

Test Beams

Miguel Arratia

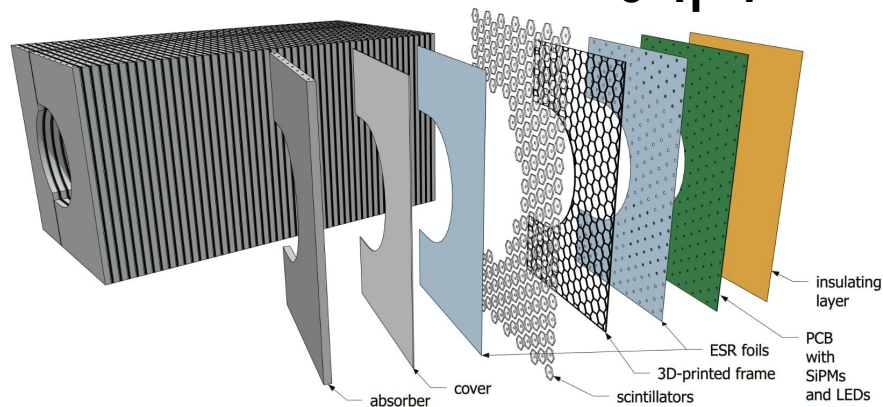


ePIC Mtg, July 25th 2024

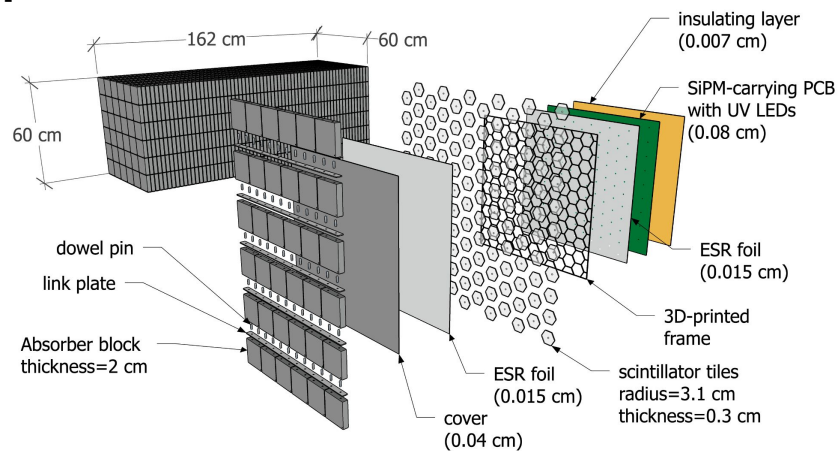




$3 < \eta < 4$



$\eta > 6$



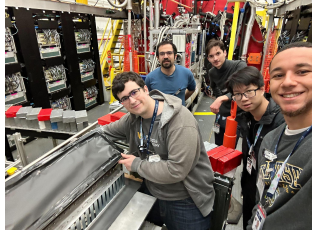
M. Arratia et al. *NIMA* 1047 (2023) 167866

R. Milton et al. arXiv:2406.12877

Past and planned beam tests

2023

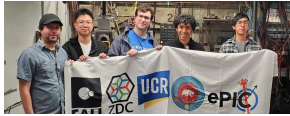
Jefferson Lab



Published

2024

CROCKER NUCLEAR LABORATORY
CYCLOTRON SERVICES



Analysing

2024-2025

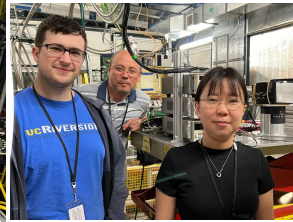
Brookhaven
National Laboratory



Ongoing
+
Analysing

2024

Fermilab



Analysing

2024

Jefferson Lab



Building

2025

Fermilab



+

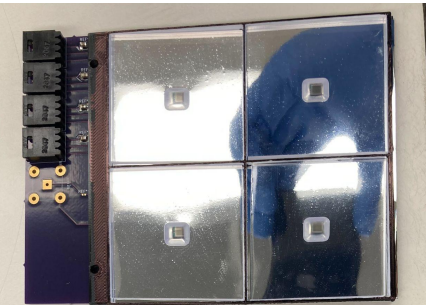
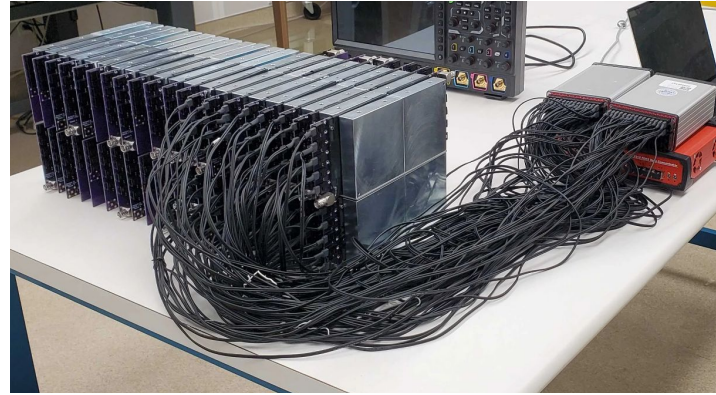


Planning ³

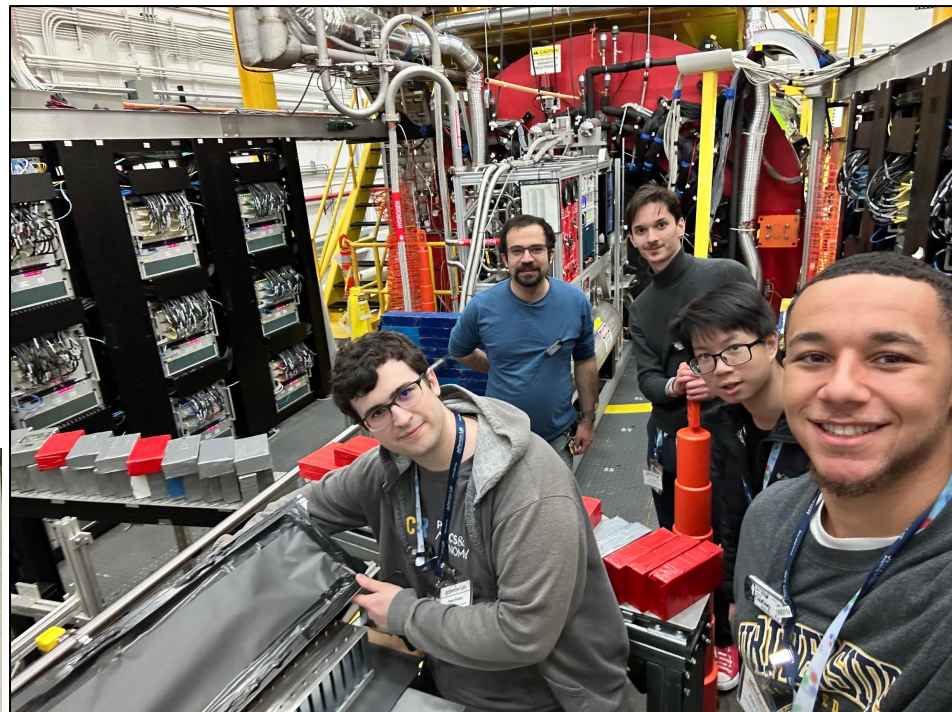
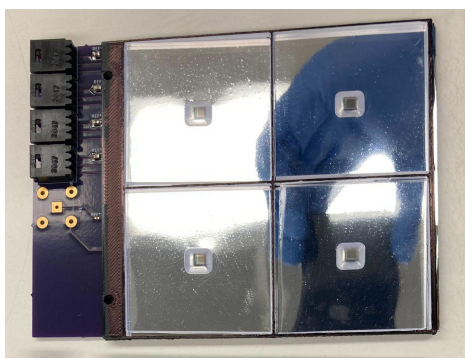
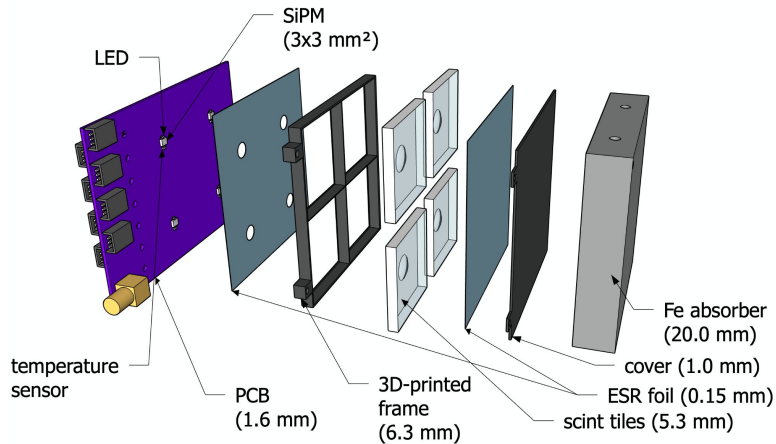
Gen-I (Jan 2023)
40 ch. 10x10 cm²

Gen-II (April 2024)
300 ch. 20x20 cm²

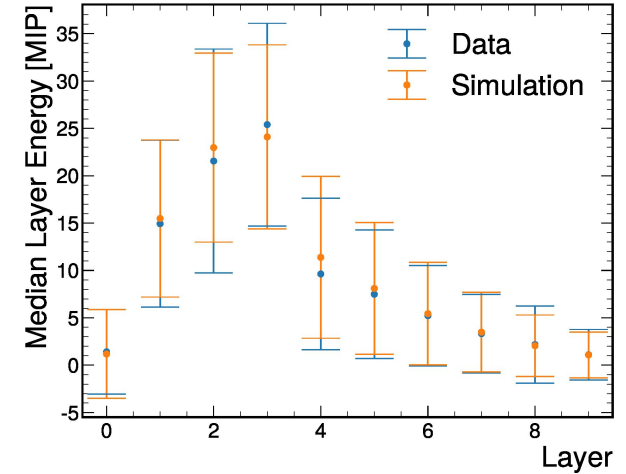
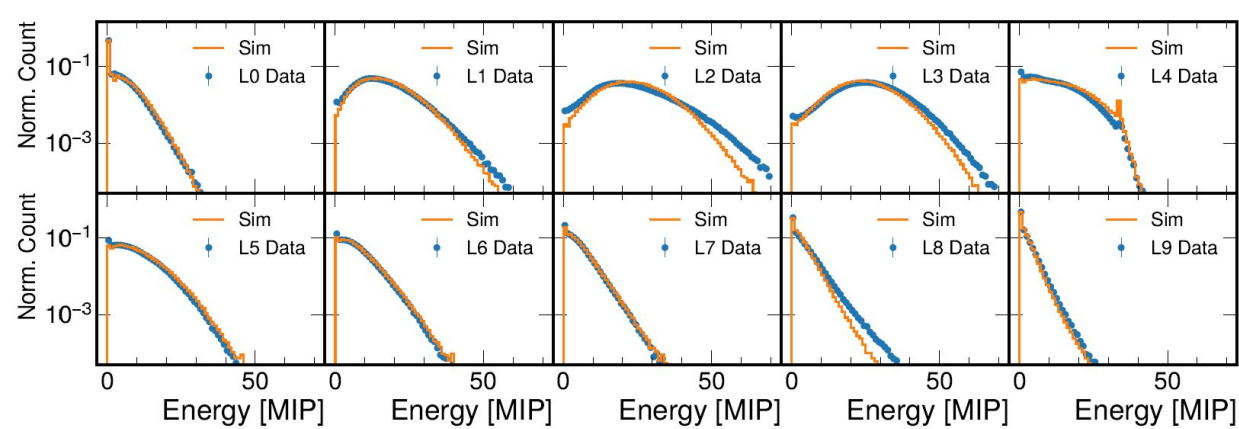
Gen-III (Fall 2024)
600 ch. 30x30 cm²



First beam test with positrons (Jan 2023)



Measured energy spectra per layer (4 GeV positron)

