



Progress Report

14th December 2023

Khushi Singla

Lokesh Kumar

Department of Physics, Panjab University, Chandigarh



Task Given by Sooraj

- To run EICrecon over some ed4hep.root files available at:
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
- To analyse the podio output using the code provided ('vtxeval.C') to get basic distributions of vertices and resolutions.
- To learn to generate PYTHIA events at fixed vertex.

Ran eicrecon over few files after copying them locally

- Copied following 2 files locally and ran EICrecon over them:
 1. `pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.0000.edm4hep.root`
 2. `pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.0001.edm4hep.root`
- Command for Copying:

```
khushi@khushi-Linux: ~  
nightly> khushi@khushi-Linux:~/eic/WORK$ mc cp S3/eictest/EPIC/FULL/23.08.0/epic_craterlake/DIS/NC/18x275/minQ2=10/pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.  
.025_hiDiv_1.0001.edm4hep.root .  
...hiDiv_1.0001.edm4hep.root: 1.47 MiB / 213.77 MiB ██████████ 157.31 KiB/s
```

- Command for Running ElCrecon:

```
[INFO] Closing Event Source for pythia0001.root
[INFO] Closing Event Source for pythia8NCDIS_18x27S_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.0001.edm4hep.root
nightly> khushi@khushi-Linux:~/eic/WORK$ eicrecon -Ppodio:output_file=pythia0001.root pythia8NCDIS_18x27S_minQ2\=10_beamEffects_xAngle\=-0.025_hiDiv_1.0001.edm4hep.r
oot
```



Analysed the output using code provided by Sooraj

Command:

```
nightly> khushi@khushi-Linux:~/eic/WORK$ root --web=off vtxeval.C'("pythia0001.root")'
```

Output:

```
=== EVENT 41 =====
Number of entries in collections:
                ReconstructedChargedParticles: 12
                CentralTrackVertices: 0
                MCParticles: 59

-----MC Particles -----
                MC Vertex: (0.07159529062734632, -0.0012359697880683271, 10.342883938911228) mm

-----Central Track Vertices -----
                RC Vertex: (999, 999, 999) mm

-----Reconstructed Particles -----
```

Structure of 'vtexval.C'

- Vertex Distributions for both MC particles and Reconstructed Particles are plotted.
- Vertex Resolution is calculated using:
MC_Vertex - Recon_Vertex

```
float diff = 999.;
int nTrks = 0;
int nvtx=0;
for(const auto& rec_vtx : rec_vtxs) {
    nvtx++;
    TVector3 aVtx(rec_vtx.getPosition().x, rec_vtx.getPosition().y, rec_vtx.getPosition().z);
    TVector3 vtx_diff = aVtx - evtVtx;
    hvr->Fill(vtx_diff.Mag());
    if ( vtx_diff.Mag() < diff ) {
        evtVtx_rc = aVtx;
        diff = vtx_diff.Mag();
    }
}
hnvtx->Fill(nvtx);

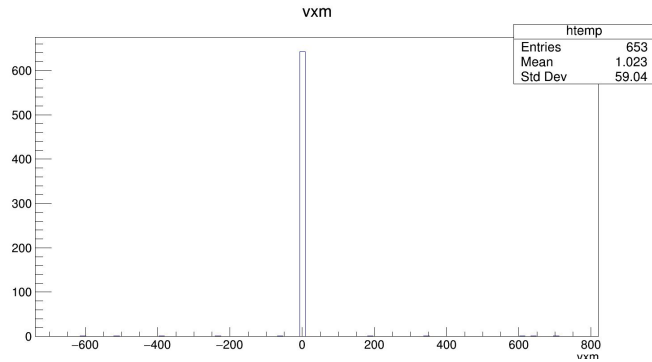
fmt::print("  {:>20}: ({} , {} , {}) mm\n", "RC Vertex", evtVtx_rc.x(), evtVtx_rc.y(), evtVtx_rc.z());
//
t.nTrks = rec_parts.size();
t.vxm = evtVtx.x();
t.vym = evtVtx.y();
t.vzm = evtVtx.z();
t.vx = evtVtx_rc.x();
t.vy = evtVtx_rc.y();
t.vz = evtVtx_rc.z();

hvxres->Fill(rec_parts.size(), evtVtx.x() - evtVtx_rc.x());
hvyres->Fill(rec_parts.size(), evtVtx.y() - evtVtx_rc.y());
hvzres->Fill(rec_parts.size(), evtVtx.z() - evtVtx_rc.z());

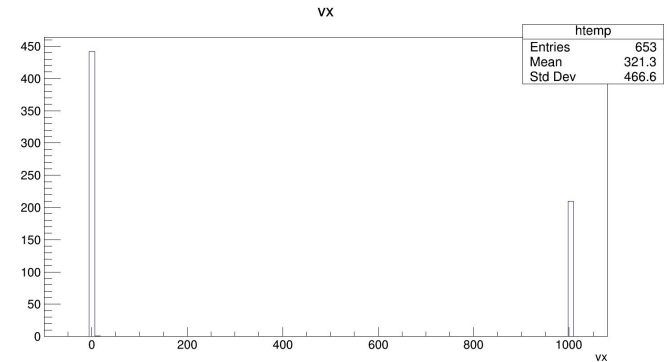
fmt::print("\n{:~^50}\n", fmt::format("Reconstructed Particles ",e));
int nn = 0;
for(const auto& rec_part : rec_parts) {
    TVector3 mom(rec_part.getMomentum().x, rec_part.getMomentum().y, rec_part.getMomentum().z);
    int q = rec_part.getCharge();
    t.pt[nn] = mom.Pt() * q;
    t.eta[nn] = mom.Eta();
    t.phi[nn] = mom.Phi();
    PrintParticle(rec_part);
    fmt::print("\n");
    nn++;
}
mTree->Fill();
```

