INTT progress report

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National Central University

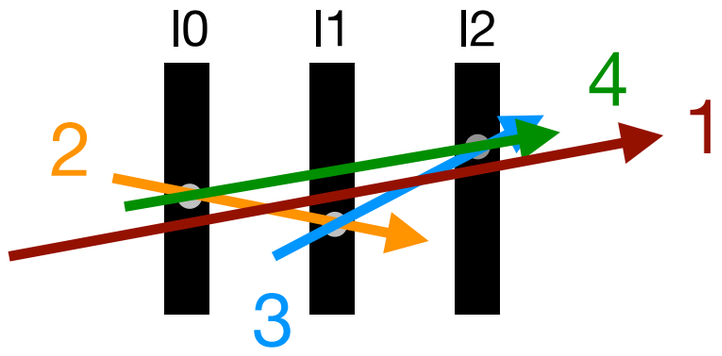
2022/1/20

Scattering

All BCO group are considered

Run 89
I1 position correction : ON
Only consider U10

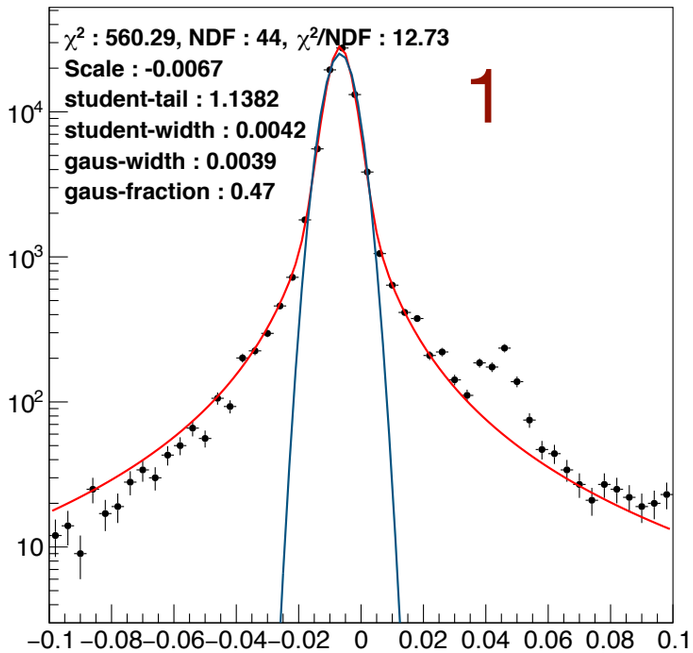
1 : 3 hits fit
2 : slope of I1-I0
3 : slope of I2-I1
4 : slope of I2-I0



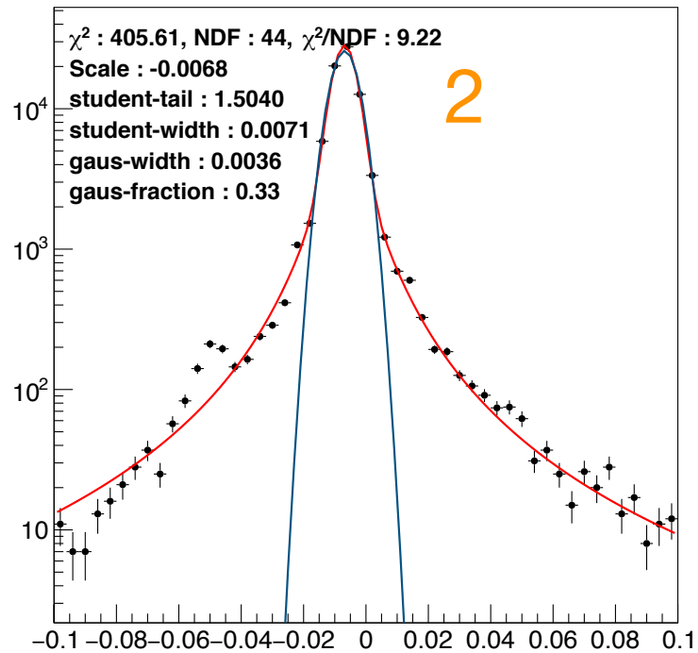
$$f_{\text{telescope}}(\theta) = N \cdot \left((1-a) \cdot \frac{1}{\sigma_G \sqrt{2\pi}} e^{-\frac{(\theta-\mu)^2}{2\sigma_G^2}} + a \cdot \frac{\Gamma(\frac{\nu+1}{2})}{\sqrt{\nu\pi}\sigma\Gamma(\frac{\nu}{2})} \left(1 + \frac{(\theta-\mu)^2}{\nu\sigma^2}\right)^{-\frac{\nu+1}{2}} \right).$$

Gaussian + student-t

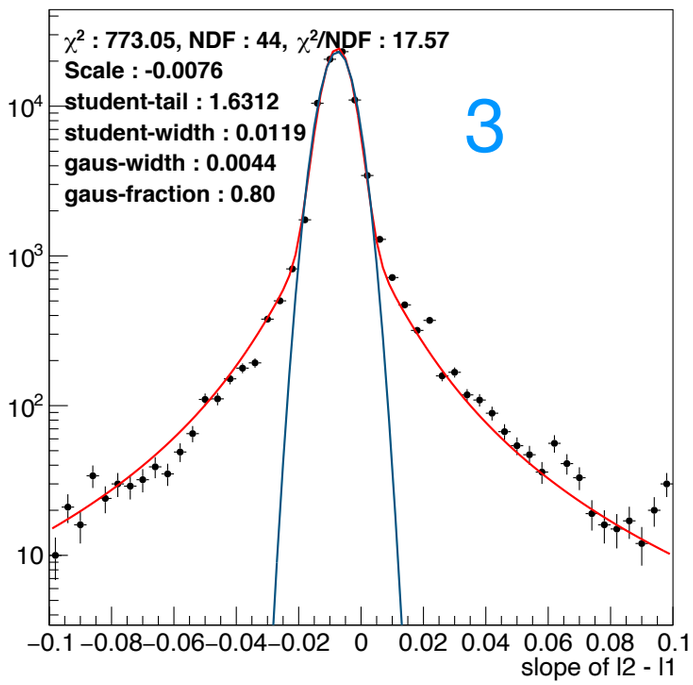
slope of 3 hits



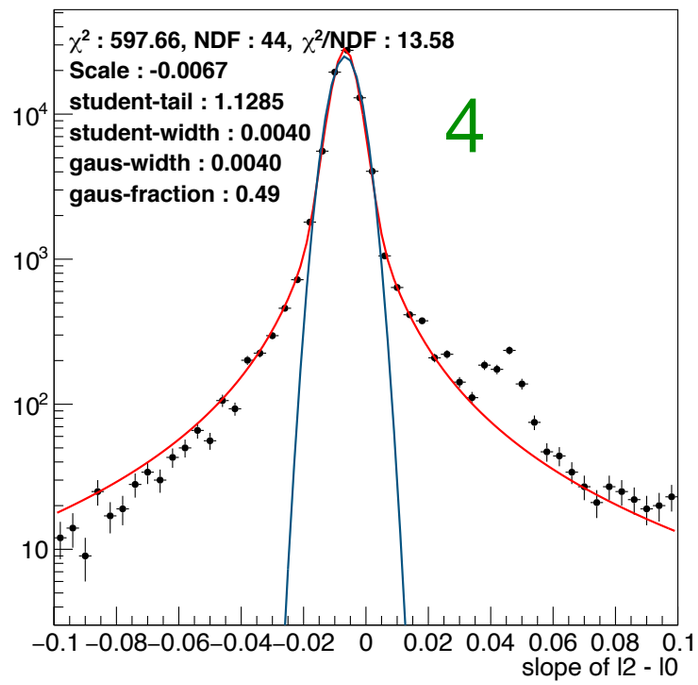
slope of I1 - I0



slope of I2 - I1



slope of I2 - I0



Scattering

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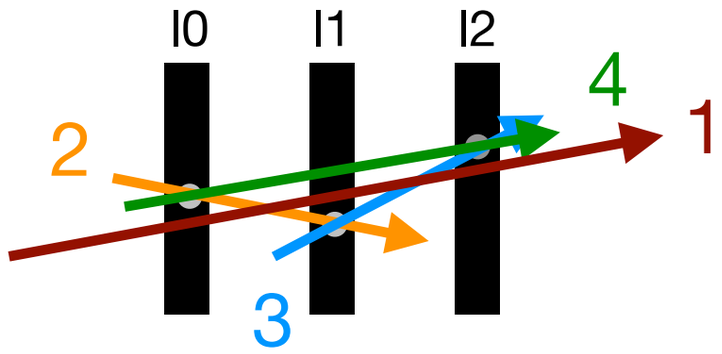

