HIT MAP OF LARGE Z CLUSTER

Tomoya Kato (form Rikkyo University) for the INTT

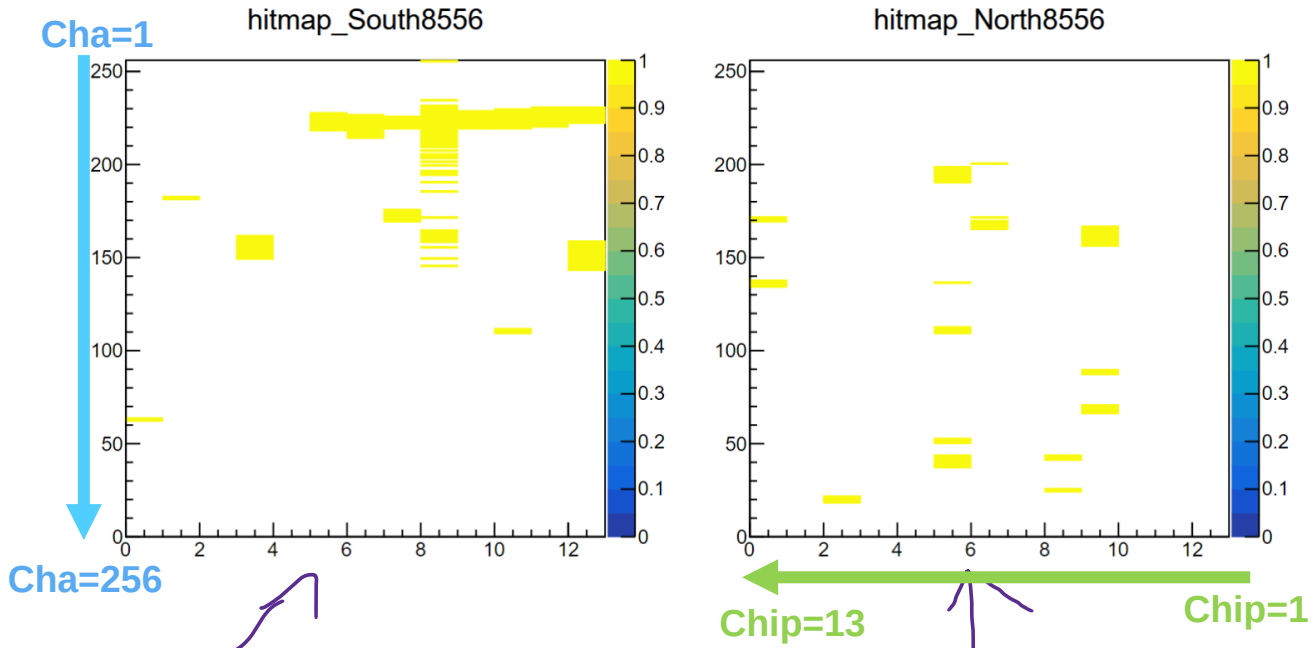
topics

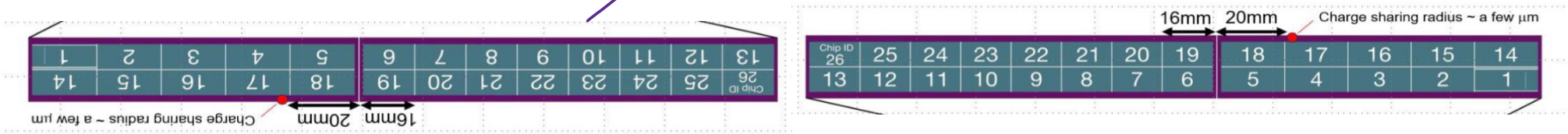
- I made Hit map with Z Cluster size= 8 ←last week
- I add the adc on z azis of hit map.
- I made three correction plot.
  1. cluster_phi_size & cluster_z_size
  2. NClus & cluster_z_size
  3. NClus & cluster_phi_size

Reminder of last week

Plot3.hit map event number is 8556

- I made the both South and North hit maps.
  - Vertical axis is channel id.
  - Horizontal axis is chip id.
  - to reproduce actual geometry,
  - Channel id was reversed in South side.
  - Chip id was reversed in North side.



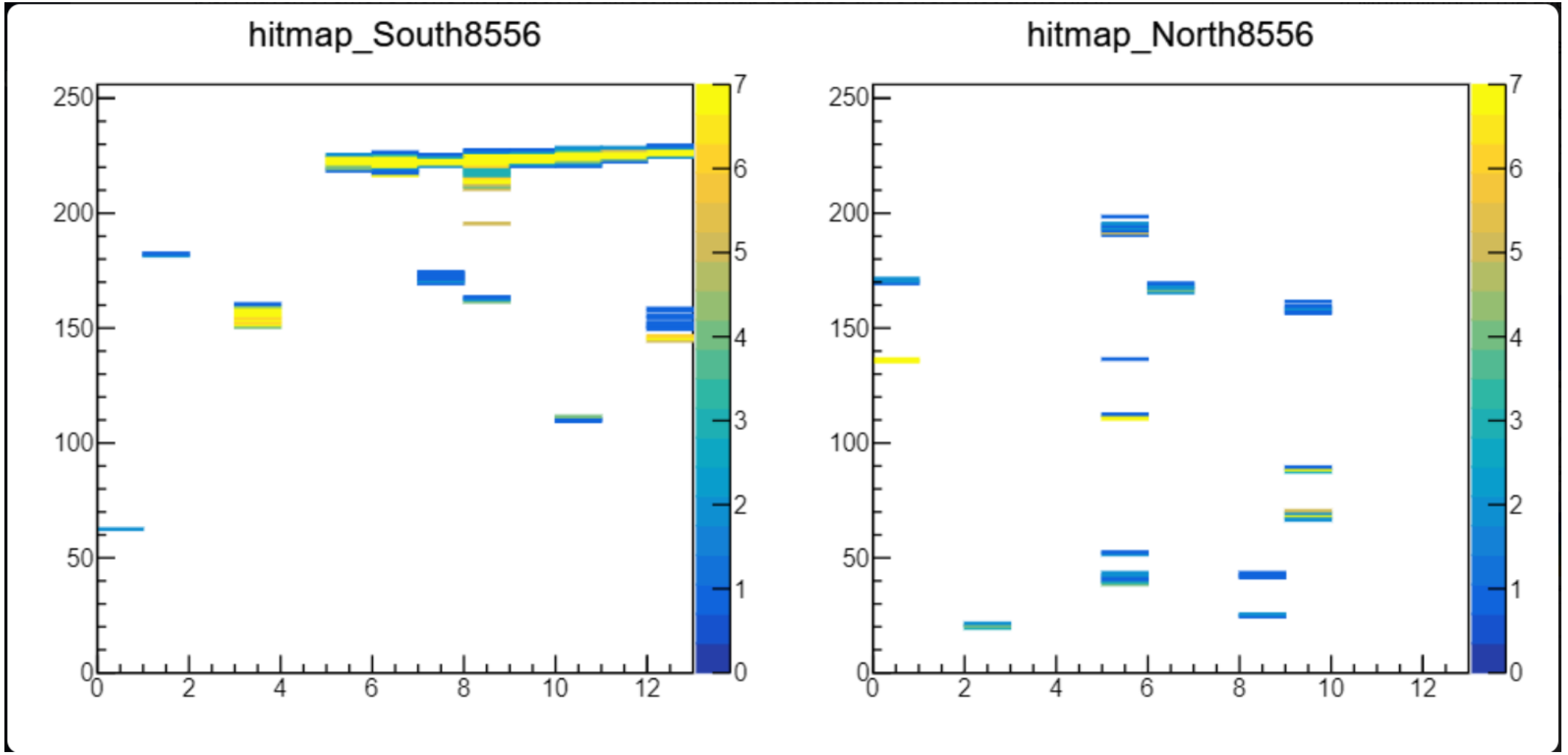


Using data information

- I used run20869,Au+Au,No Magnetic field.
- Number of event is 100k
- Original data was Decode by Genki, (it was same as data using ToyMC model study.)
- Bco cut,hot cut were applied, but I didn’t confirm that same cut were applied between cluster and row hit.

Phi size = 23

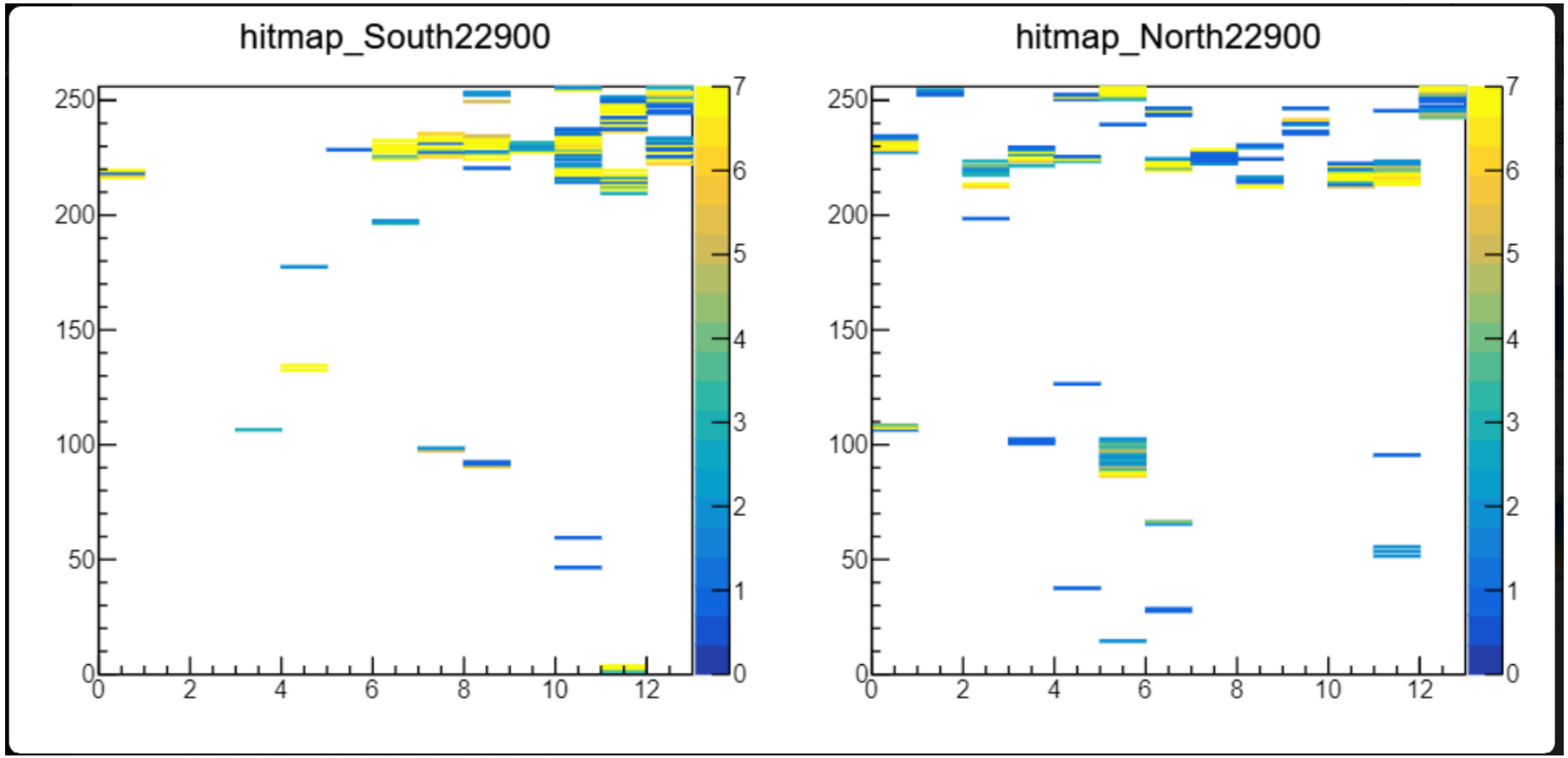
Point
*Center of the stick's ADC is 7,edge's ADC is small(0or1or2)
*large phi size may be due to charge sharing.



