sPHENIX INTT - Weekly Report

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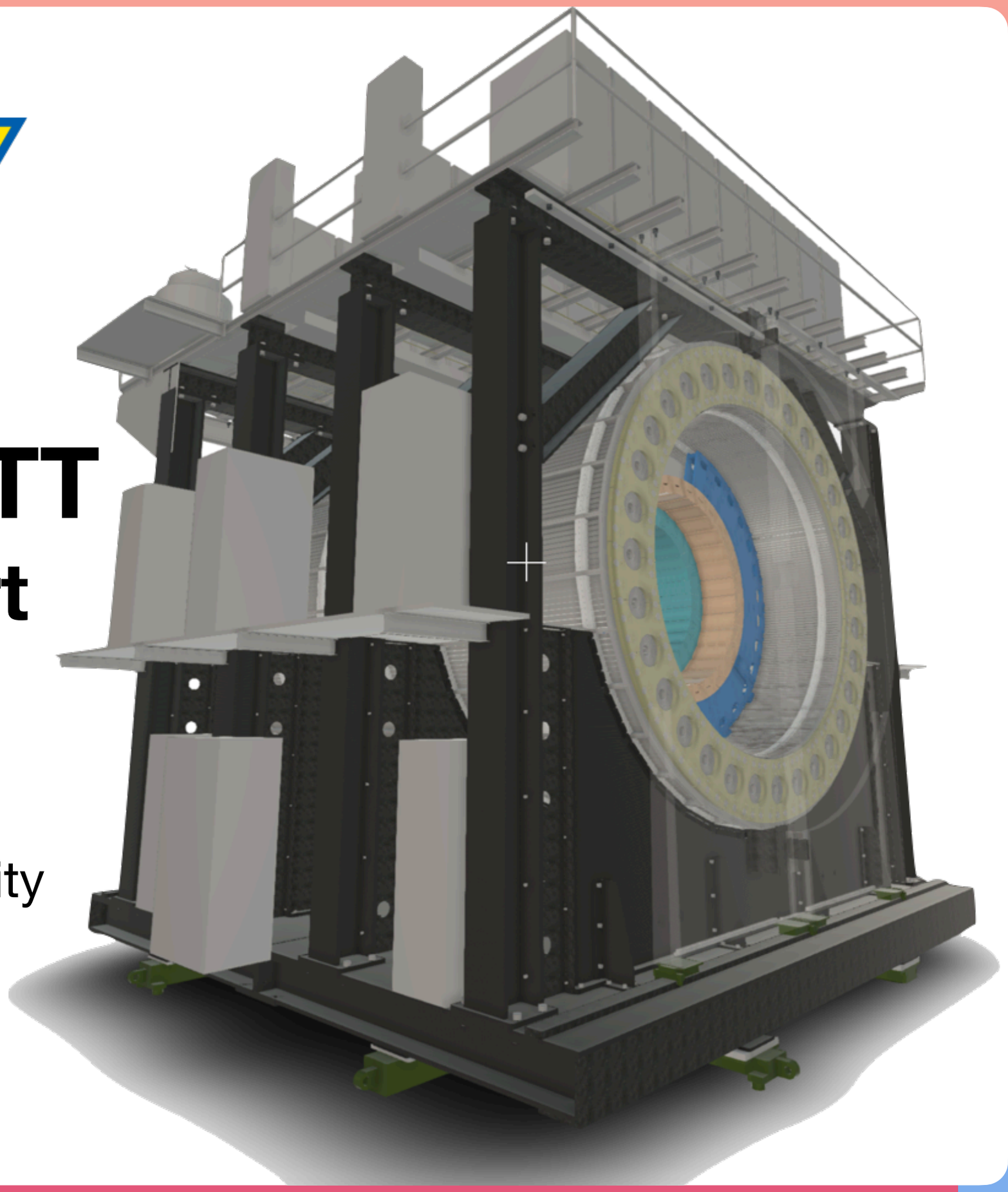
National Central University

2021/12/3



Assembly progress

Half-ladder assembly

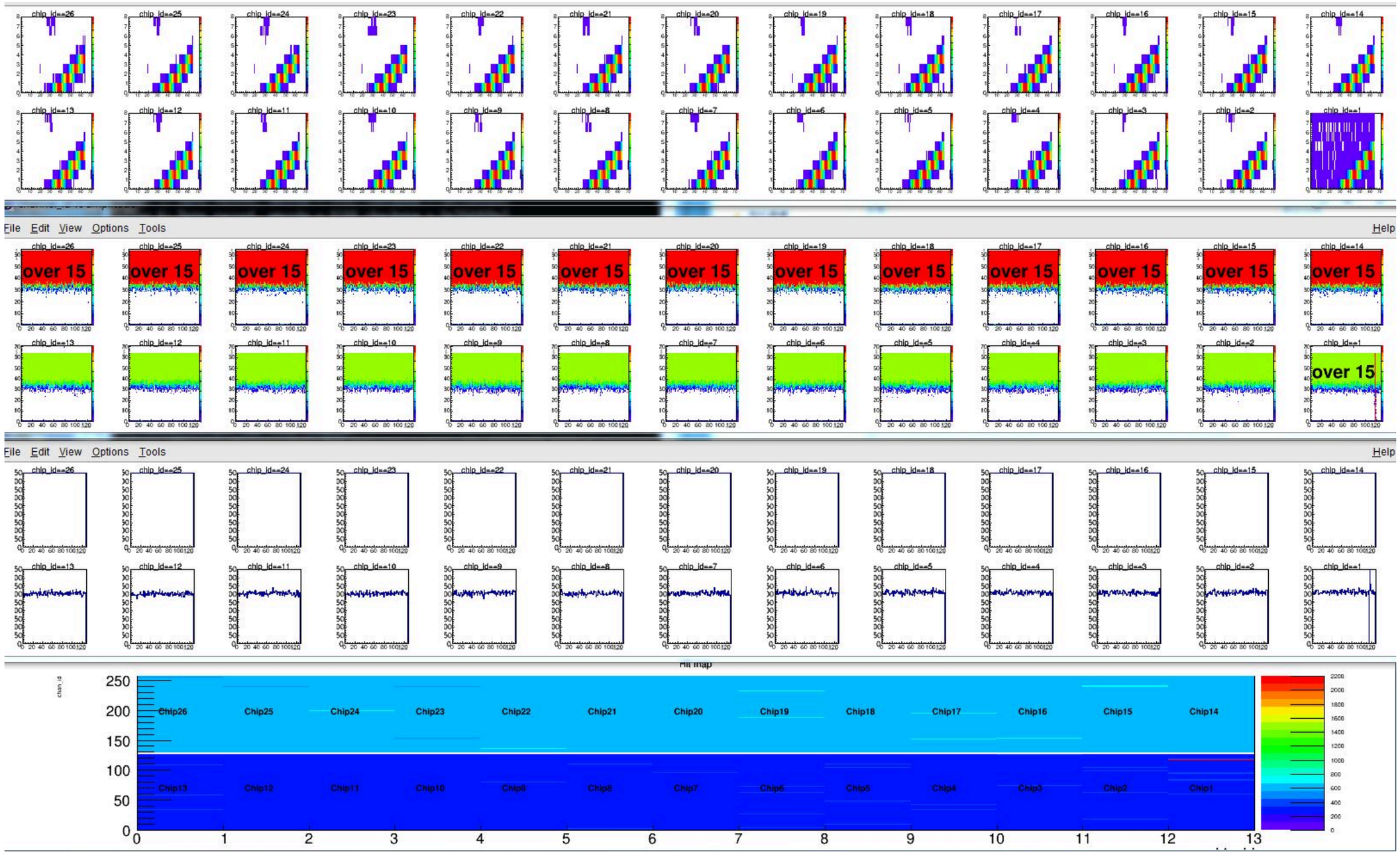
	Total	Good	Not yet bonded & tested
Chip to HDI	4	2	2
Sensor to HDI	10	6	4
Encapsulation	1	1	0
Thermal cycle	16	16	0
On ladder	32	28	X

One in NWU

- We are about to move on to next ladder assembly session.
- We don’t have space for new ladders.
- Ladder Source test campaign is scheduled to be started next week.
- Ladders will be sent to BNL after the Source test campaign.

Calibration, double entry

With long conversion cable

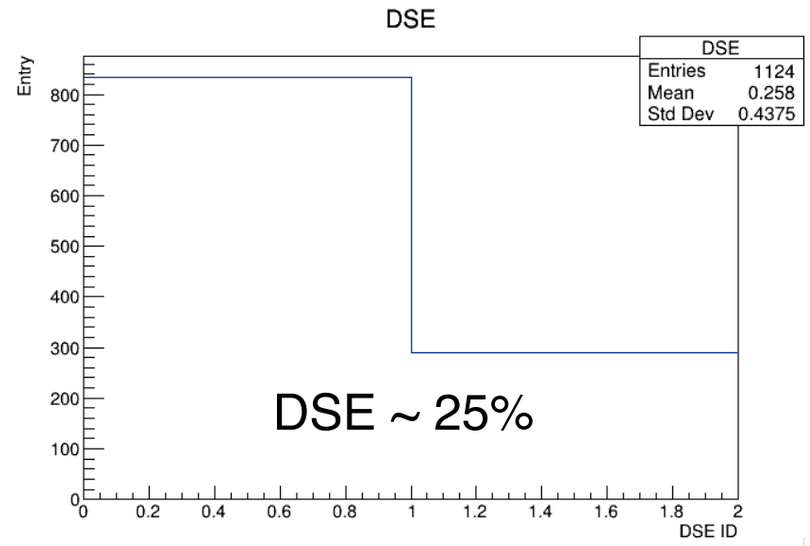


Does any facilities see this behavior before ?