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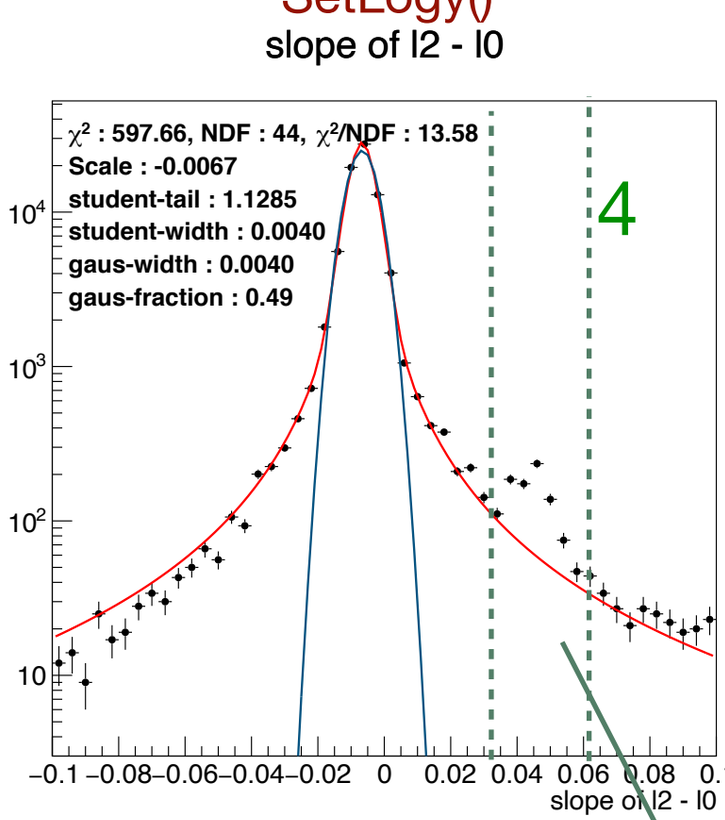
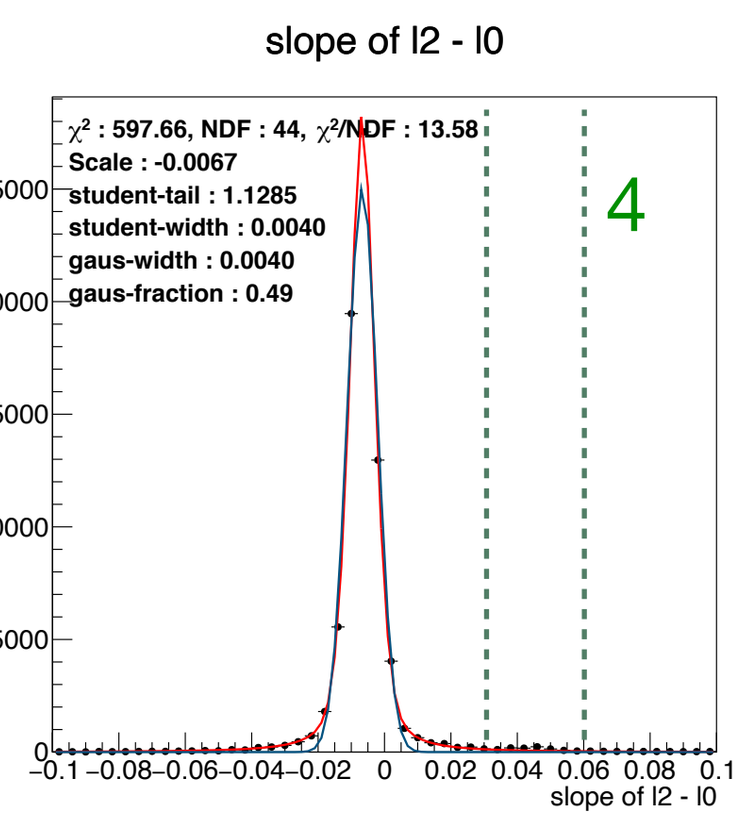
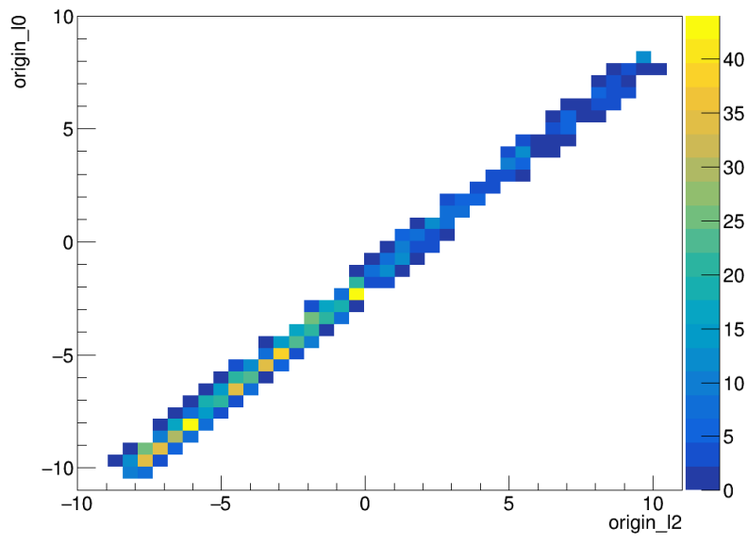
Gaussian + student-t

SetLogy()

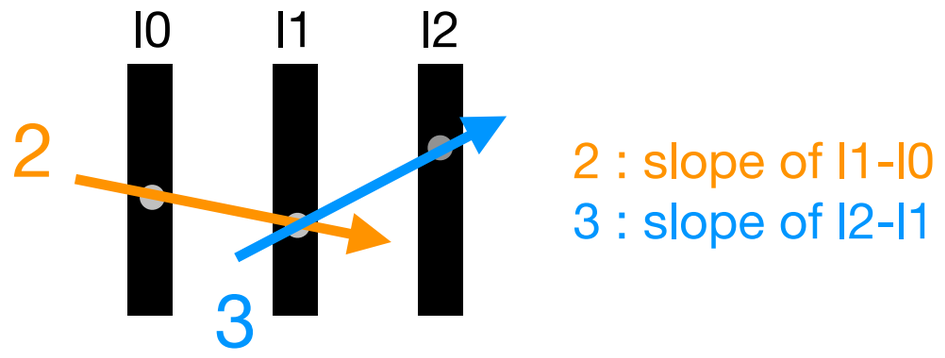




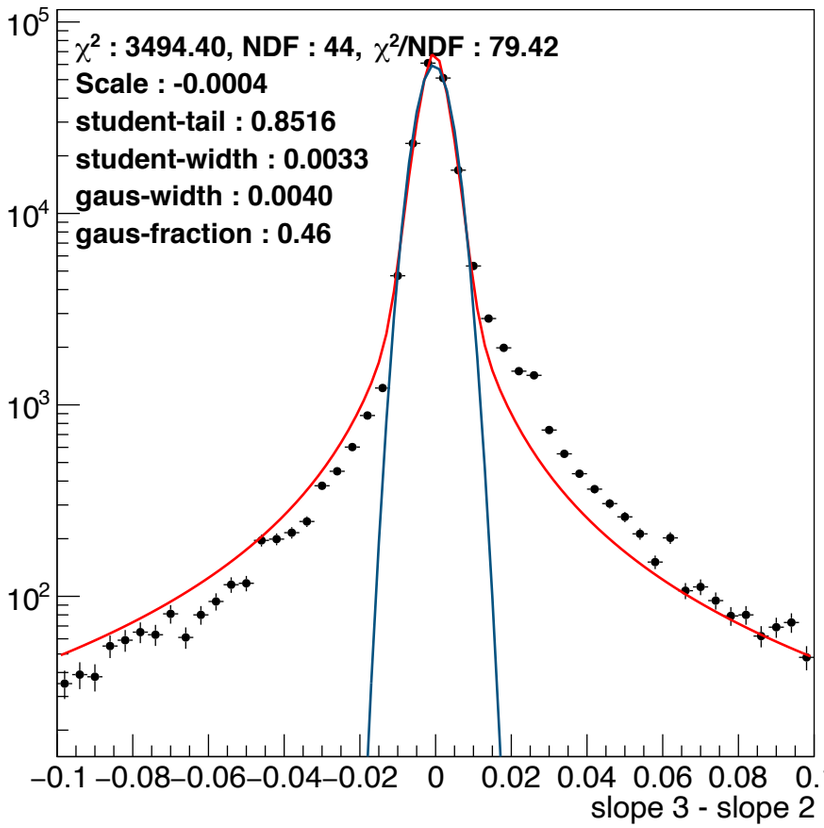


The position correlation at that peak region

Scattering

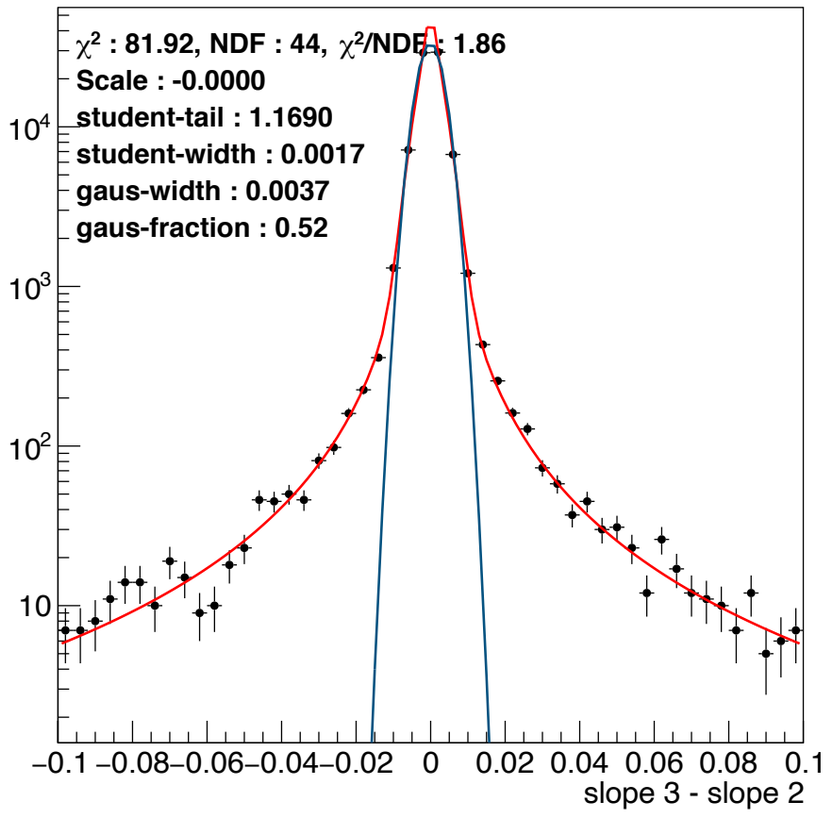


slope 3 - slope 2



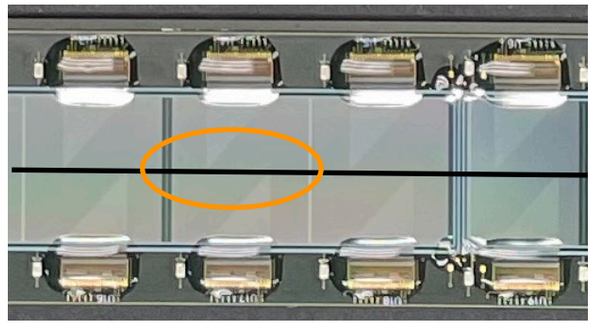
All chips are used

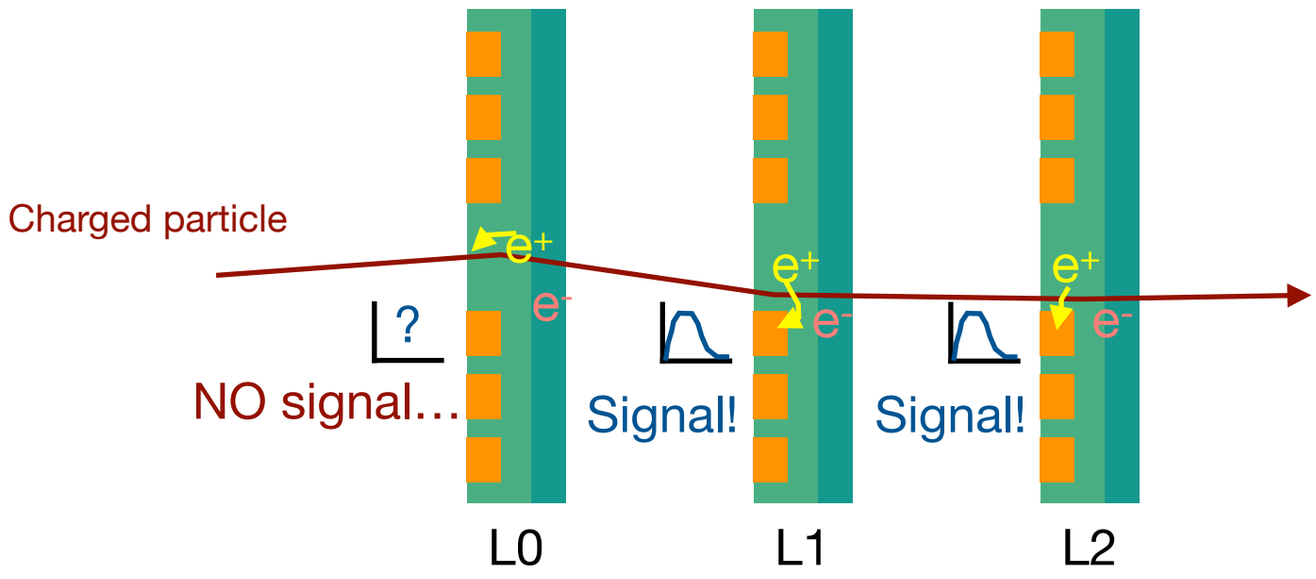
slope 3 - slope 2



Only consider U10 (beam spot)