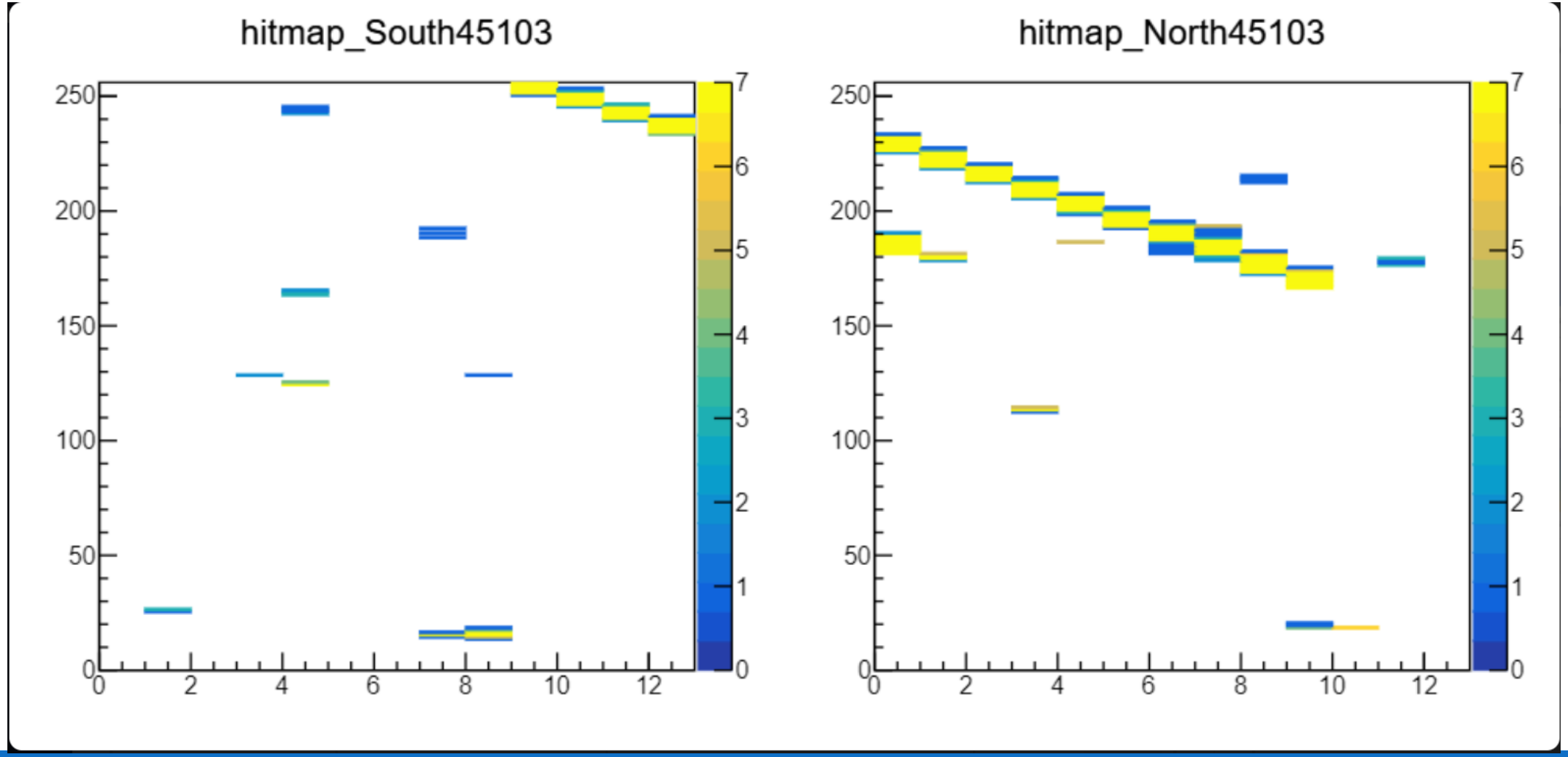
Phi size = 49

Point

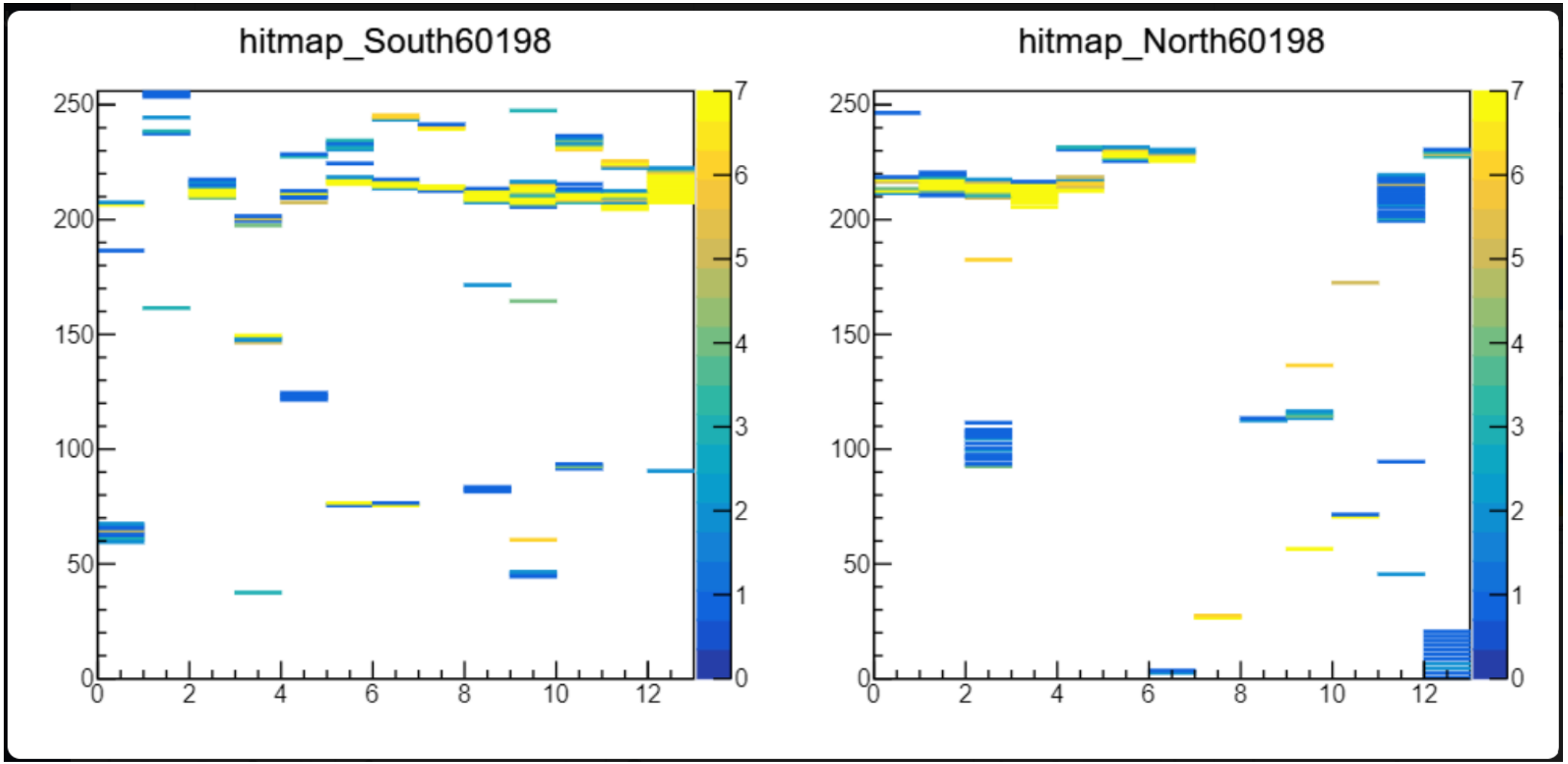
* I thought this hit map shows the accidental coincidence because line is not clear. However, To see the ADC, ADC=7 line was observed around channel =200-250. so this may be due to particle.



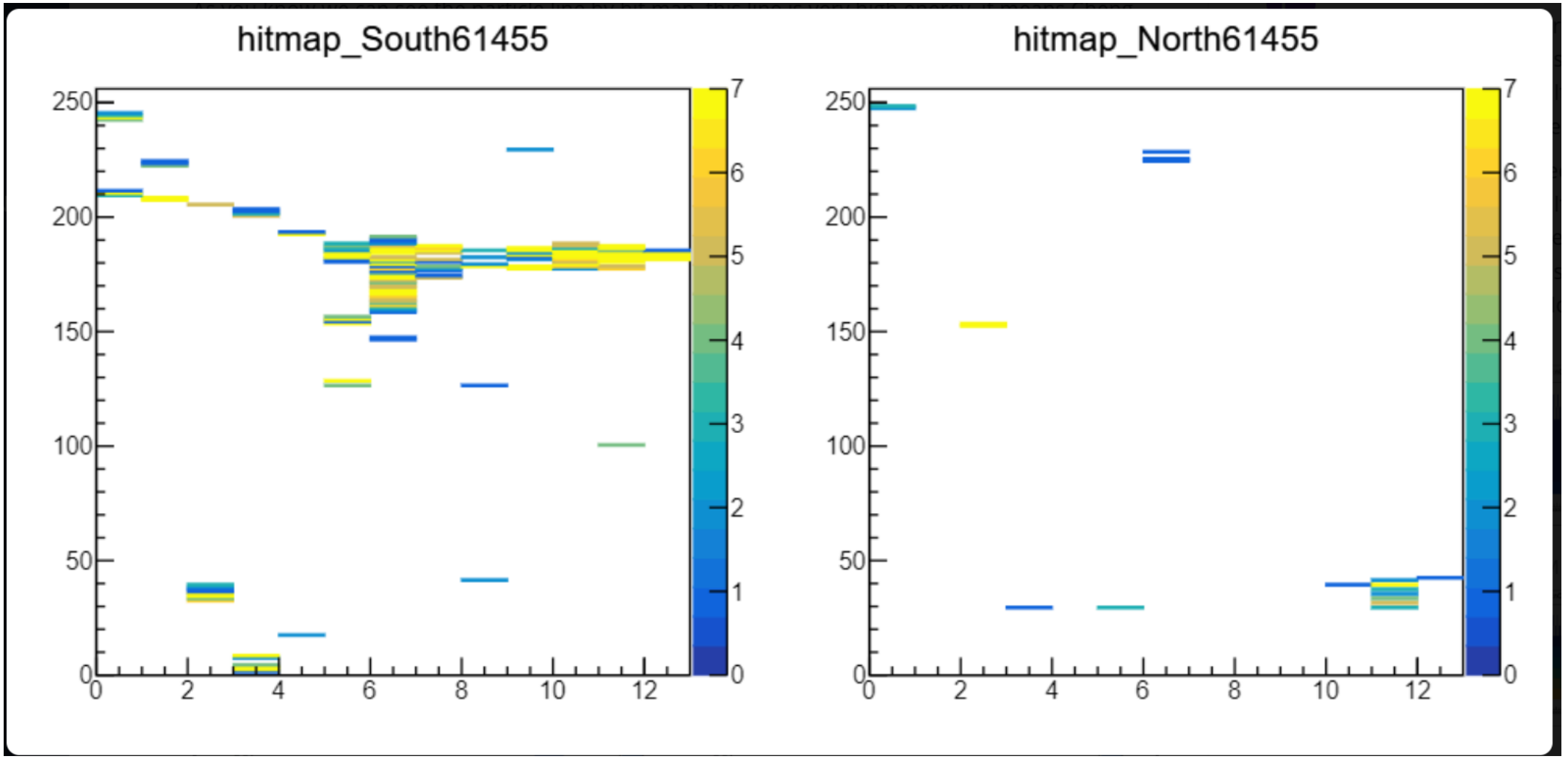
Phi size = 57


hitmap_South45103
hitmap_North45103
250
200
150
100
50
0
0
2
4
6
8
10
12
7
6
5
4
3
2
1
0

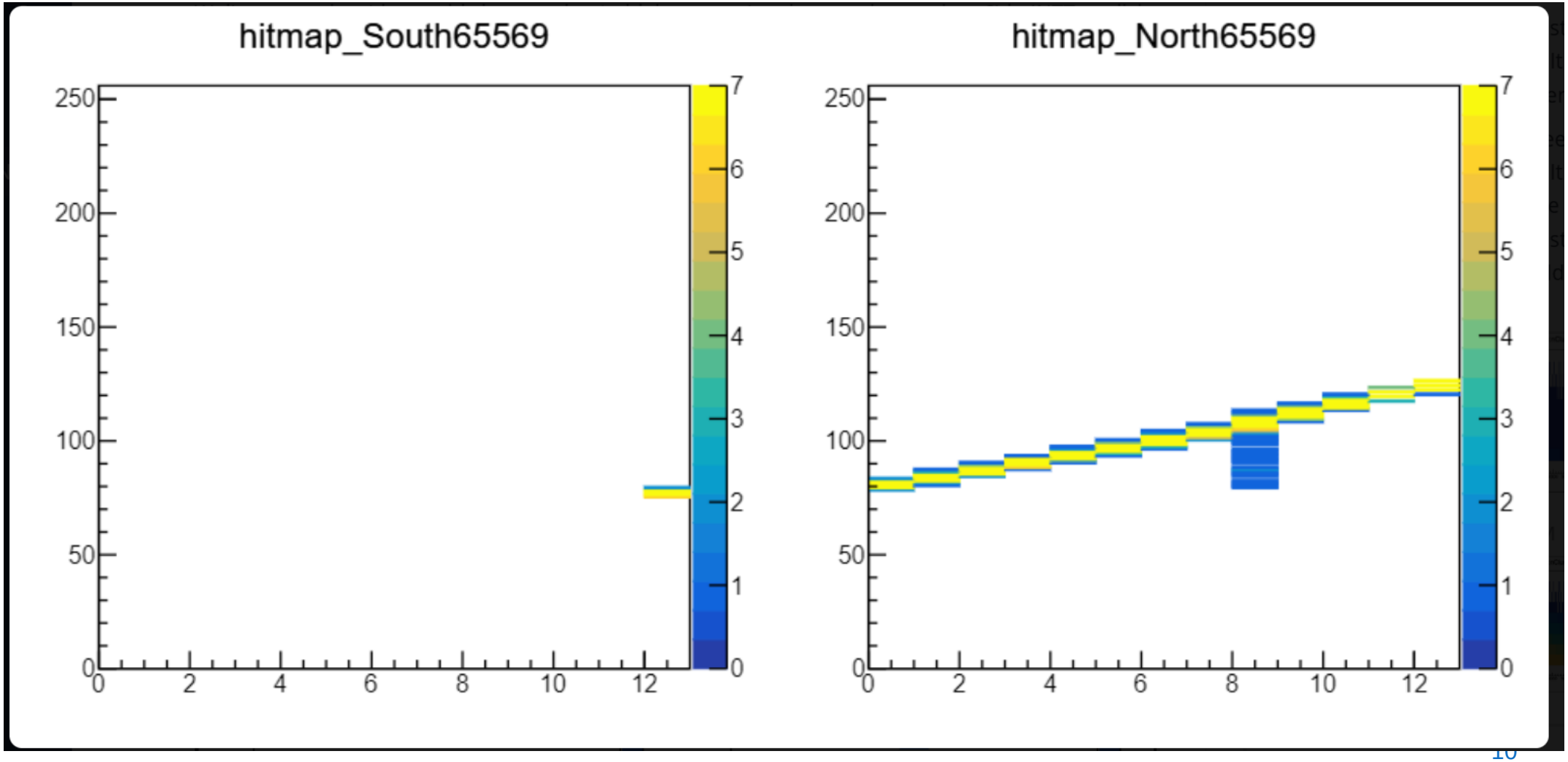
Phi size = 23


hitmap_South60198
hitmap_North60198
250
200
150
100
50
0
0
2
4
6
8
10
12
7
6
5
4
3
2
1
0

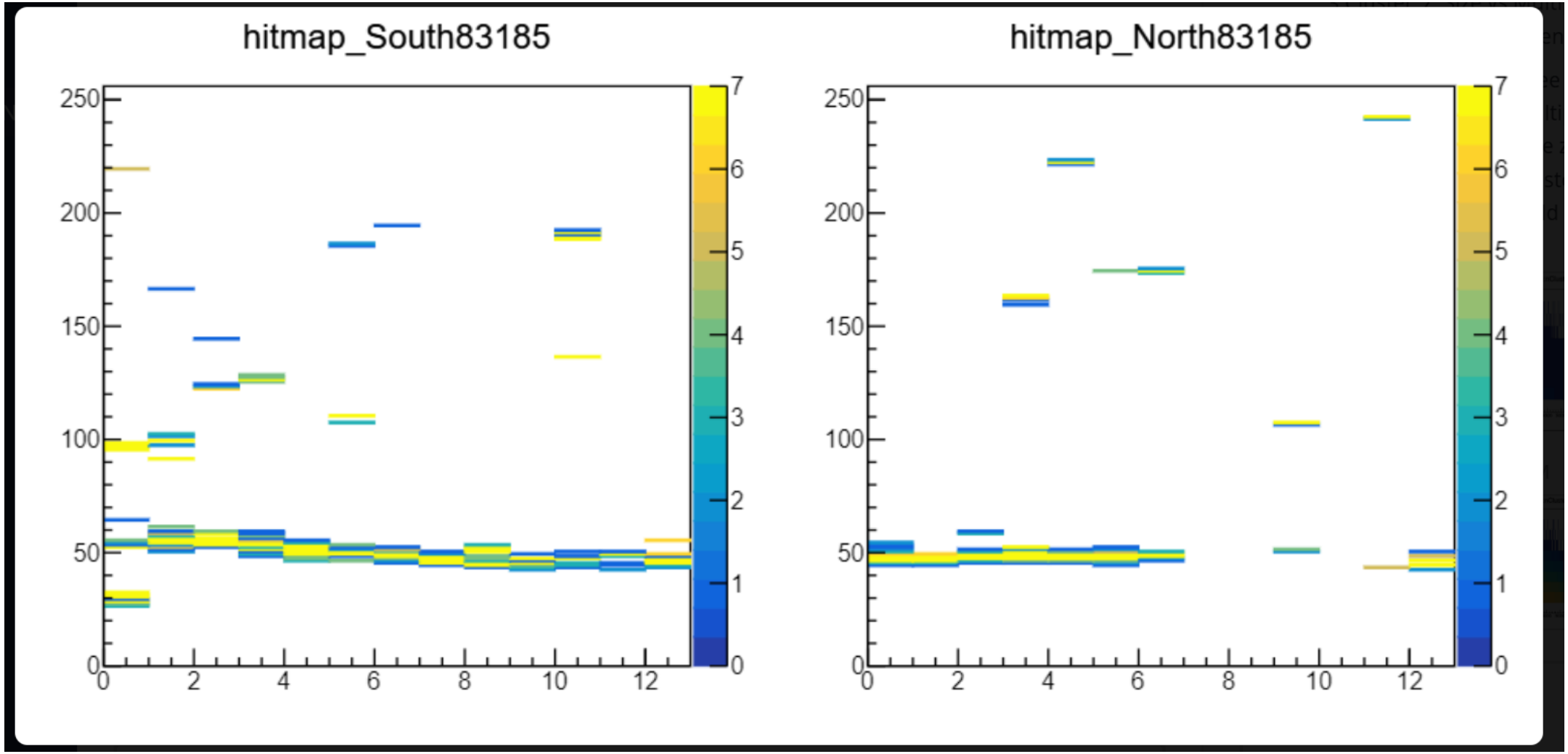
Phi size = 42


hitmap_South61455
hitmap_North61455
250
200
150
100
50
0
0
2
4
6
8
10
12
7
6
5
4
3
2
1
0

