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U.S. DEPARTMENT OF ENERGY
Office of Science

# Trajectory Hits Study

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LBL EIC meeting
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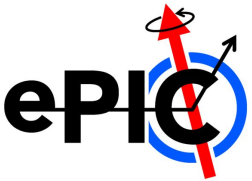
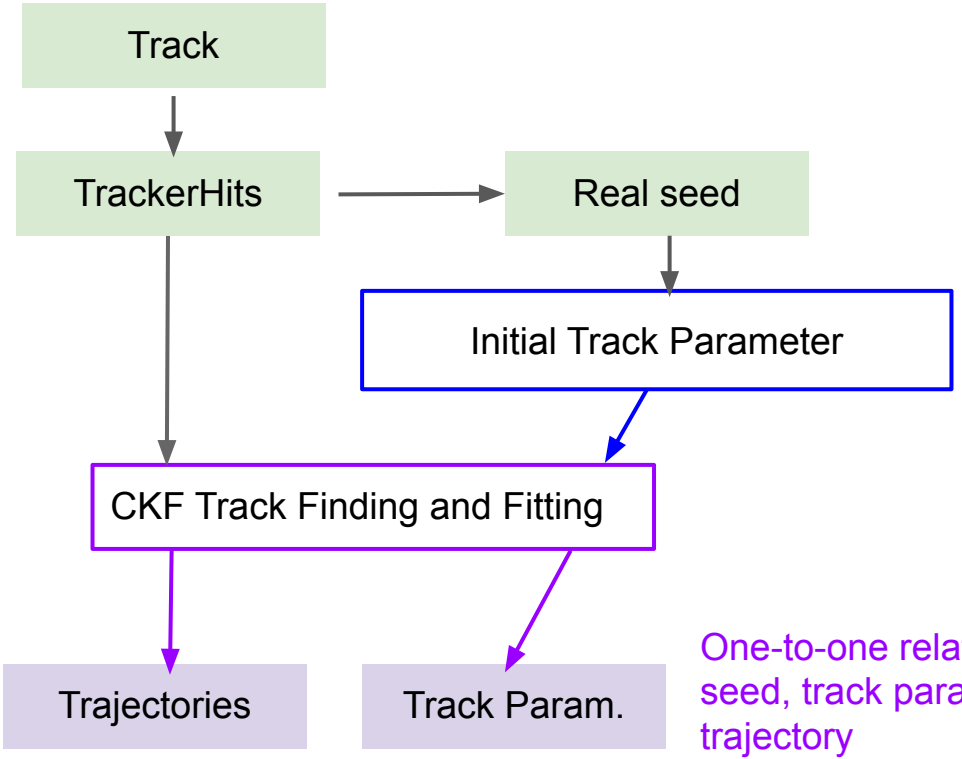


# Tracking in EICrecon




One-to-one relation b/w seed, track params, and trajectory

Q:
What hits are used to form trajectories

- Quality of seeding
- Quality of fitting
  - Chi2 per hit
  - # of hits / trajectory
  - Duplicated trajectories
  - …

# ACTS Hits Selection

acts/Core/include/Acts/TrackFinding/**MeasurementSelector.hpp**

(CKF)

if no hits on surface→ nHoles++

for (track state : track state candidates):

Track state → hits on surface

Calculate chi2 of all hits and rank, find chi2min

if chi2min >chi2CutOff (default = 15) → save chi2min as **outlier**

<chi2CutOff → save as **Measurements** up to numMeasurementsCutOff (=10) candidates

