

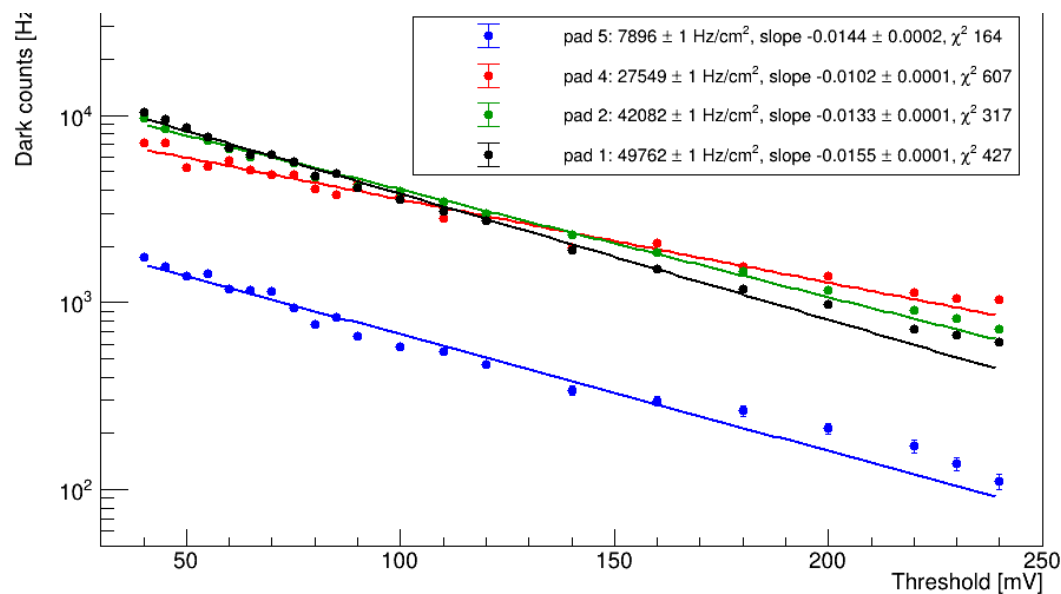
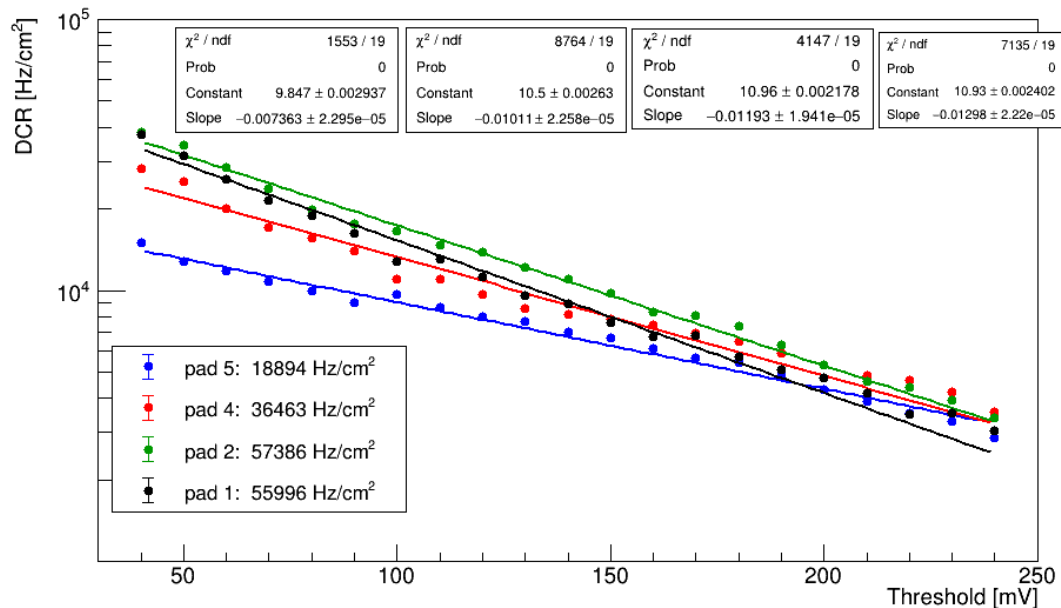
Fluctuation in currents at electrodes XoX and NoX

Jinky Agarwala

On behalf of INFN TS and INFN GE

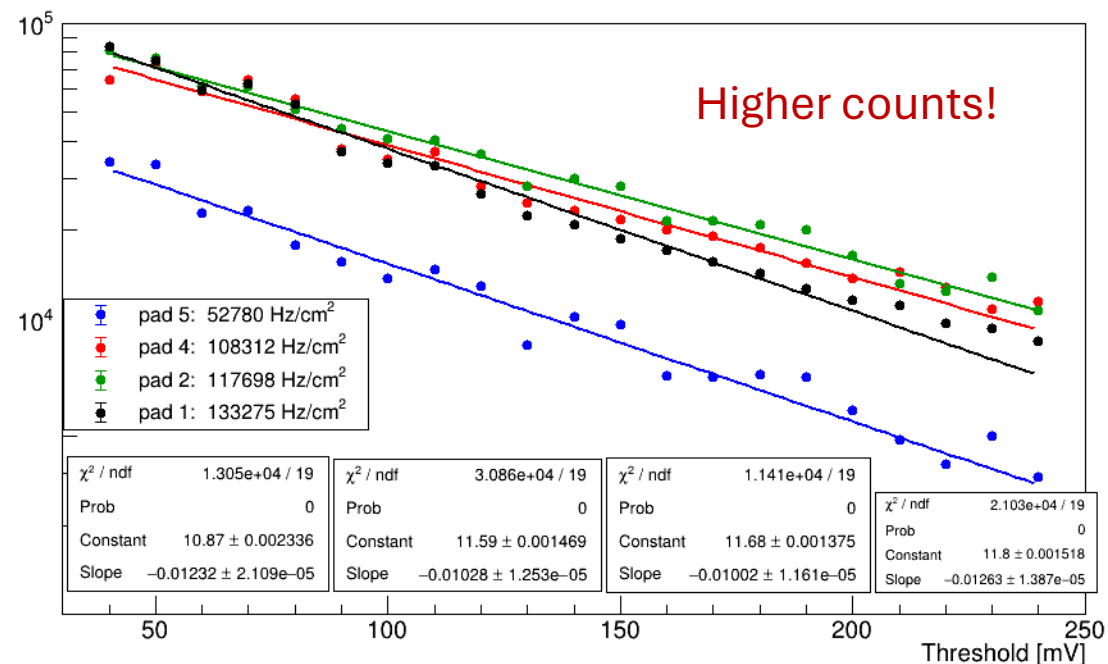
DCRs vary with detector orientation!

