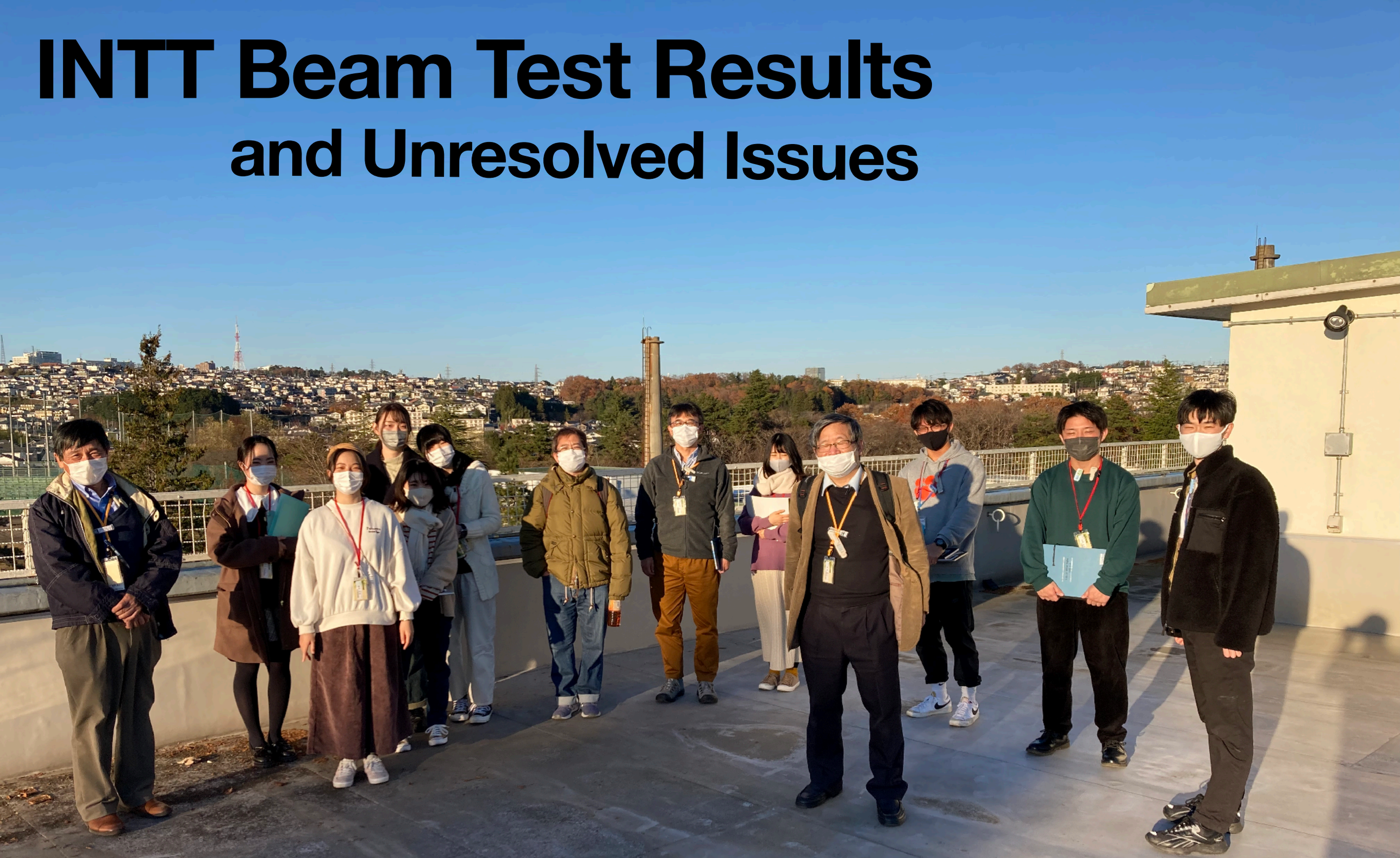
INTT Beam Test Results
and Unresolved Issues



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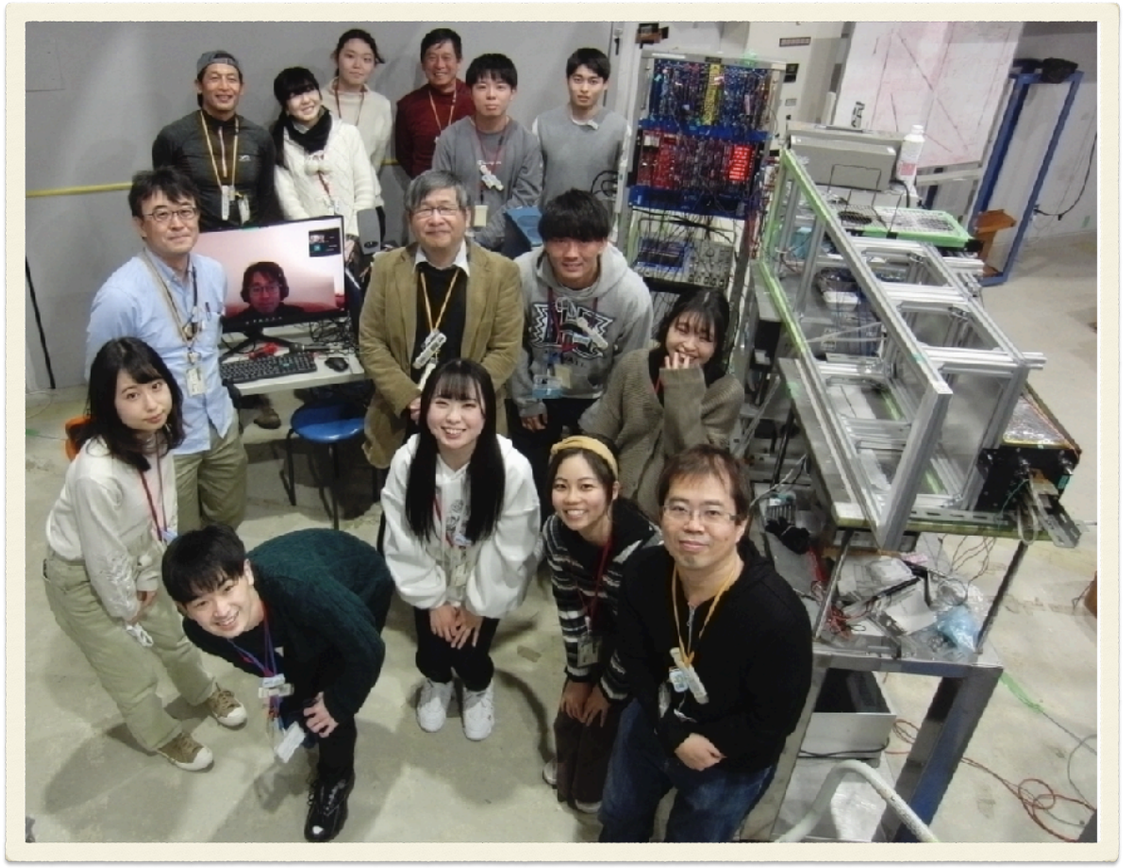
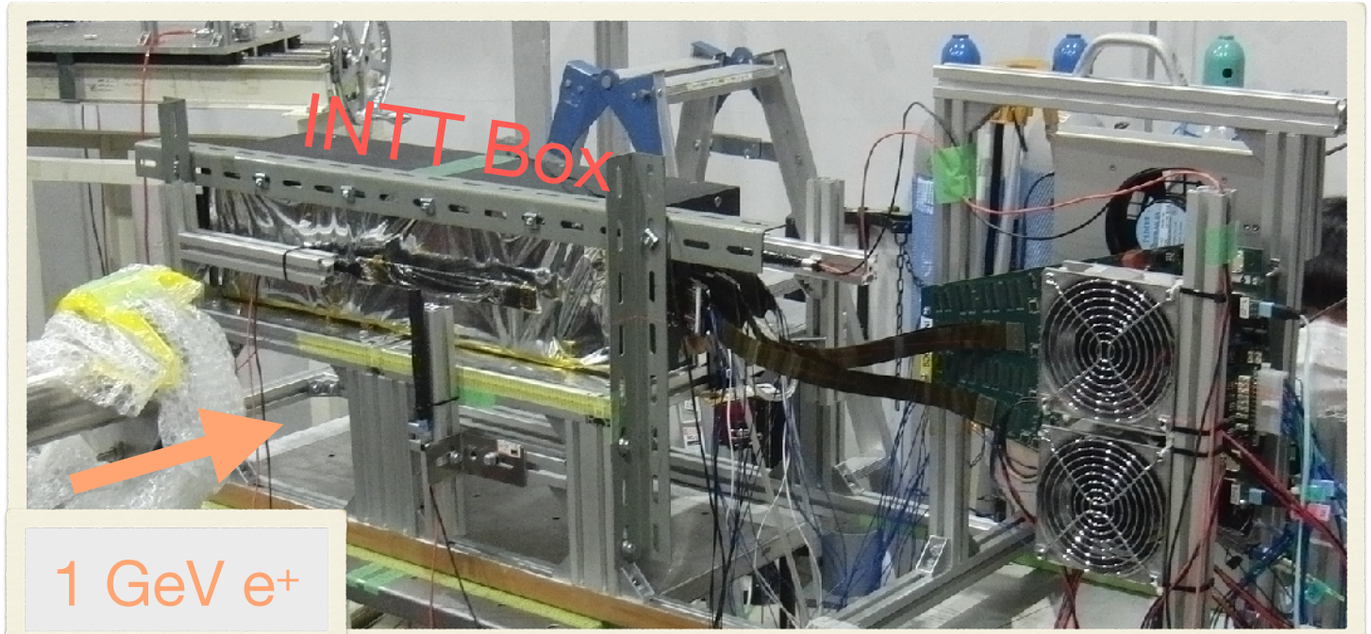
INTT collaboration meeting
Aug 16 & 17, 2022

Itaru

INTT Beam Test 2021

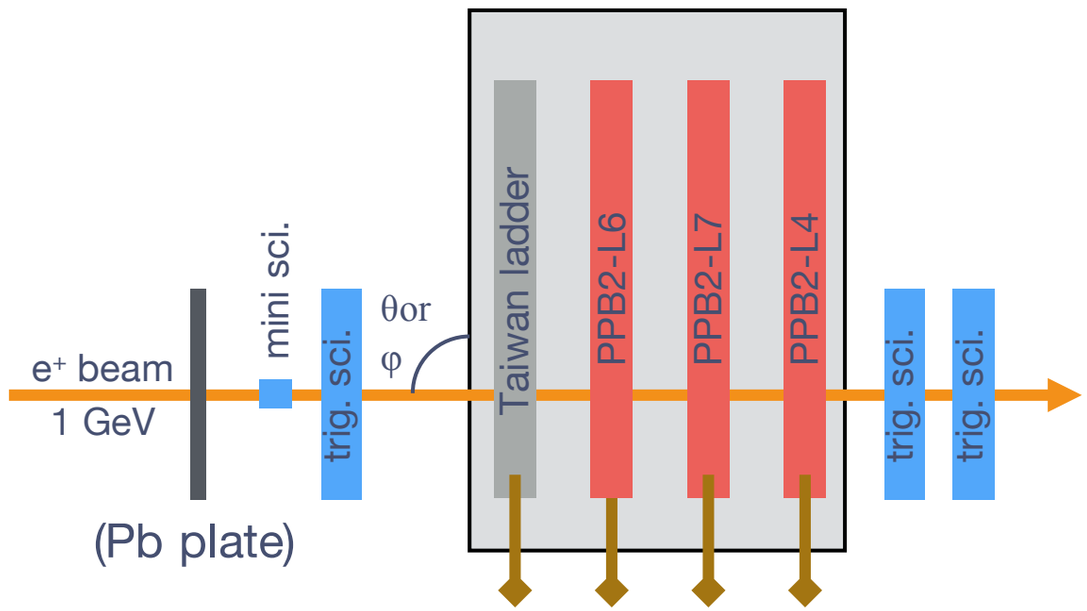
A new testbeam experiment was performed at the end of 2021, ELPH, Japan.





Mian goals :

1. measure the detection efficiency again.
2. answer the question why the efficiency can be only up to 96% in testbeam 2019 ?



The basic setup

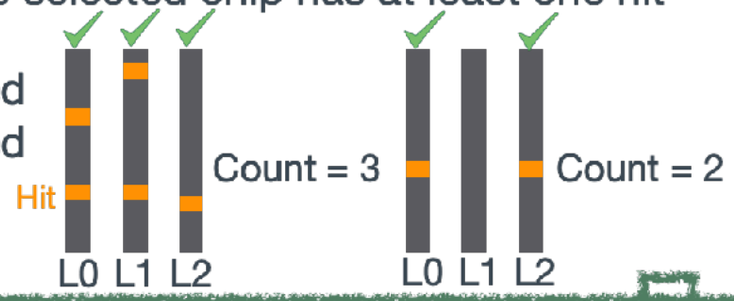
Tracking algorithm

1. In one event, only the best track is studied.
2. Particle tracks are assumed to be straight lines.
   → Low radiation length of INTT ladder.
   → Zero Magnet environment.
3. Event-profile.

Categorization

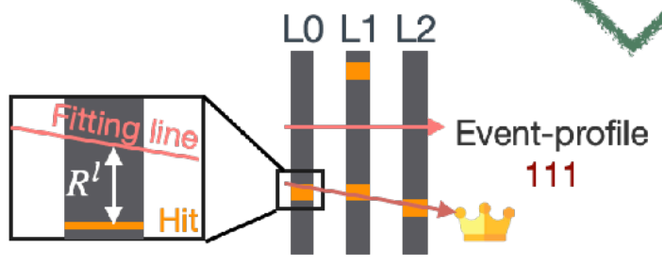
Count the number of the layers whose selected chip has at least one hit

- If count = 3 → algorithm-1 is applied
- If count = 2 → algorithm-2 is applied
- If count = 1 or 0 → skip



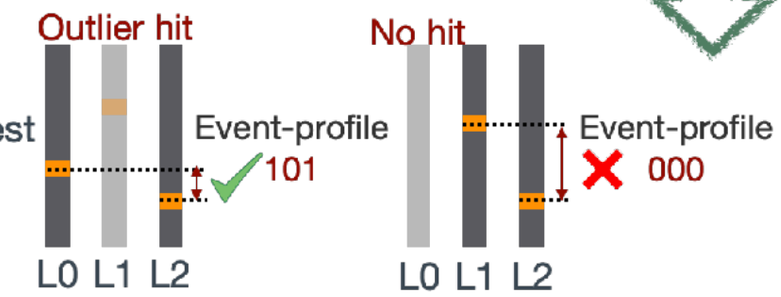
Algorithm-1

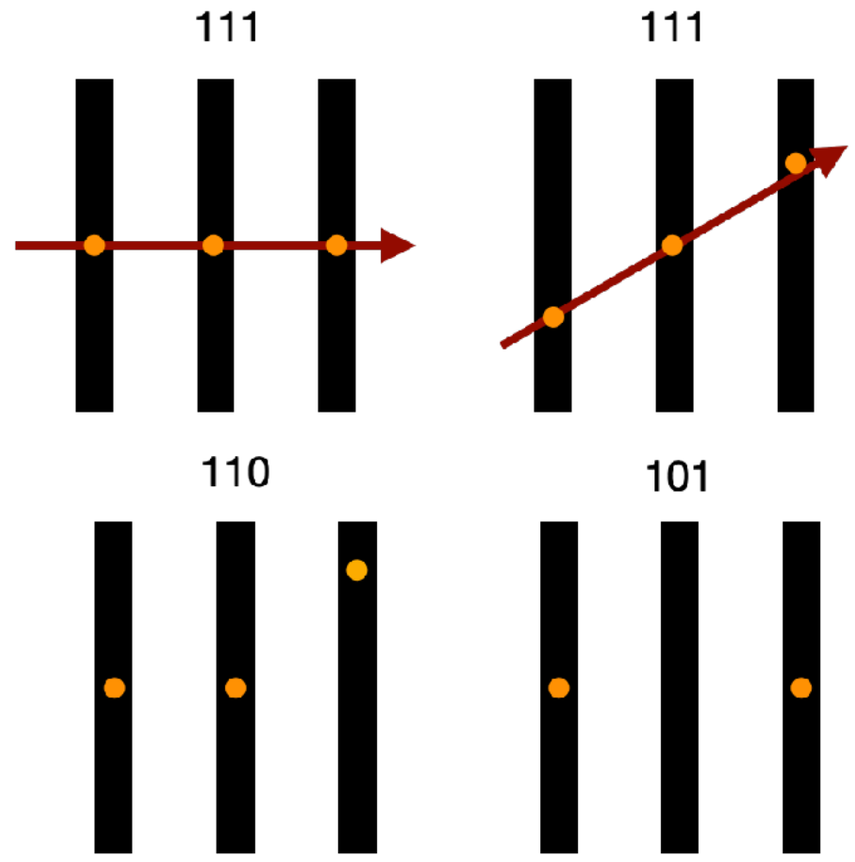
1. Fit all combinations and pick up the one with minimum χ^2 / NDF
2. Check the residual (R^l) of each layer
3. If < tolerance → event-profile 111
4. If > tolerance → algorithm-2 is applied



Algorithm-2

1. Ignore the layer with no/outlier hit
2. Check the position difference of the rest 2 layers, and assign the event profile
3. If < tolerance → 110, 101, 011
4. If > tolerance → 000

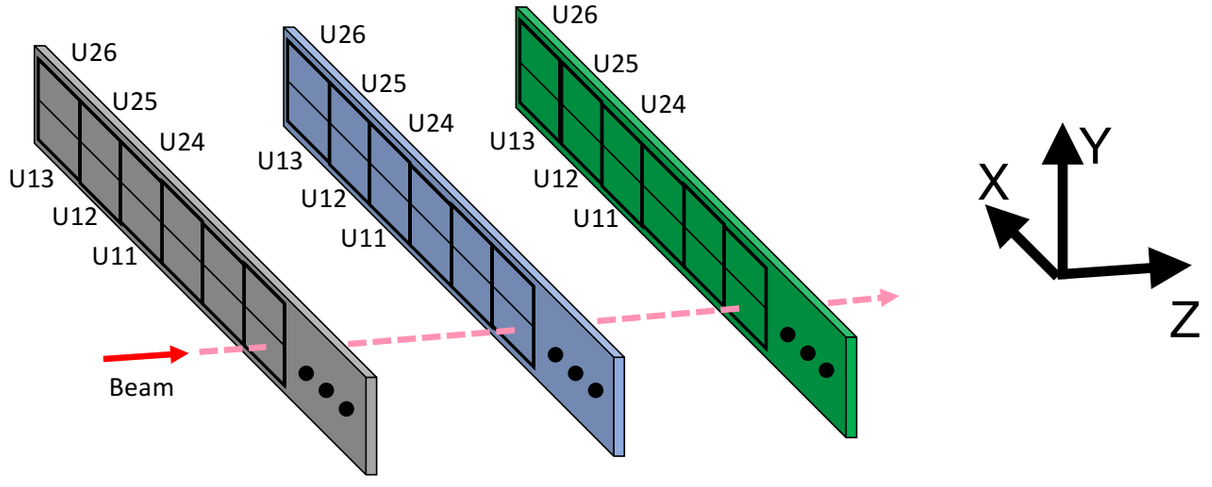




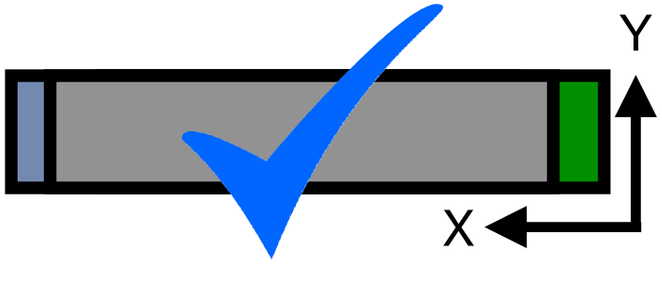
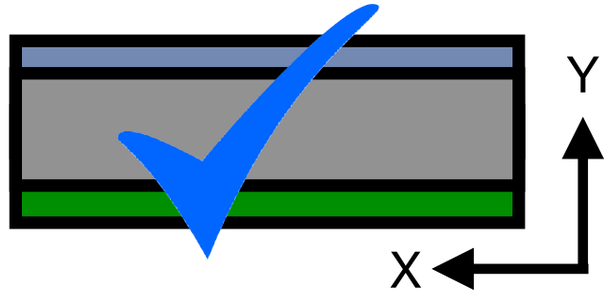
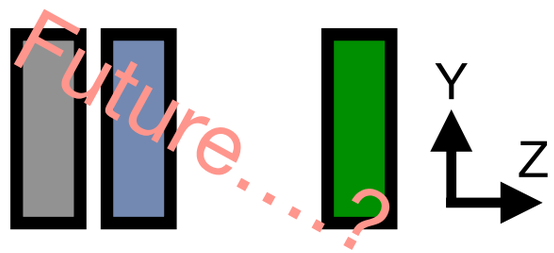
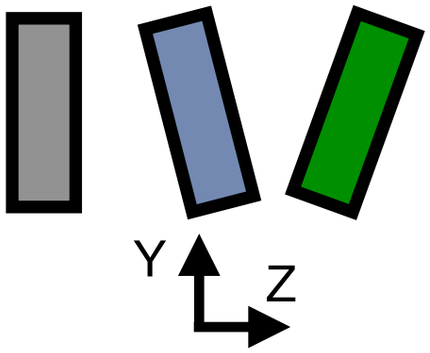
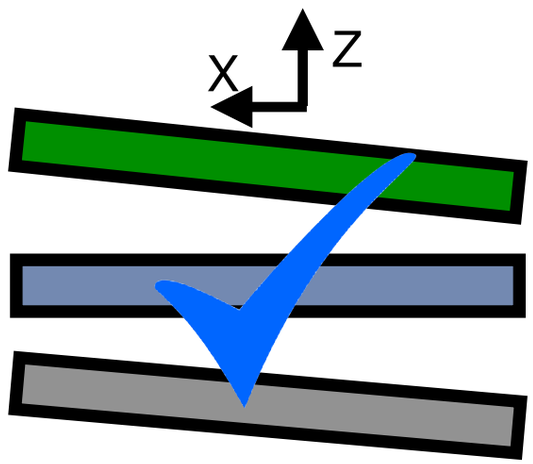
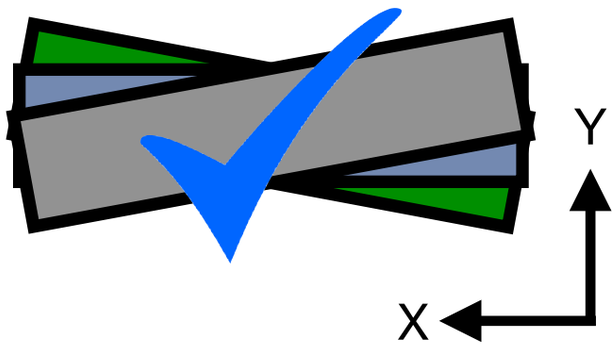
Efficiency calculation (layer-0)

$$\frac{number\ of\ 111\ event}{number\ of\ 111\ event\ +\ number\ of\ 011\ event}.$$

Before efficiency - correction

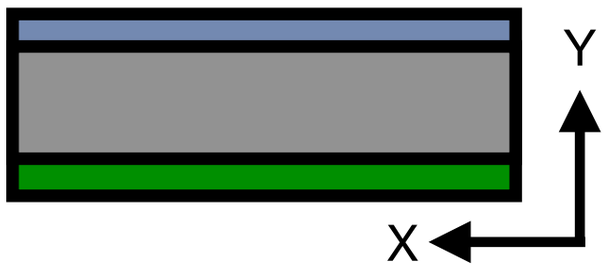


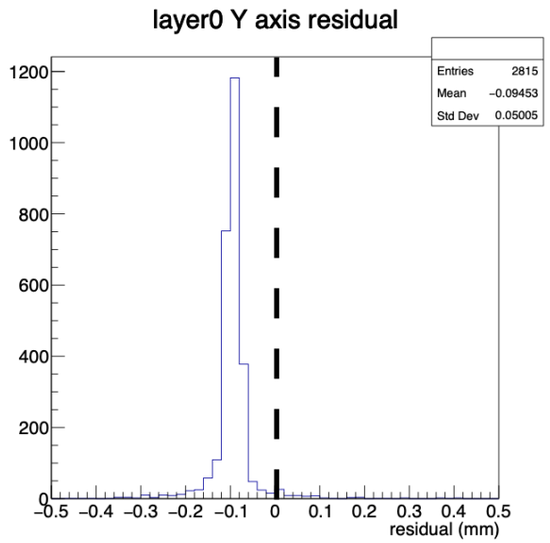
Reality :

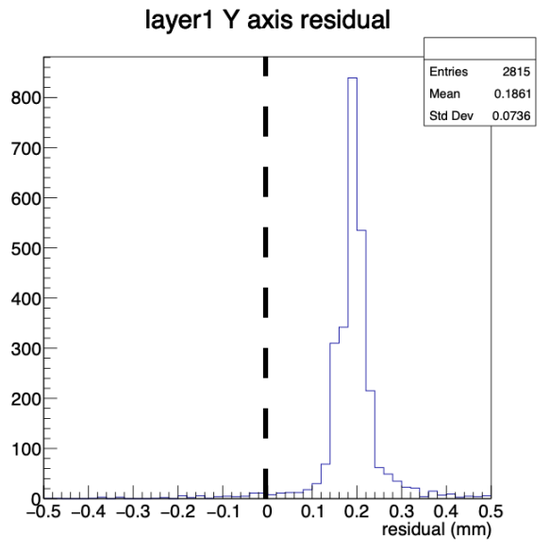
	X axis	Y axis	Z axis
Alignment			
Rotation			

