Multipixel SNSPDs for Quantum and Classical applications

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Since their introduction [1], Superconducting Nanowire Single Photon Detectors (SNSPDs) have seen substantial technological advances driven by research both in and outside the academy, pushing detection efficiencies close to unity while maintaining a low dark-count rate, increasing detection rates and improving temporal precision [2]. As single pixel SNSPDs approach their fundamental limits, new efforts have focused on multipixel architectures that increase active areas, boost maximum count-rate and enable photon number resolving (PNR) capabilities. Multipixel geometries exploiting either linear or rectangular arrays are being investigated (Fig. 1a-c), enabling free-space coupling, imaging and even spectral resolution, particle spectrometry [3] or photon number resolution (Fig. 1d-e).

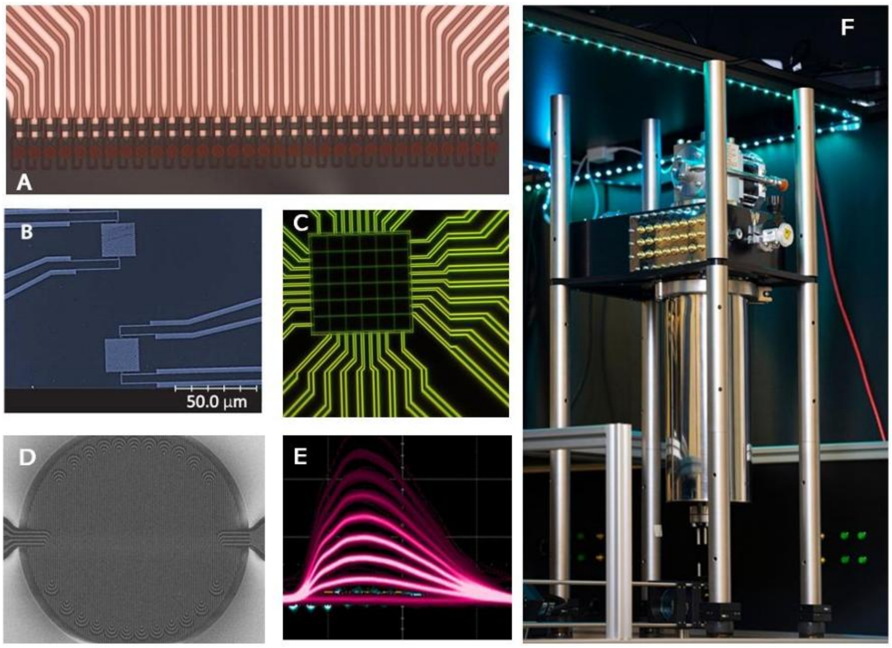

Fig. 1: *Multipixel configurations: (a,b) linear array, (c) planar array, (d,e) interleaved design with multilevel output. Cryogenic system: (f) commercial solution with optical access.*

Multi-element SNSPDs enable a wide range of applications. Linear and planar arrays add spatial resolution to detection events, supporting imaging and spectral multiplexing, while also achieving large detection areas without relying on single large SNSPDs, which are more vulnerable to fabrication defects and high kinetic inductance that limits speed. Their high speed and short recovery times benefit applications requiring elevated count rates, such as modern QKD protocols and certain quantum-computing schemes. Beyond quantum technologies, multipixel SNSPDs also enhance conventional applications including bio-imaging, fluorescence microscopy, particle detection [3], and spectroscopy. We will present recent advances across several multipixel SNSPD configurations in Fig. 1: linear arrays (a–b) for photon and particle detection [3], rectangular arrays (c) for communication and imaging, interleaved detectors (d–e) with PNR capabilities, and present a complete imaging-adapted detection system (f) with a cryostat providing direct free-space optical access.

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References
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