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Innsbruck Physics Colloquium

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Deterministic spin-photon interfaces

Semiconductor quantum dots embedded in photonic nanostructures offer a highly efficient and coherent deterministic photon-emitter interface [1]. By introducing and controlling a single spin in the quantum dot, a coherent and deterministic spin-photon interface is obtained. We review recent experimental progress on coherent spin control of quantum dots in nanophotonic waveguides [2] enabled by the growth of low-noise heterostructures and subsequent fabrication of planar photonic structures [3].We demonstrate a photonic switch that is operated by controlling a single spin [4], which is a fundamental building block for photonic quantum gates. Furthermore, we present chiral photon-emitter interaction as a mean to construct non-reciprocal photonic devices [5,6]. We finally point out potential applications of this new quantum hardware for constructing a deterministic Bell-state analyzer [7] for photons or one-way quantum repeaters [8] towards photonic quantum networks [9].

[1] Lodahl et al., Rev. Mod. Phys. 87, 347 (2015).
[2] Ding et al., Phys. Rev. Appl. 11, 031002 (2019).
[3] Lobl et al., Phys. Rev. B 165440 (2017).
[4] Javadi et al., Nature Nanotechnology 13, 398 (2018).
[5] Sollner et al., Nature Nanotechnology 10, 775 (2015).
[6] Lodahl et al., Nature 541, 473 (2017).
[7] Ralph et al., Phys. Rev. Lett. 114, 173603 (2015).
[8] Borregaard et al., Advanced Quantum Technologies 1800091 (2019).
[9] Lodahl, Quantum Science and Technology 3, 013001 (2018).

Tuesday, 7.1.2020, at 17:15 h in lecture hall C

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