2nd FLUSH REPORT

INTT tracking in pp with SIM

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2023.11.16　INTT Analysis Workshop@NCU

INTT tracking in pp with SIM

Development of tracking algorithm in pp collision with simulation

Goal in this workshop: Evaluation of my tracking algorithm with the truth information and sPHENIX tracking group

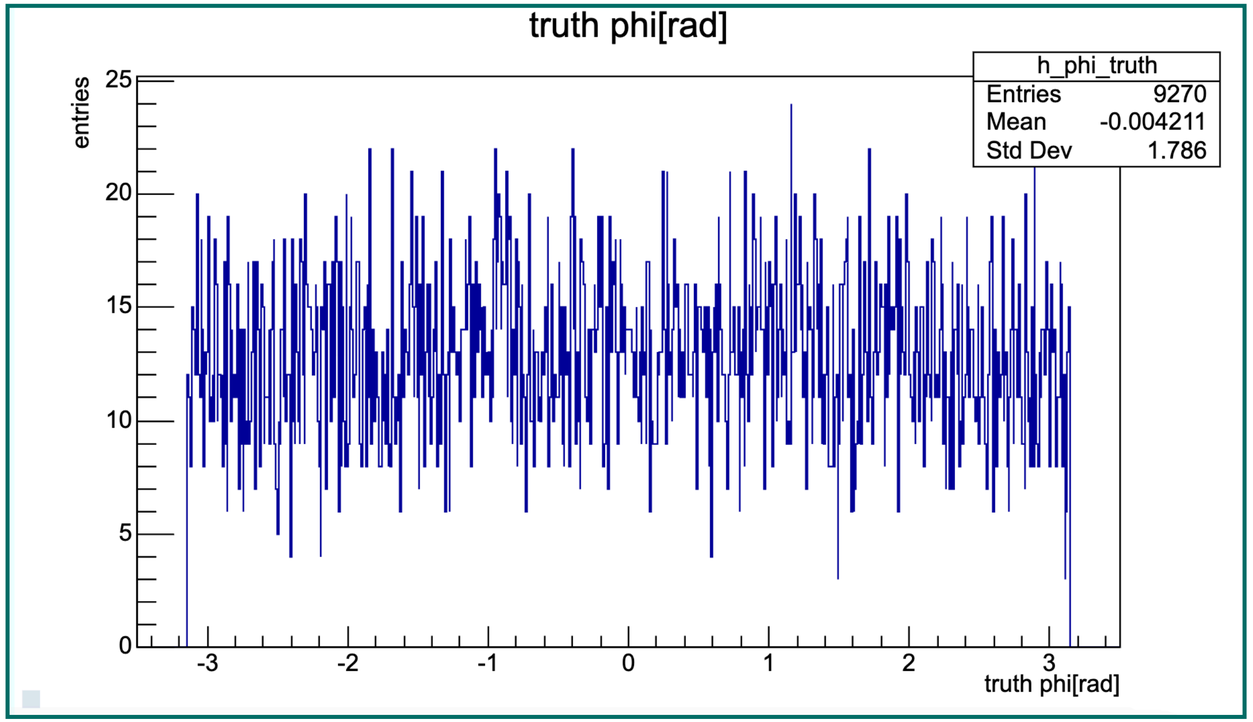
My To-Do List

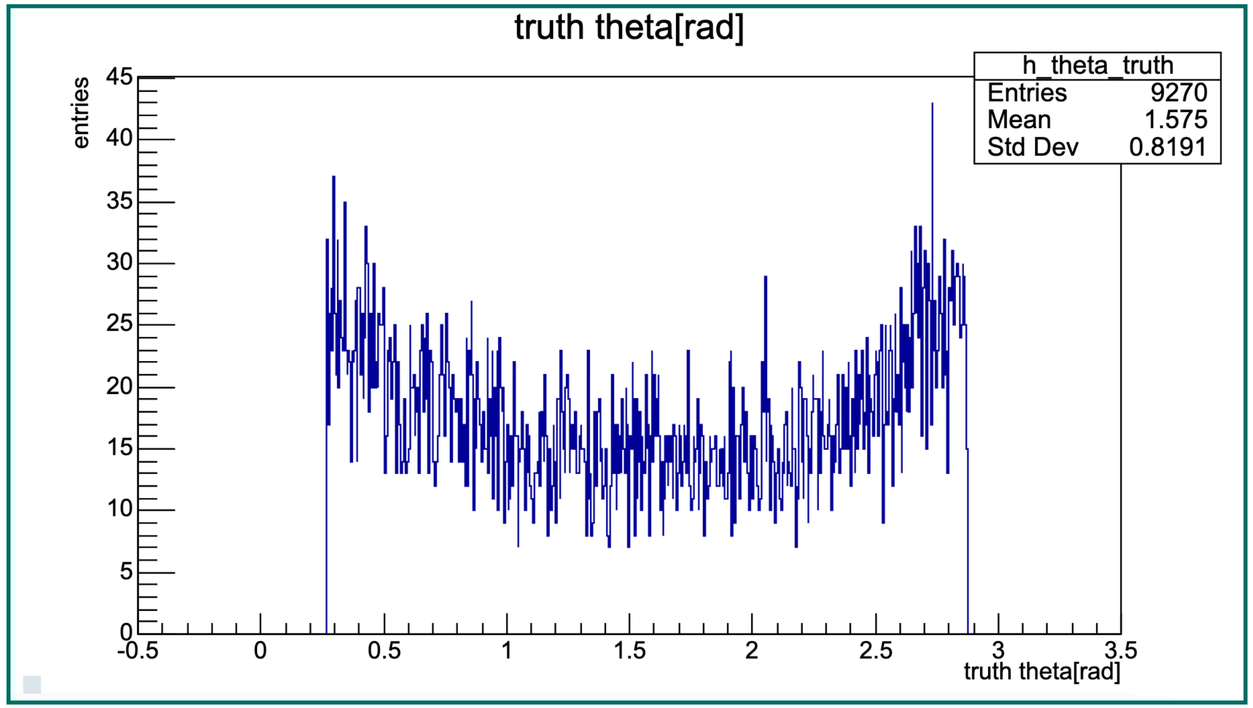
- Evaluation of my tracking algorithm with the truth track
  - Calculation of the angles (ϕ and θ) of my track
  - Checking the angles of the truth track
  - Comparison of the angles between my track and the truth track

- Evaluation of my tracking algorithm with the track which is made by sPHENIX tracking group
  - Understanding the tracking system of sPHENIX tracking group
  - Taking the tracking data of sPHENIX tracking group
  - Comparison between my track and the track which is made by sPHENIX tracking group

The angles of the truth track

- The truth angles are taken from PYTHIA.
- ϕ and θ are the angles in the x-y plane and the r-z plane respectively.
- In this study, the final-state particles in $\eta < 2$ are used.



