Vertexing @ ePIC in DIS events

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EIC group meeting, 11/21/2023

Vertex reconstruction in EPIC

Acts::IterativeVertexFinder implemented in EICRecon

Using Trajectories as input

```
app->Add(new JChainFactoryGeneratorT<IterativeVertexFinder_factory>(
        {"CentralCKFTrajectories"}, "CentralTrackVertices"));
```

Currently realistic seeding for tracks

Dataset and Geometry:
Simulation: S3/eictest/EPIC/FULL/23.08.0/epic_craterlake/DIS/NC/18x275/minQ2=10/
pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.*.edm4hep.root
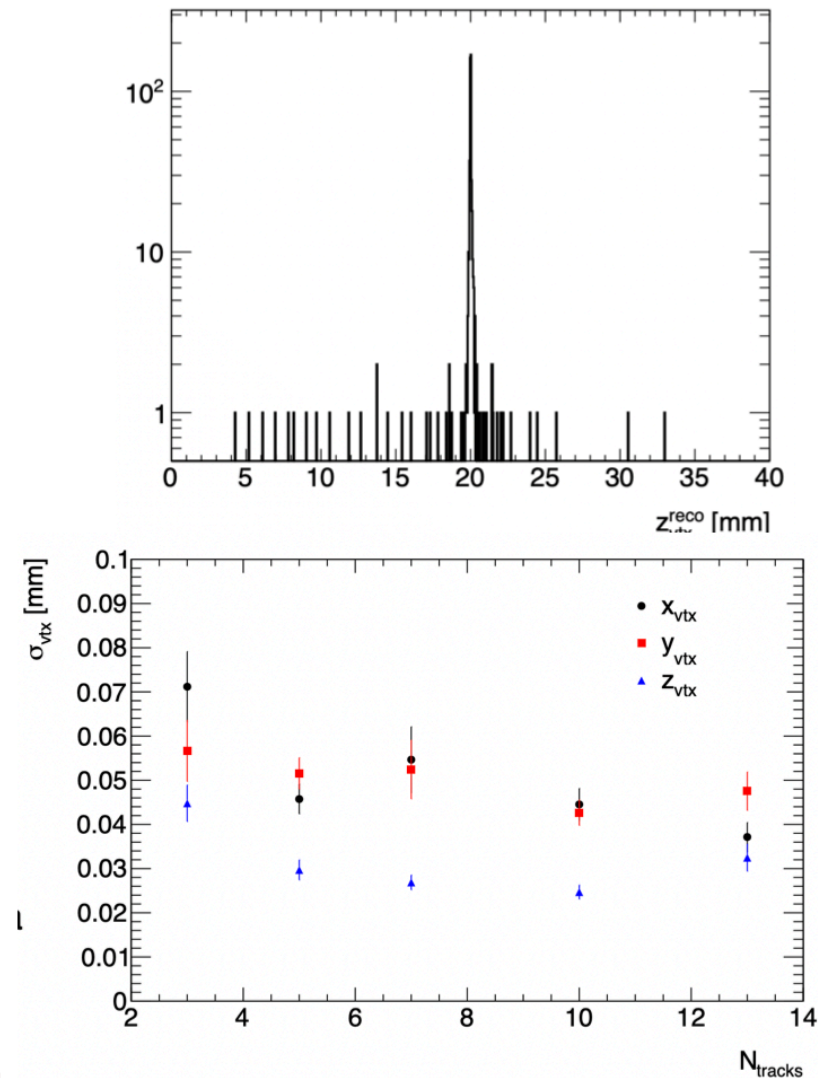
Geometry: epic-23.08.0

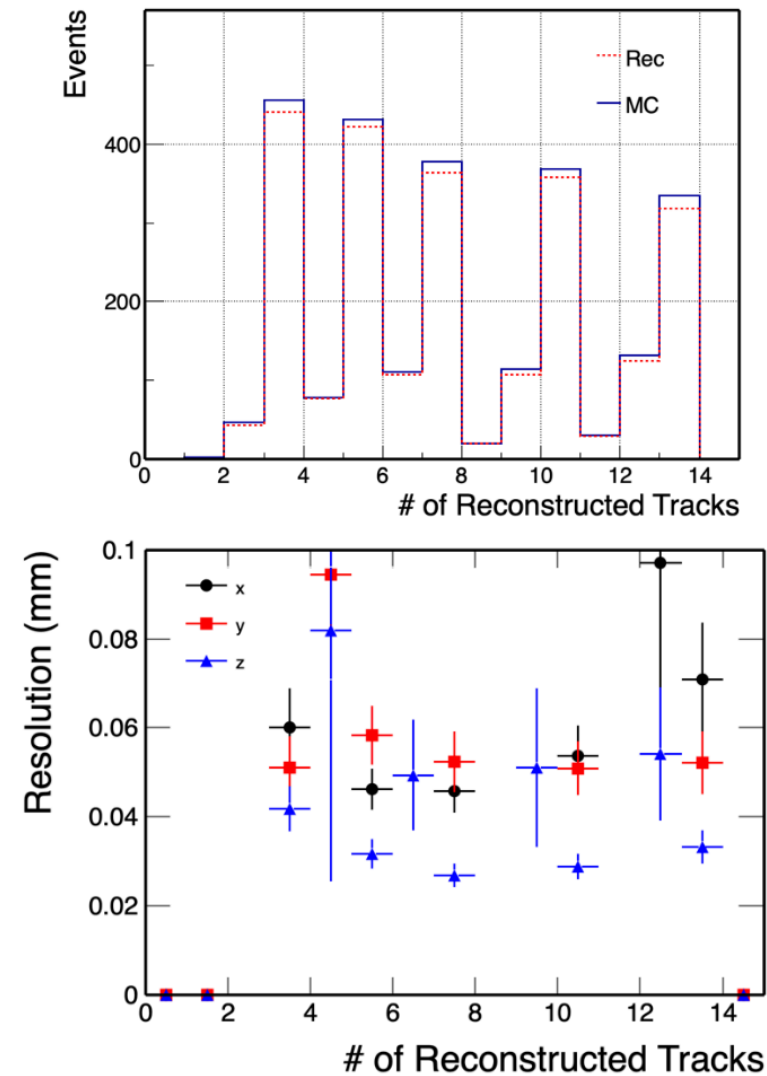Generated event vertices taken as MC vertex associated to scattered electron

Vertexing for tracks from a fixed vertex

Simulation: N pions thrown flat in acceptance and flat in 0.2<pT<5 GeV at a fixed vertex (0,0,20) mm

JO's initial test

XD re-ran ElCrecon and reproduced observations

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Resolution of the order 30-50 μm for pions thrown at a fixed vertex

