Superconducting Nanowire Single-Photon Detector

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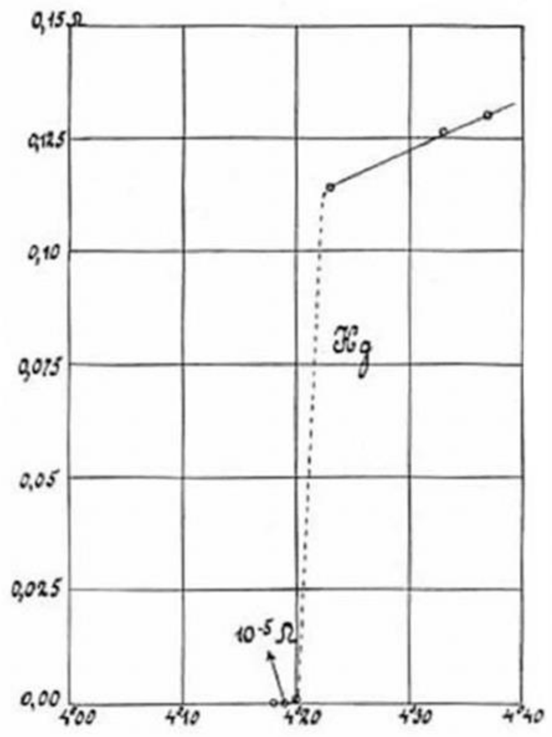
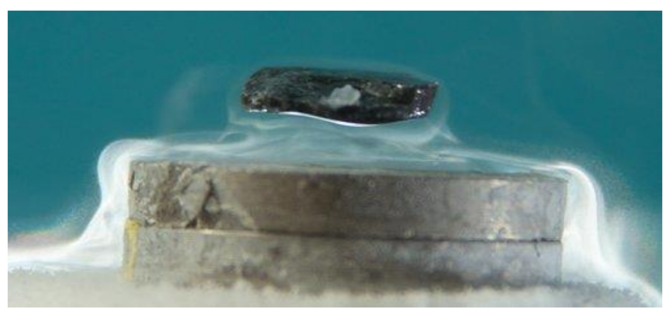
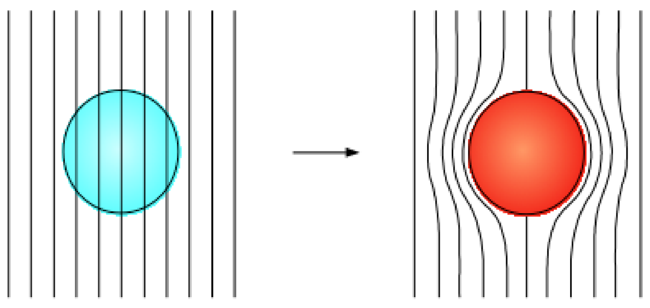
Superconductors



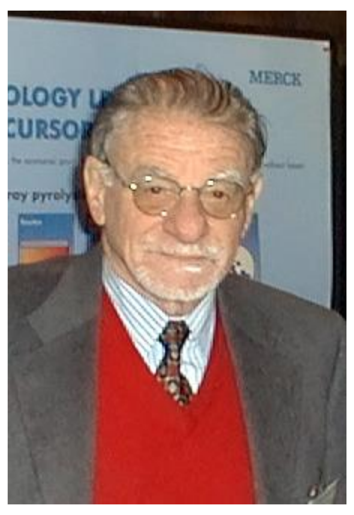
Zero resistance
(Critical temperature, Tc)





Zero magnetic field
(Meissner effect)

