

MOMENTUM RESOLUTION FOR RECONSTRUCTED PARTICLES AT MINQ2 = 1000

Allan Prince S

Dr. Nirbhay Kumar Behera

Central University of Tamil Nadu

Date:

3rd April 2024

Data Set:

File path: dtn-eic.jlab.org/work/eic2/EPIC/RECO/23.12.0/epic_craterlake/DIS/NC/18x275/minQ2=1000

Infile:

pythia8NCDIS_18x275_minQ2=1000_beamEffects_xAngle=-0.025_hiDiv_5.3208.eicrecon.tree.edm4eic.root

Analysis Code:

Reference: <https://eic.github.io/tutorial-analysis/03-analysis/index.html>

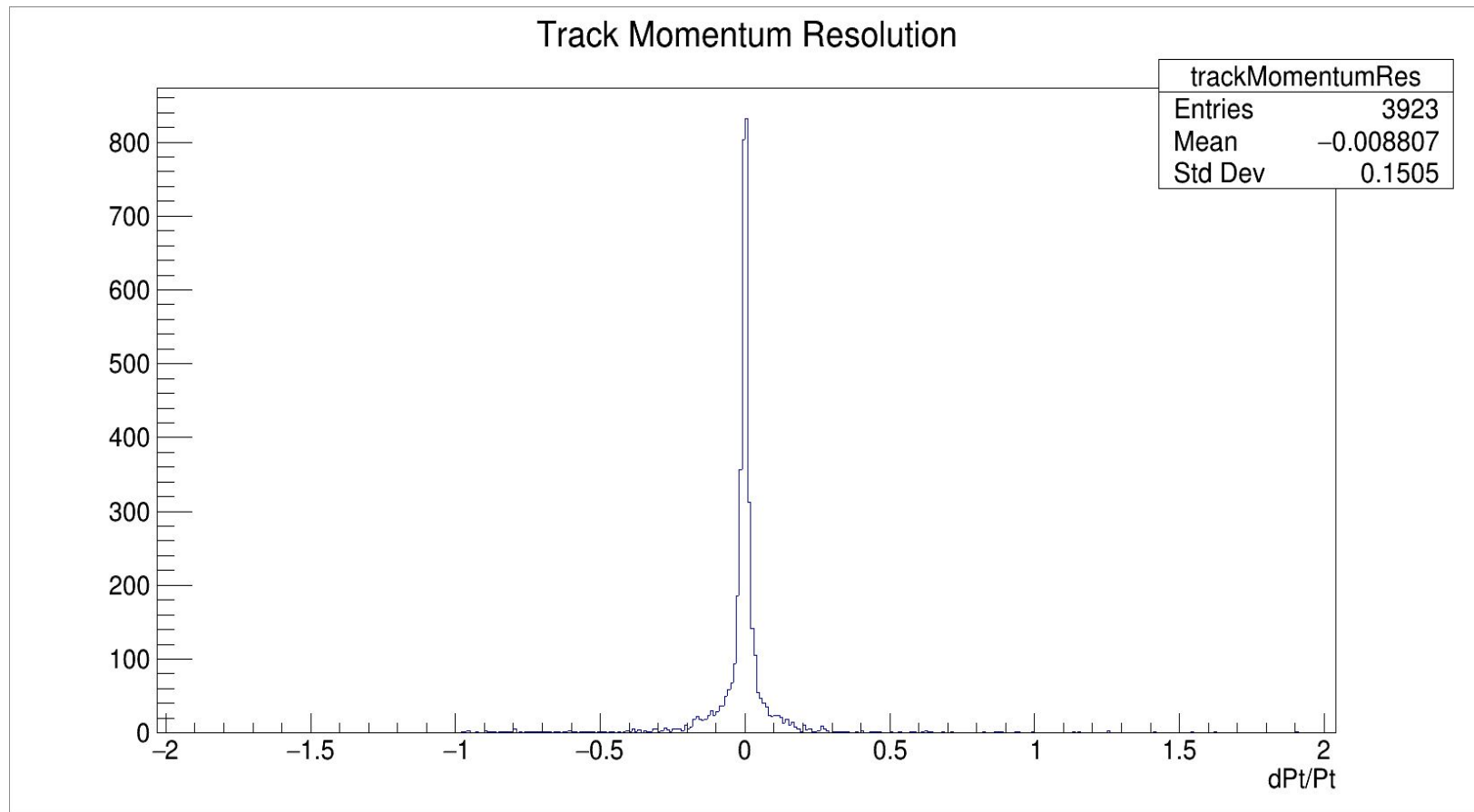
Steps:

