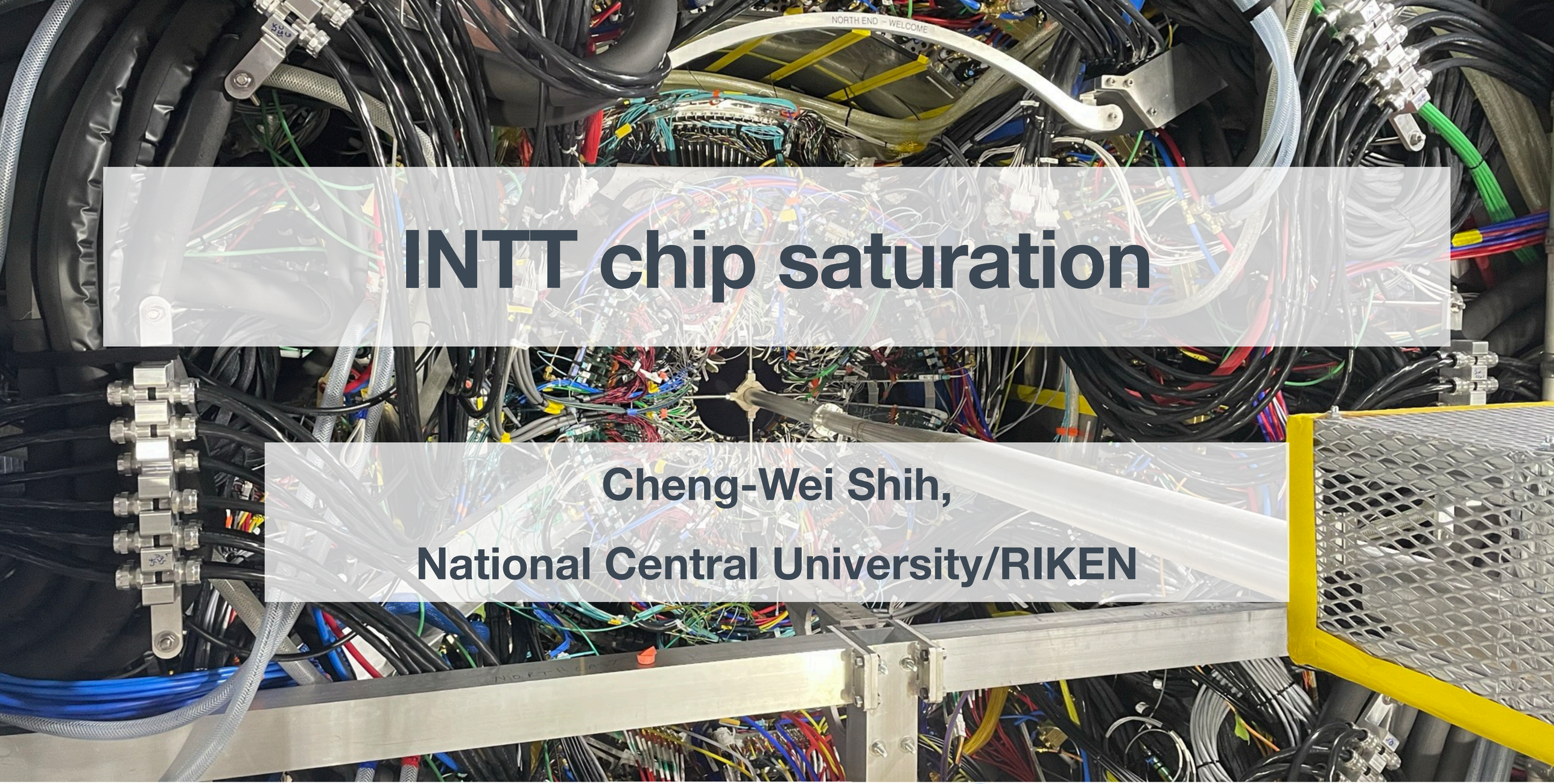


# INTT chip saturation

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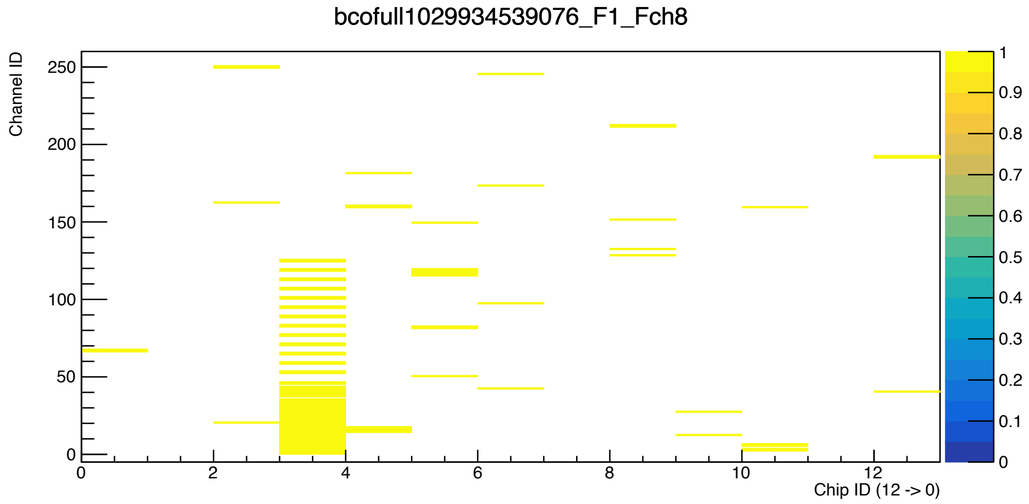
National Central University/RIKEN

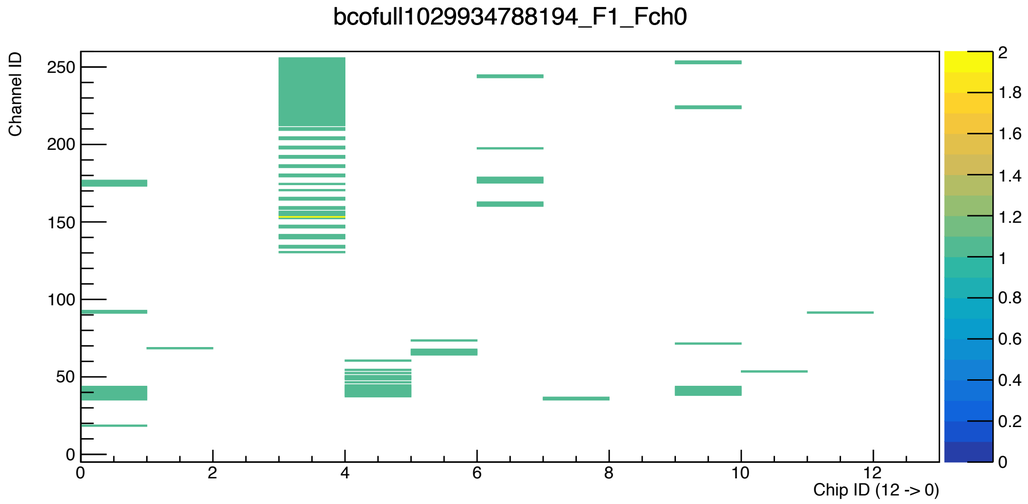
Jan 10th, 2025
INTT meeting

sPHENIX INTT sPHENIX 國立中央大學 National Central University RIKEN

# INTT hit overflow tag

- The Z axis: 1 + full_fphx * 10 + full_ROC * 100
  - If you see the entry is 1, there is no full_fphx nor full_ROC fired in that channel
  - If you see the entry is 1 ~ 5, that is the hits from other hit_BCO (I set the bco_diff cut FALSE)