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Vertex reconstruction in DIS events

Simulation: S3/eictest/EPIC/FULL/23.08.0/epic_craterlake/DIS/NC/18x275/minQ2=10/
pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.*.edm4hep.root
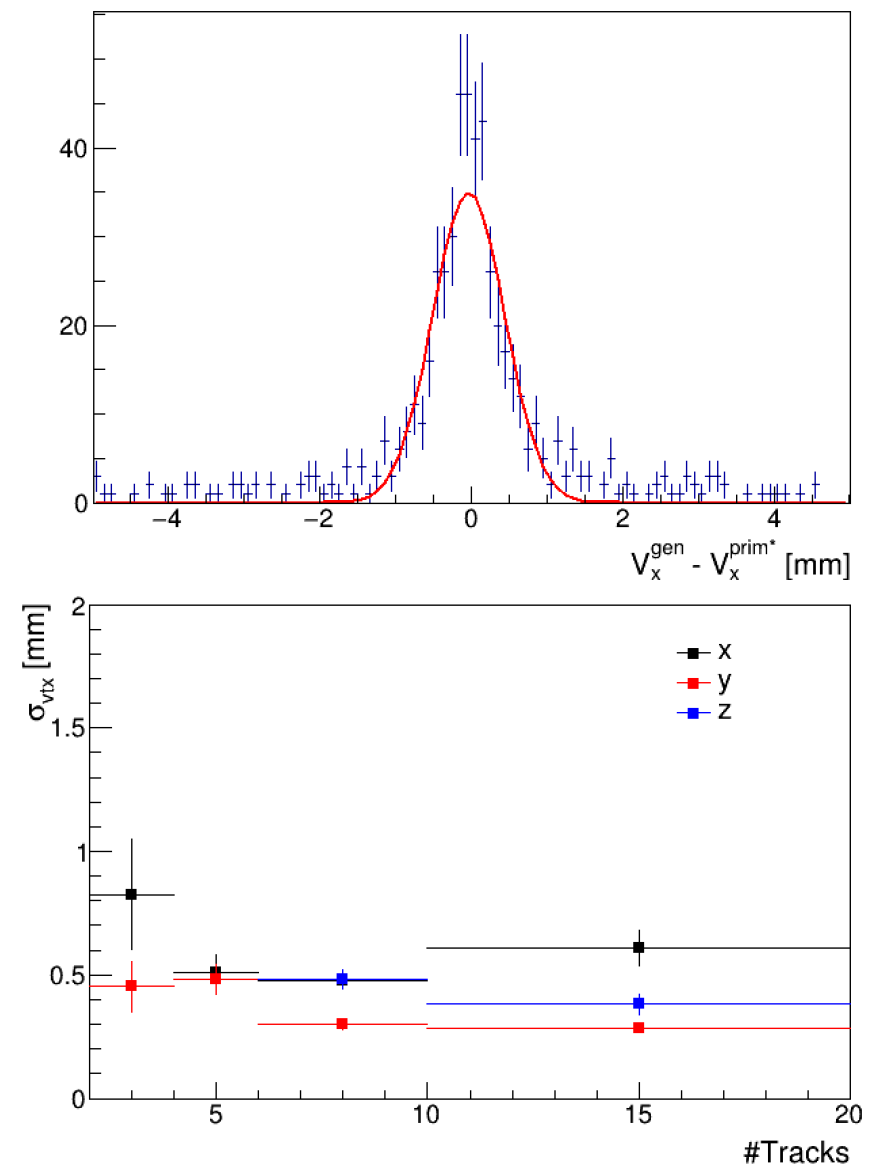
Geometry: epic-23.08.0

Generated event vertices taken as vertex associated to scattered electron

Take closest reconstructed vertex to generated vertex as primary vertex (prim*)
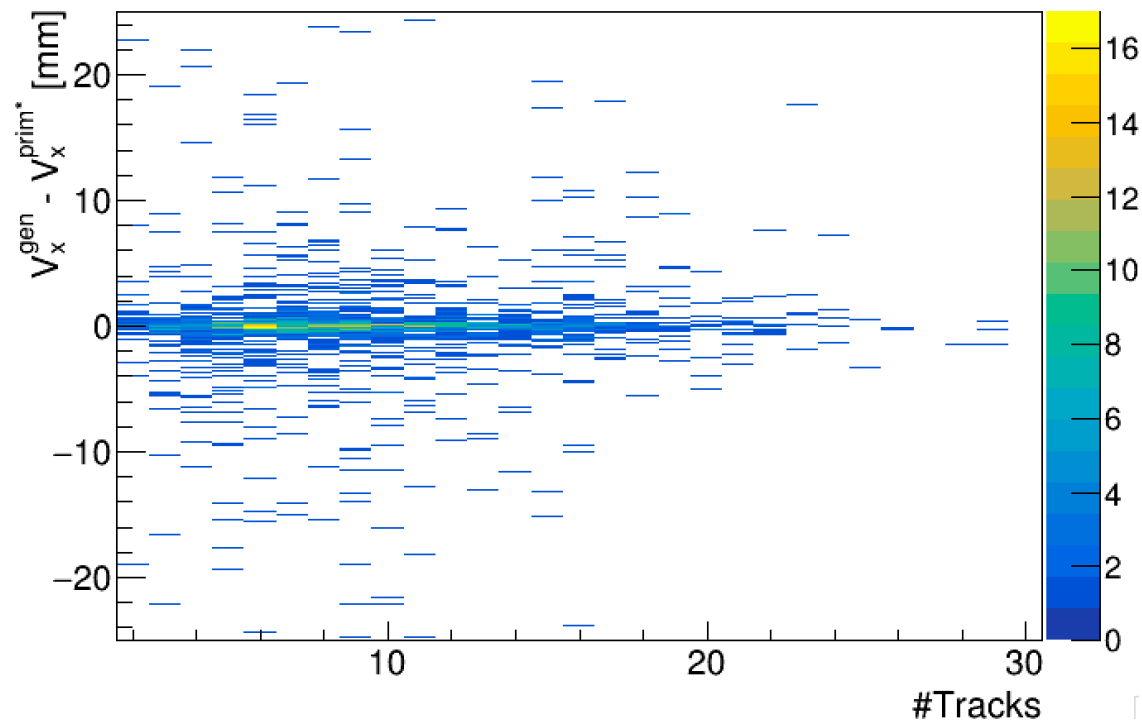
Quite poor vertex resolution. Order of magnitude worse than for tracks thrown at a fixed vertex
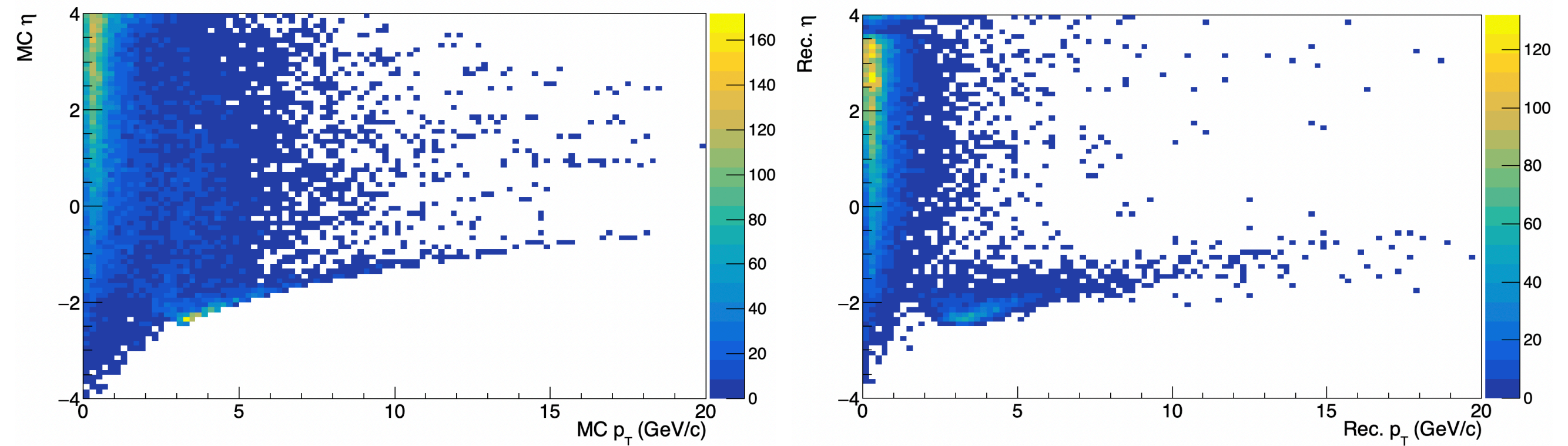
Optimize vertexing with weights for tracks?

