# Realistic tracking with single particles

Barak Schmookler

# Simulation settings

**Generation settings:**

10k single negative muons for each setting

Uniform momentum [0.5,20] GeV/c

Uniform eta [-4,4]

Uniform phi [0,2Pi]

Acts Real seeding + CKF

Updated CraterLake geometry

Generation Vertex Location:

1. (vx, vy, vz) = (0,0,0) mm
2. (vx, vy, vz) = (0,0,10) mm
3. (vx, vy, vz) = (0,0,-10) mm
4. (vx, vy, vz) = (1,0,0) mm
5. (vx, vy, vz) = (0,0,100) mm
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**We have previously done many studies for these generation locations. The tracking efficiency and resolution looks reasonable.**

https://github.com/eic/documents/blob/master/reports/general/Note-Simulations-BeamEffects.pdf

# Simulation settings

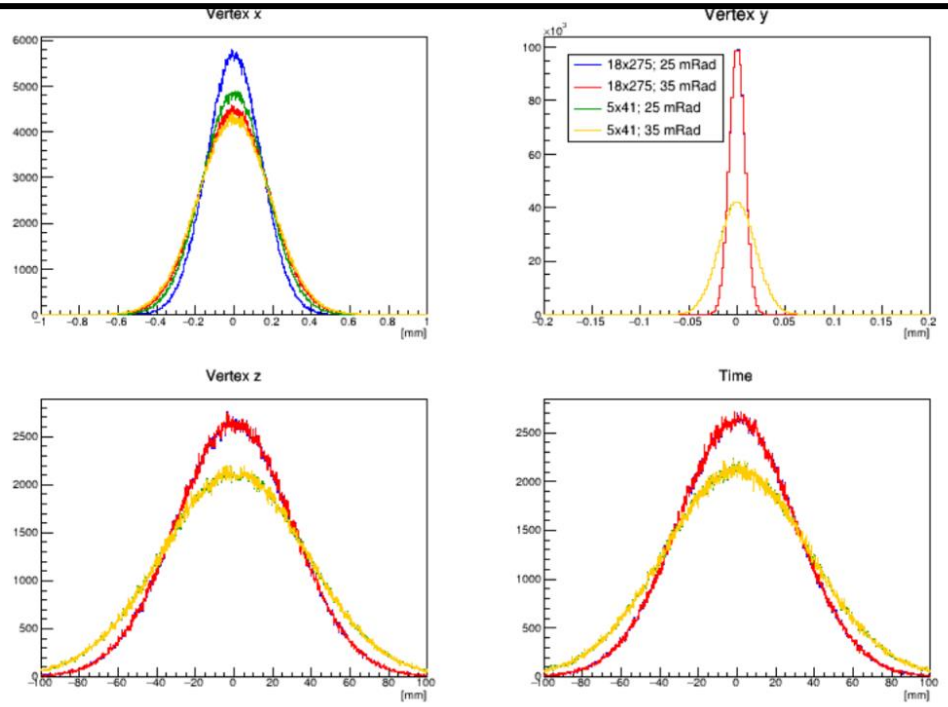


Figure 4: Detector frame vertex position and time distributions for beam energies of 18x275 GeV and 5x41 GeV and crossing angels of 25 and 35 milliradians.

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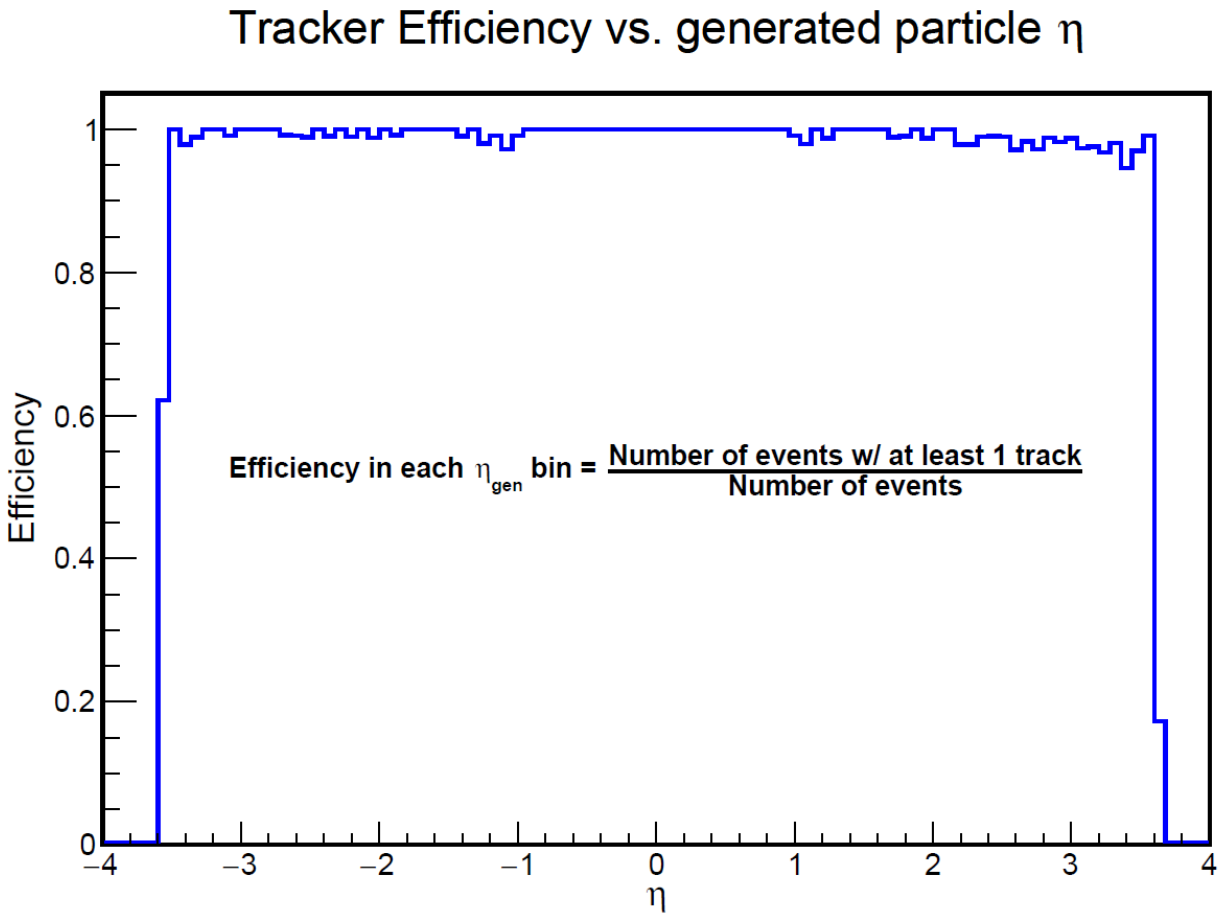
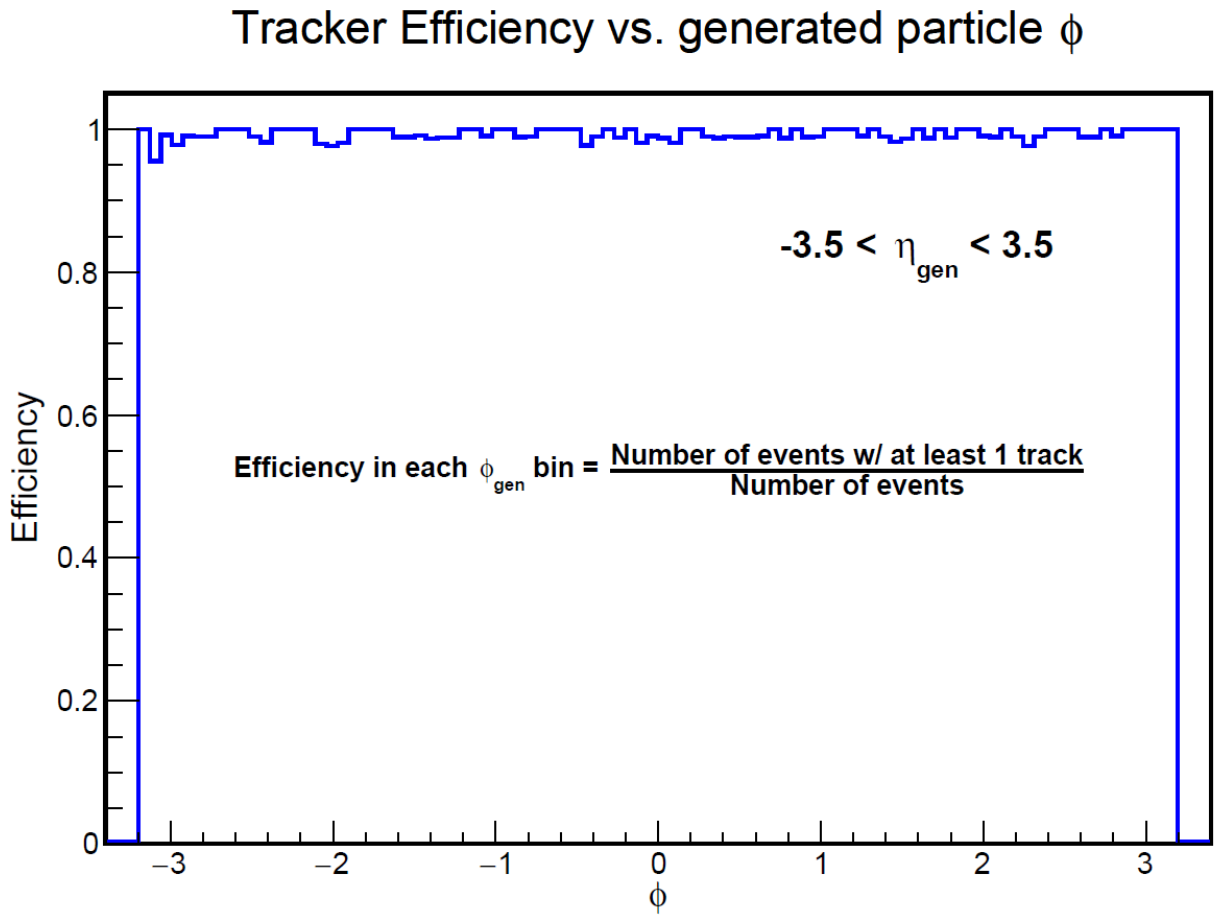
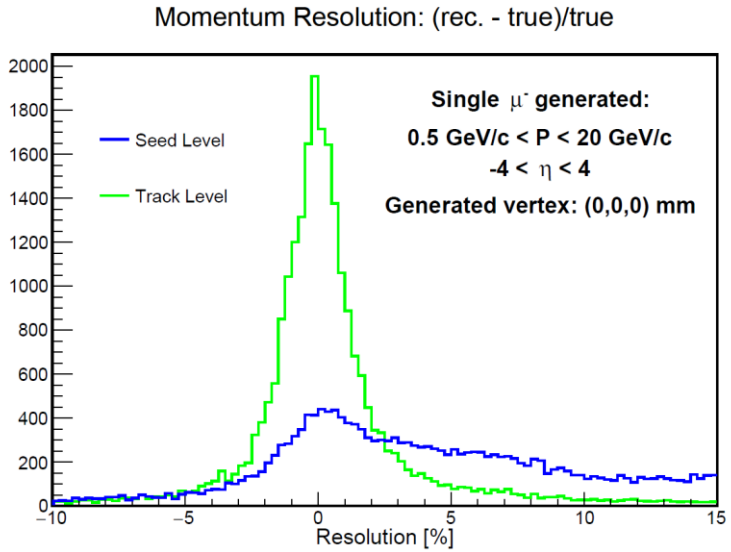
**These are new studies near the edges of the beam spot.**

