Updates on Ageing Studies Preparation
HRPPD #25

Ageing studies - Global Meet
9 April 2025

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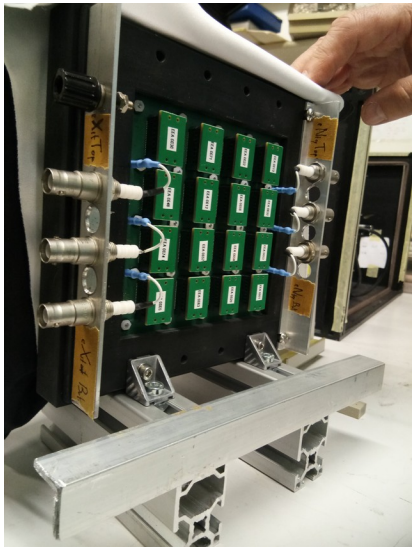
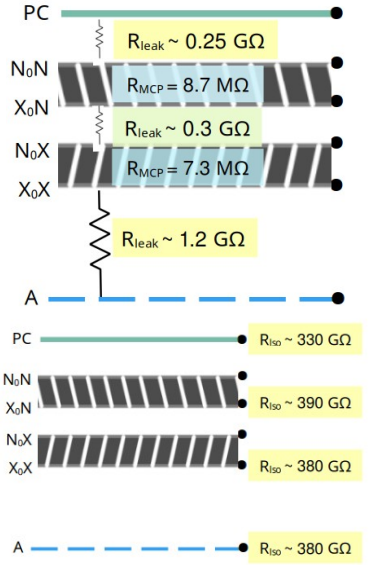
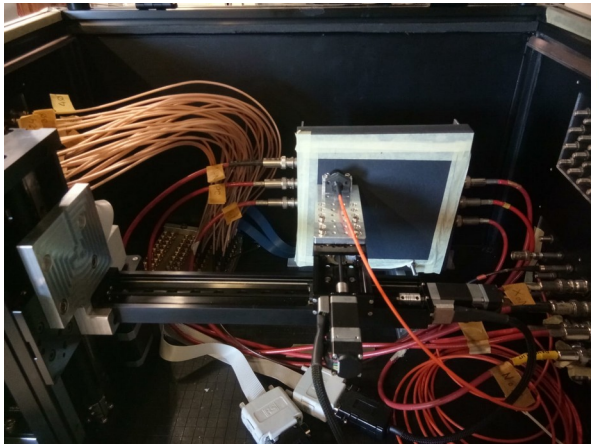
Outline

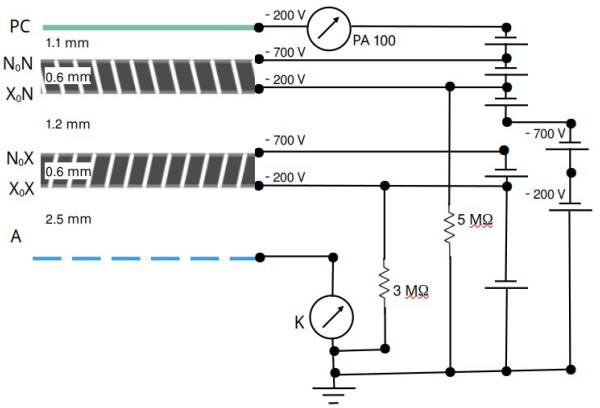
- Recap
- Signals from single channels
- Mapping – pixels to Samtec pins
- Position scan of pads
- Characterisation of Light sources

Recap from previous presentation (on 12/3/2025)

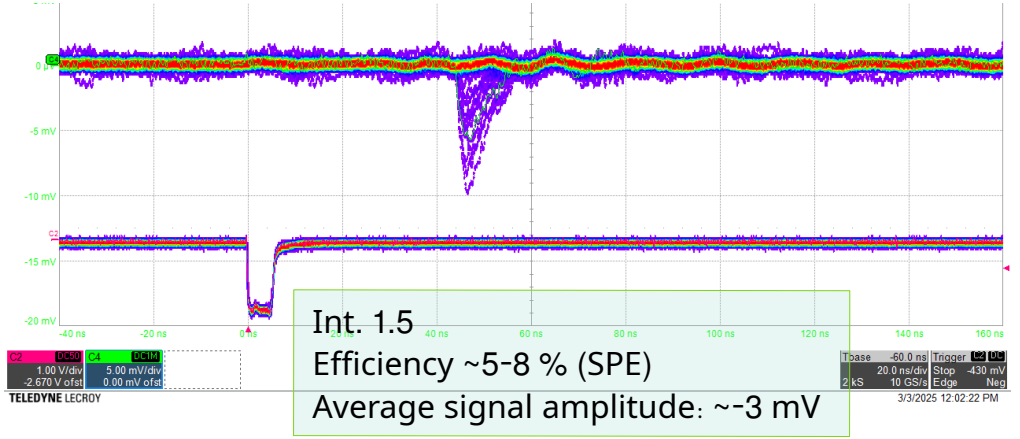






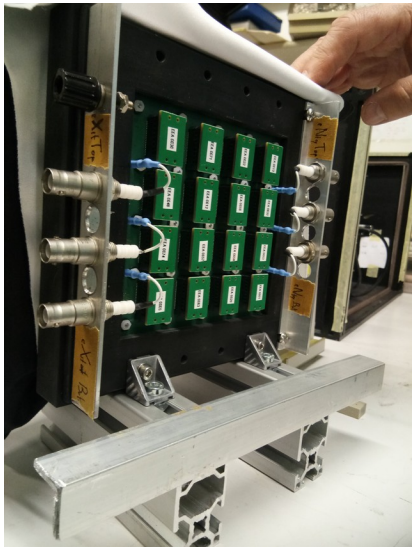


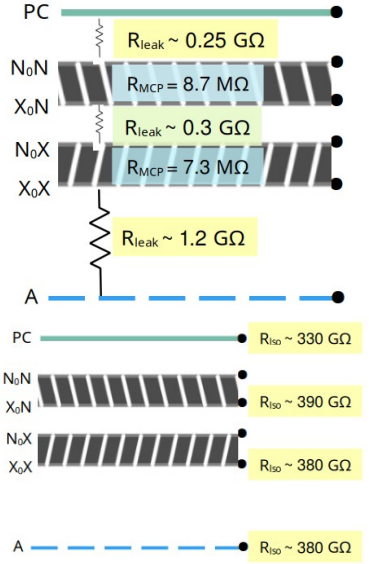
- ✔ Detector assembling and integration
- ✔ Electrical tests
- ✔ Set up, electrical circuit and instruments
- ✔ Light signal from 1024 Anode pads

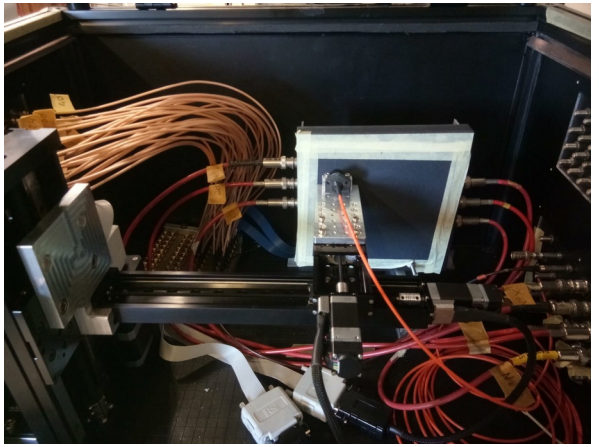


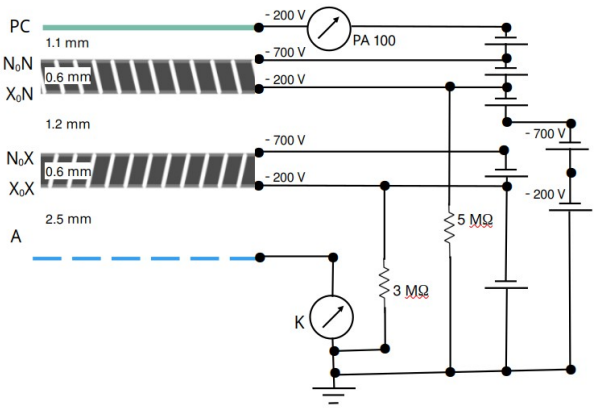
Int. 1.5
Efficiency ~5-8 % (SPE)
Average signal amplitude: ~-3 mV

Recap from previous presentation (on 12/3/2025)