Macro preparation for Testbeam2021

- Running options :
  - Layer alignment
  - Number of layer
  - 2 methods to choose the study chip (slot)

- Cut options :
  - INTT_event = 1 (coincidence signal of 3 sci + 1 INTT hit)
  - camac_tdc6 within a certain range
  - camac_adc < a certain cut (optional)
  - Double saving event (DSE) (optional)
  - Golden track considered only (optional)
  - Pure hit track only (optional)



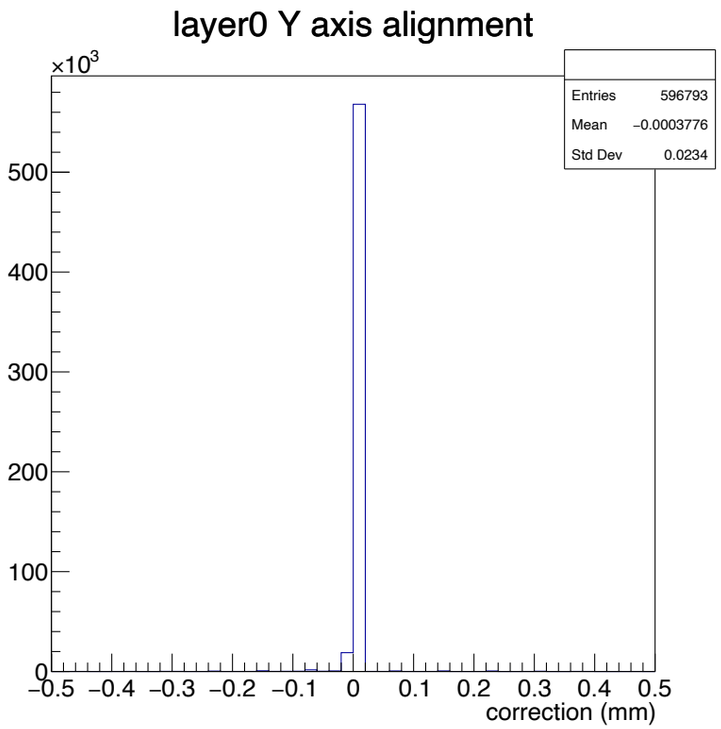
4 layers efficiency test

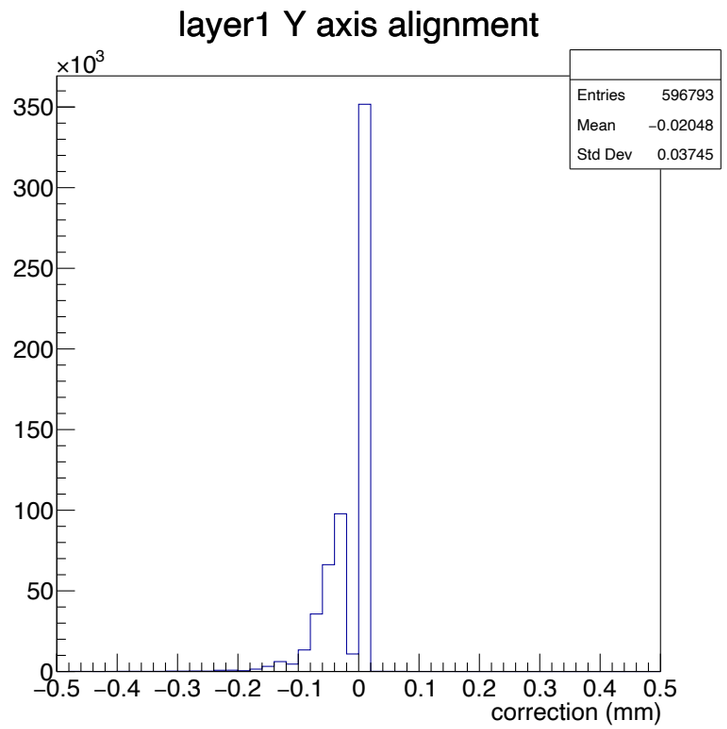
Efficiency of l1 is set to be 70% (30% of l1 data is deleted)

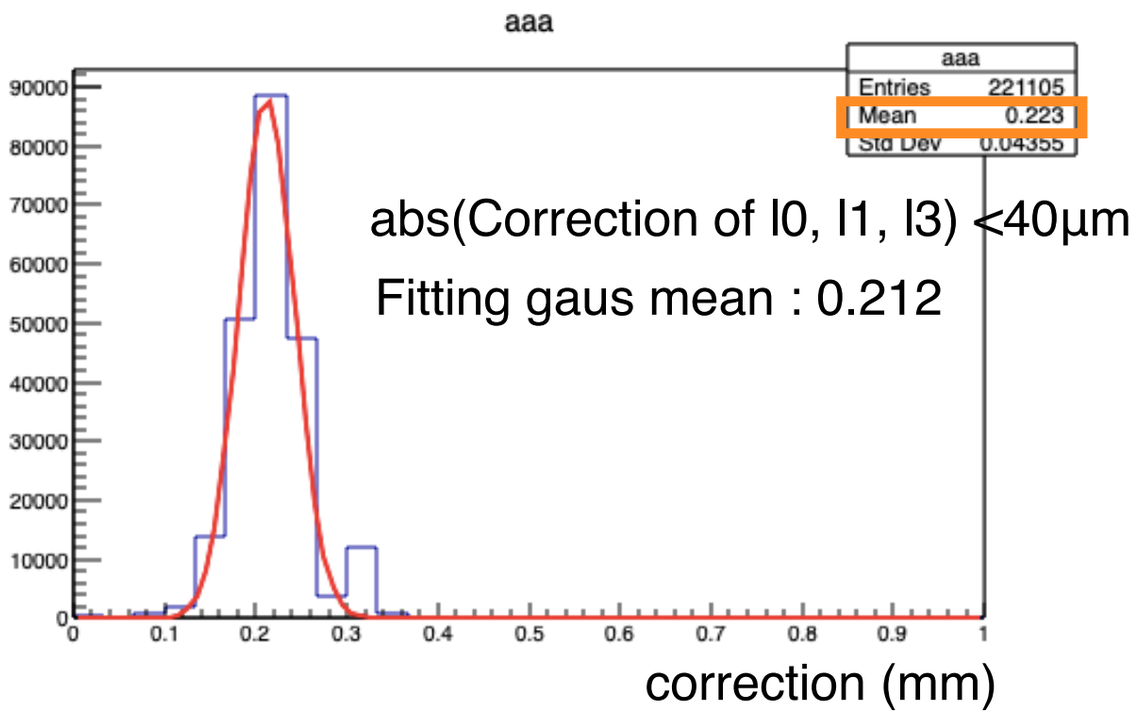
```
=====4-layers=====efficiency results==========
|| l0 : 99.95875 %
|| l1 : 71.09741 %
|| l2 : 99.95017 %
|| l3 : 99.79695 %
=====4-layers=====efficiency results==========
```

