Update of Detector Acceptance Requirement and Jet Smearing in Dijet Photoproduction

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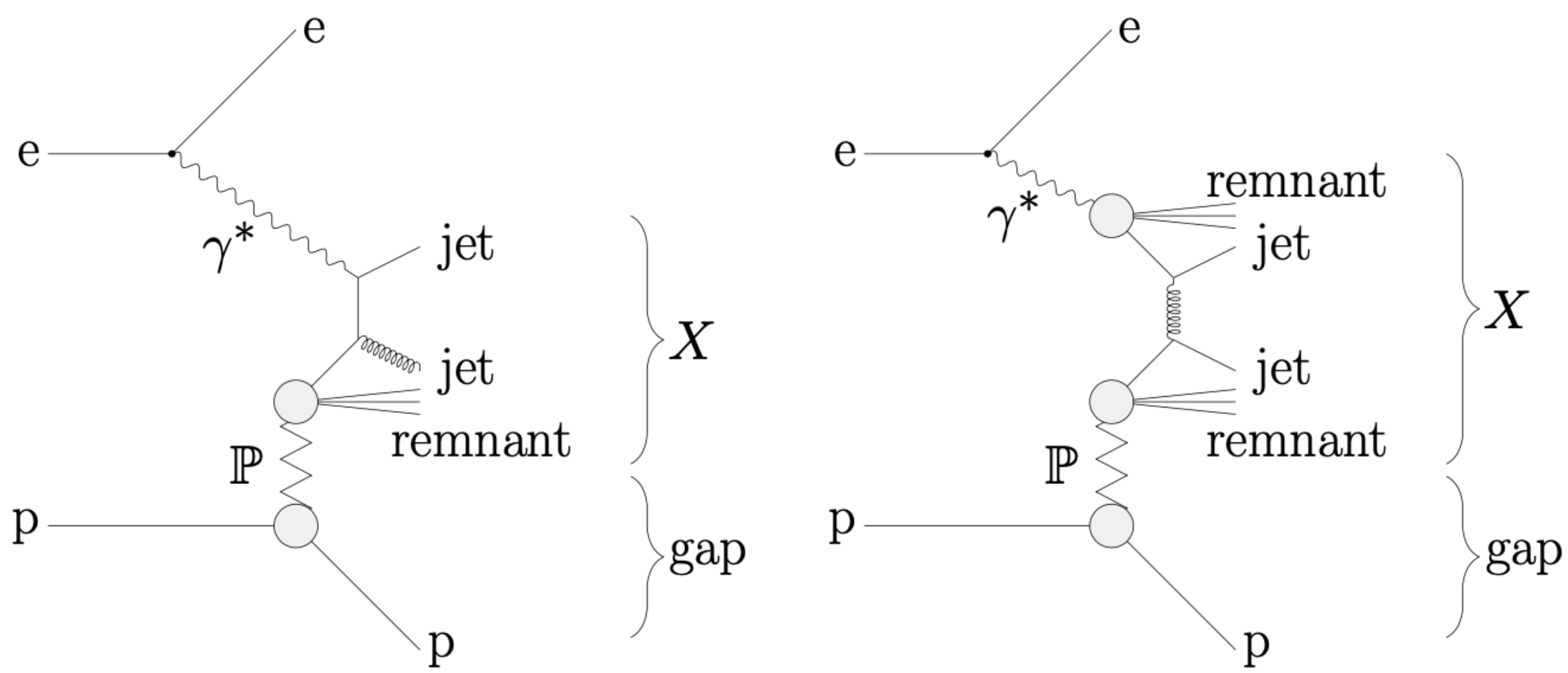
Diffractive dijet photoproduction in ep

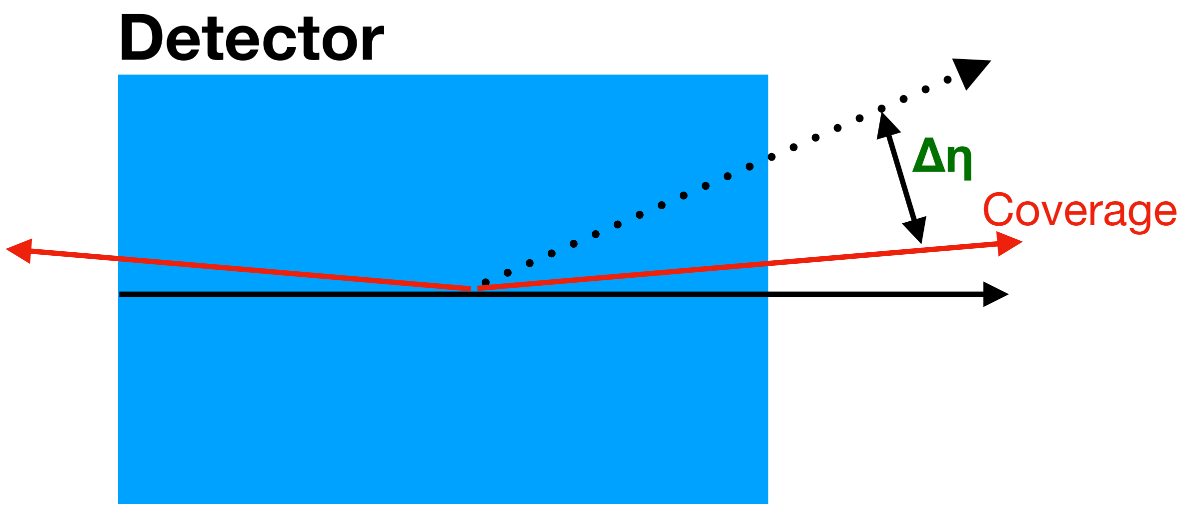


(a) (b)

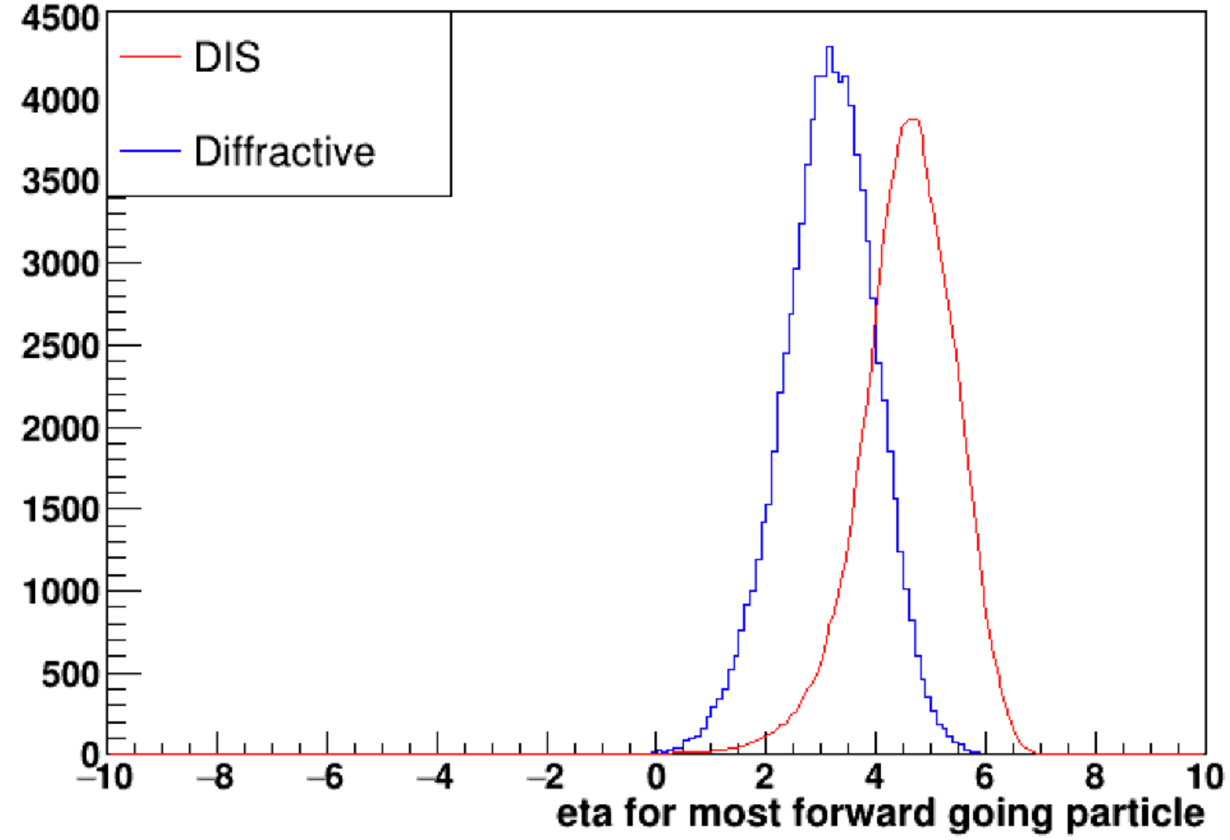
- Leading-order Feynman graphs for diffractive dijet production with photons in ep collsions;
- Left part is from direct photon contribution;
- Right part is from resolved photon contribution;
- Using Pythia8301 for our simulation;

One technique to tag on diffraction is to require a "rapidity gap" in the detector. This means that there is a region in the detector from the hadron beam towards the center of the detector in which there is no activity from the hadronic final state. The efficiency for detecting, and the purity of, diffractive events therefore depends strongly on the rapidity coverage of the detector.