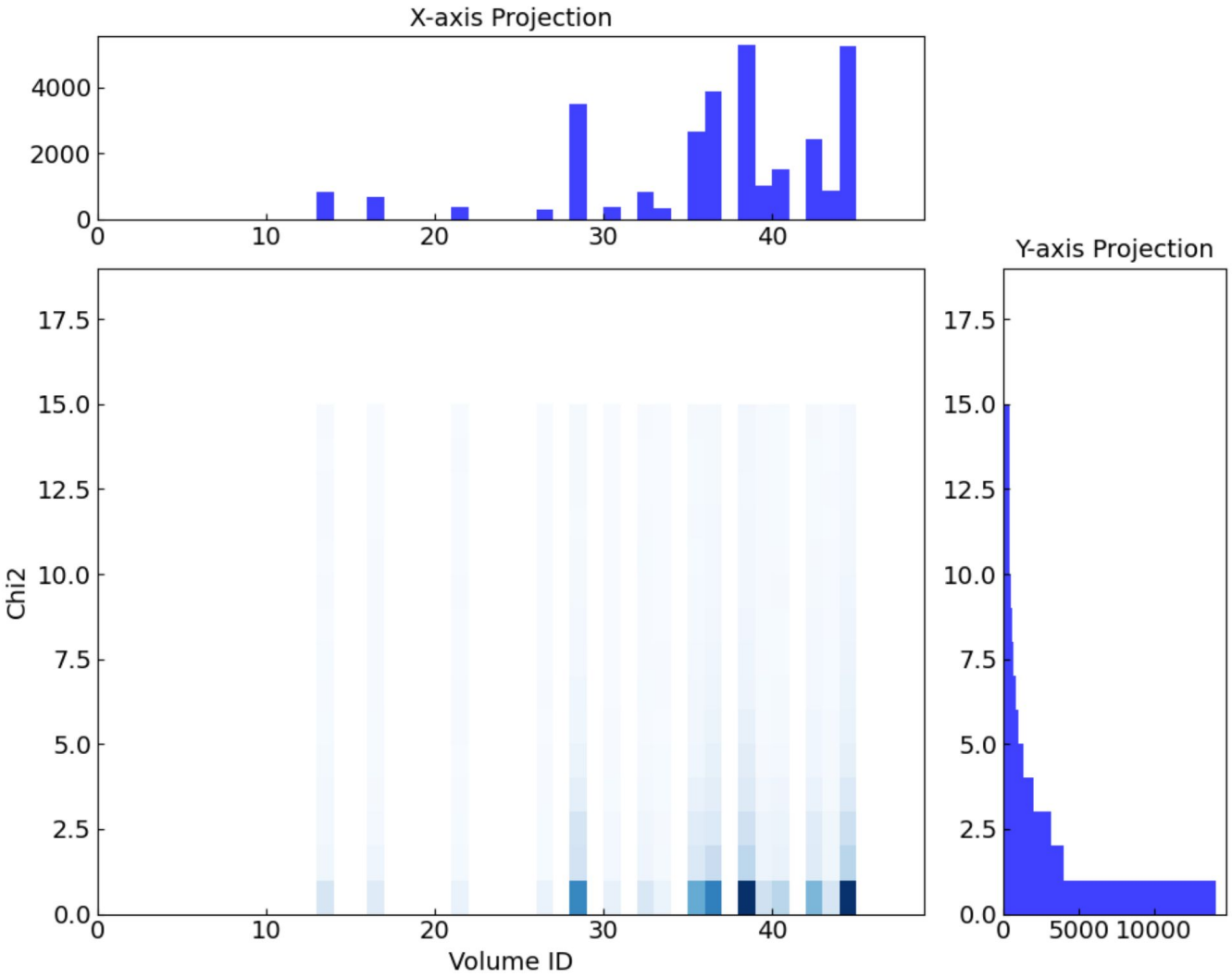
```
 9  namespace eicrecon {
10      struct CKFTrackingConfig {
11          std::vector<double> m_etaBins = {};  // {this, "etaE
12          std::vector<double> m_chi2CutOff = {15.}; //{this, "
13          std::vector<size_t> m_numMeasurementsCutOff = {10};
14      };
15  }
```

