High Speed Travelling Wave Single-Photon Detectors With Near-Unity Quantum Efficiency

OCR Number: OCR 5748

Description:

Imperfect modal matching and finite photon absorption rates have usually limited the maximum attainable detection efficiency of single photon detectors. Yale University researchers have demonstrated a high quantum efficiency single photon detector (>90%), fully embedded in a scalable, low loss silicon photonic circuit at 4 Kelvin that provides ultrashort timing jitter of 18ps at multi-GHz detection rates. The dark count rate also drops to below 0.1Hz at optimal biasing. The detector’s novel evanescent waveguide drastically increases the absorption length for incoming photons. The fibre based detector couples in light with low insertion loss. The energy resolution is as low as $1 \times 10^{-19}$ W/Hz$^{1/2}$.

![Detector Diagram](image)

Description:

- Bandwidth: unlimited
- Quantum efficiency: 94% at telecom wavelengths
- Timing resolution: 18ps
- Speed: 2GHz
- Dark count: zero
- Energy resolution: $1 \times 10^{-19}$ W/Hz$^{1/2}$
- Not damaged by strong illumination
- Zero afterpulsing probability

Fields of Application:

- Metrology/QKD/advanced scientific instruments low light level quantum optics and quantum communication. Close-to-unity photon detection efficiency is essential for scalable measurement-based quantum computation, quantum key distribution, and loophole-free Bell
experiments.
- New fields of research extending the reach of imaging to NIR and MIR; lowering the noise floor in imaging
- A new gold standard is possible for low light level by using affordable current TE cooled technologies for stable 4 Kelvin operation.
- Fast close to unity efficiency detectors significantly enhance throughput in quantum communications systems. Longer distances, and higher bit rates.

**Advantages:** Scaleable detector architecture (multiplexing)

**Stage of Development:** Proof of Concept

**Publications:**


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