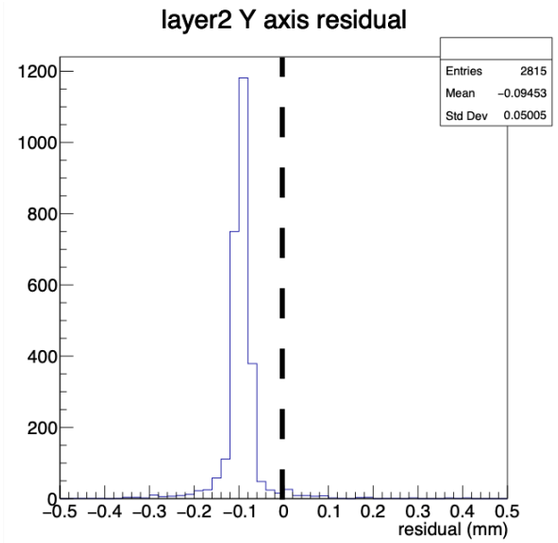
Before efficiency - alignment

Before

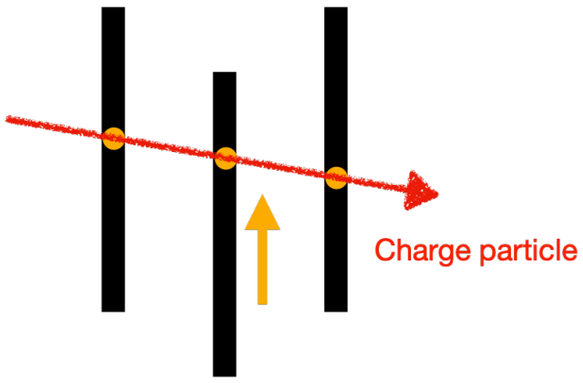




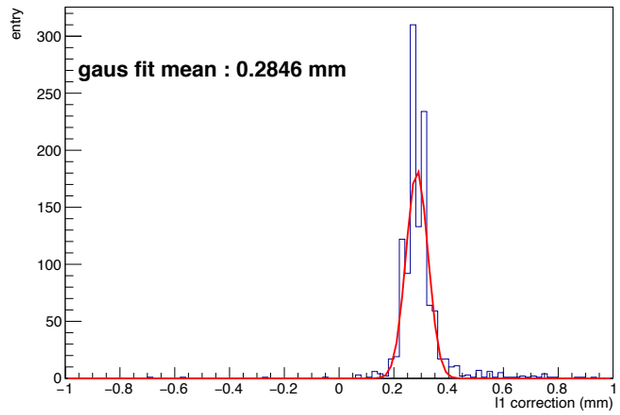




In experiment

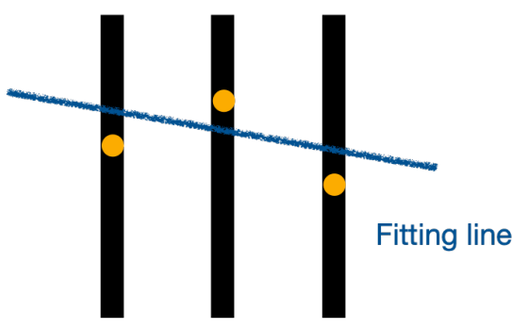


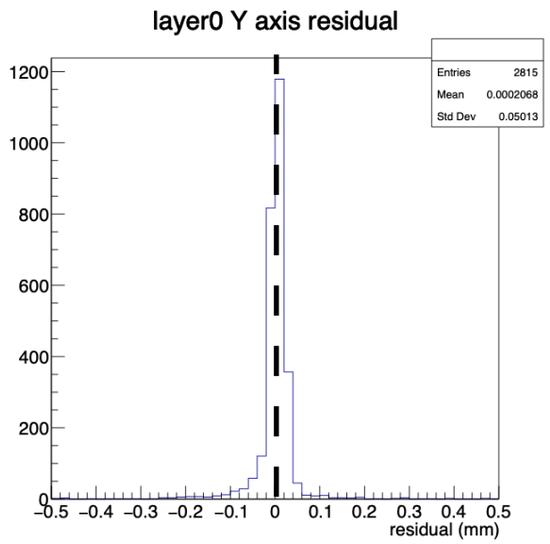
The amount of the correction

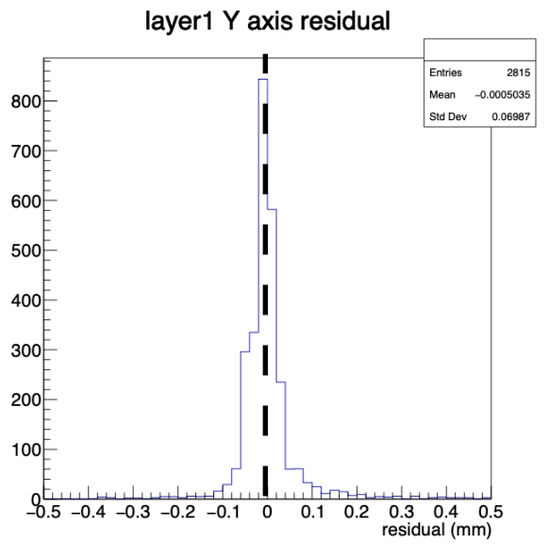


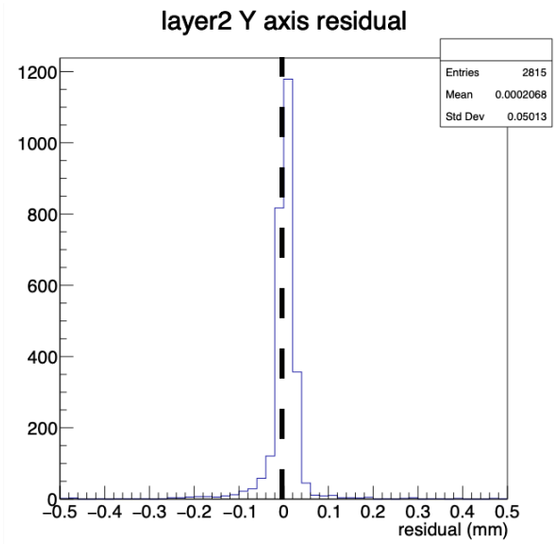
After

Our assumption

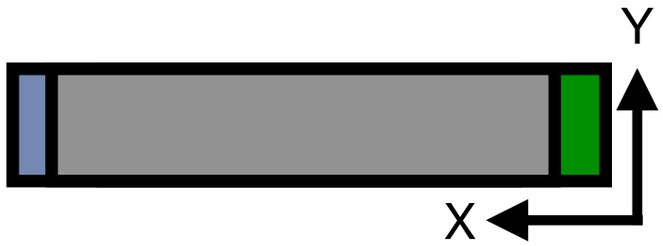






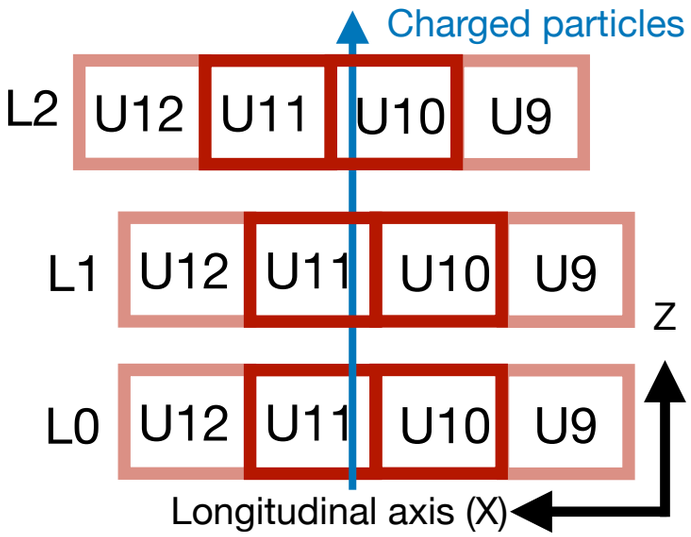


Before efficiency - alignment



Alignment on longitudinal axis
INTT : strip detector → no resolution on X axis.

Layer	Module
Layer-0	1
Layer-1	6
Layer-2	5



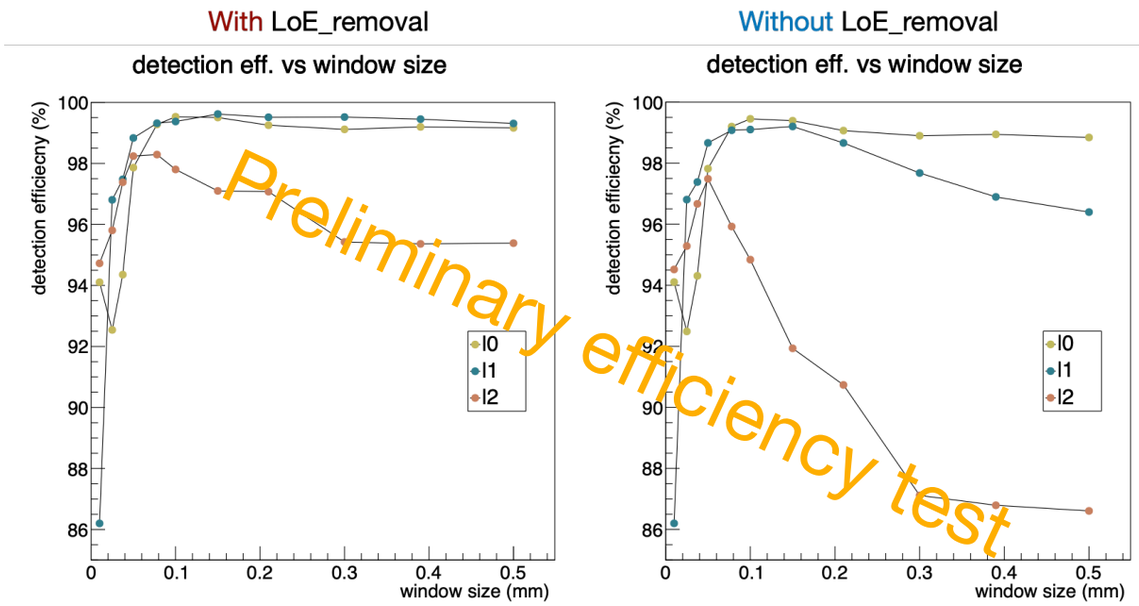
Raw data from beam test 2021, single event.

Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc
0	185	955	1	1	11	126	4
1	154	2160	1	6	11	126	4
2	354	395	1	5	10	119	0
3	137	740	1	5	10	120	4
4		2160	1				
5		2160	1				

chan_id is close to each other, but one chip_id difference.

A function “LoE_removal” is introduced to remove such event.

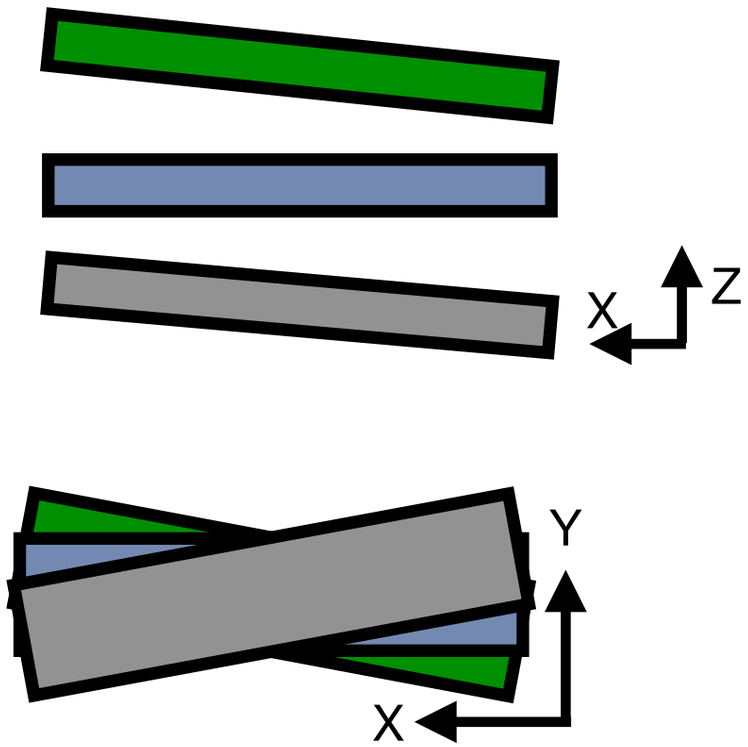
Such event doesn’t contribute to the efficiency calculation.



Improvement, ~ 7 % for layer-2.

Before efficiency - single chip selection

Slide from Genki

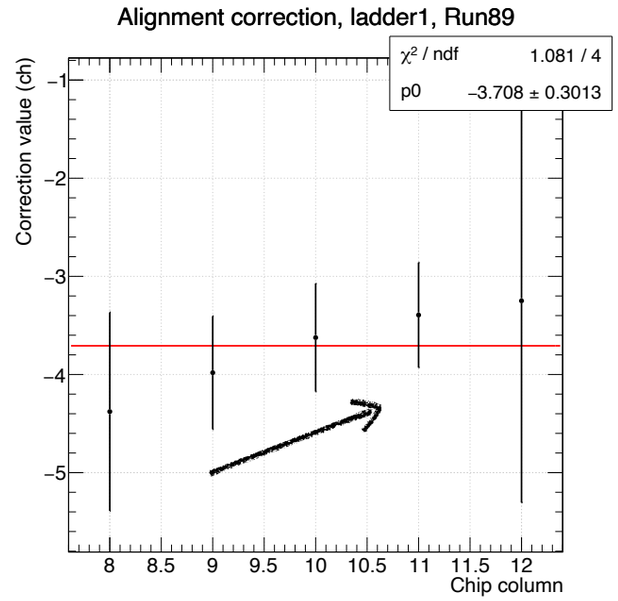


Residual, the simplest way

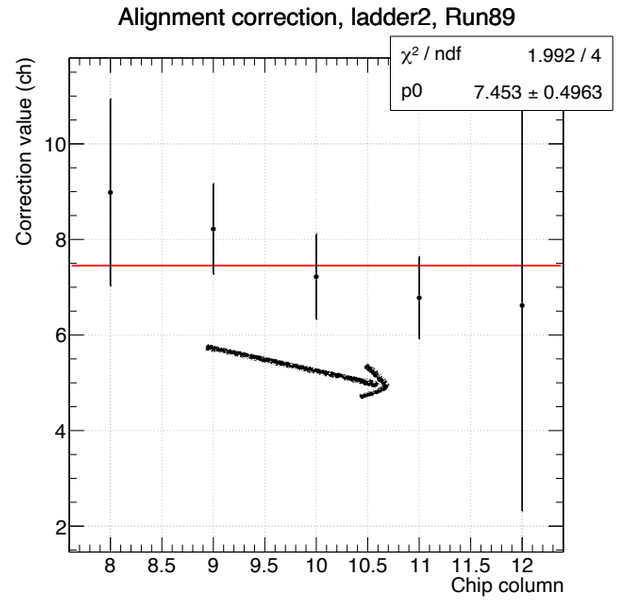
$$\Delta_1 = ch_1 - ch_{1,tracking} = ch_1 - \frac{ch_0 + ch_2}{2}$$
$$\Delta_2 = ch_2 - ch_{2,tracking} = ch_2 - \{ch_1 + (ch_1 - ch_0)\} = ch_2 - 2ch_1 + ch_0 \ (= \Delta_0)$$

Residual as a function of chip column
Run89

$$\Delta_1 = ch_1 - ch_{1,tracking}$$



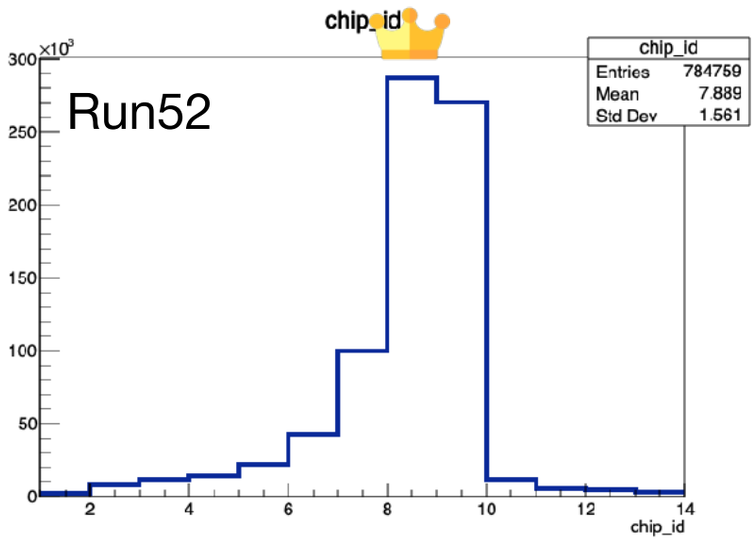
$$\Delta_2 = ch_2 - ch_{2,tracking}$$



The amount of correction might be chip dependent.

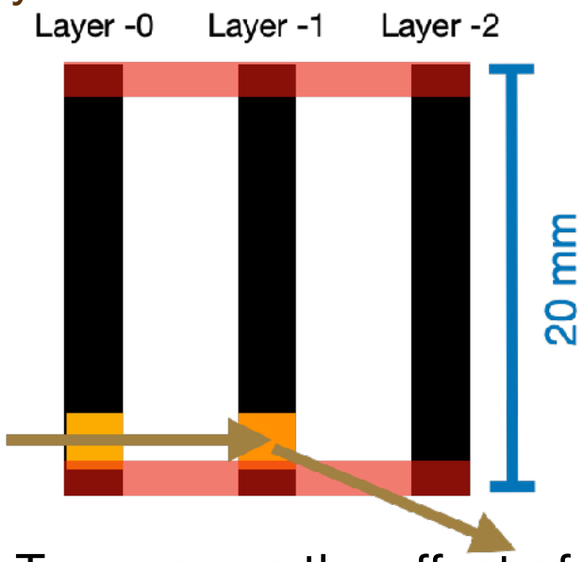
Current solution (simple) : select only one chip for efficiency study.

Statistic seems to be still enough (all BCO group is included).

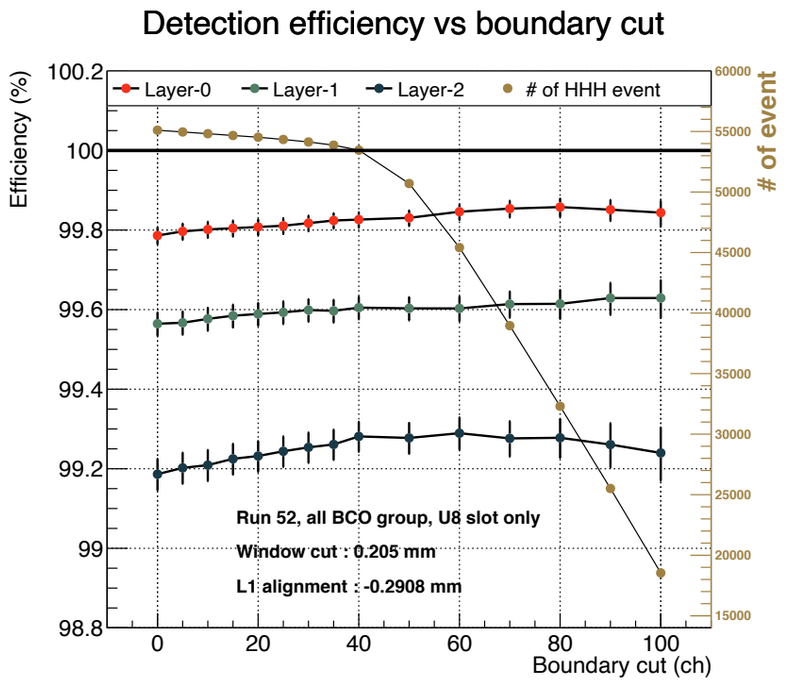


Before efficiency - determination

Boundary cut determination

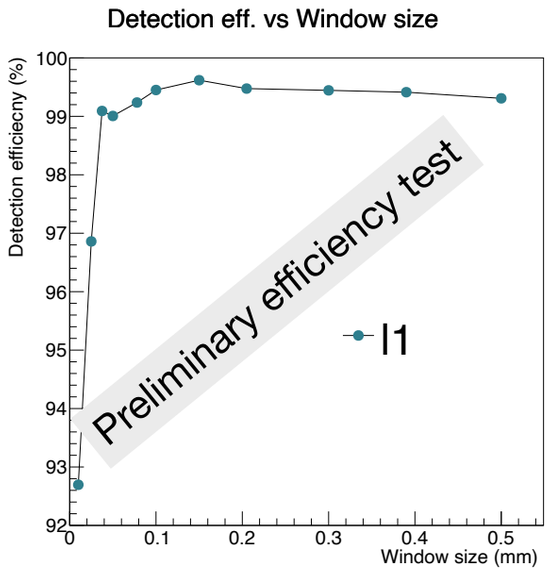


To suppress the effect of the Coulomb scattering.

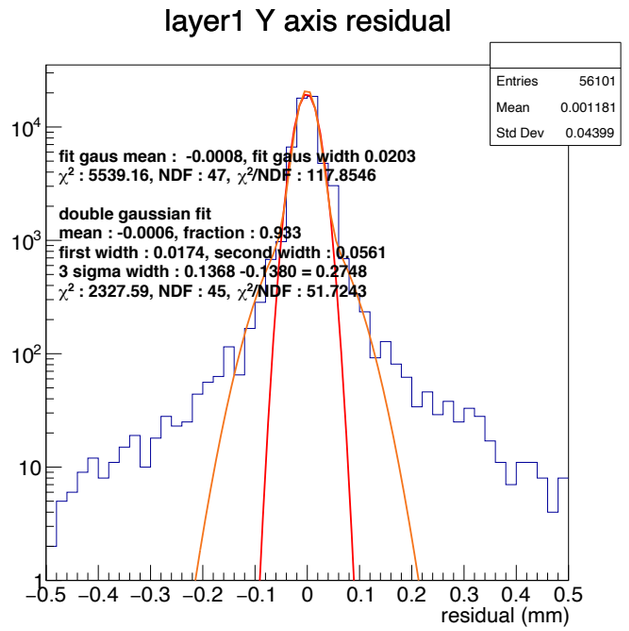


Current decision :
edge 5 channels are ignored.

Window size tolerance



In principle, the efficiency increases as window size enlarges.



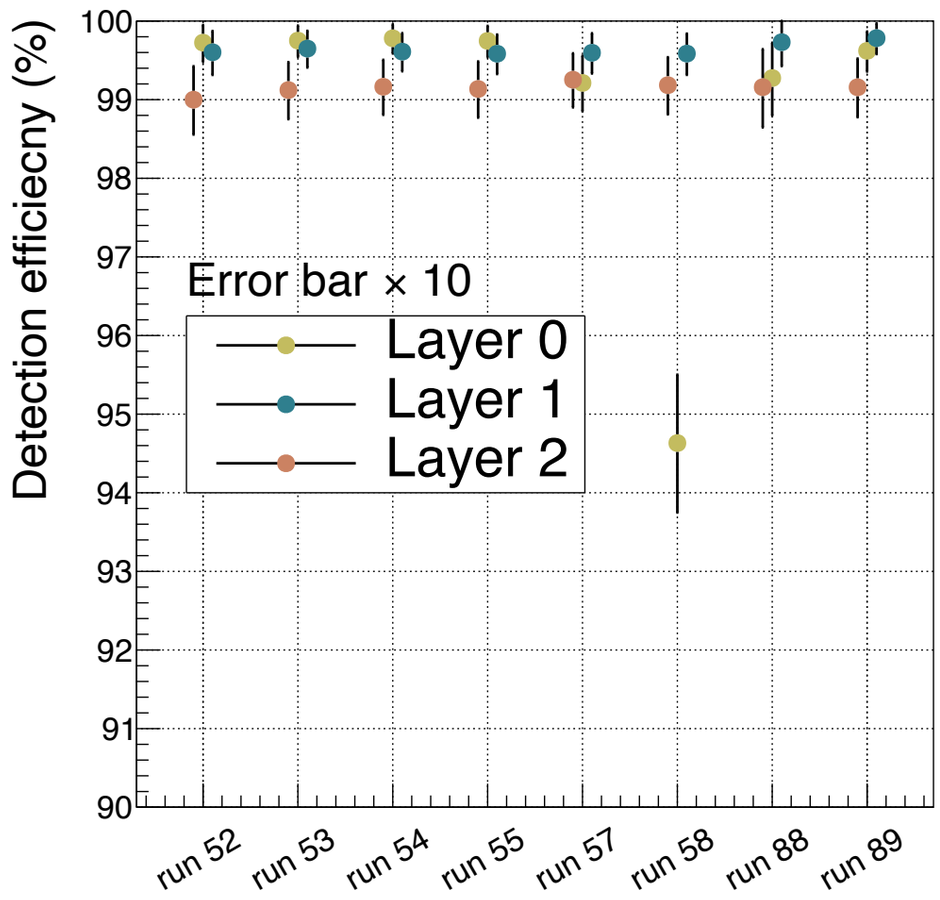
Current determination : 3σ of the double Gaussian fitting on the layer-1 residual distribution of each run.

Detection efficiency

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	$99.62^{+0.02}_{-0.03}$	$99.78^{+0.02}_{-0.02}$	$99.16^{+0.04}_{-0.04}$

Detection eff. vs run ID

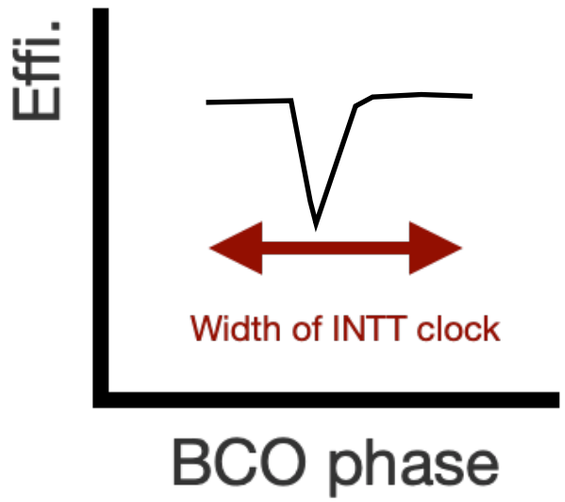


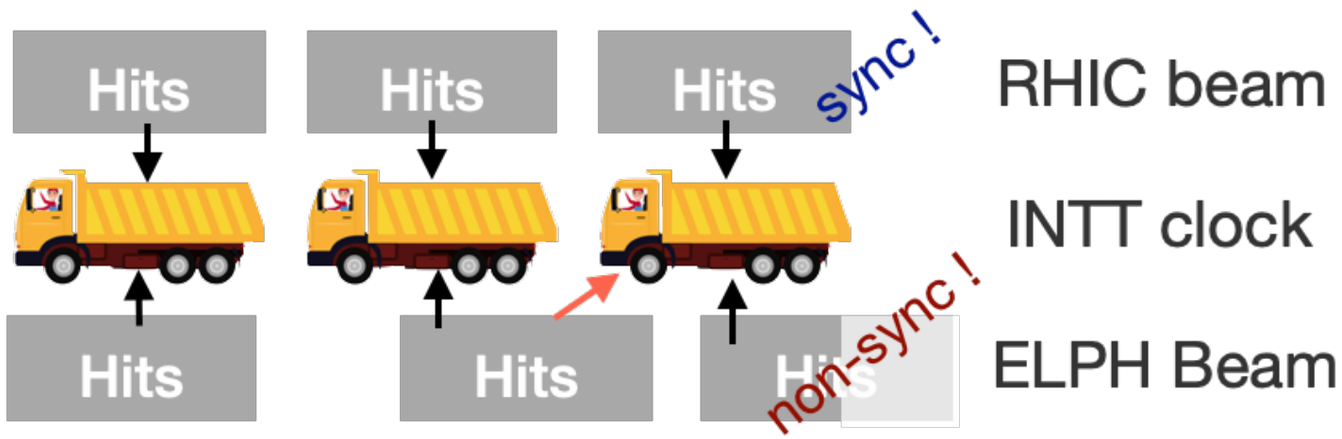
The detection efficiency can be up to 99.7%, all layers 99%.
Fits the sPHENIX requirement !

