Development of tracking algorithm for sPHENIX INTT

sPHENIX実験-中間飛跡検出器**INTT**を用いたトラッキングアルゴリズム開発について

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sPHENIX

sPHENIX

@Blookhaven National Laboratory in the U.S.

Experiments using the heavy-ion collider RHIC, in commissioning since April 2023.

<Purpose>

Jet and Upsilon particles produced in collisions are measured to determine the properties of the QGP.

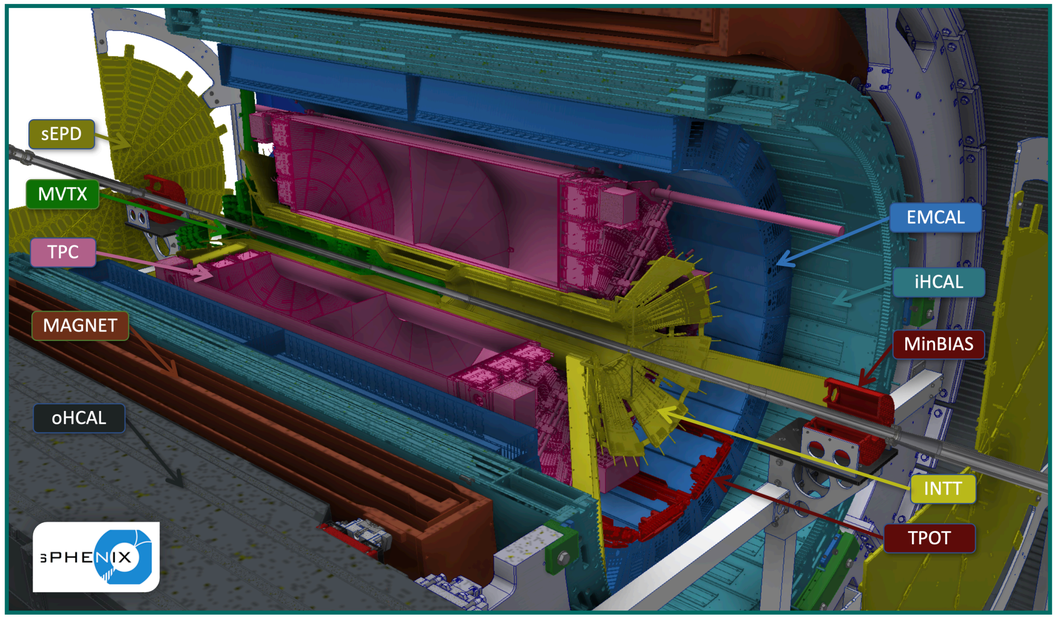
<collision particle>

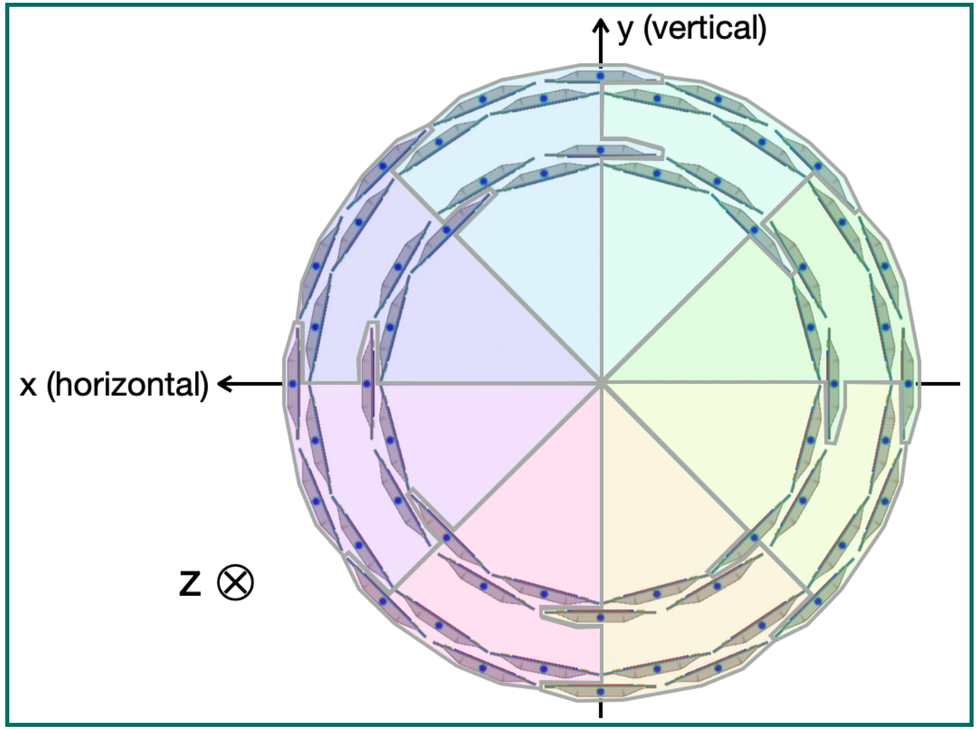
Au+Au (200GeV)