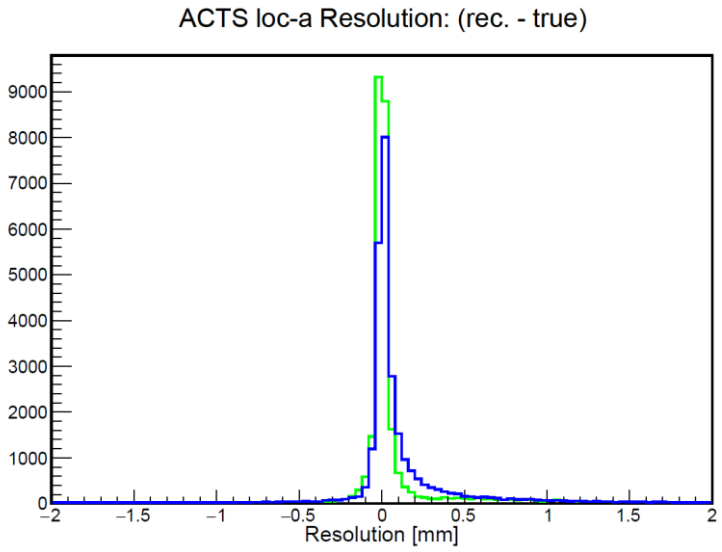
# Results from (vx,vy,vz) = (0,0,0) mm – efficiency

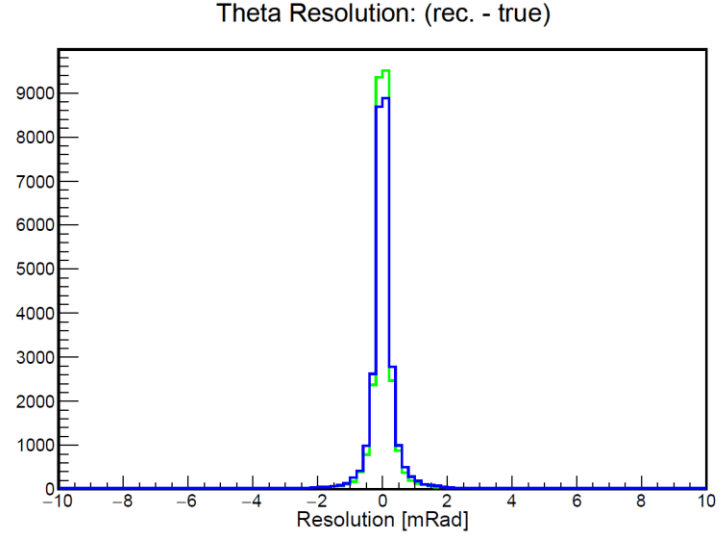


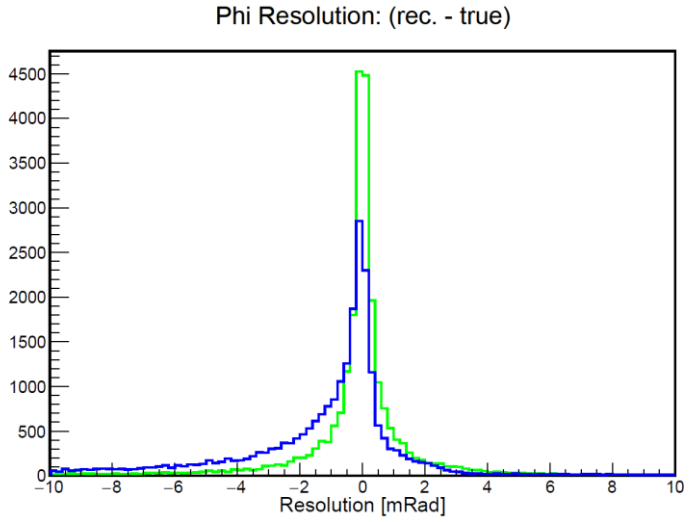



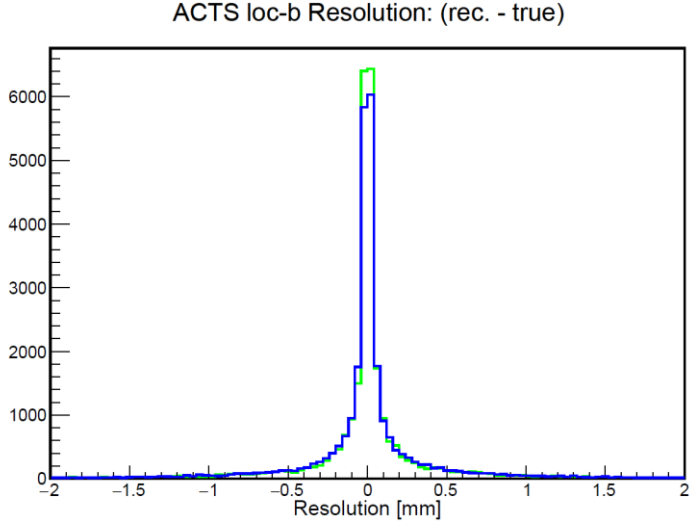
# Results from (vx,vy,vz) = (0,0,0) mm – resolution

