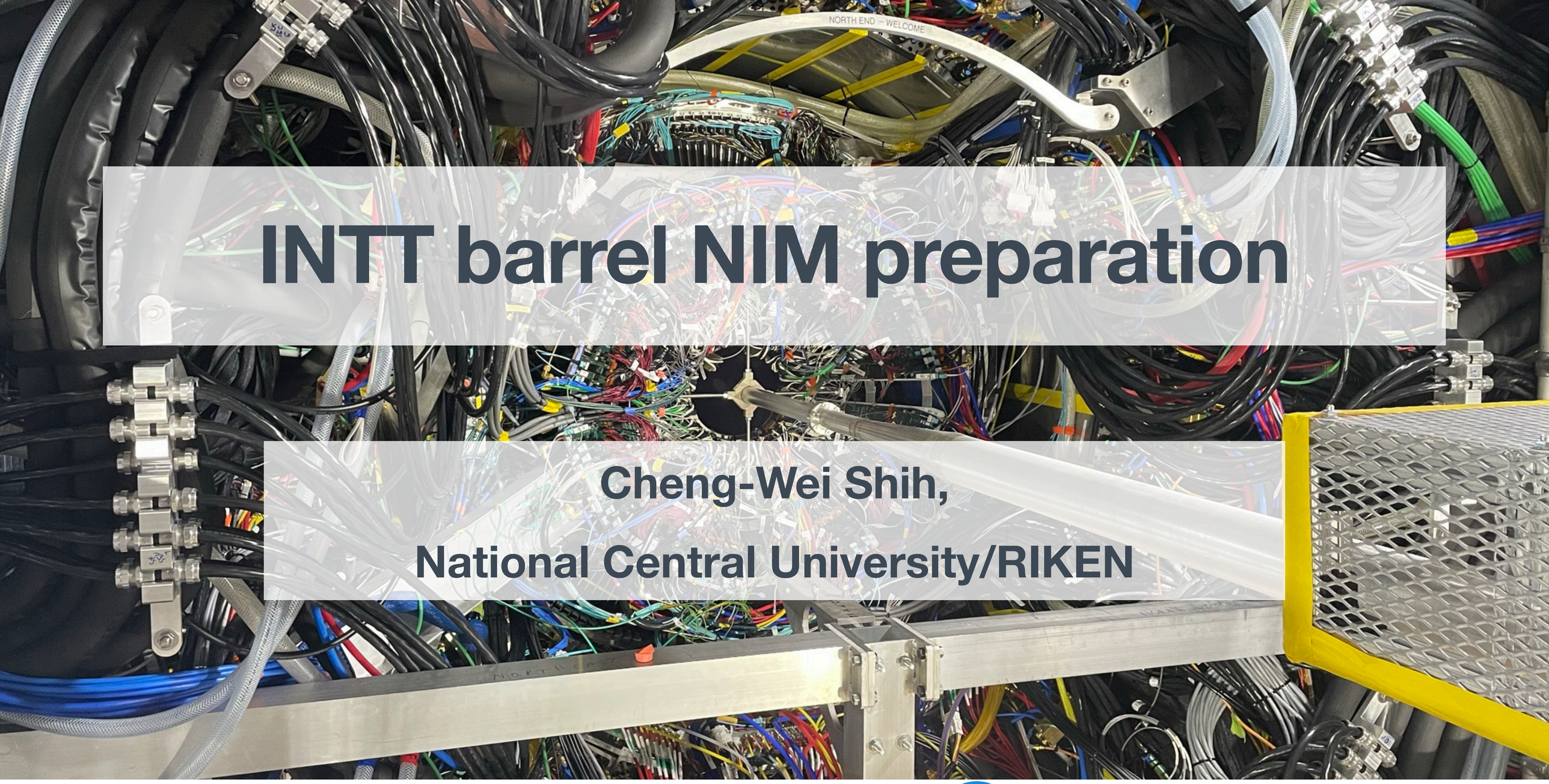


INTT barrel NIM preparation

Cheng-Wei Shih,

National Central University/RIKEN

Dec 5th, 2025
INTT meeting

sPHENIX

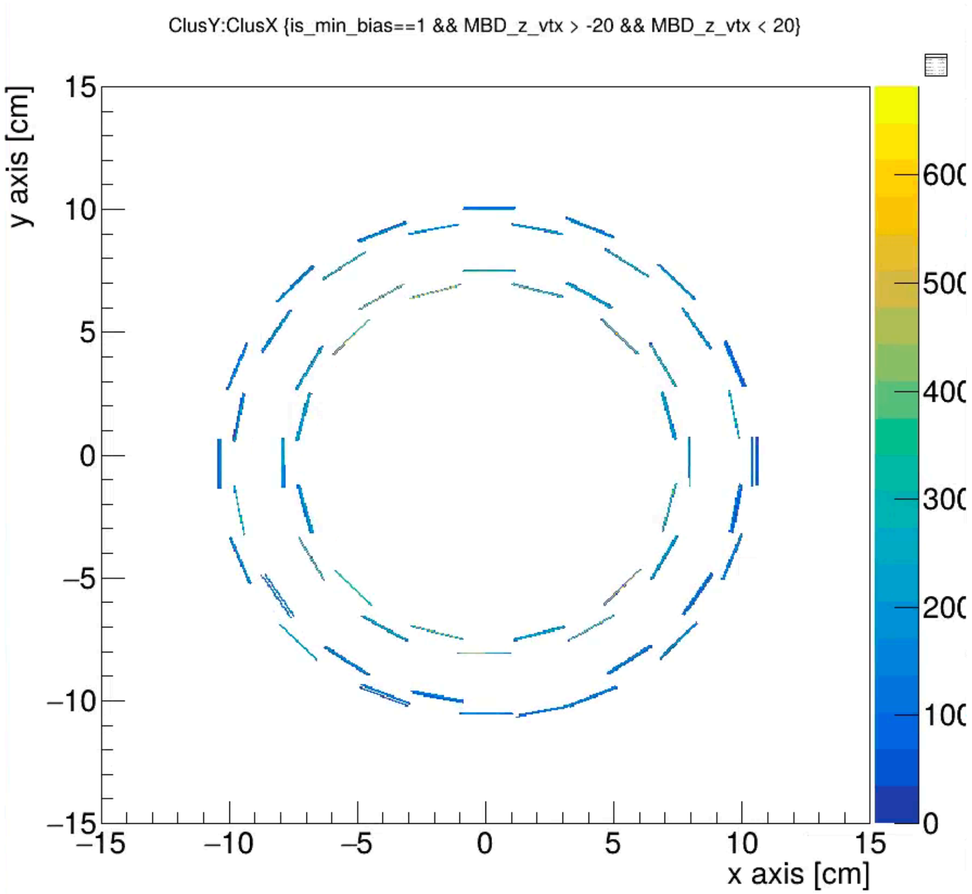
國立中央大學
National Central University

RIKEN

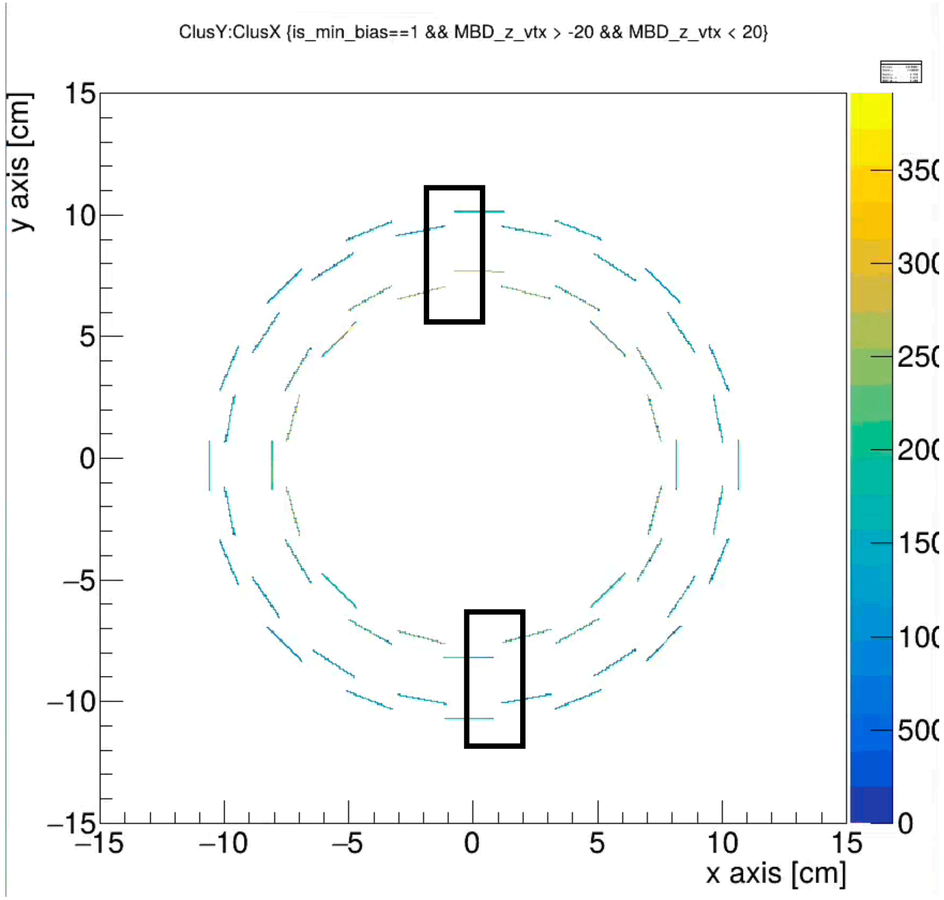
Geometry comparison

Run 54280 (zero field, Au+Au collisions, 56 x 56 bunches)

