

INTT TestBeam data checking

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// The final situation of Testbeam data

L0, ID : 1

L1, ID : 6

L2, ID : 5

same event, eID : 3 Module : layer ID Clock Scintillator trigger information

```

*****
* Row * Instance * event * module * chip_id * chan_id * adc * bco * bco_full * camac_tdc * camac_adc * INTT_even *
*****
* 3 * 0 * -1 * -1 * 11 * 27 * 3 * 0 * 4096 * 961 * 167 * 1 *
* 3 * 1 * -1 * 6 * 11 * 27 * 2 * 0 * 4096 * 2159 * 153 * 1 *
* 3 * 2 * -1 * 5 * 10 * 21 * 2 * 0 * 4096 * 393 * 372 * 1 *
* 3 * 3 * -1 * 1 * 11 * 27 * 3 * 12 * 30348 * 1068 * 137 * 1 *
* 3 * 4 * -1 * 6 * 11 * 27 * 2 * 12 * 30348 * 2159 * * 1 *
* 3 * 5 * -1 * 5 * 10 * 21 * 2 * 12 * 30348 * 2159 * * 1 *
* 3 * 6 * -1 * 1 * 10 * 74 * 3 * 27 * 45851 * * * 1 *
Type <CR> to continue or q to quit ==>
* 3 * 7 * -1 * 6 * 10 * 76 * 4 * 27 * 45851 * * * 1 *
* 3 * 8 * -1 * 5 * 10 * 71 * 2 * 27 * 45851 * * * 1 *
* 3 * 9 * -1 * 1 * 10 * 64 * 1 * 91 * 3803 * * * 1 *
* 3 * 10 * -1 * 1 * 10 * 63 * 0 * 91 * 3803 * * * 1 *
* 3 * 11 * -1 * 6 * 10 * 65 * 2 * 91 * 3803 * * * 1 *
* 3 * 12 * -1 * 5 * 10 * 60 * 2 * 91 * 3803 * * * 1 *
* 3 * 13 * -1 * 1 * 10 * 11 * 3 * 91 * 15195 * * * 1 *
* 3 * 14 * -1 * 6 * 10 * 12 * 2 * 91 * 15195 * * * 1 *
* 3 * 15 * -1 * 5 * 10 * 6 * 3 * 91 * 15195 * * * 1 *
* 3 * 16 * -1 * 6 * 10 * 13 * 0 * 91 * 15195 * * * 1 *
* 3 * 17 * -1 * 6 * 10 * 13 * 0 * 92 * 15196 * * * 1 *
* 3 * 18 * -1 * 1 * 23 * 123 * 1 * 74 * 33866 * * * 1 *
* 3 * 19 * -1 * 6 * 11 * 117 * 1 * 74 * 33866 * * * 1 *
* 3 * 20 * -1 * 6 * 11 * 118 * 3 * 74 * 33866 * * * 1 *
* 3 * 21 * -1 * 1 * 10 * 51 * 2 * 77 * 26573 * * * 1 *

```

●
●
●
Up to 406 hits

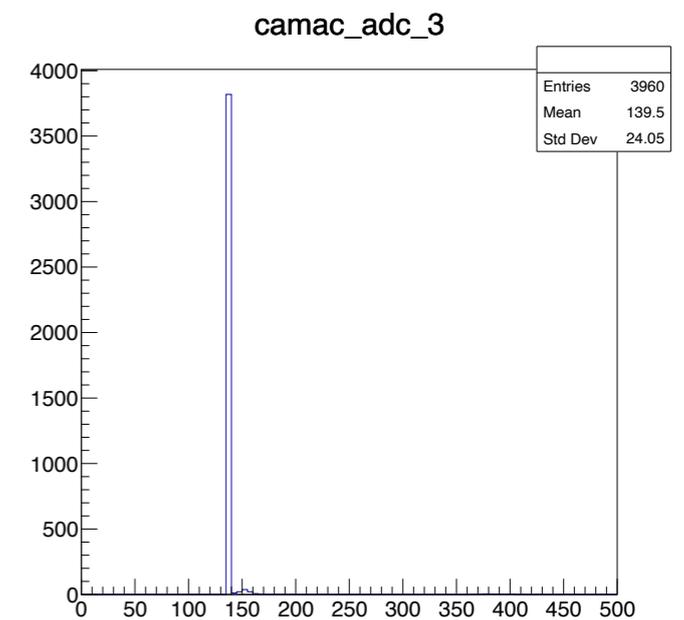
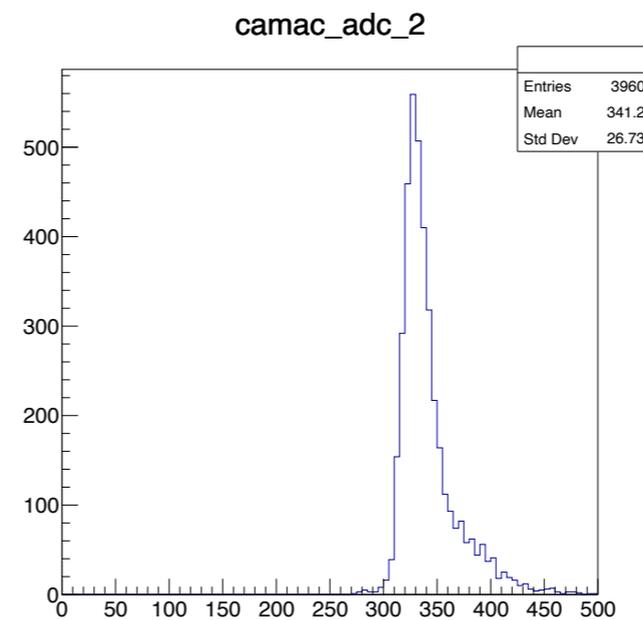
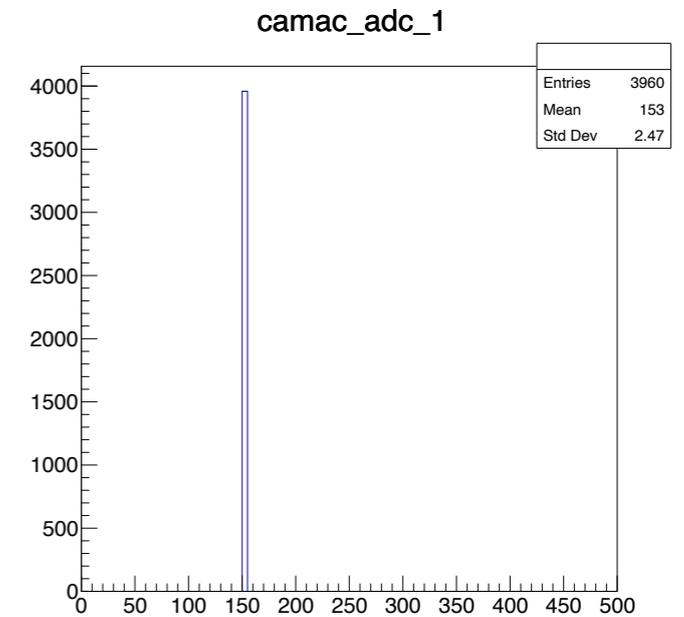
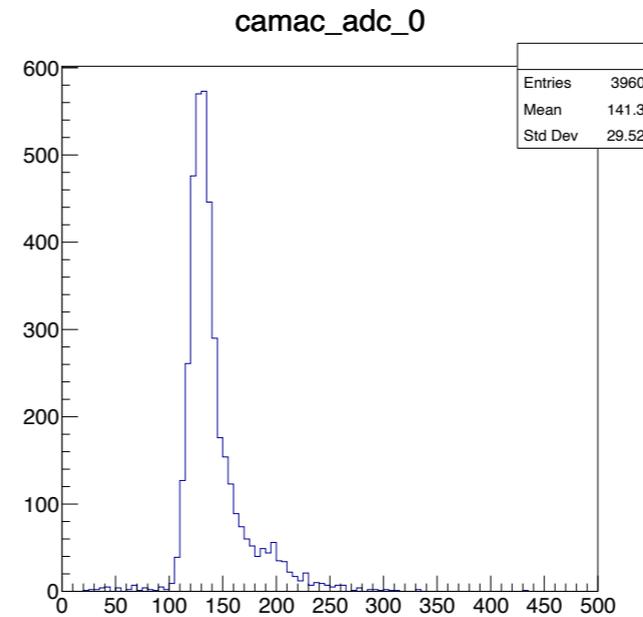
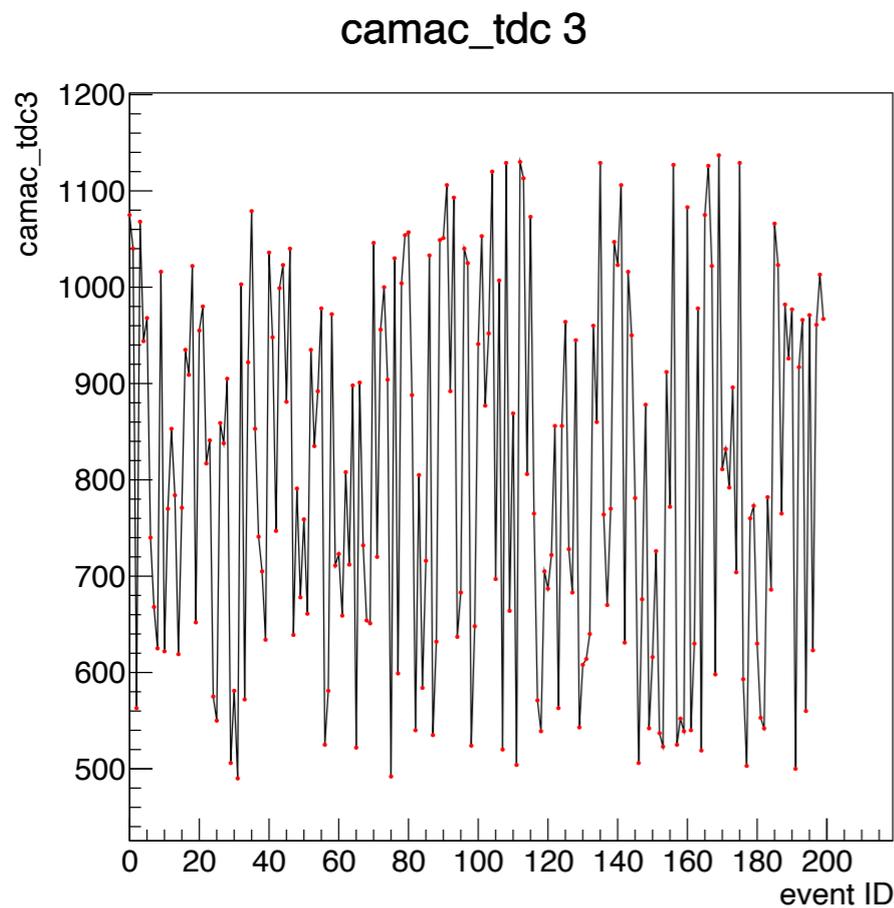
Current solution : only the hits from the first clock is studied

