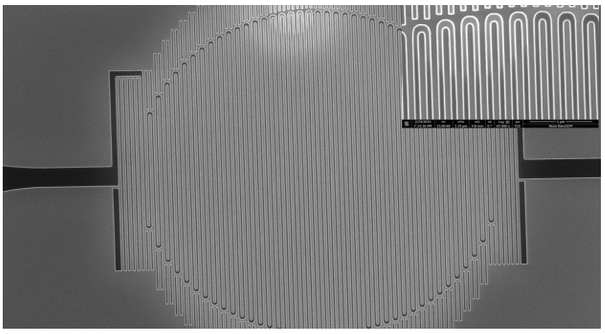
Superconducting Nanowire Single Photon Detectors

Operation principle

The superconducting nanowire single photon detectors developed by Single Quantum are the most sensitive light sensors on the market. Our devices are constituted by a thin film of superconducting material which is shaped into a meandering nanowire through nanofabrication processes. This pattern enables to cover a wide surface area, collecting the whole output of an optical fiber, while consituting a single path for the current. The detectors are operated at 2.5 Kelvin and a constant current below the critical current of the superconductor is applied to the device. The nanoscale cross section gives our photon detectors extremely high sensitivity upon absorption of just a single photon.

Scanning electron micrograph of a superconducting nanowire single photon detector. The inset shows details of the 100 nm wide nanowire.



Photon detection

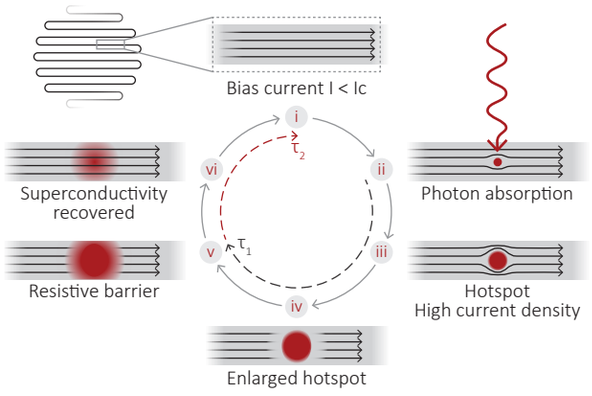
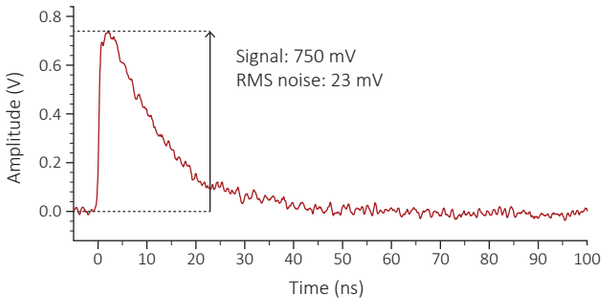


Figure adapted from: Natarajan et al. Supercond. Sci. Technol. 25, 063001 (2012).

Once a single photon is absorbed in the meandering nanowire, superconductivity is locally broken. As a result, the current is directed towards the amplification electronics and creates a voltage pulse. The detection process takes ~ 10 ps, after which the superconductivity is shortly recovered in the nanowire. The right panel shows the voltage pulse obtained each time a single photon is detected.



