Progress on Scattered Electron Identification

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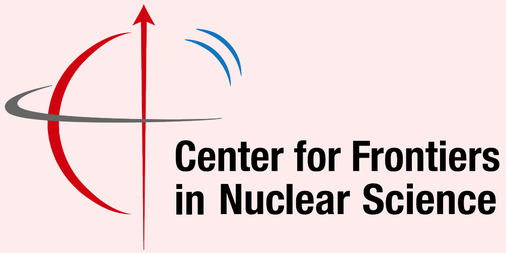
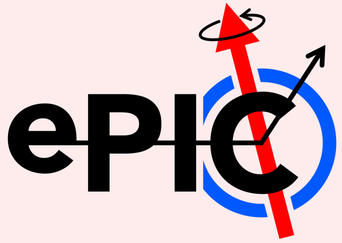
Stony Brook University

Collaboration meeting
01/21/2025





Current eID analysis and status

"ReconstructedParticle Collection"

⇓

≥ 1 track & ≥ 1 cluster
Negatively charge

⇓

$0.8 < E/p < 1.2$

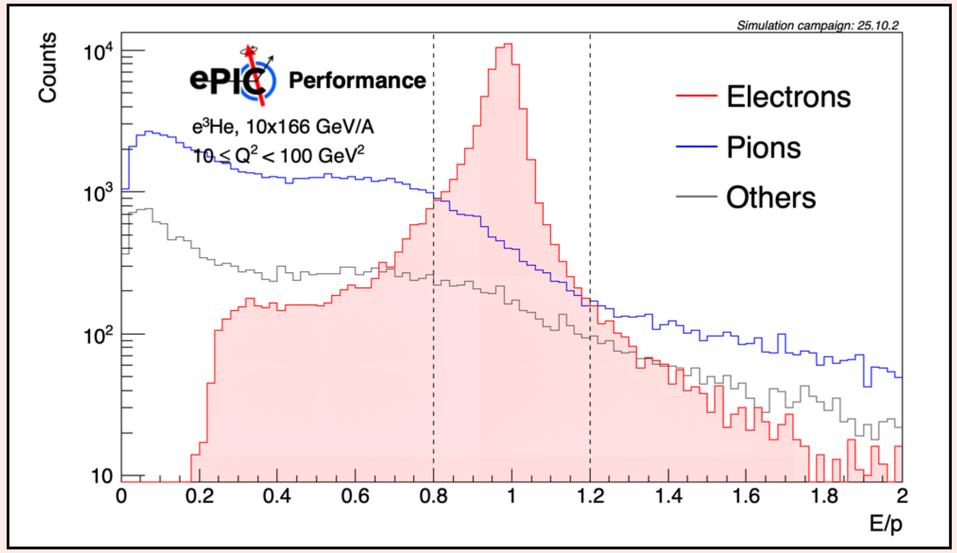
⇓

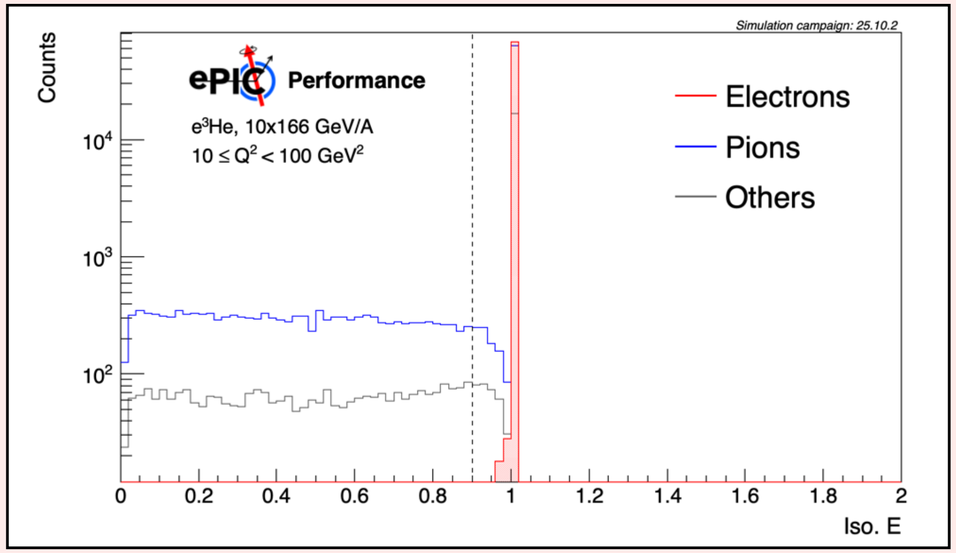
Isolated cluster:
$E_0/\Sigma E_{\delta R} > 0.9$

