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U.S. DEPARTMENT OF

**ENERGY**

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# DD4HEP Track Reconstruction Status

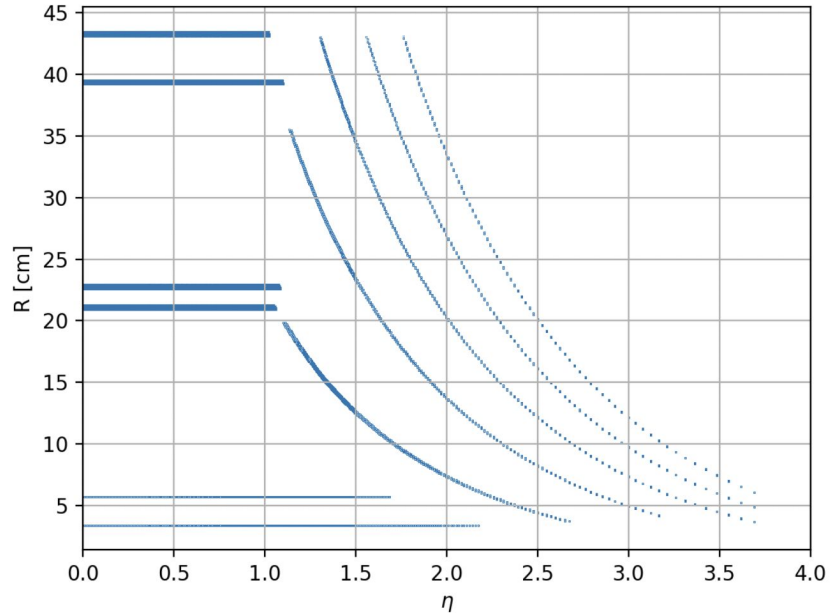
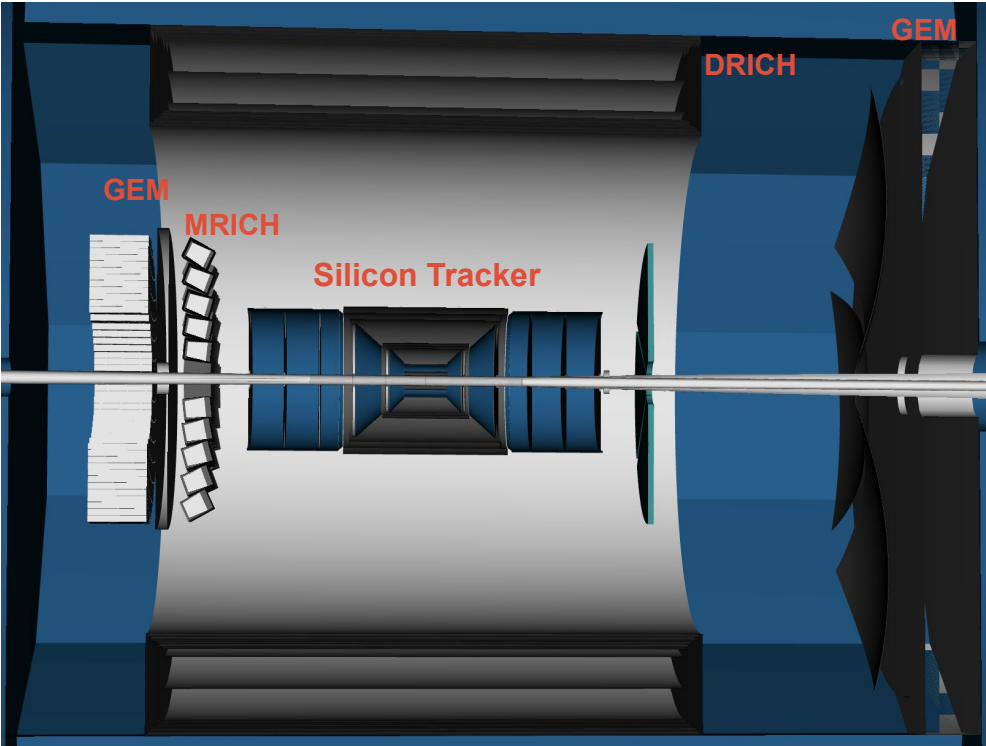
Shujie Li

