Noiseless InGaAs™ * Avalanche Photodiodes. Their benefits in an LRF system.

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PhluxTechnology.com

* **Noiseless InGaAs APDs are** as those with an excess noise factor low enough to achieve an APD gain of over 100 without SNR deterioration.

About Phlux

- Established in 2020 by Prof Chee Hing Tan, Prof. Jo Shien Ng and Ben White
- Based in Sheffield, UK
- World leading infrared sensors for imaging and communication systems.
- £4M Seed round in 2022 from major UK VCs.
- Generating commercial revenues!

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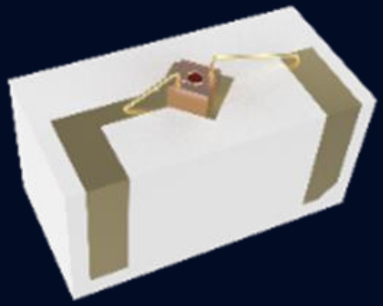
Aura – Noiseless™ InGaAs APDs

Aura is a series of Noiseless™ InGaAs APDs for LRF, LIDAR, OTDR and sensing

Key features:

- **World-leading sensitivity**
- **Low dark current**
- **Negligible excess noise**
- **High responsivity**
- **Built to Mil-Std-883**



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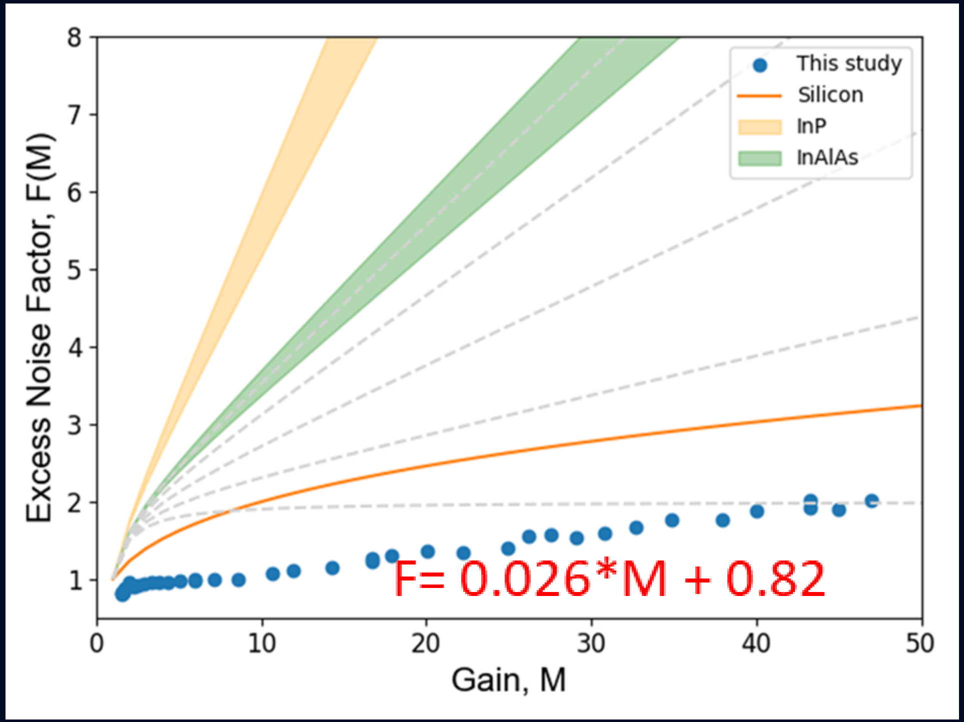
Why Noiseless InGaAs™ APDs?