Dead region performance

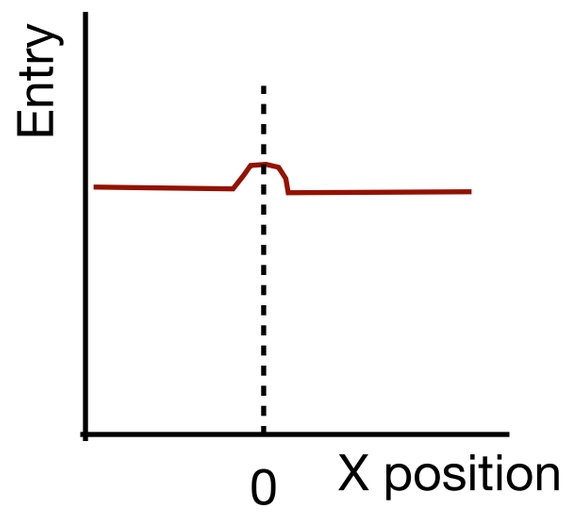




Event profile : 0 1 1

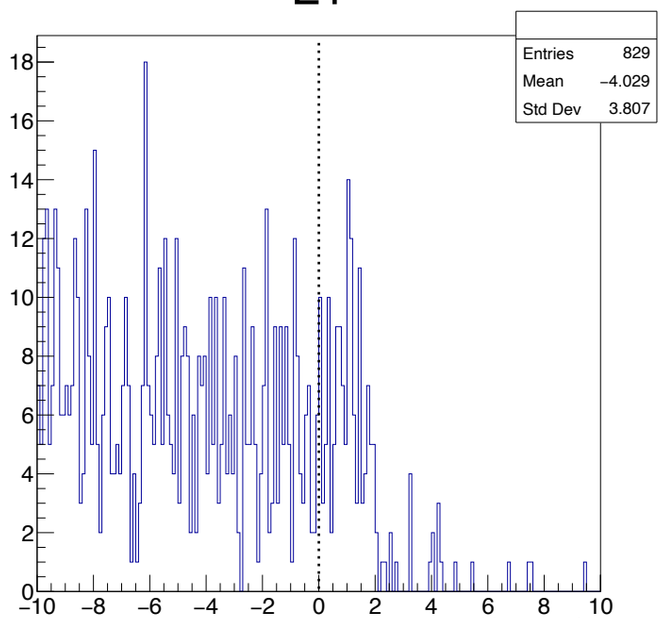
Assumption :

If the detection efficiency of dead region is not ~ 100 %, for the event profile 0 1 1 case, the position distribution of I1 and I2 should be similar to the schematic below