Distributions (x-direction)

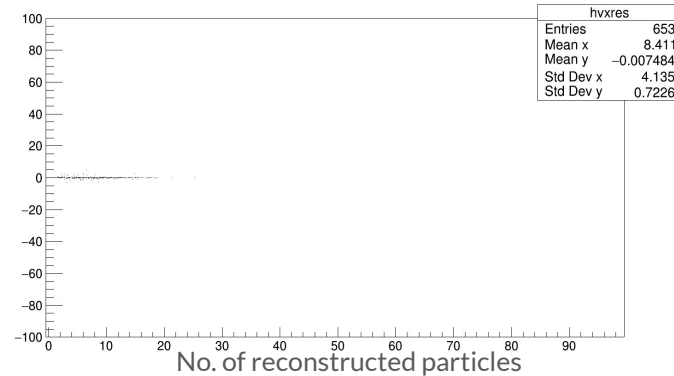
MC Particles



Reconstructed Particles

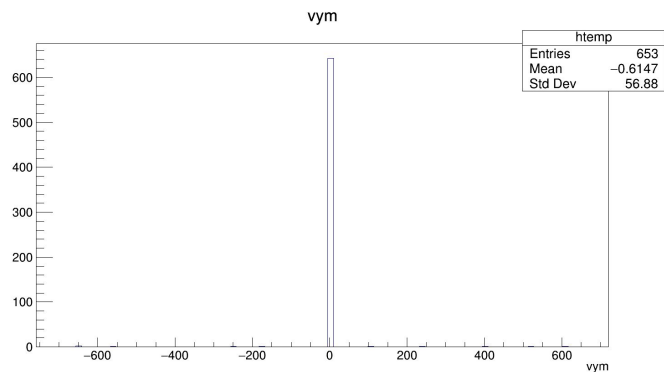


Vertex Resolution

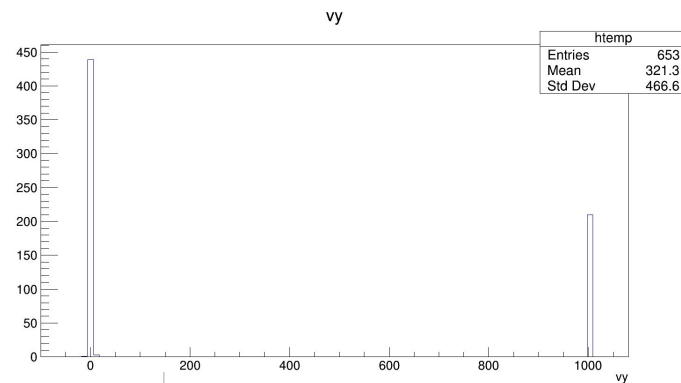


Distributions (y-direction)

