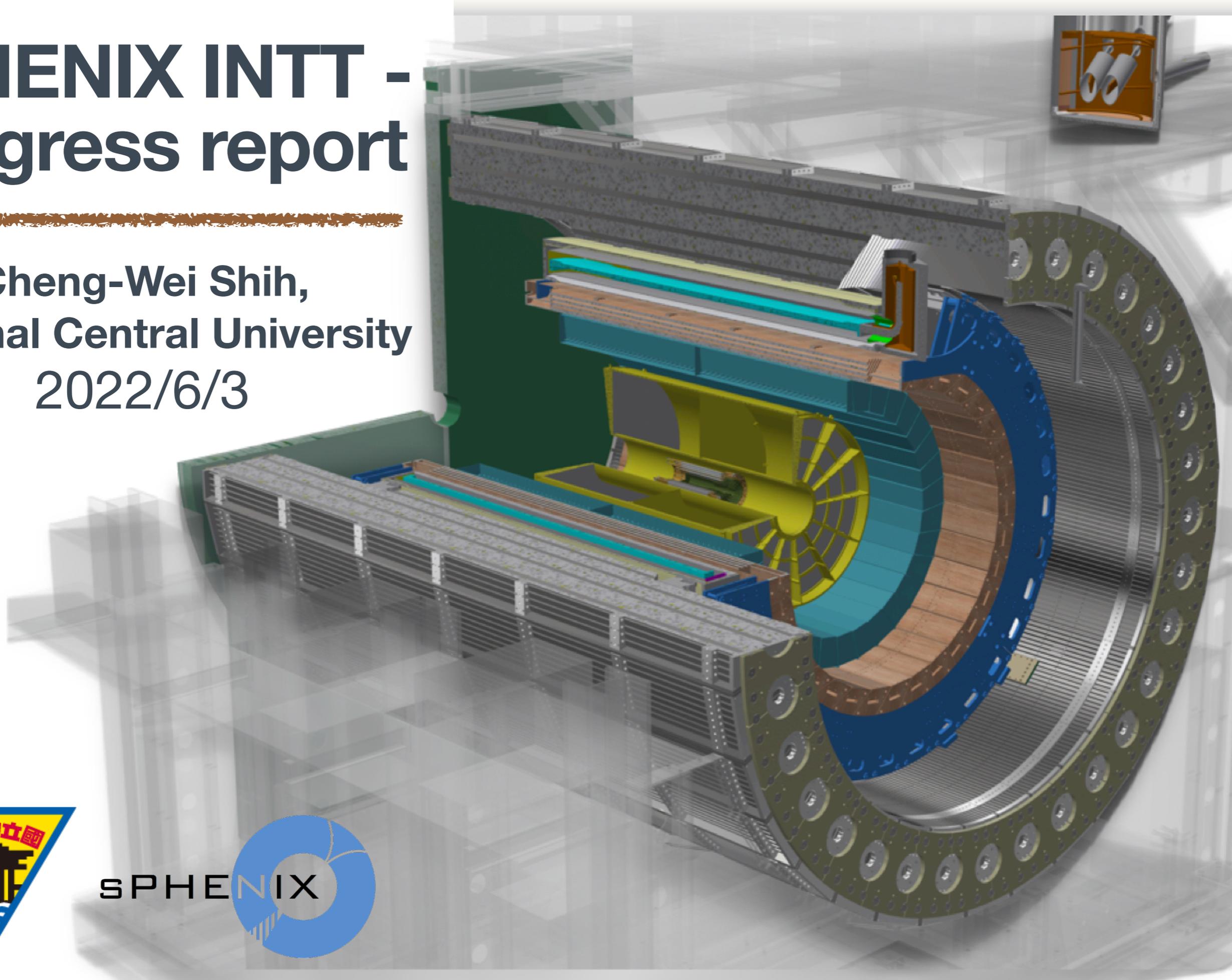


sPHENIX INTT - progress report

Cheng-Wei Shih,
National Central University
2022/6/3

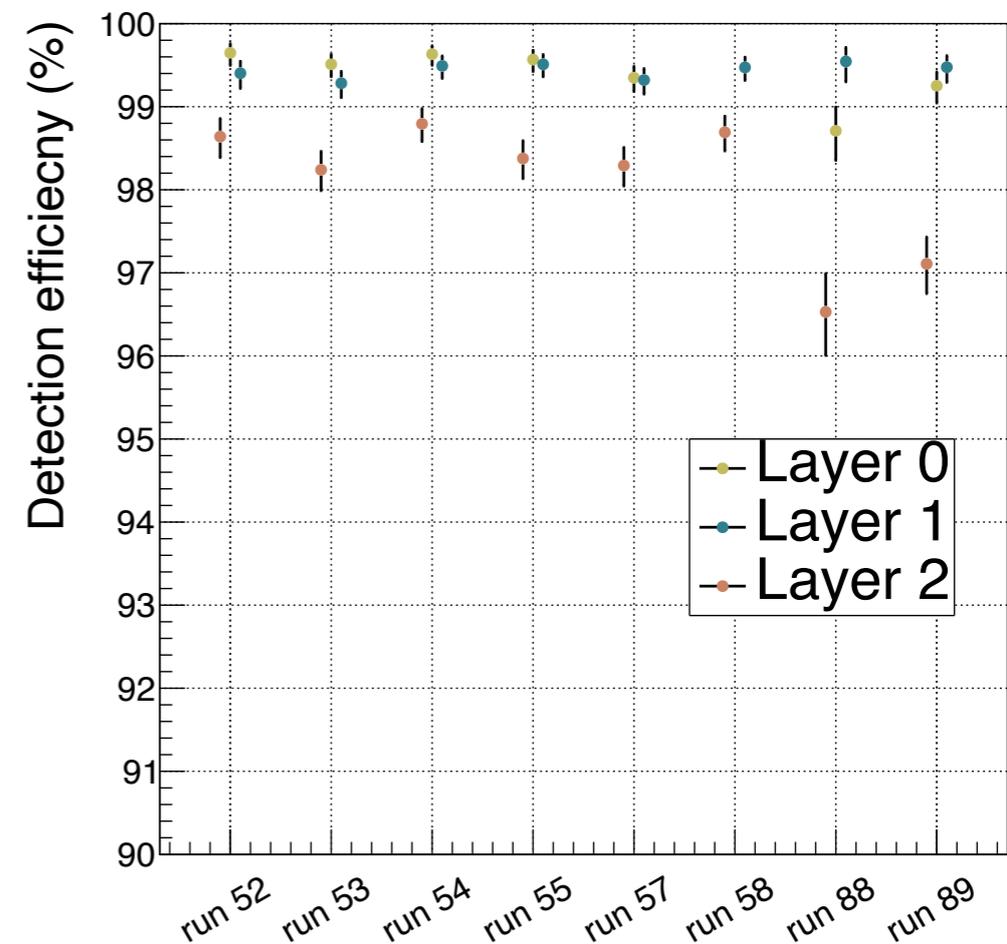


// Testbeam2021 - original results

Chip selection	all	
BCO group	first	
Window cut	fixed	0.205 mm
Transverse alignment	V	
Longitudinal misalignment rejection	V	
Boundary cut	X	

Run ID	effi. 10 (%)	effi. 11 (%)	effi. 12 (%)
52	99.647 ^{+0.109} _{-0.149}	99.402 ^{+0.143} _{-0.182}	98.640 ^{+0.215} _{-0.252}
53	99.511 ^{+0.117} _{-0.149}	99.282 ^{+0.142} _{-0.173}	98.240 ^{+0.221} _{-0.250}
54	99.632 ^{+0.100} _{-0.132}	99.491 ^{+0.118} _{-0.149}	98.793 ^{+0.182} _{-0.211}
55	99.567 ^{+0.110} _{-0.142}	99.510 ^{+0.117} _{-0.149}	98.376 ^{+0.213} _{-0.242}
57	99.349 ^{+0.134} _{-0.165}	99.320 ^{+0.137} _{-0.168}	98.291 ^{+0.216} _{-0.245}
58	94.464 ^{+0.382} _{-0.408}	99.472 ^{+0.122} _{-0.155}	98.692 ^{+0.193} _{-0.223}
88	98.709 ^{+0.284} _{-0.354}	99.544 ^{+0.167} _{-0.244}	96.529 ^{+0.460} _{-0.523}
89	99.251 ^{+0.165} _{-0.206}	99.475 ^{+0.138} _{-0.180}	97.108 ^{+0.320} _{-0.357}

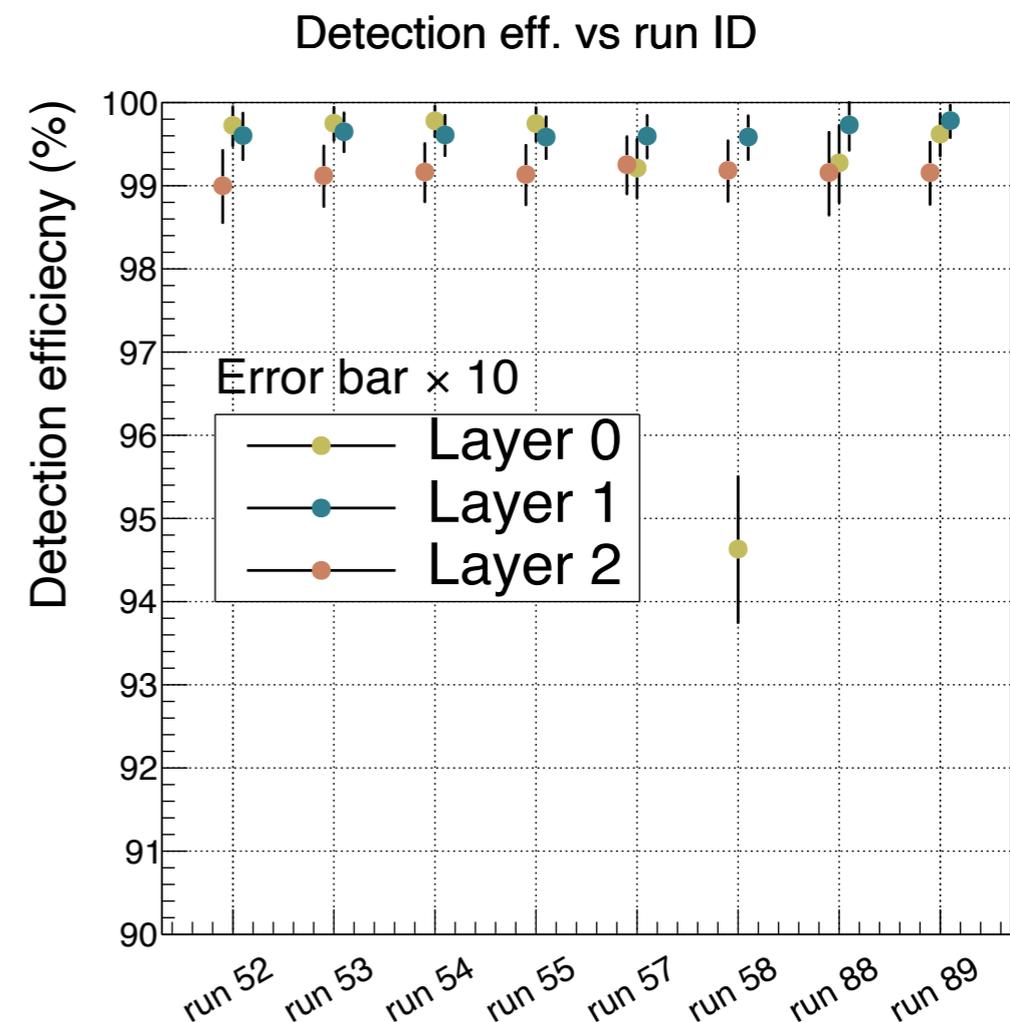
Detection eff. vs run ID



// Testbeam2021 - latest results

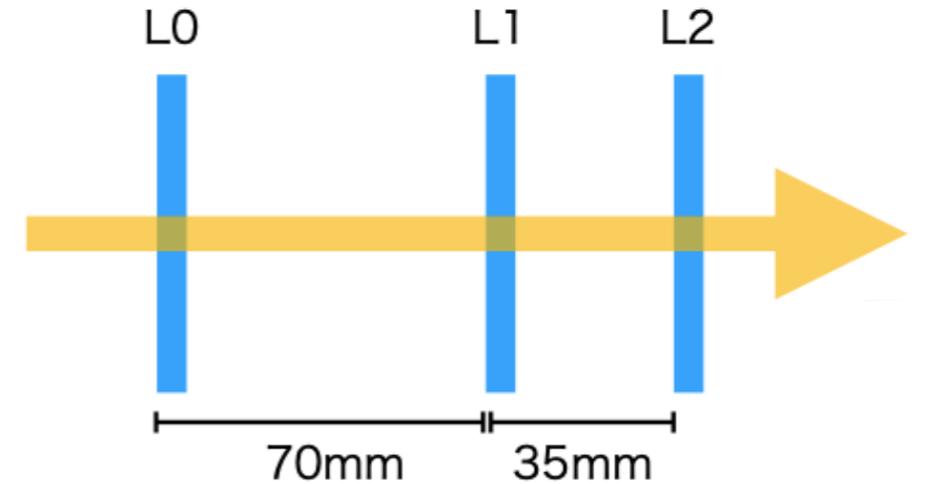
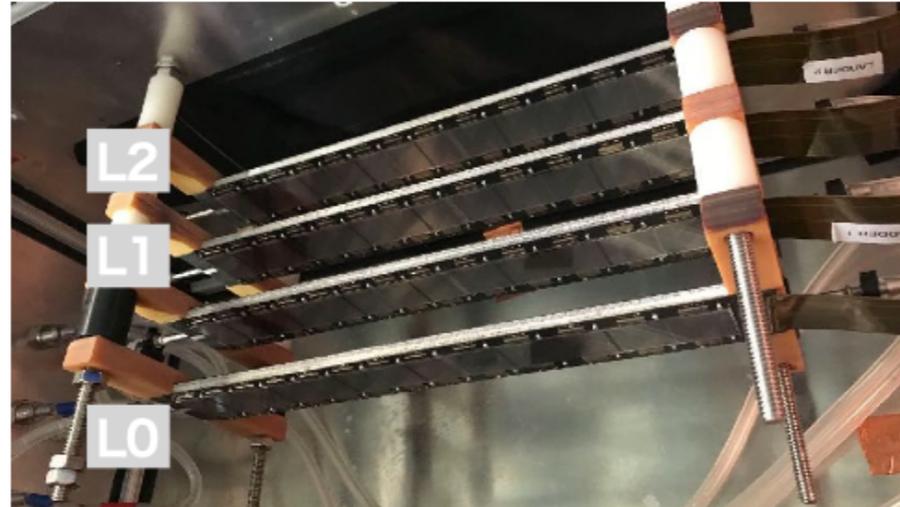
Chip selection	single	highest entry
BCO group	all	
Window cut	float	3σ of double Gaus
Transverse alignment	V	
Longitudinal misalignment rejection	V	
Boundary cut	V	± 5 channels

Run ID	effi. L0 (%)	effi. L1 (%)	effi. L2 (%)
52	99.73 ^{+0.02} _{-0.02}	99.60 ^{+0.03} _{-0.03}	99.00 ^{+0.04} _{-0.04}
53	99.75 ^{+0.02} _{-0.02}	99.65 ^{+0.02} _{-0.02}	99.12 ^{+0.04} _{-0.04}
54	99.78 ^{+0.02} _{-0.02}	99.61 ^{+0.02} _{-0.02}	99.16 ^{+0.03} _{-0.04}
55	99.75 ^{+0.02} _{-0.02}	99.58 ^{+0.02} _{-0.03}	99.14 ^{+0.03} _{-0.04}
57	99.21 ^{+0.03} _{-0.04}	99.60 ^{+0.02} _{-0.03}	99.25 ^{+0.03} _{-0.04}
58	94.63 ^{+0.09} _{-0.09}	99.59 ^{+0.03} _{-0.03}	99.18 ^{+0.04} _{-0.04}
88	99.27 ^{+0.04} _{-0.05}	99.73 ^{+0.03} _{-0.03}	99.16 ^{+0.05} _{-0.05}
89	99.62 ^{+0.02} _{-0.03}	99.78 ^{+0.02} _{-0.02}	99.16 ^{+0.04} _{-0.04}



// Testbeam 2019

Info. from Ayaka's slide,
Sep./27/2019



25 branches

```
*****
*Br 0 :event_num : event_num/I
*Entries : 527035 : Total Size= 2112821 bytes File Size = 738173
*Baskets : 40 : Basket Size= 122368 bytes Compression= 2.86
*
*Br 1 :event_num_decoder : event_num_decoder/I
*Entries : 527035 : Total Size= 2113173 bytes File Size = 738503
*Baskets : 40 : Basket Size= 122368 bytes Compression= 2.86
*
*Br 2 :nhits : nhits/I
*Entries : 527035 : Total Size= 2112645 bytes File Size = 675231
*Baskets : 40 : Basket Size= 122368 bytes Compression= 3.13
*
*Br 3 :n_packet : n_packet/I
*Entries : 527035 : Total Size= 2112777 bytes File Size = 15212
*Baskets : 40 : Basket Size= 122368 bytes Compression= 138.82
*
*Br 4 :nhits_packet : nhits_packet[n_packet]/I
*Entries : 527035 : Total Size= 103473529 bytes File Size = 2846829
*Baskets : 1452 : Basket Size= 6017536 bytes Compression= 36.34
*
*Br 5 :data_length_packet : data_length_packet[n_packet]/I
*Entries : 527035 : Total Size= 103482265 bytes File Size = 2876557
*Baskets : 1452 : Basket Size= 6018560 bytes Compression= 35.96
*
*Br 6 :paritycheck : paritycheck[n_packet]/I
*Entries : 527035 : Total Size= 103472073 bytes File Size = 2321441
*Baskets : 1452 : Basket Size= 6017024 bytes Compression= 44.56
*
*Br 7 :errorcode : errorcode[n_packet]/I
*Entries : 527035 : Total Size= 103469161 bytes File Size = 2316213
*Baskets : 1452 : Basket Size= 6016512 bytes Compression= 44.66
*
*Br 8 :fem_error : fem_error[n_packet]/I
*Entries : 527035 : Total Size= 103469161 bytes File Size = 2687620
*Baskets : 1452 : Basket Size= 6016512 bytes Compression= 38.49
*****
```

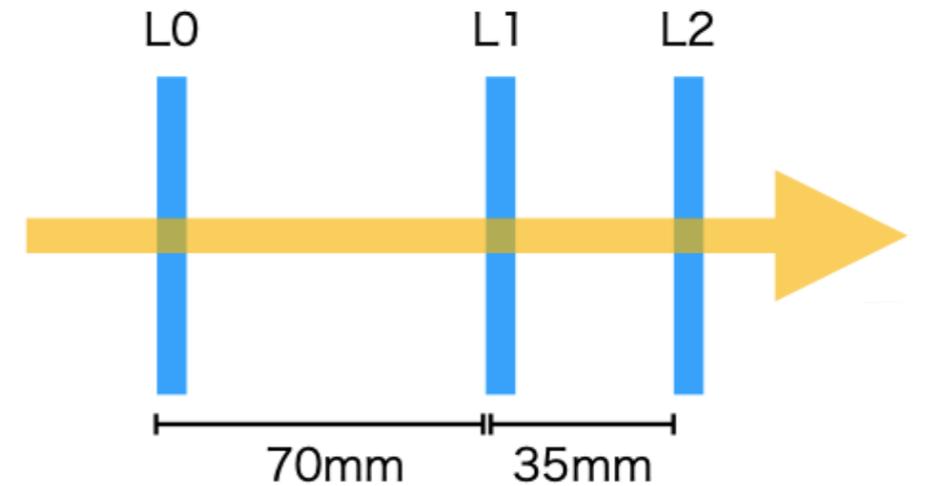
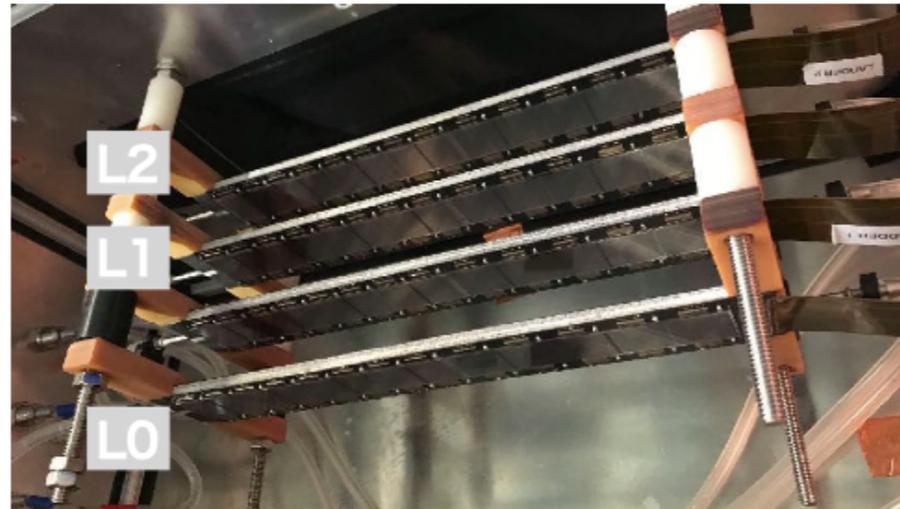
```
*****
*Br 9 :bco_packet : bco_packet[n_packet]/I
*Entries : 527035 : Total Size= 103470617 bytes File Size = 2320102
*Baskets : 1452 : Basket Size= 6017024 bytes Compression= 44.58
*
*Br 10 :event_num_packet : event_num_packet[n_packet]/I
*Entries : 527035 : Total Size= 103479353 bytes File Size = 2717644
*Baskets : 1452 : Basket Size= 6018048 bytes Compression= 38.07
*
*Br 11 :bco : bco[nhits]/I
*Entries : 527035 : Total Size= 45438267 bytes File Size = 1447466
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 31.38
*
*Br 12 :detID : detID[nhits]/I
*Entries : 527035 : Total Size= 45439607 bytes File Size = 1472502
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 30.85
*
*Br 13 :mod : mod[nhits]/I
*Entries : 527035 : Total Size= 45438267 bytes File Size = 1471685
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 30.87
*
*Br 14 :packet : packet[nhits]/I
*Entries : 527035 : Total Size= 45440277 bytes File Size = 1474071
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 30.82
*
*Br 15 :fem_id : fem_id[nhits]/I
*Entries : 527035 : Total Size= 45440277 bytes File Size = 2819907
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 16.11
*
*Br 16 :chip : chip[nhits]/I
*Entries : 527035 : Total Size= 45438937 bytes File Size = 4169884
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 10.89
*
*Br 17 :channel : channel[nhits]/I
*Entries : 527035 : Total Size= 45440947 bytes File Size = 4508139
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 10.08
*****
```

```
*****
*Br 18 :adc_value : adc_value[nhits]/I
*Entries : 527035 : Total Size= 45442287 bytes File Size = 3767320
*Baskets : 666 : Basket Size= 2670592 bytes Compression= 12.06
*
*Br 19 :arm : arm[nhits]/I
*Entries : 527035 : Total Size= 45438267 bytes File Size = 2202885
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 20.62
*
*Br 20 :cage : cage[nhits]/I
*Entries : 527035 : Total Size= 45438937 bytes File Size = 2199418
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 20.65
*
*Br 21 :station : station[nhits]/I
*Entries : 527035 : Total Size= 45440947 bytes File Size = 3852969
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 11.79
*
*Br 22 :sector : sector[nhits]/I
*Entries : 527035 : Total Size= 45440277 bytes File Size = 2363263
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 19.22
*
*Br 23 :side : side[nhits]/I
*Entries : 527035 : Total Size= 45438937 bytes File Size = 3819092
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 11.89
*
*Br 24 :strip : strip[nhits]/I
*Entries : 527035 : Total Size= 45439607 bytes File Size = 5998069
*Baskets : 666 : Basket Size= 2670080 bytes Compression= 7.57
*****
```

