

From Superconducting Nanowire single photon detectors to innovative hybrid detector for quantum applications

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Generation, manipulation, and measurement of quantum states of light are the key functionalities for photonic quantum information science (QIS). However, for real world applications they must be realized on a robust and scalable platform. Integrated optics meet the above requirements: it can integrate non-classical light sources, reconfigurable waveguide circuits, and detectors. Currently, detection is still performed off-chip, incurring in detrimental coupling losses, and limiting the potential and scalability of photonic QIS. In this framework, superconducting nanowire technologies (superconducting nanowire single photon detectors - SNSPDs) allows the realization of on chip both single photon and photon number resolving detectors (PNRDs) with high efficiency, low dark counts and high repetition rates. Moreover, the fabrication capability of electron beam lithography techniques allows the realization of much complex detectors such as innovative hybrid detector capable of measuring both photon number and quadrature of an optical state, on an integrated platform.

Exploiting the scalability of (SNSPDs) by fabricating photon number resolving (PNR) detectors via spatial multiplexing of hundreds of weakly interacting single photon detectors coupled to the evanescent field of the same waveguide, it possible to detect up to 20 photons with an overall efficiency >90%. In this way PNR detectors integrated with a directional coupler allows to measure photon number or quadrature via weak homodyne detection, the two fundamental type of measurements needed for photonic protocols.

In this presentation the multiplexing scheme together with its technological aspect will be introduced together with the first proof of principle characterizations.

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