Alignment results

Ladder 2 has a + 234 μm offset in Y axis

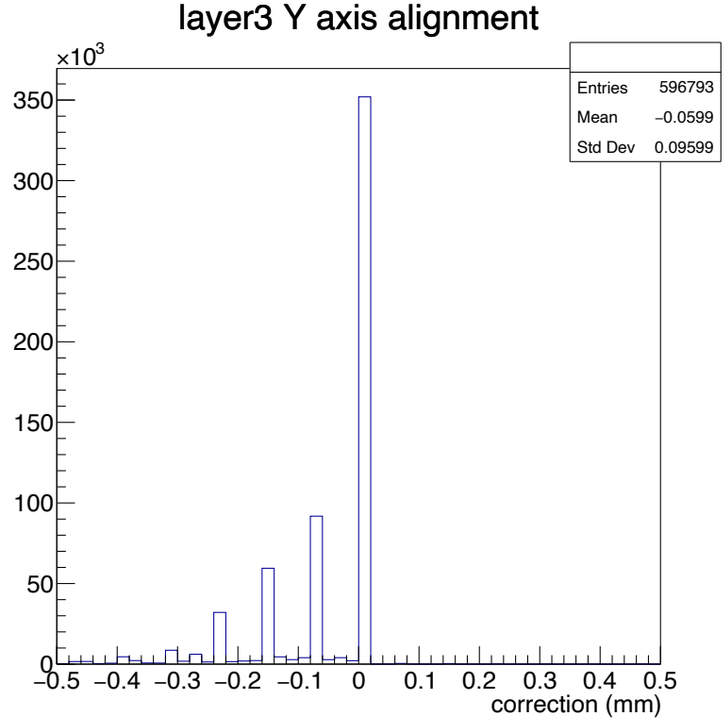






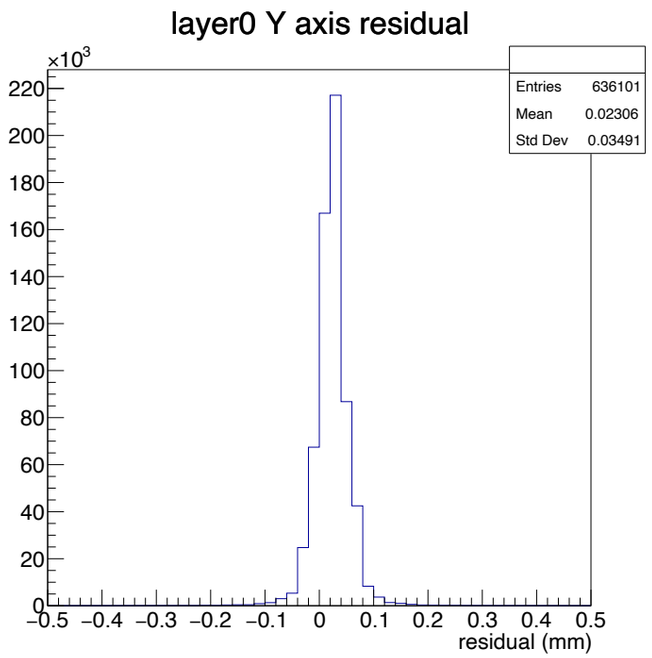
abs(Correction of l0, l1, l3) <40μm

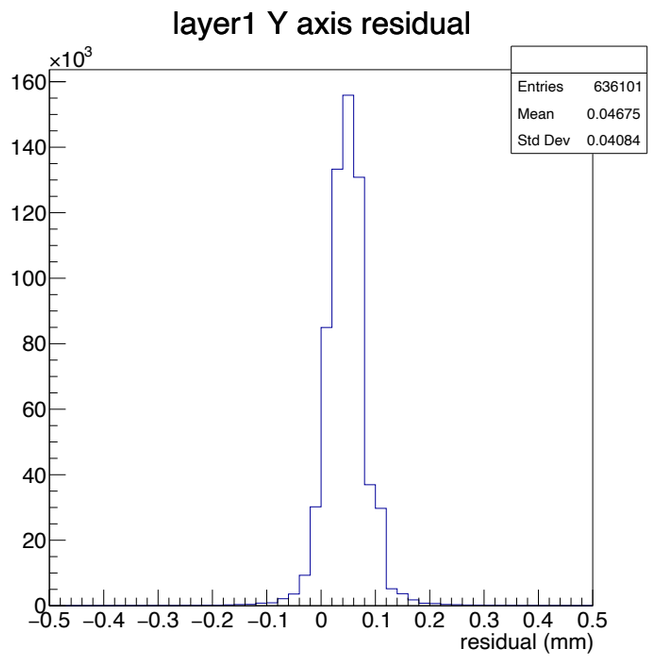
Fitting gaus mean : 0.212

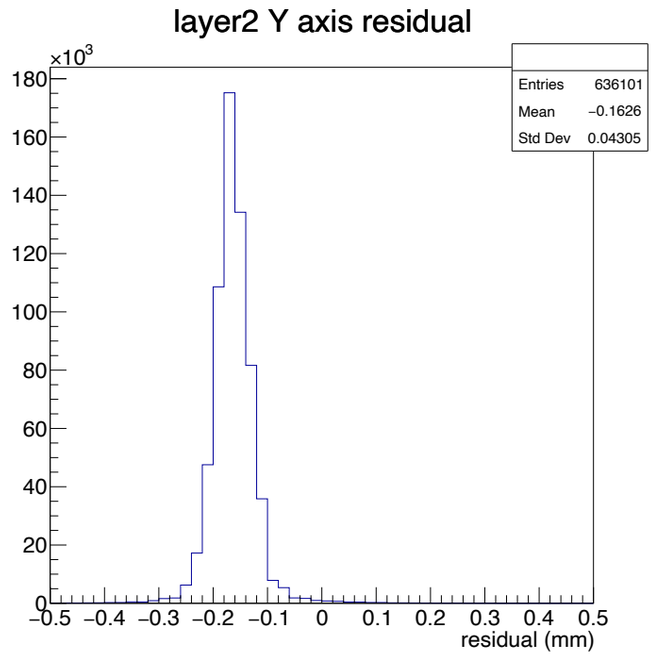


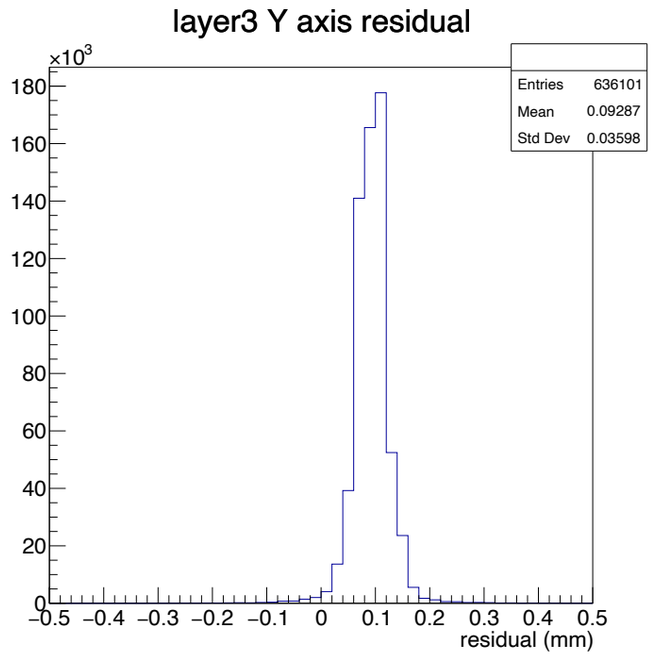
Alignment results

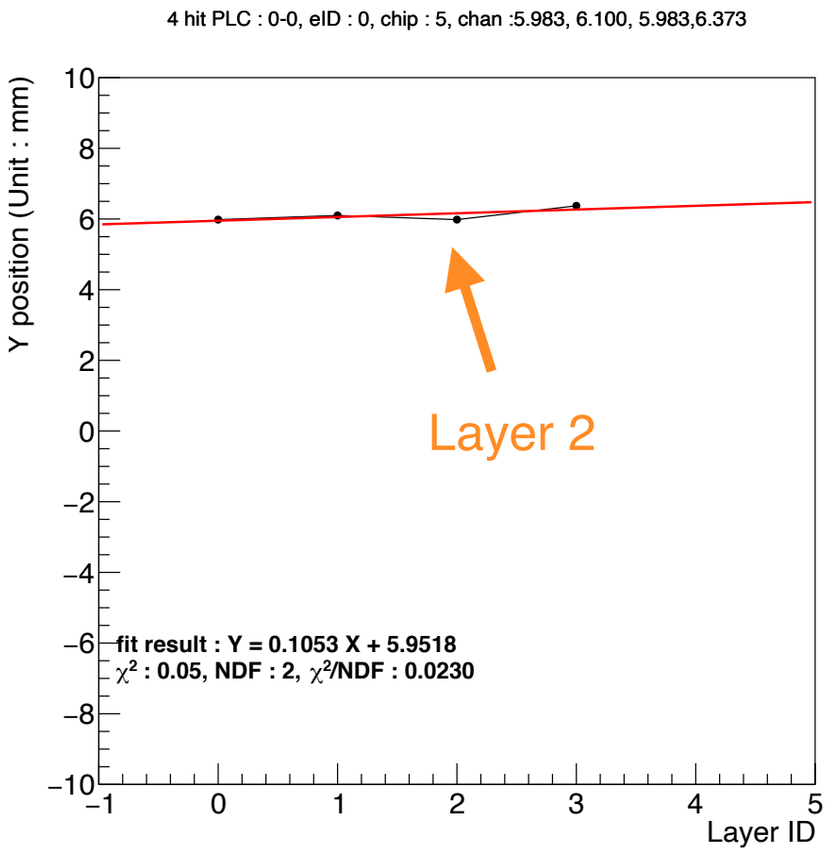
Ladder 2 has a + 234 μm offset in Y axis