// BeamData_20211210-2043_0, Run ?

Only the hits in first BCO group in the trigger event are studied.

1	Total event	3960
2	INTT_event == 1	3886
3	INTT_event == 1 && DSE1	3
4	INTT_event == 1 && DSE2	1
5	DSE ratio (3+4) / 2	0.10%

- It seems that only 2 scintillators were used in this run

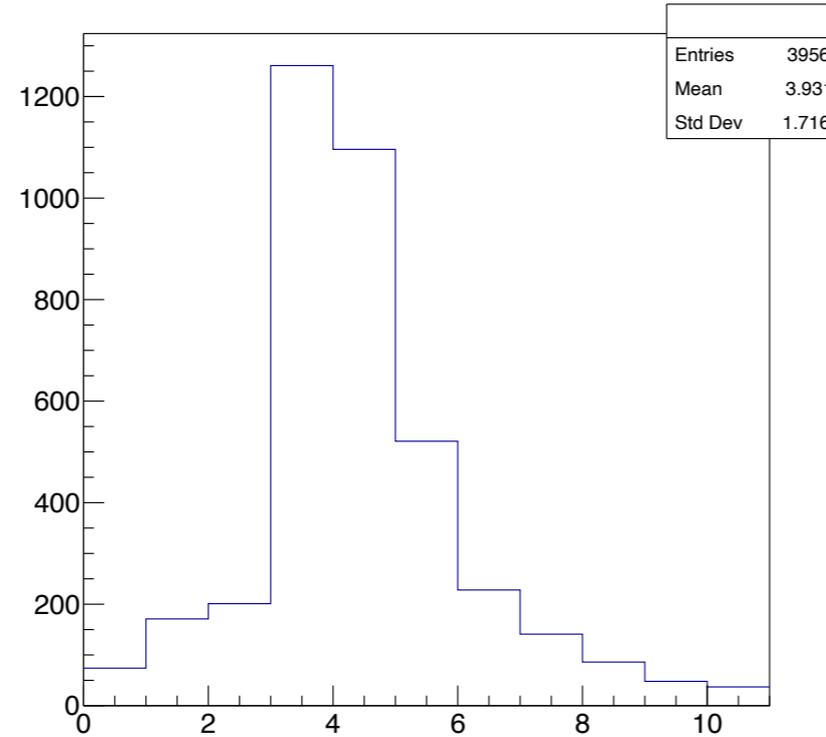


Camac system seems to be functioning

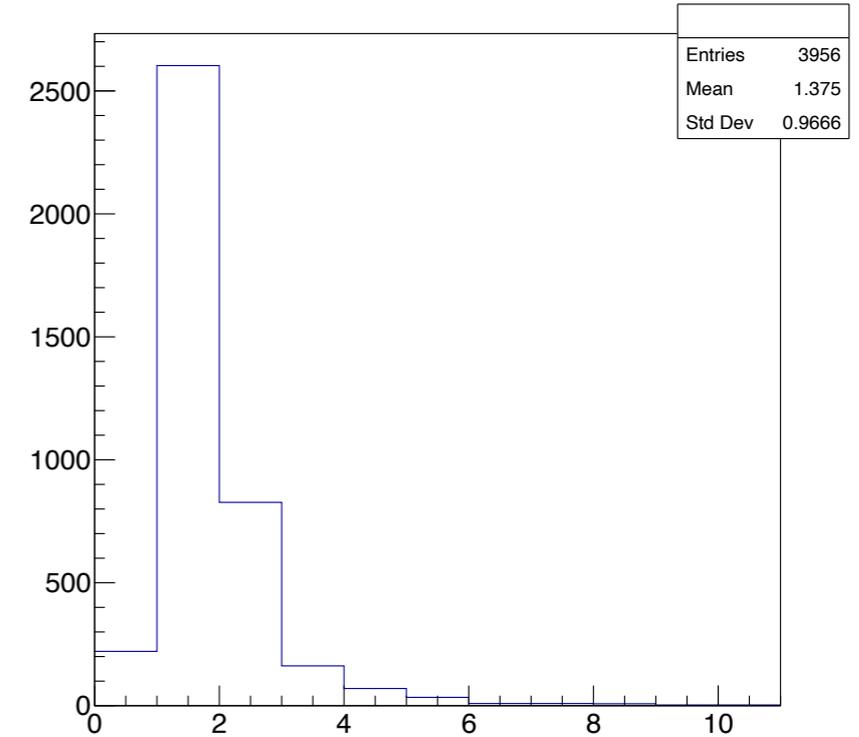
// BeamData_20211210-2043_0, Run ?