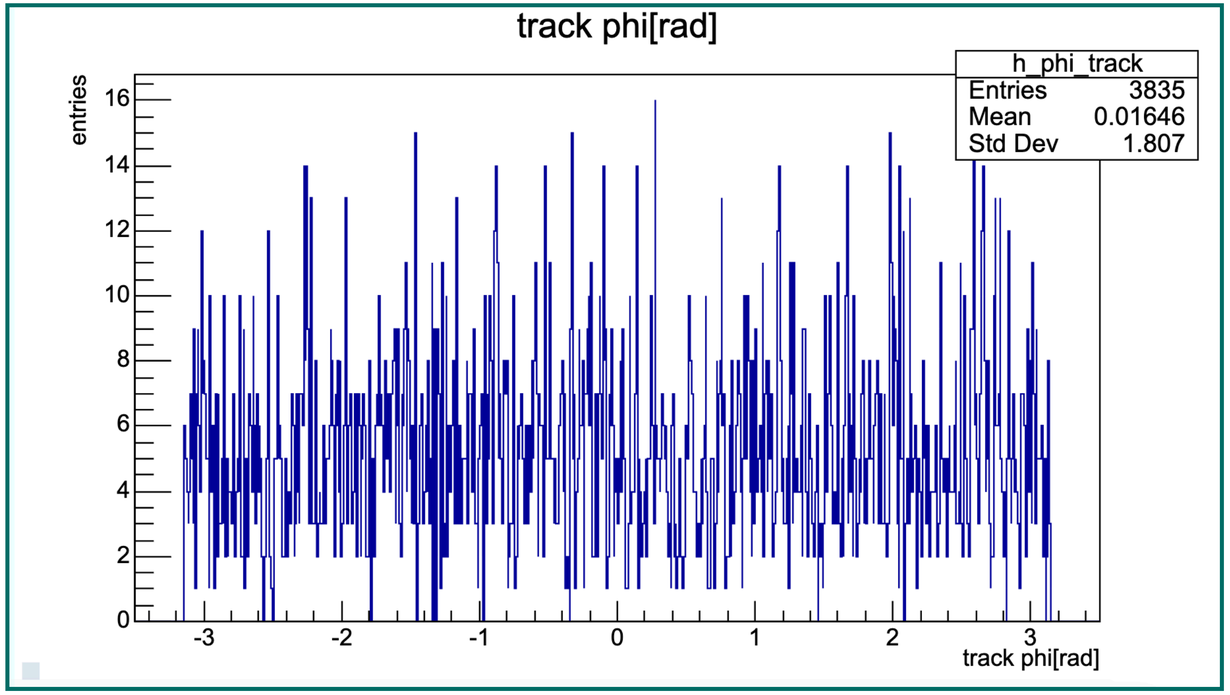


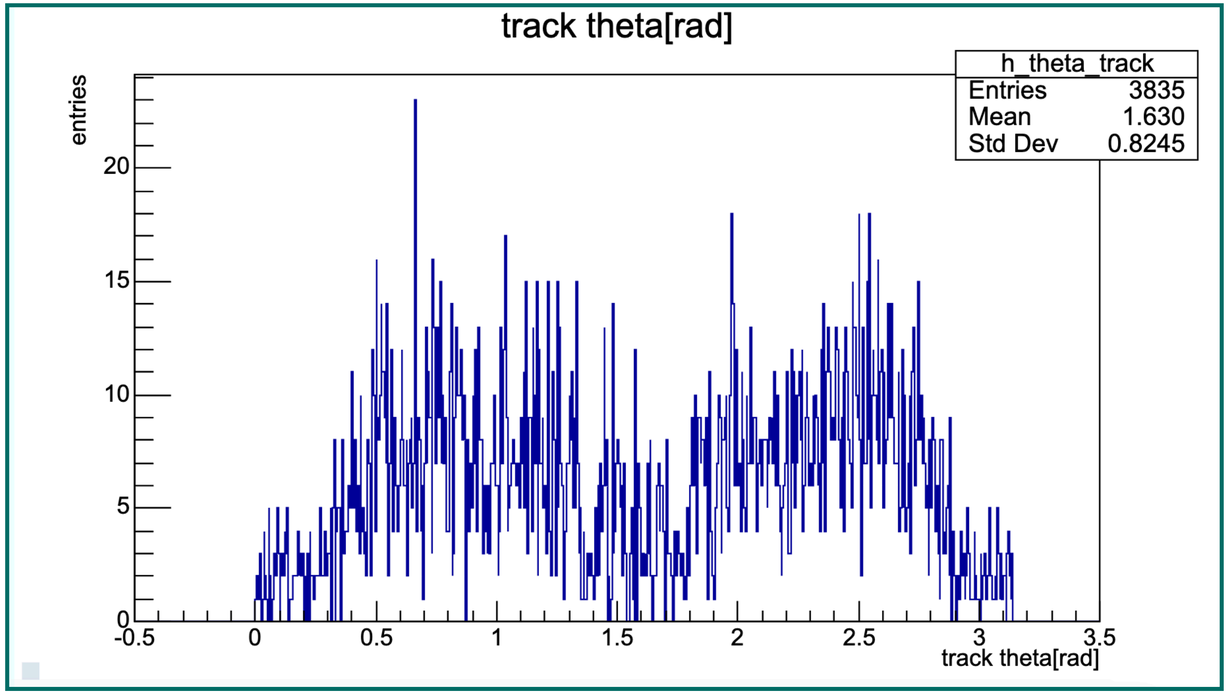
Calculation of the angles of reconstructed track

- The tracks are defined as $y = ax + b$ in x-y plane and r-z plane each.
- The angles (ϕ and θ) are calculated as below.