w/ the latest alignment parameter file



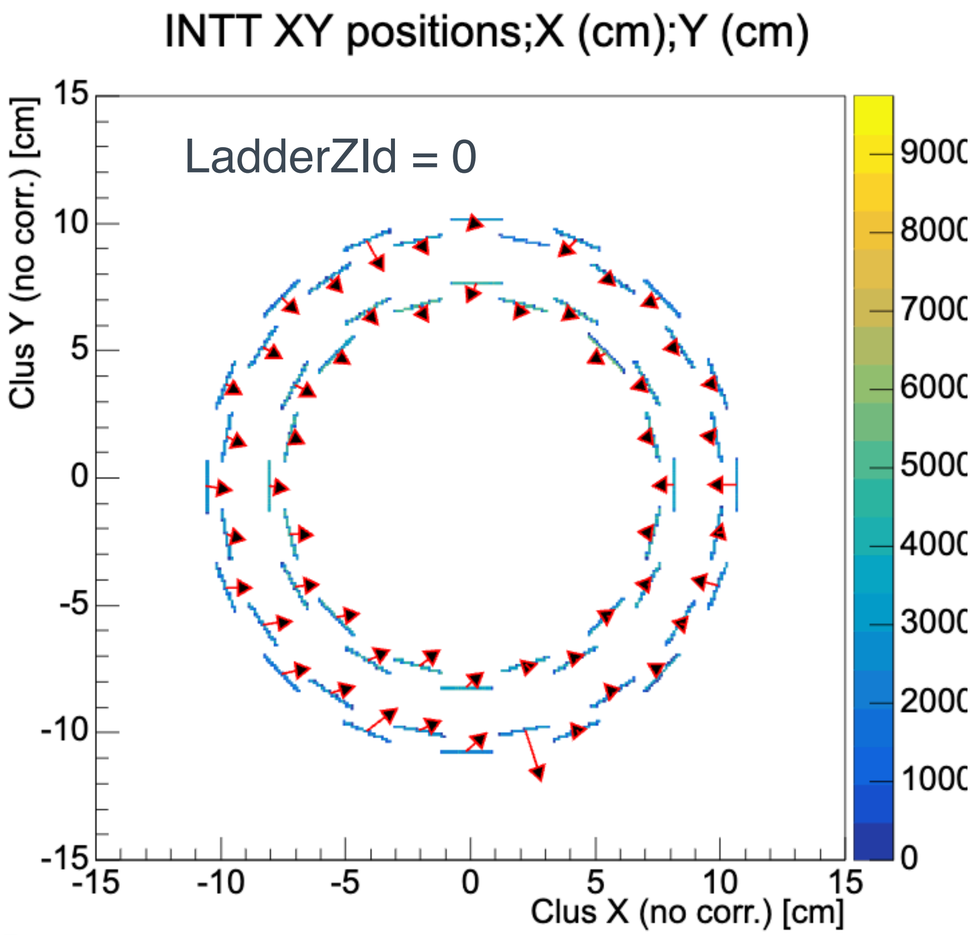
NO alignment correction

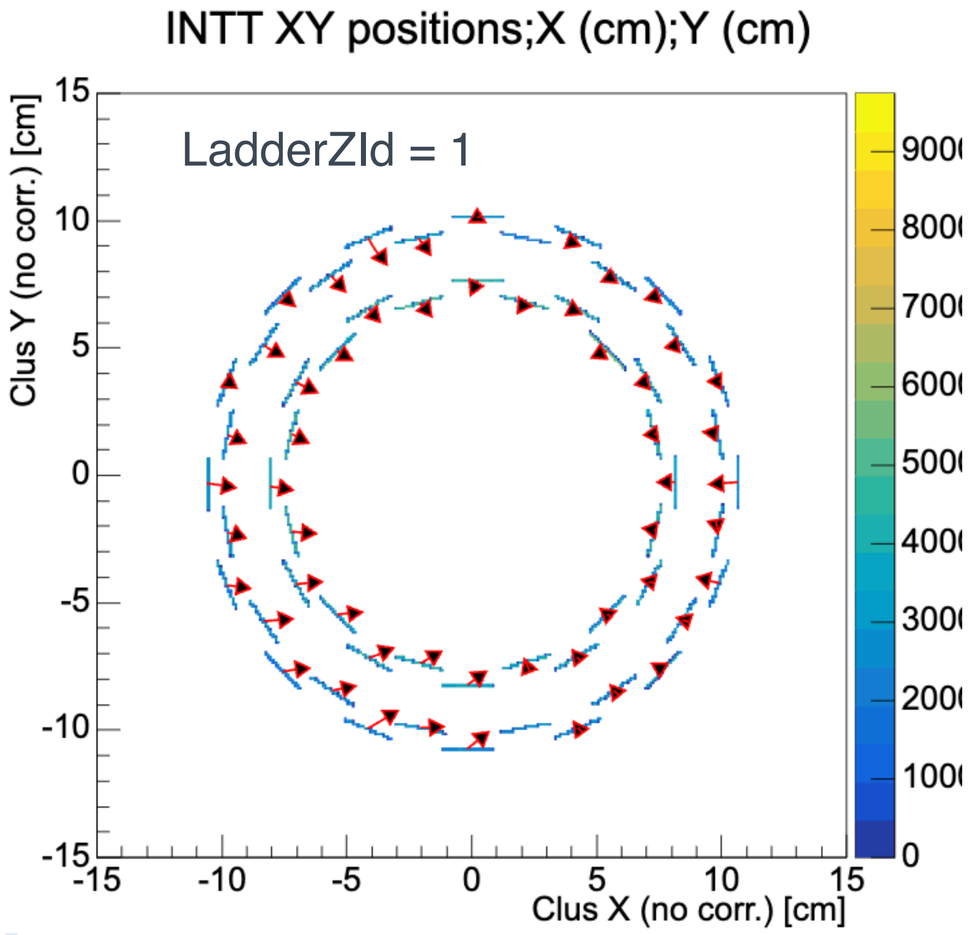


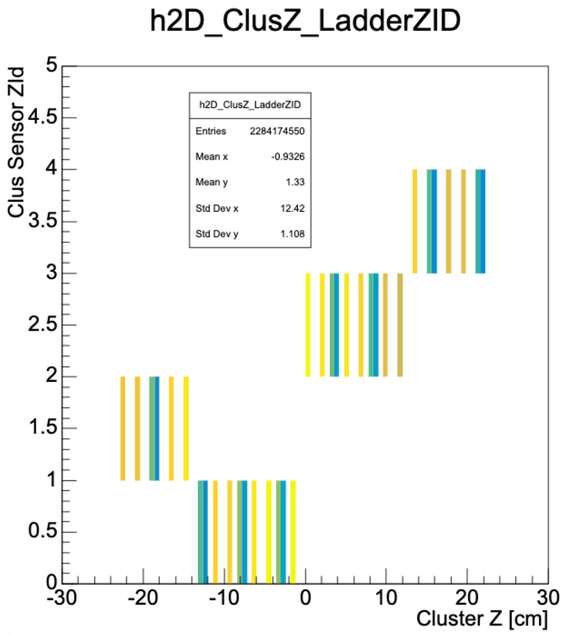
Current alignment correction has no radial constraints