Only the hits in first BCO group in the trigger event are studied.

event_hit_hist, DSE == 0, all

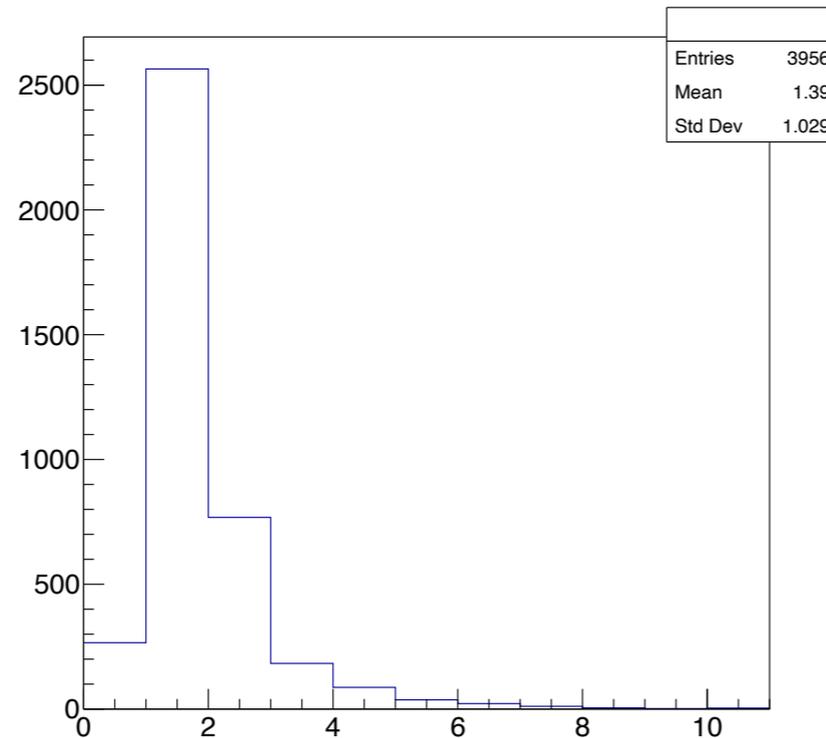


event_hit_hist, DSE == 0, I0

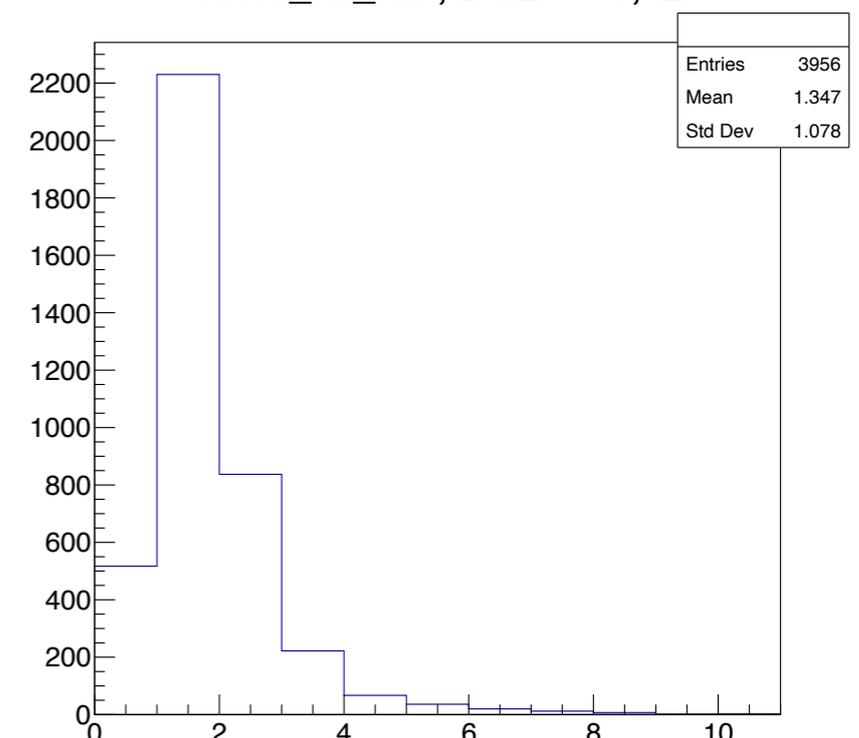


Module ID order 1, 6, 5

event_hit_hist, DSE == 0, I1

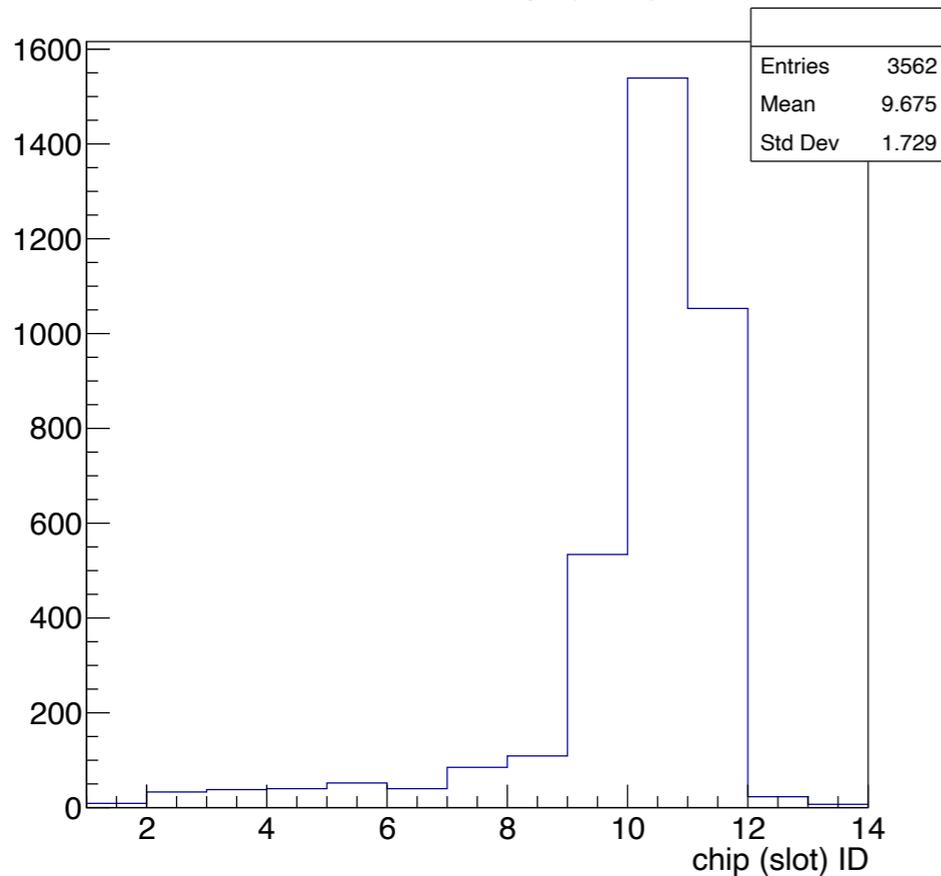


event_hit_hist, DSE == 0, I2

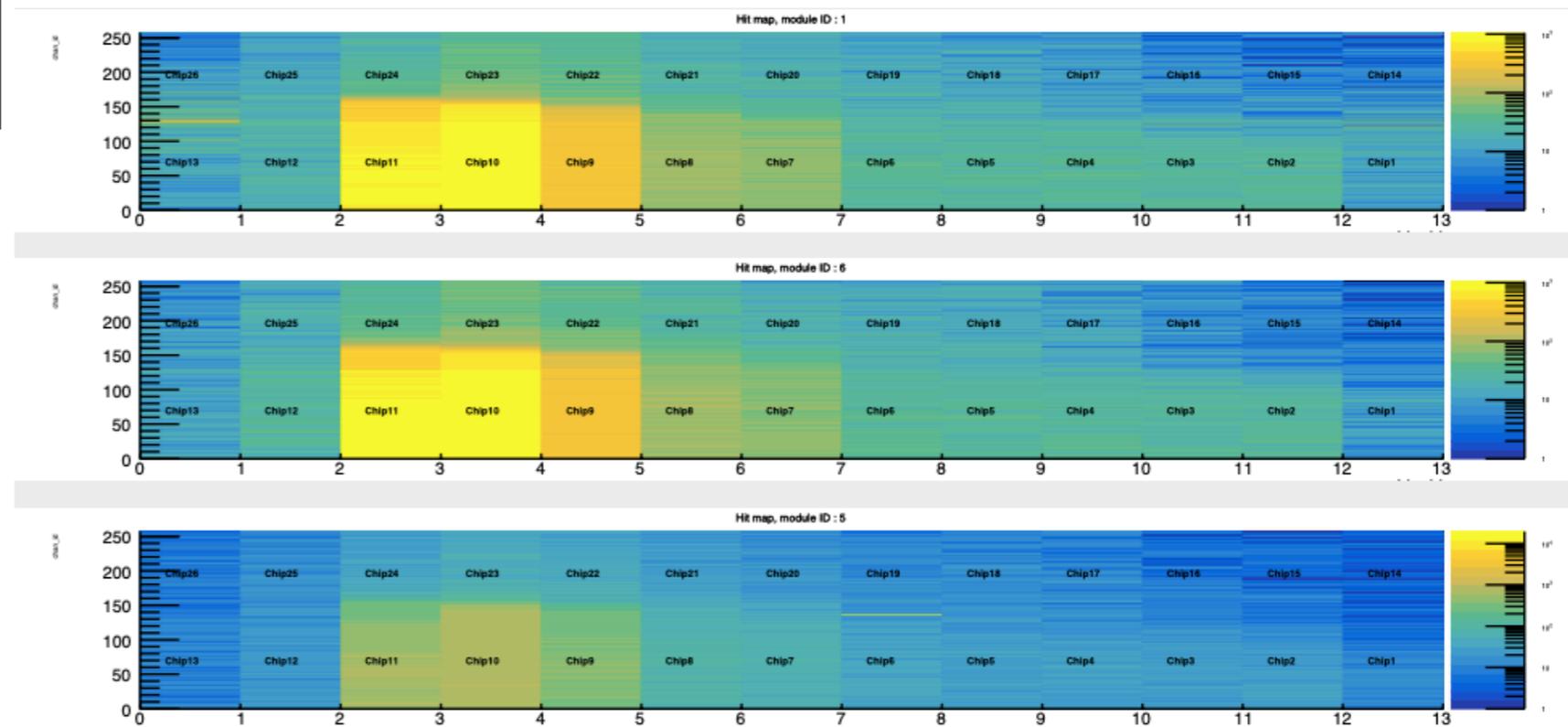


// BeamData_20211210-2043_0, Run ?

the chosen chip (slot) ID



Hit map, no cut



// BeamData_20211210-2043_0, Run ?

