conversion [3]. [1] C. Barthel et al., Fast sensing of double-dot charge arrangement and spin state with a radio-frequency sensor quantum dot, Phys. Rev. B, 81:161308, 2010. [2] M. Braun et. al., Theory of transport through quantum-dot spin valves in the weak-coupling regime, Phys. Rev. B 70:195345, 2004. [3] e. g. J. R. Petta et al., Coherent Manipulation of Coupled Electron Spins in Semiconductor Quantum Dots, Science 309:2180, 2005.
Frank Hohls	Semiconductor non-adiabatic quantized charge pumps	Pumping transport mechanisms have attracted much interest as an alternative means to generate charge and spin currents in the absence of a bias voltage. The current results from periodic modulation of certain system parameters of a nanostructure connected to source and drain leads. Of particular interest has been the quantized regime when the current varies in steps of e•f as a function of the system parameters, where e is the electron charge and f is a modulation frequency. Much theoretical and experimental work has been devoted to the adiabatic regime, when the time variation of the parameters is slow compared to characteristic relaxation times of the system [1]. In the non-adiabatic regime the system is driven out of equilibrium and the frequency f becomes another control parameter. Owing to the complex interplay between tunneling rates and frequency experimental realizations have only recently shown quantization [2]. I will present recent developments in non-adiabatic quantized charge pumping in AlGaAs/GaAs nanowire based devices. The wire is crossed by several metallic top gates, set to negative voltages to define a quantum dot (QD). Single parameter non-adiabatic charge pumping [3,4] is achieved by applying modulation frequencies of f = 0.001 to 1 GHz to one of the outer gates defining the QD, tuning the current into the quantized regime. I will present characterizations of the pump, amongst others high magnetic field experiments [5], shot noise data [6] and precision current measurements [7]. Driving a quantized current by a single modulation parameter, which is only possible in the non-adiabatic regime, is of fundamental practical importance as it enables complex on-chip circuit integration. I will discuss current up-scaling by parallel quantized operation of multiple pumps on a single chip [8], the realization of a semiconductor quantized voltage source by integration of a pump with a quantum Hall device [9] and serial integration of multiple pumps [10]. [1] H. Pothier et al., Europhys. Lett. 17, 249 (1992). [2] M. Blumenthal et al., Nature Physics 3, 343 (2007). [3] B. Kaestner et al., Phys. Rev. B 77, 153301 (2008). [4] V. Kashcheyevs & B. Kaestner, Phys. Rev. Lett. 104, 186805 (2010). [5] C. Leicht et al, Sem. Sci. Tech., 26, 055010 (2011). [6] N. Maire et al., Appl. Phys. Lett. 92, 082112 (2008). [7] B. Kaestner et al., CPEM 2012; F. Hohls et al., ICPS 2012. [8] P. Mirovsky et al., Appl. Phys. Lett. 97, 252104 (2010). [9] F. Hohls et al., Phys. Rev. Lett 109, xxxxx (2012). [10] L. Fricke et al. Phys. Rev. B 83,193306 (2011).
Cecilia Holmqvist	Spin-precession-assisted tunneling in hybrid superconducting point contacts	The transport properties of a quantum point contact coupled to a nanomagnet strongly depends on the dynamics of the nanomagnet's spin. We analyze the current-voltage characteristics of a junction coupled to a spin whose dynamics is modeled as Larmor precession brought about by an external magnetic field. The interplay between the ac Josephson current and the Larmor precession leads to Shapiro-like resonances. In addition, the current-voltage characteristics display a rich subgap structure due to spin-precession-assisted MARs. We also address the noise correlation of the current.
Myung-Joong Hwang	Majorana bound states in coupled circuit-QED systems	We have studied the low-lying excitations of a chain of coupled circuit-QED systems in the ultra-strong coupling regime, and report several intriguing properties of its two nearly degenerate ground states. The ground states are Schrödinger cat states at a truly large scale, involving maximal entanglement between the resonator and the qubit, and are mathematically equivalent to Majorana bound states. With a suitable design of physical qubits, they are protected against local fluctuations and constitute a non-local qubit. Furthermore, they can be probed and manipulated coherently by attaching an empty resonator to one end of the circuit-QED chain.