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Acceptance for DIS events

Scattered electrons well separated at backward eta

Higher momentum reconstructed tracks much reduced. Reason?

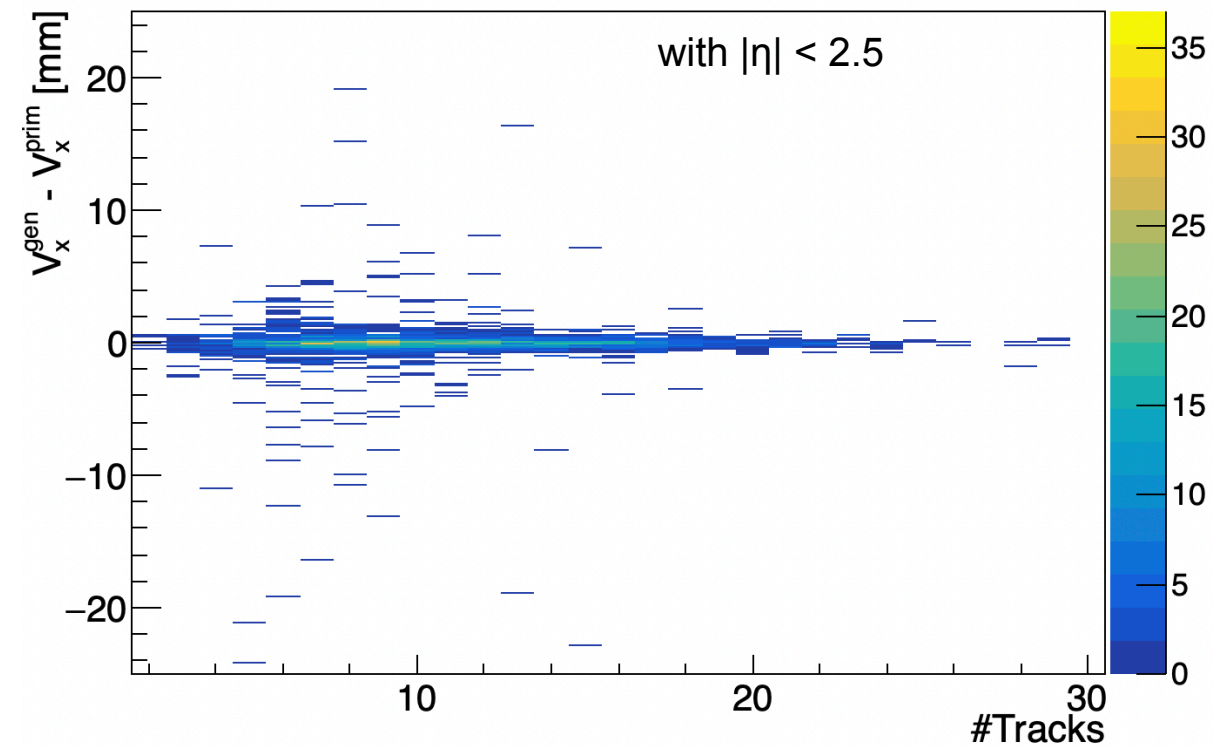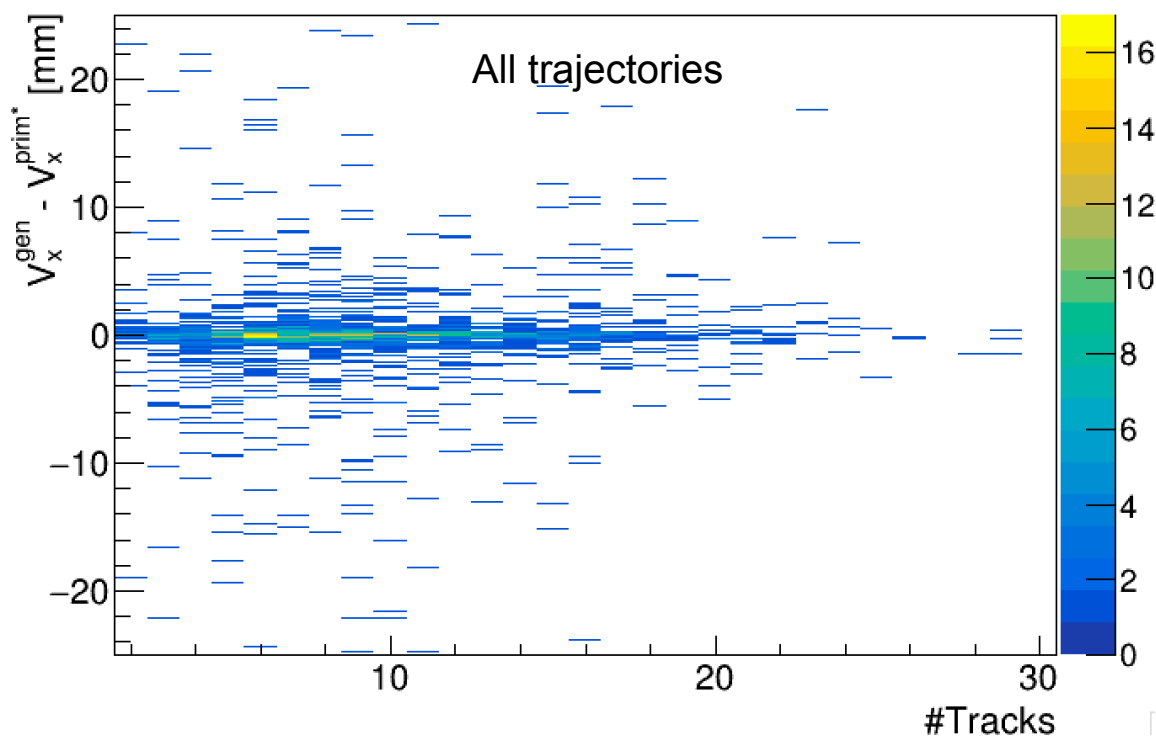

Charged tracks (|η| < 4.0)

Any issue with the dataset or missing any reconstruction options?

Using only tracks at mid-rapidity