- (camac_adc range cut) * 2 + camac_tdc3 range cut
- DSE == 0
- INTT_event == 1
- Allow multi-clusters
- Allow multi-hits to form a cluster (position)
- ADC setting : 15, 30, 60, 90, 120, 150, 180, 210 (Takashi's setting, I guess)
- Module ID order : 1, 6, 5
- Tracking window cut (X) : should be at same chip (slot)
- Tracking window cut (Y) : $\pm 5 * \text{INTT strip}$ (5 * 78 um)

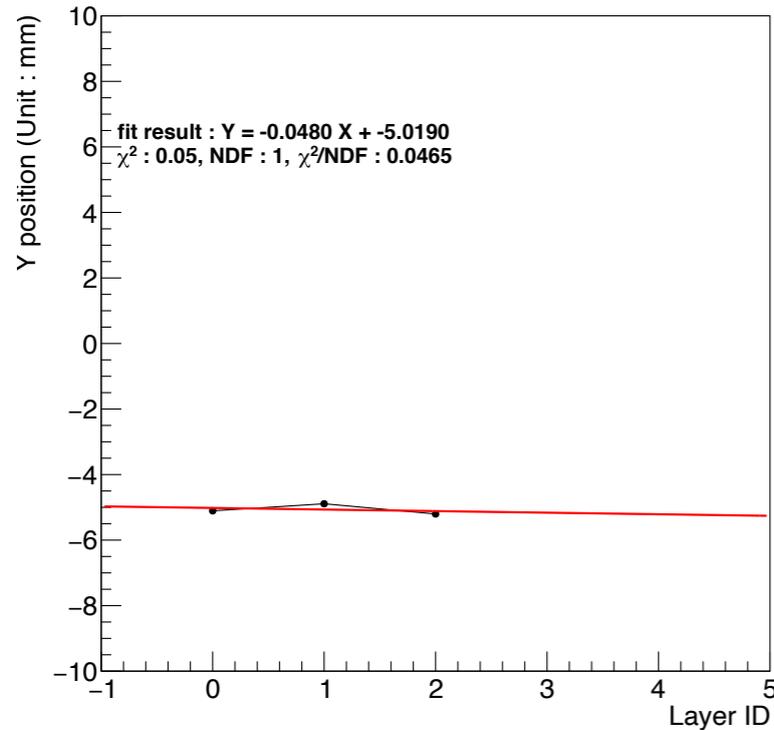
Before position correction

```
N_HHH : 2677
N_LHH : 24
N_HLH : 98
N_HHL : 417
N_LLL : 346
====3-layers====efficiency results=====
|| 10 : 99.11144 %
|| 11 : 96.46847 %
|| 12 : 86.52230 %
====3-layers====efficiency results=====
```

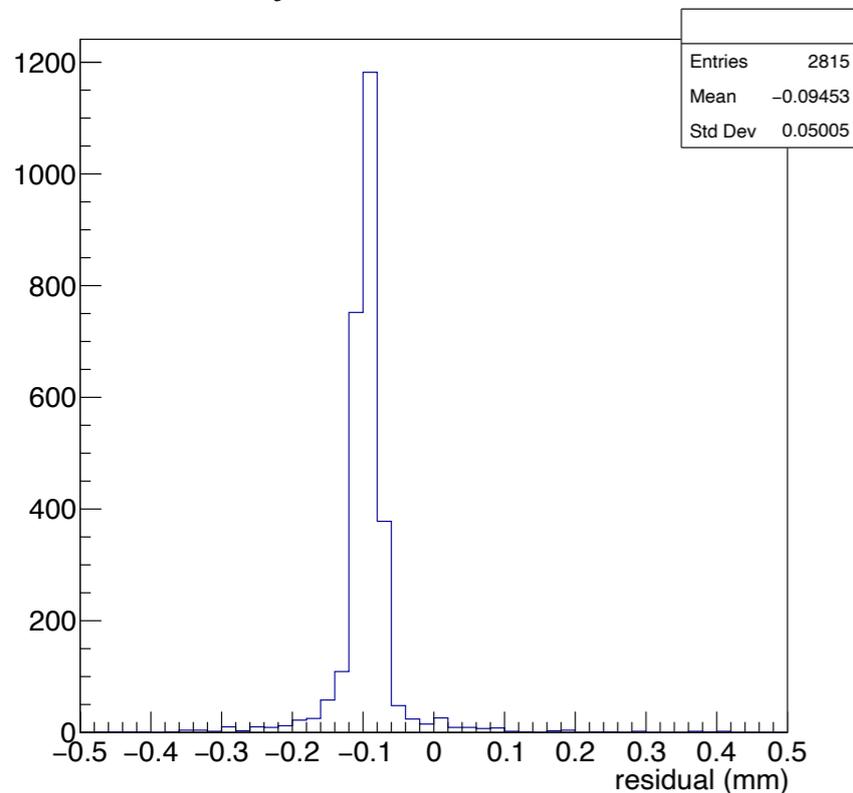
// BeamData_20211210-2043_0, Run ?

Before position correction

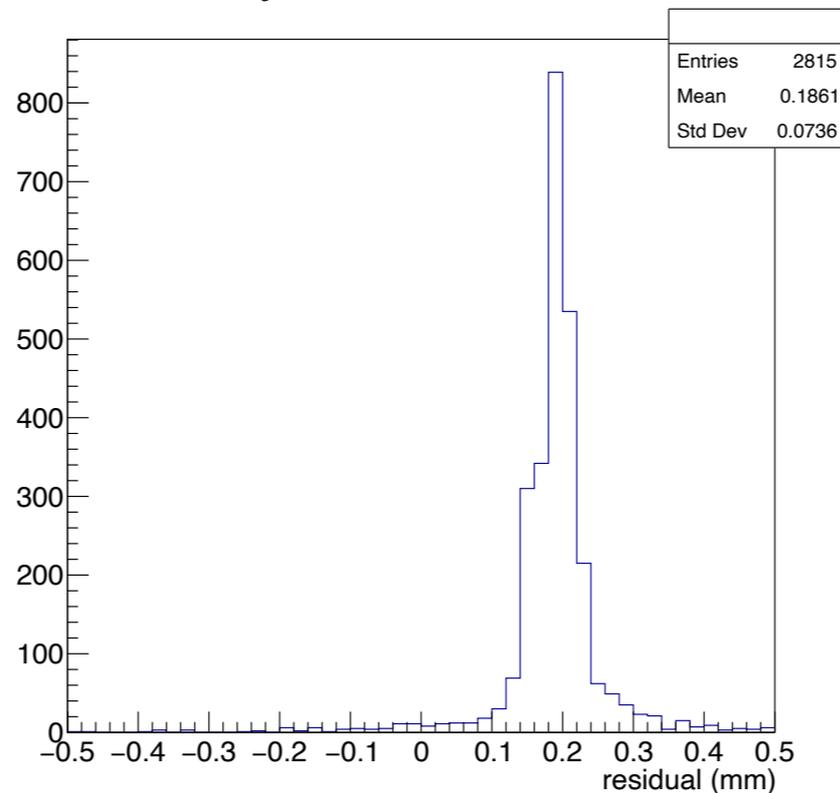
3 hit PLC : 0-0, eID : 4 ,chip : 9, position :-5.107, -4.891, -5.203