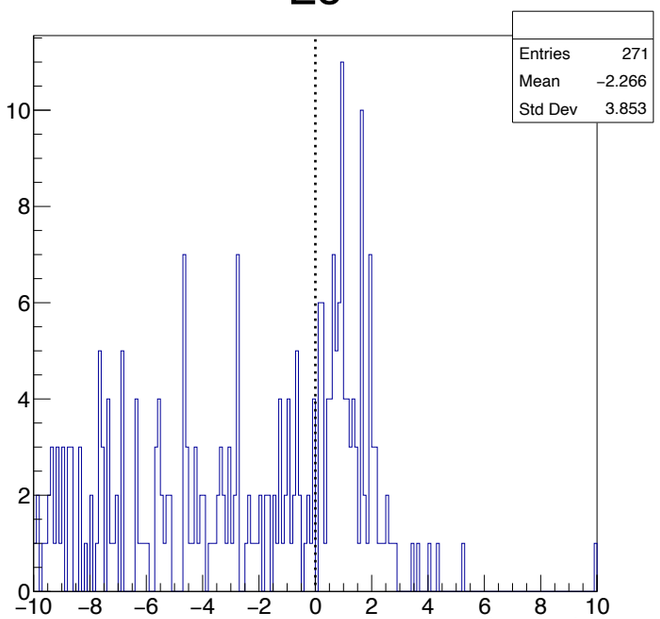


Dead region performance

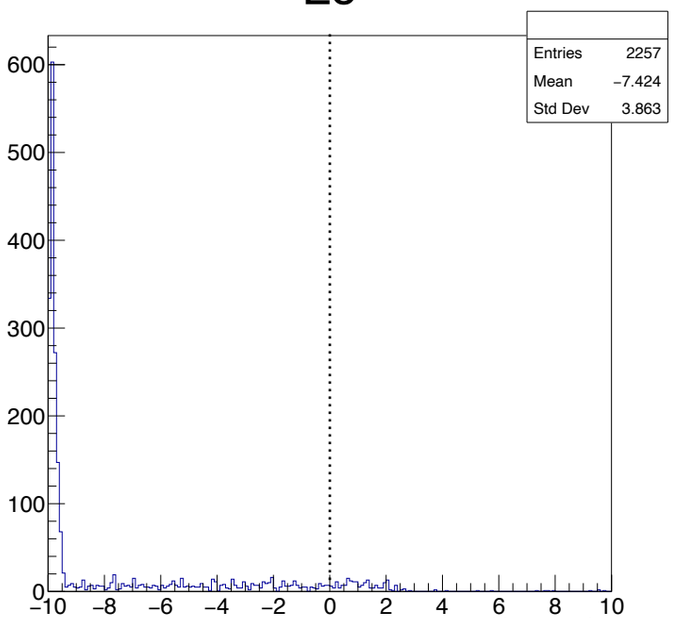
Event profile
011
L1



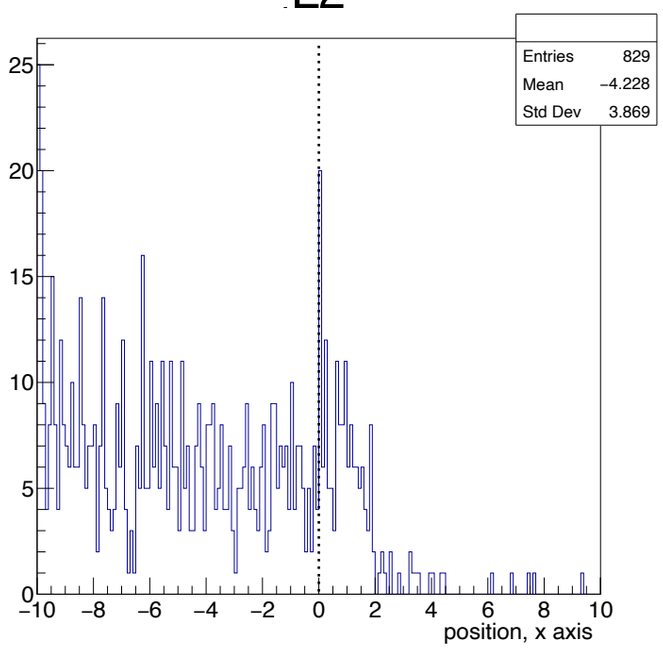
Event profile
101
L0



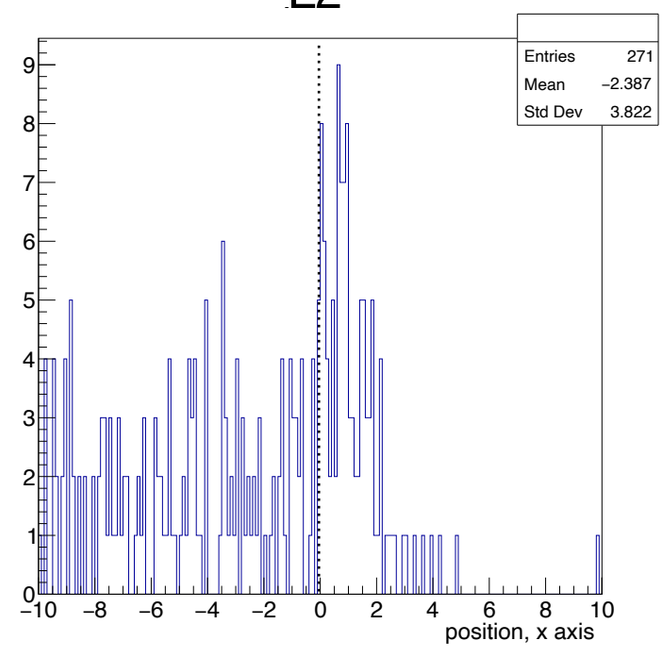
Event profile
110
L0



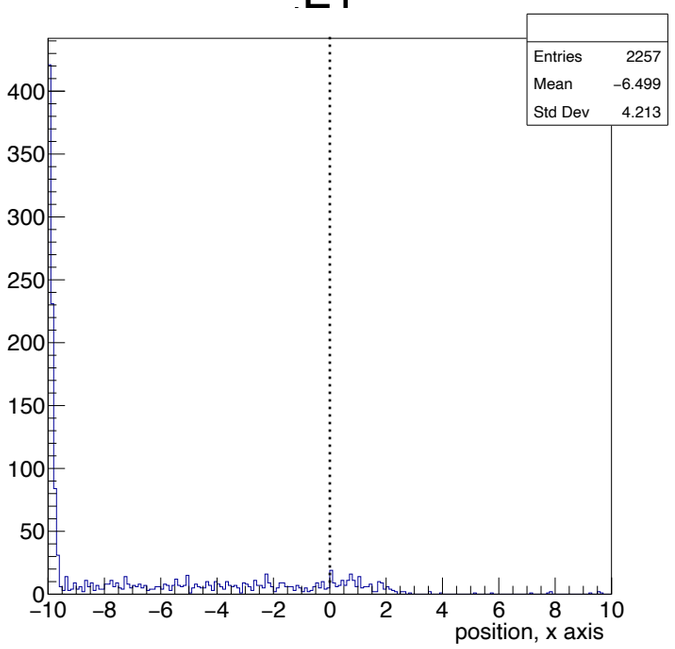
L2



L2

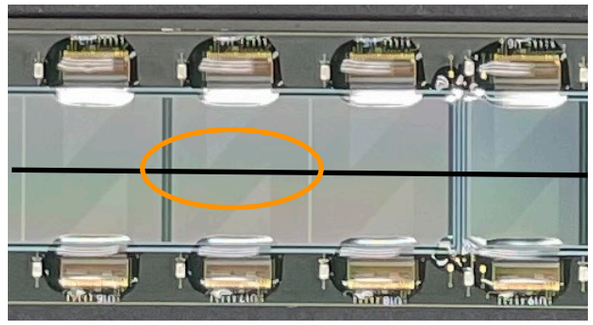


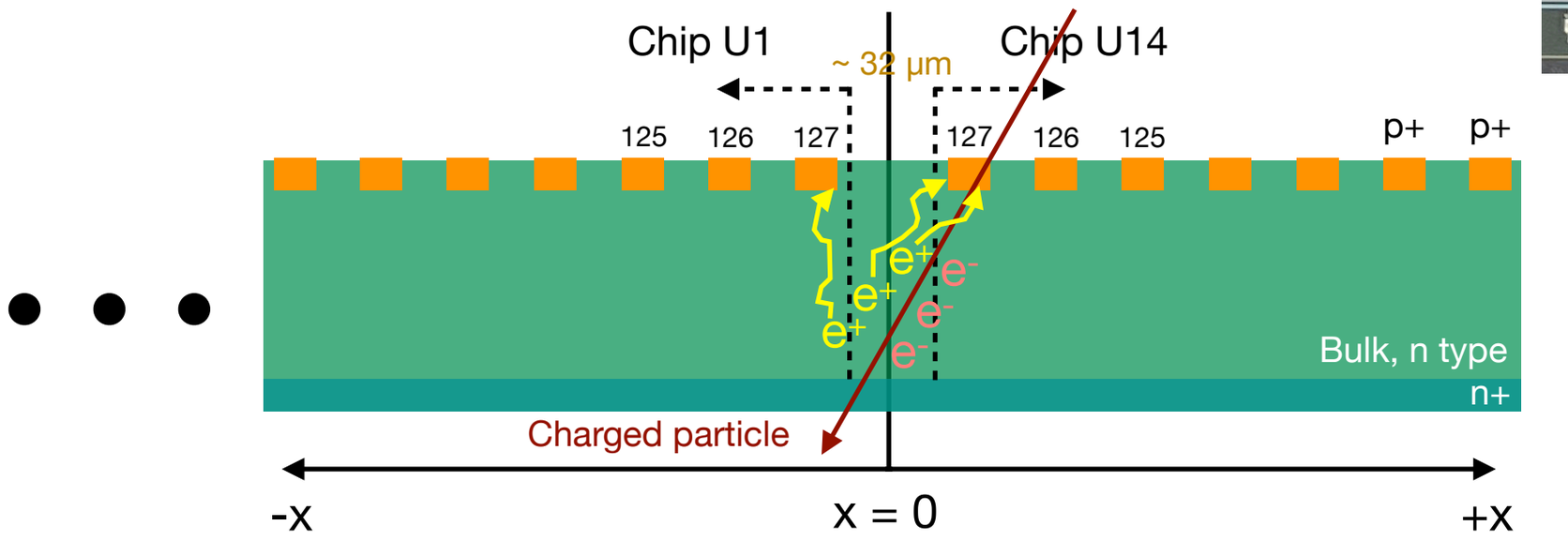
L1



The results seem to be no tendency → the efficiency of the dead region seems to be good