H. K. Onnes, (1913)
Leiden Univ.
1911, Low Tc Superc.

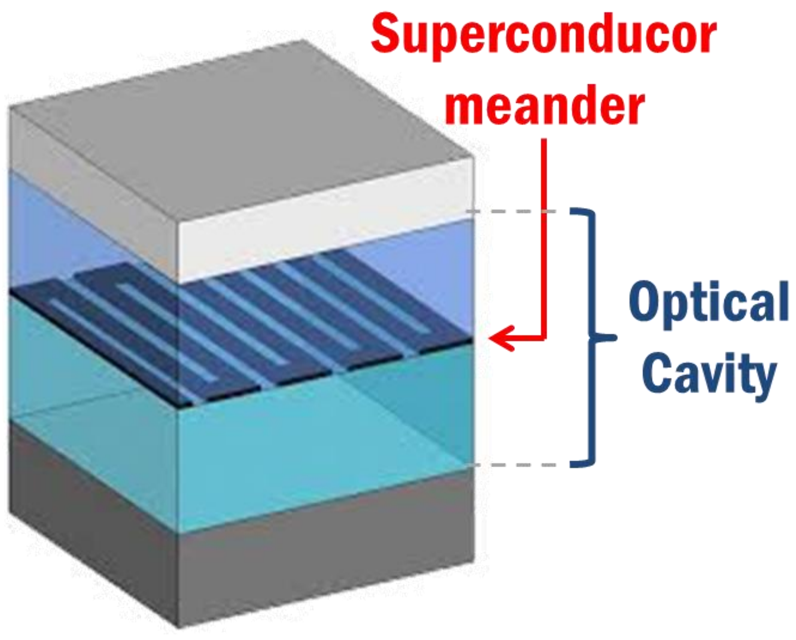


K. A. Müller, (1987)
IBM and Zurich Univ.
1986, High Tc Superc.

SNSPD

(**S**uperconducting **N**anowire **S**ingle-**P**hoton **D**etector)

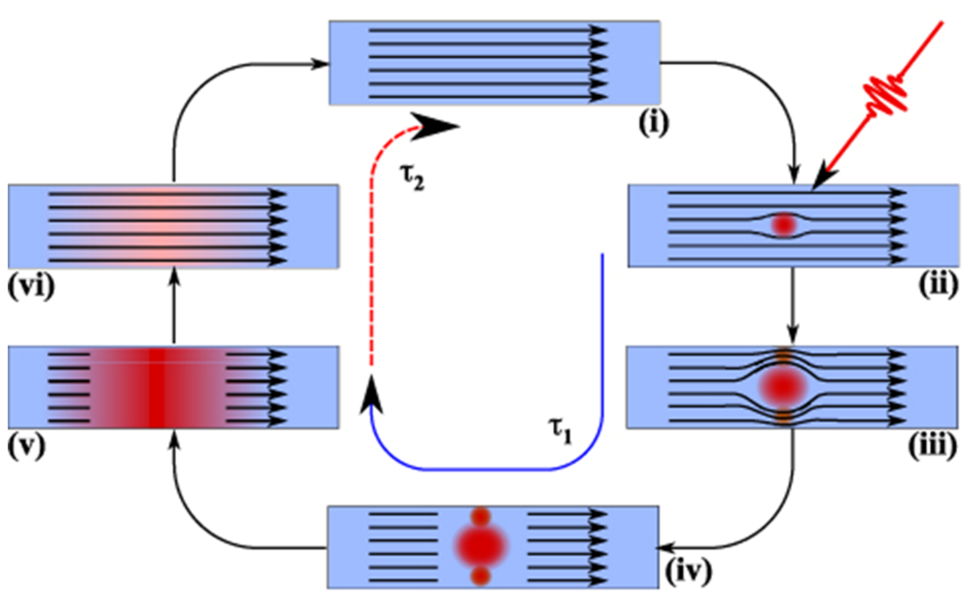
Superconducting meandering nanowires
~100 nm wide, 4 nm thick, T ≤ 5K



Single photon detection:
- 90% Quantum efficiency
- High speed
- Broad wavelength range