Thanks: Whitney Armstrong, Sylvester Joosten, Wouter Deconinck, Reynier Cruz Torres, Ernst Sichtermann

**ATHENA Tracking WG meeting**

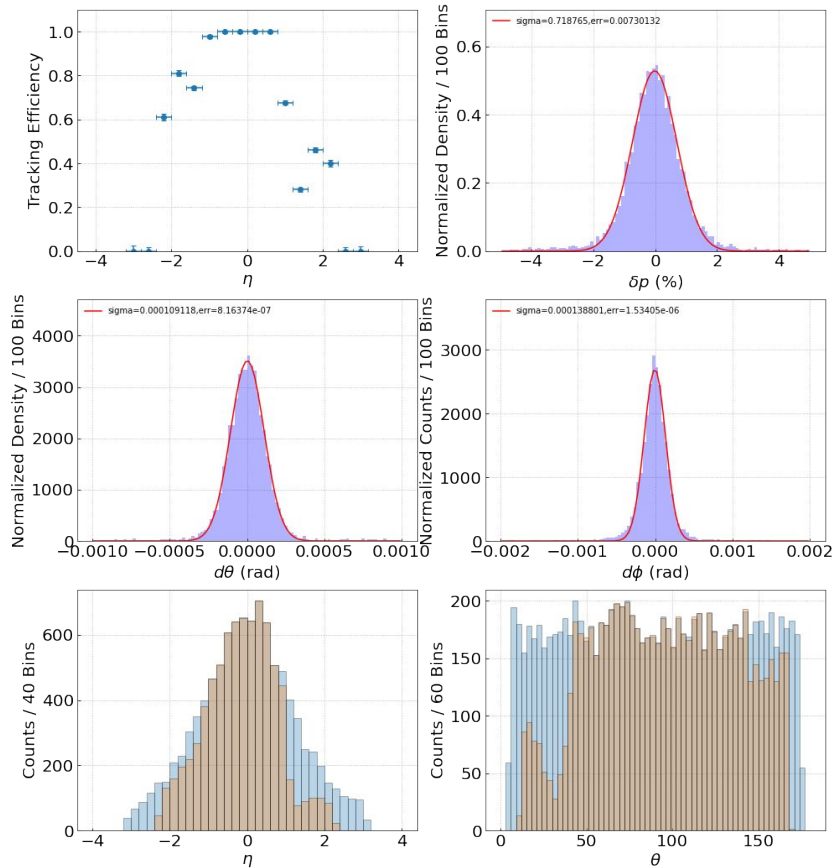
**Sept 7, 2021**

# Acadia-v1 Configuration



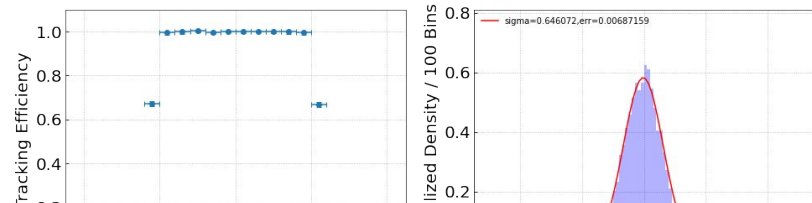
# Standard Configuration

Tracker Benchmark (Truth Init.)