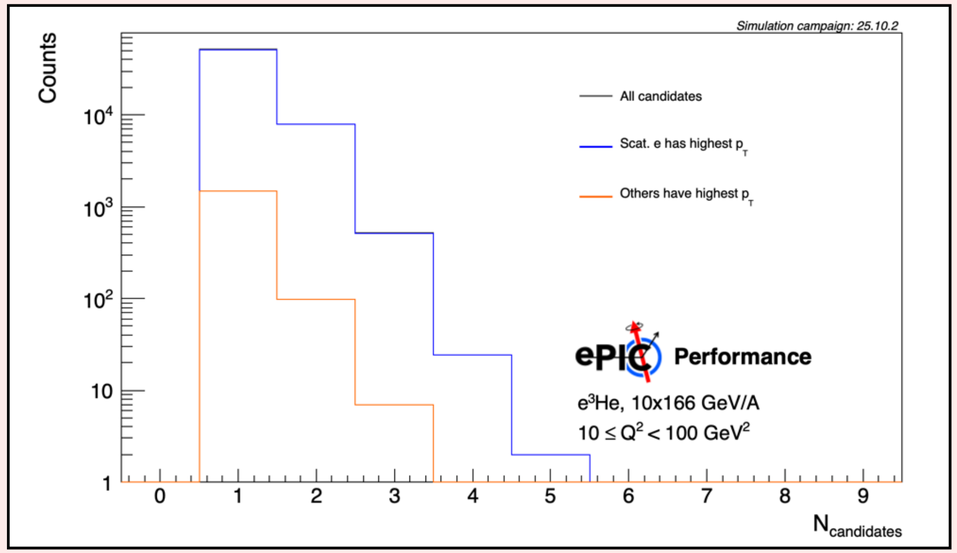
⇓

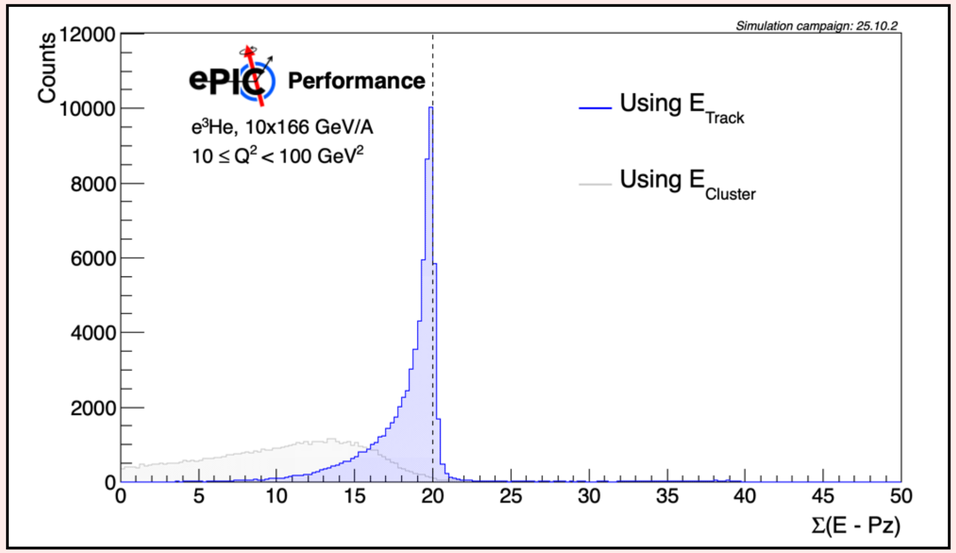
Highest p_T

⟵ Currently using MC to match clusters and tracks

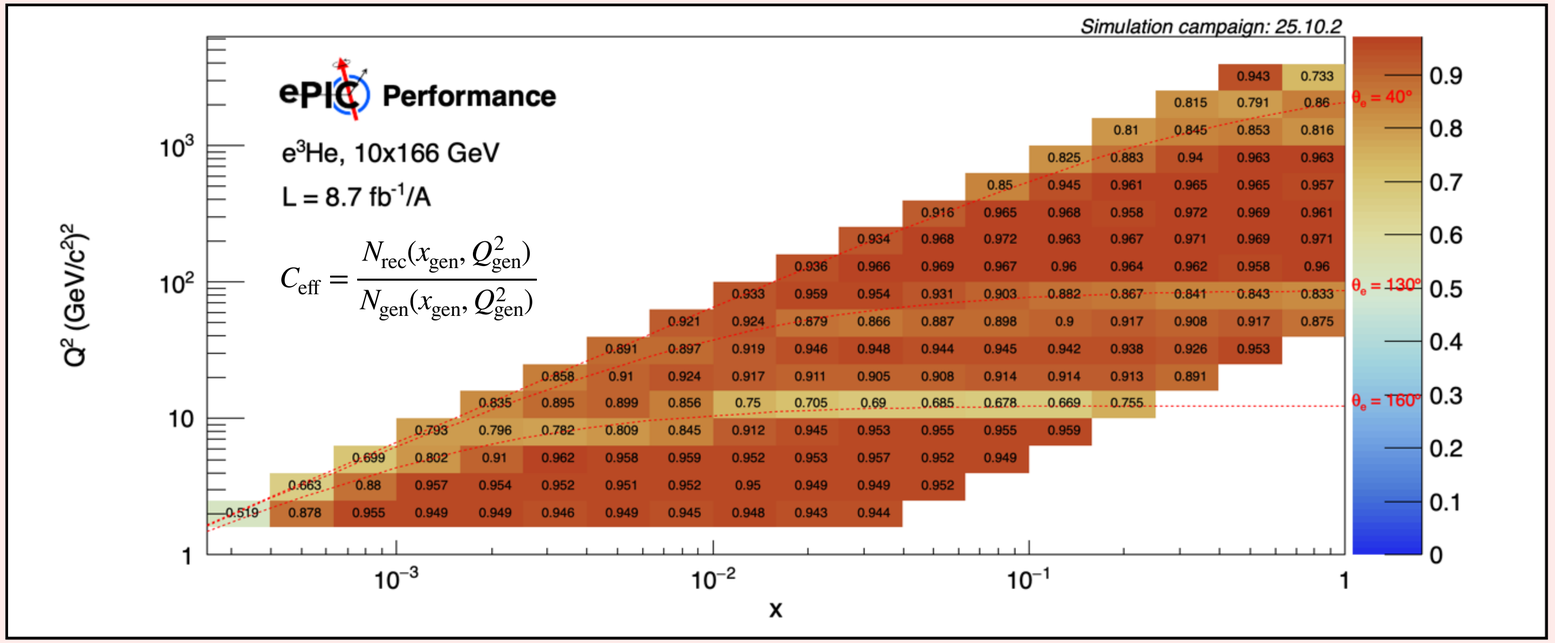


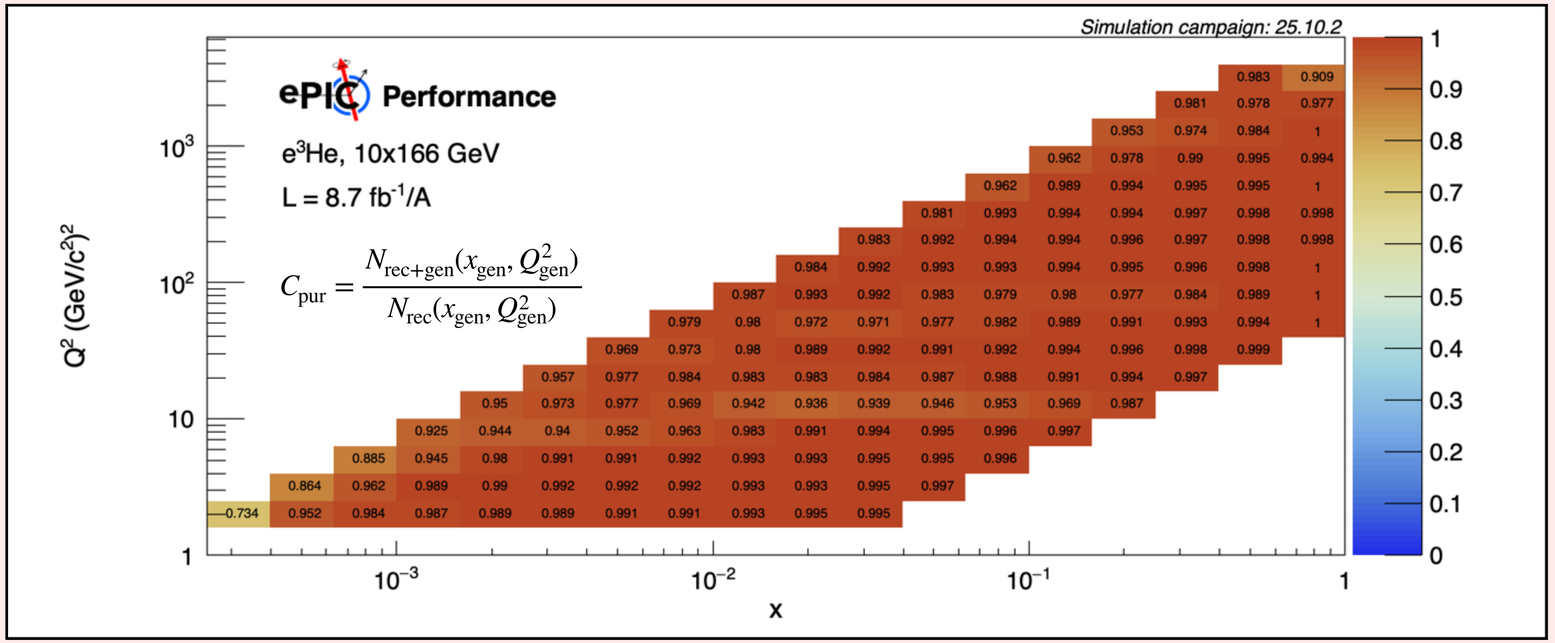


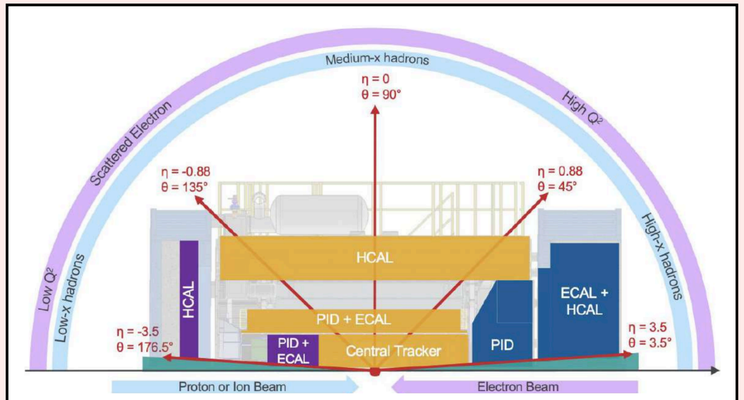


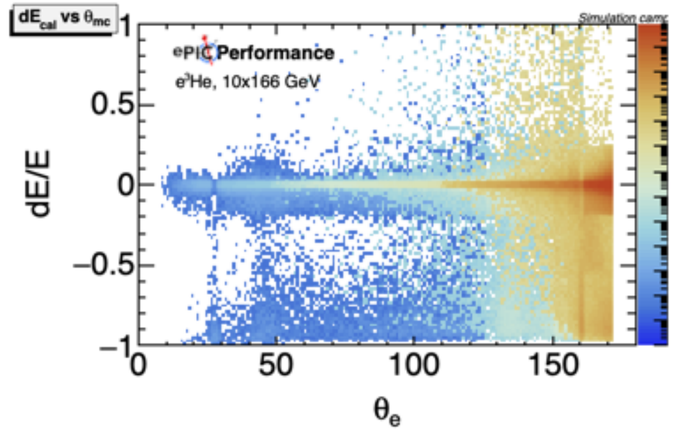


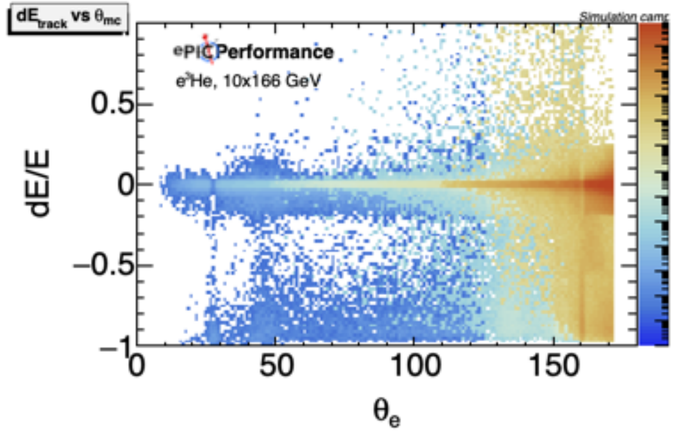
Current eID analysis and status



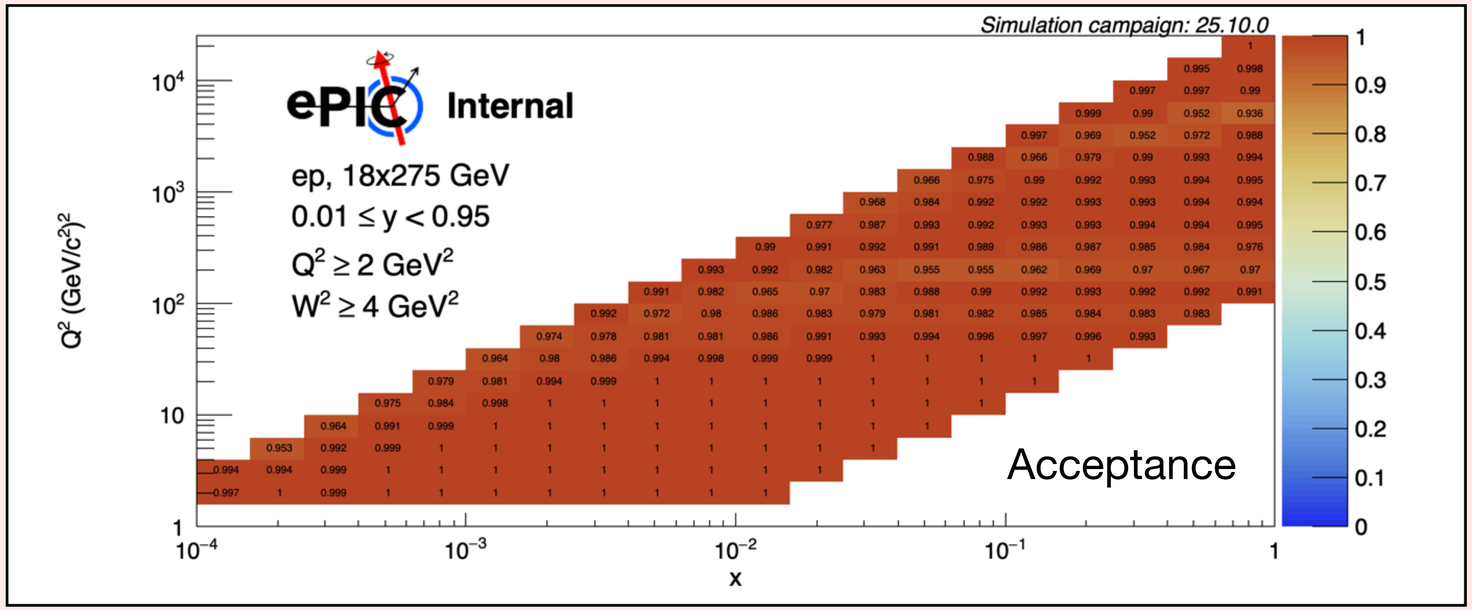


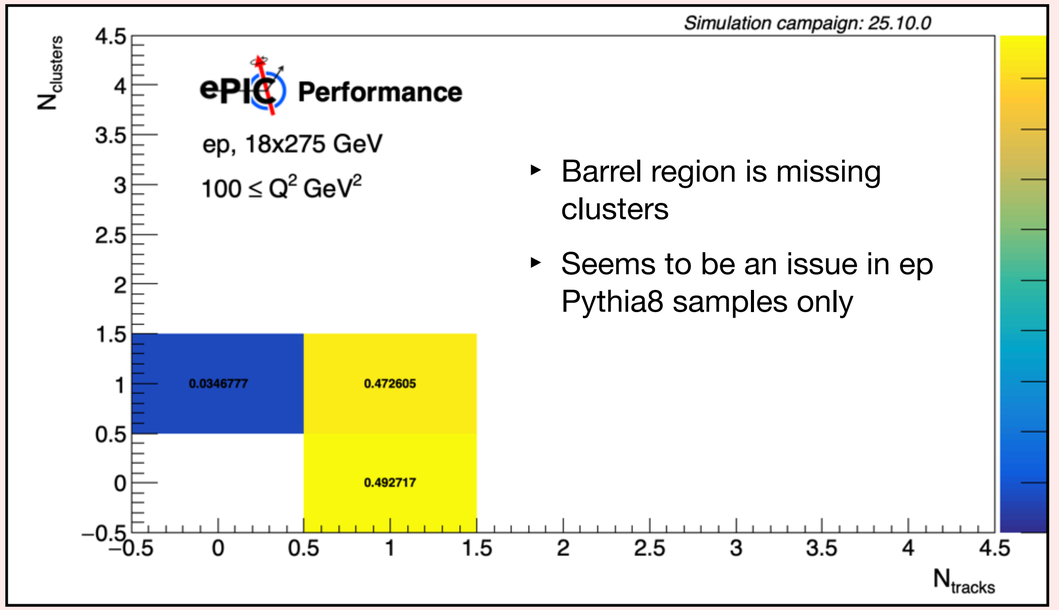




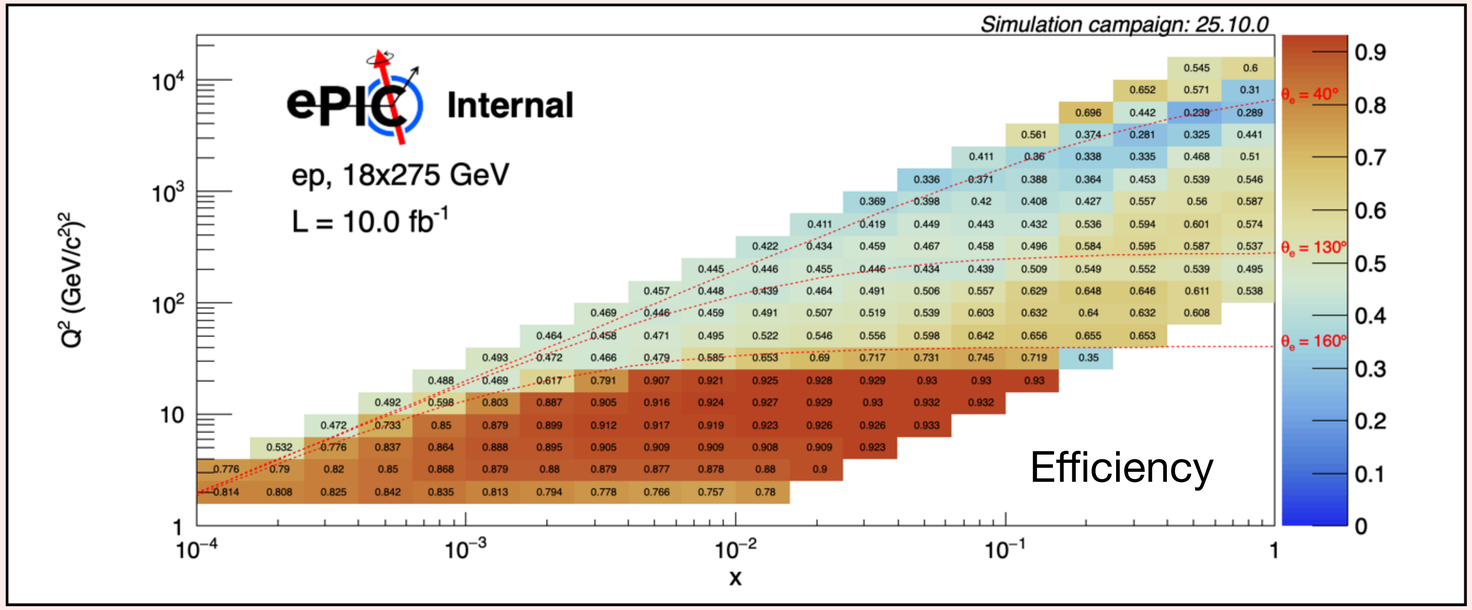


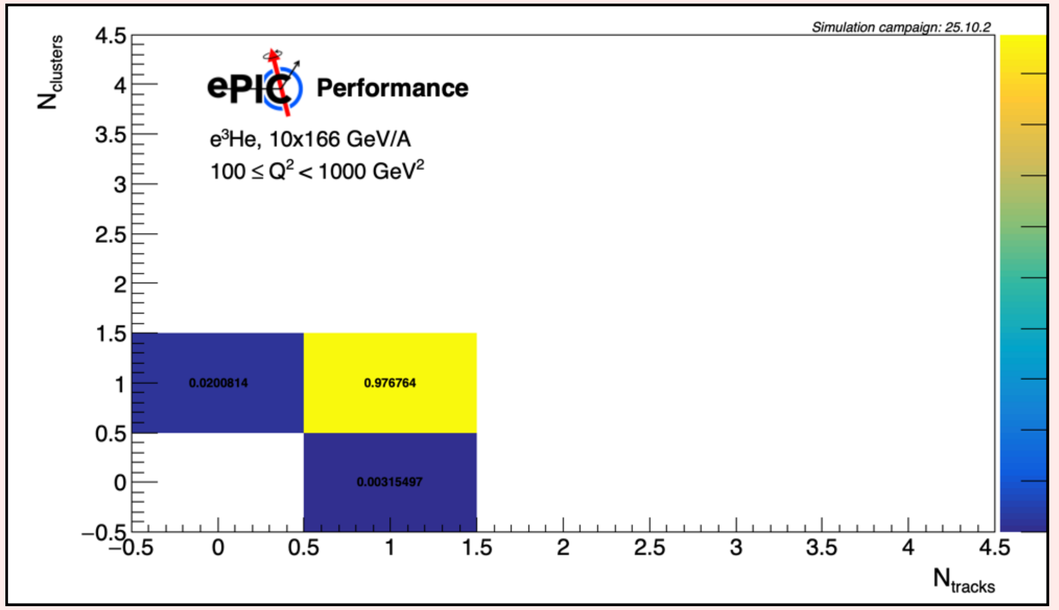
Obstacle: Issue with clusters in ep





- Barrel region is missing clusters
- Seems to be an issue in ep Pythia8 samples only