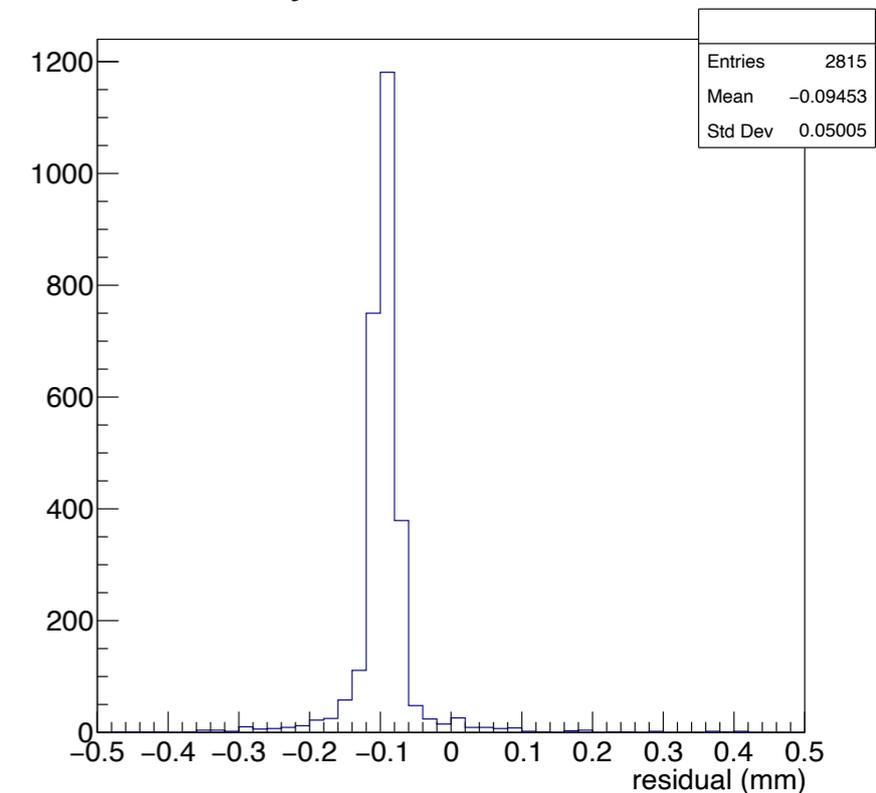
layer0 Y axis residual



layer1 Y axis residual



layer2 Y axis residual



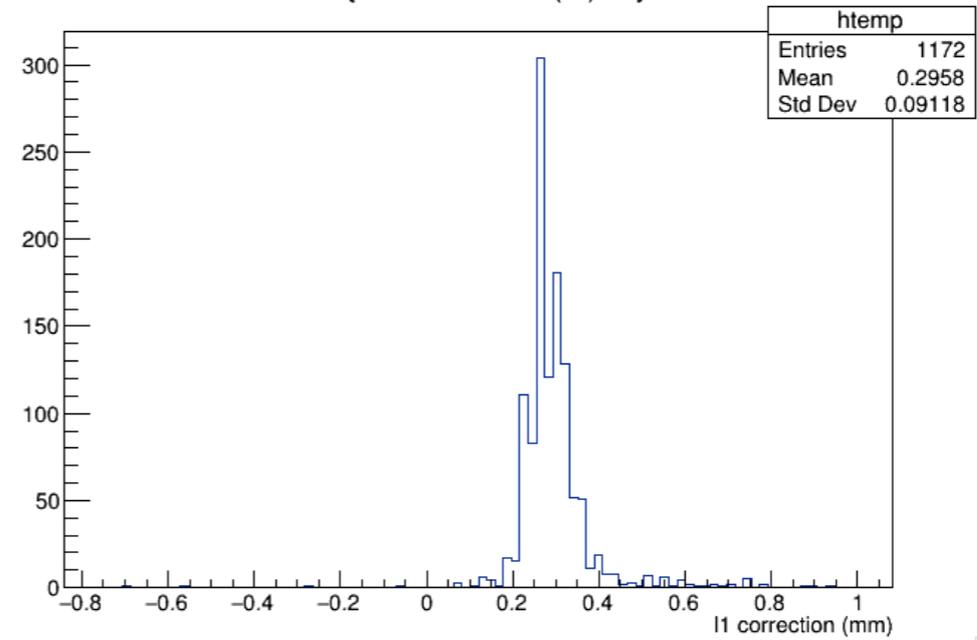
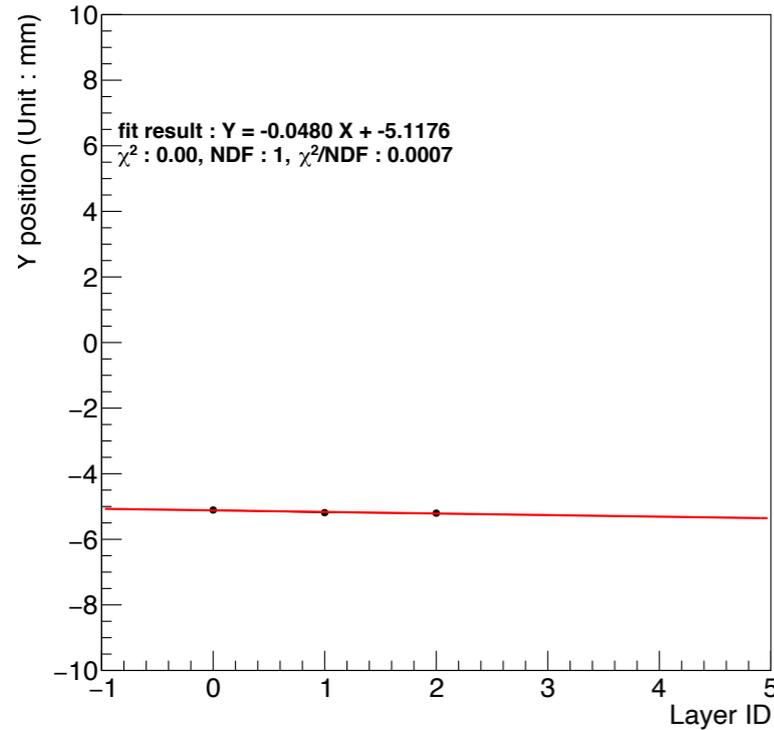
// BeamData_20211210-2043_0, Run ?

