INTT progress report

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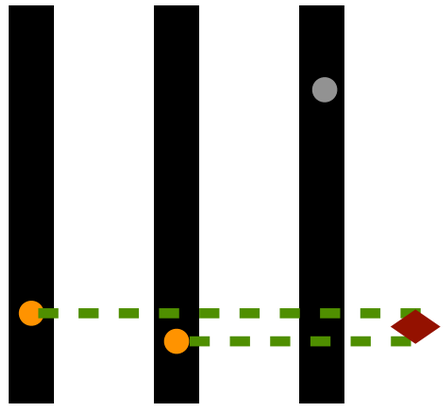
Content

- Testbeam data analysis
- Source test

Study of the hit window cut

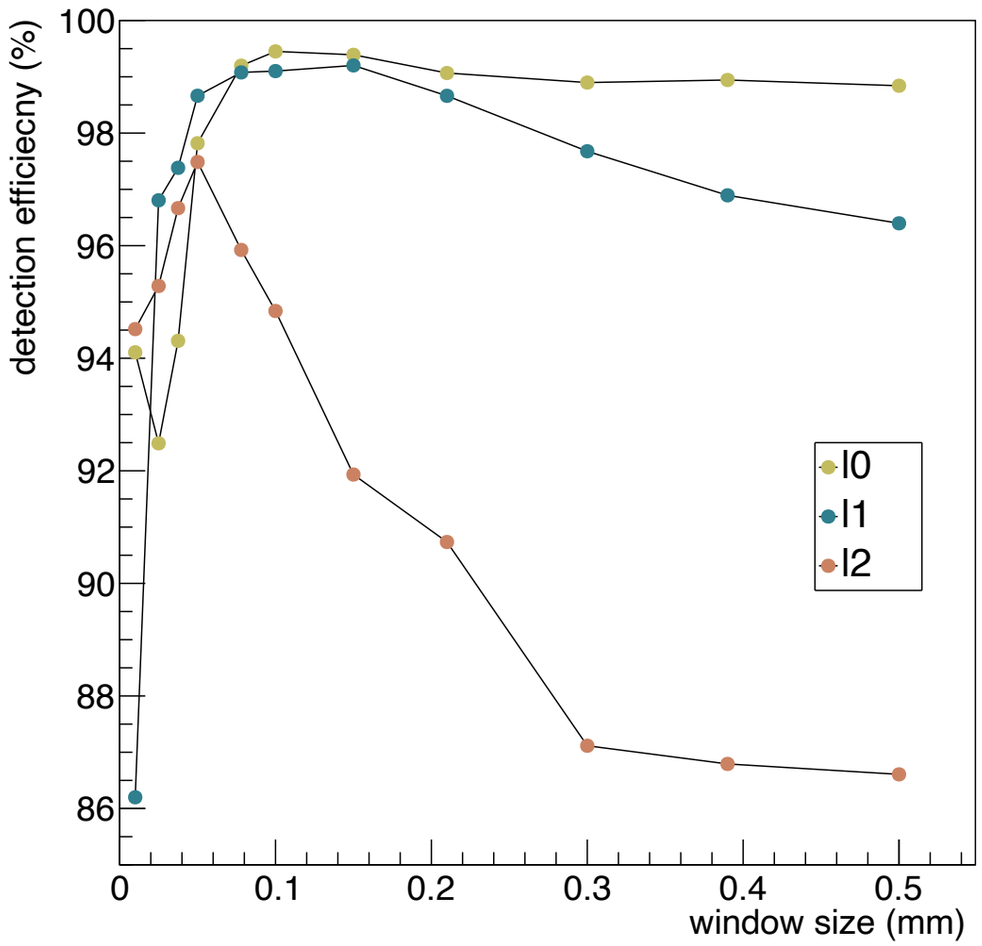


if large windows size -> 110
if small window size -> 000

Position difference ↕ window size

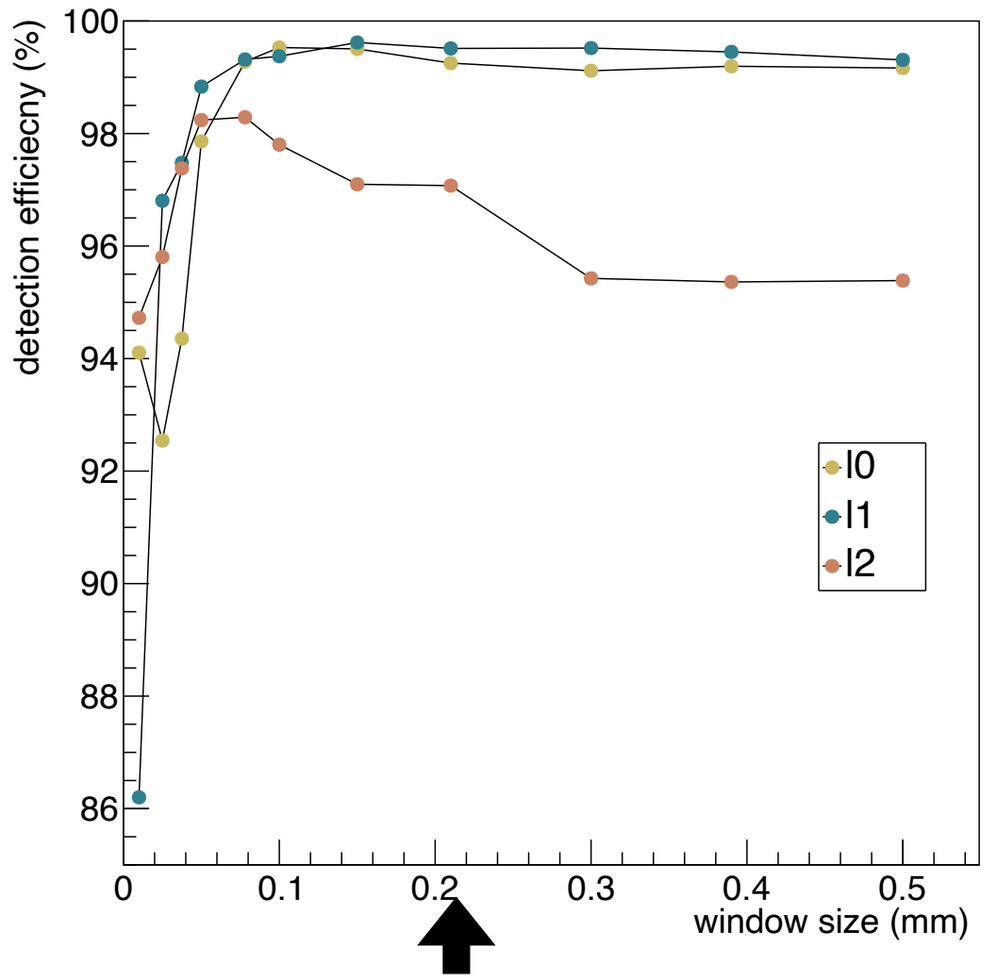
Without LoE_removal

detection eff. vs window size



After LoE_removal

detection eff. vs window size



(111)/(111+011) (111)/(111+101) (1111)/(111+110)

0.21 (3σ of residual width)

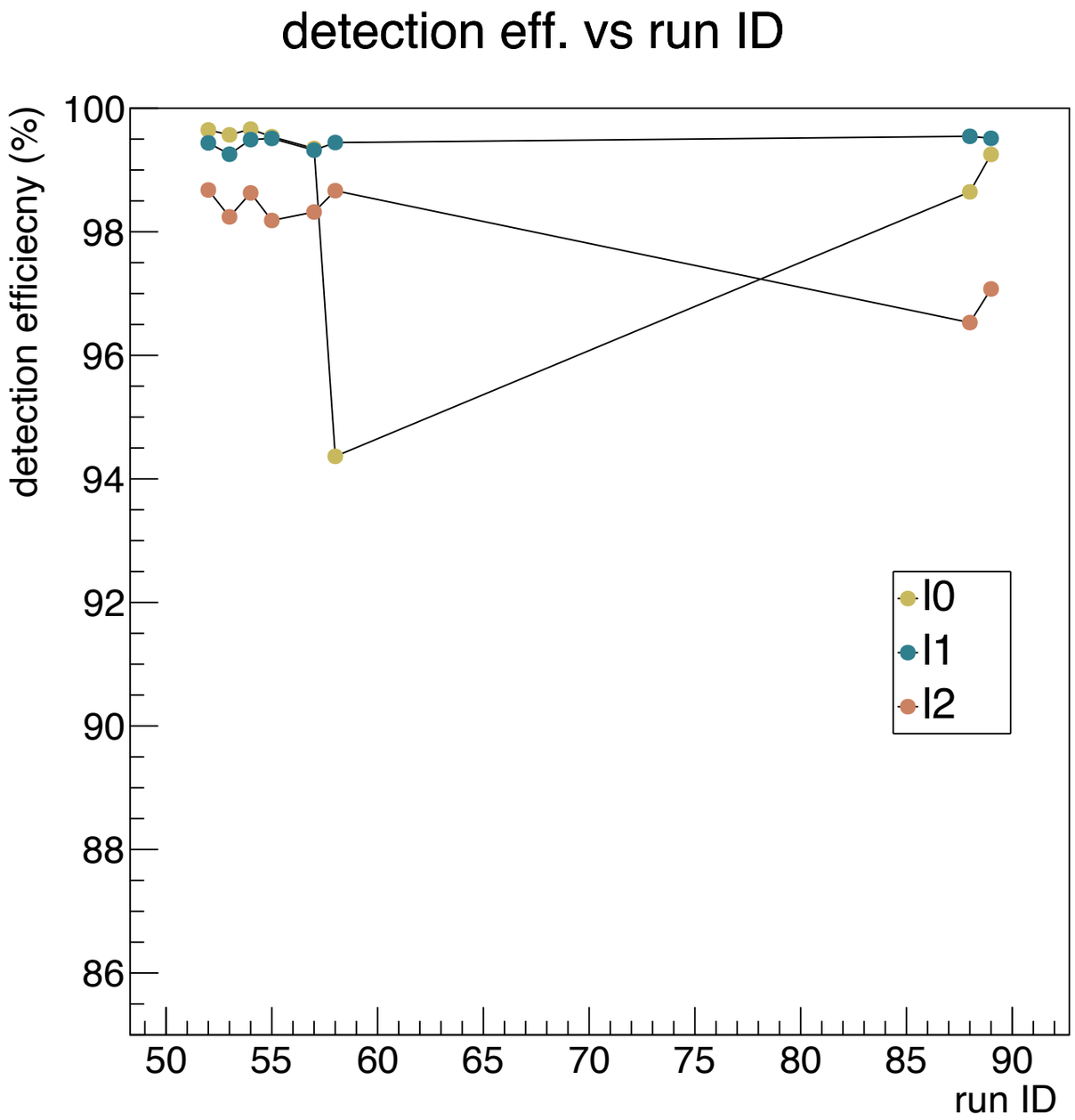
Production runs study

window size : 0.21 mm energy weighted method : by adc setting, not mV setting

		taking time	note	I0 effi.	I1 effi.	I2 effi.	DSE	align_I	amount
52	BeamData_20211210-0302_0	25 mins	U9	99.648	99.438	98.676	0.08%	I1	0.2846
53	BeamData_20211210-0329_0	25 mins	U9	99.569	99.255	98.241	0.09%	I1	0.2835
54	BeamData_20211210-0427_0	30 mins	U9	99.661	99.492	98.629	0.04%	I1	0.2856
55	BeamData_20211210-0458_0	30 mins	U9	99.539	99.511	98.183	0.20%	I1	0.2848
57	BeamData_20211210-0609_0	31 mins	U10	99.349	99.321	98.320	0.06%	I1	0.2247
58	BeamData_20211210-0642_0	31 mins	U10	94.364	99.444	98.665	0.06%	I1	0.2235
88	BeamData_20211210-2018_0	30 mins	final	98.646	99.545	96.530	0.13%	I1	0.2841
89	BeamData_20211210-2043_0	30 mins	final	99.252	99.512	97.073	0.10%	I1	0.2958

	adc0 L	adc0 R	adc1 L	adc1 R	adc2 L	adc2 R	adc3 L	adc3 R	tdc3 L	tdc3 R
52	-1	50	200	400	250	500			400	1200
53	-1	50	200	400	250	500			400	1200
54	-1	50	200	400	250	500			400	1200
55	-1	50	200	400	250	500			400	1200
57	-1	50	200	400	250	500			400	1200
58	-1	50	200	400	250	500			400	1200
88	75	300	100	350	250	500			400	1200
89	75	300	100	350	250	500			400	1200

