Short and Mid-Wave Infrared Detection with Superconducting Nanowire Single-Photon Detectors

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Superconducting nanowire single-photon detectors (SNSPDs) exhibit unprecedented detection capabilities in the visible and near-IR range [1]. Extending the spectral window of externally coupled SNSPDs to longer wavelengths is expected to have far-reaching implications, primarily for applications requiring photon-counting capabilities beyond 2 μm, but more broadly for applications currently limited by detectors with high background levels and relatively poor temporal resolution and detection efficiency. Examples include exploiting atmospheric windows beyond 2 μm for quantum and other forms of free-space optical communication, long-wavelength quantum optics, and even vibrational spectroscopy across astronomy, environmental monitoring, and fundamental molecular studies [2]. Here, we showcase the development of short-wave infrared (SWIR – 2.2-2.3 μm) and mid-wave infrared (MWIR – 3.0 μm) SNSPDs. In both wavelength ranges, we venture beyond state-of-the-art to achieve the best-reported system detection efficiencies (SDE). Furthermore, as illustrated schematically in Fig. 1, when using specific detectivity as the figure of merit in order to benchmark our SNSPDs against other detection technologies, we find that the SNSPDs outperform competing technologies. We will discuss the challenges in cryogenics, optics, and SNSPD design when building an SNSPD-based MWIR detection system and demonstrate the use of MWIR SNSPDs to characterize emerging materials platforms and quantum emitters in a previously unattainable manner

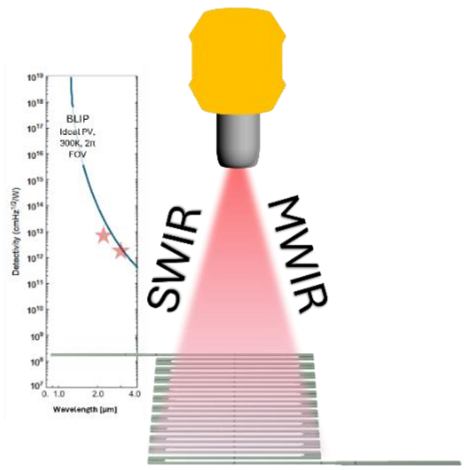

Fig. 1: *Illustration of fiber-coupled SNSPDs in the SWIR and MWIR range and their unprecedented specific detectivity values marked by red stars.*

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References

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