The alignment parameters

Scaled by 4

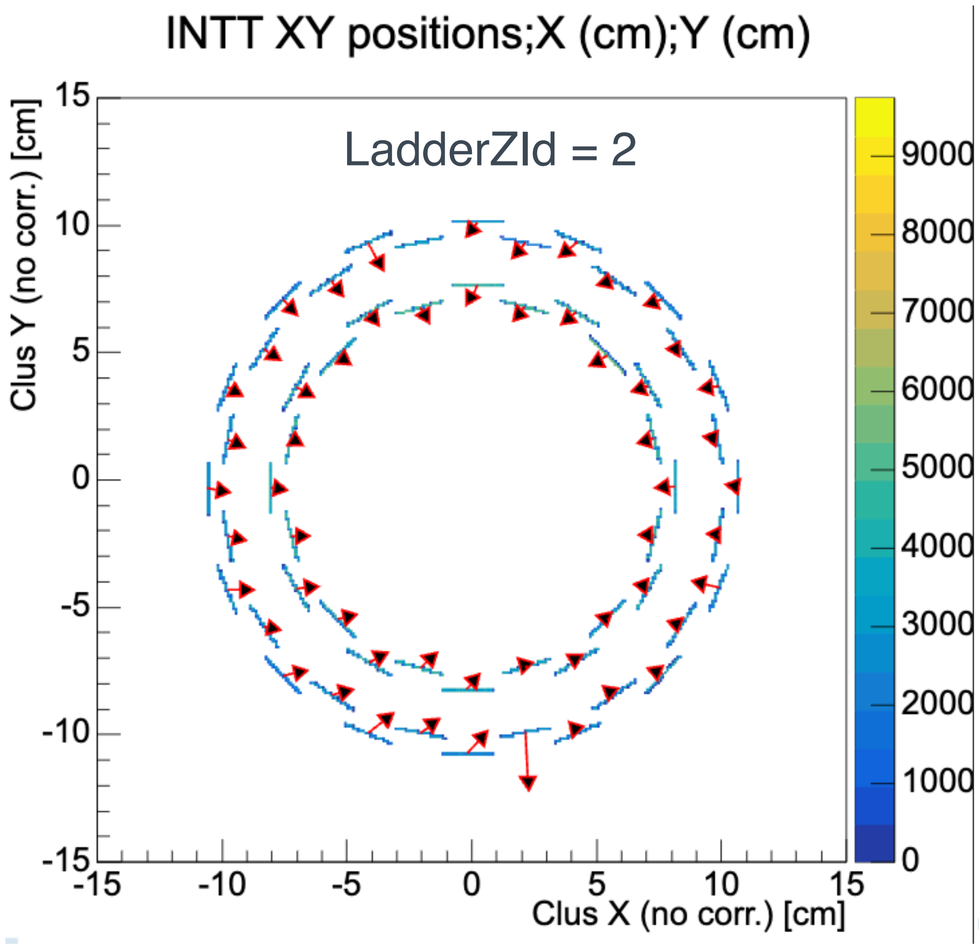


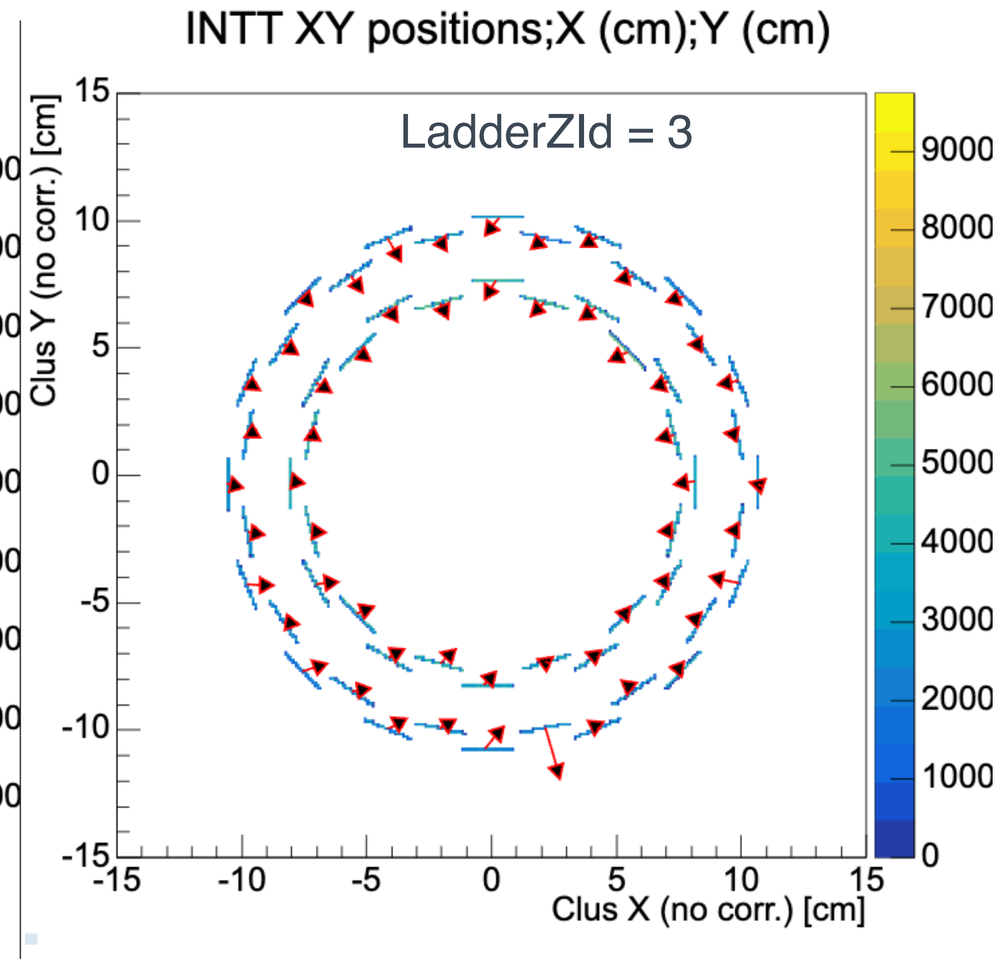


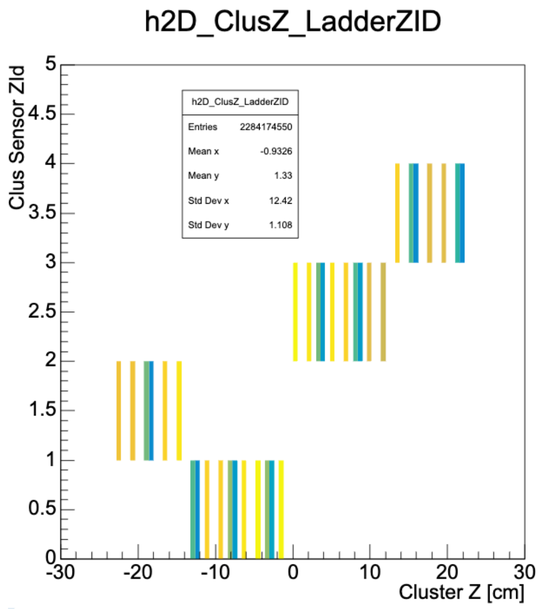


The alignment parameters

Scaled by 4





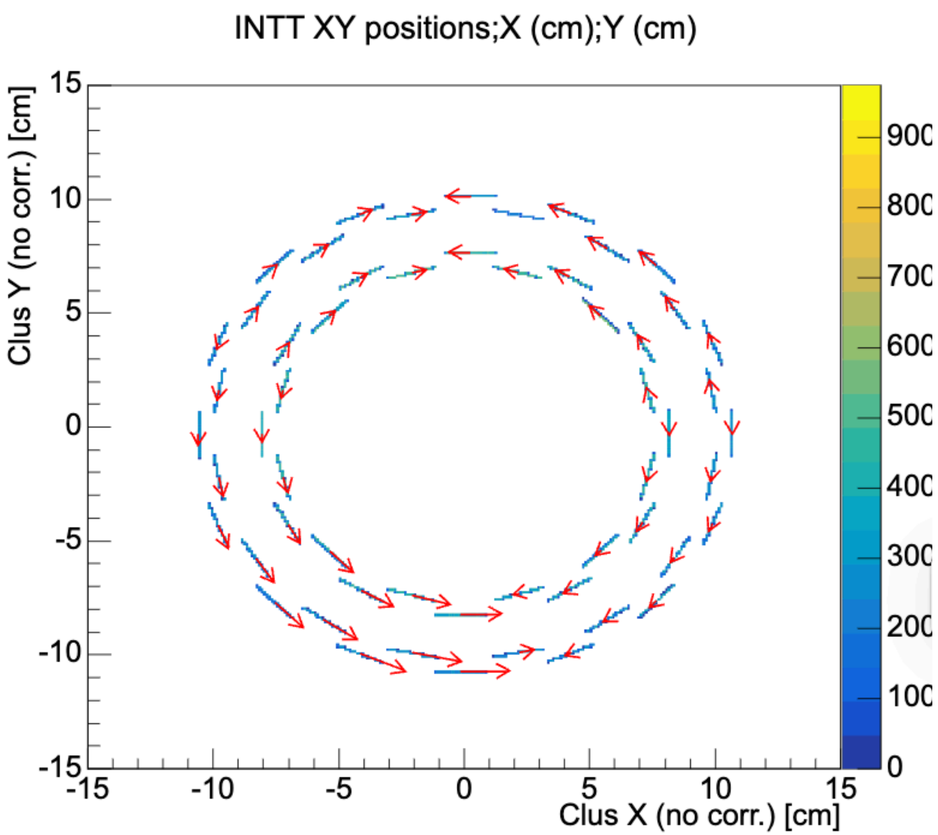


The alignment parameters

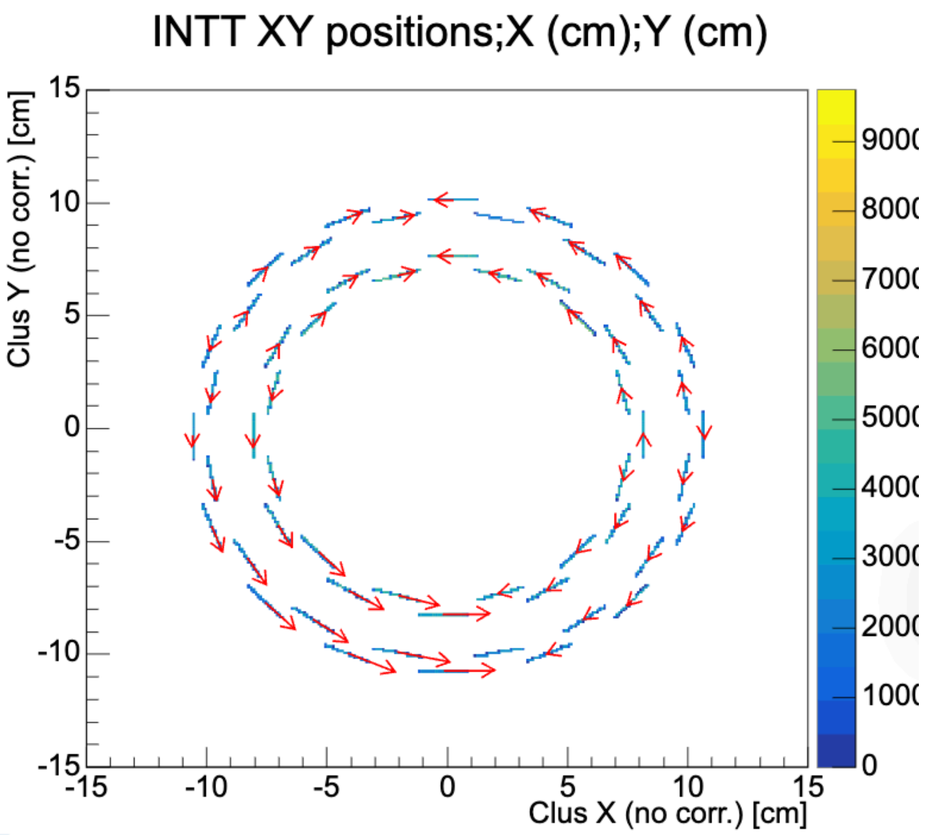
Scaled by 10

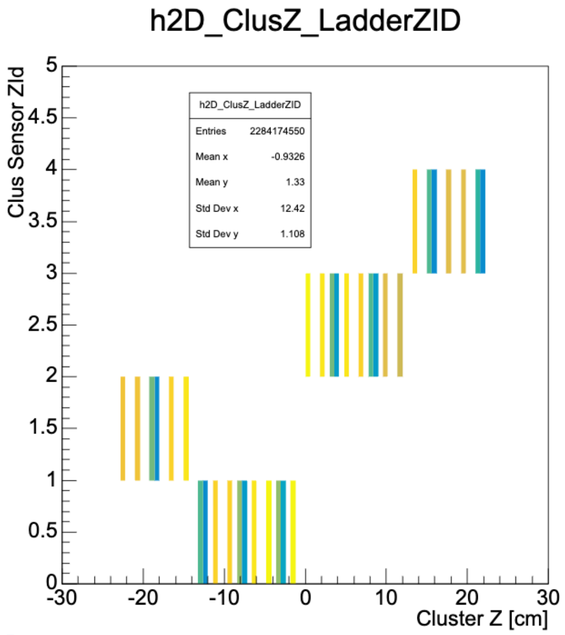
Projection the alignment shift direction onto the ladder direction