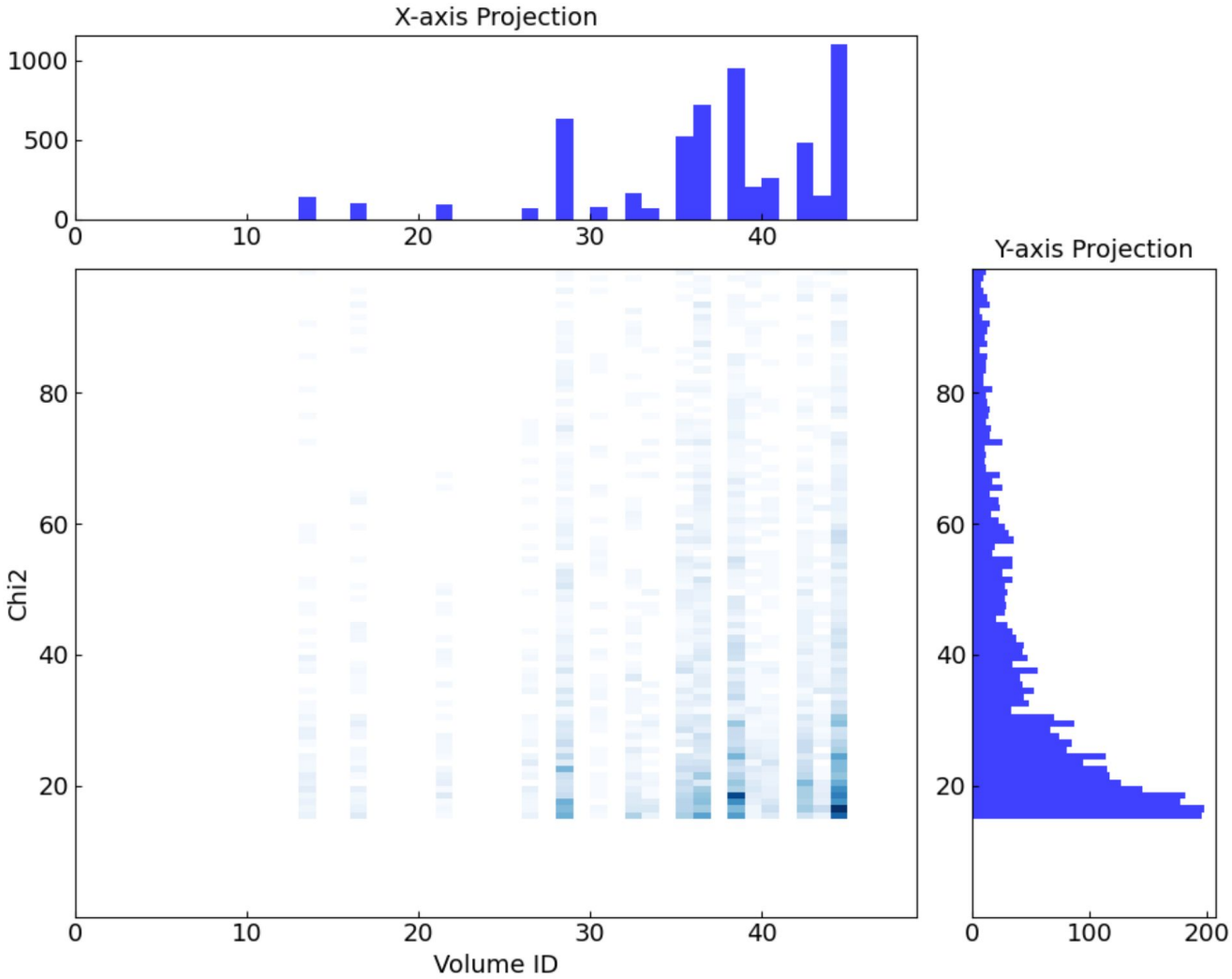
# of sensitive surfaces = nHoles + nMeasurements + nOutliers