Production runs study

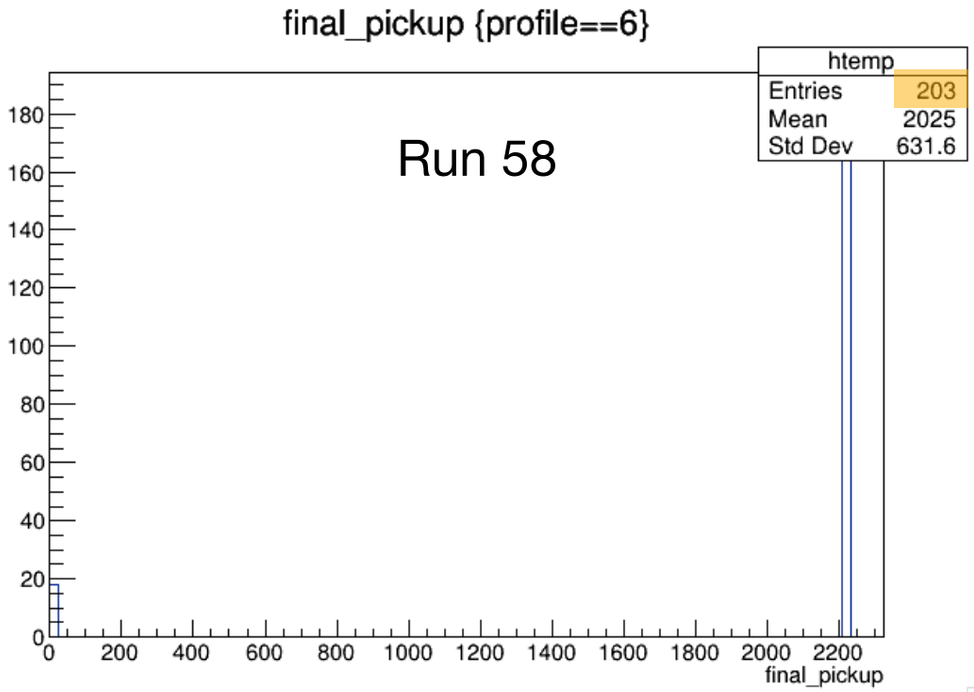


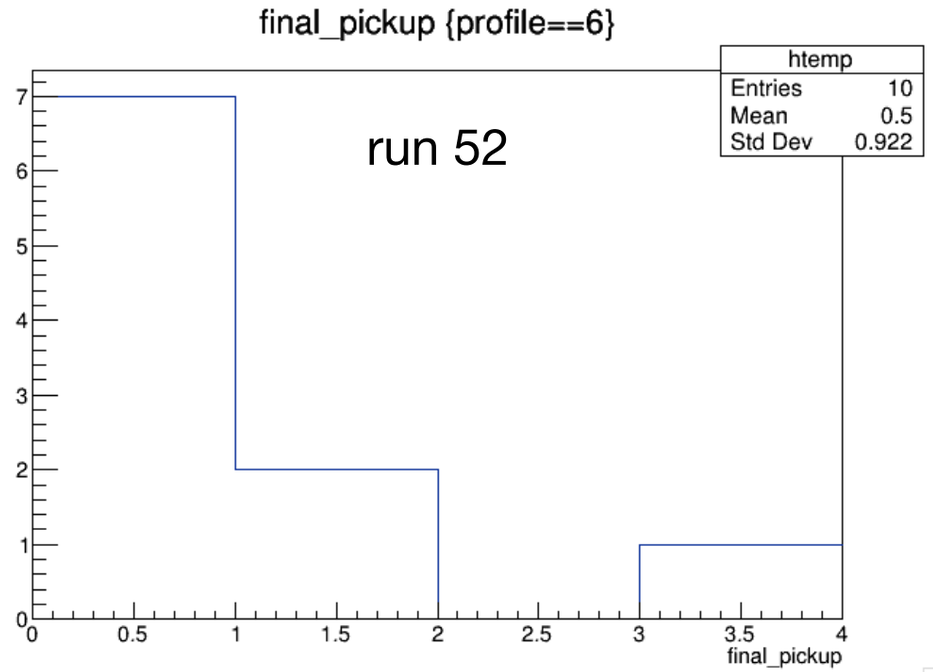
Production runs study

- The effi. of l0 of run 58 : 94%
- The row data is checked.

```
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==========
```

The event code of the event profile 011 is shown





final_pickup “2222” : only 2 layers have useful hits
final_pickup < 10 : all layers have useful hits

Run 58 : Only 2 layers have useful hits for most of the 011 events

Production runs study

Example of the 011 event of Run 58

Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
8	0	3	2155	1	6	22	53	2	5	0	8
8	1	261	259	1	5	2	0	0	5	0	8
8	2	327	399	1	5	9	109	2	5	0	8
8	3	136	1128	1	5	22	57	0	5	0	8
8	4	*	2155	1	5	22	58	1	5	0	8
8	5	*	2155	1	*	*	*	*	5	0	8

==> 6 selected entries

Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
82	0	4	2155	1	6	10	120	2	3	0	82
82	1	257	268	1	5	6	0	0	3	0	82
82	2	334	398	1	5	10	116	2	3	0	82
82	3	148	539	1	*	*	*	*	3	0	82
82	4	*	2154	1	*	*	*	*	3	0	82
82	5	*	2154	1	*	*	*	*	3	0	82

==> 6 selected entries

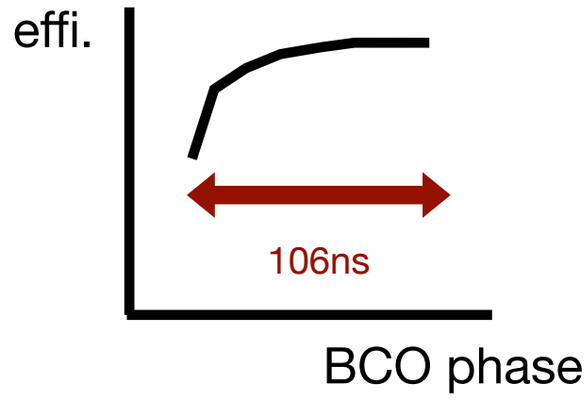
Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
83	0	3	2154	1	6	23	120	0	4	0	83
83	1	343	259	1	6	23	121	3	4	0	83
83	2	317	396	1	5	6	0	0	4	0	83
83	3	136	648	1	5	23	125	2	4	0	83
83	4	*	2154	1	*	*	*	*	4	0	83
83	5	*	2154	1	*	*	*	*	4	0	83

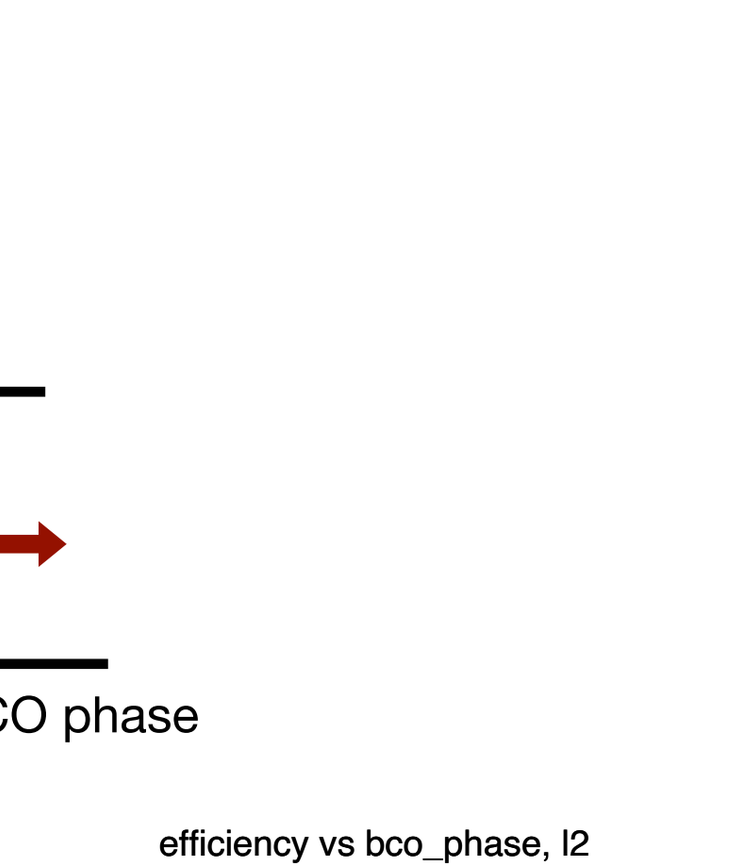
==> 6 selected entries

Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
145	0	3	2155	1	6	10	39	3	3	0	145
145	1	261	267	1	5	6	0	0	3	0	145
145	2	357	397	1	5	10	36	3	3	0	145
145	3	135	744	1	*	*	*	*	3	0	145
145	4	*	2154	1	*	*	*	*	3	0	145

Effi. vs BCO phase

One of the expectation relation

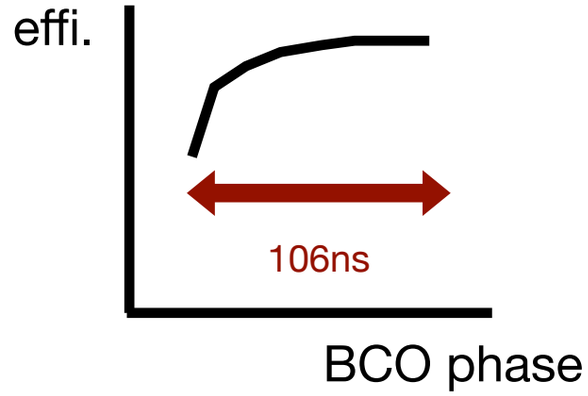


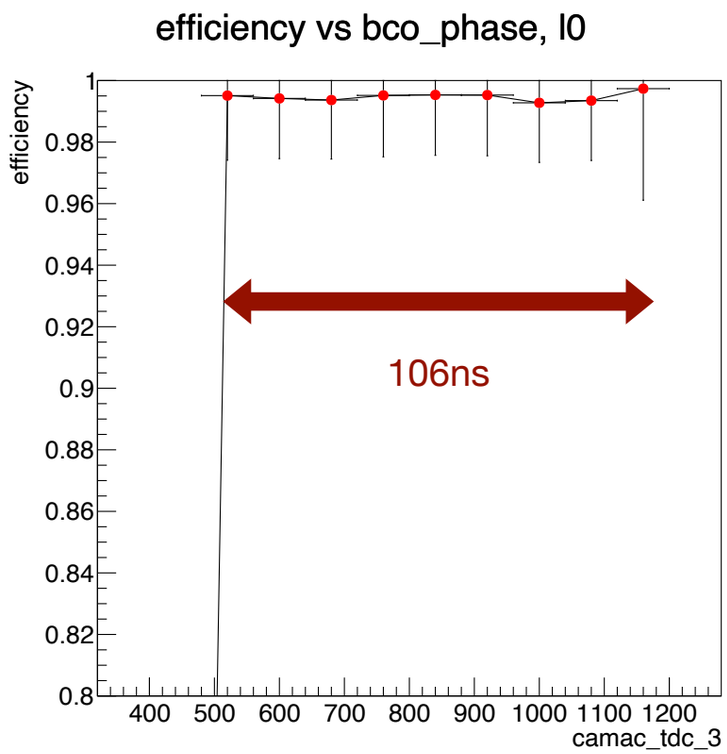


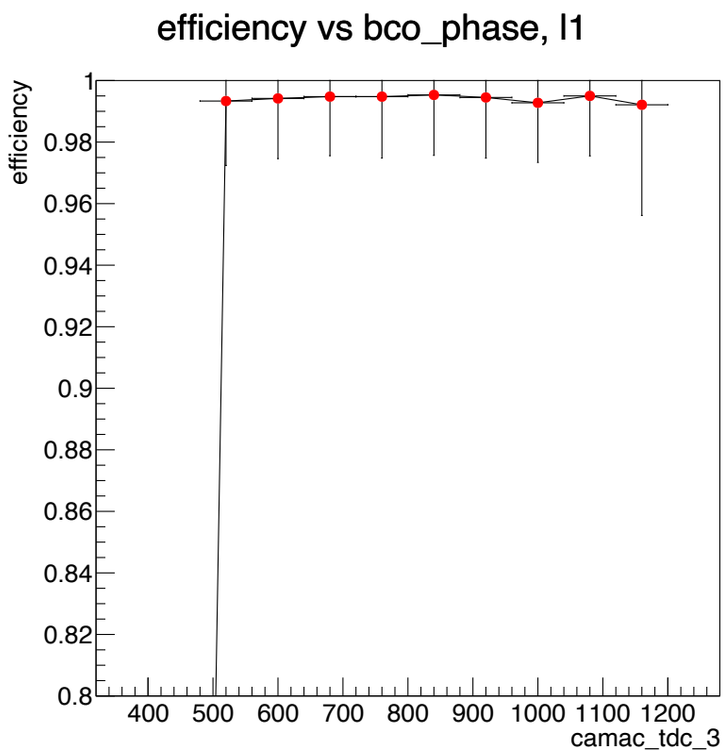
Effi. seems to be independent to the BCO phase