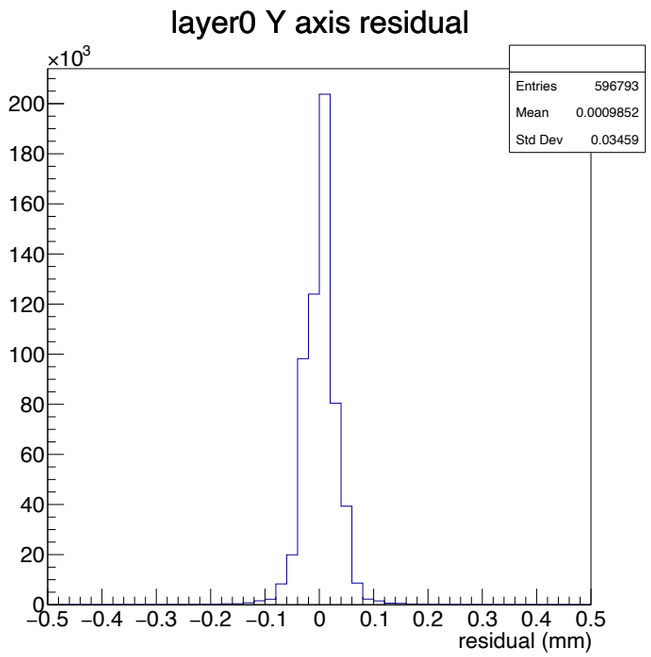


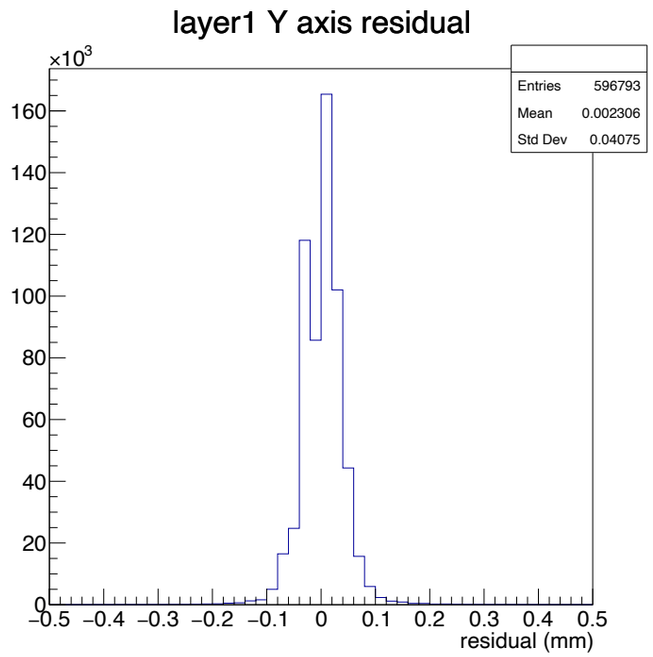


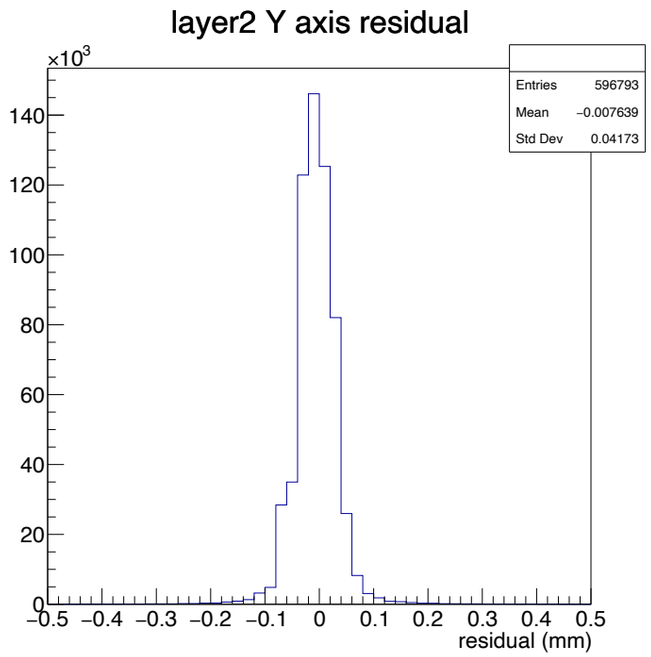


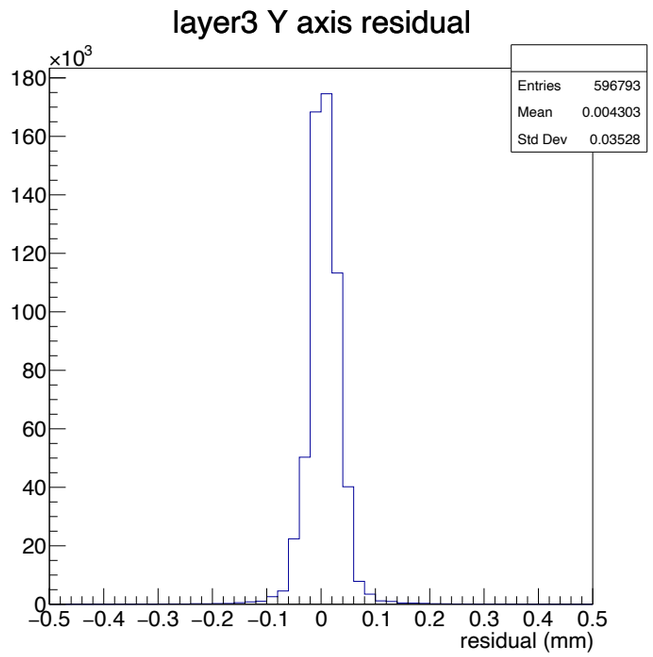
Alignment results add offset

Ladder 2 has a + 234 μm offset in Y axis

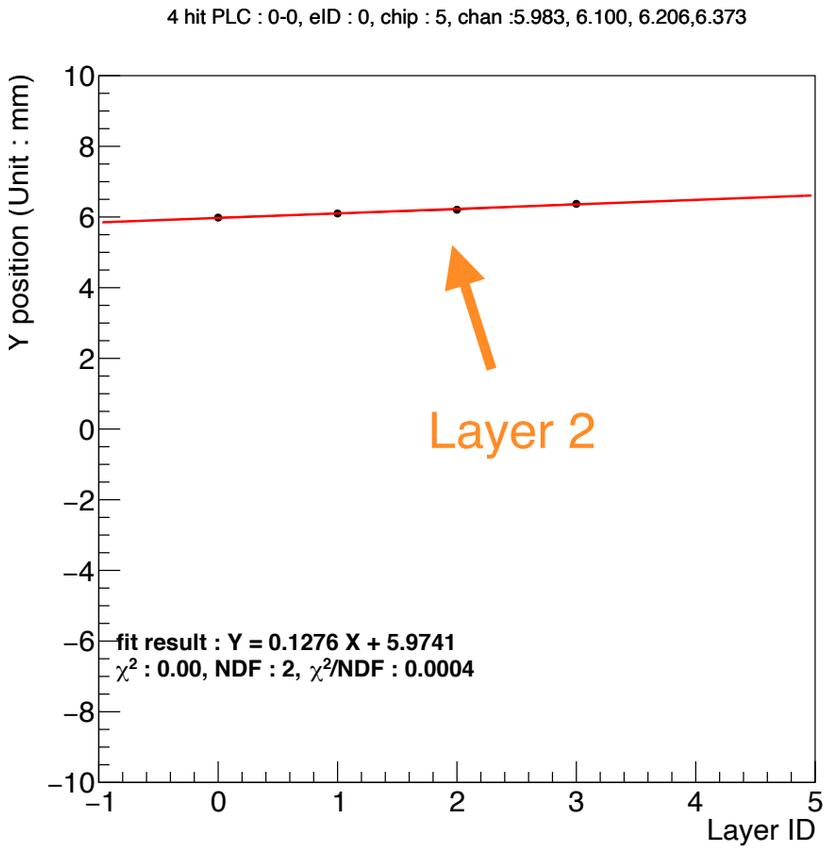








Layer2 - 0.223 mm

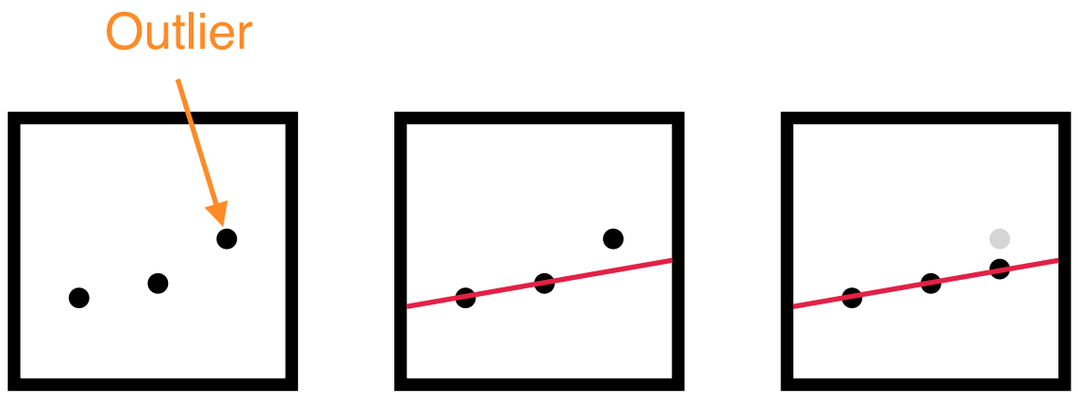


3 layers alignment

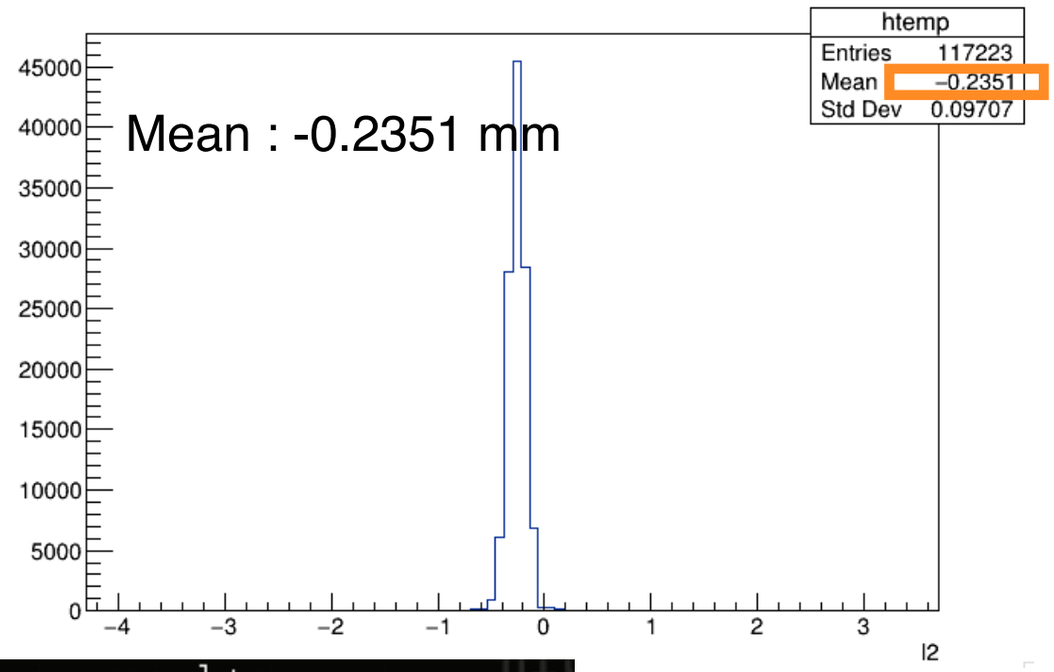
- Only 3 layers
- Efficiency of l0 is set to be 70%
- L2 has a + 234 μm offset in Y axis

```
=====3-layers=====efficiency results==========
|| l0 : 74.64354 %
|| l1 : 99.98891 %
|| l2 : 99.93620 %
=====3-layers=====efficiency results==========
```

- The procedures to correct the layer position
  1. find out the outlier
  2. fit with the rest 2 points
  3. correct the outlier to this fitting line