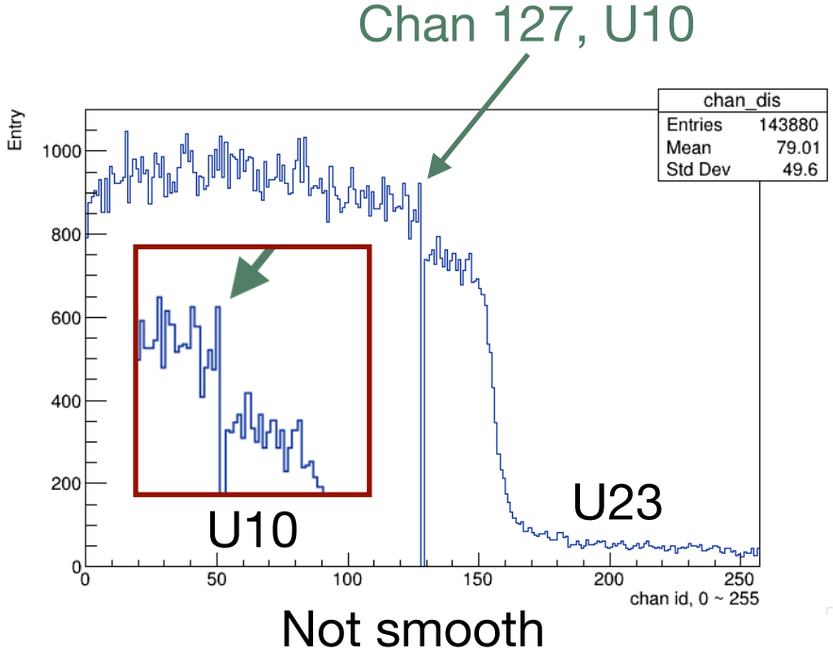
Dead region performance



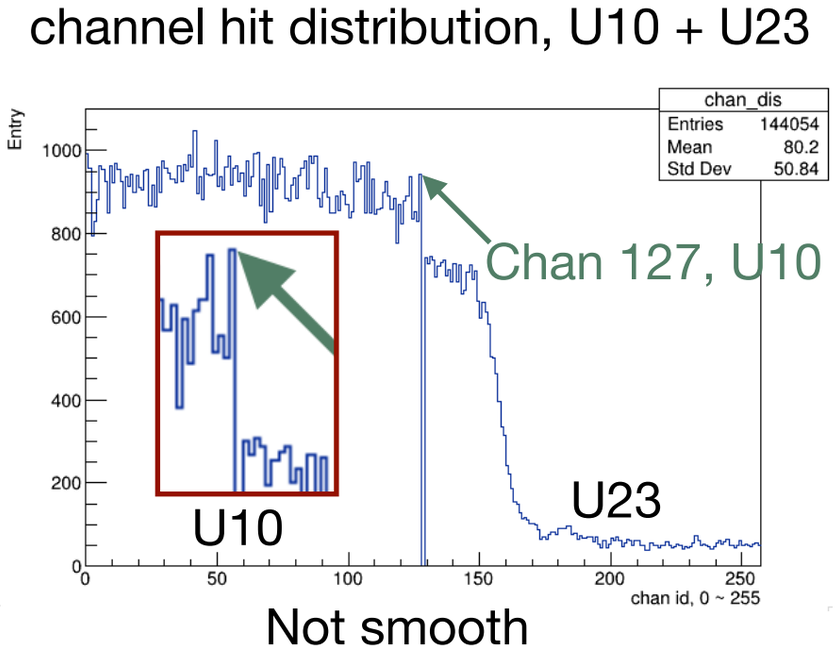


Run 89, all BCO group are used

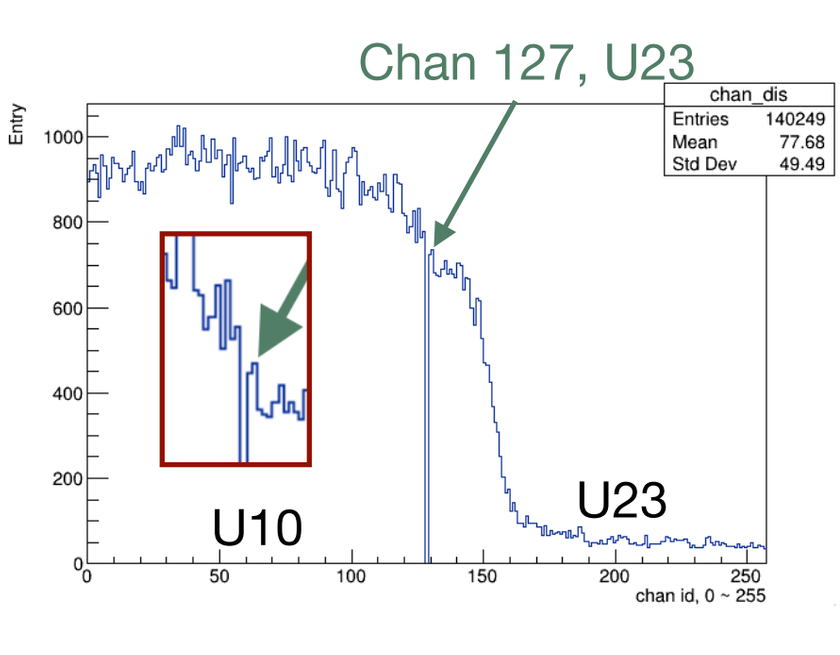
channel hit distribution, U10 + U23



Not smooth



Not smooth



The chan127 of U10 and U23 have to handle 32 μm more area than other channels

Their entry should be relatively higher

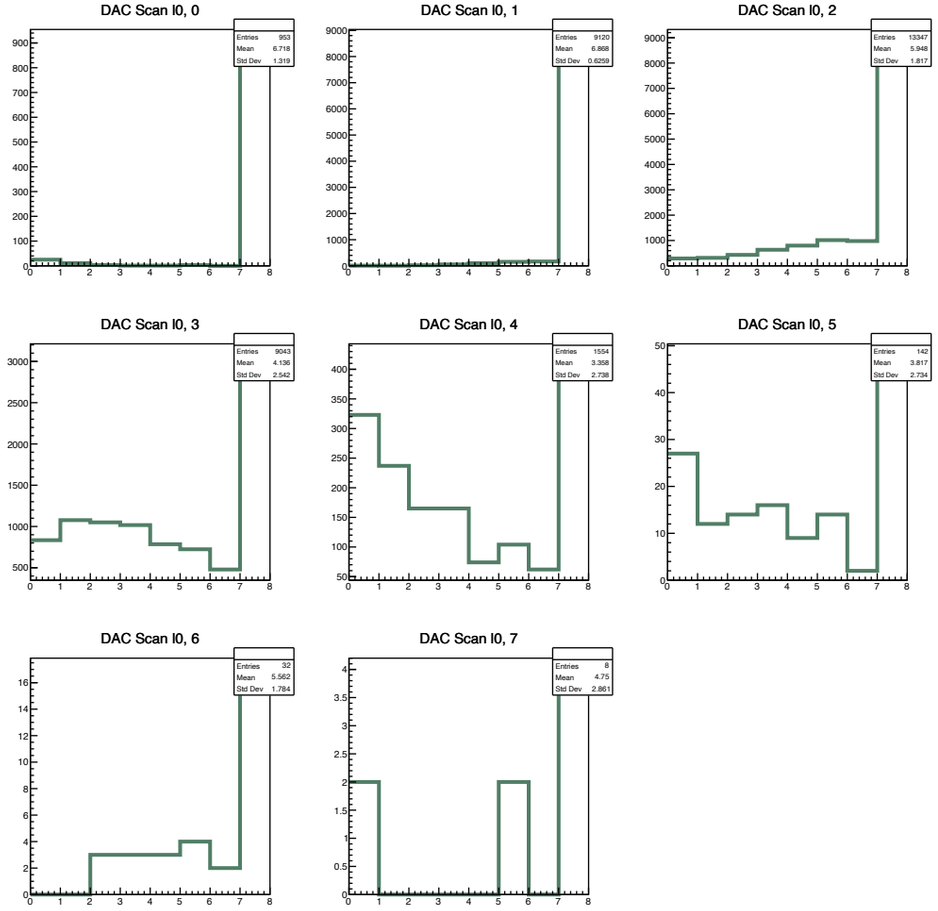
DAC scan

- Algorithm is same as Testbeam2019 :
  - 6th, 7th bins : histogram matching
  - 8th bin : overflow, neglect

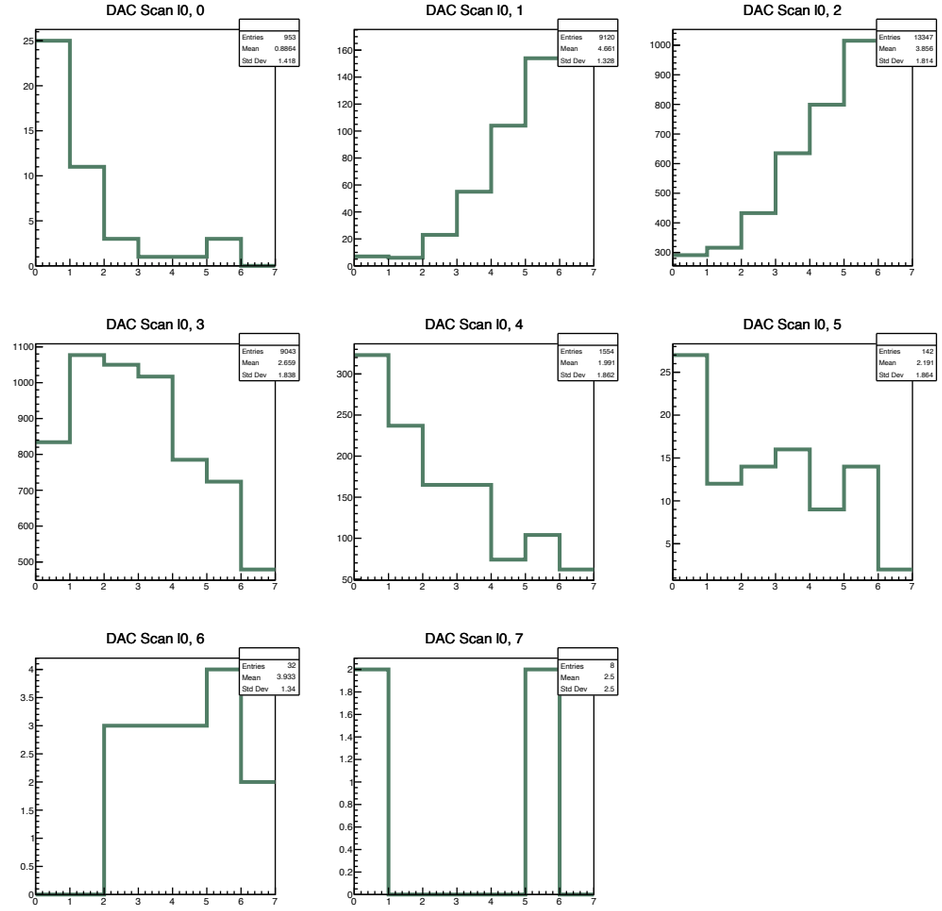
- Criteria :
  - Event profile has to be 111
  - single hit for each layer only

run1	run2	run3	run4	run5	run6	run7	run8
8	28	48	68	88	108	128	148
12	32	52	72	92	112	132	152
16	36	56	76	96	116	136	156
20	40	60	80	100	120	140	160
24	44	64	84	104	124	144	164
28	48	68	88	108	128	148	168
32	52	72	92	112	132	152	172
36	56	76	96	116	136	156	176
40	60	80	100	120	140	160	180

