Next Generation Quantum Detectors

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Quantum Detectors

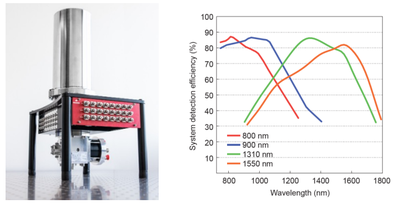
Broad range of applications

Detecting single photons with high efficiency and timing resolution opens up new possibilities for various technologies such as LIDAR, ultra-long distance communication, singlet oxygen detection for cancer treatment, OCT and quantum information.

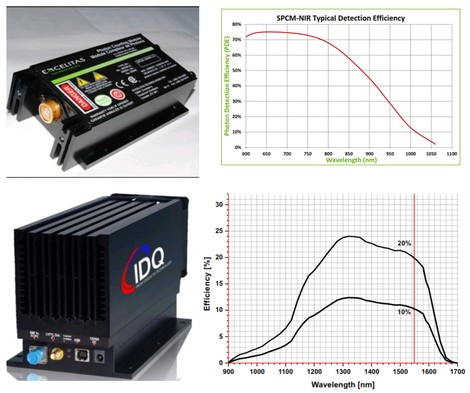
The image quality in biological tissue and the precision of LIDAR systems can be significantly improved with quantum sensing technologies. OCT imaging can be improved for early detection of blinding diseases.

State-of-the-art detectors

The two leading technologies for quantum detection are superconducting nanowires and semiconductor avalanche photodiodes.



Superconducting nanowires[6] have excellent detection efficiencies (>90%) and precise timing resolution (<50 ps); however, they require cryogenic temperature to operate (typically <4K), which results in a huge limitation for practical and portable applications.

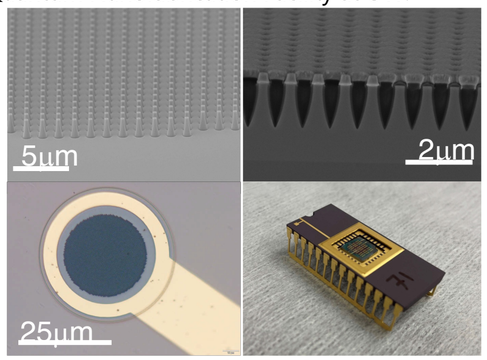


In contrast, semiconductor based single photon avalanche (SPAD) technology[7,8] exists for portable applications, nonetheless, the high efficiency is achieved for a small wavelength range and at the cost of timing resolution (200-500ps).

Next Generation Devices

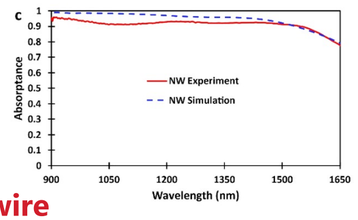
Device Fabrication

Optimized nanowire arrays are fabricated in the Quantum Nanofabrication Facility at UW.



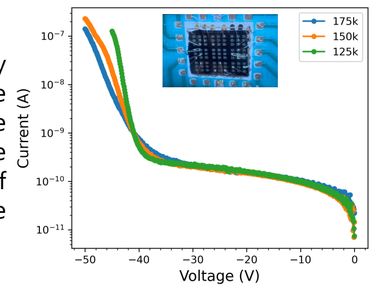
Near-Unity Optical Absorption

Near-unity absorption is achieved for an unprecedented wavelength range by optimizing the shape and geometry of InGaAs nanowire arrays[9].



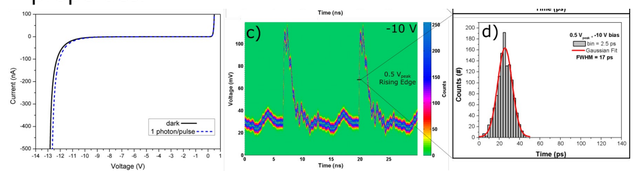
Nanowire SPADs

We are currently building nanowire based single photon avalanche diodes capable of detecting single photons efficiently.



Next Generation quantum sensors

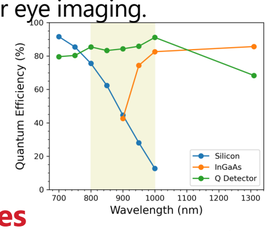
Nanowire arrays show remarkable optical and electrical properties.



Previously developed InP based nanowire quantum sensors exhibited single photon sensitivity and fast response with 0.6ns rise time and only 17ps timing jitter[10].

Valley of death

These novel detectors (Q detector) show remarkable improvement in quantum efficiency including the wavelength band "valley of death" (800-1000nm) where OCT imaging operates for enhanced sensitivity and axial resolution for eye imaging.



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