$$\phi = \mathrm{Arctan}(a_{xy})$$

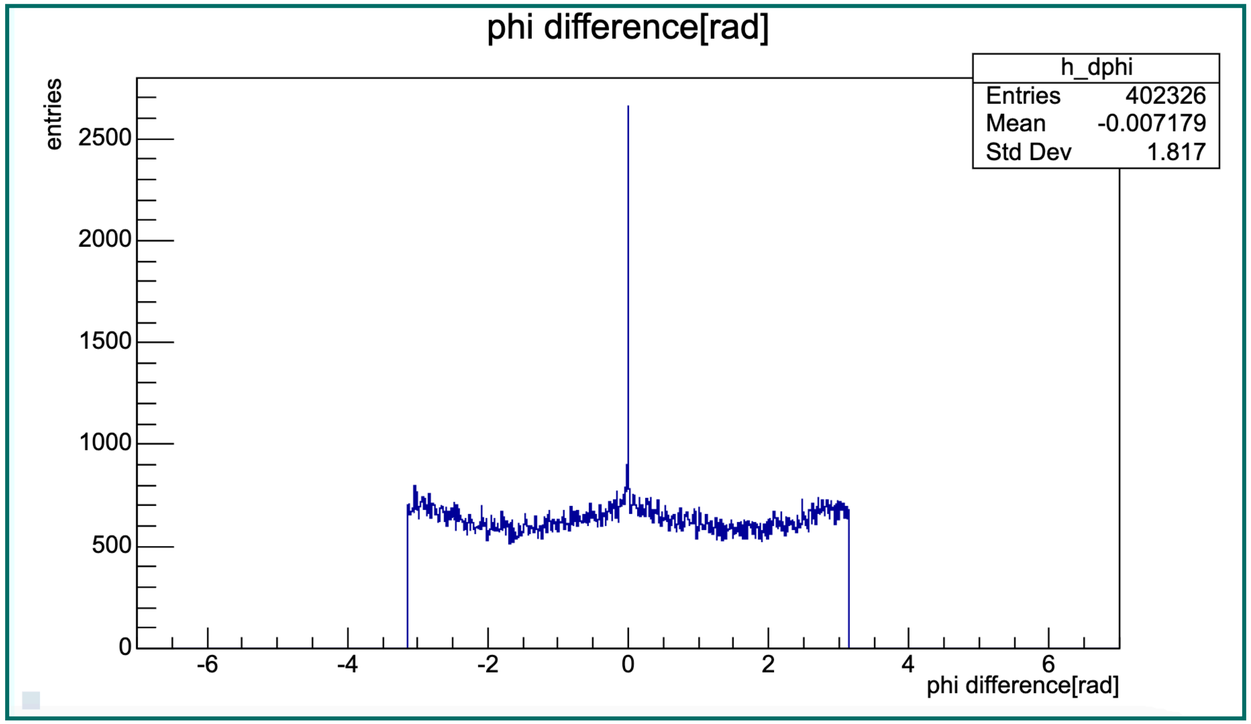
$$\theta = \mathrm{Arctan}(a_{rz})$$

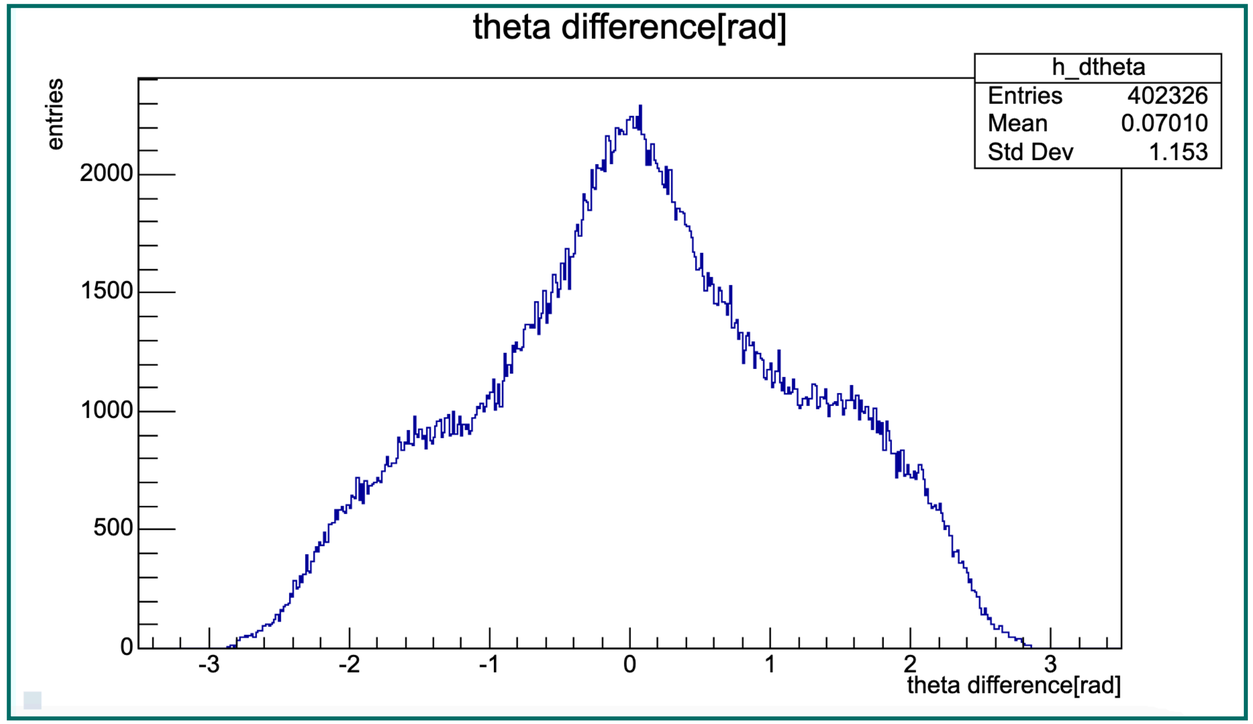




The angular difference

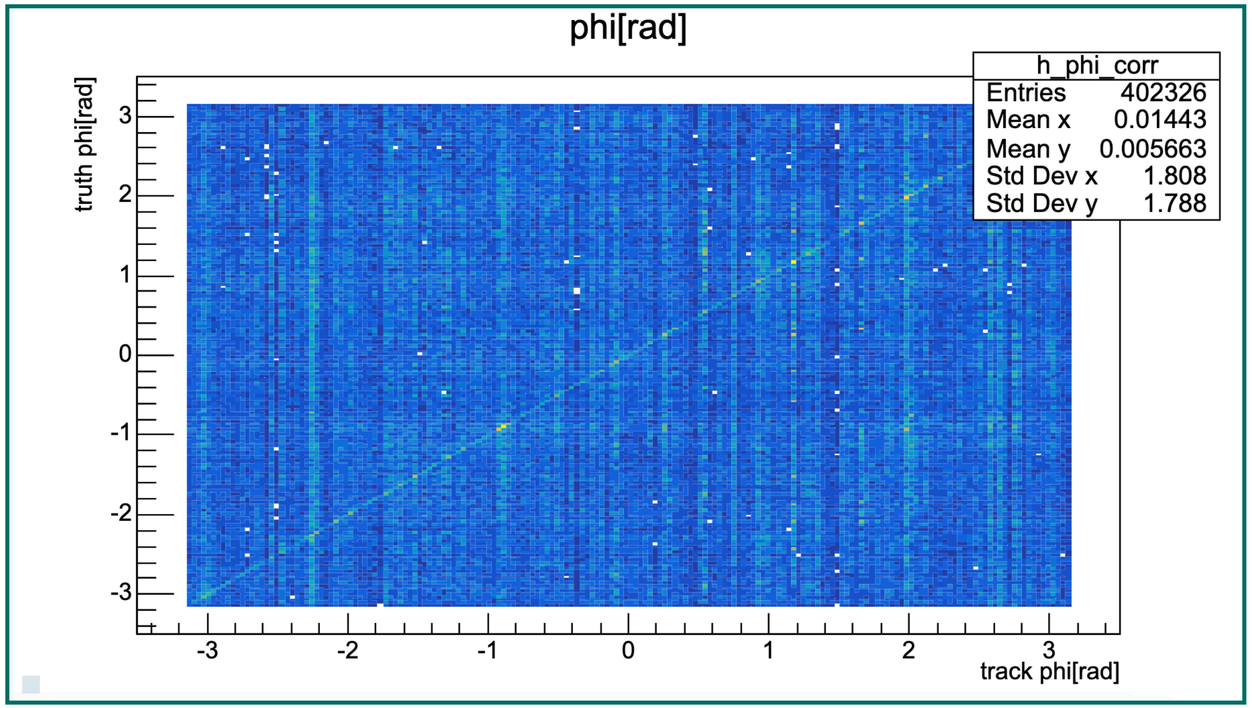
- The angular difference between one angle of reconstructed track and all of the truth tracks in one event is calculated.
- The bottom plot shows the difference of 100 events.