40° inclination, PC-HV-DOWN



Observation from data taken two weeks ago:
DCRs vary with different angular orientation of
the detector

40° inclination, PC-HV-UP



Jump in currents at XoX and NoX

Observation of last week

13 Feb. 2024, Tuesday

Notes from electronic lab book

200_850_50V_-40 degree PC-HV-DOWN; Temperature log is in recording. Currently at 25°C

During the data taking (started from -10 mV) I am keeping an eye on the monitored Voltages and Currents.

At -90 mV the counts suddenly dropped to zero. The current across the bottom MCP and that between Exit of bottom MCP and Anode **dropped** (like a **jump**, NOT fluctuation!) from 95 μ A and 377 μ A to 66 μ A and 168 μ A, respectively. **Recovered without any intervention.**

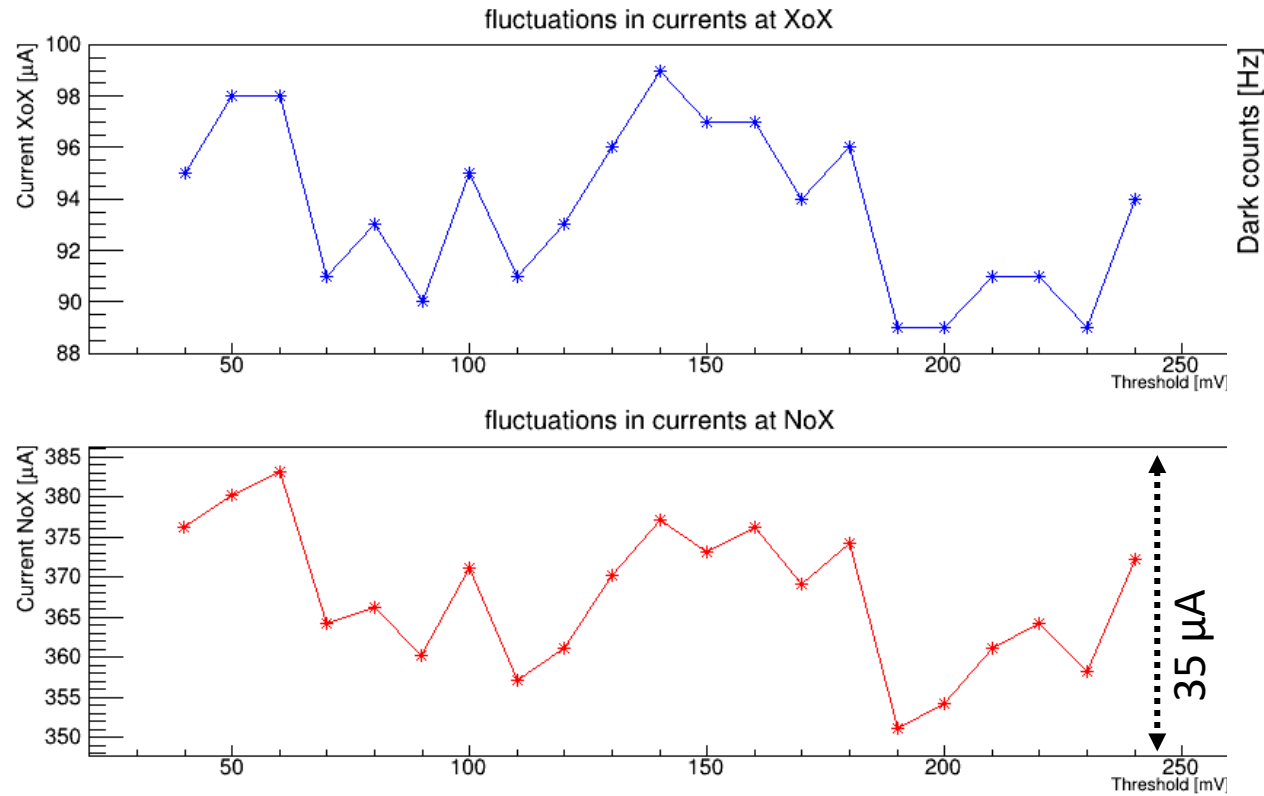
Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	94.9670	199.70	On
00.001	1000.00	875.00	376.6350	876.14	On
00.002	800.00	200.00	257.4250	200.08	On
00.003	800.00	875.00	257.1370	876.12	On
00.004	1000.00	200.00	256.9890	200.14	On
00.005	800.00	875.00	236.4440	876.20	On
00.006	500.00	50.00	0.0090	49.94	On
00.007	100.00	0.00	0.0350	0.00	Off

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	66.0670	199.64	On
00.001	1000.00	875.00	167.8540	876.14	On
00.002	800.00	200.00	257.3080	200.04	On
00.003	800.00	875.00	256.9630	876.24	On
00.004	1000.00	200.00	256.7430	200.18	On
00.005	800.00	875.00	236.1070	876.38	On
00.006	500.00	50.00	0.0870	49.94	On
00.007	100.00	0.00	0.0750	0.00	Off