INTT

<u>INTermediate Tracker</u>

- One of the three track detectors used in the sPHENIX experiment, located near the point of impact
- Strip sensor with a two-layer barrel structure
- Located 6~12cm from the beam pipe
- High time resolution and plays an important role in track reconstruction





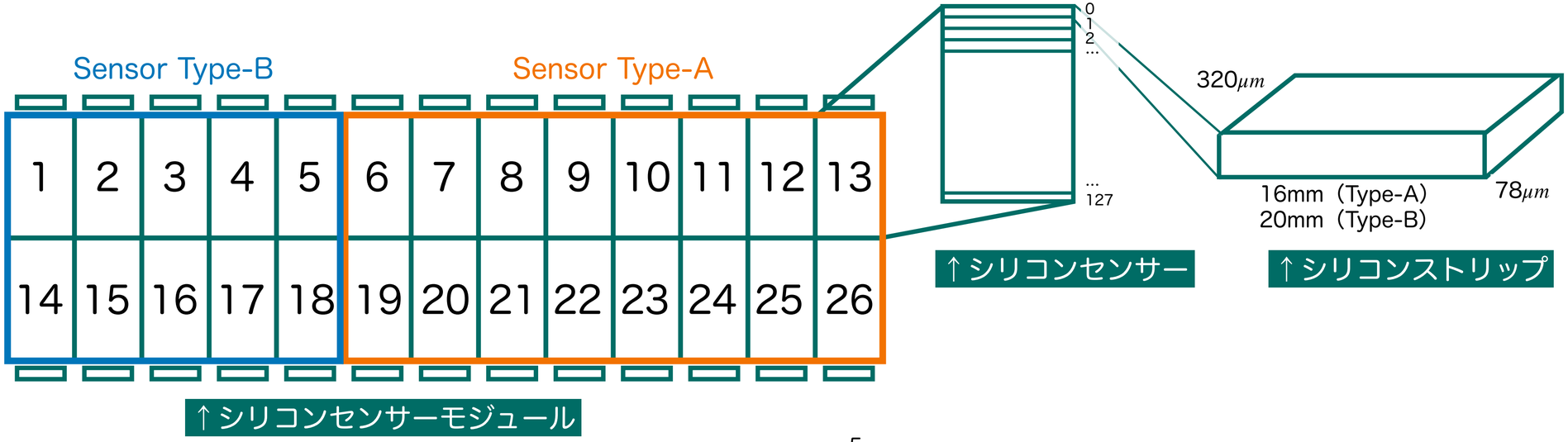
INTT SILICON SENSOR

- Silicon sensor

  $78\mu\mathrm{m} \times 320\mu\mathrm{m} \times 320\mu m$ strips ×128