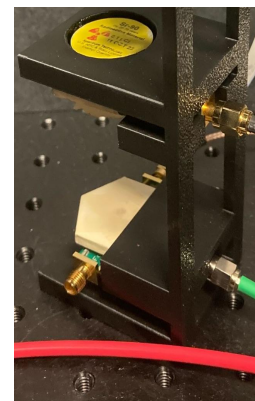
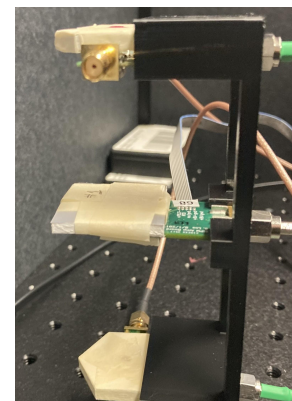
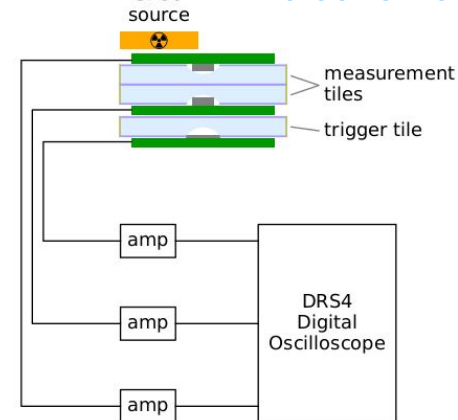
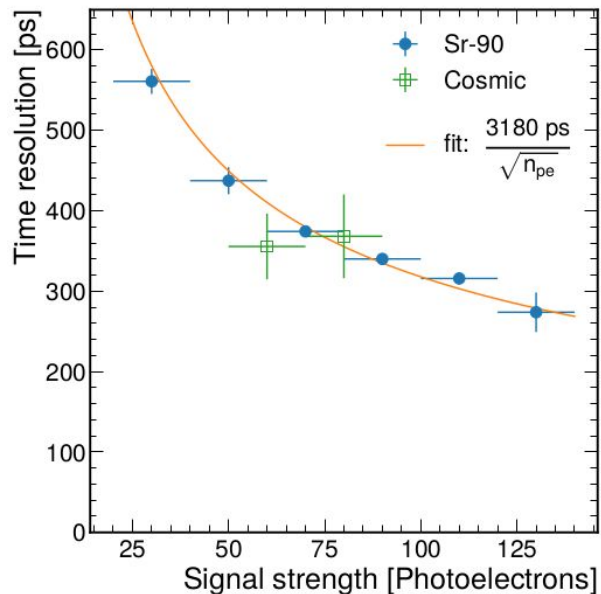
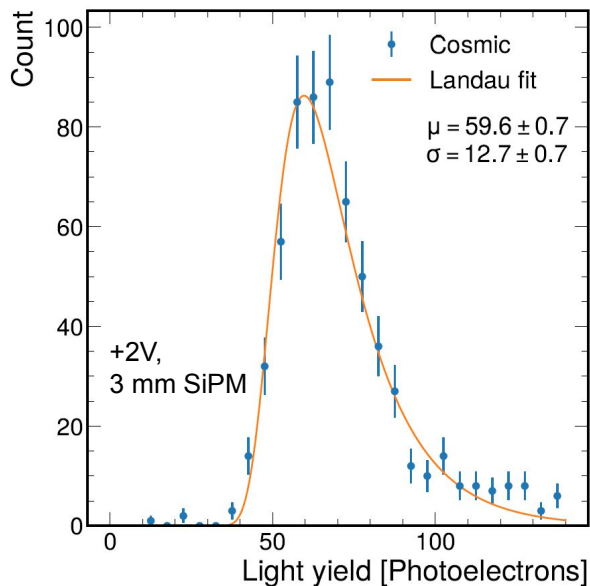


“Beam Test of the First Prototype of SiPM-on-Tile Calorimeter Insert for the EIC Using 4 GeV Positrons at JLab”

M. Arratia et al. *Instruments* 2023, 7(4), 43

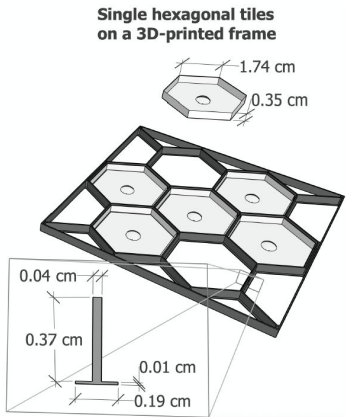
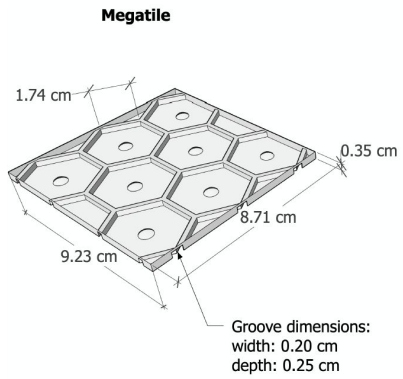
Light Yield & Time Resolution

Miguel Arratia et al
2023 JINST 18 P05045

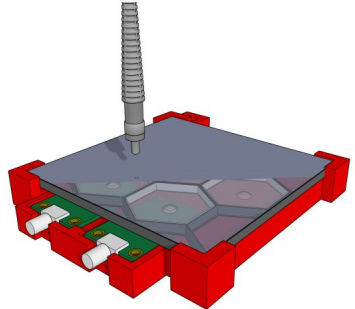
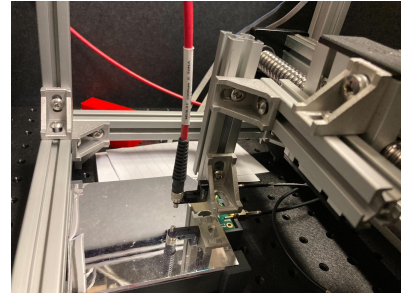
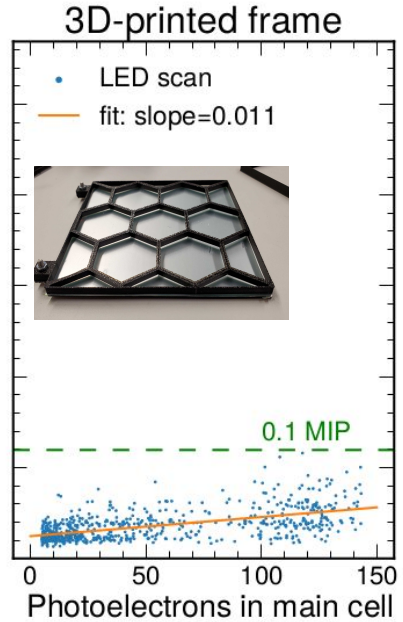
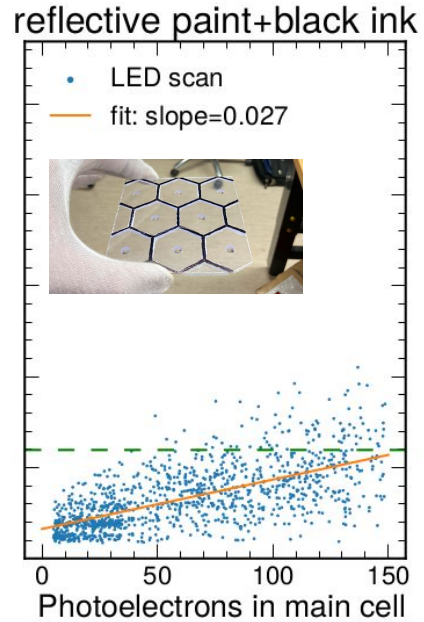
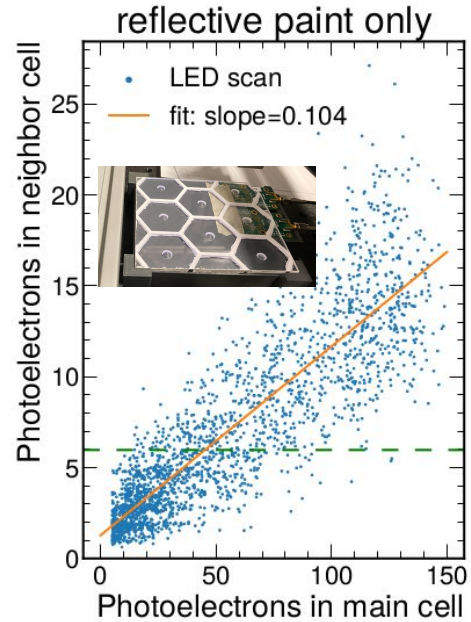


Optical Crosstalk

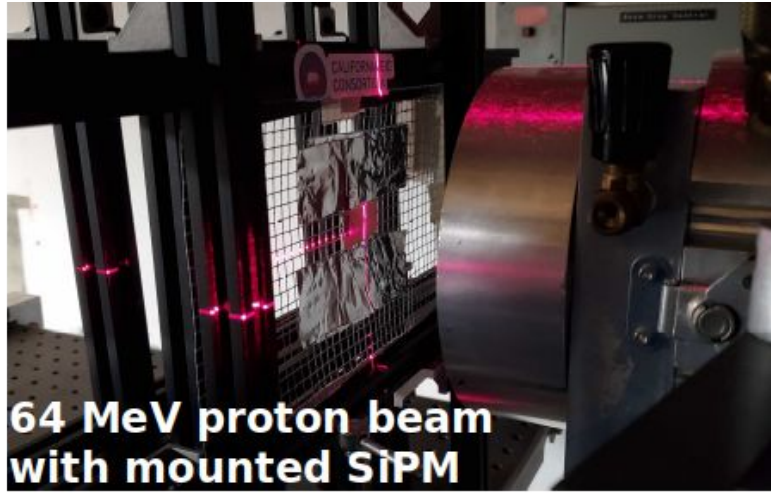
Miguel Arratia et al
2023 JINST 18 P05045



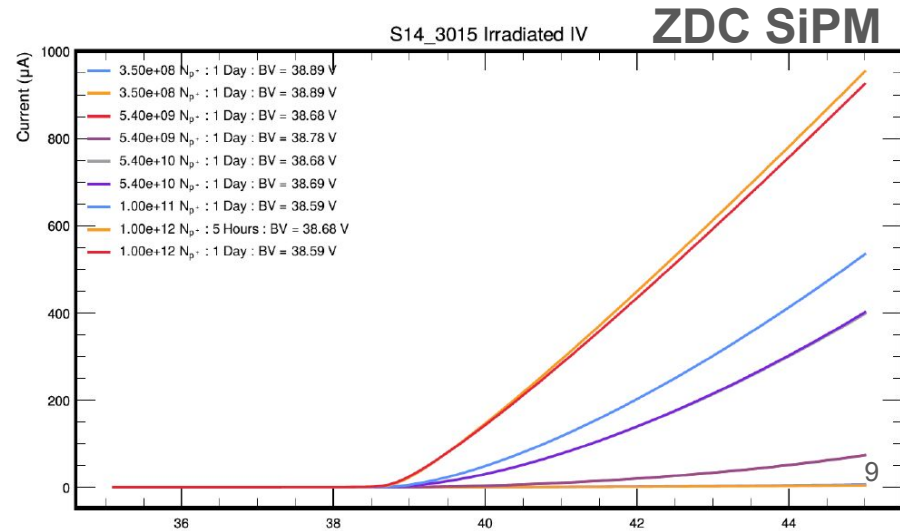
← Novel approach



SiPM proton irradiation test at UC Davis Cyclotron – May 2024



- All SiPM models to be used in all ePIC Calorimeters tested for all fluence range relevant for EIC
- Dark current vs. proton fluence for set overvoltage values, and other measurements done
- High-temperature annealing studies relevant for ZDC are ongoing