3 hit PLC : 0-0, eID : 4 ,chip : 9, position :-5.107, -5.187, -5.203

After position correction

Position correction : -295.8 μm in Y axis at I1

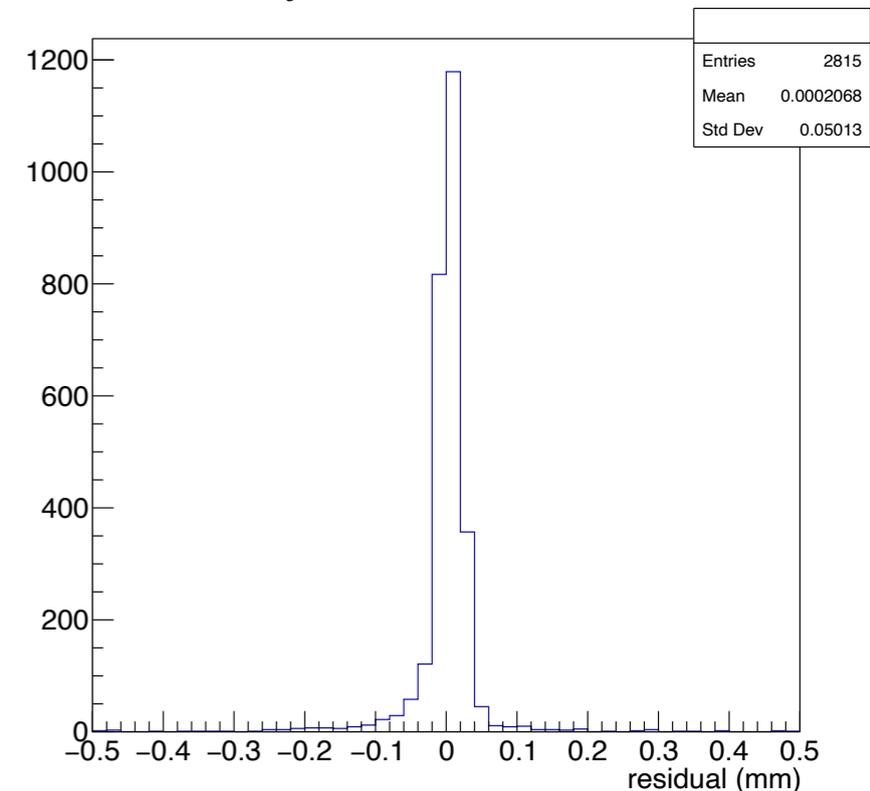
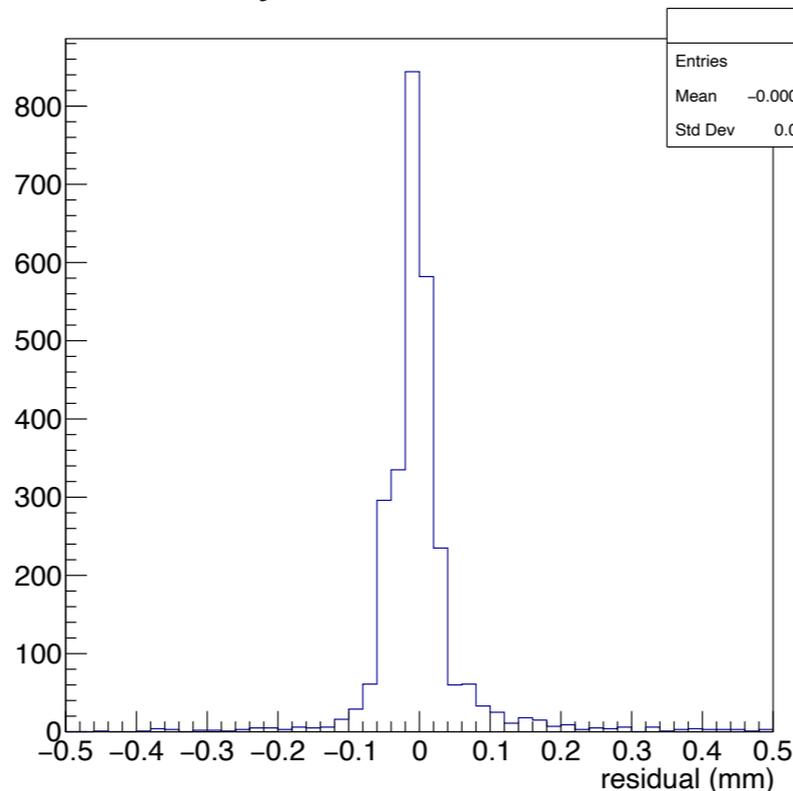
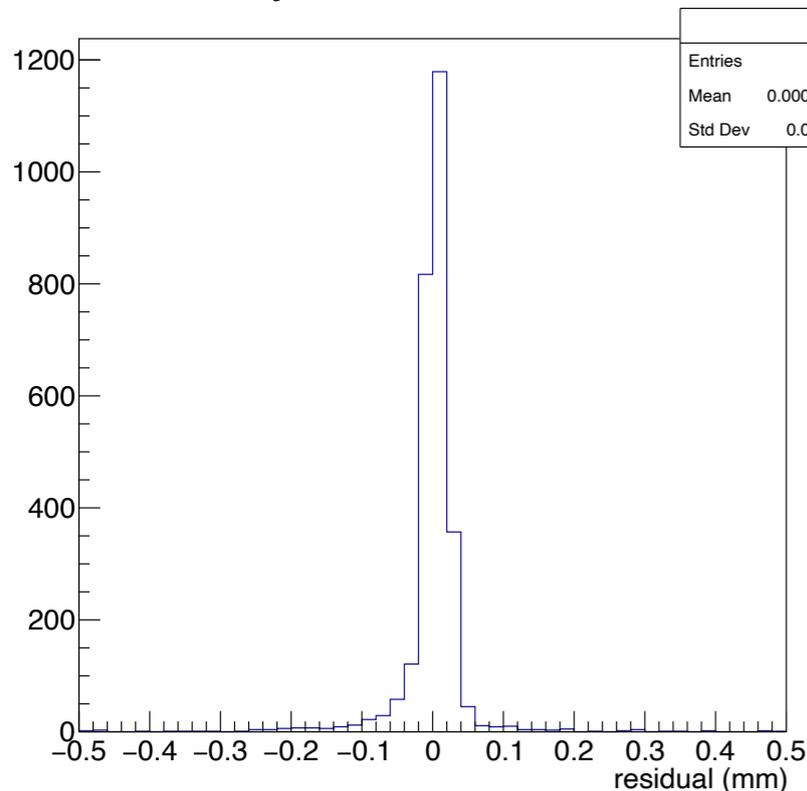
I1 {I1!=0 && fabs(I1)<1}



layer0 Y axis residual

layer1 Y axis residual

layer2 Y axis residual



// BeamData_20211210-2043_0, Run ?

Before position correction

After position correction

without adc0 cut

```
N_HHH : 2677
N_LHH : 24
N_HLH : 98
N_HHL : 417
N_LLL : 346
====3-layers====efficiency results=====
|| 10 : 99.11144 %
|| 11 : 96.46847 %
|| 12 : 86.52230 %
====3-layers====efficiency results=====
```

```
N_HHH : 2714
N_LHH : 29
N_HLH : 87
N_HHL : 413
N_LLL : 319
====3-layers====efficiency results=====
|| 10 : 98.94276 %
|| 11 : 96.89397 %
|| 12 : 86.79245 %
====3-layers====efficiency results=====
```

with adc0 cut

```
N_HHH : 1418
N_LHH : 13
N_HLH : 51
N_HHL : 250
N_LLL : 160
====3-layers====efficiency results=====
|| 10 : 99.09154 %
|| 11 : 96.52825 %
|| 12 : 85.01199 %
====3-layers====efficiency results=====
```

```
N_HHH : 1438
N_LHH : 18
N_HLH : 46
N_HHL : 247
N_LLL : 143
====3-layers====efficiency results=====
|| 10 : 98.76374 %
|| 11 : 96.90027 %
|| 12 : 85.34125 %
====3-layers====efficiency results=====
```

adc0 cut : In one event, if there is one hit whose adc is 0, this event will be excluded

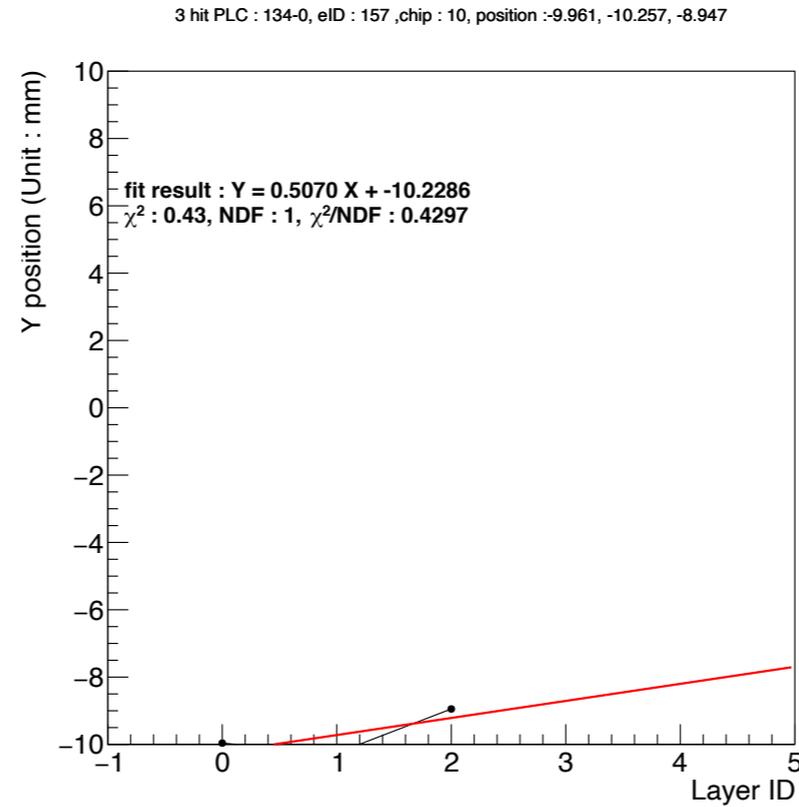
// Why the efficiency of I2 is bad ?