- Silicon sensor module

  26 silicon sensor
  - Type-A silicon sensor
  - Type-B silicon sensor

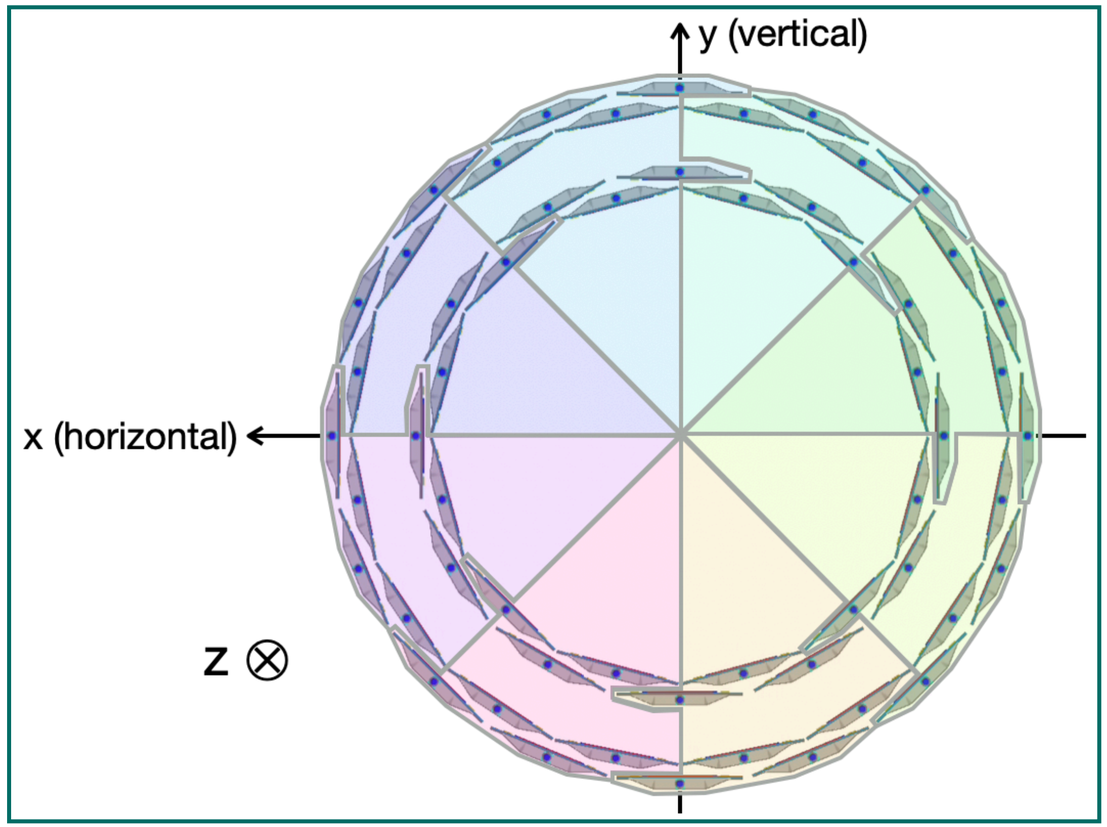


TRACKING

Tracking : reconstructing the trajectory using the hit position and beam spot, which is necessary to calculate p_T.

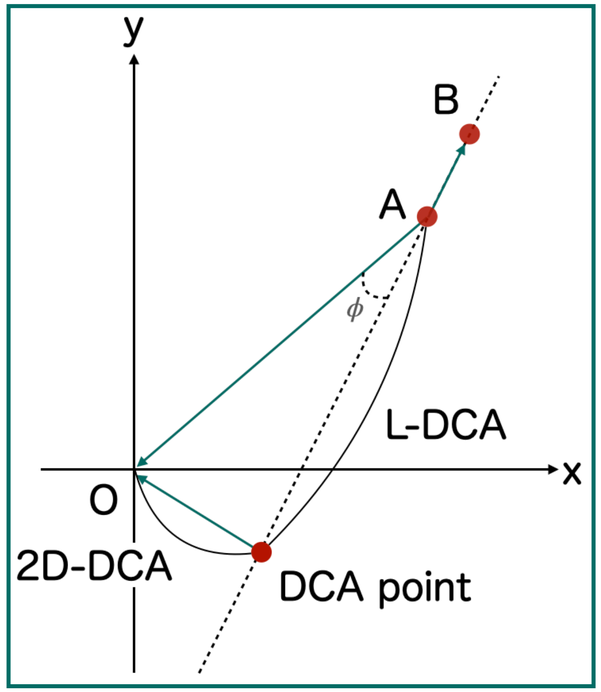
In this study, the tracking algorithm was developed using simulation results of pp collisions (200 GeV, no magnetic field).