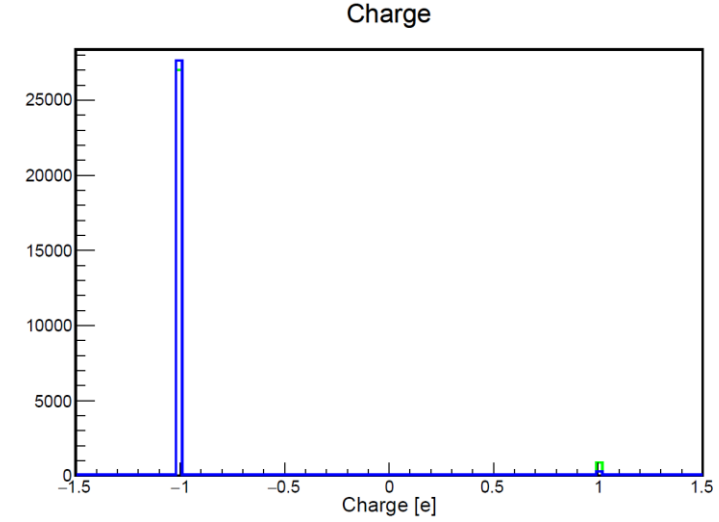


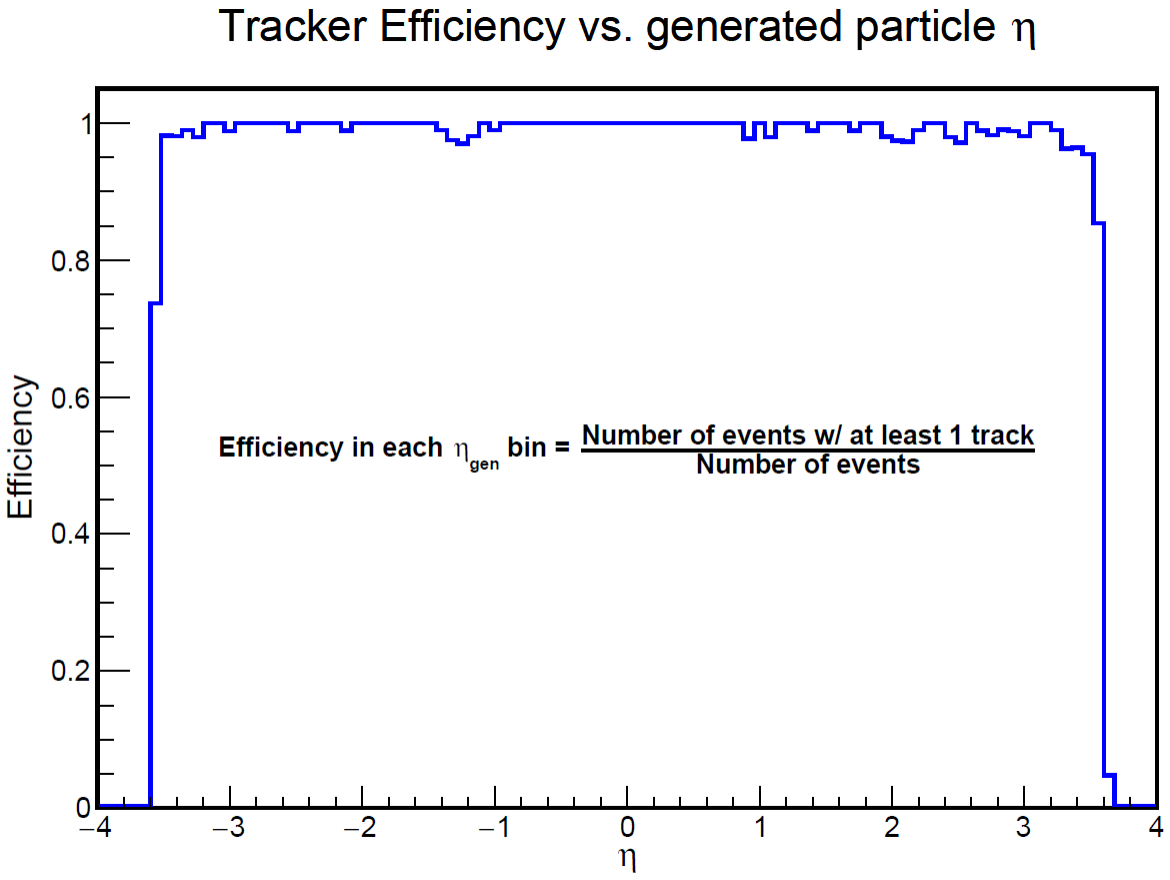



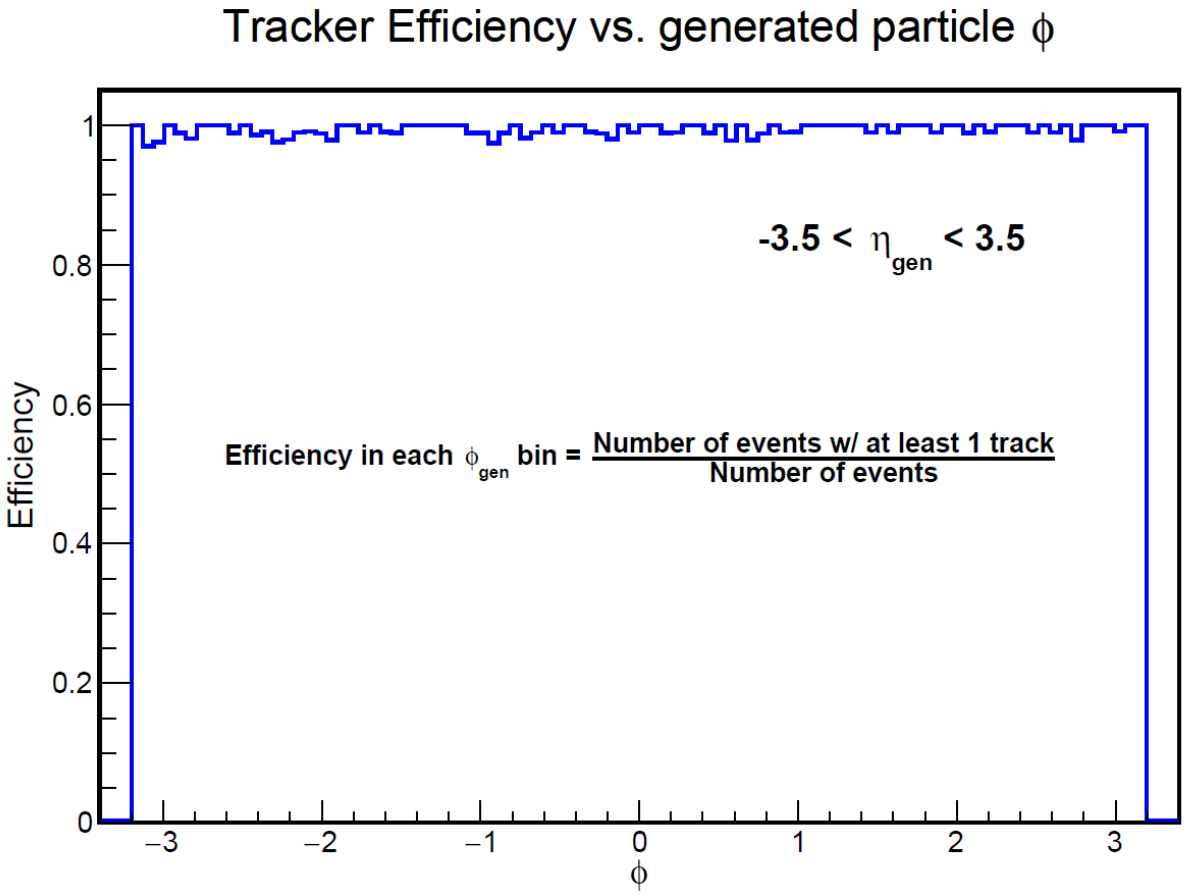



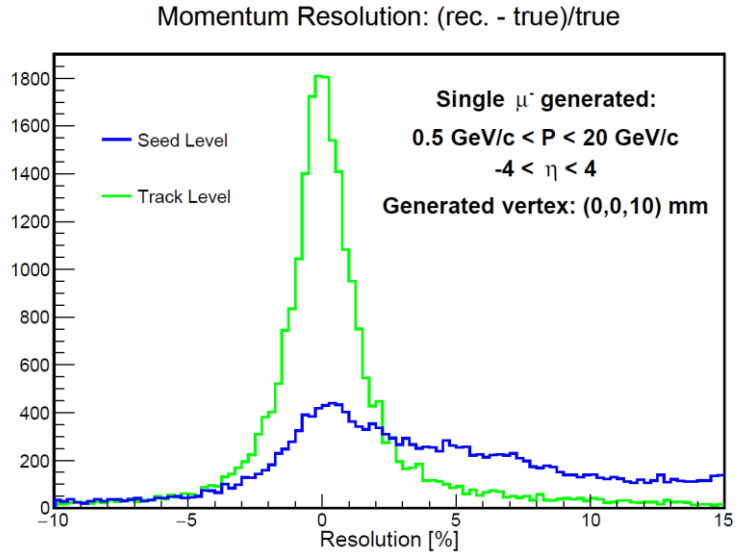



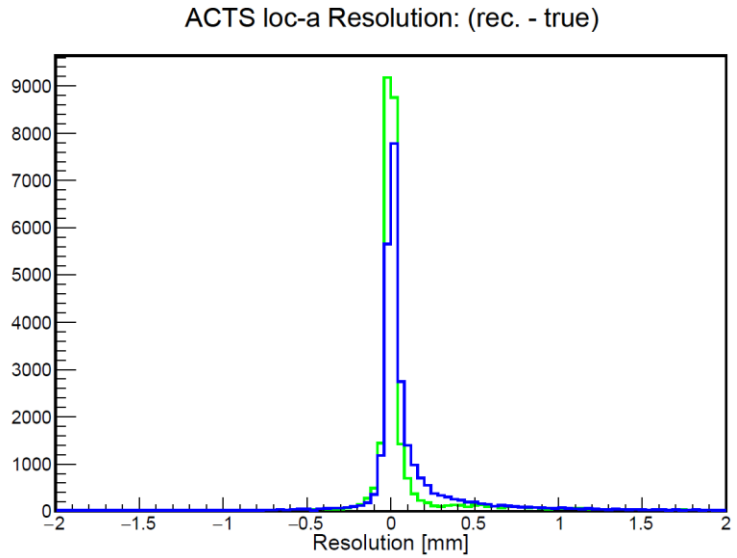
# Results from (vx,vy,vz) = (0,0,10) mm – efficiency