Phi size = 33

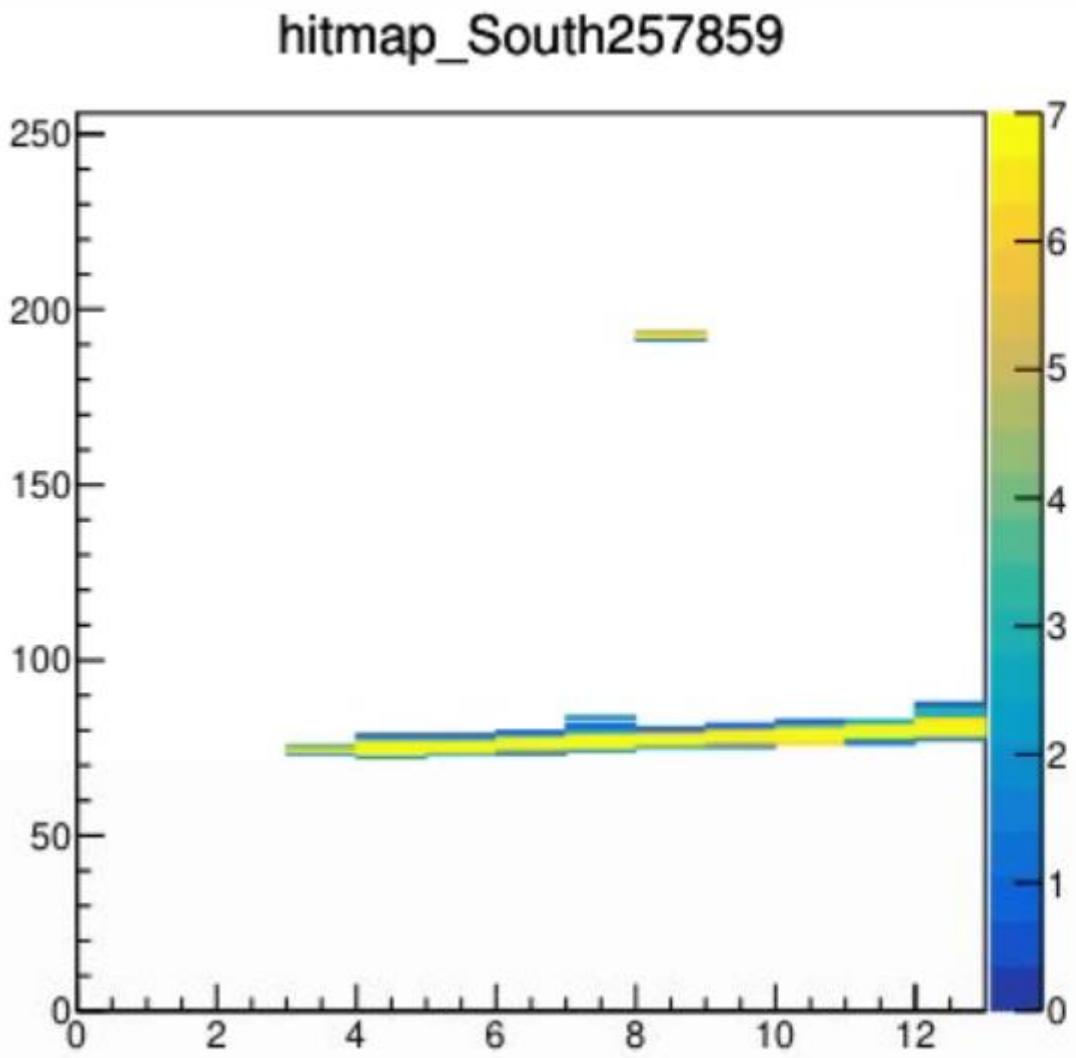

hitmap_South65569
hitmap_North65569
250
200
150
100
50
0
0
2
4
6
8
10
12
7
6
5
4
3
2
1
0

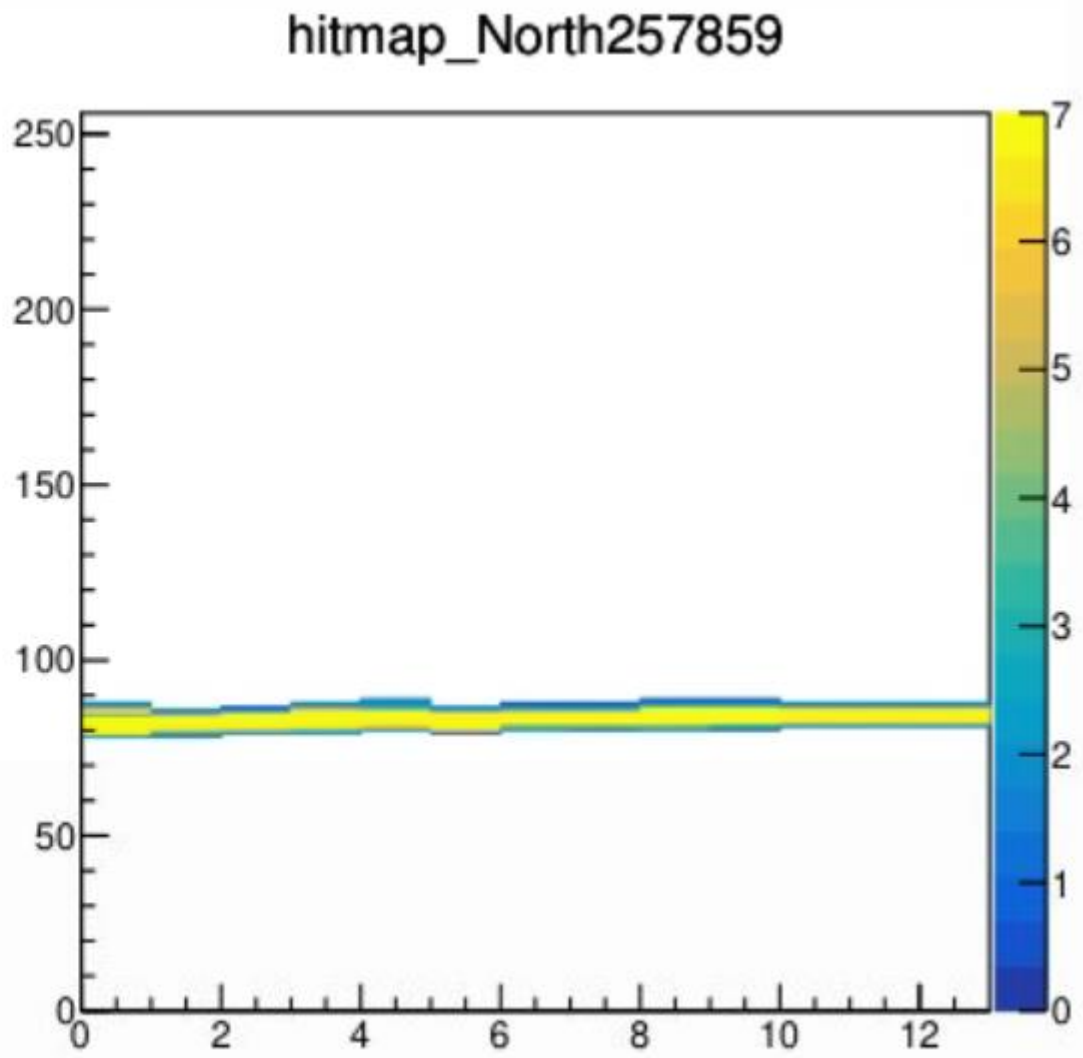
Phi size = 13


hitmap_South83185
hitmap_North83185
250
200
150
100
50
0
0
2
4
6
8
10
12
7
6
5
4
3
2
1
0

p+p run41651

To make more hit map in p+p,I have to update my code as automatically changing trk info to row.





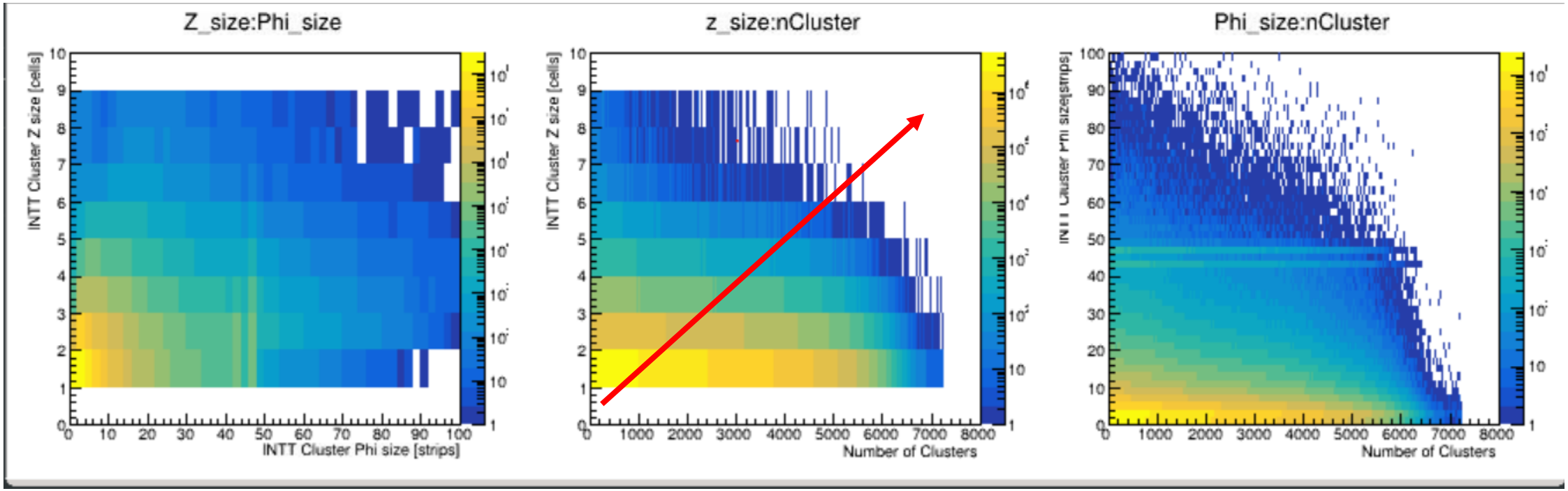
Correlation plot

- Using data

- p+p data:
  - Run 41651, 500k events, MBD N & S ≥ 1
  - Run 41652, 500k events, MBD N & S ≥ 1
  - Run 41653, 500k events, MBD N & S ≥ 1
- Au+Au data:
  - Run 20869 (zero field), 550,108 events, MBD N & S ≥ 1

Au+Au, run20869, 550k event

Plot title is horizontal axis : vertical axis.

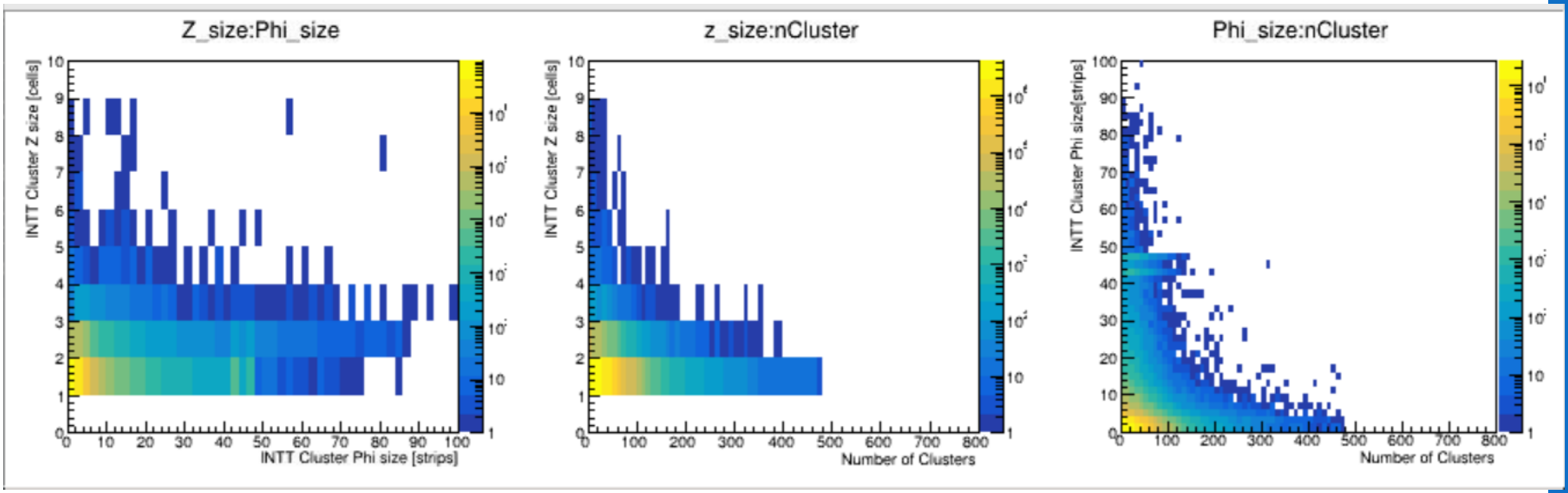


This z_size:nCluster plot shows large z size cluster is due to beam background because if due to accidental, we might see the positive correlation.

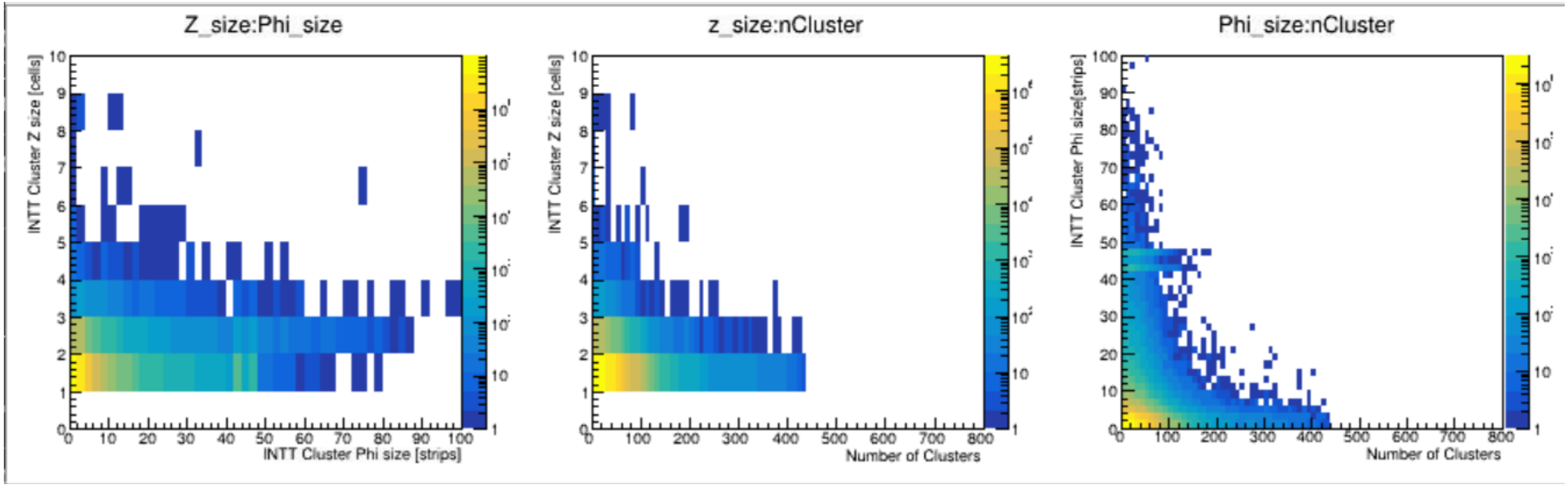
there are two spikes in the range of 40 to 5o in phi size.