Purity and efficiency



Here Δη is the minimum eta gap requirement between the most forward particle of the event and the edge the detector coverage. It means if the event has a particle in the eta gap range, we would veto this event.

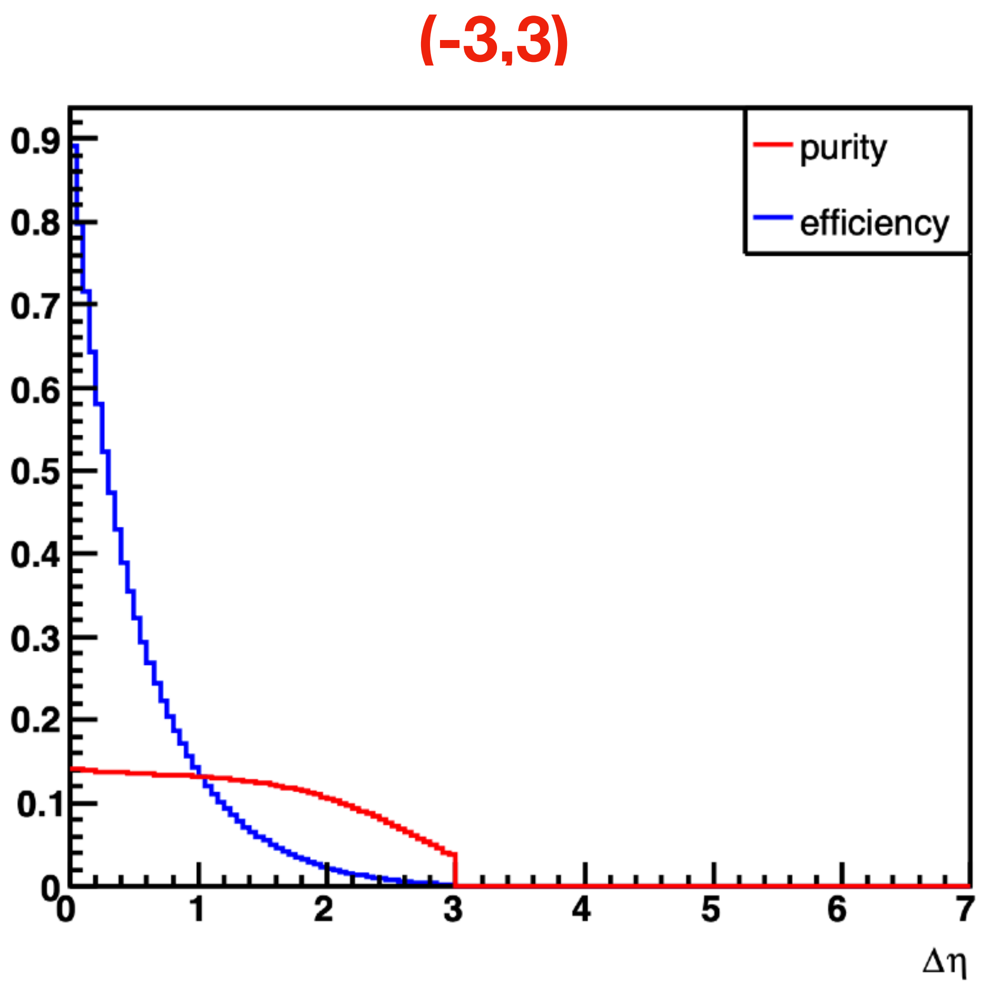


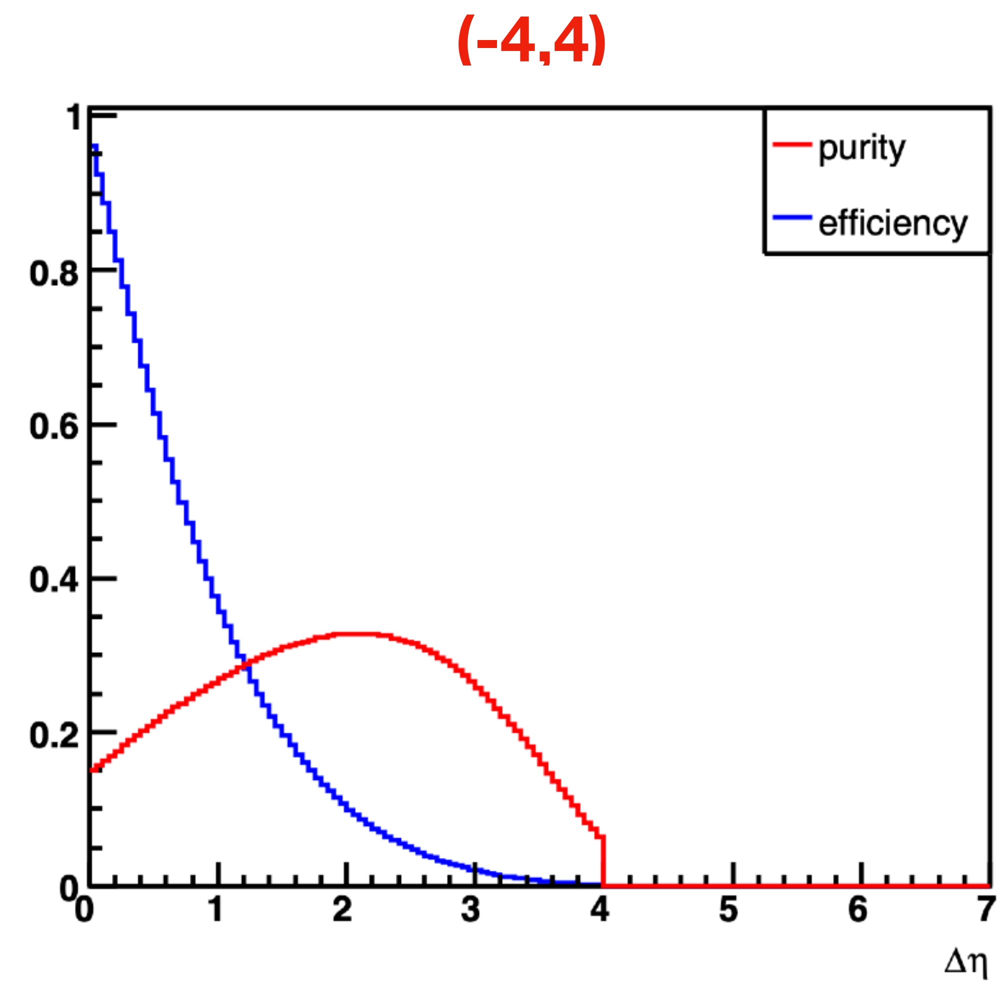
Here we can define “purity” and “efficiency” as follows

$$purity = \frac{NO\,.\,Accepted\ diffractive\ events}{NO\,.\,Accepted\ diffractive\ events + NO\,.\,Accepted\ DIS\ events}$$

$$efficiency = \frac{NO\,.\,Accepted\ diffractive\ events}{total\ diffractive\ events}$$

Purity and efficiency for different eta coverage





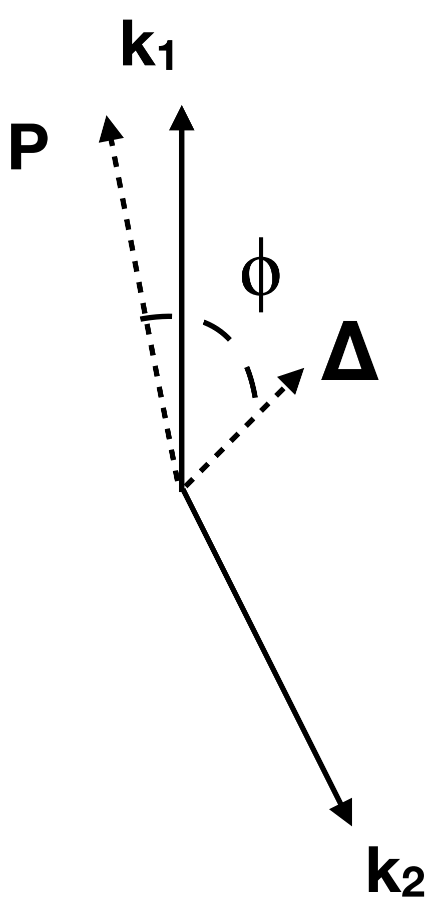
- Pythia8 for diffractive events
- Pythia6 for DIS events
- E_e= 18GeV, E_p = 275GeV
- $Q^2 < 1.0$ GeV^2
- DIFF:DIS = 1:6
- **The larger eta coverage would give us better purity of diffractive events.**