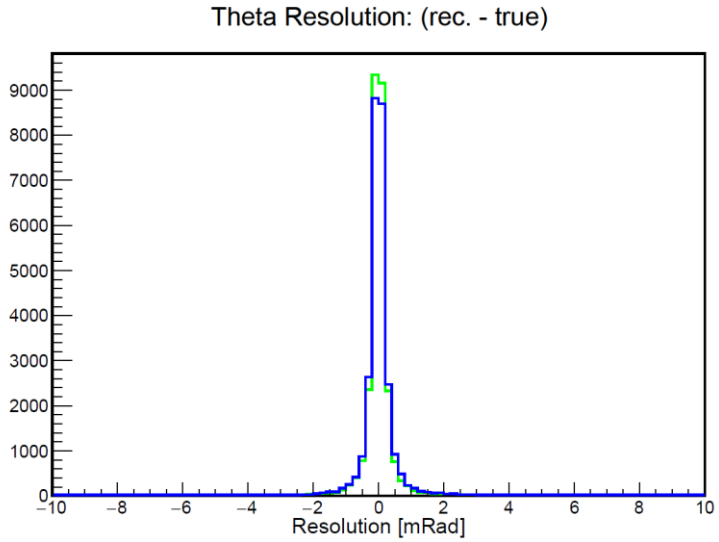


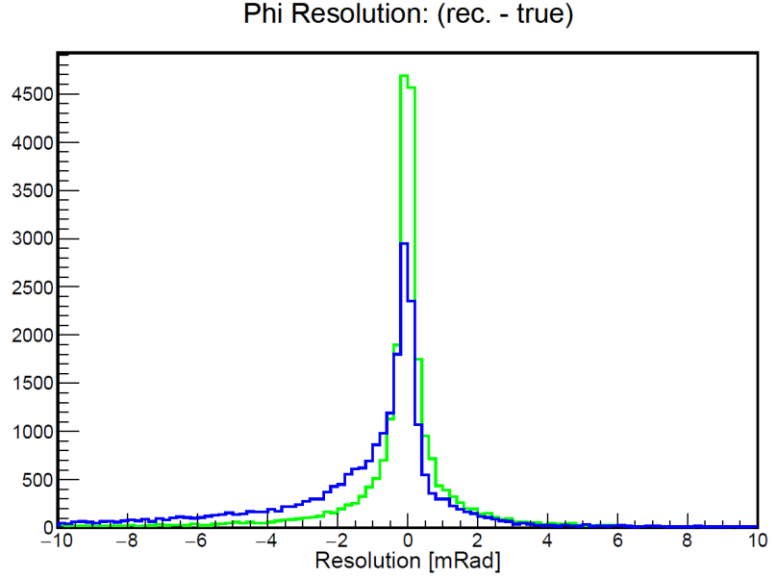



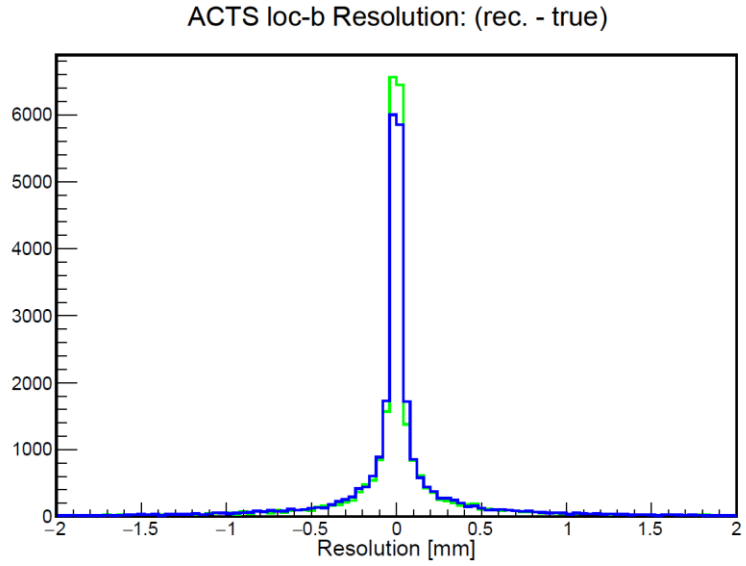
# Results from (vx,vy,vz) = (0,0,10) mm – resolution