1 p+p, run 41651, 500k events

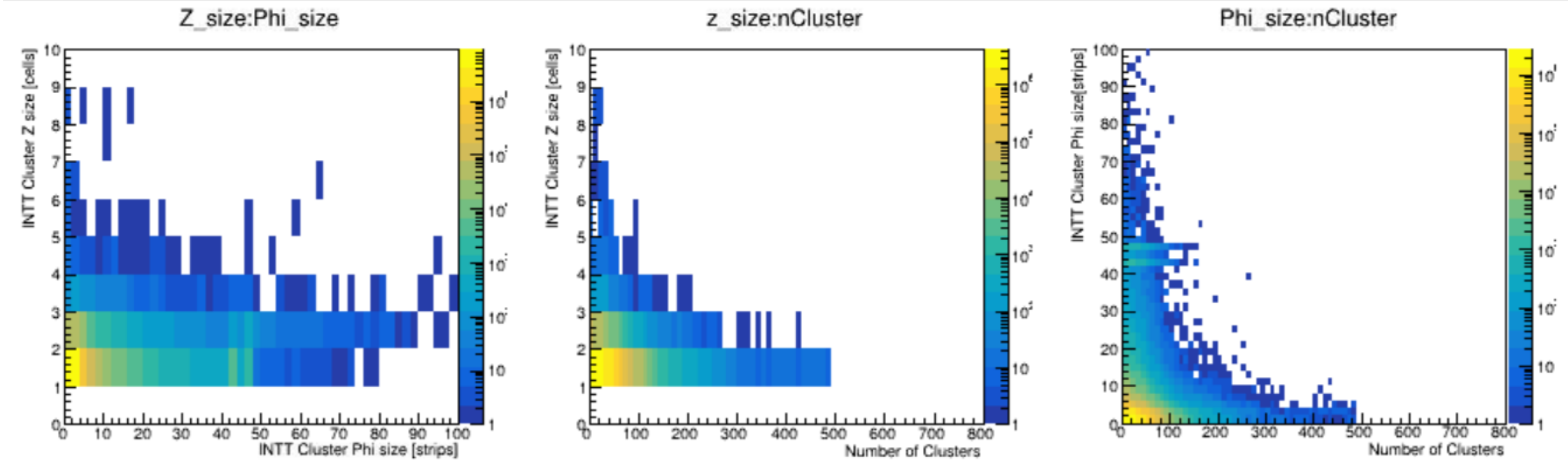
Plot title is horizontal axis : vertical axis.



2 p+p, run 41652, 500k events



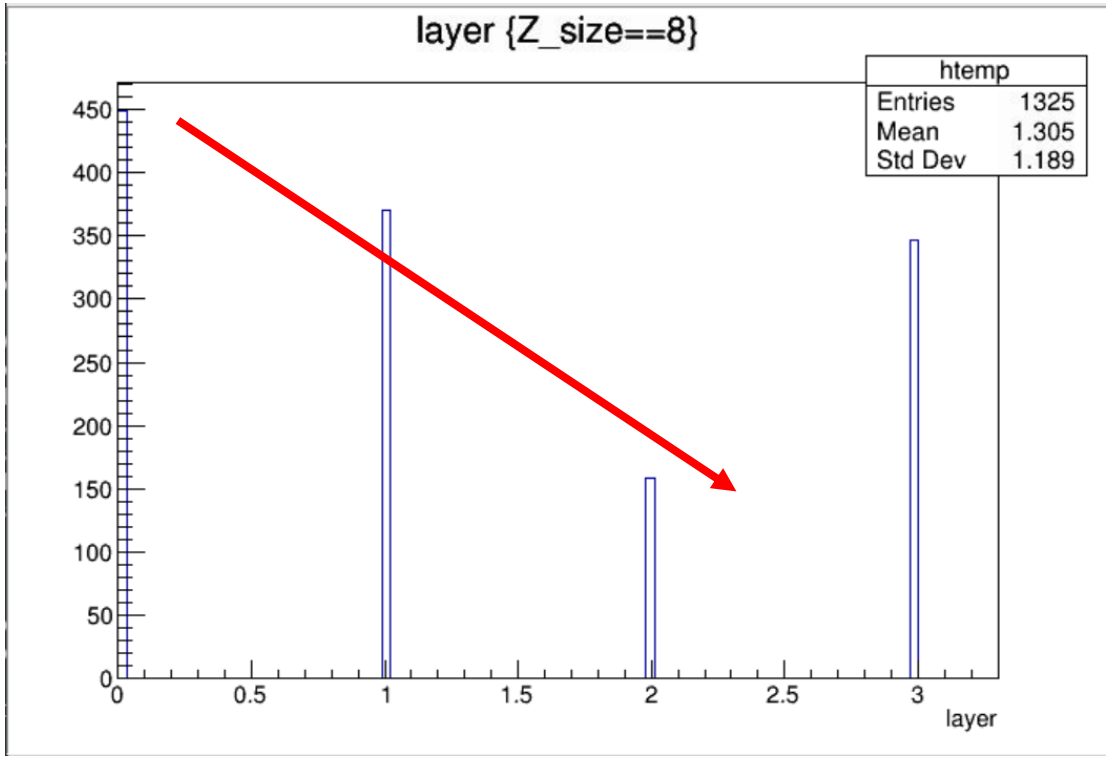
3 p+p, run 41653, 500k events



The count z size by layer

- Our expectation is that layer closed to beam axis has more hit, if Z size is due to **beam background**.

- The first 3 bins follow the expectation. Need more investigation in the fourth bin



Summary and Next to do

1. the selected 2D hit maps with hit ADC shown in the Z axis are presented
2. The hit maps place a strong evidence that INTT does have the beam background issue which is the particles flying horizontally and interacting with the INTT silicons.
3. The correlations of cluster_phi_size & cluster_z_size of different run conditions have been presented. Will try to look into the clusters with large Z size and tiny phi size.
4. NClus & cluster_z_size, and NClus & cluster_phi_size have been presented. The observed correlations are opposite to what expected.

Next to do

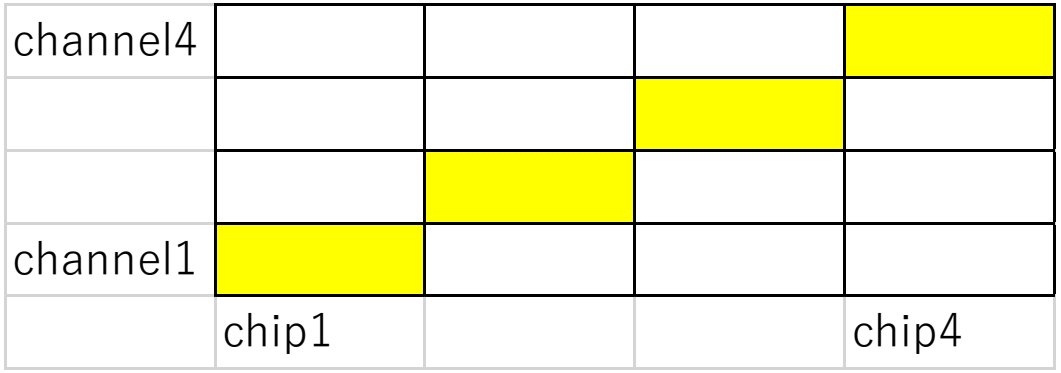
1. to have the automation way of finding and making the hitmap
2. check the correlations in the MC
3. potentially, develop the private clustering algorithm for the INTT beam background study

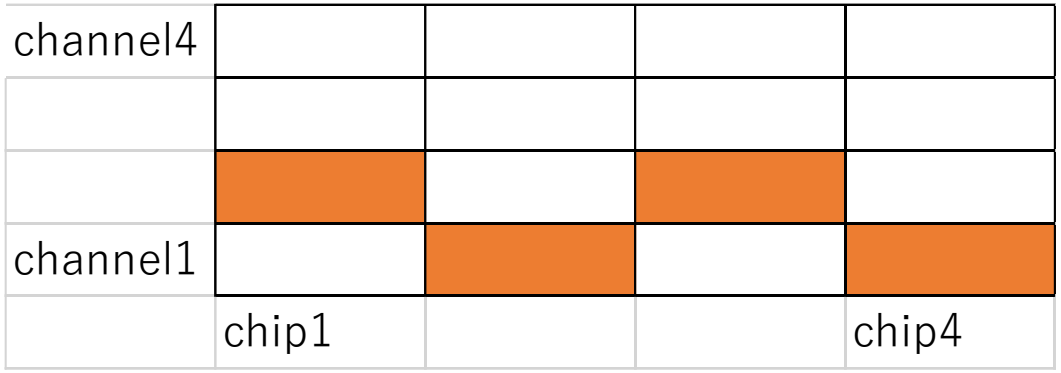
BACK UP

How did I make hit map

Why I made hit map?

- Purpose : to understand whether large Z Cluster is
- due to particles moving almost parallel to the beam axis,
- due to accidental coincidence,



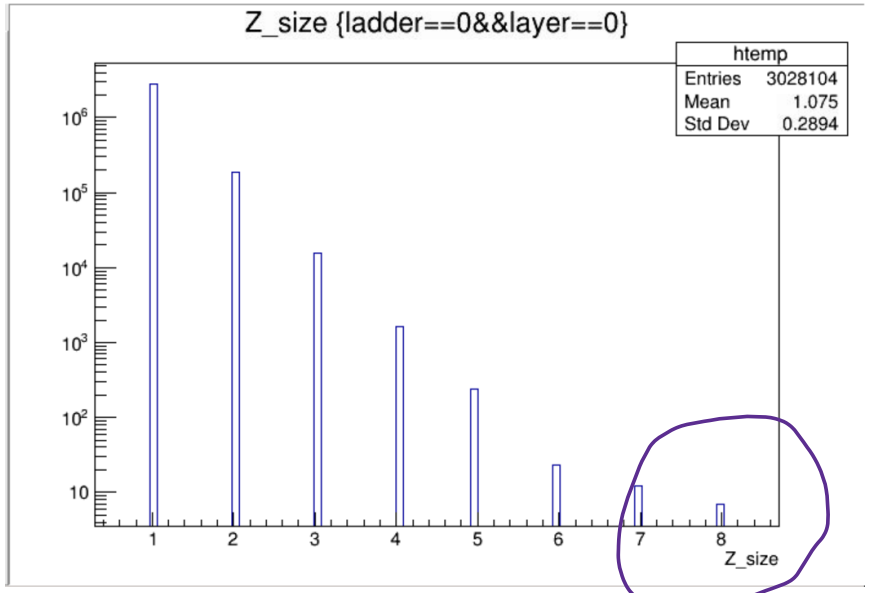


Using data information

- I used run20869,Au+Au,No Magnetic field.
- Number of event is 100k
- Original data was Decode by Genki, (it was same as data using ToyMC model study.)
- Bco cut,hot cut were applied, but I didn’t confirm that same cut were applied between cluster and row hit.

Select one ladder

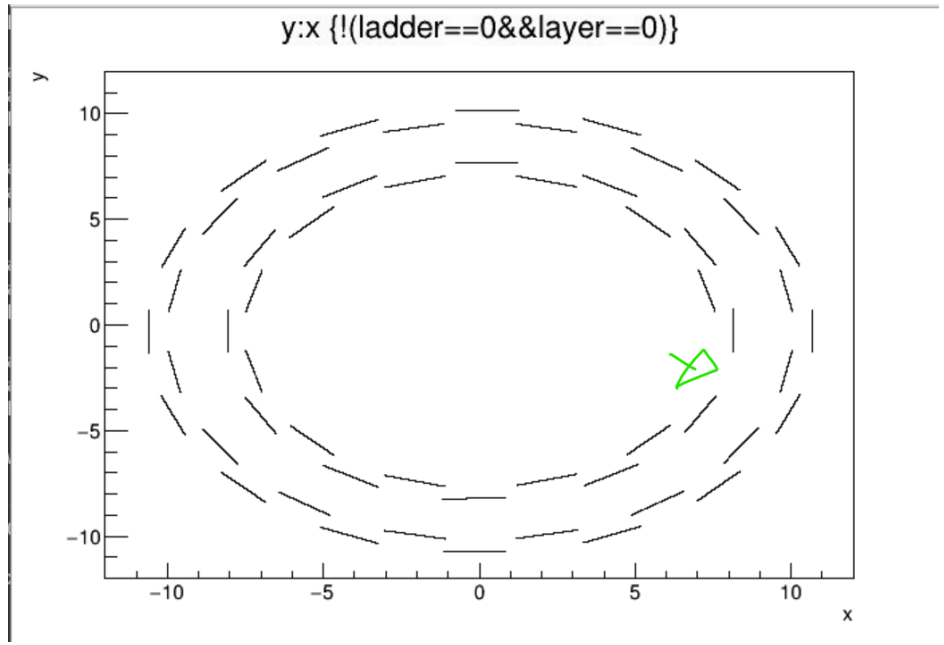
- For simplicity,
- I selected one ladder(layer=0&ladder=0).
- I made hit map of this ladder event by event when this ladder has z size =8 cluster.
- Plot1.Z size distribution with ladder 0&&layer0.