1. Get Momentum of MC particle from tree.
2. Get Momentum of reconstructed particle from tree.
3. Calculate Resolution.

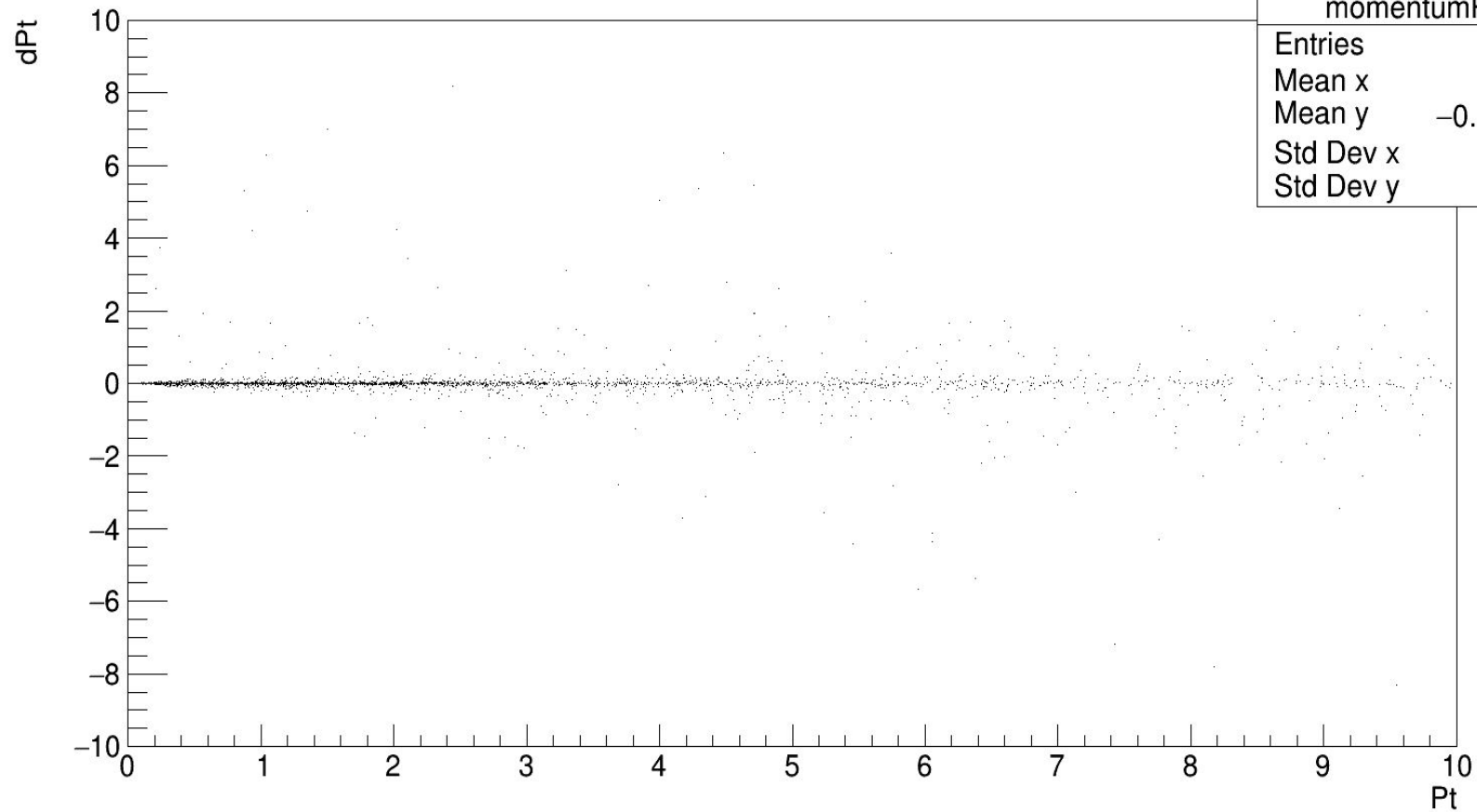
$$\text{Res} = (\text{reconstructed momentum} - \text{true momentum}) / \text{true momentum}$$