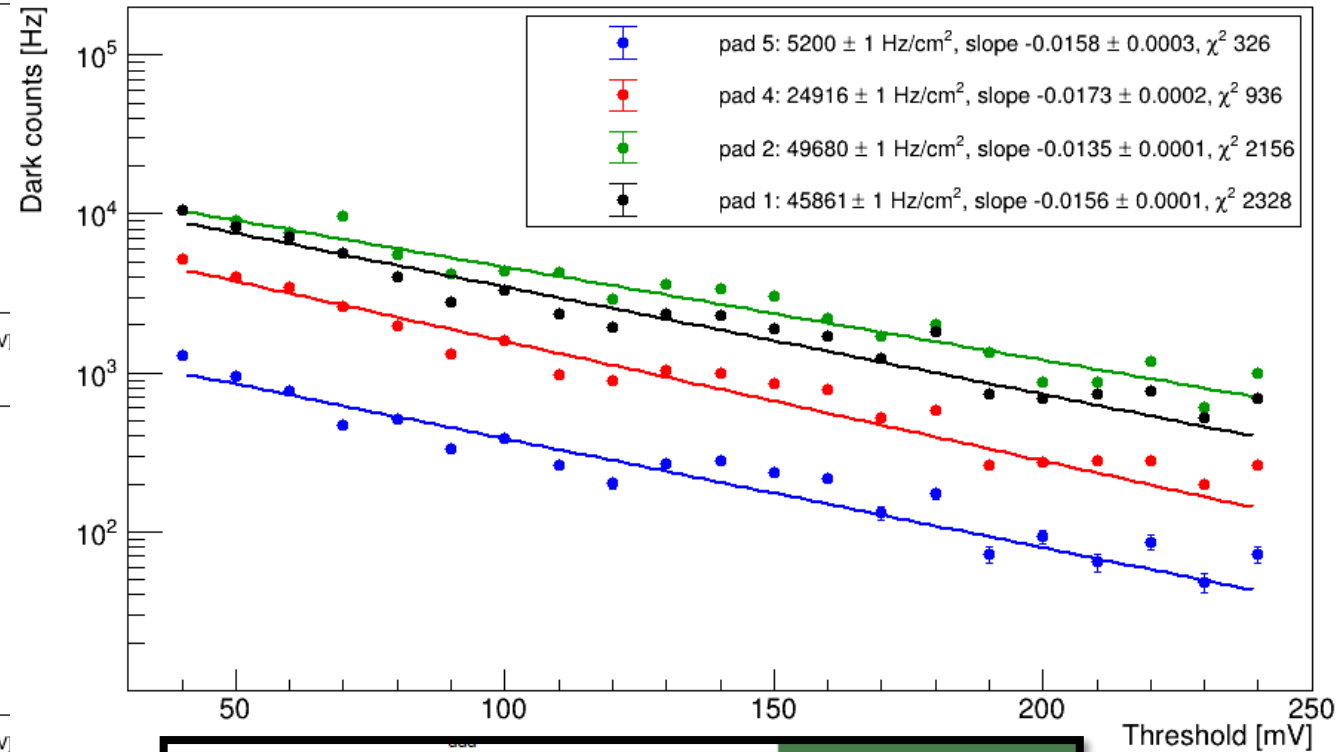
At NoX

- **Jump by 200 μ A (zero counts) and fluctuation within 100 μ A (considerably lower counts).**
- Solved by itself - when the light was ON and there was a rise in ΔV across the bottom MCP.
- **Fluctuation within 50 μ A remained. Still there.**