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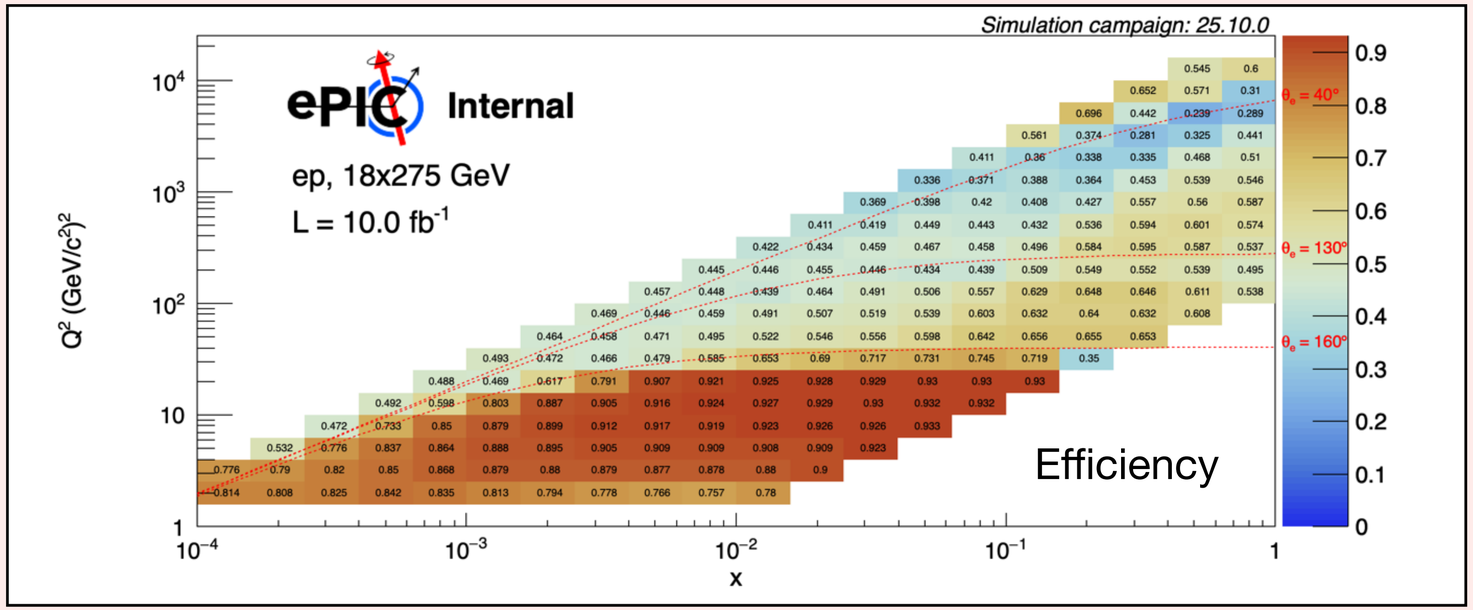

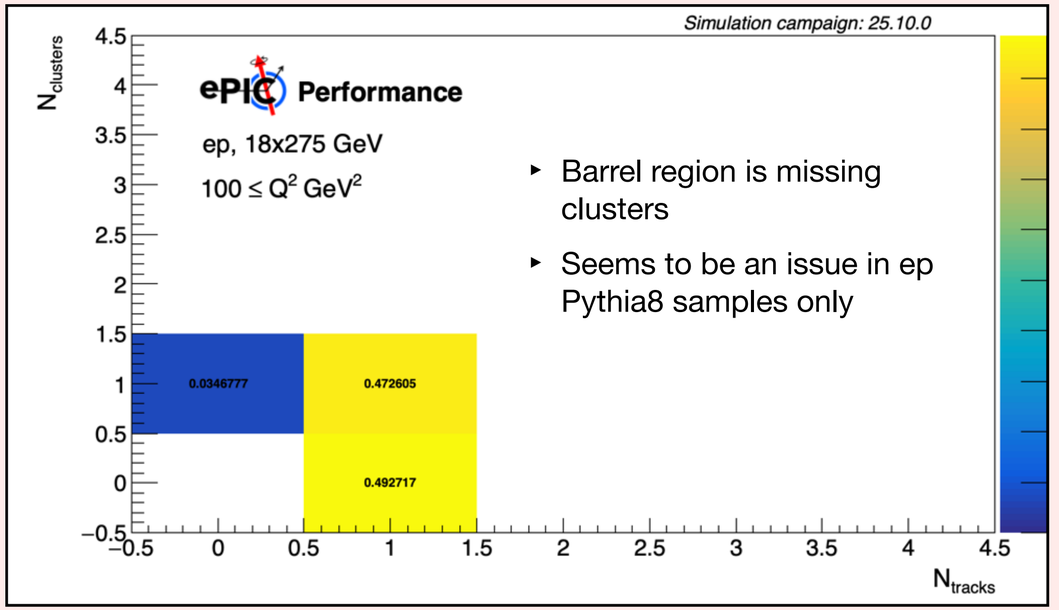

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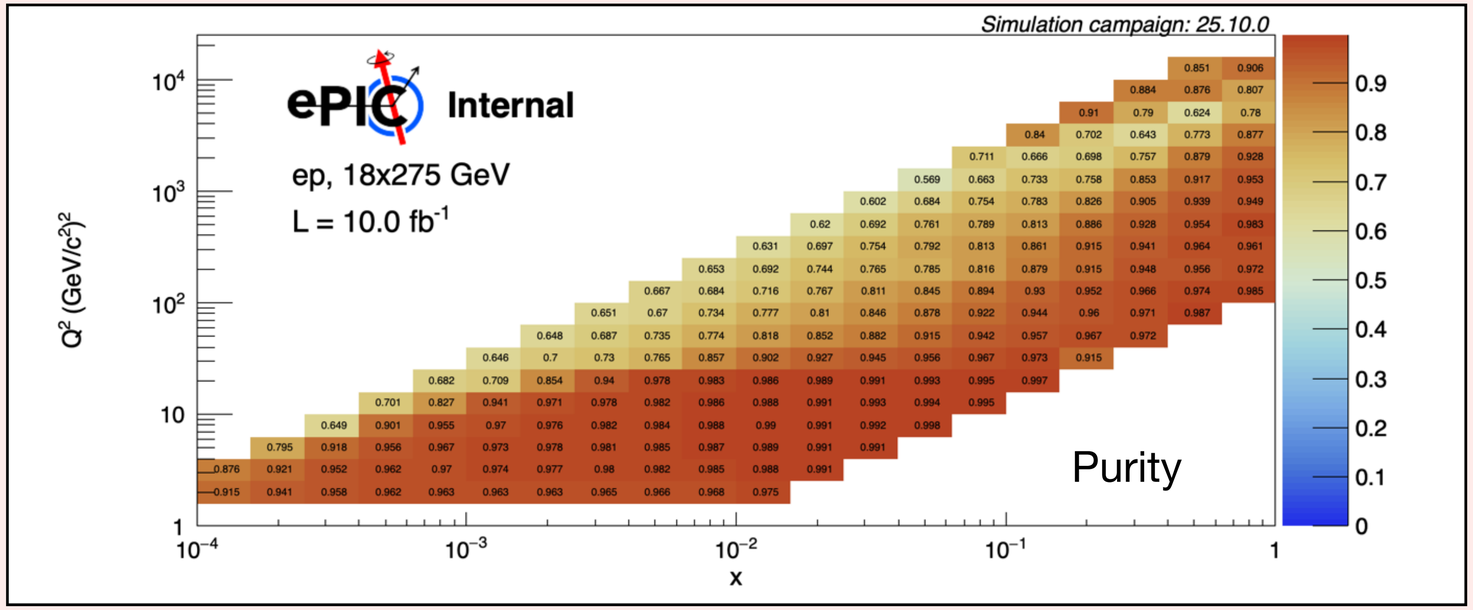
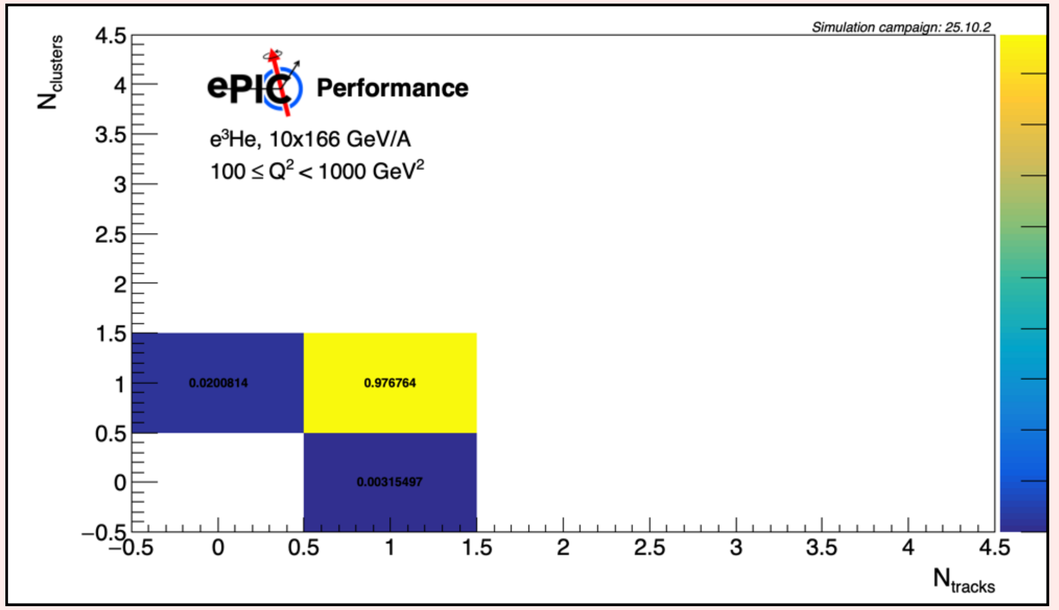
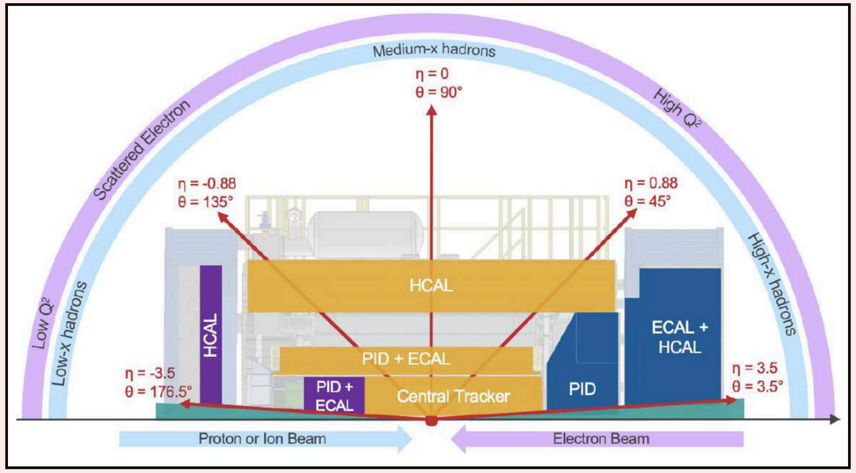