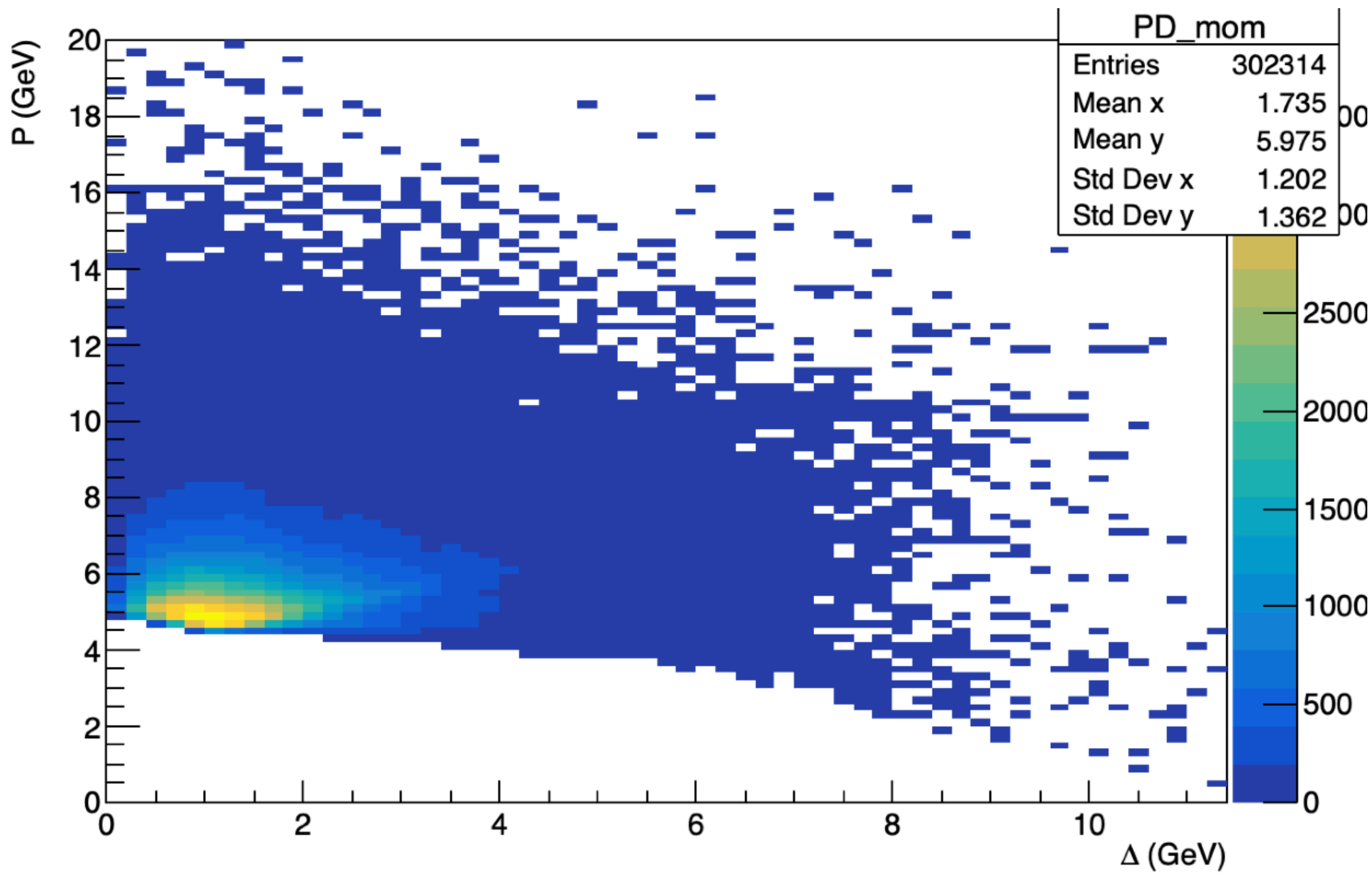
Dijet kinematics in EIC

$$\gamma^* + p \rightarrow \text{jet}_1 + \text{jet}_2 + p$$
$$(k_1) \qquad (k_2)$$

- $\mathbf{k_1}$, $\mathbf{k_2}$ is the transverse momentum vector of jet1 and jet2;
- $\mathbf{P} = 0.5(\mathbf{k_1}-\mathbf{k_2})$; "mean jet Pt";
- $\mathbf{\Delta} = \mathbf{k_1} + \mathbf{k_2}$; recoil momentum;

- Ee = 18 GeV
- Ep = 275 GeV
- pT_jet1 > 5 GeV
- pT_jet2 > 4 GeV
- -4.4< Eta < 4.4





Jet smearing in EIC-smear

✓ Simulation
- Pythia8 (diffractive)
- E_e= 18GeV, E_p = 275GeV
- $Q^2 < 1.0$ GeV^2

✓ Jet Finder
- Anti-k_T
- Lab frame
- $p_T > 0.2$ GeV
- R = 0.8
- Leading Jet $p_T > 5$ GeV
- Second Jet pt > 4GeV

✓ Smearing
- Eic-smear: Handbook detector

- In the jet smearing, we have two scenarios that needs careful handling.
  1. P>0, E=0 (π^+, π^-, K^+, K^-, $\bar{p}$)
     - Insert the default P and E into the jet finder;
     - get the E by E = sqrt(P^2+m^2) if we know the PID;
  2. P=0, E>0 (γ, n, K^0_L)
     - only using PID=11/22, and let P=E;
     - For all particles, using P = sqrt(E^2-m^2);
- True jet pt and E are the jet reconstructed from Pythia8 events without smearing.

Case 1: For P>0, E=0; using default P, E;
For P=0, E>0, only using PID=11/22, E=P;

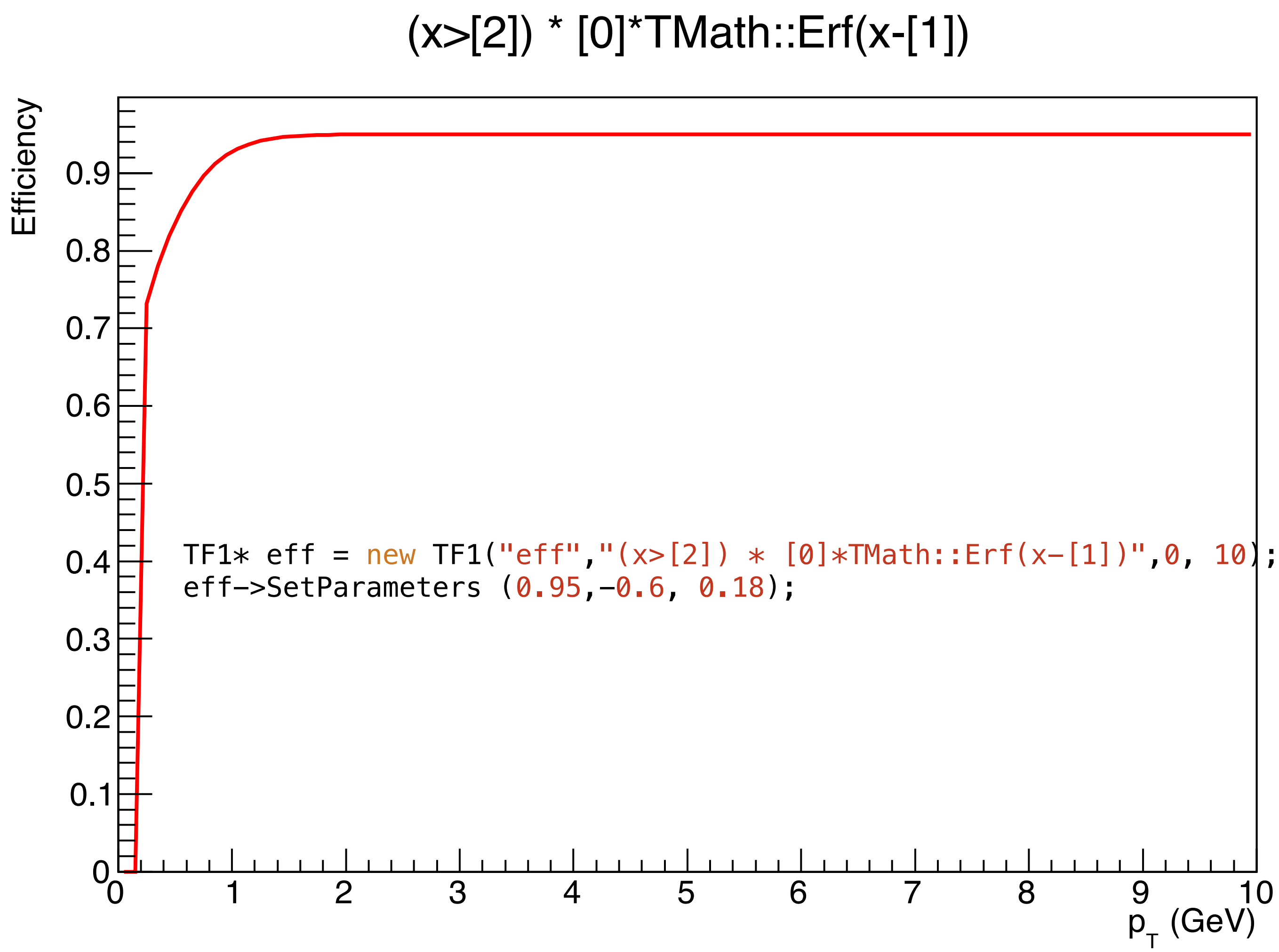
Case 2: For P>0, E=0; using P, E = sqrt(P^2+m^2);
For P=0, E>0, only using PID=11/22, E=P;