Amount of the correction of l2

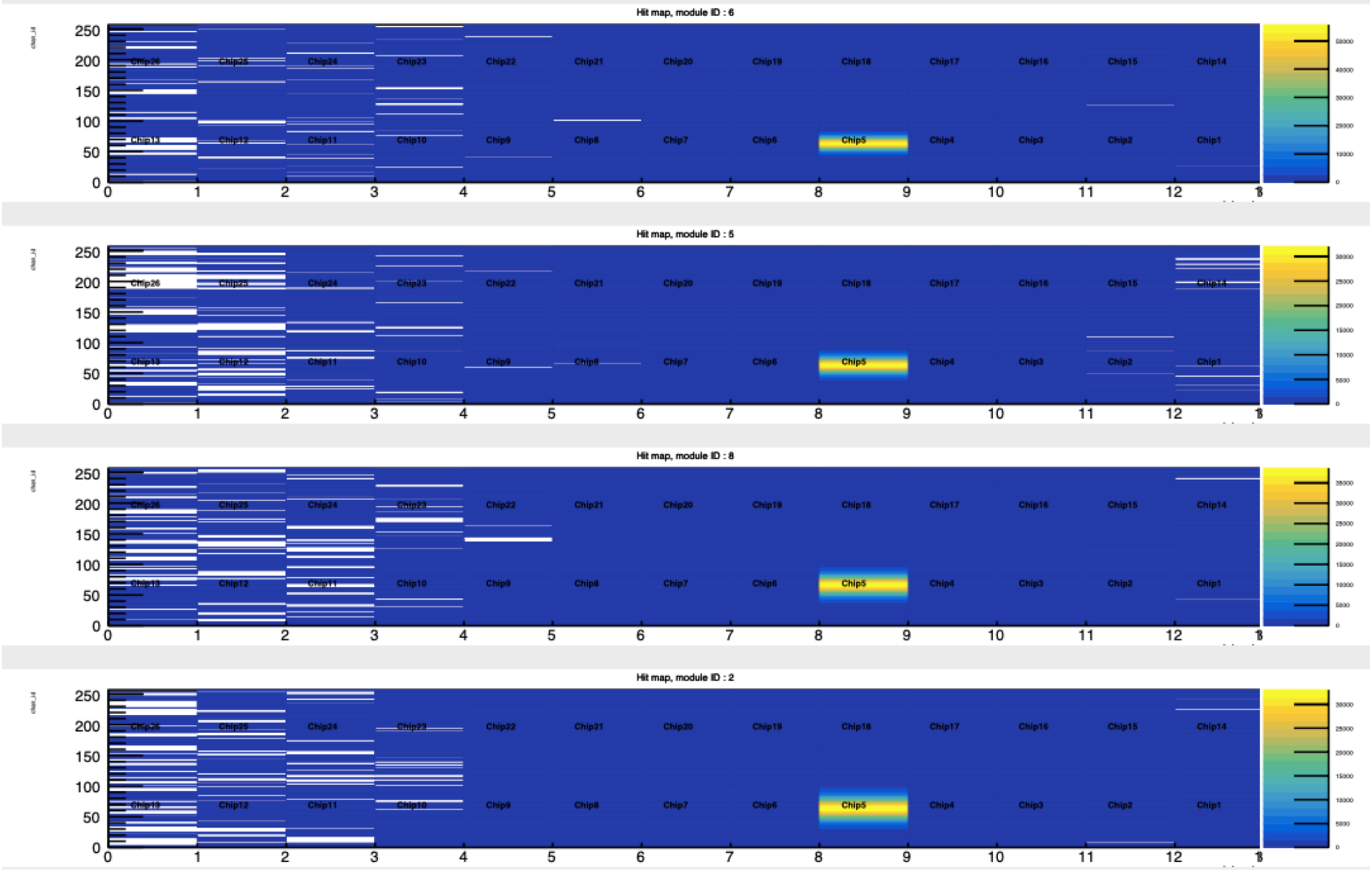



```
=====3-layers=====efficiency results==========
|| l0 : 71.88843 %
|| l1 : 99.99143 %
|| l2 : 99.94259 %
=====3-layers=====efficiency results==========
```