Tracks at forward eta could have poor resolution. Could impact vertexing

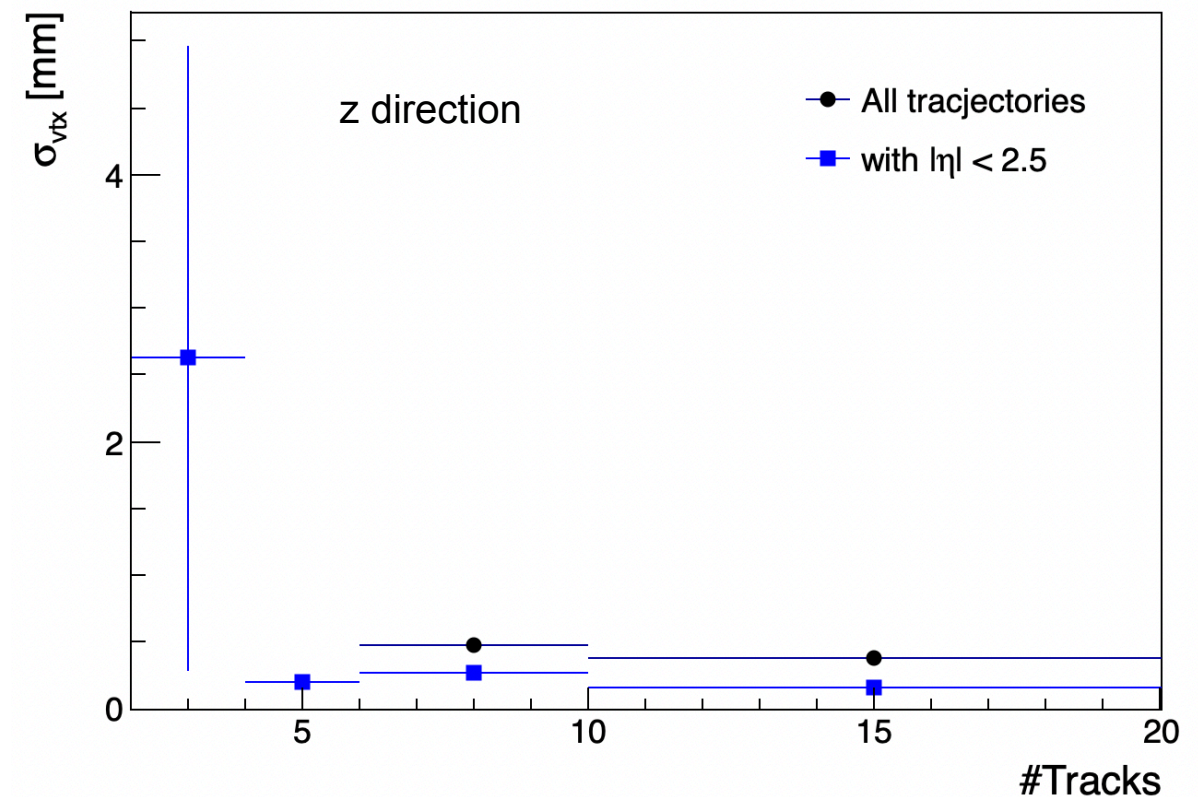Redo vertexing with only tracks within $|\eta| < 2.5$

Restricting to mid-rapidity tracks improves resolution, but not dramatically

Using only tracks at mid-rapidity

Tracks at forward eta could have poor resolution. Could impact vertexing
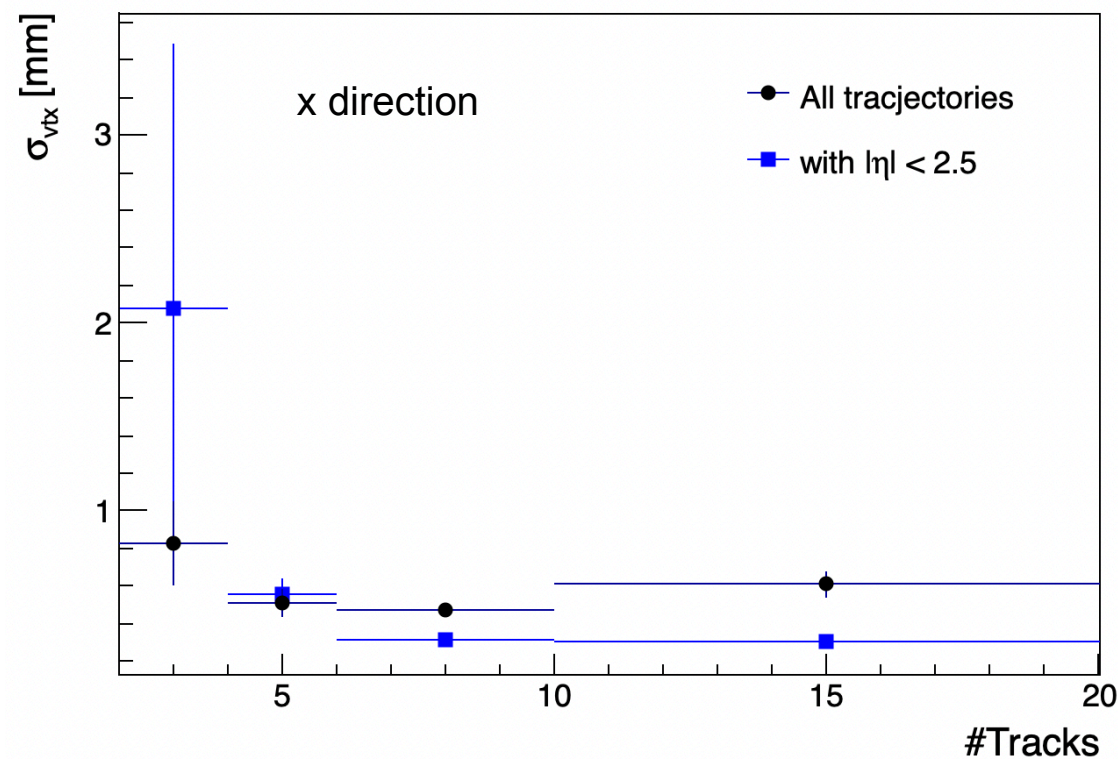
Redo vertexing with only tracks within $|\eta| < 2.5$