# Remove MRICH and DRICH

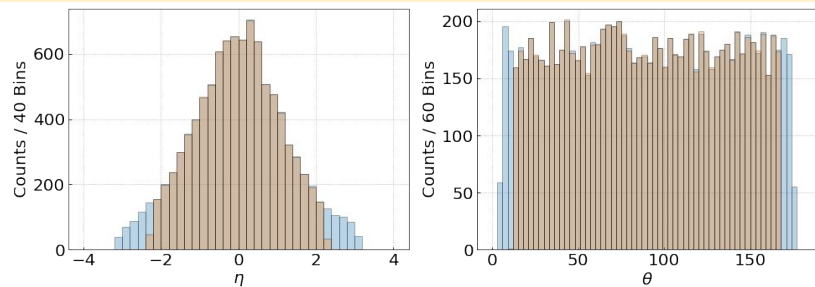
Tracker Benchmark (Truth Init.)



Huge improvement in efficiency without RICHes. Could be...

- Multi-scattering, or material-related issue (physical or with ACTS)
- ACTS track reconstruction quality

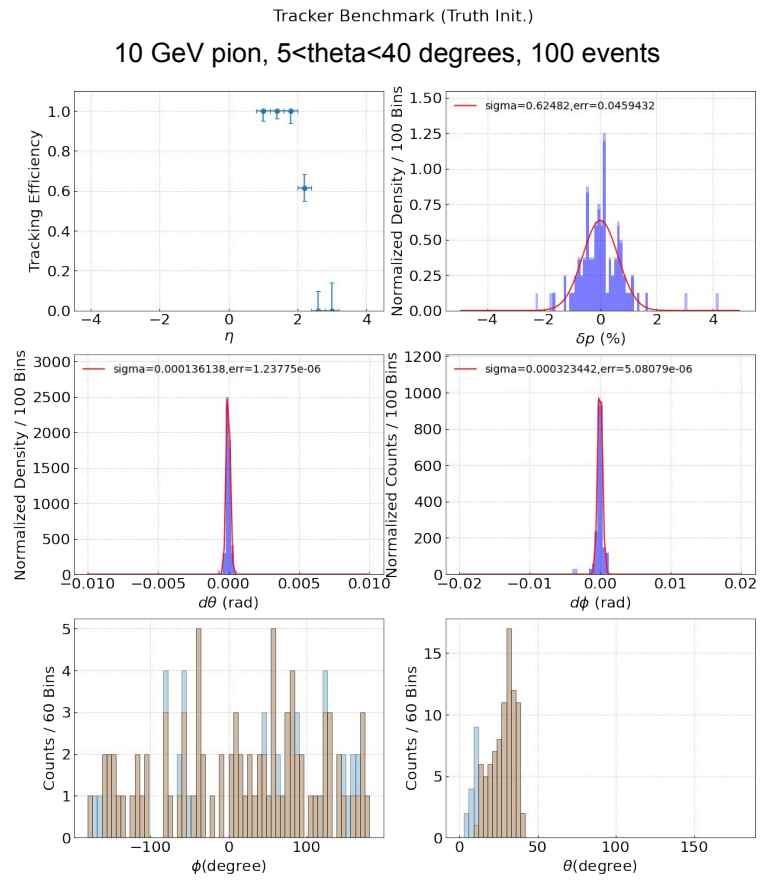
Inefficiency at  $\text{abs}(\eta) > 2$  is under investigation