Detection efficiency

- One hypothesis to explain the efficiency of testbeam 2019 :
  - The beam clock and the INTT clock were not synchronized.
  - The INTT may not have enough time save all hits.

- In testbeam 2021, we were able to measure the event process time (BCO phase).

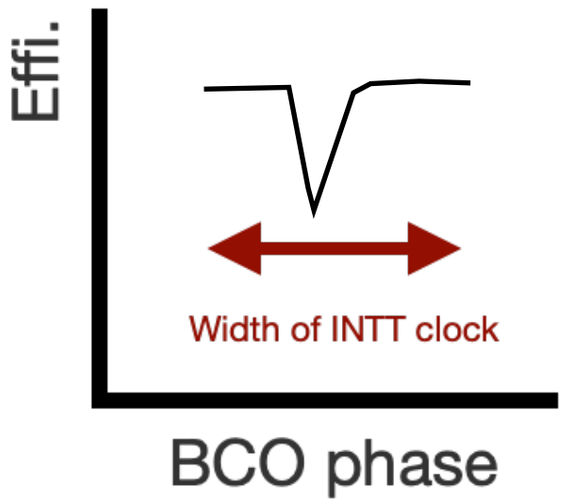


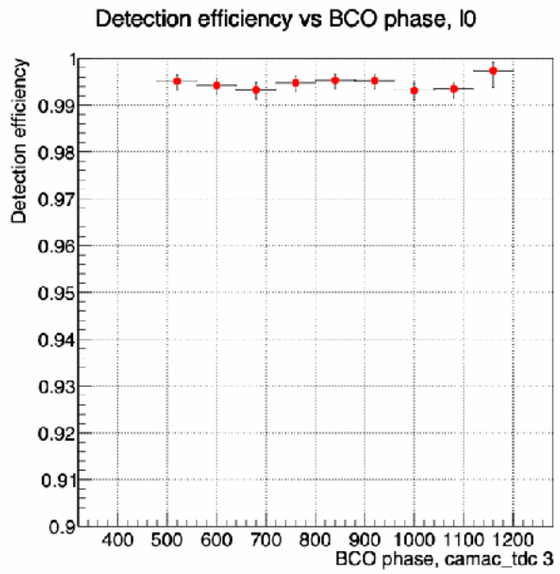


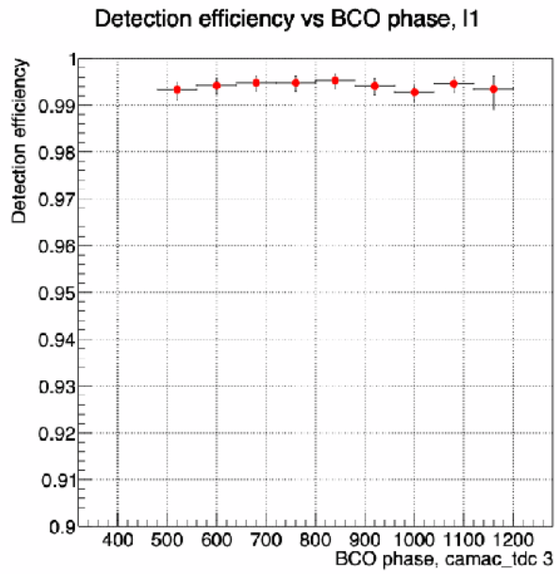
Old result, only first BCO group

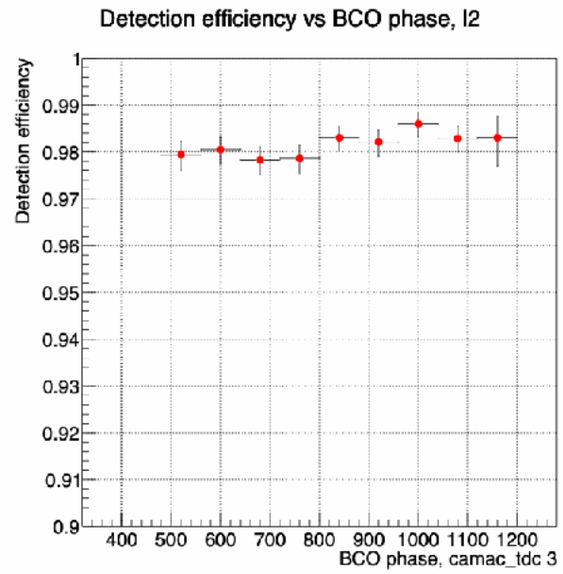
Detection efficiency

Approach 1, all checked runs, except run 58.

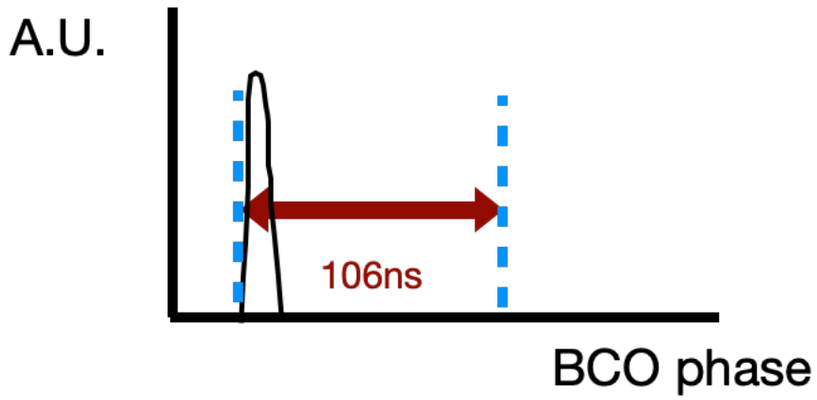


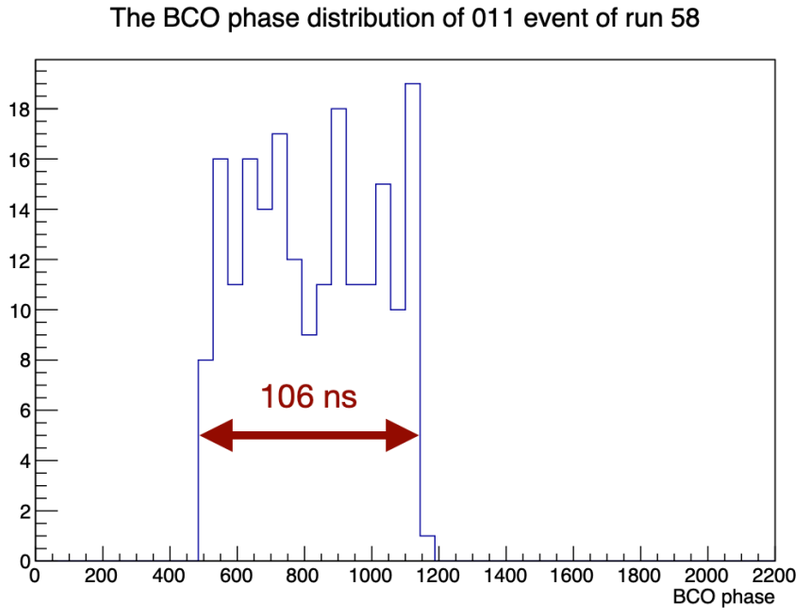






Approach 2, layer-1 of run 58





The event process time (BCO phase) seems to be independent to the efficiency, it could be due to too high event rate → INTT cosmic telescope !

INTT ladder energy deposit

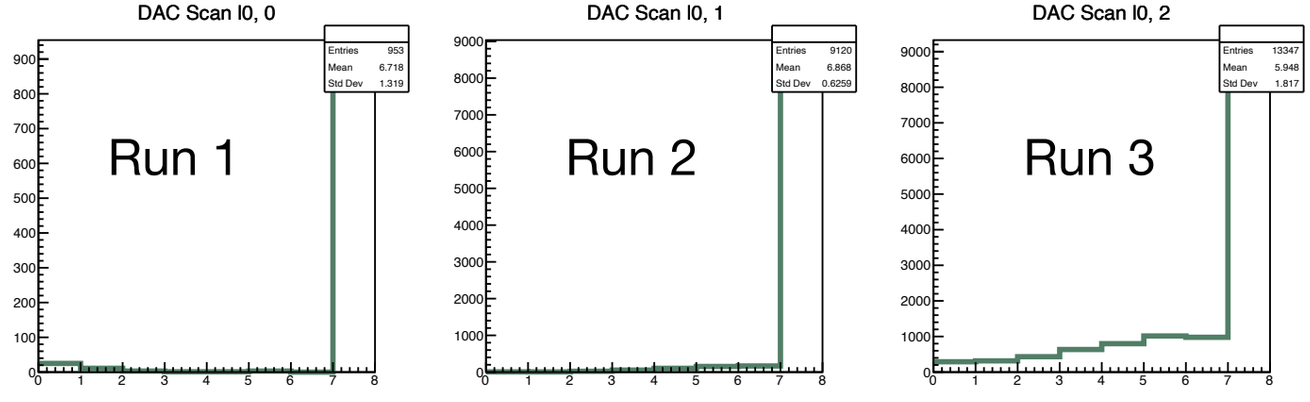
FPHX chip : 3 bits → only 8 bins to describe the distribution.
To cover the full energy deposit distribution of ladder and have good resolution → DAC Scan

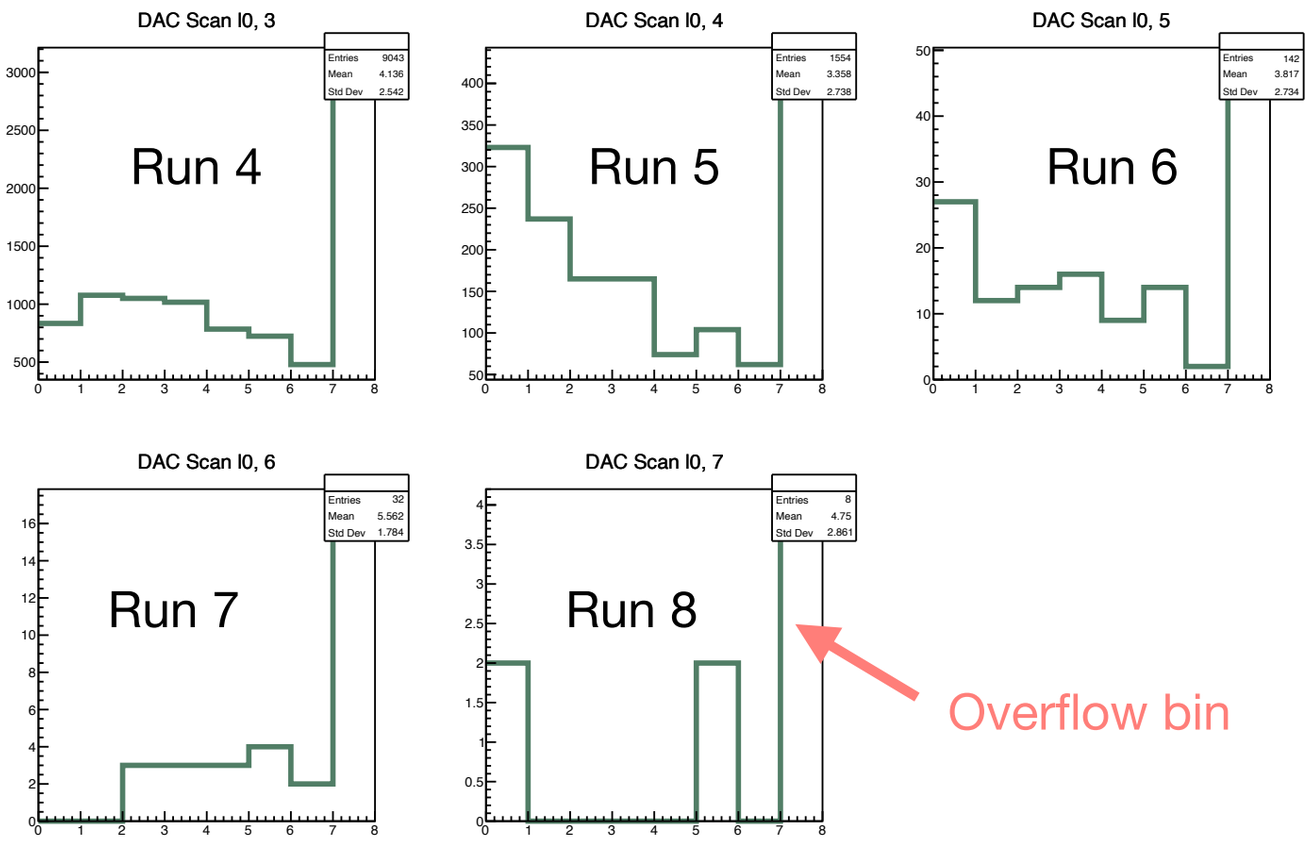
DAC Scan :

1. Narrow range, multiple runs.
2. Each run has 3 bins with same adc setting as the setting of previous run.
3. 5th and 6th bins : overlapping bins for scaling between distributions.
4. 7th bin : overflow bin, neglect.

The adc setting of each run

	run 1	run 2	run 3	run 4	run 5	run 6	run 7	run 8
adc0	8	28	48	68	88	108	128	148
adc1	12	32	52	72	92	112	132	152
adc2	16	36	56	76	96	116	136	156
adc3	20	40	60	80	100	120	140	160
adc4	24	44	64	84	104	124	144	164
adc5	28	48	68	88	108	128	148	168
adc6	32	52	72	92	112	132	152	172
adc7	36	56	76	96	116	136	156	176

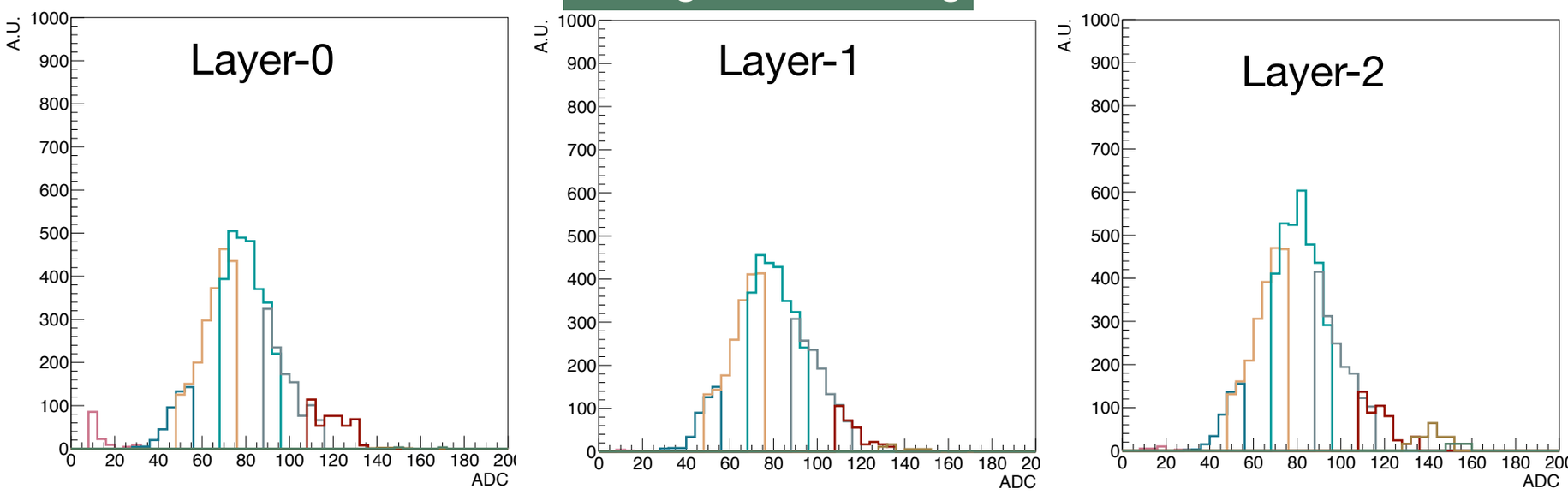




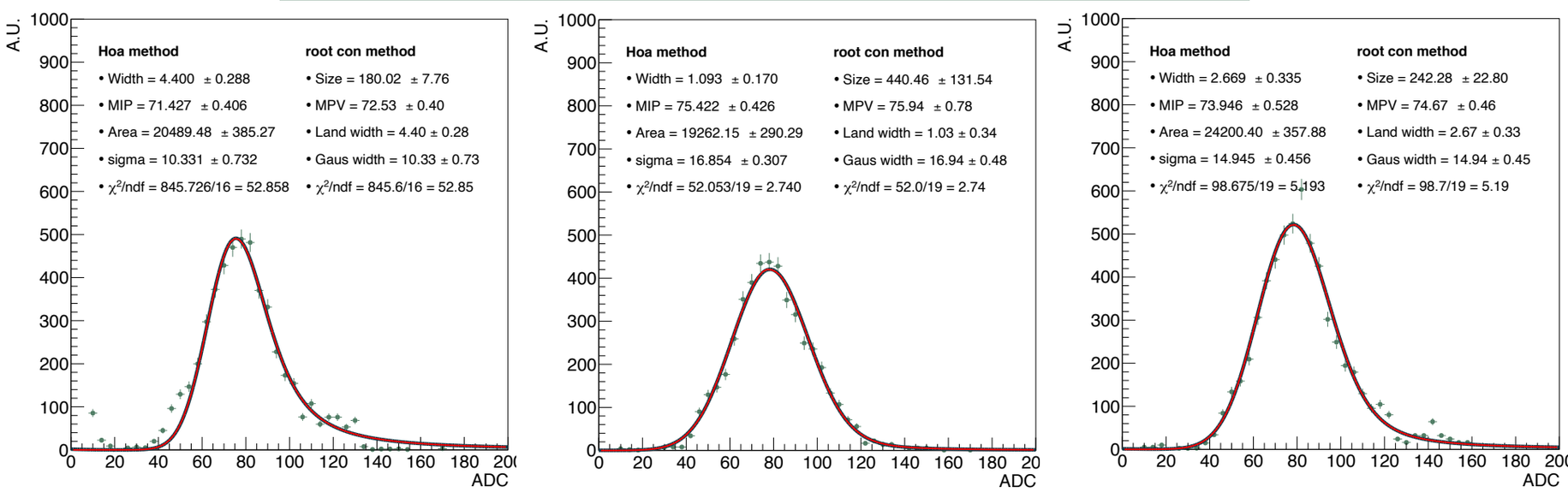
INTT ladder energy deposit

1. Only the good events
   → low noise
2. Once single hit

Histogram matching



Fitting function : Landau convolute with Gaussian

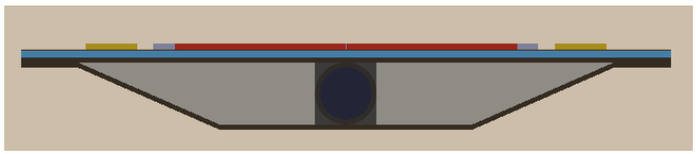


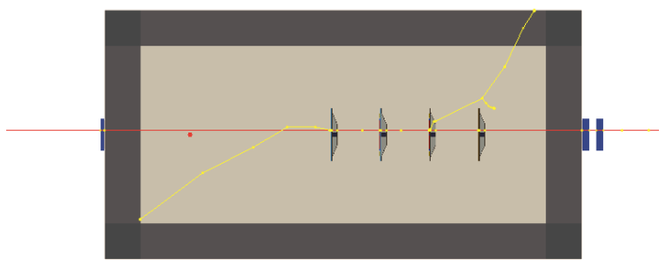
Average MPV of the distributions : 73.6 adc

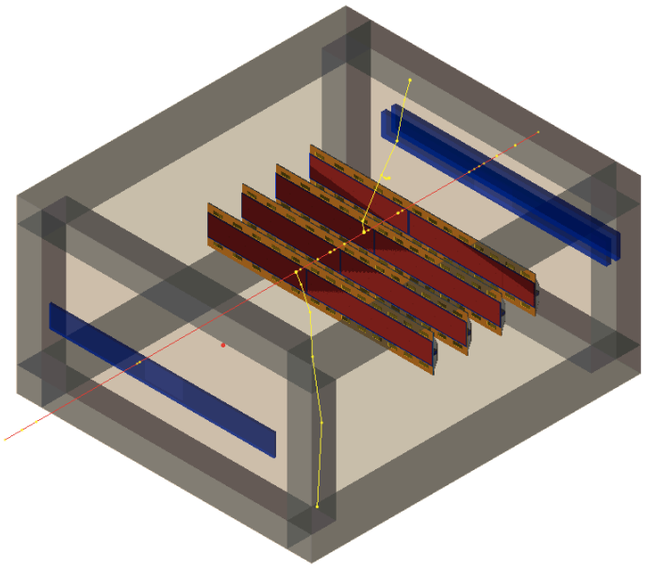
15 ~ 20 adc seems to be a good range for threshold setting to reject most of the noise.

Coulomb scattering angle

Geant4 model of testbeam 2021

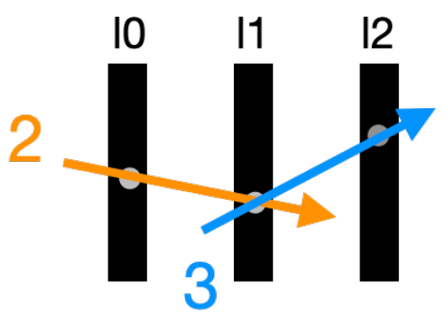




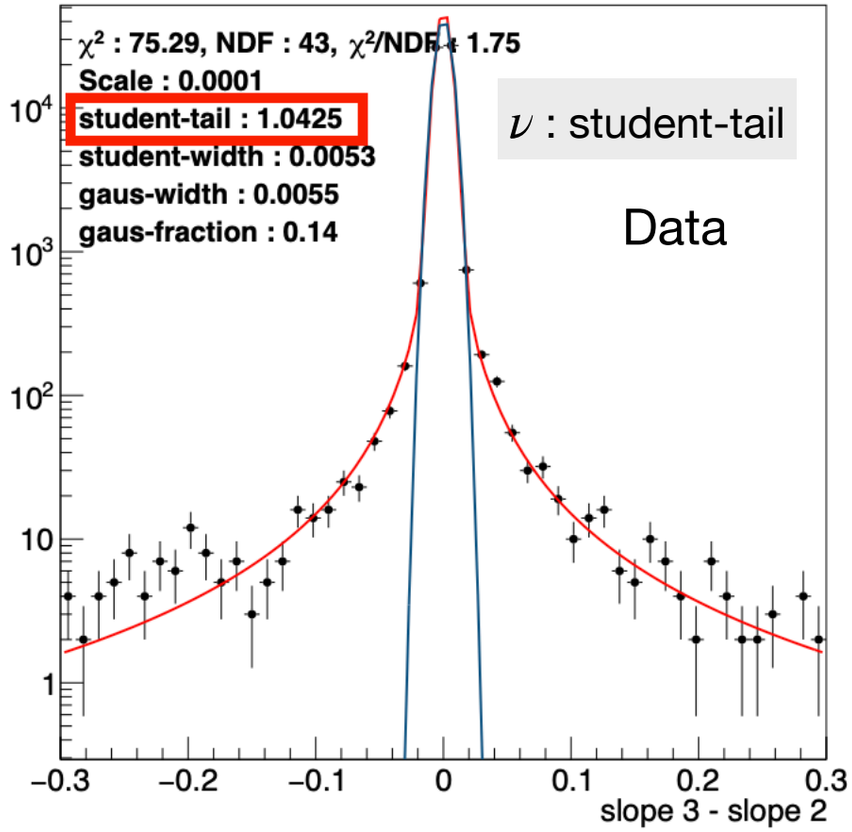


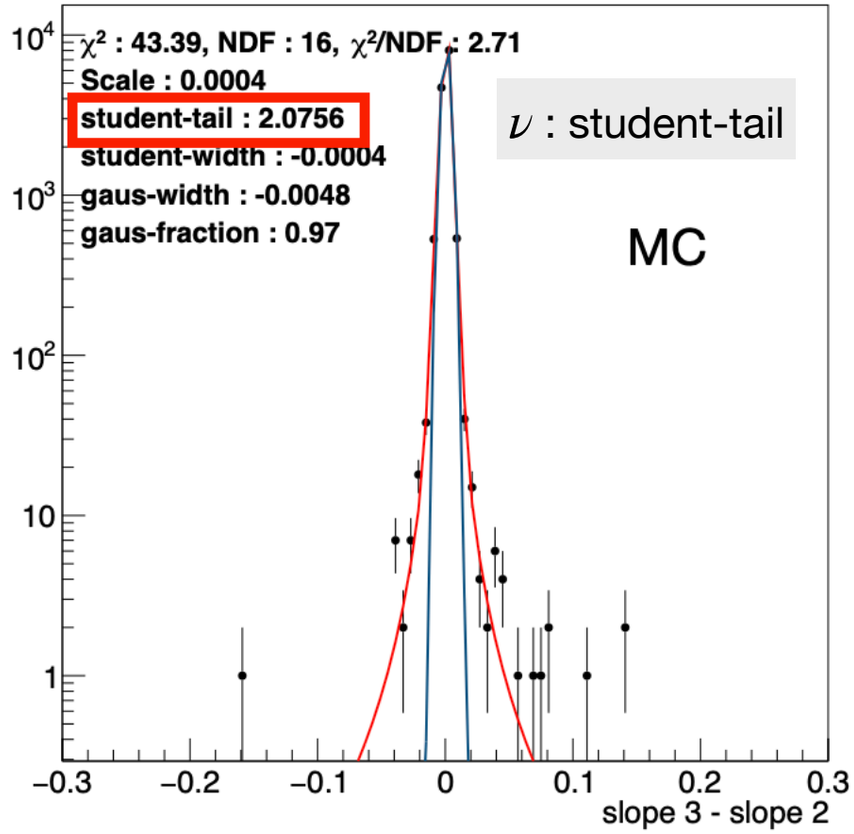
Fitting function : Gaussian + student's t

$$f(\theta) = N \cdot \left((1-a) \cdot \frac{1}{\sigma_G \sqrt{2\pi}} e^{-\frac{(\theta-\mu)^2}{2\sigma_G^2}} + a \cdot \frac{\Gamma(\frac{\nu+1}{2})}{\sqrt{\nu\pi}\sigma\Gamma(\frac{\nu}{2})} (1 + \frac{(\theta-\mu)^2}{\nu\sigma^2})^{-\frac{\nu+1}{2}} \right).$$



2 : slope of I1-I0
3 : slope of I2-I1





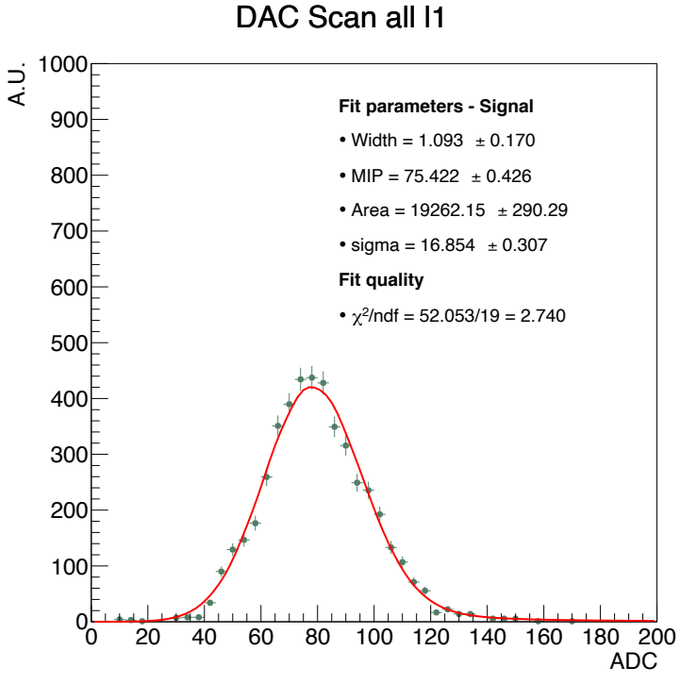
The discrepancy between the data and MC is big, requires further investigation.