Restricting to mid-rapidity tracks improves resolution by a factor of 2. Improves from ~600 μm to ~300 μm
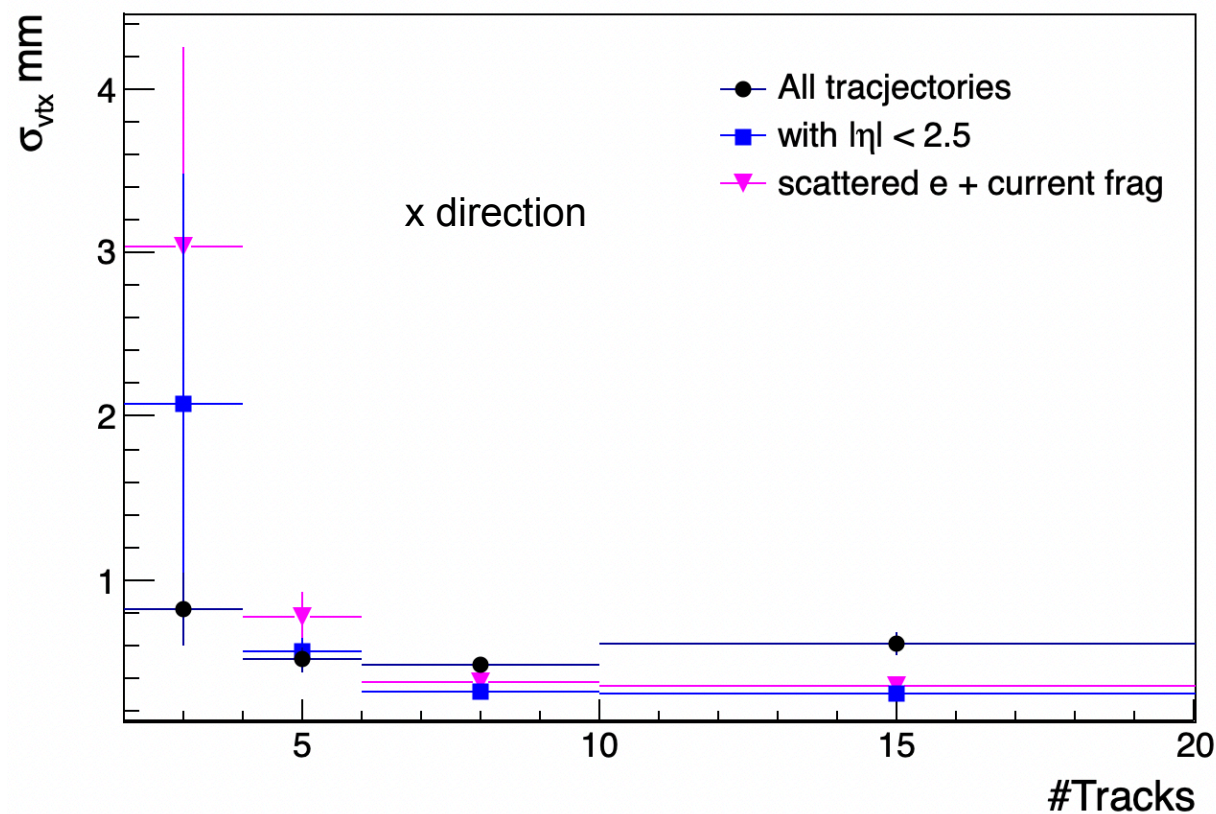
Also not efficient at less than 4 tracks

Scattered electron + leading hadrons

What if done with scattered electron and leading hadrons?