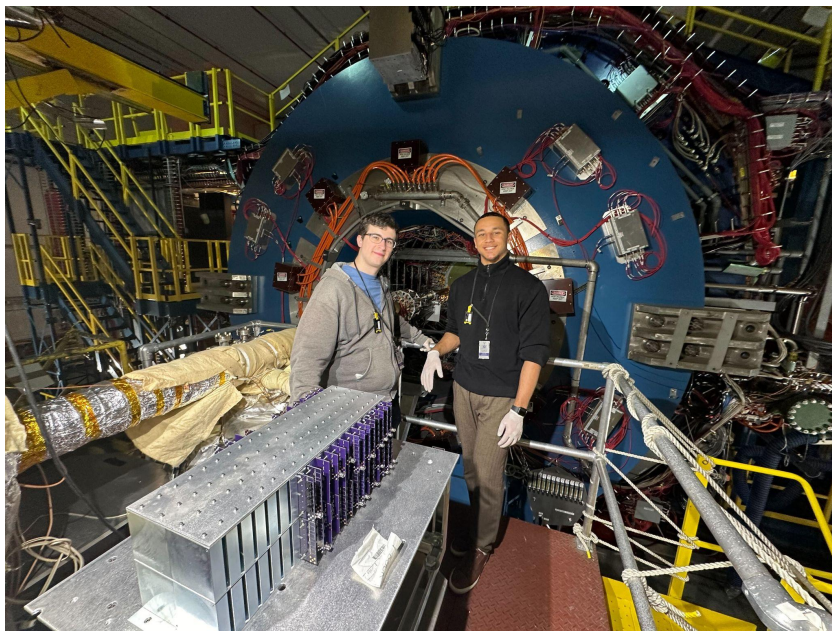
Parasitic Experiment at STAR Hall

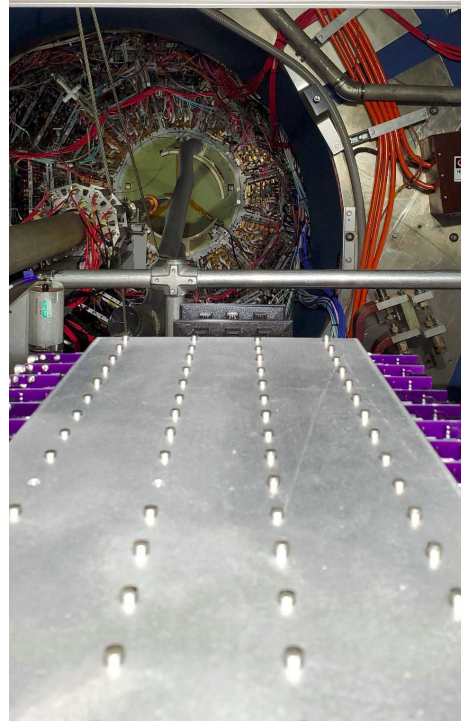
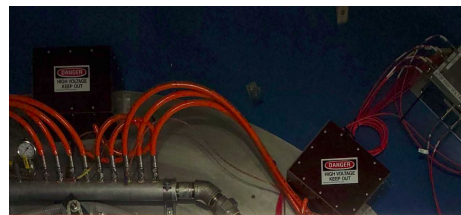
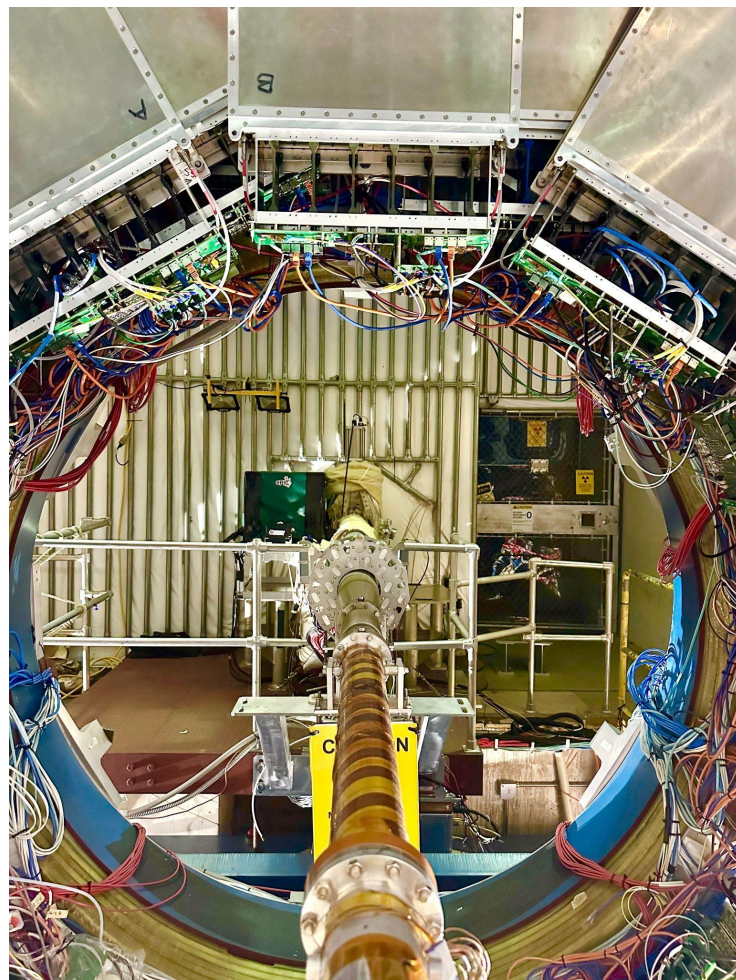
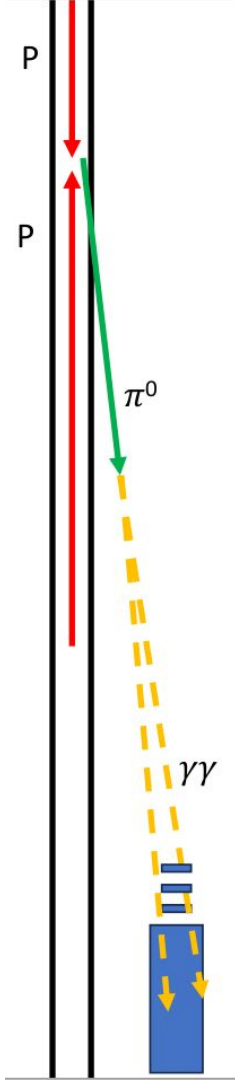


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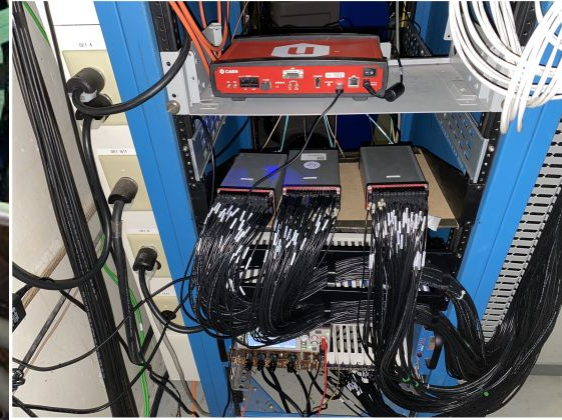
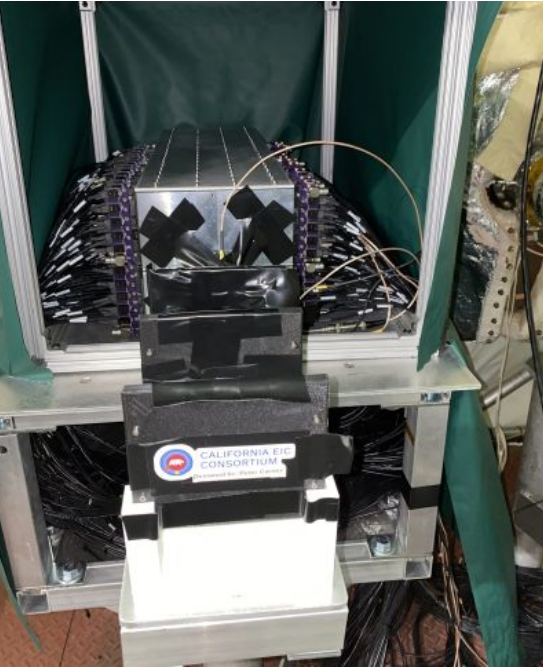
Goal: test in situ calibration (MIP and π^0) and operation stability in EIC-like fluence.
Will run until the end of RHIC in 2025.

First SiPM-on-tile Calorimeter operating in a Collider ever!

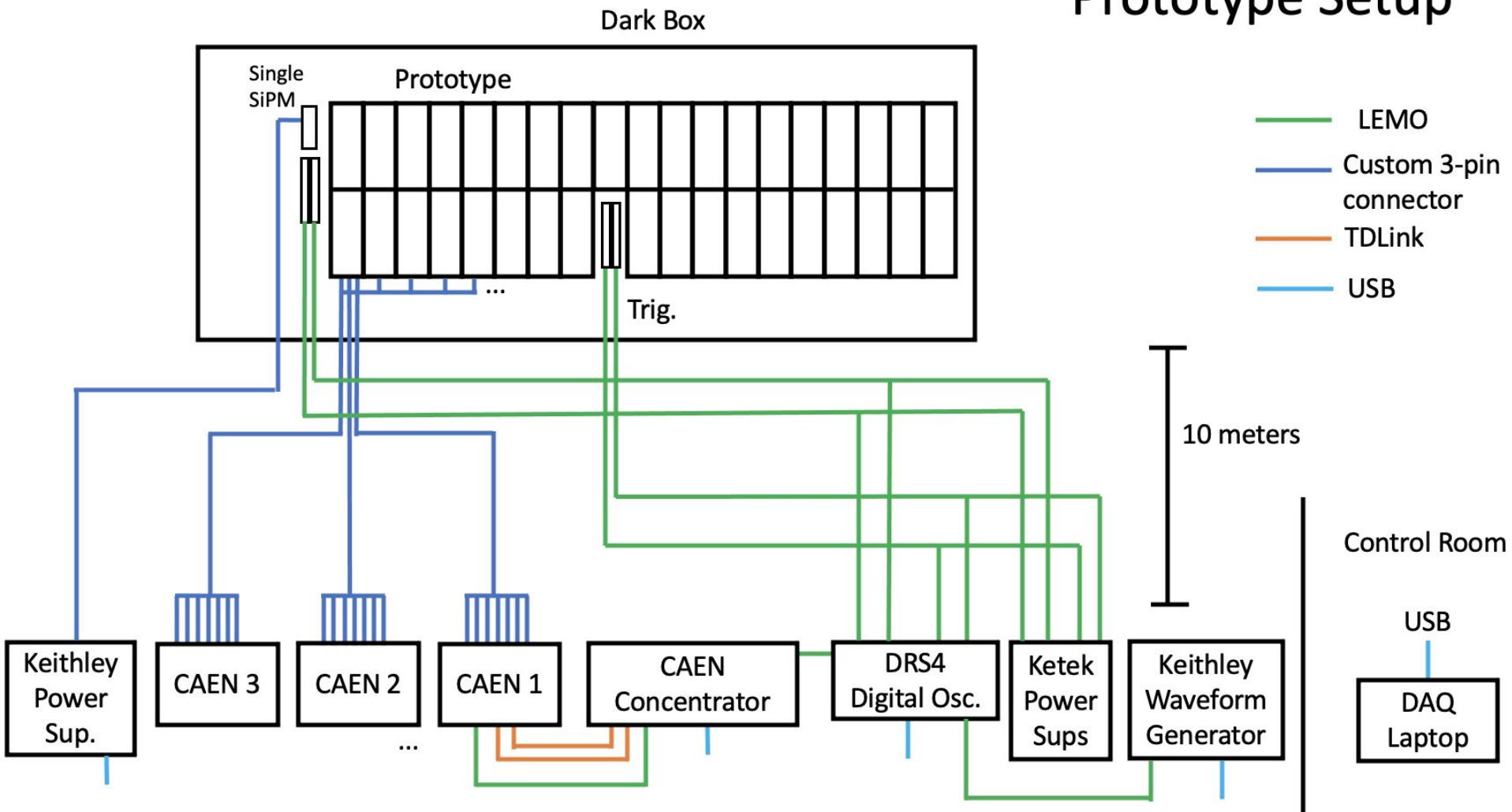




Current (Final) Status



Prototype Setup



CALI HOME QA CHANNEL PTRG COSMIC MISC

Select Run

run1 [,run2...]