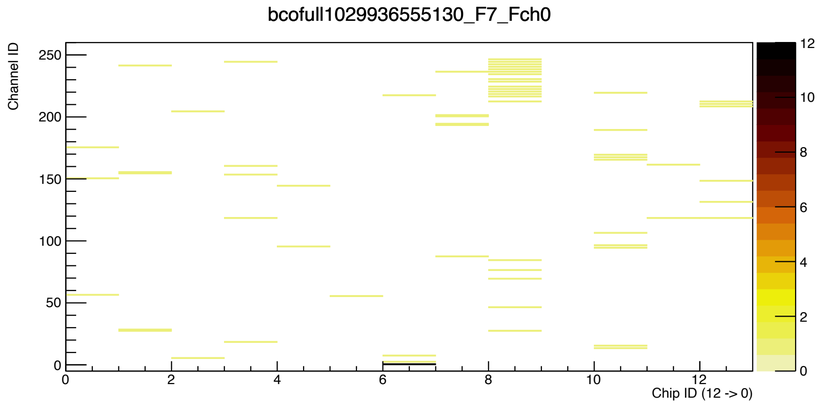


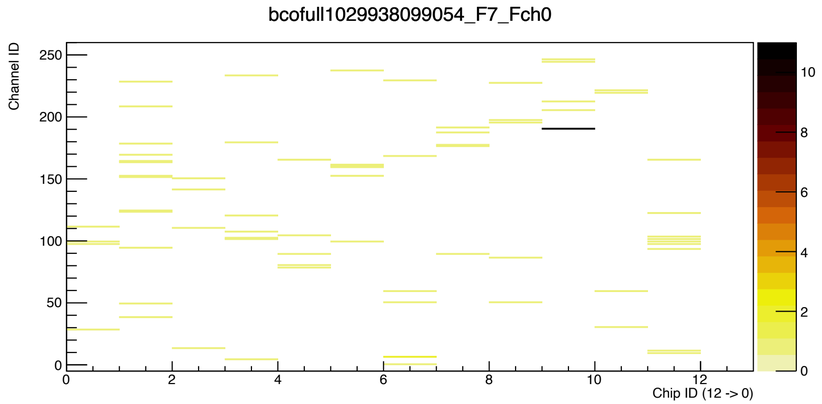



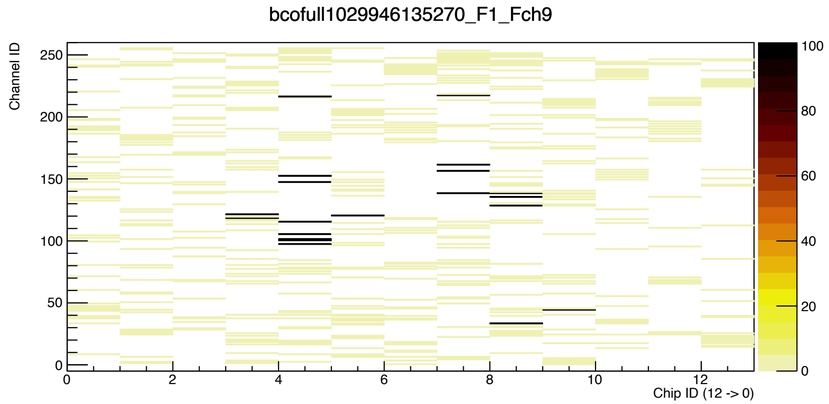

I see neither full_fphx tag nor full_ROC tag fired in those saturated chips

# INTT hit overflow tag

- The Z axis: 1 + full_fphx * 10 + full_ROC * 100
  - If you see the entry is 1, there is no full_fphx nor full_ROC fired in that channel
  - If you see the entry is 1 ~ 5, that is the hits from other hit_BCO (I set the bco_diff cut FALSE)



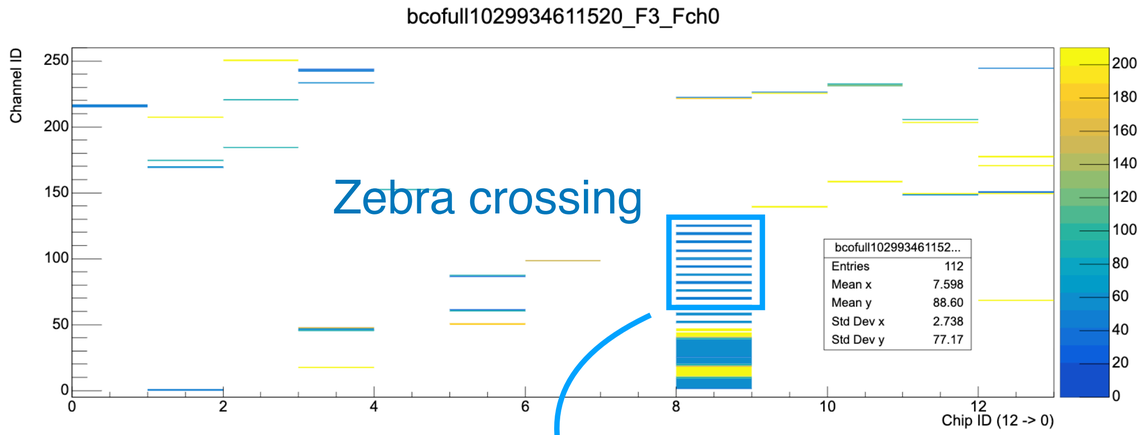




For curiosity, I also checked the hit map of the half-ladders with either full_fphx or full_ROC fired in some channels