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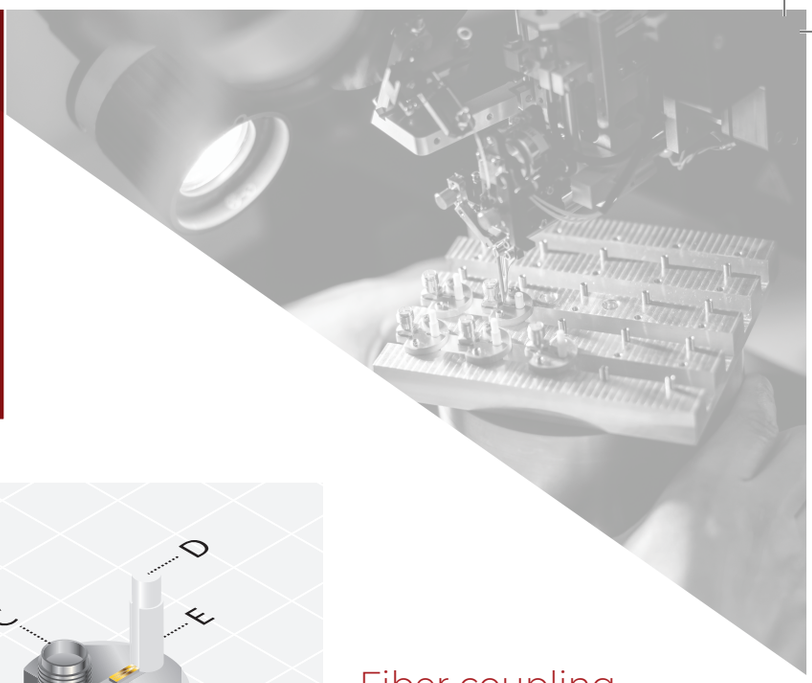
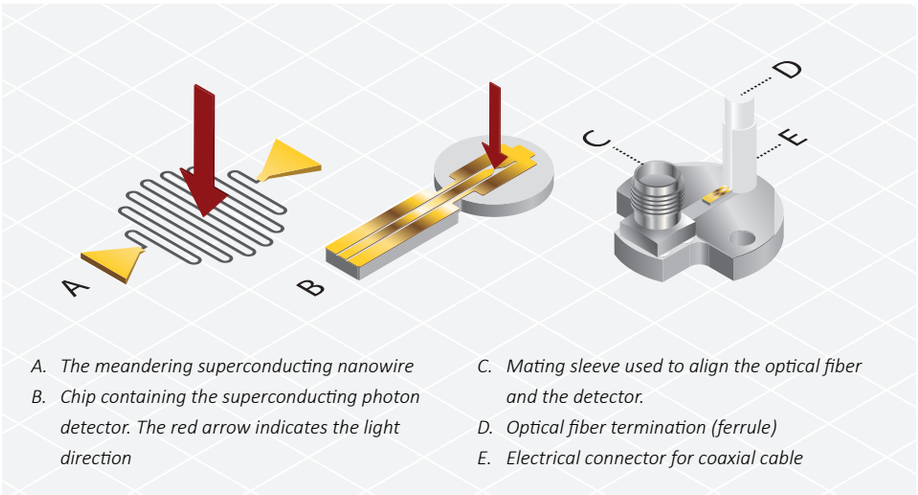




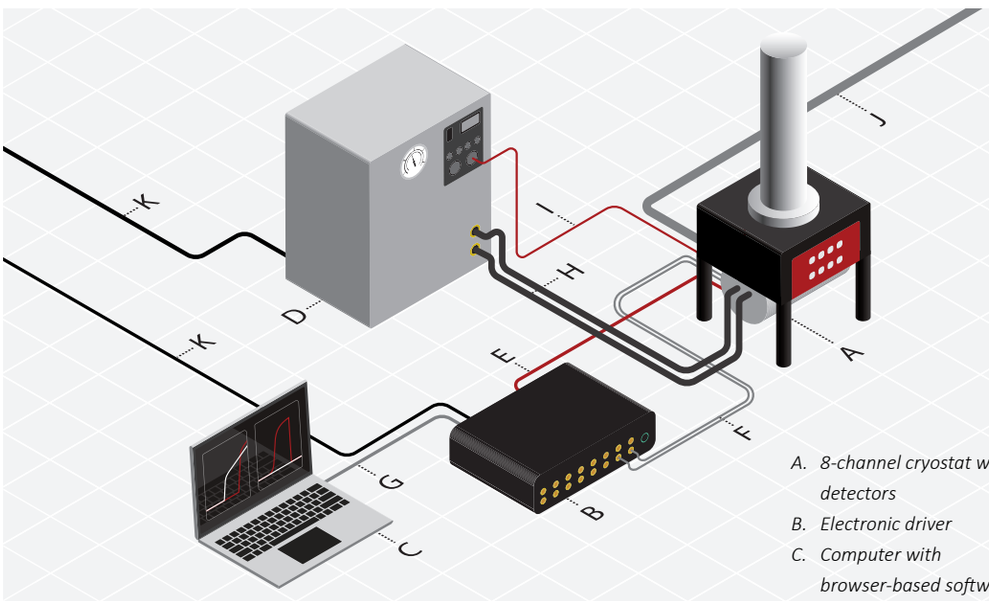
A. The meandering superconducting nanowire
B. Chip containing the superconducting photon detector. The red arrow indicates the light direction
C. Mating sleeve used to align the optical fiber and the detector.
D. Optical fiber termination (ferrule)
E. Electrical connector for coaxial cable

Fiber coupling

Each detector is coupled to an optical fiber. Our robust and efficient coupling method does not require manual intervention and is suited for cryogenic temperatures.

Plug-and-play detection system

The Single Quantum Eos is a complete measurement system that consists of a closed-cycle cryostat, helium compressor, electronic driver and up to 24 high performance fiber-coupled superconducting nanowire single photon detectors. Our custom developed electronic driver and software are unique in the market and enable fully computer-controlled operation and makes it effortless to interface with any programming language.



A. 8-channel cryostat with detectors
B. Electronic driver
C. Computer with browser-based software
D. Helium compressor
E. Fischer cable
F. SMA cables
G. LAN cable
H. Helium flexlines
I. Controller cable
J. Vacuum line
K. Power cable