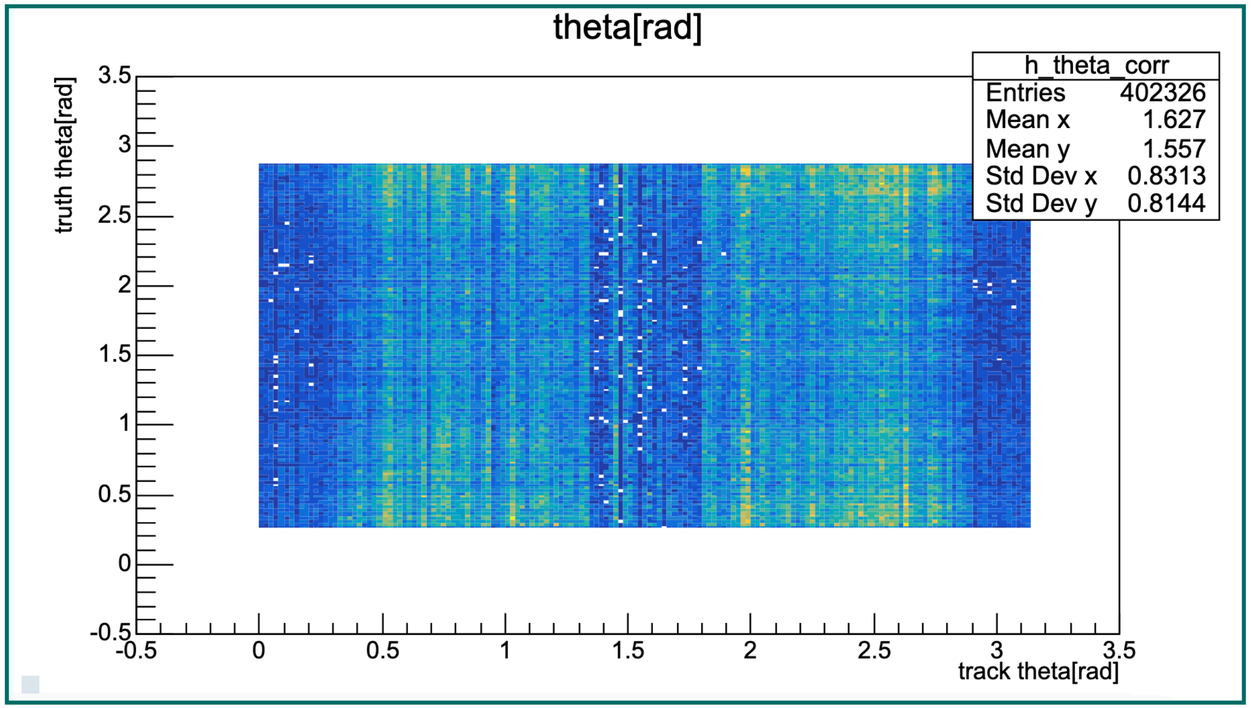




- Both of distributions have peak.