Select Day

July, 2024

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31					

June, 2024

1					
2	3	4	5	6	7
8	9	10	11	12	13
14	15	16	17	18	19
20	21	22	23	24	25
26	27	28	29	30	

May, 2024

1	2	3	4		
5	6	7	8	9	10
11	12	13	14	15	16
17	18	19	20	21	22
23	24	25	26	27	28
29	30	31			

April, 2024

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30

Run	Type	Flag	StartTime	StopTime	Len (m)	#Ch	Trigger	Events	PedRun	LG	HG	Vbias (V)
1357	data	good	2024-07-25 00:58	2024-07-25 02:28	90	192	T1 && T2 && T3	80107	1354	27	55	43
1358	data	good	2024-07-25 02:28	2024-07-25 03:58	90	192	T1 && T2 && T3	71317	1354	27	55	43
1359	data	good	2024-07-25 03:59	2024-07-25 05:29	90	192	T1 && T2 && T3	66117	1354	27	55	43
1360	data	good	2024-07-25 05:29	2024-07-25 06:59	90	192	T1 && T2 && T3	62780	1354	27	55	43
1361	data	good	2024-07-25 06:59	2024-07-25 08:29	90	192	T1 && T2 && T3	14144	1354	27	55	43
1362	data	good	2024-07-25 08:30	2024-07-25 09:32	17	192	T1 && T2 && T3	3811	1354	27	55	43
1363	ptrg	good	2024-07-25 09:36	2024-07-25 09:36	0	192	0	13669	-1	27	55	43
1364	data	good	2024-07-25 09:37	2024-07-25 11:07	90	192	T1 && T2 && T3	8509	1363	27	55	43
1365	data	good	2024-07-25 11:08	2024-07-25 12:38	90	192	T1 && T2 && T3	36396	1363	27	55	43

CALI HOME QA CHANNEL PTRG COSMIC MISC

Run: 1357 1358 1359 1360 1361 1362 1364 1365

Select Day

July, 2024

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31					

June, 2024

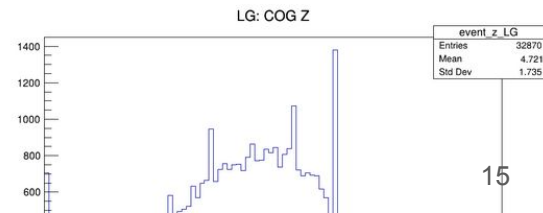
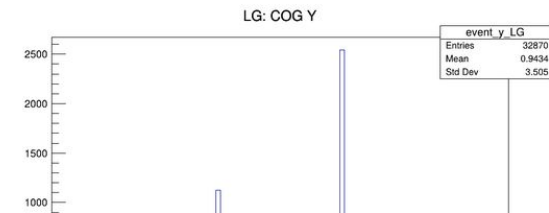
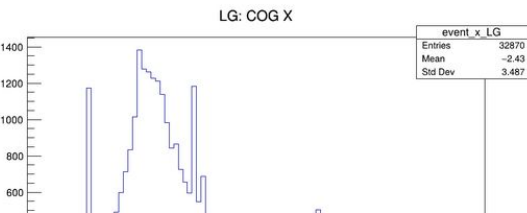
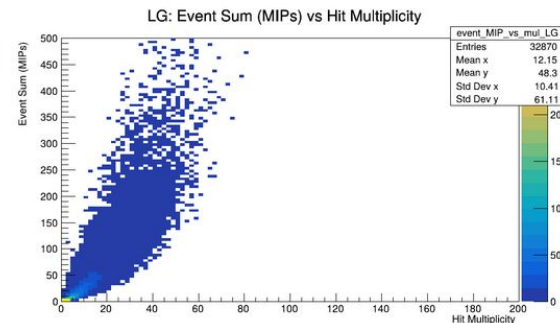
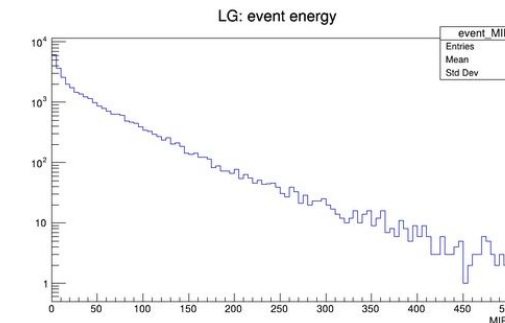
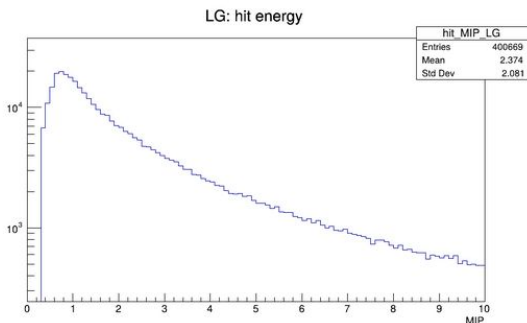
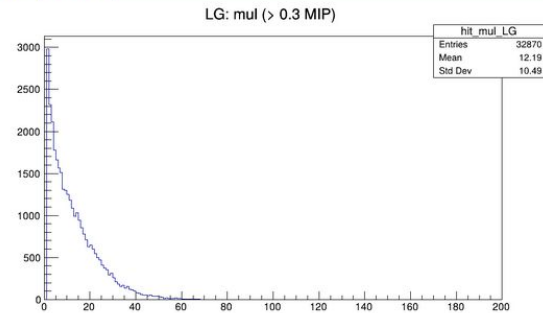
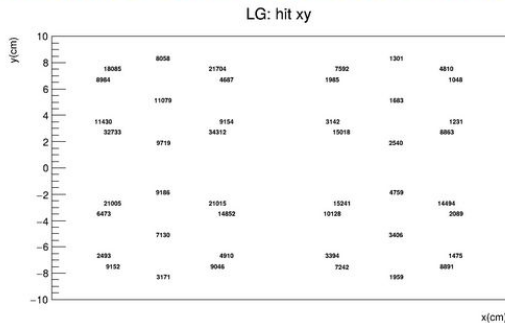
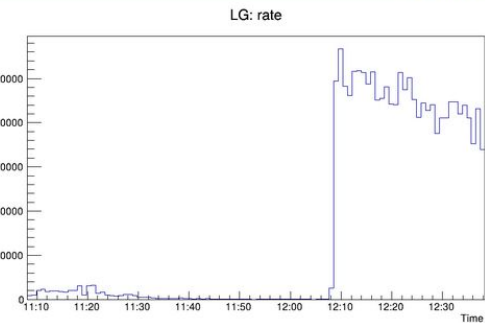
1					
2	3	4	5	6	7
8	9	10	11	12	13
14	15	16	17	18	19
20	21	22	23	24	25
26	27	28	29	30	

May, 2024

1	2	3	4		
5	6	7	8	9	10
11	12	13	14	15	16
17	18	19	20	21	22
23	24	25	26	27	28
29	30	31			

April, 2024

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30



CALI HOME QA CHANNEL PTRG COSMIC MISC

Run: 1333 1334

2024-07-23

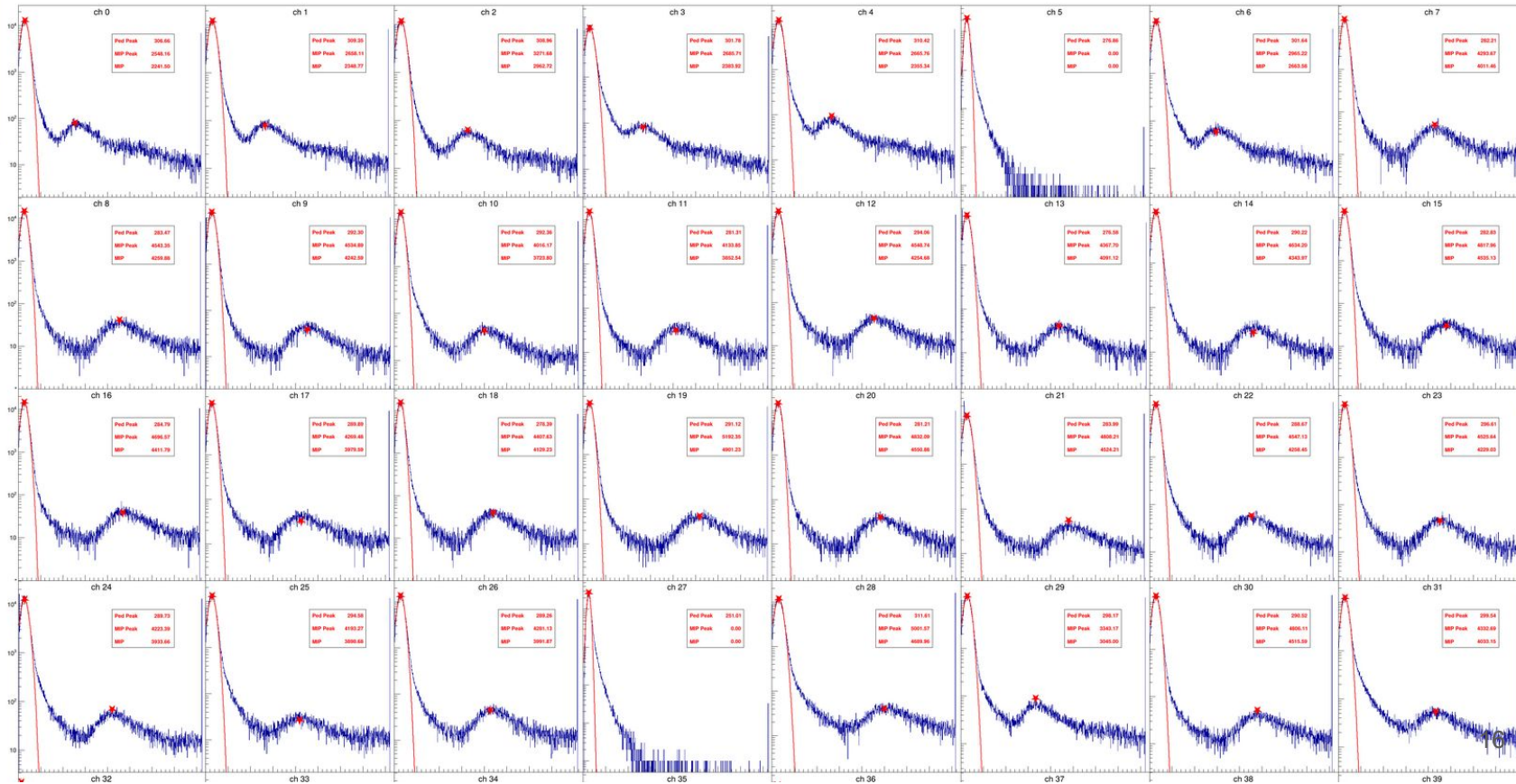
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2024-07-17

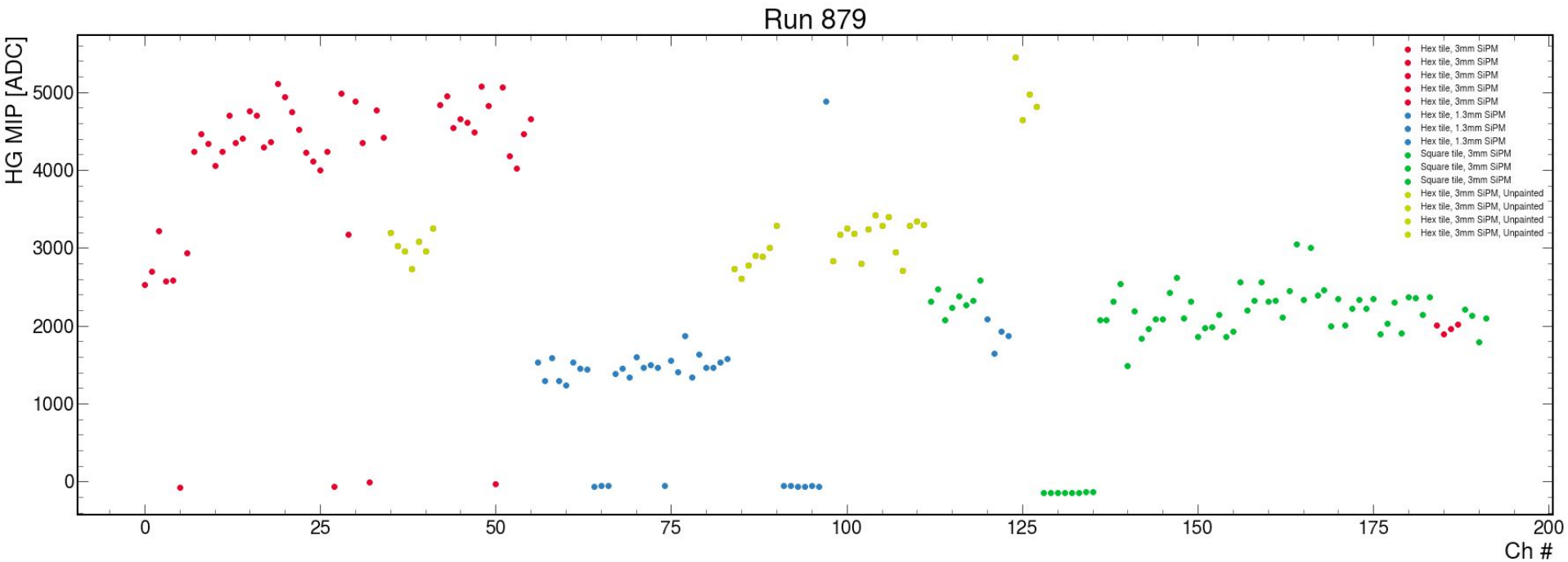
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2024-06-13