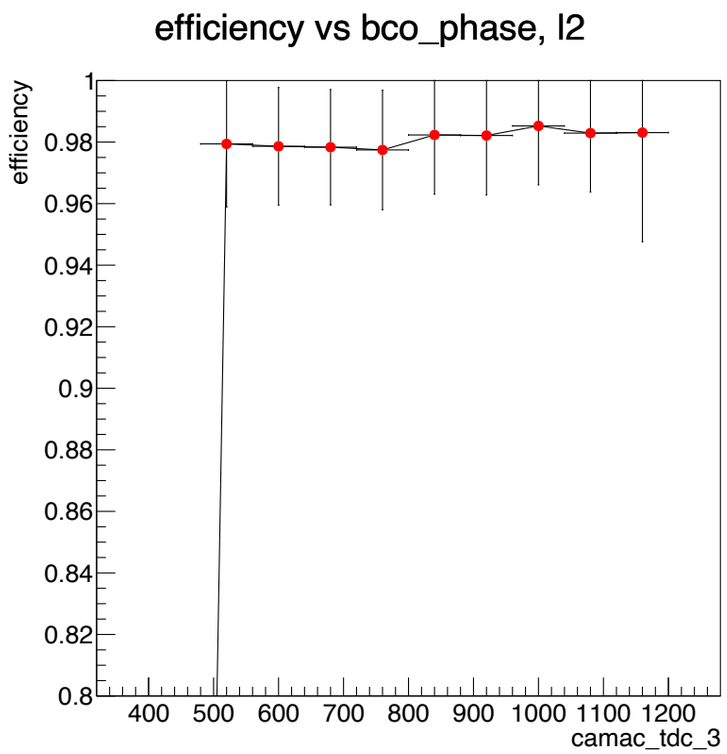
Effi. vs BCO phase

One of the expectation relation









Run 58 exclusion

Effi. seems to be independent to the BCO phase

Effi. vs BCO phase

- Another approach, Run 58

```
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 %
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=====3-layers=====efficiency results==========
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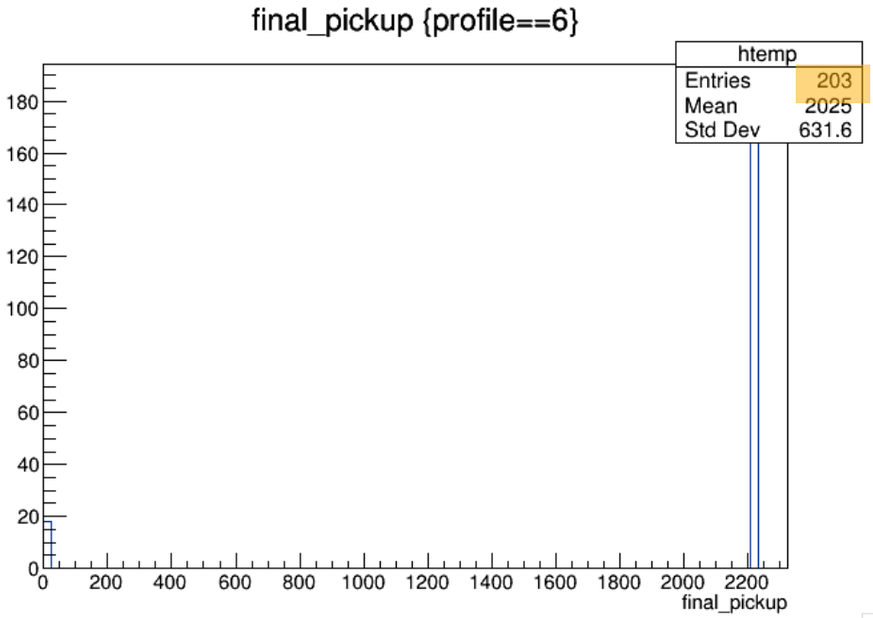
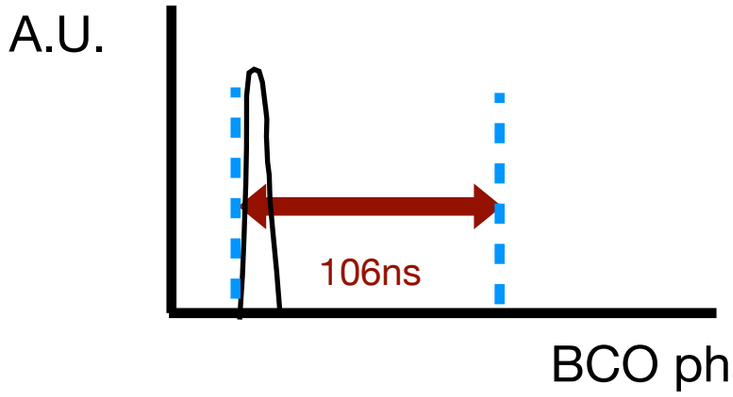
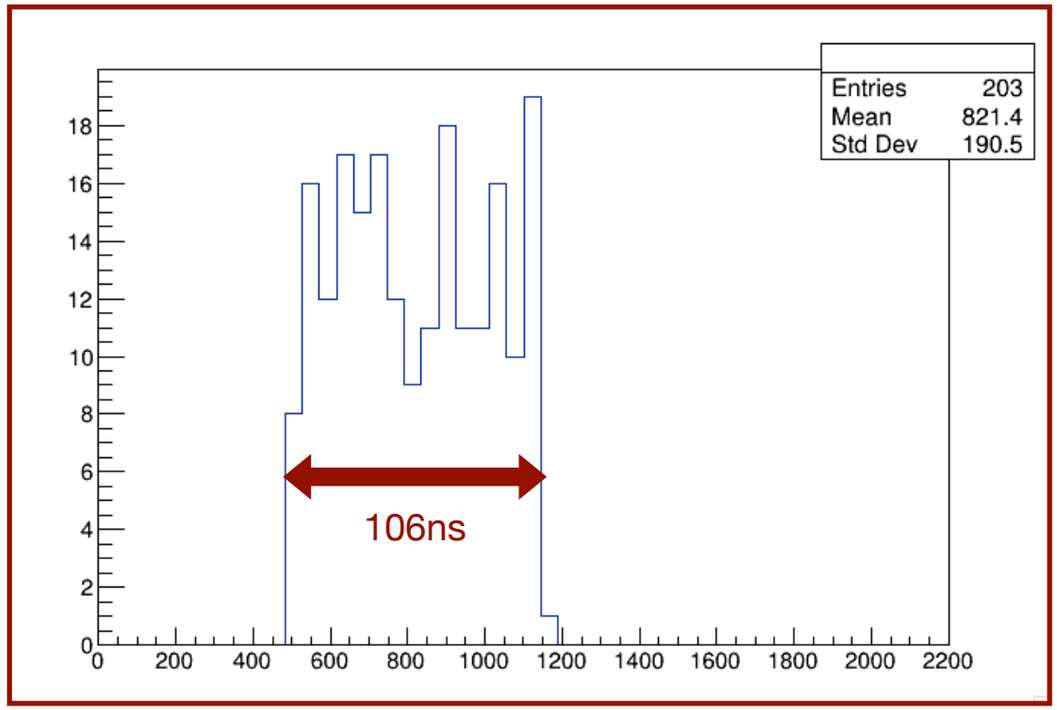


One of the expectation relation





The BCO phase distribution of the 011 events

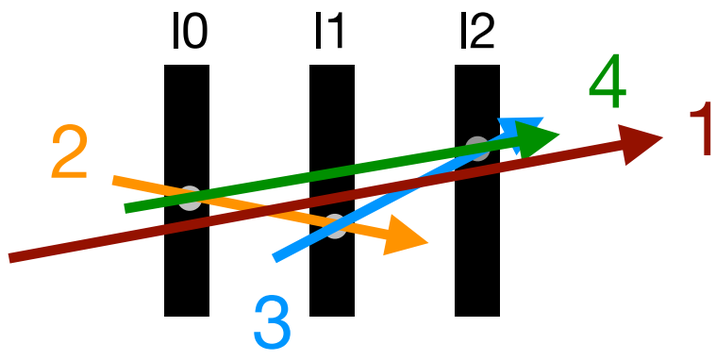
The distribution seems to be no tendency

Scattering

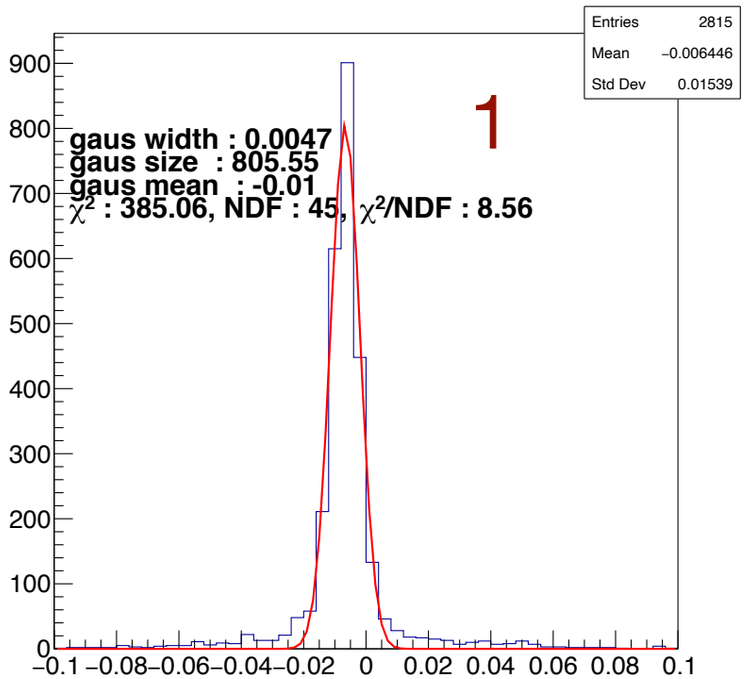
Only the hits from first BCO group are considered

Run 89
I1 position correction : ON

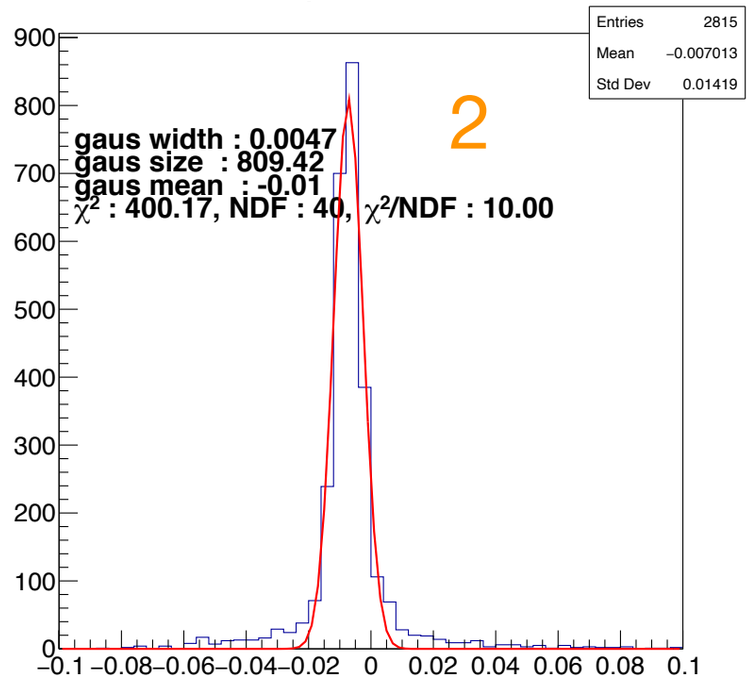
1 : 3 hits fit
2 : slope of I1-I0
3 : slope of I2-I1
4 : slope of I2-I0



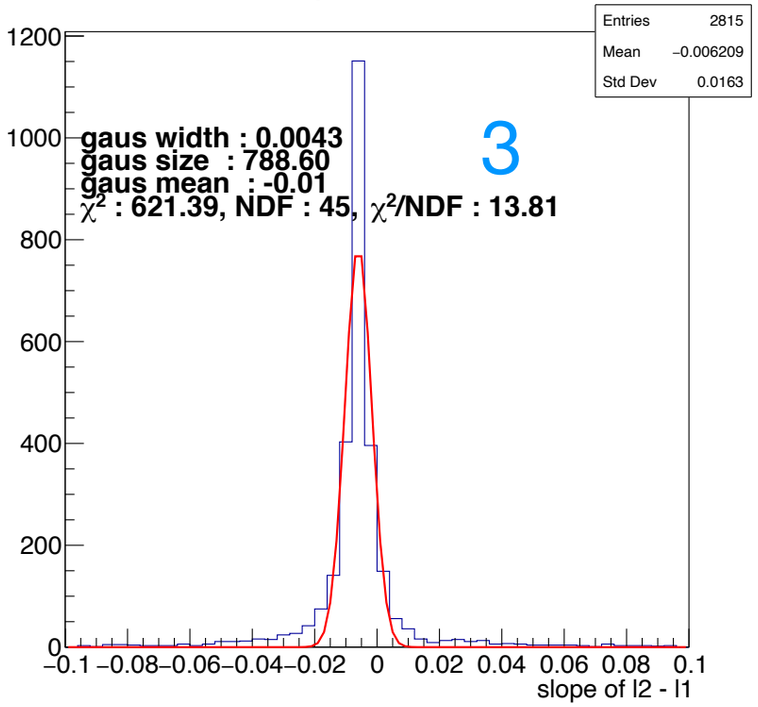
slope of 3 hits



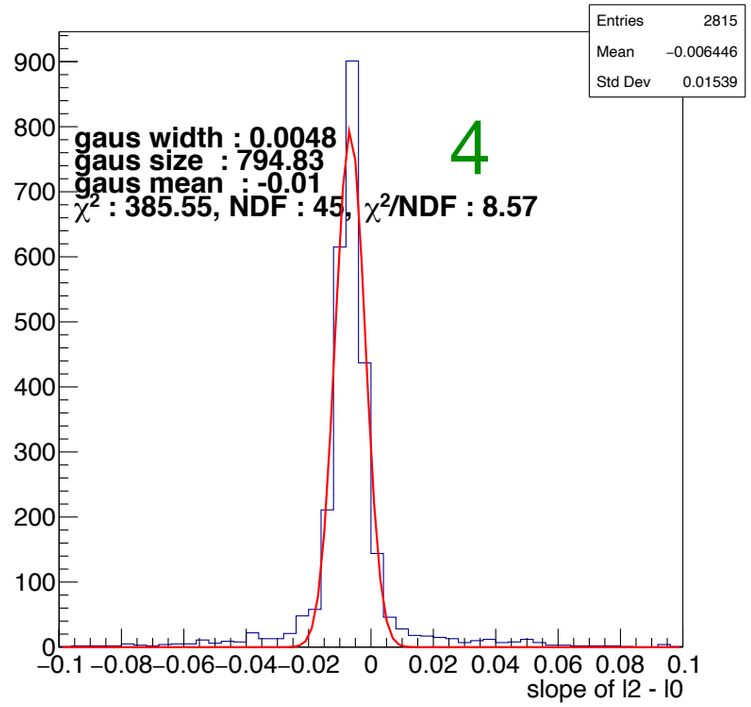
slope of I1 - I0



slope of I2 - I1



slope of I2 - I0

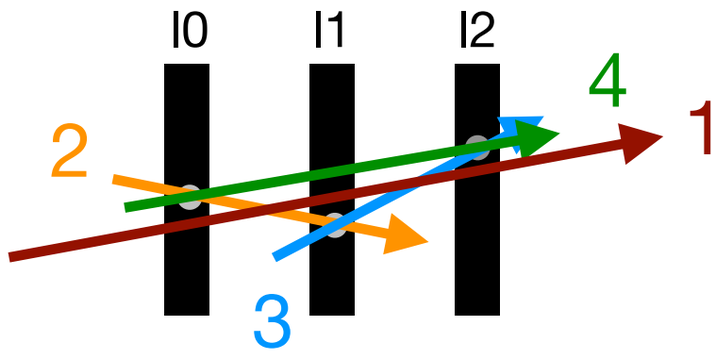