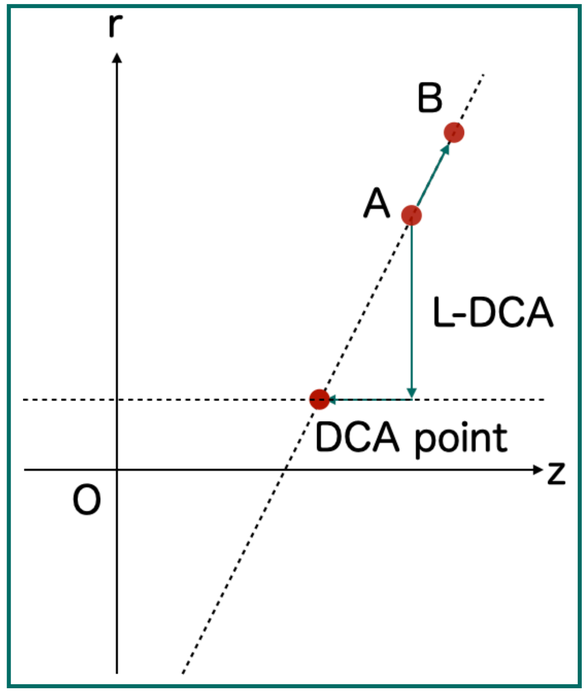
TRACKING METHOD



1. Select one point A on the inner barrel and one point B on the outer barrel and connect them with a line. (tracklet)
2. Determine the beam spot.
3. Connect the three points (A, B, beam spot) by the least-squares method and make it a track.

HOW TO GET THE BEAM SPOT





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

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

Angular difference in the X-Y plane between A and B : ϕ

- To find the beam spot, the distance of closest approach (DCA) between each tracklet and origin was calculated.

- Calculating 2D-DCA and L-DCA.

$$2D - DCA = \vec{v} \times \vec{u} = \vec{u} \cdot \sin\phi$$

$$L - DCA = \vec{v} \cdot \vec{u} = \vec{u} \cdot \cos\phi$$

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

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

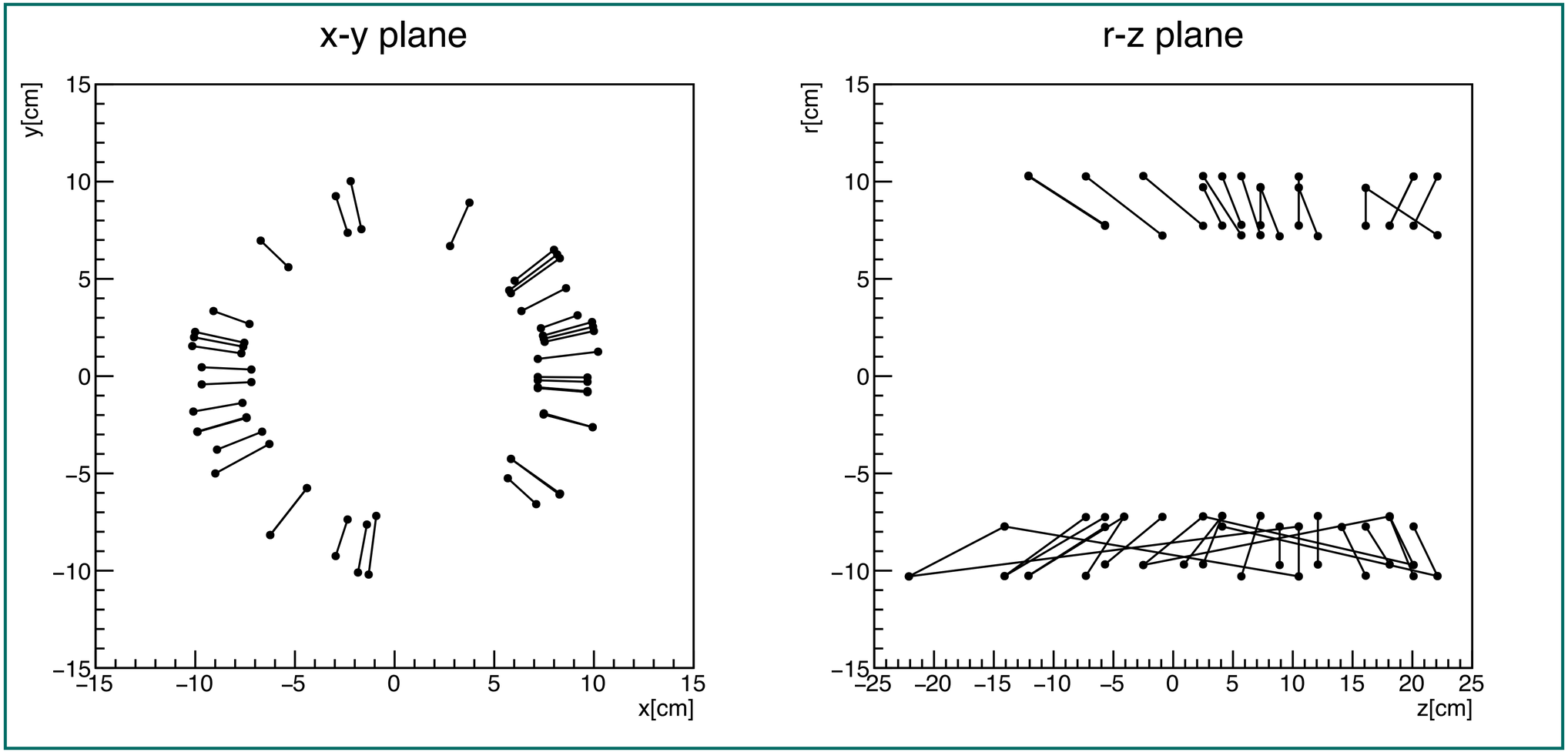
$$DCA_Y = L_{DCA} \times \vec{u}_y + A_y$$