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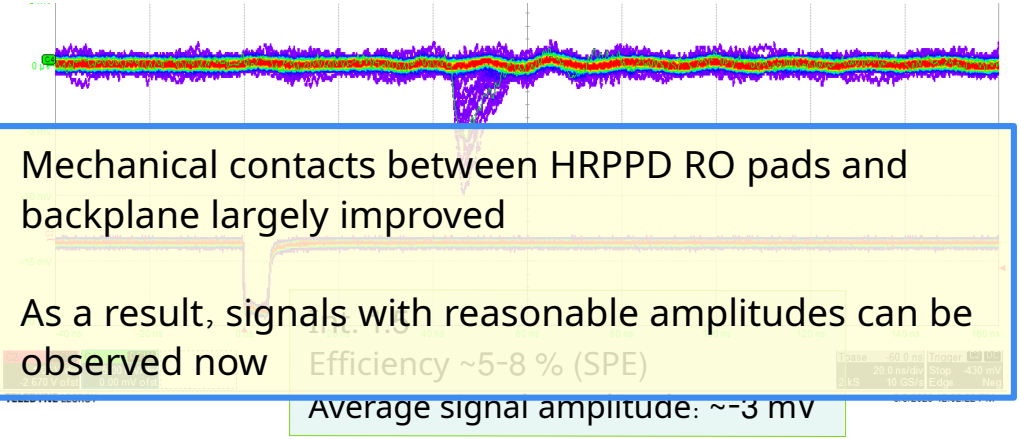
- ✔ Light signal from 1024 Anode pads

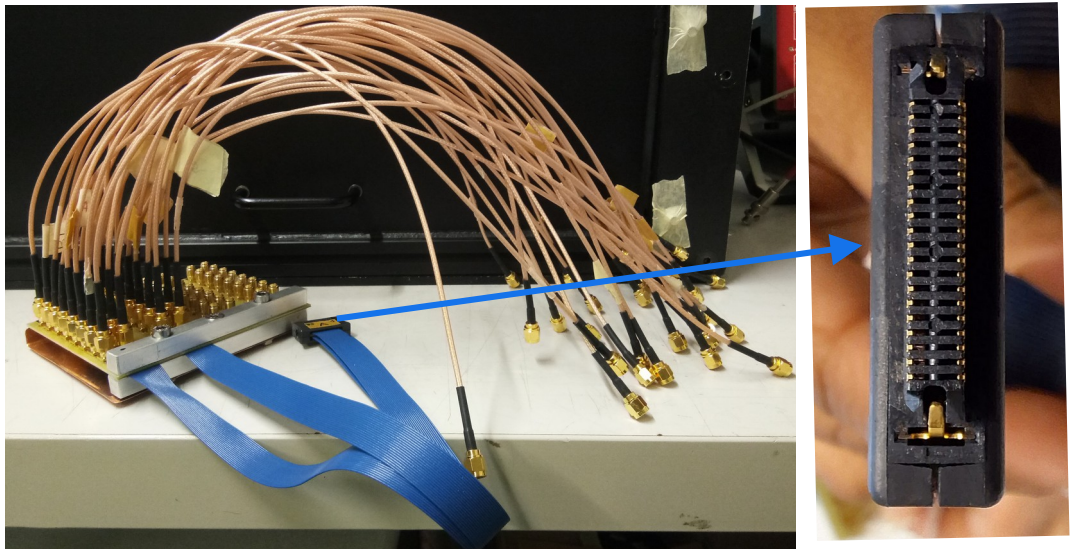


- ✔ Mechanical contacts between HRPPD RO pads and backplane largely improved
- ✔ As a result, signals with reasonable amplitudes can be observed now

Signals from single pads

Bread-board arrangement (for 32 pads)

- μ-coaxial flat cables
  - one side has Samtec connector compatible with HRPPD backplane samtec
  - other side soldered to SMA connectors on bread-board

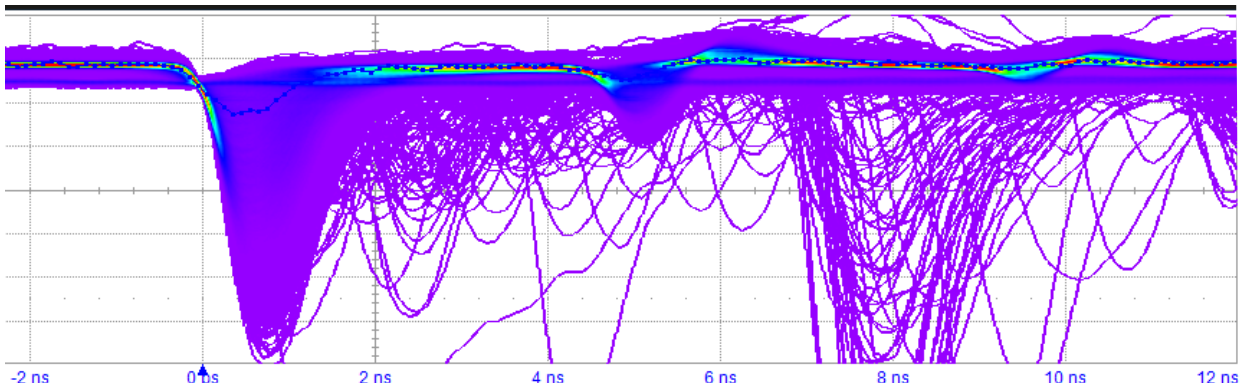


ERCD-020-40.00-TEU-TED-1-D

32 pads connected to bread-board

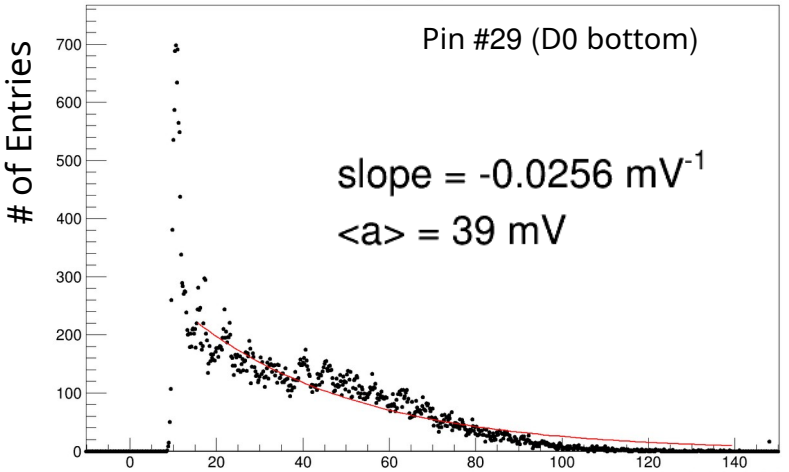
Signals from single pads

HV bias: -200_-700_-200_-700_-30 V @ XoX_NoX_XoN_NoN_PC



20 mV/div

Dark signals – Threshold -8 mV



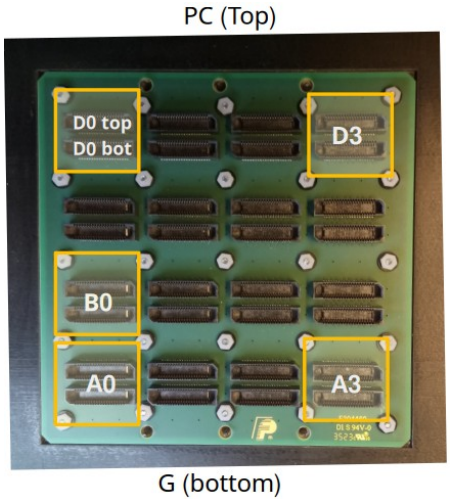
Dark signals (50k events accumulated)

- Threshold -8 mV
- <amplitude> ~ -39 mV
- Fast rising edge of < 1 ns

Correct fitting has to be implemented using a Polya function

Mapping – pixel to Samtec pin

Rear End View



A0 (Measured)

37	27	33	?	19	14	11	9
34	39	29	24	20	13	3	10
30	40	31	21	17	7	4	1
38	28	32	22	?	8	12	2
2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

D0 (Measured)

?	27	33	23	19	14	11	9
34	?	29	24	20	13	3	10
30	?	31	21	17	7	4	?
38	28	32	22	18	8	12	?
2	12	8	18	22	32	28	38
1	4	7	17	21	?	40	37
10	3	13	20	24	29	?	34
9	11	14	19	23	30	27	33

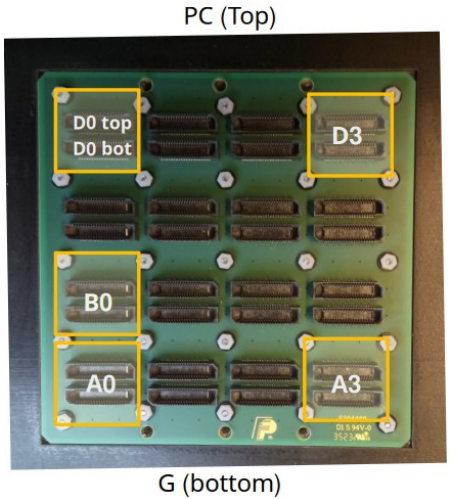
Top

Bottom

Pads where the Signals are NOT found are marked by “?”