Case 3: For P>0, E=0; using default P, E;
For P=0, E>0, P = sqrt(E^2-m^2);

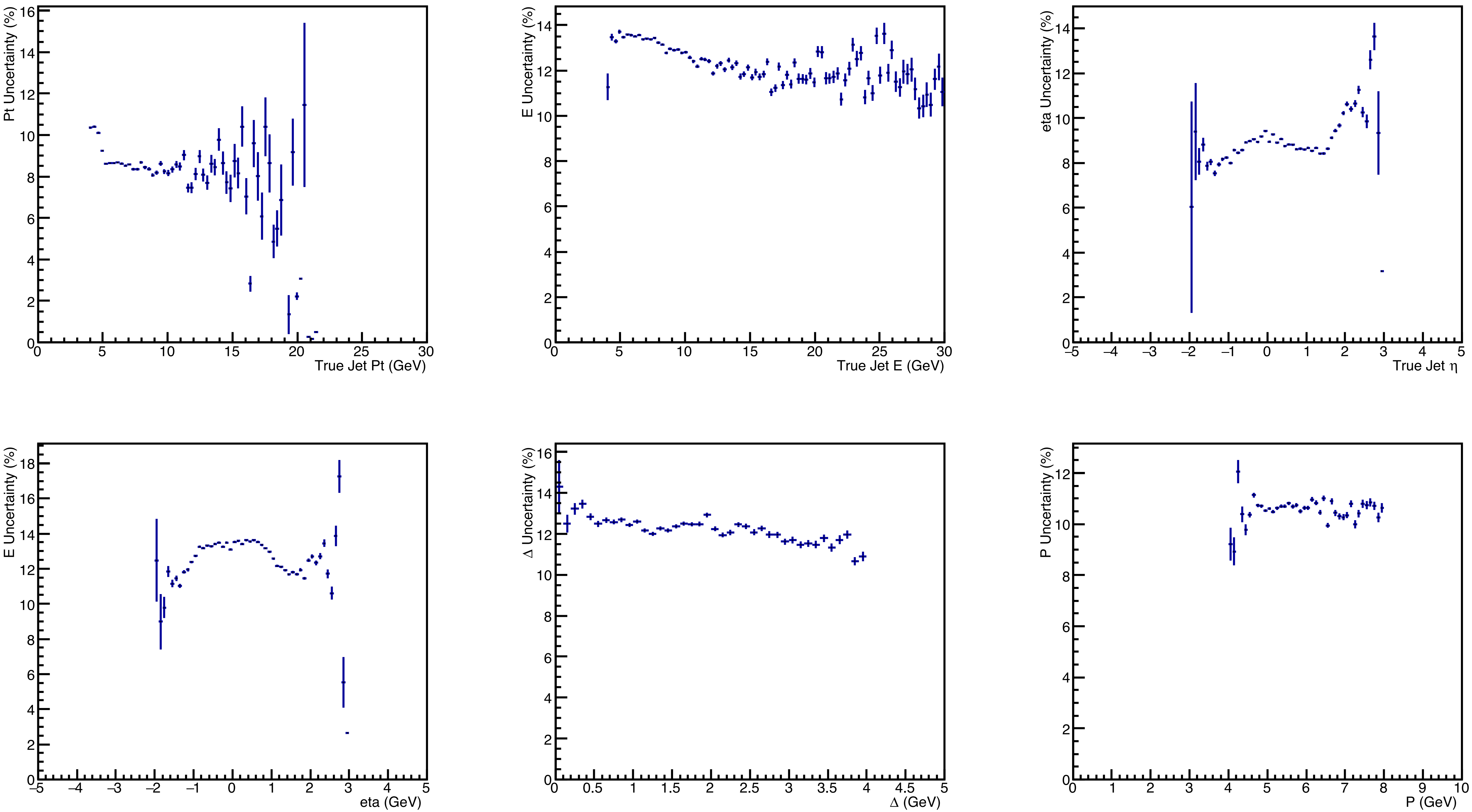
Case 4: For P>0, E=0; using P, E = sqrt(P^2+m^2);
For P=0, E>0, P = sqrt(E^2-m^2);

Tracking inefficiency

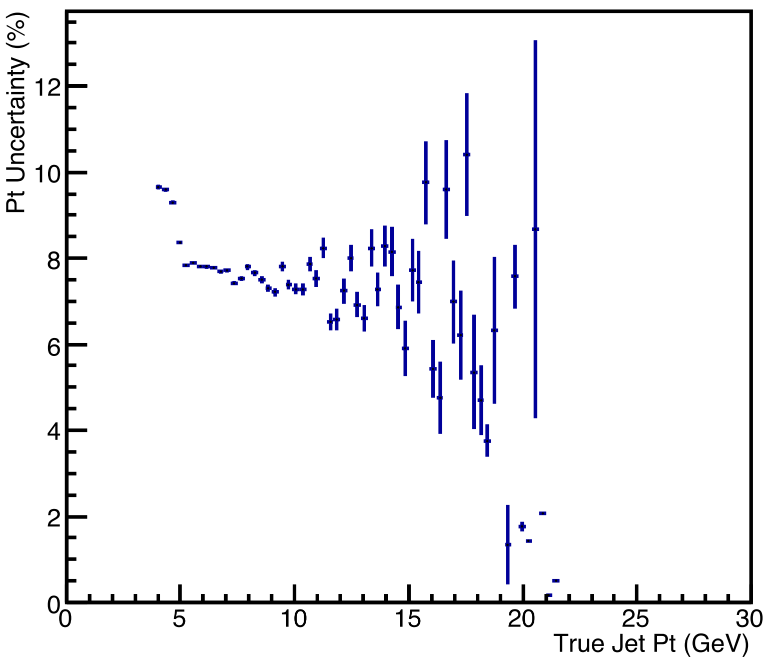
Eic-smear doesn't provide tracking inefficiency. We implement a hypothetic efficiency distribution here. For pT>1GeV, efficiency ≈ 95% and drop toward small pT.

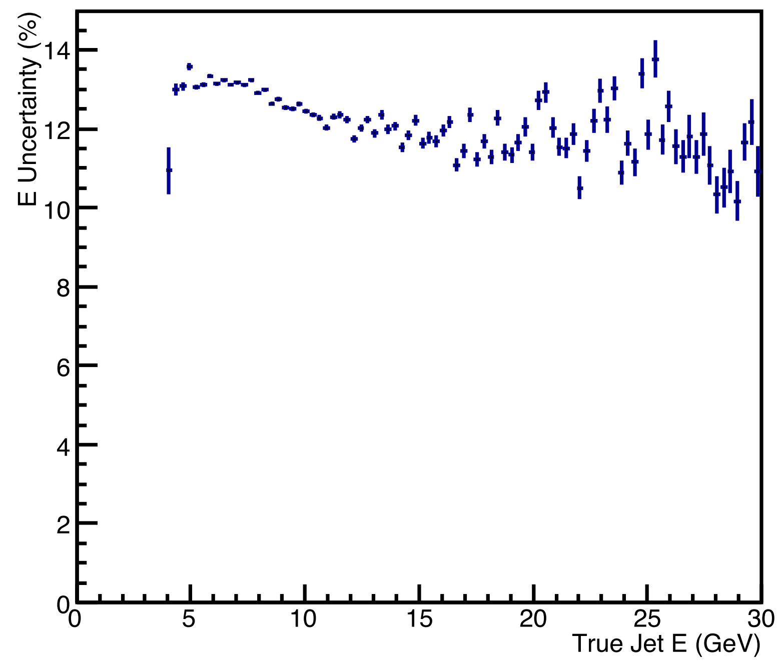


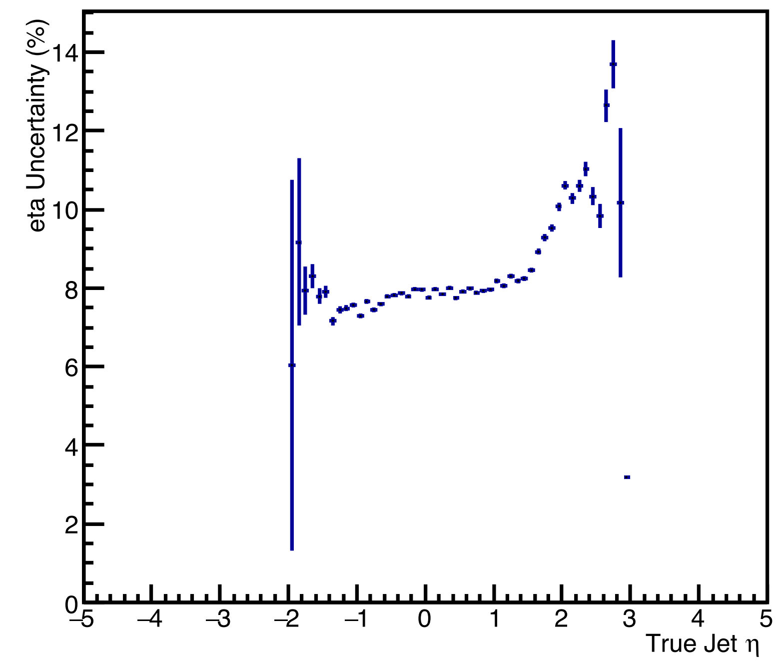
Case 1: For P>0, E=0; using default P, E;
For P=0, E>0, only using PID=11/22, E=P;