Scattered electron taken as track with charge = -1 at most negative rapidity
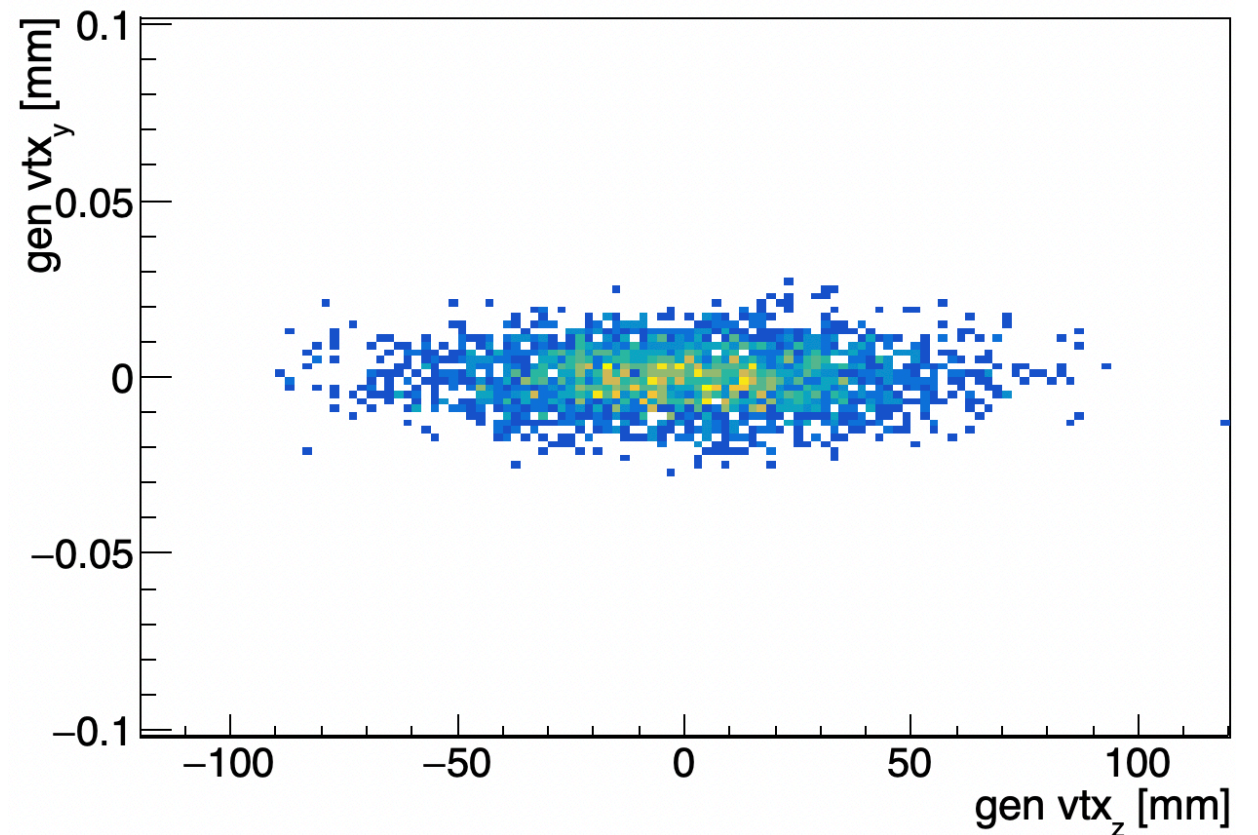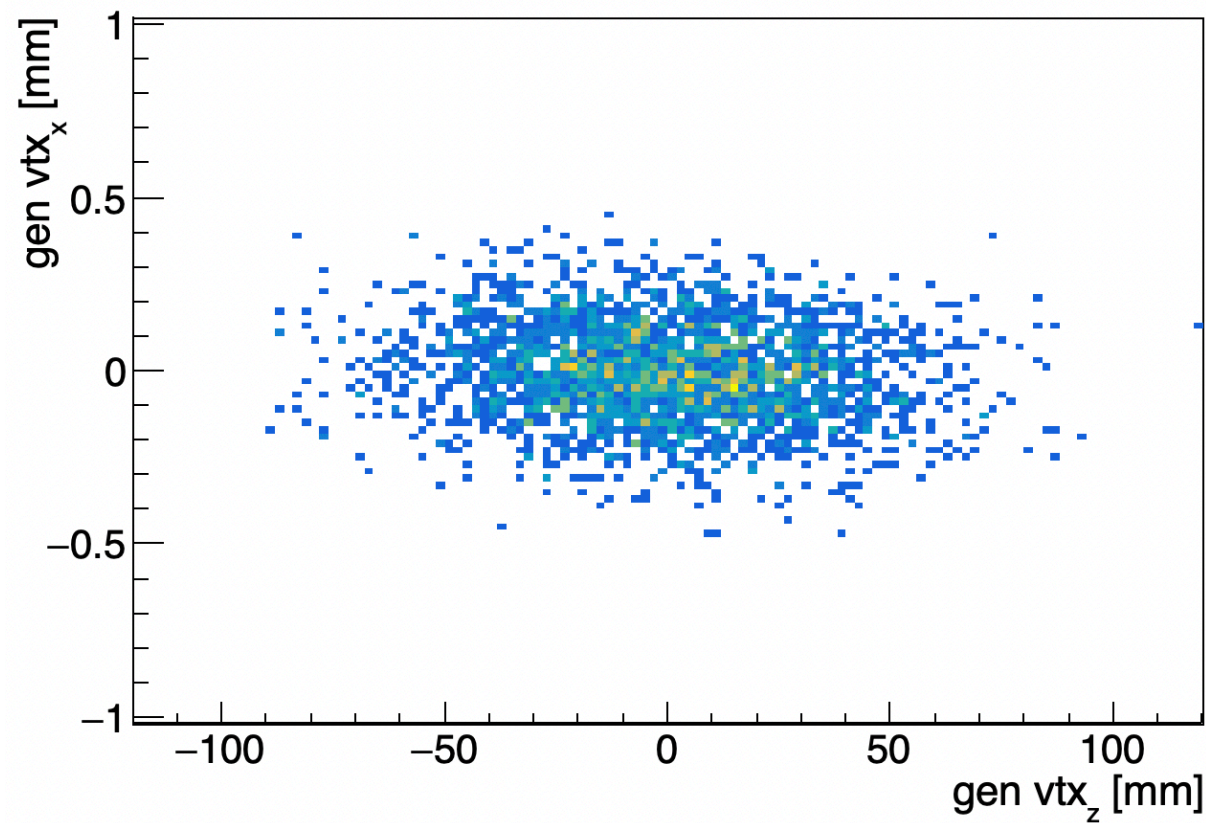Leading hadrons in transverse plane opposite to it within delta_phi of π/4