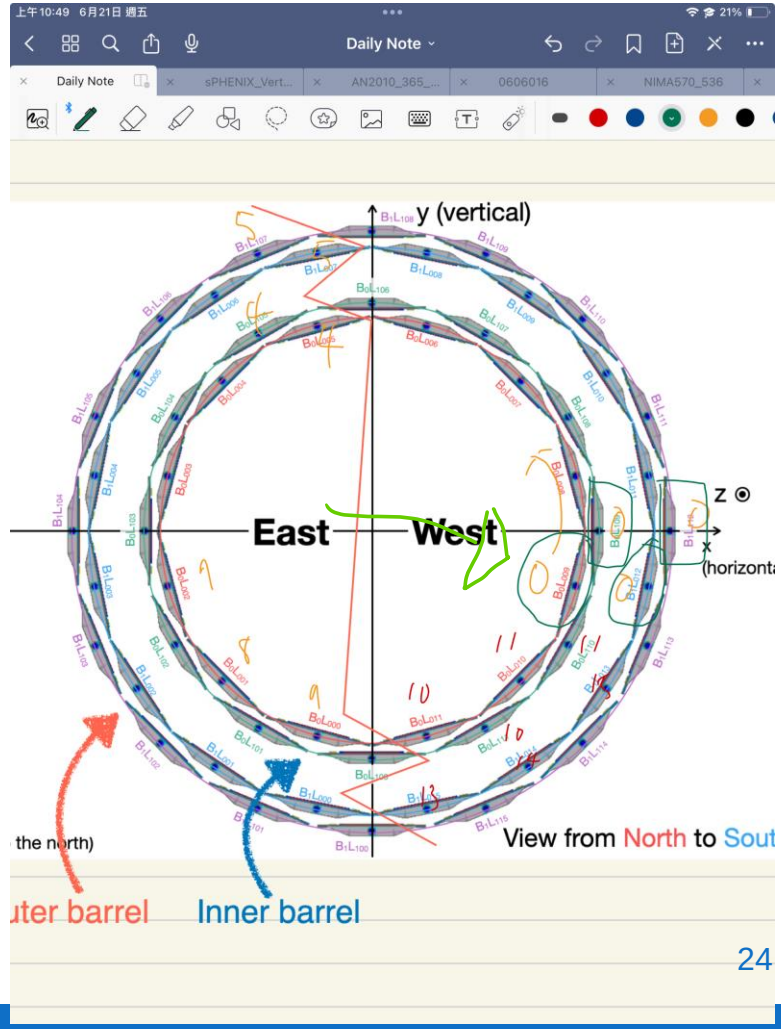
7 events

check the ladder name

- Compere plot2 to plot3, name of laddr0 &layer0 is B0L009.
- Plot2. x:y position of ladder 0&&layer0.



- Plot3.



result

- In this ladder, I found 7 events which has z size=8.
- It is written in the following order,
- name of ladder , event number , zID(zID=0 and 1 are south,zID=2,3 are North),Zsize,Phi size

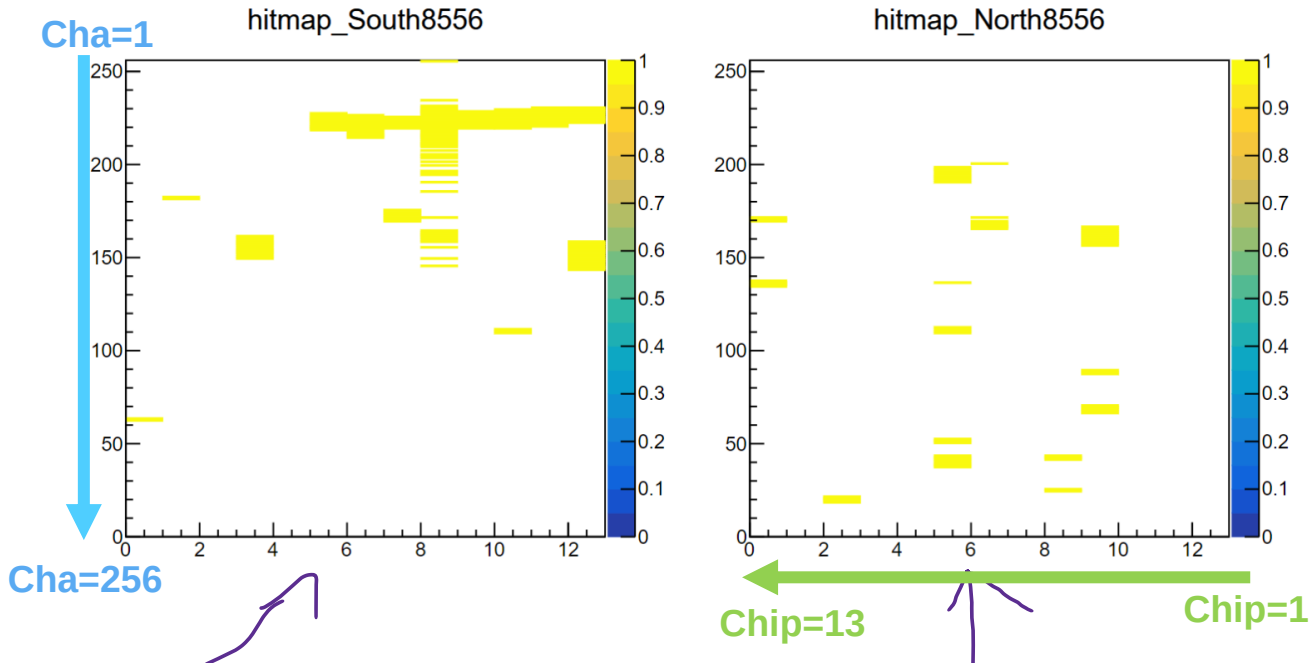
```
root [0]
Processing hitmap3.cc...
lay0ladder0 EVENT NUMBER=8556,zID=0, Z_size=8, Phi_size=23
lay0ladder0 EVENT NUMBER=22900,zID=0, Z_size=8, Phi_size=49
lay0ladder0 EVENT NUMBER=45103,zID=2, Z_size=8, Phi_size=57
lay0ladder0 EVENT NUMBER=60198,zID=0, Z_size=8, Phi_size=23
lay0ladder0 EVENT NUMBER=61455,zID=0, Z_size=8, Phi_size=42
lay0ladder0 EVENT NUMBER=65569,zID=2, Z_size=8, Phi_size=33
lay0ladder0 EVENT NUMBER=83185,zID=0, Z_size=8, Phi_size=13
```

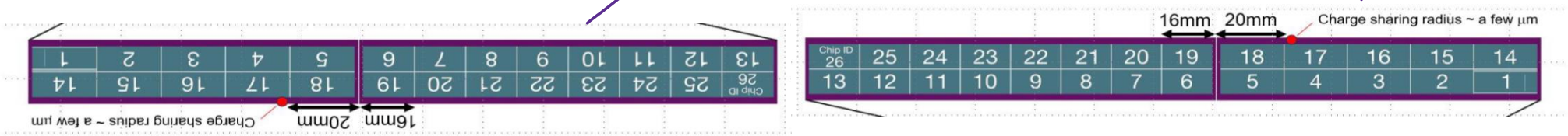
result2

Plot3.hit map event number is 8556

- I made the both South and North hit maps.
  - Vertical axis is channel id.
  - Horizontal axis is chip id.

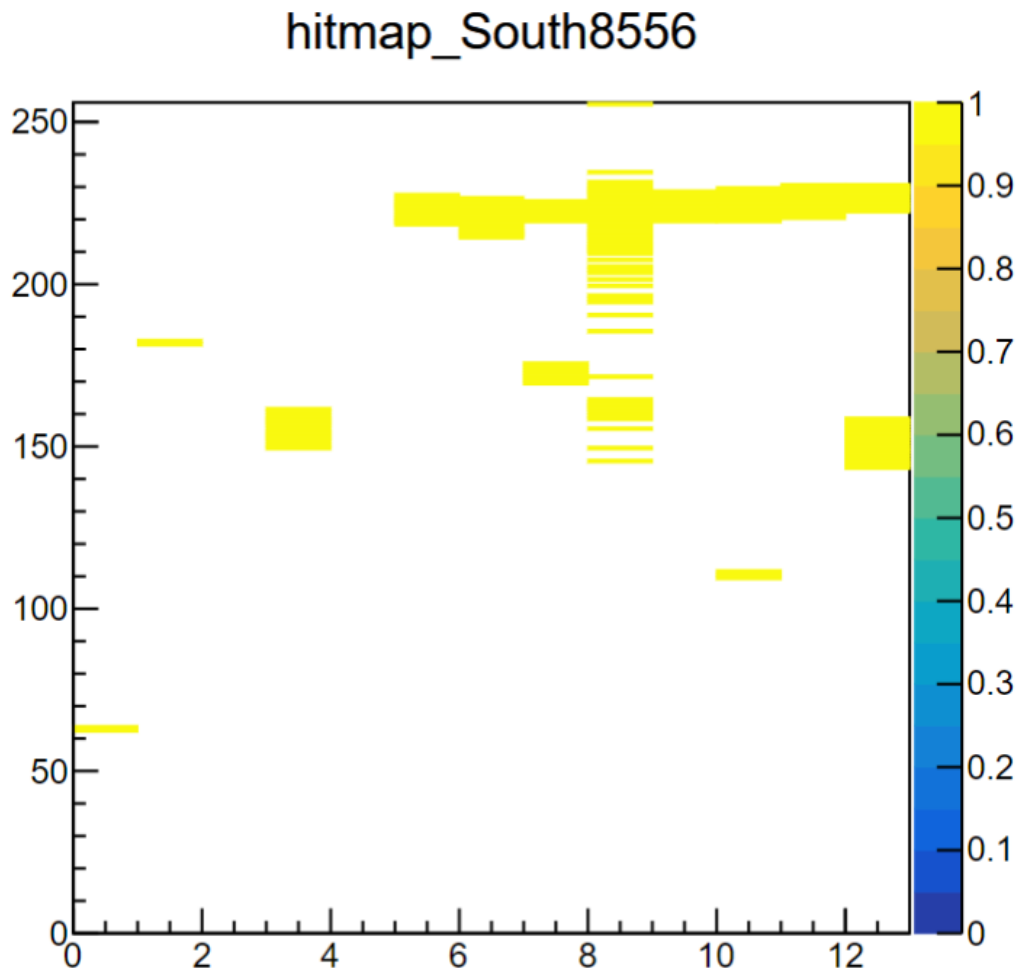
- to reproduce actual geometry,
- Channel id was reversed in South side.
- Chip id was reversed in North side.

