Solid-state spin-photon interfaces for quantum information processing

P. Lodahl
Sparrow Quantum and Niels Bohr Institute, University of Copenhagen, Denmark;
lodahl@nbi.ku.dk

Semiconductor quantum dots embedded in photonic nanostructures offer a highly efficient and coherent deterministic photon-emitter interface enabling on-demand single-photon sources and multi-photon entanglement sources [1,2]. We discuss the fundamental operational principles of these devices and introduce a protocol of deterministic entanglement generation by controlling a single spin in the quantum dot [3]. We will present the experimental state-of-the-art of multi-photon entanglement generation [4,5] including the realization of photon fusion [6], which is a primitive for fusion-based quantum computing. Finally, we discuss potential applications of this novel hardware for quantum communication and photonic quantum computing [7].

References

[1] Lodahl et al., Rev. Mod. Phys. 87, 347 (2015).
[2] Lodahl, Ludwig and Warburton, Phys. Today 75, 3-44 (2022).
[3] Tiurev et al., Phys. Rev. A L030601 (2022).
[4] Appel et al., Phys. Rev. Lett. 128, 233602 (2022).
[5] Meng et al., arXiv: 2310.12038
[6] Meng et al., arXiv: 2312.09070
[7] Uppu et al., Nature Nano. 16, 1308 (2021).