

4-Pixel SNSPD System for Stellar Intensity Interferometry

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Stellar Intensity Interferometry (SII) retrieves stellar angular diameters by measuring correlations between intensity fluctuations detected at two separated telescopes [1]. SII relies critically on fast and low-noise photon counting. In addition, the measurable signal is extremely small ($g^2-1 \approx 10^{-3}$ or below), making detector timing resolution and noise the dominant sensitivity limits.

Current SII implementations mostly employ avalanche photodiodes (APDs). However, the achievable correlation contrast is directly reduced by detector jitter and quantum efficiency, motivating the use of Superconducting Nanowire Single-Photon Detectors (SNSPDs) [2], which provide sub-100ps timing jitter, low dark count rates, and high detection efficiency.

Here, we present a laboratory SII detection system based on two 4-pixel SNSPD arrays and a thermal-light source (Fig. 1). We measure stable second-order correlations and directly compare SNSPD and APD performance. SNSPDs produce significantly narrower correlation peaks and higher contrast, consistent with reduced timing broadening and improved signal-to-noise ratio. These results demonstrate the advantages of SNSPD architectures for future telescope-based SII instruments and support their use in long-baseline optical arrays with enhanced performances.

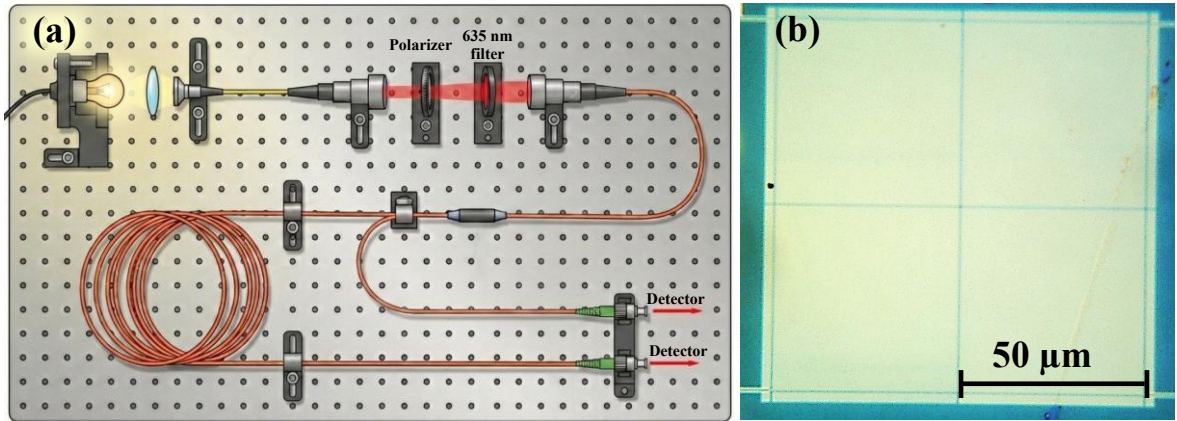


Fig. 1: (a) Schematic illustration of the experimental setup; (b) optical microscope image of a representative 4-pixel SNSPD used in the experiment.

References

- [1] W. Guerin, et al., *Comptes Rendus Physique* 26, 659 (2025).
- [2] I. Esmail Zadeh, et al., *Appl. Phys. Lett.* 118, 190502 (2021).