Single photon generation, manipulation and detection with nanowires

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We generate single and entangled pairs of photons at telecom wavelengths using quantum dots and demonstrate quantum key exchange as well as entanglement and synchronization over a deployed optical fiber connecting our lab in downtown Stockholm to Ericsson research labs 17 km away. A key element is the single photon detection for which we have developed high-performance superconducting nanowire single photon detectors. We will present results on detectors coupled to single mode optical fibers as well as free space multipixel detectors that enable spectroscopy by time-stamping every detection event to generate spectra as well as correlations, cross-correlations and lifetimes from one measurement with unprecedented detection efficiency, noise level and time resolution. These detectors find applications in quantum communication, integrated quantum circuits as well as for lidar and quantum microscopy. We will discuss these applications along with the specific detector requirements for technologies based on single photon detection. Further improvements in terms of time resolution, photon number resolution and extended detection ranges will also be discussed. We also report on schemes to manipulate light on-chip, based on integrated photonics where SiN waveguides as well as LiNbO substrates combined with nanowire quantum dots enable additional control on the emission of single photons. Our single photon sources based on semiconductor quantum dots can generate single photons as well as entangled photon pairs at telecom wavelengths to enable implementation of long-distance quantum communication.