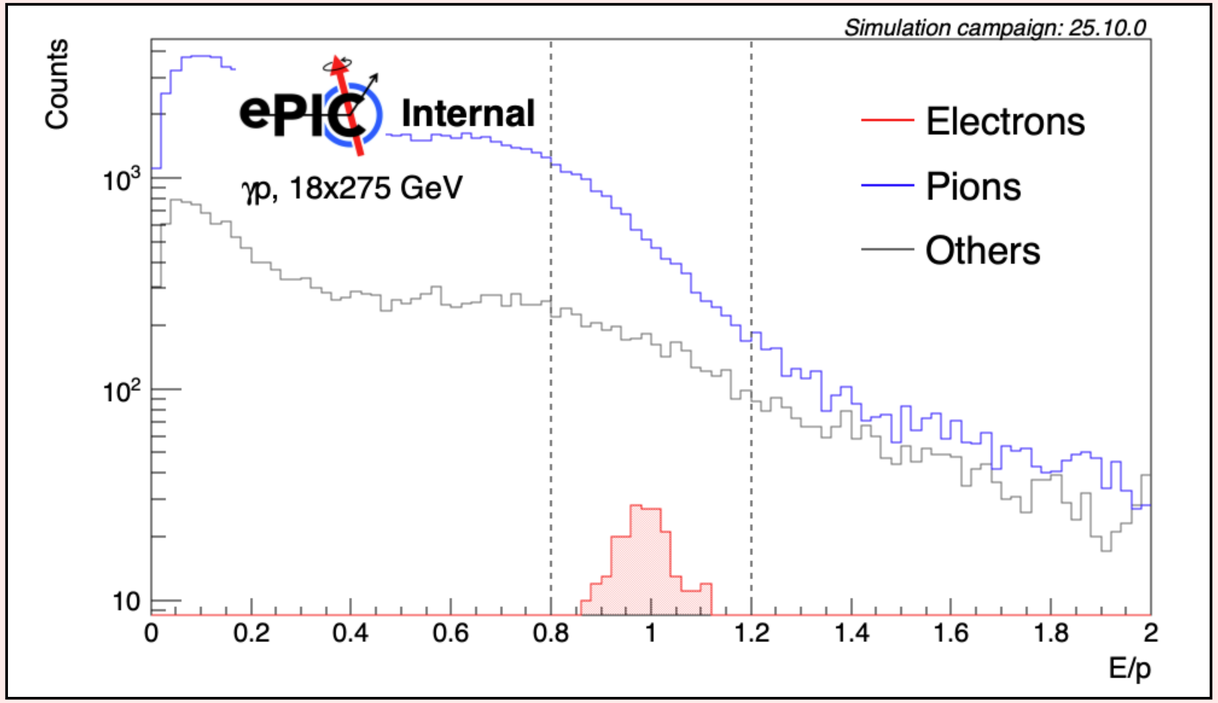


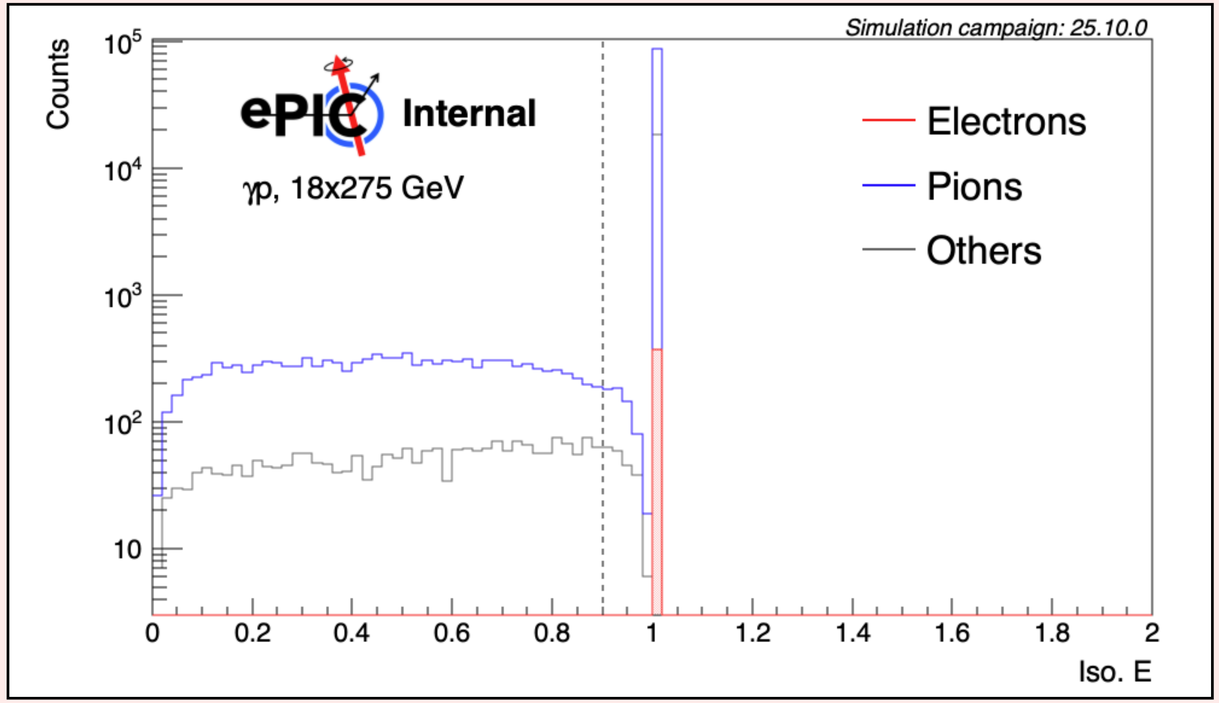
Photoproduction background

π background lower the purity at very high y at low x and low Q^2



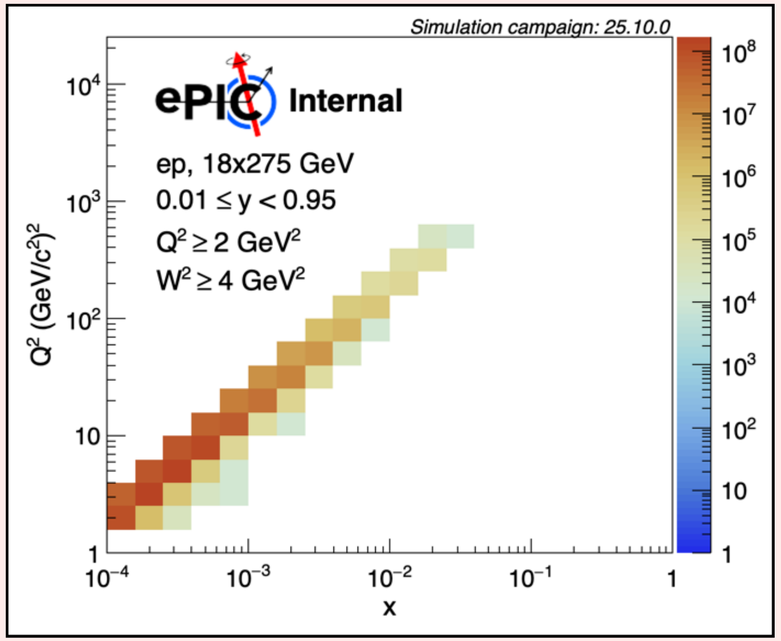
Low Q^2 event samples:
SIDIS/pythia6-eic/
1.0.0/18x275/q2_0to1/