Useful branches : event_num, nhits, fem_id[nhits], chip[nhits], channel[nhits], adc_value[nhits]

// Testbeam 2019 - ladder ID

Info. from Ayaka's slide,
Sep./27/2019



Ayaka's ana code, effana.cpp

```
if (100 < runnum && runnum <= 634)
{
  // For 2019 beam test w/o bus extender
  if (fem_id[ihit] == 0) layer = 1; //ladder 3
  else if (fem_id[ihit] == 1) layer = 2; //ladder 2
  else if (fem_id[ihit] == 3) layer = 0; //ladder 4
  if (layer == -1) continue;
}
```

Layer	Ladder ID	fem_id
0	4	3
1	3	0
2	2	1

// Testbeam 2019 - ladder conditions

Info. from Itaru's slide,
June/12/2019

INTT Wire Bonding Status

Microscope
inspection



Upstream							Ladder 4						
CHIP ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Status													
CHIP ID	14	15	16	17	18	19	20	21	22	23	24	25	26
Status													
						Ladder 1							
CHIP ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Status	suspicious	suspicious				suspicious							
CHIP ID	14	15	16	17	18	19	20	21	22	23	24	25	26
Status													
				Ladder 3									
CHIP ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Status				bad									
CHIP ID	14	15	16	17	18	19	20	21	22	23	24	25	26
Status													
Downstream							Ladder 2						
CHIP ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Status					suspicious								
CHIP ID	14	15	16	17	18	19	20	21	22	23	24	25	26
Status													

Sensor-A

Sensor-B

// Testbeam 2019 - run 615

data	DAC setting	Table pos (H)	Table pos (V)	Total entries	4 chips around beam spot	Noise chips	L0 (chip: efficiency [%])	L1 (chip: efficiency [%])	L2 (chip: efficiency [%])
615	11	1570	155	527035	6, 7, 19, 20	L1: 1-5, 14-18, L2: 23	6: 96.0 ± 0.55, 7: 93.55 ± 0.60	6: 65.5 ± 1.1, 7: 63.9 ± 0.90	6: 85.9 ± 0.98, 7: 85.8 ± 0.78

ADC setting

Table from Kai-Yu's slide

DAC	DAC Scan1	DAC Scan2	DAC Scan3	DAC Scan4	DAC Scan5	DAC Scan6	DAC Scan7	DAC Scan8	DAC Scan9	DAC Scan10	DAC Scan11	DAC Scan12	DAC Scan13
	value	value	value	value									
0	8	28	48	68	88	108	128	148	168	188	208	228	96
1	12	32	52	72	92	112	132	152	172	192	212	232	100
2	16	36	56	76	96	116	136	156	176	196	216	236	104
3	20	40	60	80	100	120	140	160	180	200	220	240	108
4	24	44	64	84	104	124	144	164	184	204	224	244	112
5	28	48	68	88	108	128	148	168	188	208	228	248	116
6	32	52	72	92	112	132	152	172	192	212	232	252	120
7	36	56	76	96	116	136	156	176	196	216	236	256	124

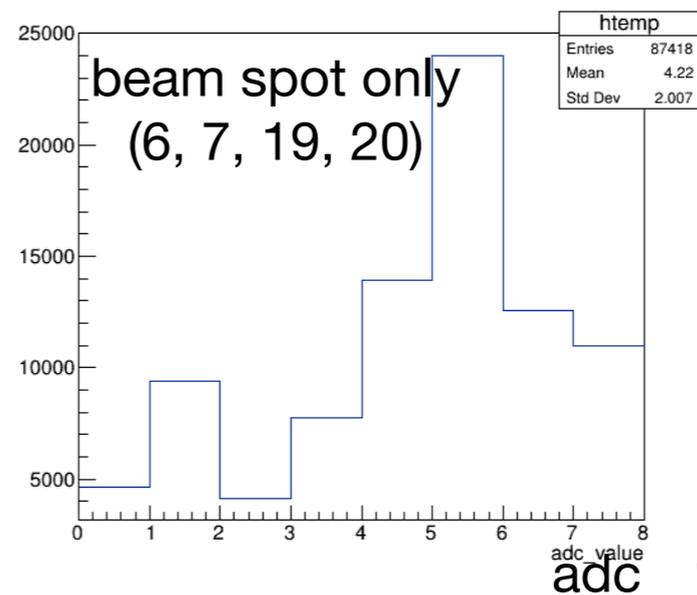
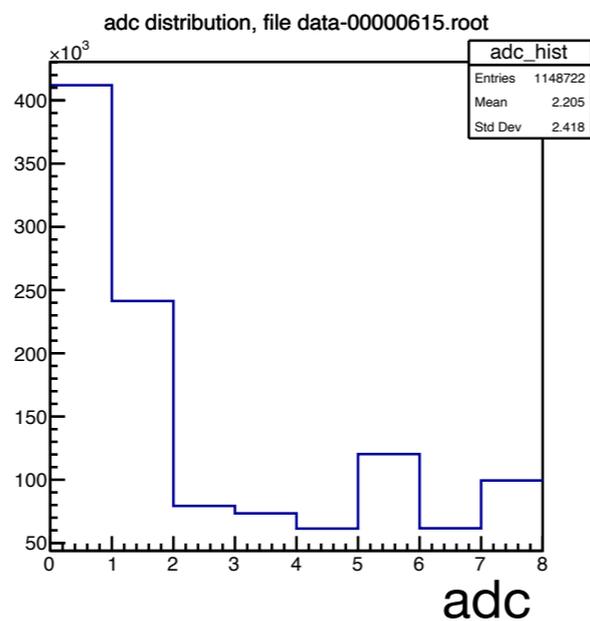
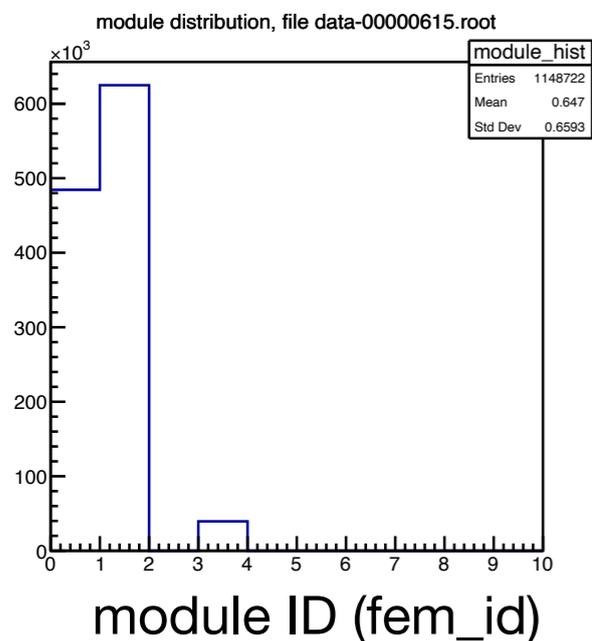
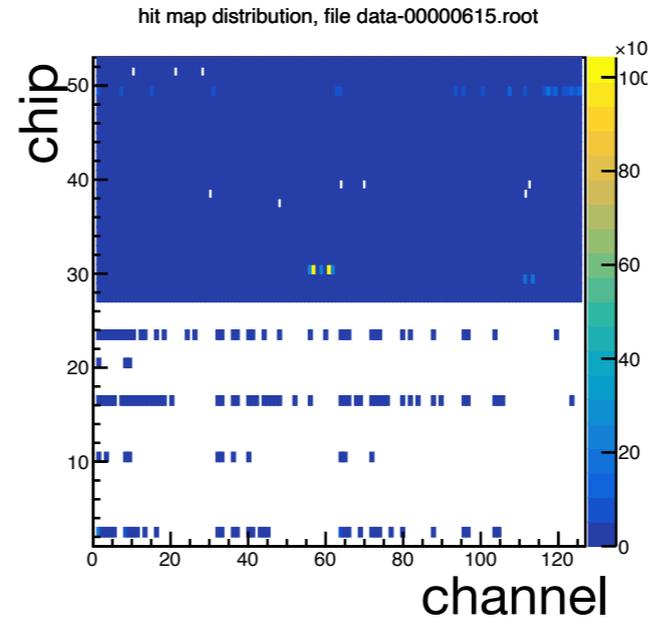
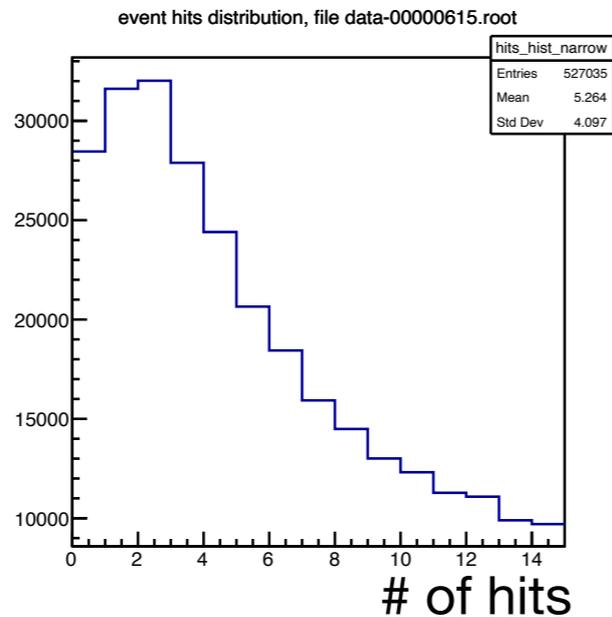
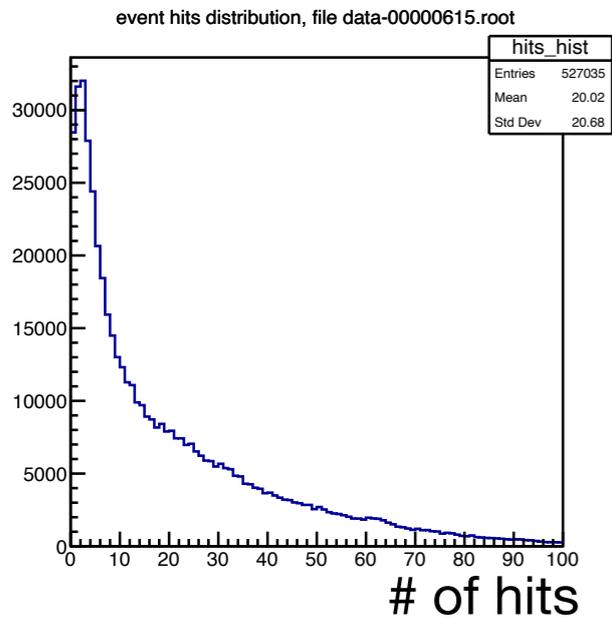
Info. from Ayaka's slide, July 4th 2019

DAC	Threshold
0	14
1	16
2	32
3	48
4	80
5	112
6	144
7	176

↔
Contradiction

// Testbeam 2019 - run 615

data	DAC setting	Table pos (H)	Table pos (V)	Total entries	4 chips around beam spot	Noise chips	L0 (chip: efficiency [%])	L1 (chip: efficiency [%])	L2 (chip: efficiency [%])
615	11	1570	155	527035	6, 7, 19, 20	L1: 1-5, 14-18, L2: 23	6: 96.0 + 0.55, 7: 93.55 + 0.60	6: 65.5 + 1.1, 7: 63.9 + 0.90	6: 85.9 + 0.98, 7: 85.8 + 0.78



Info. from Ayaka's slide, July 4th 2019

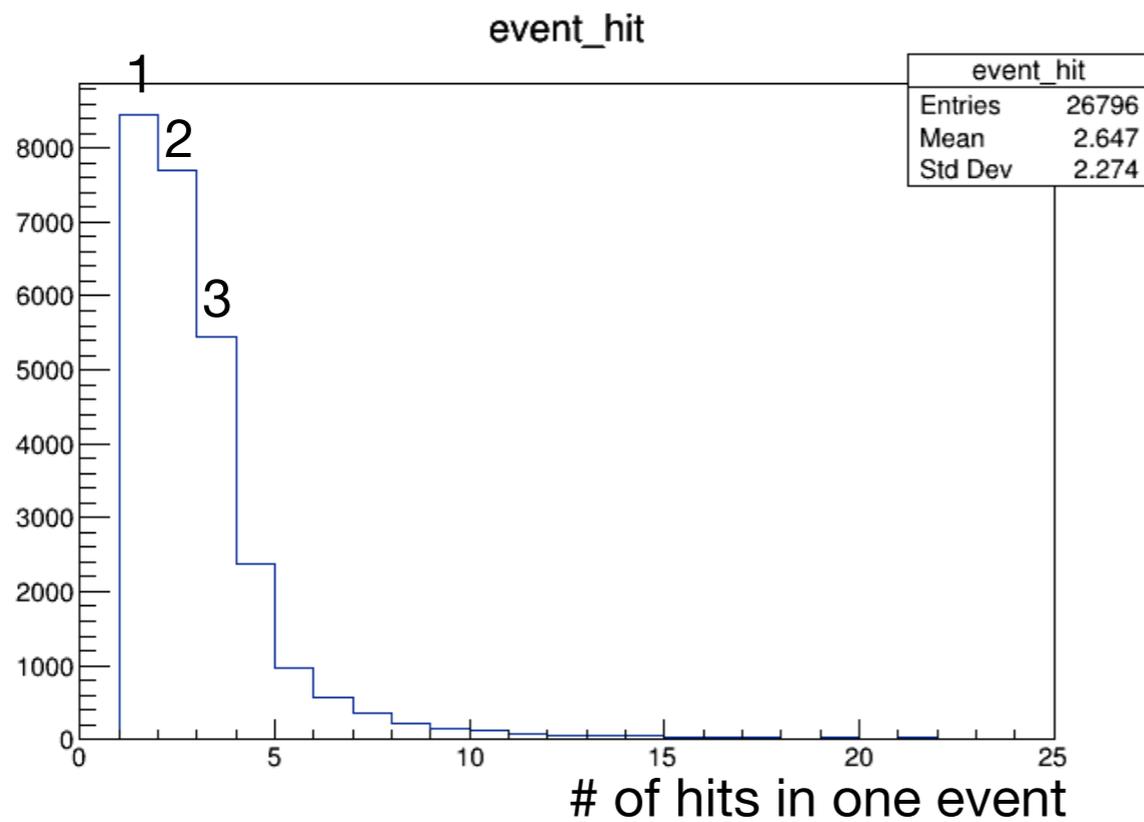
DAC	Threshold	mV
0	14	266
1	16	274
2	32	338
3	48	402
4	80	530
5	112	658
6	144	786
7	176	914

Ayaka's setting seems to be reasonable

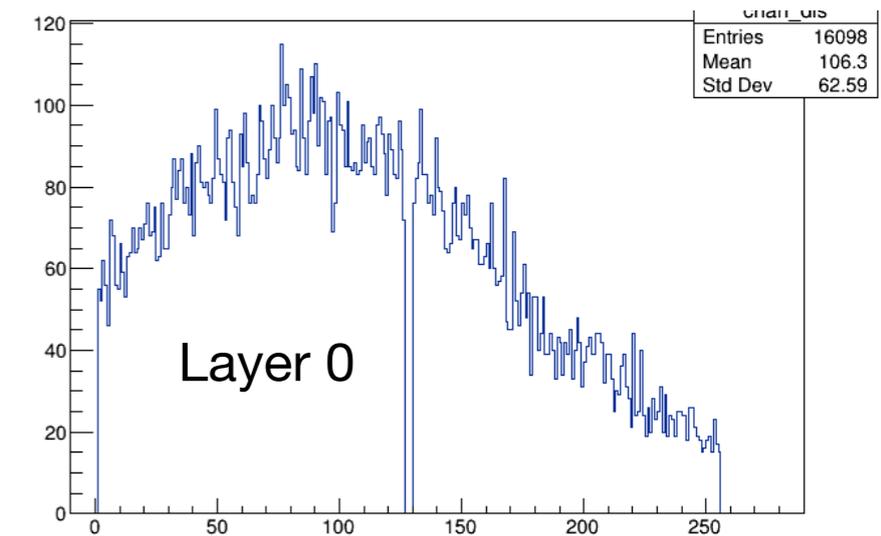
// Testbeam 2019 - run 615

Pre-selection :

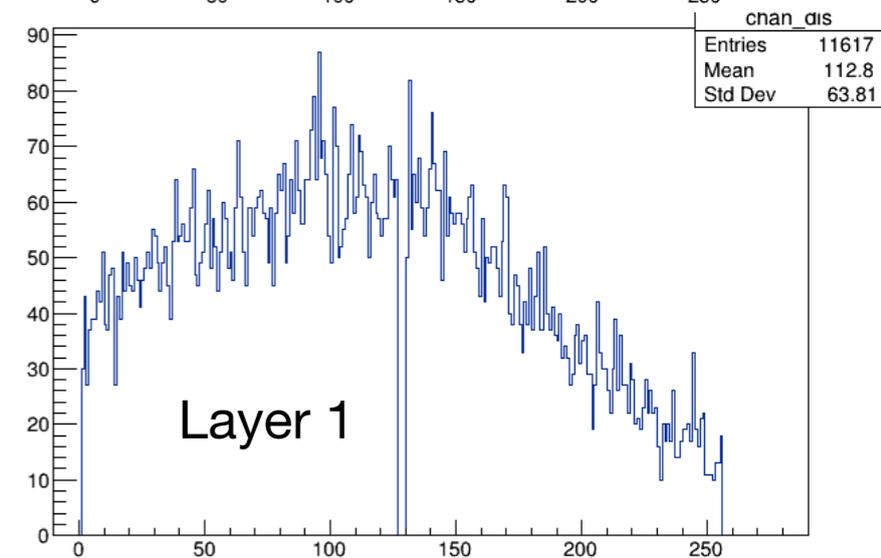
1. channel ID $\neq 0$ and $\neq 127$
2. $adc > 1$
3. chip ID == (6 or 7 or 19 or 20)



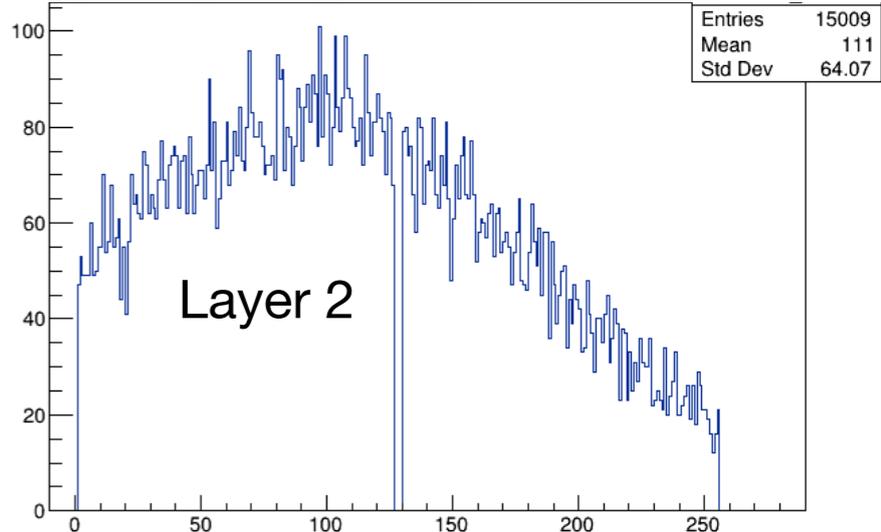
Entry : 16098



Entry : 11617



Entry : 15009



// Testbeam 2019 - run 615

Efficiency results from Ayaka

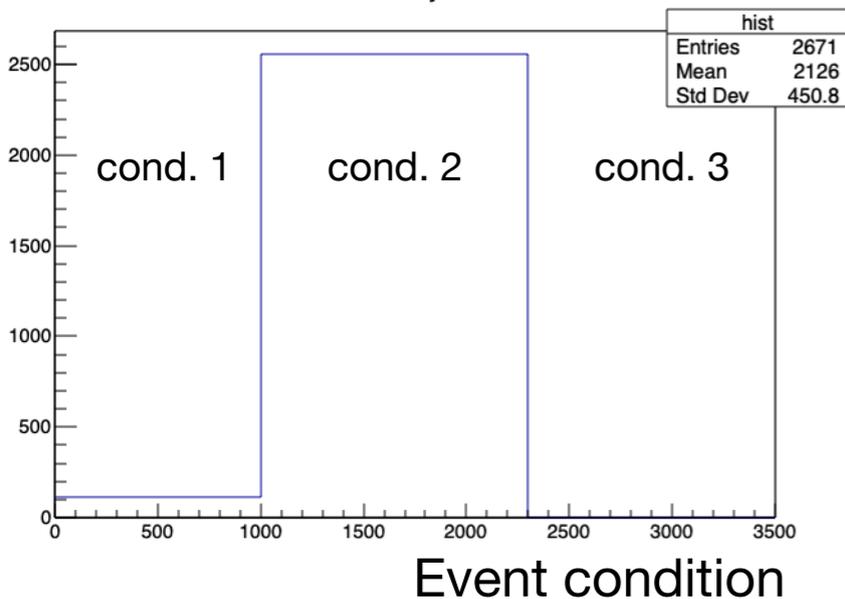
	Efficiency (U7)
Layer 0	$93.55 \pm 0.6\%$
Layer 1	$63.9 \pm 0.9\%$
Layer 2	$85.8 \pm 0.78\%$