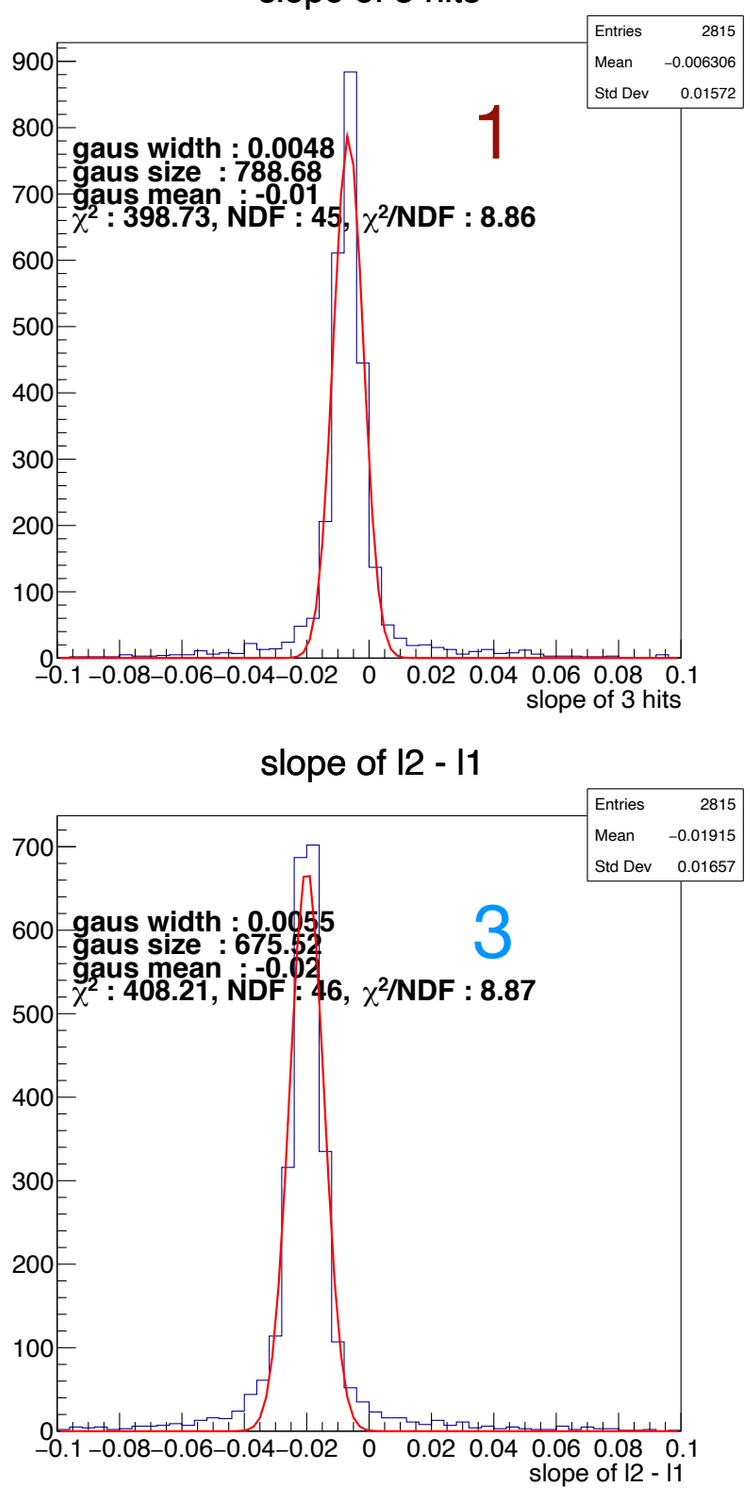
Scattering

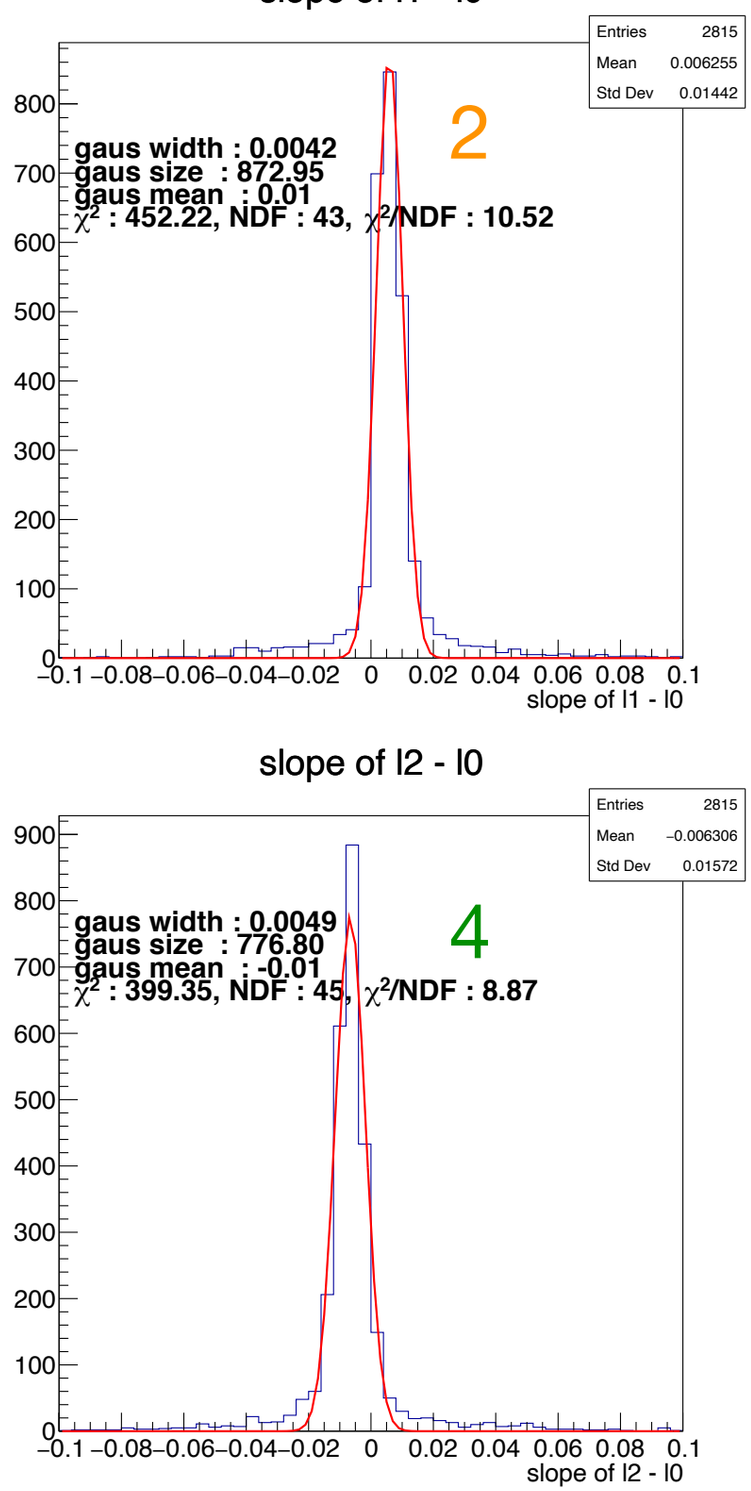
Only the hits from first BCO group are considered

Run 89
I1 position correction : OFF

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





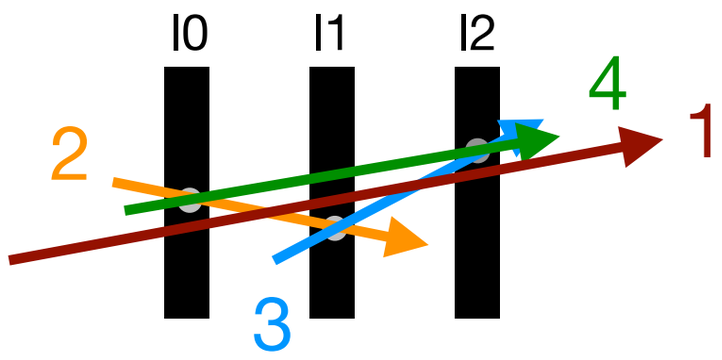


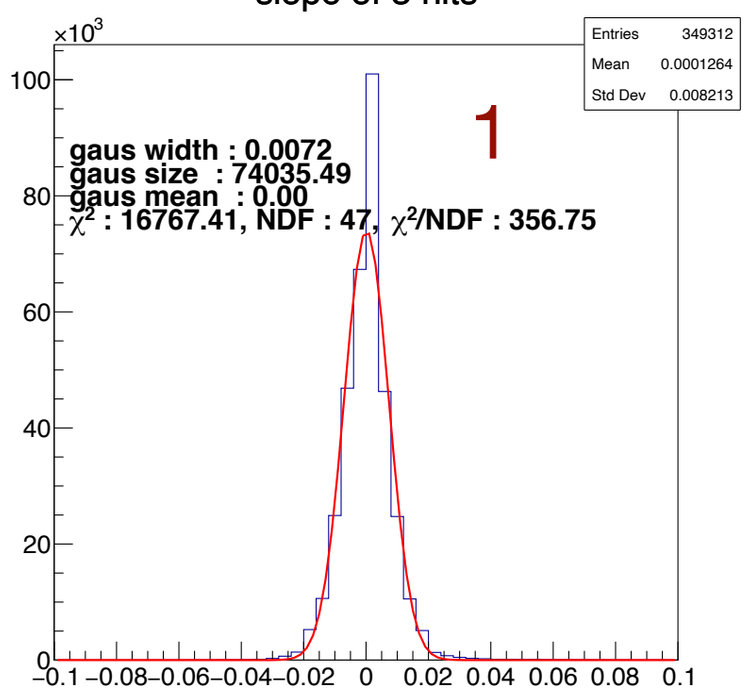
Scattering

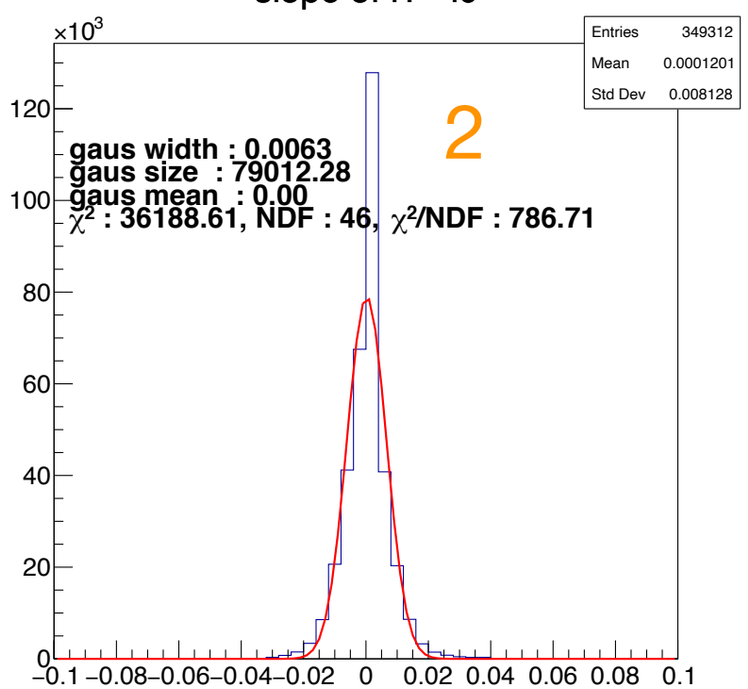
Only the hits from first BCO group are considered

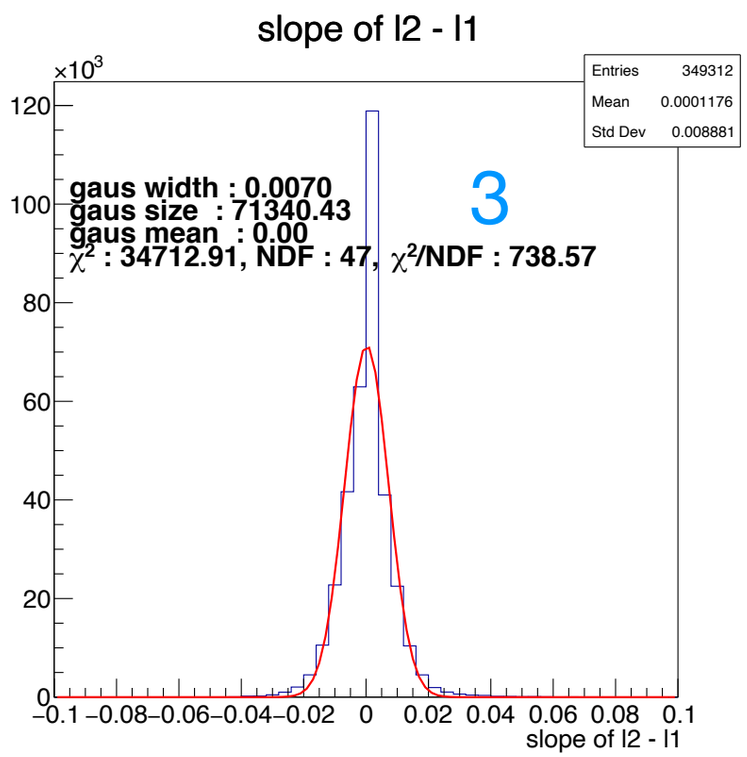
G4 simulation
(Not latest model)
(Beam quality not considered)

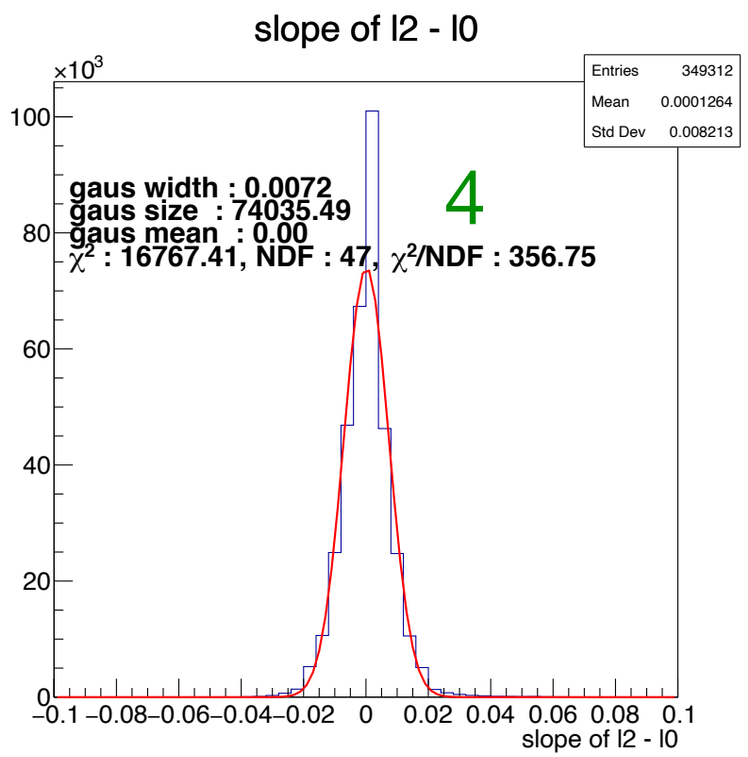
1 : 3 hits fit
2 : slope of l1-l0
3 : slope of l2-l1
4 : slope of l2-l0









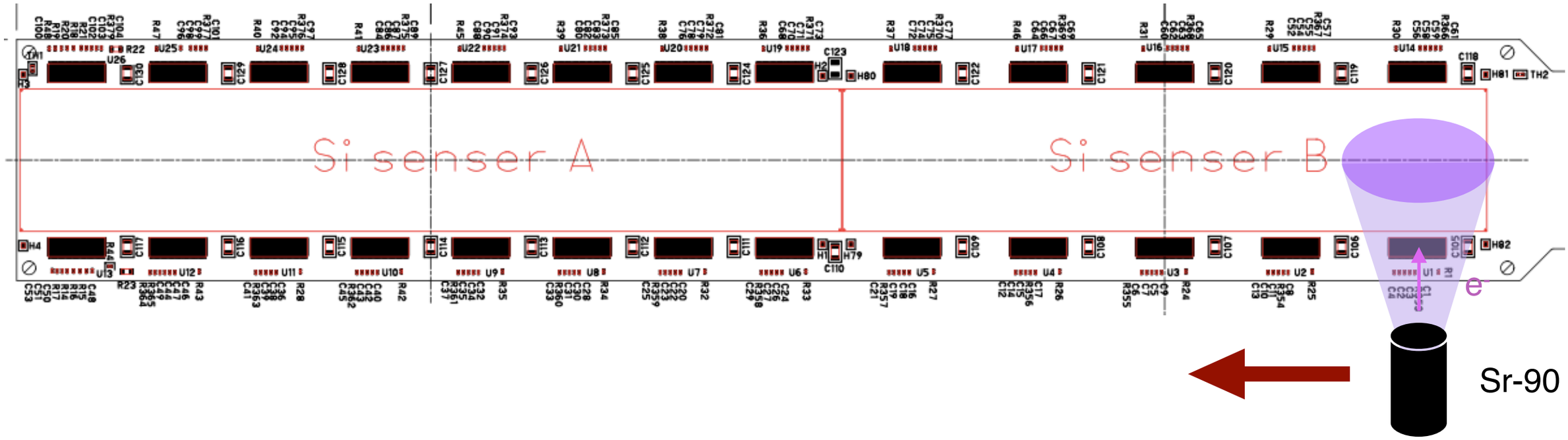


Source test

Source test plan for massive ladders

- Source test procedures :
  1. source moves to one chip
  2. wait for 2 mins
  3. source move to next chip
  4. wait for 2 mins…

Silicon faces down



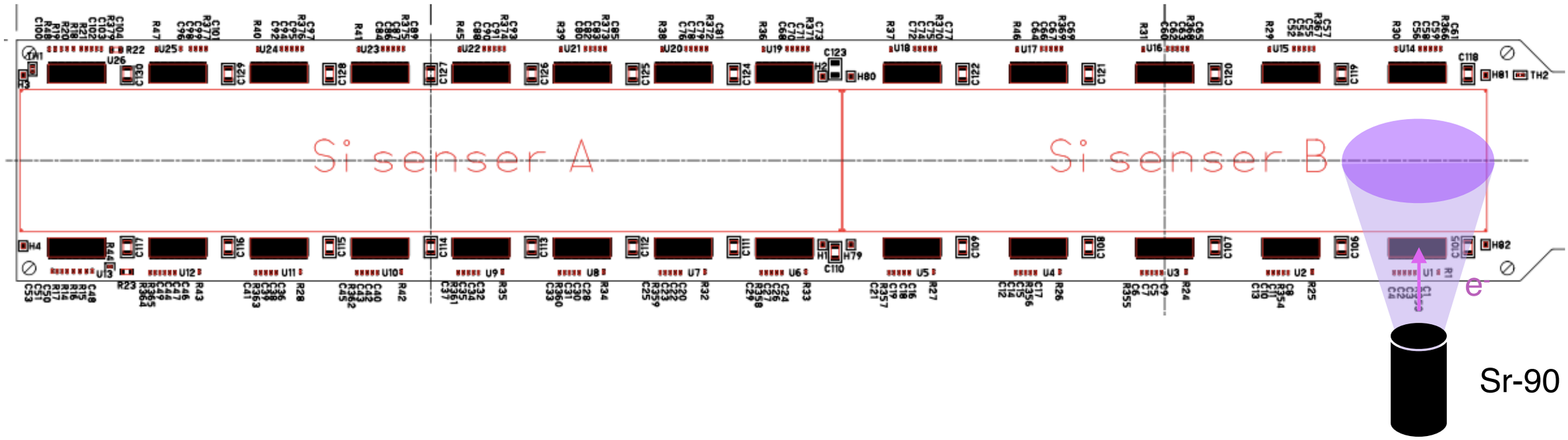
1. Wait for 2 mins
2. Move to next chip

(2 mins ＊13 chips) ＊2 sides ~ 1 hours for one ladder source test

Source test plan for massive ladders

- Source test procedures :
  1. source moves to one chip
  2. wait for 2 mins
  3. source move to next chip