4. Plot the histograms.

Output:



dPt vs Pt



THANK YOU


```

1 void trackResolution(TString infile="pythia8NCDIS_18x275_minQ2=1000_beamEffects_xAngle=-0.025_hiDiv_5.3208.eicrecon.tree.edm4eic.root")
2 {
3     TFile *ofile = TFile::Open("out1.hist.root","RECREATE"); // Output file for histograms
4
5     TChain *mychain = new TChain("events"); // Input file chain
6     mychain->Add(infile);
7
8     TTreeReader tree_reader(mychain); // Initialize reader
9
10    // Get Particle Information
11    TTreeReaderArray<int> partGenStat(tree_reader, "MCParticles.generatorStatus");
12    TTreeReaderArray<float> partMomX(tree_reader, "MCParticles.momentum.x");
13    TTreeReaderArray<float> partMomY(tree_reader, "MCParticles.momentum.y");
14    TTreeReaderArray<float> partMomZ(tree_reader, "MCParticles.momentum.z");
15    TTreeReaderArray<int> partPdg(tree_reader, "MCParticles.PDG");
16
17    // Get Reconstructed Track Information
18    TTreeReaderArray<float> trackMomX(tree_reader, "ReconstructedChargedParticles.momentum.x");
19    TTreeReaderArray<float> trackMomY(tree_reader, "ReconstructedChargedParticles.momentum.y");
20    TTreeReaderArray<float> trackMomZ(tree_reader, "ReconstructedChargedParticles.momentum.z");
21
22    // Get Associations Between MCParticles and ReconstructedChargedParticles
23    TTreeReaderArray<unsigned int> recoAssoc(tree_reader, "ReconstructedChargedParticleAssociations.recID");
24    TTreeReaderArray<unsigned int> simuAssoc(tree_reader, "ReconstructedChargedParticleAssociations.simID");
25
26
27    // Define Histograms
28    TH1D *matchedPartTrackDeltaR = new TH1D("matchedPartTrackDeltaR", "Delta R Between Matching Thrown and Reconstructed Charged Particle", 5000, 0., 5.);
29    TH1D *trackMomentumRes = new TH1D("trackMomentumRes", "Track Momentum Resolution; dPt/Pt", 2000, -10., 10.);
30    TH2D *momentumRes = new TH2D("momentumRes", "dPt vs Pt; Pt; dPt", 2000, 0., 10., 2000, -10., 10.);
31
32    while(tree_reader.Next()) { // Loop over events
33
34        for(unsigned int i=0; i<partGenStat.GetSize(); i++) // Loop over thrown particles
35        {
36            if(partGenStat[i] == 1) // Select stable thrown particles
37            {
38                int pdg = TMath::Abs(partPdg[i]);
39
40                if(pdg == 11 || pdg == 13 || pdg == 211 || pdg == 321 || pdg == 2212) // Look at charged particles (electrons, muons, pions, kaons, protons)
41                {
42                    TVector3 trueMom(partMomX[i], partMomY[i], partMomZ[i]);
43
44                    float trueEta = trueMom.PseudoRapidity();
45                    float truePhi = trueMom.Phi();
46
47                    // Loop over associations to find matching ReconstructedChargedParticle
48                    for(unsigned int j=0; j<simuAssoc.GetSize(); j++)
49                    {
50                        if(simuAssoc[j] == i) // Find association index matching the index of the thrown particle we are looking at
51                        {
52                            TVector3 recMom(trackMomX[recoAssoc[j]], trackMomY[recoAssoc[j]], trackMomZ[recoAssoc[j]]); // recoAssoc[j] is the index of the matched ReconstructedChargedParticle
53

```

```
52         TVector3 recMom(trackMomX[recoAssoc[j]],trackMomY[recoAssoc[j]],trackMomZ[recoAssoc[j]]); // recoAssoc[j] is the index of the matched ReconstructedChargedParticle
53
54         // Check the distance between the thrown and reconstructed particle
55         float deltaEta = trueEta - recMom.PseudoRapidity();
56         float deltaPhi = TVector2::Phi_mpi_pi(truePhi - recMom.Phi());
57         float deltaR = TMath::Sqrt(deltaEta*deltaEta + deltaPhi*deltaPhi);
58
59         double deltaMom = recMom.Mag() - trueMom.Mag();
60         double momRes = deltaMom/trueMom.Mag();
61
62         matchedPartTrackDeltaR->Fill(deltaR);
63
64         trackMomentumRes->Fill(momRes);
65
66         momentumRes->Fill(trueMom.Mag(),deltaMom);
67     }
68 }
69 }
70 }
71 }
72 }
73
74 ofile->Write(); // Write histograms to file
75 ofile->Close(); // Close output file
76 }
77
```