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

- The beam spot is the average of the DCA.

TRACKLET

- Tracklets are defined as those with $|\phi| > 0.1$.

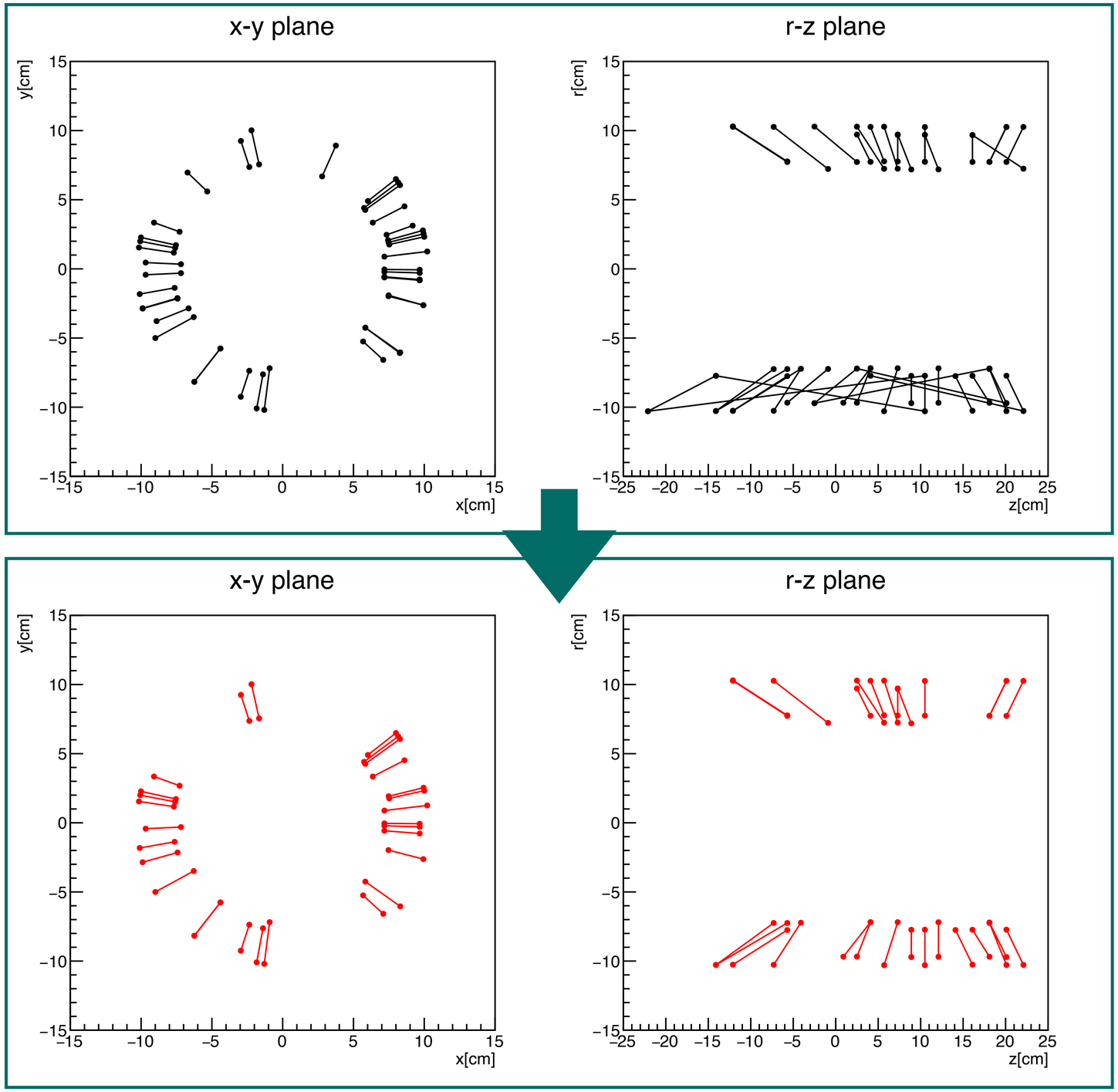


Some tracklets share hit points.