Repeated DCR measurements at 40°



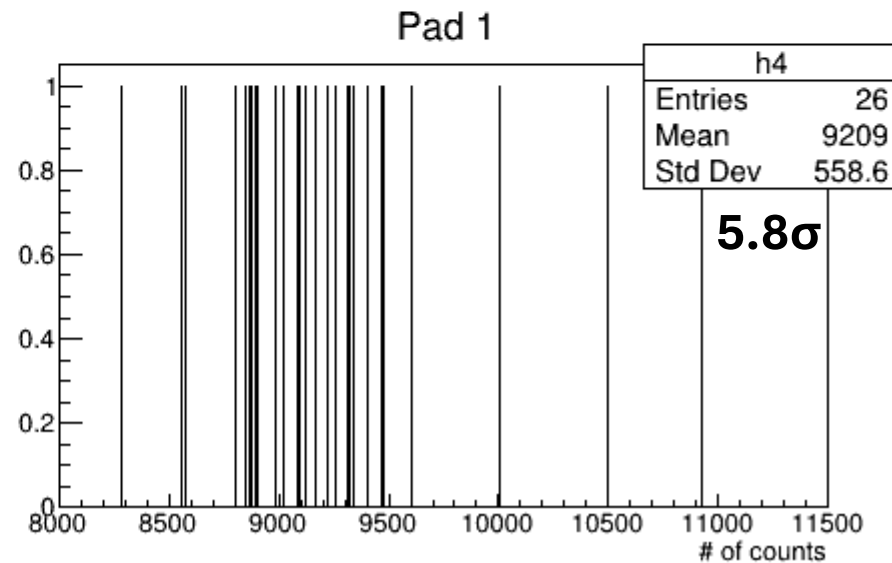
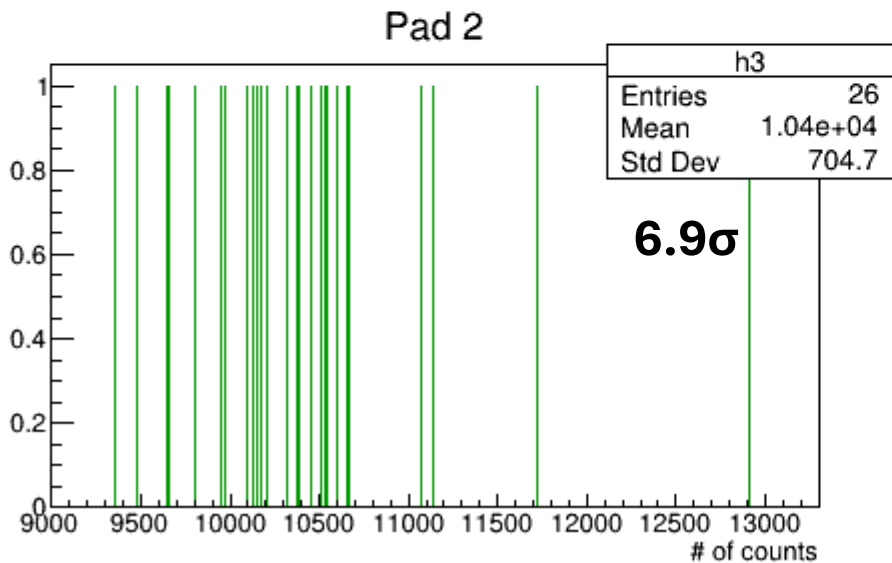
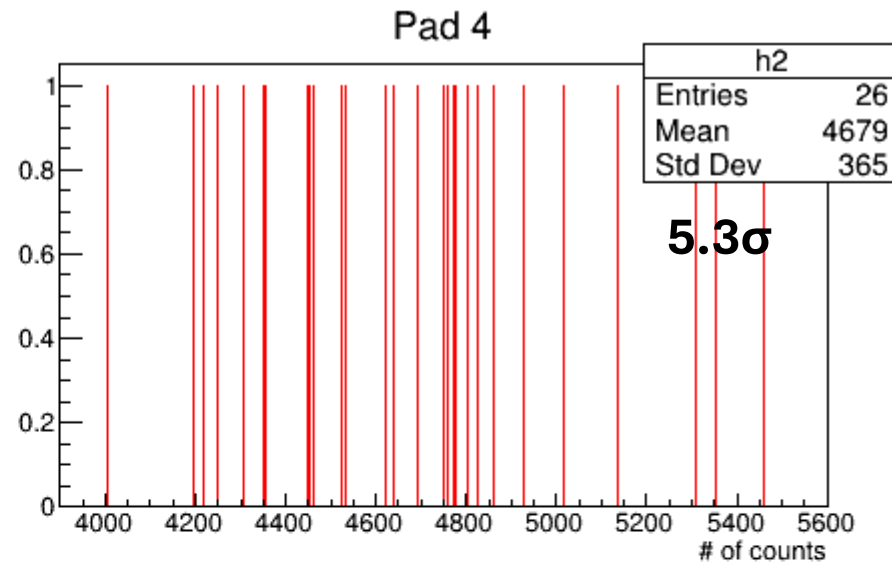
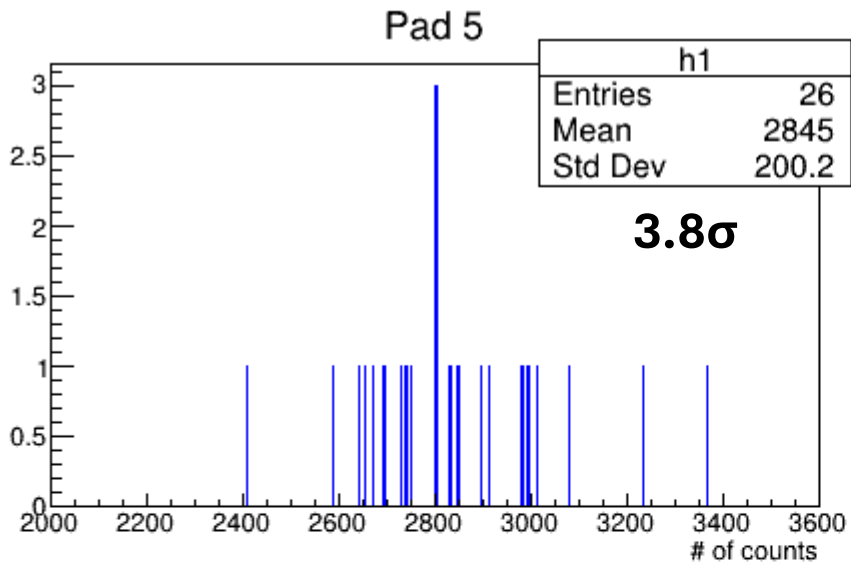
40° inclination, PC-HV-UP 20240216



Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	97.3560	199.84	On
00.001	1000.00	875.00	400.3190	876.12	On

- Large Chi-squared values – NOT good fits!
- The systematic fluctuations coming from fluctuation in currents are more than 5σ (next slide).
- **The values of DCRs are compatible with what measured at MNP17 CERN. So, the previous measurements provided wrong values (most probably because of higher currents at XoX and NoX).**