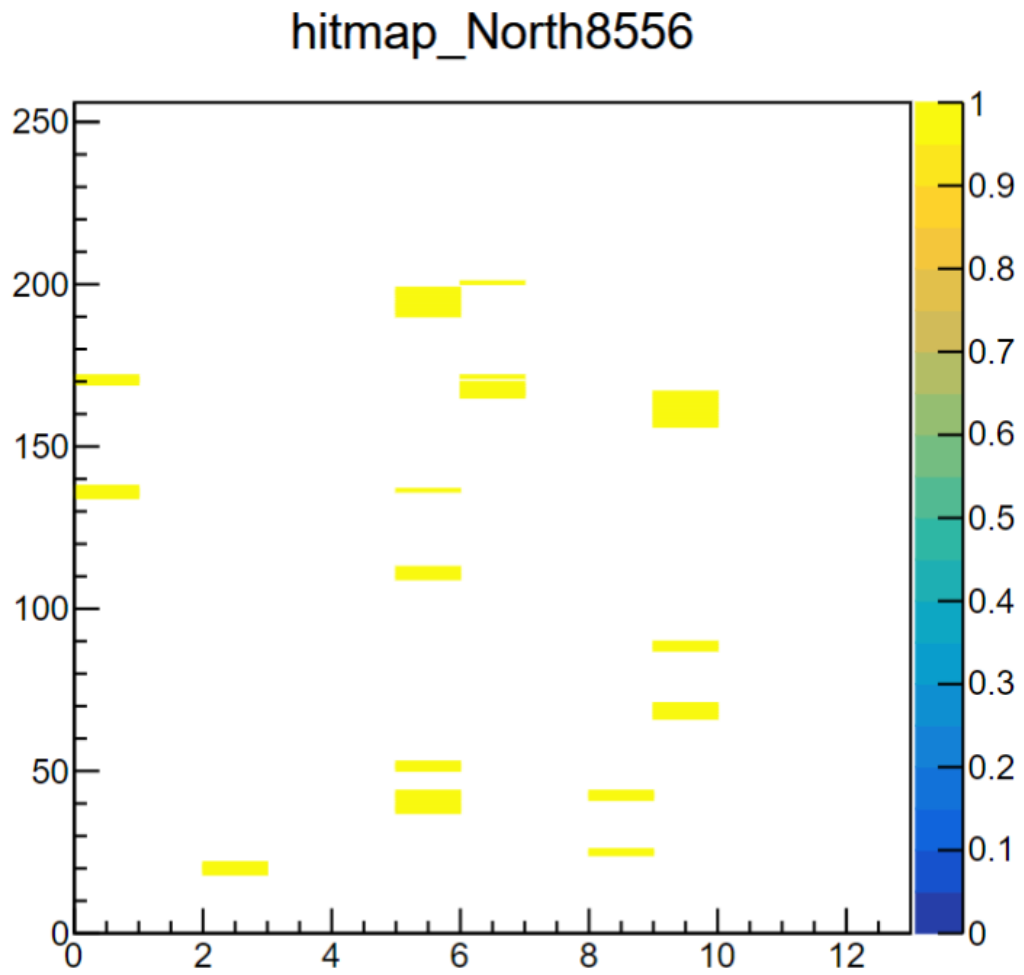




Z vtx

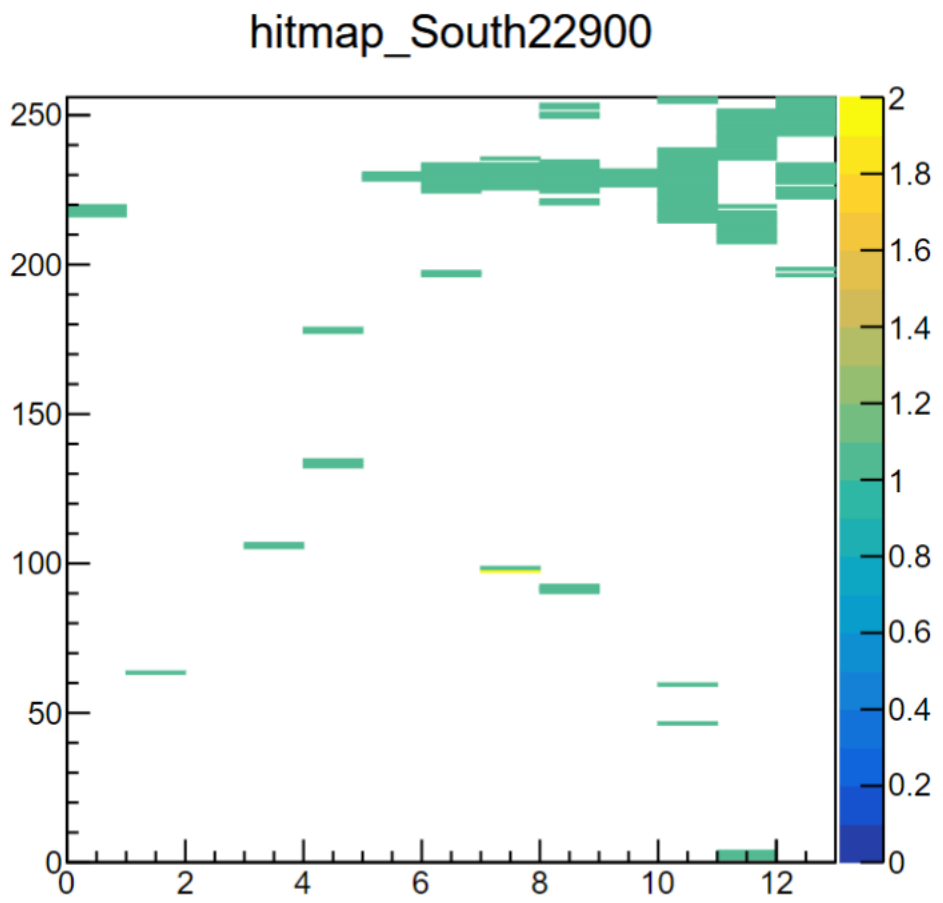
Phi size = 23

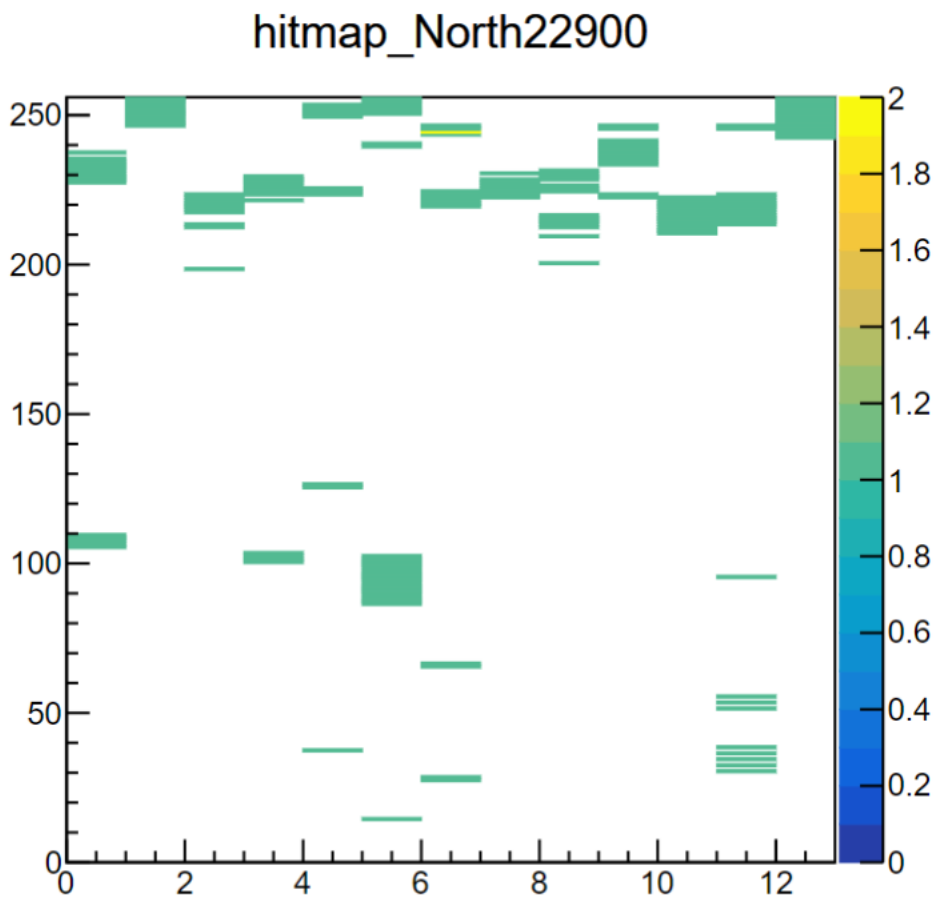

hitmap_South8556
250
200
150
100
50
0
0
2
4
6
8
10
12
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


hitmap_North8556
250
200
150
100
50
0
0
2
4
6
8
10
12
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

Phi size = 49

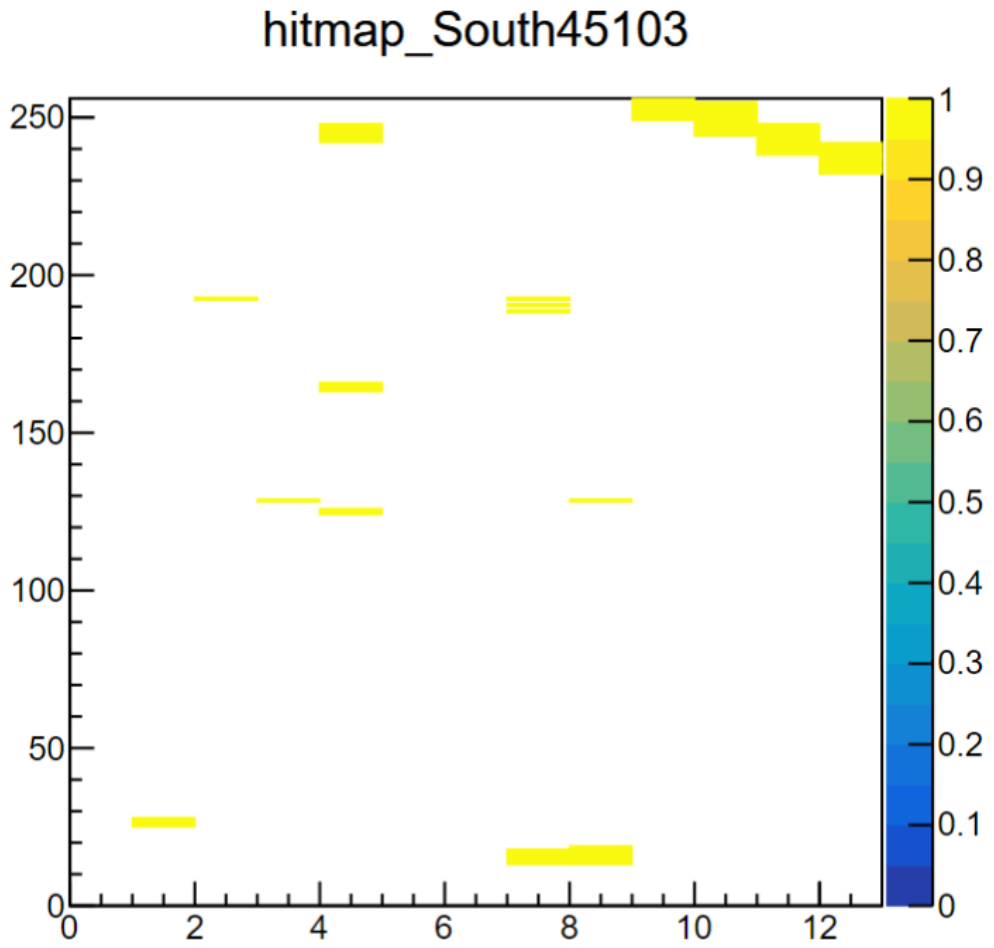
Point
*It looks like the accidental coincidence due to large phi size.

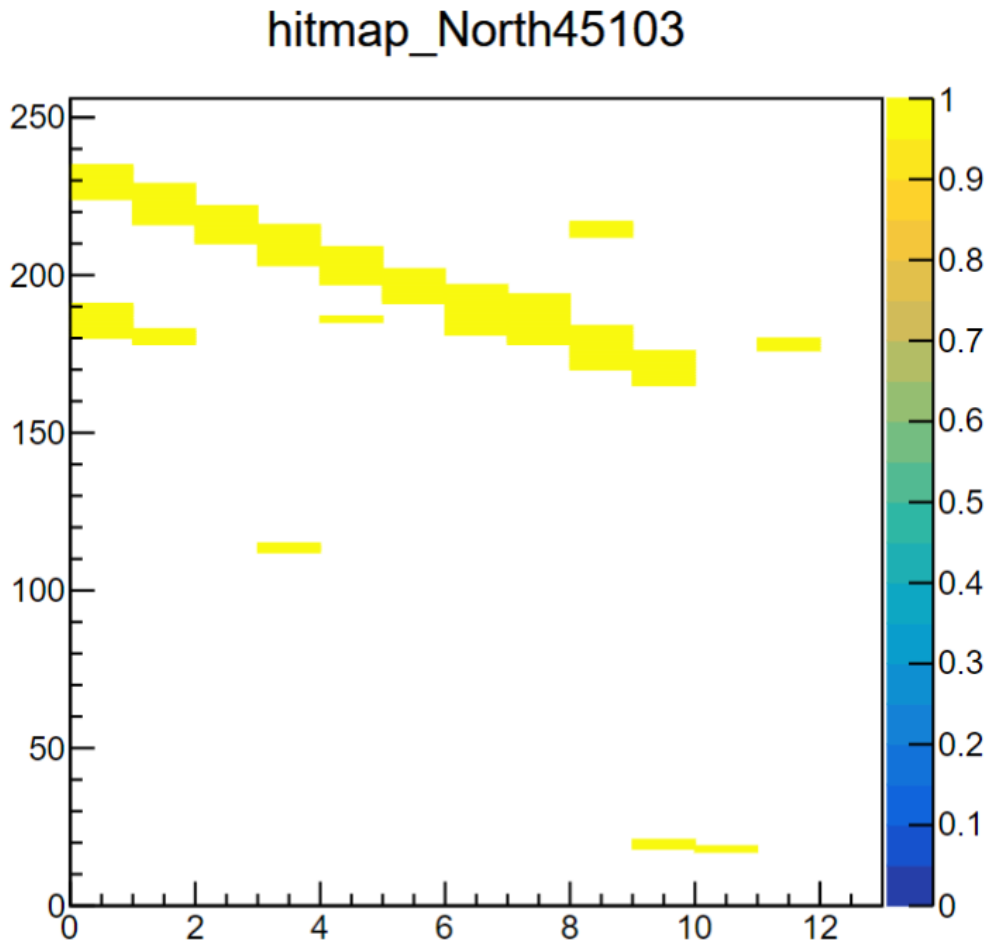




Phi size = 57

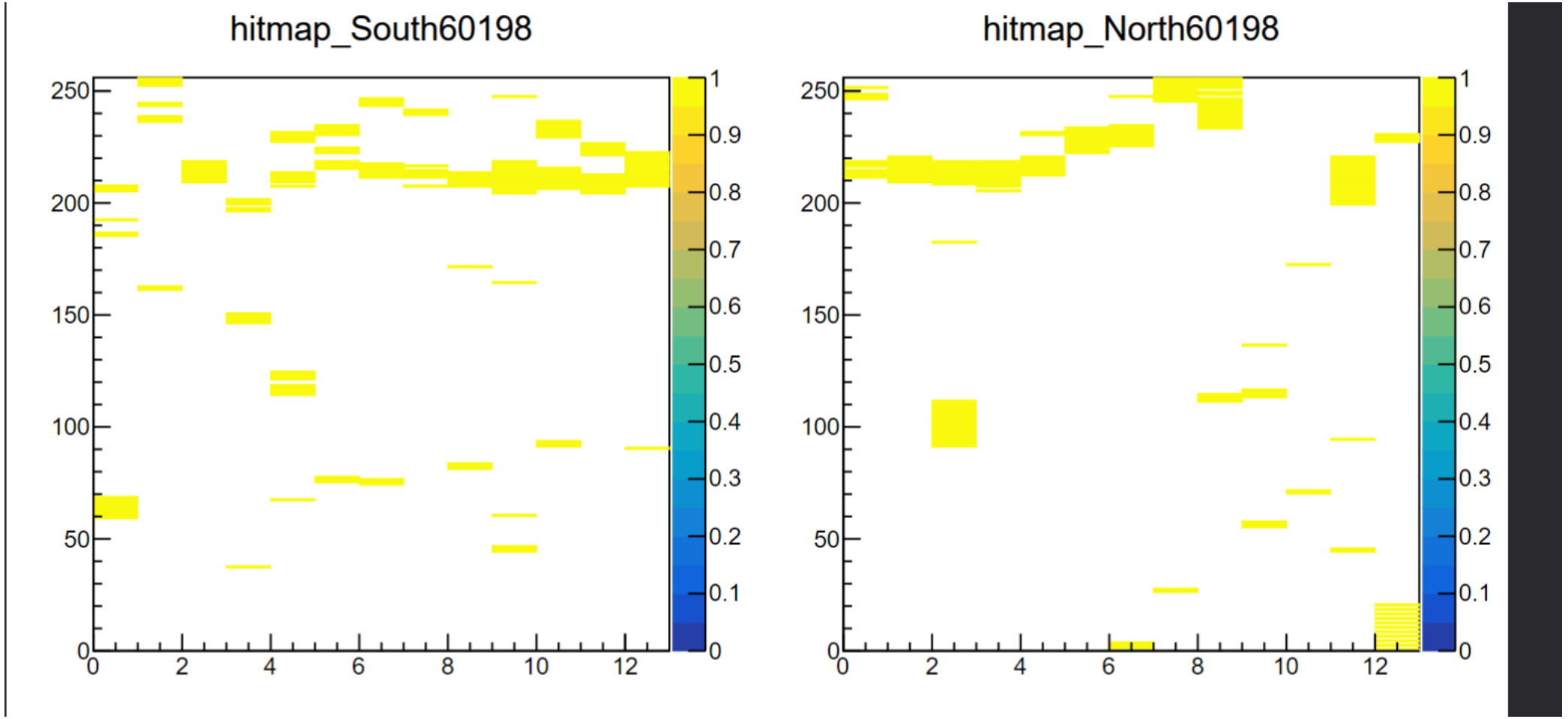
Point
*Connection between South and North was found.
*There are not charge sharing between S and N ,A and B.