Unresolved issues

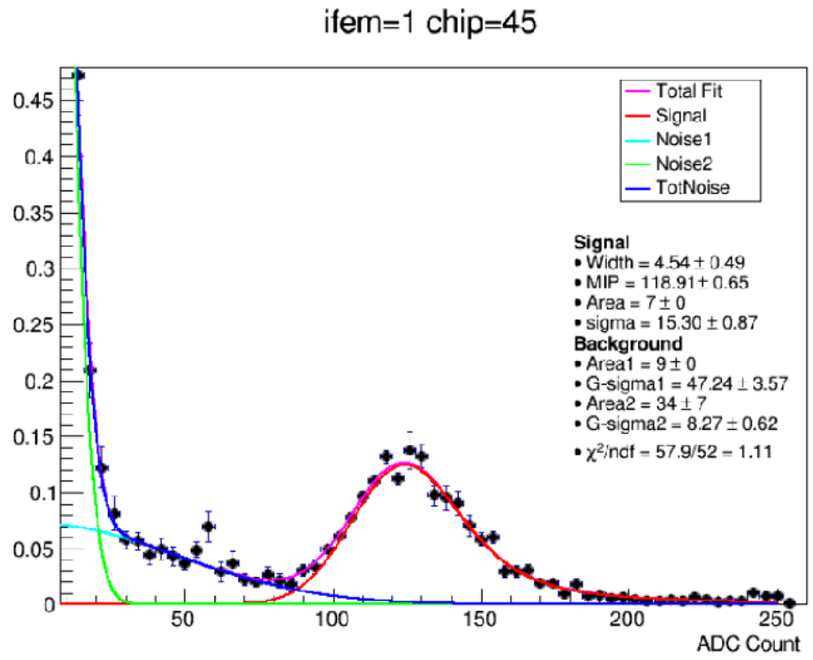
- DAC Scan edep difference, 2019 and 2021
- Offset determination
- Felix & FEM # of event difference
- Run 88 & 89 - satellite peak
- Asymmetry hit distribution
- Scattering angle

Unresolved problem - edep difference

Testbeam2021, 50 V
Positron beam, 1 GeV



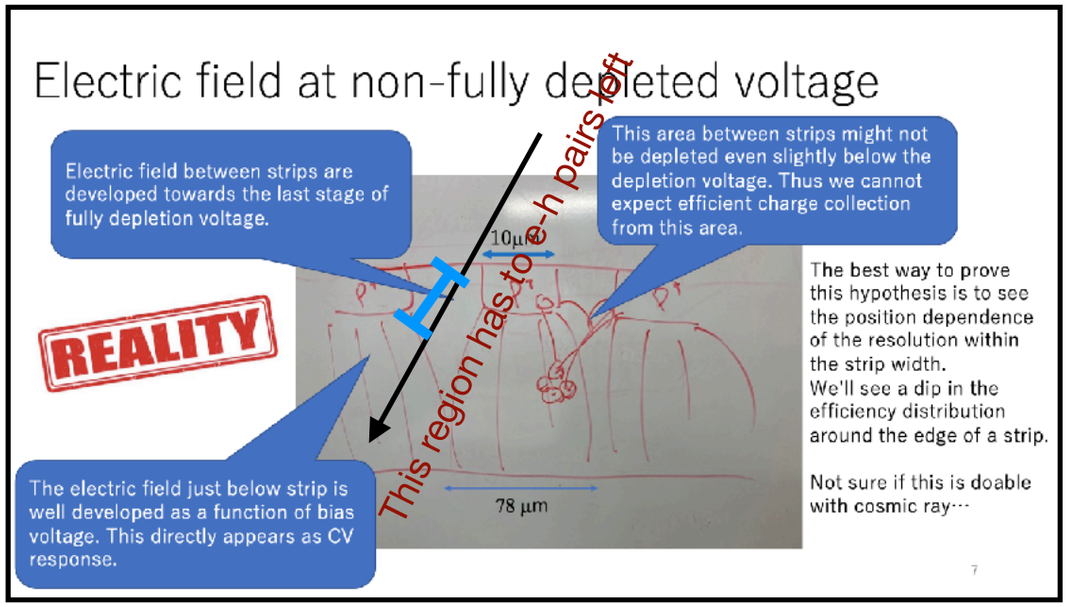
Testbeam2019, 100 V
Proton beam, 120 GeV



The peaks are different

Based on series of the studies and theory, 2019 edep seems to be correct.
2021 edep should be higher

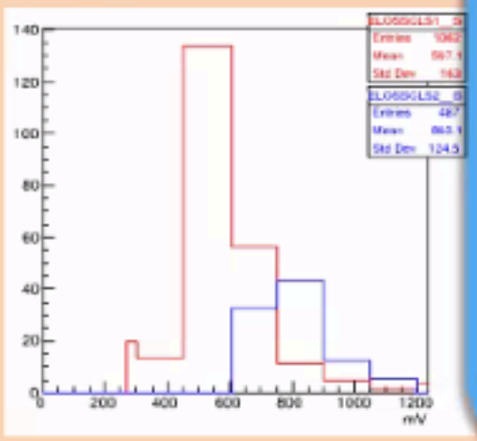
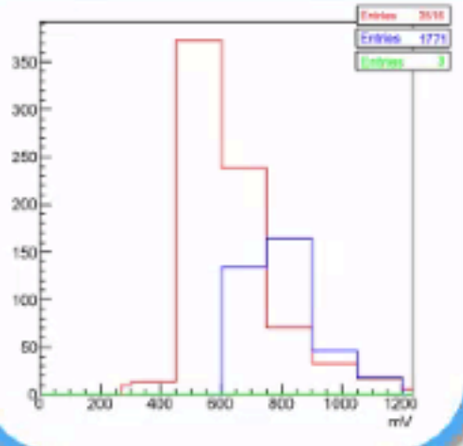
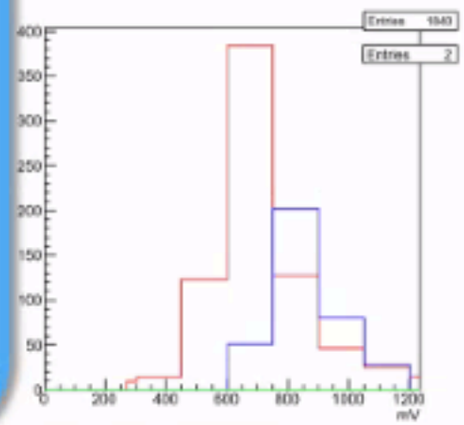
Currently best guess, slide from Itaru



Unresolved problem - Offset

宇宙線測定とシミュレーションの比較

表：ゲイン値の対応と測定エネルギー損失分布

	宇宙線測定	シミュレーション	
ゲイン値	約100eV/fC	85eV/fC	100eV/fC
オフセット		198mV	198mV
ピーク位置　1ヒット 2ヒット	450~600mV 750~900mV	450~600mV 750~900mV	600~750mV 750~900mV
			

赤：ヒット数= 1
青：ヒット数= 2

・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

Offset value 200 mV from the experiment of NWU.

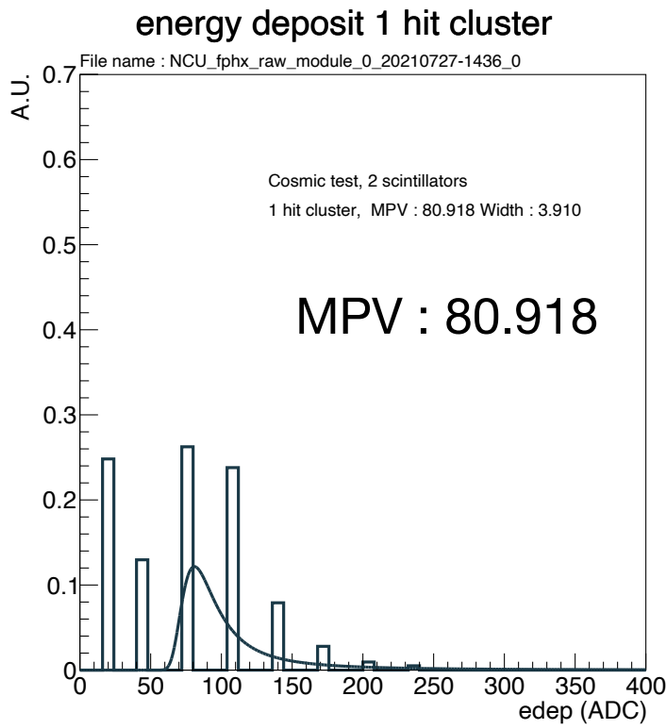
Unresolved problem - Offset

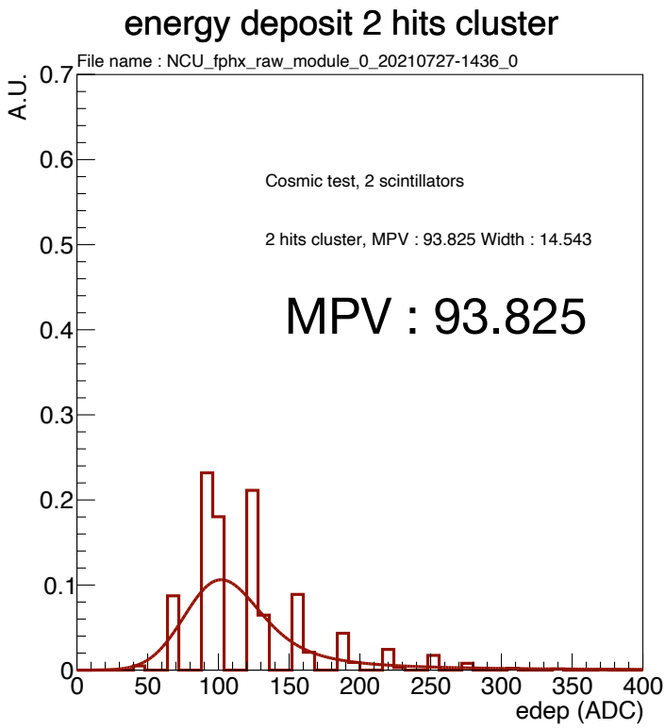
	Beam	Beam energy	silicon thickness (um)	edep (keV)	Paper link	note
1	Proton	1 GeV	300 um	130.8 ± 3.8 keV	link1	
2	Proton	115 GeV	300 um	85.5 ± 2.8 keV	link1	
3	Proton	50 GeV	300 um	85.79 keV	link2	
4	Proton	50 GeV	320 um	92.4389 keV	link2	interpolation from link2, Table 2
5	Proton	12 GeV	320 um	90.158 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

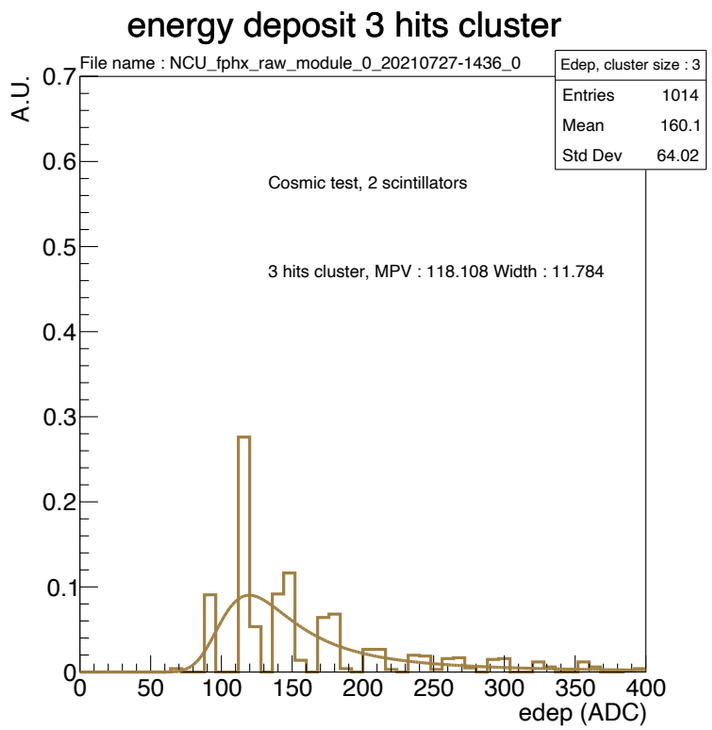
For testbeam2019, the peak with a setting of gain 100 and offset 280 can be consistent with other experiments.

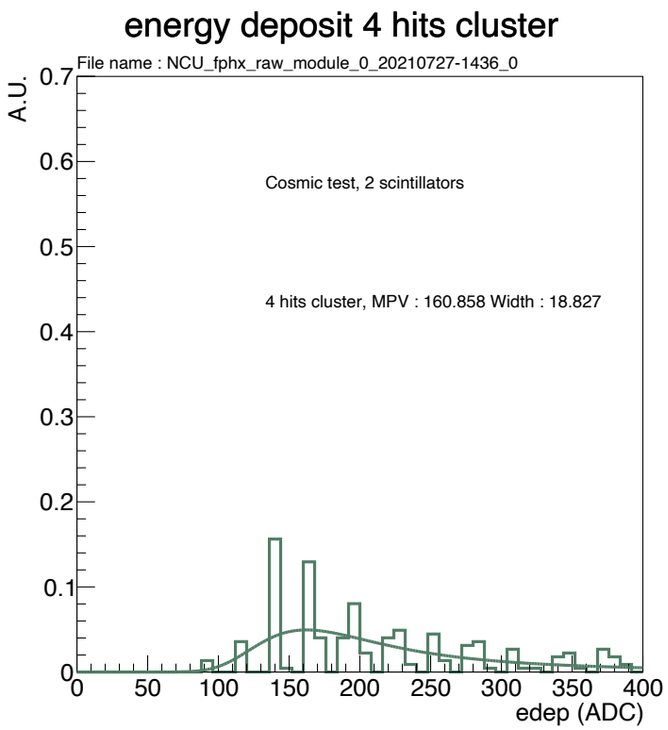
*without bin width correction

Unresolved problem - Offset

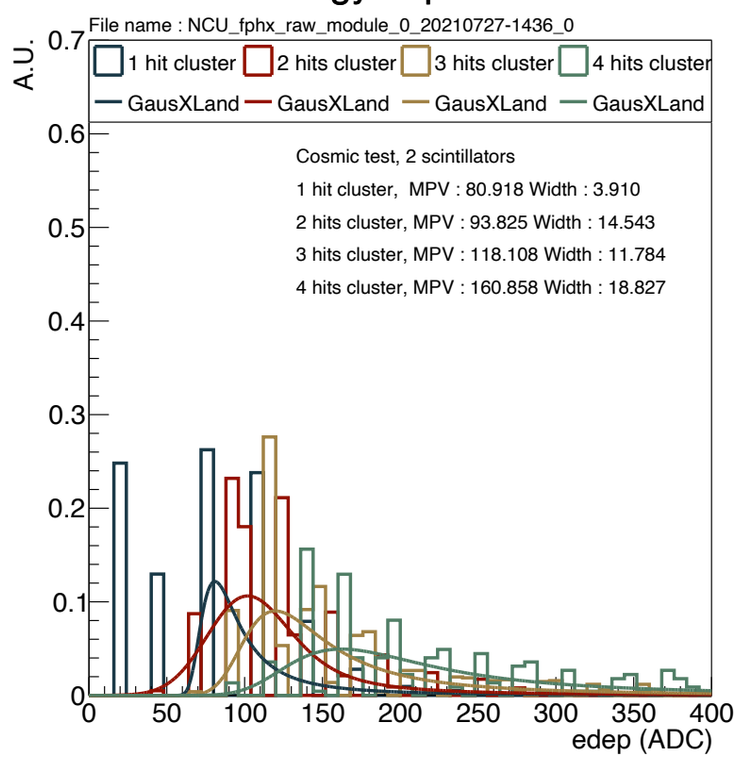








Linear scale
With normalization
(Fine bin)



mV = 4 * adc + 210

(93.825-80.918)*4+210 = 261.628

Unresolved problem - Felix & FEM event num. difference

Slide from Genki

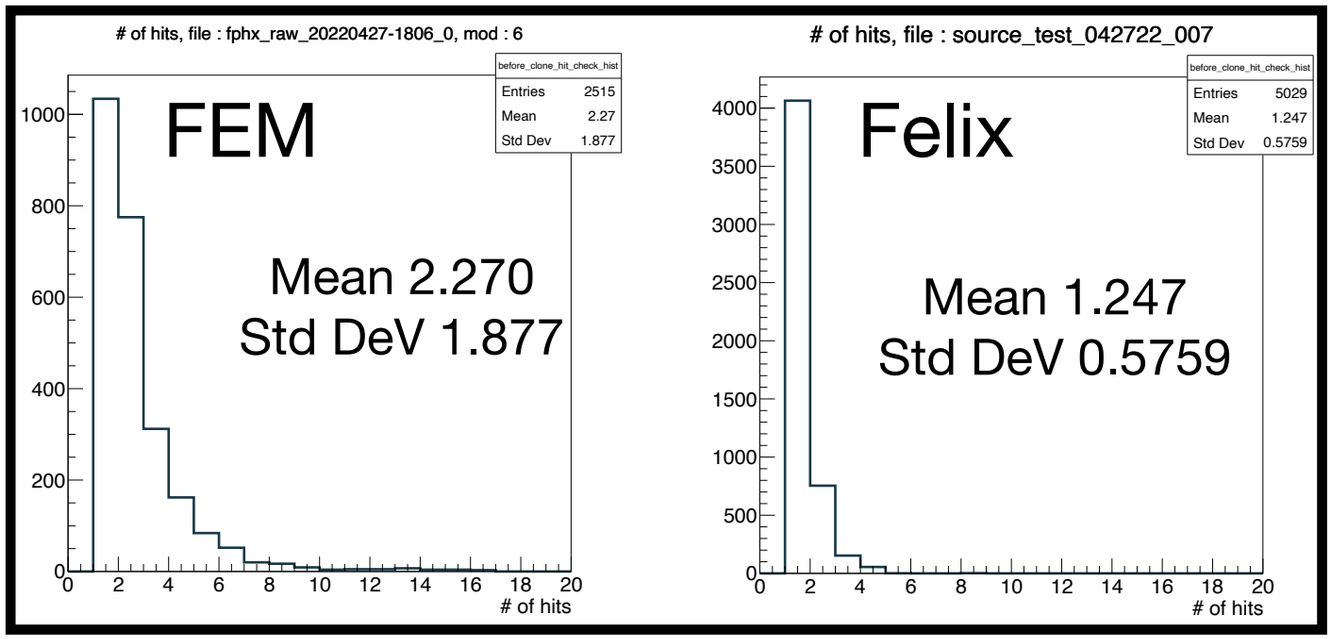
	FEM readout		Felix readout	Felix/FEM
Measurement Duration (min)	5	Measurement Duration (min)	5	
Parameters	Module, chip, ch, ADC, BCO, BCOfull, etc	Parameters	Chip, ch, ADC, BCO,	
#hits from C3 port	2176188	#hits from C3 port	6973600	320%
#hits on chip2 from C3 port	867372	#hits on chip2 from C3 port	2359665	272%

!!!

- Question : the FEM board loses at least 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.
- Experiment : source test, same source, distance, ladder. Only FEM/Felix change

Unresolved problem - Felix & FEM event num. difference

	FEM			Felix			FEM/Felix	FEM/Felix
Condition		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