After adding the l2 correction back

The online monitoring plot

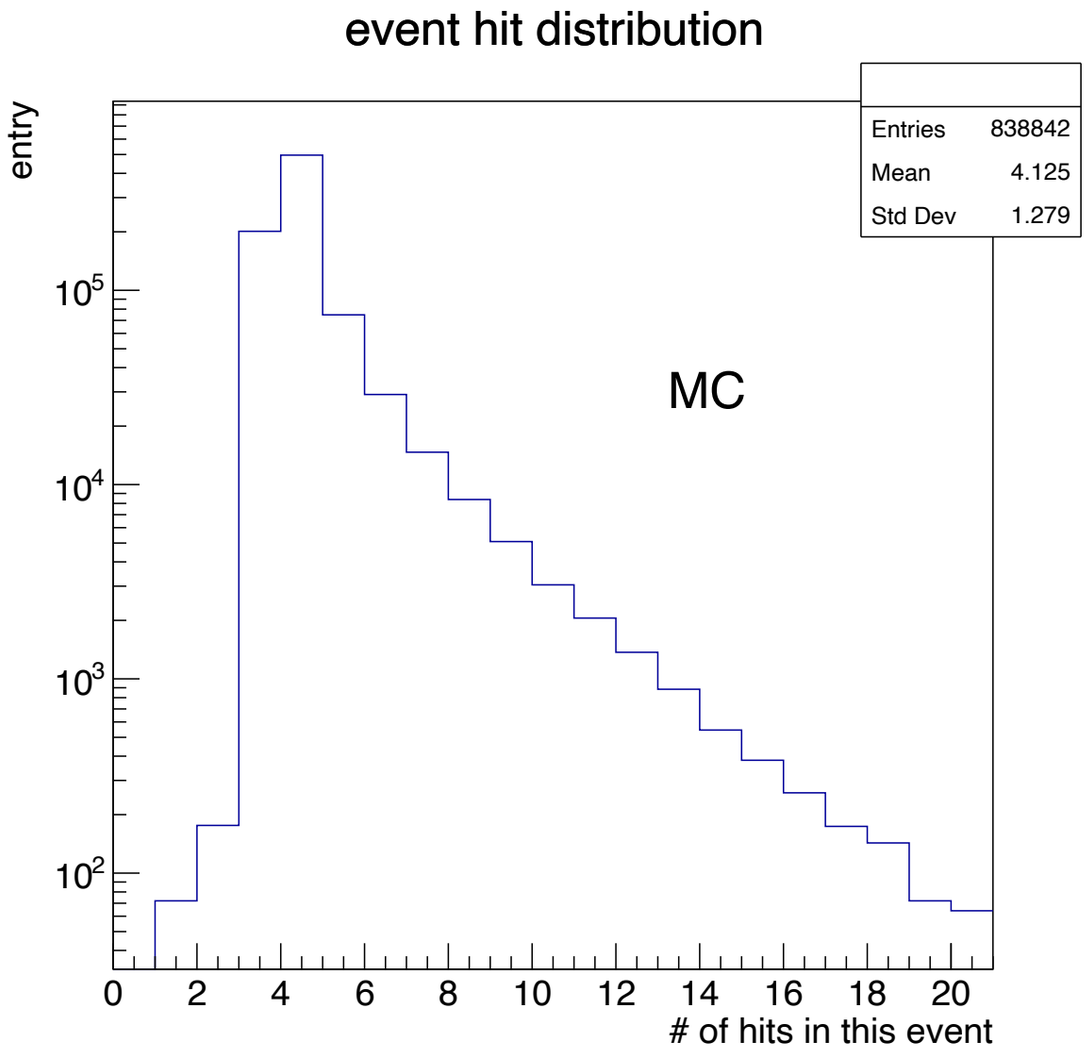
Hit map, demo with MC

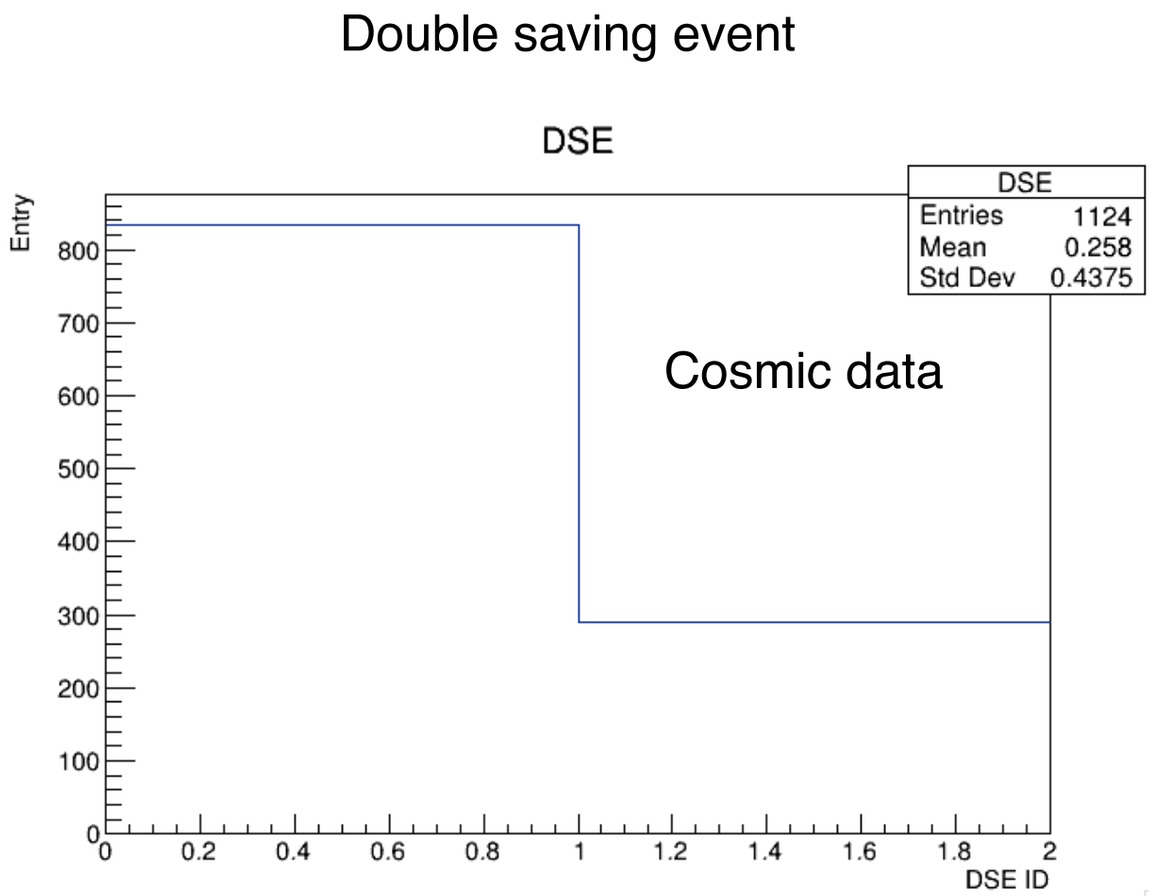


The online monitoring plot

The chip adc distribution, demo with MC

The online monitoring plot





The peak should be at 4 as we have 4 layers ladder

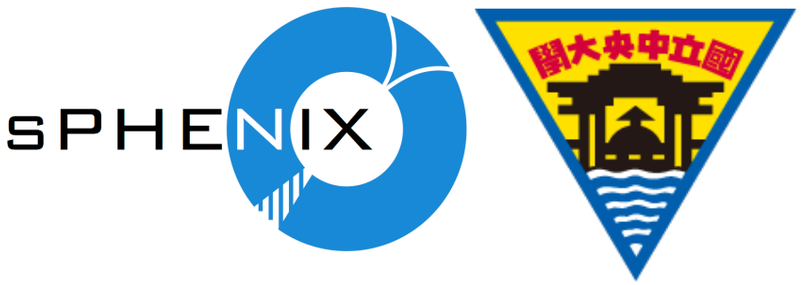
Summary

- Lots of the cut options ✓
- Online monitoring plots ✓
- Efficiency for 3 or 4 layers ✓
- Alignment study for 3 or 4 layers ✓

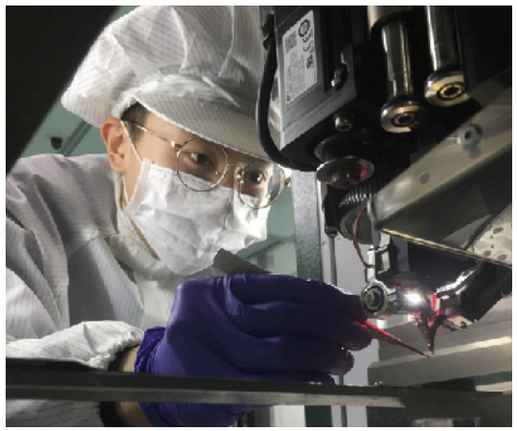
- Ready for Testbeam !

- Next step :
  - Multi-tracks in one event

Back up

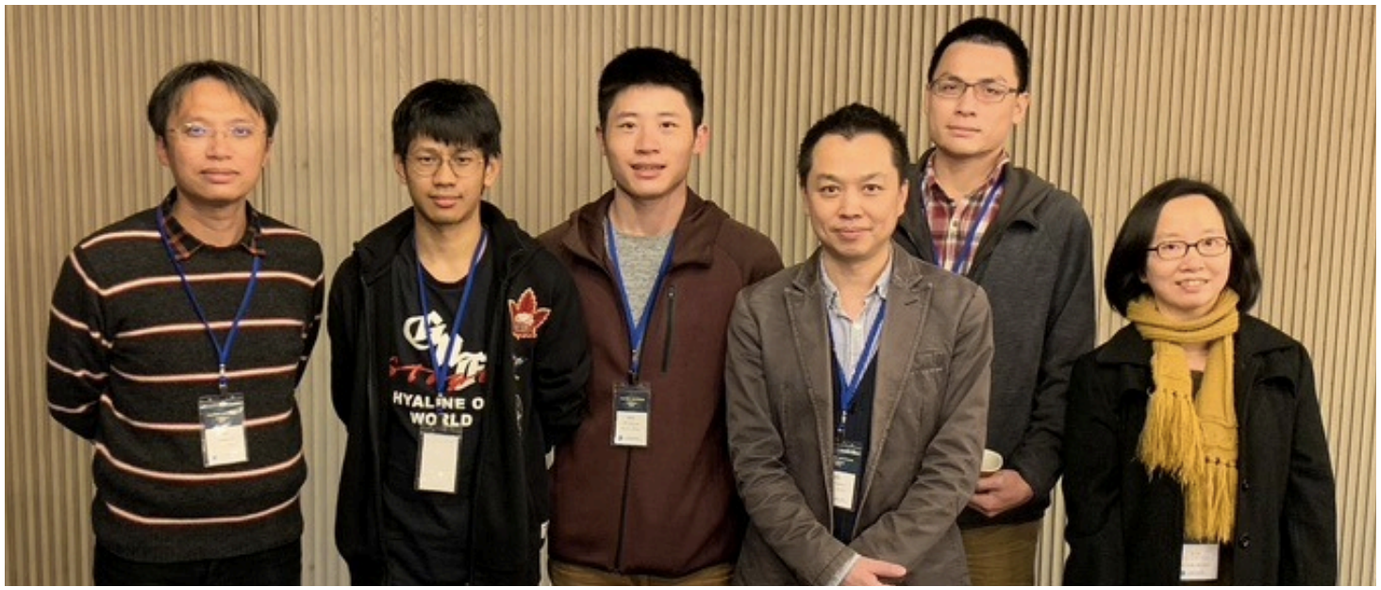


Taiwan INTT team



Ou-Wei Cheng

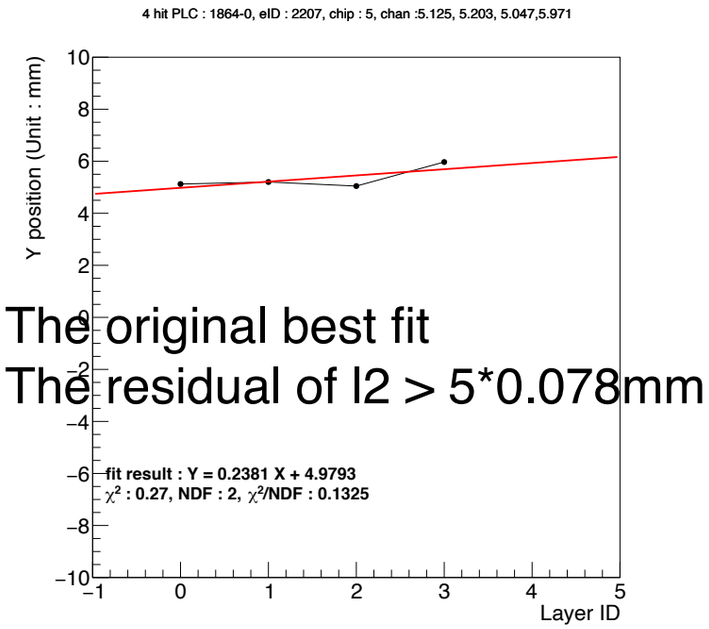
Kai-Yu Cheng



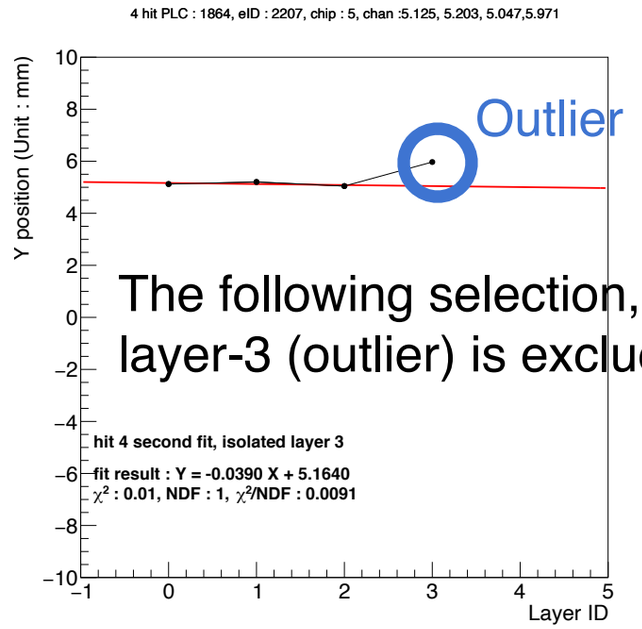
Chia-Ming Kuo Cheng-Wei Shih Lian-Sheng Tsai
Wei-Che Tang Rong-Shyang Lu Jenny Huang