Vyacheslavs Kashcheyevs	Quantum fluctuations and coherence in high-precision single-electron capture	The phase of a single quantum state is undefined unless the history of its creation provides a reference point. Thus quantum interference may seem hardly relevant for the design of deterministic single-electron sources which strive to isolate individual charge carriers quickly and completely. We provide a counterexample by analyzing the non-adiabatic separation of a localized quantum state from a Fermi sea due to a closing tunnel barrier. We identify the relevant energy scales and suggest ways to separate the contributions of quantum non-adiabatic excitation and backtunneling to the rare non-capture events. In the optimal regime of balanced decay and non-adiabaticity, our simple electron trap turns into a single-lead Landau-Zenner-backtunneling interferometer, revealing the dynamical phase accumulated between the particle capture and leakage. The predicted "quantum beats in backtunneling" may turn a single-electron-source error into a valuable signal revealing essentially non-adiabatic energy scales of a dynamic quantum dot.
Sigmund Kohler	Steady-state coherent transfer by adiabatic passage	Steady-state coherent transfer by adiabatic passage We propose steady-state electron transport based on coherent transfer by adiabatic passage (CTAP) in a linearly arranged triple quantum dot with leads attached to the outer dots. Its main feature is repeated steering of single electrons from the first dot to the last dot without relevant occupation of the middle dot. The coupling to leads enables a steady-state current, whose shot noise is significantly suppressed provided that the CTAP protocol performs properly. This represents an indication for the direct transfer between spatially separated dots and, thus, may resolve the problem of finding experimental evidence for the non-occupation of the middle dot. J. Huneke, G. Platero, and S. Kohler arXiv:1207.3197 [cond-mat]
Manohar Kumar	Is Pt atomic chain have itinerant magnetic order?	Pt is a metal with a modestly Stoner enhanced magnetic susceptibility, indicating proximity to a ferromagnetic order. A transition to ferromagnetism can be induced by reducing dimensions, as evidenced by recent work on Pt clusters. For these reasons, the ferromagnetic order predicted from model calculations of atomic chains was not fully unexpected. Experimentally, it is very hard to design a probe that can directly measure the magnetism of atomic chains. Here, we demonstrate Shot noise, the intrinsic noise due to the discrete electronic charge, reveals information on the magnetic state of Pt atomic chain. In contrast to the predictions, we find clear evidence for a non-magnetic ground state of Pt atomic

		chains. This could be due to blocking of the fully spin polarized channels while transmission is carried by the less massive and poorly polarized s-electrons. We will compare the Pt measurement with shot noise measurement on ferromagnetic atomic contacts.
Sebastian Mehl	Influence of Noise on the Exchange-Only Qubit	Spin qubits have attracted interest as one realization scheme to achieve quantum computation in a solid state system. Encoding qubits into more than one quantum dot has turned out to be experimentally very favorable. When encoding a qubit into three quantum dots one can show that electrostatic bias offers full control of the qubit. It generates tunable exchange interactions between neighboring quantum dots. We present the influence of noise on the exchange-only qubit and discuss coherence properties. We especially point out how the definition of the qubit in the embedding Hilbert space can lead to different coherence properties.
Tomas Novotny	Theory of single-Josephson-junction-based microwave amplifier	I will present a theory describing the recently proposed and realized microwave amplifier based on the negative resistance of a selectively damped Josephson junction [P. Lahteenmaki et al., Sci. Rep. 2, 276 (2012)]. The theory uses the Gaussian expansion around the limit cycle and its results are in excellent agreement with the measured as well as simulated characteristics of the device. I will also sketch the prospects of semi-analytical approaches and possibilities of optimization of the devices based on the presented theory.