Example

Average	1.96	2.62
Std DeV	0.21	0.53

For the case of FEM, it has more hits in one clock

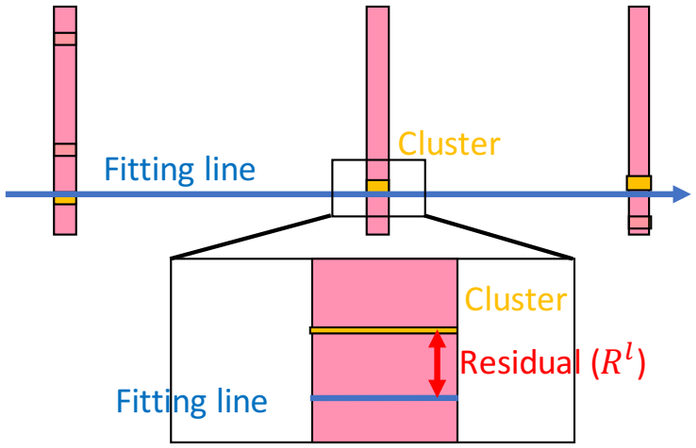
Unresolved problem - Satellite peak

U10

run89_no_clone.root

alignment, 0.2850 mm @ I1

With BEC

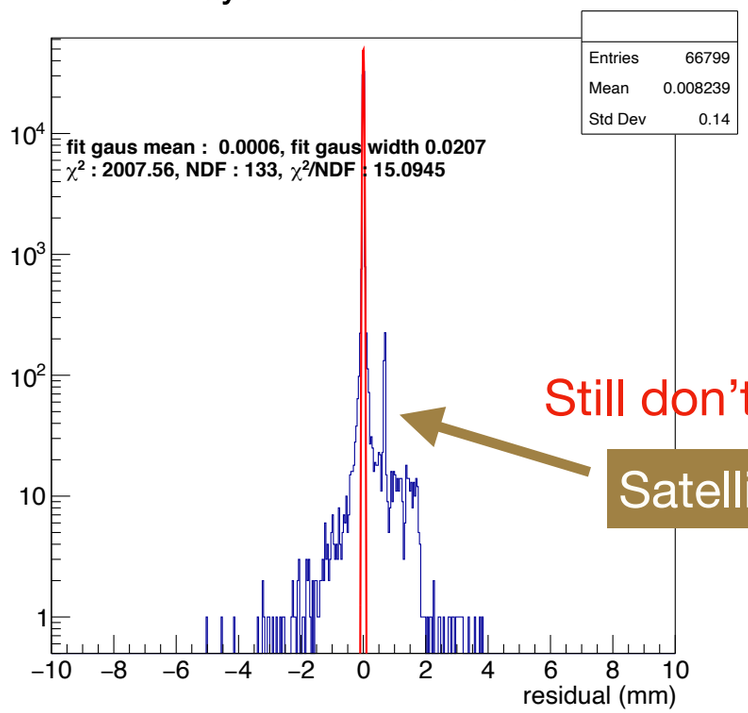


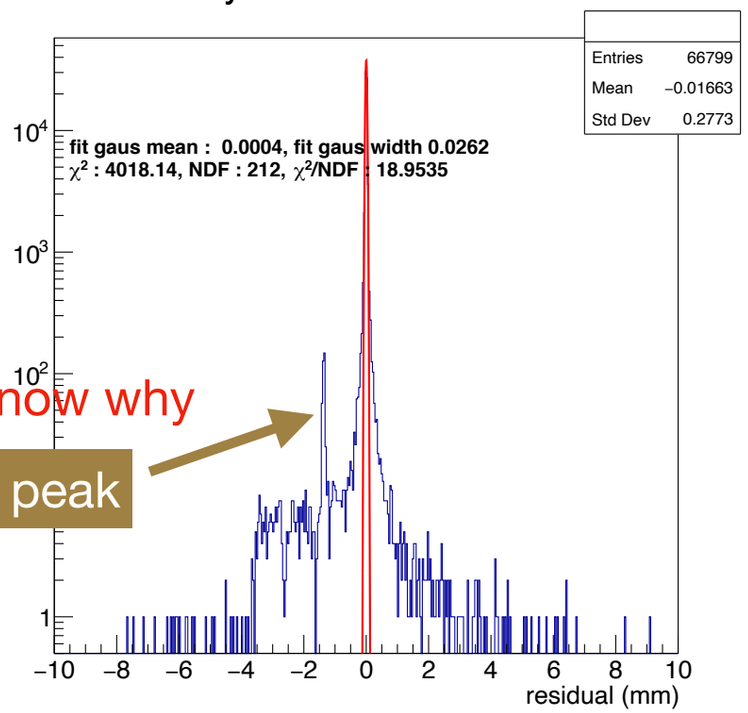
U8

run52_no_clone.root

alignment, 0.2908 mm @ I1

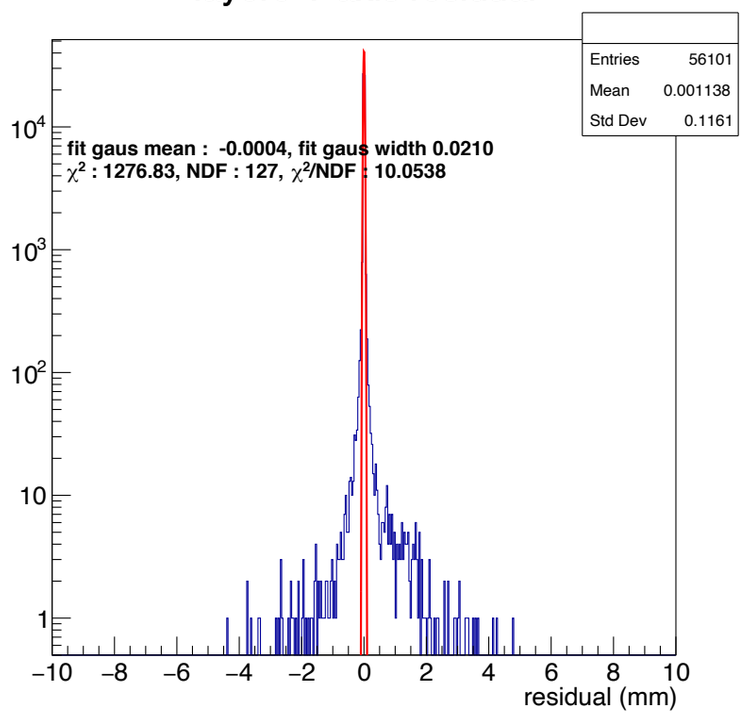
Without BEC

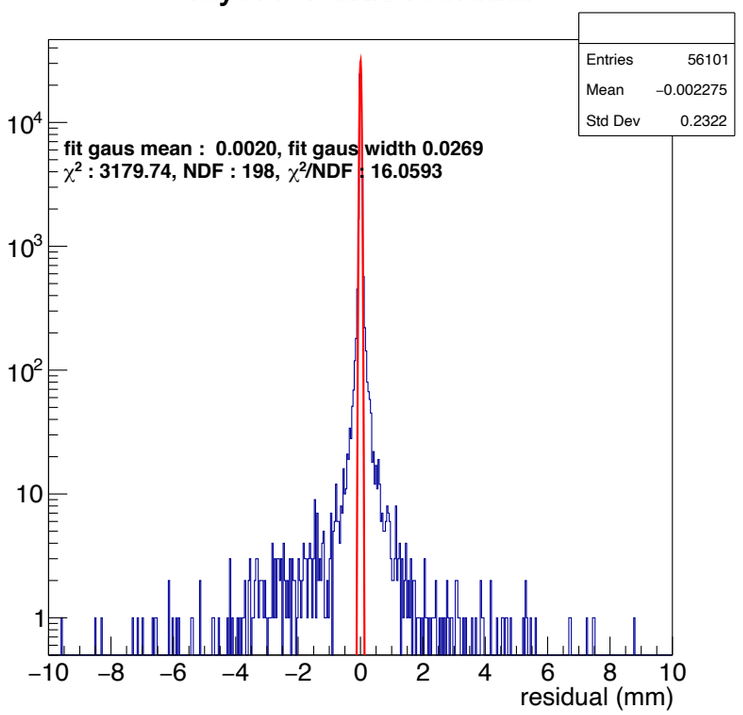




Still don't know why

Satellite peak

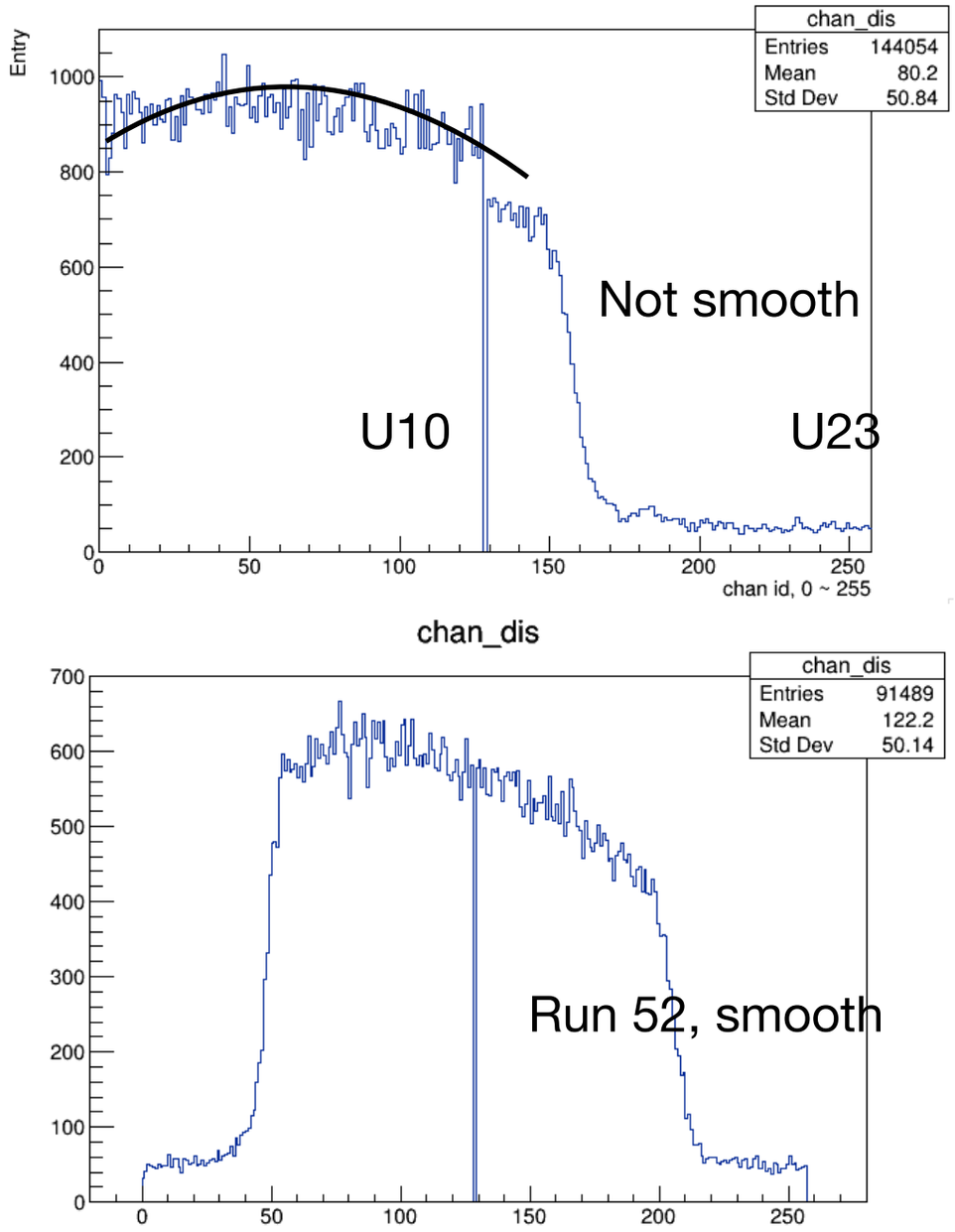




Unresolved problem - asymmetry hit

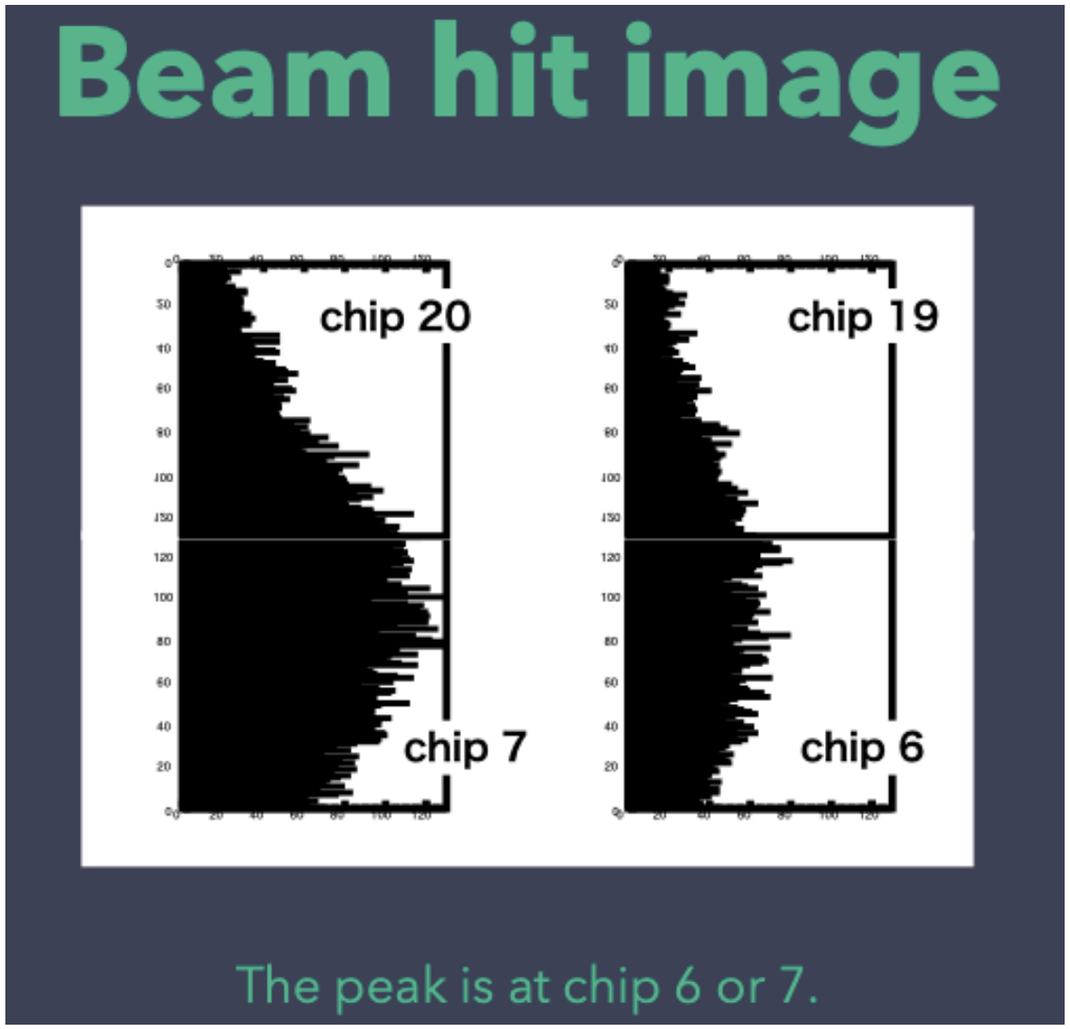
TestBeam2021

Run 89, all BCO group are used
channel hit distribution, U10 + U23



TestBeam2019

Ayaka's slide



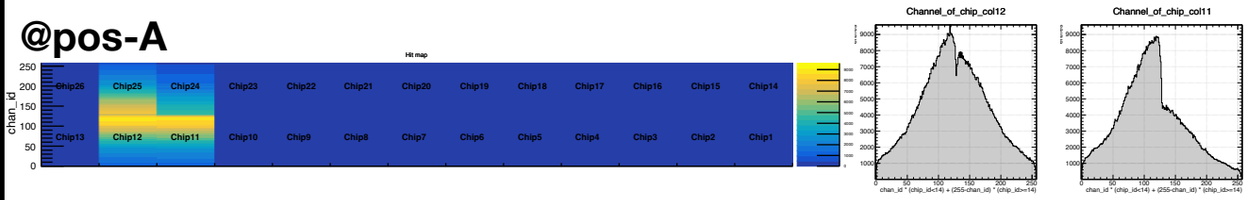
Smooth

Unresolved problem - asymmetry hit

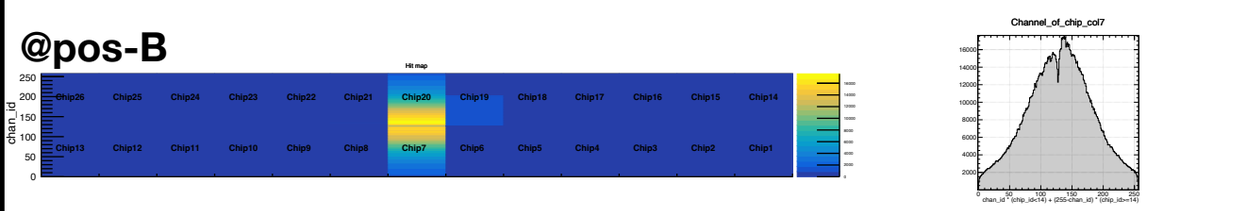
Slide from Genki

FEM

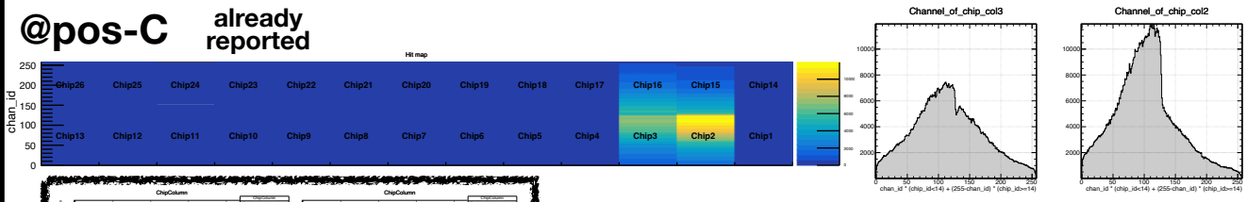
@pos-A

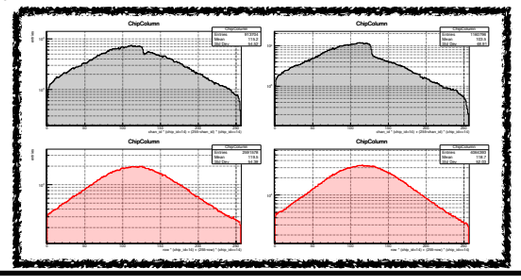


@pos-B



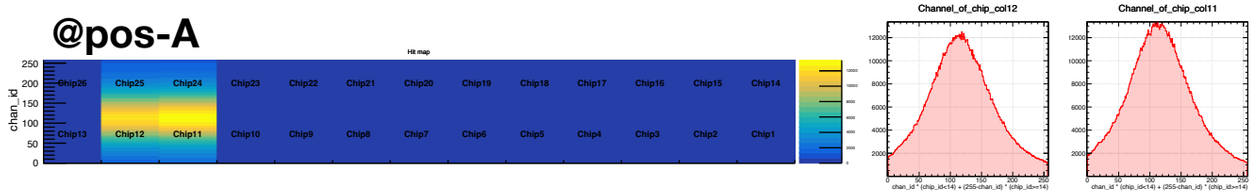
@pos-C already reported



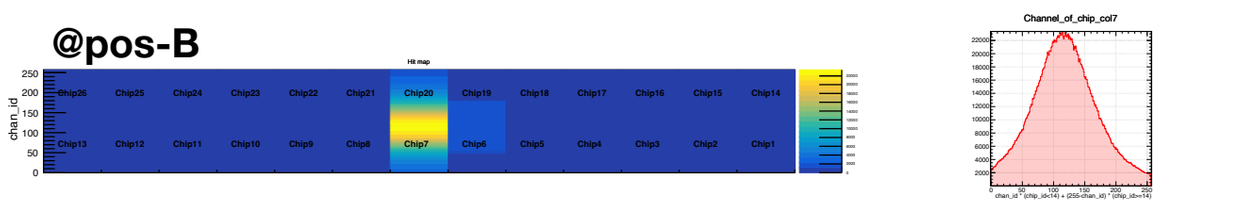


Felix

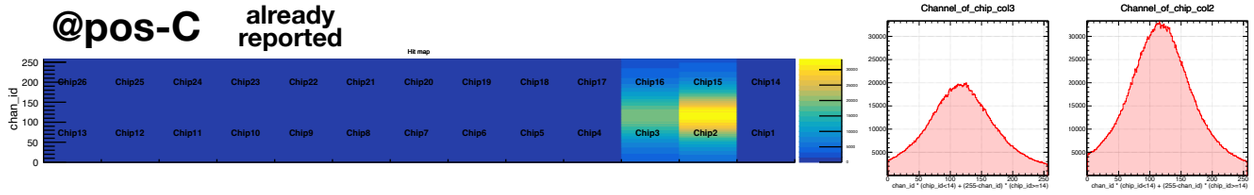
@pos-A



@pos-B

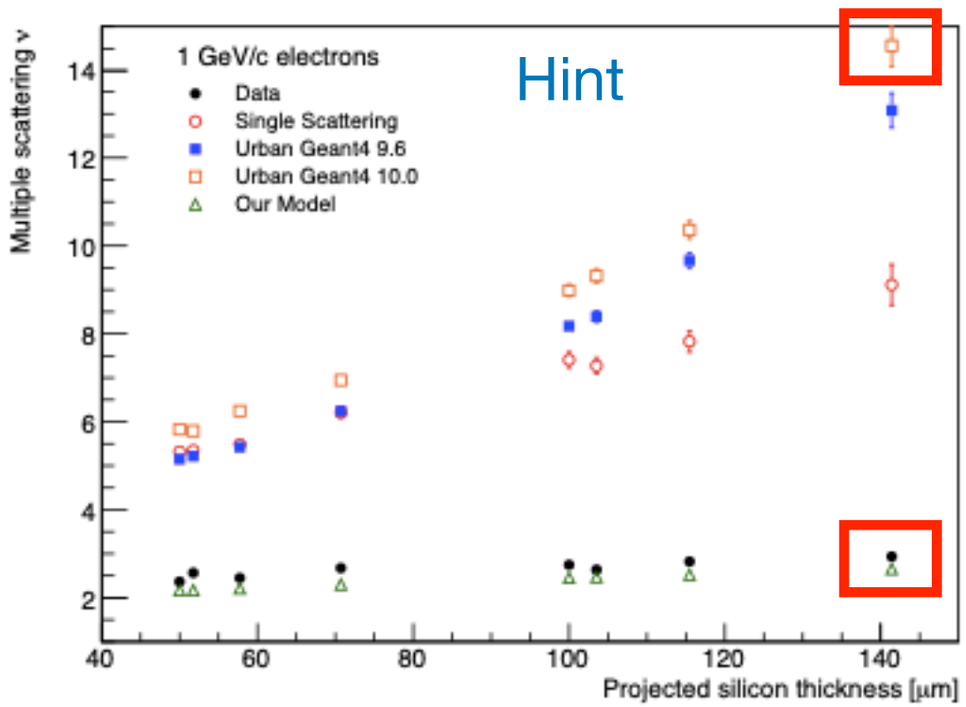


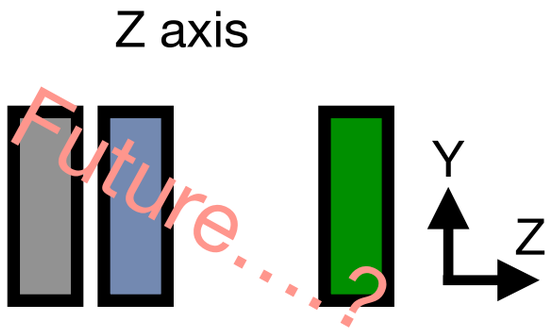
@pos-C already reported



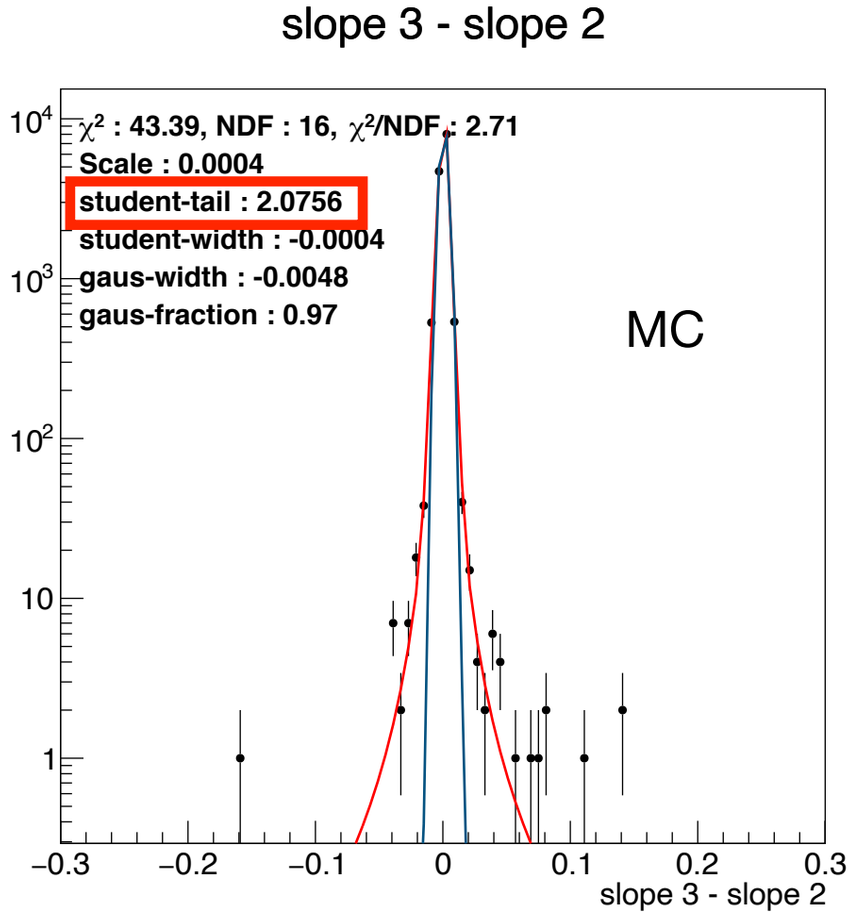
The Felix system obtained reasonable distributions at various positions of the radiation source. The channel distributions obtained by the FEM had 2 dropping regions at both ends, which cannot be explained by physics.

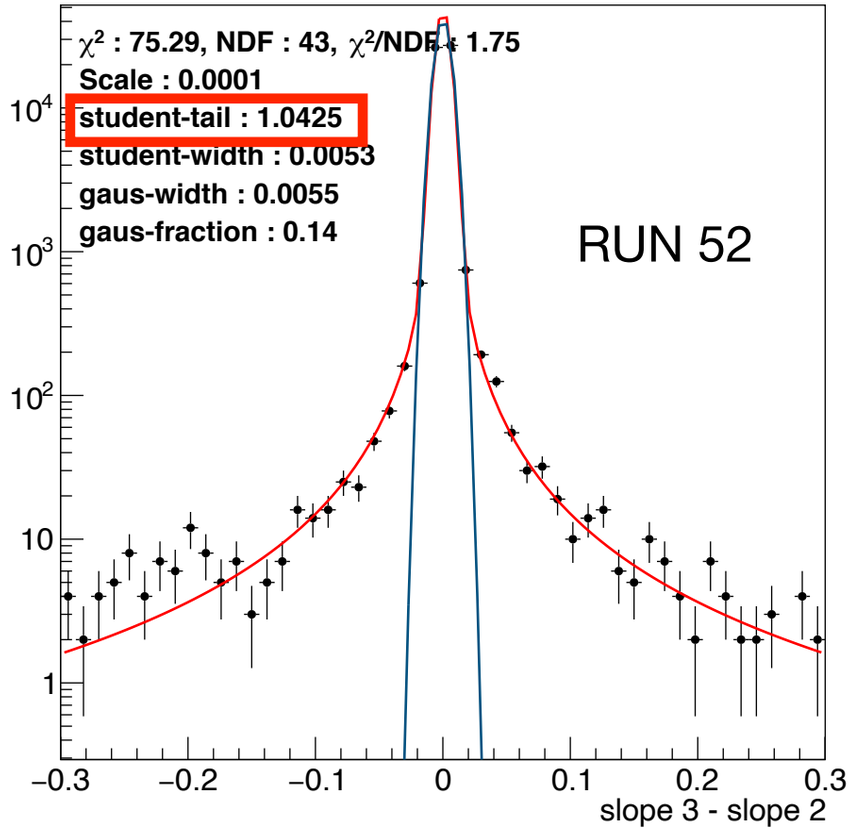
Unresolved problem - scattering angle





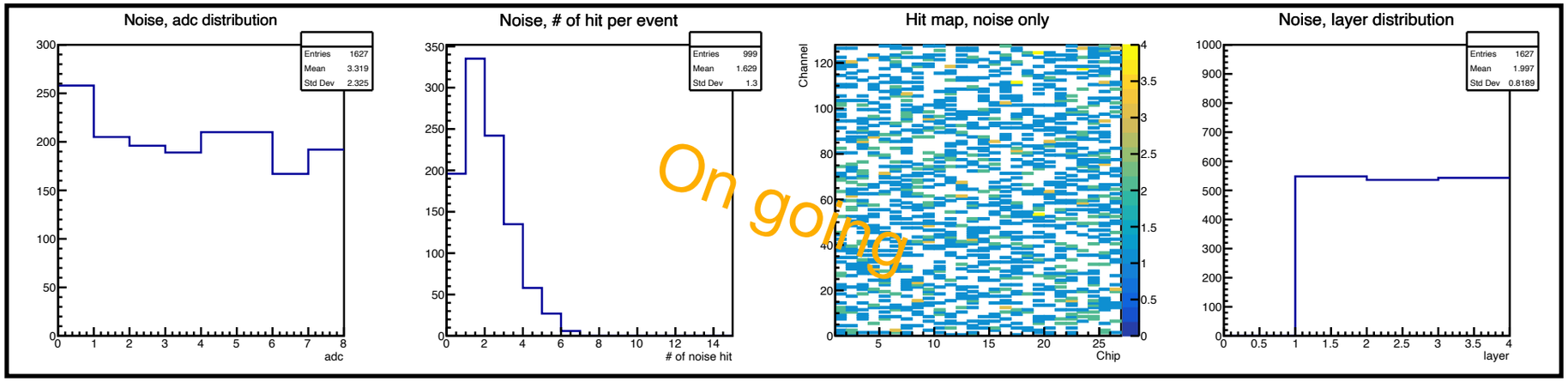
Plan : try to add noise hit first.