# Inefficiency between $1 < \text{abs}(\eta) < 2$

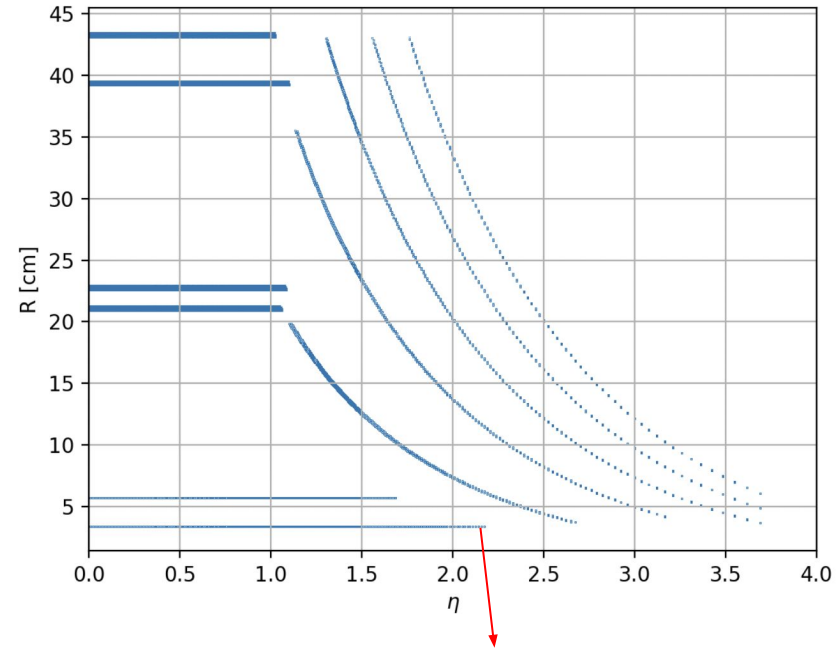
**Fixed** by updating how the Cherenkov detectors track secondaries

See [commits](#) by Wouter



# No tracks at $|\eta| > 2$

- Hypothesis 2: tracking algorithm performance
  - limited number of hits available for the Kalman filter at forward region
  - Chi2 cuts (default = 15)