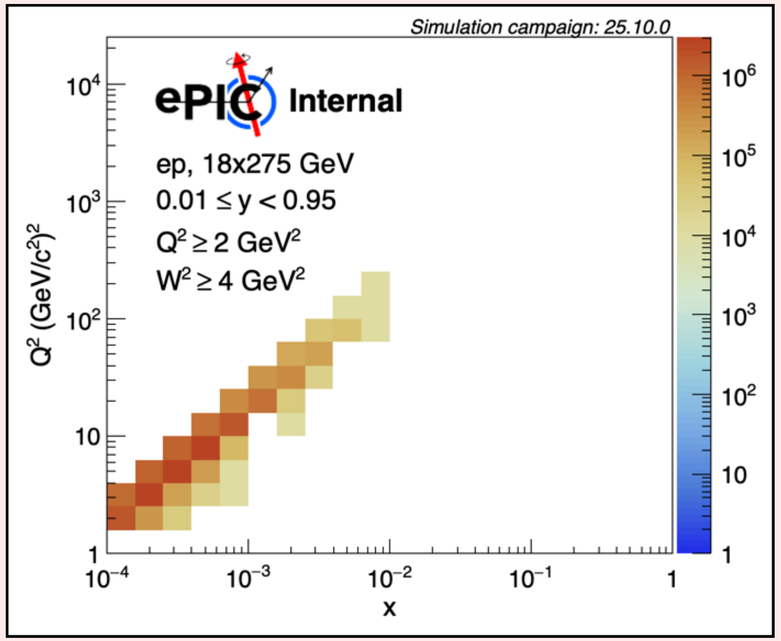


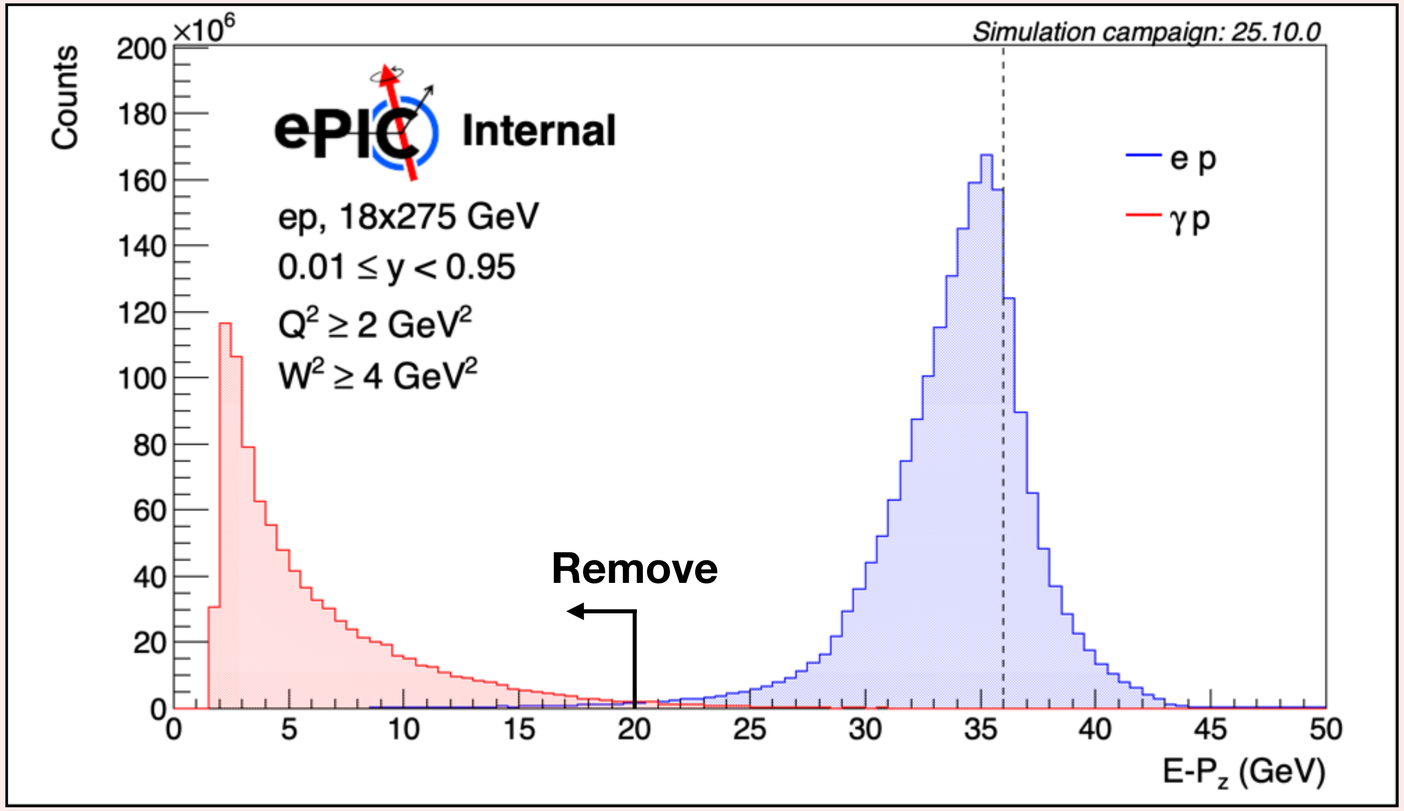


Photoproduction background

Reduced by ~97.95%

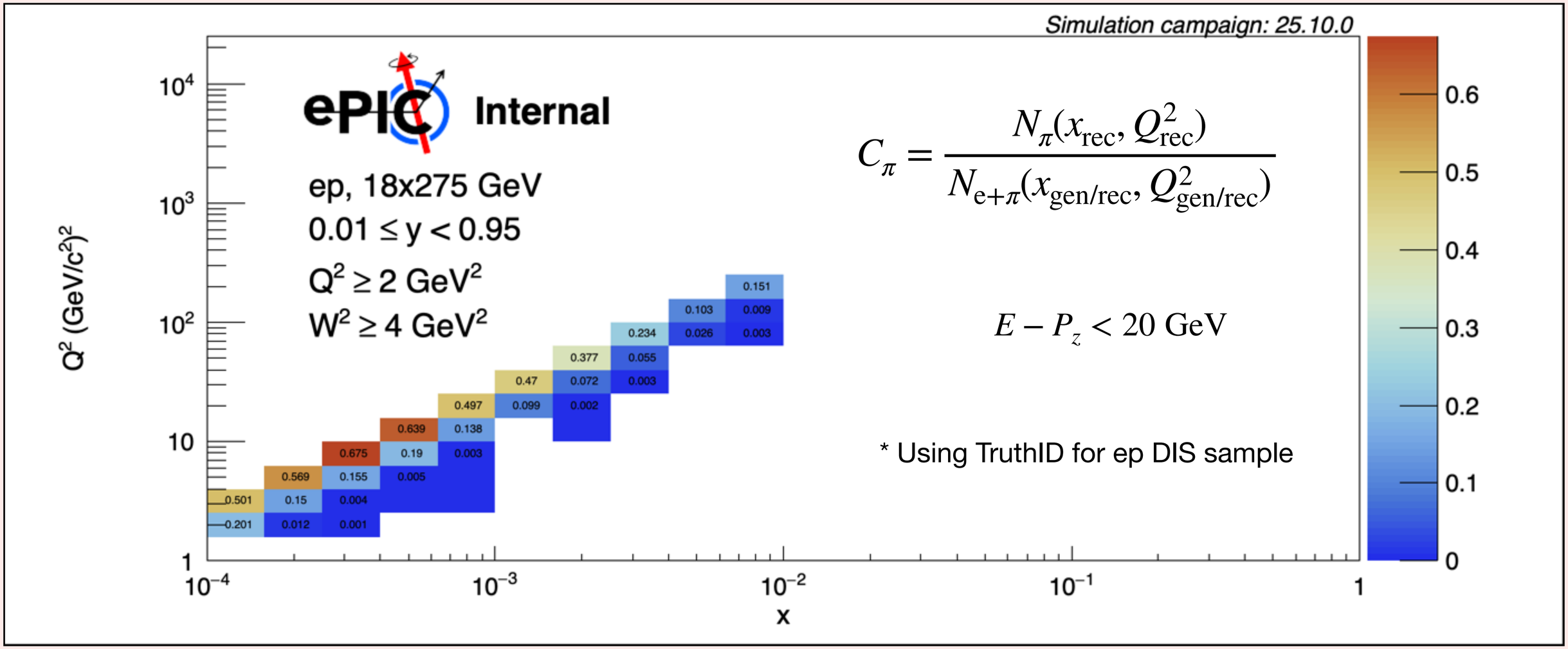






Both samples are scaled to $L = 10\ \mathrm{fb}^{-1}$

Photoproduction background



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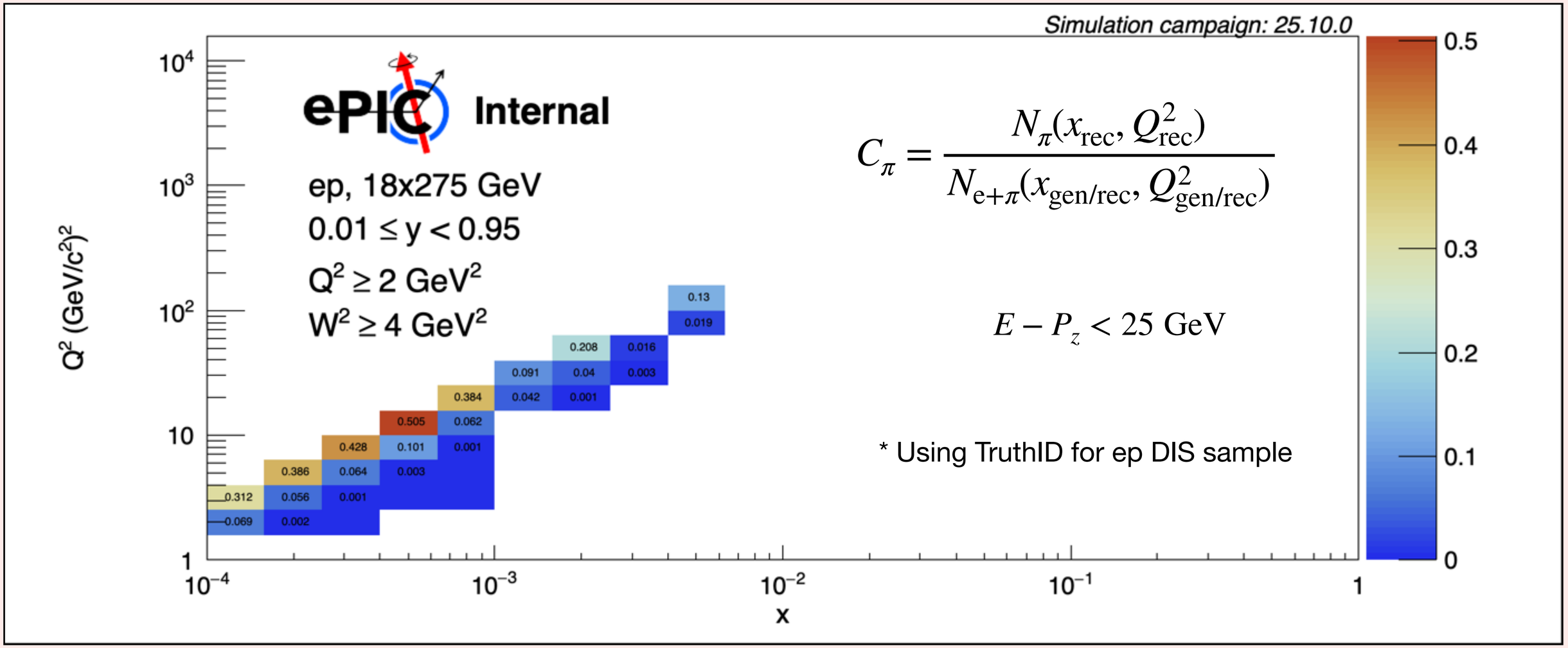
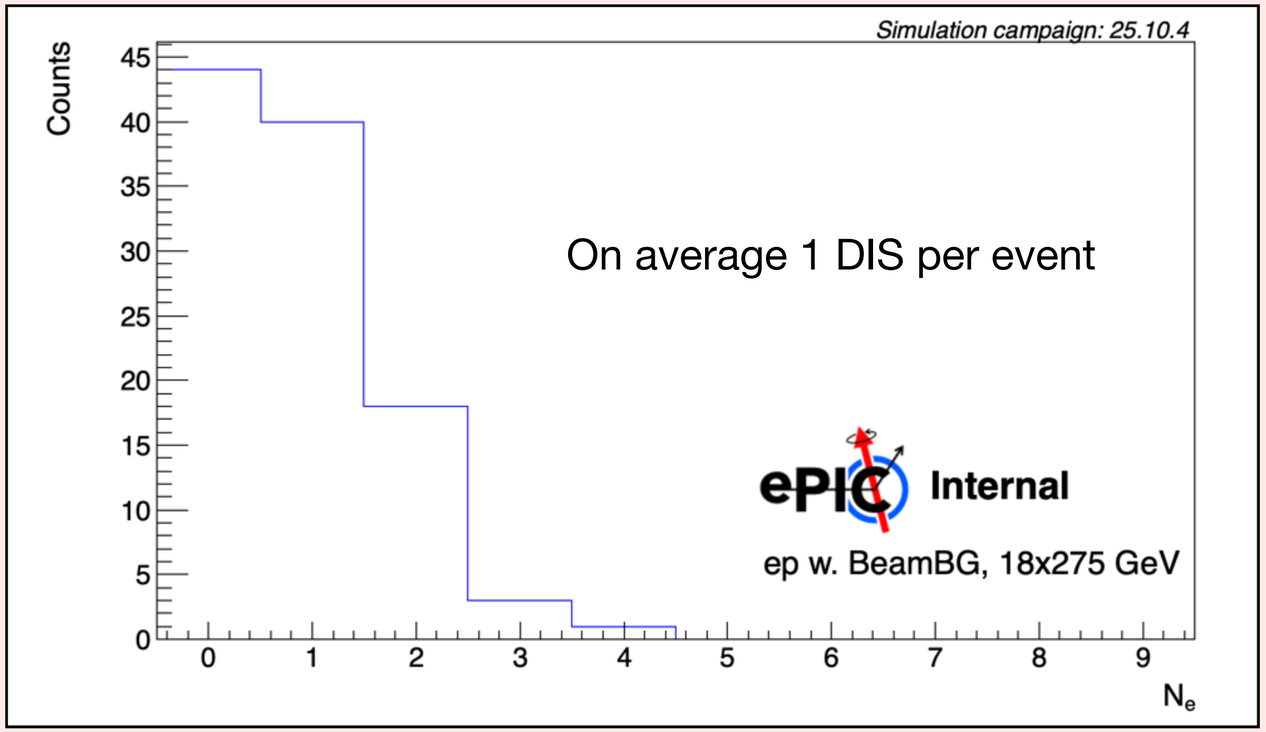


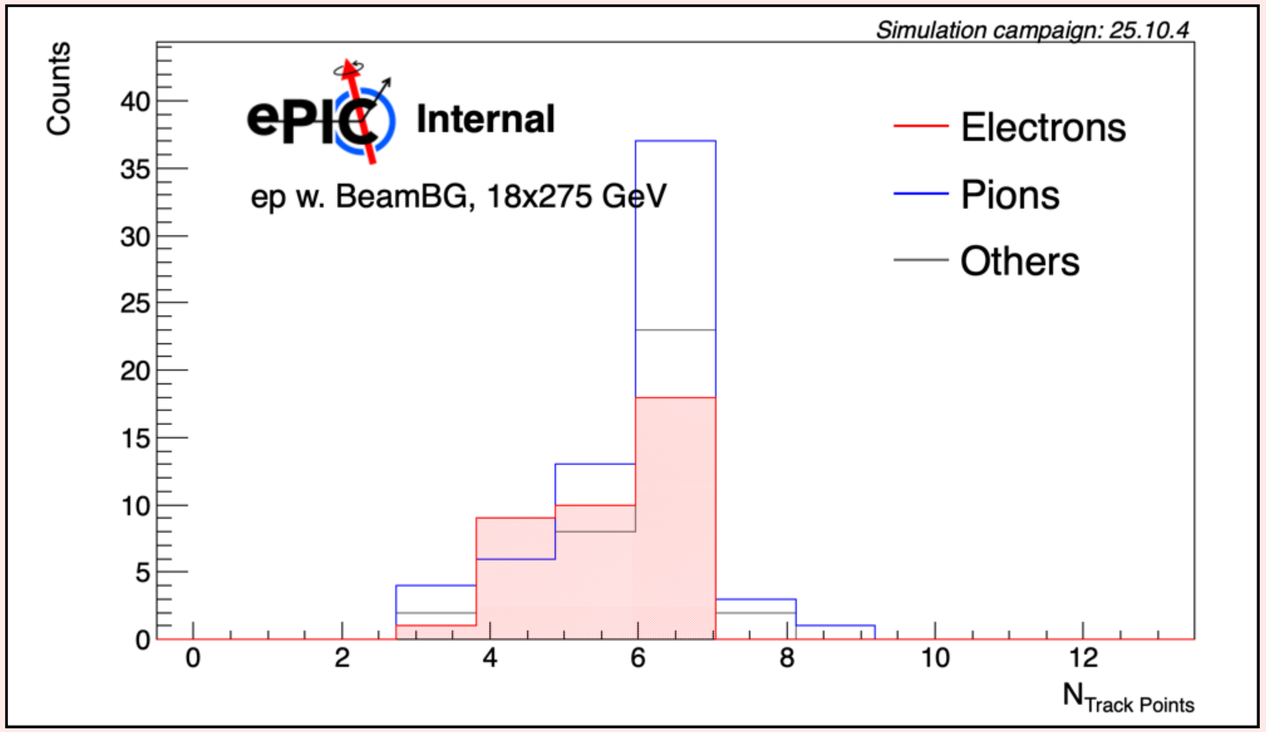
eID with beam background

Machine background samples:
Bkg_1SignalPer2usFrame/
Synrad_18GeV_Vac_10000Ahr_Runtime_50s_Egas_18GeV_Hgas_275GeV/DIS/NC/
18x275/minQ2=1

Number of scattered electrons



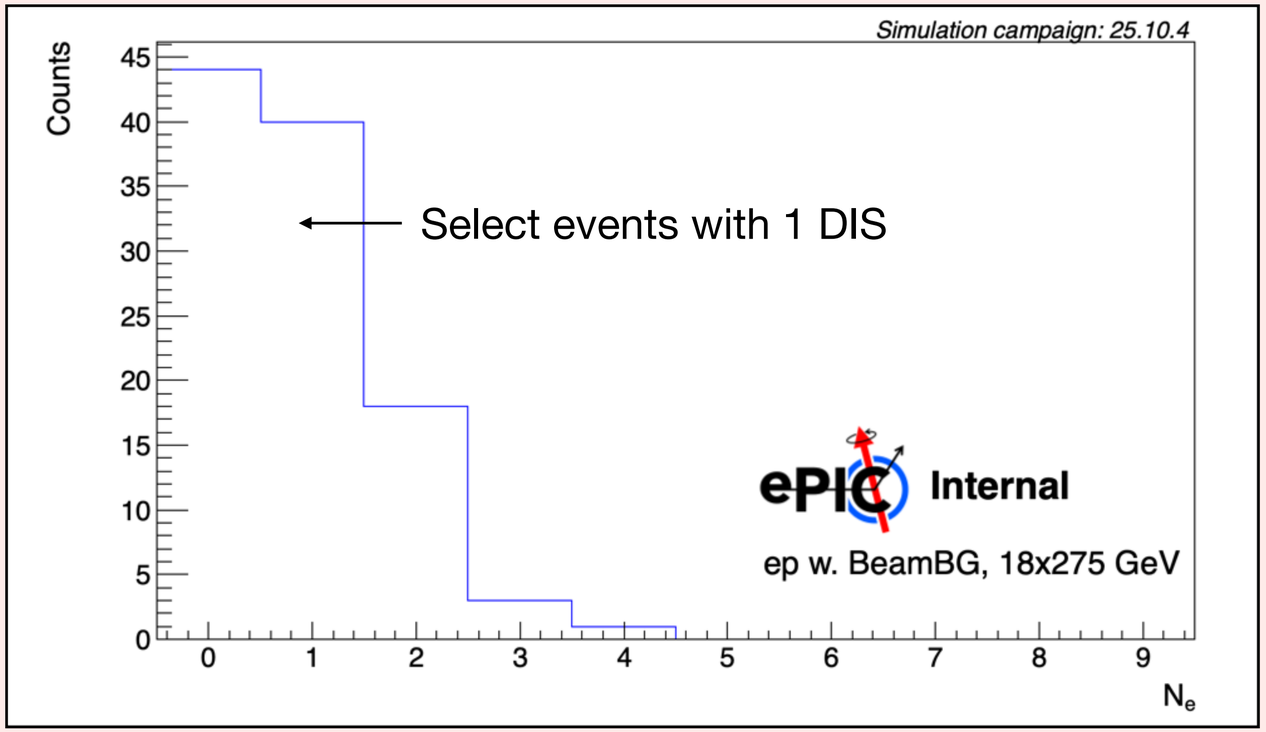
Number of points used for tracks



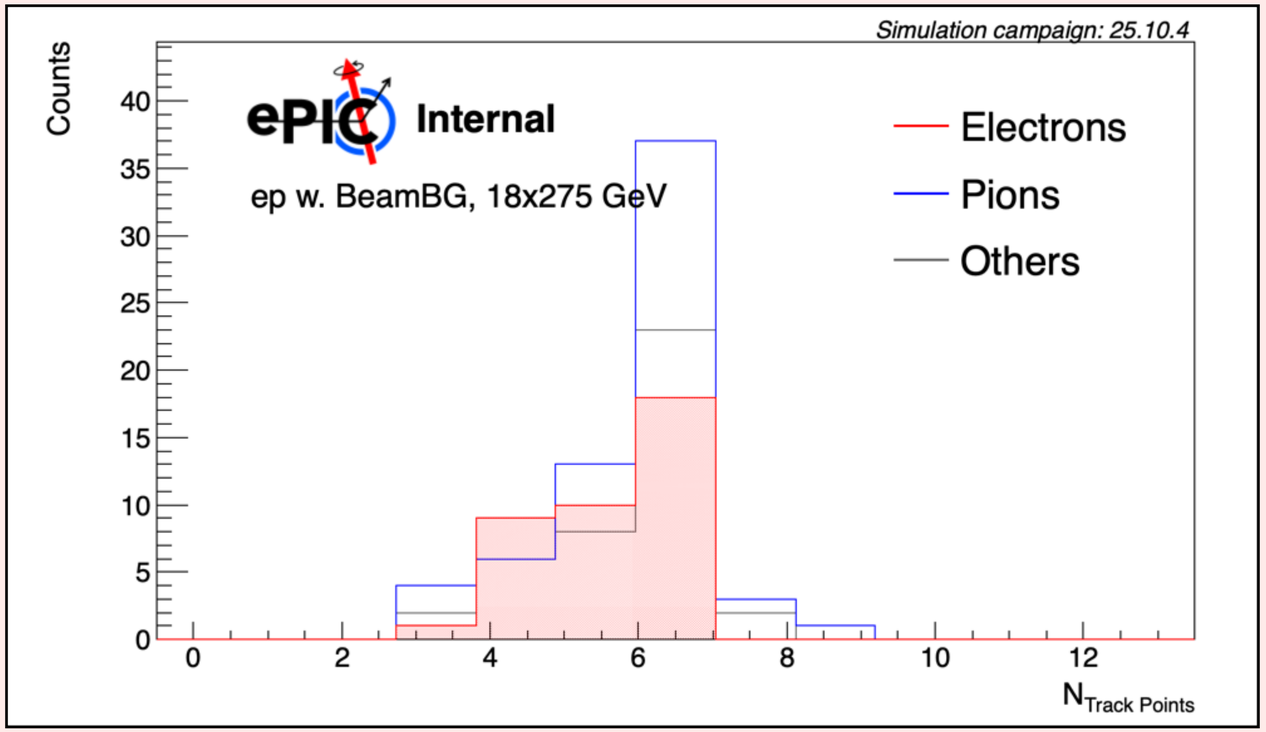
eID with beam background

Machine background samples:
Bkg_1SignalPer2usFrame/
Synrad_18GeV_Vac_10000Ahr_Runtime_50s_Egas_18GeV_Hgas_275GeV/DIS/NC/
18x275/minQ2=1

