Real-time single-photon selection from single and multi-element SNSPDs

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Photon-number resolved detection of photons finds many uses in photonic quantum information processing, including recently demonstrated experiments on gaussian boson sampling [1] and feedforward protocols [2]. The accurate detection of photon-numbers is highly dependent on a high detection efficiency as loss changes the photon statistics. High efficiency detectors such as SNSPDs are well suited for this task, with both multi pixel detector as well as single pixel detectors capable of resolving photon-number. We first showcase a cryogenic integrated circuit capable of performing a feedforward operation based on a photon-number measurement in a multipixel detector. By integrating the multipixel detector readout electronics used in [3] we achieve an electronic latency of (1.5 ± 0.5) ns compared to (20 ± 2) ns for the previous realization.

Gaining photon-number information from single element SNSPDs benefits from a simple device structure compared to multi-pixel detectors but usually requires complex readout electronics like time to digital converters. We showcase a low latency cryogenic circuit capable of photon-number selection from a single element SNSPD with intrinsic photon-number resolution. One specific use case for photon-number measurements is the heralding of single photon from pair sources. This is demonstrated by selectively triggering on the single-photon component of a coherent state as shown in Fig. 1.

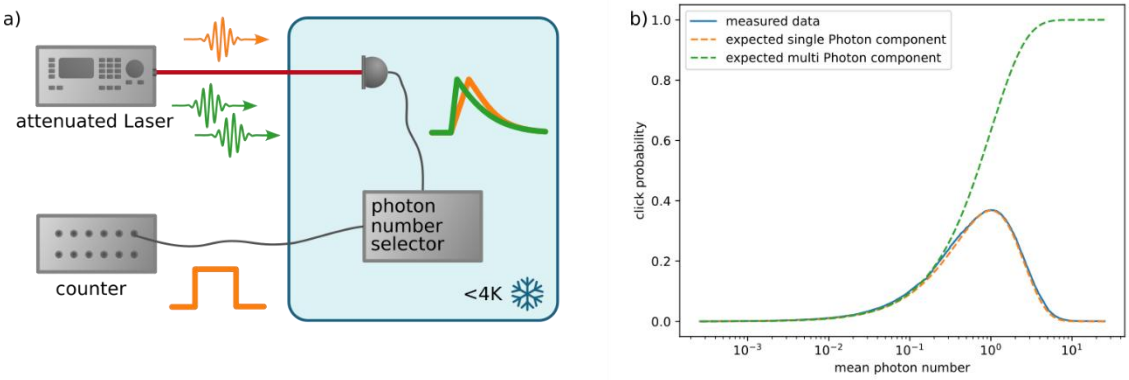

Fig. 1: *a) The setup used to measure the single-photon selection. b) The measured click statistics after the photon-number selection circuit compared to the expected Poissonian statistics*

Funding acknowledgement

This work was partially funded by the European Union [European Research Council (ERC), "Quantum Engineering of Superconducting Array Detectors In Low-Light Applications" (QuESADILLA), Grant No. 101042399].

References

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