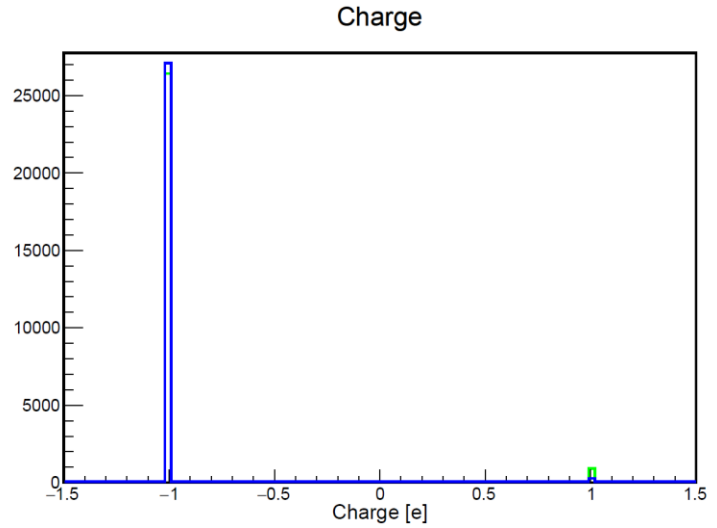


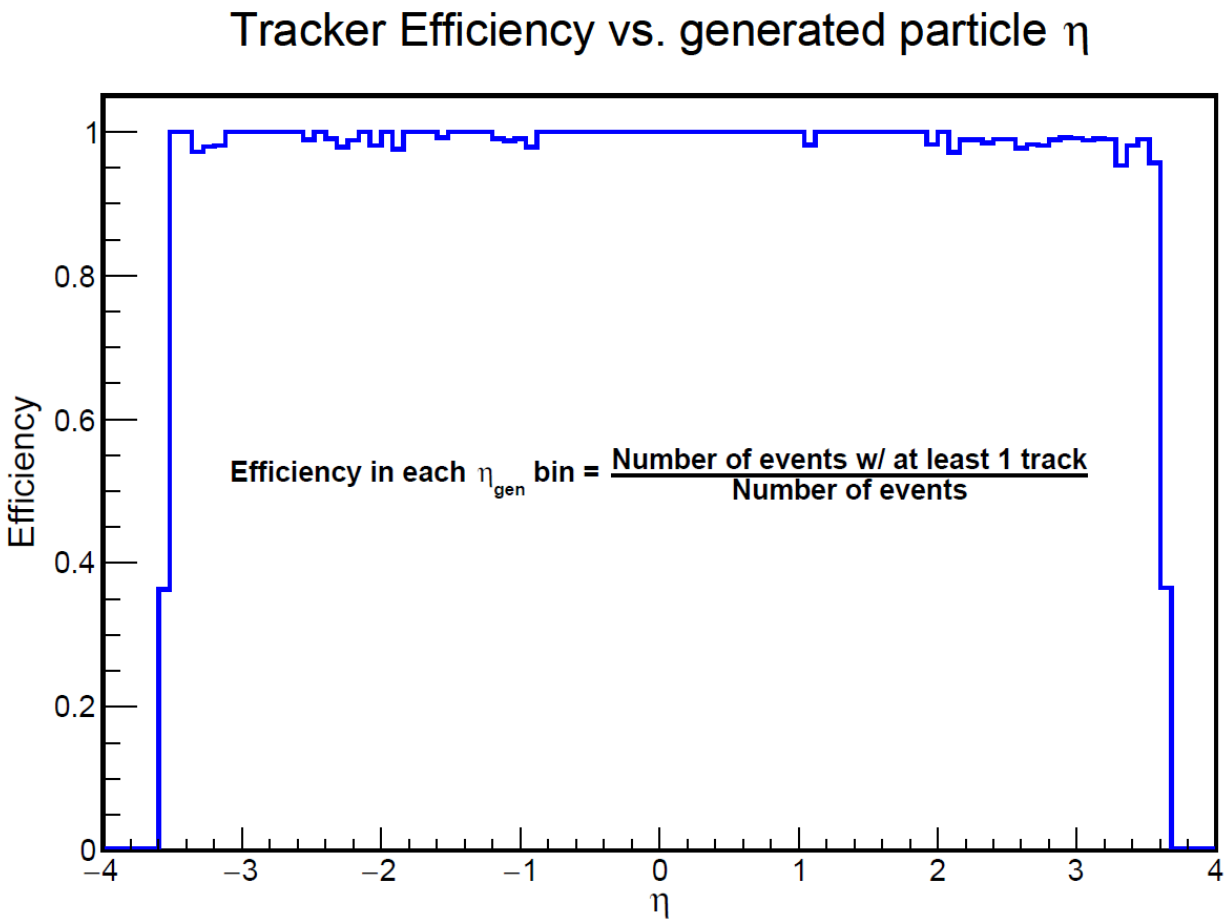



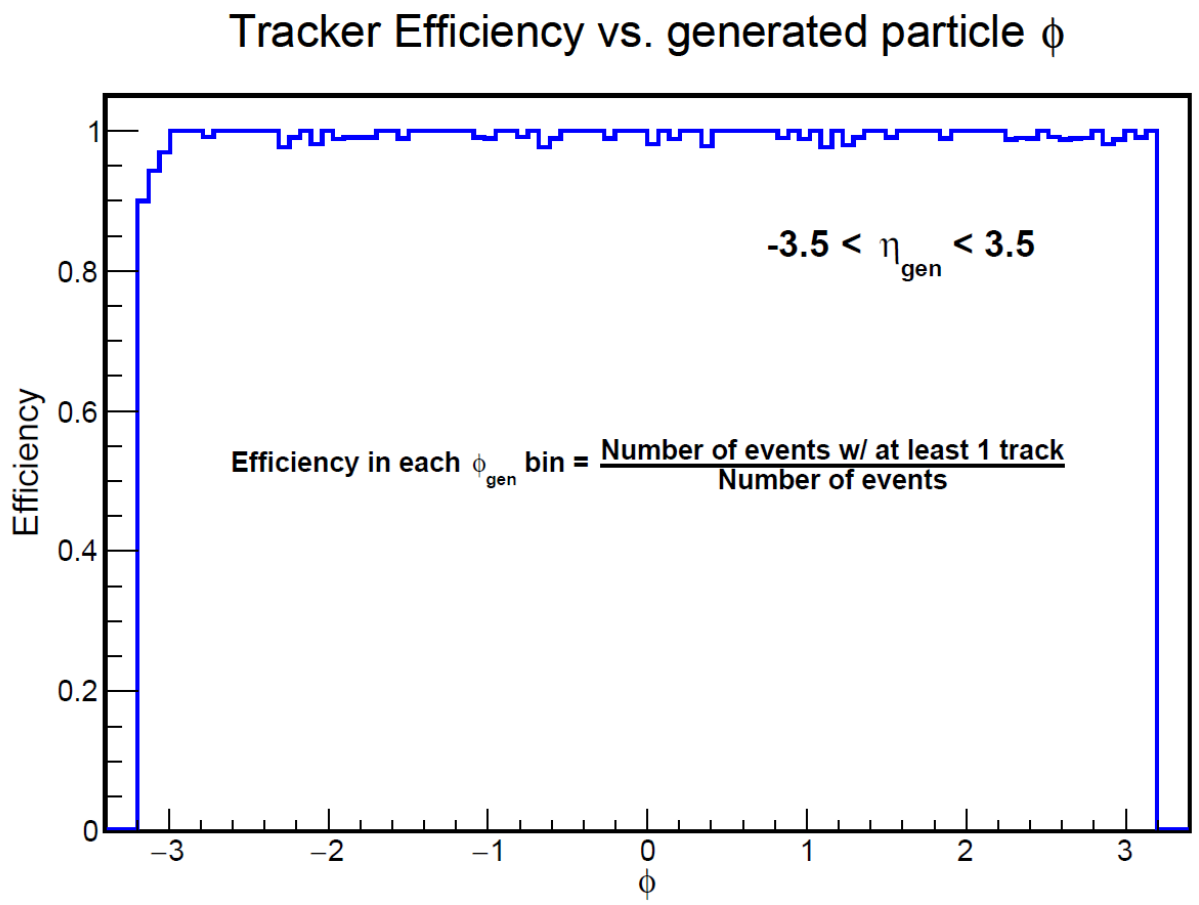



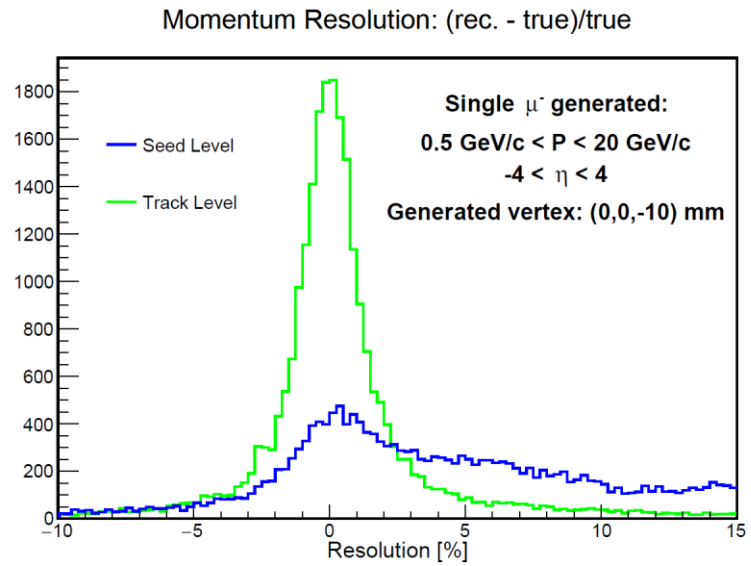



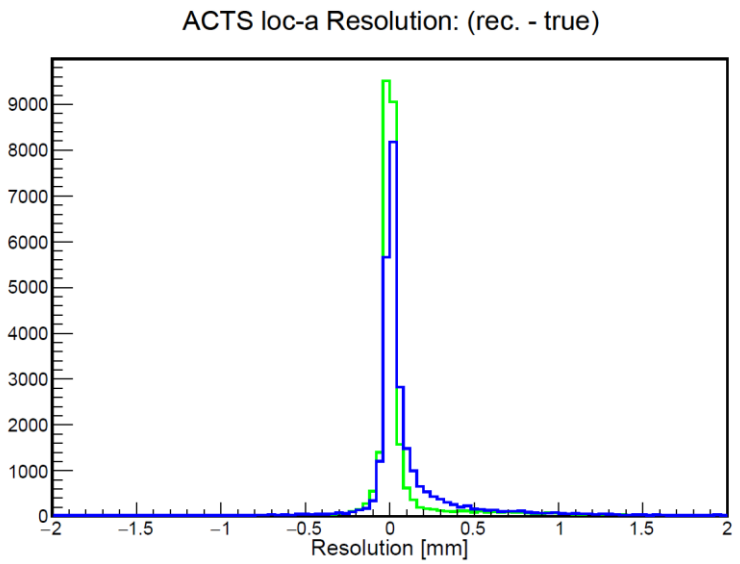
# Results from (vx,vy,vz) = (0,0,-10) mm – efficiency

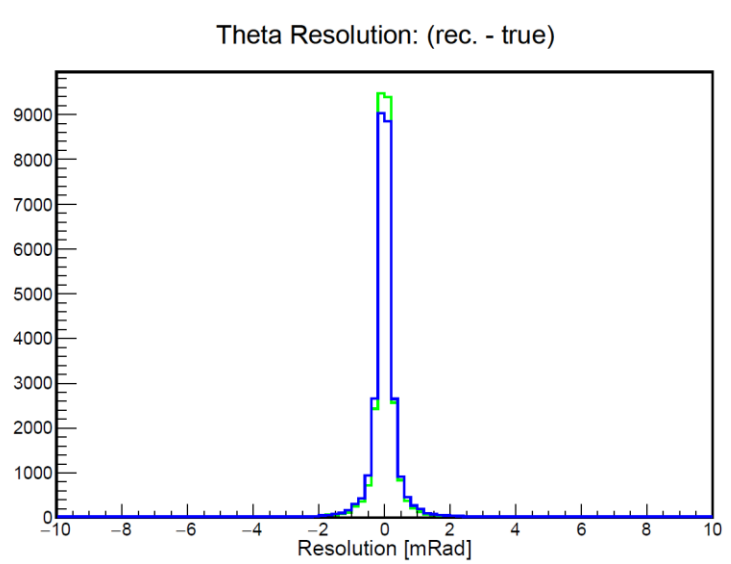


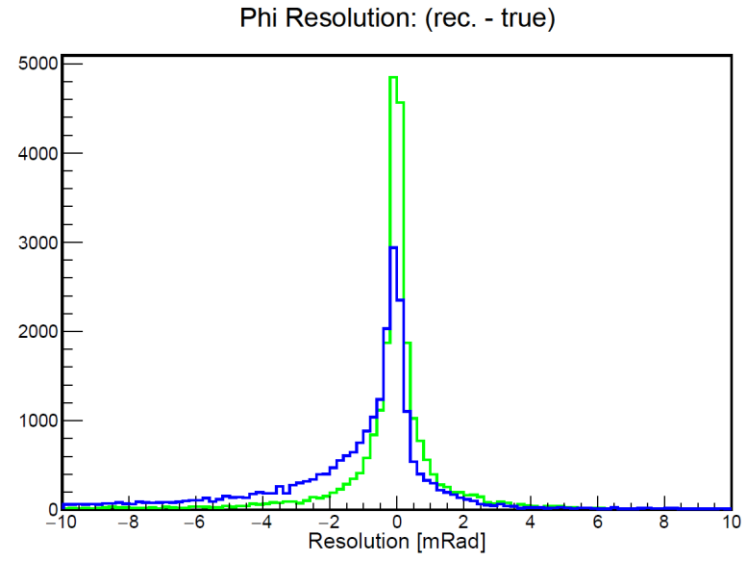



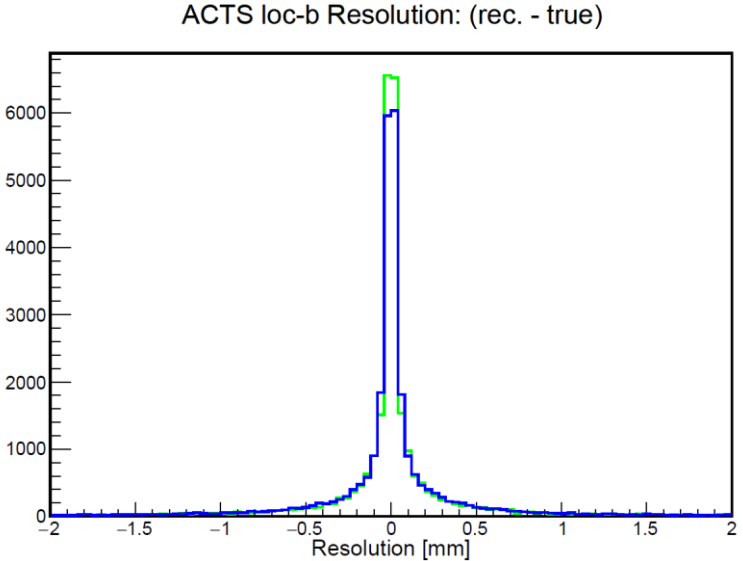
# Results from (vx,vy,vz) = (0,0,-10) mm – resolution