Fluctuation more that 5 σ



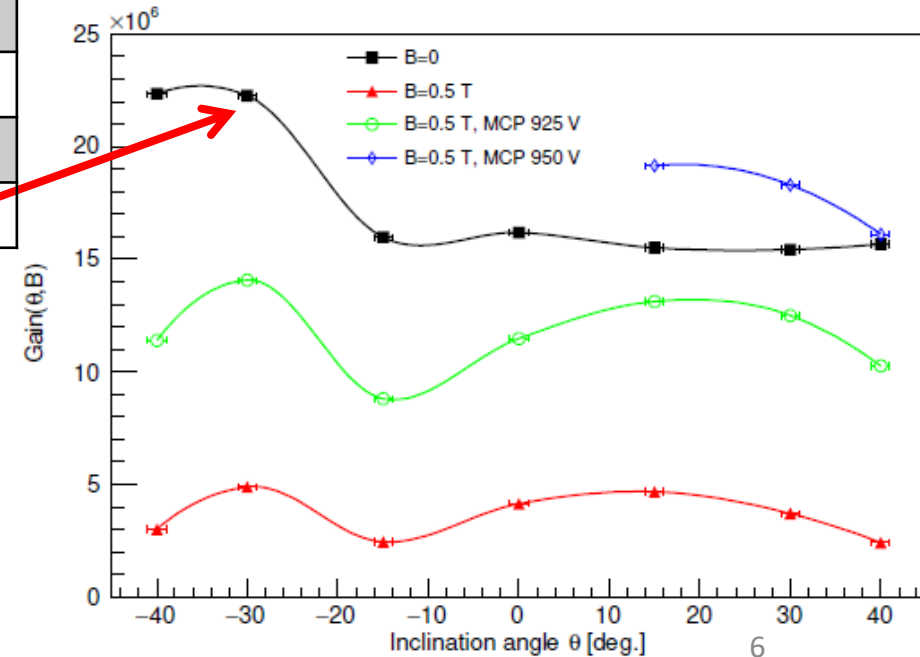
- At threshold value -40 mV, counts for 1 sec registered.
- 26 measurements taken for each of the four counters.
- Histogram bin width 1.

Currents at XoX and NoX (MNP17)

Photo-Cathode	Run Number	Orientation	PC-HV-Connector	Currents at electrode		
				XoX [μA]	NoX [μA]	PC [nA]
NOT connected	46	30°	DOWN	97.275	383.665	- 15
	78	40°	DOWN	93.335	380.904	- 8
	62	30°	UP	92.977	404.443	4
	77	40°	UP	98.863	404.575	50
Connected	103	0°	horizontal	99.557	376.722	35
	119	30°	DOWN	86.944	365.893	88
	113	40°	DOWN	87.578	356.666	66
	108	15°	UP	95.047	371.267	63
	141	30°	UP	130.229	440.066	45

- For listed runs, $B = 0$.
- Nominal biasing voltage for PC NOT connected: 200_900_50V.
- Nominal biasing voltage for PC connected: 200_875_50V.
- For larger inclination of the detector with PC-HV-connector moved upward, monitored currents at XoX and NoX (in particular at NoX) went higher.

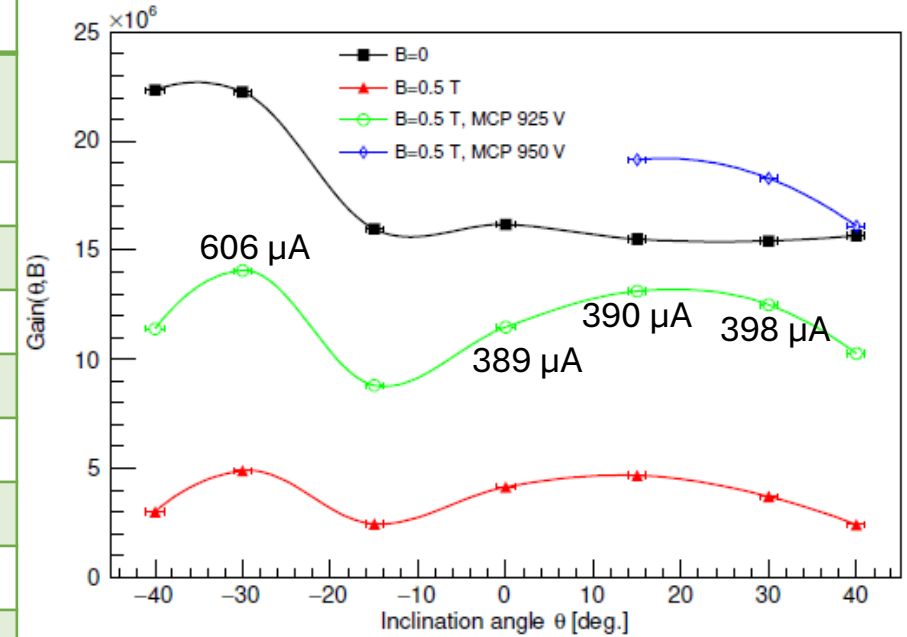
We don't have the screenshot for the other point at 40°. But we have several, taken in the lab for same configuration (next slide)



Currents at XoX and NoX (MNP17)

B=0.5 T; Biasing voltages: 200_925_50V

Photo-Cathode	Run Number	Orientation	PC-HV-Connector	Currents at electrode		
				XoX [μ A]	NoX [μ A]	PC [nA]
Connected	117	40°	DOWN	75.036	400.526	63
	123	30°	DOWN	74.287	397.762	20
	136	15°	DOWN	73.701	389.656	65
	105	0°	horizontal	75.433	388.916	15
	112	15°	UP	73.296	387.343	79
	145	30°	UP	142.724	605.862	52
	150	40°	UP	82.930	419.141	37