Mapping – pixel to Samtec pin

Rear End View



A0 (Measured)

37	27	33	?	19	14	11	9
34	39	29	24	20	13	3	10
30	40	31	21	17	7	4	1
38	28	32	22	?	8	12	2

D0 (Measured)

?	27	33	23	19	14	11	9
34	?	29	24	20	13	3	10
30	?	31	21	17	7	4	?
38	28	32	22	18	8	12	?

Top

Bottom

2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

2	12	8	18	22	32	28	38
1	4	7	17	21	?	40	37
10	3	13	20	24	29	?	34
9	11	14	19	23	30	27	33

Pads where the Signals are NOT found are marked by “?”

From two Gerber files:

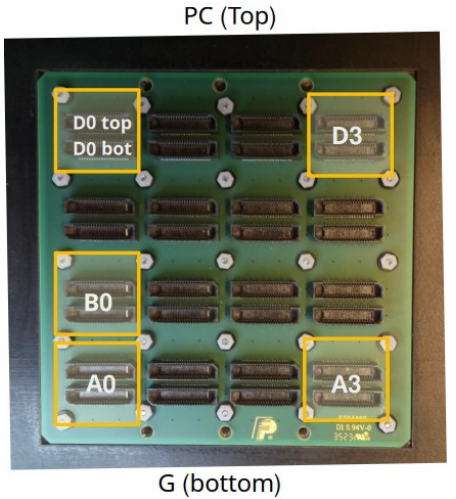
- Anode pads to RO pads
- Backplane

33	27	30	23	19	9	11	1
34	39	29	24	20	13	3	10
37	40	31	21	17	7	4	14
38	28	32	22	18	8	12	2

2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

Mapping – pixel to Samtec pin

Rear End View



A0 (Measured)

37	27	33	?	19	14	11	9
34	39	29	24	20	13	3	10
30	40	31	21	17	7	4	1
38	28	32	22	?	8	12	2

Top

2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

Bottom

D0 (Measured)

?	27	33	23	19	14	11	9
34	?	29	24	20	13	3	10
30	?	31	21	17	7	4	?
38	28	32	22	18	8	12	?

2	12	8	18	22	32	28	38
1	4	7	17	21	?	40	37
10	3	13	20	24	29	?	34
9	11	14	19	23	30	27	33

Pads where the Signals are NOT found are marked by "?"

Measured **Mapping Bottom (4x8) fully compatible** with Mapping produced from Gerber files. **NOT** the case for Top (4x8).

From two Gerber files:

- Anode pads to RO pads
- Backplane

33	27	30	23	19	9	11	1
34	39	29	24	20	13	3	10
37	40	31	21	17	7	4	14
38	28	32	22	18	8	12	2

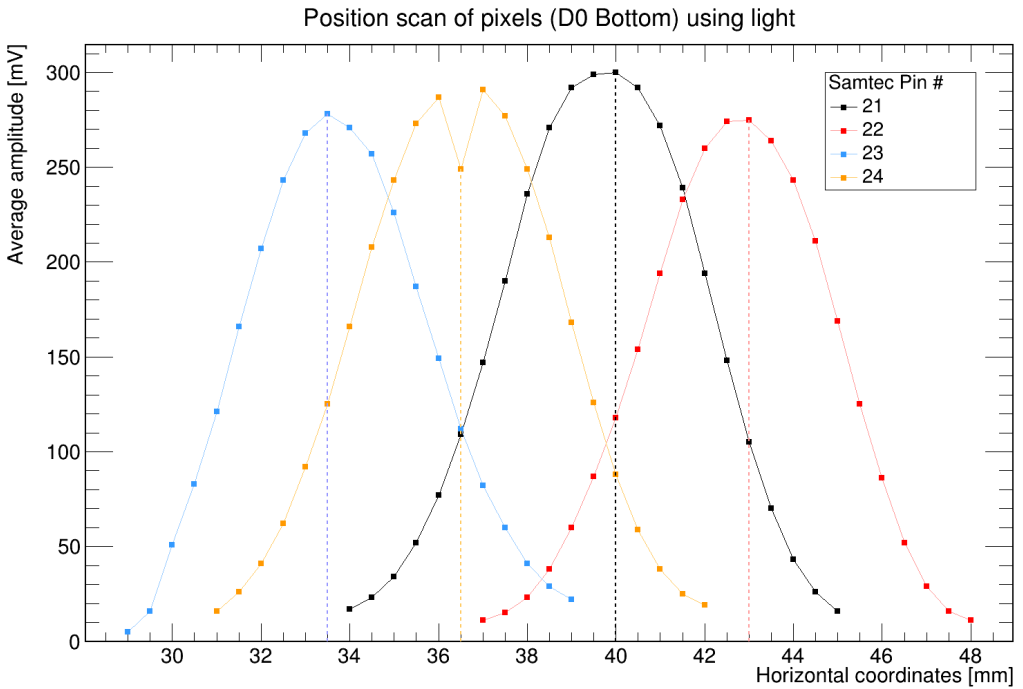
2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

Position scan of pixels

- Average amplitude (~ 2k events) vs. position
- In a step of 0.5 mm

- -200_-700_-200-700_-30 V
- Light intensity 2.0 (<n.p.e.> ~7)
- Trigger on Laser sync pulse (1.2 V_{RMS}) of rate 1.0 kHz

Y_{centre} = 91.5
~ 2 mm light spot



Observed Pitch 3-3.50 mm

Position scan of pixels

- Average amplitude (~ 2k events) vs. position
- In a step of 0.5 mm

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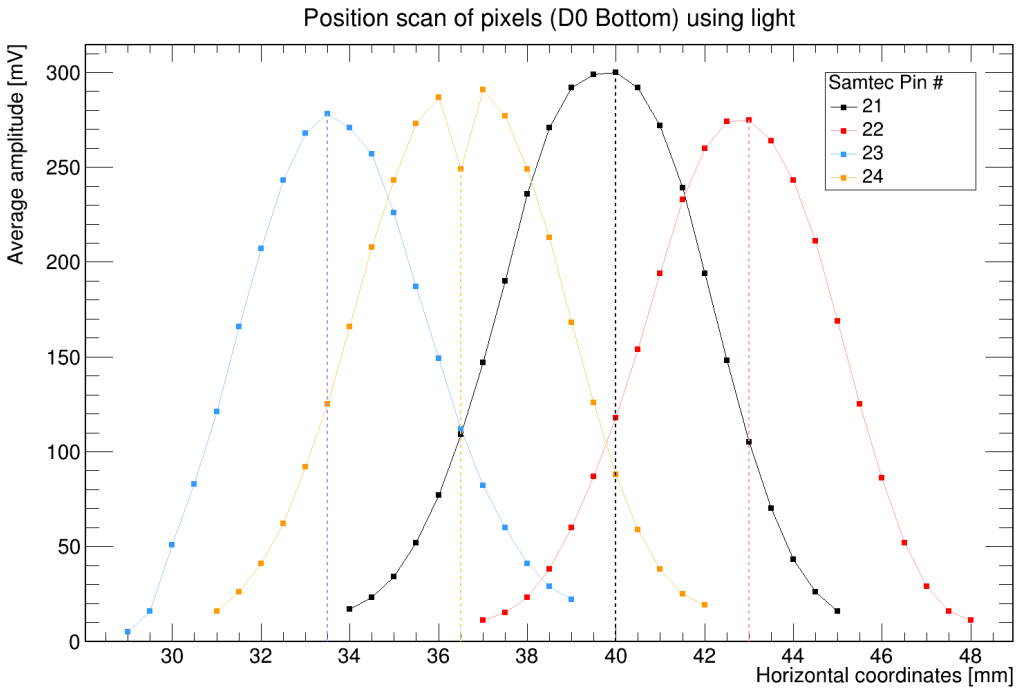
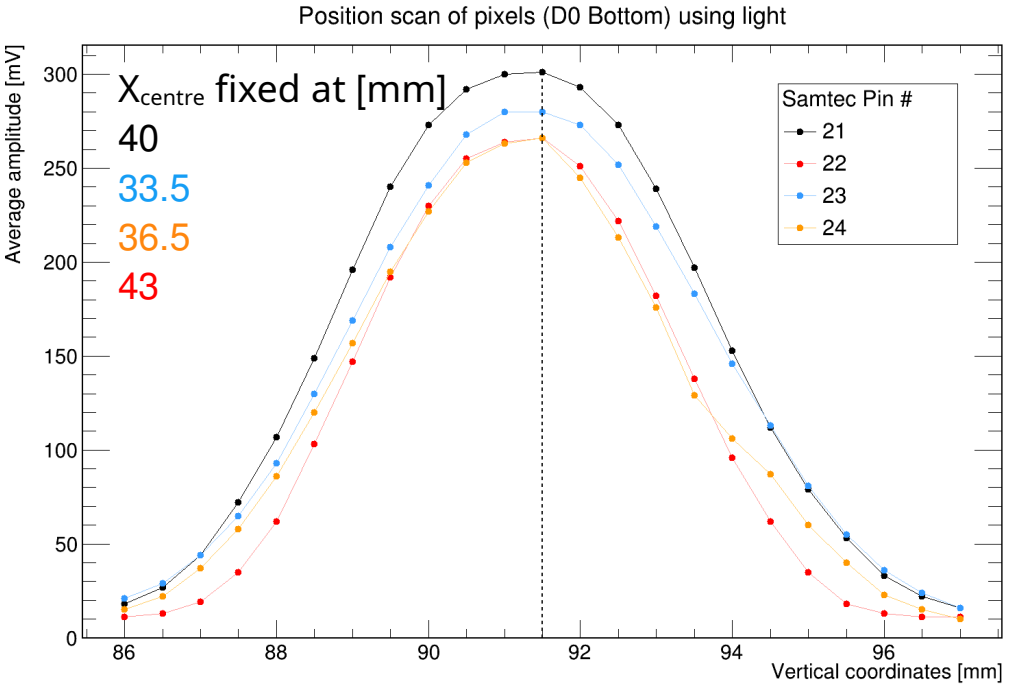