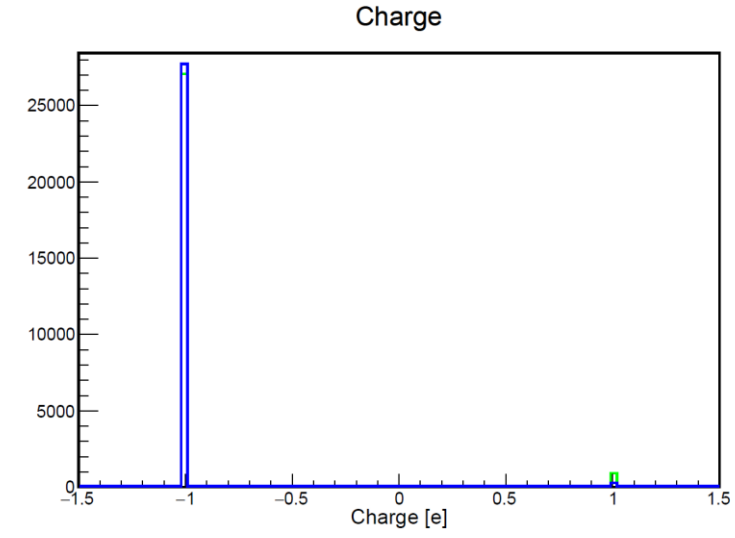


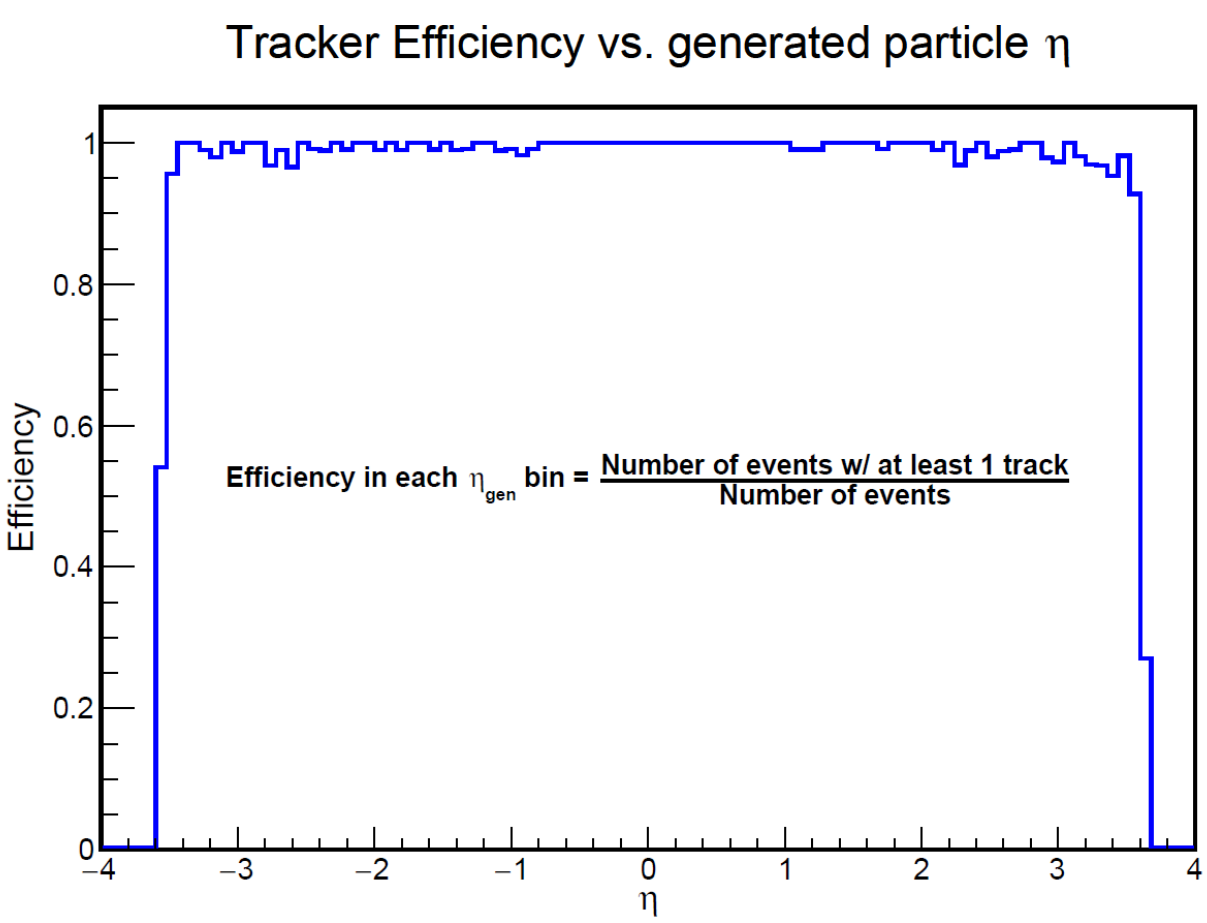



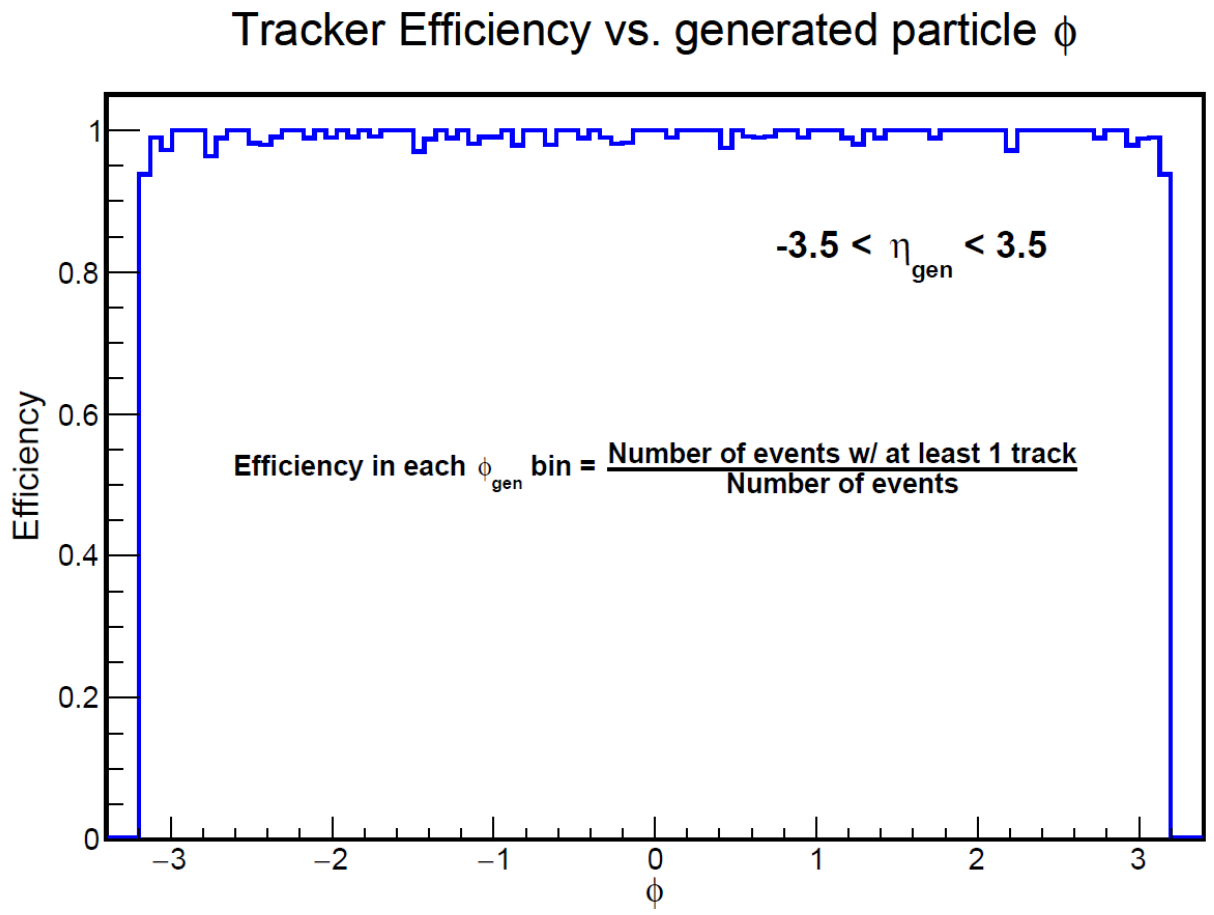



# Results from (vx,vy,vz) = (1,0,0) mm – efficiency



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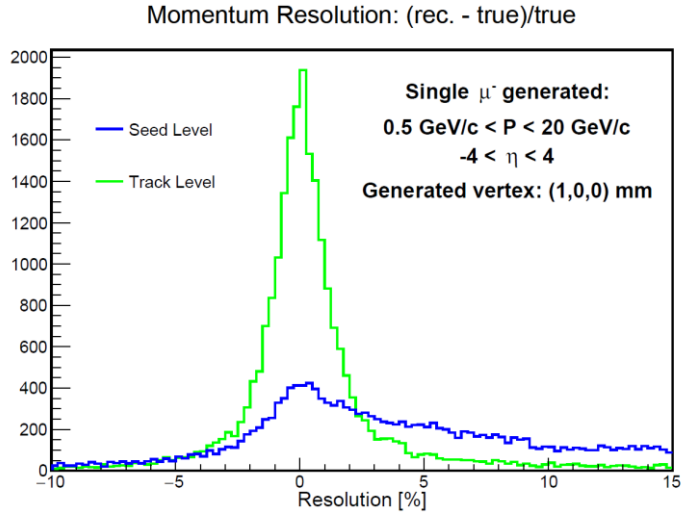