I see no particular pattern

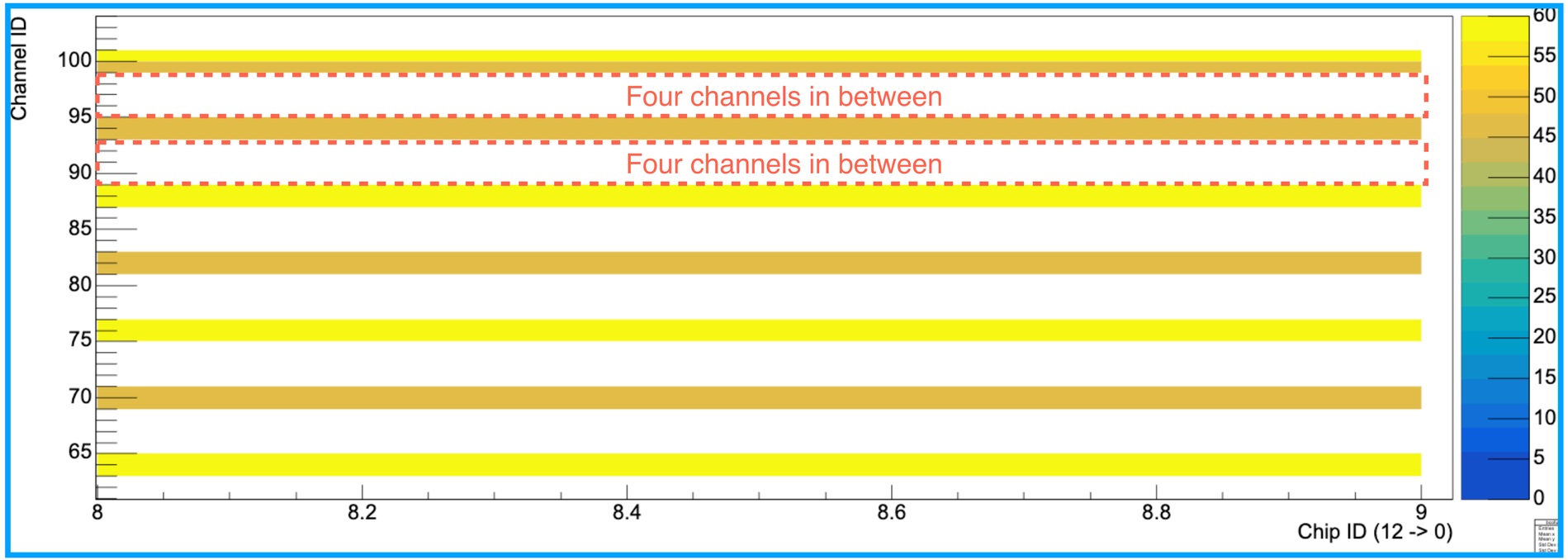
# Further study of the chip saturation

Run 54280




Recap

Two channels for each streak




The pattern of chip saturated : big chunk + zebra crossing, and big chunk always closer to the edge

# Further study of the chip saturation

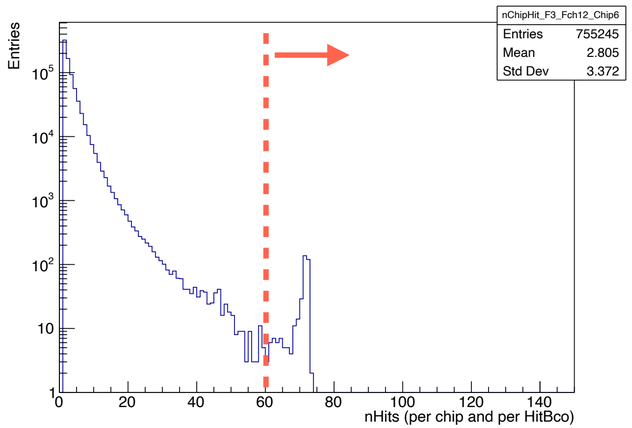
Run 54280

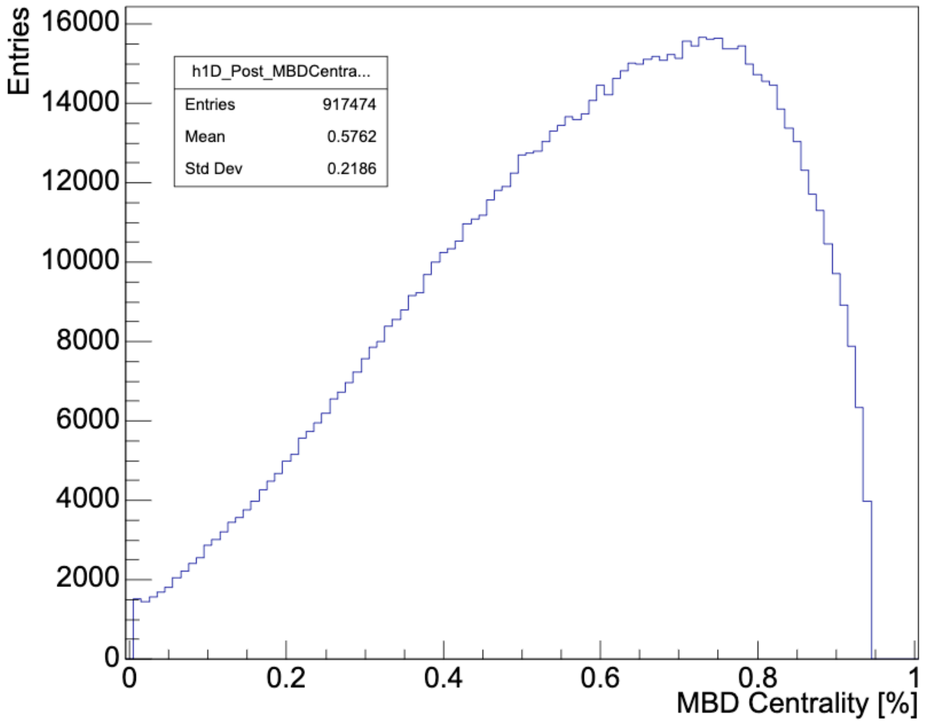
Event selection: is_min_bias == 1 && IMBD_z_vtxl ≦ 60

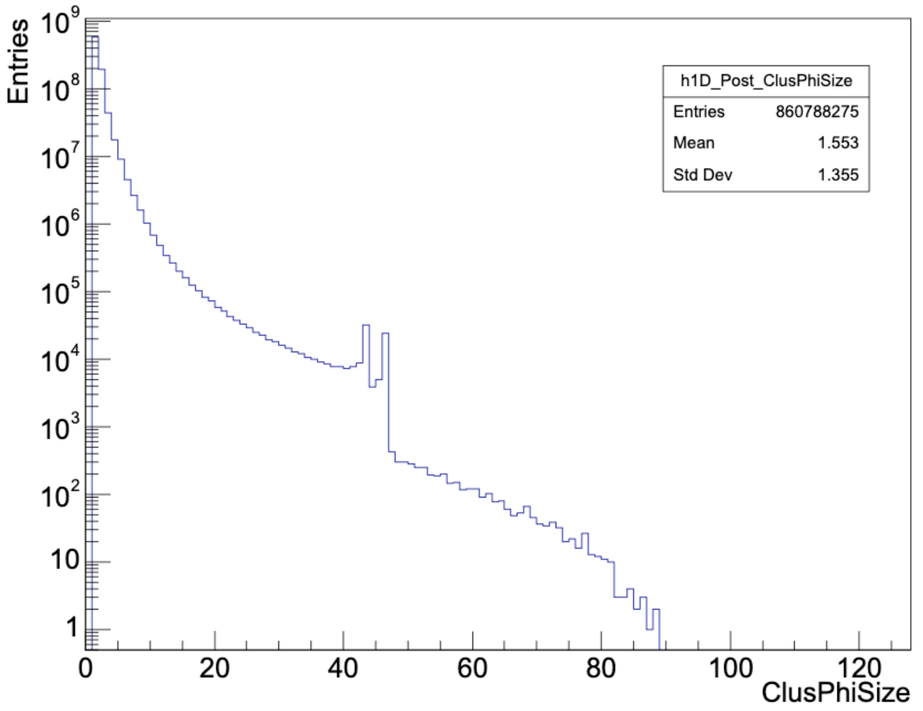
Attempt 1.

