Plenary Talks - abstract

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QUANTUM PHOTONICS WITH SOLID-STATE DEVICES

ABSTRACT

Spontaneous parametric down conversion has served as an excellent workhorse for proof-of-principle demonstrations of multi-photon entanglement and optical quantum computing [1,2]. Yet, its probabilistic nature and higher-order photon emission limit the scalability in optical quantum information processing. Truly single photon sources based on semiconductor quantum dots offer distinct advantages including a scalable solid-state platform, ultrabrightness and interconnectivity with matter qubits. A key prerequisite for their use in optical quantum computing and solid-state quantum networks is a high level of indistinguishability. In this talk, I will present our recent experiments on generating deterministic, highly indistinguishable, robust and tunable single photons from a single quantum dot [3]. The methods used include pulsed resonance fluorescence, adiabatic rapid passage, and spin-flip Raman scattering. Two-photon interference was observed from the same dot with an indistinguishablity up to 99.5% and remotes dots up to 87%. The intrinsic spin-photon correlation also allows the generation of Greenberger-Horne-Zeilinger-type spin-photon entanglement and deterministic quantum state transfer between single photons and single spins. Lastly, I will briefly present our recent experiment results on photon antibunching from two-dimensional atomic layers [4].

References:

[1] Pan et al. Rev. Mod. Phys 84, 777 (2012);
[2] Wang et al. Nature 518, 516 (2015);
[3] He et al. Nature Nanotechnology 8, 213 (2013);
[4] He et al. Nature Nanotechnology 10, 497 (2015).