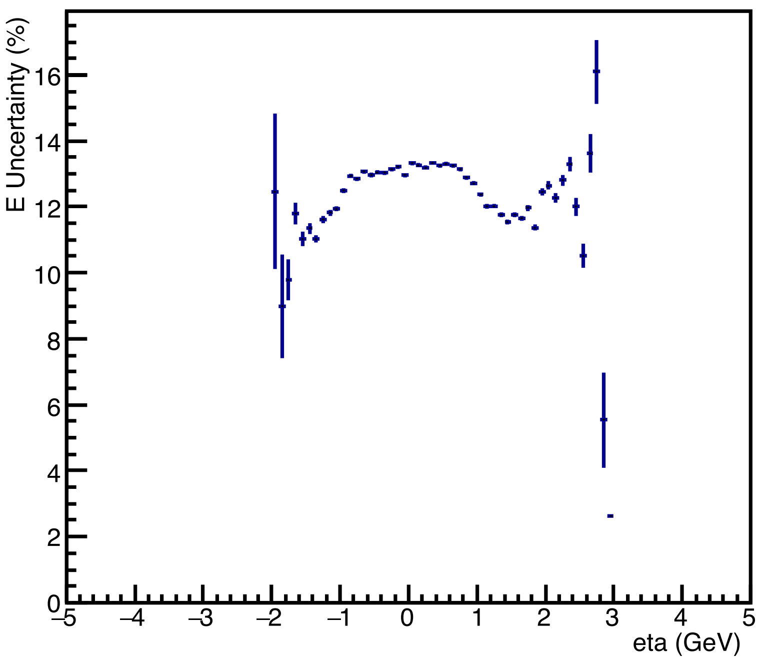


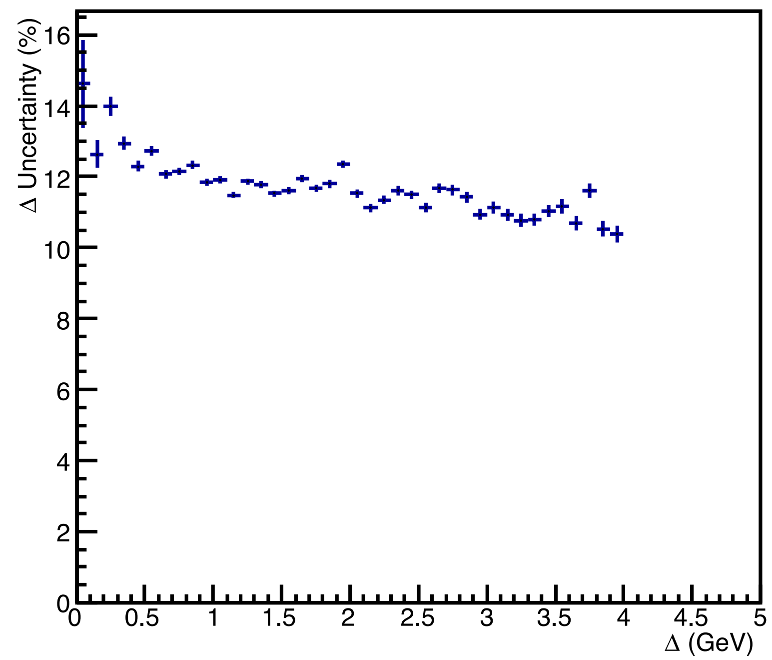
Case 2: For P>0, E=0; using P, E = sqrt(P^2+m^2); For P=0, E>0, only using PID=11/22, E=P;