# Analysis Script

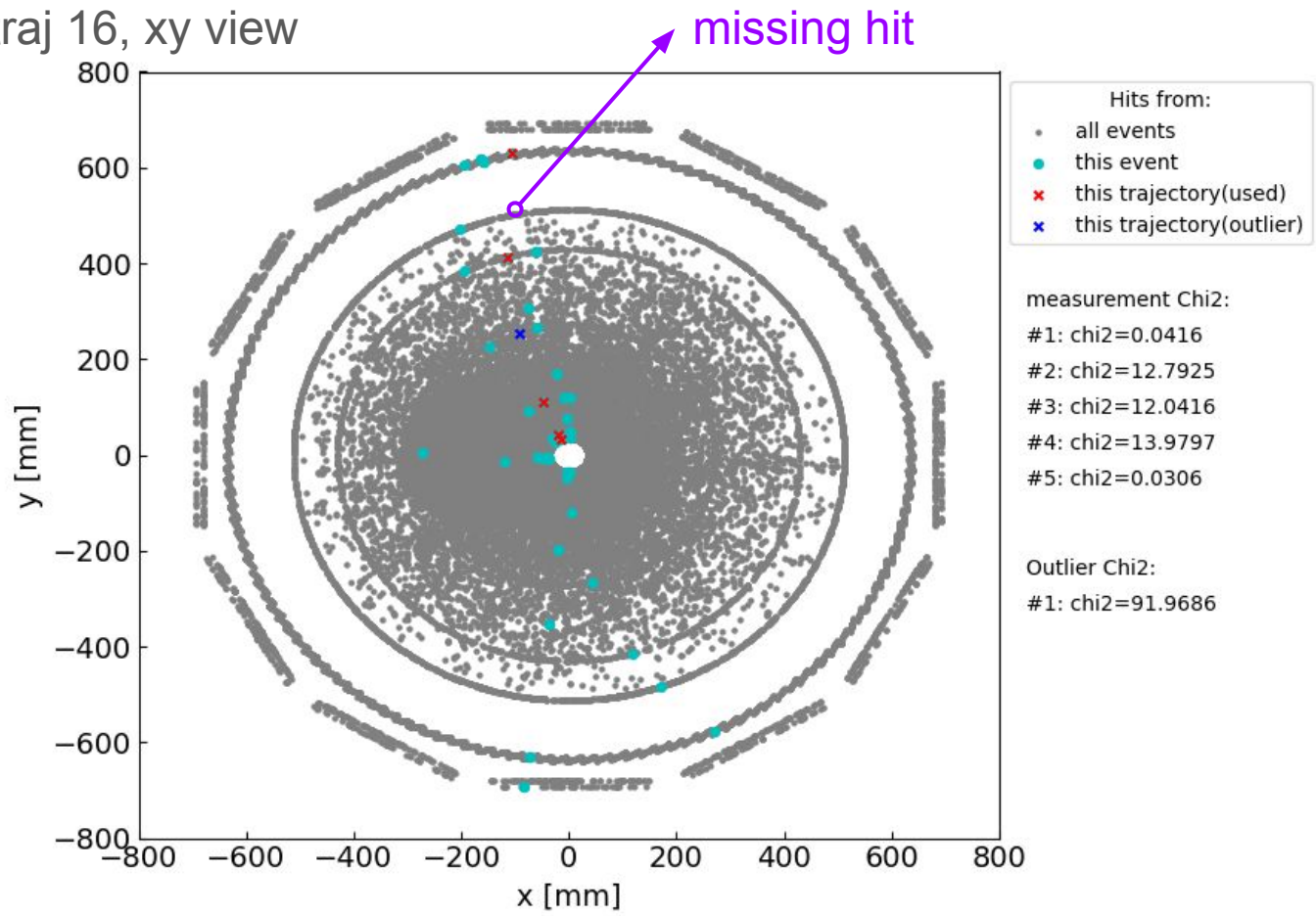
- Jupyter notebook with uproot4 to extract info from root trees (metadata, events …), checked with Nov. simulation campaign data.
- Functions:
  - Podio CollectionID to branches
  - Convert ACTS geometry ID of each hits to volume and surface ID
  - For each trajectory, extract associated hits from the pointer member, and chi2 from vector member

**Event sample:**
root://dtn-eic.jlab.org//work/eic2/EPIC/RECO/23.11.0/epic_craterlake/DIS/NC/18x275/minQ2=10/pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.0000.eicrecon.tree.edm4eic.root