APD (200 µm)	Responsivity M=1, (A/W)	Dark Current M=10, (A)	Excess noise M=20	Capacitance (pF)
Phlux GenII	**0.97**	**14.0**	**1.34**	**2.8**
Laser Components	0.94	25	5.6	1.7
Hamamatsu	0.9	150*	9	1.5
Excelitas	0.93	45	9	2.5

Near Noiseless APD

Low Dark Current (especially low bulk dark current that gets amplified)

Incredibly low Excess Noise compared to peers

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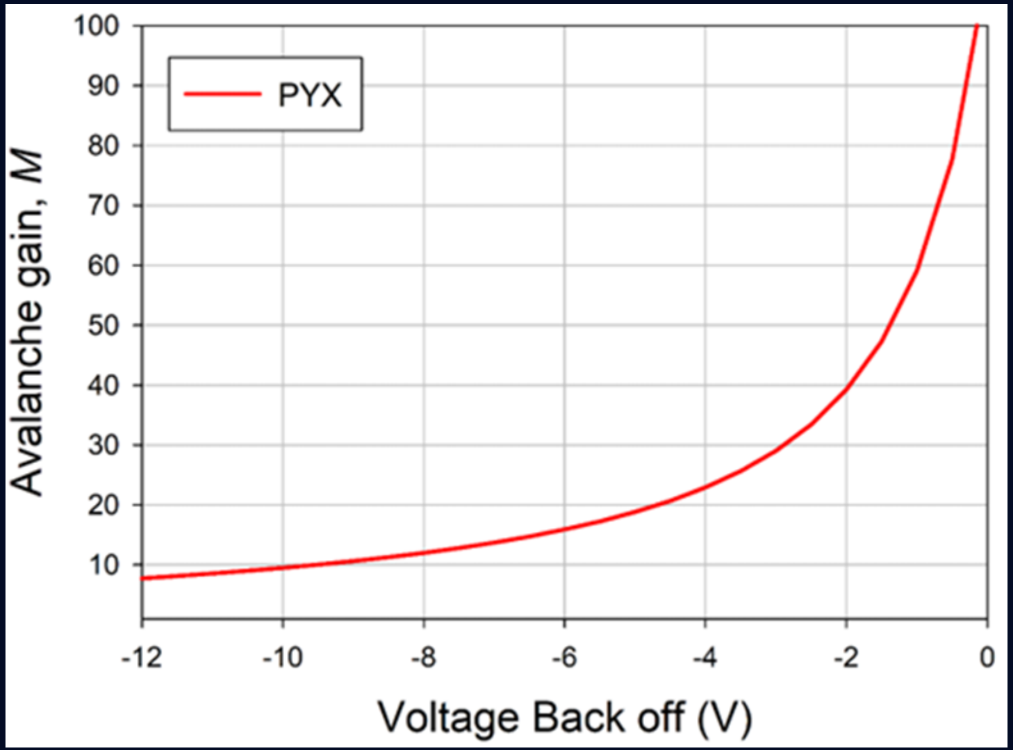
Why Noiseless InGaAs™ APDs?



APD Gain > 100

M=300 on 30um and ~100 on 200um devices (Compared to typical max 20 for competitors)