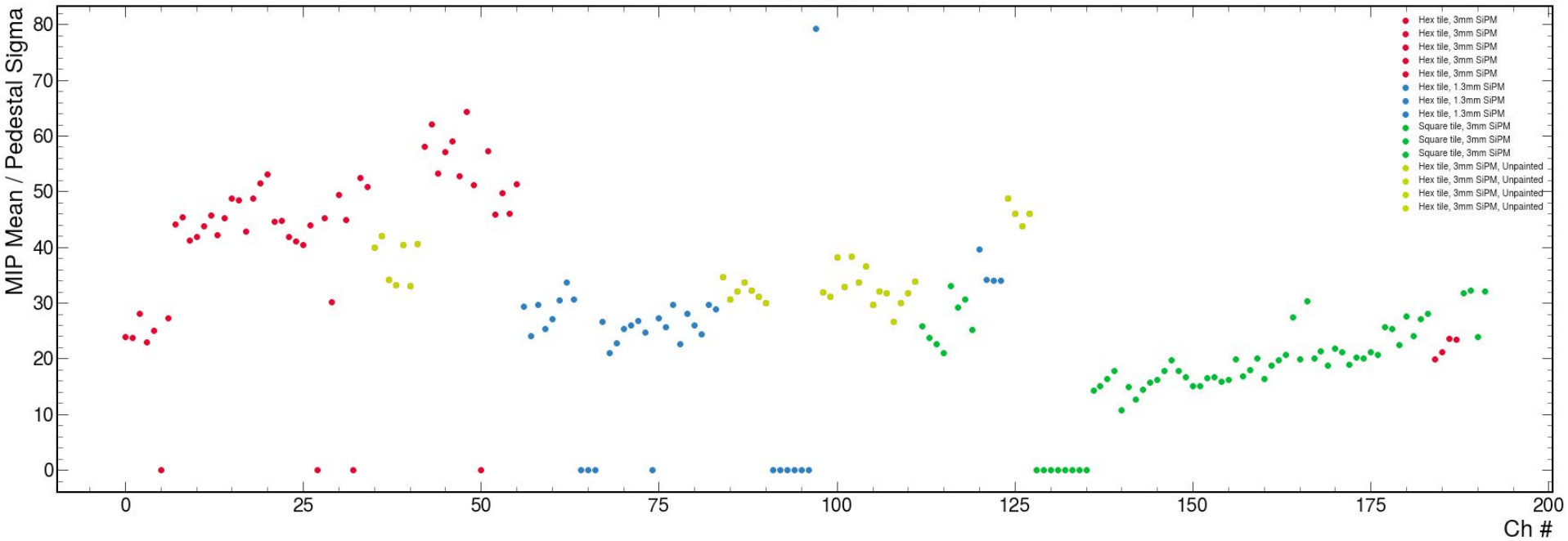


MIP Calibration

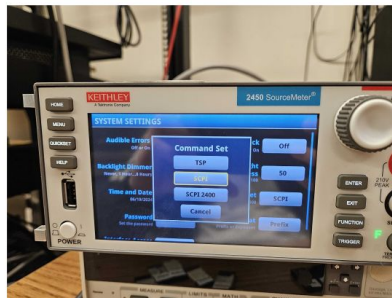
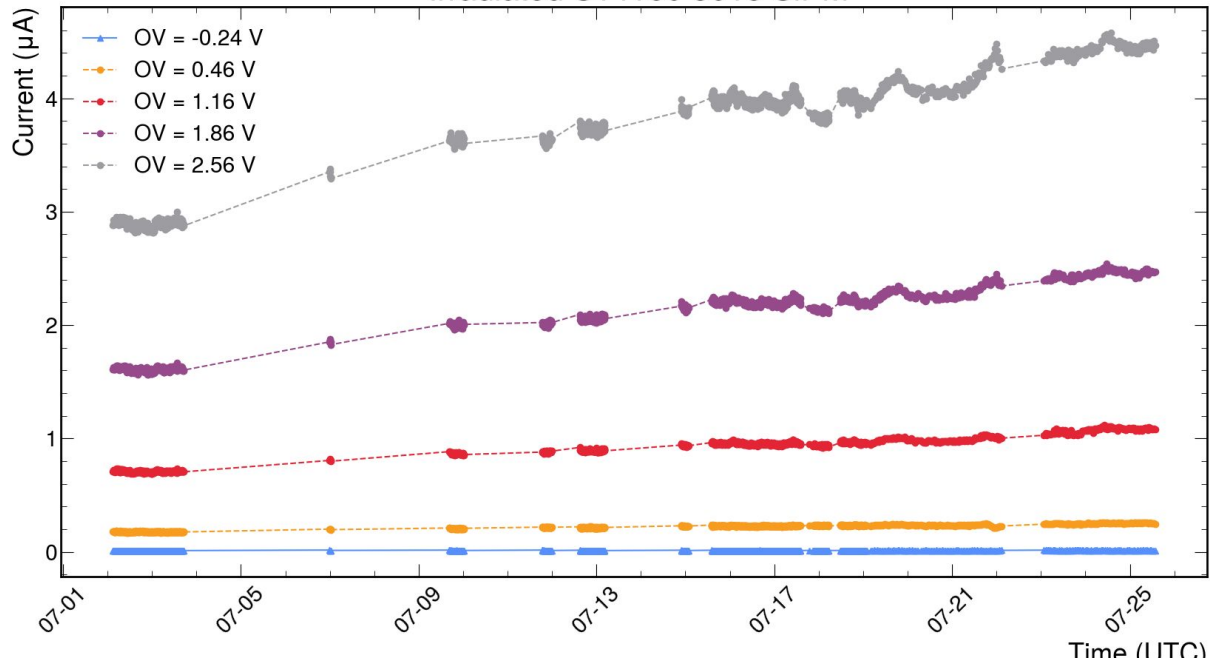


Signal to Noise Ratio

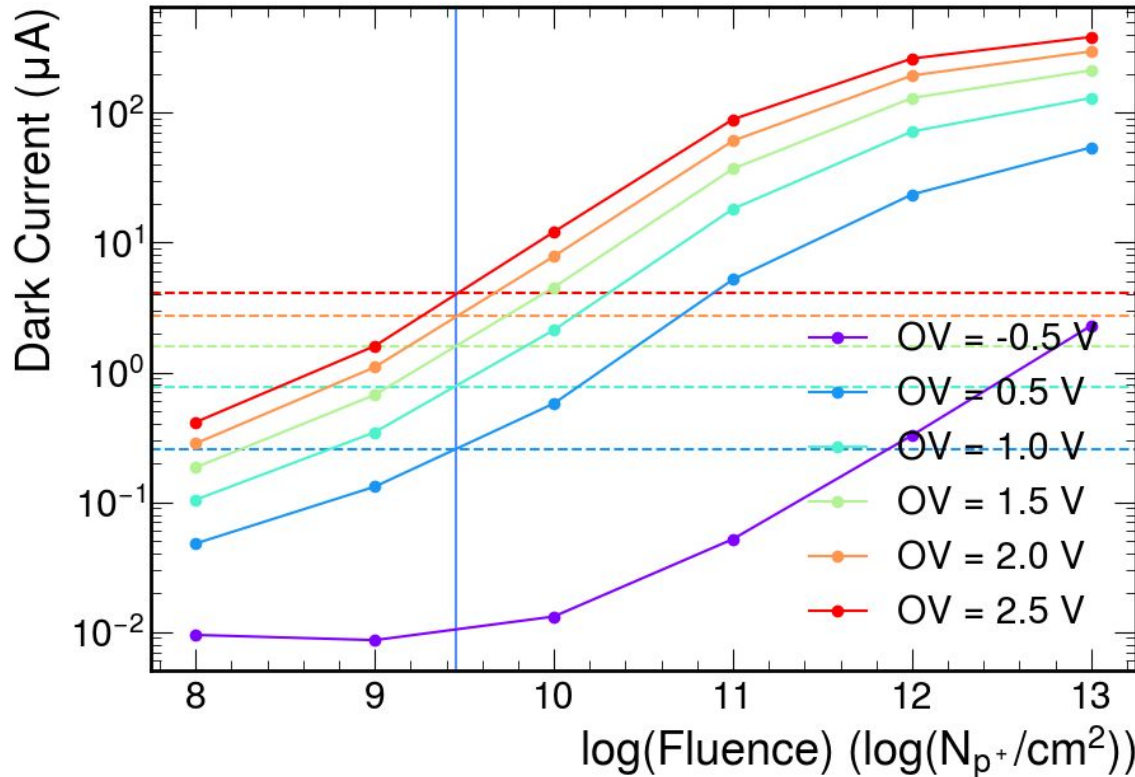
Run 879



Dark Current Monitor for Irradiated S14160 3015 SiPM



Combining Irradiation Campaign data with Insitu monitoring, we deduce equivalent fluence



LG: event energy

Select Day

July, 2024

- 1 2
- 7 8 9
- 14 15 16
- 21 22 23
- 28 29 30

June, 2024

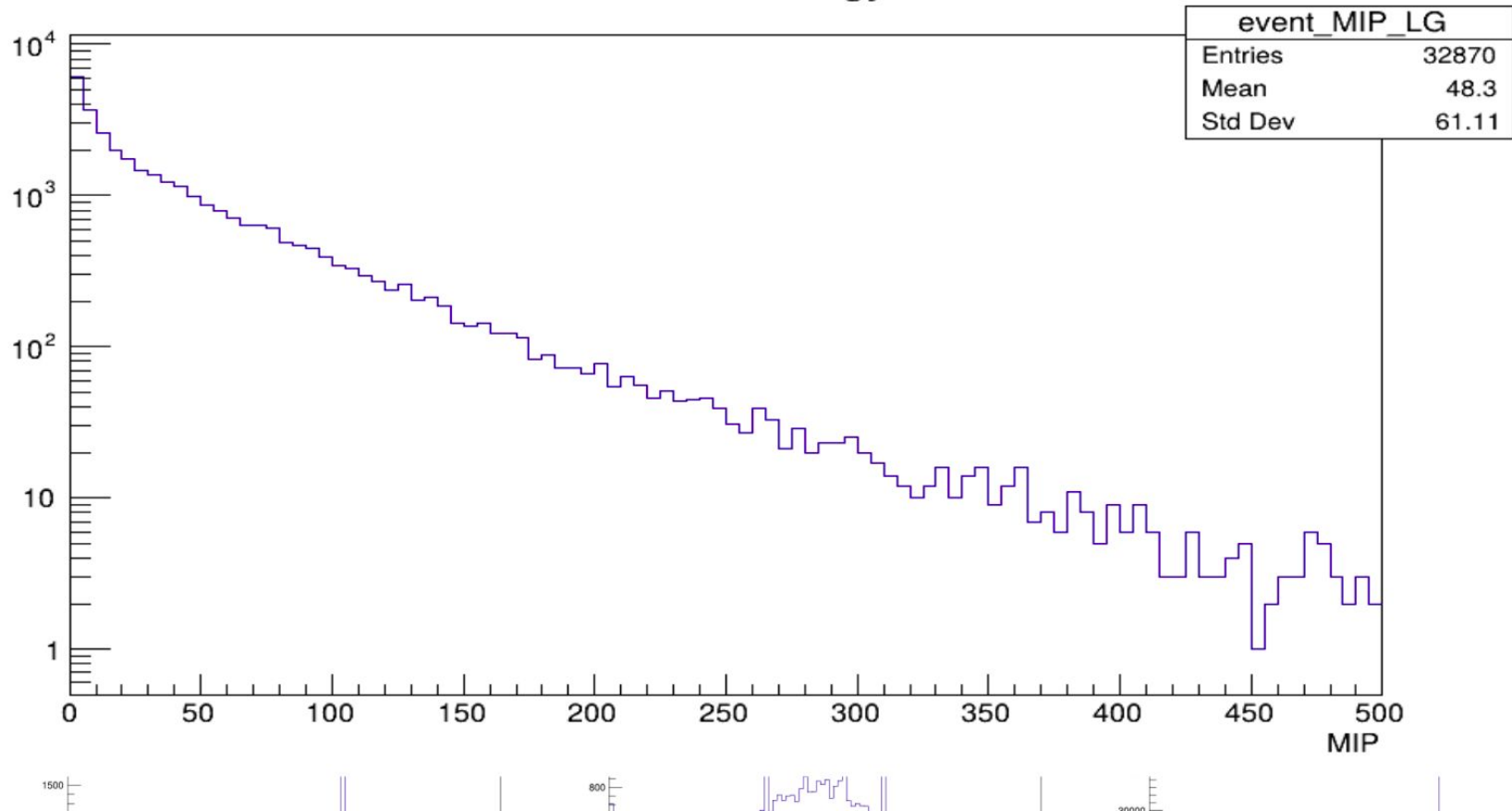
- 2 3 4
- 9 10 11
- 16 17 18
- 23 24 25
- 30