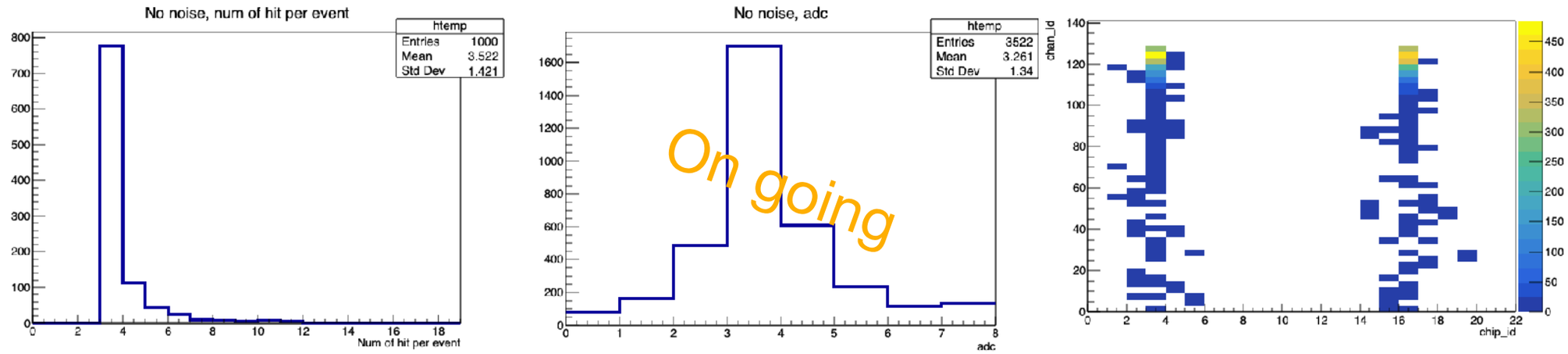


MC - noise hit add

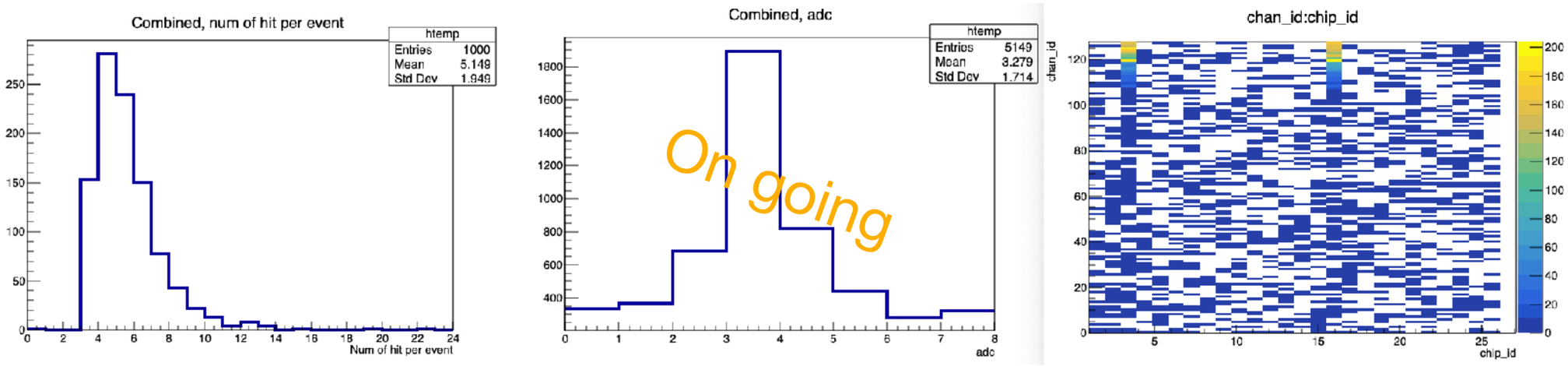
Noise hit distributions



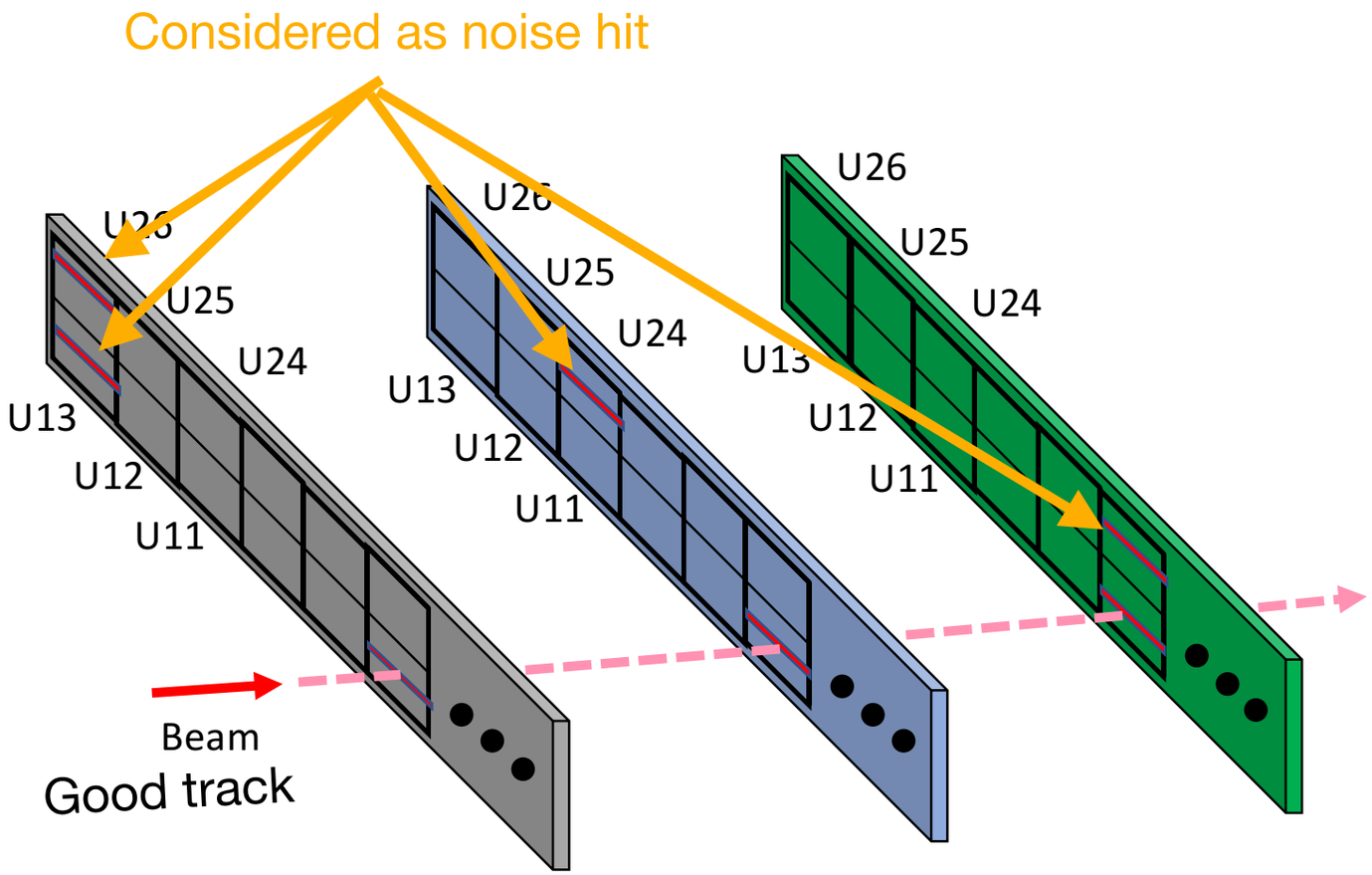
No noise



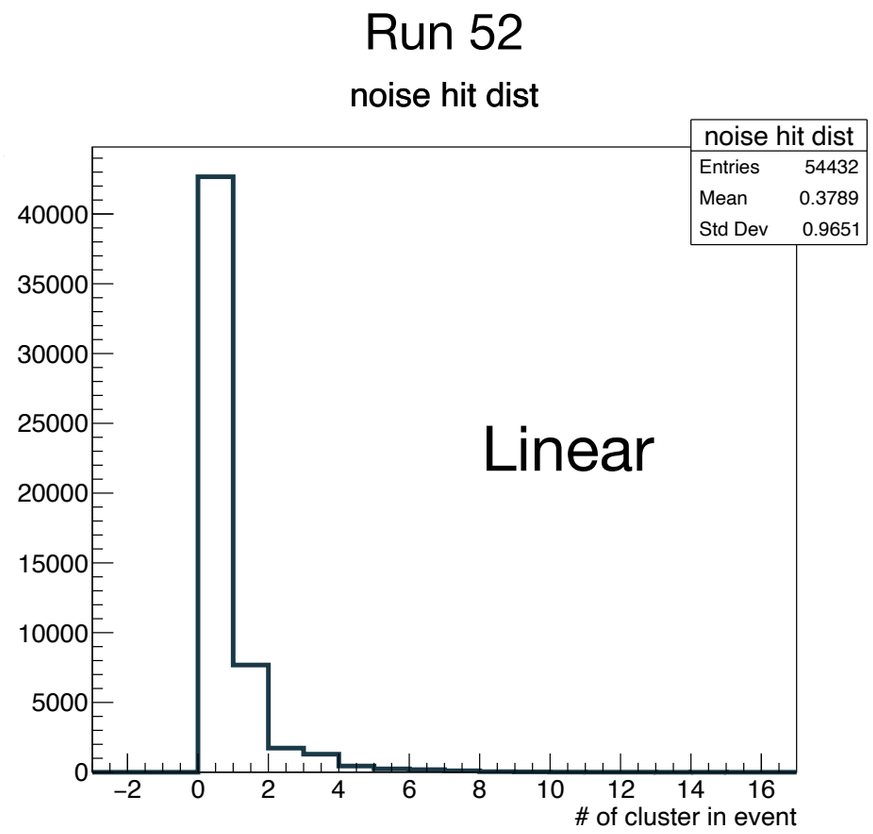
Combined, noise + MC

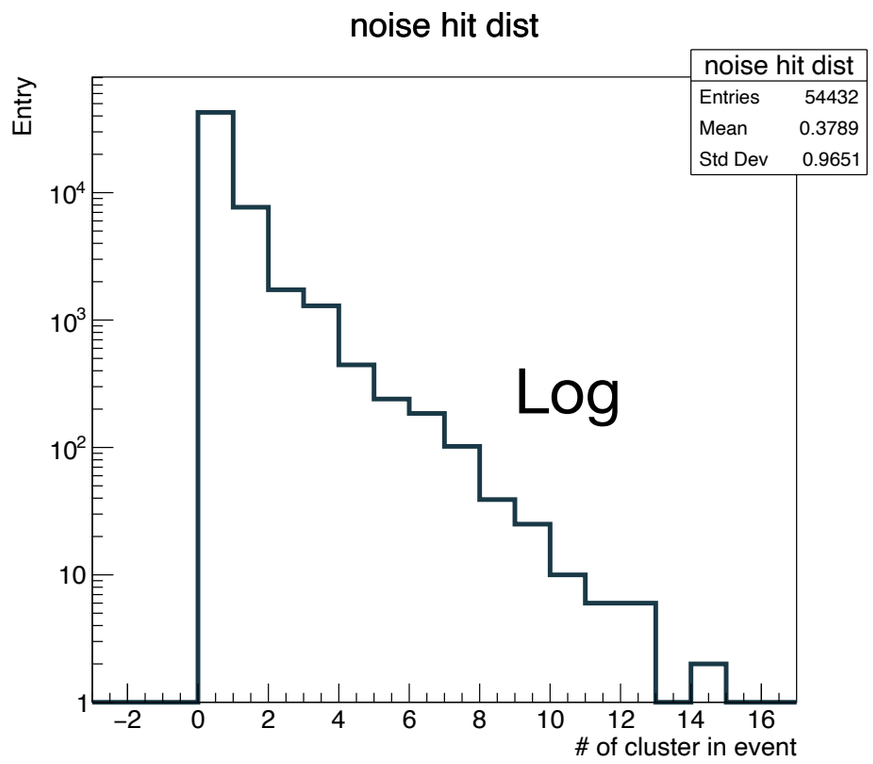


Noise hit extraction



Only check the good track event
Total cluster : 7





Summary

- A new beam test experiment was performed at the end of 2021, ELPH, Japan.
- Based on current analysis method, the efficiency can be up to 99.7% and 99% for all three layers !
- The true effi. - bco phase relation has to rely on INTT telescope.
- Still some unresolved issues remaining.
- Work hard to push it to the publication.

Back up

Step-1, first-order criteria

The schematic of the testbeam setup is shown in Figure B.1, a charged particle passes through the chip 24 of 3 ladders. In testbeam 2021, 3 scintillators were installed as the external trigger. The event has to pass the first-order criteria for further analysis, the signal size of the scintillators has to be within a range, and at least 2 hits in total is required, in addition, the measured event process time is required to be less than 106 ns.

Assumption :

1. No magnetic field, low radiation length → trajectory is a straight line
2. Only the best track is selected

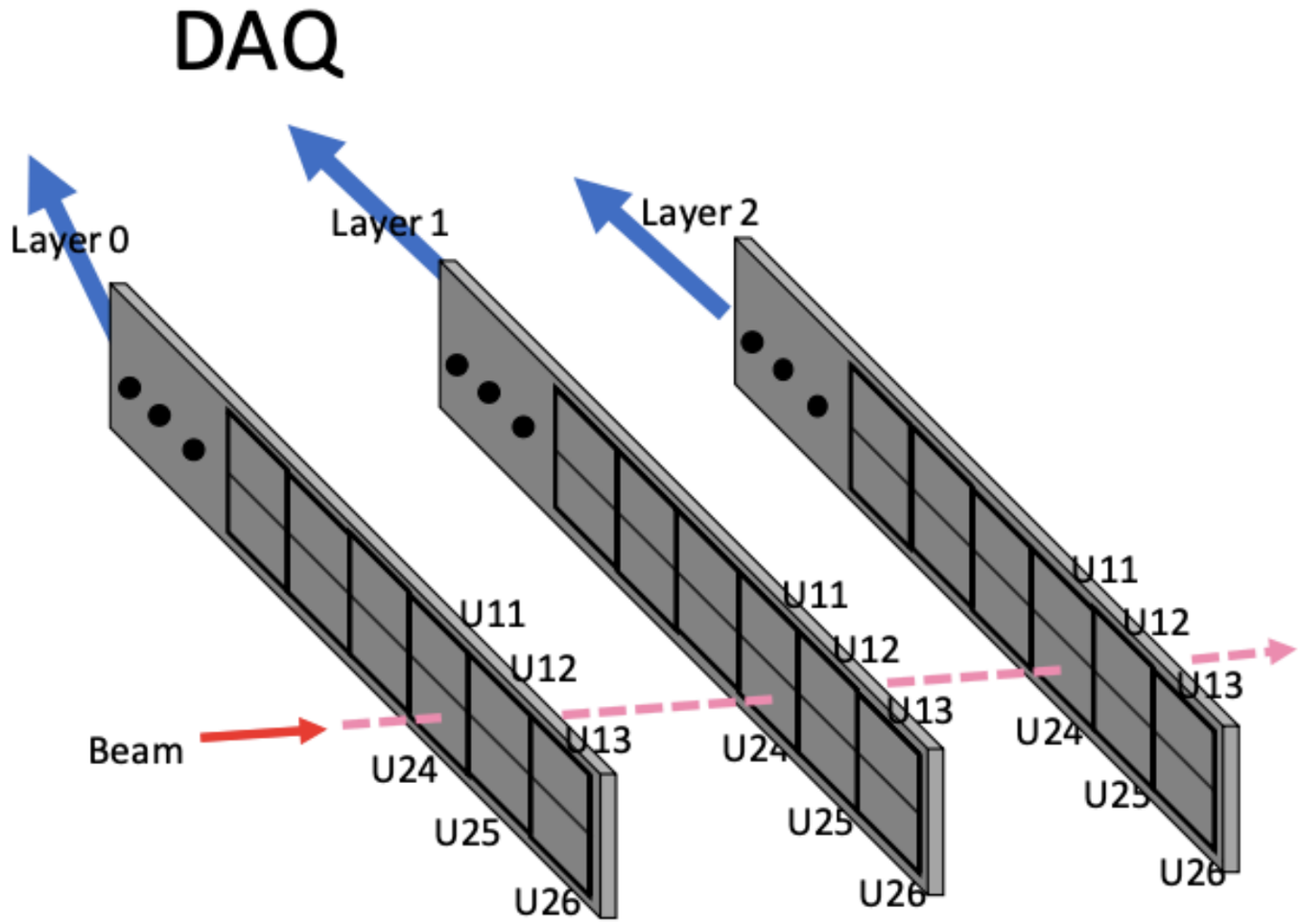


FIGURE B.1: Step 1, the schematic of the testbeam setup.

Step-2, slot selection

Since only the best track is selected and studied, the first step is to find the best track by narrowing the search scope gradually. Let's start with the **slot** selection. The assumption of the event in Figure B.2 is as follows. Five chips have hits in total, three are from the chip 24 of three layers, the rest two are from the chip 22 of layer-0 and the chip 8 of layer-1. We introduce you the **slot**, which is the combination of the top chip and bottom chip. The examples are listed, slot 13 = chip 13 + chip 26 and slot 11 = chip 11 + chip 24. Therefore, the ladder has 13 slots in total. The **VOTE** is used for slot selection, as long as the slot has hits, the **VOTE** of the slot counts one. Therefore, the maximum **VOTE** of one slot is three. In the event of Figure B.2, the VOTE of slot 8 = 1, the VOTE of slot 9 = 1, the VOTE of slot 11 = 3. The winner, slot 11, is selected for further analysis.

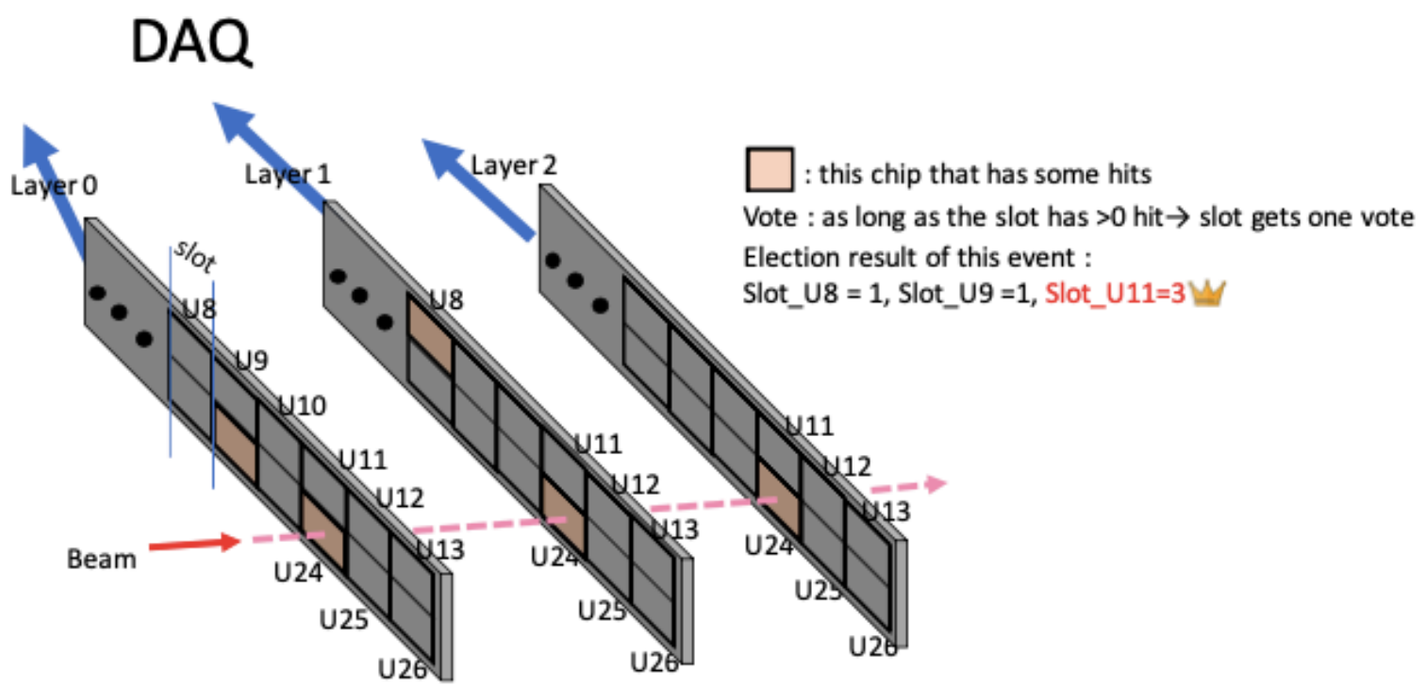


FIGURE B.2: Step 2, the slot selection.

Step-3, clustering

Step 3, clustering

Now the slot is selected, the next step is to cluster the hits of the selected slot of each layer. Take the slot 11 of layer-0 as an example, shown in Figure B.3. We assume there are nine channels fired in total. The original coordinate makes the clustering difficult, the channel ID orientations of the top and bottom chip are opposite. We introduce you a new coordinate, the same orientation with the channel ID from 0 to 255, as demonstrated in Figure B.3. The adjacent fired channels are clustered together. Therefore, there are three clusters in total, shown in Figure B.4.

The positions of the clusters are calculated by the energy weighted method B.1, where P_j^l is the position of the cluster j of layer l, E_n represents the energy deposit of channel n, C_n is defined as the position of the channel n.

$$P_j^l = \frac{\Sigma_n E_n C_n}{\Sigma_n E_n} \tag{B.1}$$

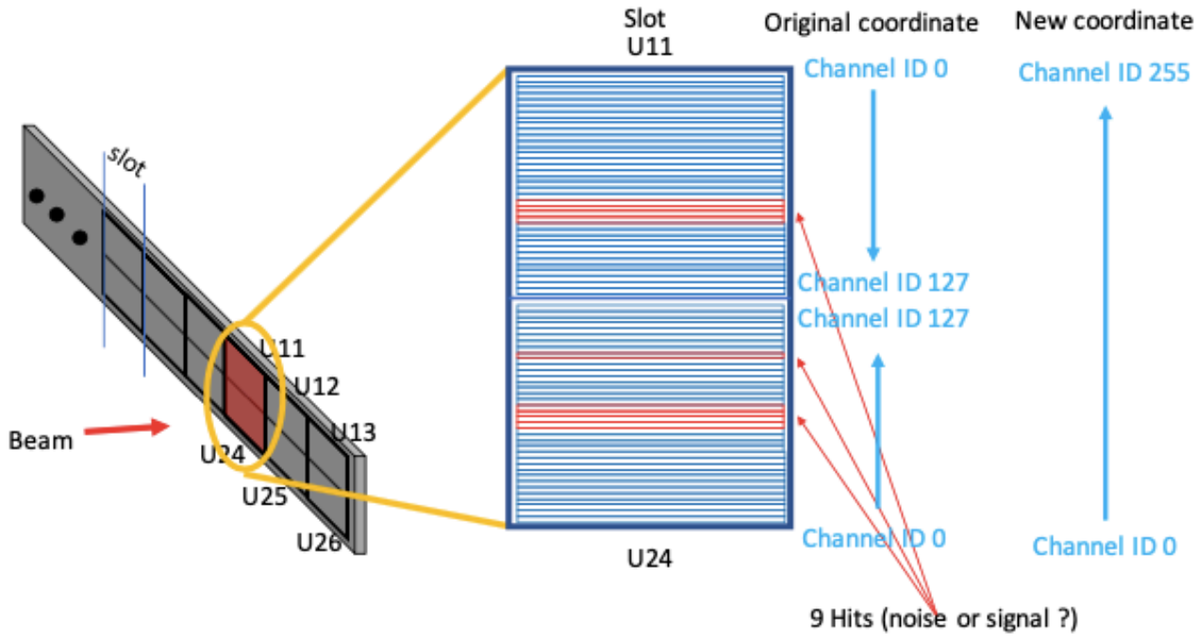


FIGURE B.3: Step 3, before clustering, 9 fired channels.

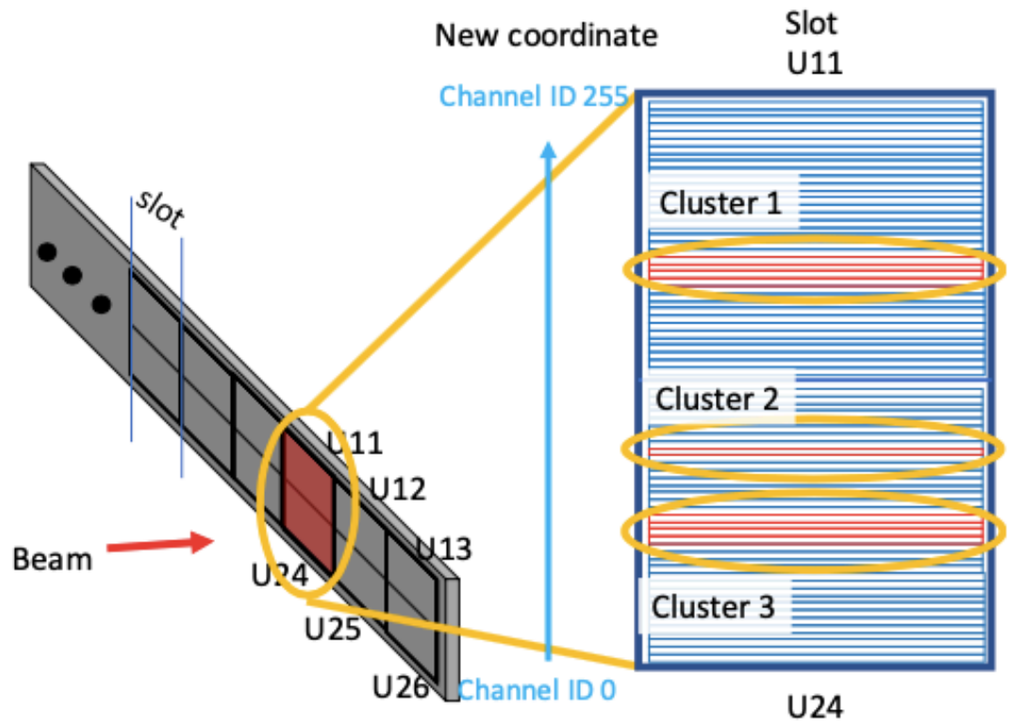


FIGURE B.4: Step 3, after clustering, 9 fired channels are reduced into 3 clusters.

Step-4, fitting

Now the clustering has been performed on each layer. Let's assume that the slot 11 of layer-0 has 3 clusters, the slot 11 of layer-1 has 1 cluster, and the slot 11 of layer-2 has 2 clusters. The schematic is displayed in Figure B.5. $3 \times 1 \times 2$, there are 6 combinations in total. All the combinations are fit with the linear polynomial function, and the combination with minimum reduce χ^2 is selected to be the best track of the event.

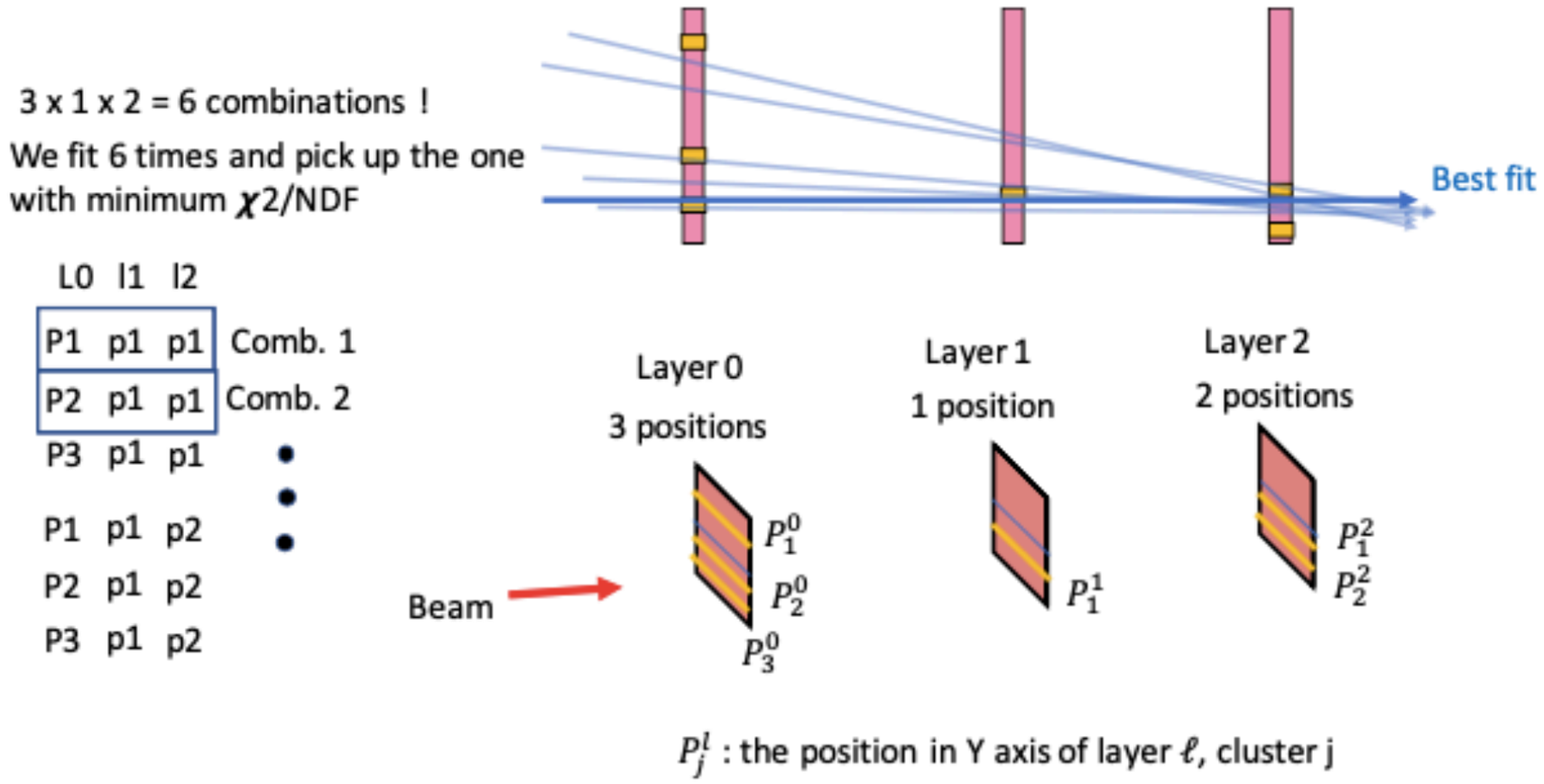


FIGURE B.5: Step 4, all the combinations are fit with the linear polynomial function.