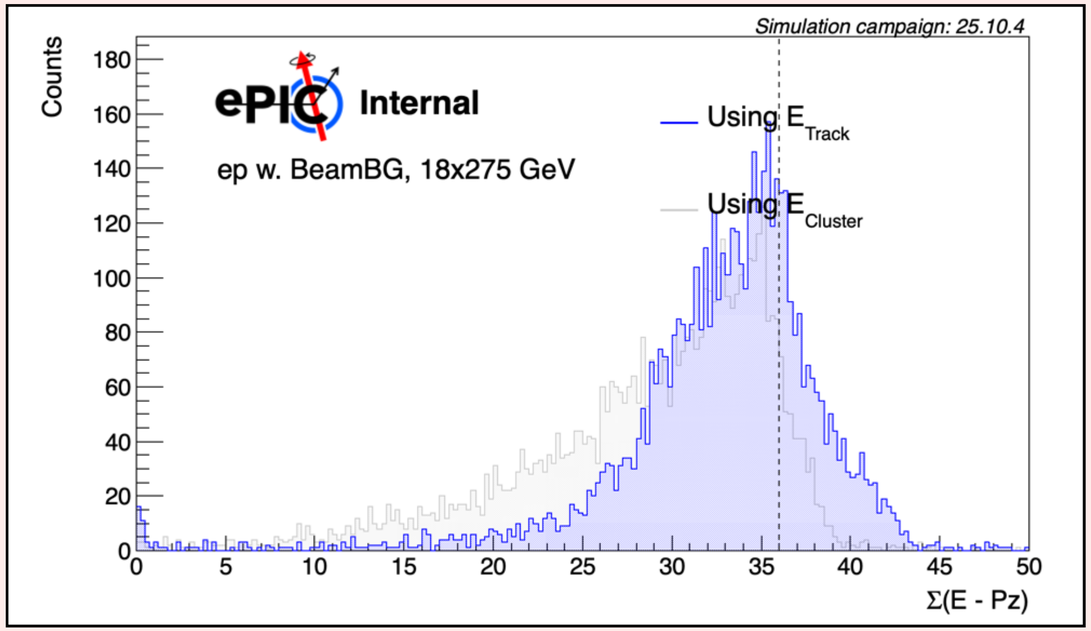
Number of scattered electrons

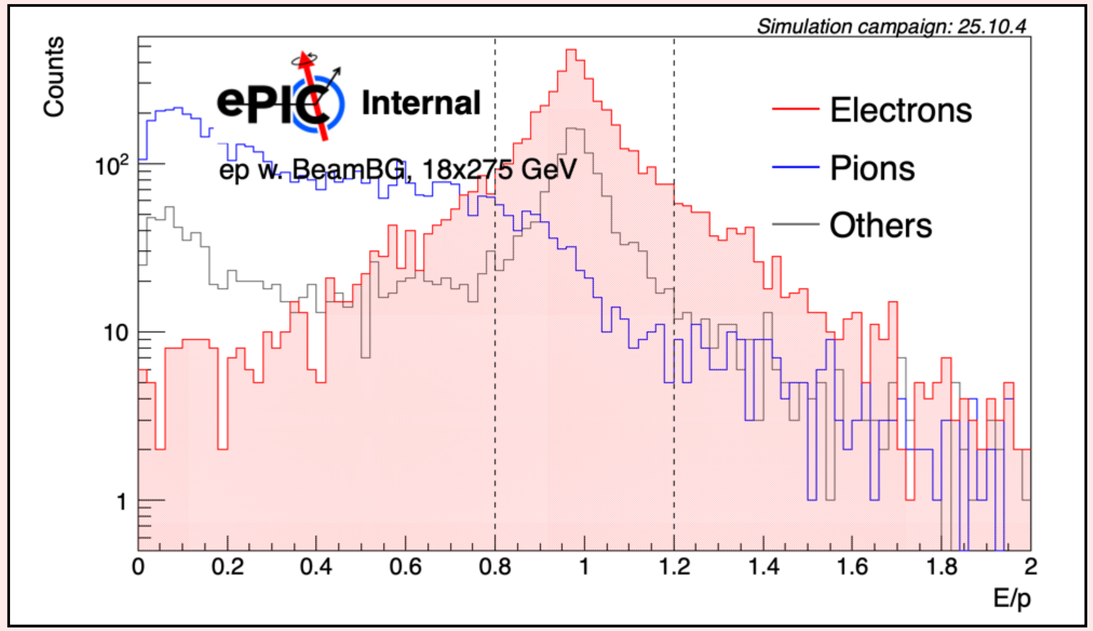


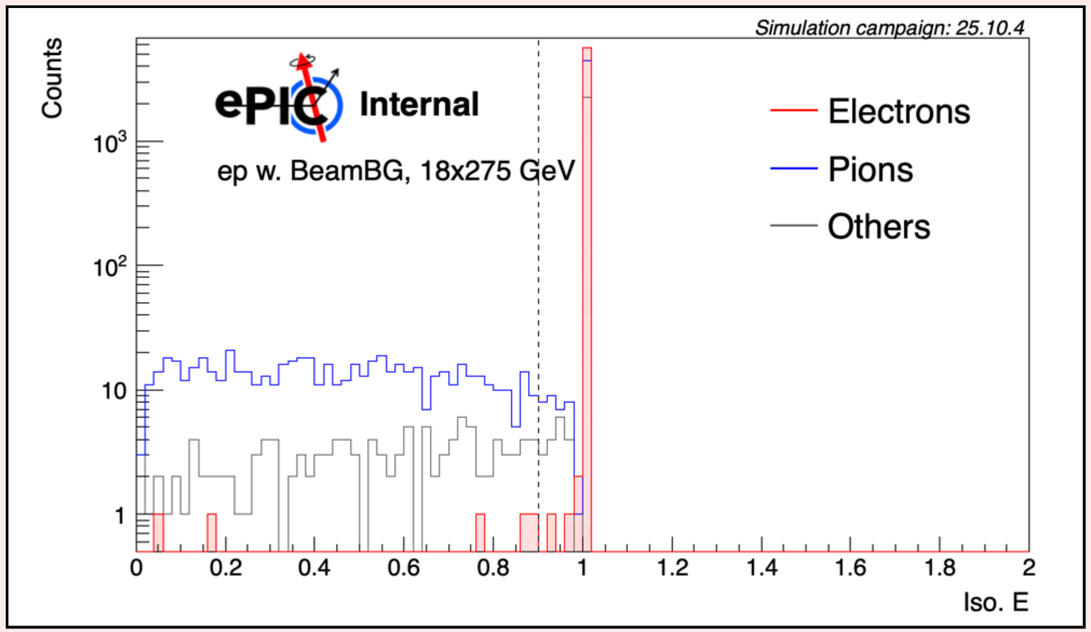
Number of points used for tracks

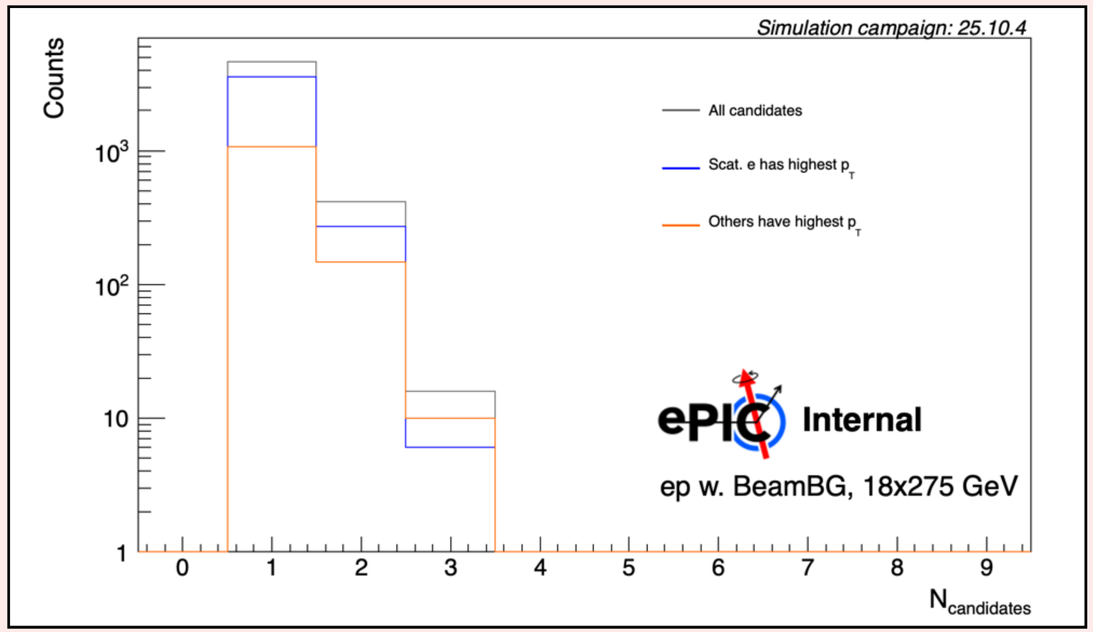


eID with beam background - 1 DIS events

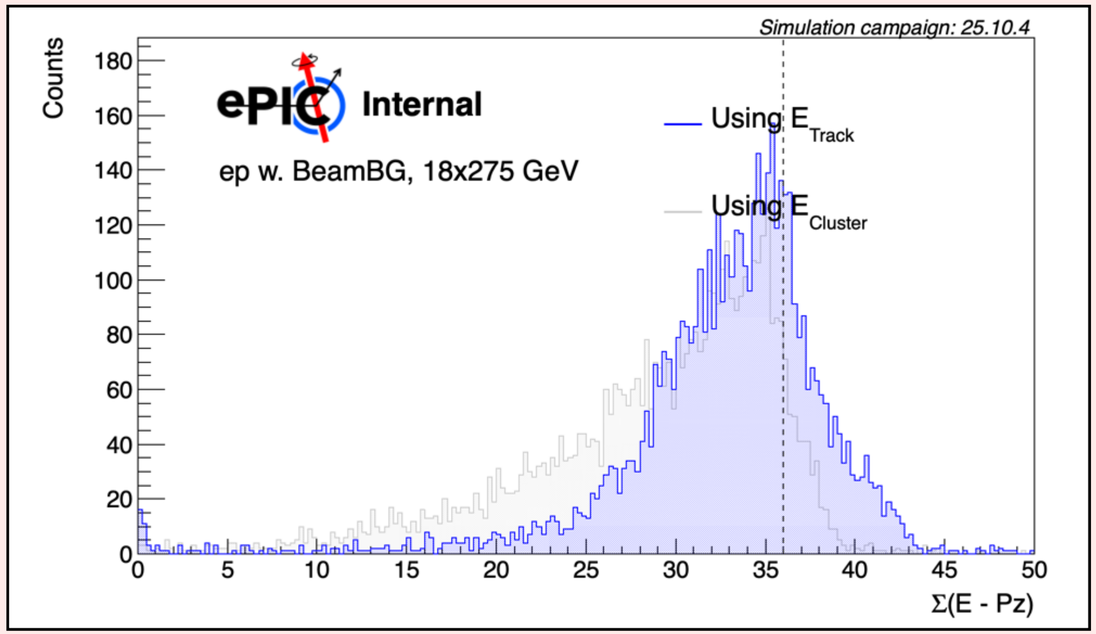


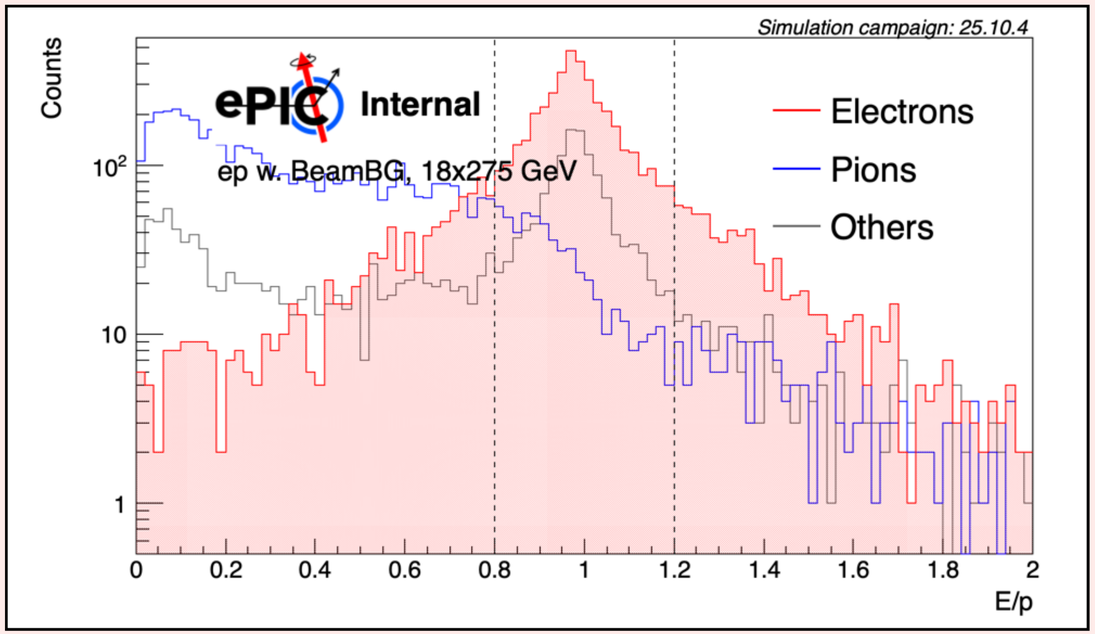