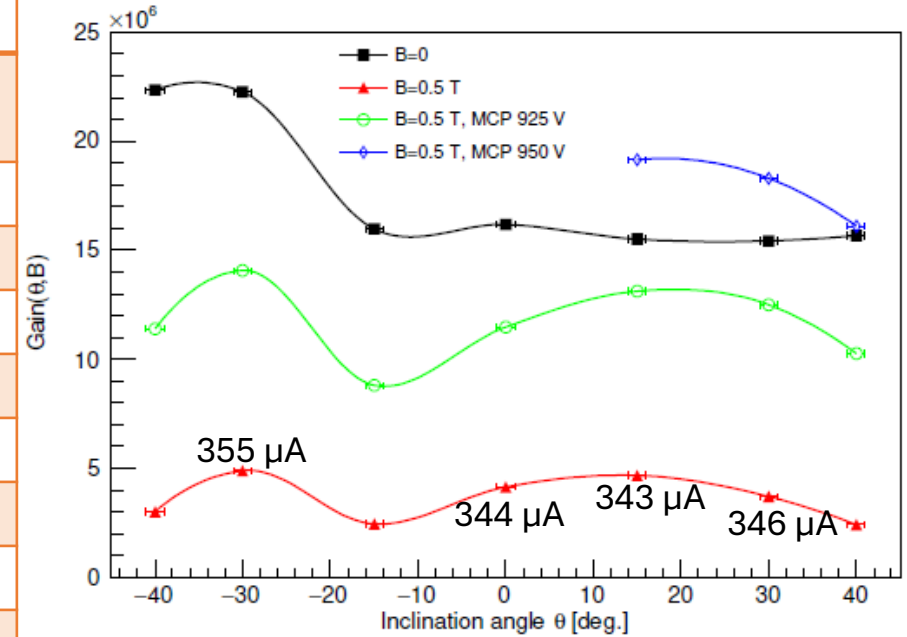


Gain at +30° is lower than that at +15°. Probably we miss some percentage also at 30° like at 40°.

Currents at XoX and NoX (MNP17)

B=0.5 T; Nominal biasing voltages: 200_875_50V

Photo-Cathode	Run Number	Orientation	PC-HV-Connector	Currents at electrode		
				XoX [μ A]	NoX [μ A]	PC [nA]
Connected	114	40°	DOWN	68.710	345.646	58
	120	30°	DOWN	68.8050	346.418	72
	133	15°	DOWN	69.050	340.019	38
	104	0°	horizontal	70.806	343.954	63
	109	15°	UP	71.771	343.490	52
	142	30°	UP	69.021	354.539	38
	147	40°	UP	68.458	348.857	24



Screenshot had been captured immediately after a run was launched. There were always some fluctuations at least by few μ A during a particular run. So, a lower gain at 0° than that at +15° can be justified.

Currents at XoX and NoX (Lab)

- Some screenshots recently taken in Trieste lab when the detector is tilted at 40° with PC-HV-connector moved upward.
- 200_875_50V.
- Currents at PC are negative. Some currents apart from photo-current!

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	124.4030	200.08	On
00.001	1000.00	875.00	425.8660	877.36	On
00.002	800.00	200.00	262.4780	199.96	On
00.003	800.00	875.00	262.0790	876.06	On
00.004	1000.00	200.00	261.9650	200.08	On
00.005	800.00	875.00	248.8270	876.28	On
00.006	500.00	50.00	-3.0690	49.84	On
00.007	100.00	0.00	0.0830	0.00	Off

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	122.0420	199.66	On
00.001	1000.00	875.00	422.6280	876.72	On
00.002	800.00	200.00	263.7210	200.24	On
00.003	800.00	875.00	263.1850	876.38	On
00.004	1000.00	200.00	262.8070	200.42	On
00.005	800.00	875.00	248.7540	876.46	On
00.006	500.00	50.00	-2.4330	50.22	On
00.007	100.00	0.00	0.0690	0.00	Off

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	130.3030	200.34	On
00.001	1000.00	875.00	437.0720	869.92	On
00.002	800.00	200.00	258.4630	200.28	On
00.003	800.00	875.00	258.9430	876.28	On
00.004	1000.00	200.00	259.6760	200.18	On
00.005	800.00	875.00	244.1530	876.62	On
00.006	500.00	50.00	-3.6650	52.12	On
00.007	100.00	0.00	0.0690	0.00	Off

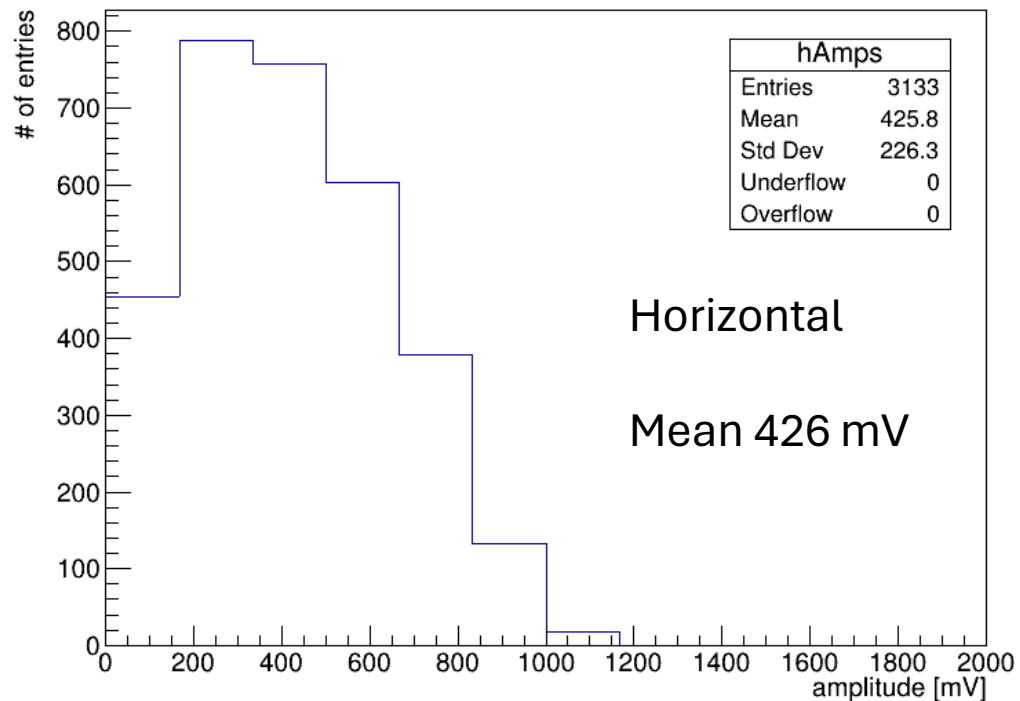
Hint of unintended resistance in the circuit!