Andreas Nunnenkamp	Single-photon Optomechanics	Optomechanics experiments are rapidly approaching the regime where the radiation pressure of a single photon displaces the mechanical oscillator by more than its zero-point uncertainty. We show that in this limit the power spectrum has multiple sidebands and that the cavity response has several resonances in the resolved-sideband limit. Using master-equation simulations, we also study the crossover from the weak-coupling many-photon to the single-photon strong-coupling regime. Finally, we find non-Gaussian steady states of the mechanical oscillator when multiphoton transitions are resonant. Our study provides the tools to detect and take advantage of this novel regime of optomechanics.
David Oehri	Scattering matrix approach to interacting electron transport	We investigate the modification in mesoscopic electronic transport due to electron-electron interactions making use of scattering states. We demonstrate that for a specific (finite range) interaction kernel, the knowledge of the scattering matrix is sufficient to take interaction effects into account. We calculate perturbatively the corrections to the current and current-current correlator; in agreement with previous work, we find that, in linear response, interaction effects can be accounted for by an effective (renormalized) transmission probability. Beyond linear response, simple renormalization of scattering coefficients is not sufficient to describe the current-current correlator, as additional corrections arise due to irreducible two-particle processes. Furthermore, we find that the correlations between opposite-spin currents induced by interaction are enhanced for an asymmetric scatterer, generating a nonzero result already to lowest order in the interaction.
Ivan Pentegov	Shot noise measurements in a low temperature Scanning Tunneling Microscope	Shot noise measurements in a low temperature Scanning Tunneling Microscope I.S. Pentegov(1), B. Borca(1), V. Schendel(1), U. Schlickum(1), P.Wahl(1,2), K.Kern(1,3) 1 Max-Planck-Institute for Solid State Research Stuttgart , Germany 2 SUPA, School of Physics and Astronomy, University of St Andrews North Haugh, St Andrews, Scotland, UK 3 École Polytechnique Fédérale de Lausanne Lausanne, Switzerland e-mail: i.pentegov@fkf.mpg.de Shot noise, which occurs whenever a current flows due to the discreteness of the electrical charge, becomes especially significant in the limit of nanoscale conductors. When the size of a conductor is approaching the ballistic limit, the Landauer model, describing the current flow, can be applied. The conductor is viewed as a parallel circuit of N independent transmission channels with individual transmission probabilities[1]. The conductance shows a stepwise behavior, increasing by multiples of the conductance quantum with the number of open channels. The noise level is suppressed whenever the conductance is close to a multiple of a conductance quantum – indicating that a transmission channel becomes almost fully transparent[2]. Hence, shot noise is a prosperous source of complementary information to what is obtained by DC conductance measurements alone for systems operating in a quantum regime, e.g. Kondo effect in quantum dots[3]. STM is a powerful technique to investigate local properties on the atomic scale, clear advantage of it is the possibility to conduct precise noise measurements on well defined objects like single atoms or molecules in addition to topographic imaging. Our aim is to obtain noise level dependencies on the DC current flow from the tunneling regime up to a quantum point contact between the STM tip and individual atoms or molecules on the surface. The challenges associated with combining the shot noise measurement with STM circuitry are discussed. References: [1] C.Beenaker, C.Schöneberger, Physics Today 56(5), 2003 [2] H.E. van den Brom and J.M. van Ruitenbeek, Phys. Rev. Lett. 82(7), 1999 [3] Yoshiaki Yamauchi et al., Phys. Rev. Lett. 106, 2011
