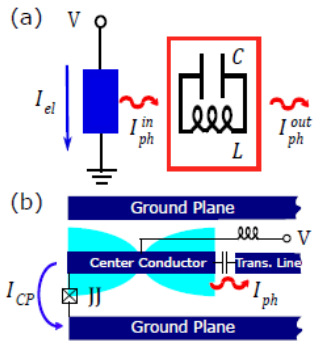
Charge transfer photonics: Sensing electrical current noise and nonlinear quantum dynamics with quantum microwaves | 6GS	**Start Date:** March 1st 2015
PhD: Jennifer Gosner (Ulm)	**PIs:** Prof. Joachim Ankerhold (Ulm) Prof. Dirk Lebiedz (Ulm)



Abstract: More than sixty years ago, Glauber showed that classical currents generate classical radiation. At low temperatures, this is no longer true as charge currents must be represented by operators. The question is thus: Can the quantum noise of charge currents be obtained from the quantum noise of the corresponding photon radiation? This issue has received particular attention recently in a newly emerging field which explores the quantum optics of mesoscopic conductors. In one class of set-ups, Josephson junctions (JJs) are integrated into resonator circuits and are biased by external dc-voltages. Charge transfer (coherent or incoherent) leads to the emission of photons into the cavity and the controlled creation of quantum microwave states. In this project we plan to address potential applications, namely, to operate these devices as sensors for nonlinear cavity quantum dynamics far from equilibrium and as probes for the full counting statistics (fcs) of charge transfer via photon detection. Specifically, the following topics will be addressed: (i) The nonlinear quantum dynamics for stronger driving at multi-photon resonances, (ii) the relation of electrical current noise and the statistics of radiated quantum microwaves, and (iii) the analysis of set-ups, where nano-beams as nano-mechanical resonators are capacitively coupled to the gate of voltage-biased Cooper pair transistors and embedded in resonators. This aggregate may not only allow to cool the mechanical motion of nano-beams but at the same time provides a very sensitive tool to monitor it close to the quantum limit.

Recent results:

- *Theoretical proposal and experimental realization of a new source for correlated quantum microwave photons*
- *Characterization of a new type of dissipative quantum phase transition*
- *Invited plenary talk (JA): Frontiers in Quantum and Mesoscopic Thermodynamics, Prague, July 2017*

Publications:

M. Westig, B. Kubala, O. Parlavecchio, Y. Mukharsky, C. Altimiras, P Joyez, D. Vion, P. Roche, M. Hofheinz, D Esteve, M Trif, P. Simon, J. Ankerhold, and F. Portier, *Emission of non-classical radiation by inelastic Cooper pair tunneling* arXiv:1703.05009 , Phys. Rev. Lett. in press.

Yaxing Zhang, J. Gosner, S. M. Girvin, J. Ankerhold, and M. I. Dykman, *Multiple-period Floquet states and time-translation symmetry breaking in quantum oscillators* arXiv:1702.07931, Phys. Rev. A in press.

Further Collaborators: M. Dykman (Michigan State University, USA)