Some $\mathrm{DCA_z}$s seem to be extremely far from the beam spot.

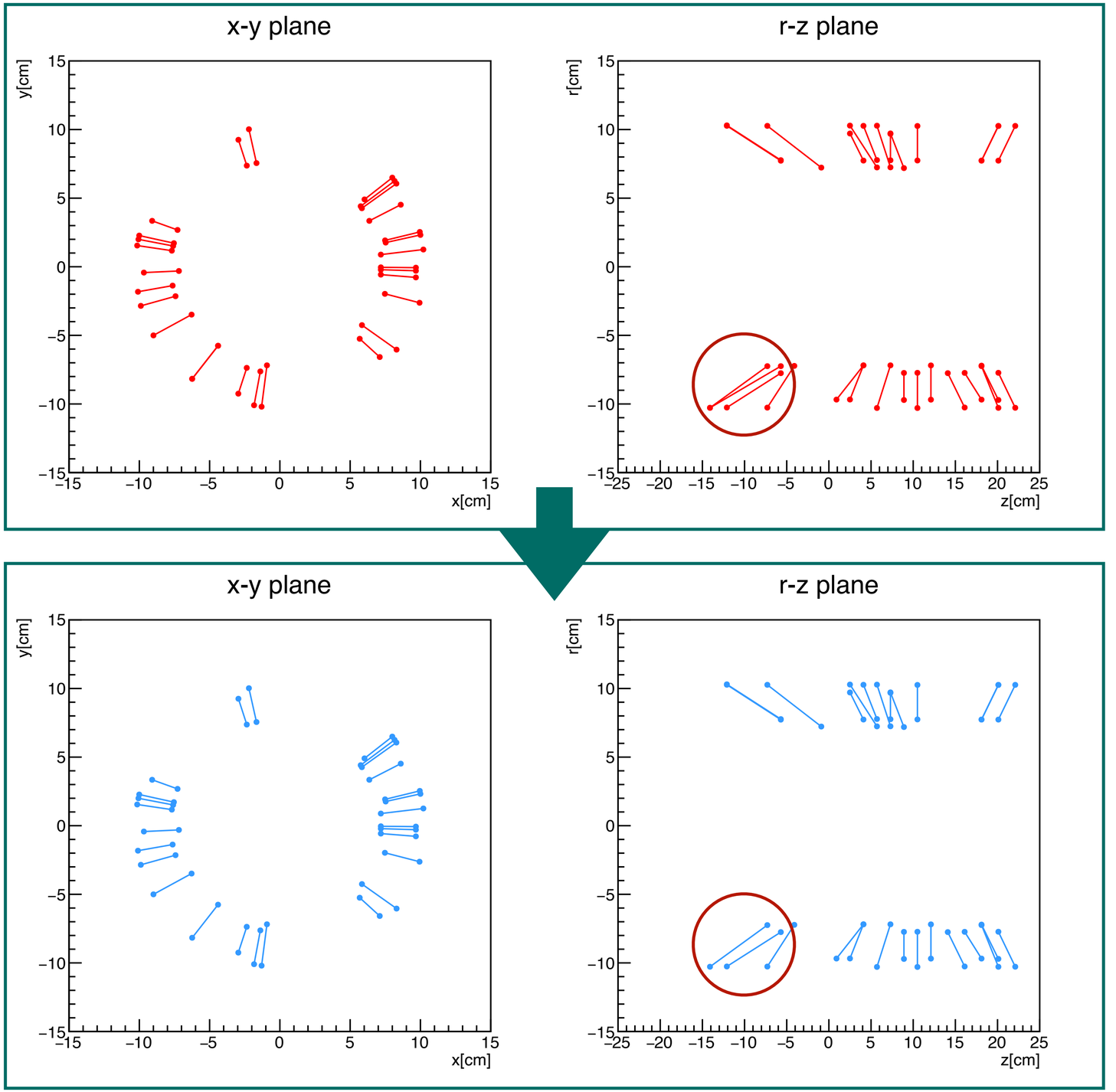
DCA CUT

- A DCA cut was applied to exclude those extremely far from the beam spot.
- In this case, only tracklets within 1 sigma from the 2D-DCA mean and DCA_z were used.



