Strong non-reciprocal and non-linear transport of photons mediated by a single quantum emitter

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At the current stage, solid-state quantum optics can strongly impact photonic quantum information processing. Solid-state quantum emitters can generate the necessary single photons and more sophisticated cluster states deterministically, currently posing a significant bottleneck for photonic quantum information processing. In this talk, I will present our work on realizing some of these elements using quantum dots in optical microcavities. In the first part, I will present an efficient source of indistinguishable single photons [1]. I will show that we achieve an end-to-end efficiency of 57 %, 2.3 times higher than the state-of-the-art, and discuss the significance of this improvement for photonic quantum technologies. In the second part, I will present an optical equivalent of a diode [2]. I will show that a single quantum dot can block the transmission of the photons in one direction while allowing the transport in the opposite direction. I will also show that the transmission of photons in our diode is non-linear and that the onset of the non-linearity is at the single-photon limit.

[1] [1] Tomm, Javadi, Antoniadis, Najer, Löbl, Korsch, Schott, Valentin, Wieck, Ludwig, Warburton, Nat. Nanotechnol. **16**, 399 (2021).

[2] N. O. Antoniadis, N. Tomm, T. Jakubczyk, R. Schott, S. R. Valentin, A. D. Wieck, A. Ludwig, R. J. Warburton, A. Javadi, *Npj Quantum Inf.* **8**, 27 (2022).