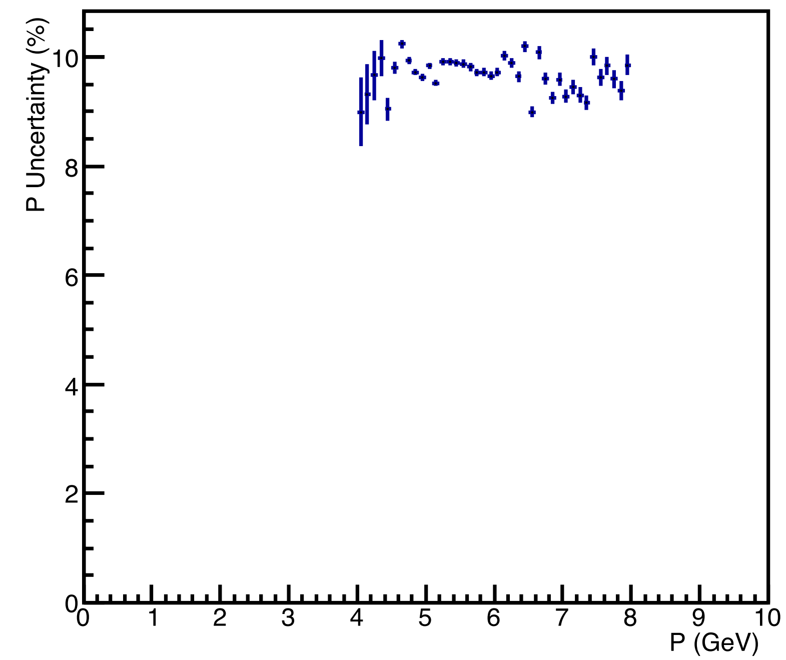




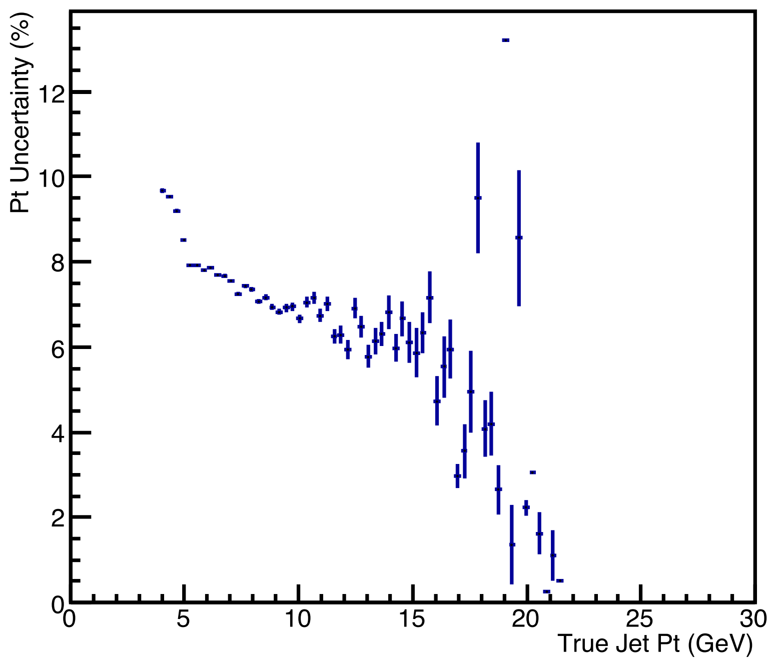


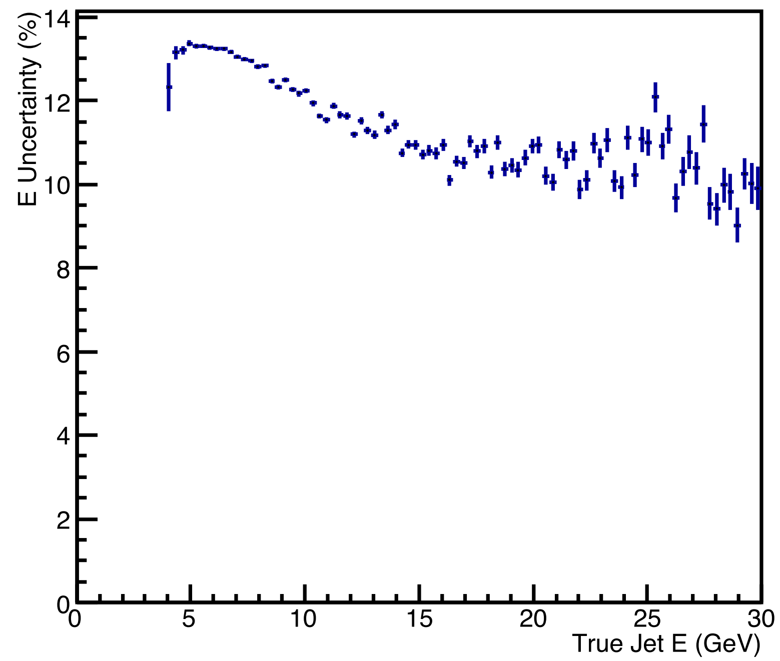


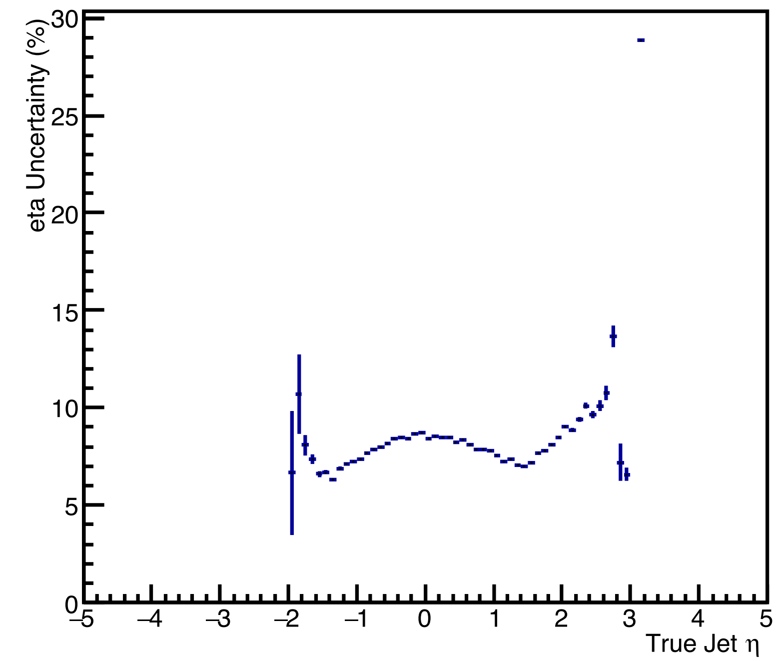


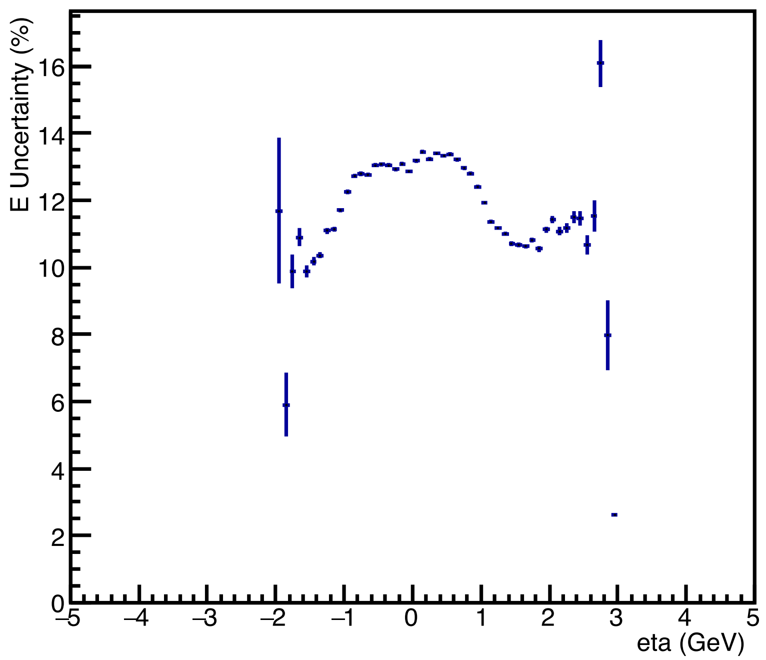


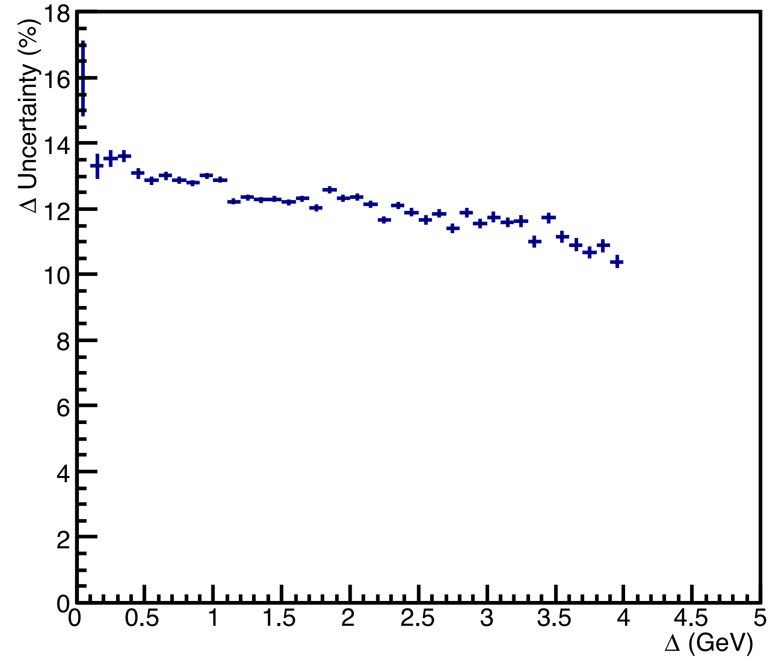
Case 3: For P>0, E=0; using default P, E;
For P=0, E>0, P = $\mathrm{sqrt}(E^2 - m^2)$;