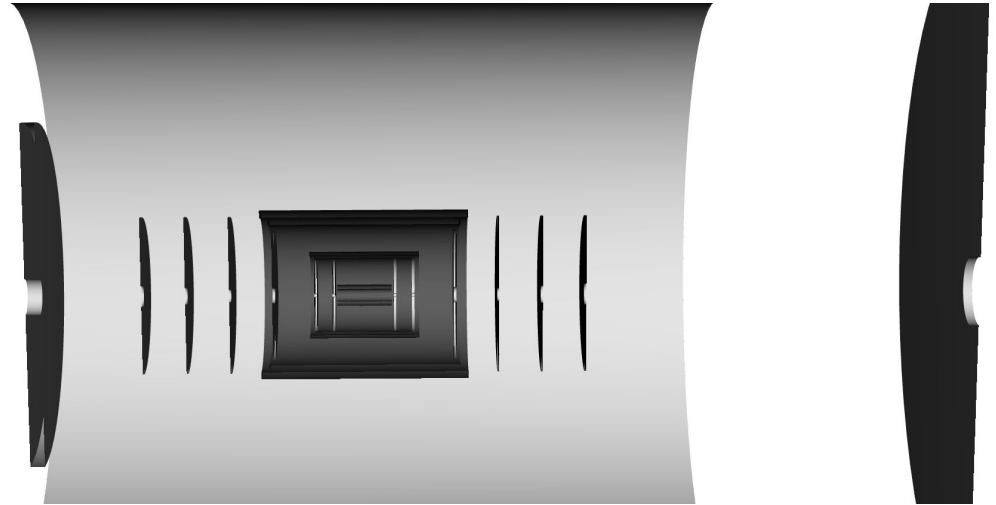


No track once missed the vertex layer

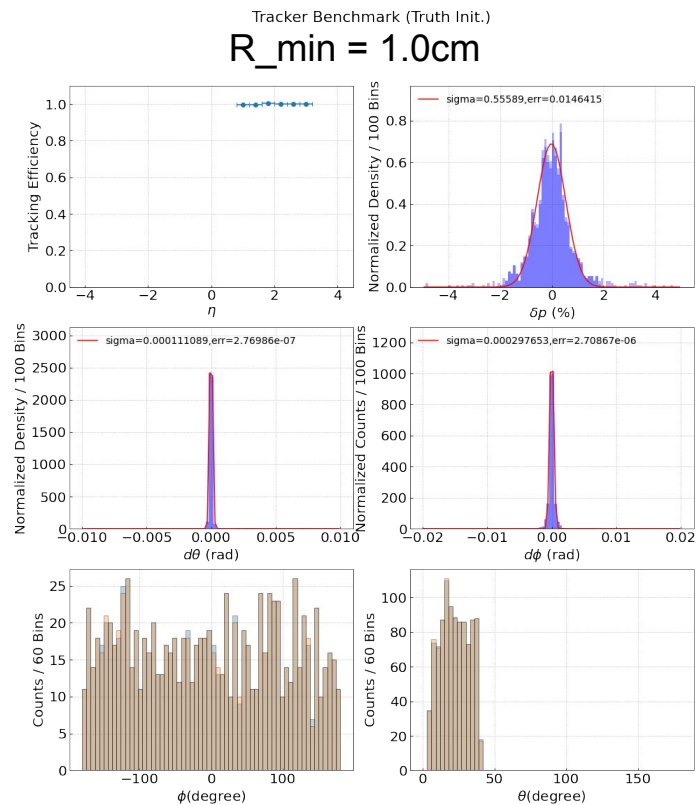
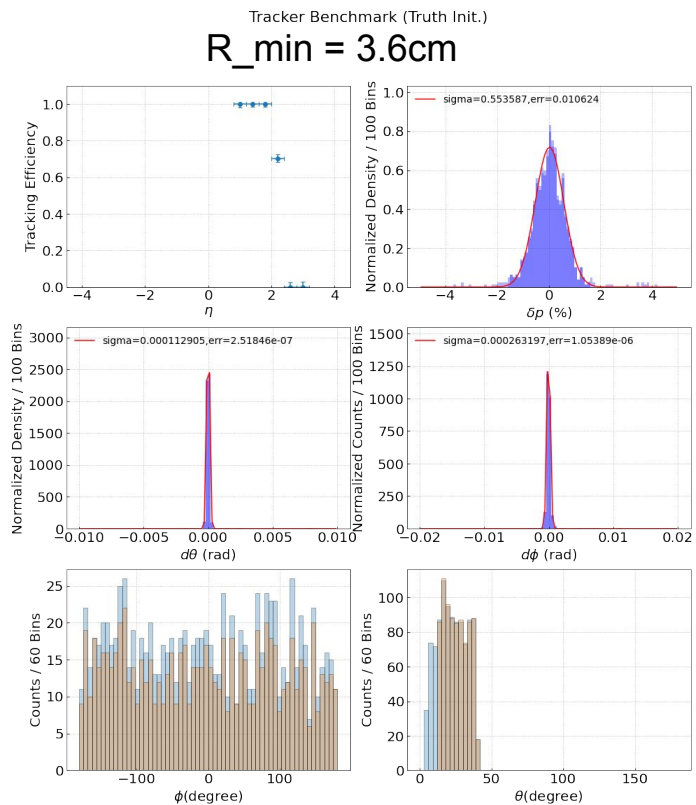
# No tracks at $|\eta| > 2$ : test configurations

- Only tracking detectors
  - silicon barrel
  - silicon disk
  - GEM
- No cones, support shells
- No beampipes