Data taking in Trieste lab

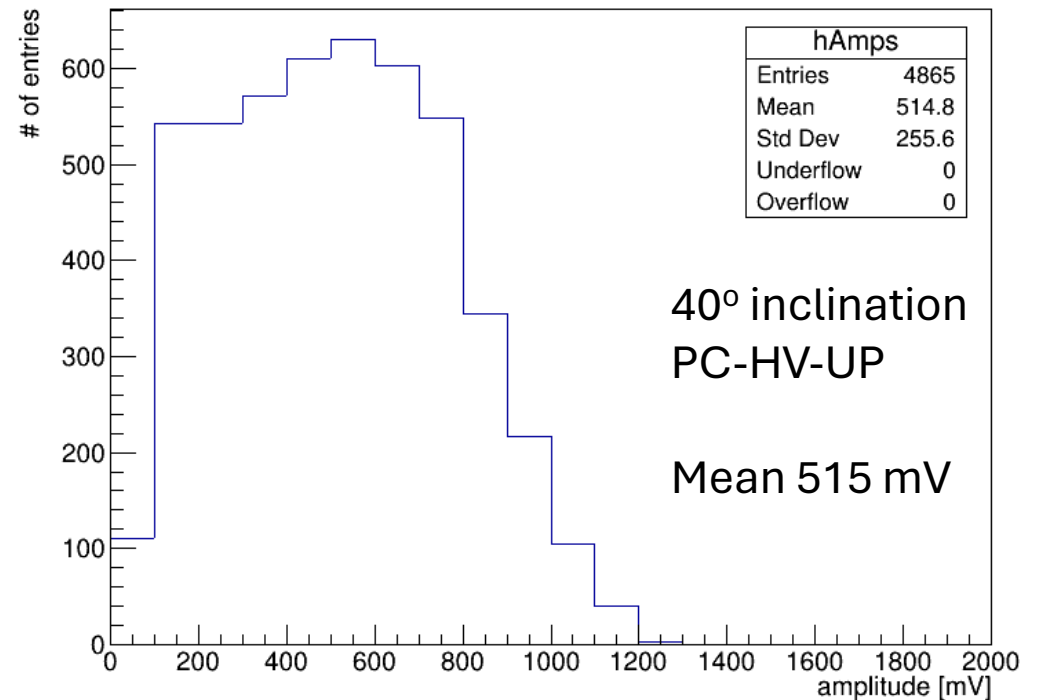
- Laser controller in External TR
- 600 Hz, 20 ns width, Intensity 2.0

Oscilloscope - central pad is read
5% of TR events

amplitude distribution, 0 deg



amplitude distribution, 40 deg PC_HV_UP



Data taking in Trieste lab

- Laser controller in External TR
- 600 Hz, 20 ns width, Intensity 2.0

Oscilloscope - central pad is read

horizontal

ddd						
Custom	ISet	VSet	IMon	VMon	Pw	
00.000	1000.00	200.00	97.1140	199.82	On	
00.001	1000.00	875.00	391.5550	876.30	On	
00.002	800.00	200.00	256.6760	200.06	On	
00.003	800.00	875.00	256.3440	876.14	On	
00.004	1000.00	200.00	256.2770	200.18	On	
00.005	800.00	875.00	249.2990	876.28	On	
00.006	500.00	50.00	0.0440	49.96	On	
00.007	100.00	0.00	0.0900	0.00	Off	