  4. wait for 2 mins…

Silicon faces down



Wait for 2 mins
Move to next chip
Wait for 2 mins
Move to next chip
Wait for 2 mins
Move to next chip

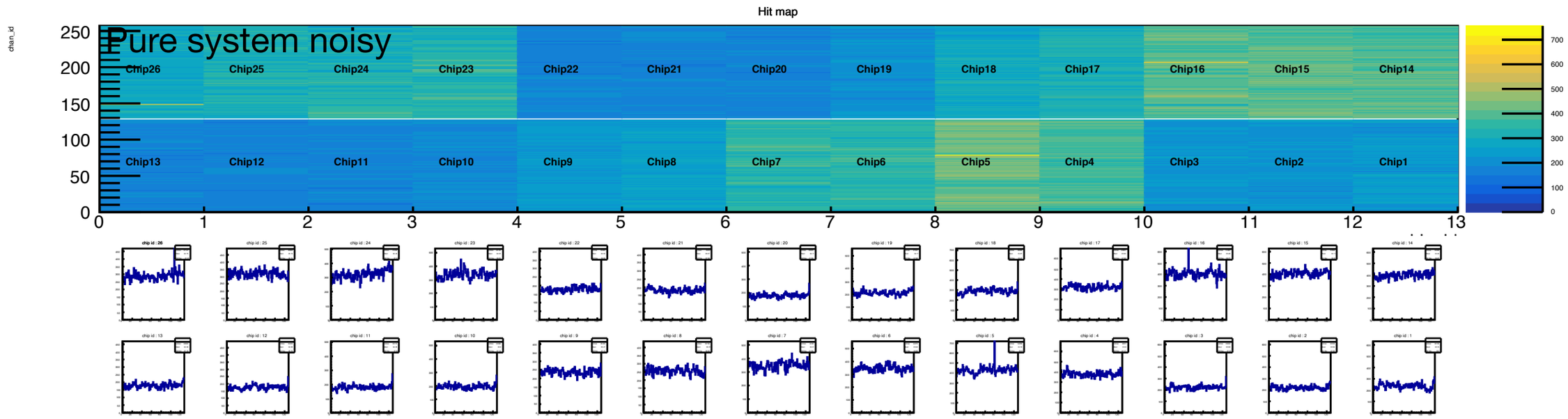
(2 mins ＊13 chips) ＊2 sides ~ 1 hours for one ladder source test

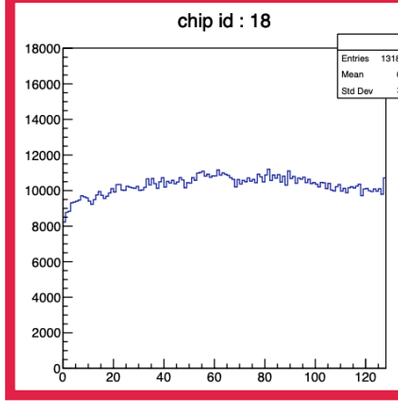
Source test plan for massive ladders

Self-trigger
adc0 : 40

Measurement : 1282 mins
Total event : 926089
→ 926089/(3328·1282)=0.217

→ 0.217 events per channel per mins





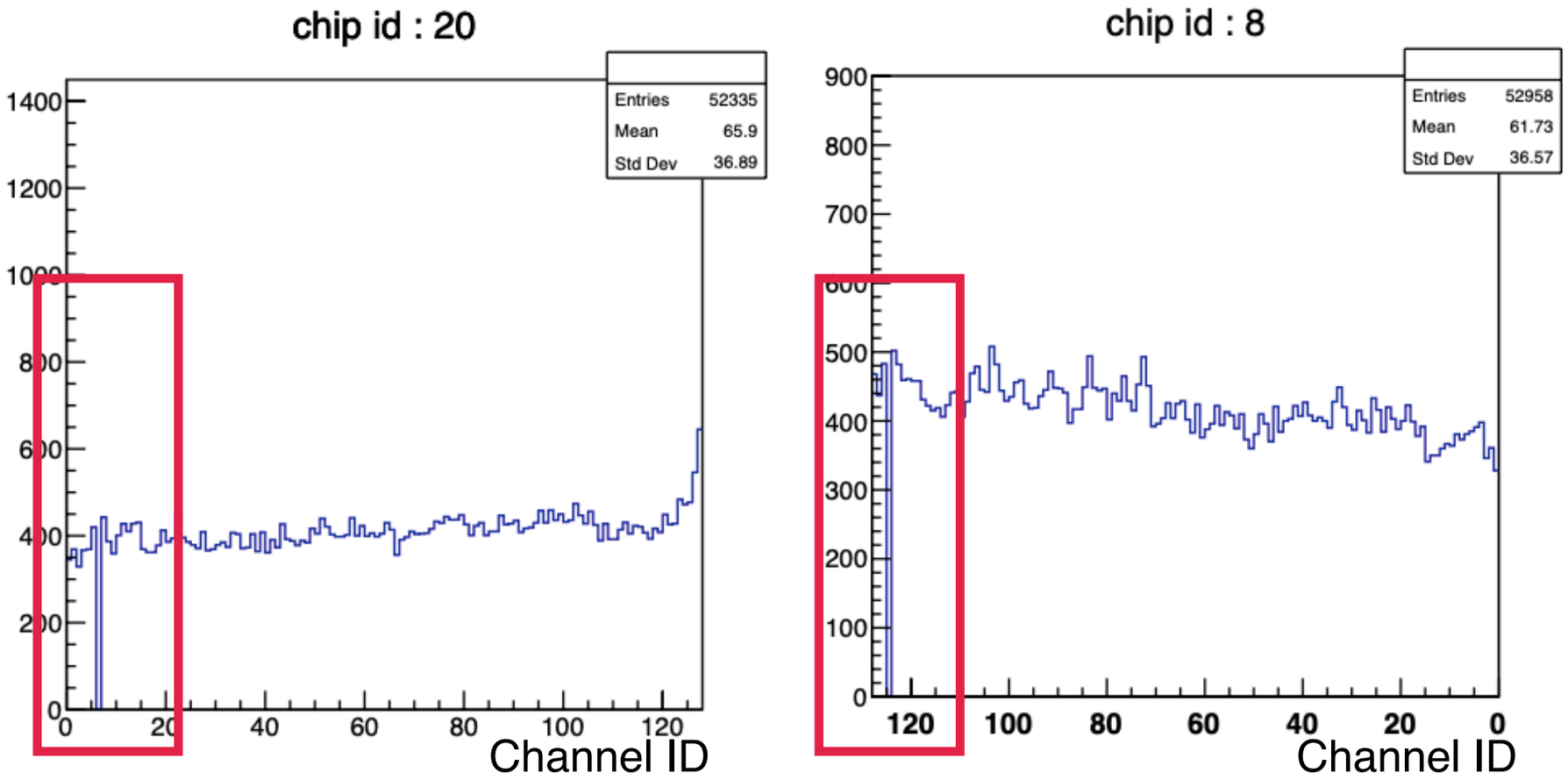
With source
Measurement : 10 mins
Total event of U18 : 1318551
→ 1030 events per channel per min

To verify Silicon, 1 mins is enough

Source test plan for massive ladders

- Silicon faces down
- Self-trigger mode
- adc0 : 40
- 2 mins measurement

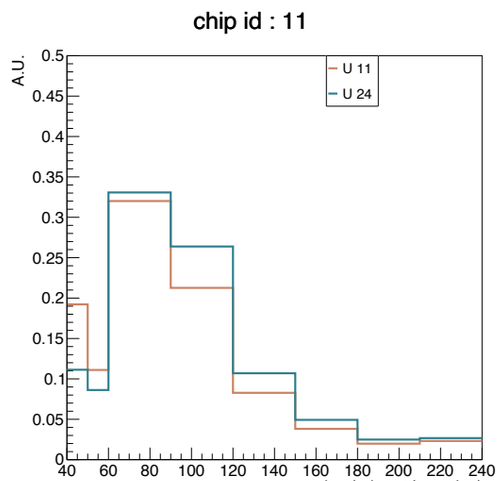
2 un-bonded channels : U8 C124, U20 C6

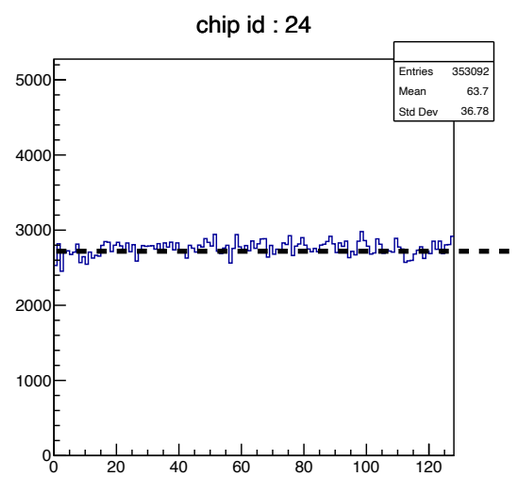


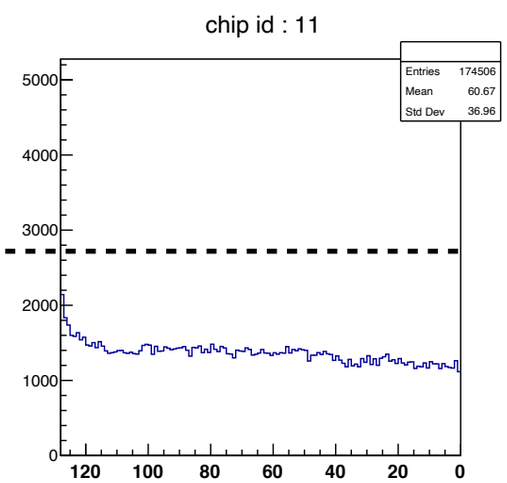
Un-bonded channel can be identified under a 2 mins measurements

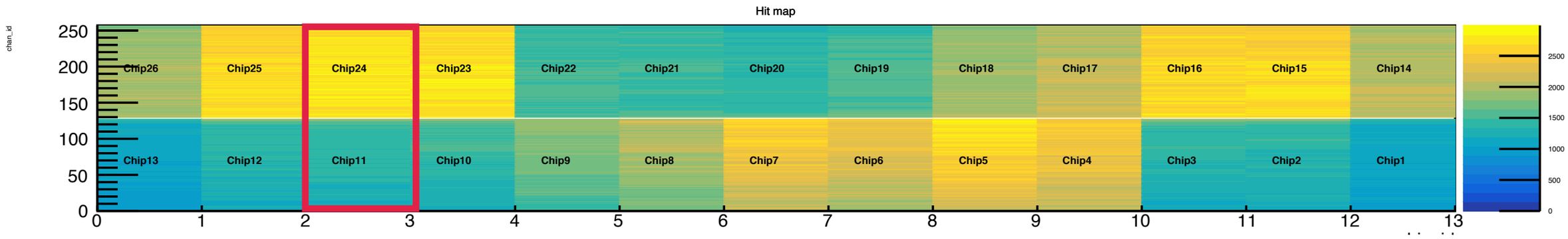
Source test plan for massive ladders

- Silicon faces down
- Self-trigger mode
- adc0 : 40
- 2 mins measurement









