

Superconducting nanowire single photon detectors for quantum information and communications

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Superconducting nanowire single photon detectors (SNSPD or SSPD) are highly promising devices in the growing field of quantum information and communications technology. We have developed a practical SSPD system with our superconducting thin films and devices fabrication, optical coupling packaging, and cryogenic technology. The SSPD system consists of six-channel SSPD devices and a compact Gifford-McMahon (GM) cryocooler, and can operate continuously on 100 V ac power without the need for any cryogens. The SSPD devices were fabricated from high-quality niobium nitride (NbN) ultra-thin films that were epitaxially grown on single-crystal MgO substrates. The packaged SSPD devices were temperature stabilized to 2.96 K +/- 10 mK. The system detection efficiency for an SSPD device with an area of 20x20 μm^2 was found to be 2.6% and 4.5% at wavelengths of 1550 and 1310 nm, respectively, at a dark count rate of 1 c/s, and a jitter of 100 ps full width at half maximum (FWHM). We also performed ultra-fast BB84 quantum key distribution (QKD) field testing and entanglement-based QKD experiments using these SSPD devices.

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