Observed Pitch 3-3.50 mm

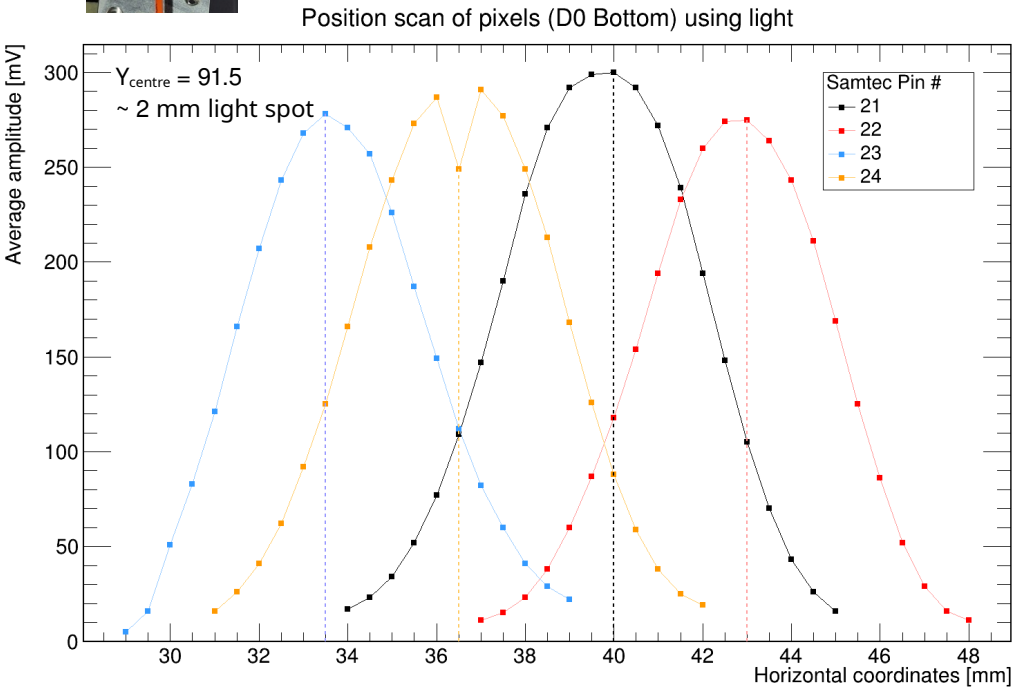


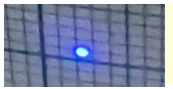
Lateral charge spread

- Average amplitude (~ 2k events) vs. position
- In a step of 0.5 mm

- -200_-700_-200-700_-30 V
- Trigger on Laser sync pulse (1.2 V_{RMS}) of rate 1.0 kHz

Laser Intensity 2.0 (n.p.e ~7)





Focusing lens mounted

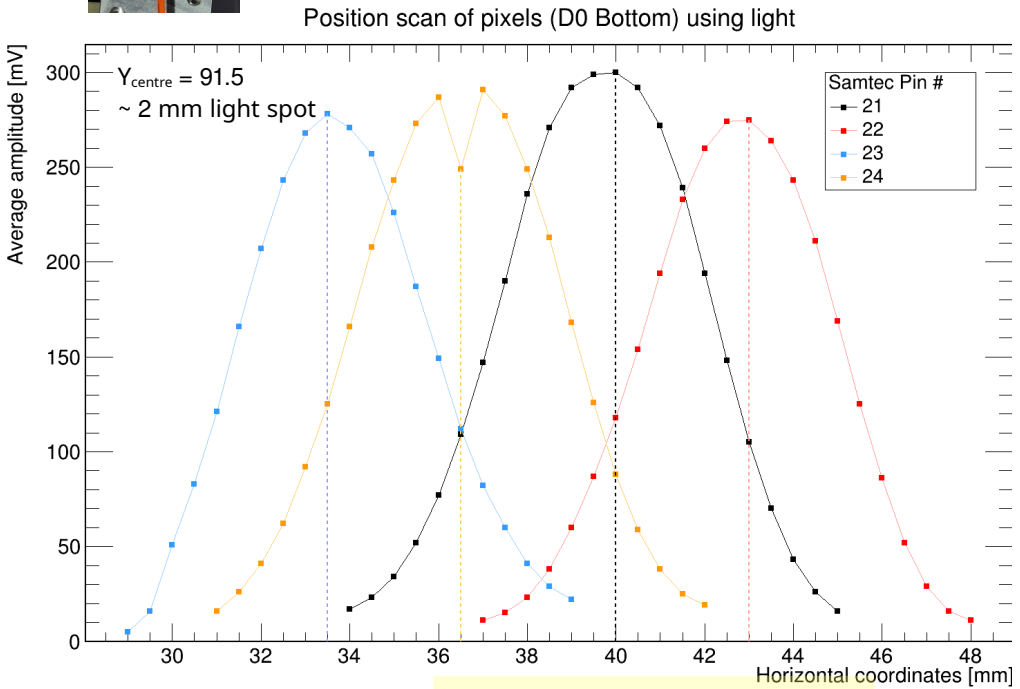
Laser Intensity 3.5
n.p.e. ~7

Lateral charge spread

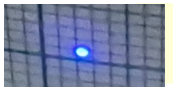
- Average amplitude (~ 2k events) vs. position
- In a step of 0.5 mm

- -200_-700_-200-700_-30 V
- Trigger on Laser sync pulse (1.2 V_{RMS}) of rate 1.0 kHz

Laser Intensity 2.0



60% on the Pad
40% on adjacent pads



Focusing lens mounted

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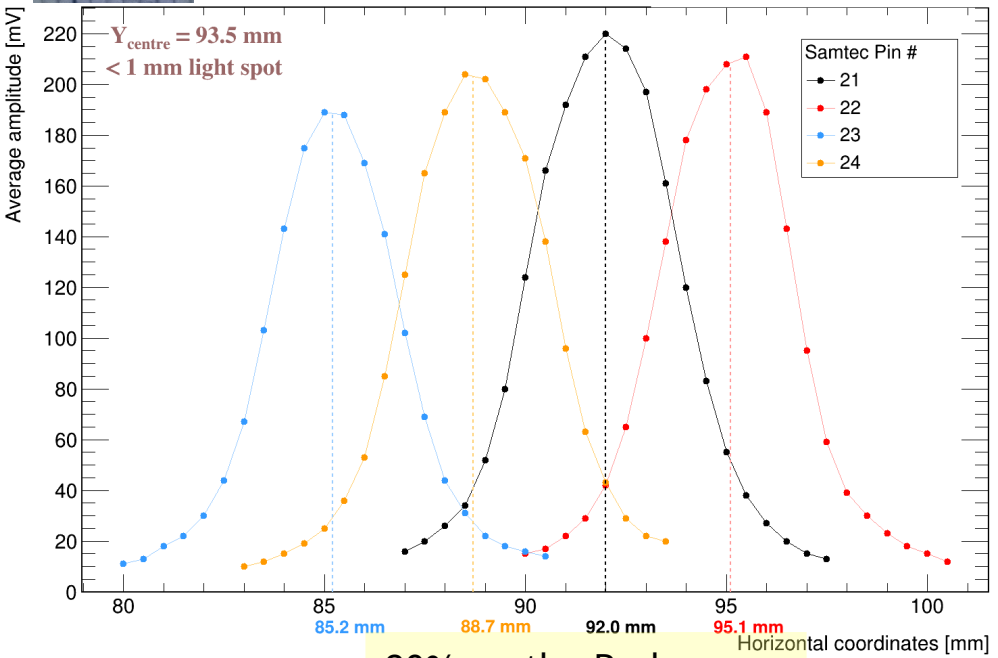
n.p.e. ~7