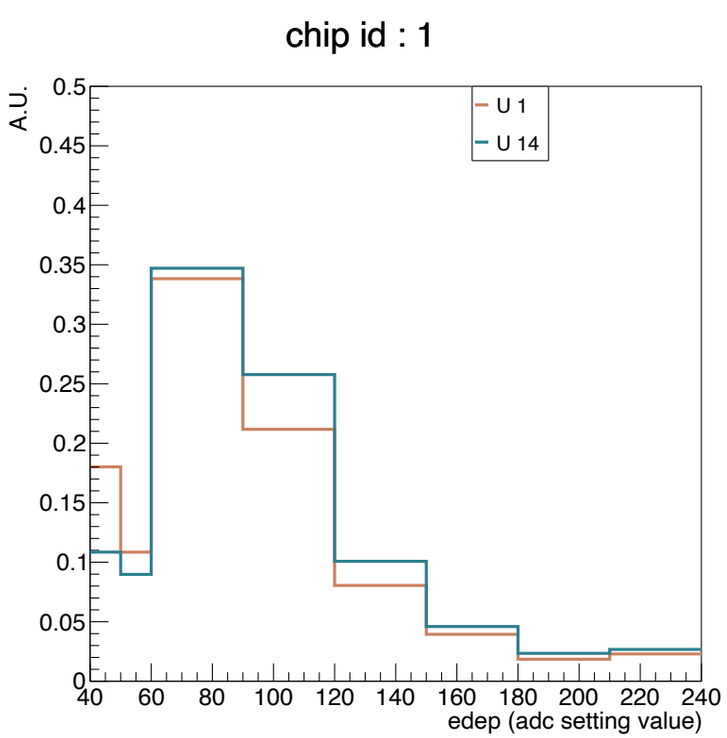
Each chip is exposed under Sr-90 for 2 mins, the # of entry is expected to be similar

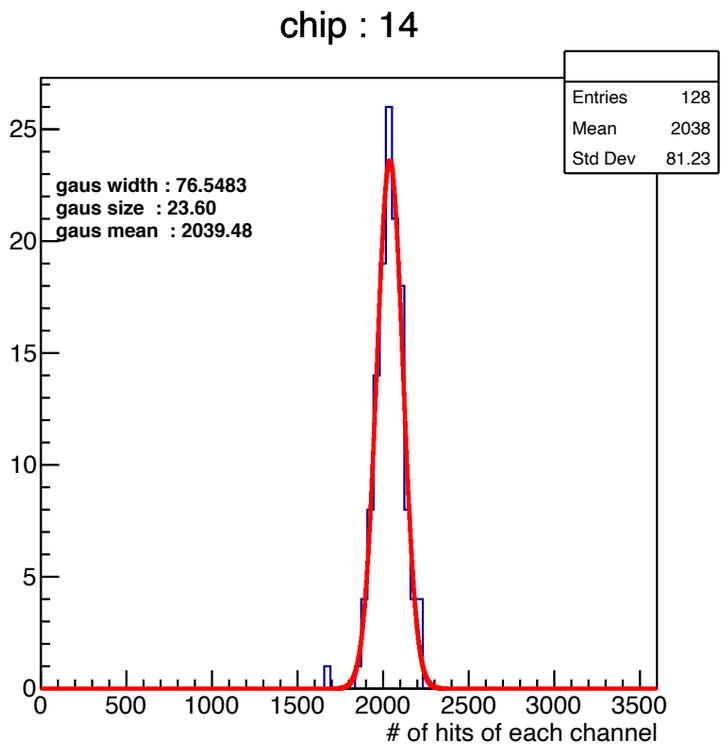
The number of entry is not symmetry

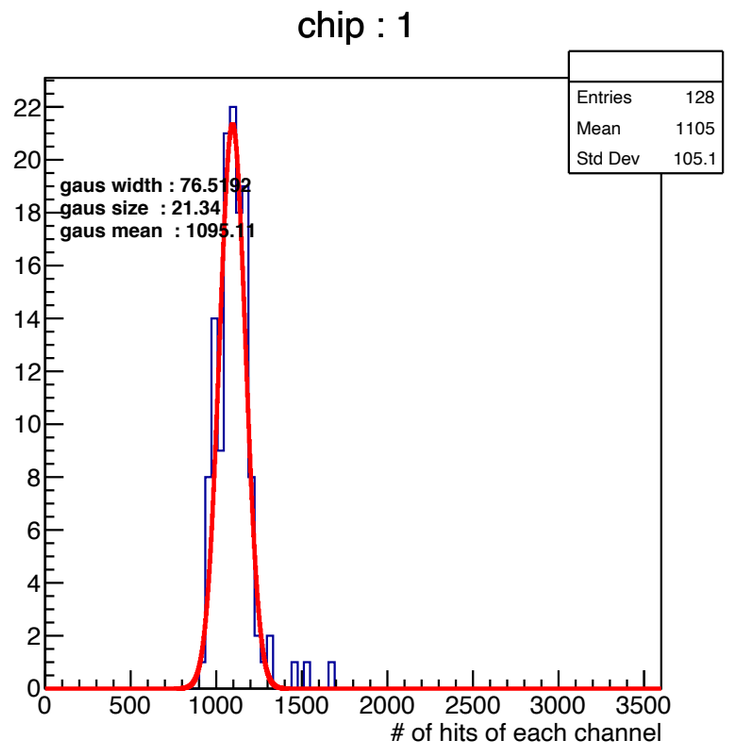
Still OK for the source test QA (I think)

Source test plan for massive ladders

- Current source test QA plan
  - Check the chip adc distribution (overall performance)
  - Check the chan hit distribution (chip independence)
    - Set a 3 or 4 sigma cut based on the gaussian fit.

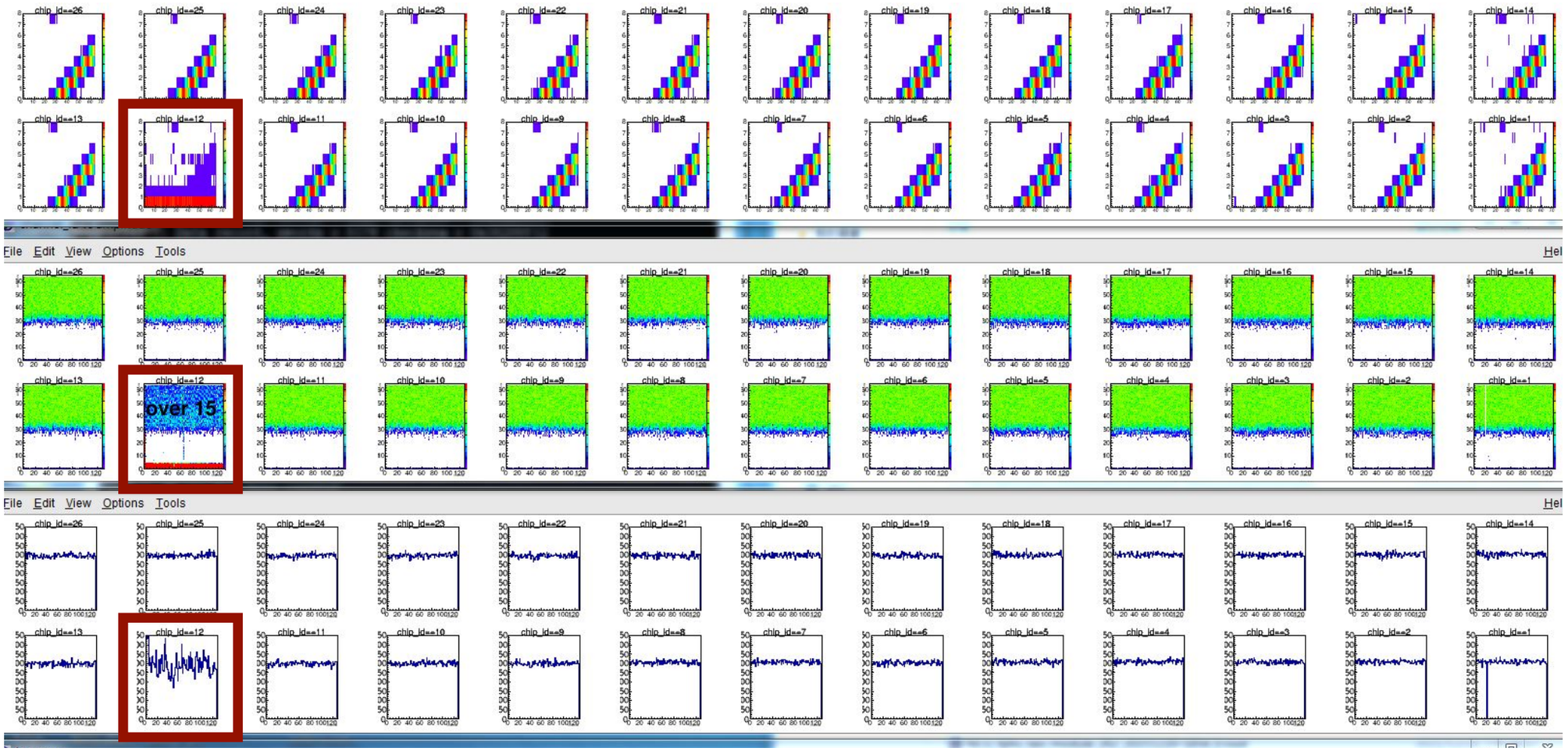






Shortage of self-trigger mode

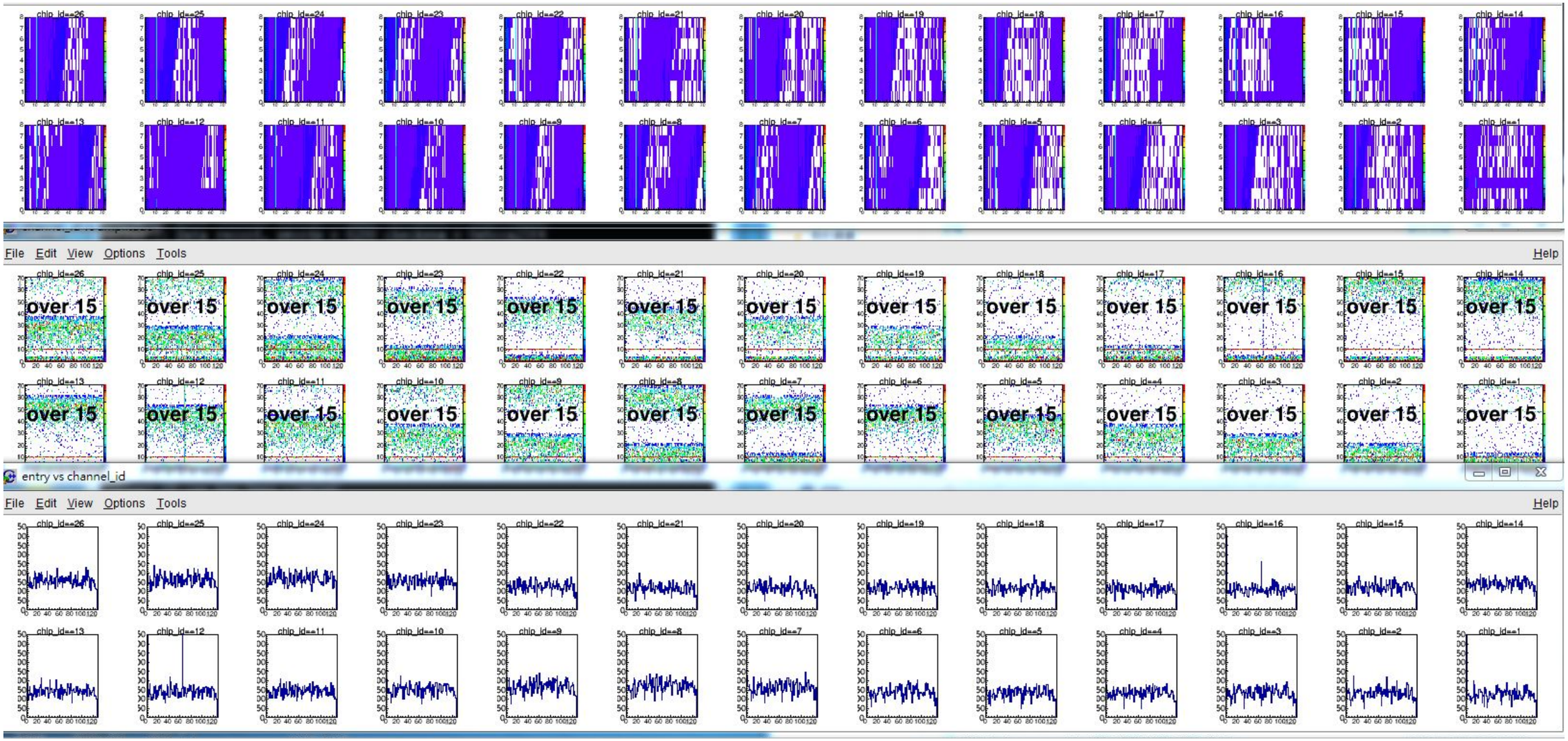
- As long as there is one channel that is super noisy, source test (self-trigger) could not be performed properly.



Channel 0 and 1 of U12 : super noisy

Shortage of self-trigger mode

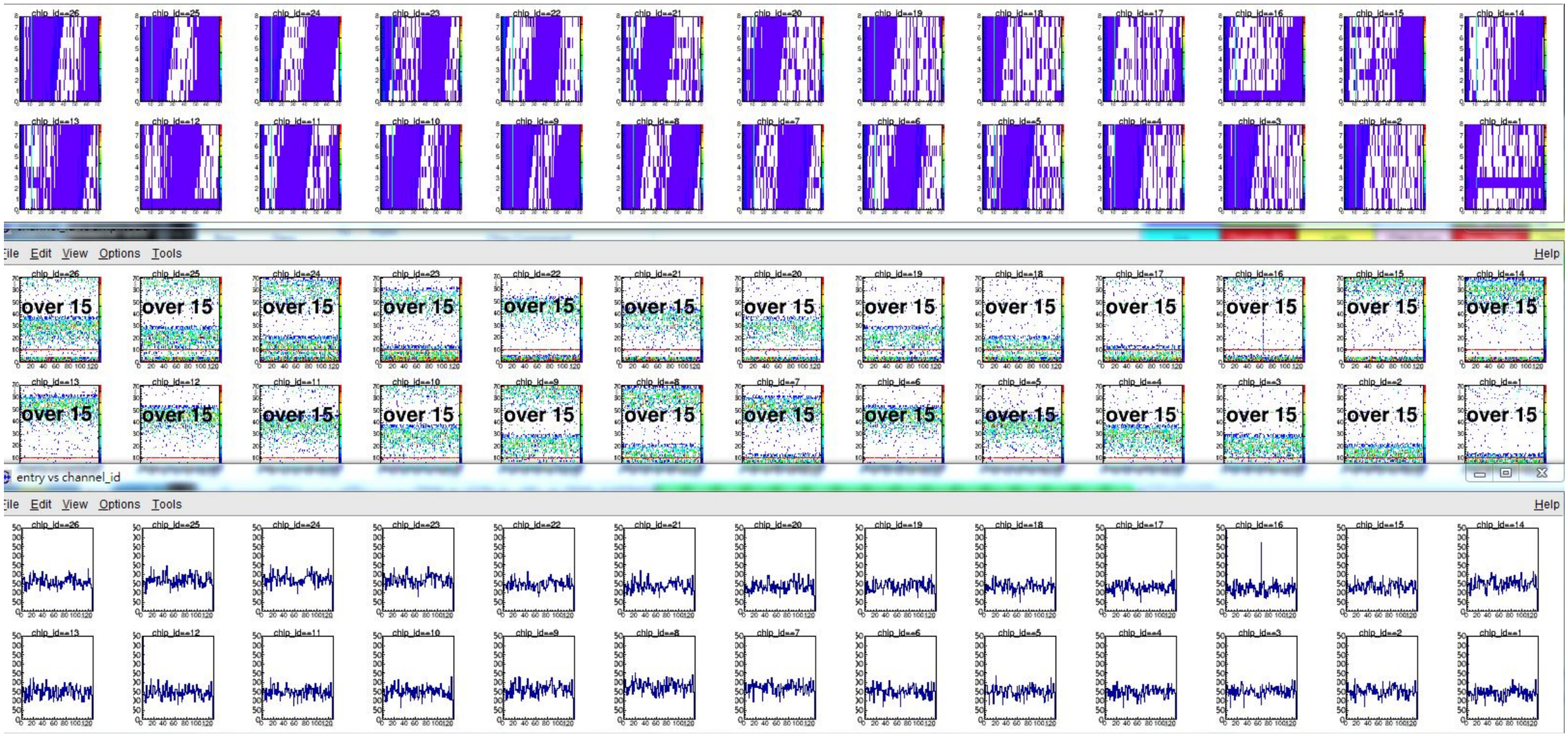
adc0 : 40



Solution : disable those specific, noisy channel (not available in current DAQ system)

Shortage of self-trigger mode

adc0 : 150



Solution : disable those specific, noisy channel (not available in current DAQ system)

Summary

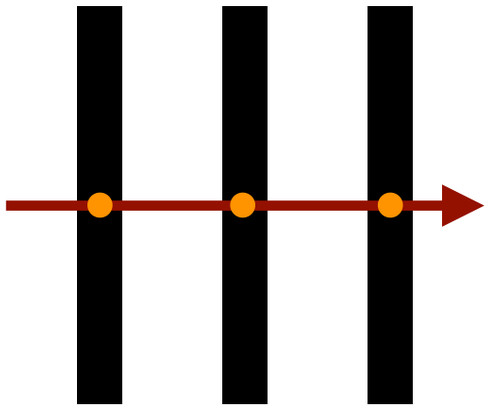