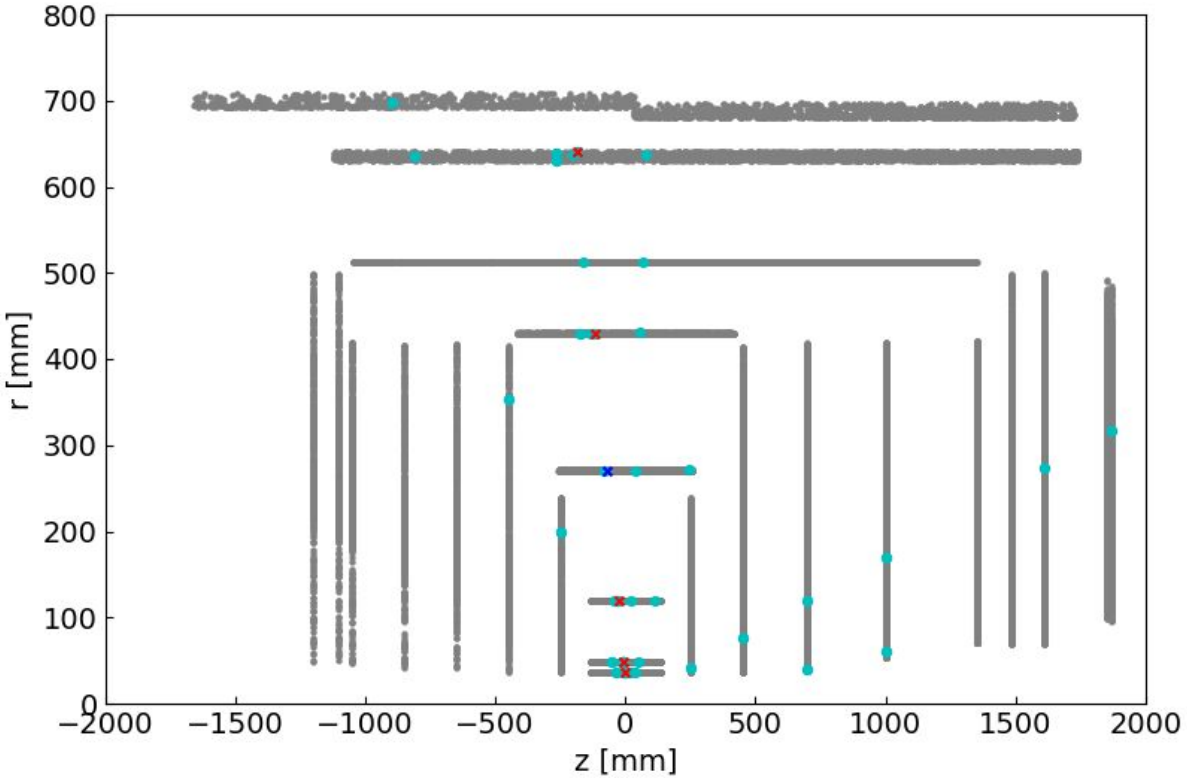

X-axis Projection
4000
2000
0
0
10
20
30
40
Y-axis Projection
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Chi2
0
10
20
30
40
Volume ID
0
5000
10000


X-axis Projection
1000
500
0
0
10
20
30
40
Y-axis Projection
80
60
40
20
0
100
200
Chi2
Volume ID