May, 2024

- 5 6 7
- 12 13 14
- 19 20 21
- 26 27 28

April, 2024

- 1 2
- 7 8 9
- 14 15 16
- 21 22 23
- 28 29 30



1500

800

50000

lit_mul_LG

sv

200

event_x_LG

sv

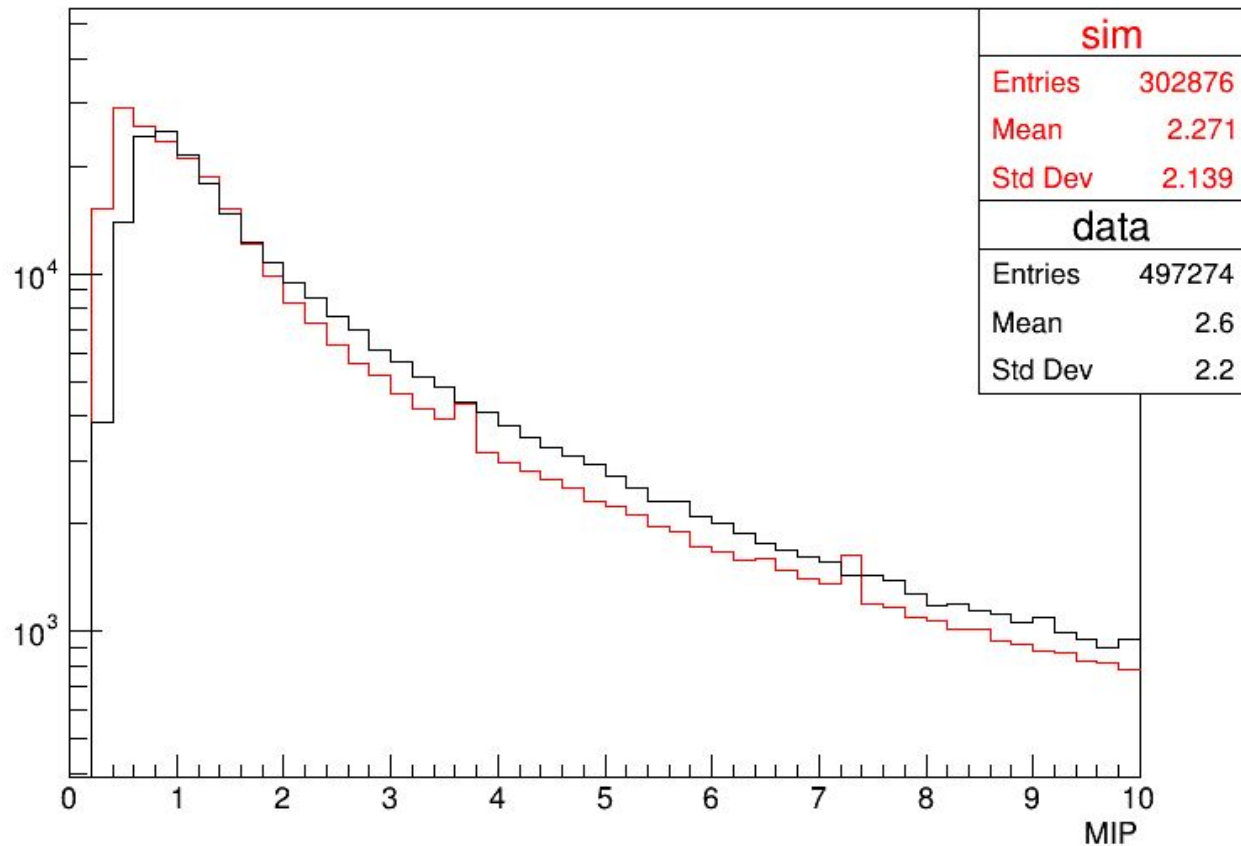
10

cm

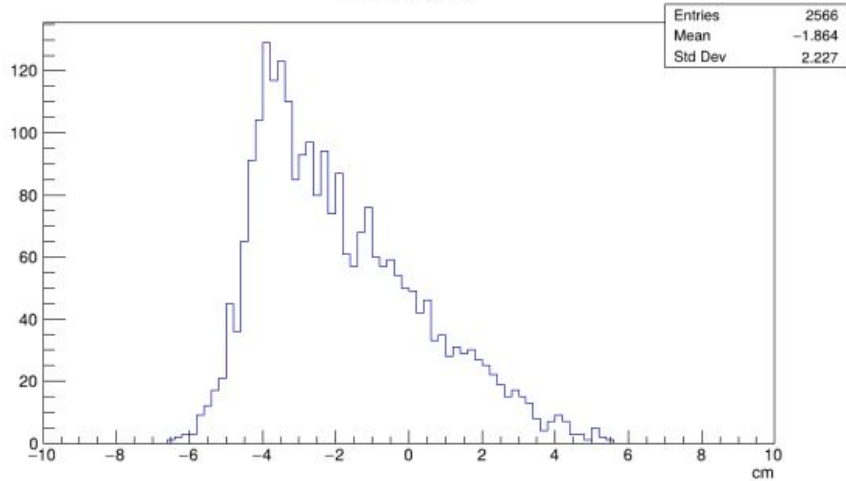


Data vs Pythia8

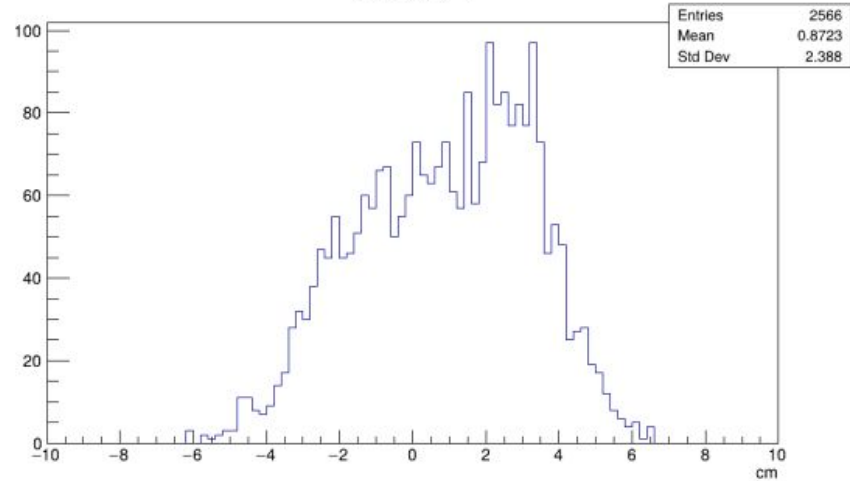
Hit Energy



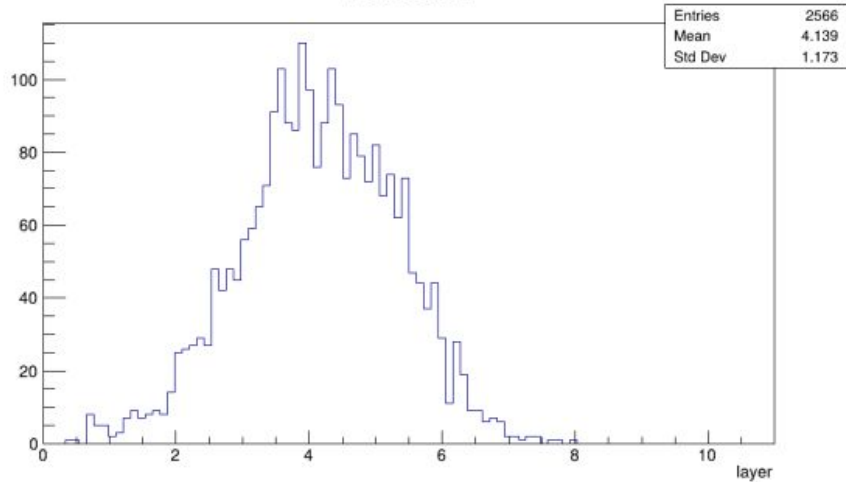
HG: COG X



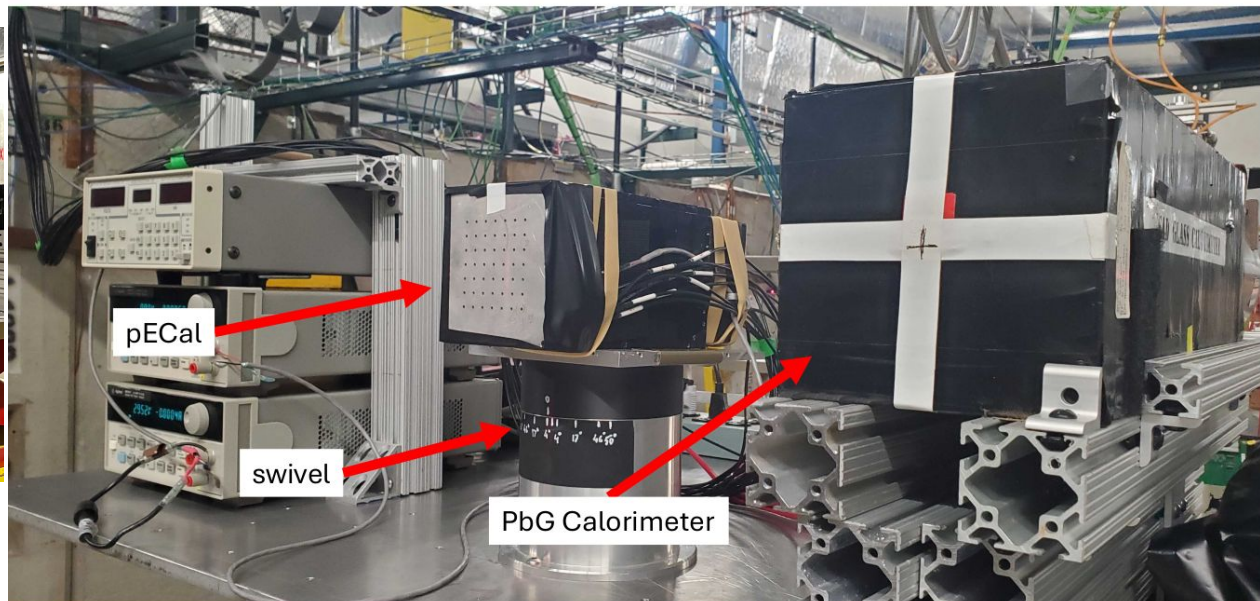
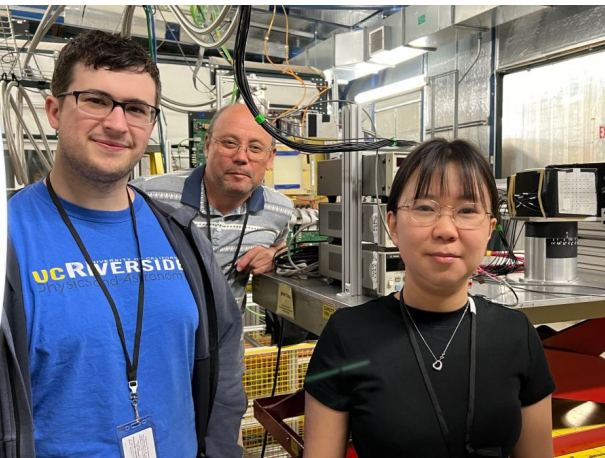
HG: COG Y