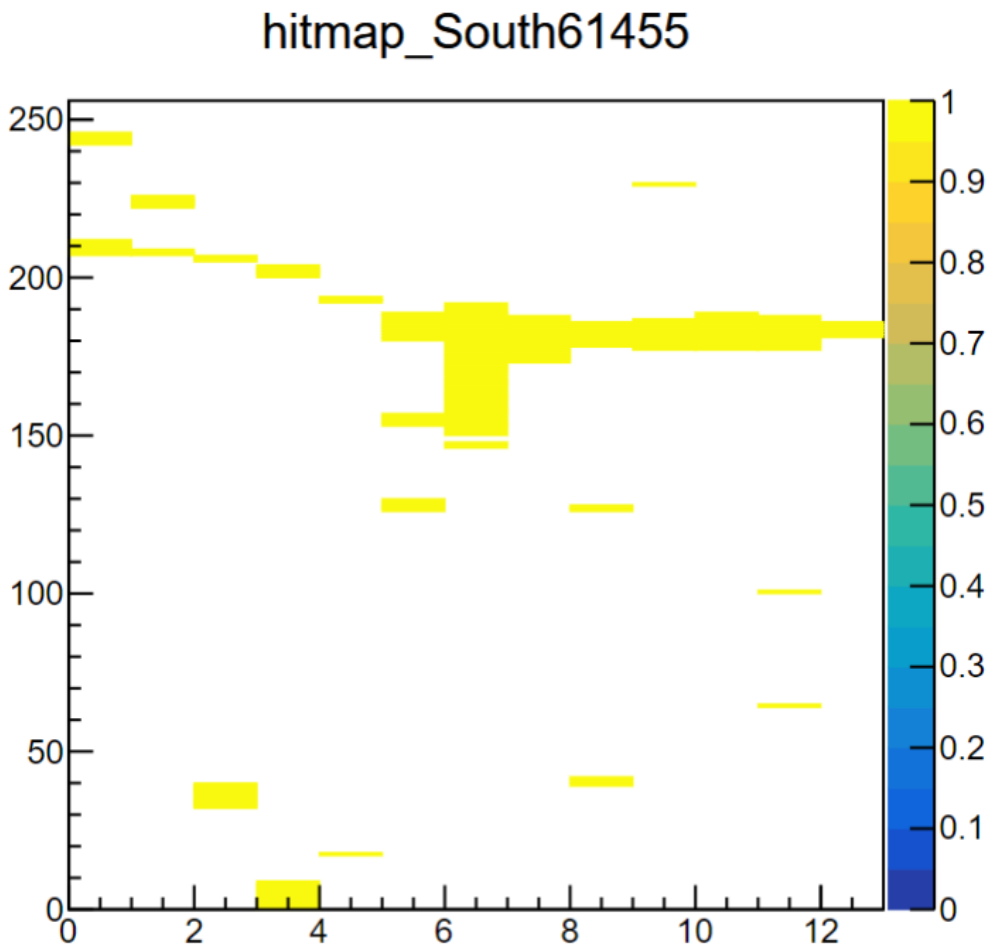
Phi size = 23

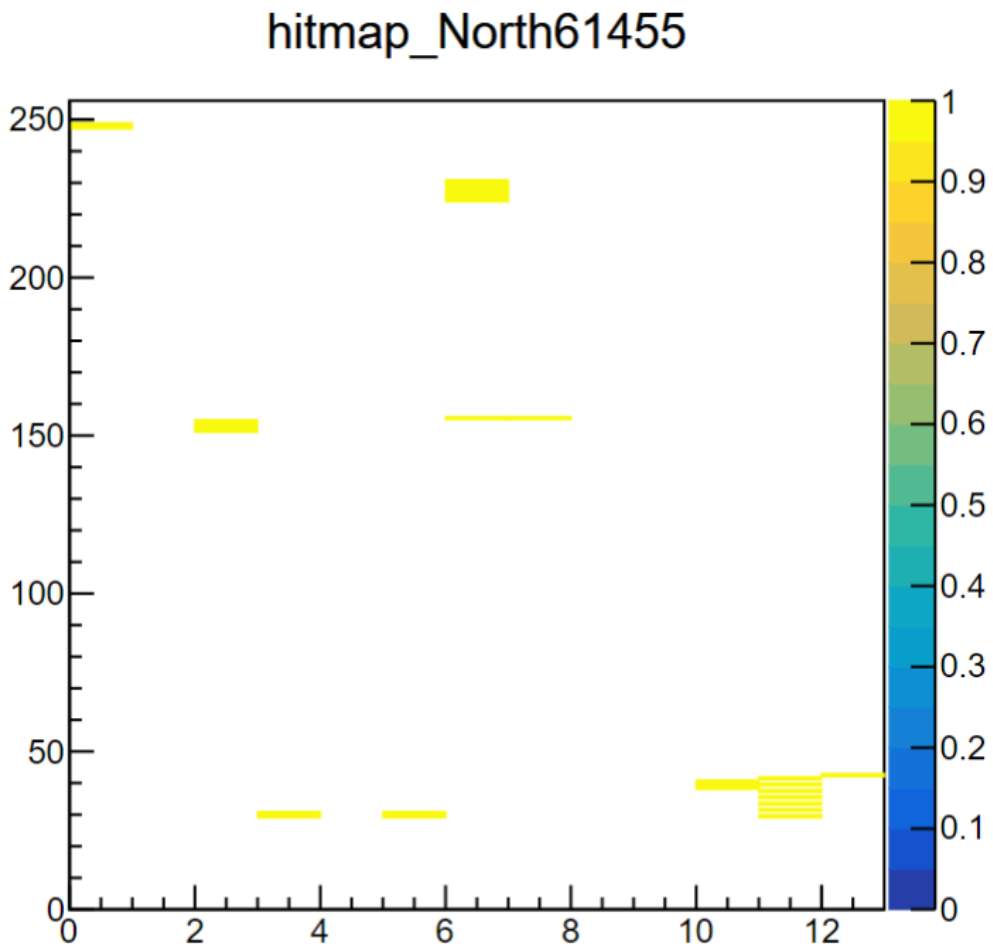
Point
*It is hard to make comment because connection between S and N might be found, but line was not clearly line.



Phi size = 42

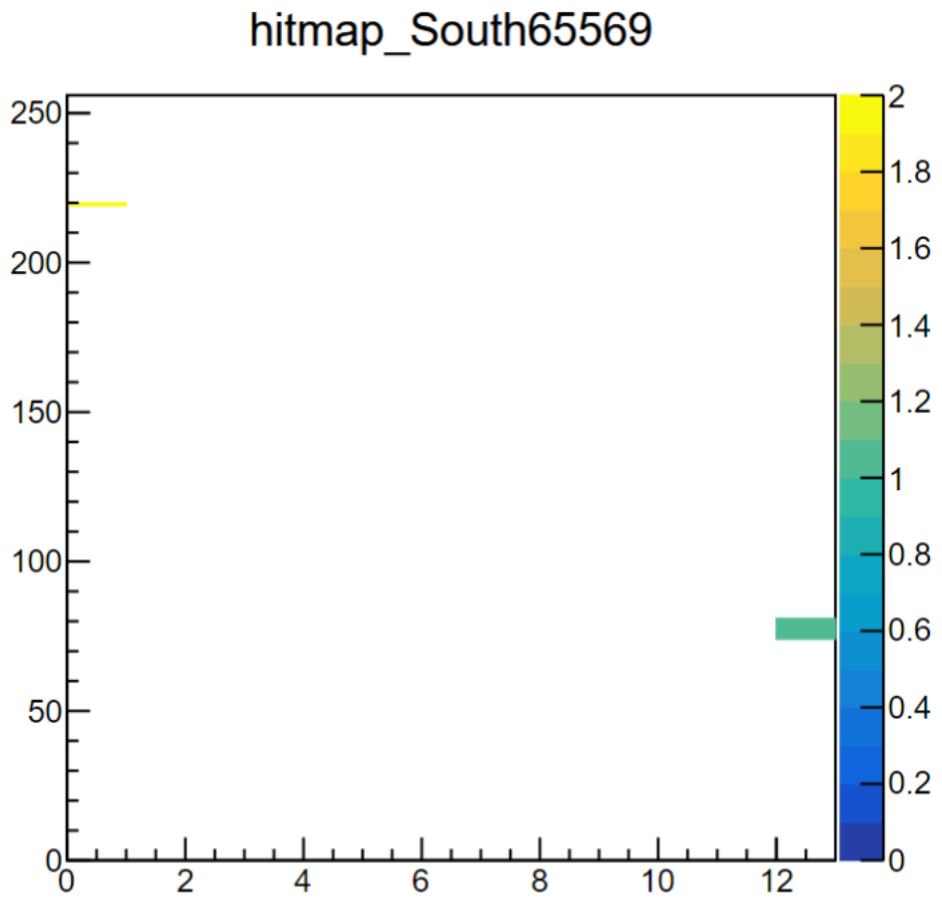
Point
* ……..

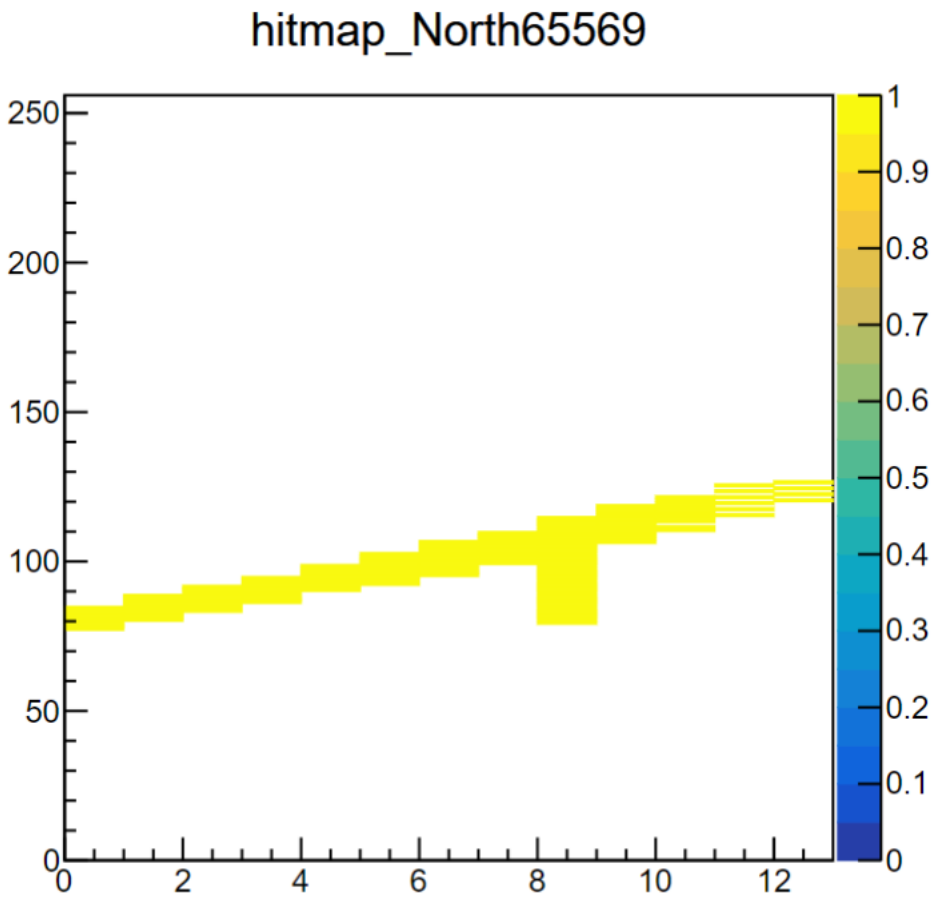




Phi size = 33

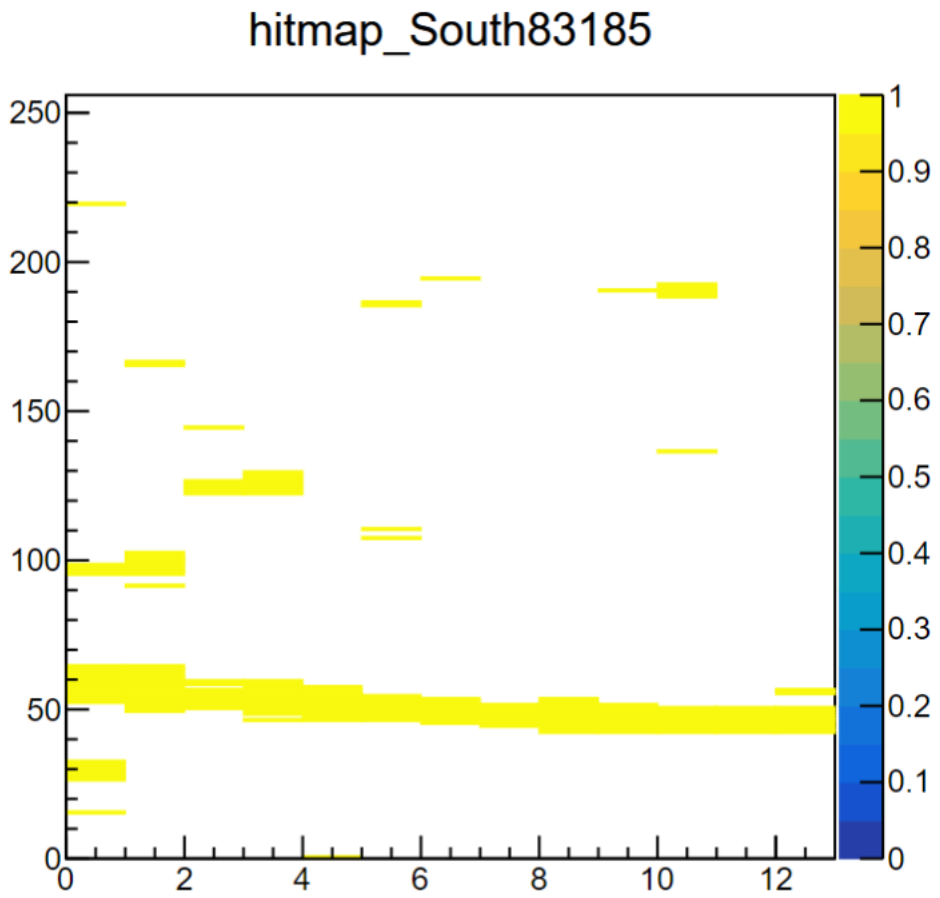
Point
*Connection between South and North might be found.
*Connection between type A and type B was found.
*There are not charge sharing between S and N ,A and B.

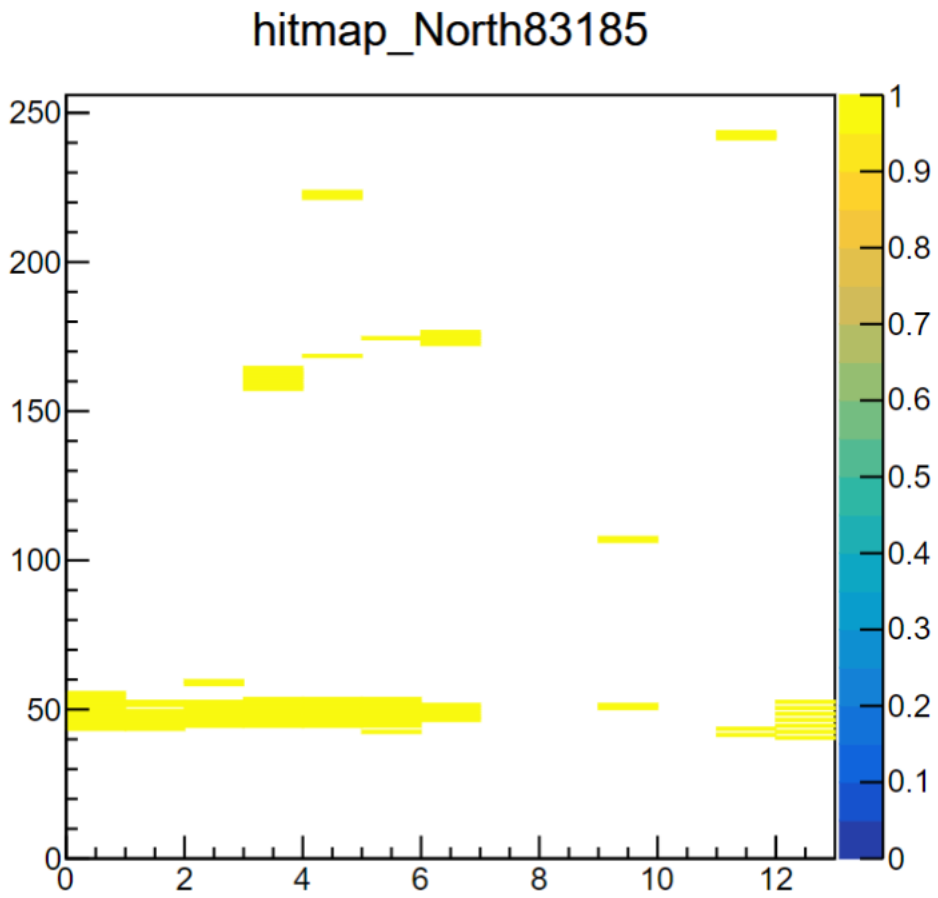




Phi size = 13

Point
*Connection between South and North was found.
*Connection between type A and type B was found.
*There are not charge sharing between S and N ,A and B.



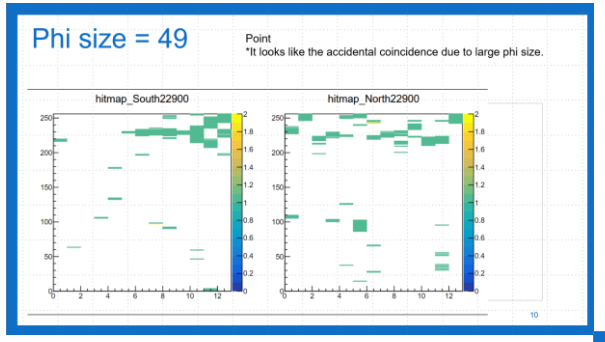


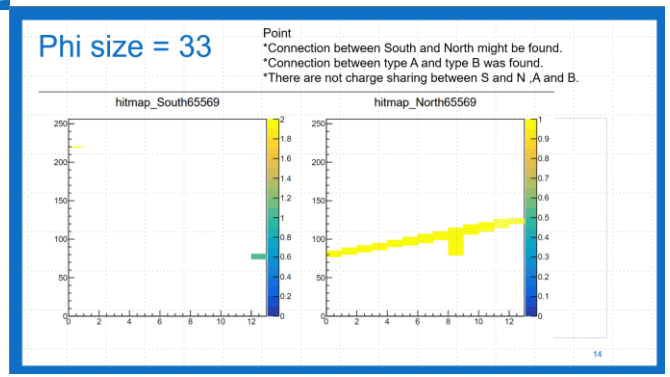
conclusion

- I made hit map of Z size =8.
- I found the both accidental and particle.