As long as one chip with number of hits > 60 discard the whole event

Chip N hit distribution




Such selection would mitigate the issue (spikes are smaller), not fully removed. And it introduces the centrality bias

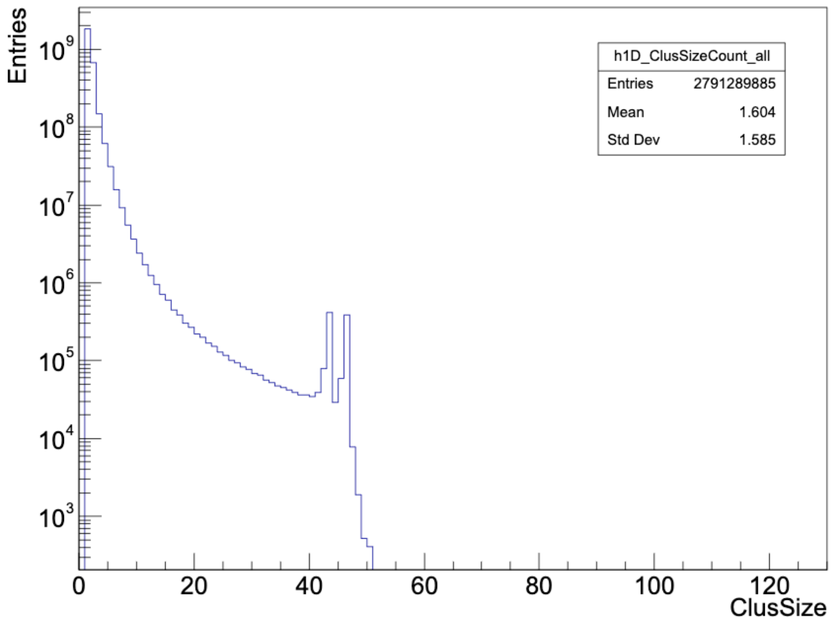
# Further study of the chip saturation

Event selection: is_min_bias == 1 && IMBD_z_vtxl ≦ 60

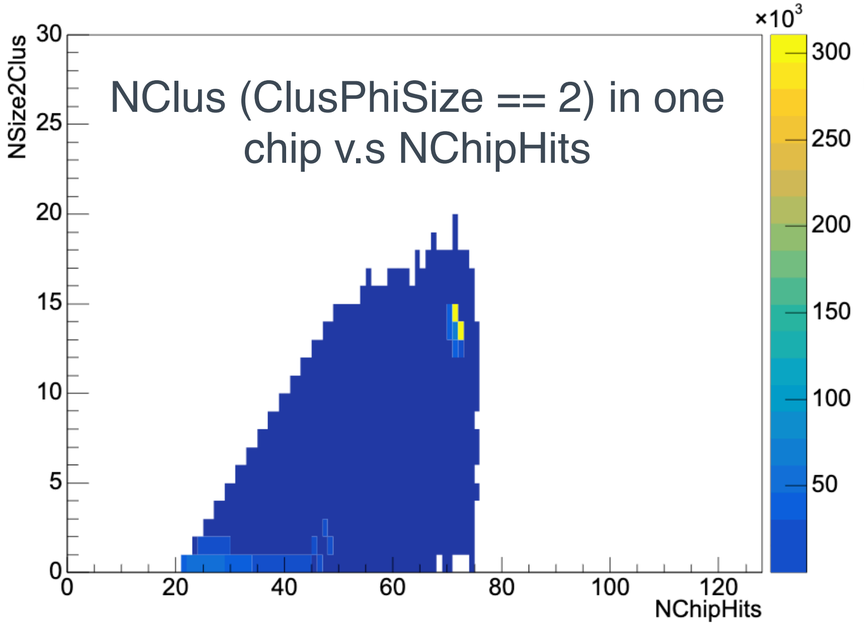
Run 54280

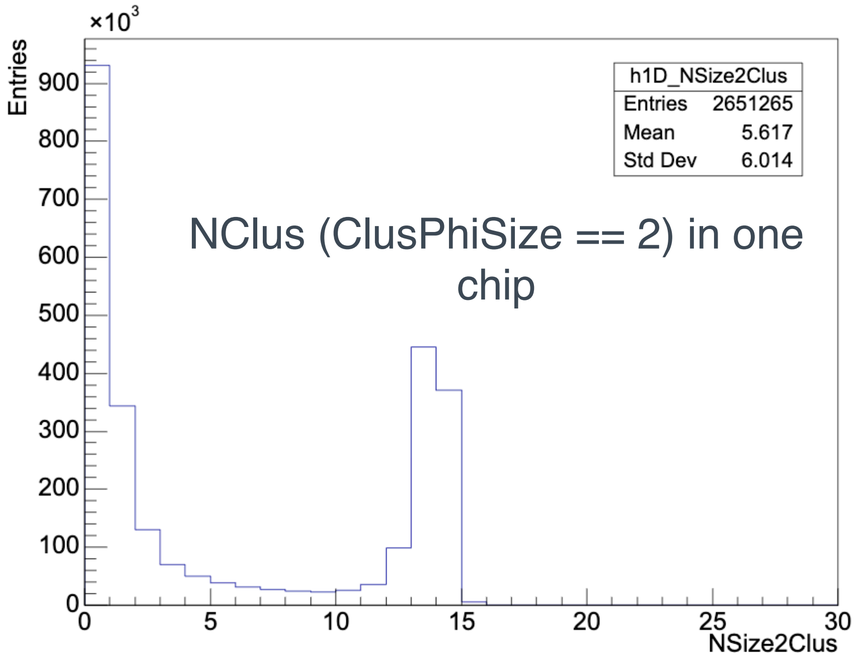
Single chip clustering for all the chips
TimBucket cut & bad channel masked & hitQA & Clone Hit removed

Cluster phi size




If the largest ClusPhiSize > 20




Several chips are with lots of clusters with PhiSize 2 (zebra crossing) if the largest cluster in that chip is made of more than 20 channels (chunk)