My results

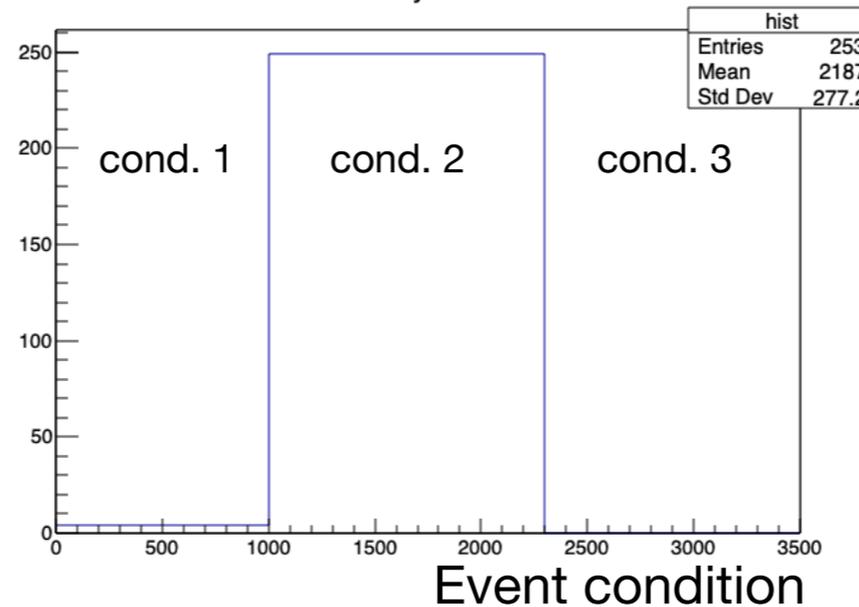
	Efficiency (U7)
Layer 0	$57.84^{+0.63}_{-0.63} \%$
Layer 1	$93.54^{+0.39}_{-0.42} \%$
Layer 2	$89.30^{+0.48}_{-0.50} \%$

Layer ID determination seems to be incorrect

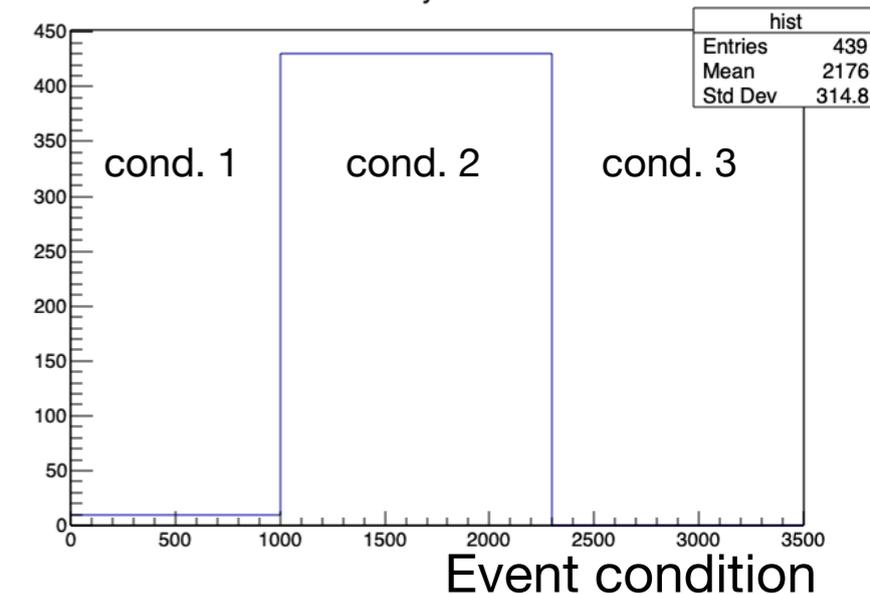
Layer 0



Layer 1



Layer 2



Only 2 layers have useful hits for most of the bad events. → not algorithm dependent

// Offset determination

Info. found from other papers

	Beam	Beam energy	silicon thickness (um)	edep (keV)	Paper link	note
1	Proton	1 GeV	300 um	130.8 ± 3.8 keV	link1	
2	Proton	115 GeV	300 um	85.5 ± 2.8 keV	link1	
3	Proton	50 GeV	300 um	85.79 keV	link2	
4	Proton	50 GeV	320 um	92.4389 keV	link2	interpolation from link2, Table 2
5	Proton	12 GeV	320 um	90.158 keV	link3	Extrapolation from link3, Figure 11
6	Proton	120 GeV	320 um	111.697 keV		Testbeam2019, Gain 100, Offset 200
7	Proton	120 GeV	320 um	93.297 keV		Testbeam2019, Gain 100, Offset 280

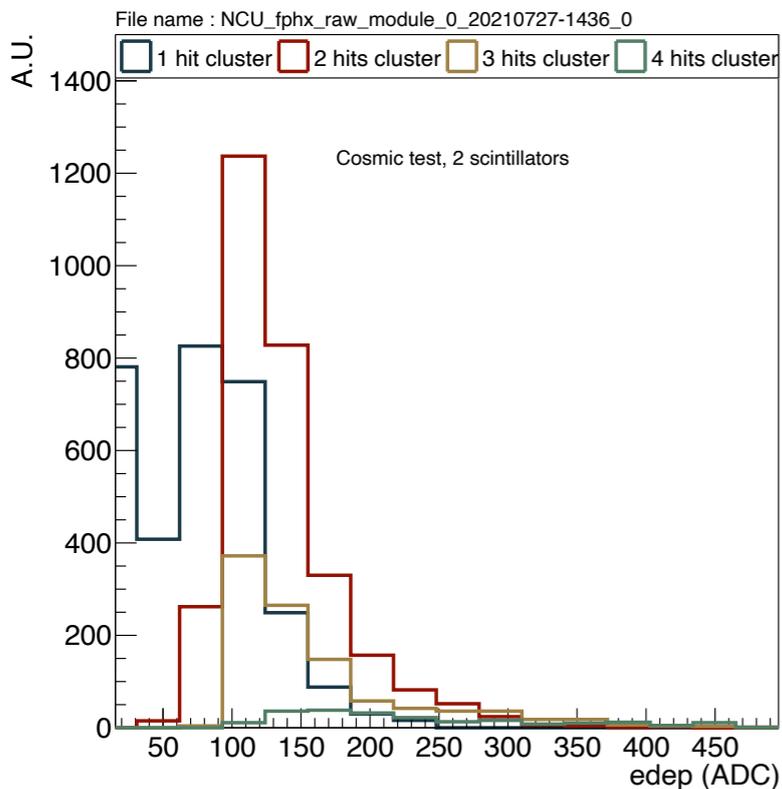
For testbeam 2019, the Offset value should be 280.

// Offset determination

*without bin width correction

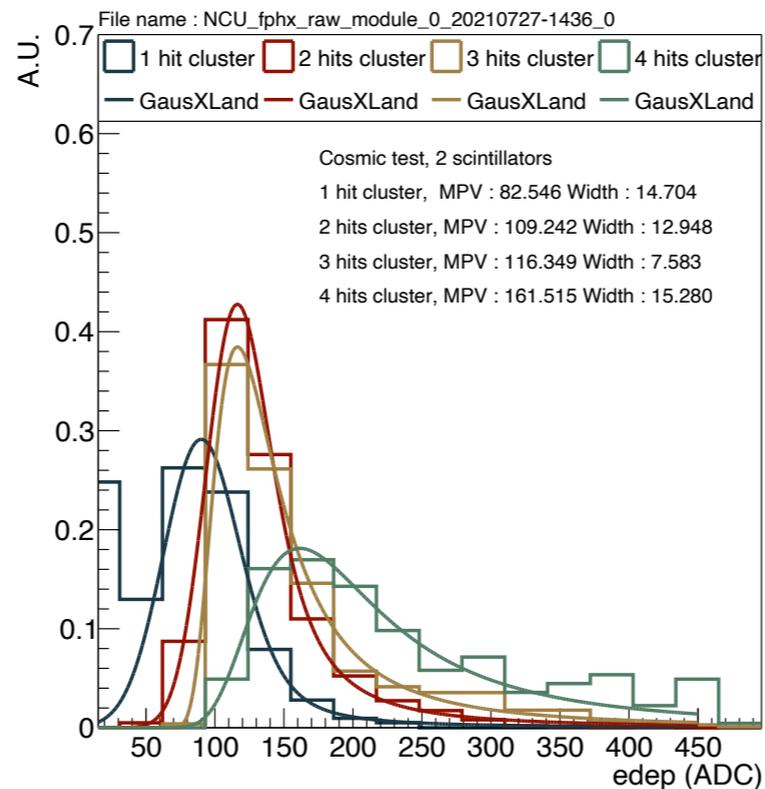
Linear scale
Without normalization

energy deposit

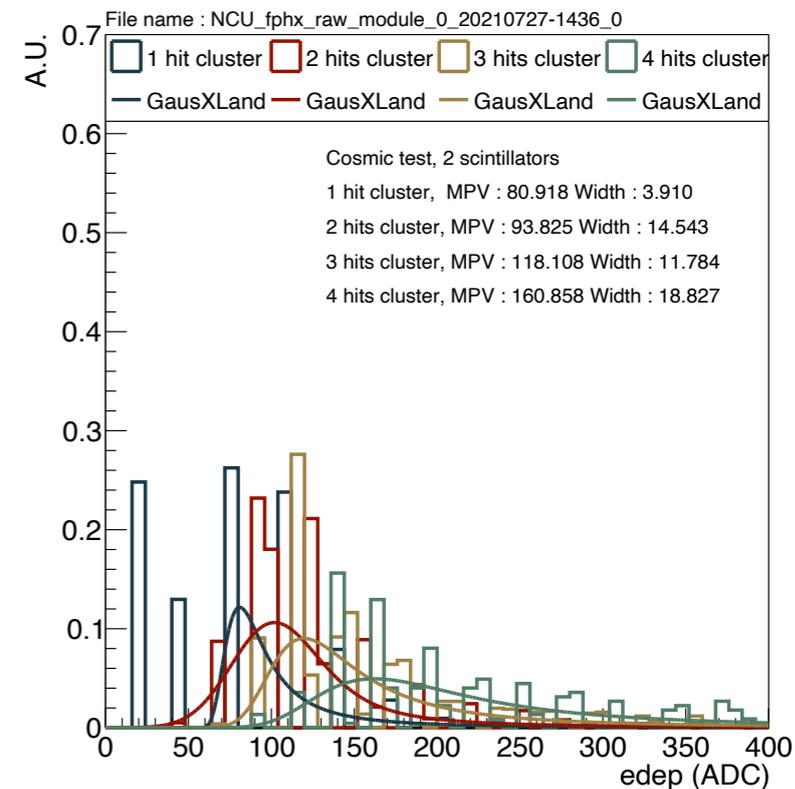


Linear scale
With normalization

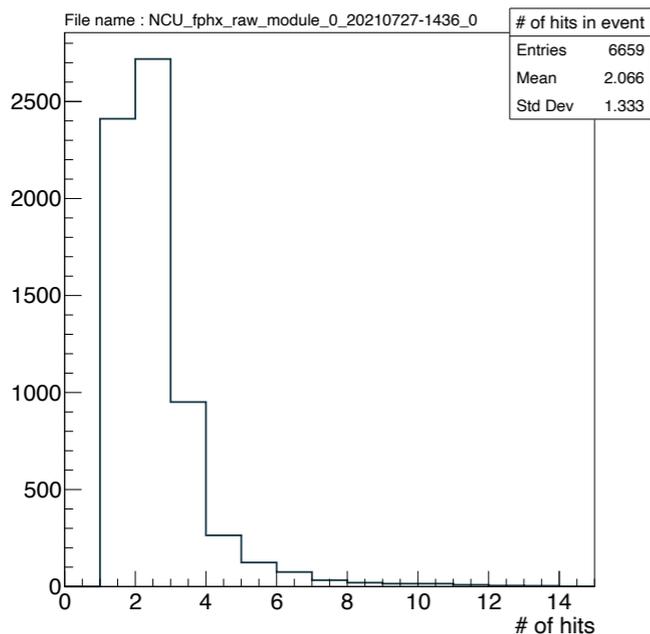
energy deposit



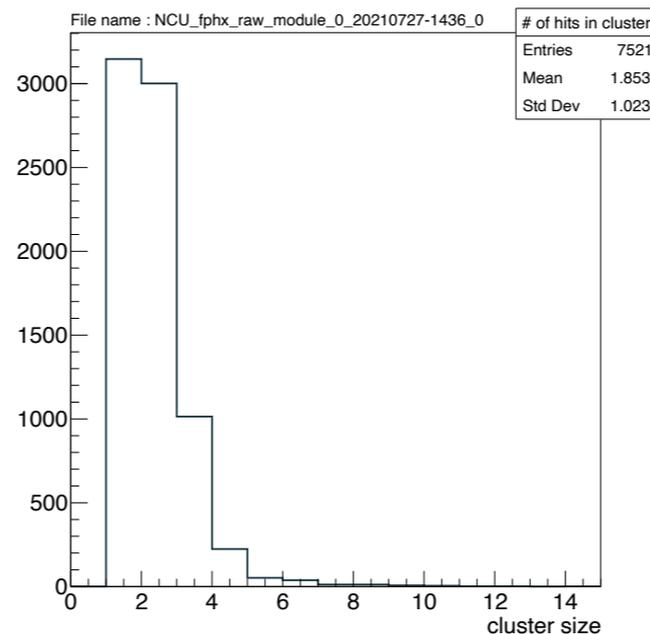
Linear scale
With normalization
(Fine bin)
energy deposit



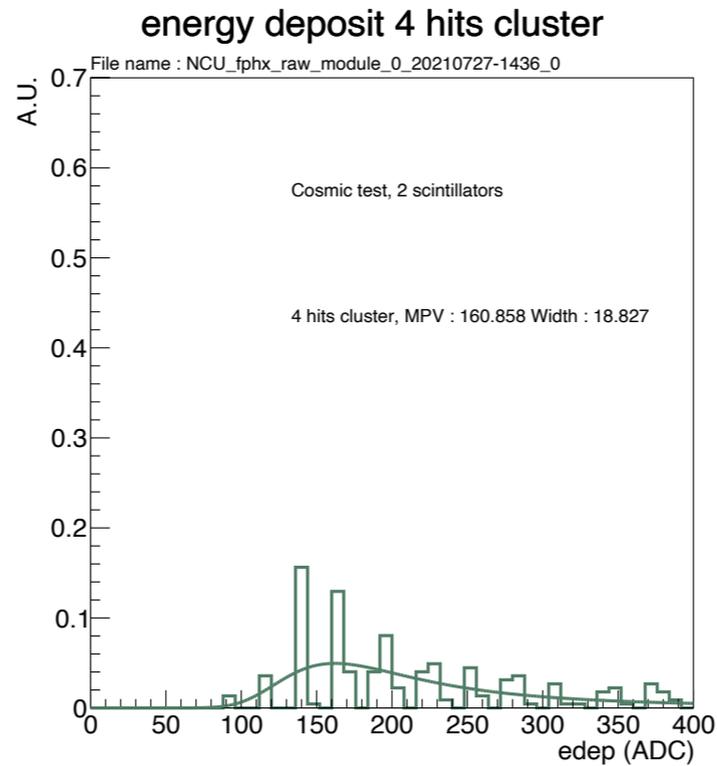
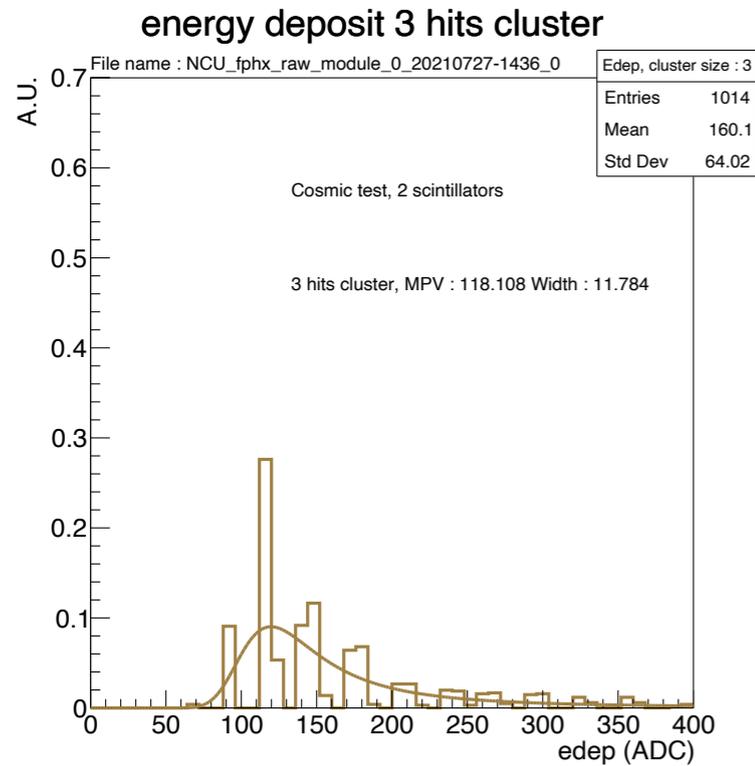
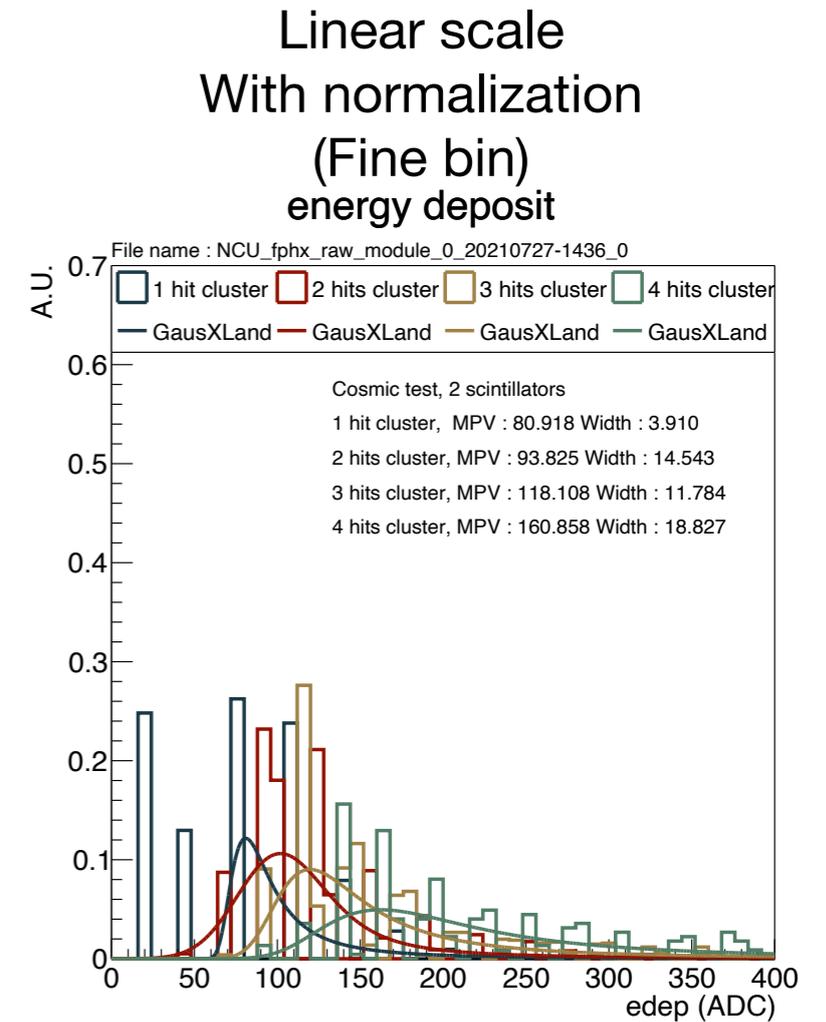
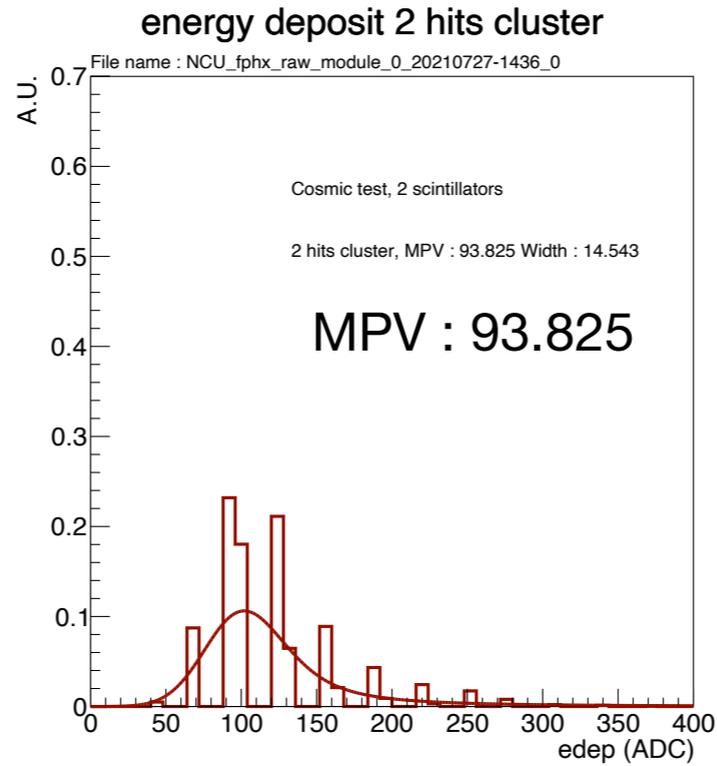
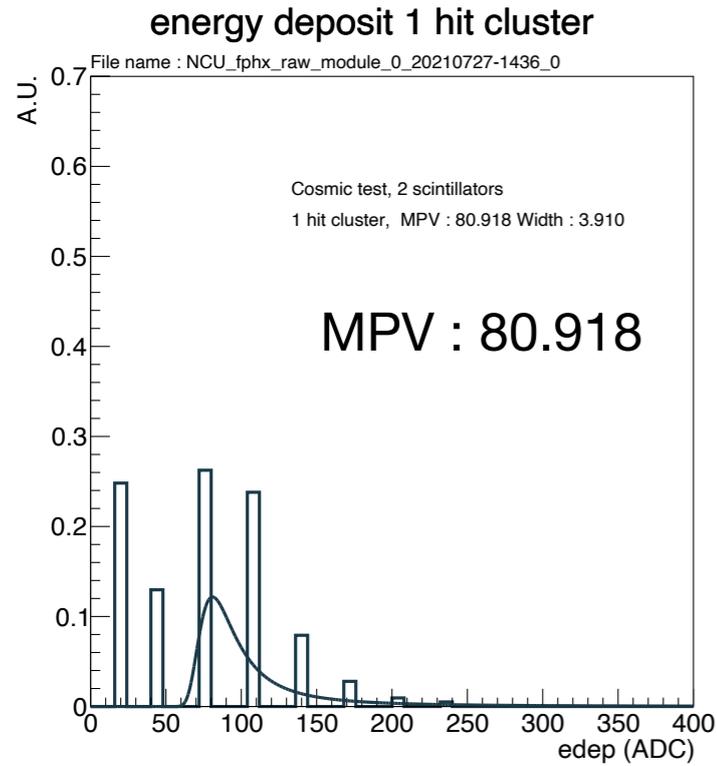
of hits in event