Event profile example

Example of event profile : 1110



The original best fit
The residual of l2 > 5*0.078mm



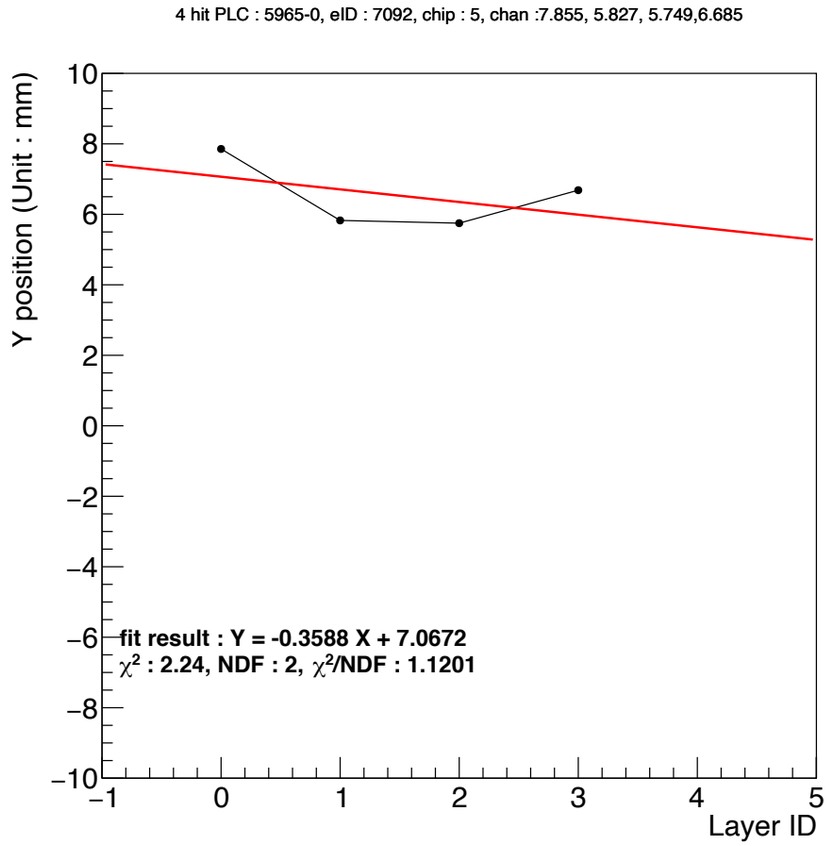
The following selection,
layer-3 (outlier) is excluded

Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
2207	0	45	152	1	6	5	62	3	22	0	2207
2207	1	99	140	1	5	5	61	3	22	0	2207
2207	2	92	132	1	8	5	63	5	22	0	2207
2207	3		0	1	2	5	41	1	22	0	2207
2207	4		0	1	2	5	42	1	22	0	2207
2207	5		882	1	2	5	43	1	22	0	2207
2207	6			1	2	5	44	0	22	0	2207
2207	7			1	2	5	45	0	22	0	2207
2207	8			1	2	5	46	0	22	0	2207
2207	9			1	2	5	47	1	22	0	2207
2207	10			1	2	5	48	0	22	0	2207
2207	11			1	2	5	49	0	22	0	2207
2207	12			1	2	5	50	0	22	0	2207
2207	13			1	2	5	51	1	22	0	2207
2207	14			1	2	5	52	1	22	0	2207
2207	15			1	2	5	53	0	22	0	2207
2207	16			1	2	5	54	1	22	0	2207
2207	17			1	2	5	55	1	22	0	2207
2207	18			1	2	5	56	1	22	0	2207
2207	19			1	2	5	57	1	22	0	2207
2207	20			1	2	5	58	1	22	0	2207
2207	21			1	2	5	59	3	22	0	2207

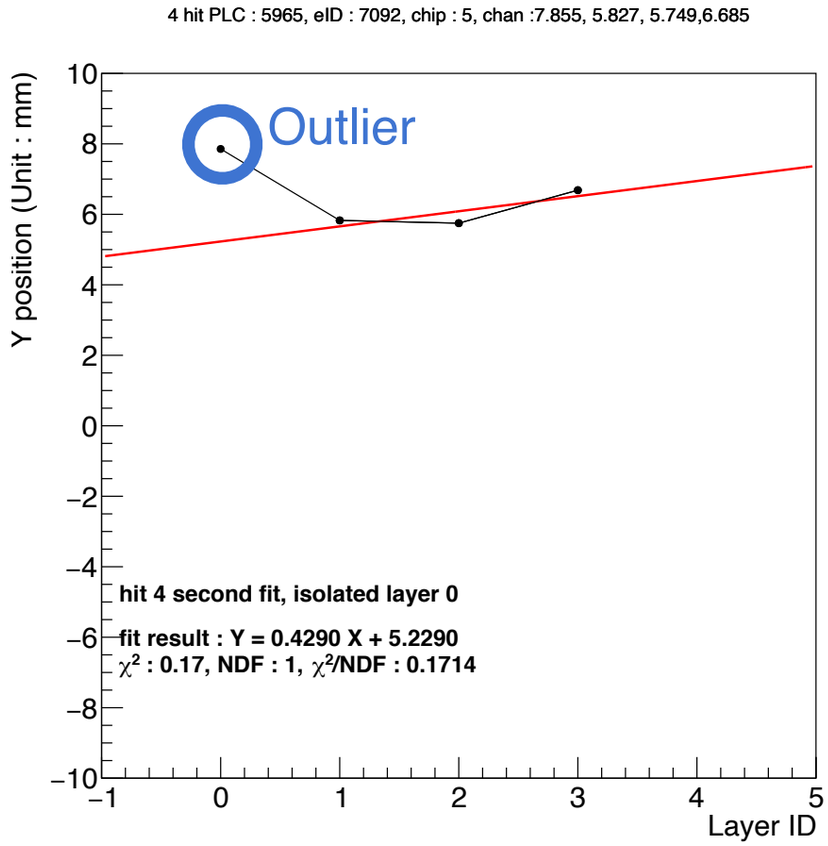
Same cluster !

Event profile example

Example of event profile : 0111



The original best fit
The residual of l1 > 5*0.078mm



The following selection, layer-0 (outlier) is excluded

```
root [1] tree_both->Scan("camac_adc:camac_tdc:INTT_event:module:chip_id:chan_id:adc:nele:DSE:eID","eID==7092")
*****************************************************************************************************************************************
*    Row   * Instance * camac_adc * camac_tdc * INTT_even *    module *   chip_id *   chan_id *       adc *      nele *       DSE *       eID *
*****************************************************************************************************************************************
*     7092 *        0 *        47 *       159 *         1 *         6 *         5 *        27 *         3 *         4 *         0 *      7092 *
*     7092 *        1 *       100 *       140 *         1 *         5 *         5 *        53 *         3 *         4 *         0 *      7092 *
*     7092 *        2 *       101 *       138 *         1 *         8 *         5 *        54 *         3 *         4 *         0 *      7092 *
*     7092 *        3 *           *         0 *         1 *         2 *         5 *        42 *         2 *         4 *         0 *      7092 *
*     7092 *        4 *           *         0 *         1 *           *           *           *           *         4 *         0 *      7092 *
*     7092 *        5 *           *       821 *         1 *           *           *           *           *         4 *         0 *      7092 *
*****************************************************************************************************************************************
```

Other examples of rejected event

Too large adc

```
root [1] tree_both->Scan("camac_adc:camac_tdc:INTT_event:module:chip_id:chan_id:adc:nele:DSE:eID","eID==8000")
************************************************************************************************************************************
*    Row   * Instance * camac_adc * camac_tdc * INTT_even *    module *   chip_id *   chan_id *       adc *      nele *       DSE *       eID *
************************************************************************************************************************************
*     8000 *        0 *        45 *       178 *         1 *         6 *         5 *        67 *         4 *         9 *         0 *      8000 *
*     8000 *        1 *       169 *       141 *         1 *         5 *         5 *        68 *         6 *         9 *         0 *      8000 *
*     8000 *        2 *      1834 *       158 *         1 *         8 *         5 *        69 *         3 *         9 *         0 *      8000 *
*     8000 *        3 *           *         0 *         1 *         2 *         5 *        69 *         3 *         9 *         0 *      8000 *
*     8000 *        4 *           *         0 *         1 *         2 *         5 *        70 *         3 *         9 *         0 *      8000 *
*     8000 *        5 *           *       886 *         1 *         2 *         5 *        71 *         1 *         9 *         0 *      8000 *
*     8000 *        6 *           *           *         1 *         2 *         5 *        72 *         0 *         9 *         0 *      8000 *
*     8000 *        7 *           *           *         1 *         2 *         5 *        73 *         0 *         9 *         0 *      8000 *
*     8000 *        8 *           *           *         1 *         2 *         5 *        74 *         1 *         9 *         0 *      8000 *

************************************************************************************************************************************
```

Only 1 hit

```
************************************************************************************************************************************
*    Row   * Instance * camac_adc * camac_tdc * INTT_even *    module *   chip_id *   chan_id *       adc *      nele *       DSE *       eID *
************************************************************************************************************************************
*     5855 *        0 *        45 *       165 *         1 *         2 *         5 *        29 *         3 *         1 *         0 *      5855 *
*     5855 *        1 *        99 *       140 *         1 *           *           *           *           *         1 *         0 *      5855 *
*     5855 *        2 *        94 *       145 *         1 *           *           *           *           *         1 *         0 *      5855 *
*     5855 *        3 *           *         0 *         1 *           *           *           *           *         1 *         0 *      5855 *
*     5855 *        4 *           *         0 *         1 *           *           *           *           *         1 *         0 *      5855 *
*     5855 *        5 *           *       909 *         1 *           *           *           *           *         1 *         0 *      5855 *
************************************************************************************************************************************
```

Only 1 cluster

```
************************************************************************************************************************************
*    Row   * Instance * camac_adc * camac_tdc * INTT_even *    module *   chip_id *   chan_id *       adc *      nele *       DSE *       eID *
************************************************************************************************************************************
*    11244 *        0 *        54 *       146 *         1 *         6 *         5 *        92 *         5 *         2 *         0 *     11244 *
*    11244 *        1 *       146 *       139 *         1 *         2 *         6 *       109 *         3 *         2 *         0 *     11244 *
*    11244 *        2 *       111 *       126 *         1 *           *           *           *           *         2 *         0 *     11244 *
*    11244 *        3 *           *         0 *         1 *           *           *           *           *         2 *         0 *     11244 *
*    11244 *        4 *           *         0 *         1 *           *           *           *           *         2 *         0 *     11244 *
*    11244 *        5 *           *       843 *         1 *           *           *           *           *         2 *         0 *     11244 *
************************************************************************************************************************************
```

Issue of double saving event

MC ——> interface macro ——> filter macro ——> tracking ana macro
TestBeam ————————————> filter macro ——> tracking ana macro

Interface macro : to convert the MC data format into TestBeam data format
filter macro : to filter the double saving hits in each event.

one event real data

Some hits seem to be recorded twice : 1<->3, 2<->4, 5<->7 and 6 <-> 8. I think it is ok as long as both are identical.