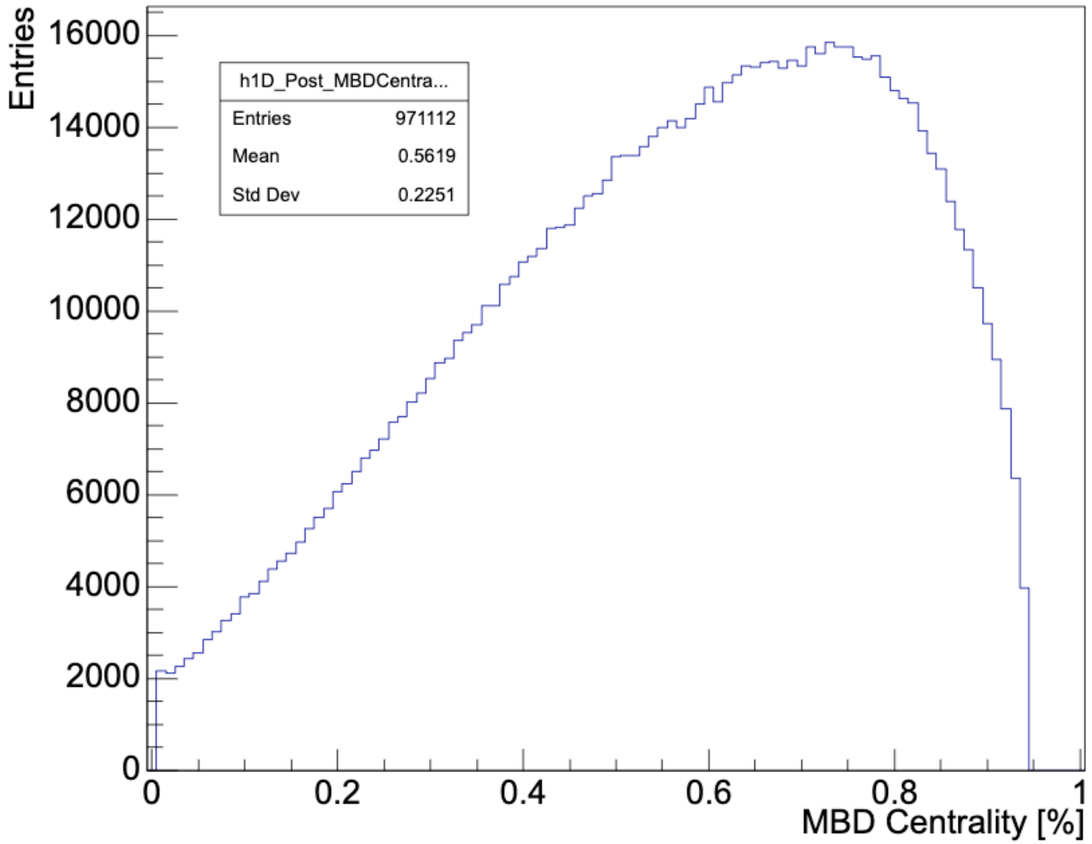
# Further study of the chip saturation

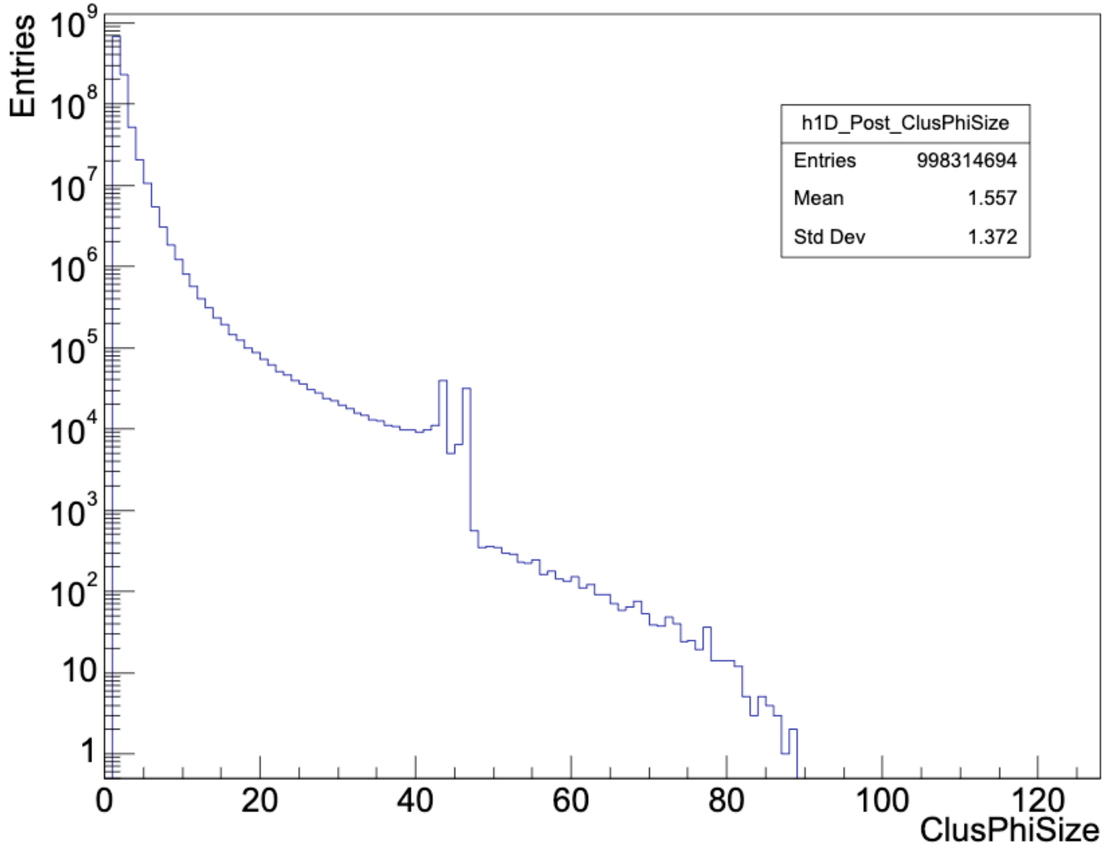
Event selection: is_min_bias == 1 && IMBD_z_vtxl ≦ 60

Run 54280

Attempt 2.

As long as one chip whose largest cluster is with ClusPhiSize > 20 and Number of PhiSize2 clusters > 10, discard the event