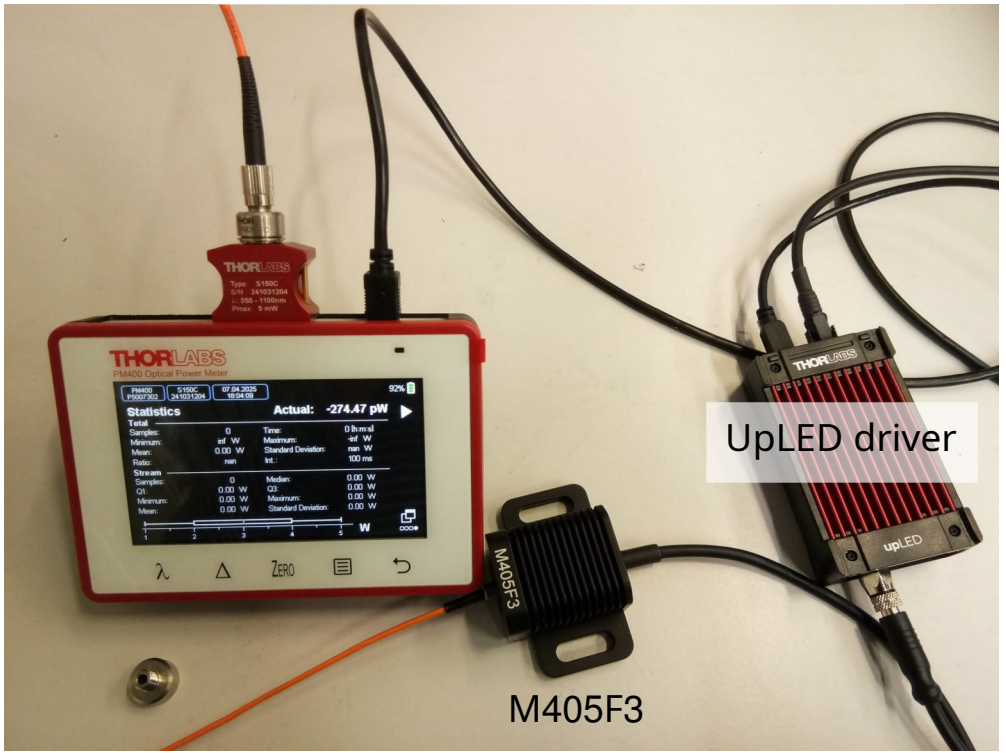
80% on the Pad
20% on adjacent pads

Characterisation of light sources

- Pulsed Laser (SPE measurement)
  - 405 nm (Picoquant)
- Continuous LED (Ageing tests)
  - M405F3 (Thorlabs)

Power measurement of light sources

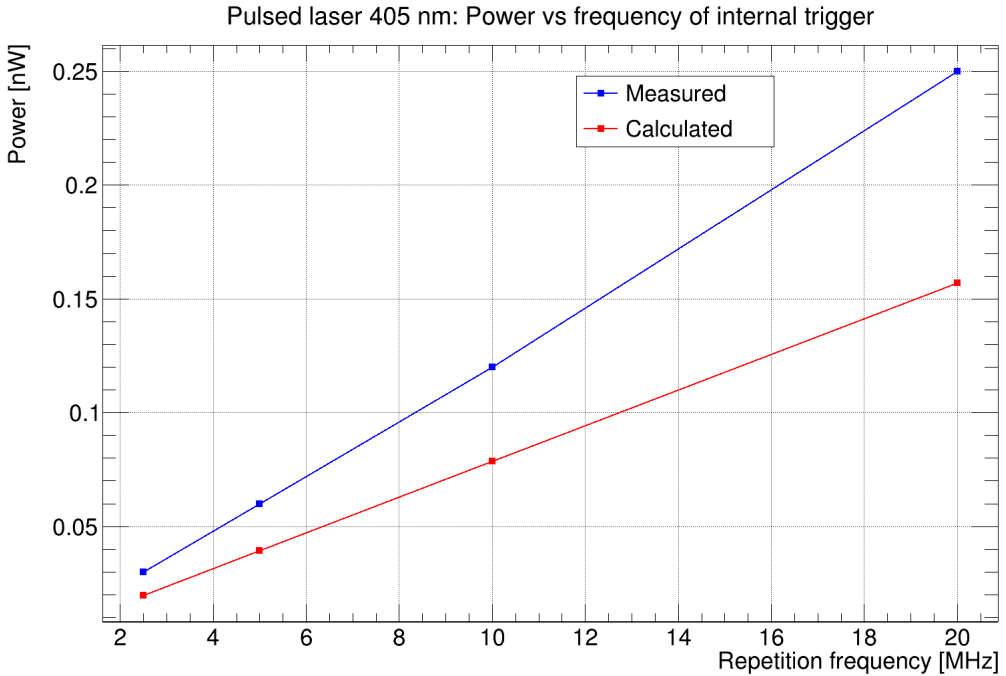
Optical Power Meter with Console

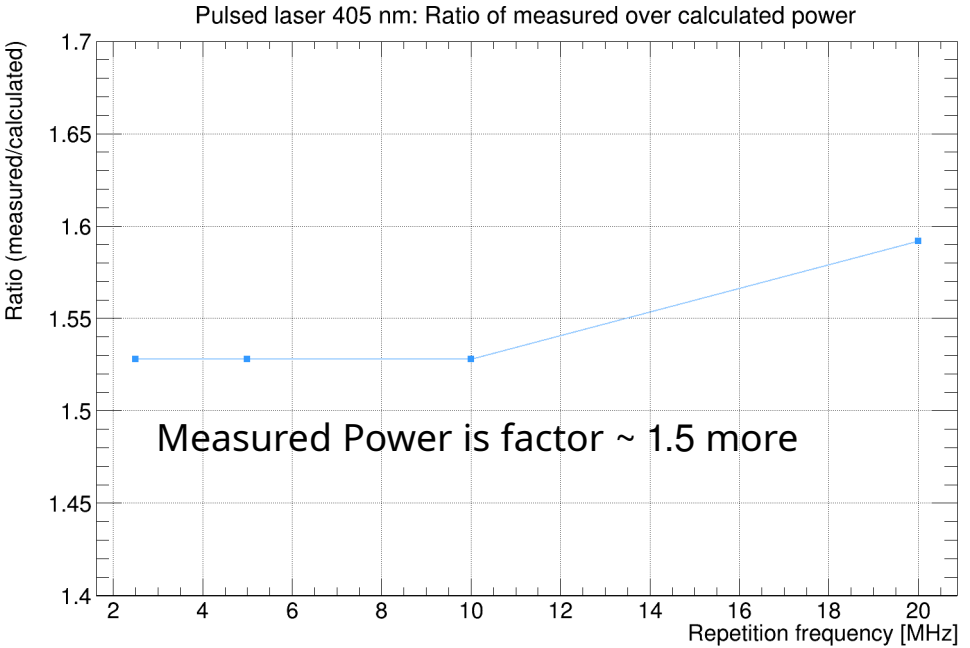


Pulsed laser

Pulsed Laser at internal trigger mode

Fixed Intensity 1.7 (npe ~ 1.6)



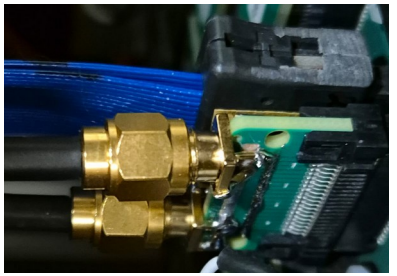


$P_{Calculated}$ (W) = f (Hz) x npe (/pulse) x QE^{-1} x E (J)