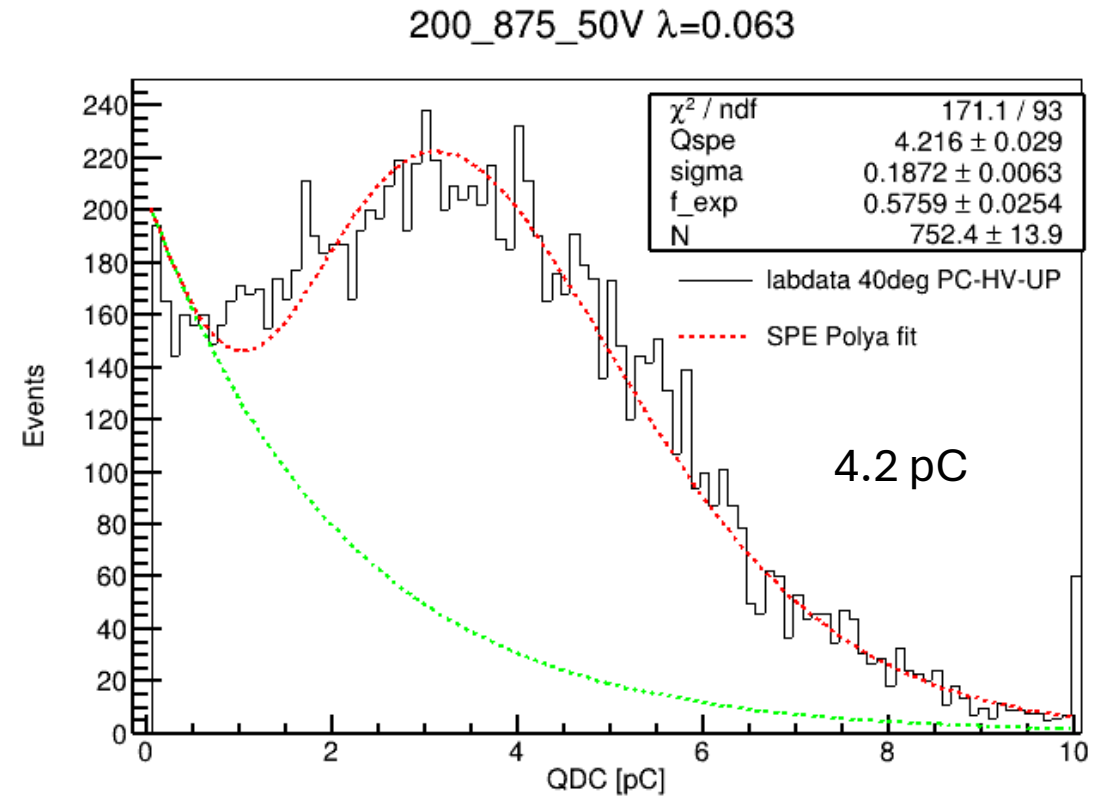
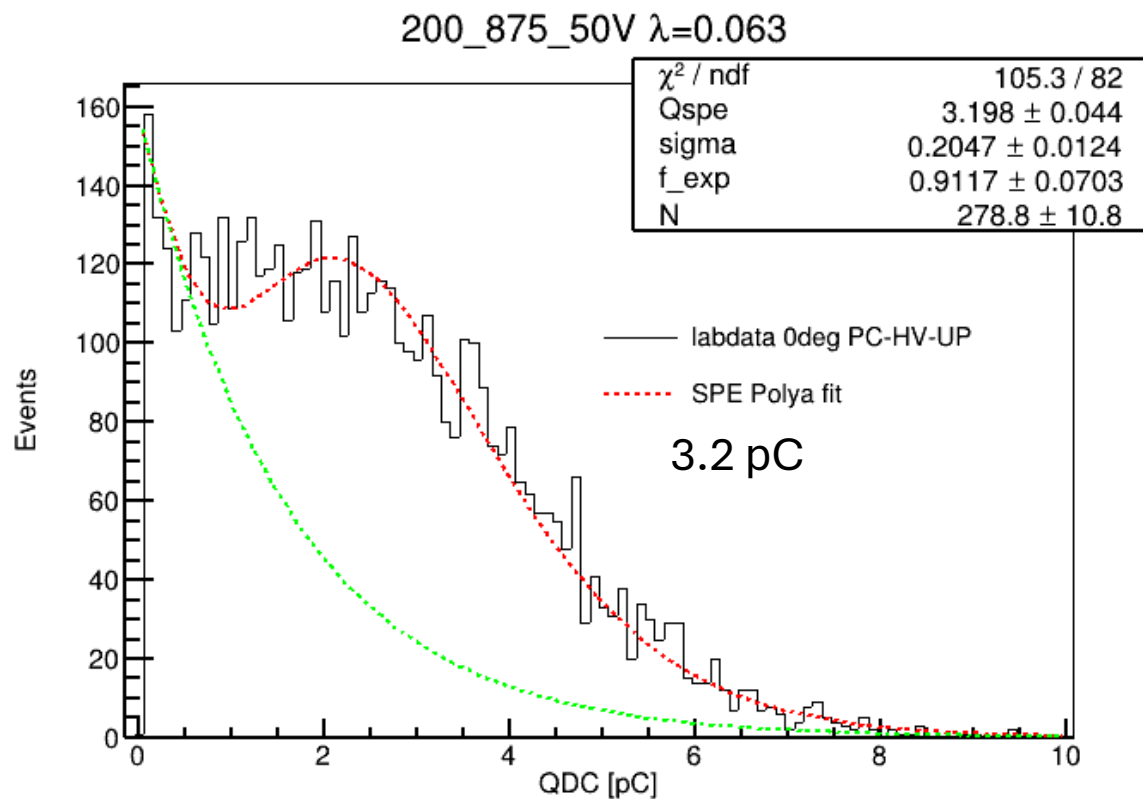
40° inclination, PC-HV-UP

ddd						
Custom	ISet	VSet	IMon	VMon	Pw	
00.000	1000.00	200.00	136.1770	200.20	On	
00.001	1000.00	875.00	455.8090	871.70	On	
00.002	800.00	200.00	260.5560	200.08	On	
00.003	800.00	875.00	260.2470	876.42	On	
00.004	1000.00	200.00	260.8830	200.14	On	
00.005	800.00	875.00	247.5870	876.42	On	
00.006	500.00	50.00	-1.6100	50.84	On	
00.007	100.00	0.00	0.0670	0.00	Off	

Data taking in Trieste lab

- Laser controller in External TR
- 600 Hz, 20 ns width, Intensity 2.0

4 – 5 % non-empty events



Data taking in Trieste lab

- Laser controller in External TR
- 600 Hz, 20 ns width, Intensity 2.0

4 – 5 % non-empty events

horizontal

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	97.4340	199.80	On
00.001	1000.00	875.00	398.3920	876.16	On
00.002	800.00	200.00	256.6740	200.08	On
00.003	800.00	875.00	256.3520	876.18	On
00.004	1000.00	200.00	256.2150	200.20	On
00.005	800.00	875.00	258.9260	876.30	On
00.006	500.00	50.00	0.0490	49.98	On
00.007	100.00	0.00	0.0900	0.00	Off

40° inclination, PC-HV-UP

Custom	ISet	VSet	IMon	VMon	Pw
00.000	1000.00	200.00	133.2110	199.84	On
00.001	1000.00	875.00	434.9940	876.62	On
00.002	800.00	200.00	260.3520	199.98	On
00.003	800.00	875.00	259.8020	875.98	On
00.004	1000.00	200.00	259.8480	200.08	On
00.005	800.00	875.00	246.2230	876.20	On
00.006	500.00	50.00	-0.2850	49.60	On
00.007	100.00	0.00	0.0430	0.00	Off

Conclusion

- Higher gain at larger inclination (with PC-HV connector moving upward) can be explained by higher currents across the bottom MCP.
- We will investigate the source of these high currents next week.

Thank you!