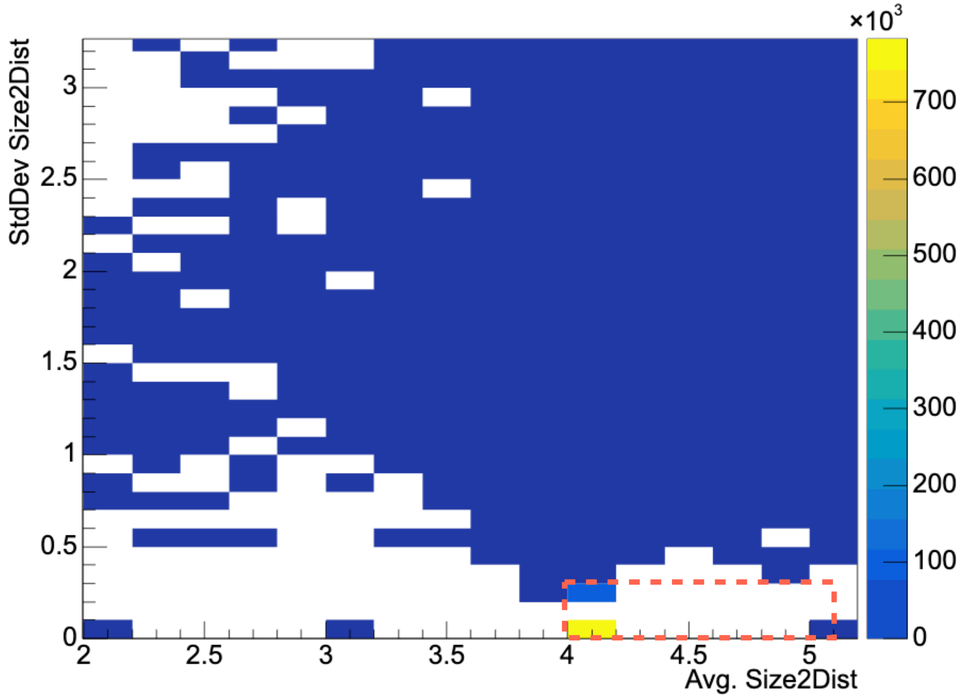



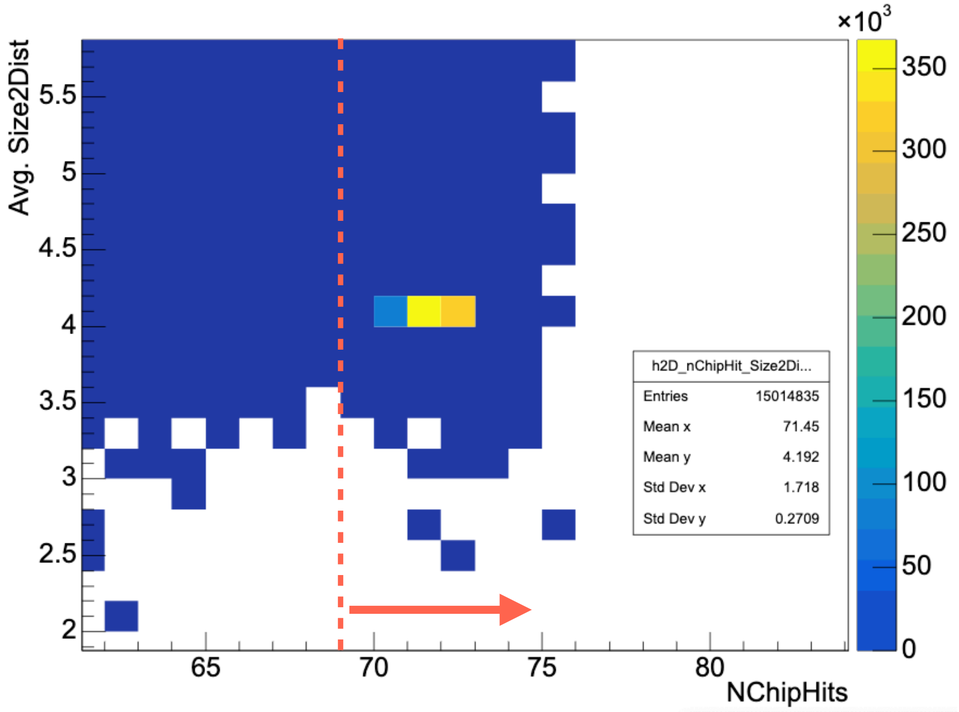
# Further study of the chip saturation

Event selection: is_min_bias == 1 && IMBD_z_vtxl ≦ 60

Run 54280

Try to quantify the channel spacing in the zebra crossing by
Avg. and StdDev of distances b/w clusters with PhiSize = 2 in single chip (**Size2Dist**)



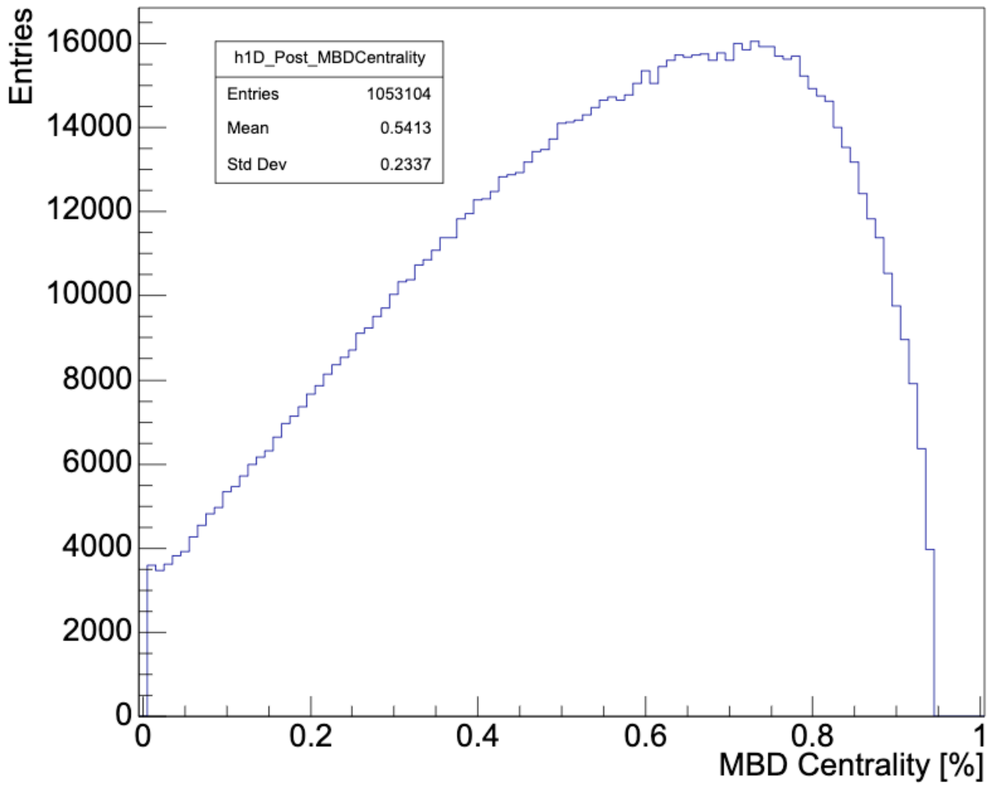

4 ≦ Avg. Size2Dist < 5 && StdDev Size2Dist < 0.3 && NChipHis > 68 seems to be a good rejection region