Step-5, track quality check

Step 5, track quality check

The best track is found, the next step is to check the quality of this best track. The residuals, the distance between the fitting line and P_j^l, are checked, as shown in Figure B.6.

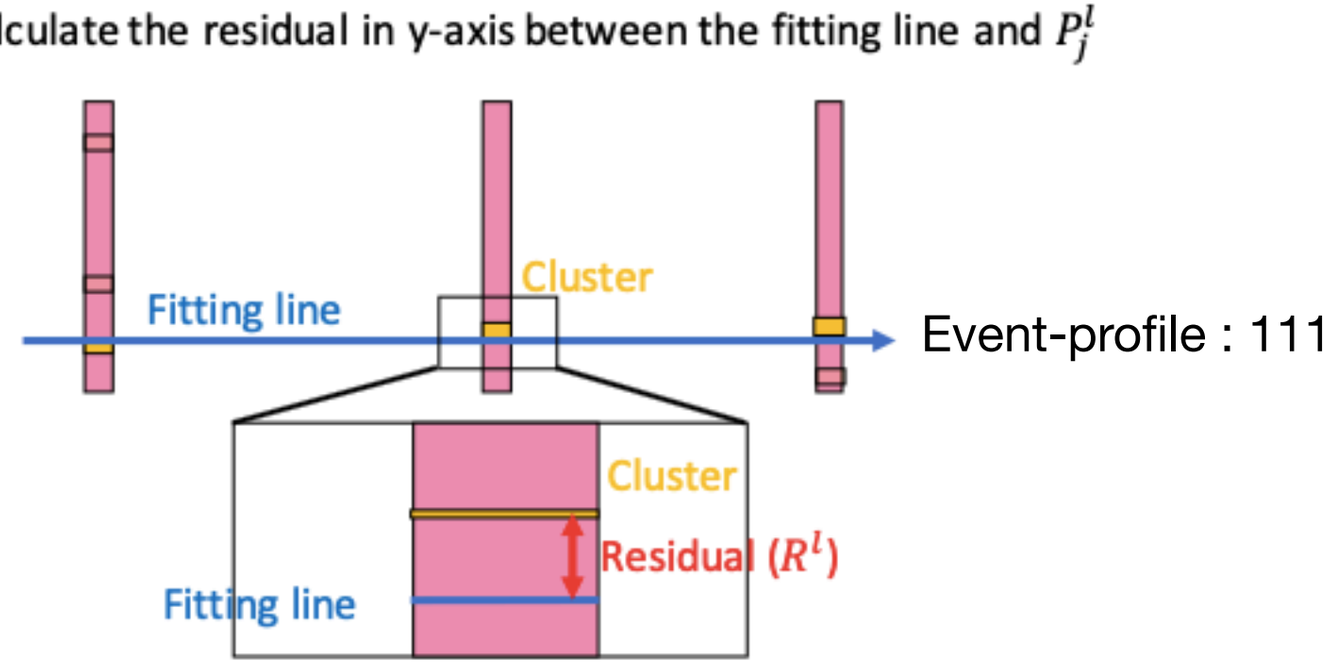


FIGURE B.6: Step 5, the distances between the cluster positions and fitting line are calculated.

Step-5, track quality check

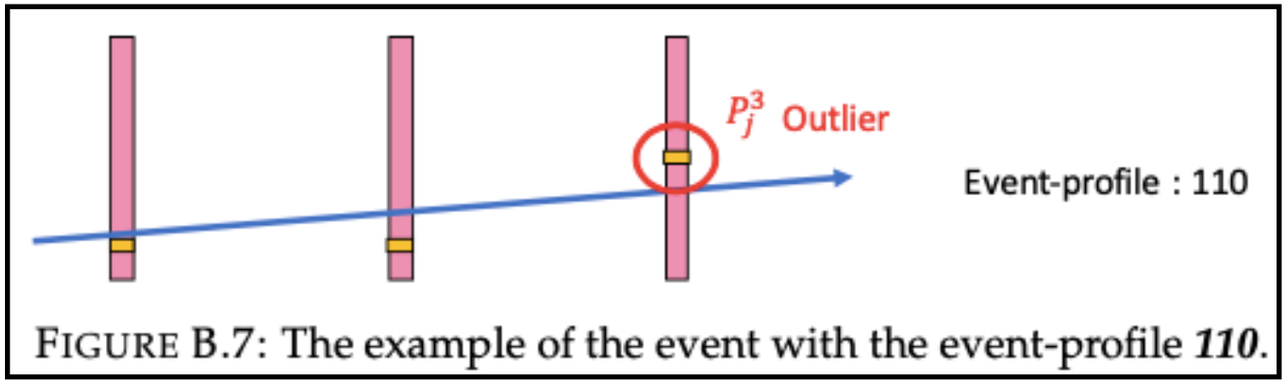


FIGURE B.7: The example of the event with the event-profile ***110***.

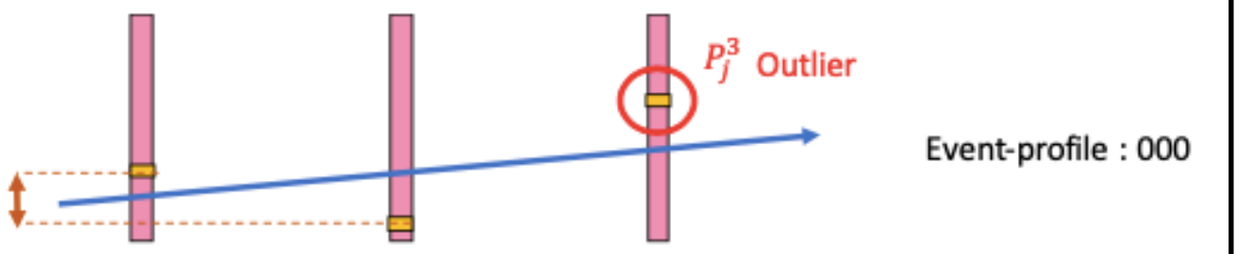


FIGURE B.8: The example of the event with the event-profile ***000***.

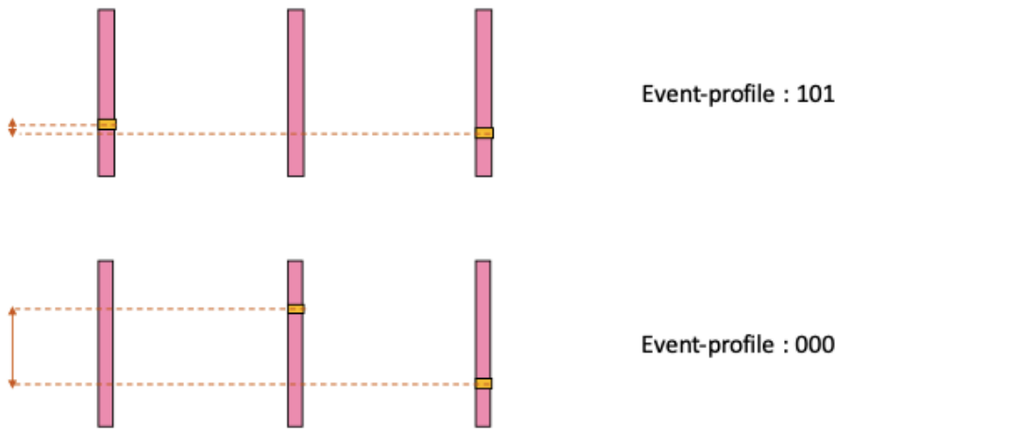


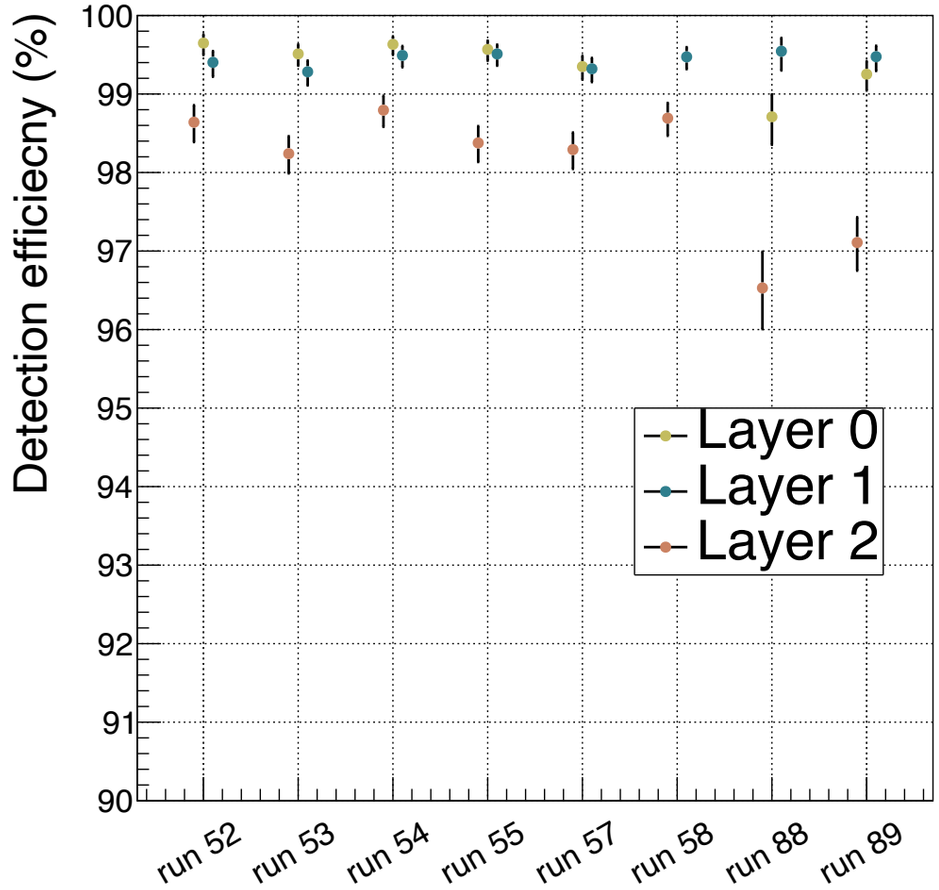
FIGURE B.9: (top) The example of the 2-clusters event with the event-profile ***101***. (bottom) The example of the 2-clusters event with the event-profile ***000***.

Testbeam2021 - original results

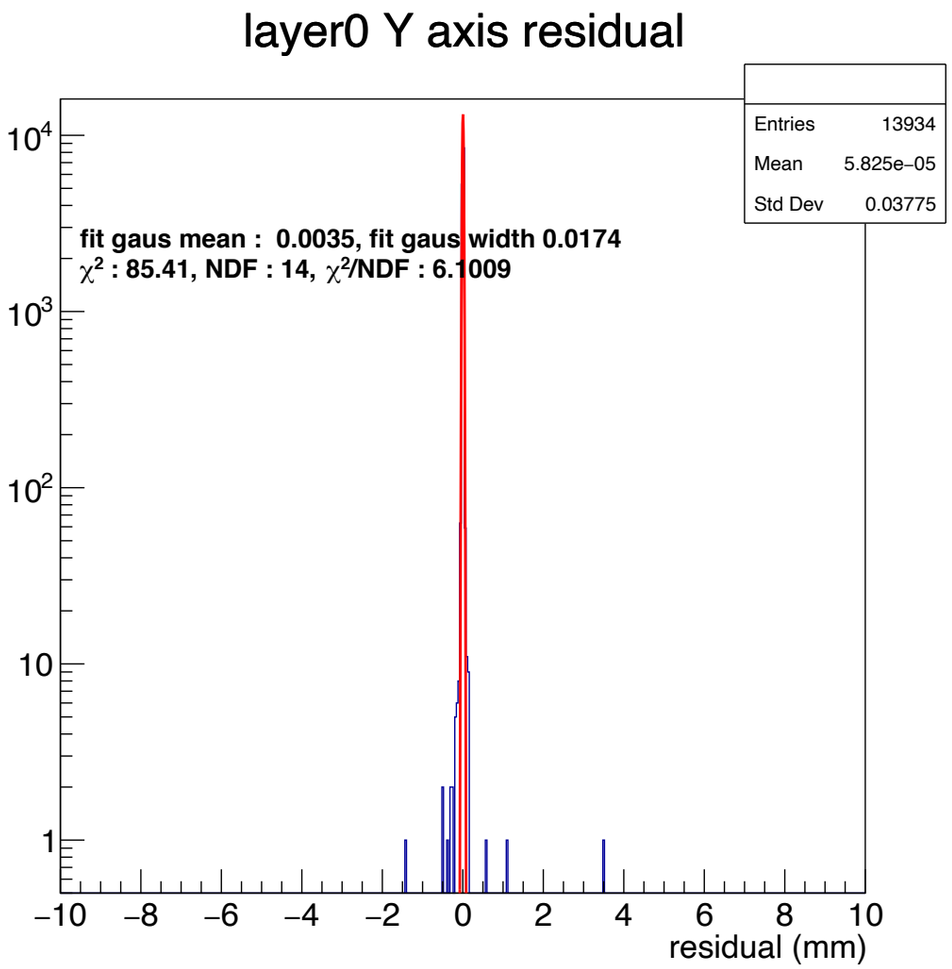
Chip selection	all	
BCO group	first	
Window cut	fixed	0.205 mm
Transverse alignment	V	
Longitudinal misalignment rejection	V	
Boundary cut	X	

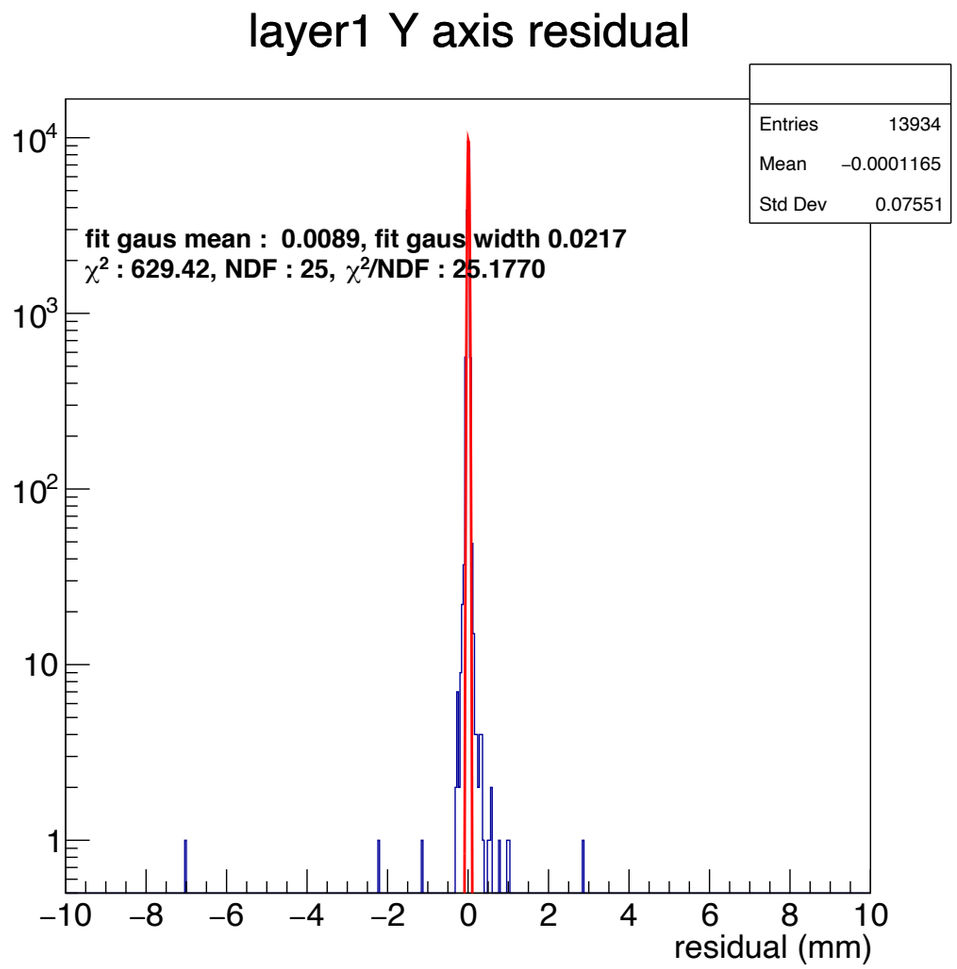
Run ID	effi. l0 (%)	effi. l1 (%)	effi. l2 (%)
52	$99.647^{+0.109}_{-0.149}$	$99.402^{+0.143}_{-0.182}$	$98.640^{+0.215}_{-0.252}$
53	$99.511^{+0.117}_{-0.149}$	$99.282^{+0.142}_{-0.173}$	$98.240^{+0.221}_{-0.250}$
54	$99.632^{+0.100}_{-0.132}$	$99.491^{+0.118}_{-0.149}$	$98.793^{+0.182}_{-0.211}$
55	$99.567^{+0.110}_{-0.142}$	$99.510^{+0.117}_{-0.149}$	$98.376^{+0.213}_{-0.242}$
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



Tracking macro test with MC

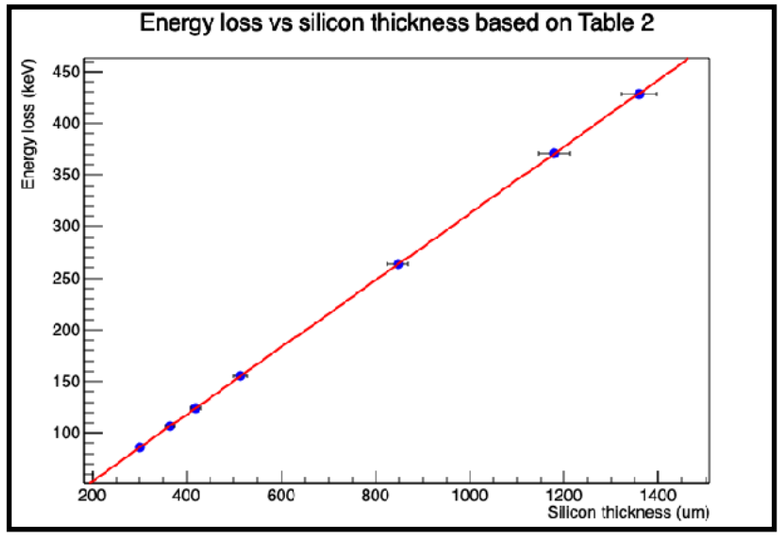





```
run file : e+_beam-para_coulomb-on_100k-events_1_convert_filter
layer 3 final counting :
 N_HHH : 13522
 N_LHH : 3
 N_HLH : 6
 N_HHL : 8
 N_LLL : 738
=====3-layers=====efficiency results==========
99.97782        +0.01207        -0.02157
99.95565        +0.01759        -0.02648
99.94087        +0.02046        -0.02915
=====3-layers=====efficiency results==========
```

Offset setting, info. found from papers

link 2 plot



Fit : Y = 3.23932e-01*X -1.12194e+01

link 3 plot

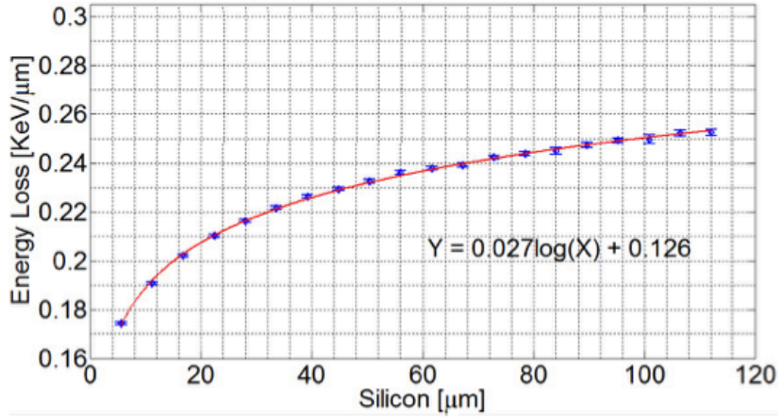


Figure 11. Energy loss for 12GeV protons passing through several silicon thickness.

// Window cut study

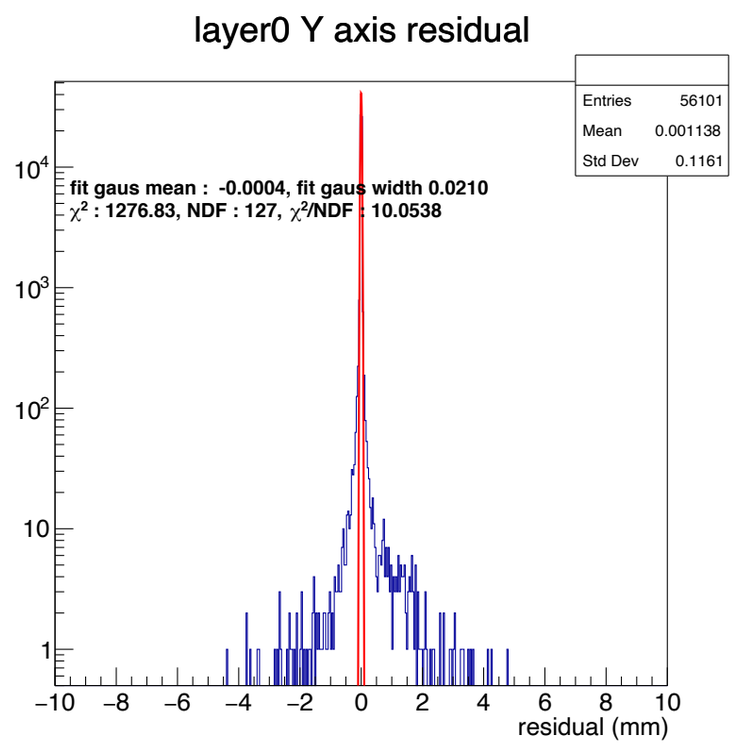
U8 || U21

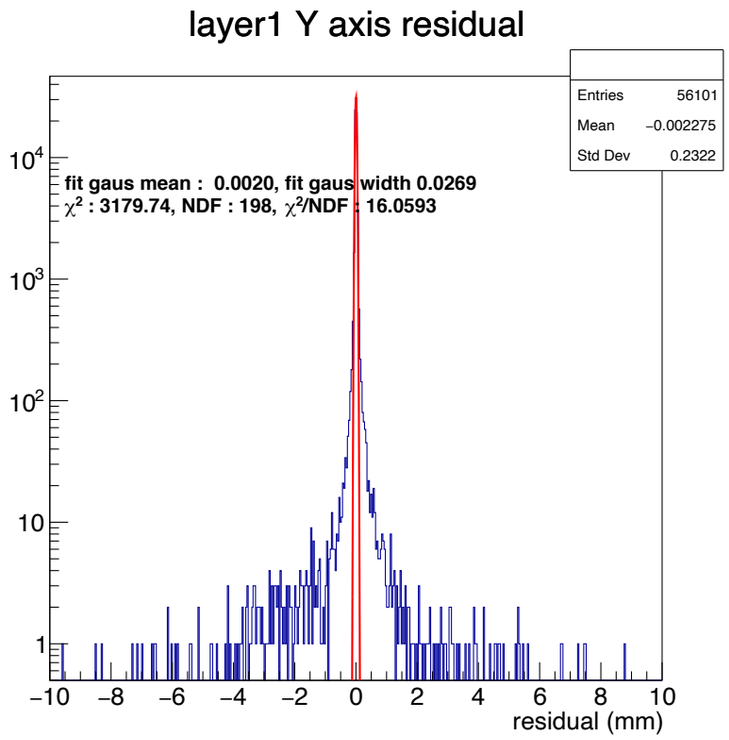
run52_no_clone.root

alignment, 0.2908 mm @ l1

3σ width of layer - 1

-0.5 mm to 0.5 mm is considered



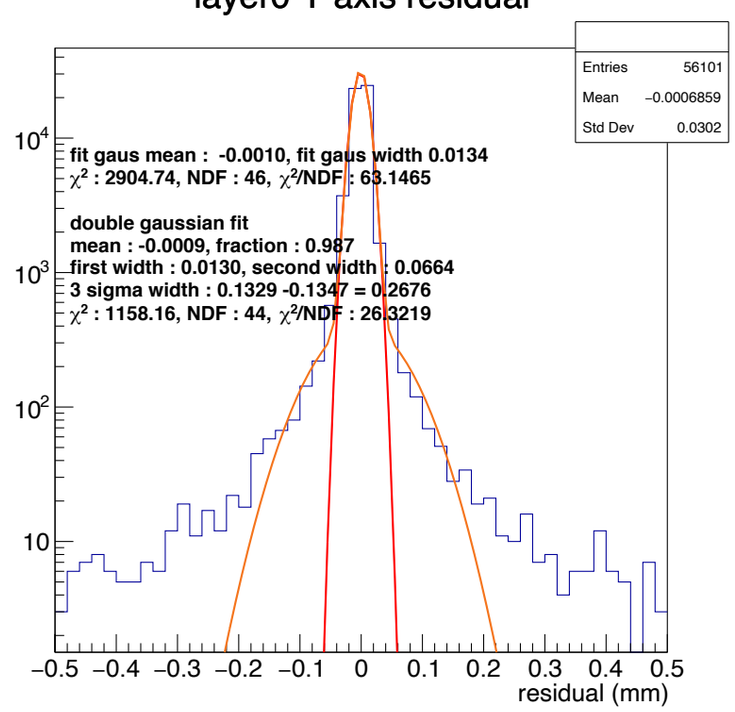


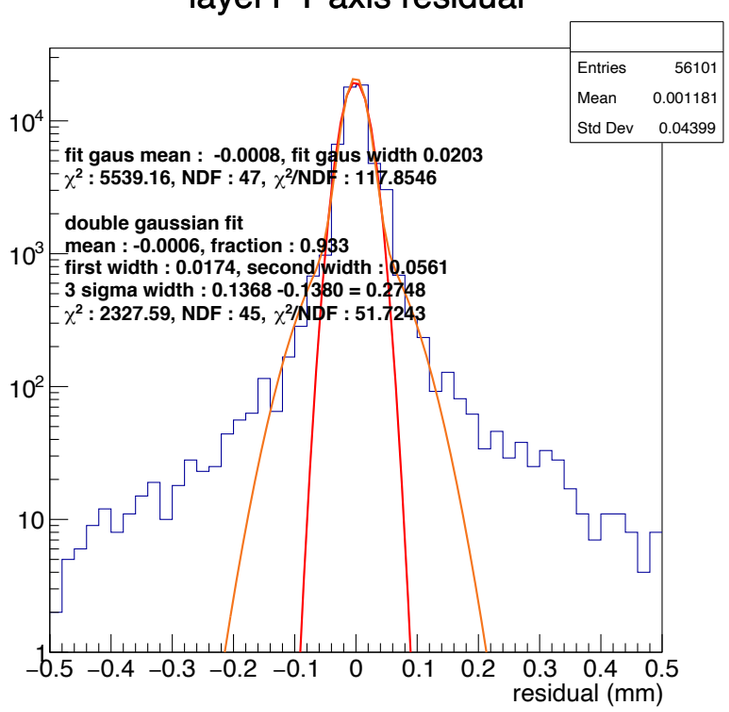
Calculate with histogram

Std dev	0.132 mm
Double gaus	0.1374 mm
Effective sigma	0.333 mm

Calculate with raw data

minimum width to contain the 0.9973% (3 sigma) event





// Window cut study

U8 || U21

run52_no_clone.root

alignment, 0.2908 mm @ l1

3σ width of layer - 1

-0.5 mm to 0.5 mm is considered

Calculate with histogram

Std dev	0.132 mm
Double gaus	0.1374 mm
Effective sigma	0.333 mm

Calculate with raw data

Boundary cut 5 ch

window size	effi. L0 (%)	effi. L1 (%)	effi. L2 (%)
0.205 mm	$99.80^{+0.02}_{-0.02}$	$99.57^{+0.03}_{-0.03}$	$99.20^{+0.04}_{-0.04}$
0.132 mm	$99.76^{+0.02}_{-0.02}$	$99.59^{+0.03}_{-0.03}$	$99.13^{+0.04}_{-0.04}$
0.137 mm	$99.73^{+0.02}_{-0.02}$	$99.60^{+0.03}_{-0.03}$	$99.00^{+0.04}_{-0.04}$
0.333 mm	$99.83^{+0.02}_{-0.02}$	$99.52^{+0.03}_{-0.03}$	$99.27^{+0.04}_{-0.04}$