The angular correlation between truth & reconstructed truck

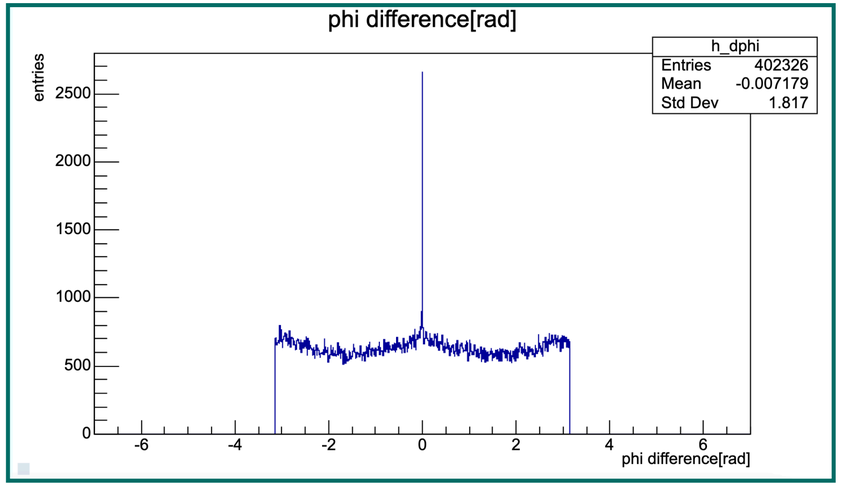


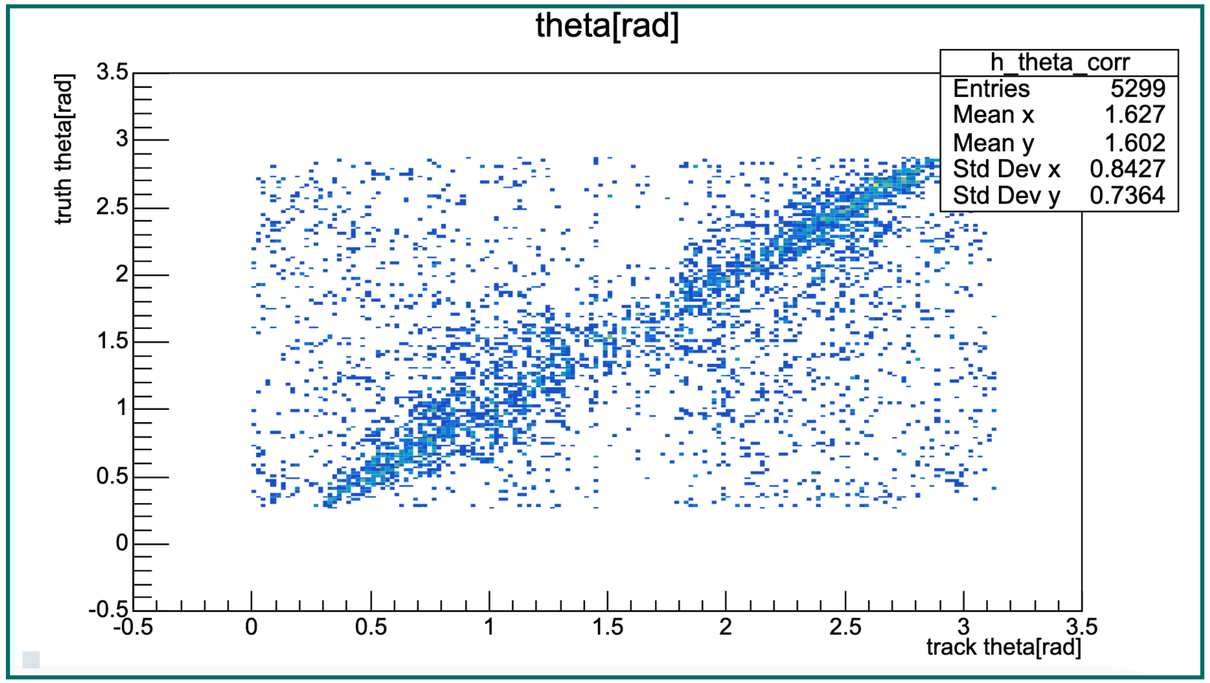


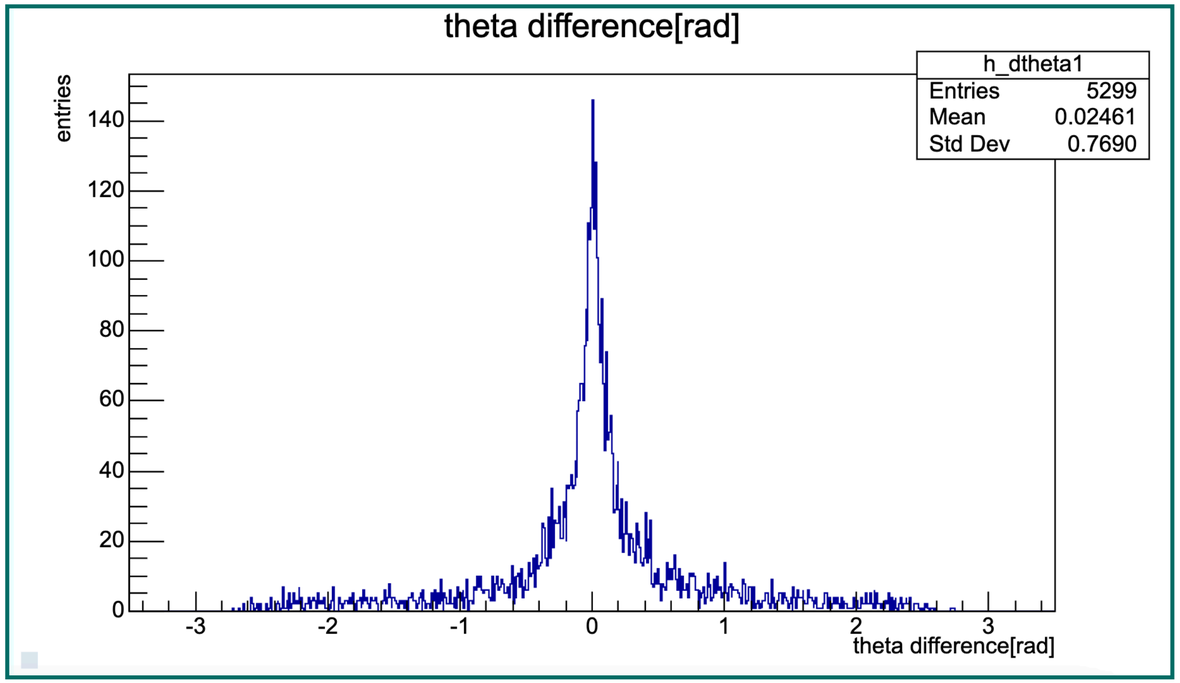
- The ϕ between the truth and reconstructed track has good correlation.
- But the θ has no correlation.

The ϕ cut

- The ϕ cut which selects only the peaks of the ϕ distribution ($\phi < 0.01$) is applied in the θ correlation and the θ difference distribution.

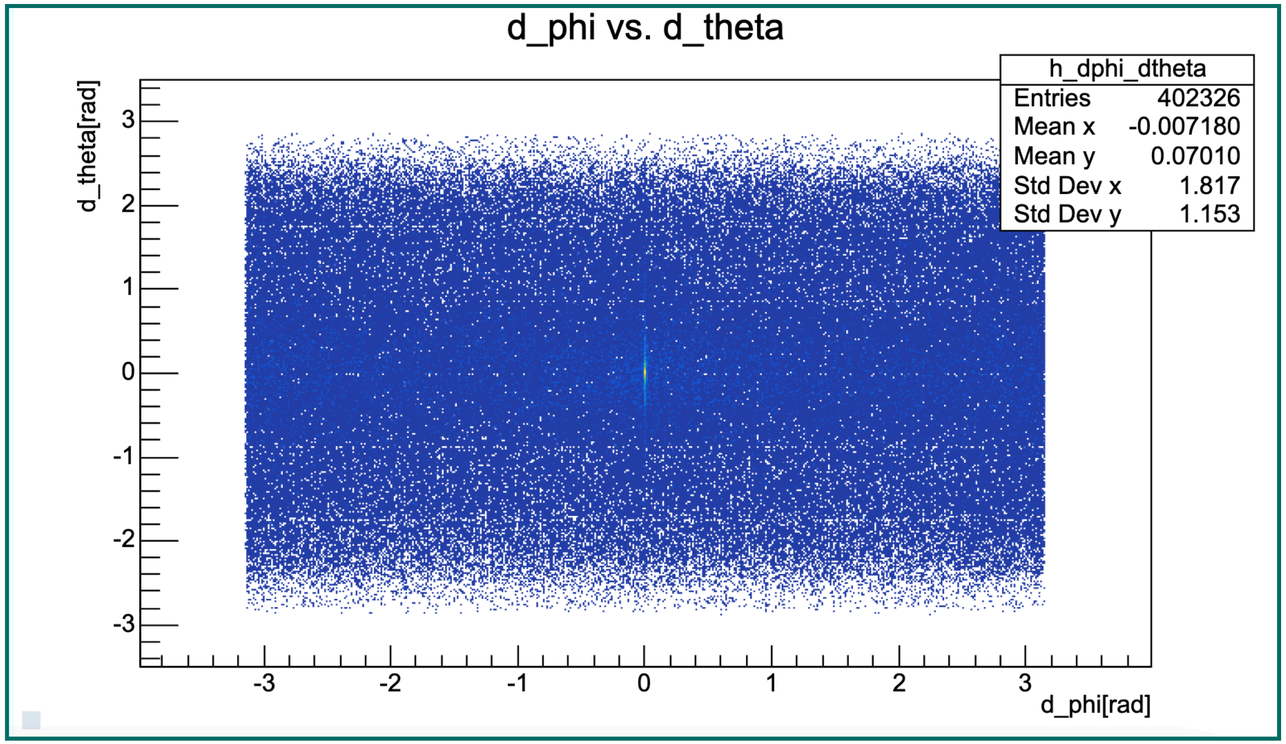






- <u>The θ distribution has good correlation and θ difference has more stronger peak.</u>

$\Delta\phi$ vs. $\Delta\theta$



- $\Delta\phi$ vs. $\Delta\theta$ distribution has peak.
- The correct combinations of the the reconstructed track and the truth track is in this peak.

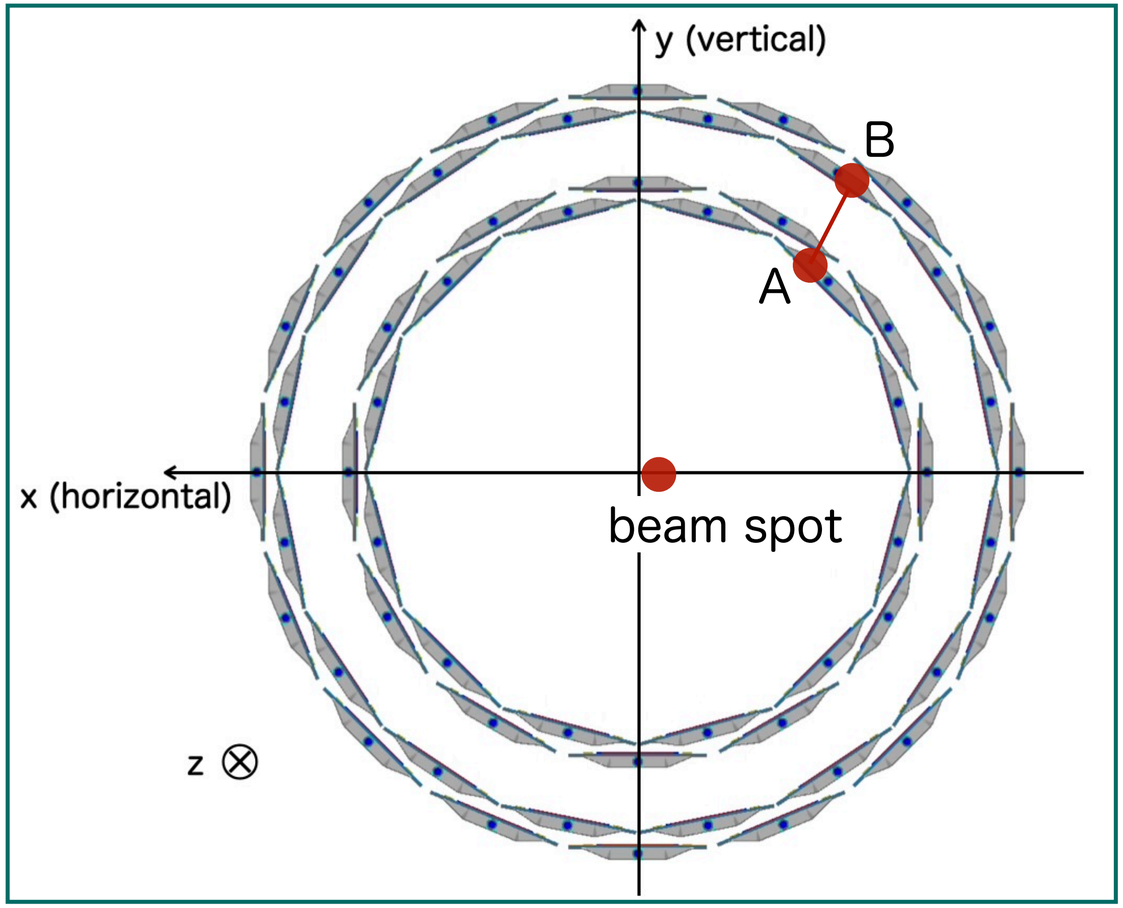
<u>Next step</u>

- After setting the window, I'd like to calculate the ratio of the correct combination in the window.