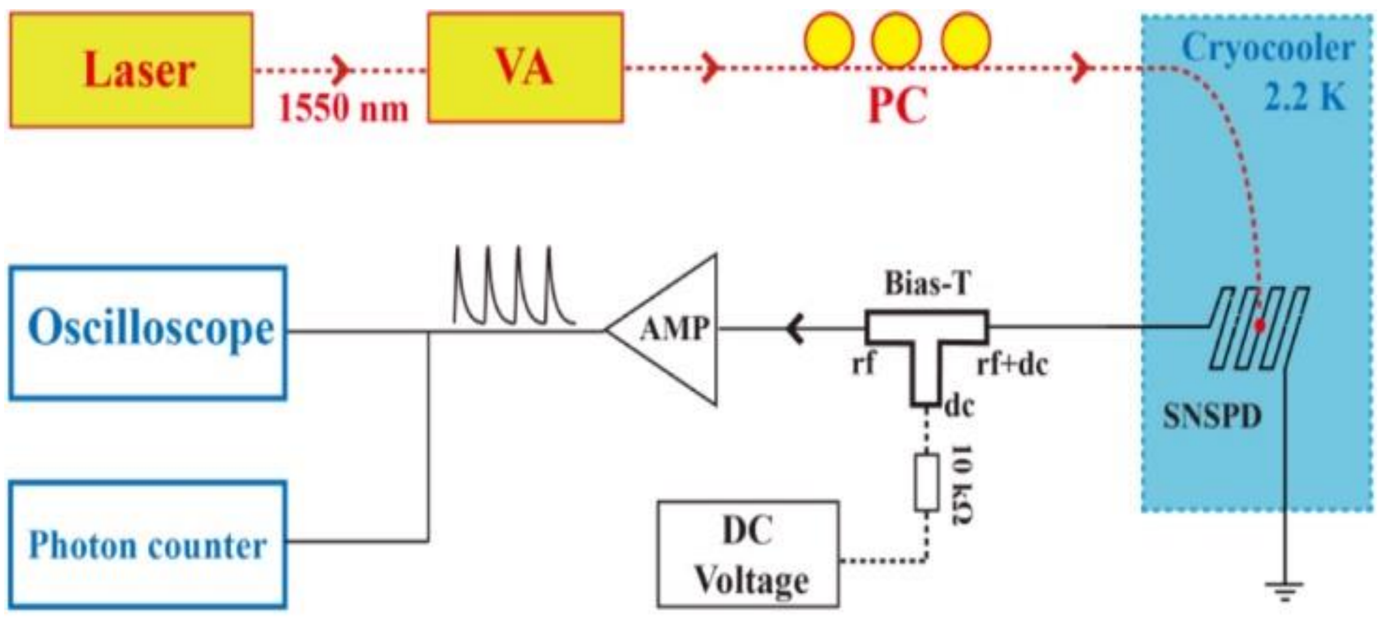
Applications:
- Quantum communication
- Spectroscopy of quantum emitters

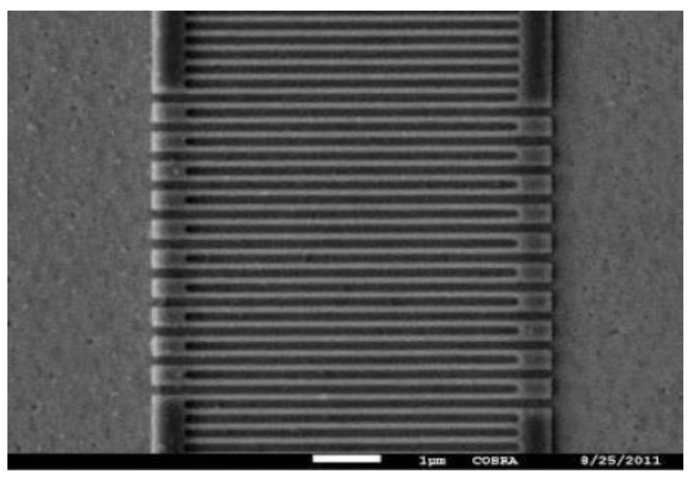
WORKING PRINCIPLE



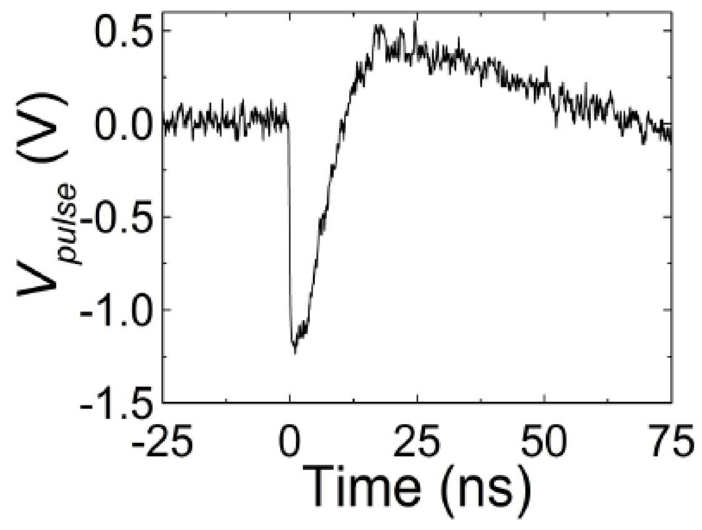
Detection process:
- zero resistance
- photon absorption
- current redistribution and heating
- resistive area
- Cooling down
- zero resistance