Row	Instance	event	chip_id	chan_id	module	adc	bco	bco_full	camac_tdc	camac_adc	INTT_even
17	0	-1	22	84	6	2	111	62063	138	204	1
17	1	-1	22	83	6	1	111	62063	140	206	1
17	2	-1	22	85	6	1	111	62063	167	245	1
17	3	-1	22	83	6	1	112	62064	0		1
17	4	-1	22	85	6	1	112	62064	0		1
17	5	-1	21	103	5	7	113	62065	676		1
17	6	-1	16	0	5	0	113	62065			1
17	7	-1	21	103	5	7	114	62066			1
17	8	-1	16	0	5	0	114	62066			1

But if you check another event shown below, you can see there is one hit recorded twice but with different adc....

one event real data

Row	Instance	event	chip_id	chan_id	module	adc	bco	bco_full	camac_tdc	camac_adc	INTT_even
11	0	-1	21	127	5	7	90	53850	156	161	1
11	1	-1	21	126	5	1	90	53850	140	212	1
11	2	-1	21	126	5	7	90	53850	132	379	1
11	3	-1	5	107	6	2	90	53850	0		1
11	4	-1	21	8	5	7	90	53850	0		1

Type <CR> to continue or q to quit ==>

Row	Instance	event	chip_id	chan_id	module	adc	bco	bco_full	camac_tdc	camac_adc	INTT_even
11	5	-1	21	120	5	3	90	53850	600		1
11	6	-1	21	5	5	2	90	53850			1
11	7	-1	16	0	5	0	90	53850			1
11	8	-1	21	66	5	6	91	53851			1
11	9	-1	16	0	5	0	91	53851			1

It will effect on tracking result as the energy-weighted method is applied.

6

Macro preparation for Testbeam2021

MC ——> interface macro ——> filter macro ——> tracking ana macro
TestBeam ——————————> filter macro ——> tracking ana macro

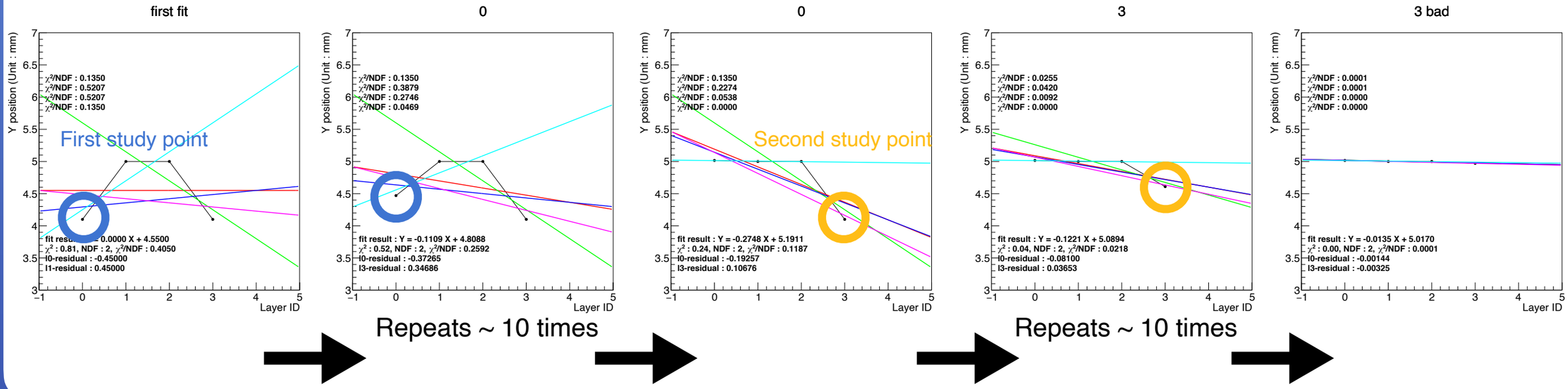
- 3 added branches in filter_N_v3.c makes the analysis easier
  - nele : number of element in the this event (vector)
  - DSE : double saving event indicator
    - If double saving event appears, DSE = 1, else DSE = 0
  - eID : event ID

Row	Instance	camac_adc	camac_tdc	INTT_even	module	chip_id	chan_id	adc	nele	DSE	eID
5855	0	45	165	1	2	5	29	3	1	0	5855
5855	1	99	140	1					1	0	5855
5855	2	94	145	1					1	0	5855
5855	3		0	1					1	0	5855
5855	4		0	1					1	0	5855
5855	5		909	1					1	0	5855

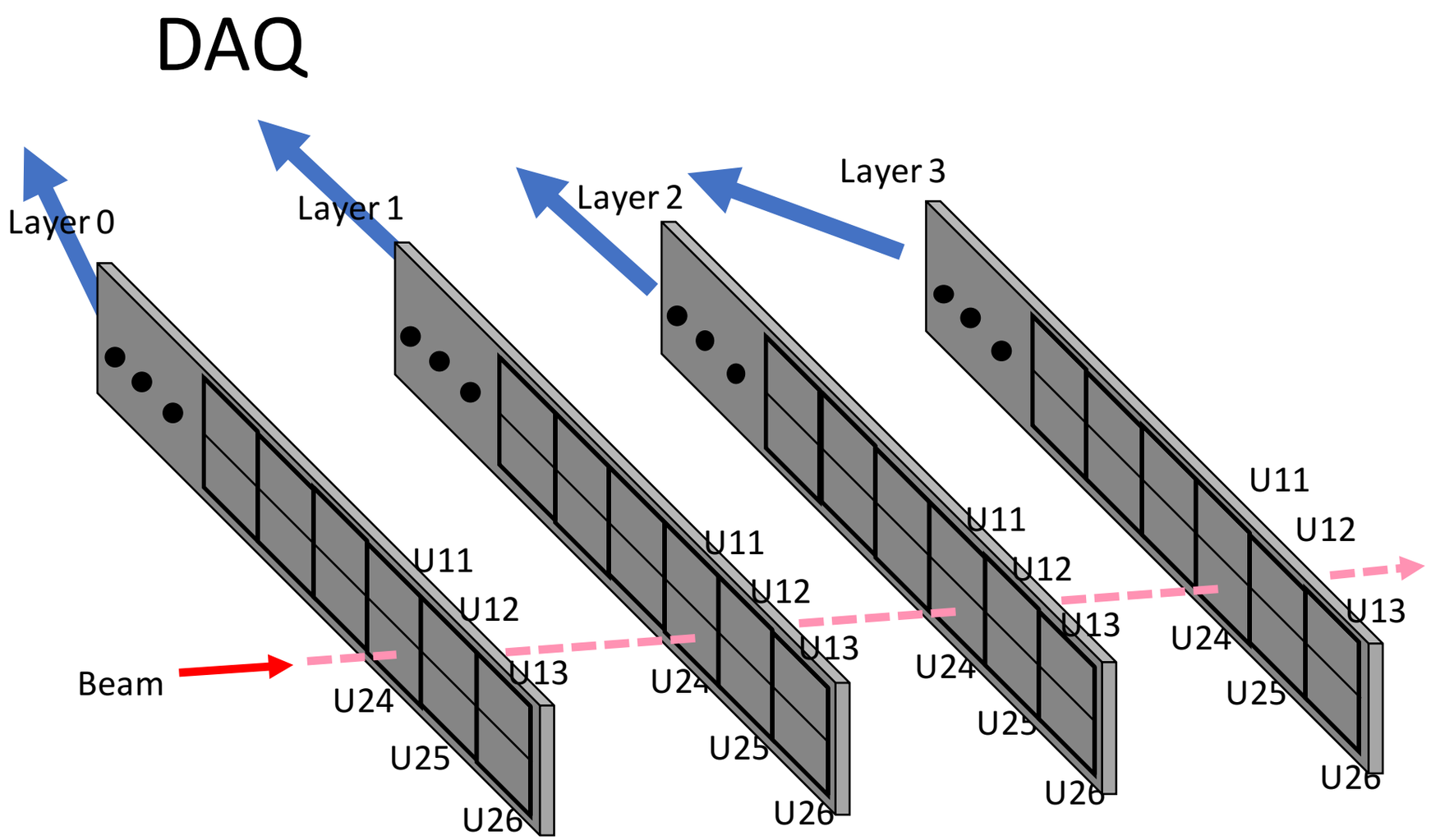
Alignment algorithm

- Only works on 4 layers Testbeam
  - Global fit (red line) : 4 points fitting line
  - 4 Local fits (rest color): 3 points fitting line

- The procedures to correct the layer position
  1. Find the point with largest residual (layer 0 in the example)
  2. Correct the point position by 0.3*original residual
  3. Fit the points again
  4. Check the new r-χ^2 of Global fit and 4 local fits
  5. If all r-χ^2 become smaller : calculate new residual, repeat action 2 and 3
  6. If one of r-χ^2 becomes larger or residual < 3μm: stop, back to the previous position.
  7. Move to the next point



Current Testbeam setup in G4



Channel ID order