BACK UP

TRACKING METHOD

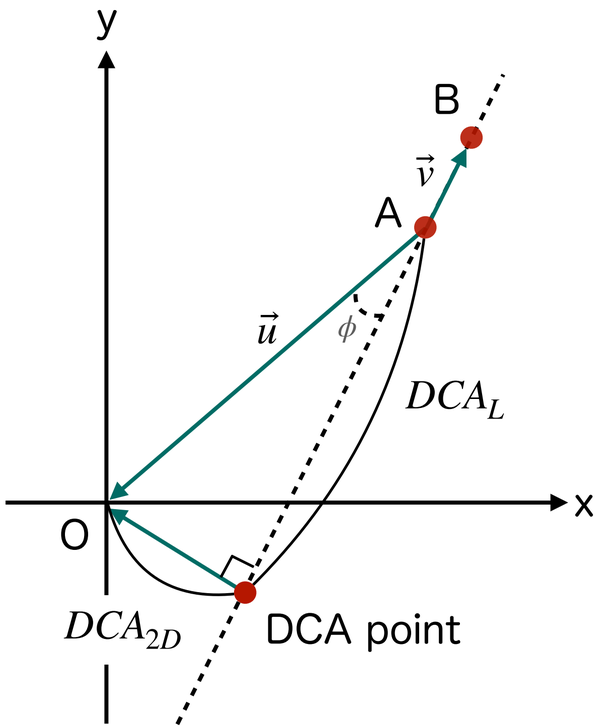
<Simulation>
PYTHIA + GEANT4 (100 events)
p + p collision, $\sqrt{s} = 200\mathrm{GeV}$, no magnetic field.



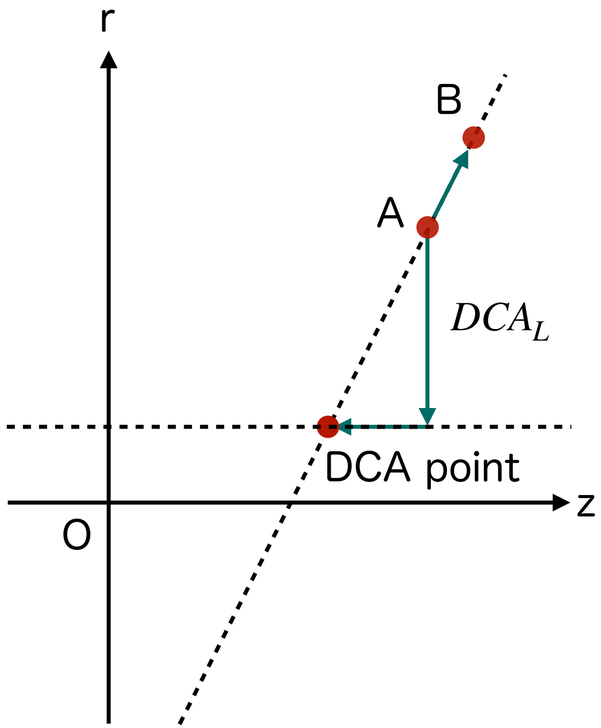
1. Selection a cluster A on the inner barrel and a cluster B on the outer barrel.
2. Connection them with a line (tracklet).
3. Determination the beam spot using tracklets.
4. Connection the three points (A, B, beam spot) by the least-squares method (track).

HOW TO GET THE BEAM SPOT4

x-y plane



r-z plane



Unit vector between A and B : $\vec{v}$

Unit vector between A and O : $\vec{u}$

- To find the beam spot, the distance of closest approach (DCA) between each tracklet and origin was calculated.
- Calculating DCA_{2D} and DCA_L.

$$\mathrm{DCA_{2D}} = \vec{\mathrm{v}} \times \vec{\mathrm{u}} = \vec{\mathrm{u}} \cdot \sin\phi$$

$$\mathrm{DCA_L} = \vec{\mathrm{v}} \cdot \vec{\mathrm{u}} = \vec{\mathrm{u}} \cdot \cos\phi$$

- Using DCA_L, the DCA position of the tracklet can be calculated.

$$DCA_X = DCA_L \times \vec{u}_x + A_x$$

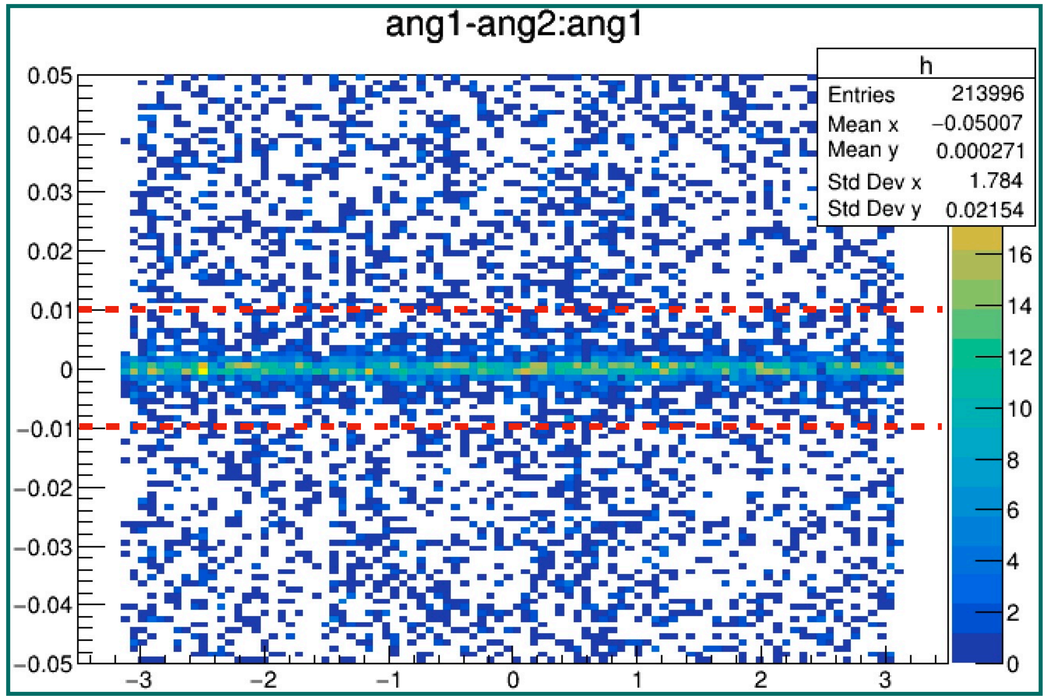
$$DCA_Y = DCA_L \times \vec{u}_y + A_y$$