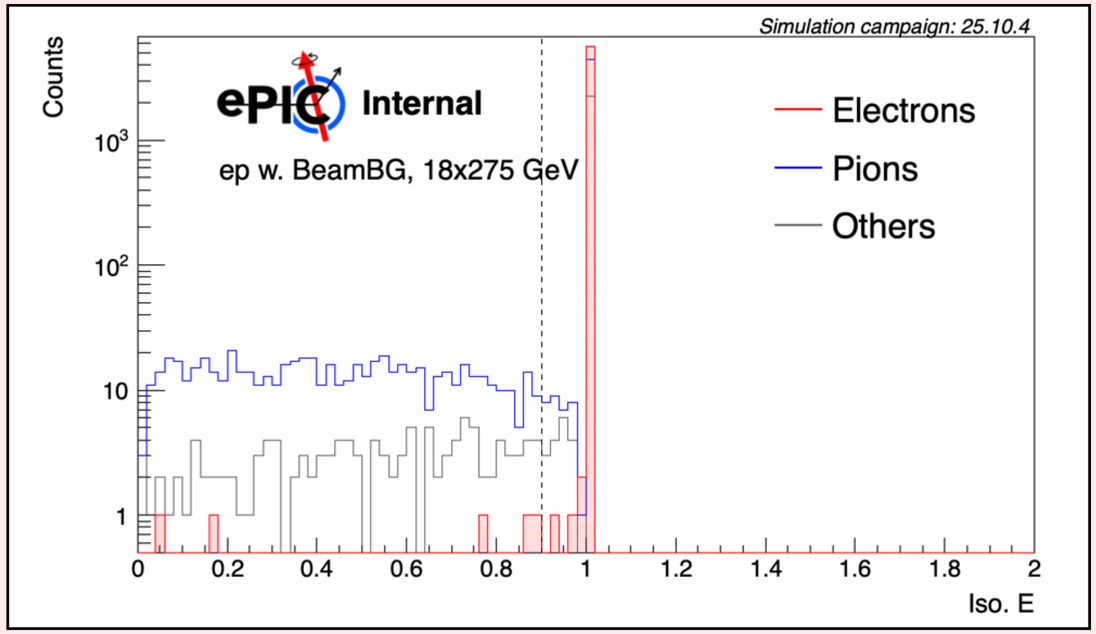


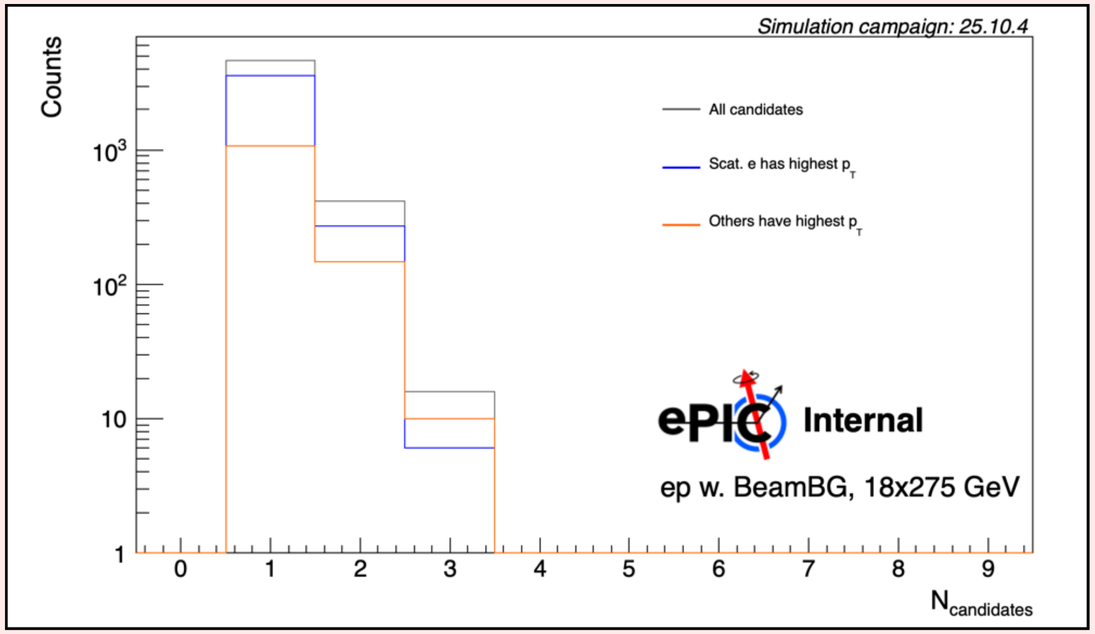


eID with beam background - 1 DIS events, > 3 track points

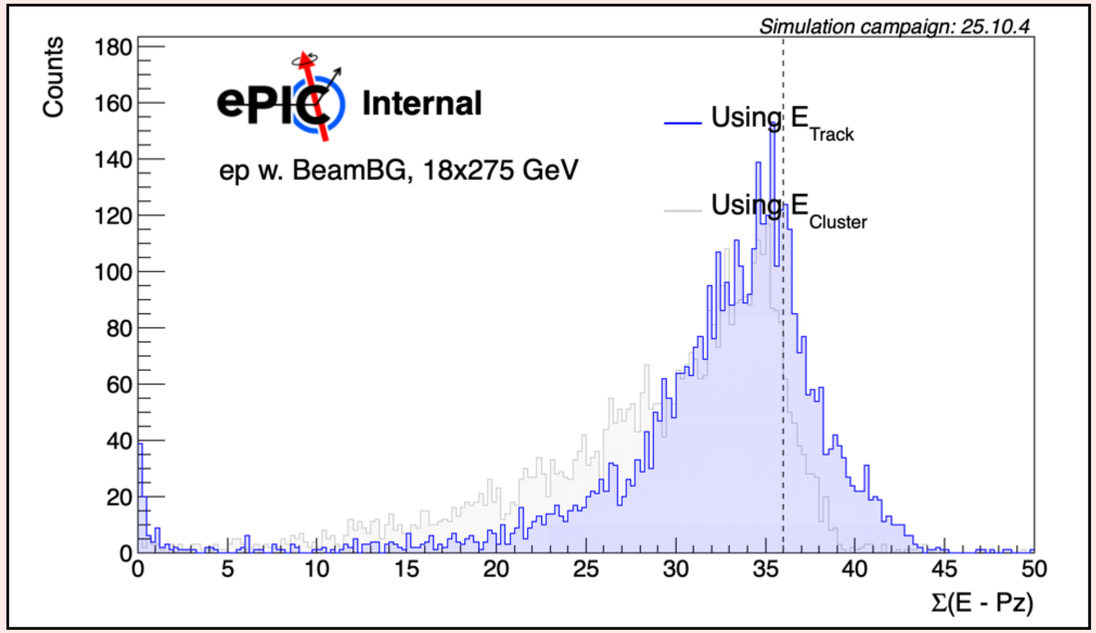


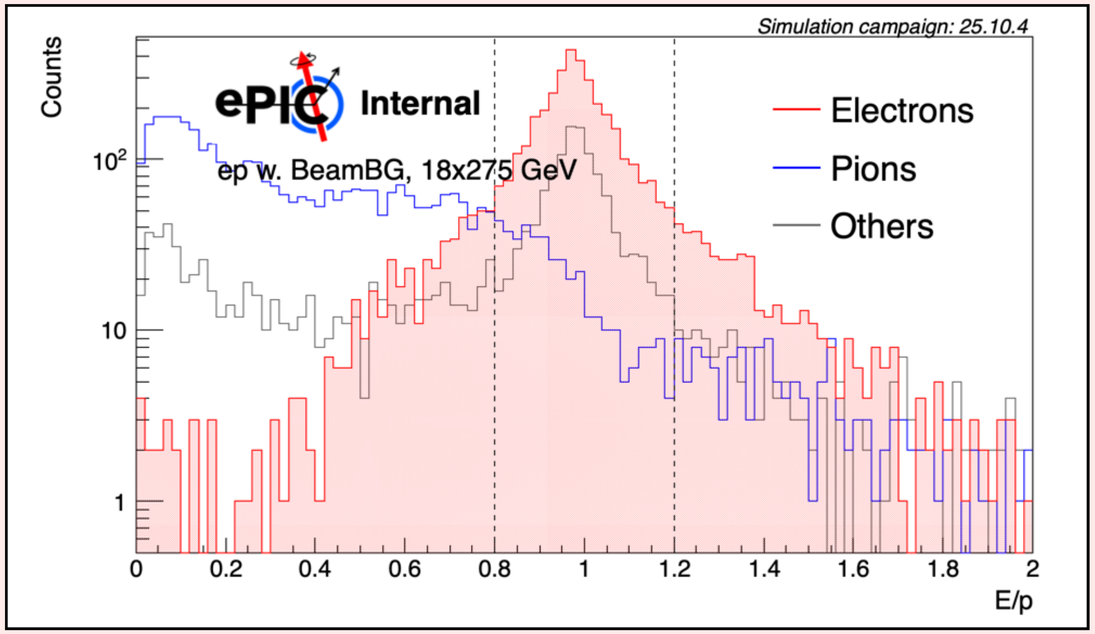


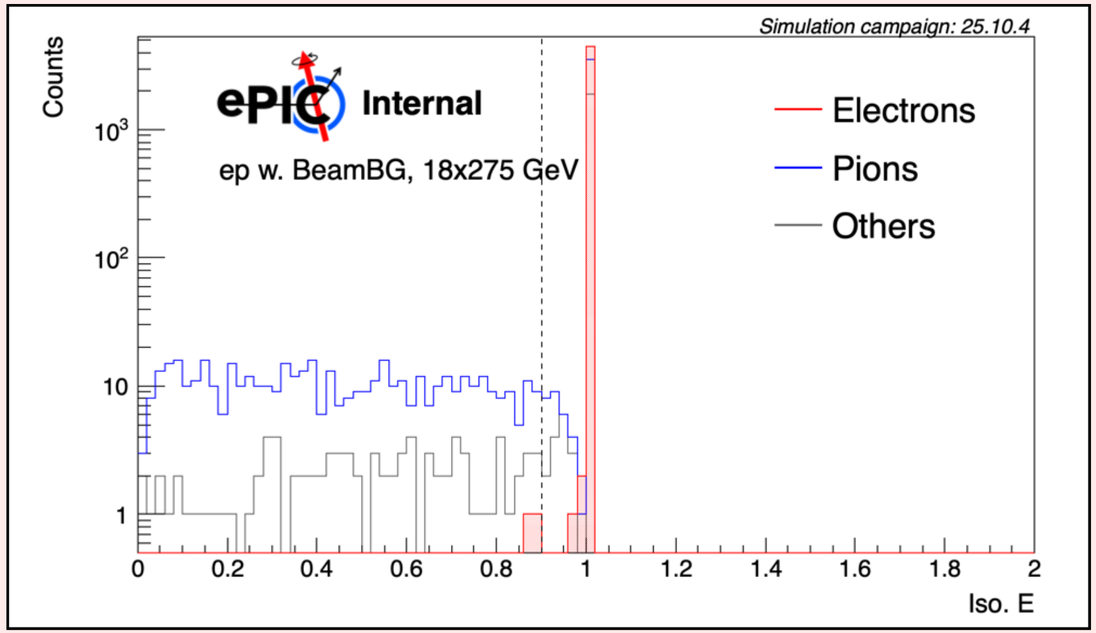


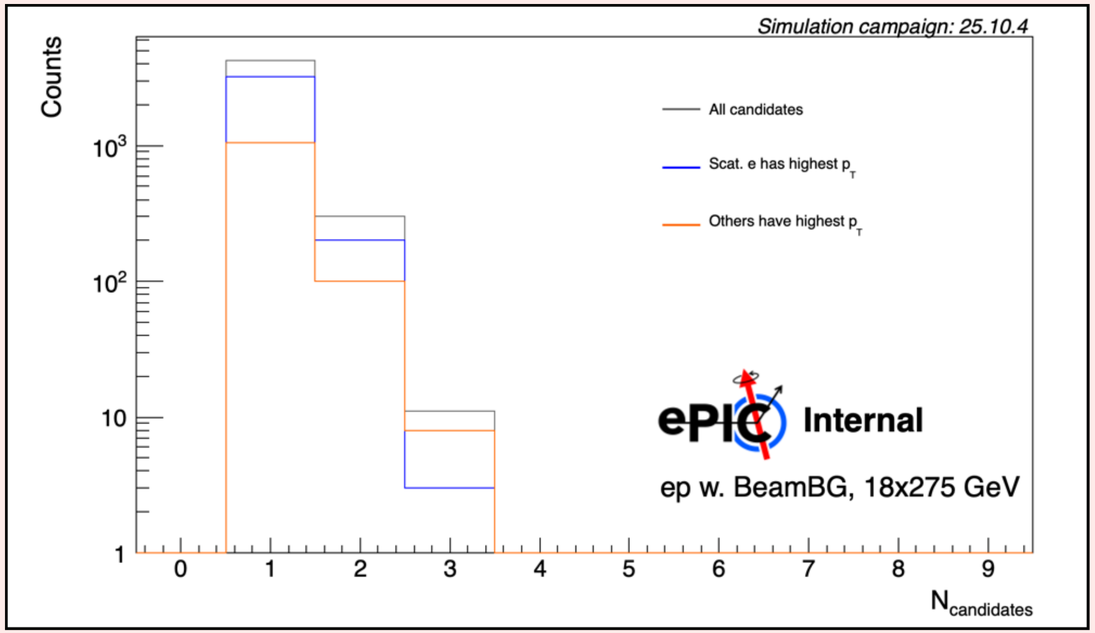


eID with beam background - 1 DIS events, > 4 track points