of hits in cluster



// Offset determination



$$mV = 4 * adc + 210$$

$$(93.825 - 80.918) * 4 + 210 = 261.628$$

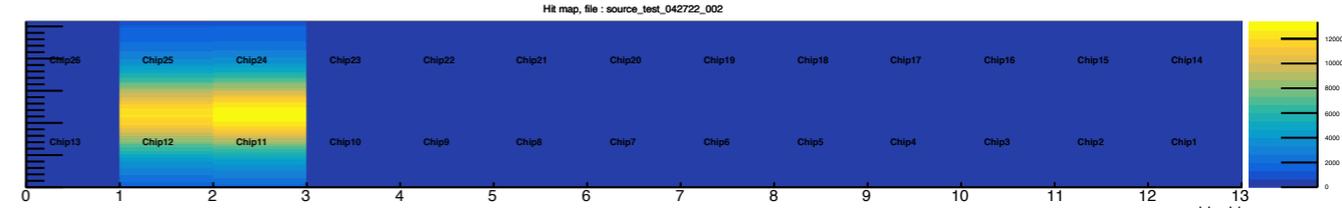
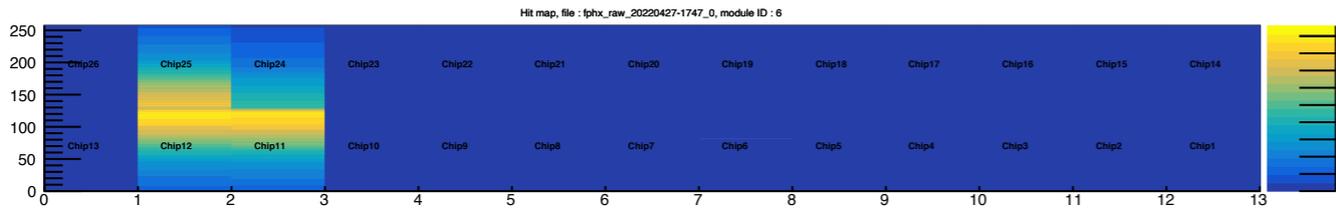
// FEM/Felix board comparison

- Will compare : adc distribution, clone hit rate, # of hit in one BCO group
- # of hit in one BCO group :
 - Try to answer the question :
 - The FEM board loses 50% ~ 65% of hits (or events), why the detection efficiency can be still up to 99.7% in the testeabm experiment ?
 - Hypothesis : what FEM loses is “the entire event” instead of “hit”.
 - At the same test condition, the # of hit in BCO group should be the same.

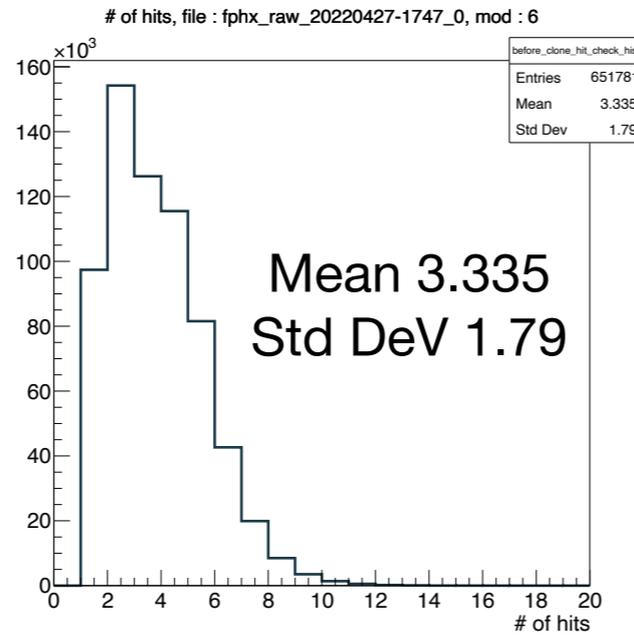
Data from Genki

Condition	Measurement	Time (min)	Source	#Metal plate	FEM data	Felix data	Remarks
	Source at fixed position	1	@A	0	-	1	
source 1	Source at fixed position	5	@A	0	1747	2	
source 2	Source at fixed position	5	@B	0	1740	3	
BG 1	background	5	High DAC BG	0	1225	4	
BG 2	background	5	Low DAC BG	0	1248	5	
source 3	Moving source	5	Moving	0	1753	6	
BG 3	background	5	Moving BG	0	1806	7	
source 4	With a metal plate	5	@B	1	1732	8	
source 5	With 2 metal plates	5	@B	2	1705	9	

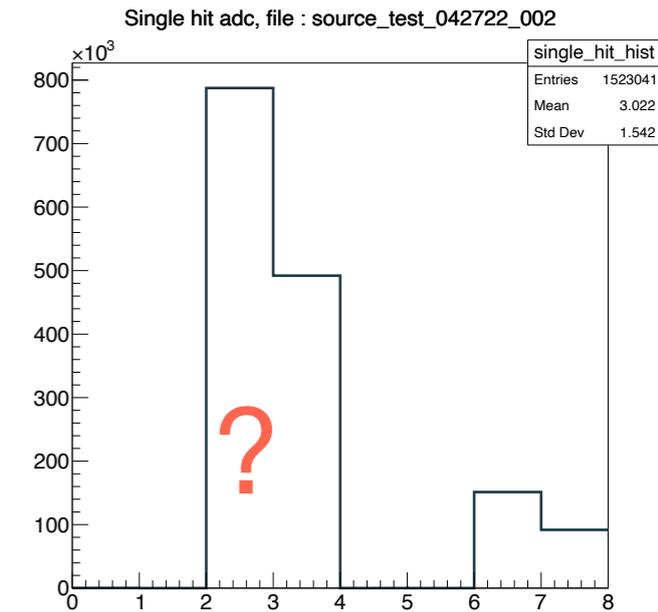
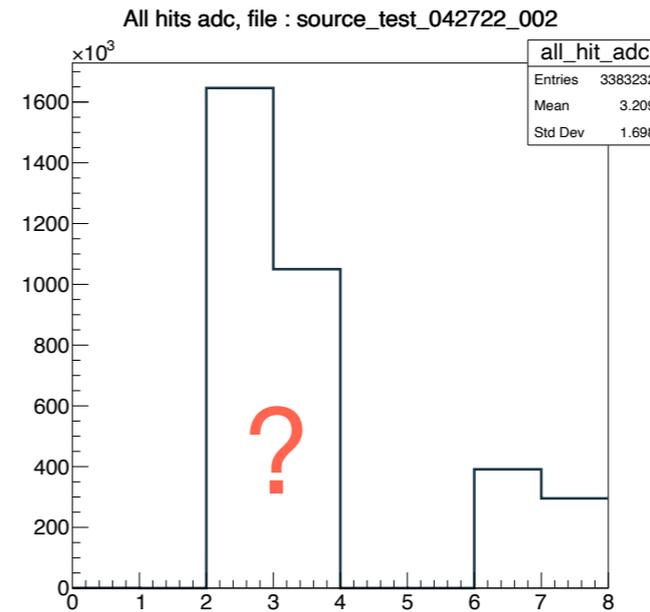
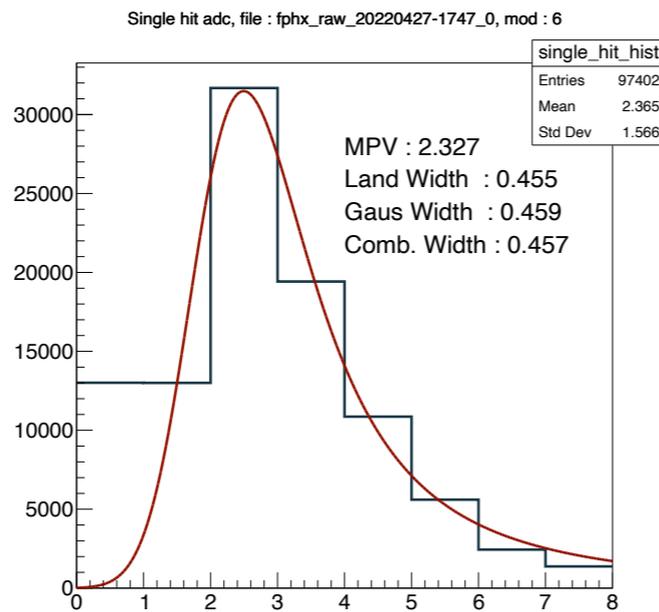
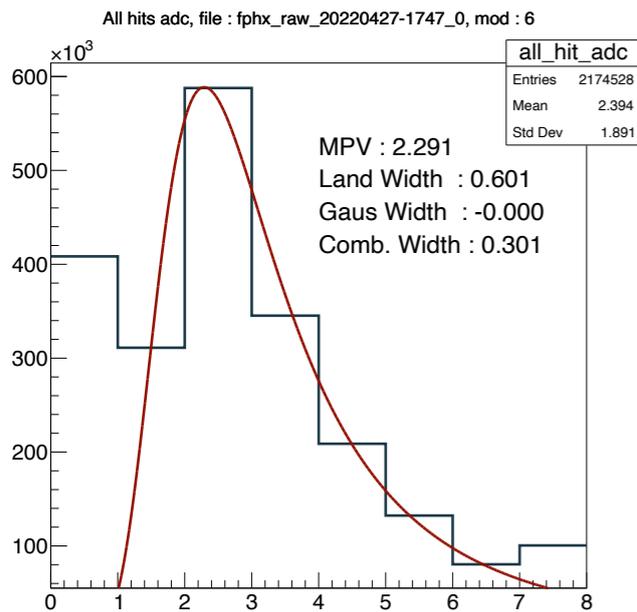
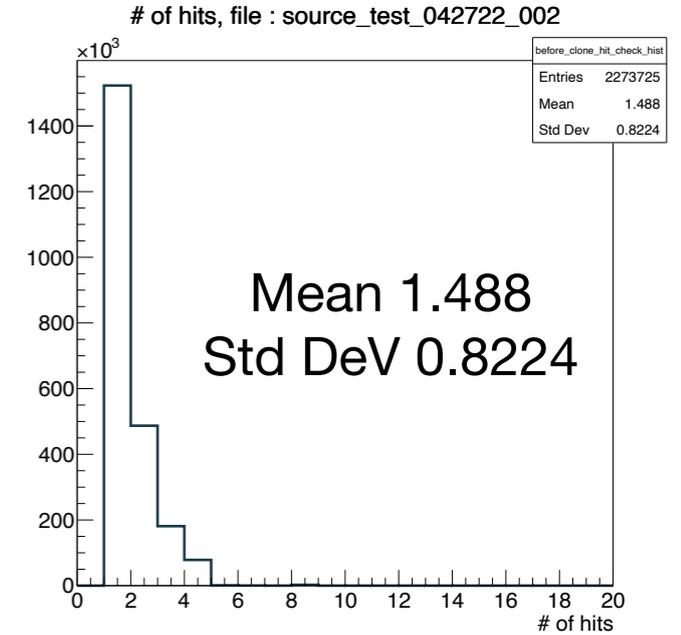
FEM/Felix board comparison - source 1



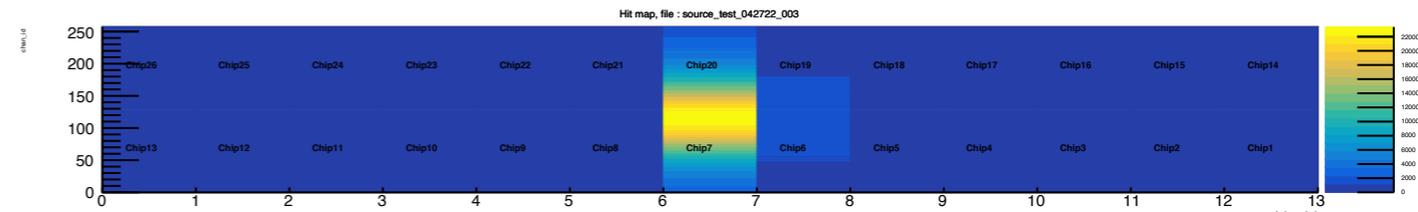
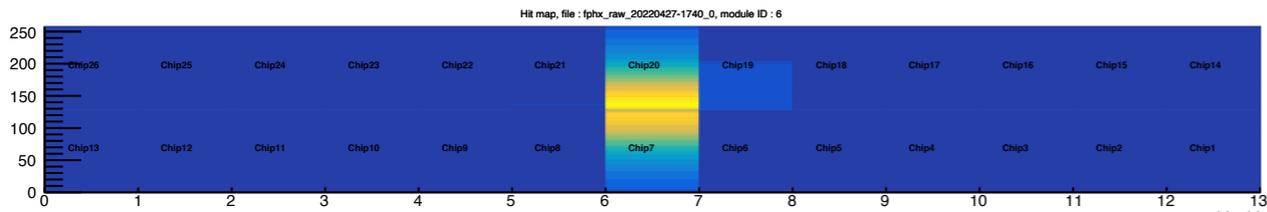
FEM



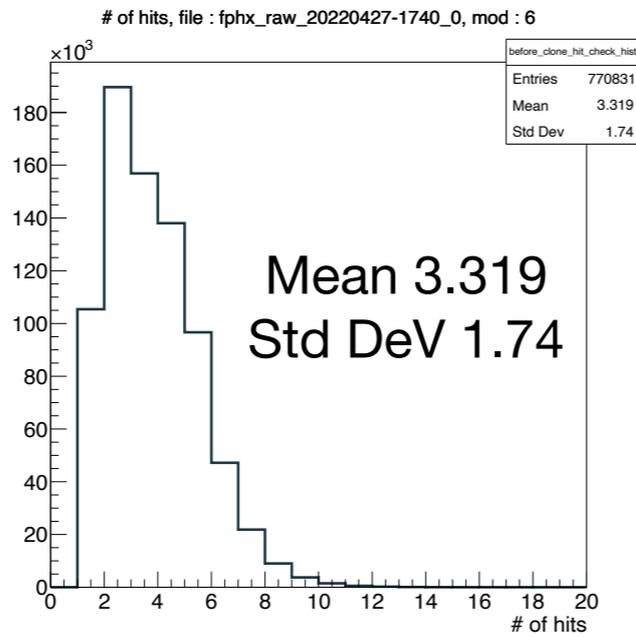
Felix



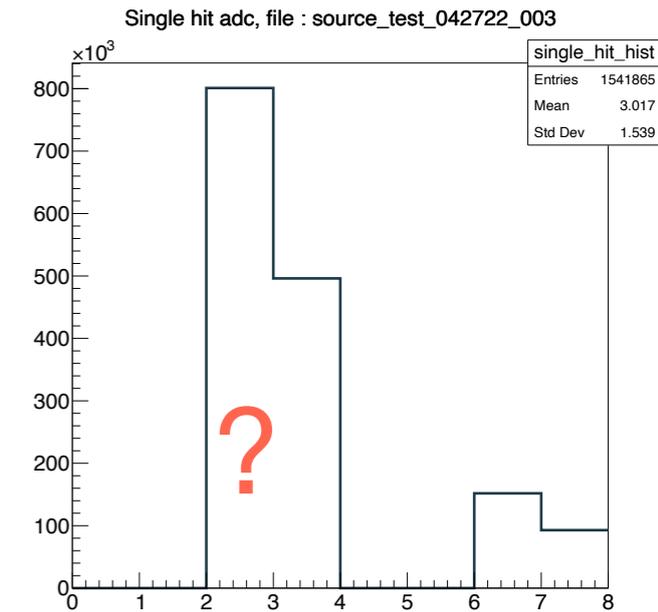
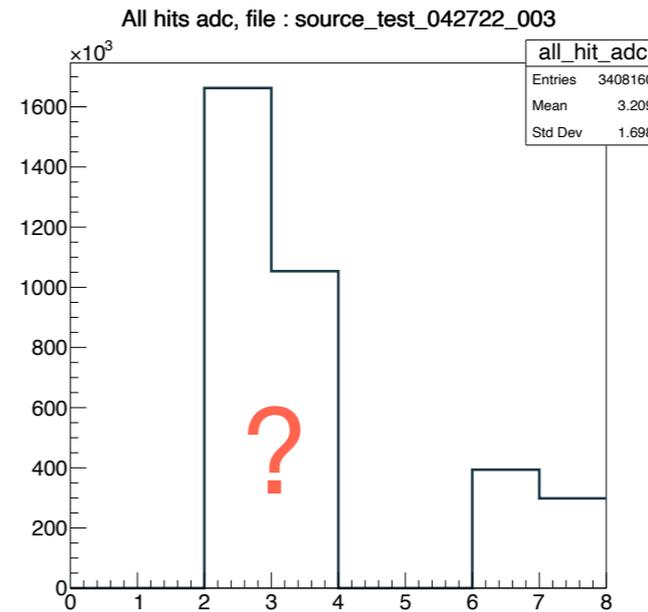
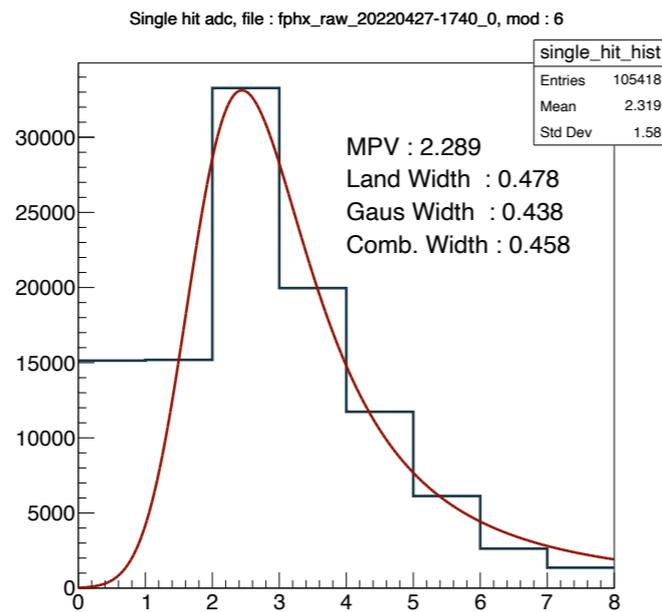
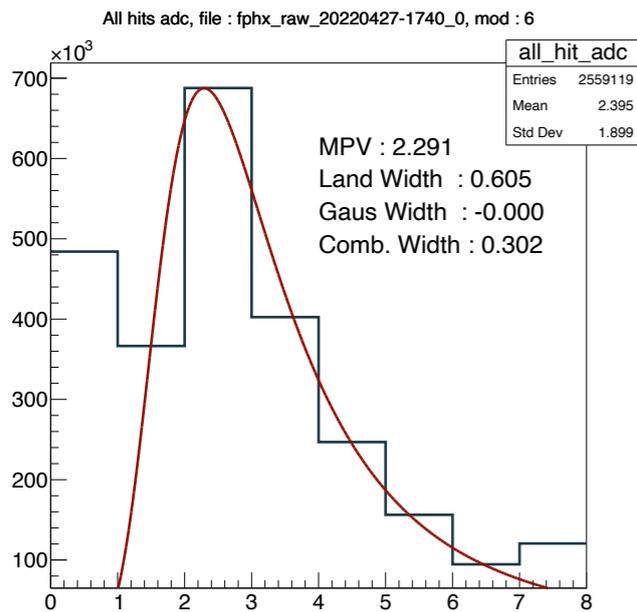
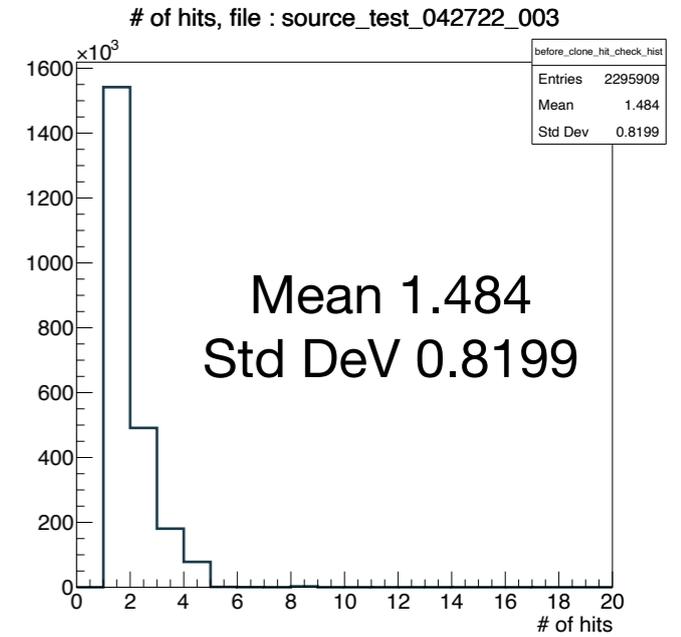
// FEM/Felix board comparison - source 2