LadderZId = 0



LadderZId = 1



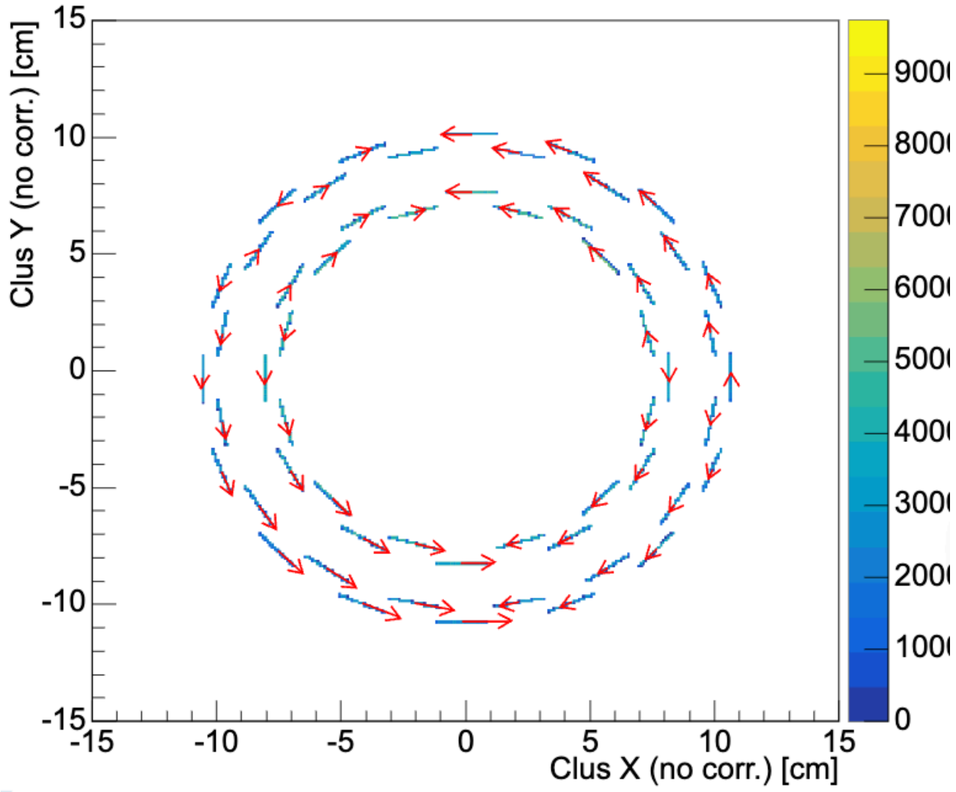


The alignment parameters

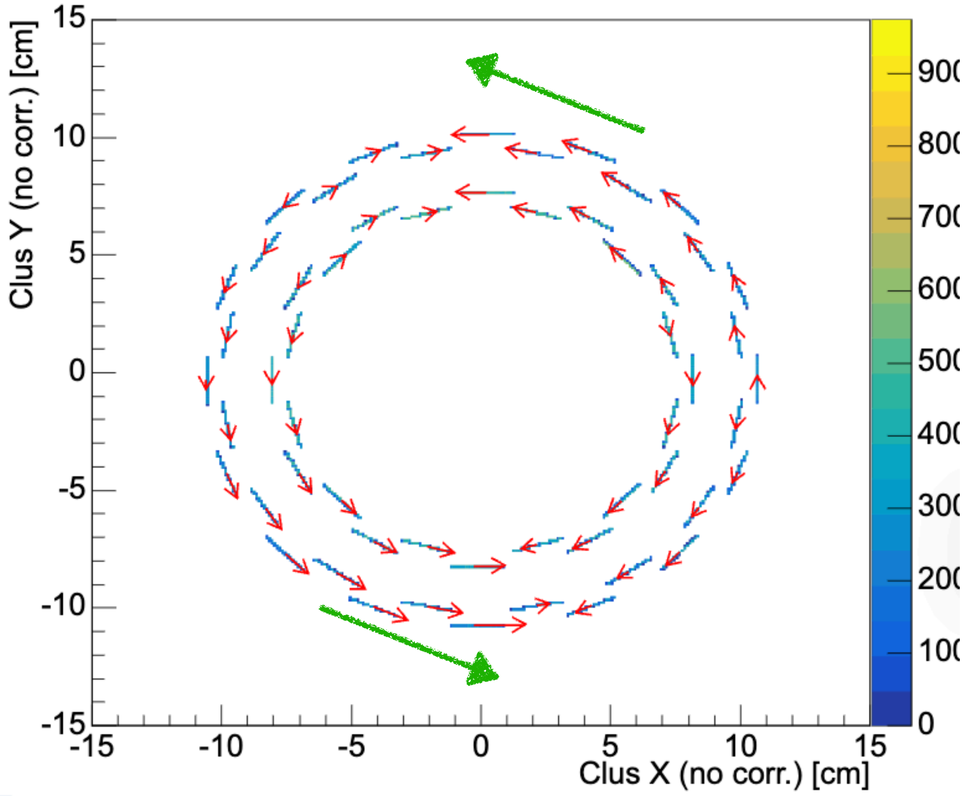
Scaled by 10

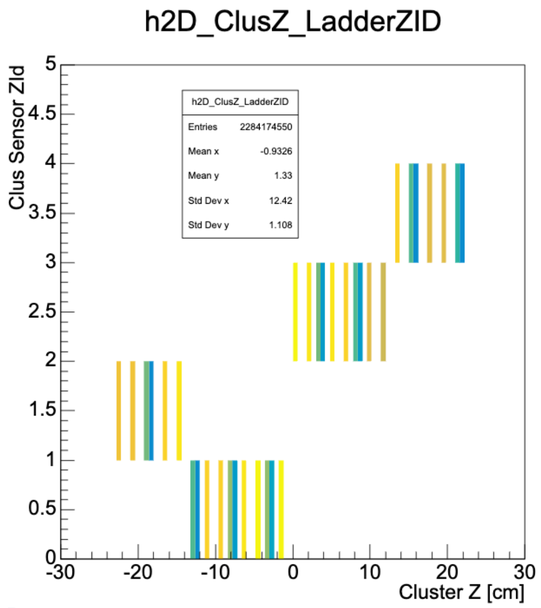
Projection the alignment shift direction onto the ladder direction

LadderZId = 2

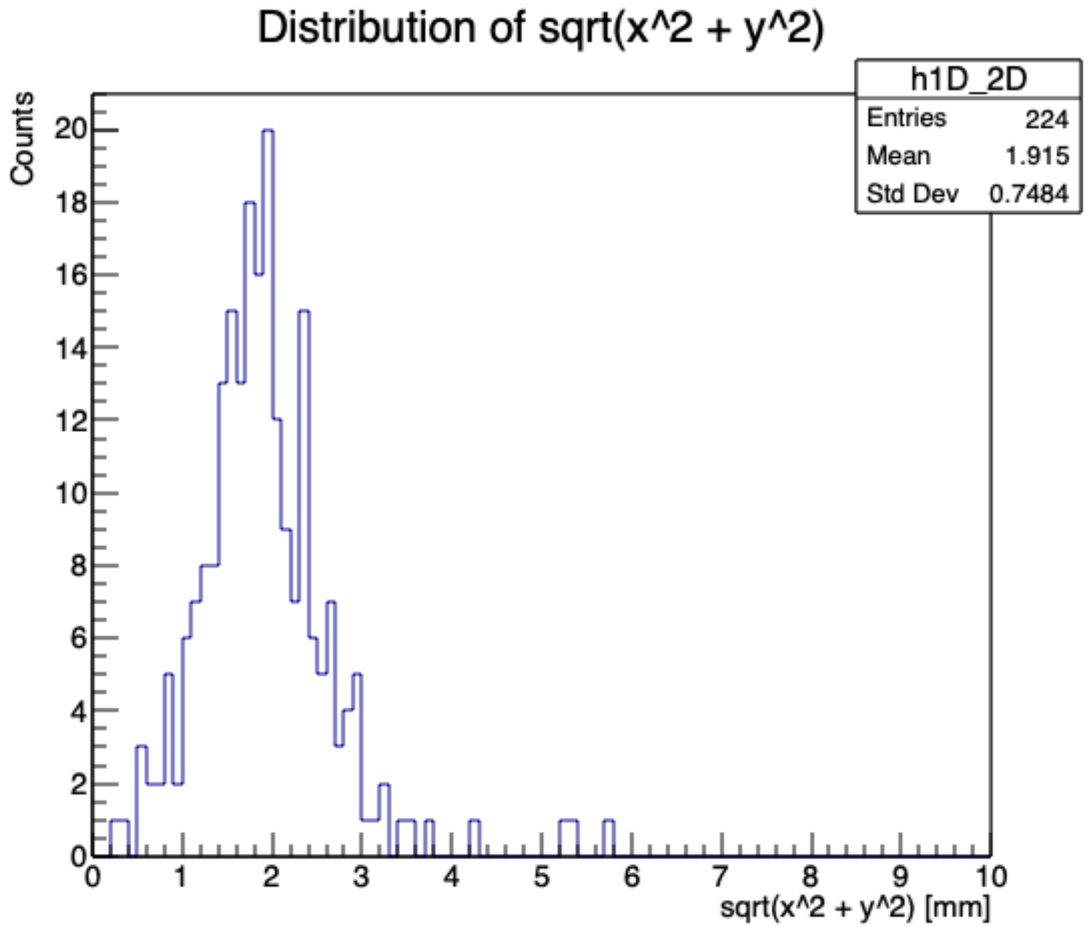


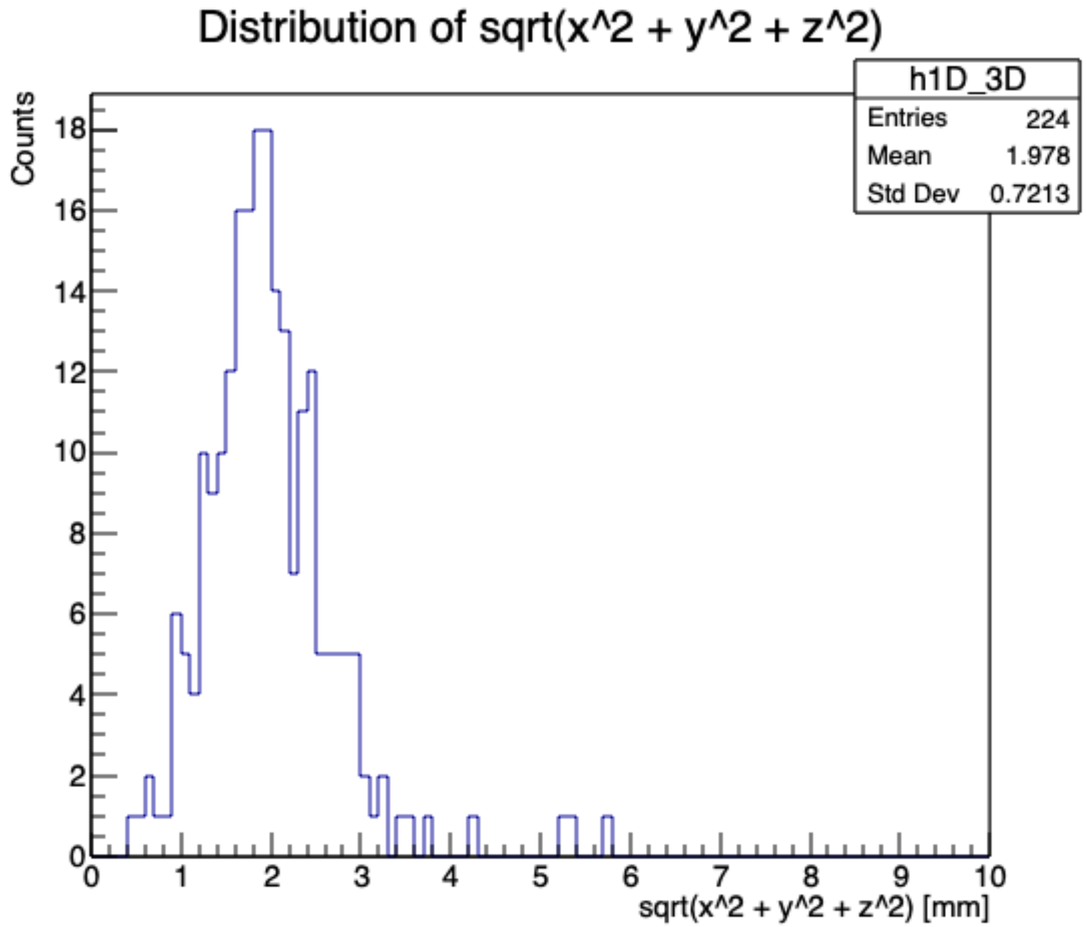
LadderZId = 3





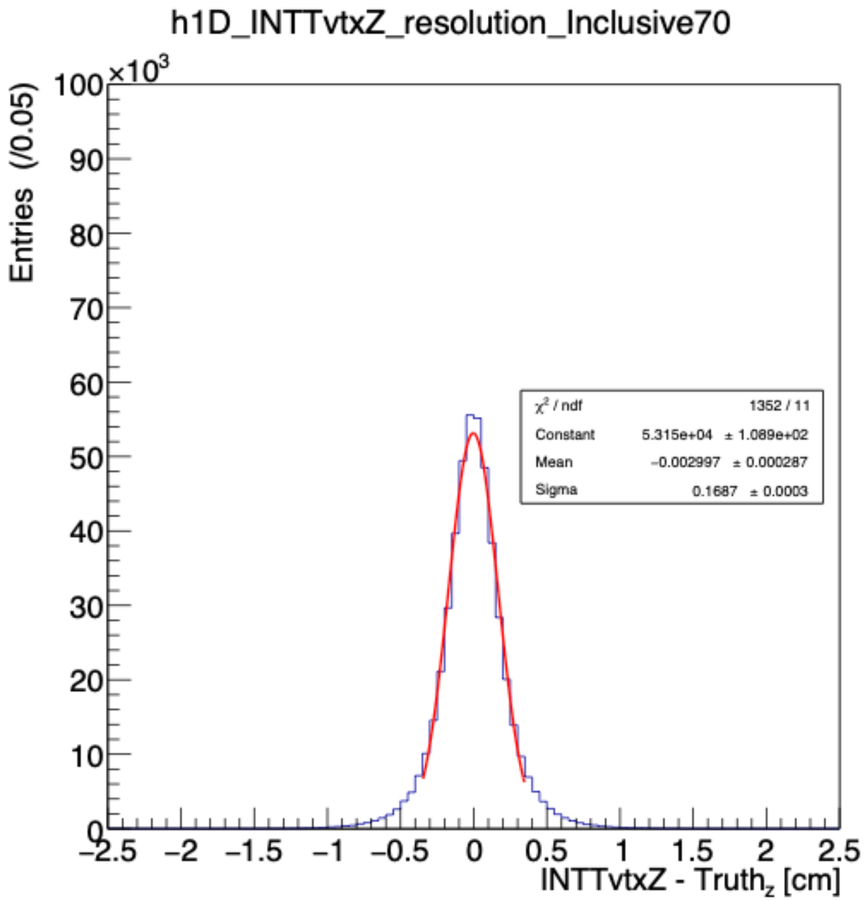
The alignment parameters





z-vertex reconstruction, resolution

Evaluated using HIJING MC simulation



between the INTT ladder and the beamline. In contrast, the z-vertex variation is significantly

– 6 –

larger, approximately 9.4 cm. Determining the z-vertex on an event-by-event basis is crucial for accurately establishing the tracklet kinematics. This is achieved with a reconstruction resolution of 0.17 cm for the selected centrality interval as determined in simulation.