With 8th bin, L0



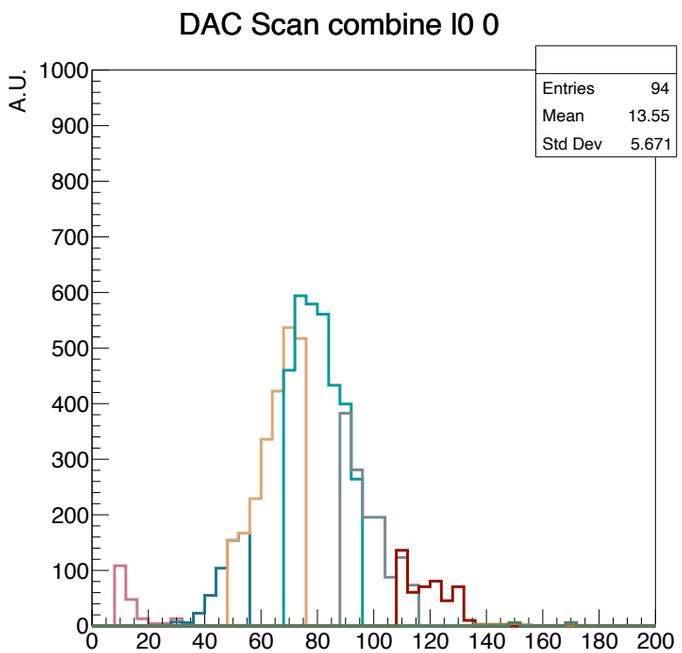
Without 8th bin, L0

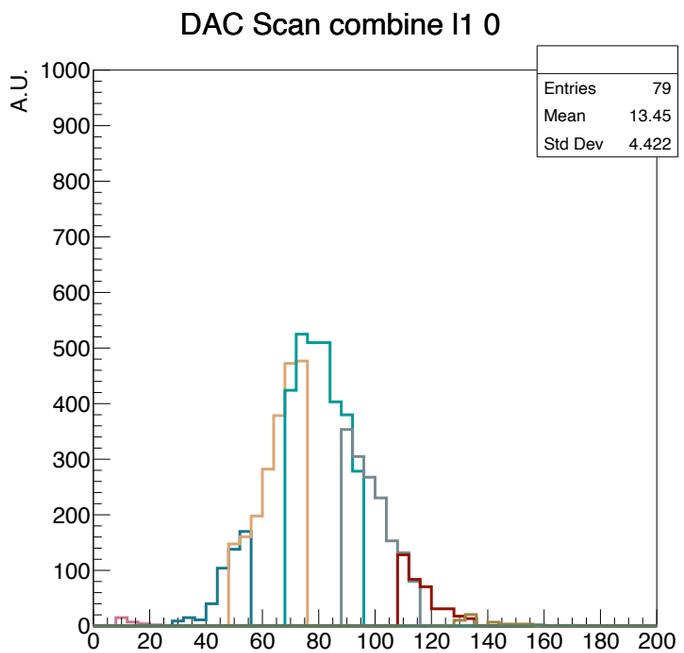


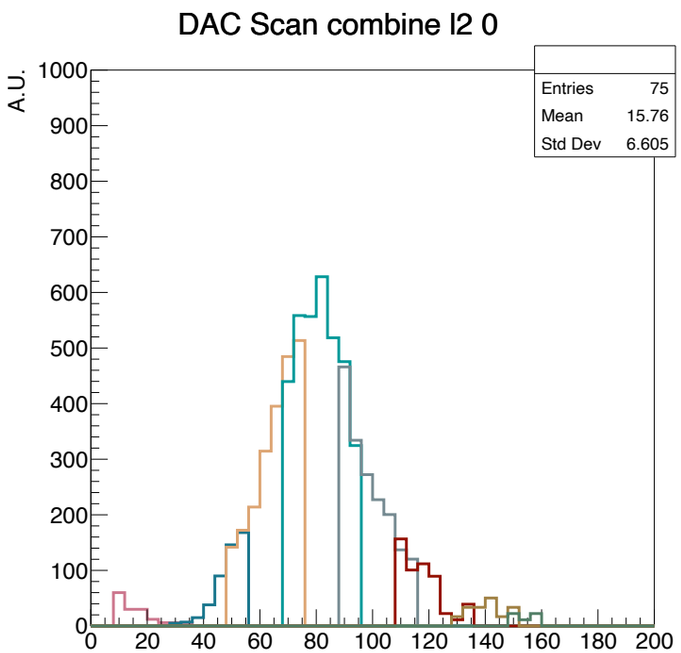
DAC scan

- Event profile has to be 111
- single hit for each layer only

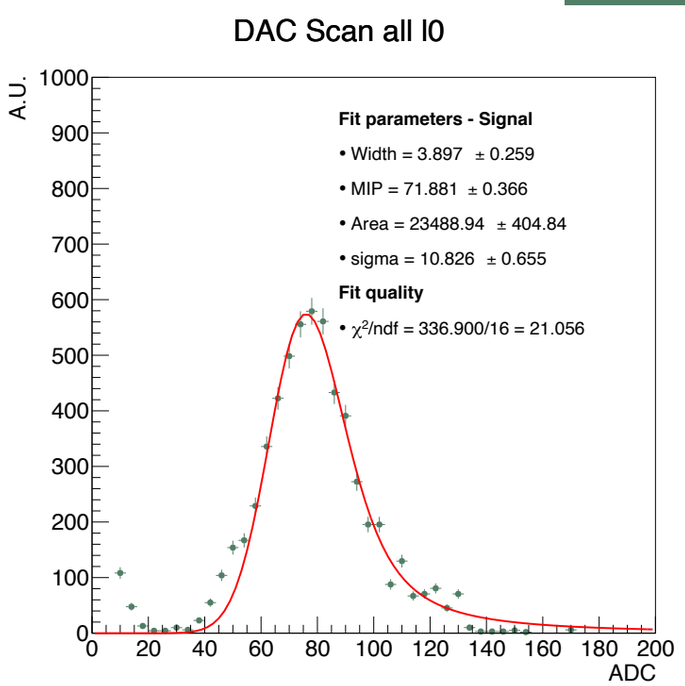
Histogram matching



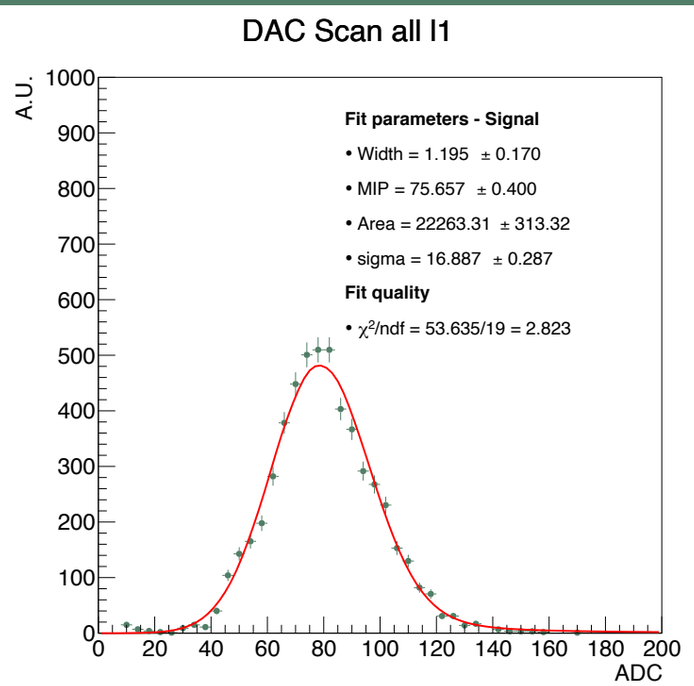




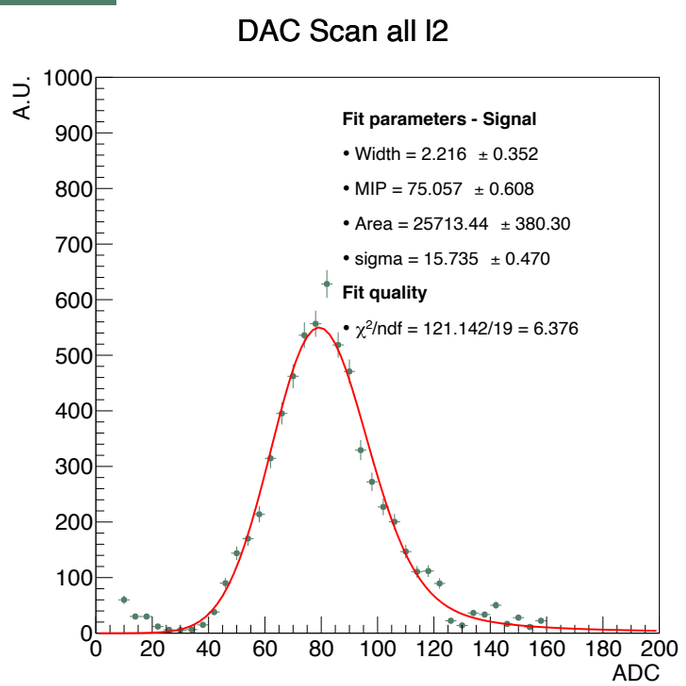
Fitting function : Landau convolute with Gaussian



MPV : 71.9



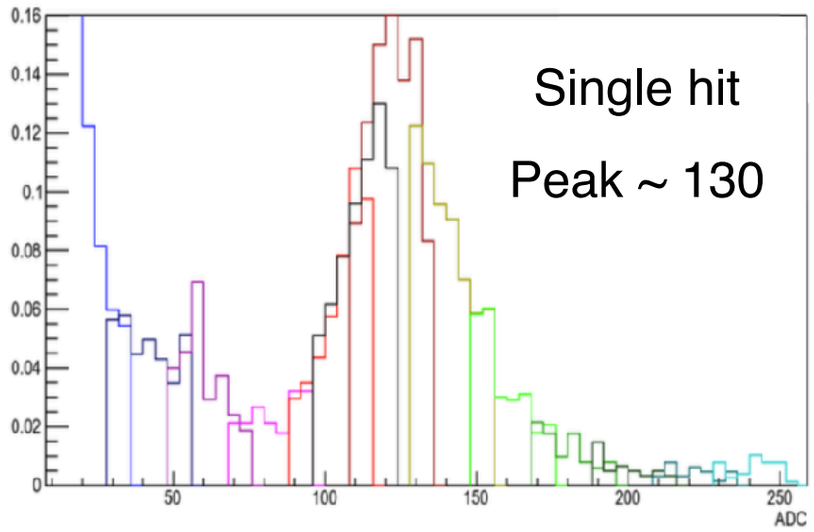
MPV : 75.7

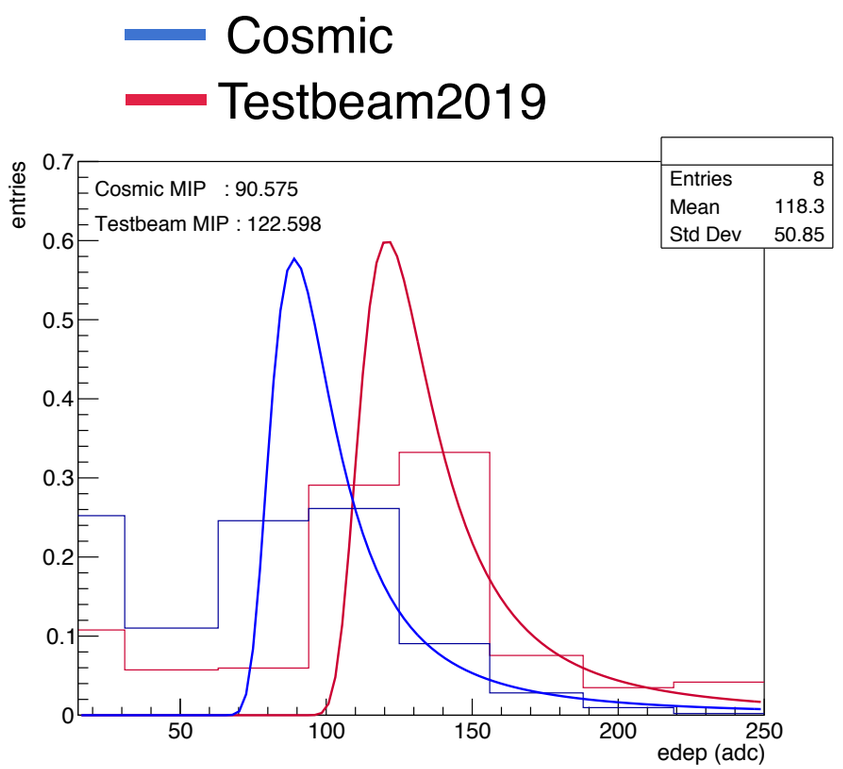


MPV : 75.1

DAC scan - comparison

TestBeam2019

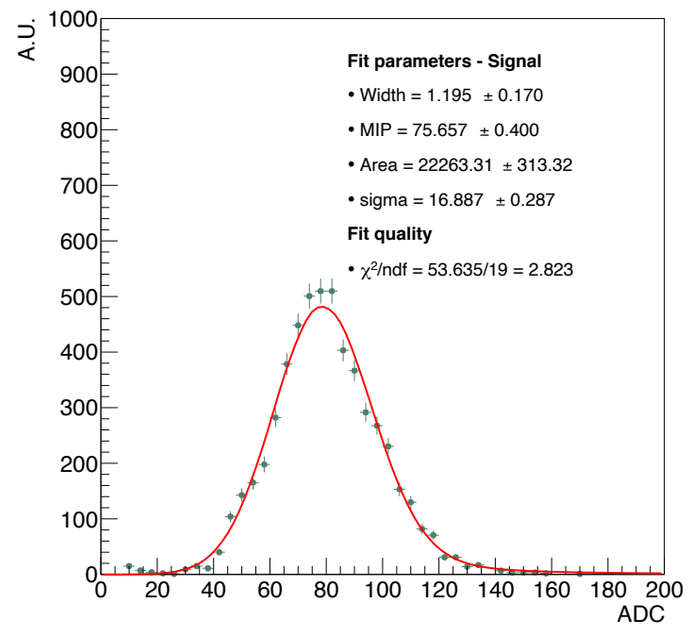




Cosmic MPV : 90.58

Testbeam : 122. 598

DAC Scan all I1



Bias voltage : 50V

MPV : 75.7

Summary

- Scattering :
  - The distribution of the scattering happening in middle layer becomes symmetry if only the chip U10 is considered.
  - There is a small peak at the shoulder (log scale), still don’t know the reason.

- The efficiency of the dead region seems to be good.

- DAC Scan
  - The MPV of the energy deposit is ~ 76, it’s smaller than the previous result. It may due to the smaller supply voltage (50V)

Back up

To do 2022/01/20

- ~~effi. vs BCO phase~~
  - ~~combine others data file~~

- ~~effi. as function of run ID~~

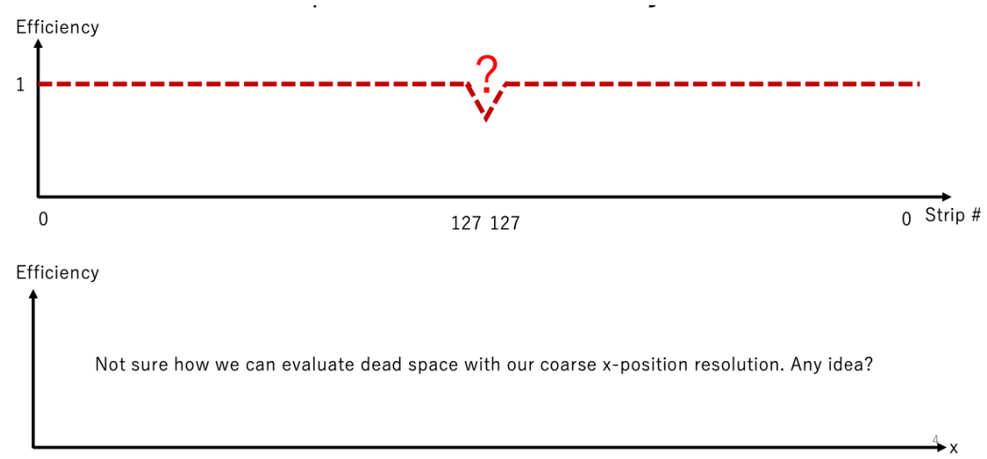
- 3 hits angle, 3*(2 hits angle) distributions, slope2 - slope3 (single/multi coulomb scattering)
  - ~~Use rest groups in event for the study~~
  - ~~Log plot~~
  - ~~studnet-t distribution~~
  - ~~(I1-I0) - (I2-I1)~~
  - ~~Or combine all production data~~
  - ~~Why the (I1-I0) - (I2-I1) is not symmetry,~~
    - ~~solve : if I only selected the chip10.~~
  - Why there is a small peak at right shoulder

- Try to estimate the amount of mis-alignment in longitudinal axis.

