

Very low noise AlGaAsSb avalanche photodiodes for IR Lidar

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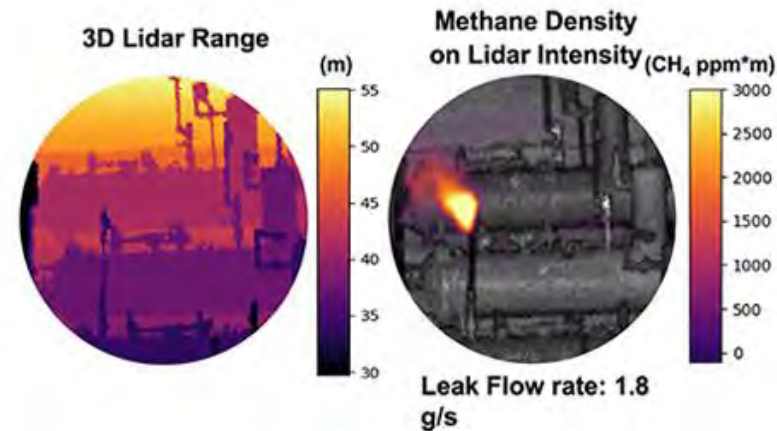
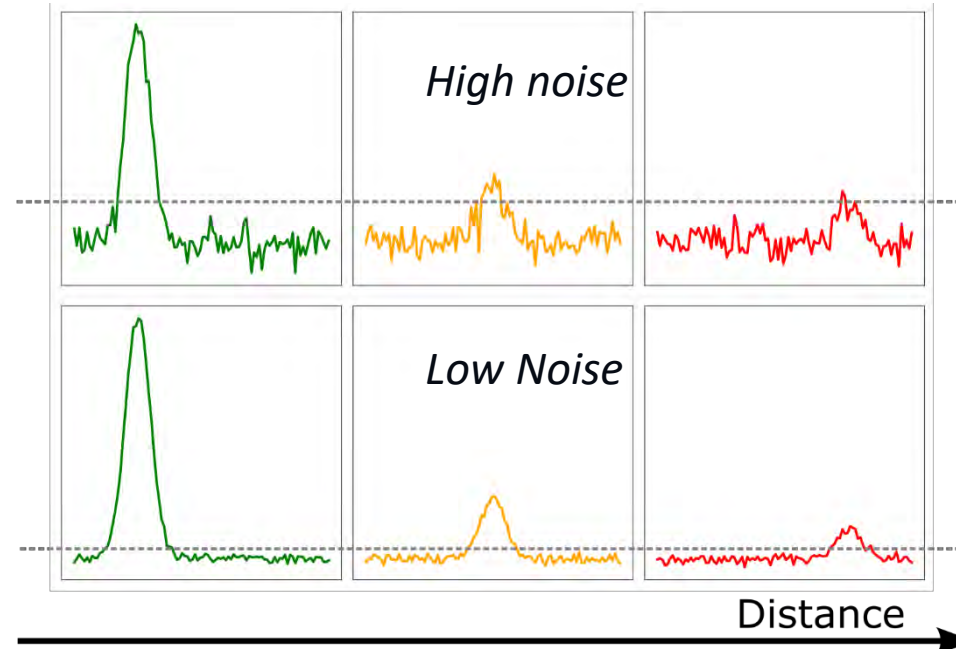
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Funders

UKSA,
EPSRC (UK),
Innovate UK,
University of Sheffield (UK),
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Limitation imposed by noise

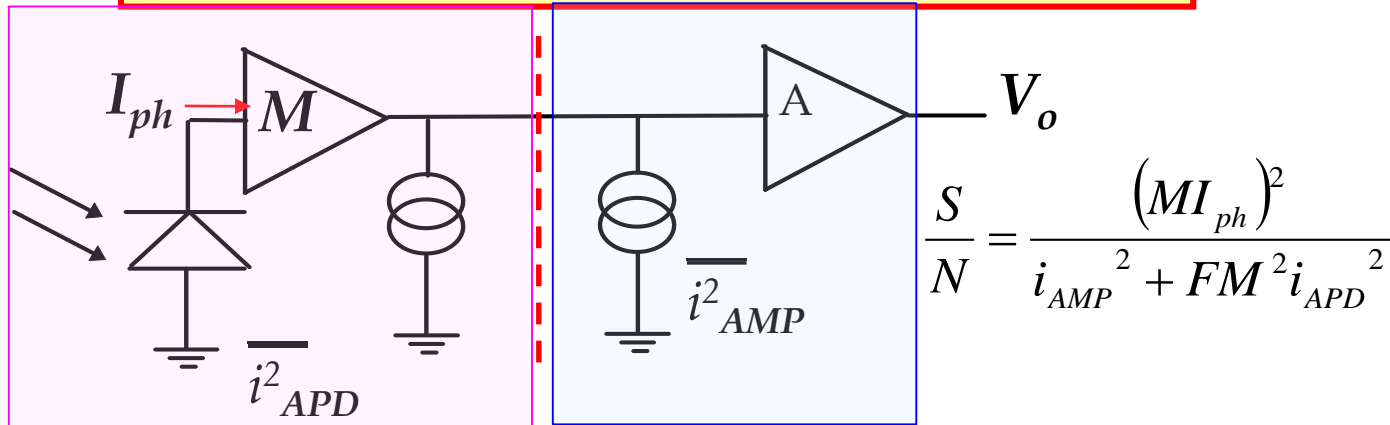
- Signal measured if above dashed line.
- High noise detector cannot reliably detect back-scattered pulses
- Atmospheric conditions can present additional obscurant
- Long range remote gas sensing is extremely challenging
- Current Single Photon Detectors are expensive