No selection on η

Similar performance as restricting on η

Improves resolution by ~a factor of 2. Improves from ~600 µm to ~300 µm

Does not explain the overall order of magnitude worse resolution
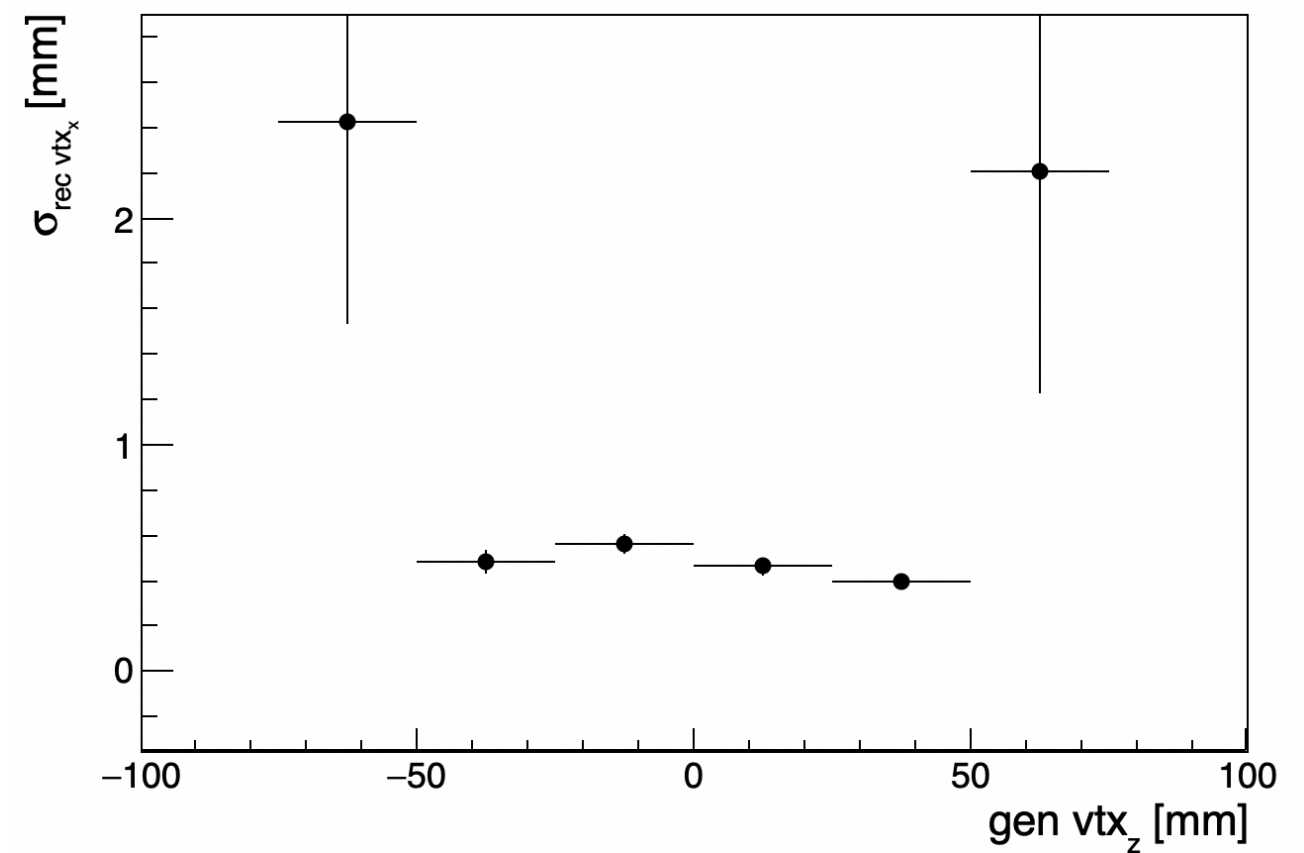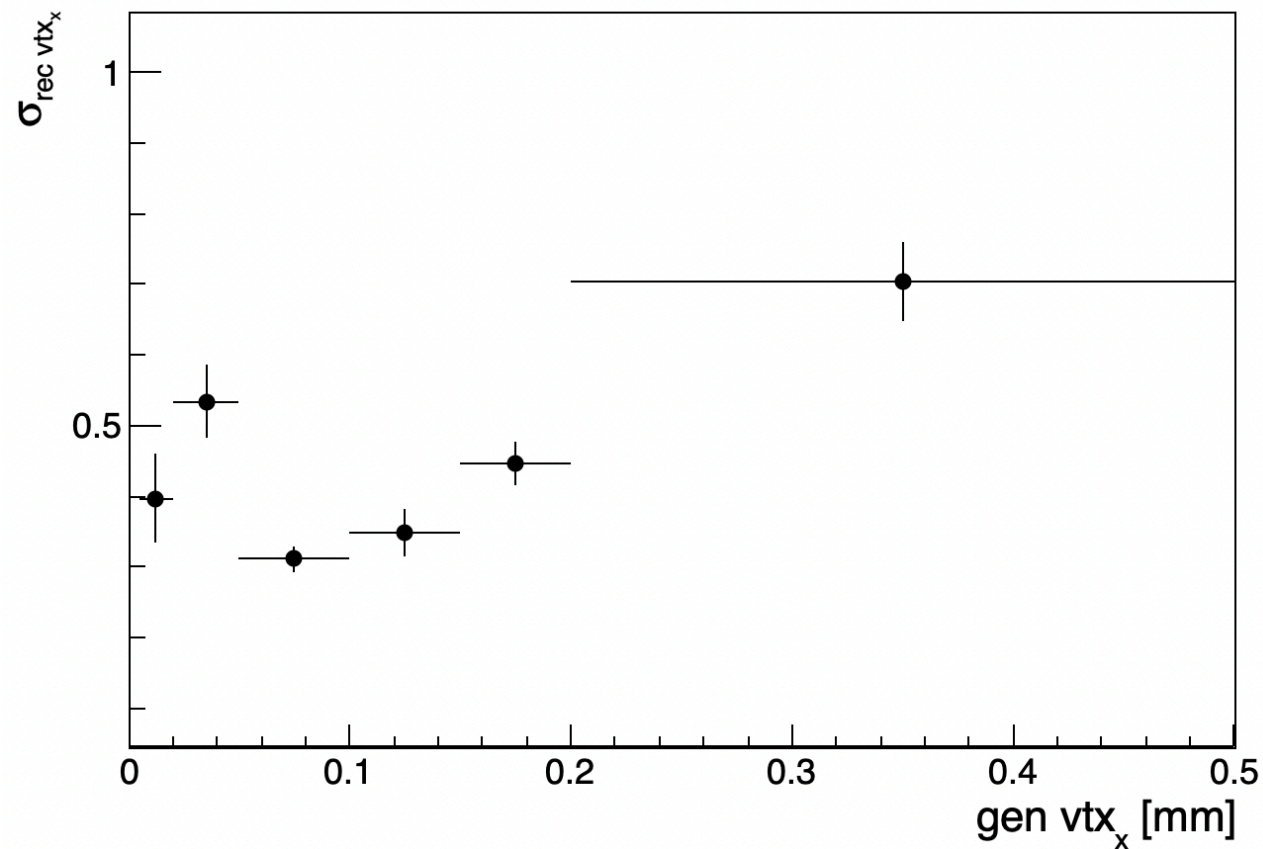
Generated vertex positions

Are generated vertex positions causing the large resolution?

Generated vertex positions quite broad in x and z

Generated vertex position dependence

Are generated vertex positions causing the large resolution?