Added disks at  $z = \pm 16$  cm with  $r_{\min} = 1$  cm

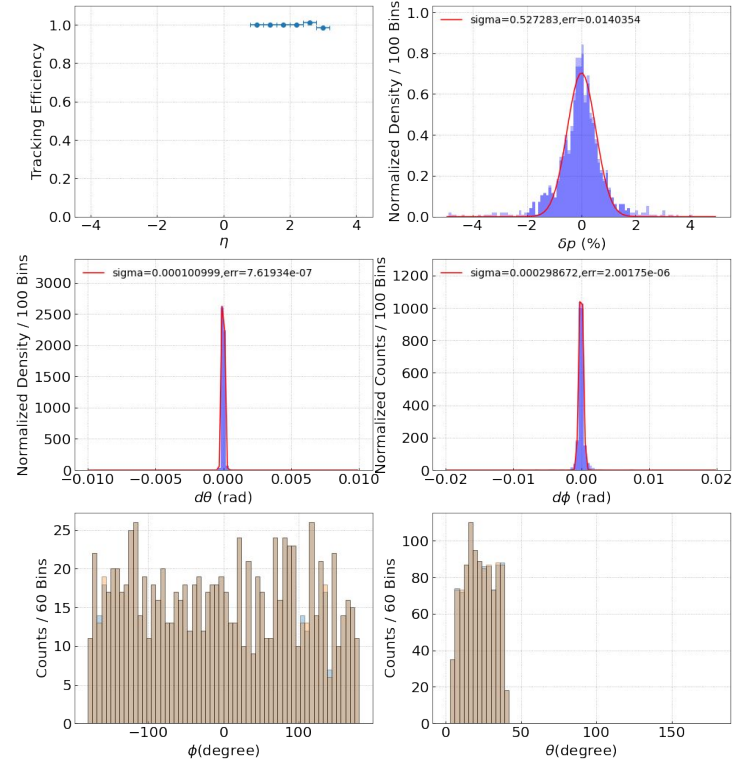
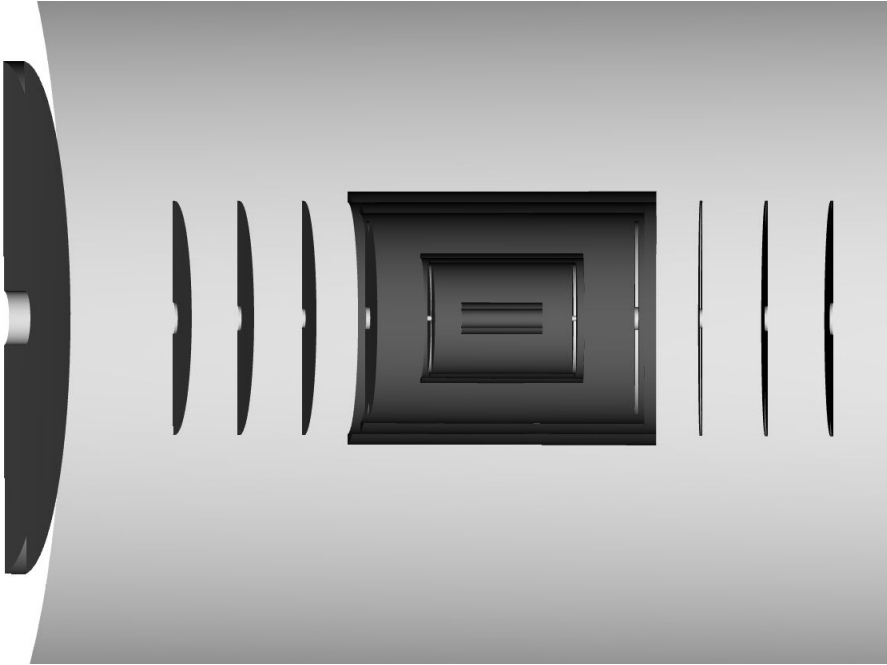


# Test1: Adding disks at $z=\pm 16\text{cm}$



# Test 2: Standard trackers with disk1 rmin=1cm

Tracker Benchmark (Truth Init.)