Here shows some events whose event profile is 110 (I2 no hit)
Seems that the chip_id of some hits are misidentified.

```
*****
* Row * Instance * camac_adc * camac_tdc * INTT_even * module * chip_id * chan_id * adc * nele * DSE * eID *
*****
* 6 * 0 * 185 * 955 * 1 * 1 * 11 * 126 * 4 * 4 * 0 * 6 *
* 6 * 1 * 154 * 2160 * 1 * 6 * 11 * 126 * 4 * 4 * 0 * 6 *
* 6 * 2 * 354 * 395 * 1 * 5 * 10 * 119 * 0 * 4 * 0 * 6 *
* 6 * 3 * 137 * 740 * 1 * 5 * 10 * 120 * 4 * 4 * 0 * 6 *
* 6 * 4 * * 2160 * 1 * * * * * 4 * 0 * 6 *
* 6 * 5 * * 2160 * 1 * * * * * 4 * 0 * 6 *
*****
==> 6 selected entries
*****
* Row * Instance * camac_adc * camac_tdc * INTT_even * module * chip_id * chan_id * adc * nele * DSE * eID *
*****
* 7 * 0 * 141 * 959 * 1 * 1 * 10 * 84 * 2 * 3 * 0 * 7 *
* 7 * 1 * 153 * 2160 * 1 * 6 * 10 * 87 * 5 * 3 * 0 * 7 *
* 7 * 2 * 342 * 395 * 1 * 5 * 9 * 82 * 1 * 3 * 0 * 7 *
* 7 * 3 * 137 * 668 * 1 * * * * * 3 * 0 * 7 *
* 7 * 4 * * 2160 * 1 * * * * * 3 * 0 * 7 *
* 7 * 5 * * 2160 * 1 * * * * * 3 * 0 * 7 *
*****
==> 6 selected entries
*****
* Row * Instance * camac_adc * camac_tdc * INTT_even * module * chip_id * chan_id * adc * nele * DSE * eID *
*****
* 12 * 0 * 132 * 954 * 1 * 1 * 11 * 56 * 2 * 3 * 0 * 12 *
* 12 * 1 * 153 * 2160 * 1 * 6 * 11 * 58 * 3 * 3 * 0 * 12 *
* 12 * 2 * 333 * 394 * 1 * 5 * 10 * 53 * 2 * 3 * 0 * 12 *
* 12 * 3 * 136 * 853 * 1 * * * * * 3 * 0 * 12 *
* 12 * 4 * * 2160 * 1 * * * * * 3 * 0 * 12 *
* 12 * 5 * * 2160 * 1 * * * * * 3 * 0 * 12 *
*****
```

// Why the efficiency of I2 is bad ?

noise track ?



```

*****
*   Row   * Instance * camac_adc * camac_tdc * INTT_even *   module *   chip_id *   chan_id *       adc *       nele *       DSE *       eID *
*****
*   157 *     0 *    106 *    952 *     1 *     1 *    10 *     0 *     3 *     3 *     0 *    157 *
*   157 *     1 *    153 *   2159 *     1 *     6 *    10 *     0 *     2 *     3 *     0 *    157 *
*   157 *     2 *    310 *    389 *     1 *     5 *    10 *    13 *     3 *     3 *     0 *    157 *
*   157 *     3 *    137 *    525 *     1 *     * *     * *     * *     3 *     0 *    157 *
*   157 *     4 *     * *   2159 *     1 *     * *     * *     * *     3 *     0 *    157 *
*   157 *     5 *     * *   2159 *     1 *     * *     * *     * *     3 *     0 *    157 *
*****

```

// chip_id misidentification issue

Not only happens on I2

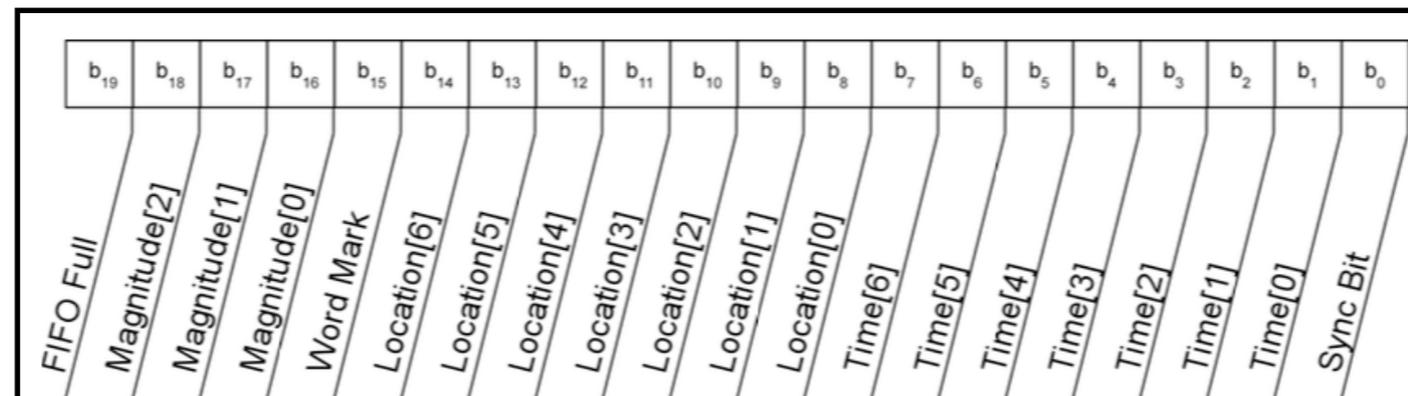
module ID 6 : I1

```

*****
* Row * Instance * camac_adc * camac_tdc * INTT_even * module * chip_id * chan_id * adc * nele * DSE * eID *
*****
* 129 * 0 * 118 * 966 * 1 * 1 * 10 * 67 * 2 * 5 * 0 * 129 *
* 129 * 1 * 153 * 2159 * 1 * 6 * 11 * 68 * 1 * 5 * 0 * 129 *
* 129 * 2 * 348 * 393 * 1 * 6 * 11 * 69 * 0 * 5 * 0 * 129 *
* 129 * 3 * 136 * 543 * 1 * 5 * 10 * 63 * 5 * 5 * 0 * 129 *
* 129 * 4 * * 2159 * 1 * 5 * 10 * 64 * 0 * 5 * 0 * 129 *
* 129 * 5 * * 2159 * 1 * * * * * * 5 * 0 * 129 *
*****
* 166 * 0 * 122 * 956 * 1 * 1 * 9 * 108 * 2 * 5 * 0 * 166 *
* 166 * 1 * 153 * 2160 * 1 * 6 * 10 * 109 * 1 * 5 * 0 * 166 *
* 166 * 2 * 318 * 395 * 1 * 6 * 10 * 110 * 2 * 5 * 0 * 166 *
* 166 * 3 * 137 * 1126 * 1 * 5 * 9 * 103 * 2 * 5 * 0 * 166 *
* 166 * 4 * * 2160 * 1 * 5 * 9 * 104 * 3 * 5 * 0 * 166 *
* 166 * 5 * * 2160 * 1 * * * * * 5 * 0 * 166 *
*****

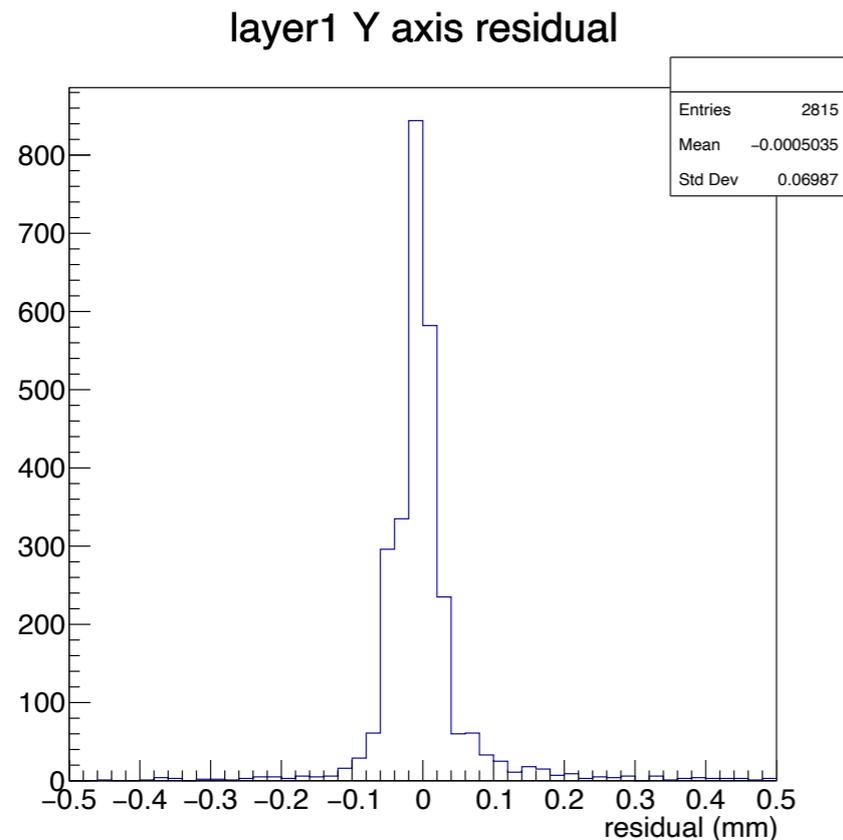
```