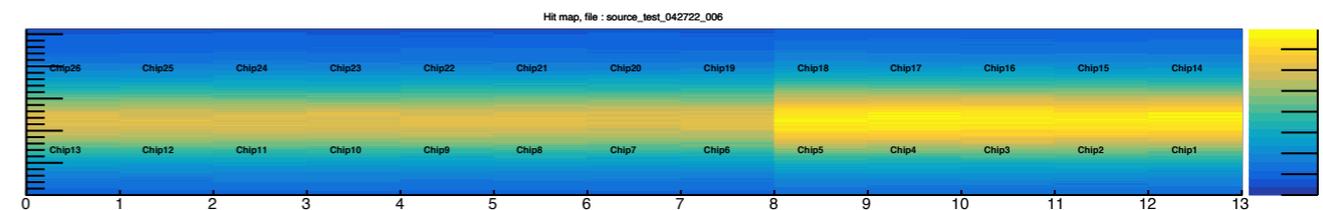
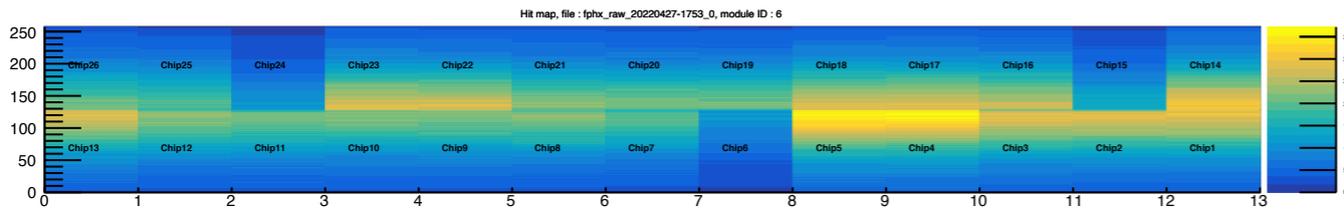
FEM



Felix

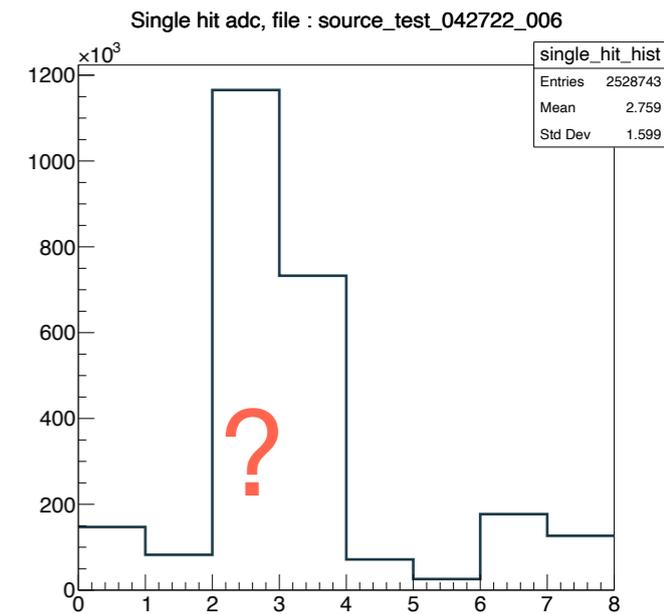
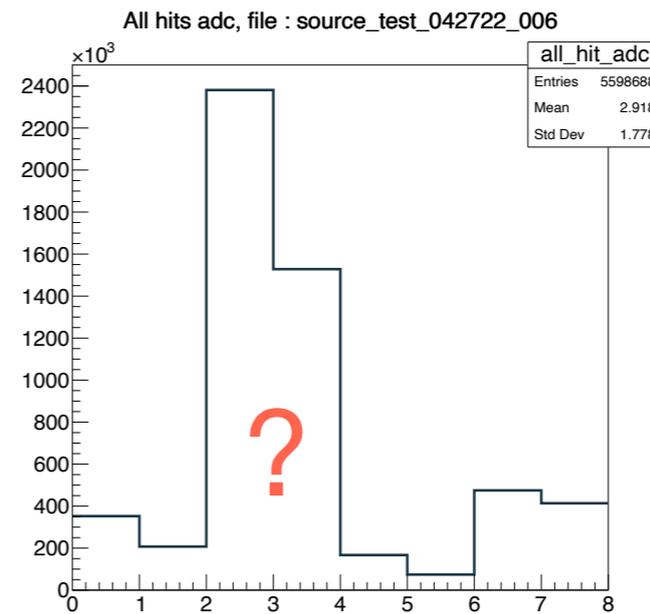
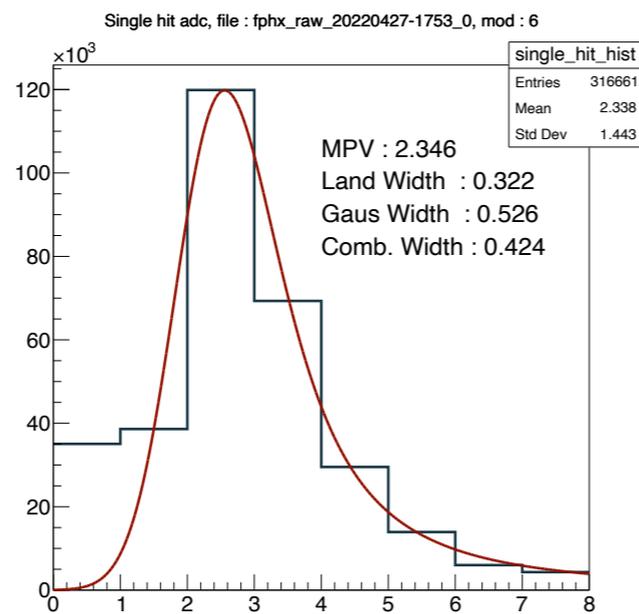
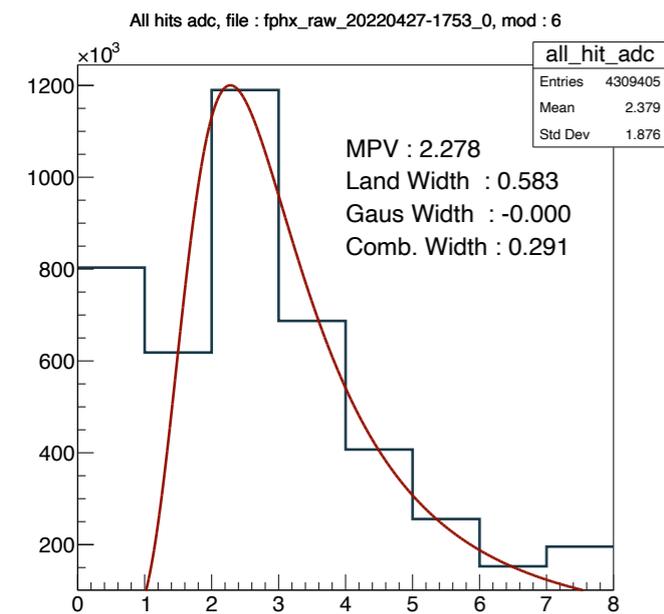
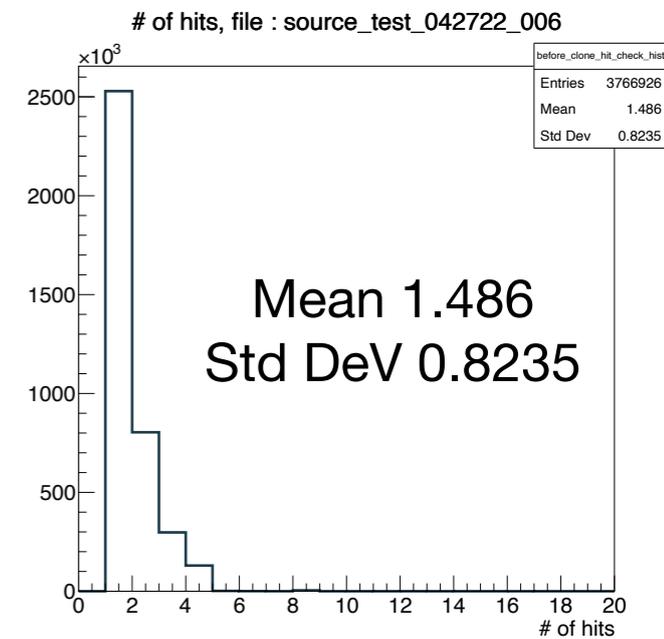
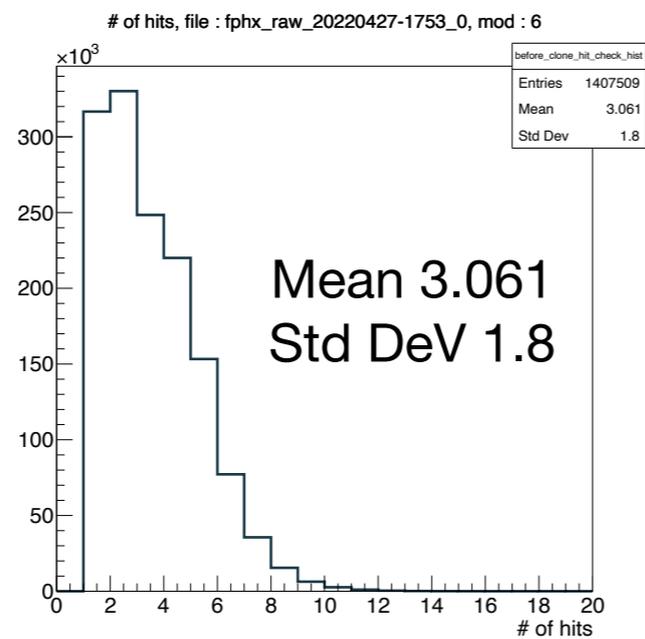


// FEM/Felix board comparison - source 3

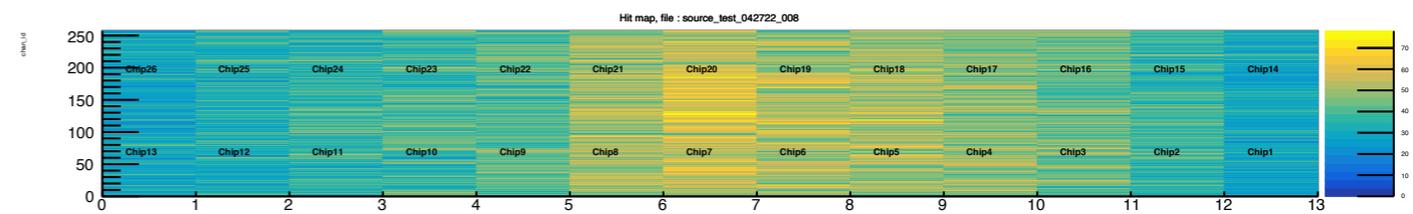
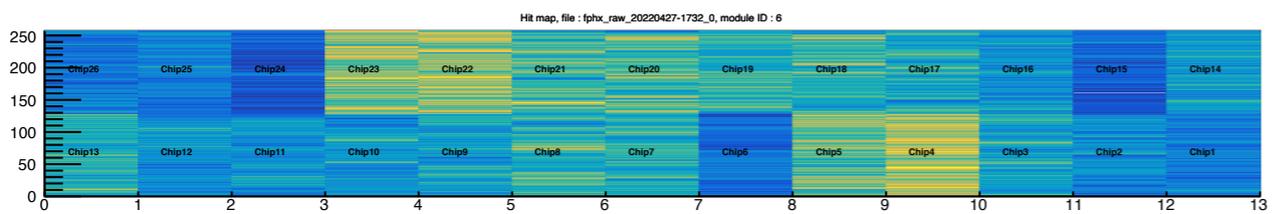


FEM

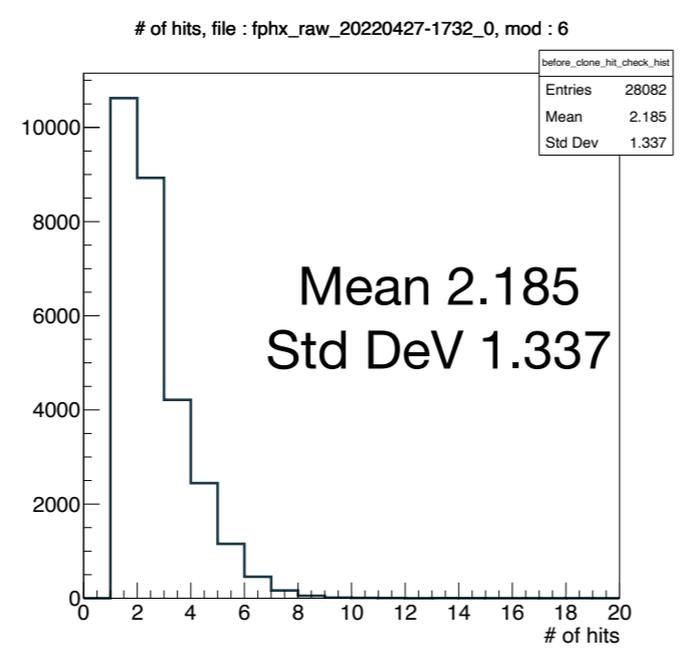
Felix



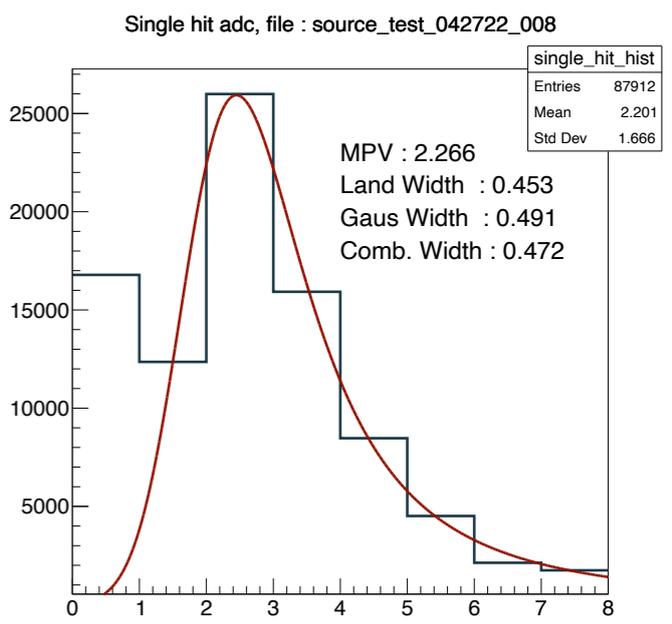
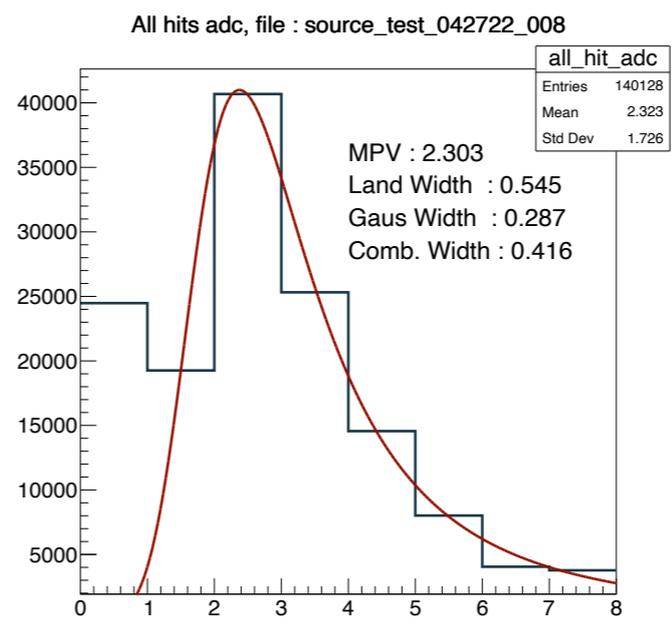
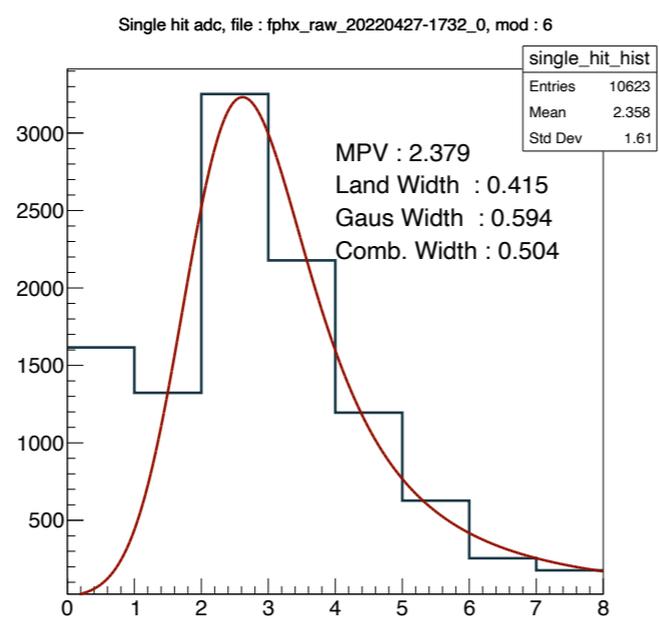
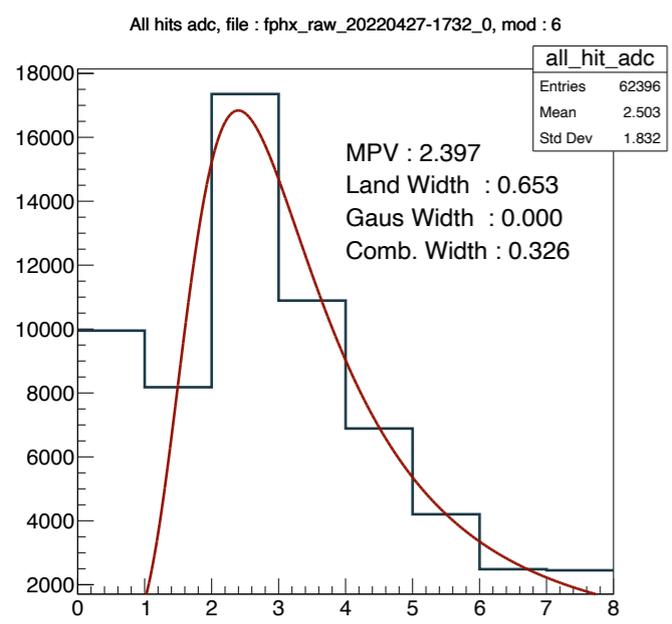
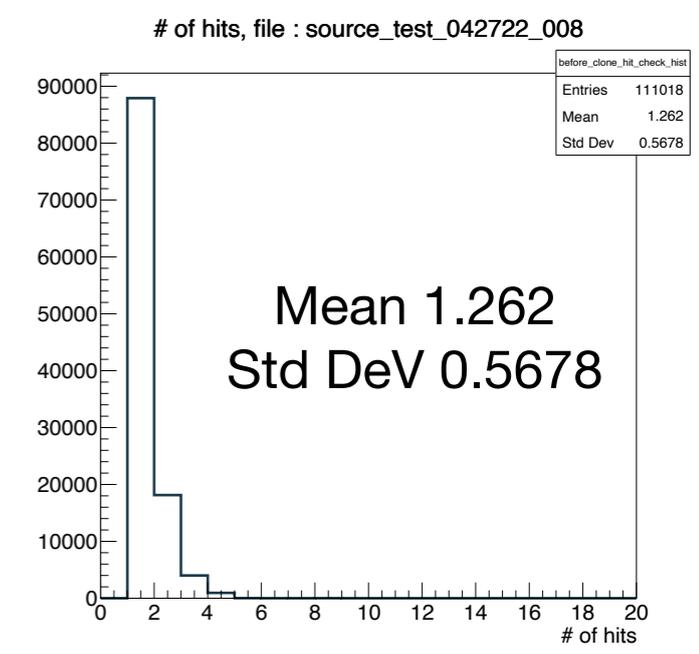
FEM/Felix board comparison - source 4



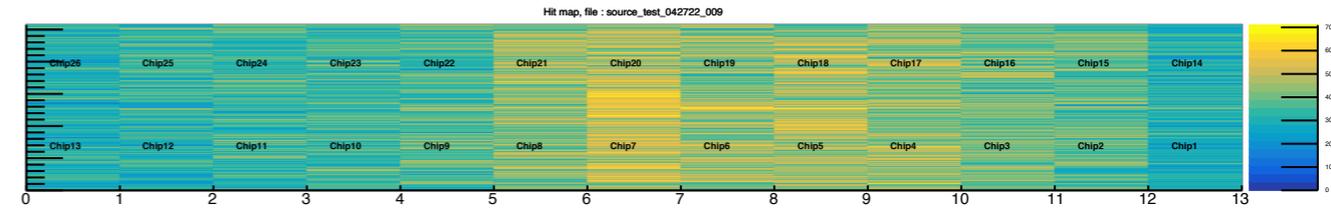
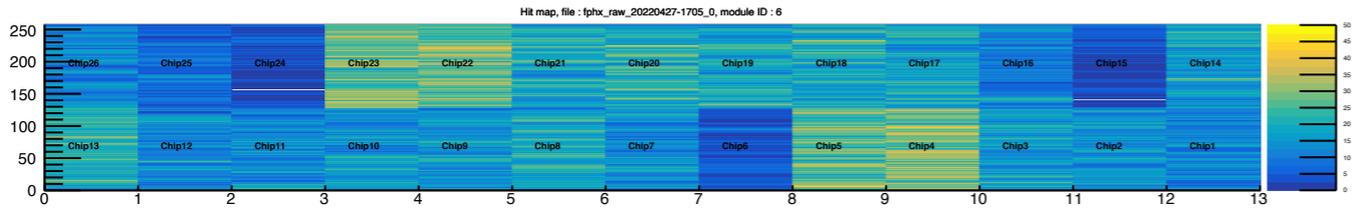
FEM