E = hc/λ; λ = 405 nm

Pulsed laser

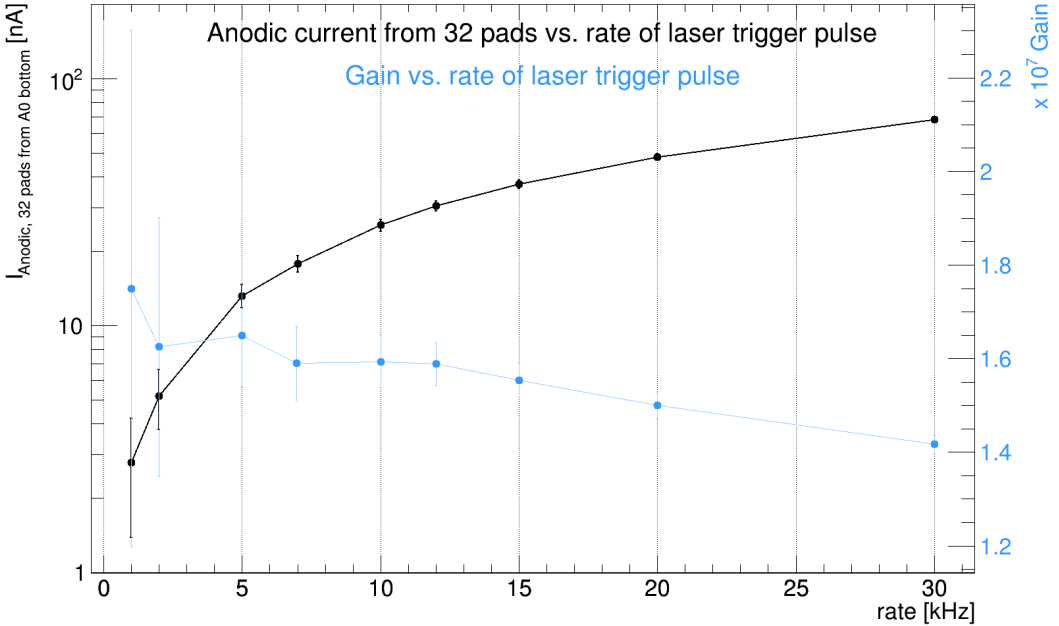
- Anodic Currents from 32 pads (A0 Bottom) measured by keithley as a function of external trigger pulse rate
- **Purpose:** to have control on Anodic current/Gain as a function of known input pulse rate;



A0 bot								
	37	27	33	?	19	14	11	9
	34	39	29	24	20	13	3	10
	30	40	31	21	17	7	4	1
	38	28	32	22	?	8	12	2
	2	12	8	18	22	32	28	38
	1	4	7	17	21	31	40	37
	10	3	13	20	24	29	39	34
	9	11	14	19	23	30	27	33

HV bias: -200_-700_-200_-700_-30 V @ XoX_NoX_XoN_NoN_PC

Fixed laser intensity 1.7



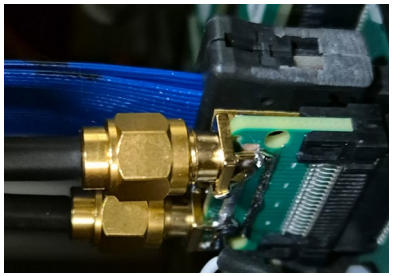
$$Gain = \frac{I^{Light} - I^{Dark}}{rate \times n.p.e. \times e}$$

I_{Dark} ~ 27.5 nA

n.p.e. ~ 1.6 for intensity 1.7

Pulsed laser

- Anodic Currents from 32 pads (A0 Top) measured by keithley as a function of external trigger pulse rate
- **Purpose:** to have control on Anodic current/Gain as a function of known input pulse rate;



A0 top

37	27	33	?	19	14	11	9
34	39	29	24	20	13	3	10
30	40	31	21	17	7	4	1
38	28	32	22	?	8	12	2
2	12	8	18	22	32	28	38
1	4	7	17	21	31	40	37
10	3	13	20	24	29	39	34
9	11	14	19	23	30	27	33

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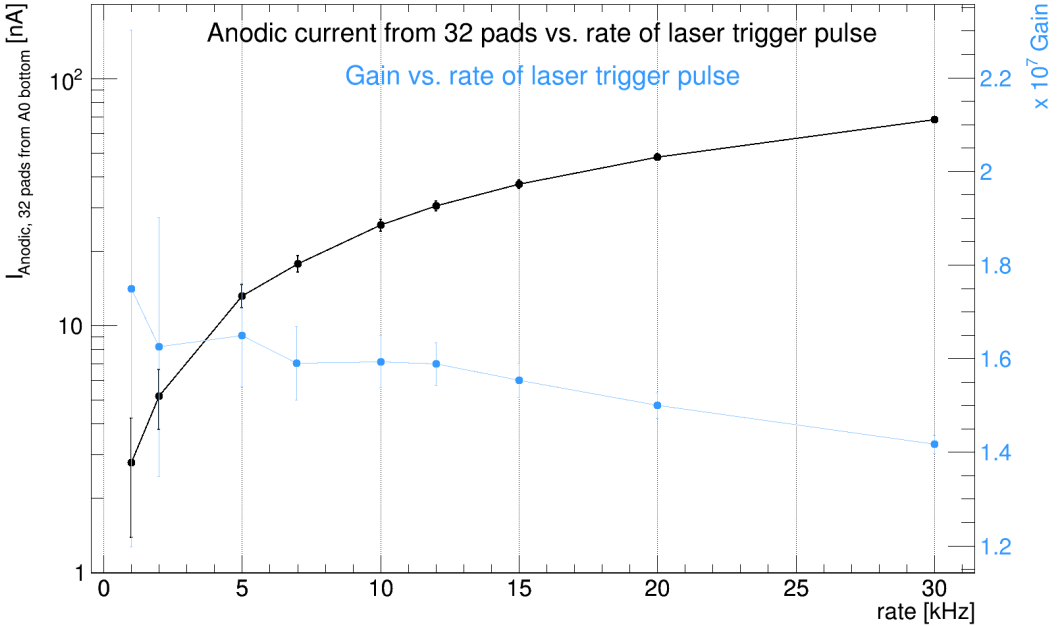
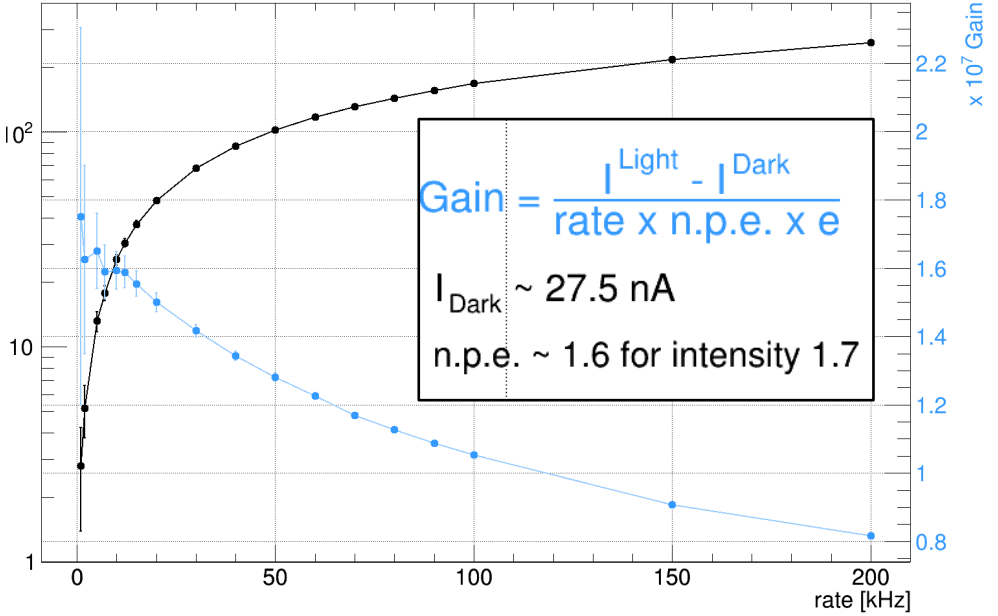
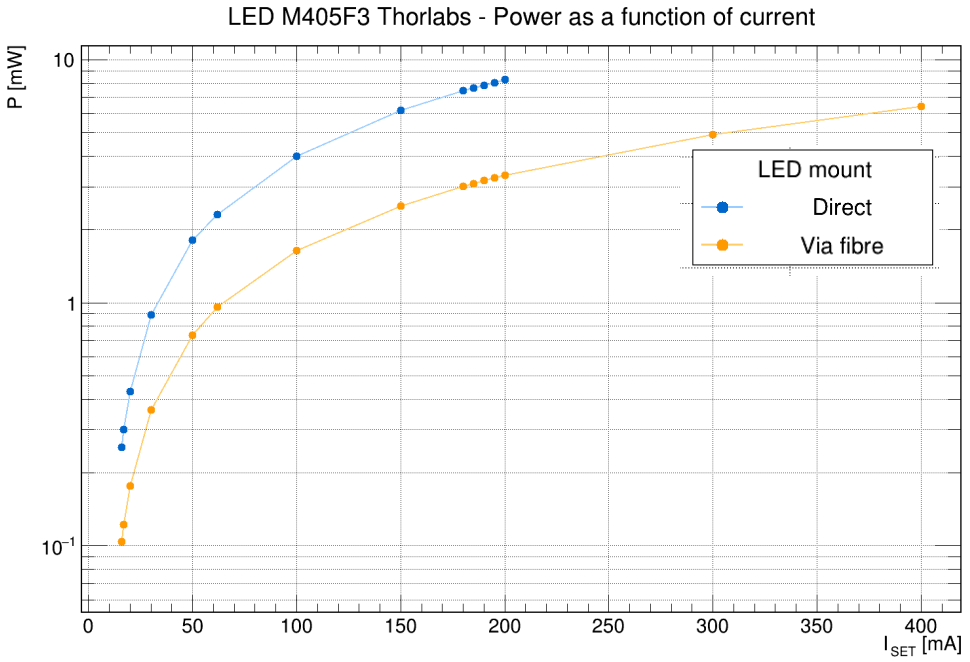
Fixed laser intensity 1.7

