SFB/TRR 21 - Colloquium

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Semiconductor sources of photon pairs

For fundamental tests of quantum physics as well as for quantum communications non-classical states of light are an important tool. In our research we focus on developing semiconductor-based and integrated sources of single photons and entangled photon pairs. In my talk I will present two approaches that we have been following towards this goal. In the first approach we demonstrate efficient photon pair generation in an AlGaAs Bragg-reflection waveguide. Spontaneous parametric down-conversion creates photon pairs at telecommunication wavelengths. The various phase-matching solutions present in our device can be used to create time-bin or polarization entanglement. This approach can to lead to a fully integrated photon pair source with the pump laser, active and passive optical devices all on a single semiconductor chip. In our second approach we use resonant two-photon excitation of a single InAs/GaAs quantum dot to deterministically trigger a biexciton-exciton cascade. We demonstrate Rabi oscillations, Ramsey interference and all-optical coherent control of the quantum dot resulting in single and paired photons with a high degree of indistinguishability. This indistinguishability results in time-bin entanglement, which is a useful variant for long distance communication.

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