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This value of 0.17 cm is quoted in the paper (Au+Au collisions)
May be interesting to use the three-value method to obtain a data-driven value (doable)

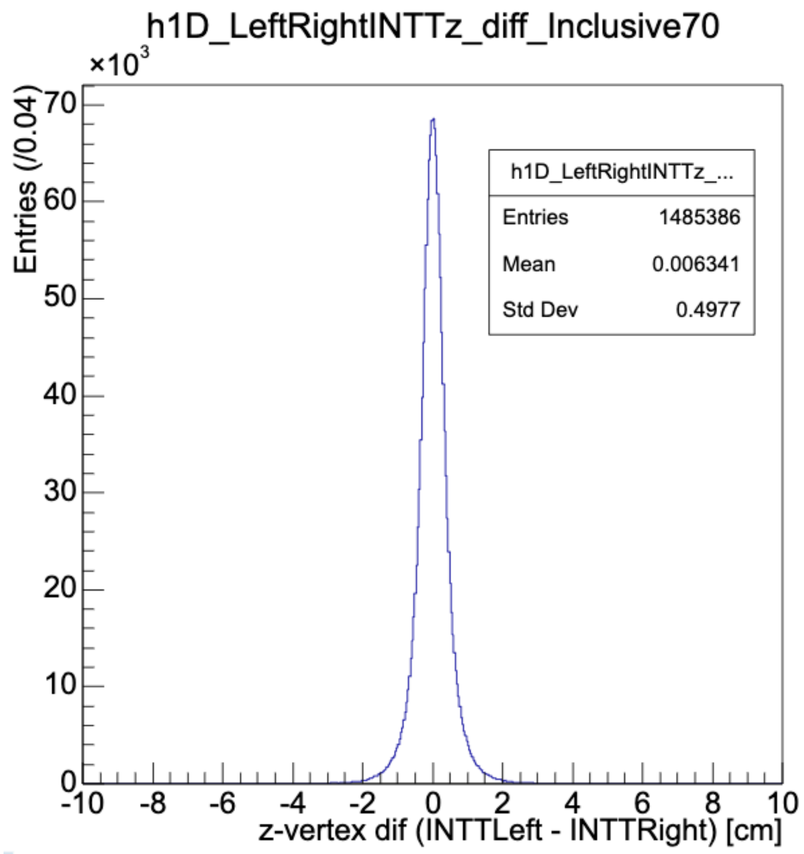
z-vertex reconstruction, resolution (data driven)

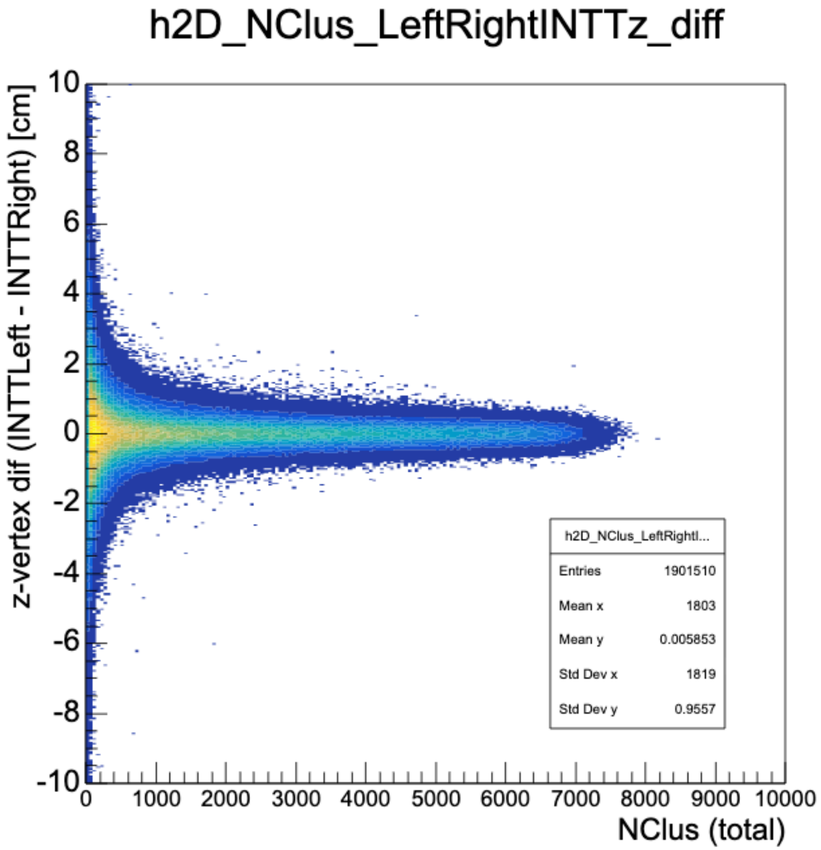
- One can try to determine the resolution in a data-driven way
- Ideal: three-detector method $\sigma_0, \sigma_1, \sigma_2$
  - Assuming the resolution distributions are all following the Gaussian functions
  - Square of width of $(Z_{\text{det.0}} - Z_{\text{det.1}}) = \sigma_0^2 + \sigma_1^2$
  - If $\sigma_0 \sim \sigma_1 \rightarrow$ We can obtain the σ_0 and σ_1
  - Obtain the resolution of σ_2 by
    - Square of width of $(Z_{\text{det.2}} - (Z_{\text{det.0}} + Z_{\text{det.1}})/2.) = \sigma_2^2 + \frac{1}{2}\sigma_1^2$

- Divide the INTT into east and west parts, and reconstruct the z-vertex, respectively (σ_0 and σ_1)
- Bin differences into a histogram

z-vertex reconstruction, resolution (data driven)

Distribution of z-vertex difference between the reco. by INTTLeftOnly and INTTRightOnly

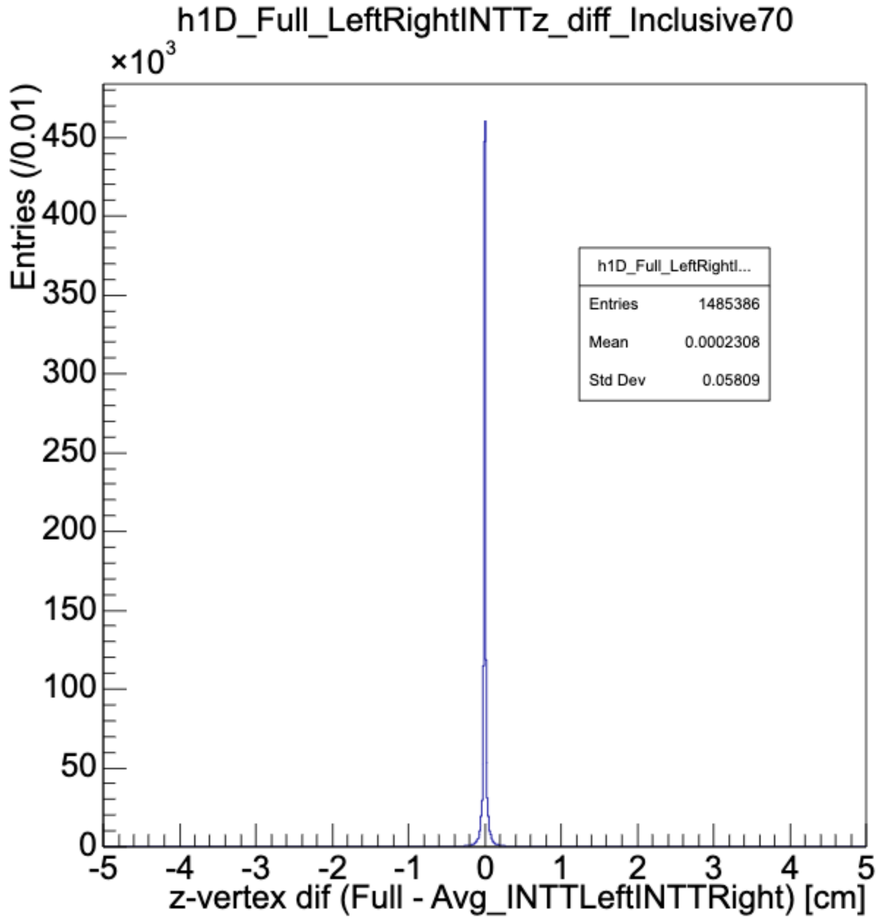




Width of 0.4977 → $\sigma_0 \sim \sigma_1 = 0.352$ cm

z-vertex reconstruction, resolution (data driven)

Full - (left+right)/2



The best approach would be using the silicon seeds, but removing the INTT-cluster component and reconstructing the z-vertex by MVTX clusters

Not so trivial

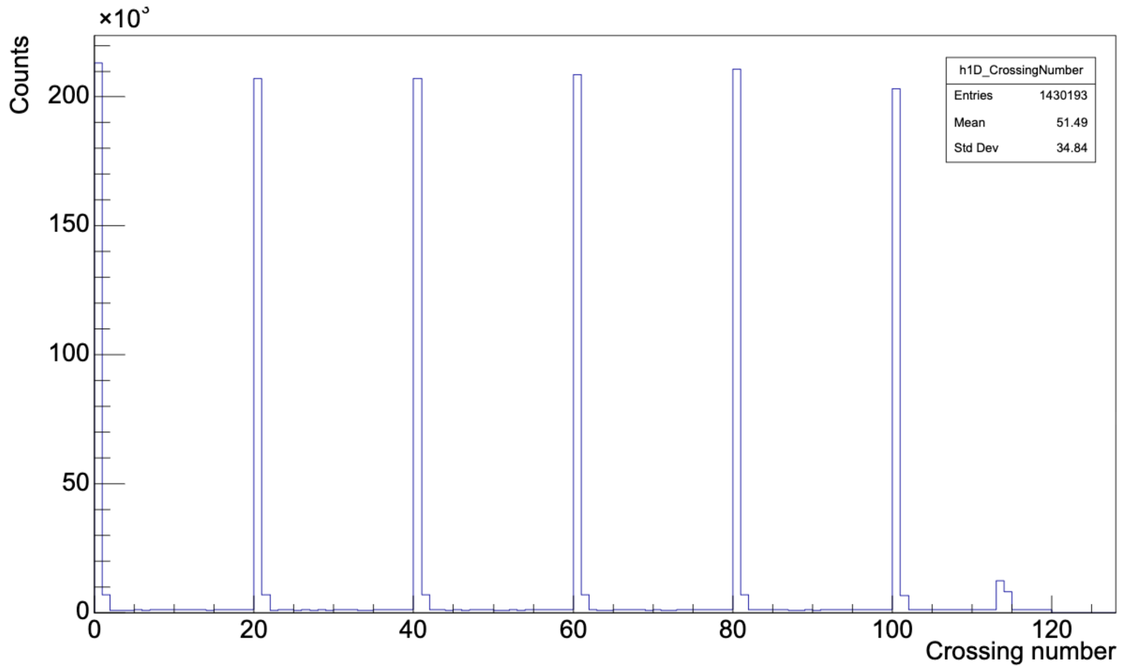
The proposed method doesn't work, as the full reco. z-vertex is highly correlated with the average half-reconstructed z-vertices