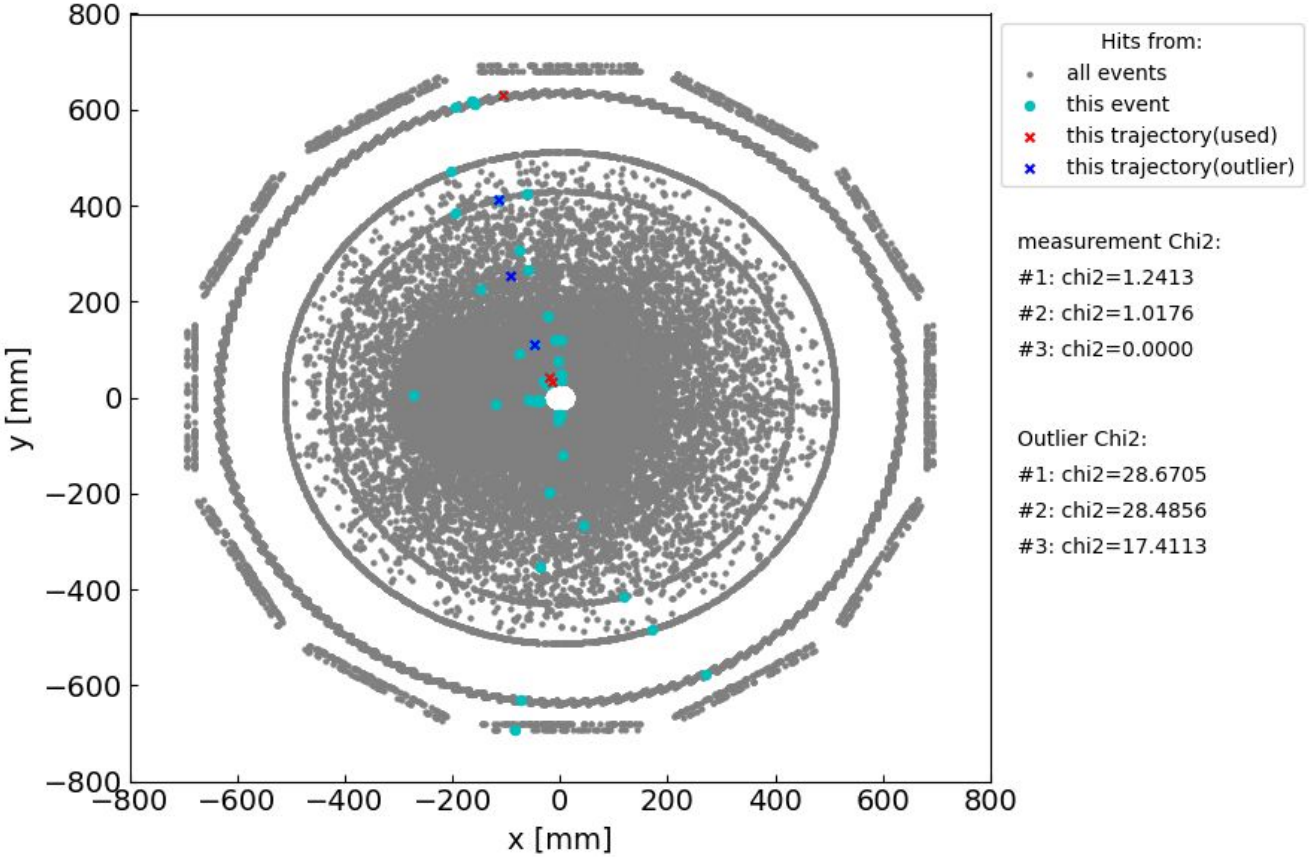
# Event 1, traj 16, xy view



# Event 1, traj 16, zr view

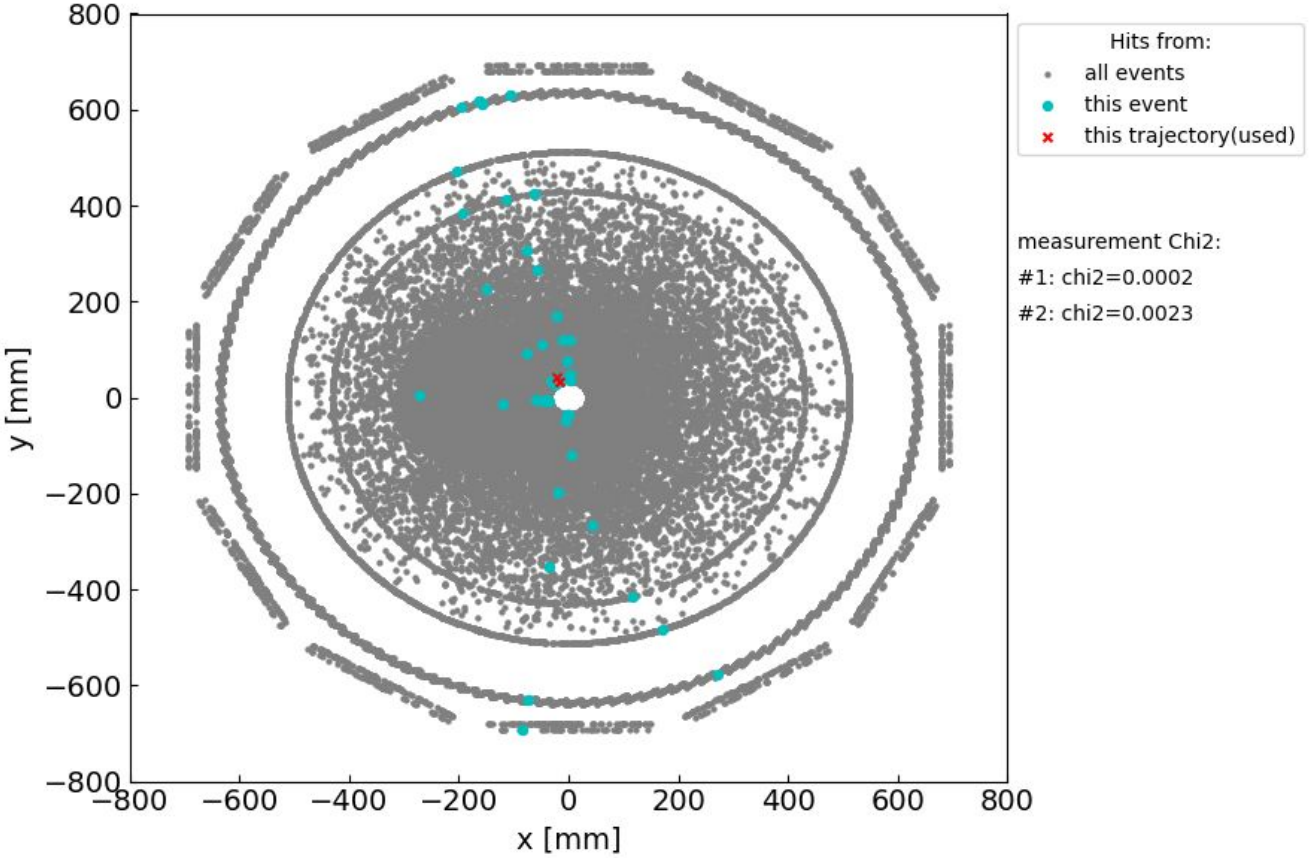


# Event 1, traj 14, xy view



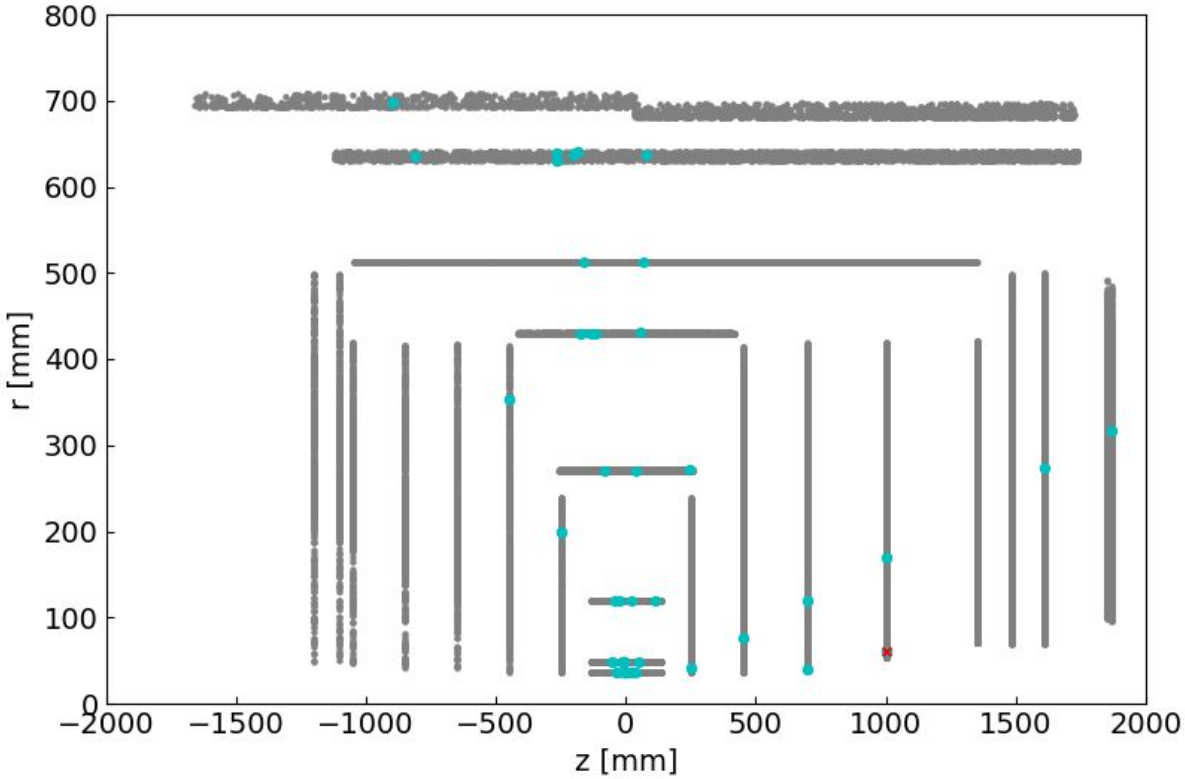