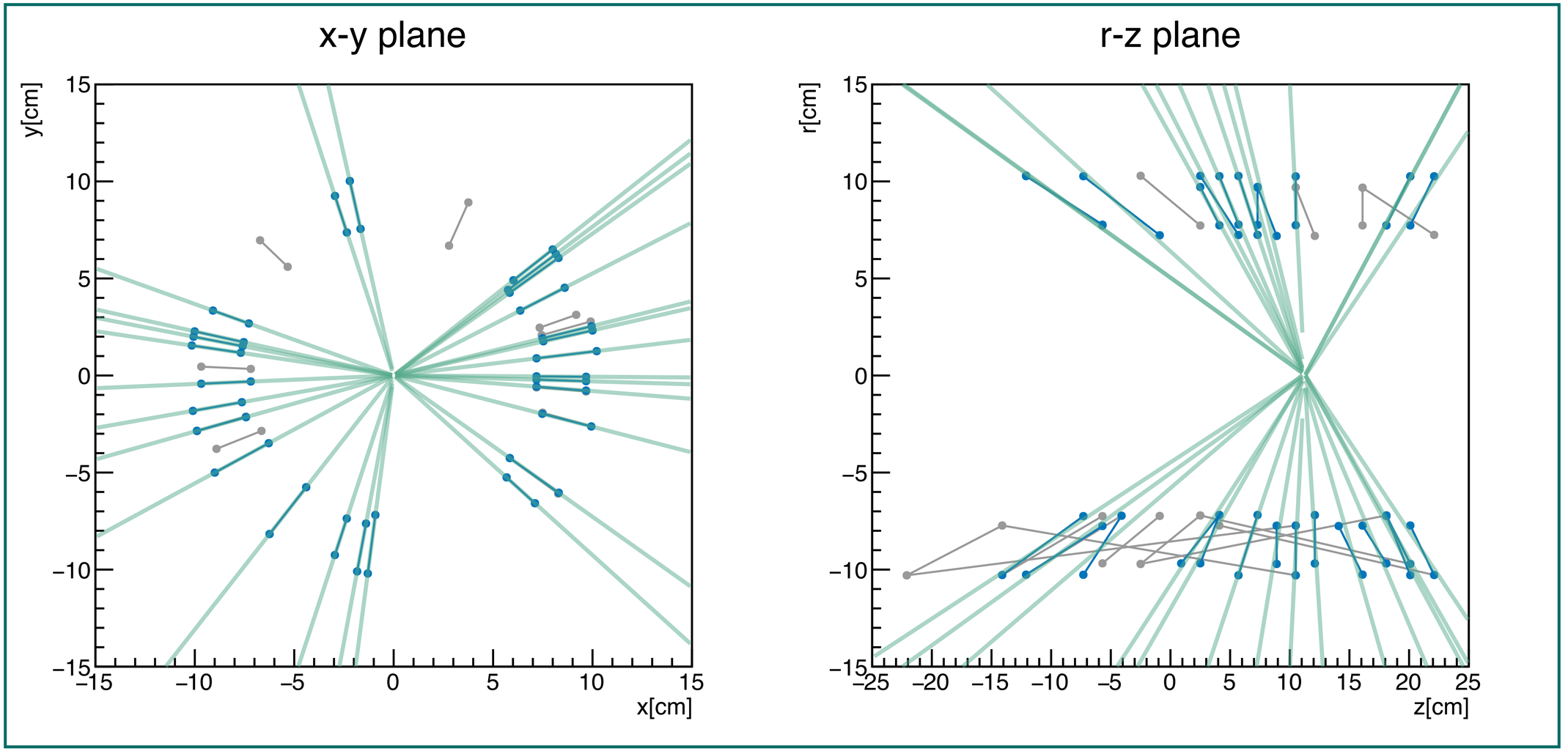
ELIMINATION OF POINT SHAREING

- If the tracklets share a point, the one whose 2D-DCA is smaller is used.