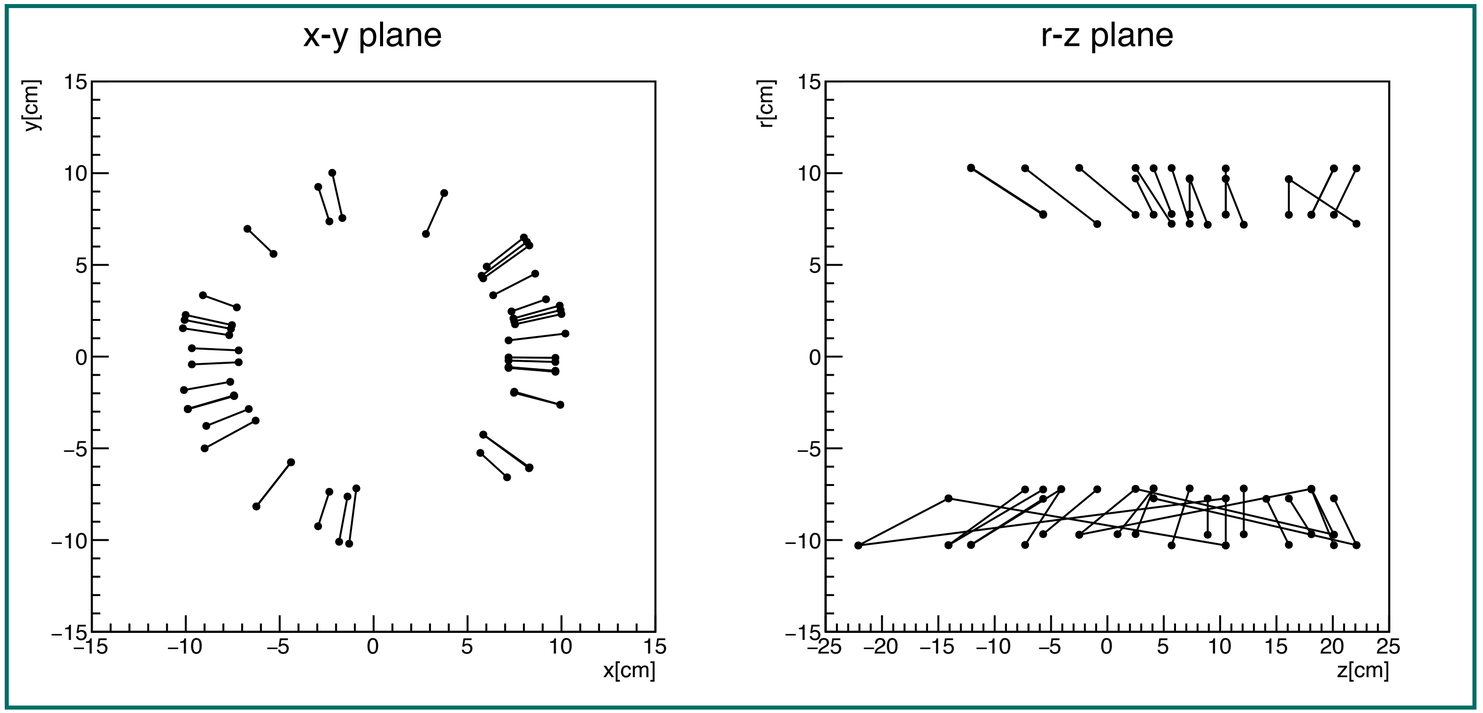
$$DCA_Z = DCA_L \times \vec{u}_z + A_z$$

- <u>The beam spot is the average of the DCA.</u>

TRACKLET

- Tracklets are defined as tracklets with angular difference in the X-Y plane between A and B $\Delta\phi < 0.01$ [rad].



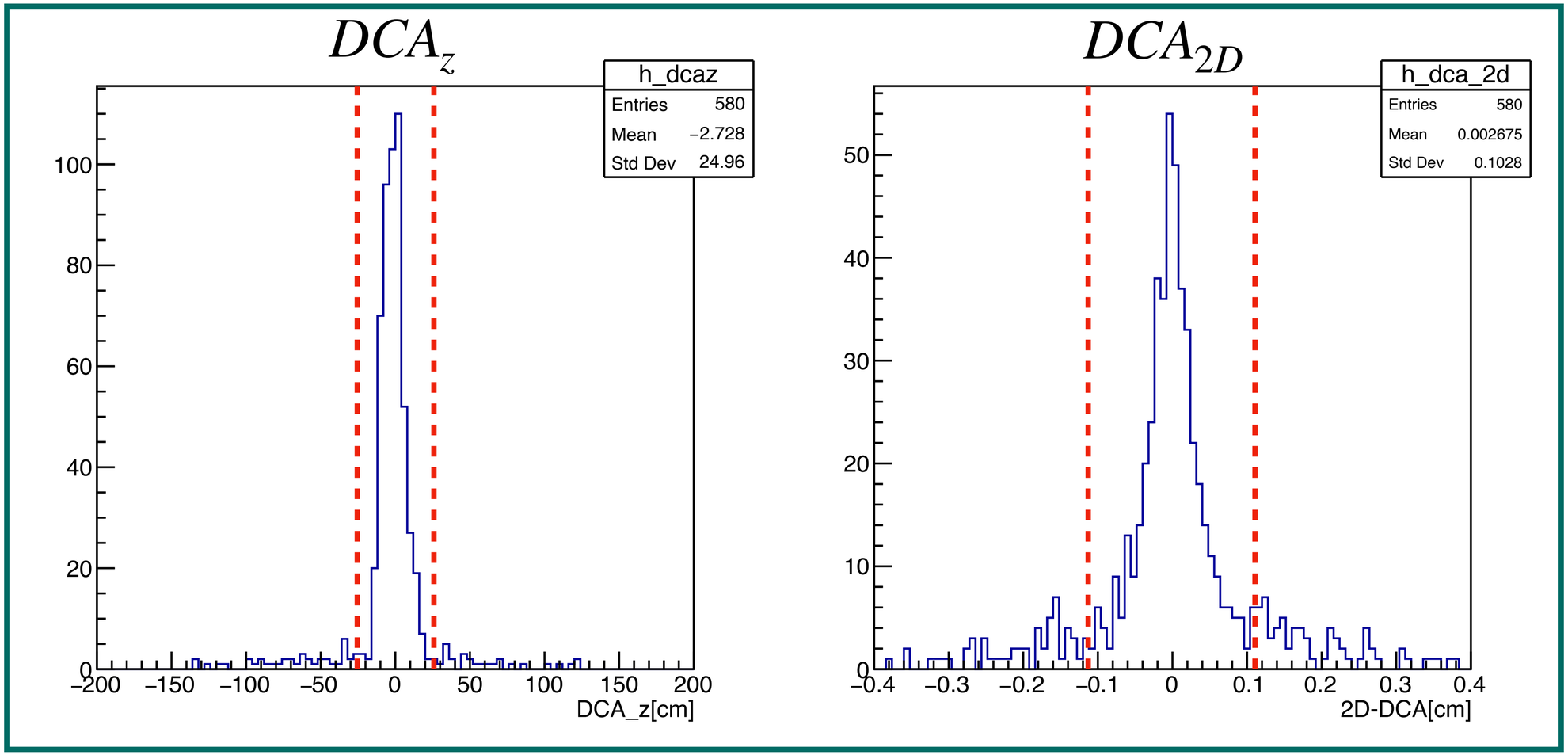


Some tracklets share a cluster.