- The LoE_removal improves the detection efficiency of I1 and I2 by an amount of ~ 3% and 9%
- The production runs are studied, most of the runs are good.
- The detection efficiency seems to be a constant as bco phase changing.
- 2 mins source exposure seems to be enough for the source test QA.
- The unsymmetrical entry issue is observed.
- As long as there is one noisy channel, the source test can not be performed properly.

Back up

Some definitions

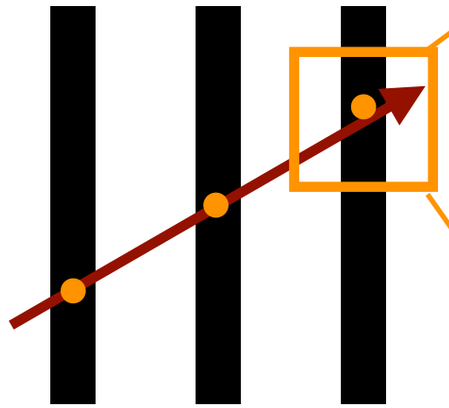
3 hits case

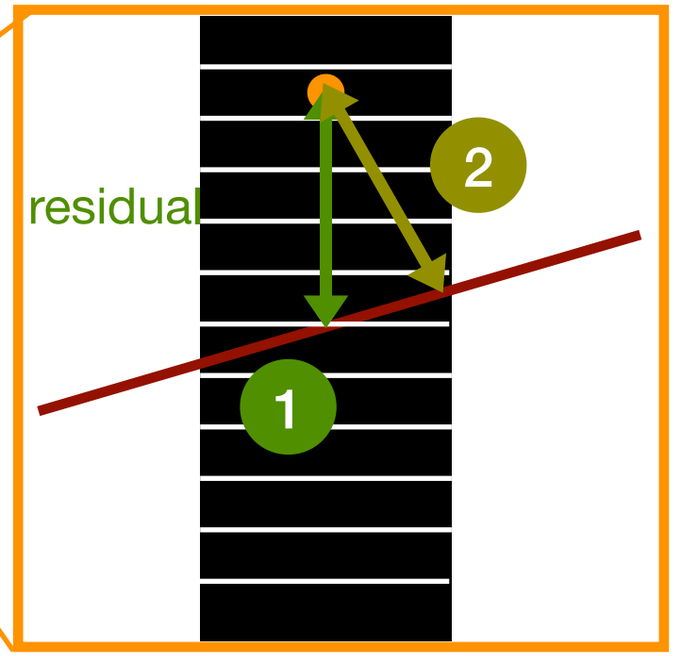
Expected event



Large angle, but still ok

As long as the residual smaller than window size

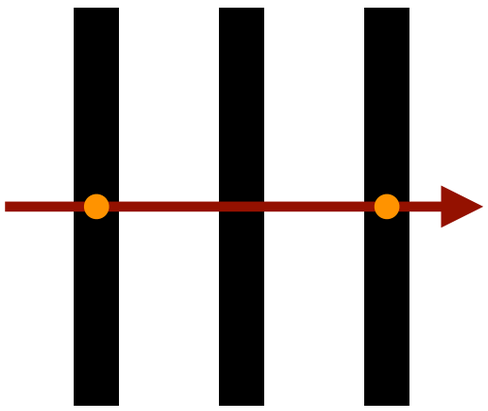




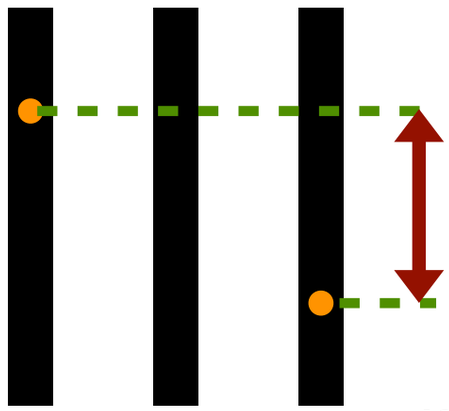
Current algorithm:
method 1 is used for residual calculation

2 hits case

Expected event



Is it a good event ?



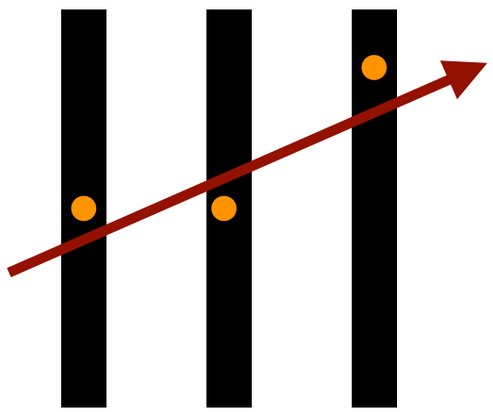
Current algorithm :
If the position difference > window size → 000
else → 101

Some definitions

3 hits case

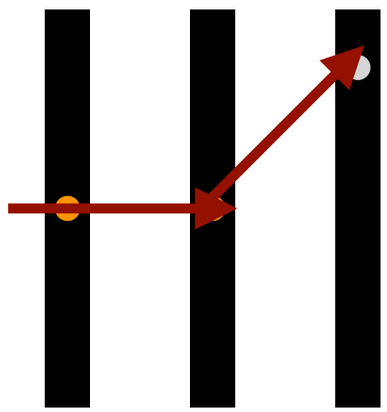
1

Bad event example
residual too big



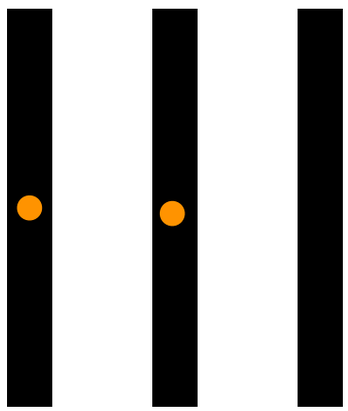
2

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

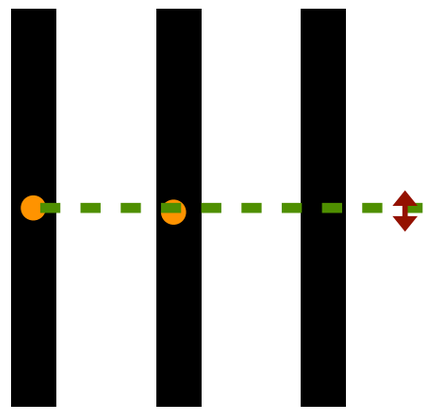