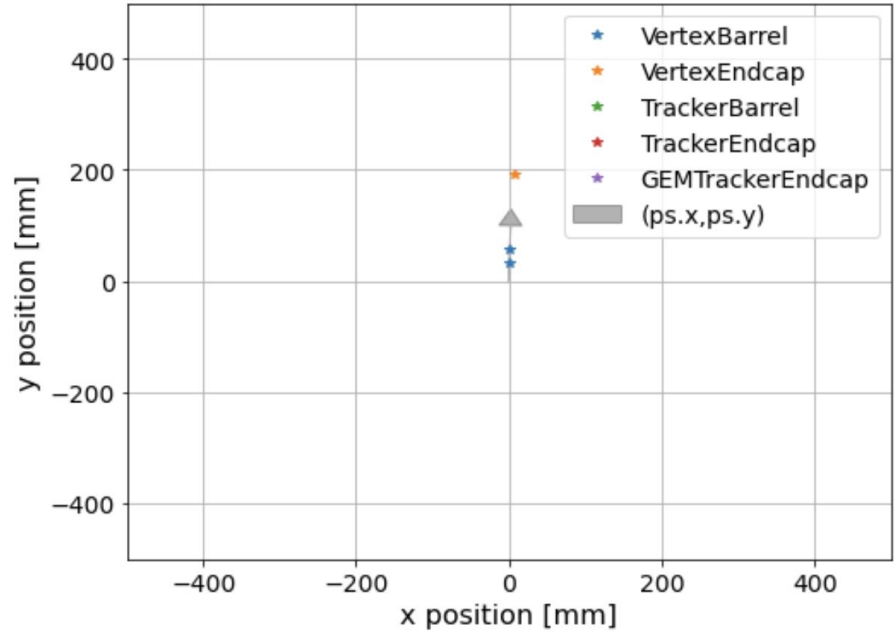


Conclusion: adding an endcap hit provided good efficiency at forward region



# Look into the reconstruction of a good track:

event # 4,  $\eta=1.1267$ , good



## Example output (NOT the exact same event):

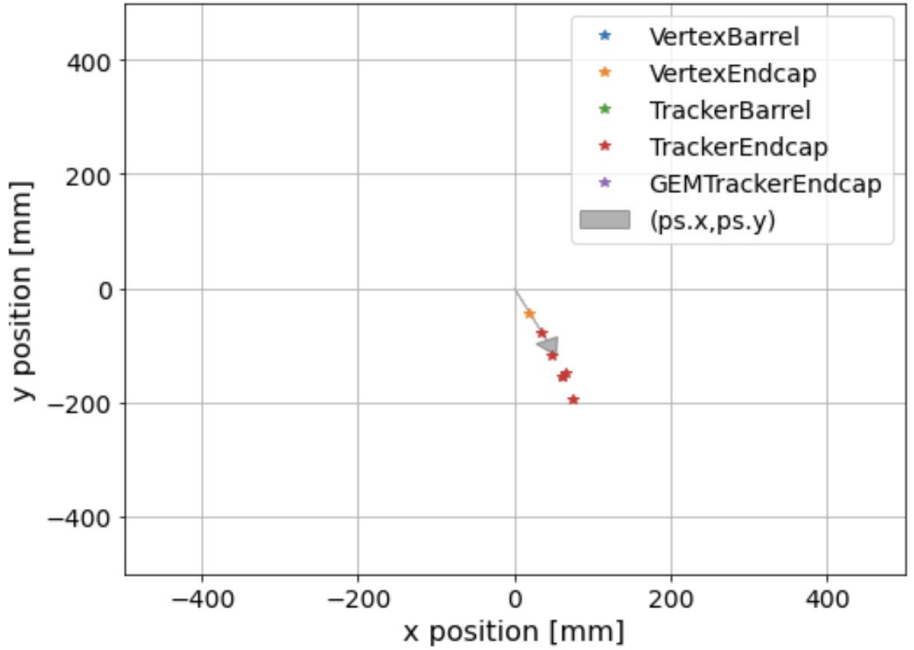
```

trk_srcsInkr   DEBUG hit position   : -383.017 -86.3065 522.68
trk_srcsInkr   DEBUG dd4hep loc pos  : -7.45 -522.68 3.41304e-14
trk_srcsInkr   DEBUG surface center : -385.147 -79.1675 3.50132e-18
trk_srcsInkr   DEBUG acts local center: -7.45 -522.68
trk_srcsInkr   DEBUG acts loc pos   : -7.45, -522.68
truth_trk_init DEBUG Invoke track finding seeded by truth particle with p = 10.0001 GeV
truth_trk_init DEBUG charge = 1
truth_trk_init DEBUG q/p = 0.0999994
parts_from_fit DEBUG 1 trajectories
parts_from_fit DEBUG loc 0 = -0.0142731
parts_from_fit DEBUG loc 1 = 0.00884713
parts_from_fit DEBUG phi = -2.88892
parts_from_fit DEBUG theta = 0.644418
parts_from_fit DEBUG q/p = 0.101251
parts_from_fit DEBUG p = 9.87646
parts_from_fit DEBUG err phi = 0.00258408
parts_from_fit DEBUG err th = 0.001603
parts_from_fit DEBUG err q/p = 0.00227836
parts_from_fit DEBUG chi2 = 0.344765
parts_from_fit DEBUG # fitted parameters : 1
parts_from_fit DEBUG track predicted p = 10.0001 GeV
parts_with_trut... DEBUG Matched track 0 with MC particle 2

parts_with_trut... DEBUG - Track: (mom: 9.876463, theta: 0.6444184, phi: -2.8889172, charge: 1)
parts_with_trut... DEBUG - MC particle: (mom: 10.000064174096659, theta: 0.644306691125586,
phi: -2.8892593459118294, charge: 1, type: 211
out          DEBUG Filling DataTree .
    
```