Some DCA_zs seem to be extremely far from the beam spot.

DCA cut

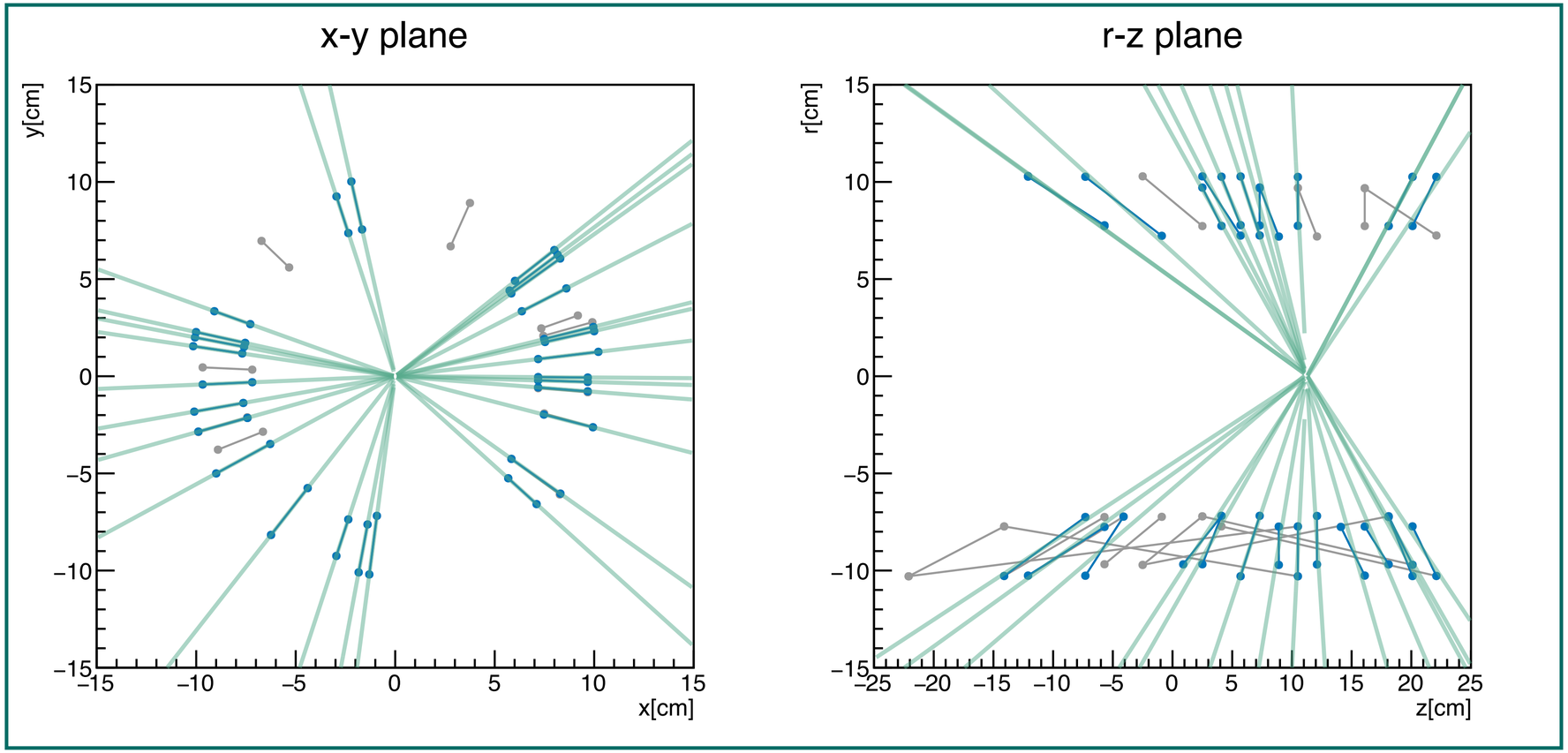
In this study, only tracklets that DCA_{2D} and DCA_z is within 1 sigma from the mean are used.



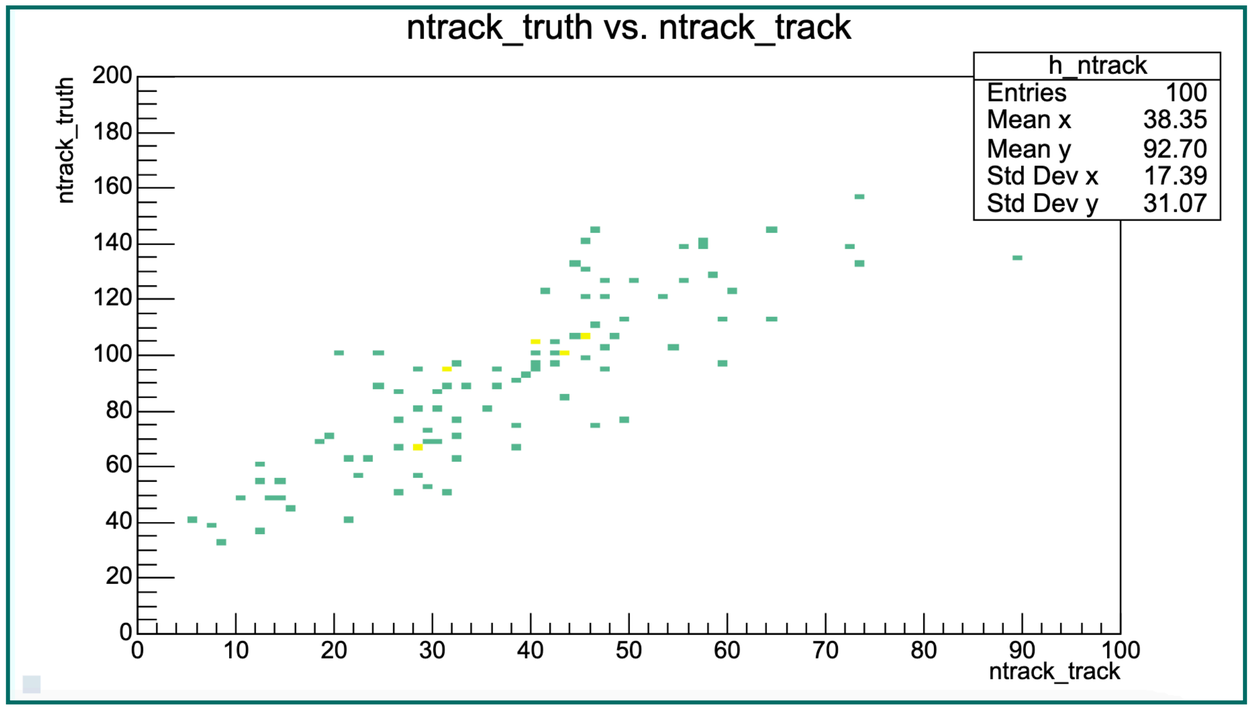
RESULT OF TRACKING

Blue : clusters and tracklets Green : reconstructed tracks

Glay : excluded clusters and tracklets



of tracks


ntrack_truth vs. ntrack_track
h_ntrack
Entries 100
Mean x 38.35
Mean y 92.70
Std Dev x 17.39
Std Dev y 31.07
ntrack_truth
ntrack_track
0
20
40
60
80
100
120
140
160
180
200
0
10
20
30
40
50
60
70
80
90
100