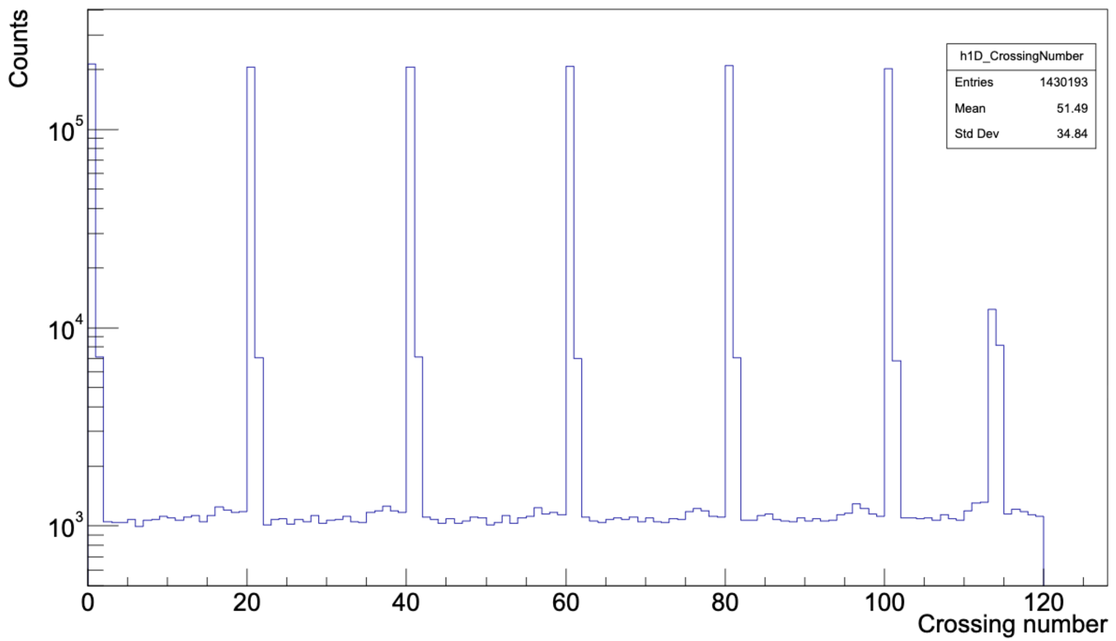
But since they are highly correlated, if we assume $\sigma^2_{\text{full}} = \frac{1}{2}\sigma^2_{\text{half}} = 0.248$ cm

(seems reasonable considering the residual misalignment)

Run 75573

- Run 75573: Run25 AuAu, Zero-field, 6x6 bunches
- INTTRawHit DST (GL1 included) from official production:
  - /sphenix/lustre01/sphnxpro/production/run3auau/calib/ana514_nocdbtag_v001



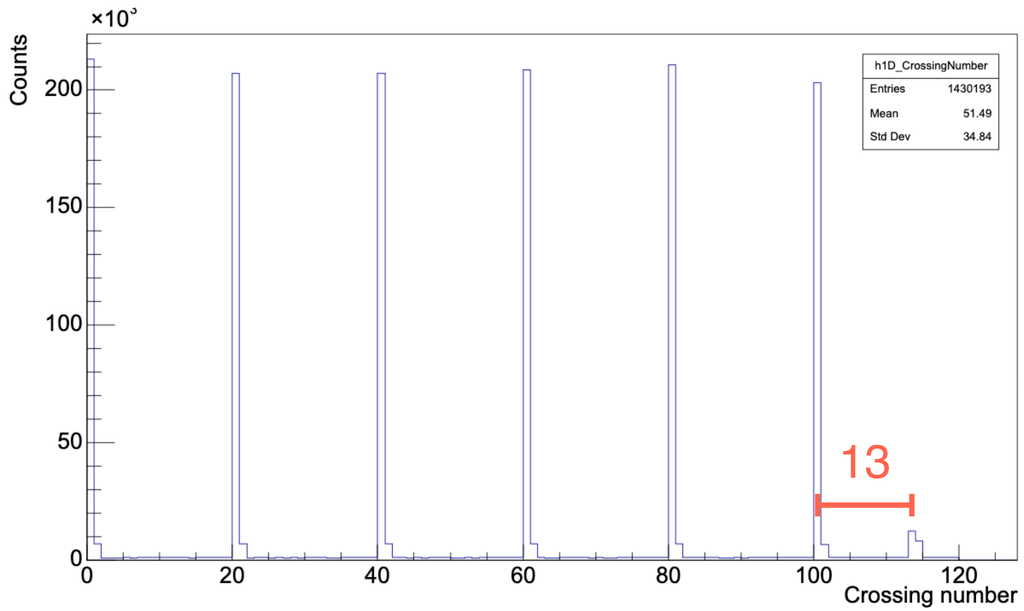


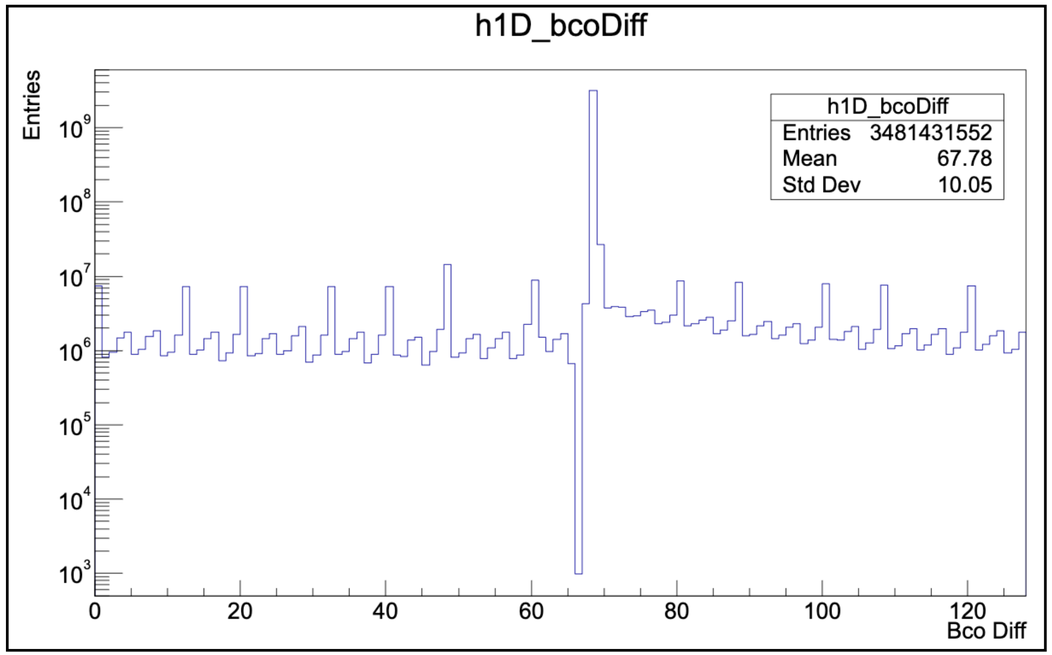
Very interestingly, there appears a shoulder right next to each peak

I don't know whether this is expected

Run 75573

- Run 75573: Run25 AuAu, Zero-field, 6x6 bunches
- INTTRawHit DST (GL1 included) from official production:
  - /sphenix/lustre01/sphnxpro/production/run3auau/calib/ana514_nocdbtag_v001



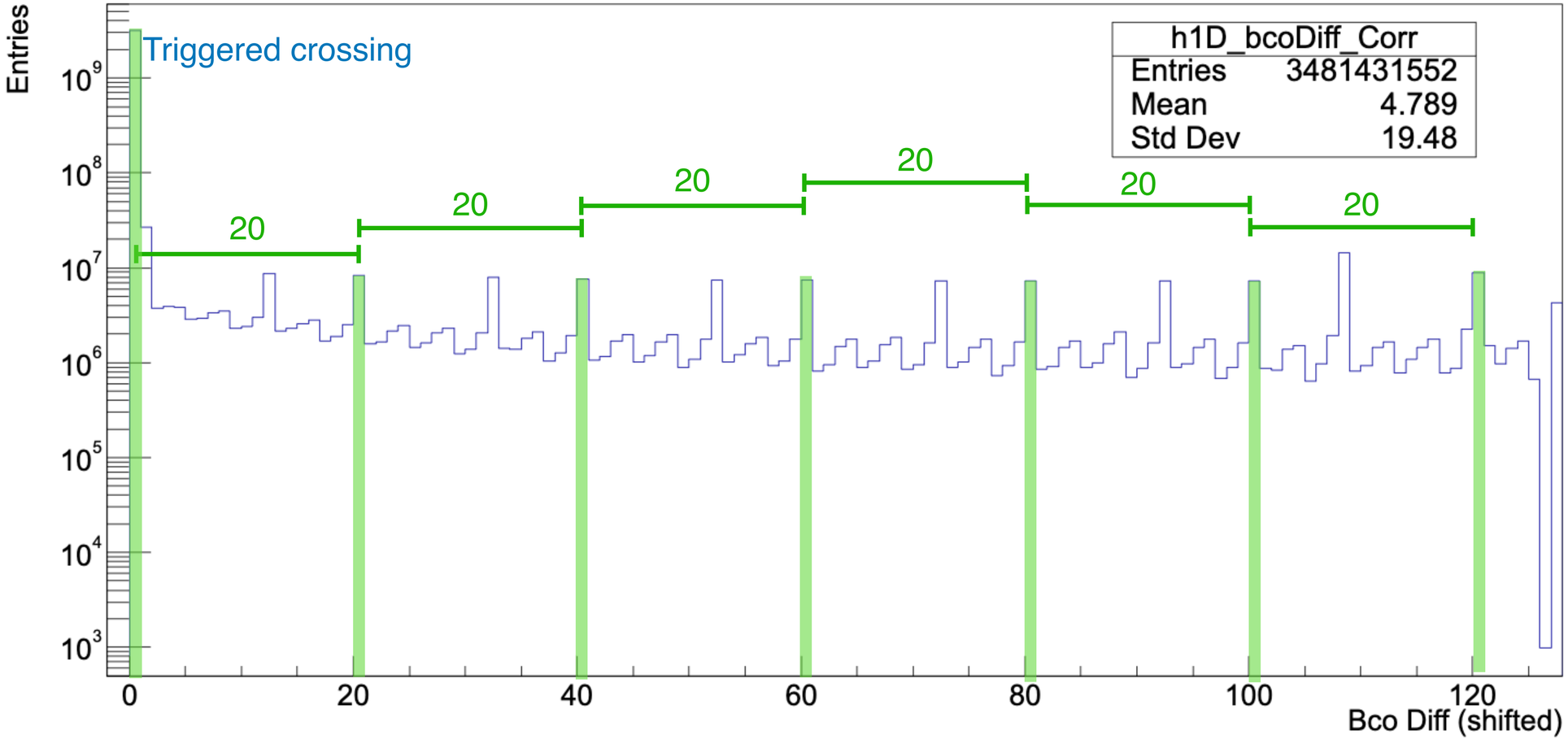


We have seen the shoulder structure in the INTT Bco_diff distribution, which includes the effect from the beam condition and perhaps the triggered hits being carried over

Follow-up question: why do we see more than six spikes in INTT BCO_Diff plot???????