Resolution worsens when generated vertices are further away from z=0

But does not explain the large values of resolution seen in DIS events

Summary/Plans

Poor vertex resolution in DIS events:
- Order of magnitude worse than that in YR or tracks thrown at a fixed vertex
- Not from tracks with poor resolution in the forward region
- Not from transverse offset of generated vertices
- Improvement in vertex resolution with track weighting/selection

Next steps:
- Check DCA of trajectories that go into vertex finder
- Check with truth seeding for tracking
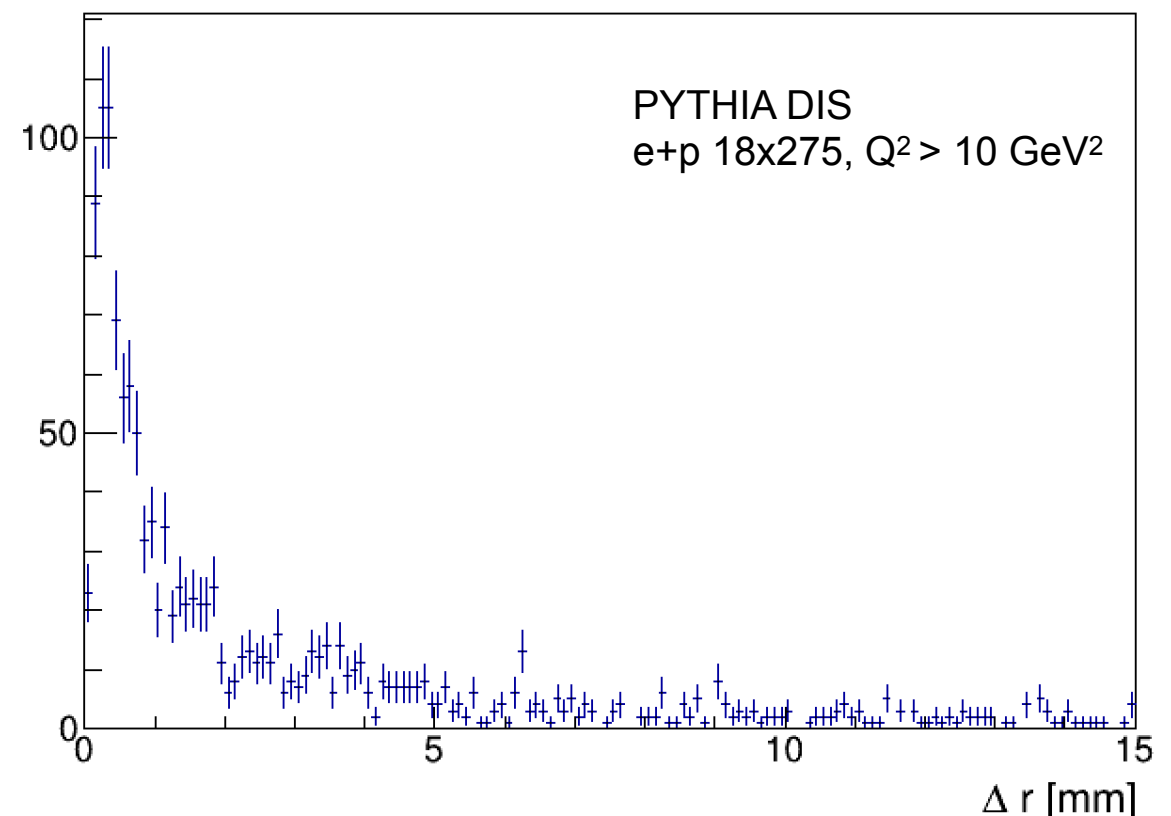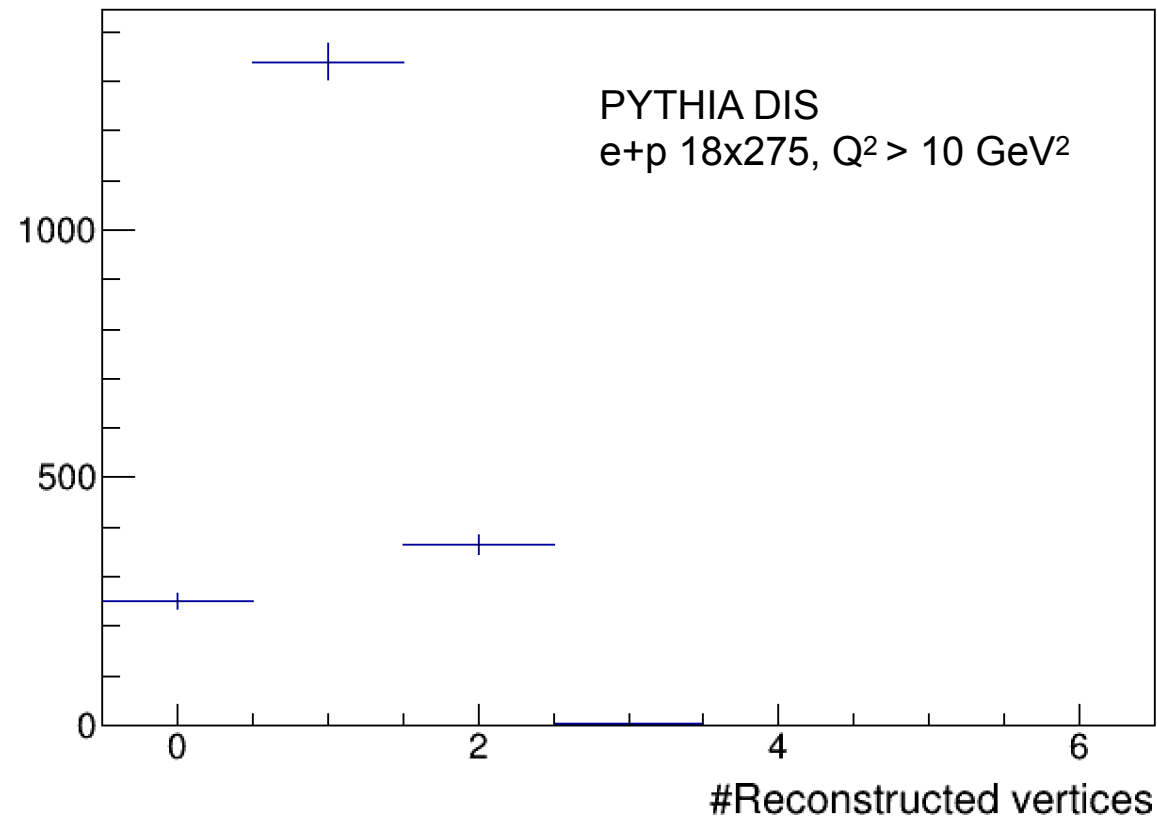- Check with DIS events at fixed vertex

Back Up

Vertex reconstruction in DIS events

Simulation: S3/eictest/EPIC/FULL/23.08.0/epic_craterlake/DIS/NC/18x275/minQ2=10/
pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.*.edm4hep.root

Geometry: epic-23.08.0

Generated event vertices taken as vertex associated to scattered electron

Some vertexing inefficiency
Right plot is 3D distance to generated vertex for all reconstructed vertices