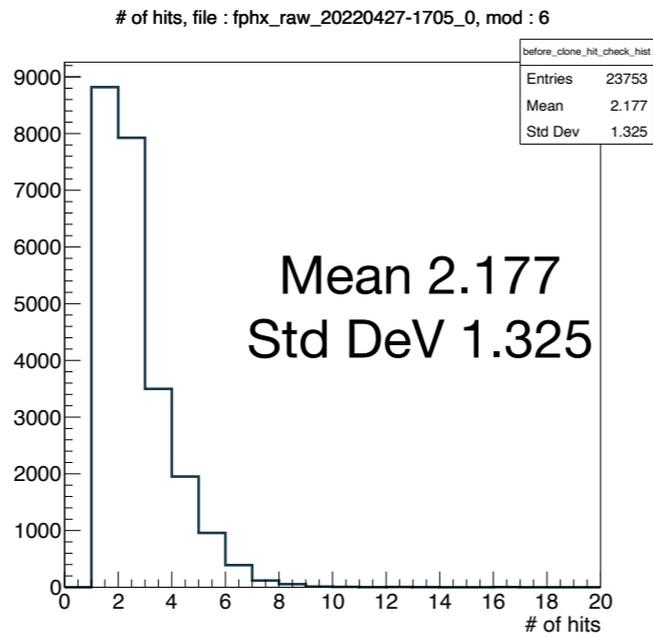
Felix



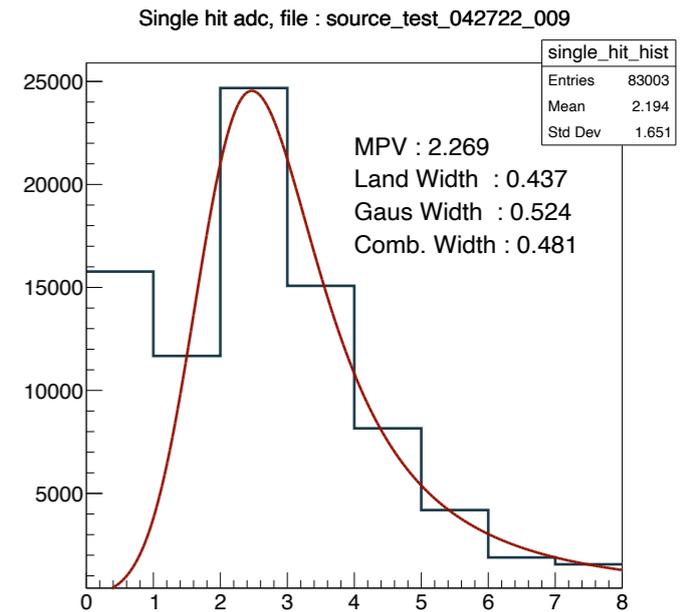
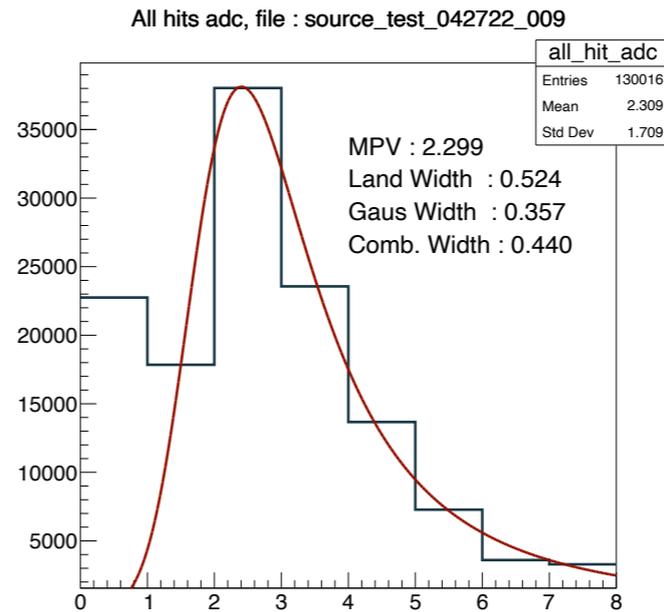
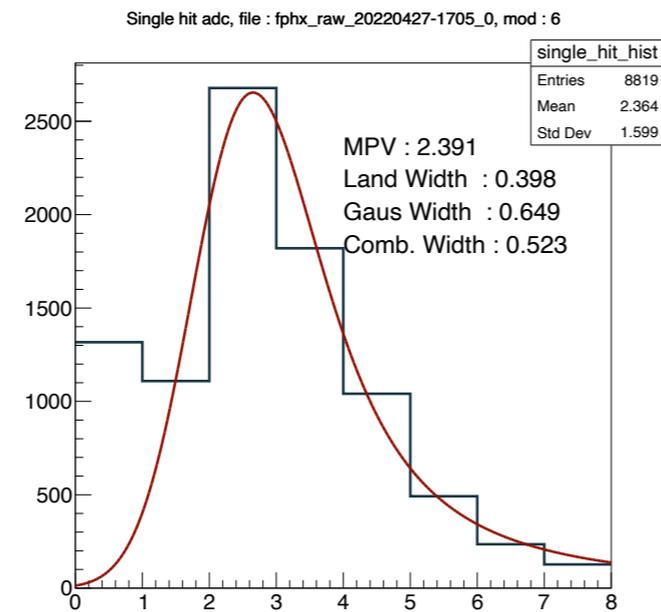
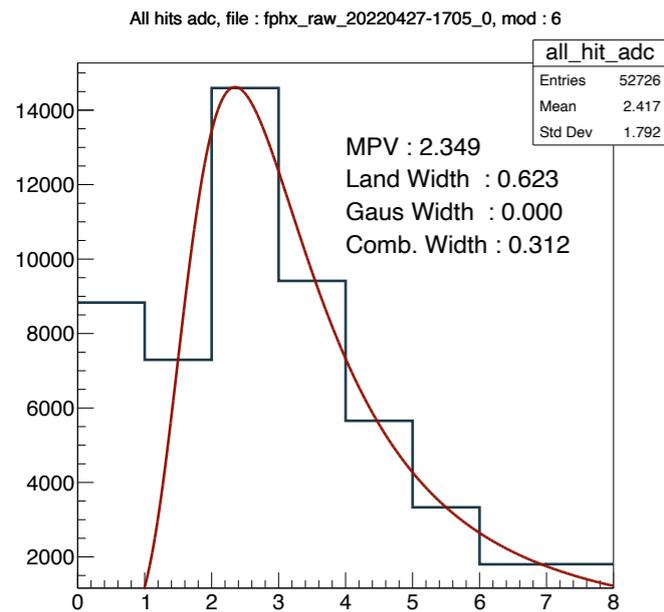
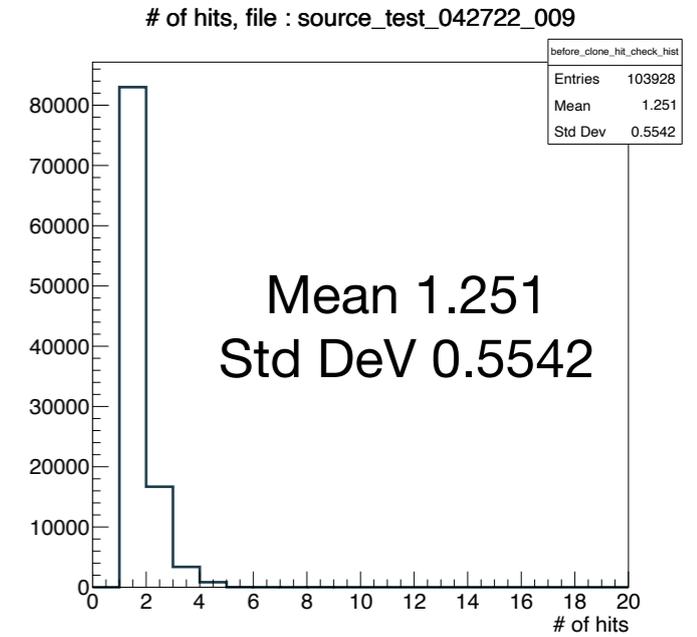
FEM/Felix board comparison - source 5



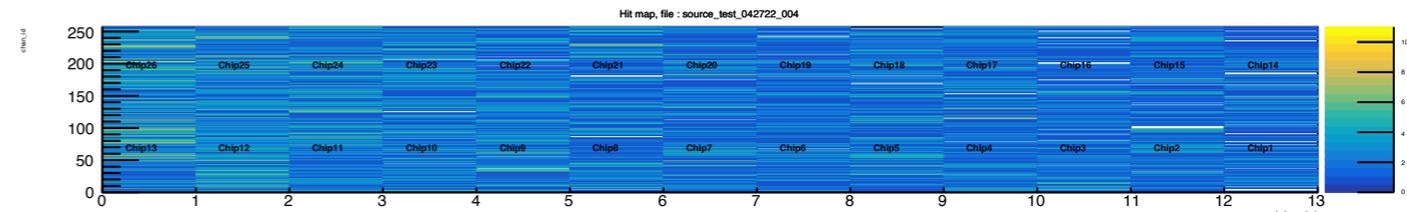
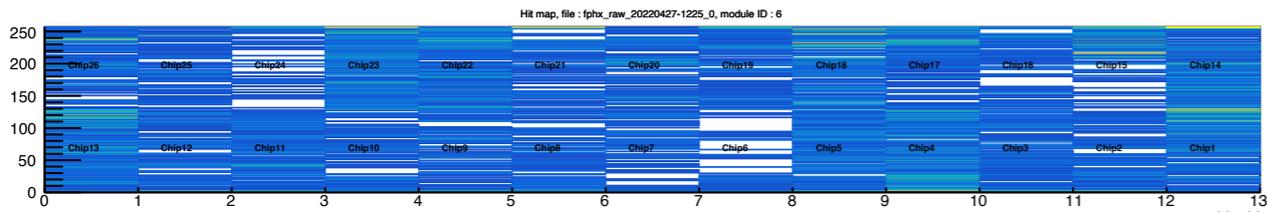
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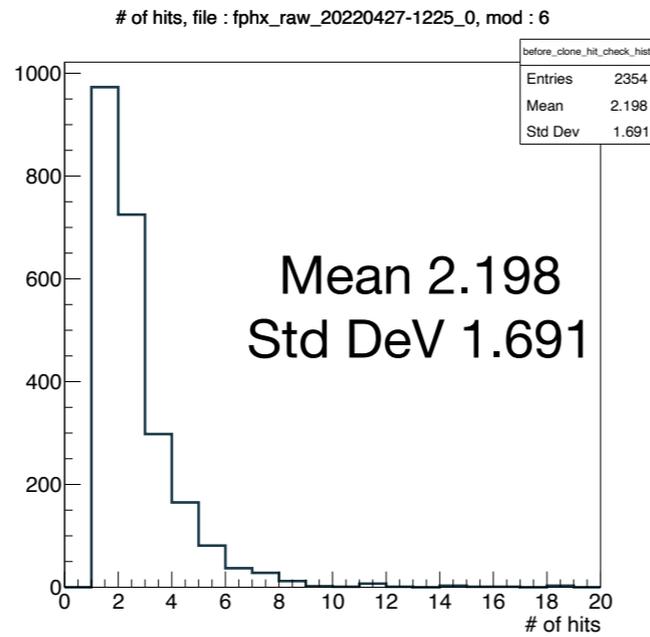
Felix



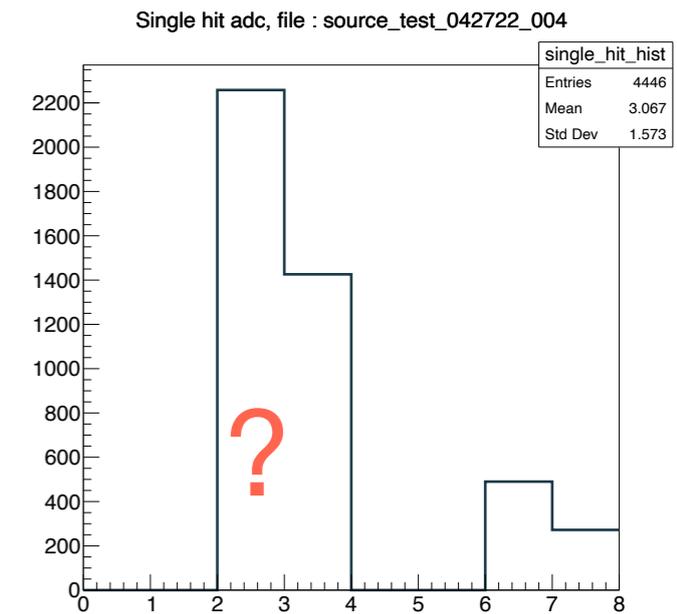
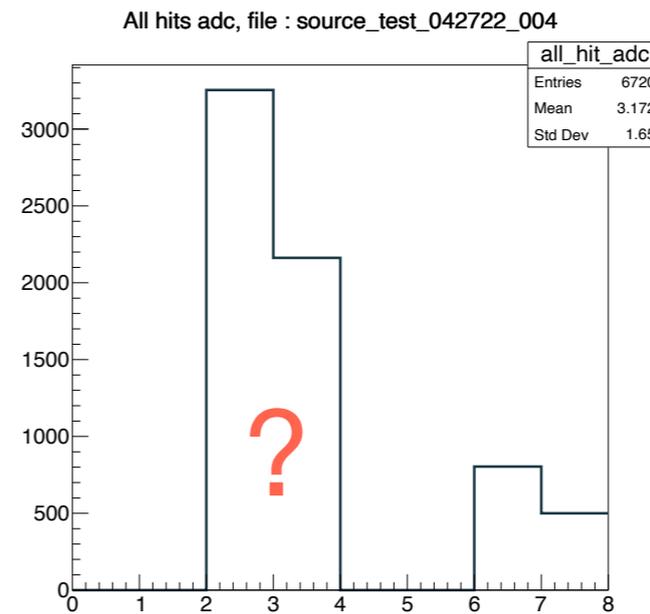
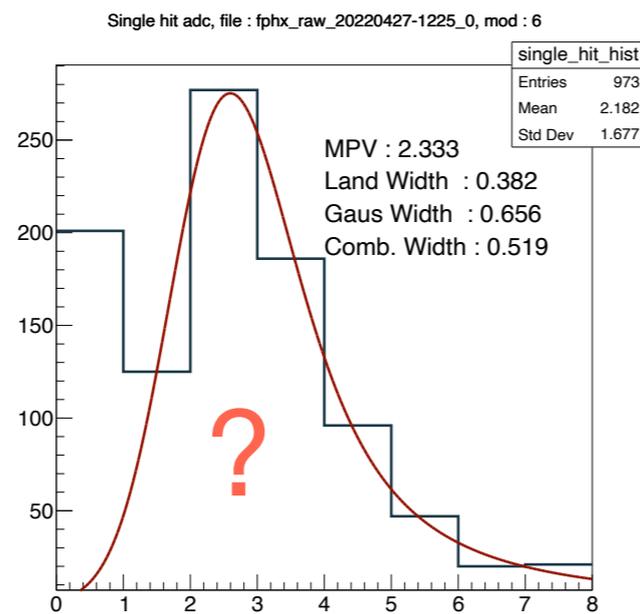
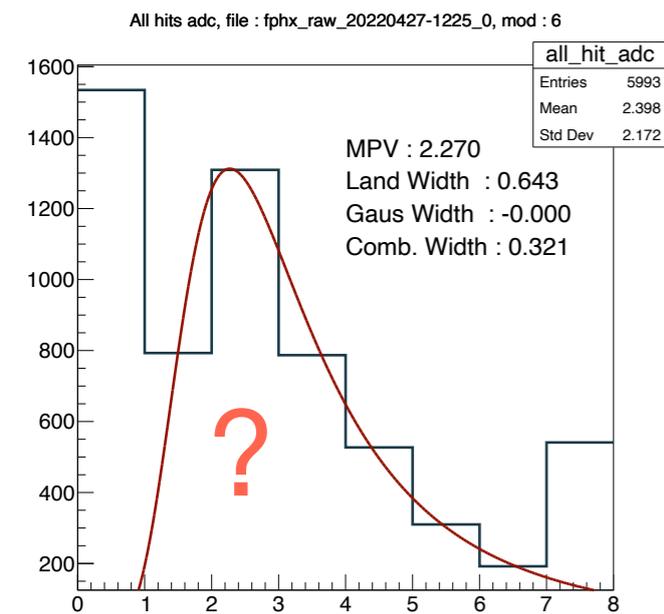
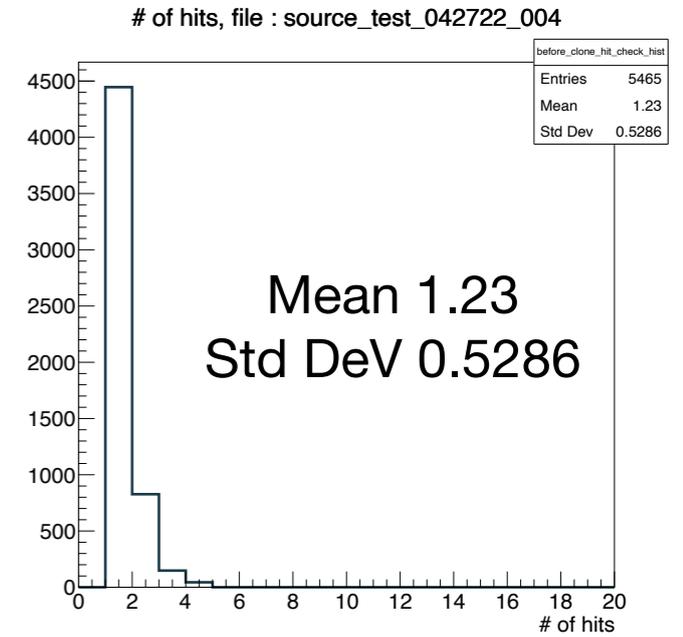
FEM/Felix board comparison - Background 1



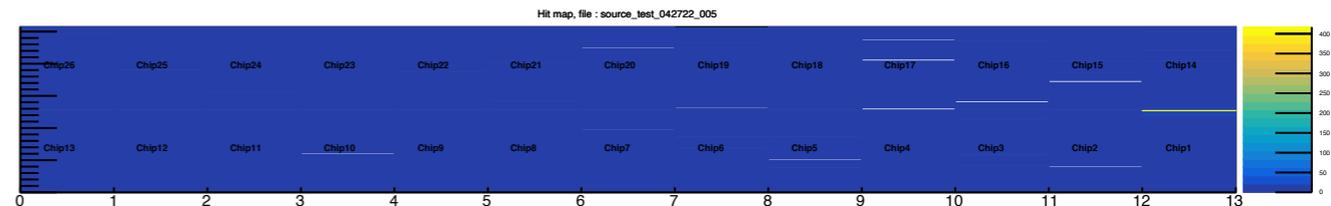
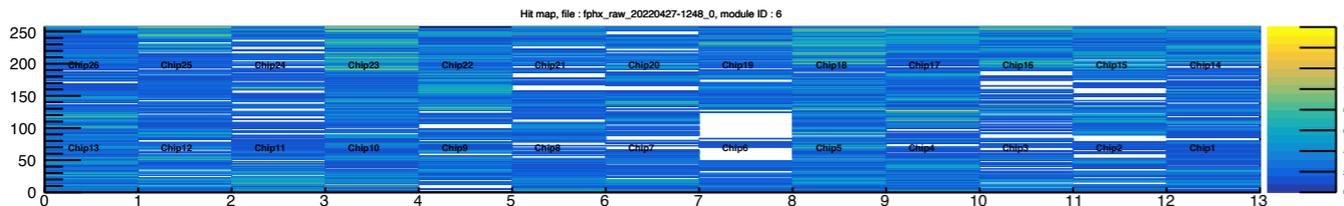
FEM