QLM's imaging technology can quantify emissions of greenhouse gases.

Avalanche Photodiodes

Avalanche photodiode and amplifier



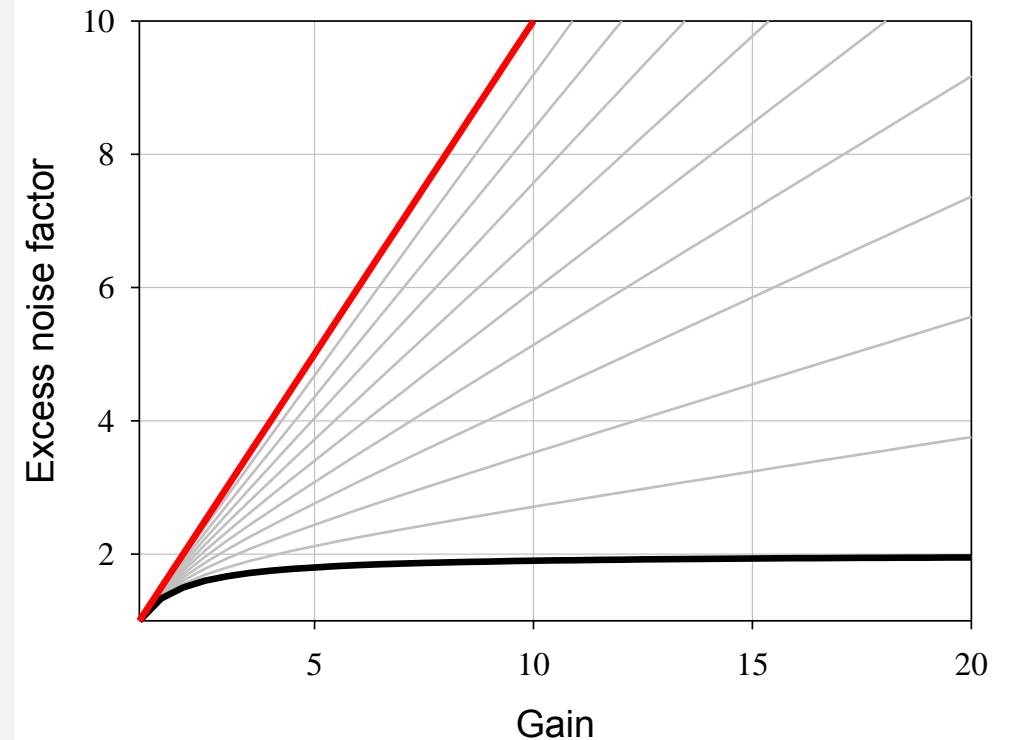
Noise can be reduced by a factor of M^2 , if excess noise factor F is small.

$$F = \frac{\langle M^2 \rangle}{\langle M \rangle^2}$$

$$F = kM + (2 - 1/M)(1 - k)$$

$$F \rightarrow 2, k = 0$$

$$k = \frac{\beta}{\alpha}$$



- Why AlGaAsSb?
- Si-like APD performance at infrared wavelengths
- State-of-art APD performance
- Conclusions and Potential Impact

PART 1

Why AlGaAsSb?

Achieving Si-like APDs at Infrared Wavelengths

Noisy APD, $\alpha \sim \beta$

Low noise APD, $\alpha \gg \beta$

Changes

I. Increase E_{so}

Holes confined within Heavy Hole Band, hole ionisation suppressed

E_{so}

InP $\beta > \alpha$

InAs $\alpha \gg \beta$

InSb $\alpha \gg \beta$

E_{so} increases when P \rightarrow As \rightarrow Sb

PART 2

Si-like APD performance at
infrared wavelengths