Extremely high gain-bandwidth product

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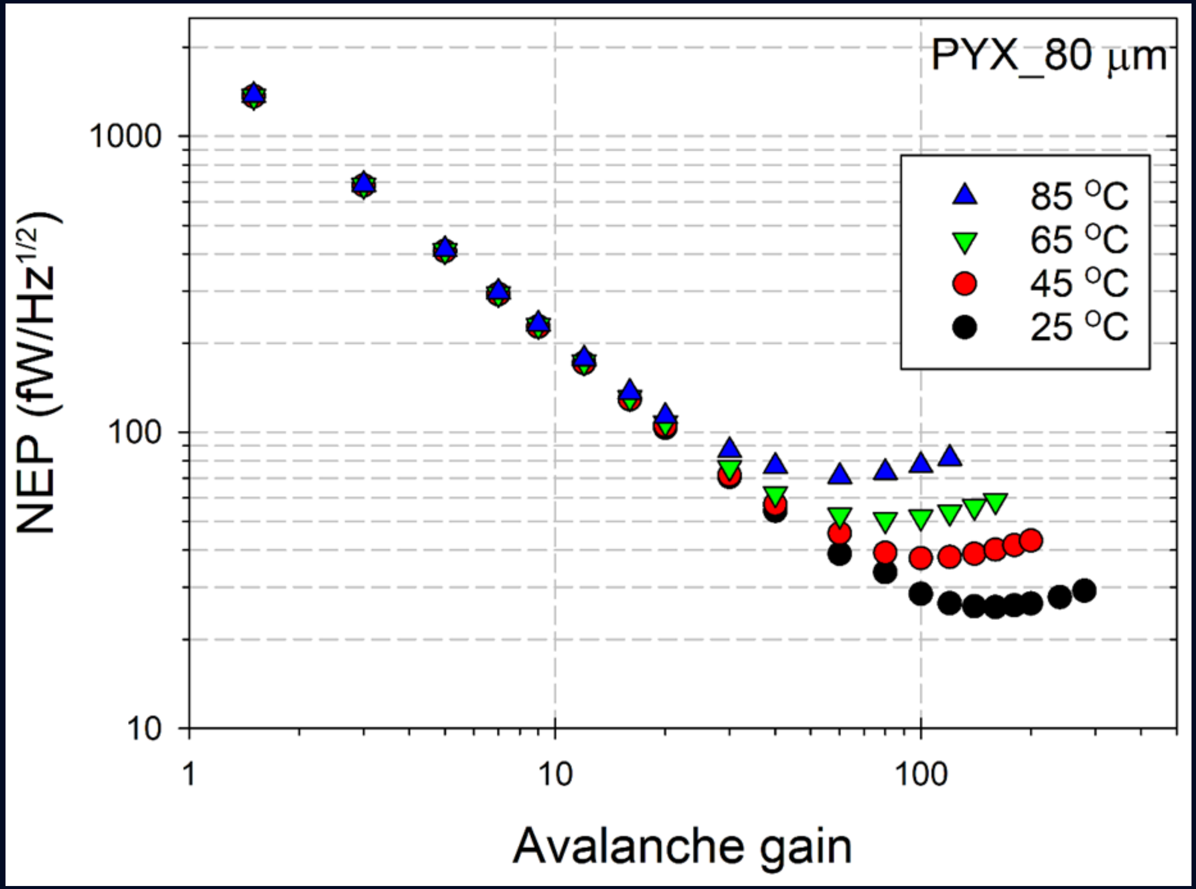
Noise Equivalent Power & High Temperatures



High operating temperature.

High Gain+Low Noise = NEP up to 12x lower than Traditional InGaAs APD

NEP at 85 °C only ~2x NEP at 25 °C when M=60

The coefficient of Vbr only 20mV/C compared to 120mV/C

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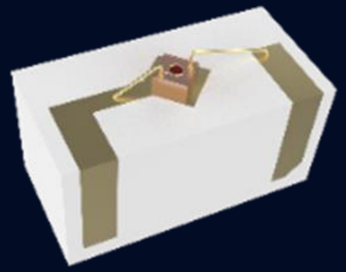
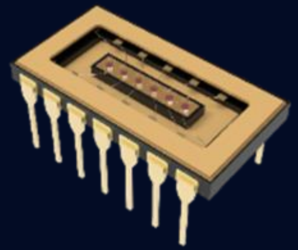
Products today & Roadmap

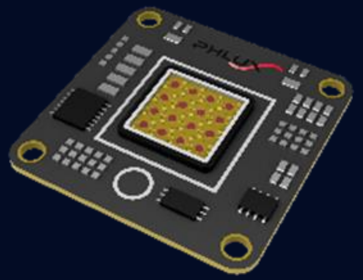


- Noiseless InGaAs™ APDs
- Available in Pigtailed, To-can, SMD, CER and die form
- High Gain Low-k Linear Mode

- Integrated modules delivering the ultimate sensitivity.
- APD + TIA integrated into receiver subsystem
- TE cooling and drive electronics
- Single Photon Counting Module (Geiger Mode)



- Ultra-High Gain - Operates like a SiPM but can detect at 1550 nm



- Intelligent ToF imaging systems
- Focal plane array and ROIC

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AIR SPAD – 1650 nm SPAD for gas sensing