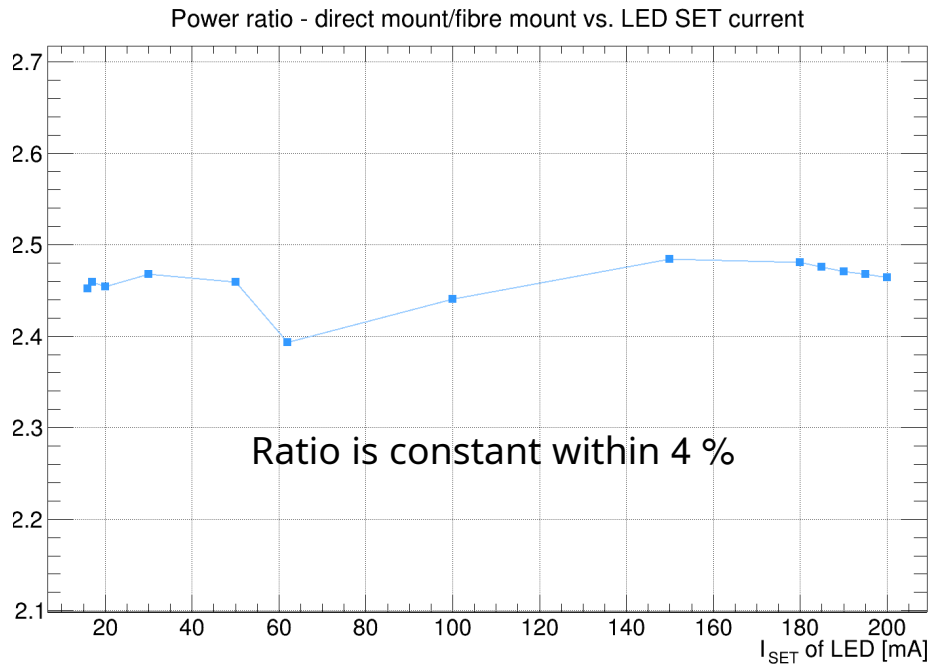




Continuous LED

- LED M405F3; Fibre: 400 µm core, 0.39 NA
- Minimum I_{SET} of LED for enough forward bias is 16 mA





- Direct mount was measured in order to understanding the power meter
- Reduction in power with fibre is compatible with fibre dimension

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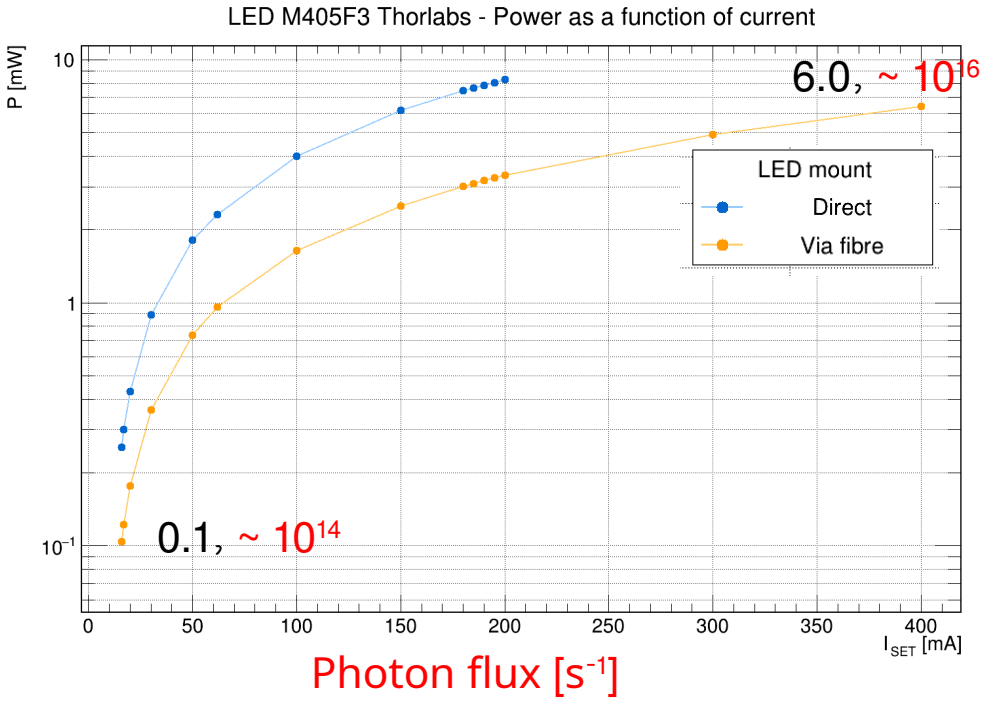
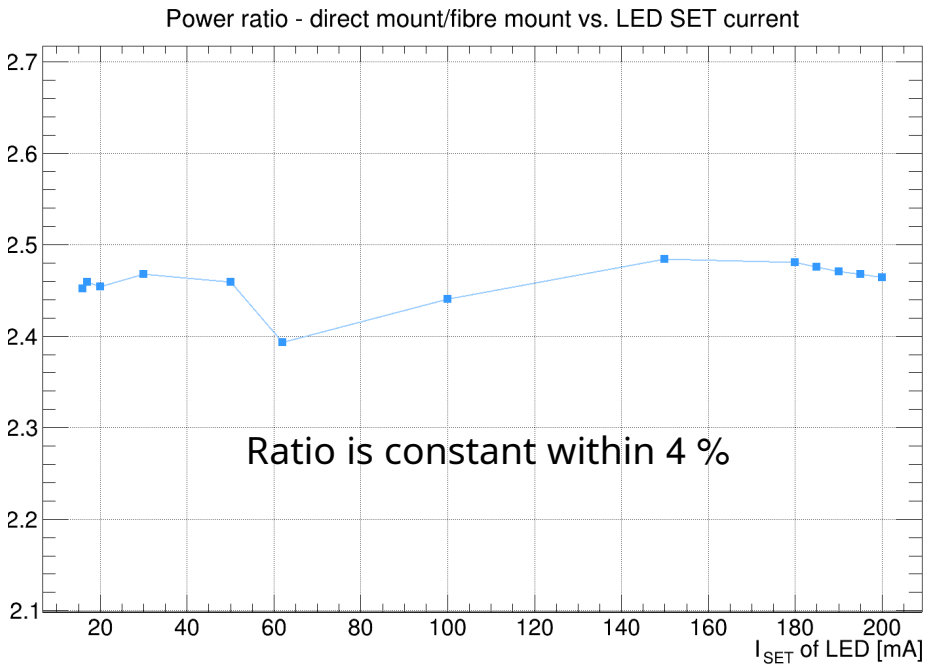
- LED M405F3; Fibre: 400 µm core, 0.39 NA
- Minimum I_{SET} of LED for enough forward bias is 16 mA





We will use ND filters for further reduction of photon flux

Summary

- Mechanical contacts between HRPPD and backplane improved- we can see signals/measure currents from a single Anode pad or a group of 32 pads.
- Mapping of Anode pixels to Samtec pins are performed - top (4 x 8) NOT compatible with Gerber files.
- Horizontal and vertical position scans of pixels performed. Measured pixel pitch is compatible with the design.
- Characterisation of light sources in terms of power/photon flux started and ongoing.