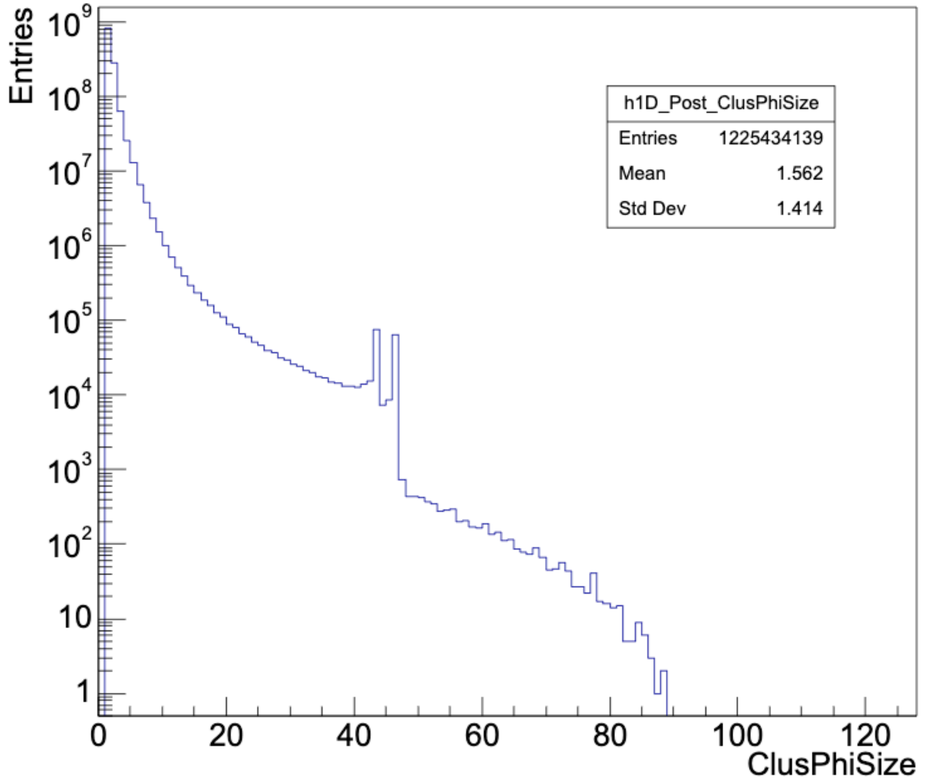
# Further study of the chip saturation

Attempt 3.

As long as one chip falling in this region, discard the whole event

4 ≦ Avg. Size2Dist < 5 && StdDev Size2Dist < 0.3 && NChipHis > 68




Even with such strict selections, we can still not be free from chip saturation issue

The behavior maybe more dynamic than expected, there might be no way to solve it

# Summary

- The chip saturation issue seems not be caused by the overflow tag
  - The what is the overflow tag? The behaviors should be studied more
  - Since the chip saturation issue is not due to the overflow, we should present to the operation board meeting sometime soon (along with the carried-over hit issue) (The slide is prepared)

- The potential strategies for mitigating the chip saturation issue are investigated
  - The attempts are tested, none are reliable
  - We might not have the way to solve it

- I will check the run 8020 (open_time 120) before Run25
  - I guess we can not count on the official decoder
  - Luckily I have the decoded files in the `INTTDAQ`, I will check it when I got time

# The remaining tasks of INTT

- Fraction of hits moved to next of BCO bin (Due to the imperfect coarse/fine delay)
- INTT chip timing stability (the chip timing can shift, is it a severe issue ?)
- Coarse delay scan practice (Have some data with different coarse-delay settings aiming at improving the INTT timing resolution, we will need to practice it for the run 2025 preparation)
- INTT good run list (streaming first, then triggered for p+p)
- INTT hit-carried-over issue (in AuAu and p+p, and mitigation strategy)
- Threshold setting of run 2025 (the current one underestiamtes real spectrum)
- Hit saturation in Run 2025
- Calibration data analysis (artificial charge injection to chips)

- The discrenapcy between data and MC (Simulation optimization)
- INTT radiation damage
- INTT geometry optimization

- (Sort like closed)
  - Spikes at 43 and 46 of cluster phi size distribution
  - hit saturation issue