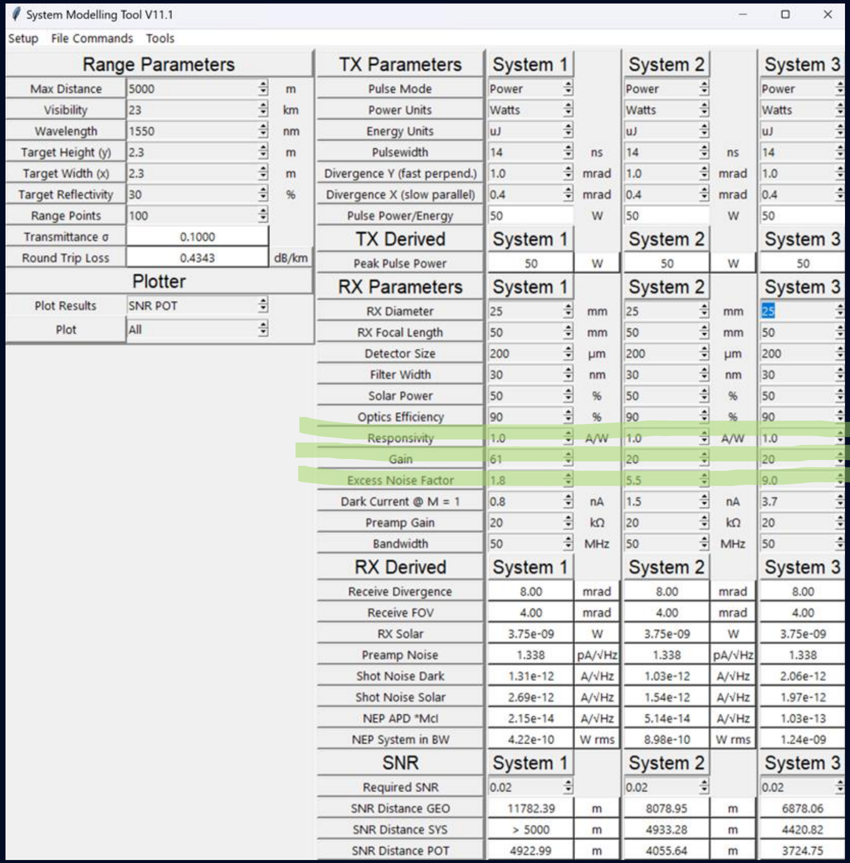
QUDITS – 1550 nm SPAD for Quantum Comms

Grants also Help our R&D efforts - £1.3Million so far

+ To be Announced soon: €500k grant for work into Rad Hard High speed APD receiver module for Free Space Comms

Benefits to LRF?

Based on System modelling data supplied by an LRF design consultancy (part owned by the presenter) for three APD types in identical systems



