Efficient Photon Collection & Conversion from Single Solid-State Quantum Emitters

A. Ahlrichs[1], F. Böhm[1], T. Kroh[1], C. Müller[1], N. Nikolai[1], and O. Benson[1]

[1]*Institute of Physics, Humboldt-University Berlin, Newtonstr. 15, 12489 Berlin, Germany*
E-mail: oliver.benson@physik.hu-berlin.de

A crucial functionality of any quantum network is the efficient conversion of stationary and flying qubits. Whereas numerous quantum systems have been employed as stationary qubits, photons are the only possible carriers for flying qubits. The efficiency of conversion has intrinsic limitations given by, e.g., internal quantum yield of the stationary system or its spectral purity. However, there is also the purely classical problem of coupling to special guided or directed optical modes or the conversion to other frequencies (e.g. the telecom band).
In this presentation we address the issue of the conversion of stationary qubits in solid-state emitters such as quantum dots or defect centers in diamond. In one part we discuss strategies to employ efficient photon coupling of light from defect centers in diamond via dielectric or plasmonic antenna structures [1,2] as well as coupling to optical fibers [3]. In a second part we report on our efforts to efficiently convert photons from defect centers and quantum dots in the telecom band [4].

References

[1] "Wiring up pre-characterized single-photon emitters by laser lithography", Q. Shi, B. Sontheimer, N. Nikolay, A.W. Schell, J. Fischer, A. Naber, O. Benson, M. Wegener, Sci. Rep. 6, 31135, (2016).
[2] "Quantum emitters coupled to circular nanoantennas for high brightness quantum light sources", H. Abudayyeh and R. Rapaport, Quant. Sci. and Technol., 034004 (2017).
[3] "Fiber-Coupled Diamond Micro-Waveguides toward an Efficient Quantum Interface for Spin Defect Centers", M. Fujiwara, O. Neitzke, T. Schröder, A. W. Schell, J. Wolters, J. Zheng, S. Mouradian, M. Almoktar, S. Takeuchi, D. Englund, and O. Benson, ACS Omega 2, 7194-7202 (2017)
[4] "Heralded wave packet manipulation and storage of a frequency-converted pair photon at telecom wavelength", T. Kroh, A. Ahlrichs, B. Sprenger, and O. Benson, Quant. Sci. Technol. 2, 034007 (2017)