* 0.205 mm : original cut, std method of run89

Testbeam 2019 - run 615

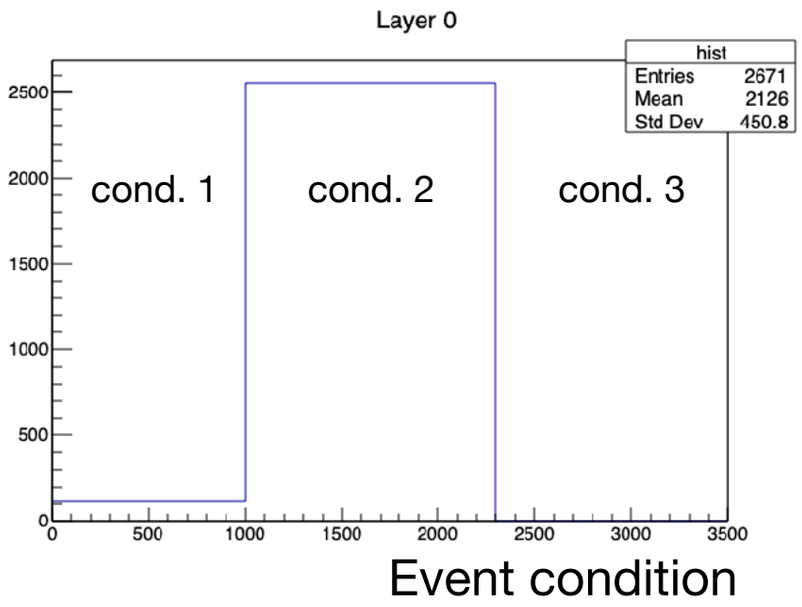
Efficiency results from Ayaka

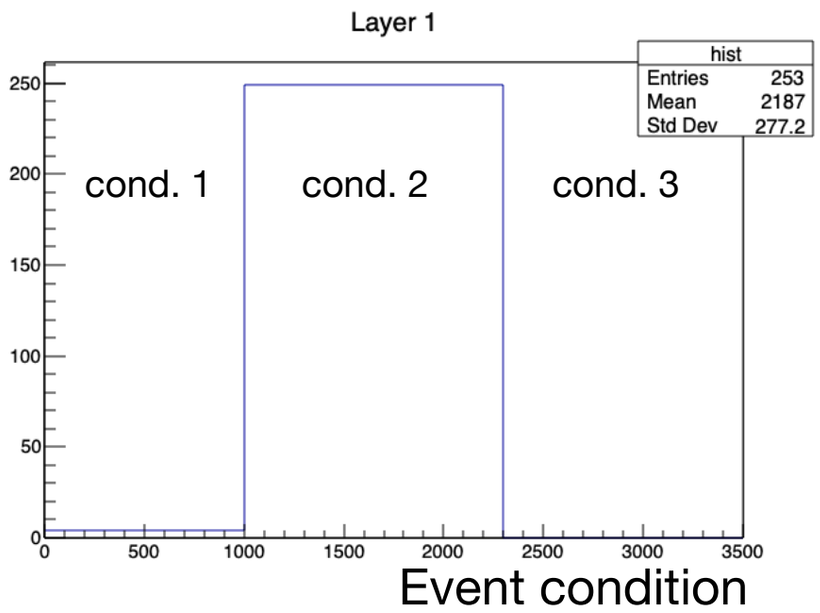
	Efficiency (U7)
Layer 0	93.55 ± 0.6%
Layer 1	63.9 ± 0.9%
Layer 2	85.8 ± 0.78%

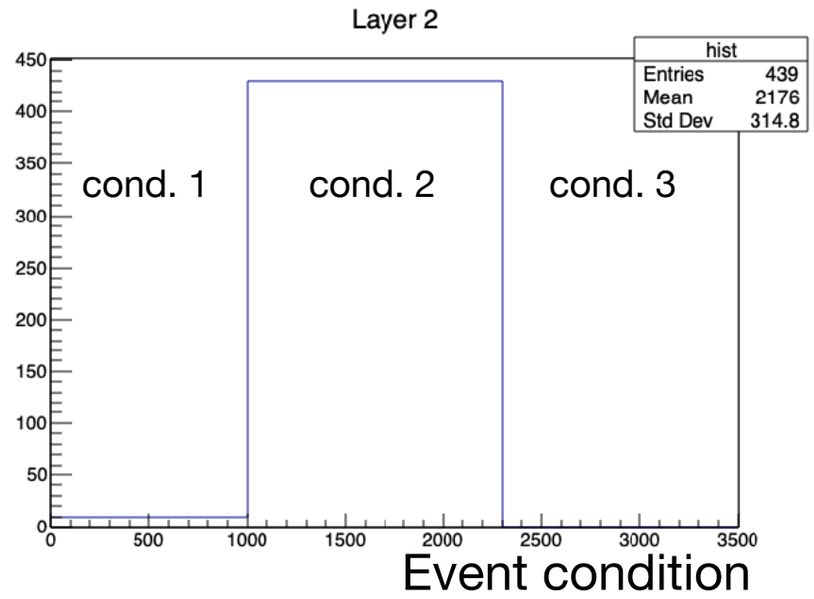
My results

	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







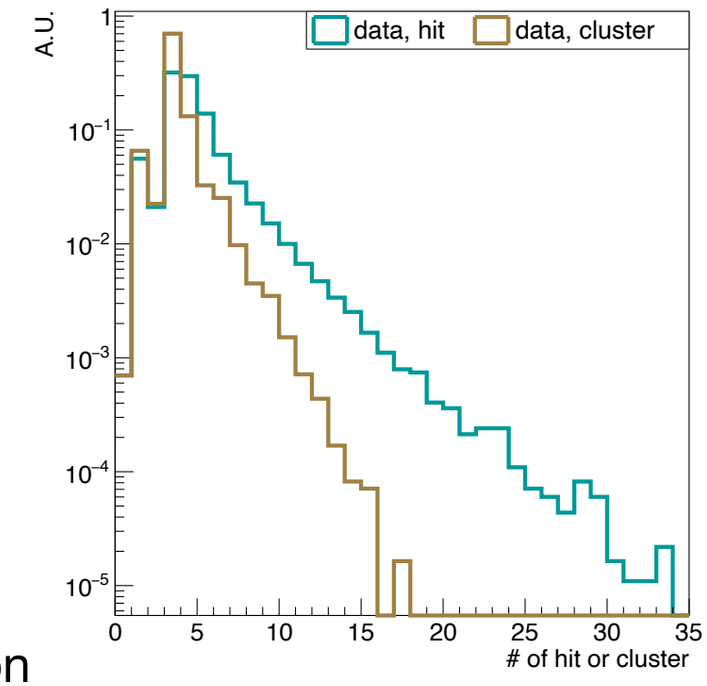
Only 2 layers have useful hits for most of the bad events. → not algorithm dependent

of hit (cluster) comparison

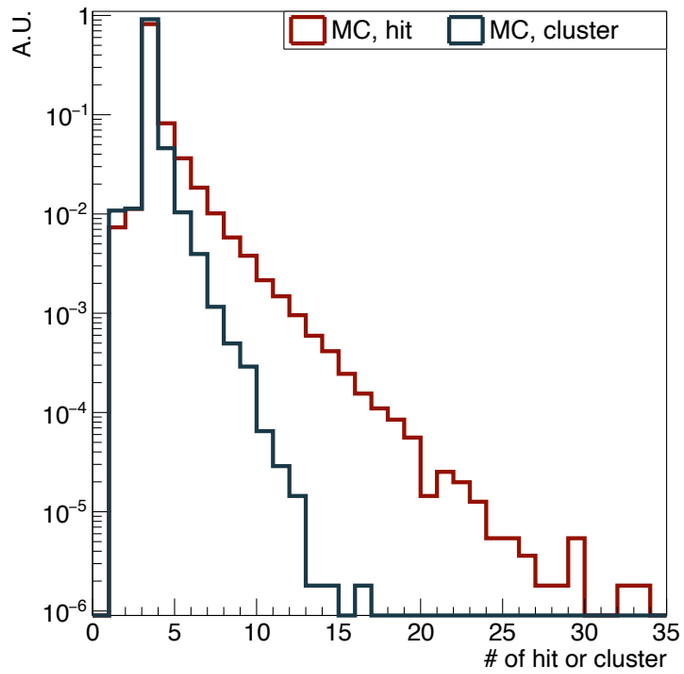
Goal :
explain the discrepancy between data and MC by introducing the noise hit in MC ?

Run 52 is used for the comparison
log scale

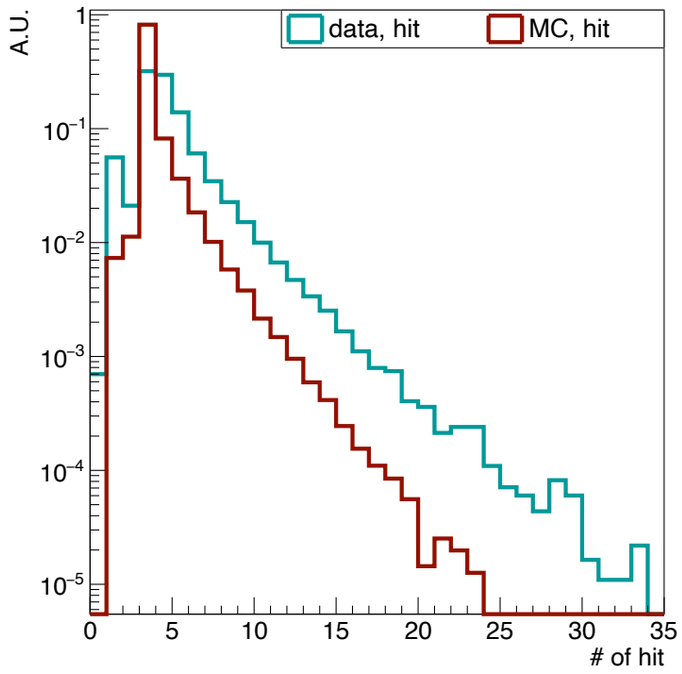
(Data) # of hit vs # of cluster



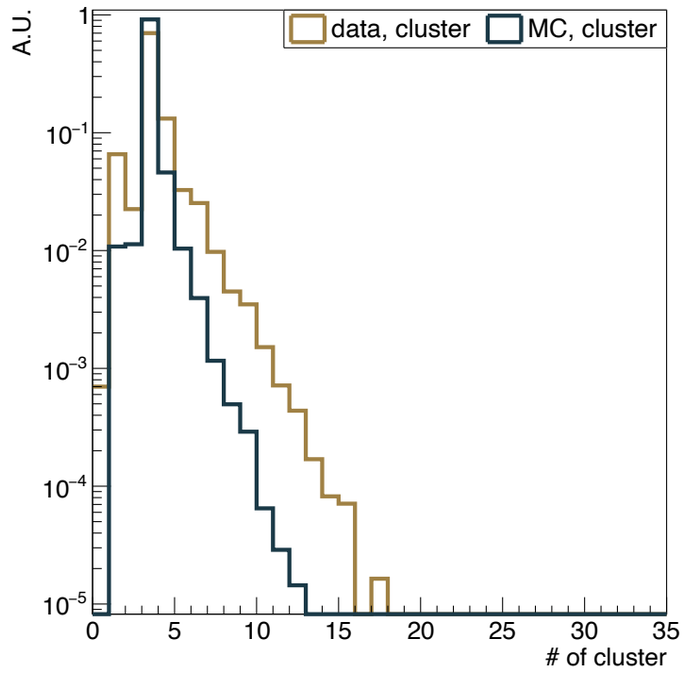
(MC) # of hit vs # of cluster



# of hit, Data - MC comparison



# of cluster, Data - MC comparison

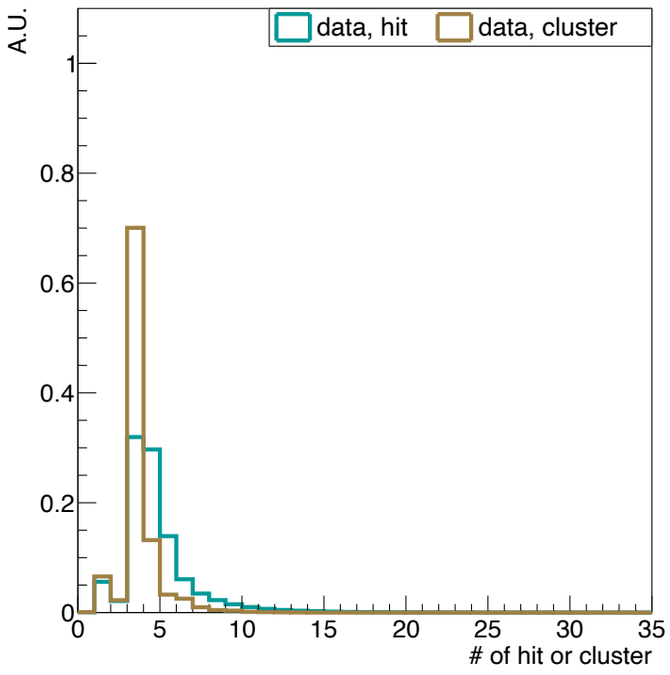


of hit (cluster) comparison

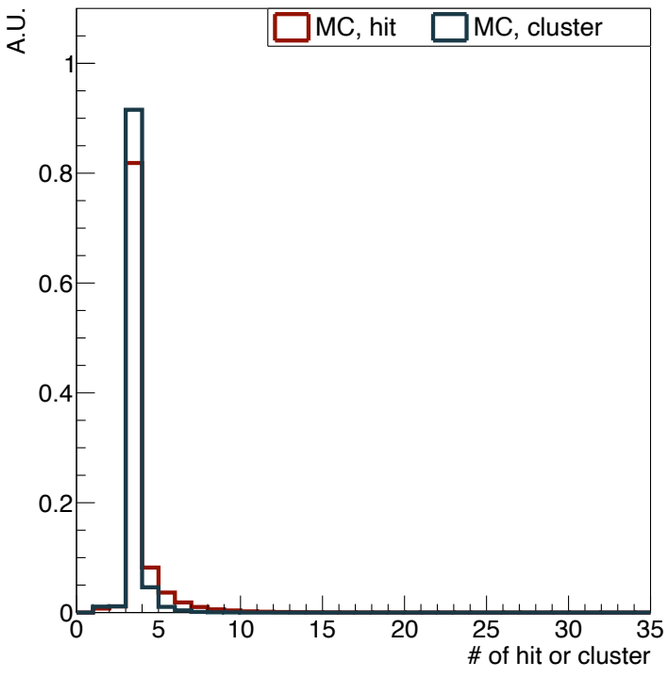
Goal :
explain the discrepancy between data and MC by introducing the noise hit in MC ?

Run 52 is used for the comparison

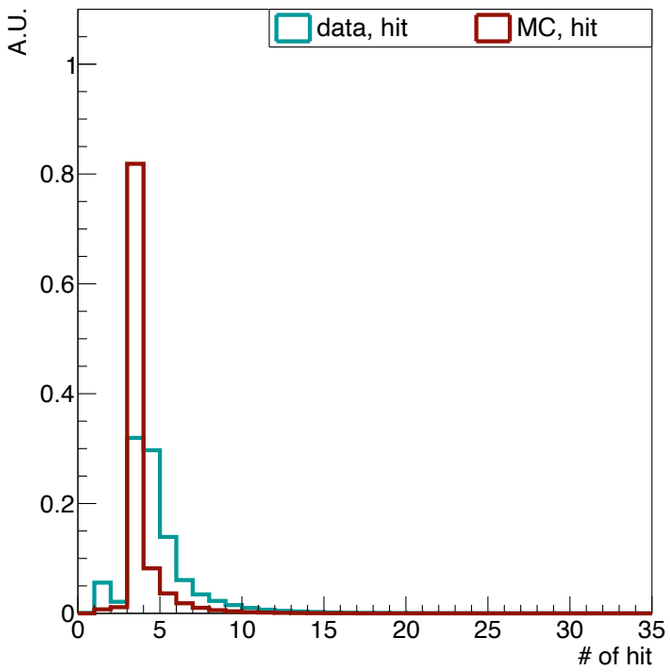
(Data) # of hit vs # of cluster



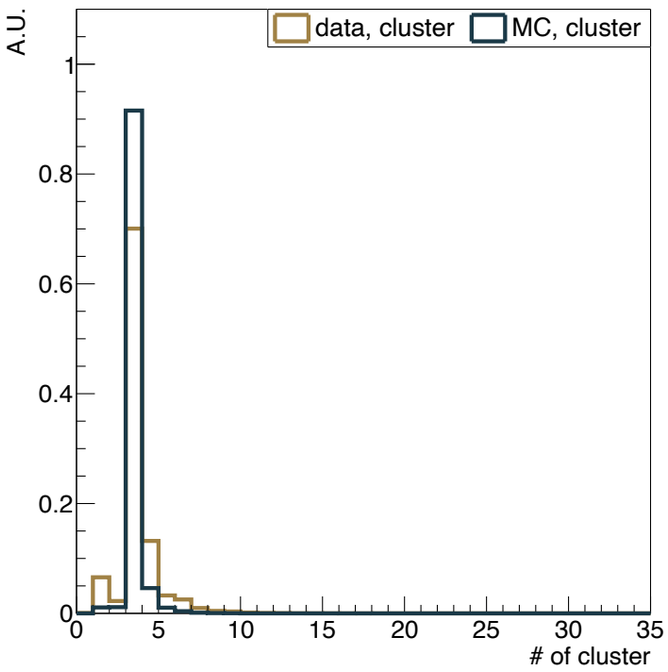
(MC) # of hit vs # of cluster



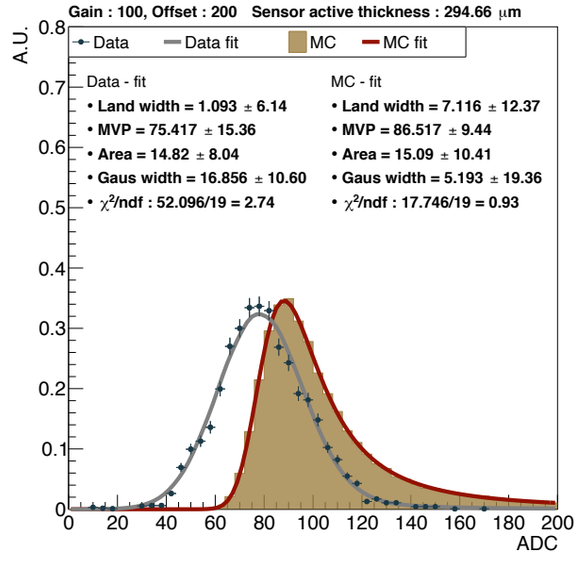
# of hit, Data - MC comparison



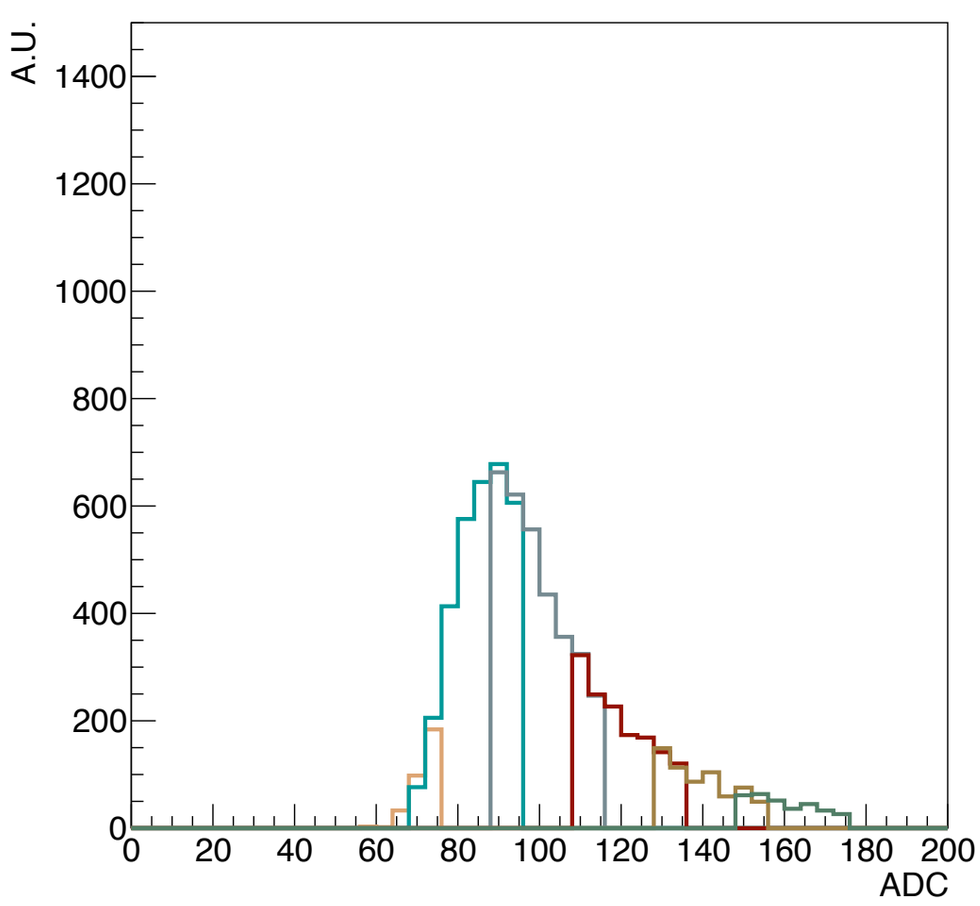
# of cluster, Data - MC comparison



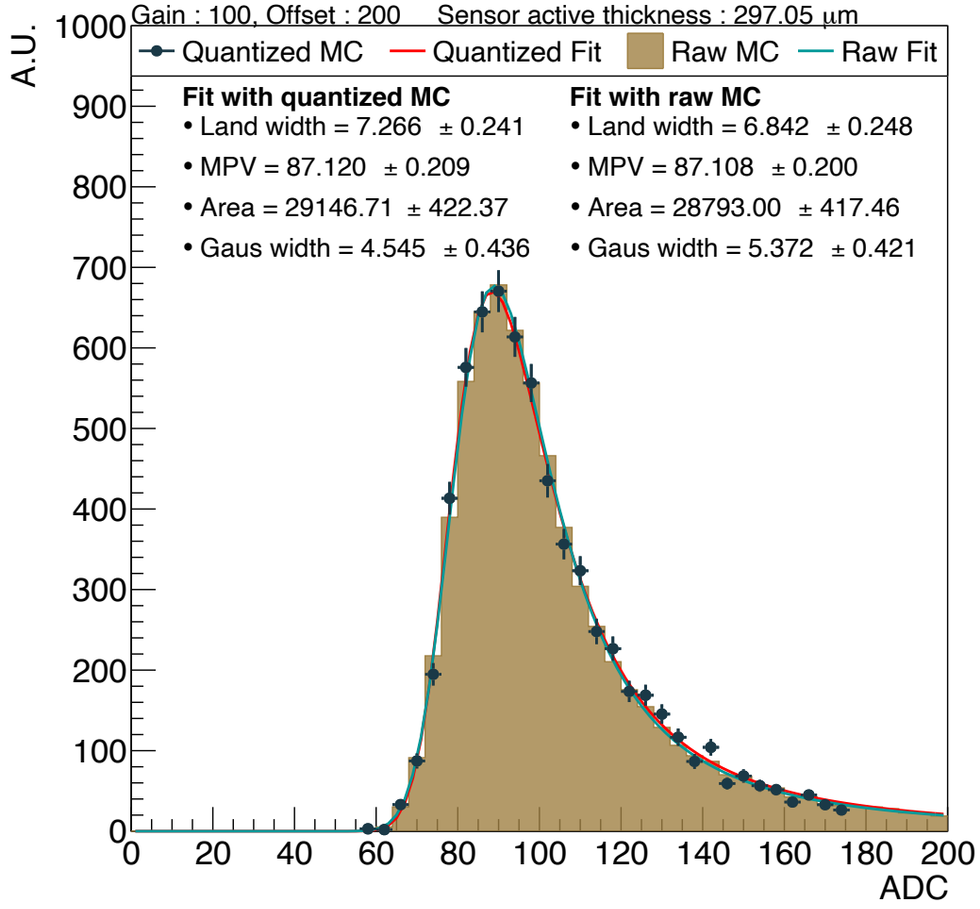
MC, DAC Scan quantization



DAC Scan combine I0 0



MC quantization test



INTT Beam Test Results and Unresolved Issues

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INTT collaboration meeting
Aug 16 & 17, 2022