# Look into the reconstruction of a no-track event:

event # 99,  $\eta=2.46554$ , no track



```
|  |  |  |
| --- | --- | --- |
| trk_srcslnkr | DEBUG hit position | : 198.129 -0.32 1217.64 |
| trk_srcslnkr | DEBUG dd4hep loc pos | : 0.32 1.42089e-13 -39.96 |
| trk_srcslnkr | DEBUG surface center | : 238.089 -1.34898e-13 1217.64 |
| trk_srcslnkr | DEBUG acts local center | : 0.32 -39.96 |
| trk_srcslnkr | DEBUG acts loc pos | : 0.32, -39.96 |
| trk_srcslnkr | DEBUG cov matrix: |  |
| 0.0001 | 0 |  |
| 0 | 0.0001 |  |
| trk_srcslnkr | DEBUG hit position | : 159.119 1.27 977.635 |
| trk_srcslnkr | DEBUG dd4hep loc pos | : -1.27 1.42186e-13 -72.92 |
| trk_srcslnkr | DEBUG surface center | : 232.039 -1.31471e-13 977.635 |
| trk_srcslnkr | DEBUG acts local center | : -1.27 -72.92 |
| trk_srcslnkr | DEBUG acts loc pos | : -1.27, -72.92 |
| trk_srcslnkr | DEBUG cov matrix: |  |
| 0.0001 | 0 |  |
| 0 | 0.0001 |  |
| trk_srcslnkr | DEBUG hit position | : 162.939 0.37 1217.64 |
| trk_srcslnkr | DEBUG dd4hep loc pos | : -0.37 1.42131e-13 -75.15 |
| trk_srcslnkr | DEBUG surface center | : 238.089 -1.34898e-13 1217.64 |
| trk_srcslnkr | DEBUG acts local center | : -0.37 -75.15 |
| trk_srcslnkr | DEBUG acts loc pos | : -0.37, -75.15 |
| truth_trk_init | DEBUG Invoke track finding seeded by truth particle with p = 10.0001 GeV |  |
| truth_trk_init | DEBUG | charge = 1 |
| truth_trk_init | DEBUG | q/p = 0.0999995 |
|  | ERROR TrackFindingAlgorithm Logger CombinatorialKalmanFilter failed: |  |

```

**CombinatorialKalmanFilterError:5 ⇒ NO track found**

Dropped field strength? What else??