Vadim Ponomarenko	Bunching of fractional electron charges in counting statistics of edge-state Mach-Zehnder interferometer.	We have studied the counting statistics of charge transfer between the two edges of Quantum Hall liquids of, in general, different filling factors, $\nu_{0,1}=1/(2 m_{0,1}+1)$, with $m_0 \geq m_1\geq 0$, forming Mach-Zehnder interferometer (MZI). Zero temperature expression for the cumulant generating function in the large-time limit is obtained from the known Bethe ansatz solution [1] for symmetric interferometer with equal propagation times along the two edges between the contacts and time-independent bias voltage V. The low-V limit of the generating function can be interpreted in terms of the regular Poisson process of electron tunneling, while its large-V asymptotics reproduces the m-state dynamics ($m\equiv 1+m_+m_$) of quasiparticles with fractional charge e/m and anyon braiding statistics. Description of this dynamics as an m-state cyclic Poisson process is further extended to finite temperature T and non-symmetrical fractional edge-state MZI and is also addressed to transport through a quantum dot under Coulomb blockade ($m=2$). The counting statistics of this process demonstrates bunching of the fractional electron charges which we quantified by calculating the time dependent probabilities of finding fractional and integer electron charges transferred. It is shown that the integer charge transfer probability remains bigger than any fractional charge transfer ones (and $\ge 1/m$) and in the long time limit coincides with the Fano factor at $T=0$. This relation is generalized to finite temperatures in the form of the fluctuation-dissipation theorem. [1] V. V.\ Ponomarenko and D.V.\ Averin, Mach-Zehnder interferometer in the Fractional Quantum Hall regime. Phys.Rev.Lett, vol.99, 066803 (2007).
Emily Pritchett	Microwave Photon Counting and Cavity State Preparation with Josephson Photomultipliers	Authors: Emily Pritchett, Luke Govia, and Frank Wilhelm (all affiliated with Saarland University) Abstract: Many of the benchmark experiments of quantum optics have been tested in the growing field of circuit-QED where quantized superconducting circuits exchange energy as microwave-frequency radiation. While the controllability of superconducting circuits adds to the catalogue of experiments accessible in QED, some tasks, such as single-photon detection, remain challenging in the limit of low-frequency, large-wavelength photons. Here we study current-biased Josephson junctions as microwave photon counters by calculating the back action of photon detection on a microwave cavity and specify the optimal working conditions of junctions for photon counting. Furthermore, we show that exotic microwave cavity states are straightforward to prepare by measurement post-selection with such junction-based microwave-photon counting devices.

Marco Schirò	Non-Equilibrium Many Body Physics with Electrons and Photons	Small quantum mechanical systems made of few interacting degrees of freedom coupled to an external environment represent paradigms of transport, dissipation and non equilibrium phenomena in strongly correlated systems at nanoscale. Experimental realizations of these so called quantum impurity models appear in a variety of different physical contexts, from quantum dots and single molecules attached to leads to hybrid nano-devices realized interfacing quantum dots with microwave resonators on a chip. In this talk I will discuss several examples of non equilibrium many body physics in systems made by correlated electrons and photons.
Thomas Schmidt	Spin-charge separation in one-dimensional fermion systems beyond the Luttinger liquid theory	We develop a nonperturbative zero-temperature theory for the dynamic response functions of interacting one-dimensional spin-1/2 fermions. In contrast to the conventional Luttinger liquid theory, we take into account the nonlinearity of the fermion dispersion exactly. We calculate the power-law singularities of the spectral function and the charge- and spin-density structure factors for arbitrary momenta and interaction strengths. The exponents characterizing the singularities are functions of momenta and differ significantly from the predictions of the linear Luttinger liquid theory. We generalize the notion of the spin-charge separation to the nonlinear spectrum. This generalization leads to phenomenological relations between threshold exponents and the threshold energy.