# Event 1, traj 15, xy view

Trajectory with only 2 measurements



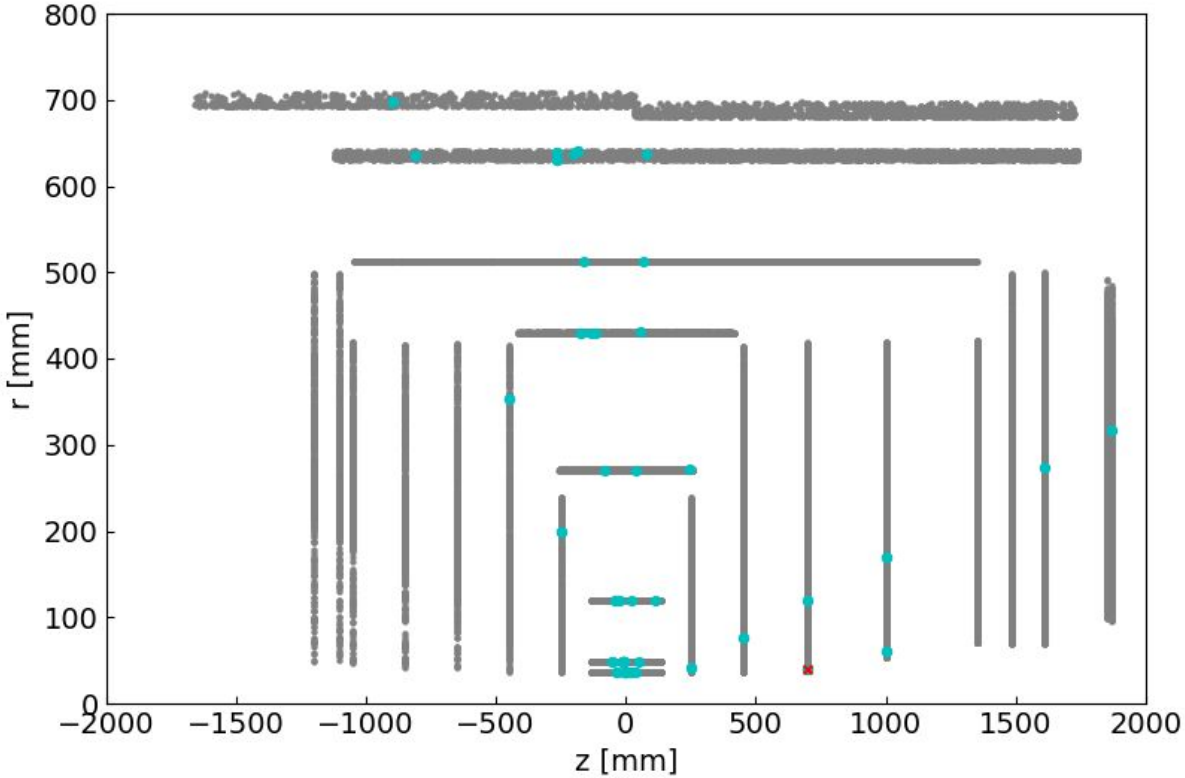
Event 1, traj 4, zr view

Trajectory with only 1 measurements



Event 1, traj 3, zr view

Trajectory with only 1 measurements



# To do

- Optimize Chi2 cut
  - Chi2 distribution at each tracking surface
  - Chi2 calculation for outer silicon barrels
- Understand missing hits
- Understand trajectory with less than 3 hits
  - Seeding quality?
- Use trajectory-hit info to remove duplicates etc