HL 57: Quantum Dots and Wires: Quantum Optics II

Time: Wednesday 12:15–13:00 Location: H15

HL 57.1 Wed 12:15 H15

Photon Statistics Excitation Spectroscopy of a Single Two Level System — •Max Strauss[1], Marlon Placke[1], Sören Kreinberg[1], Christian Schneider[2], Martin Kamp[2], Sven Höfling[2,3], Janik Wolters[1], and Stephan Reitzenstein[1] — [1]Institut für Festkörperphysik, TU Berlin, Germany — [2]Technische Physik, Universität Würzburg, Germany — [3]SUPA, School of Physics and Astronomy, University of St. Andrews, UK

The interaction of a coherent light wave with a fermionic two level system (TLS) is one of the corner stones of modern quantum optics. Interestingly, its inherent nonlinearity makes it also an ideal probe for the photon statistics of the interacting light field. In recent years this exciting field of quantum optics has been extended from atomic systems to semiconductor nanostructures, e.g. to the coherent control of self-assembled quantum dots (QDs). Here, we address a so far unexplored regime of resonance fluorescence in which the QD is excited not with a laser but with a narrowband chaotic light source. By analysing the resonantly scattered emission of the TLS, we find that the photon statistics of the excitation source greatly influences the TLS's dynamics in quantitative agreement with theoretical predictions.

HL 57.2 Wed 12:30 H15

Optical Counting Statistics of Single Electron Tunneling into a Single Self-Assembled Quantum Dot — Annika Kurzmann[1], Arne Ludwig[2], Andreas D. Wieck[2], Axel Lorke[1], and •Martin Geller[1] — [1]Faculty of Physics and CENIDE, University of Duisburg-Essen, Lotharstr. 1, 47057 Duisburg, Germany — [2]Chair of Applied Solid State Physics, Ruhr-Universität Bochum, Universitätsstr. 150, 44780 Bochum, Germany

We demonstrate here an optical detection scheme to observe single electron tunneling into a single self-assembled quantum dot (QD). The detection scheme is based on driving the excitonic transition into resonance fluorescence [1]. It allows us to use optical counting statistic [2] to reveal the interactions and correlations between excitons and electrons.

The single QD is embedded in a diode structure with a 3D charge reservoir, which allows the controlled charging and discharging of the QD. The time-resolved resonance fluorescence of the exciton is measured, while tunneling between the charge reservoir and the QD is possible. In the generated telegraph-noise we directly observe quantum jumps of the electrons tunneling into and out of the QD, which gives access to the distribution of the fluctuations, i.e. shot noise and Fano factor. A reduced Fano factor is observed for equal tunneling rates into and out of the QD, due to an enhanced correlation in the current fluctuation.

[1] C. Matthiesen et al., Phys. Rev. Lett. **108**, 093602 (2012).
[2] L. S. Levitov et al., J. Math. Phys. **37**, 4845 (1996).

HL 57.3 Wed 12:45 H15

Creation of a squeezed photon distribution using artificial atoms with broken inversion symmetry — •Martin Koppenhöfer and Michael Marthaler — Karlsruhe Institut of Technology, Karlsruhe, Germany

We consider a two level system with both a transversal and a longitudinal coupling to the electromagnetic field of a resonator. Using a polaron transformation, this Hamiltonian can be mapped onto a Jaynes-Cummings Hamiltonian with generalized field operators acting on the electromagnetic field in the resonator. In contrast to the usual ladder operators a and $a^\dagger$, these operators exhibit a non-monotous coupling strength with respect to the number n of photons in the resonator. Especially, there are roots of the coupling between qubit and resonator at certain photon numbers n_0. We show that this effect can be exploited to generate photon-number squeezed light, characterized by a Fano factor $F \ll 1$, with a large number of photons (e.g. of the order of 10^4).