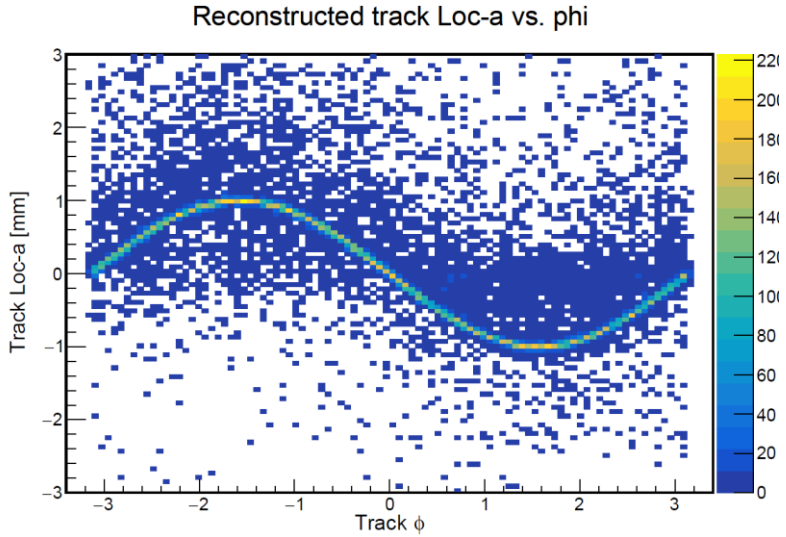
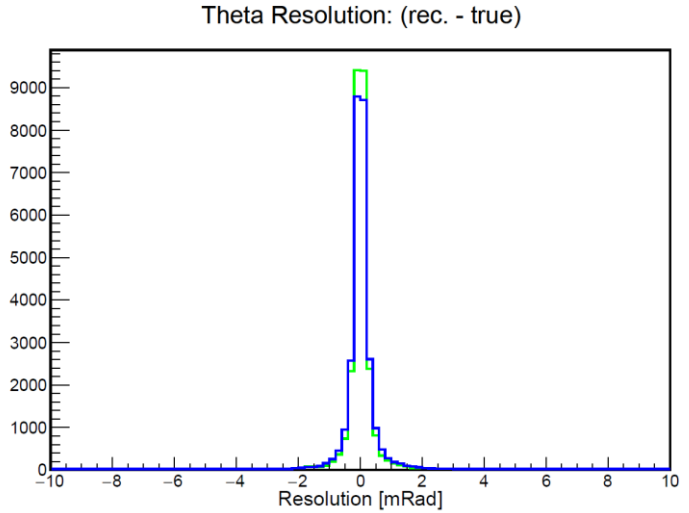
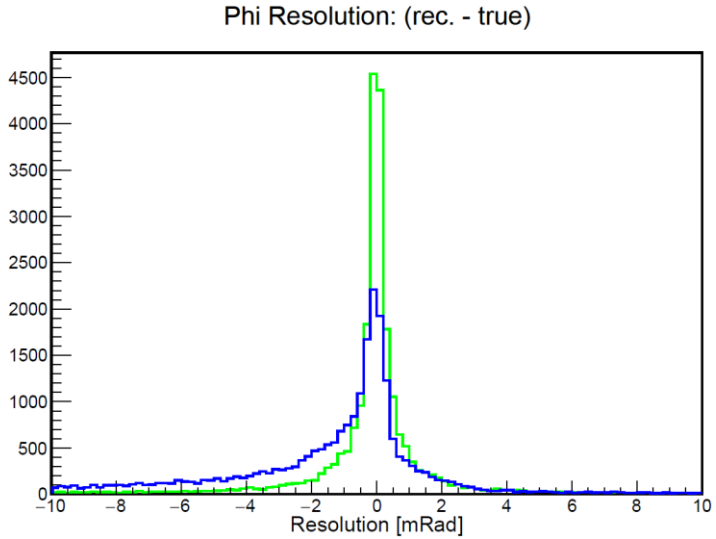
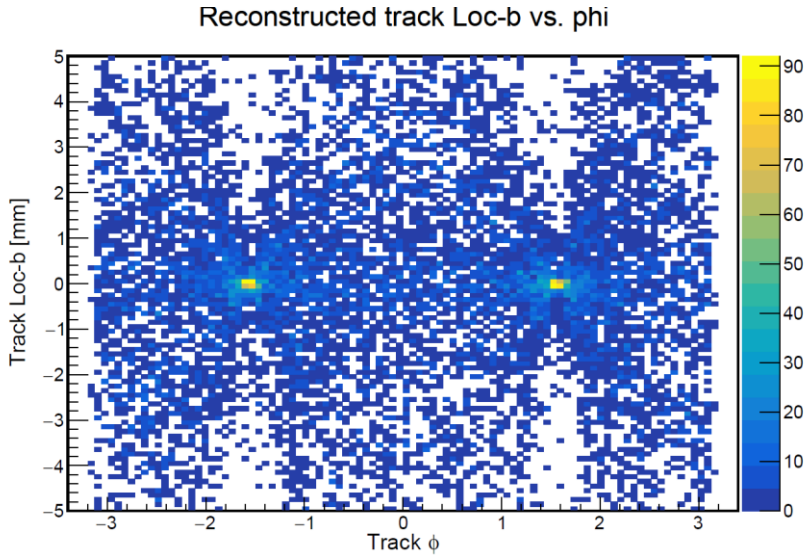
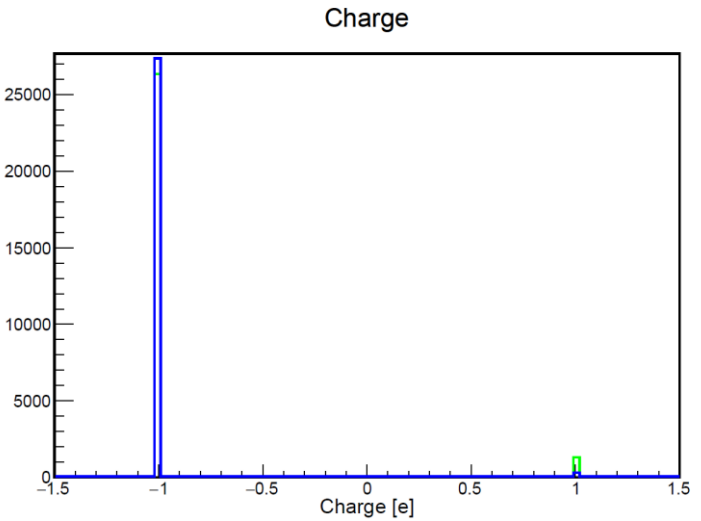