Shyam Shankar	Quantum back-action of variable strength measurement	
Janine Splettstoesser	Zero-frequency noise in adiabatically driven quantum systems	We investigate the noise created by an adiabatically driven quantum dot pump, subject to Coulomb interaction. In order to calculate the zero-frequency noise, we make use of a real-time non-equilibrium diagrammatic approach within a perturbative expansion in the tunnel coupling to the reservoirs. We develop an approach to include a treatment of the explicit, slow time dependence of the Hamiltonian to the calculation of the zero-frequency current noise. As a generic example, we consider the case of a single-level quantum dot coupled to two electronic reservoirs, where charge pumping arises by applying two out-of-phase time-dependent parameters, leading to a modulation of the energy levels, the bias or the tunnel couplings. We study the properties of the adiabatic correction to the zero-frequency noise, i.e., the pumping noise. If no bias is applied, the adiabatic correction shows Coulomb-interaction induced deviations from the fluctuation-dissipation theorem. Furthermore we show that the adiabatic correction to the Fano factor carries information about the coupling asymmetry and it is independent of the choice of the pumping parameters. When including a time-dependent finite bias, we find that there can be pumping noise even if there is zero pumped charge, indicating the underlying processes leading to a suppression of the pumped charge. Ref.: R.-P. Riwar, J. Splettstoesser, and J. Konig, in preparation.
Grégory Strübi	Precision measurements beyond weak-value amplification	The measurement of small physical effects naturally appears to be very sensitive to the unavoidable technical noise of real-world systems. Therefore one could anticipate that progress in this direction requires to increase the precision and stability of the experimental setup. Nevertheless, the new method of weak-value amplification provides a way around those requirements. Indeed, this scheme has been successfully used to measure the displacement [1] and deflection [2] of a laser beam to an unprecedented precision. On the theory side however, there are still open questions. We propose a generalization of the original scheme which provides an alternative viewpoint and sheds some light on the problem. We show how the smallness of the effect to be measured allows to trade efficiently technical noise for statistical uncertainty, which can in principle be overcome by many repetitions of the experiment. [1] O. Hosten and P. Kwiat, Observation of the spin Hall effect of light via weak measurements, Science 319, 787 (2008). [2] P. B. Dixon et al., Ultrasensitive beam deflection measurement via interferometric weak value amplification, Phys. Rev. Lett. 102, 173601 (2009).
Giovanna Tancredi	Noise spectrum analysis of a superconducting circuit	Extensive characterization of noise sources is crucial for superconducting bit circuits. In this poster we present a novel technique for accessing environmental noise spectra. that can be applied to any type of threshold detector. We exploit this technique in the case of a Cavity Bifurcation amplifier consisting of a superconducting coplanar waveguide embedding a SQUID array as nonlinear element. We present both theory and experimental results.
Yasuhiro Tokura	Thermoelectric transport in partially coherent three-terminals	A voltage probe made of an ideal electron reservoir provides a dephasing source in the two-terminal configurations. We have proposed non-ideal reservoir, which is multiply tunnel coupled to quantum dots and maintains partial coherence of the electron wave. We have investigated Aharonov-Bohm oscillations in the transport through this system and argued the symmetry of the transport coefficient with respect to the magnetic flux. In this contribution, we extend our work to have different local temperatures in electrodes, and argue the thermoelectric transport and its symmetry.
Niels Ubbelohde	Shot-Noise at a Fermi-Edge Singularity: Non-Markovian Dynamics	In a measurement of the electron shot noise we probe the correlations in the transport through InAs quantum dots at a Fermi-edge singularity, a many particle interaction effect between the quantum dot potential and the electrons in the lead. The suppression of noise due to the Coulomb blockade mechanism in the transport of single electrons is well described by a Markovian master equation model as a function of tunneling rates. In the regime of the Fermi-edge singularity however, the measured data cannot be understood within the Markovian model. Qualitative and quantitative agreement with the theoretical model can be achieved by taking non-Markovian dynamics into account. A detailed comparison shows how at low temperatures the interaction effect leads to quantum correlations between the dot potential and the fermionic reservoir.
