HL 40: On-Chip Quantum Photonics II

Organizers: Simone Portalupi and Peter Michler (Universität Stuttgart)

Time: Tuesday 14:45–16:00 Location: H16

Invited Talk HL 40.1 Tue 14:45 H16

On-chip generation, routing and detection of nonclassical light — •Kai Müller[1,2], Kevin A. Fischer[1], Constantin Dory[1], Günther Reithmaier[2], Fabian Flassig[2], Konstantin G. Lagoudakis[1], Tomas Sarmiento[1], Michael Kaniber[2], Jonathan J. Finley[2], and Jelena Vuckovic[1] — [1]E. L. Ginzton Laboratory, Stanford University, Stanford, California 94305, USA — [2]Walter Schottky Institut, Am Coulombwall 4, 85386 Garching, Germany

Nonclassical light can be generated on chip using self-assembled quantum dots strongly coupled to photonic crystal cavities. However, the highly dissipative nature of such systems typically limits the achievable fidelities. Here we show that detuning emitter and cavity mode [1] and understanding the coupling to phonons [2] facilitates high-fidelity generation of single photons. Moreover, by exploiting a novel self-homodyne suppression technique [3] we demonstrate generation of highly-indistinguishable photons [4].

On-chip detection can be realized by integration of superconducting single photon detectors. To this ends, we fabricate patterned NbN films directly onto GaAs waveguides. The absorption of a single photon produces a measurable electric signal which allows us to demonstrate on-chip detection of emission from single quantum dots [5-6].

[1] K. Müller et al. Phys. Rev. Lett. 114, 233601 (2015) [2] K. Müller et al. Phys. Rev. X. 5, 031006 (2015) [3] K. A. Fischer et al. arXiv:1512.04102 (2015) [4] K. Müller et al. arXiv:1512.05626 (2015) [5] G. Reithmaier et al. Scientific Reports 3, 1901 (2013) [6] G. Reithmaier et al. Nano Letters, 15 (8), 5208 (2015)

Invited Talk HL 40.2 Tue 15:15 H16

On-chip quantum optics using quantum dot microcavities and waveguide structures — Pierce Munnelly[1], Matthias Karow[1], Arsenty Kaganskiy[1], Jan-Hindrik Schulze[1], Andre Strittmatter[1], Martin Kamp[2], Sven Rodt[1], Sven Höfling[2], Tobias Heindel[1], Christian Schneider[2], and •Stephan Reizenstein[1] — [1]Institute of Solid State Physics, Technische Universität Berlin, 10623 Berlin, Germany — [2]Technische Physik, Universität Würzburg, 97074 Würzburg, Germany

The generation, manipulation, and detection of single photons on an integrated semiconductor platform containing passive and active elements is a central goal of on-chip quantum optics. Progress in this field will strongly benefit from monolithically integrated and electrically contacted building blocks.

In this talk I will present an on-chip device concept which is based on monolithically integrated and electrically driven whispering gallery mode quantum dot (QD) microlasers which can resonantly excite single-QD microcavity structures operating in the regime of cavity quantum electrodynamics (cQED). This concept is used to observe cQED effects in a fully integrated platform, to generate non-classical light, and to detect light in an on-chip configuration. Moreover, I will present work on planar waveguide structures with deterministically integrated quantum dots.

HL 40.3 Tue 15:45 H16

On-chip Photodetectors using Electrically Contacted Quantum Dot Micropillars — •Pierce Munnelly[1], Matthias Karow[1], Tobias Heindel[1], Martin Kamp[2], Sven Höfling[2], Christian Schneider[2], and Stephan Reitzenstein[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Berlin, Germany — [2]Technische Physik, Universität Würzburg, Würzburg, Germany

An important goal of nanophotonics is to unite the generation of coherent or single-photon states of light with efficient manipulation and detection techniques for advanced schemes in quantum information science. As the optical parts of the circuits are more heavily integrated and components are shrunk to smaller and smaller scales, it will also become harder to assess and control the quality of light sources within optoelectronic devices via conventional out-of-plane detection methods such as micro-photoluminescence spectroscopy.

In this contribution, a novel, micrometer-scaled, on-chip photon detector will be presented. The detector is based on an electrically contacted quantum dot micropillar and operates in the regime of cavity quantum electrodynamics. The potential of our concept is exemplarily demonstrated by determining the input-output characteristics and the threshold current of a monolithically integrated whispering gallery mode laser.