Summary

- Mechanical contacts between HRPPD and backplane improved- we can see signals/measure currents from a single Anode pad or a group of 32 pads.
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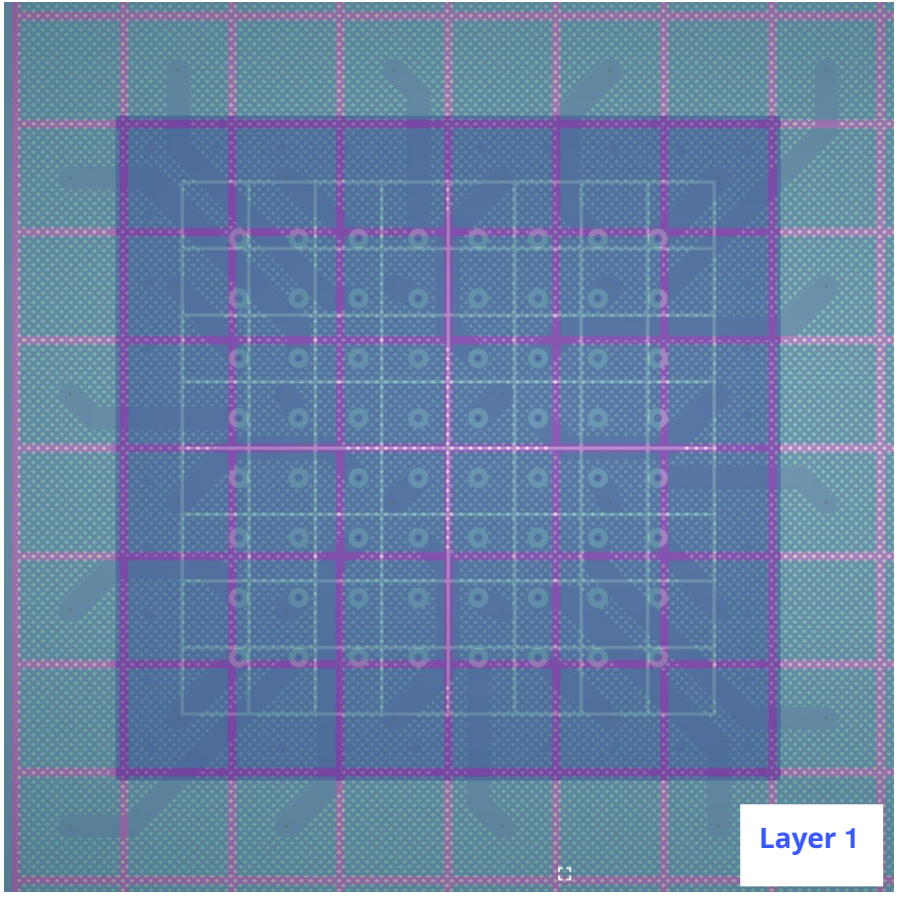
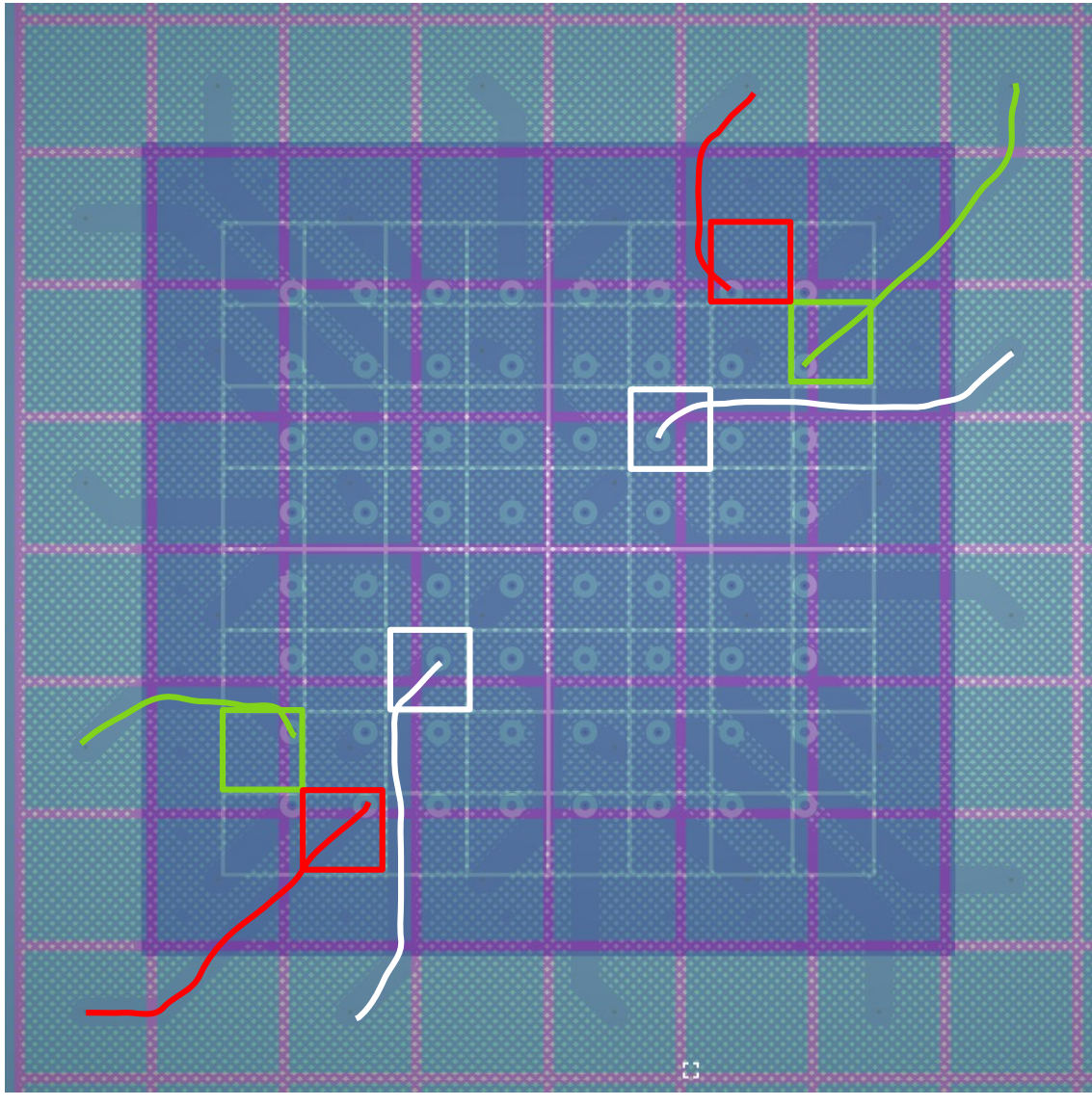
Thank you!

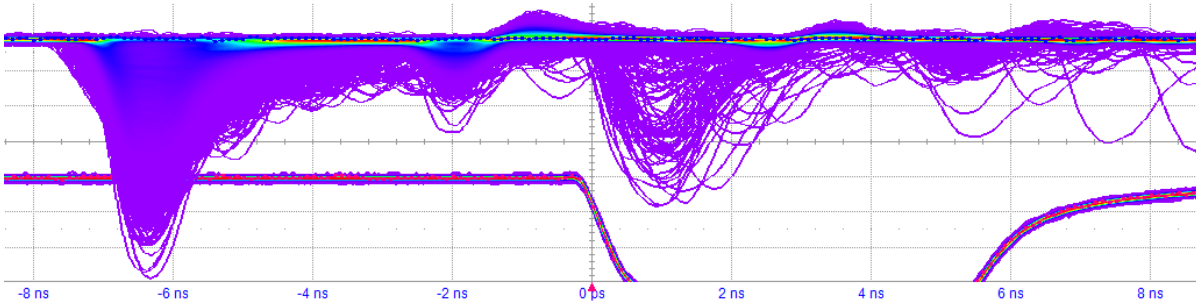
Mapping puzzle





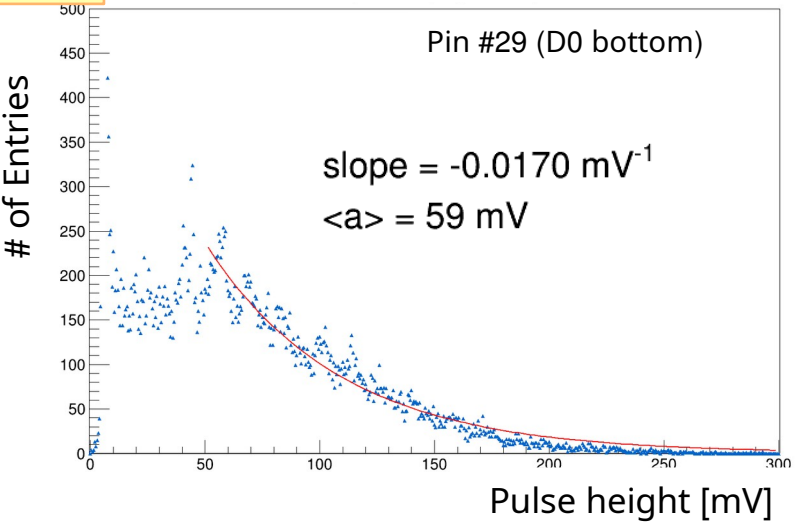
Signals from single pads

HV bias: -200_-700_-200_-700_-30 V @ XoX_NoX_XoN_NoN_PC



50 mV/div

Light signals – Intensity 1.7



Light signals (50k events accumulated)

- Triggering on Laser sync pulse (1.2 V_{RMS}; 600 Hz)
- Intensity: 1.7
- <amplitude> ~ -59 mV
- <n.p.e.> ~ 1.6

Correct fitting has to be implemented using a Polya function