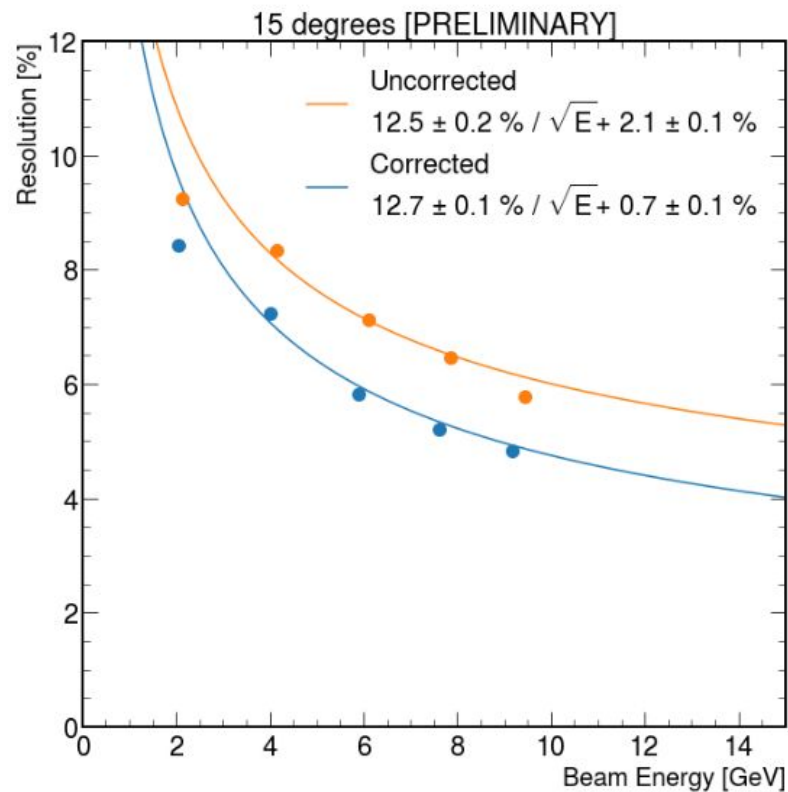
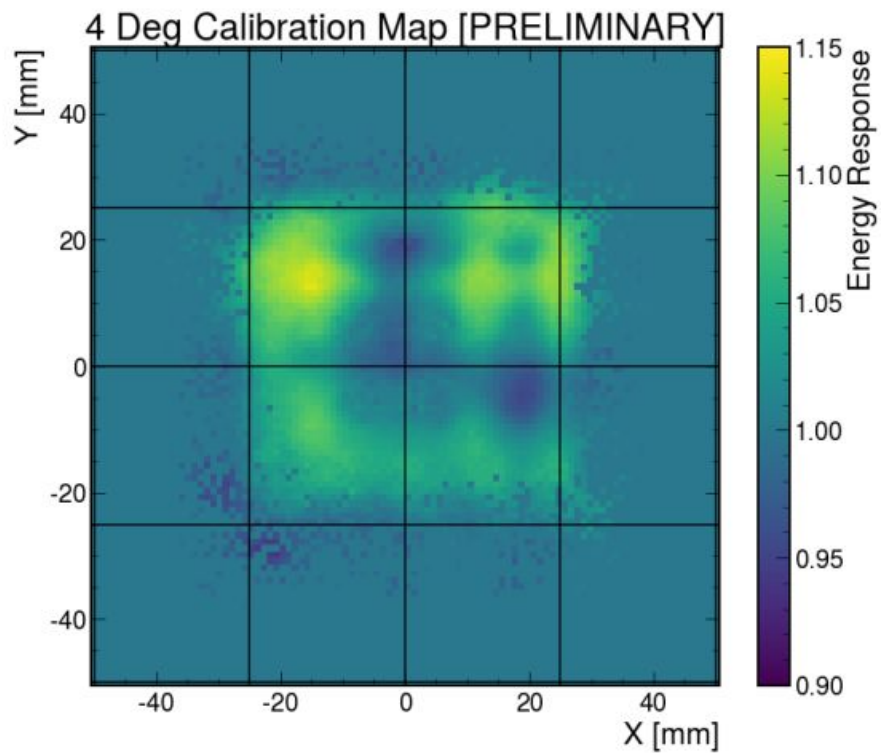


HG: COG Z



$$\text{COG} = \frac{\sum_i E_i \cdot \vec{X}}{\sum_i E_i}$$





Gen-III Prototype construction

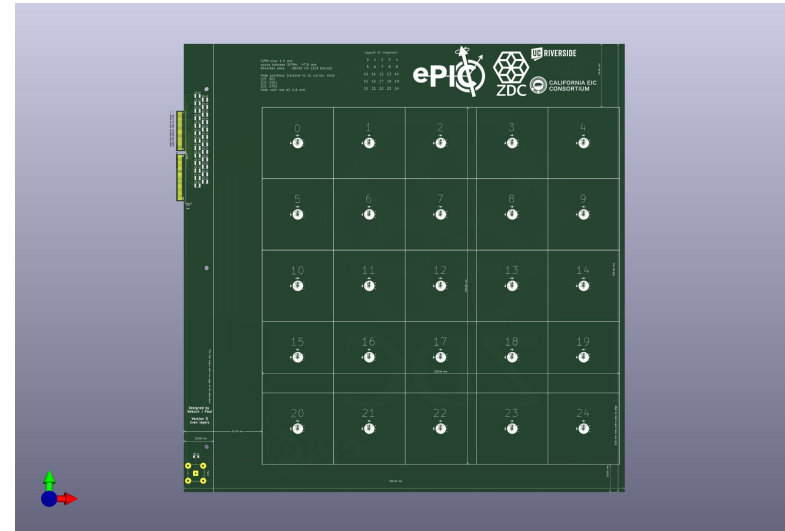
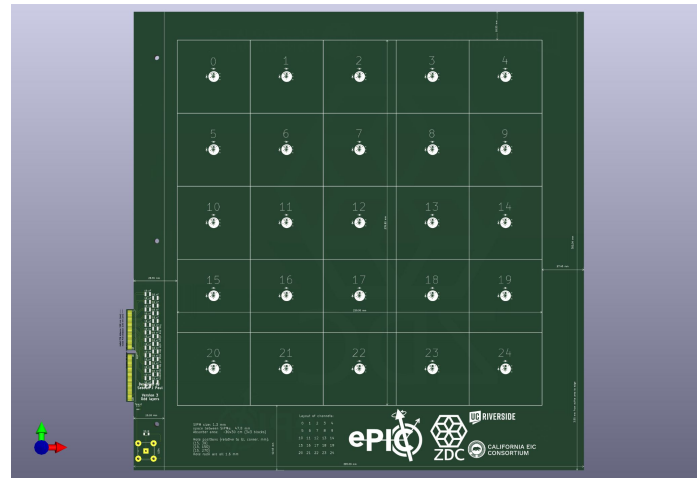
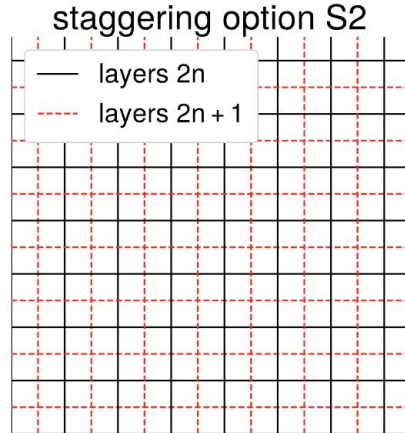
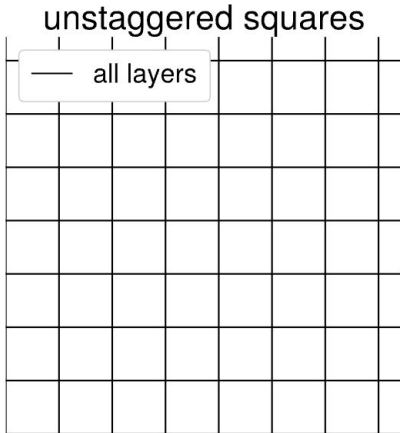
- 30x30 cm² ($\frac{1}{4}$ transverse area of full detector)
- 15 layers (full detector uses 60)
- Constructed similar to the full detector
- Staggered square cell pattern

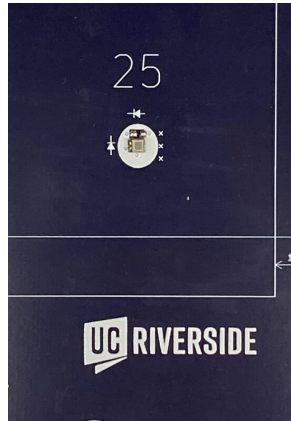
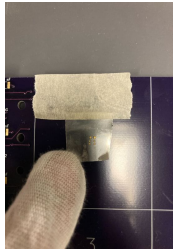
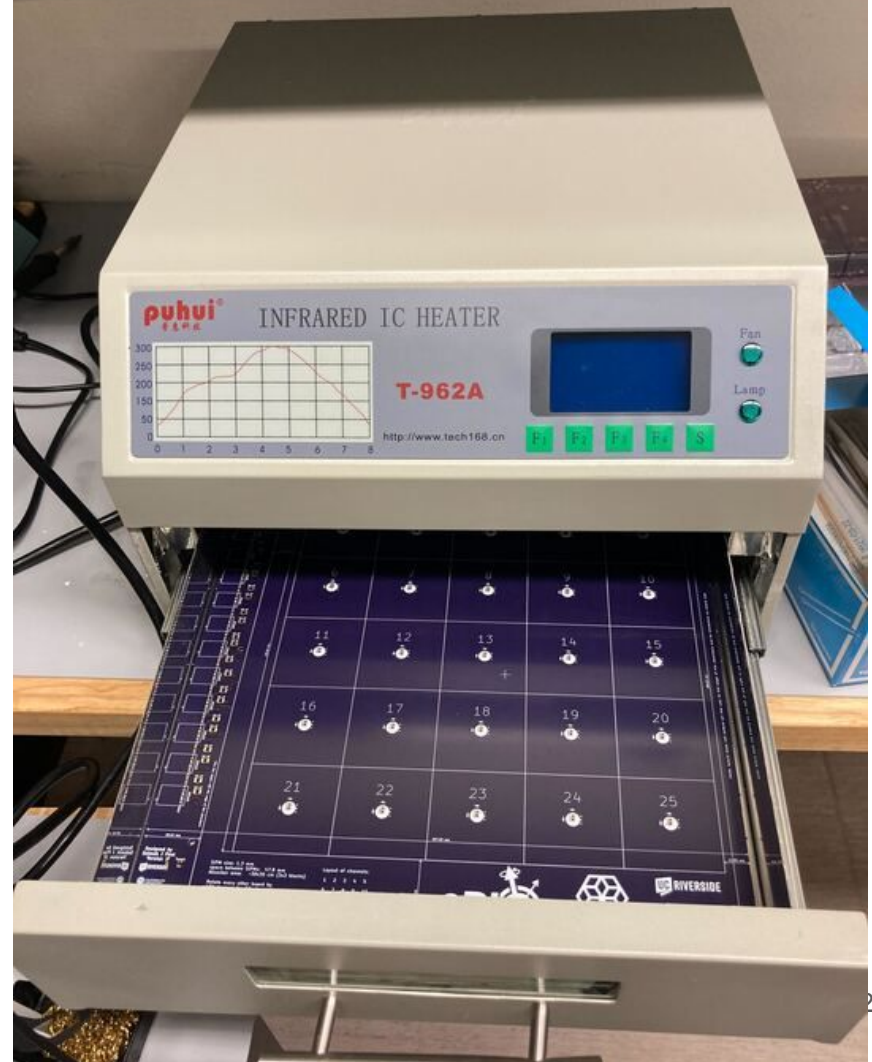
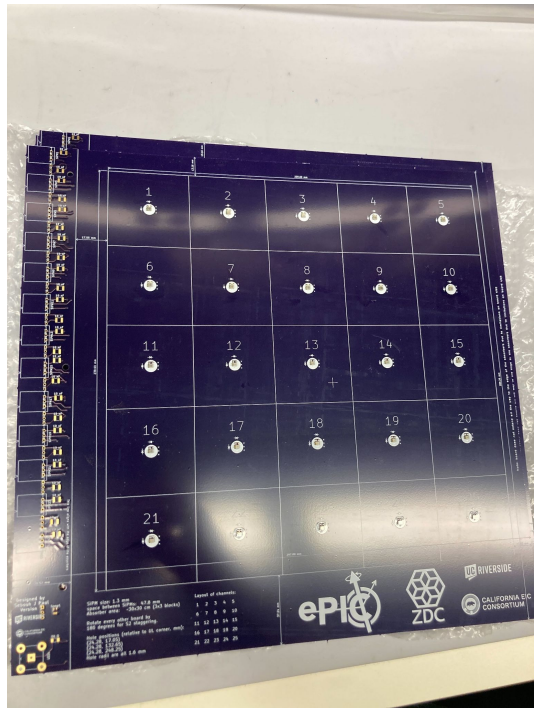