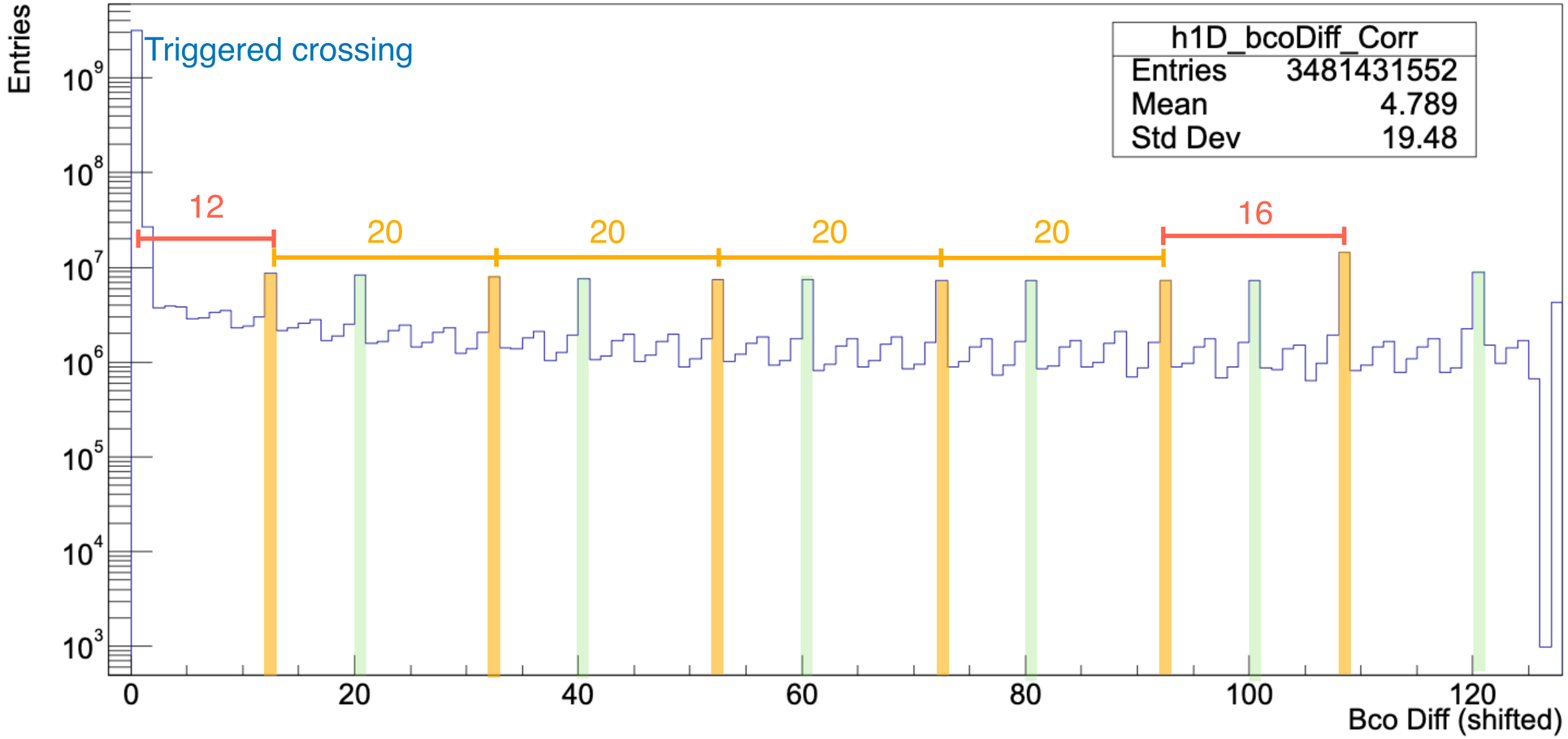
Run 75573

- Run 75573: Run25 AuAu, Zero-field, 6x6 bunches
- INTTRawHit DST (GL1 included) from official production:
  - /sphenix/lustre01/sphnxpro/production/run3auau/calib/ana514_nocdbtag_v001



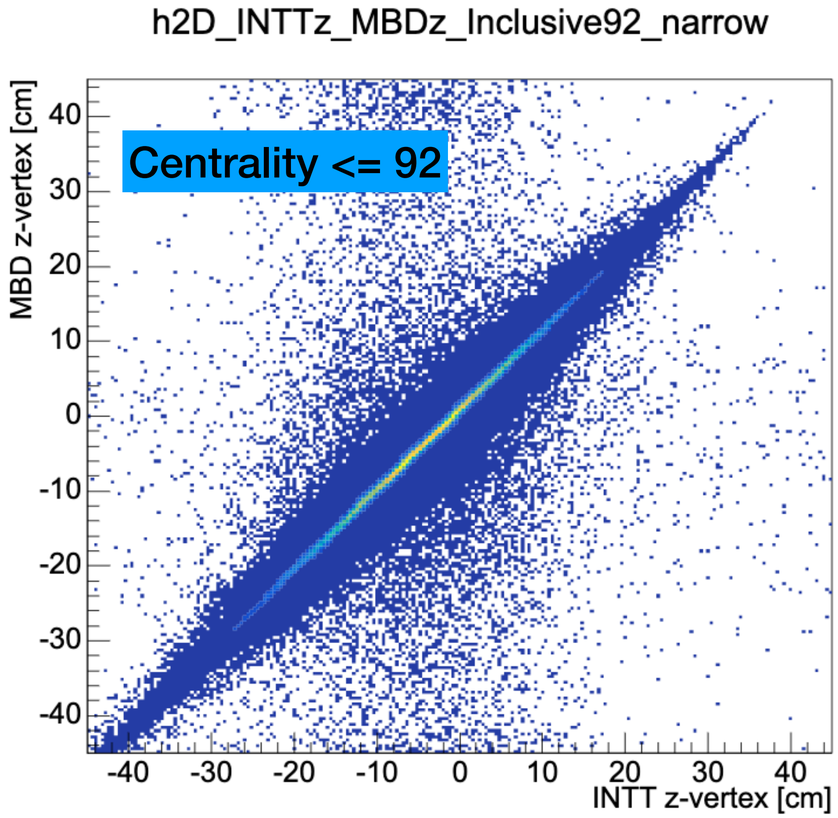
Run 75573

- Run 75573: Run25 AuAu, Zero-field, 6x6 bunches
- INTTRawHit DST (GL1 included) from official production:
  - /sphenix/lustre01/sphnxpro/production/run3auau/calib/ana514_nocdbtag_v001