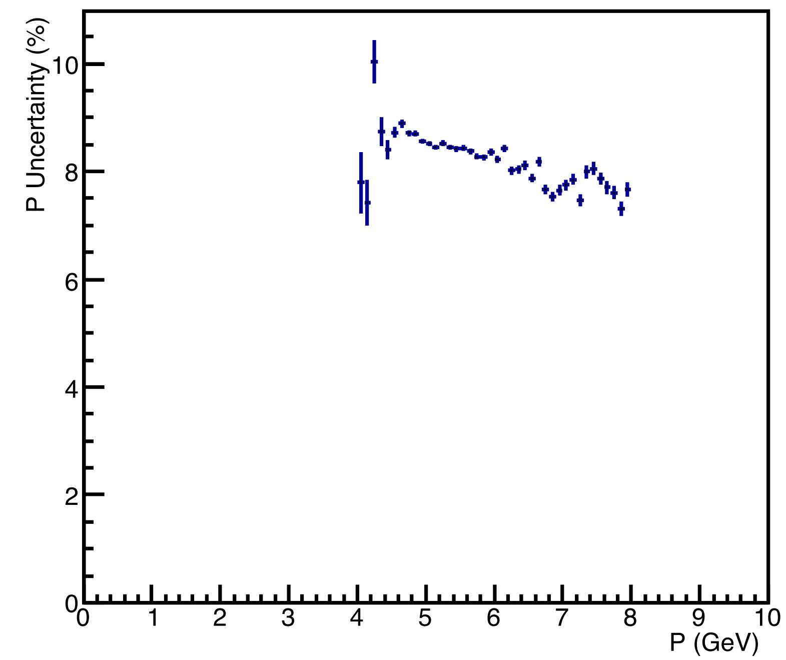




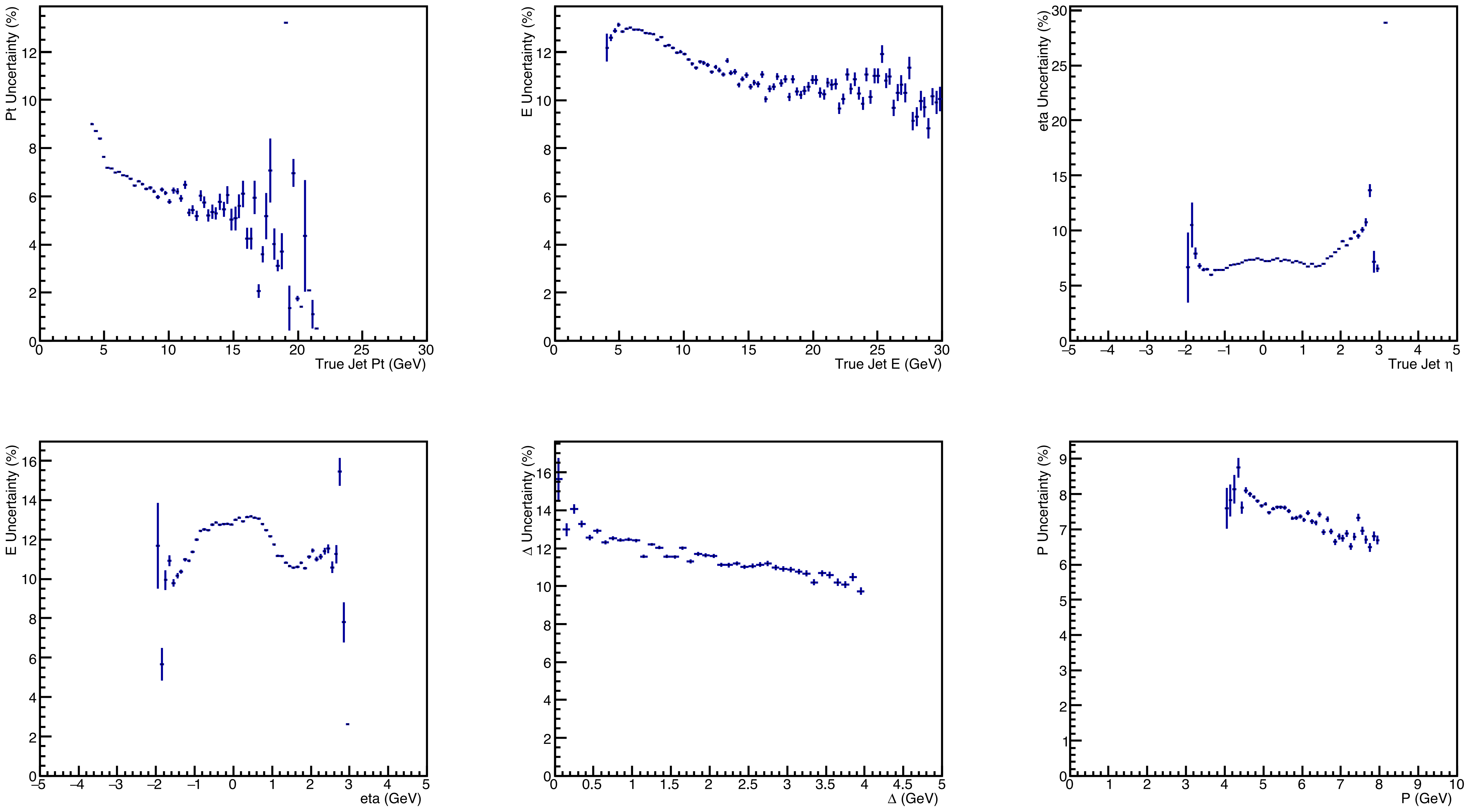




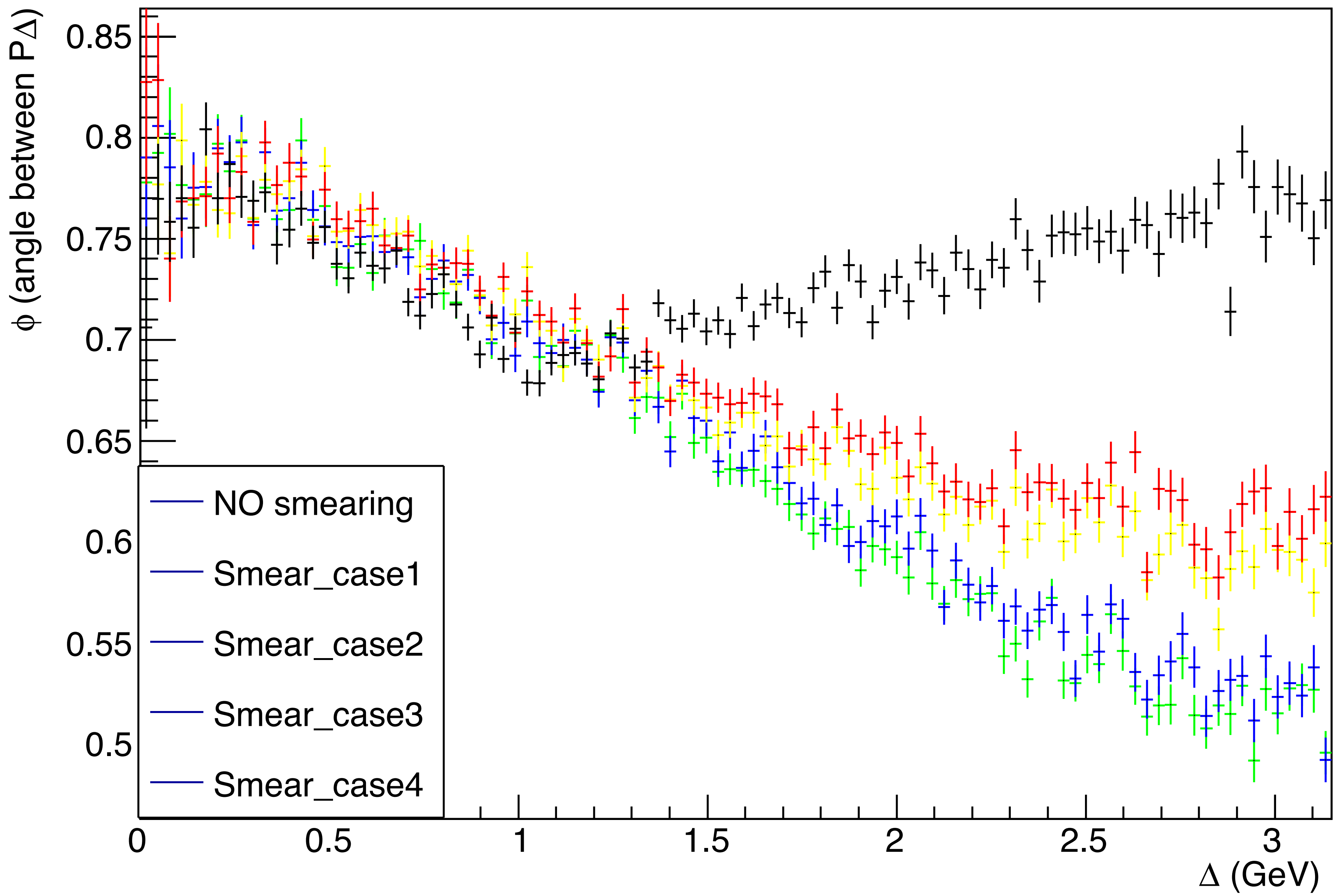




Case 4: For P>0, E=0; using P, E = sqrt(P²+m²); For P=0, E>0, P = sqrt(E²-m²);