Yasuhiro Utsumi	Work fluctuation theorem for a classical circuit coupled to a quantum conductor	We propose a setup for a quantitative test of the quantum fluctuation theorem. It consists of a quantum conductor, driven by an external voltage source, and a classical inductor-capacitor circuit. The work done on the system by the voltage source can be expressed by the classical degrees of freedom of the LC circuit, which are measurable by conventional techniques. In this way the circuit acts as a classical detector to perform measurements of the quantum conductor. We prove that this definition is consistent with the work fluctuation theorem. The system under consideration is effectively described by a Langevin equation with non-Gaussian white noise. Our analysis extends the proof of the fluctuation theorem to this situation.
Malte Vogl	Criticality in transport through the quantum Ising chain	We consider thermal transport between two reservoirs coupled by a quantum Ising chain as a model for non-equilibrium physics induced in quantum-critical many-body systems. By deriving rate equations based on exact expressions for the quasiparticle pairs generated during the transport, we observe signatures of the underlying quantum phase transition in the steady-state energy current already at finite reservoir temperatures. arXiv: 1208.5989, submitted
Philip Wollfarth	Full counting statistics applied to Cooper-pair pumping	We investigate geometric charge pumping in superconducting Josephson devices using the method of Full Counting Statistics. In previous studies the expectation value of the current operator was calculated and a very delicate handling of the dissipative master equation governing the dynamics of the system was required. E.g., the rotating wave (secular) approximation turned to be non-charge-conserving. We include the counting field (charge measuring divide) into the master equation and investigate the influence of voltage fluctuation on the pumping process.
Fan Wu	Unconventional matching network for low signal amplification and noise detection	More and more interest is rising in radio-frequency measurements of mesoscopic systems, such as nano-scale amplifiers and shot noise detection schemes. In these measurements, the impedance mismatch between high-impedance sample and microwave transmission line would seriously reduce the signal-to-noise ratio and the cut-off frequency. Here we will present an unconventional on-board impedance matching circuit, which has a wide bandwidth of 4-8 GHz and which is capable to transfer up to 1 kOhm source impedance to 50 Ohm lines. The impedance transformer is realized with standard microwave engineering techniques and can be implemented directly on normal PCB sample holders. Experimental tests with the transformer are performed on graphene-based field effect transistors with an impedance in the range of hundreds of Ohms.
Michael Wulf	Electron Accounting: A proof of principle	A standard of current based on a counted number of electrons passing through a constraint in a given time has been an elusive goal for three decades. The current needs to be both: sufficiently large to be scaled by the methods of resistance metrology (at least 100pA) while electrons need to be counted to an error-threshold better than 10 ppb. Devices that “pump” one electron at a time for each period of a driving signal are regarded to be the most promising route to attain said goal. When two such devices operate in series, the charge build up on a small node between the two pumps can be monitored and will only change when either pump makes an error, but remain constant during error-free operation. Operating at least three such pumps in series while monitoring the charges between adjacent pumps even allows the attribution of the errors observed by time resolved cross-correlation measurements. The current flowing through the structure is thus known to higher accuracy then would be attainable by use of just a single device. Detailed analysis of the

statistical evolution exhibited by such a circuit allows for the direct construction of an algorithm making this estimate including its uncertainty [1].

Our prototype experiment uses dynamical quantum dots [2, 3] formed in a lithographically patterned 2-dimensional electron gas by applying voltages as pumps and metallic single-electron transistors formed by 2-angle shadow evaporation of Aluminium.

We demonstrate the crucial modes of operation: First an electron is shuttled through the structure and observed at each node. This mode allows for the verification of pump operation and single electron resolution of the node charge. The current in this mode is however limited by the detector bandwidth. In a second mode all pumps are operated simultaneously, so that only errors are detected. In this mode attainable accurate currents are only limited by the requirement that errors be resolvable.

We thereby demonstrate an architecture that eases the requirements on individual components for an electron counting circuits, which may facilitate a counting, based representation of the Ampere. The concept of accounting for electrons by only detecting the rare error events may translate to other pump technologies [4].

[1] M. Wulf and A. B. Zorin, e-print arXiv:0811.3927
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