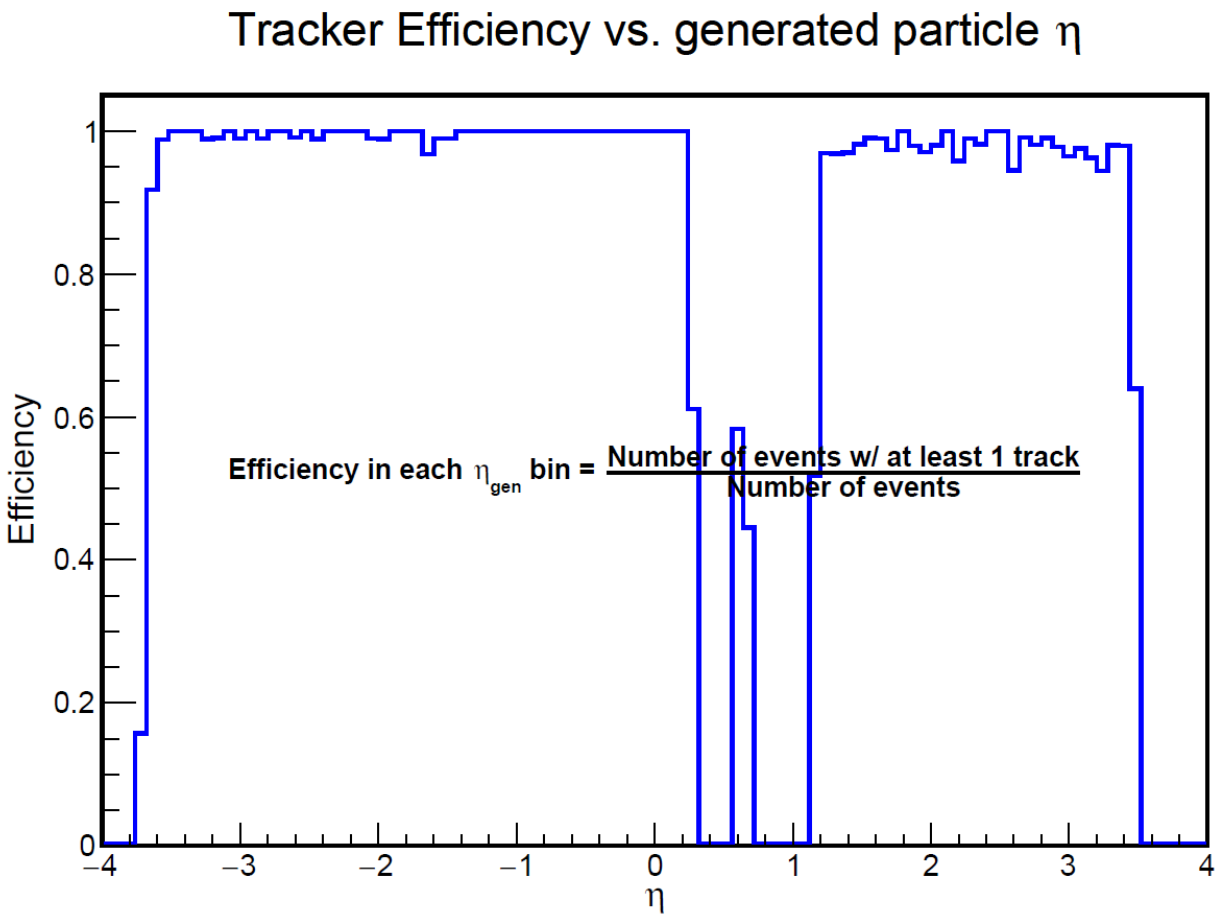



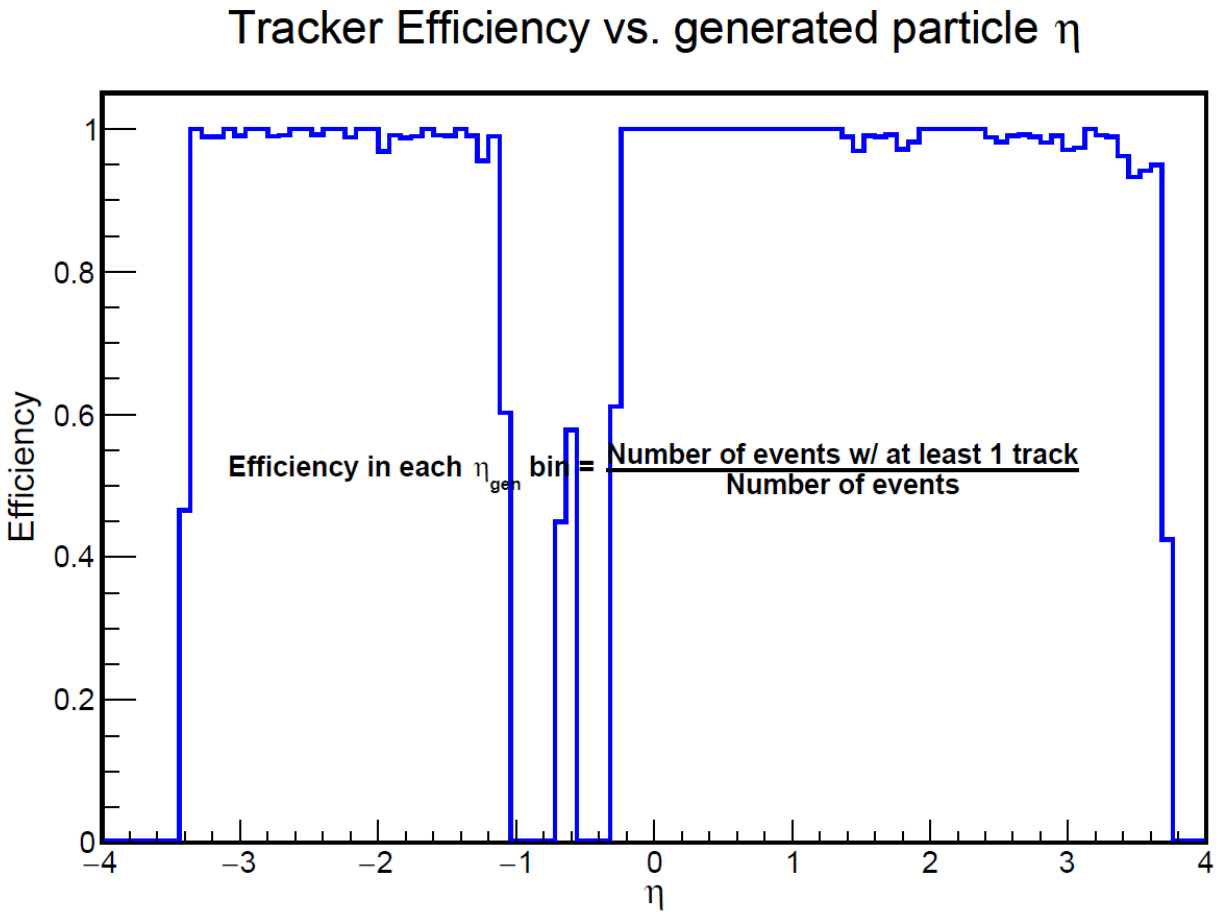
# Ongoing work on above settings

- Checking effect of initial error matrix that goes into CKF.
- Repeating studies with other particle types.
- Working on recreating resolution plots that contain more differential information (e.g. momentum resolution as a function of momentum and eta).

# Efficiency holes when Results from (vx,vy,vz) = (0,0,+-100) mm




**For vz = +100mm**




**For vz = -100mm**

# We may need to adjust the seed-finder parameters a bit

```
/// SEED FINDER GENERAL PARAMETERS
float m_rMax = 440. * Acts::UnitConstants::mm; // max r to look for hits to compose seeds
float m_rMin = 33. * Acts::UnitConstants::mm; // min r to look for hits to compose seeds
float m_zMax = 1700. * Acts::UnitConstants::mm; // max z to look for hits to compose seeds
float m_zMin = -1500. * Acts::UnitConstants::mm; // min z to look for hits to compose seeds
float m_deltaRMinTopSP = 10. * Acts::UnitConstants::mm; // Min distance in r between middle and top SP in one seed
float m_deltaRMaxTopSP = 200. * Acts::UnitConstants::mm; // Max distance in r between middle and top SP in one seed
float m_deltaRMinBottomSP = 10. * Acts::UnitConstants::mm; // Min distance in r between middle and bottom SP in one seed
float m_deltaRMaxBottomSP = 200. * Acts::UnitConstants::mm; // Max distance in r between middle and bottom SP in one seed
float m_collisionRegionMin = -250 * Acts::UnitConstants::mm; // Min z for primary vertex
float m_collisionRegionMax = 250 * Acts::UnitConstants::mm; // Max z for primary vertex

unsigned int m_maxSeedsPerSpM = 0; // max number of seeds a single middle sp can belong to - 1
float m_cotThetaMax = 1.0 / tan(2. * atan(exp(-4.0))); // Cotangent of max theta angle (based on eta)

float m_sigmaScattering = 5; // How many standard devs of scattering angles to consider
float m_radLengthPerSeed = 0.1; // Average radiation lengths of material on the length of a seed
float m_minPt = (100. * Acts::UnitConstants::MeV) / m_cotThetaMax; // MeV (in Acts units of GeV) - minimum transverse momentum
float m_bFieldInZ = 1.7 * Acts::UnitConstants::T; // T (in Acts units of GeV/[e*mm]) - Magnetic field strength
float m_beamPosX = 0; // x offset for beam position
float m_beamPosY = 0; // y offset for beam position
float m_impactMax = 3. * Acts::UnitConstants::mm; // Maximum transverse PCA allowed
float m_bFieldMin = 0.1 * Acts::UnitConstants::T; // T (in Acts units of GeV/[e*mm]) - Minimum Magnetic field strength
float m_rMinMiddle = 20. * Acts::UnitConstants::mm; // Middle spacepoint must fall between these two radii
float m_rMaxMiddle = 400. * Acts::UnitConstants::mm;
```

**First check can be to look at the tracker hits x vs. y and r vs. z spacings and distributions for the events in the gaps.**

# Summary

- We have done many studies for realistic seeding with z shifted by up to 10mm from (0,0,0) in detector coordinates, as well as studies with shifts up to 1mm in the transverse direction.
- When we generate events from z = +-100mm, we see some efficiency gaps in the tracking. These gaps may be related to the seed-finder parameters, but it needs to be studied.