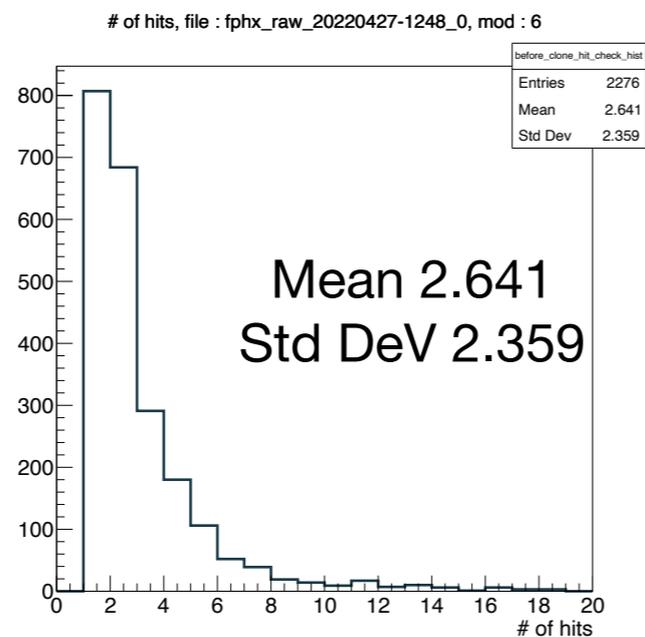
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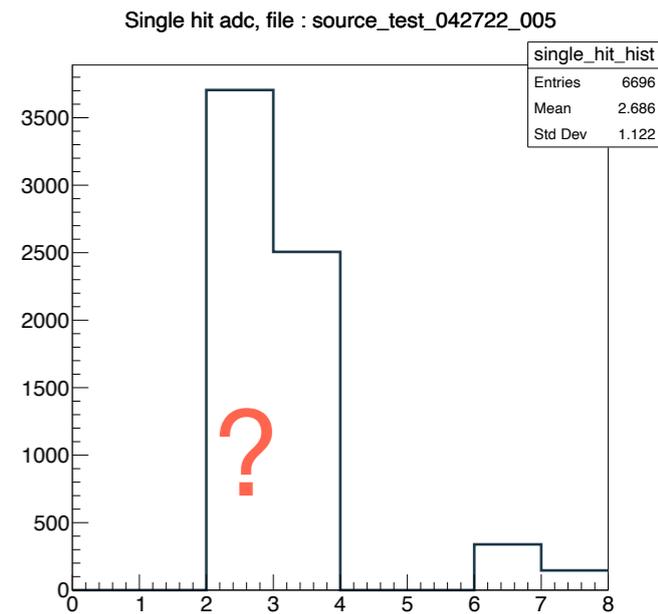
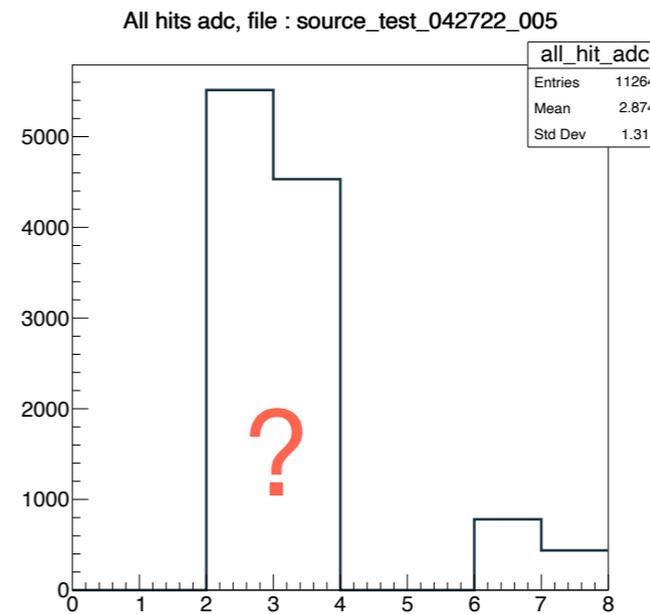
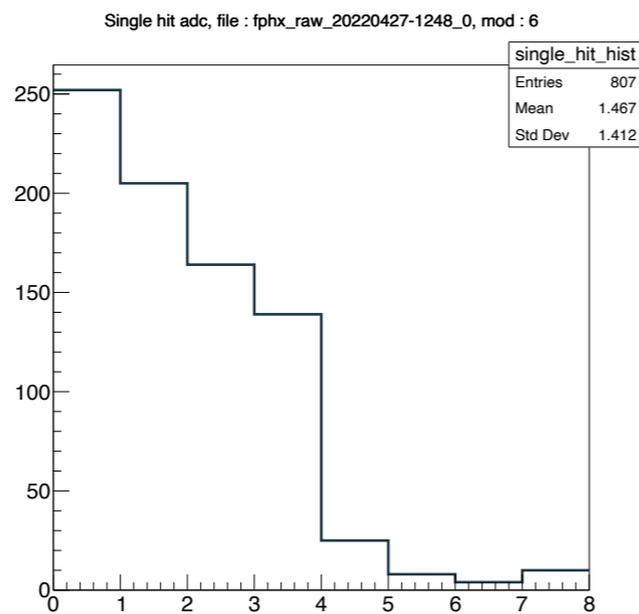
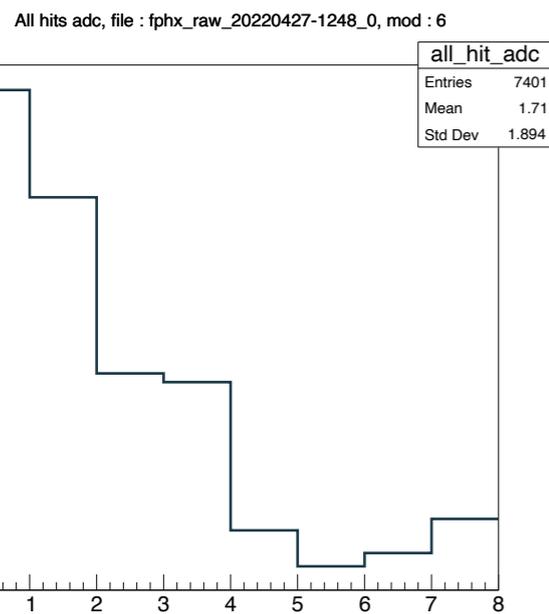
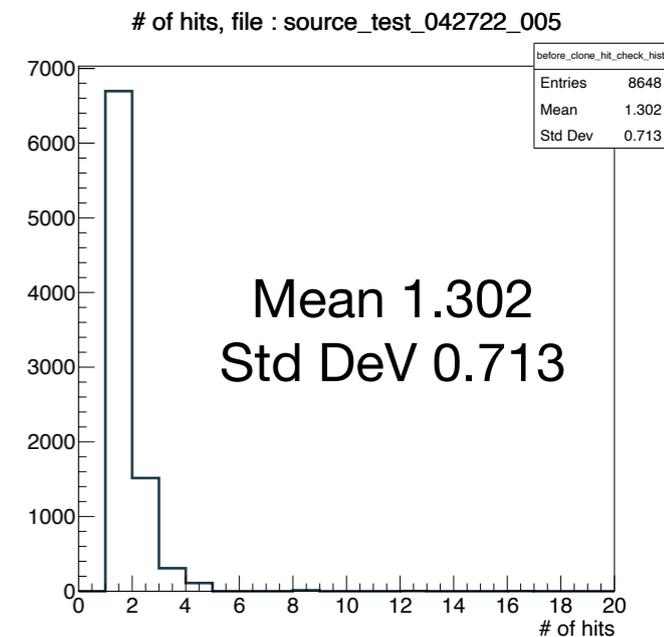
// FEM/Felix board comparison - Background 2



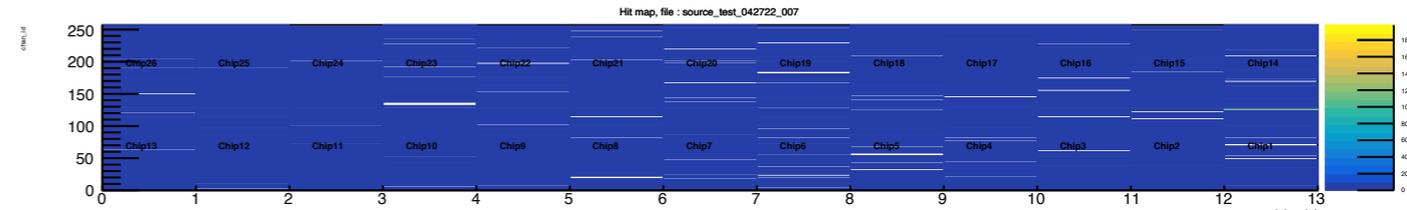
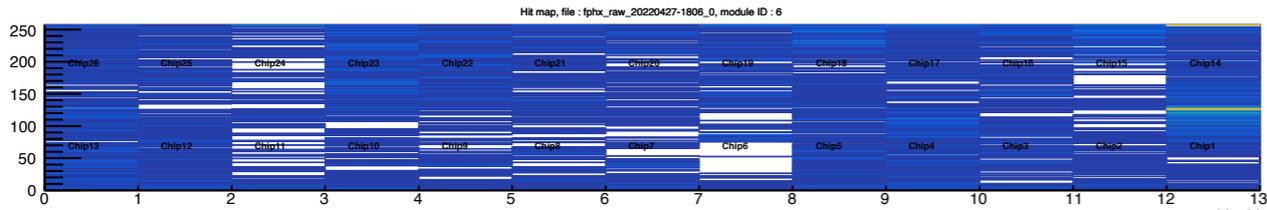
FEM



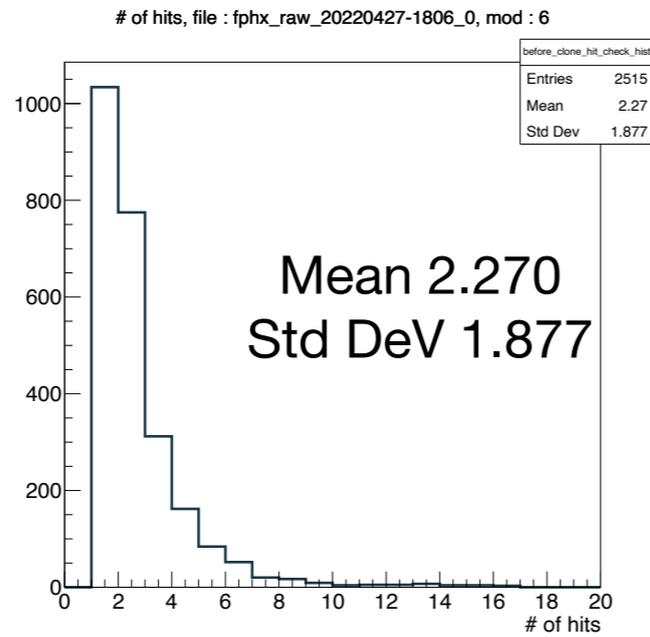
Felix



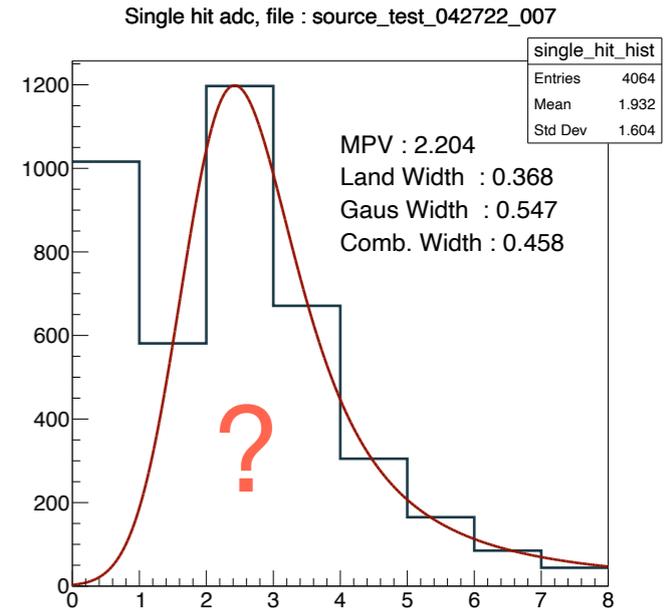
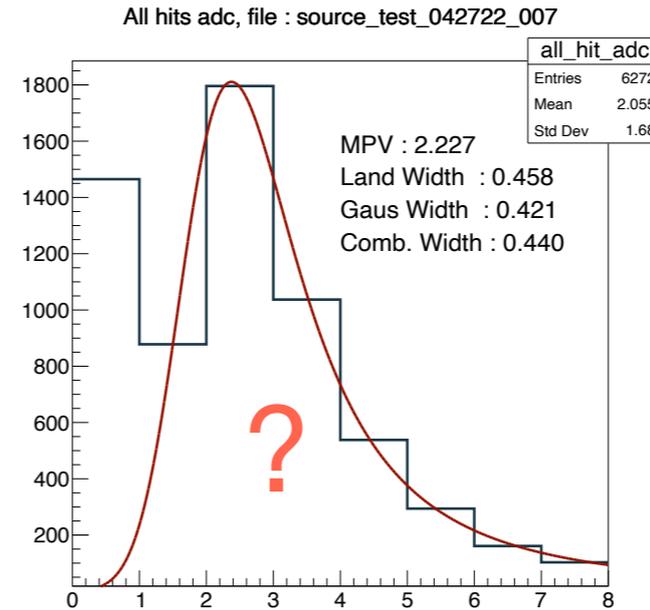
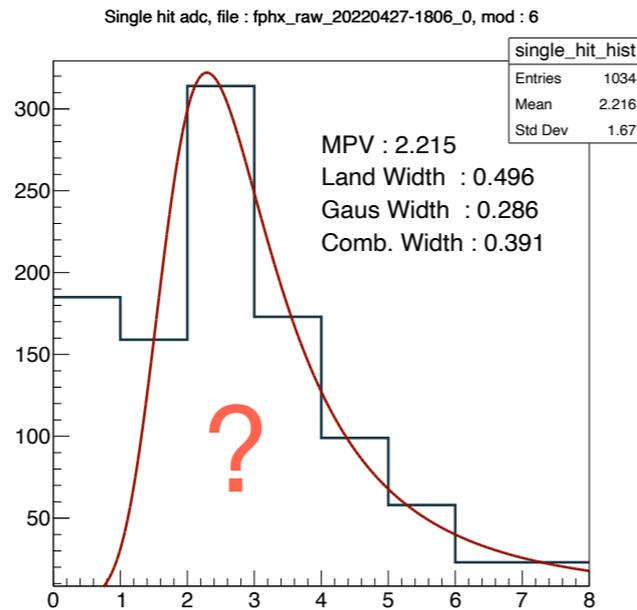
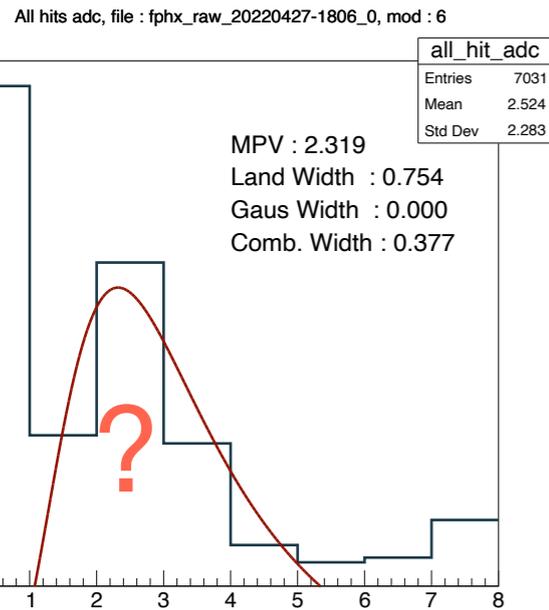
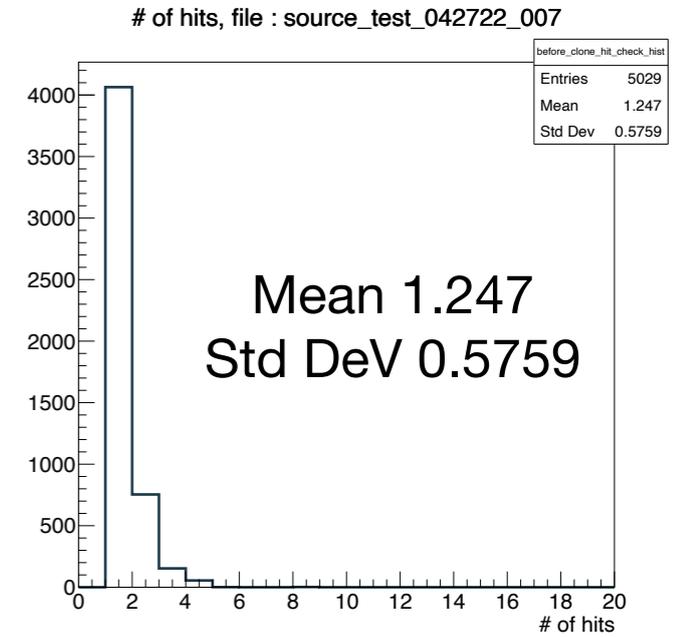
// FEM/Felix board comparison - Background 3



FEM



Felix



// FEM/Felix board comparison - # of hits (event)

FEM

Felix

Condition	FEM			Felix			FEM/Felix	FEM/Felix	
		Total hits	BCO group		Total hits	BCO group	Total hits ratio	BCO group ratio	
source 1	1747	2.17E+06	6.52E+05	002	3.38E+06	2.27E+06	64.27%	28.67%	
source 2	1740	2.56E+06	7.71E+05	003	3.41E+06	2.30E+06	75.09%	33.57%	
BG 1	1225	5.99E+03	2.35E+03	004	6.72E+03	5.47E+03	89.18%	43.07%	
BG 2	1248	7.40E+03	2.28E+03	005	1.13E+04	8.65E+03	65.70%	26.32%	
source 3	1753	4.31E+06	1.41E+06	006	5.60E+06	3.77E+06	76.97%	37.36%	
BG 3	1806	7.03E+03	2.52E+03	007	6.27E+03	5.03E+03	112.10%	50.01%	
source 4	1732	6.24E+04	2.81E+04	008	1.40E+05	1.11E+05	44.53%	25.29%	
source 5	1705	5.27E+04	2.38E+04	009	1.30E+05	1.04E+05	40.55%	22.86%	
							Average	71.05%	33.39%
							Std DeV	23.22%	9.52%

// FEM/Felix board comparison - clone hit

```

*****
* Row * event * ampl * chip_id * chan_id * module * adc * bco * bco_full * fpga_id * fem_id *
*****
* 1788 * 1788 * 0 * 13 * 1 * 5 * 0 * 54 * 822 * 0 * 0 *
* 1789 * 1789 * 0 * 13 * 1 * 5 * 4 * 54 * 822 * 0 * 0 *
* 1790 * 1790 * 0 * 0 * 4 * 5 * 0 * 54 * 822 * 0 * 0 *
* 1791 * 1791 * 0 * 25 * 109 * 5 * 7 * 54 * 822 * 0 * 0 *
* 1792 * 1792 * 0 * 1 * 0 * 5 * 2 * 54 * 822 * 0 * 8 *
* 1793 * 1793 * 0 * 14 * 1 * 6 * 6 * 54 * 822 * 0 * 8 *
* 1794 * 1794 * 0 * 15 * 1 * 6 * 0 * 54 * 822 * 0 * 8 *
* 1795 * 1795 * 0 * 15 * 1 * 6 * 2 * 54 * 822 * 0 * 8 *
* 1796 * 1796 * 0 * 15 * 1 * 6 * 4 * 54 * 822 * 0 * 8 *
* 1797 * 1797 * 0 * 23 * 97 * 6 * 2 * 54 * 822 * 0 * 8 *
* 1798 * 1798 * 0 * 23 * 54 * 6 * 2 * 54 * 822 * 0 * 8 *
* 1799 * 1799 * 0 * 25 * 56 * 6 * 2 * 54 * 822 * 0 * 8 *
* 1800 * 1800 * 0 * 1 * 0 * 5 * 2 * 54 * 822 * 0 * 8 *

```

Clone event +=1

FEM



Felix

* Clone hit ratio = clone hit event / BCO group

Condition		Total hits	BCO group	clone hit event	clone hit ratio		Total hits	BCO group	clone hit event	clone hit ratio
source 1	1747	2.17E+06	6.52E+05	15	0.0023%	002	3.38E+06	2.27E+06	77	0.0034%
source 2	1740	2.56E+06	7.71E+05	11	0.0014%	003	3.41E+06	2.30E+06	138	0.0060%
BG 1	1225	5.99E+03	2.35E+03	13	0.5523%	004	6.72E+03	5.47E+03	0	0.0000%
BG 2	1248	7.40E+03	2.28E+03	12	0.5272%	005	1.13E+04	8.65E+03	0	0.0000%
source 3	1753	4.31E+06	1.41E+06	34	0.0024%	006	5.60E+06	3.77E+06	190	0.0050%
BG 3	1806	7.03E+03	2.52E+03	13	0.5169%	007	6.27E+03	5.03E+03	0	0.0000%
source 4	1732	6.24E+04	2.81E+04	11	0.0392%	008	1.40E+05	1.11E+05	1	0.0009%
source 5	1705	5.27E+04	2.38E+04	13	0.0547%	009	1.30E+05	1.04E+05	0	0.0000%

// FEM/Felix board comparison - event size

FEM

Felix

Condition	FEM			Felix			FEM/Felix	FEM/Felix	
		Mean	Std DeV		Mean	Std DeV	Mean ratio	Std DeV ratio	
source 1	1747	3.335	1.790	002	1.488	0.822	2.24	2.18	
source 2	1740	3.319	1.740	003	1.484	0.820	2.24	2.12	
BG 1	1225	2.198	1.691	004	1.230	0.529	1.79	3.20	
BG 2	1248	2.641	2.359	005	1.302	0.713	2.03	3.31	
source 3	1753	3.061	1.800	006	1.486	0.824	2.06	2.19	
BG 3	1806	2.270	1.877	007	1.247	0.576	1.82	3.26	
source 4	1732	2.185	1.337	008	1.262	0.568	1.73	2.35	
source 5	1705	2.177	1.325	009	1.251	0.554	1.74	2.39	
							Average	1.96	2.62
							Std DeV	0.21	0.53