PCB board: staggered design

Two versions, shifted diagonally by half a cell, alternating layer by layer

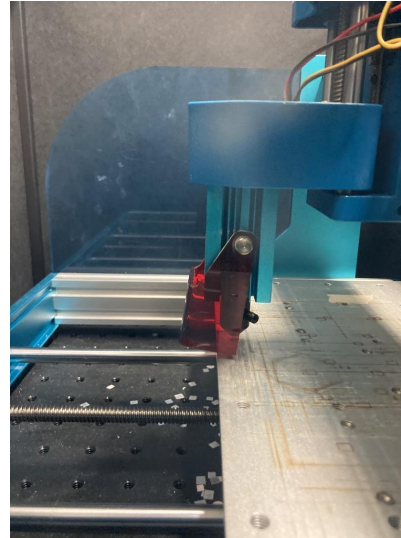
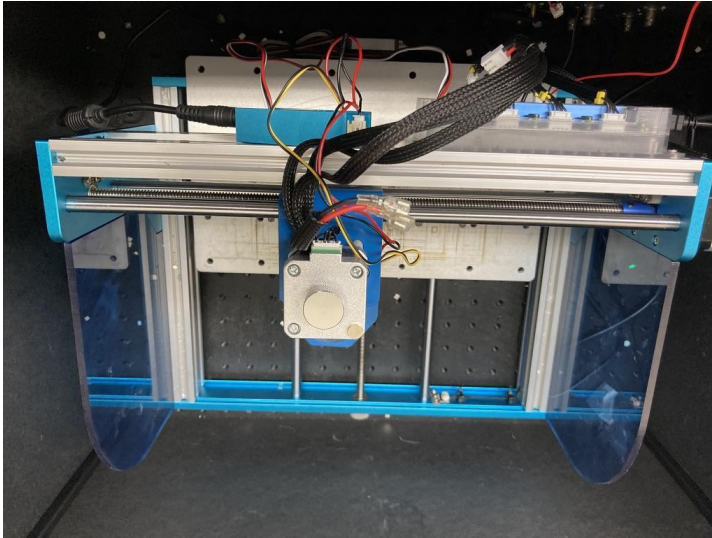
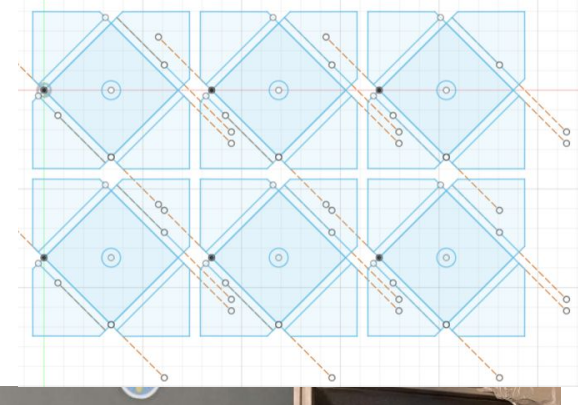
Purpose: to improve the position resolution of the detector

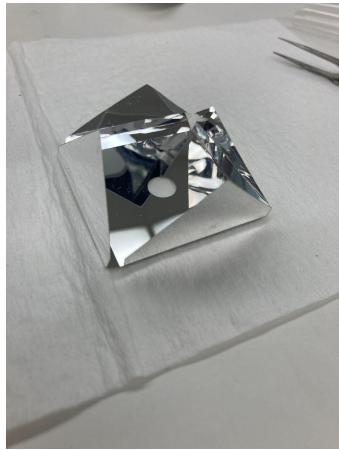
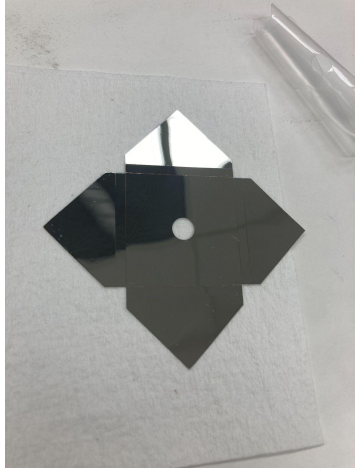




Laser Cutting for Reflective Foil

Laser component attached to CNC Machine,
and placed in a dark box for safety.



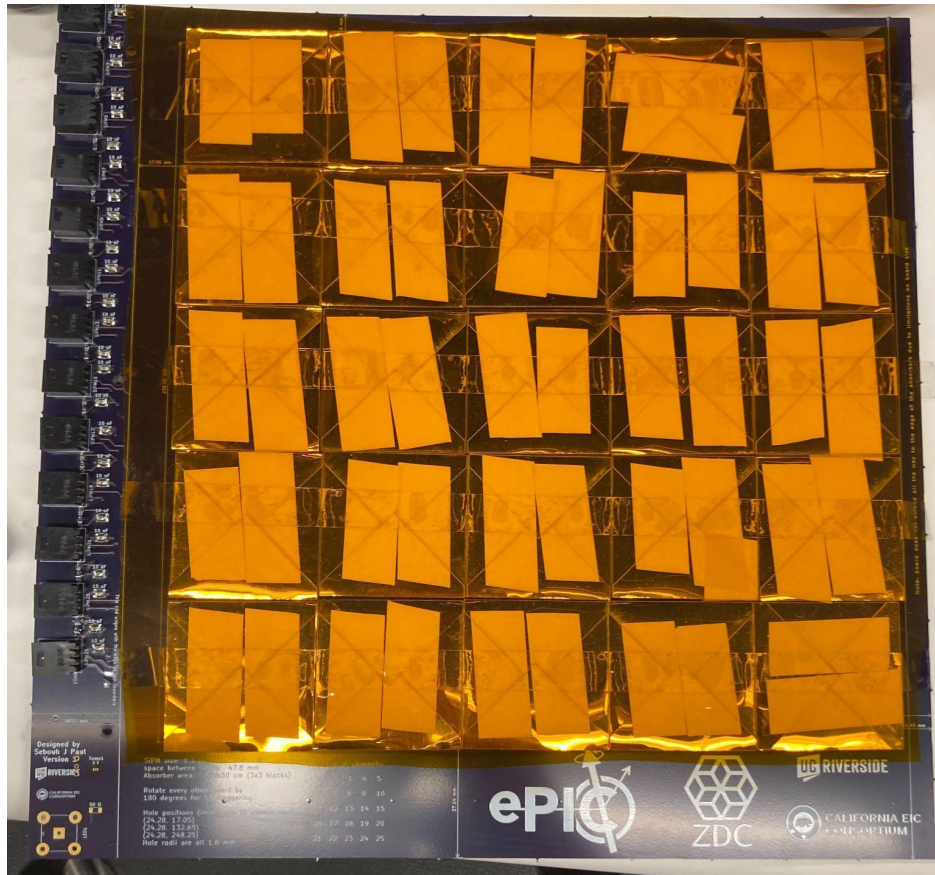


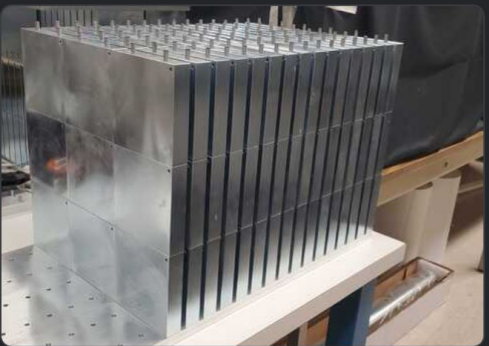
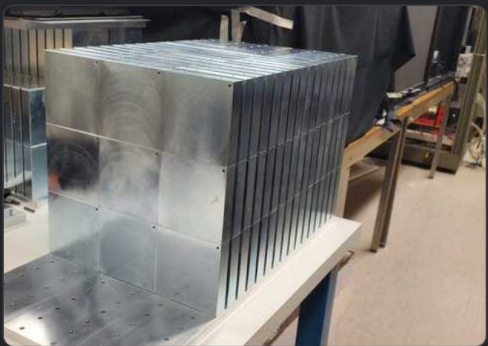
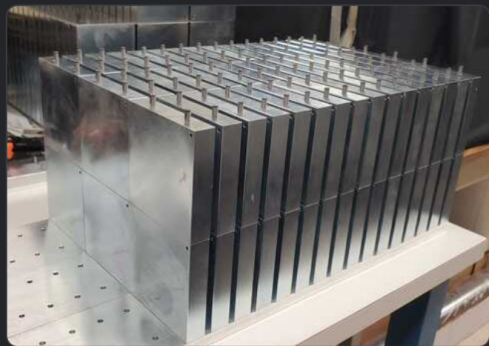
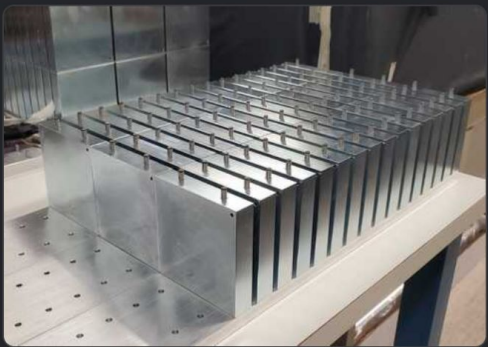
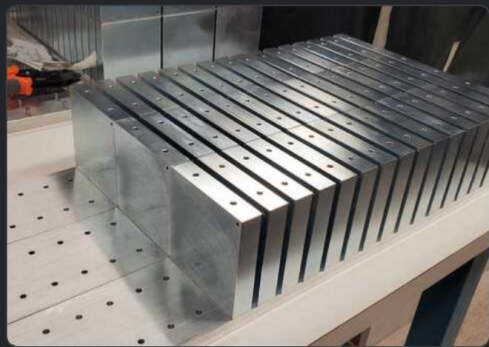
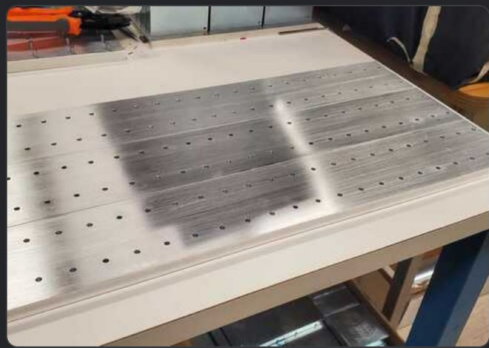
Laser cut sides with etched folds.

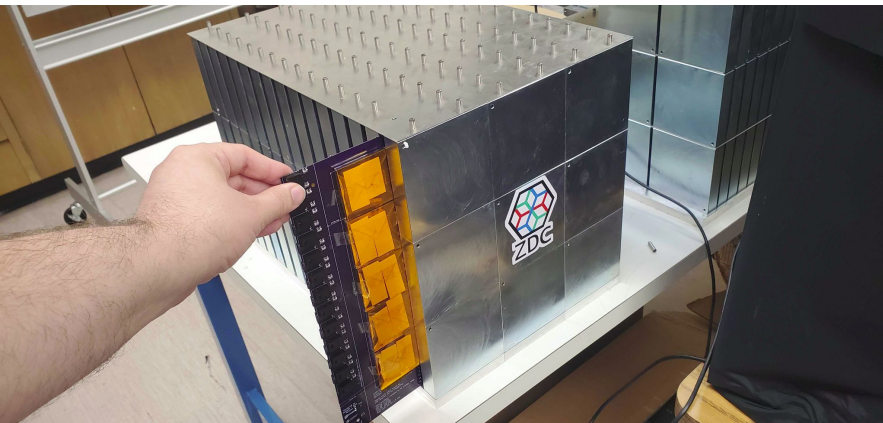
Folds are made.

Component is placed





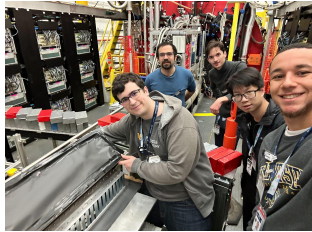




Past and planned beam tests

2023

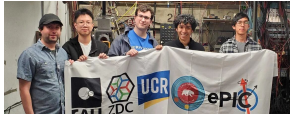
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2024-2025

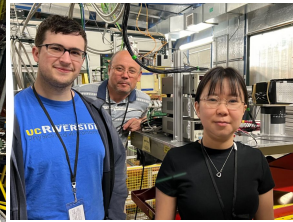
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Analysing

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Analysing

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2025

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Planning ³⁴