-

To do

- Geant4 scattering
- ~~efficiency vs chan ID (or position)~~ ->
- ~~DAC_scan~~



To do, low priority

- with BEC
- angle cut in the detection effi.
- angle <-> alignement relation
- alignment rotational correction
- multi-track
- To check the data of the testbeam last time not really understand ayaka’s algorithm
- camac_adc3 : small scintillator, it has some function.
- nth BCO group to be picked study

To do source test 2021/01/07

- Study the group issue (unsymmetrical entry)
  - MPV of adc of each channel vs channel entry
  - Test-pulse : gain (slope) of each channel vs entry ? or just compare

- Mask the noisy channel

- without source
  - scan the threshold 15, 25, 35, 40. each one 10 mins, find the best one.
  - 2000 electrons -> corresponding adc setting ?

- with source
  - adc0 : 40 -> 2 mins for each chip -> OK

Scattering

All BCO group are considered

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Only consider U10

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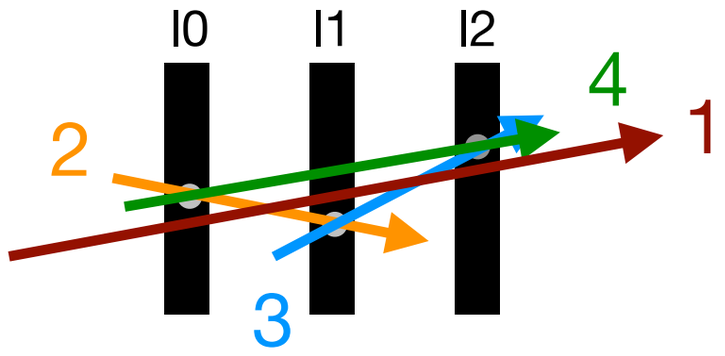
4 : slope of I2-I0



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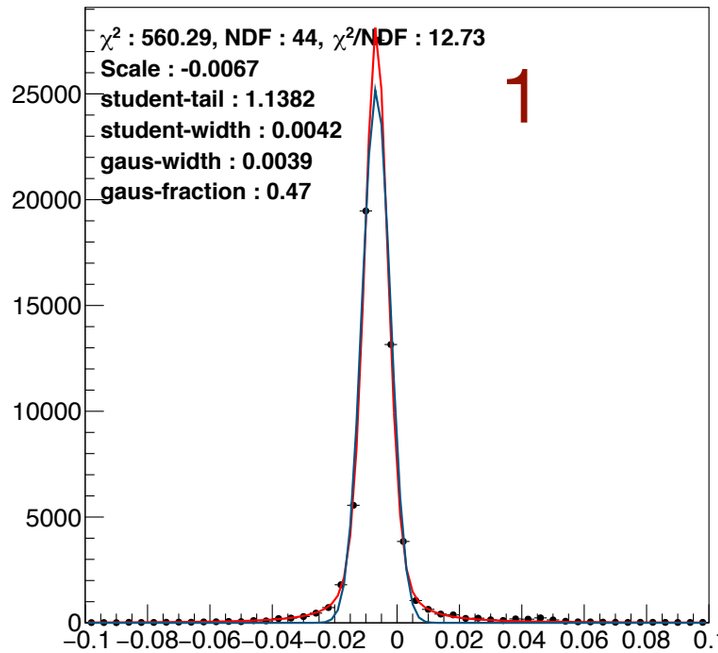
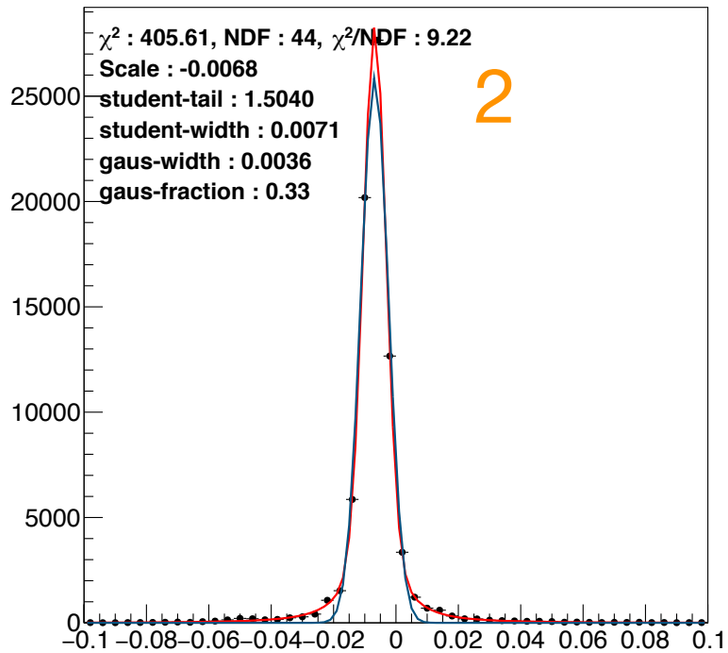
Gaussian + student-t