// INTT sensor, full depletion voltage

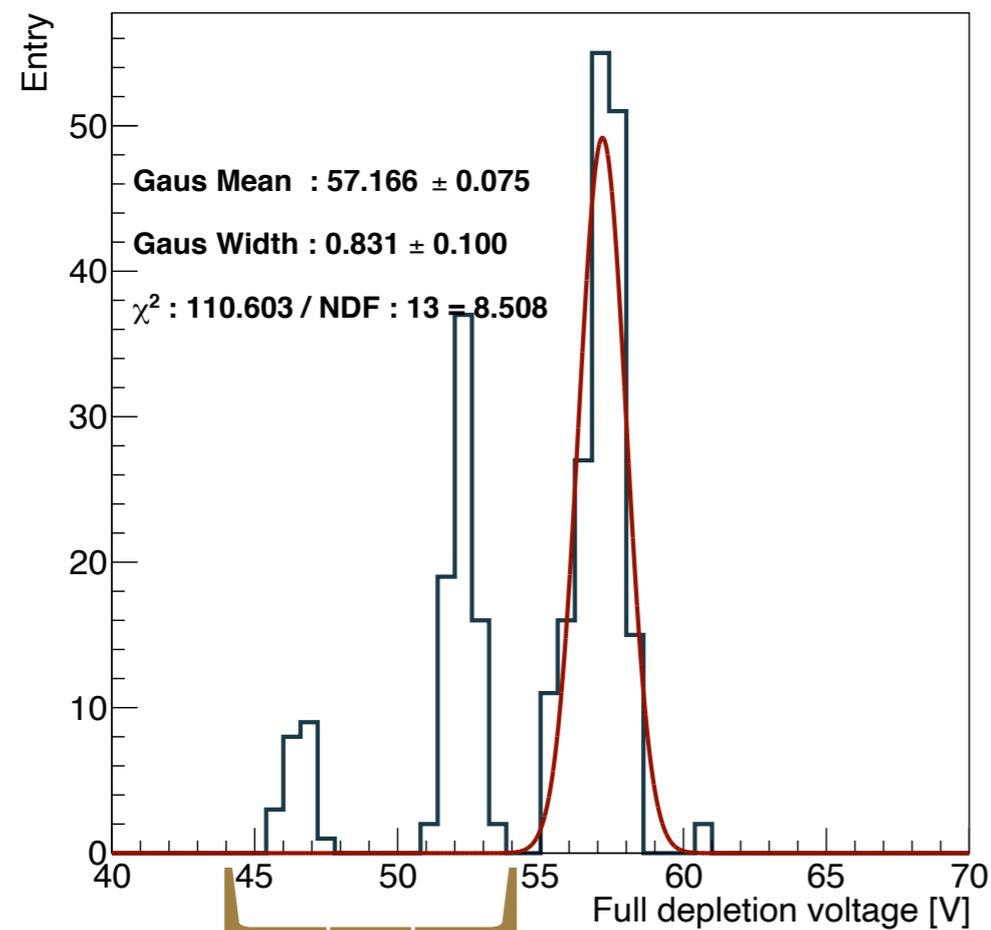
274 sets of sensors are included,

file title : 190528_S...datasheet (149 sets) + 211130_S...datasheet (25 sets) + 200519_S...datasheet (100 sets)

sensor ID (A & B) : 1011 ~ 1159 + 1161 ~ 1185

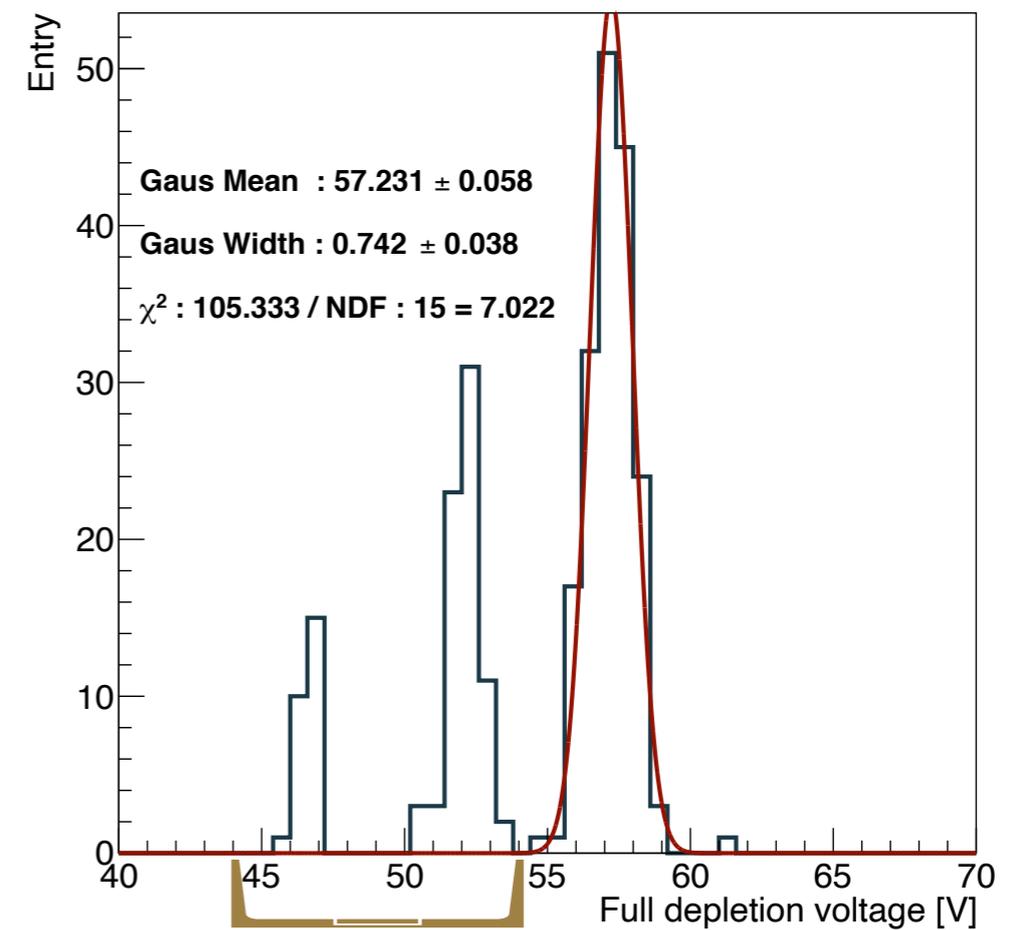
1231 ~ 1330 (A) & 1223 ~ 1322 (B)

Type-A, full depletion voltage



200519_S...datasheet

Type-B, full depletion voltage



200519_S...datasheet

INTT sensor, leakage current

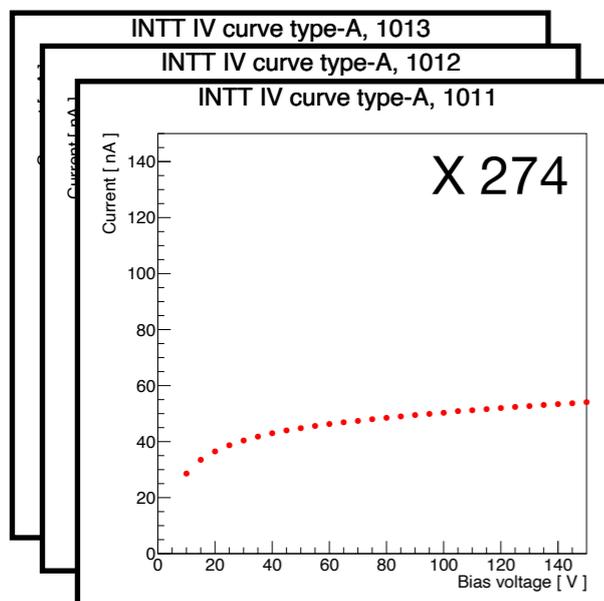
274 sets of sensors are included,

file title : 190528_S...datasheet (149 sets) + 211130_S...datasheet (25 sets) + 200519_S...datasheet (100 sets)

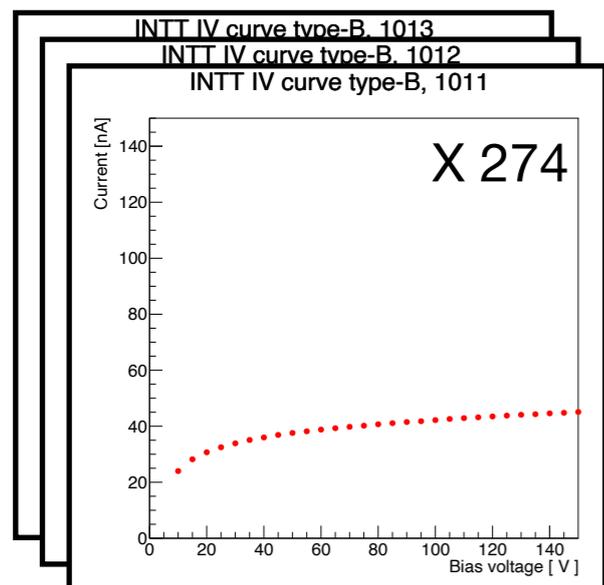
sensor ID (A & B) : 1011 ~ 1159 + 1161 ~ 1185

1231 ~ 1330 (A) & 1223 ~ 1322 (B)

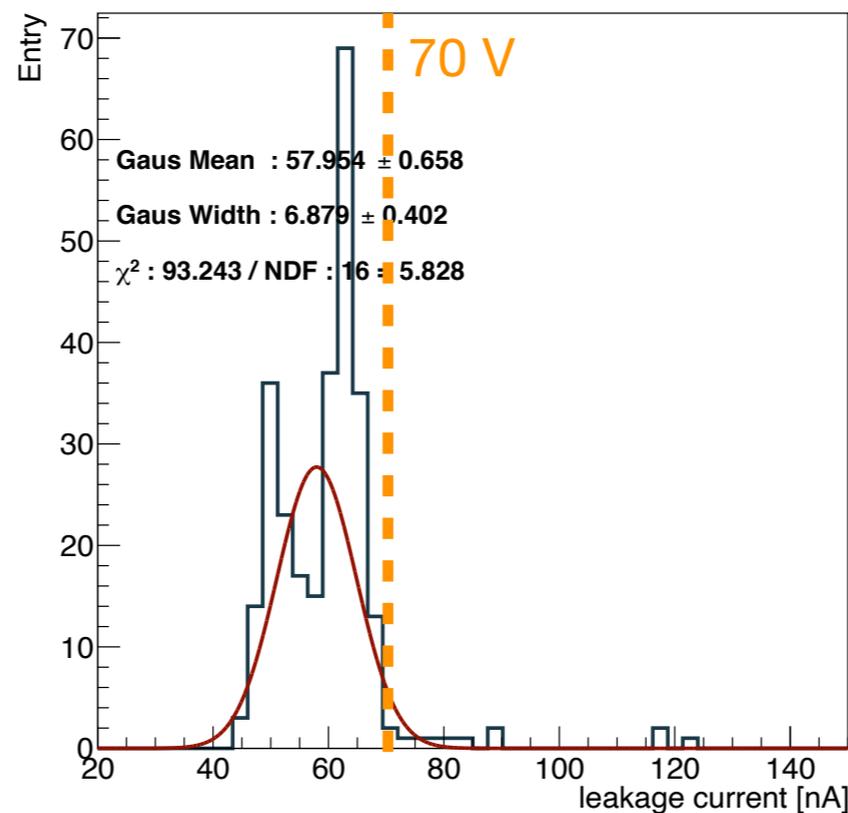
Type A



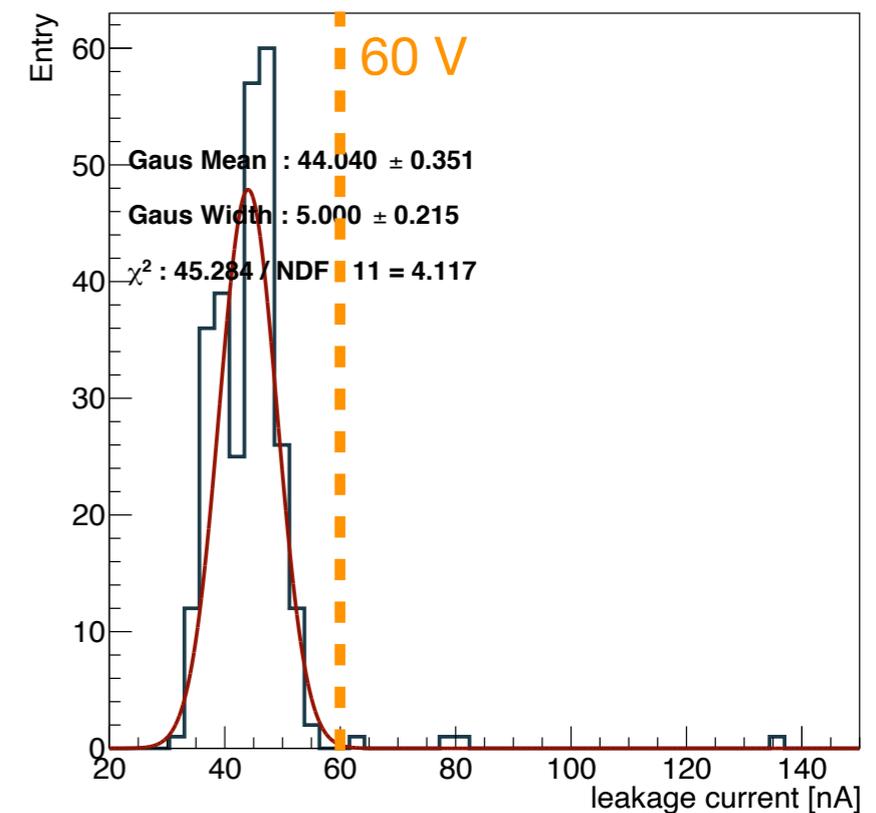
Type B



Type-A, leakage current at 100 V



Type-B, leakage current at 100 V



// INTT sensor, leakage current

274 sets of sensors are included,

file title : 190528_S...datasheet (149 sets) + 211130_S...datasheet (25 sets) + 200519_S...datasheet (100 sets)

sensor ID (A & B) : 1011 ~ 1159 + 1161 ~ 1185

1231 ~ 1330 (A) & 1223 ~ 1322 (B)

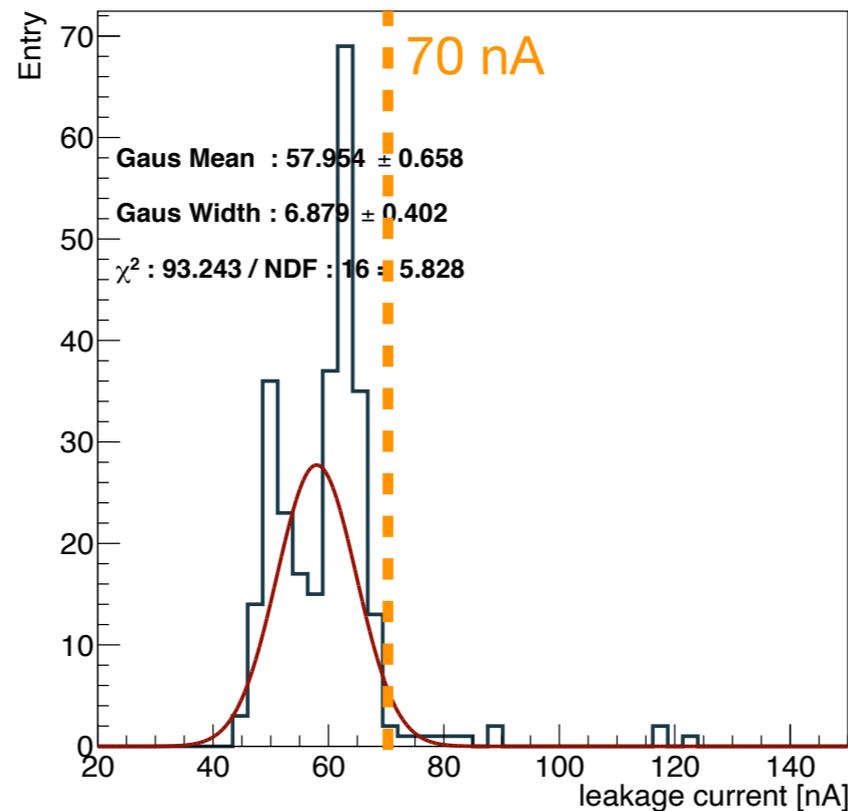
HC : High Current (current > cut)

“<—“ : current > 80 nA

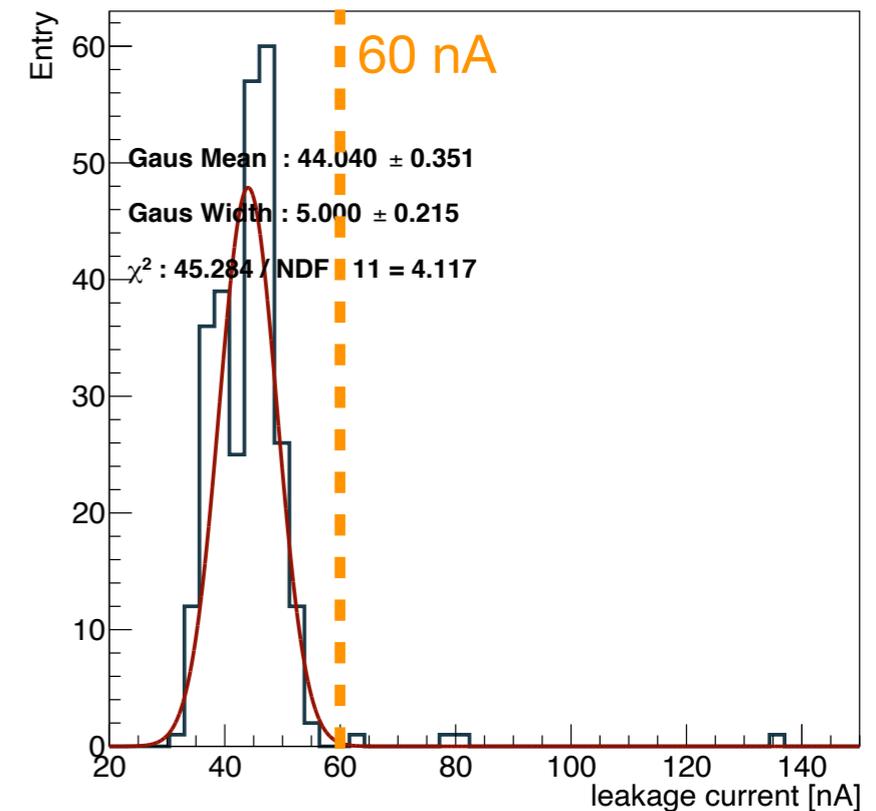
type A, HC : 118.2,	ID : 1047	<---
type A, HC : 79.5,	ID : 1048	
type A, HC : 116.4,	ID : 1116	<---
type A, HC : 88.8,	ID : 1117	<---
type A, HC : 121.5,	ID : 1118	<---
type A, HC : 80.1,	ID : 1119	<---
type A, HC : 70.5,	ID : 1127	
type A, HC : 89.9,	ID : 1244	<---
type A, HC : 73.7,	ID : 1257	
type A, HC : 75.2,	ID : 1279	
type A, HC : 84.3,	ID : 1291	<---
type A, HC : 70.8,	ID : 1301	

type B, HC : 79.2,	ID : 1045	
type B, HC : 136.4,	ID : 1118	<---
type B, HC : 62.4,	ID : 1119	
type B, HC : 81.2,	ID : 1120	<---

Type-A, leakage current at 100 V



Type-B, leakage current at 100 V



// Summary

- The results of detection efficiency is updated, the efficiency can be up to $\sim 99.8\%$. The improvements of the layer 2 are around 1%.
- The efficiency of Testbeam2019 data is checked. Result seems to be consistent with Ayaka's.
- In the cosmic test, the MPV difference between 1 hit and 2 hits distributions is $(93.825-80.918)*4+210 = 261.628$
- The performances of FEM and Felix seem to be inconsistent, requires more investigations.
- The leakage current of all INTT sensors are checked. The leakage current of some sensors are a little bit higher.

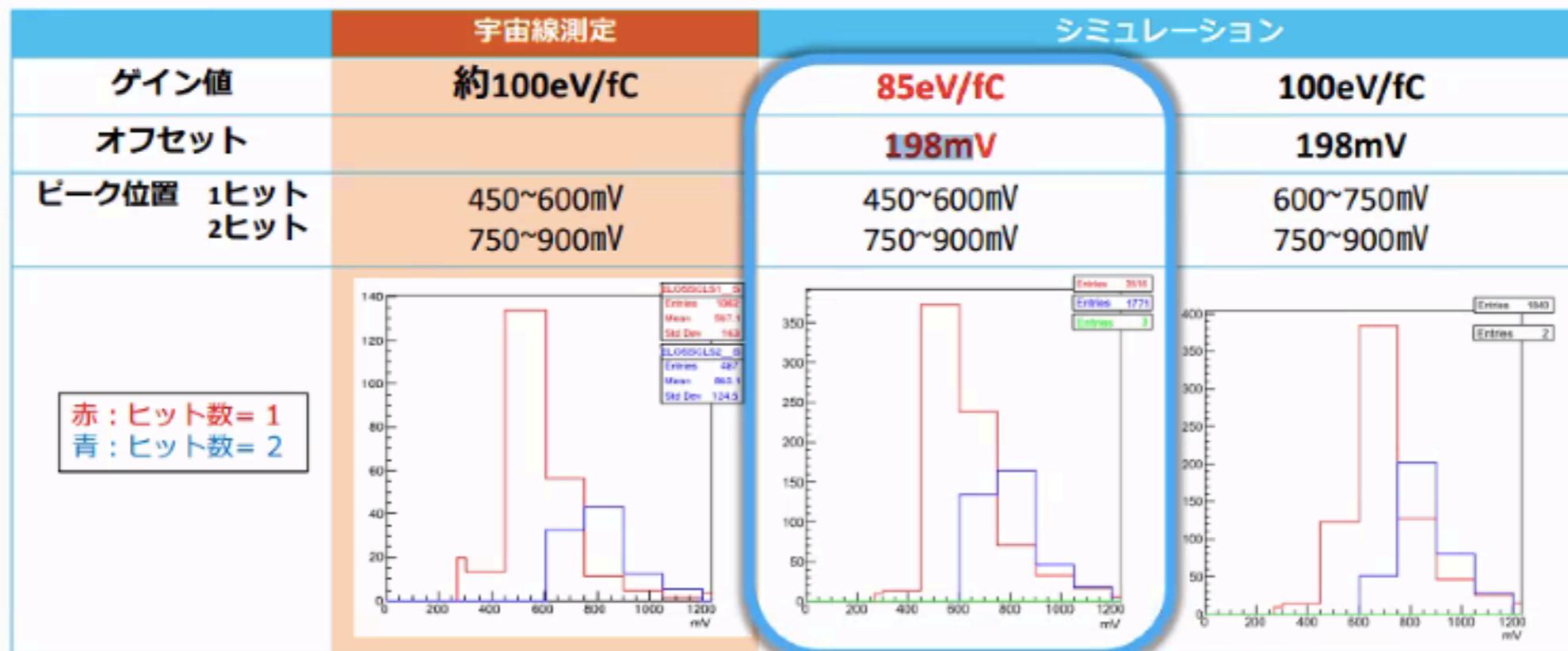
Back up

// Offset determination

宇宙線測定とシミュレーションの比較

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表：ゲイン値の対応と測定エネルギー損失分布



・ゲイン値85eV/fC、オフセット198mVの時、もっとも宇宙線のデータに近い
本研究で測定した粒子は宇宙線であり、宇宙線のエネルギー損失分布のピークを確認できた。

2/21/2020

2019年度卒業研究発表会 柴田実香

The experiment of NWU concludes the offset value is 200 mV

// Ayaka's analysis code

effana.cpp

```
TBranch *b_nhits, *b_bco, *b_station, *b_chip, *b_chan, *b_adc, *b_fem_id;

tree->SetMakeClass(1);
tree->SetBranchAddress("nhits", &nhits, &b_nhits);
tree->SetBranchAddress("bco", bco, &b_bco);  Not use
tree->SetBranchAddress("station", station, &b_station);  Not use
tree->SetBranchAddress("chip", chip, &b_chip);
tree->SetBranchAddress("channel", chan, &b_chan);
tree->SetBranchAddress("adc_value", adc, &b_adc);
tree->SetBranchAddress("fem_id", fem_id, &b_fem_id);
```

// Raw number - FEM

	Total hits	BCO	clone hit event	clone hit ratio
1705	52726	23753	13	0.0547%
1732	62396	28082	11	0.0392%
1806	7031	2515	13	0.5169%
1753	4309405	1407509	34	0.0024%
1248	7401	2276	12	0.5272%
1225	5993	2354	13	0.5523%
1740	2559119	770831	11	0.0014%
1747	2174528	651781	15	0.0023%

// Raw number - Felix

	Total hits	BCO group	clone hit event	clone hit ratio
009	130016	103928	0	0.0000%
008	140128	111018	1	0.0009%
007	6272	5029	0	0.0000%
006	5598688	3766926	190	0.0050%
005	11264	8648	0	0.0000%
004	6720	5465	0	0.0000%
003	3408160	2295909	138	0.0060%
002	3383232	2273725	77	0.0034%