RESULT OF TRACKING

- Blue : hits and tracklets Green : reconstructed tracks
- Glay : eliminated hits and tracklets



SUMMARY

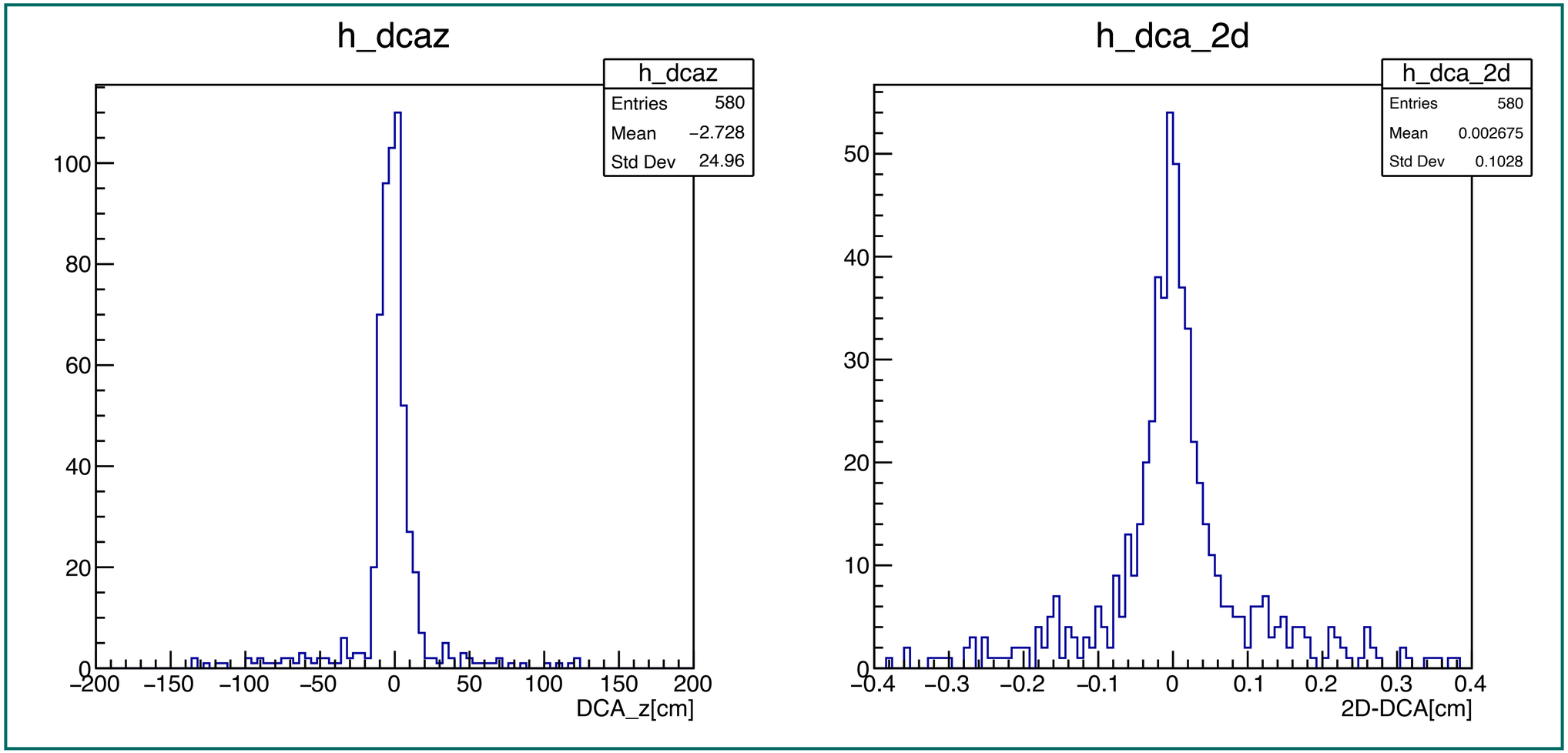
- Tracking in simulations of pp collisions (no magnetic field).Done!

Next to do

- Tracking in pp collisions with magnetic field and Au+Au collisions

BACK UP

DCA-zと2D-DCA


h_dcaz
h_dcaz
Entries 580
Mean −2.728
Std Dev 24.96
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200
DCA_z[cm]
h_dca_2d
h_dca_2d
Entries 580
Mean 0.002675
Std Dev 0.1028
50
40
30
20
10
0
−0.4 −0.3 −0.2 −0.1 0 0.1 0.2 0.3 0.4
2D-DCA[cm]