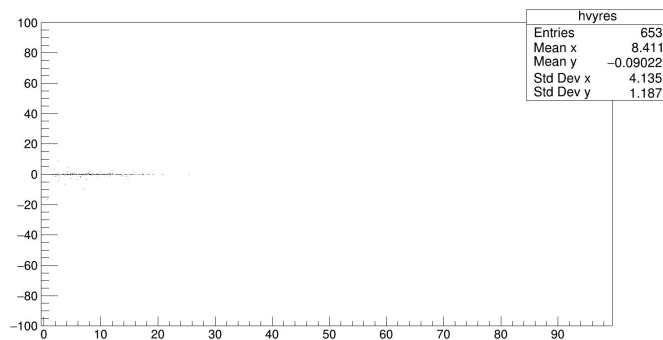
MC Particles



Reconstructed Particles



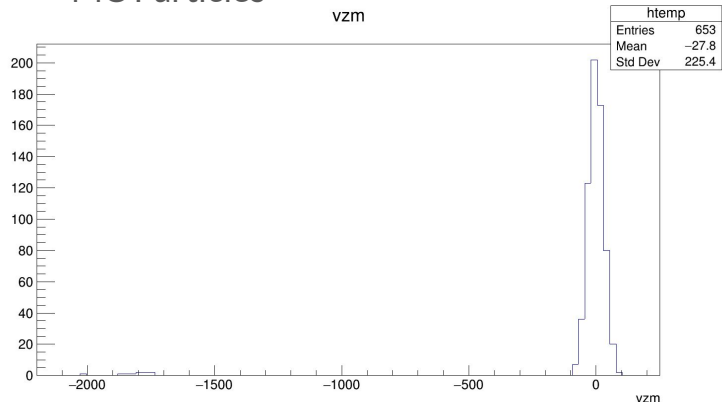
Vertex Resolution



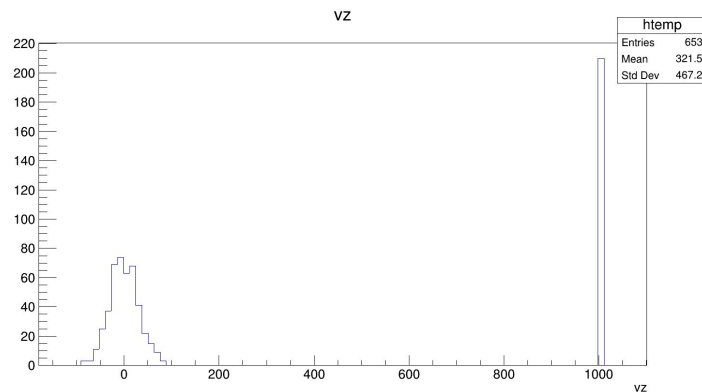
No. of reconstructed particles

Distributions (z-direction)

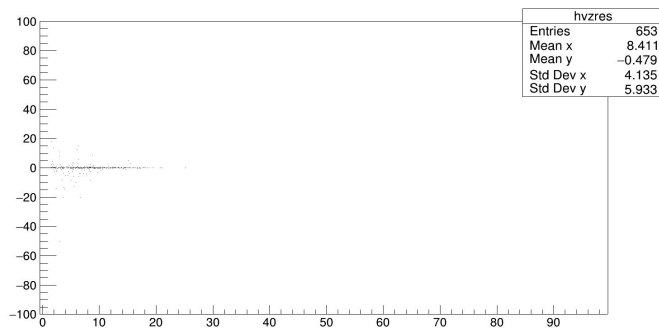
MC Particles



Reconstructed Particles



Vertex Resolution



No. of reconstructed particles



Further Goals

- To understand the code in vtxeval.C file.
- To read about PYTHIA and learn to generate PYTHIA events at fixed vertex.