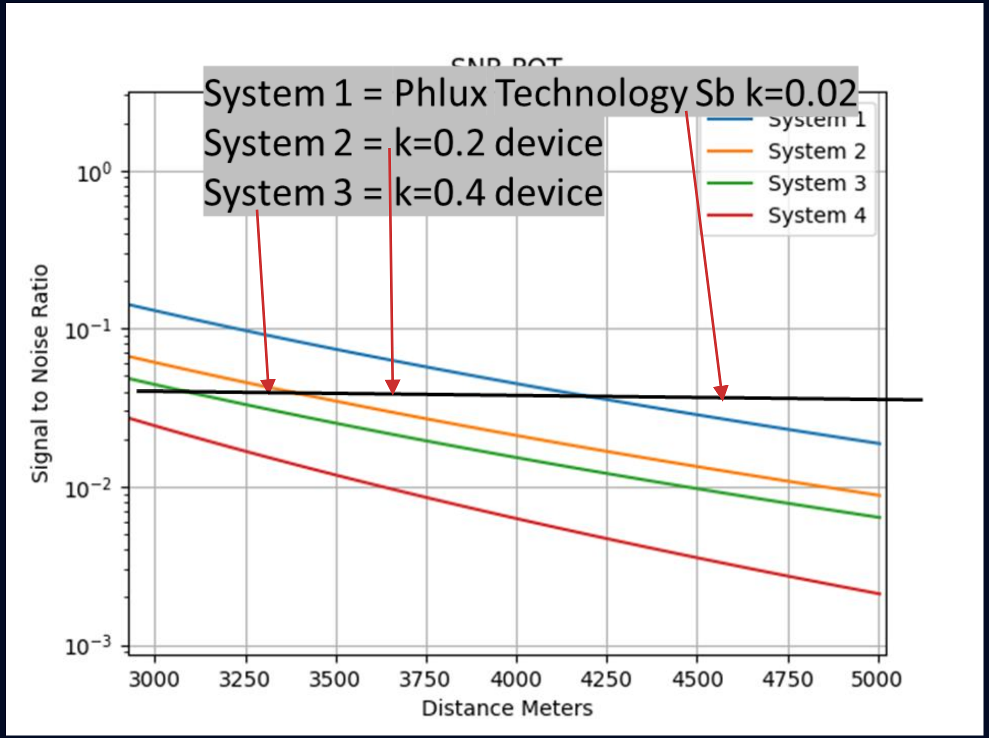
System Modelling Tool V11.1

Setup File Commands Tools

Range Parameters		
Max Distance	5000	m
Visibility	23	km
Wavelength	1550	nm
Target Height (y)	2.3	m
Target Width (x)	2.3	m
Target Reflectivity	30	%
Range Points	100	
Transmittance σ	0.1000	
Round Trip Loss	0.4343	dB/km

Plotter	
Plot Results	SNR POT
Plot	All

TX Parameters	System 1		System 2		System 3
Pulse Mode	Power		Power		Power
Power Units	Watts		Watts		Watts
Energy Units	uJ		uJ		uJ
Pulsewidth	14	ns	14	ns	14
Divergence Y (fast perpend.)	1.0	mrad	1.0	mrad	1.0
Divergence X (slow parallel)	0.4	mrad	0.4	mrad	0.4
Pulse Power/Energy	50	W	50	W	50
TX Derived	**System 1**		**System 2**		**System 3**
Peak Pulse Power	50	W	50	W	50
RX Parameters	**System 1**		**System 2**		**System 3**
RX Diameter	25	mm	25	mm	25
RX Focal Length	50	mm	50	mm	50
Detector Size	200	μm	200	μm	200
Filter Width	30	nm	30	nm	30
Solar Power	50	%	50	%	50
Optics Efficiency	90	%	90	%	90
Responsivity	1.0	A/W	1.0	A/W	1.0
Gain	61		20		20
Excess Noise Factor	1.8		5.5		9.0
Dark Current @ M = 1	0.8	nA	1.5	nA	3.7
Preamp Gain	20	kΩ	20	kΩ	20
Bandwidth	50	MHz	50	MHz	50
RX Derived	**System 1**		**System 2**		**System 3**
Receive Divergence	8.00	mrad	8.00	mrad	8.00
Receive FOV	4.00	mrad	4.00	mrad	4.00
RX Solar	3.75e-09	W	3.75e-09	W	3.75e-09
Preamp Noise	1.338	pA/√Hz	1.338	pA/√Hz	1.338
Shot Noise Dark	1.31e-12	A/√Hz	1.03e-12	A/√Hz	2.06e-12
Shot Noise Solar	2.69e-12	A/√Hz	1.54e-12	A/√Hz	1.97e-12
NEP APD *Mcl	2.15e-14	A/√Hz	5.14e-14	A/√Hz	1.03e-13
NEP System in BW	4.22e-10	W rms	8.98e-10	W rms	1.24e-09
SNR	**System 1**		**System 2**		**System 3**
Required SNR	0.02		0.02		0.02
SNR Distance GEO	11782.39	m	8078.95	m	6878.06
SNR Distance SYS	> 5000	m	4933.28	m	4420.82
SNR Distance POT	4922.99	m	4055.64	m	3724.75



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A Phlux Aura APD based LRF could have a Rx lens of 15mm diameter in comparison to a 25mm Rx lens for k=0.2 APD - yet still offer same performance. Or 20-30% longer range with same Rx optic – customer can choose which benefit he desires.

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Thank you

To find out more, visit our website PhluxTechnology.com

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