Abstract:
Single photons play a central role as quantum information carriers in quantum networks to connect distant nodes. A promising approach is the realization of efficient atom-cavity interfaces, which allows the deterministic and reversible transfer of information between the flying photons and the stationary atomic quantum bit. In this work, we use light-matter interfaces based on a single semiconductor quantum dot, acting as an artificial atom, deterministically coupled to a micropillar cavity. We show that such a device is both an efficient emitter and receiver of single photons, and can be used to implement basic quantum functionalities.

First, the device is shown to act as a source of single photons, which allows the generation of highly indistinguishable photons with a record brightness. These single-photon sources are then used to investigate path-entangled N00N states and propose a new tomographical method. And finally, we observe optical nonlinearities at the single photon level, and we demonstrate the filtering of single photon Fock states from classical incident light pulses.