ToyMC model

- Discussion from compere data to ToyMC model and this result is consistent.



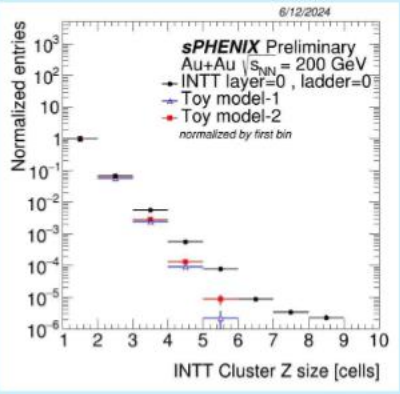


Result of the Toy-MC model

Model-1. The proof of principle test.

One expects the chance to form z-cluster would get smaller and smaller as the size gets larger.

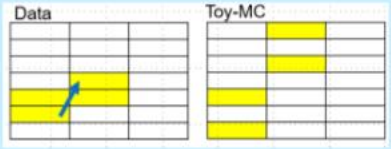
However, the model-1 distribution falls faster than Au+Au data.



Model-2. Realistic Hit Rates.

Agreement between Au+Au data and toy-MC model-2 result is better than that of model-1.

However the MC still undershoots data in higher z-cluster region.



The possible reasons for this disagreement are:
1. Even hit rate is data driven, the hit patten is not sufficiently realistic in MC, e.g. missing correlated hit cluster.
2. Possibility of real trajectories parallel to the beam line.

Work in progress, Please give me your idea!

Flow of make hit map

- 1 Select one ladder
- -> I selected layer=0&&ladder=0
- 2 check the ladder name
- 3 change the ladder name to Felix id and ladder id
- 4 using TrkClusterContainor, I find event number which has z size = 8 in layer=0&&ladder=0.
- 5 using RawhitContainor, I get raw hit information,
- 6 convert chip and channel
- 7 if (event number and Felix id and ladder id are all expected, hist was filled)

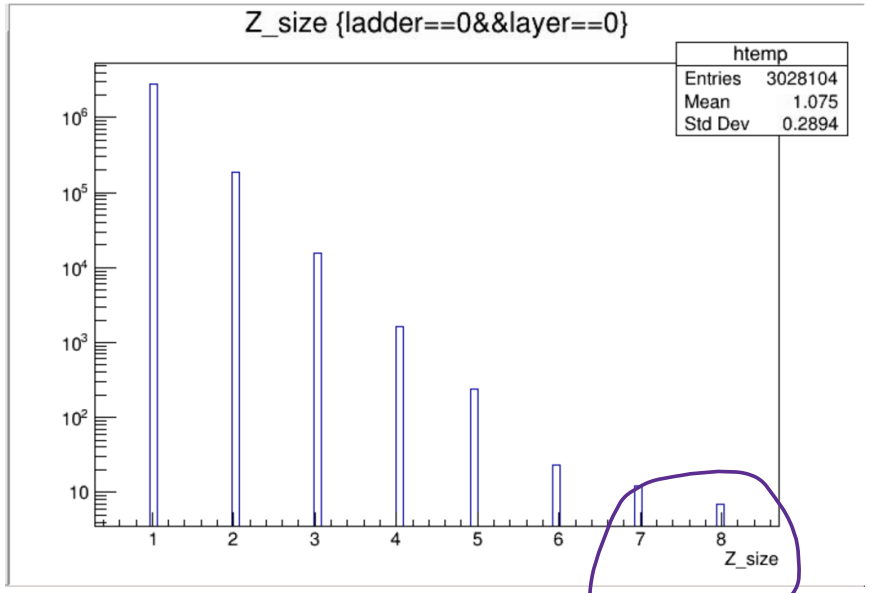
Using data information

- I used run20869,
- Number of event is 100k
- Original data was Decode by Genki, it was same as data using ToyMC model.
- Bco cut,hot cut were applied, but I didn’t confirm that same cut were applied between cluster and row hit.

1 Select one ladder

- I selected layer=0&&ladder=0
- Select reason,
- It is easy for me to compere past result.

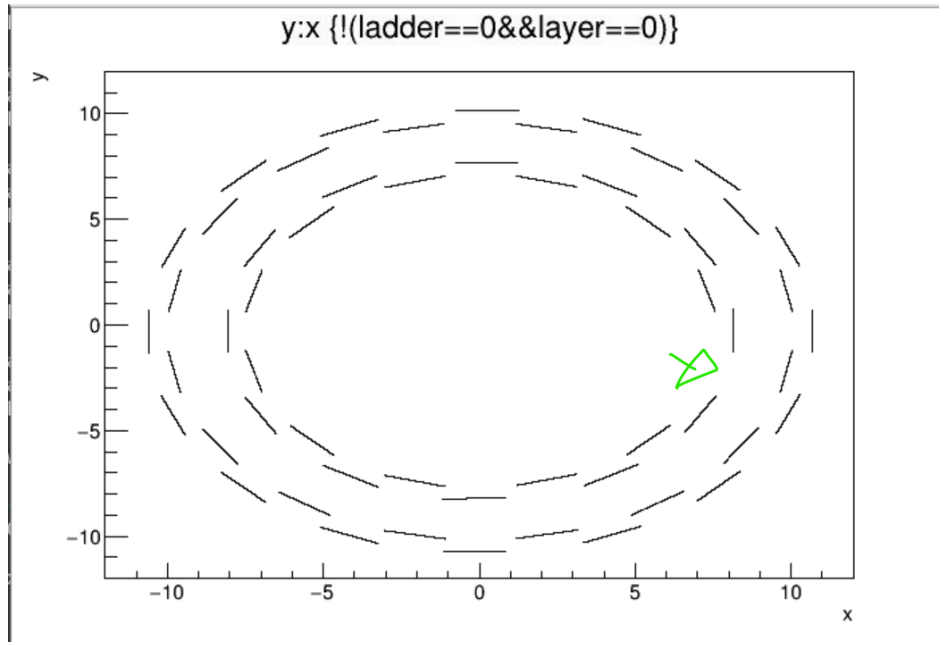
- Plot1.Z size distribution with ladder 0&&layer0.



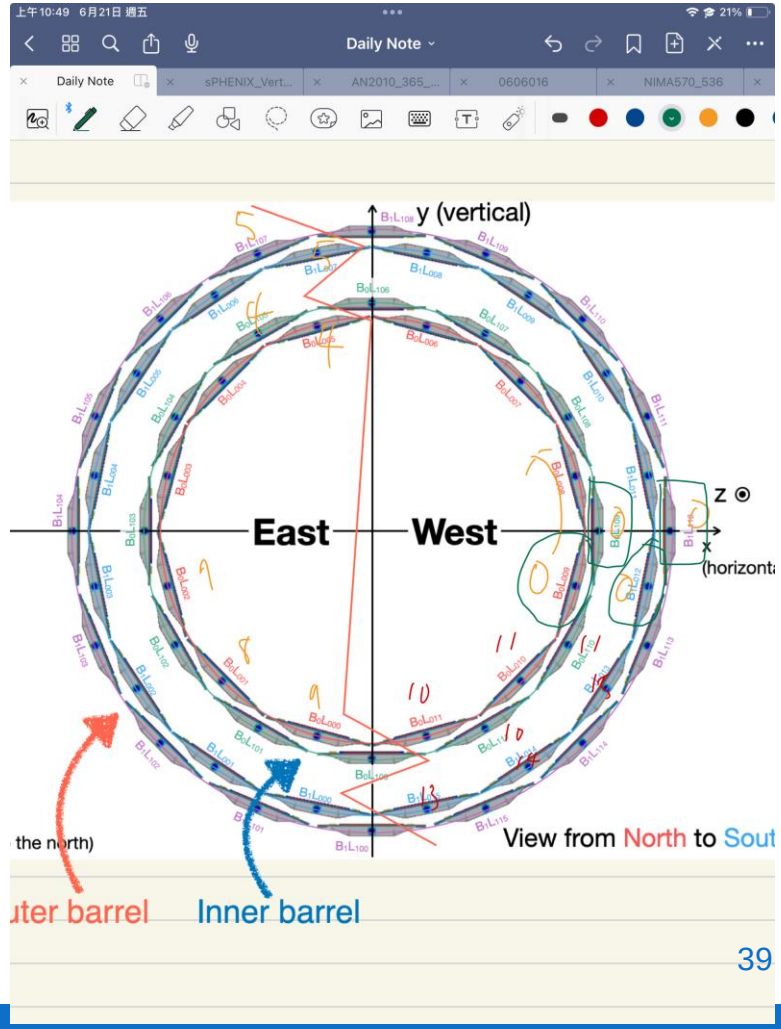
7 events

2 check the ladder name

- Compere plot2 to plot3, name of laddr0 &layer0 is B0L009.
- Plot2. x:y position of ladder 0&&layer0.



- Plot3.



3 change the ladder name to Felix id and ladder id

- Using the map of ladder.
- Place of map,
- ssh Intt0, cd INTT/map_ladder/2024/intt0_map_20240226_1730.txt
- From plot4 and plot5, B0L005 is (Felix,ladder),(5,11) and (1,8)

- Plot4. map intt5

```
#felix_ch       ROC_port        Ladder
0       C1      B0L003N
1       B1      B0L104N
2       D2      B0L103N
3       D1      B1L004N
4       A2      B1L005N
5       C2      B1L104N
6       A1      B1L105N

7       C3      B1L107N
8       B1      B1L007N
9       C1      B1L006N
10      D2      B1L106N
11      A1      B0L005N
12      C2      B0L105N
13      D1      B0L004N

# source : ver20230306_INTT_sort_box_mapping.XLSX
# log 1 : made by CW_shih, time : 2023-03-26, 18:00
# ROC1 : RC-2N
# ROC2 : RC-3N
intt5_map_20240308.txt (END)
```

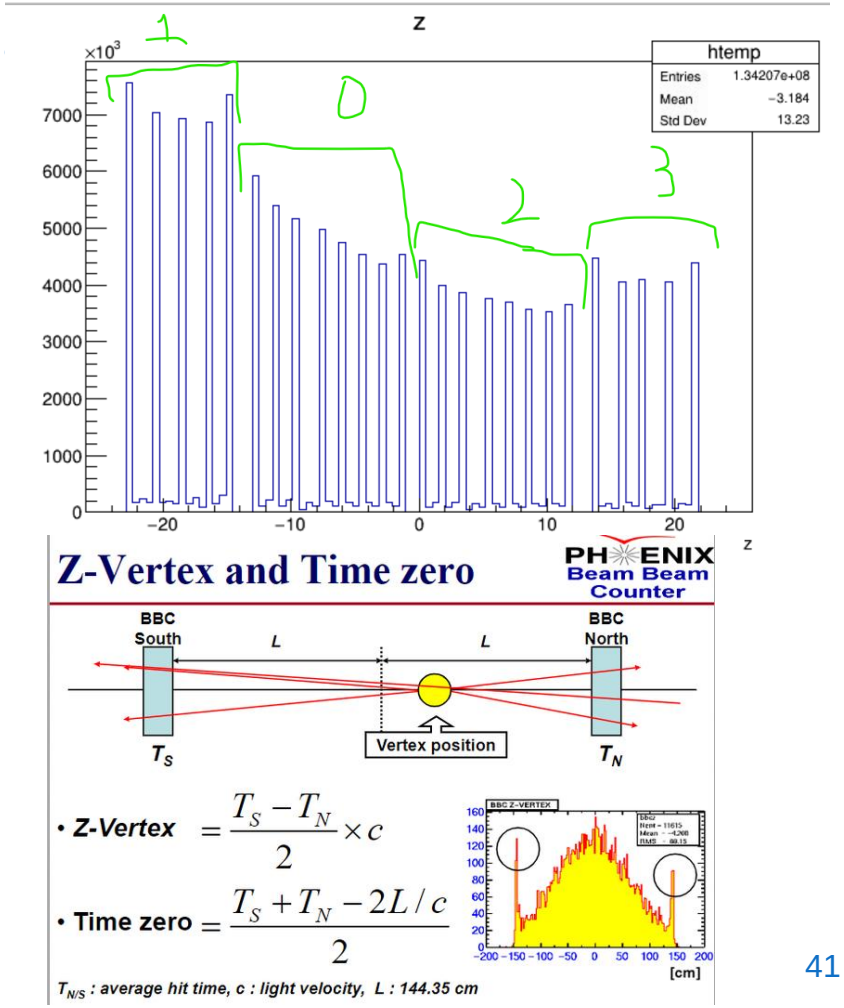
```
#felix_ch       ROC_port        Ladder
0   C2  B1L105S
1   C1  B0L104S
2   A2  B0L103S
3   B3  B1L004S
4   A1  B1L104S
5   B1  B0L003S
6   D2  B1L005S

7   C2  B1L107S
8   C1  B0L005S
9   A1  B0L004S
10   B3  B1L006S
11   A2  B1L106S
12   B2  B0L105S
13   D1  B1L007S

# File : /home/inttdev/map/RC-2S_3Smap.txt
# Time : 2023-03-29 13:08:29.491312
# ROC1 : RC-2S(SE0)
# ROC2 : RC-3S(SW5)
intt1_map_20240303_1230.txt (END)
```

Plot5. map intt1

Decide whether Z size=8 in north or south

- In trkcluscontainor, it has zID information.
- zID is correspond to ¼ silicon.
- From plot7,z<0 is south,then zID =0,1 is south.
- So I can know (Felix,ladder) form Cluster.
- I made both of north and south hit map to confirm exist of z size>8,>13

- Plot6. zID means. Plot7.z vertex



Flow 4 and 5

- 4 using TrkClusterContainor, I find event number which has z size = 8 in layer=0&&ladder=0.
- 5 using RawhitContainor, I get raw hit information,
- Code is here, /sphenix/u/tomoya/work/24.05/v2_own_dst_ana/macro/result/hitmap/hitmap2.cc
- Plot7. event number which has

  Z size = 8 and zID.

```
root [0]
Processing hitmap2.cc...
lay0ladder0 EVENT NUMBER=8556, zID=0
lay0ladder0 EVENT NUMBER=22900, zID=0
lay0ladder0 EVENT NUMBER=45103, zID=2
lay0ladder0 EVENT NUMBER=60198, zID=0
lay0ladder0 EVENT NUMBER=61455, zID=0
lay0ladder0 EVENT NUMBER=65569, zID=2
lay0ladder0 EVENT NUMBER=83185, zID=0
```

convert chip and channel

- Channel calculation and Chip calculation are below,

```
int chip_fix_N = -1;
int channel_fix_N = -1;

 int chip_fix_S = -1;
 int channel_fix_S = -1;

channel_fix_N = int(chip / 13) * 255 + pow(-1, int(chip/ 13)) * channel ;
chip_fix_N = 12 - static_cast<int>(chip)%13 ;

channel_fix_S =255 - (int(chip / 13) * 255 + pow(-1, int(chip / 13)) * channel);
chip_fix_S = static_cast<int>(chip)%13 ;
```

TITLE

Tomoya Kato (form Rikkyo University)

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