Now this event becomes a 2 hits case
2 hits algorithm is performed

3



4



Position difference

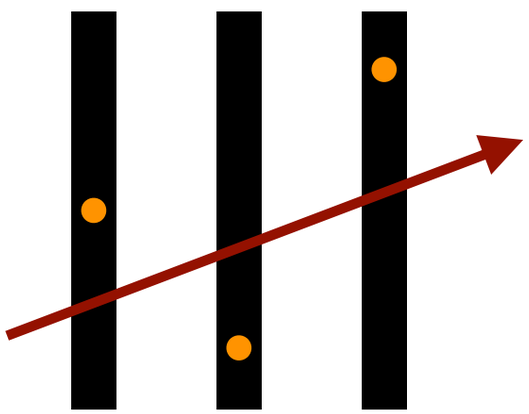
Position difference < window size
→ final profile 1 1 0

Some definitions

3 hits case

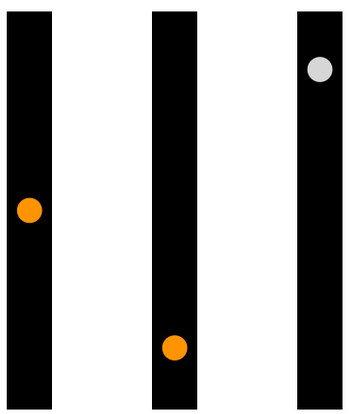
1

Bad event example
residual too big



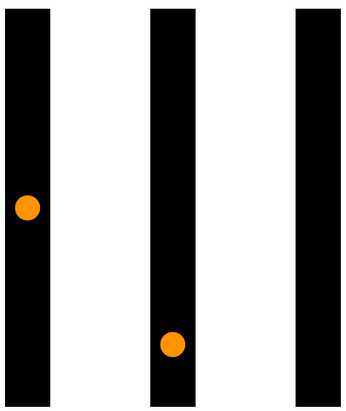
2

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

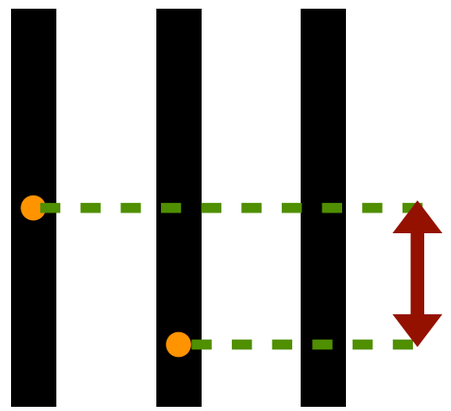


Now this event becomes a 2 hits case
2 hits algorithm is performed

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

To do 2021/12/23

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

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

- 3 hits angle, 2*(2 hits angle) distributions (single/multi coulomb scattering), residual plots
  - Use rest groups in event for the study
  - ~~Or combine all production data~~

- angle cut in the detection effi.

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

- nth BCO group to be picked study

To do, low priority

- alignment rotational correction
- multi-track
- with BEC
- To check the data of the testbeam last time not really understand ayaka’s algorithm