The data word map from chip to ROC



// Study of the hit window cut

- With I1 position correction
- Window cut : 0.07×3 ($3 \times$ std dev of I1 residual distribution)
- adc0 cut : false



Std DeV : 0.069

```
layer 3 final counting :
```

```
N_HHH : 2654
```

```
N_LHH : 25
```

```
N_HLH : 36
```

```
N_HHL : 271
```

```
N_LLL : 576
```

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

```
I1 I0 : 99.06682 %
```

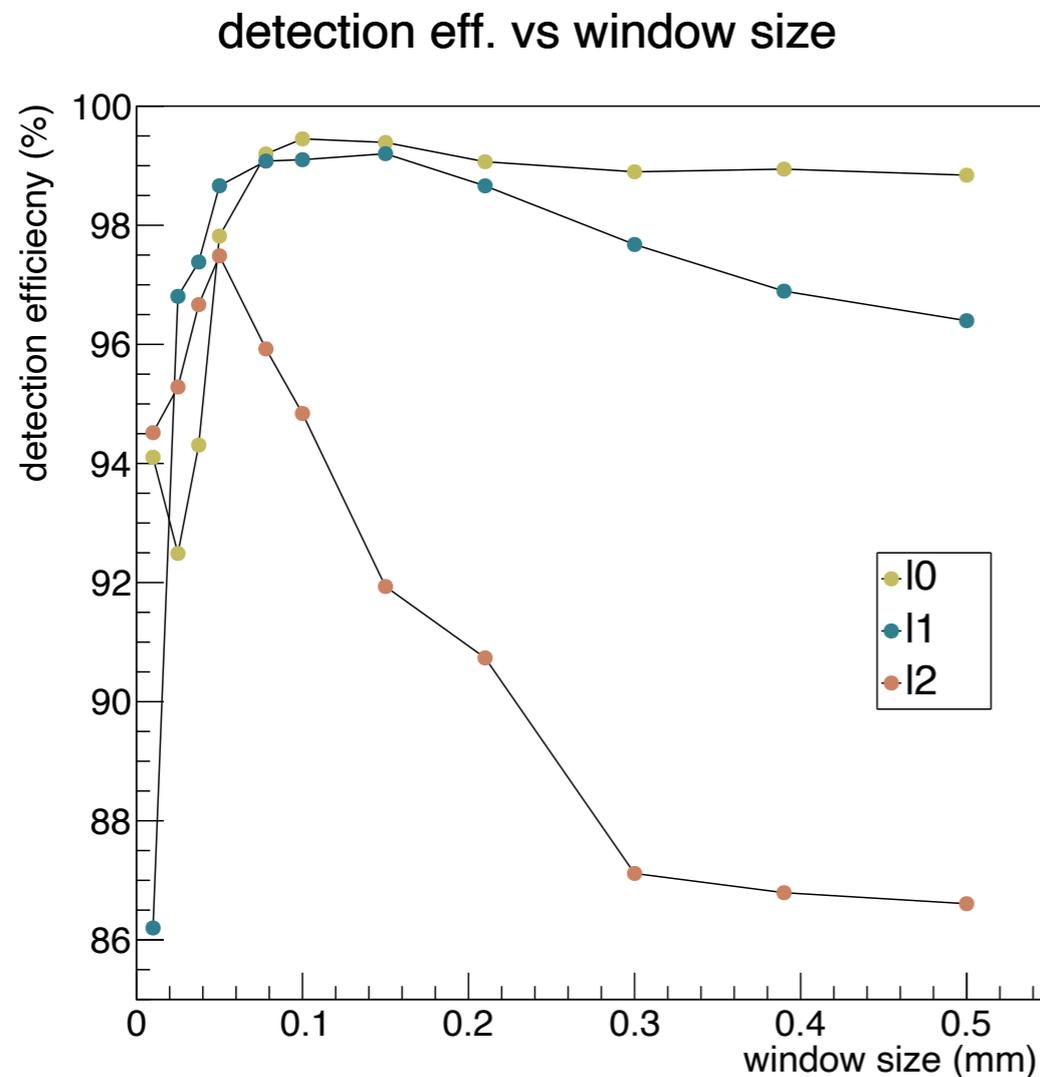
```
I1 I1 : 98.66171 %
```

```
I1 I2 : 90.73504 %
```

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

// Study of the hit window cut

- With I1 position correction
- adc0 cut : false



Reason of the detection eff. of I2 decrease as window size increase : chip_id misidentification issue

For example :

I0 : U1, Chan 10

I1 : U1, Chan 13

I2 : **U2**, Chan 10

If window size :

1. 2 * strip width → event profile : 000
2. 4 * strip width → event profile : **110**

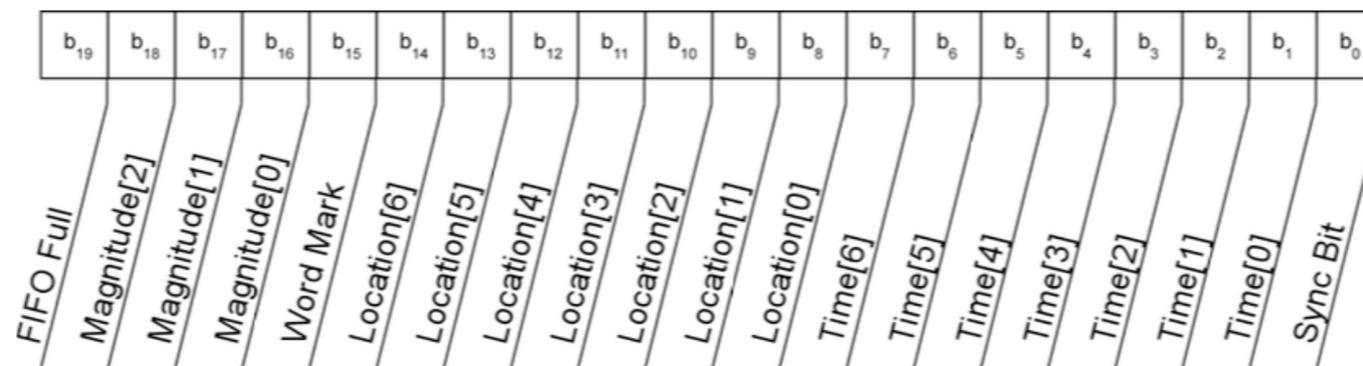
// Summary

- Based on current cuts, the efficiency can be up to $\sim 99\%$
- The alignment algorithm works well, I1 has a $+300\text{ }\mu\text{m}$ offset.
- It seems that some chip_id could be misidentified, I think it is not because of the data word distortion.
- To do list :
 - Find out the best hit window for the detection efficiency study.
 - Study the detection efficiency as function of BCO phase.

Back up

// Note

- Based on current situation and for the detection efficiency study, we only focus on the first BCO group of the trigger event. For the rest BCO group, we neglect them.
- So based on this setting, the detection efficiency as function of BCO phase is no longer a constant. we should see some changes.
- what is the gap between each ladder ? (should the actual x position be considered in the analysis)
- (chip_id misidentified problem) The sensor detection seems to be very good, but because of the ~~data word distortion, the detection efficiency is effected.~~
 - ~~In the case of DAQ system with BEC + GC, the detection efficiency is expected to be lower due to the data word distortion.~~
 - It is not the data word distortion problem because the serial-out signal from chip to User is shown below. But the chip_id is identified by those independent signal wire. I don't know the reason yet.
 - The data word distortion issue is still possible to happen, but it should only effect on the adc, chan_id, bco.



// to do list

- Implementation of actual x position
- find out the best window cut value
 - residual calculation, slope correction \leftrightarrow overall angle correction
- Detection eff. vs BCO phase

- multi-track ?