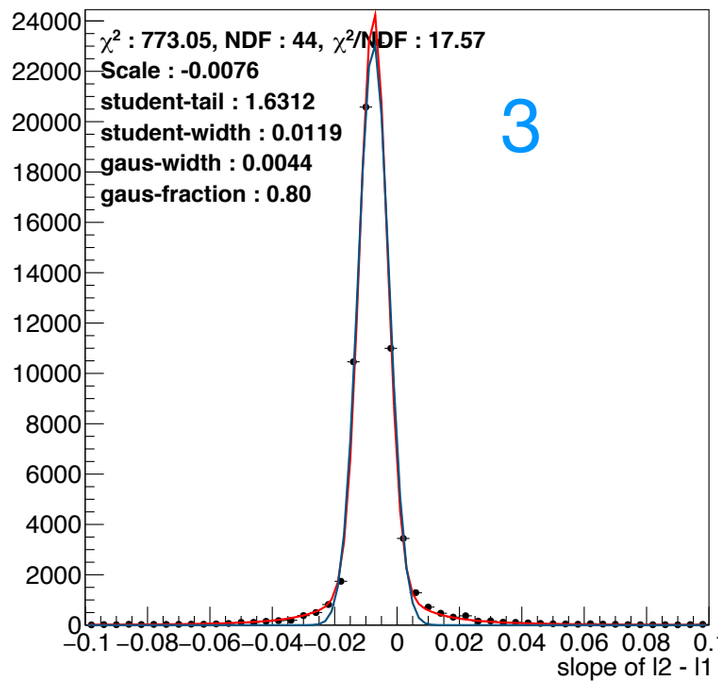
slope of 3 hits



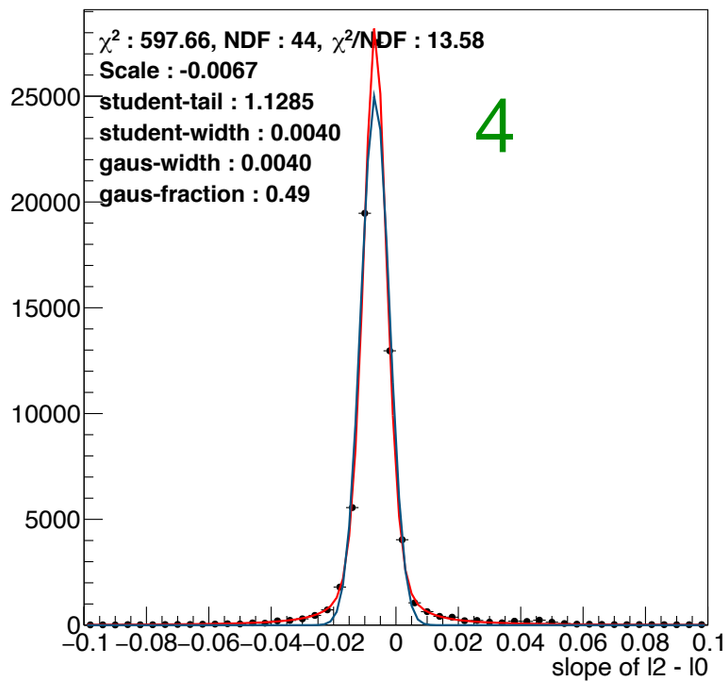
slope of I1 - I0



slope of I2 - I1



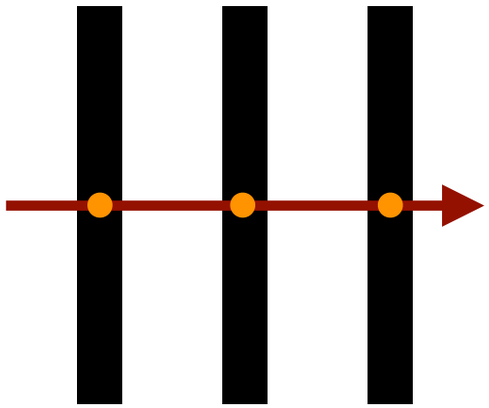
slope of I2 - I0



Some definitions

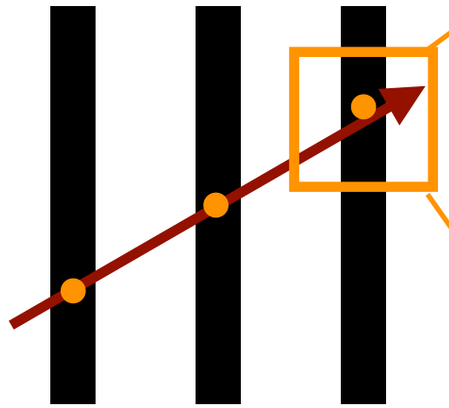
3 hits case

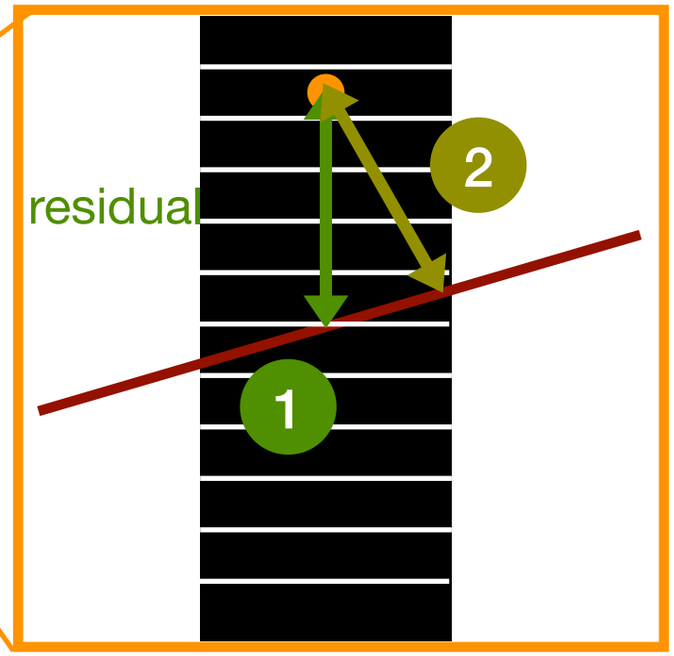
Expected event



Large angle, but still ok

As long as the residual smaller than window size

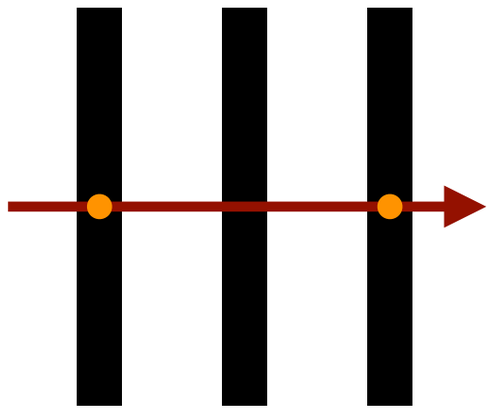




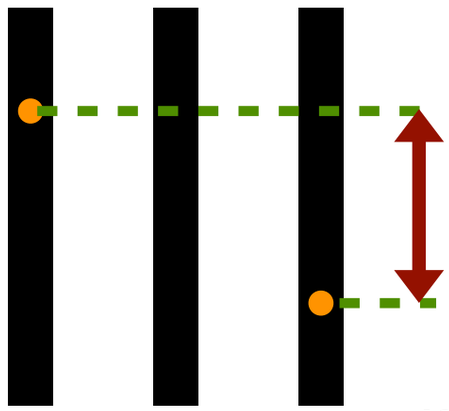
Current algorithm:
method 1 is used for residual calculation

2 hits case

Expected event



Is it a good event ?



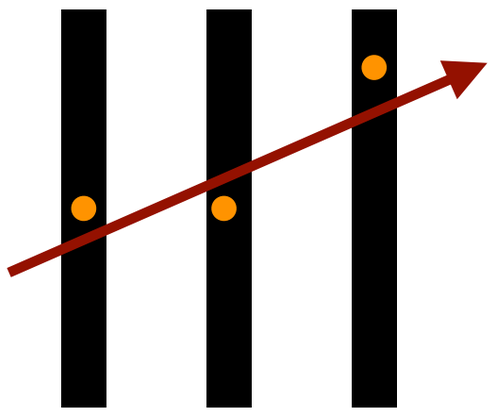
Current algorithm :
If the position difference > window size → 000
else → 101

Some definitions

3 hits case

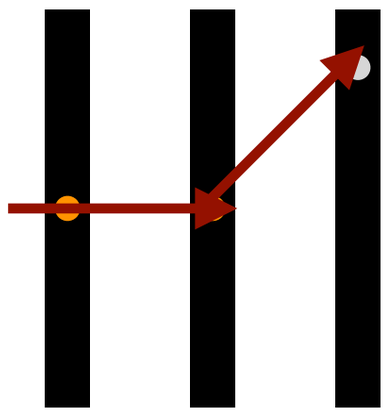
1

Bad event example
residual too big



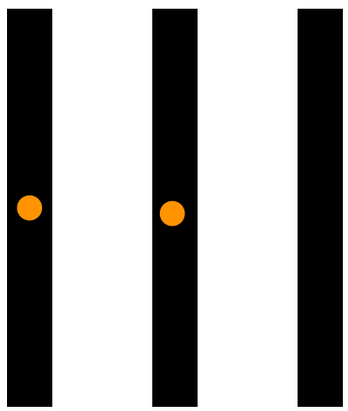
2

First, exclude one hit
(picked by another algorithm)
in the example : l2

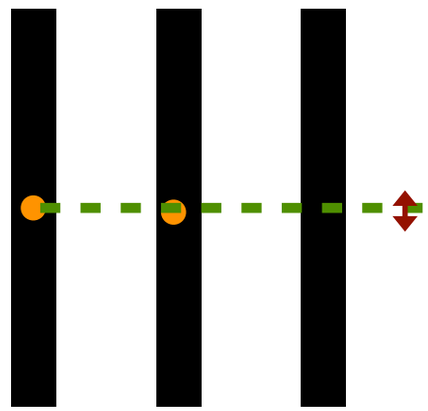


Now this event becomes a 2 hits case
2 hits algorithm is performed

3



4



Position difference

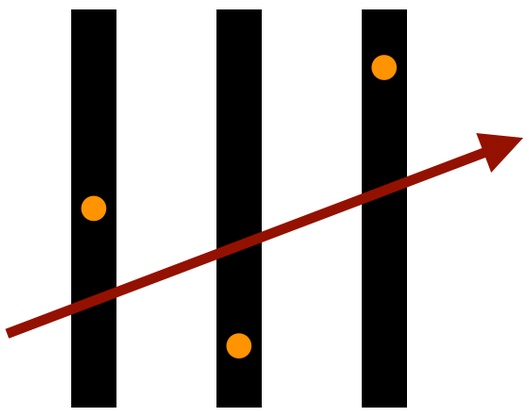
Position difference < window size
→ final profile 1 1 0

Some definitions

3 hits case

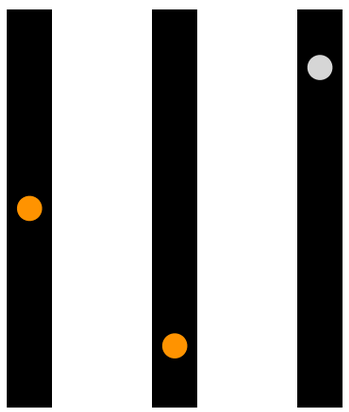
1

Bad event example
residual too big



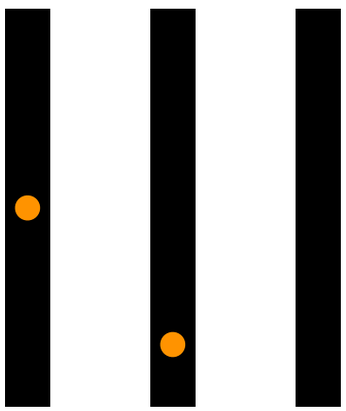
2

First, exclude one hit
(picked by another algorithm)
in the example : l2

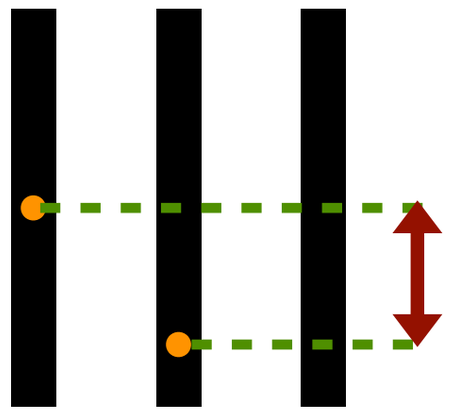


Now this event becomes a 2 hits case
2 hits algorithm is performed

3



4



Position difference > window size
→ final profile 0 0 0

Production run stu

```
run file : BeamData_20211210-0302_0_filter
layer 3 final counting :
 N_HHH : 2832
 N_LHH : 10
 N_HLH : 16
 N_HHL : 38
 N_LLL : 578
=====3-layers=====efficiency results==========
|| l0 : 99.64814 %
|| l1 : 99.43820 %
|| l2 : 98.67596 %
=====3-layers=====efficiency results==========
```

run 52

```
run file : BeamData_20211210-0329_0_filter
layer 3 final counting :
 N_HHH : 3463
 N_LHH : 15
 N_HLH : 26
 N_HHL : 62
 N_LLL : 809
=====3-layers=====efficiency results==========
|| l0 : 99.56872 %
|| l1 : 99.25480 %
|| l2 : 98.24113 %
=====3-layers=====efficiency results==========
```

run 53

```
run file : BeamData_20211210-0427_0_filter
layer 3 final counting :
 N_HHH : 3524
 N_LHH : 12
 N_HLH : 18
 N_HHL : 49
 N_LLL : 745
=====3-layers=====efficiency results==========
|| l0 : 99.66063 %
|| l1 : 99.49181 %
|| l2 : 98.62860 %
=====3-layers=====efficiency results==========
```

run 54

```
run file : BeamData_20211210-0458_0_filter
layer 3 final counting :
 N_HHH : 3458
 N_LHH : 16
 N_HLH : 17
 N_HHL : 64
 N_LLL : 755
=====3-layers=====efficiency results==========
|| l0 : 99.53944 %
|| l1 : 99.51079 %
|| l2 : 98.18285 %
=====3-layers=====efficiency results==========
```

run 55

```
run file : BeamData_20211210-0609_0_filter
layer 3 final counting :
 N_HHH : 3511
 N_LHH : 23
 N_HLH : 24
 N_HHL : 60
 N_LLL : 768
=====3-layers=====efficiency results==========
|| l0 : 99.34918 %
|| l1 : 99.32107 %
|| l2 : 98.31980 %
=====3-layers=====efficiency results==========
```

run 57

```
run file : BeamData_20211210-0642_0_filter
layer 3 final counting :
 N_HHH : 3399
 N_LHH : 203
 N_HLH : 19
 N_HHL : 46
 N_LLL : 807
=====3-layers=====efficiency results==========
|| l0 : 94.36424 %
|| l1 : 99.44412 %
|| l2 : 98.66473 %
=====3-layers=====efficiency results==========
```

run 58

```
run file : BeamData_20211210-2018_0_filter
layer 3 final counting :
 N_HHH : 1530
 N_LHH : 21
 N_HLH : 7
 N_HHL : 55
 N_LLL : 449
=====3-layers=====efficiency results==========
|| l0 : 98.64603 %
|| l1 : 99.54457 %
|| l2 : 96.52997 %
=====3-layers=====efficiency results==========
```

run 88

```
 N_HHH : 2654
 N_LHH : 20
 N_HLH : 13
 N_HHL : 80
 N_LLL : 794
=====3-layers=====efficiency results==========
|| l0 : 99.25206 %
|| l1 : 99.51256 %
|| l2 : 97.07388 %
=====3-layers=====efficiency results==========
```

run 89