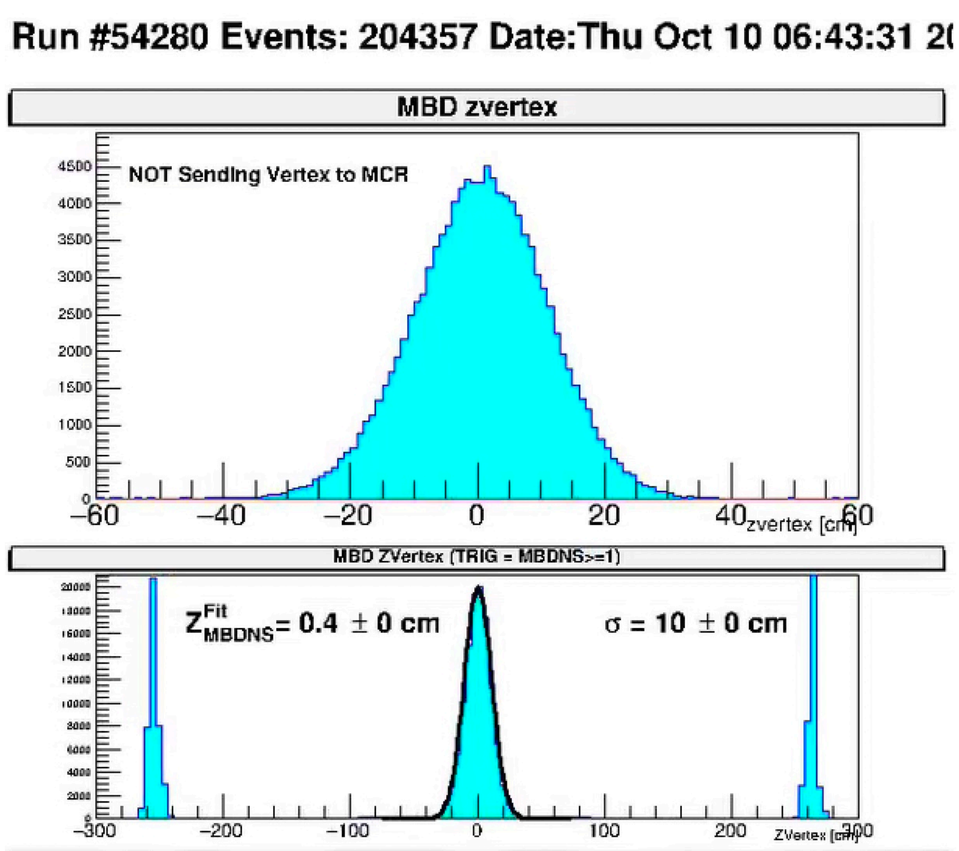
Google doc link

2

# Back up

# Run description - 54280

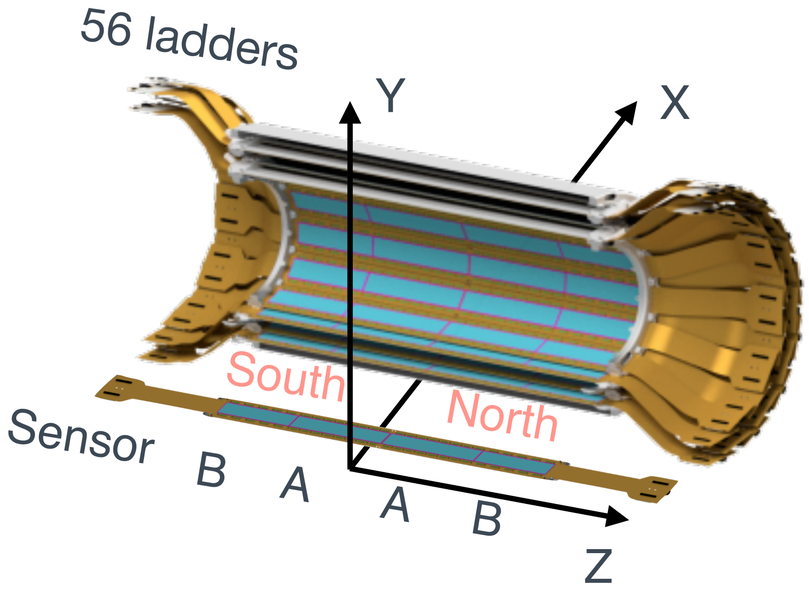
- Spike appears at each end of MBD
- The mini-bias definition is not yet available (as far as I know)
- Live trigger available to constraint the MBD vertex Z



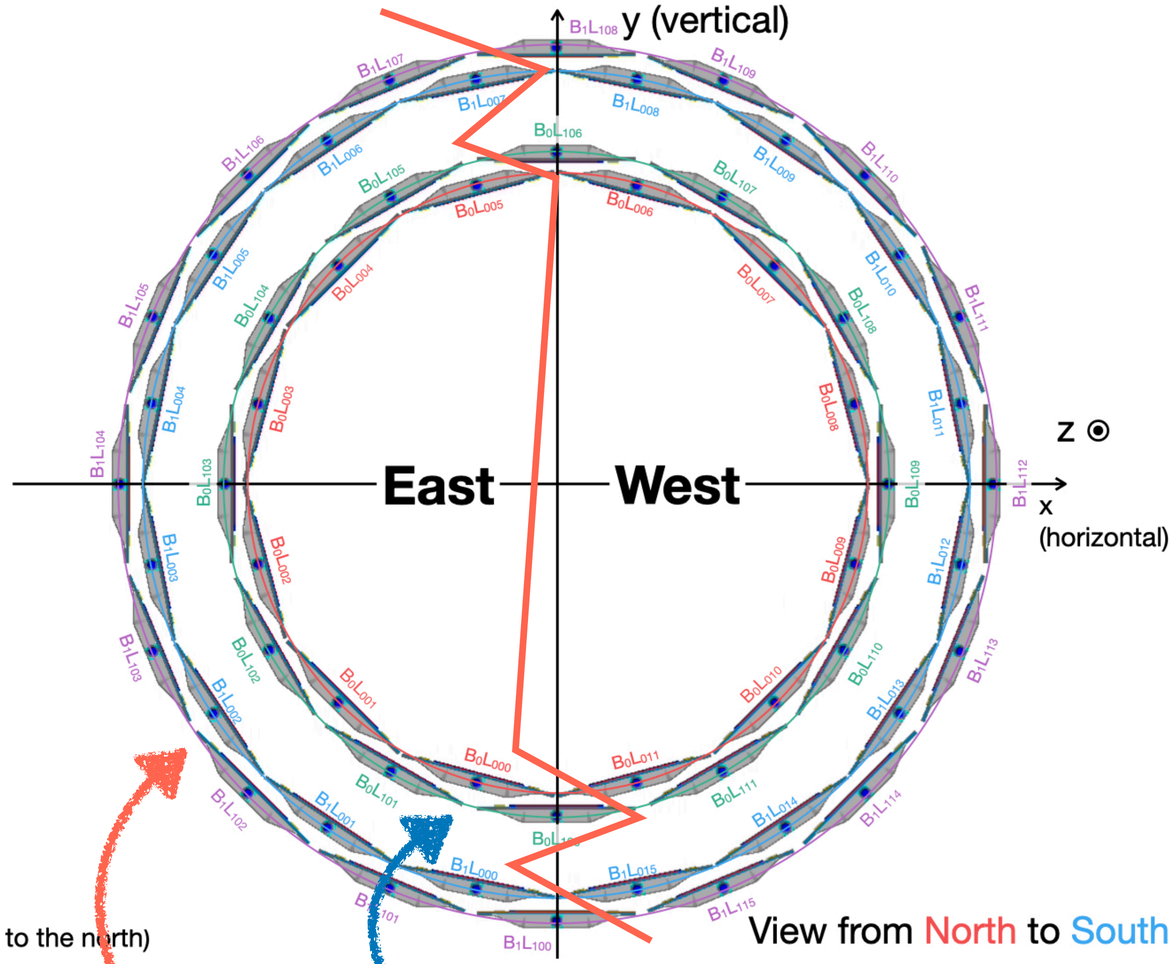

| Trigger input channel | Name | enabled | Scaledown | Raw | Live <\div> | Scaled | Live (%) |
|---|---|---|---|---|---|---|---|
| 0 | Clock | yes | 93810 | 33836274325 | 33663041357 | 358838 | 99.5 |
| 1 | ZDC South | yes | off | 102829214 | 102308816 | 0 | 99.5 |
| 2 | ZDC North | yes | off | 98430768 | 95872319 | 0 | 97.4 |
| 3 | ZDC Coincidence | yes | 60 | 9417100 | 9370209 | 153672 | 99.5 |
| 4 | HCAL Singles/Coincidence | yes | off | 30282609 | 30125423 | 0 | 99.5 |
| 5 | | yes | off | 33836274325 | 33663041357 | 0 | 99.5 |
| 6 | | yes | off | 0 | 0 | 0 | 0 |
| 7 | | yes | off | 0 | 0 | 0 | 0 |
| 8 | MBD S >= 2 | yes | off | 86958423 | 86380777 | 0 | 99.3 |
| 9 | MBD N >= 2 | yes | off | 85797943 | 85195687 | 0 | 99.3 |
| 10 | MBD N&S >= 2 | yes | 0 | 10242665 | 10187457 | 10187457 | 99.5 |
| 11 | MBD N&S >= 1 | yes | off | 18093659 | 17967450 | 0 | 99.3 |
| 12 | MBD N&S >= 2, vtx < 10 cm | yes | off | 4021509 | 4000602 | 0 | 99.5 |
| 13 | MBD N&S >= 2, vtx < 30 cm | yes | off | 5799143 | 5768655 | 0 | 99.5 |

# INTT geometry

INTT: 2 sensors X 2 sides of half-ladders X 56 ladders = 224 sensors




Notation: $B_xL_{yzz}$
- x: Barrel ID (0 for inner or 1 for outer)
- y: Layer ID (0 for inner or 1 for outer)
- zz: Ladder ID (from 0 to 15)




Axis (Right-haded coordinate)
- x-axis: $\vec{y} \times \vec{z}$
- y-axis: Vertically upward direction
- z-axis: The blue beam direction (pointing to the north)