Optical NbN SNSPD



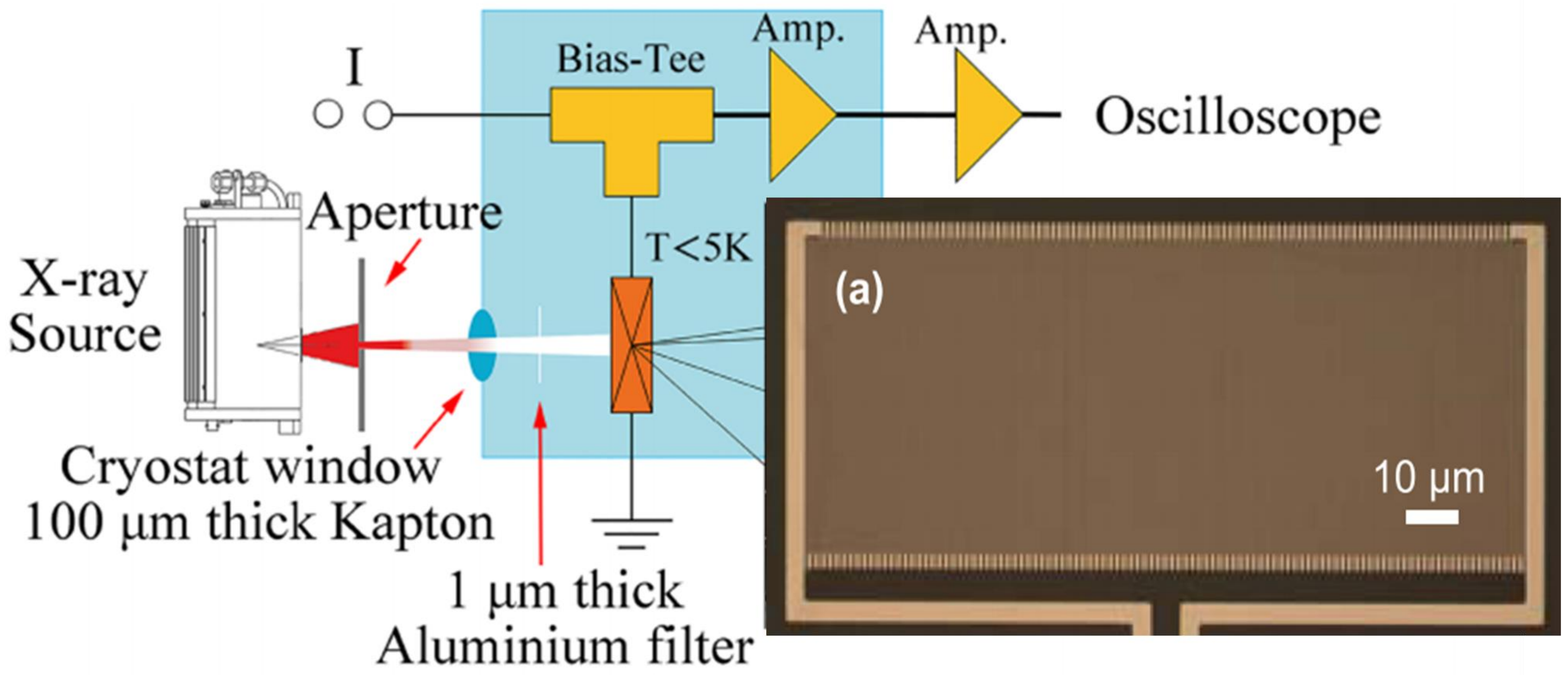


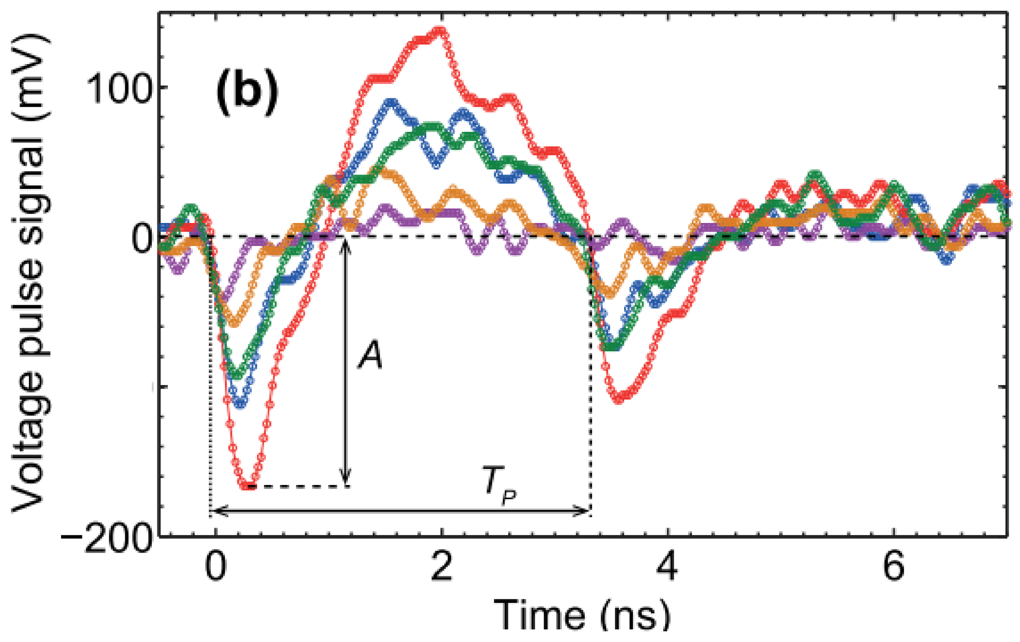
SNSPD SEM image

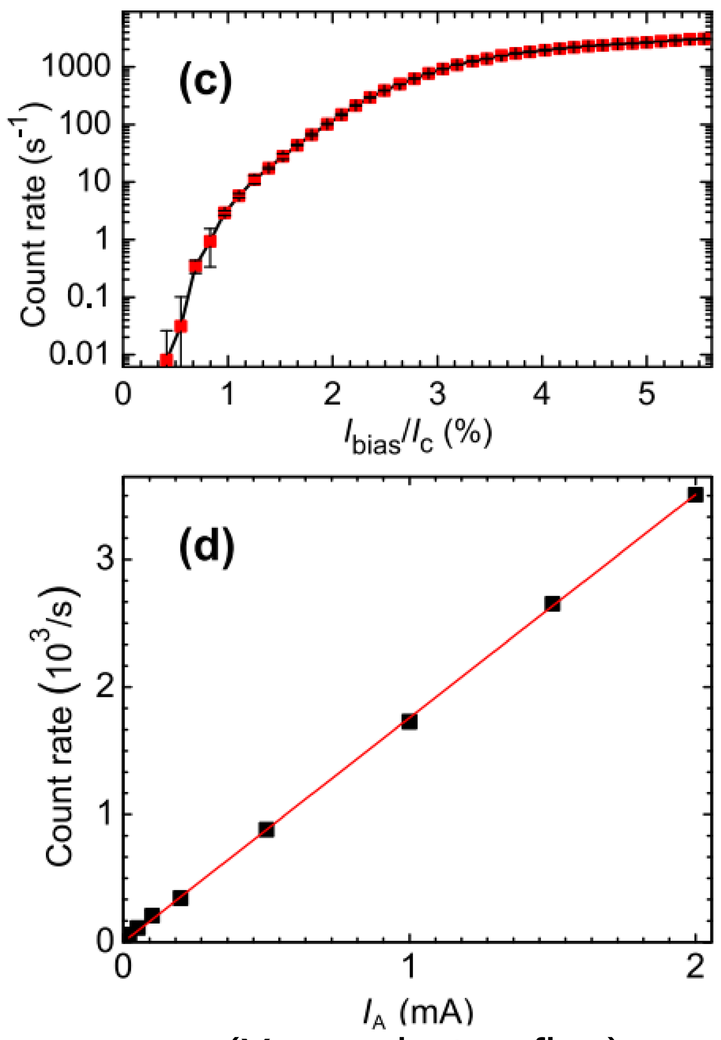


Signal pulse

X-ray Nb SNSPD







(X-ray photon flux)

Amplitude:
Energy resolution

Internal efficiency :
100% @ high bias currents

Sensitivity:
Single photon detection

X. Zhang, Q. Wang, A. Schilling, AIP Advances **6** (11), 115104

K. Inderbitzin, et al., Appl. Phys. Lett. **101** (2012), 162601