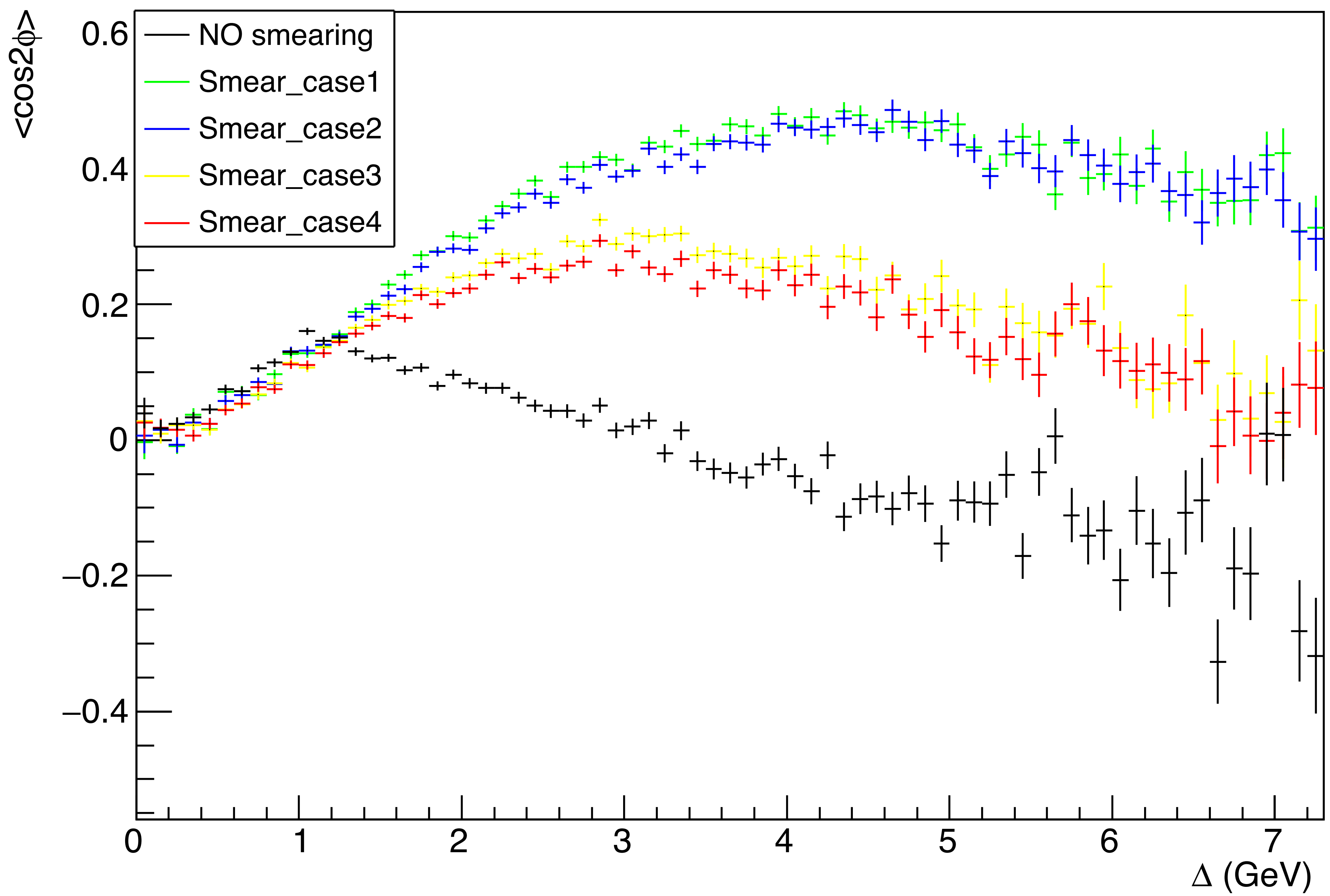


P Δ angle (ϕ) VS Δ



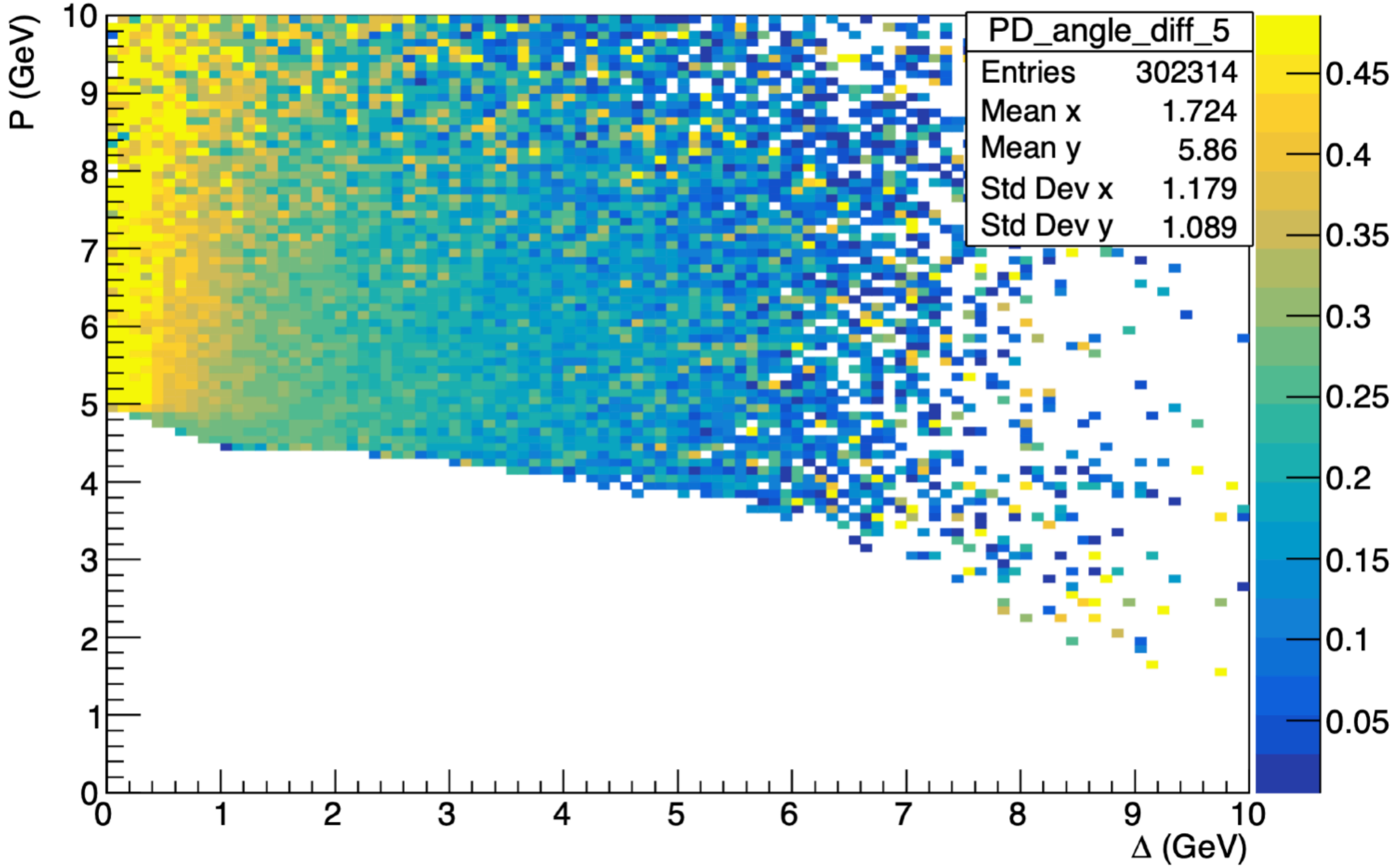
- There is systematical uncertainty after Δ>1.2 GeV.

<cos2ϕ> VS Δ



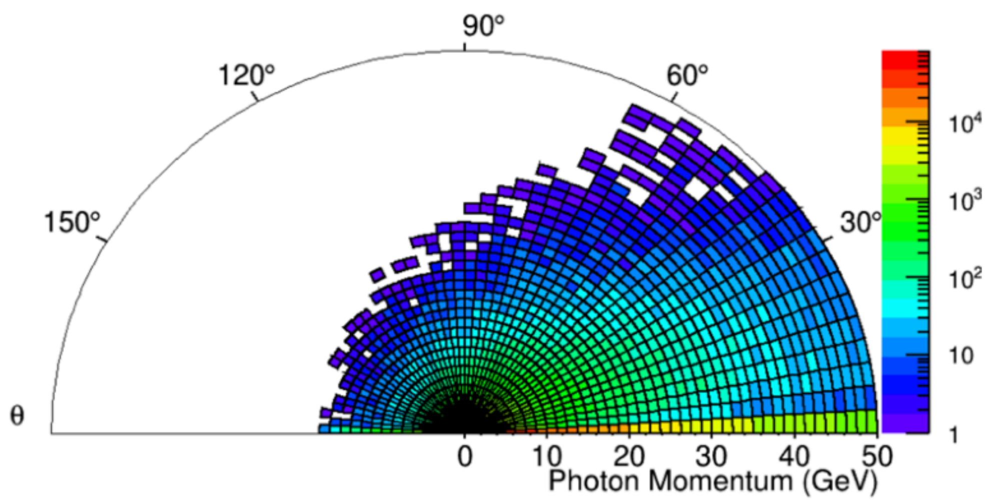
Φ is the angle between P and Δ.

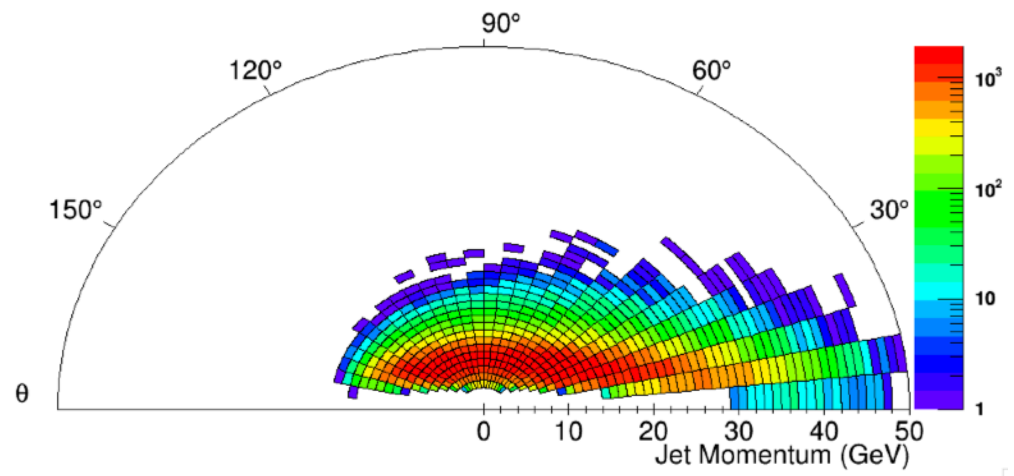
P Δ angle (ϕ) uncertainty



- **For small Δ we have larger uncertainty for the angle between P and Δ.**

Diffractive dijet photoproduction in ep





We study the hard diffraction dijet photoproduction in ep collision (18GeVX275GeV). We select leading Jet p_T > 5 GeV and second jet pt > 4GeV.

Reconstruct jet:

- Measure track with p_T > 0.2 GeV
- Tracking momentum resolution ~1%
- Ecal: 2% + 12%/Sqrt(E)
- Hcal: 6% + 45%/Sqrt(E)

Kinematic range:

- $-4 < \eta < 4$
- $Q^2 < 1 GeV^2$

Summary

- We study the purity and efficiency of hard diffractive events in different detector eta coverage;
- The larger eta coverage would give us better purity of diffractive events.
- We give the dijet smearing results in dijet photoproduction;
- We can give a good reconstructed angle between P and Δ for $\Delta<1.2$ GeV;

Backup