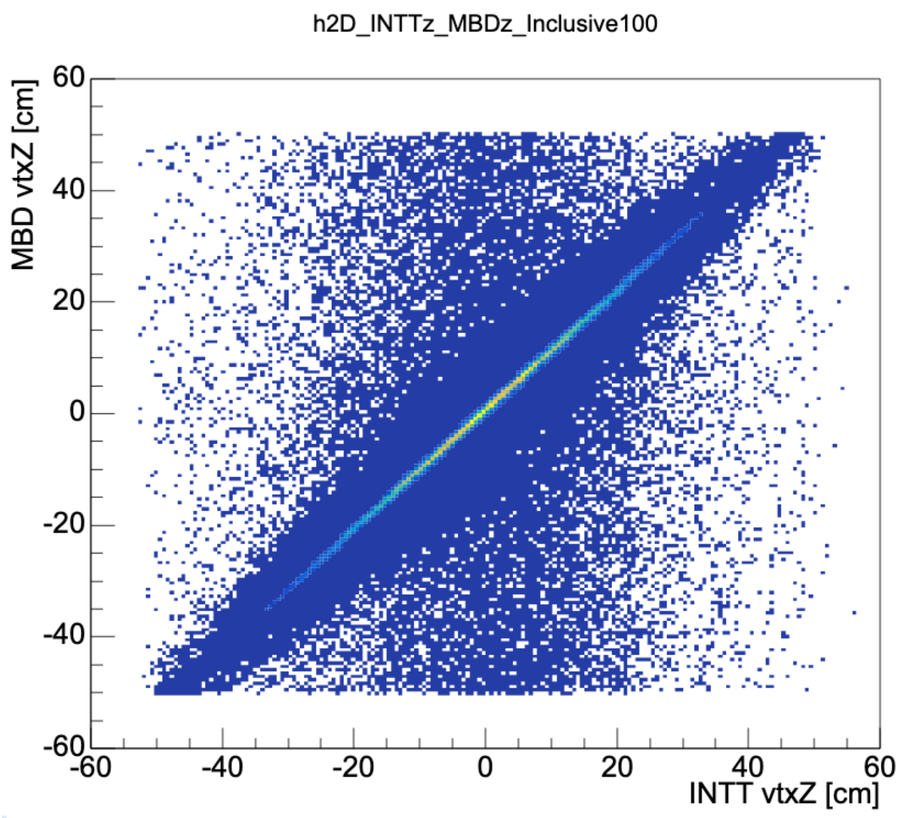


z-vertex reconstruction

Run 54280
zero field, Au+Au collisions,
56 x 56 bunches
ana.441



Run 75573
Run25 zero field, Au+Au collisions
6 x 6 bunches
ana.520

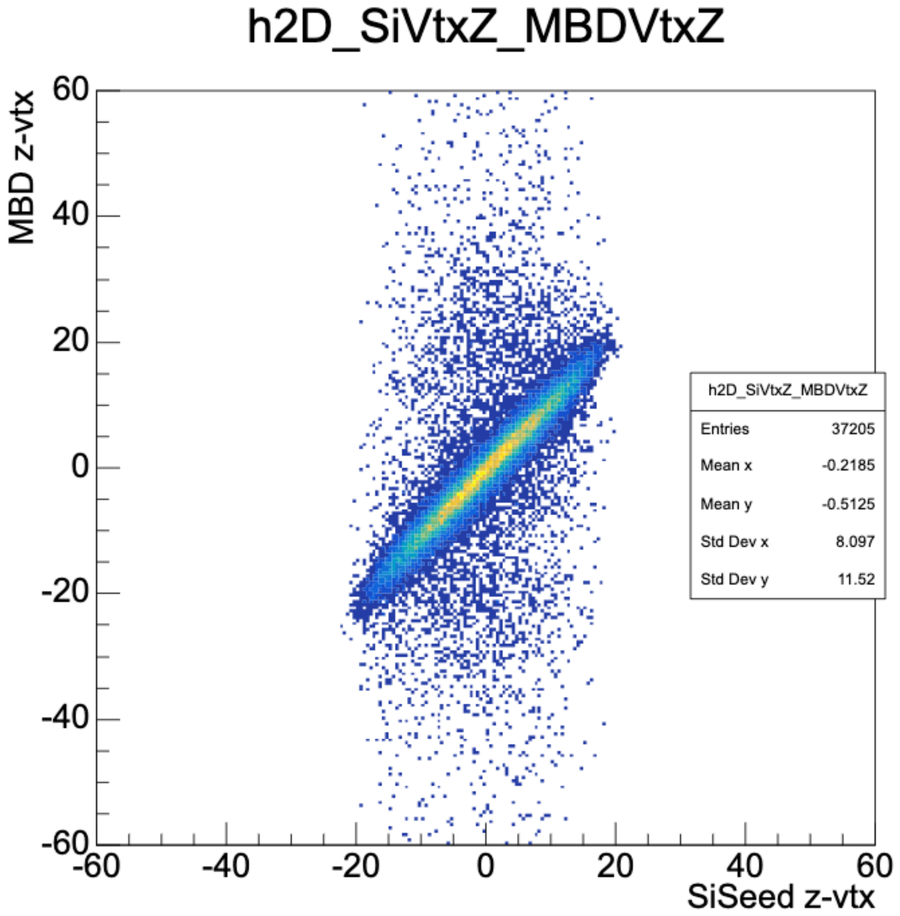


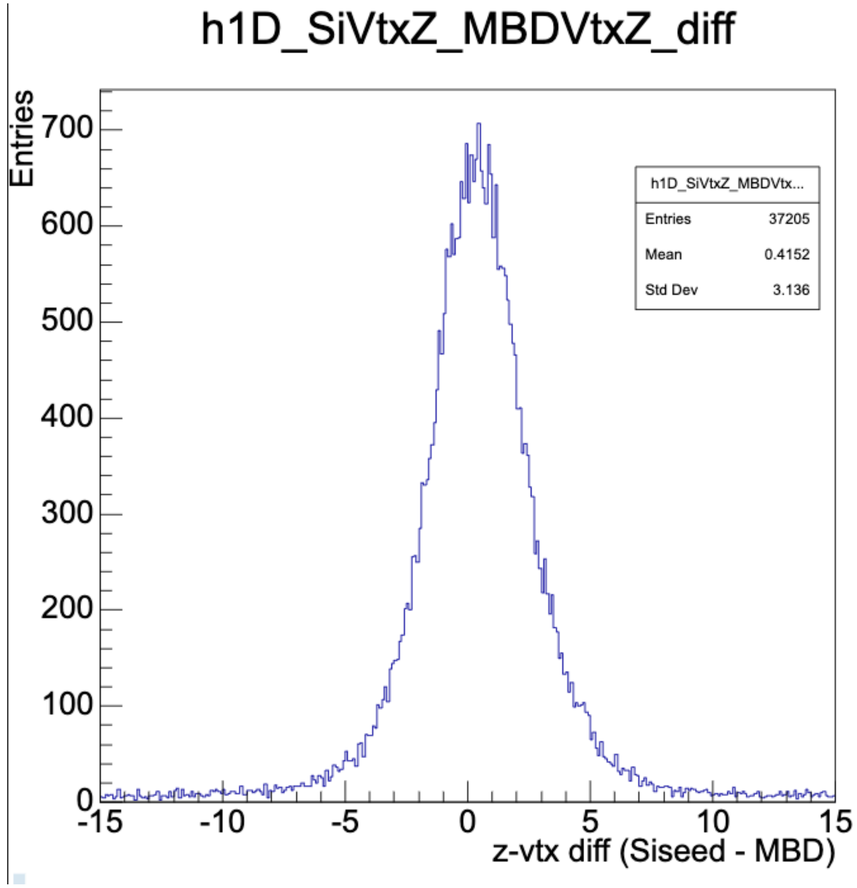
Very similar

z-vertex reconstruction (silicon seed)

p-p collisions

Just for a reference





Even with the recent analysis build and using the silicon-seed z-vertex, you can still see the spread

Summary

- The alignment parameters for INTT are visualized
  - (Interestingly) most of the ladders are more inward than what the survey suggests
  - Seems to be a systematic effect; one more survey can help

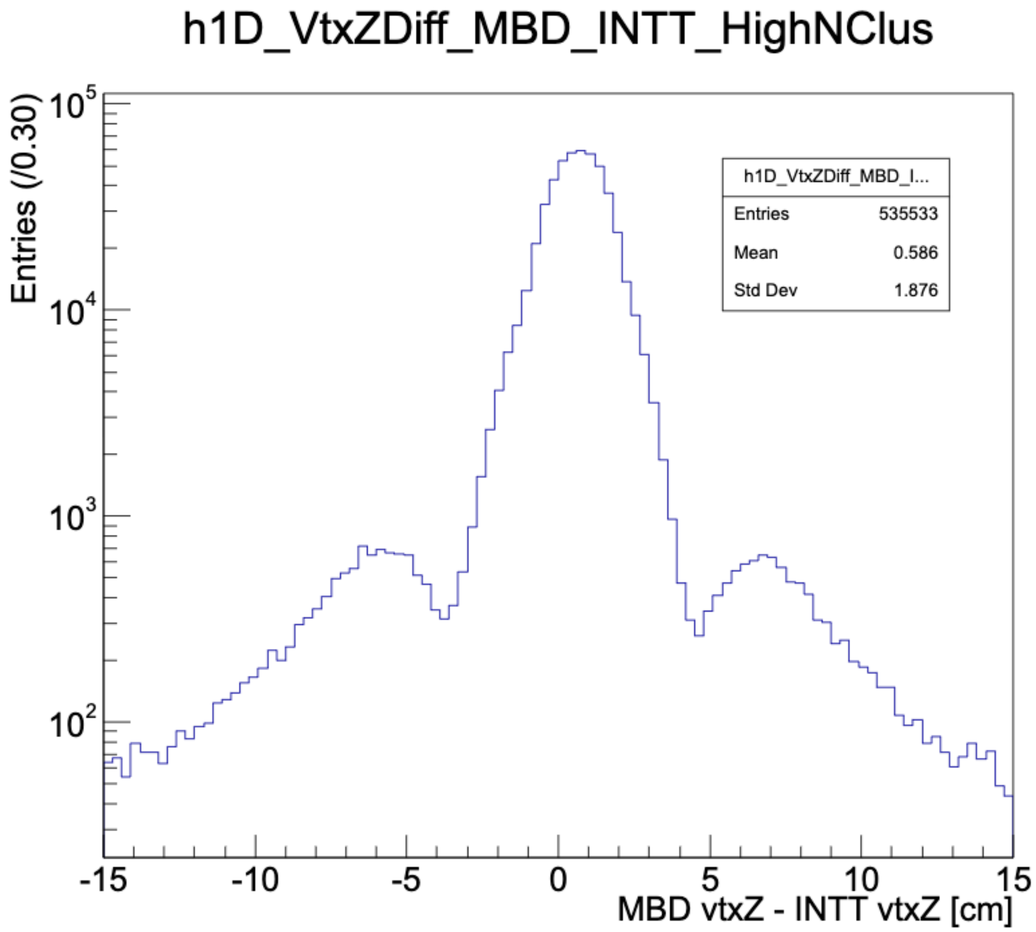
- INTT z-vertex reco. resolution
  - Note that one number, 0.17 cm, has been mentioned in a published paper
  - A simple data-driven approach has been tested with half-barrel resolution of 0.35 cm, leading to an “expected” full barrel resolution ~0.24 cm

- For the recently taken 6x6 run
  - Shoulder found in the bunch crossing distribution, which coincides with the INTT bco_diff distribution
  - Somewhat we see unreasonablly more than six spikes in this run

- The new z-vertex correlation seems to be pretty much similar to the previous one
  - Similar spread also appears using silicon seeds

Back up

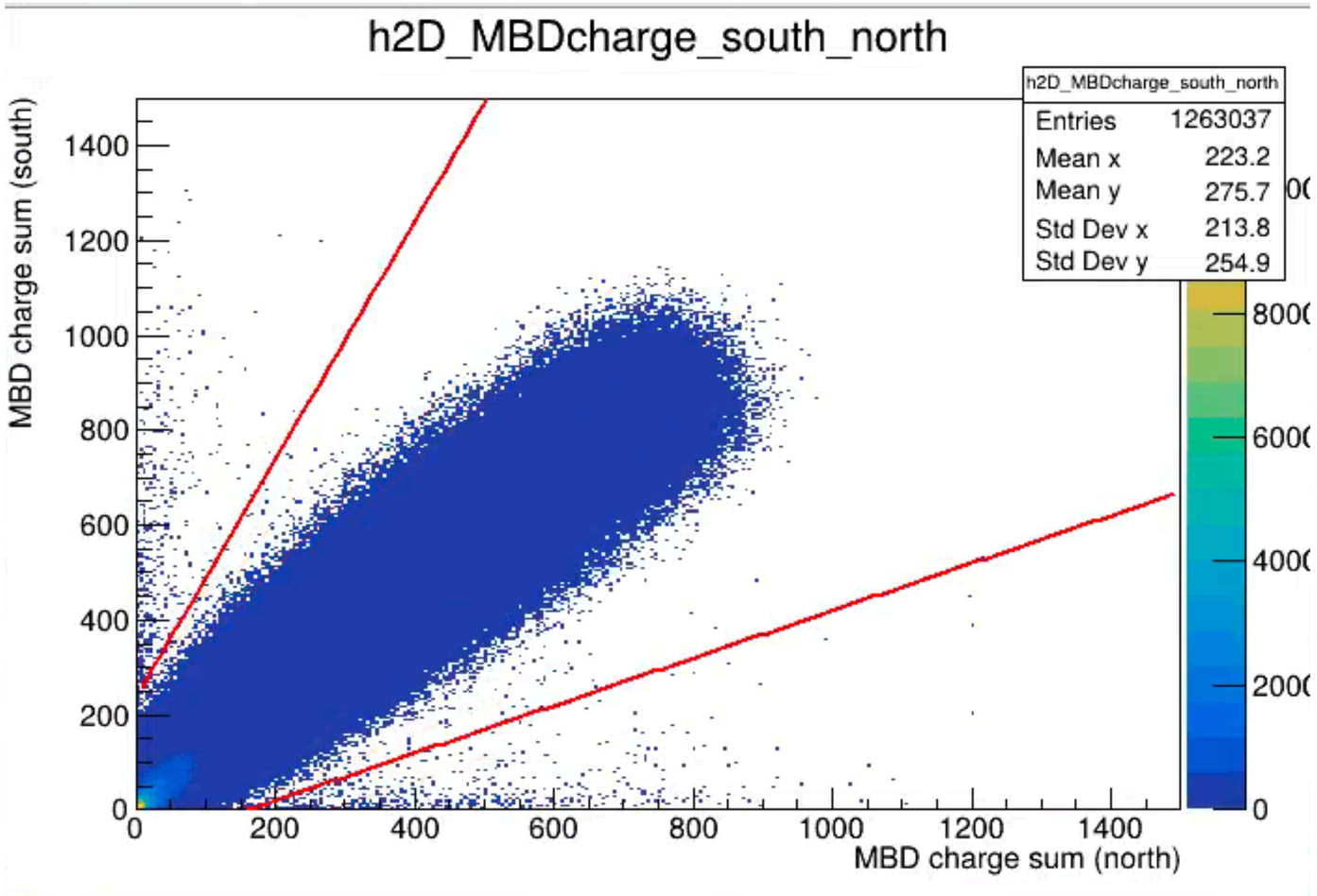
z-vertex difference between INTT and MBD



Still see the two satellite bumps

Already inforomed Mickey several months ago, no update from him

The MBD asymmetry cut



- Run 54280, with run24_ana517 alignment parameters

unit : [cm]
final average vertex XY should be used :
line filled X : -0.00610342 +/- 0.00122848
line filled Y : 0.189778 +/- 0.000993072
quadrant X : -0.00296484 +/- 0.00442758
quadrant Y : 0.191328 +/- 0.0026492
avg: {-0.00453413, 0.190553} [cm]
Fit avg: {-0.0061016, 0.189775} [cm]