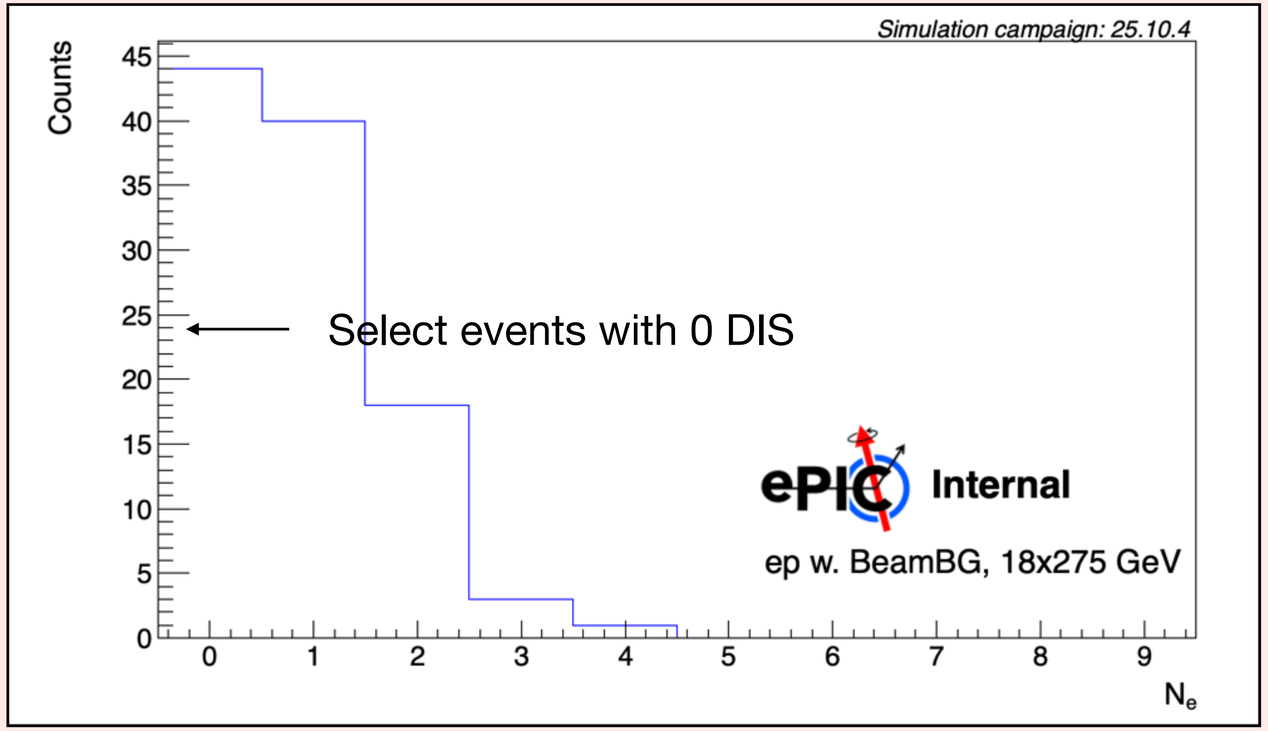


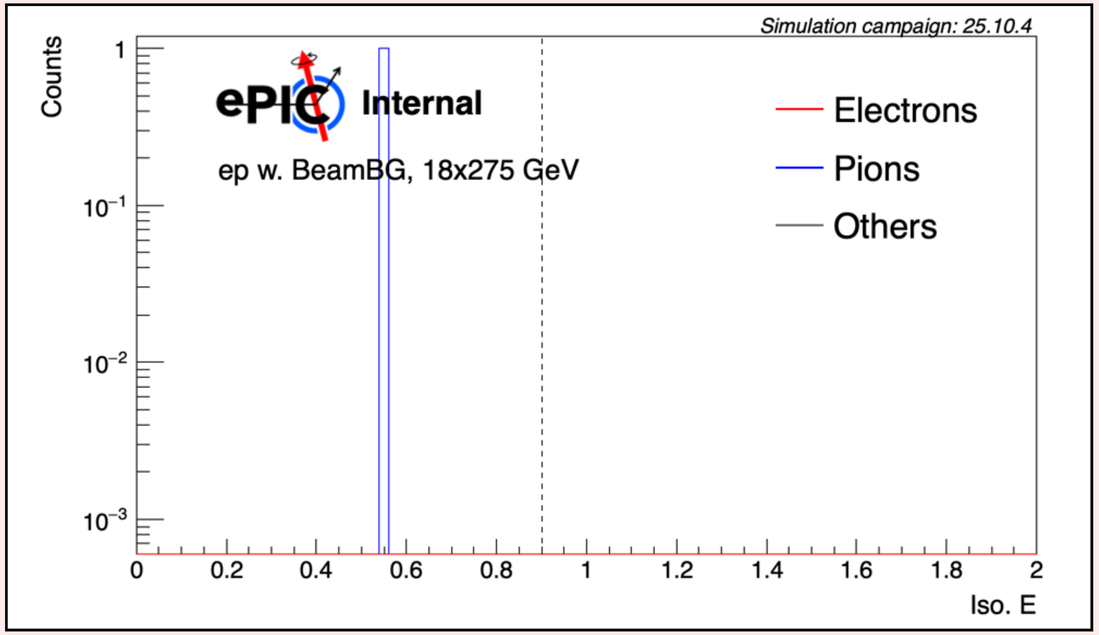


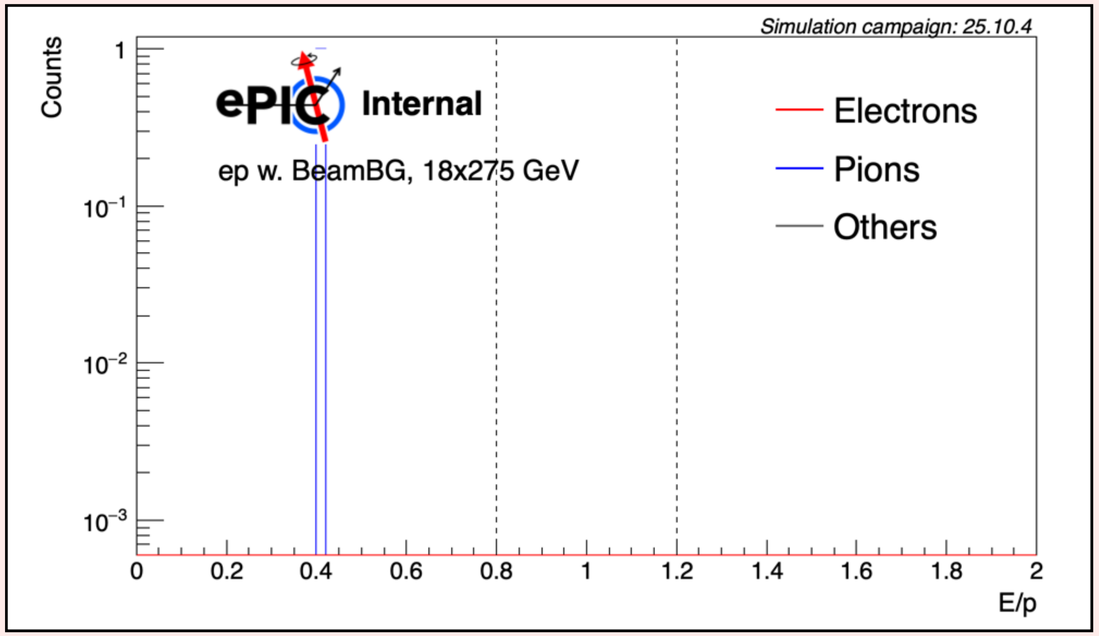


eID with beam background - 0 DIS events, > 3 track points

Number of scattered electrons

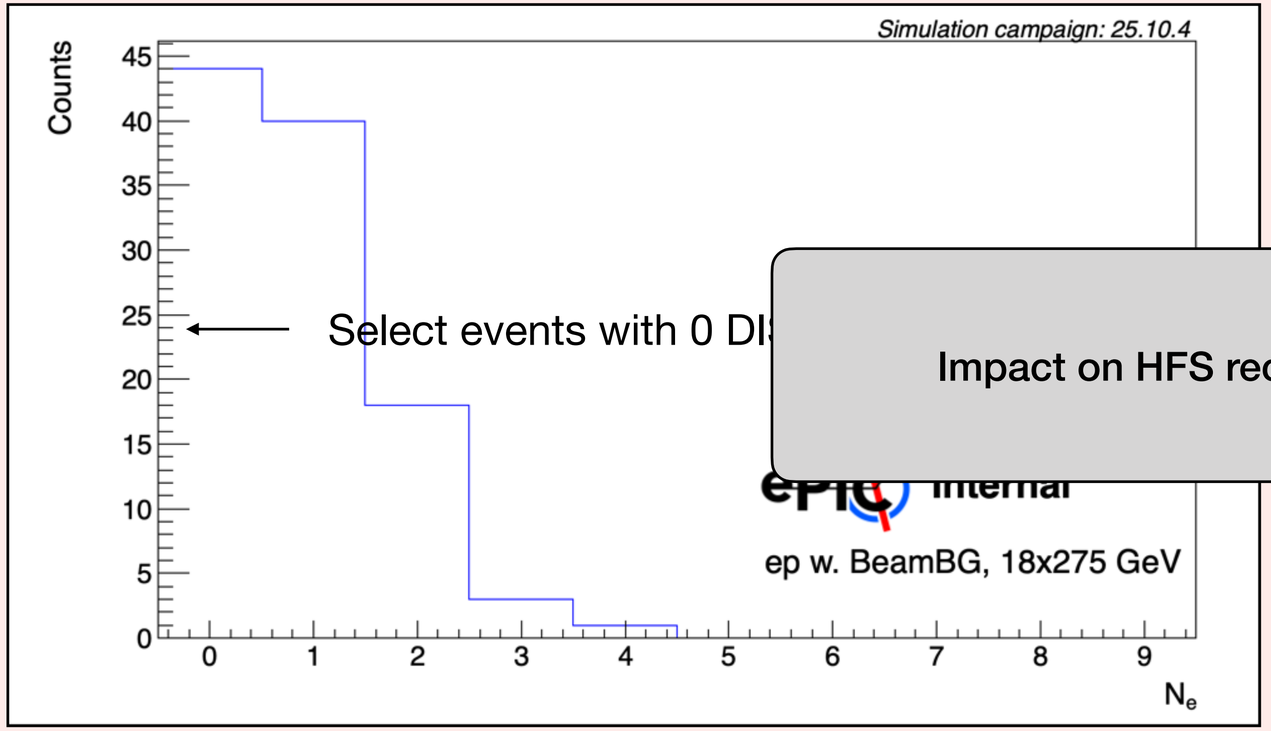






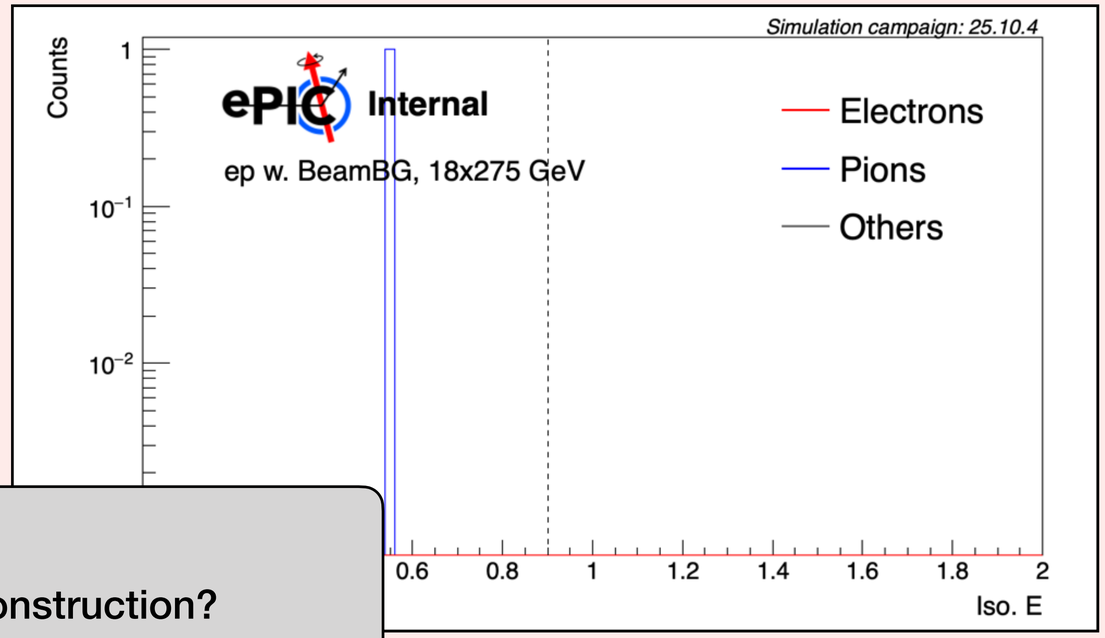
eID with beam background - 0 DIS events, > 3 track points

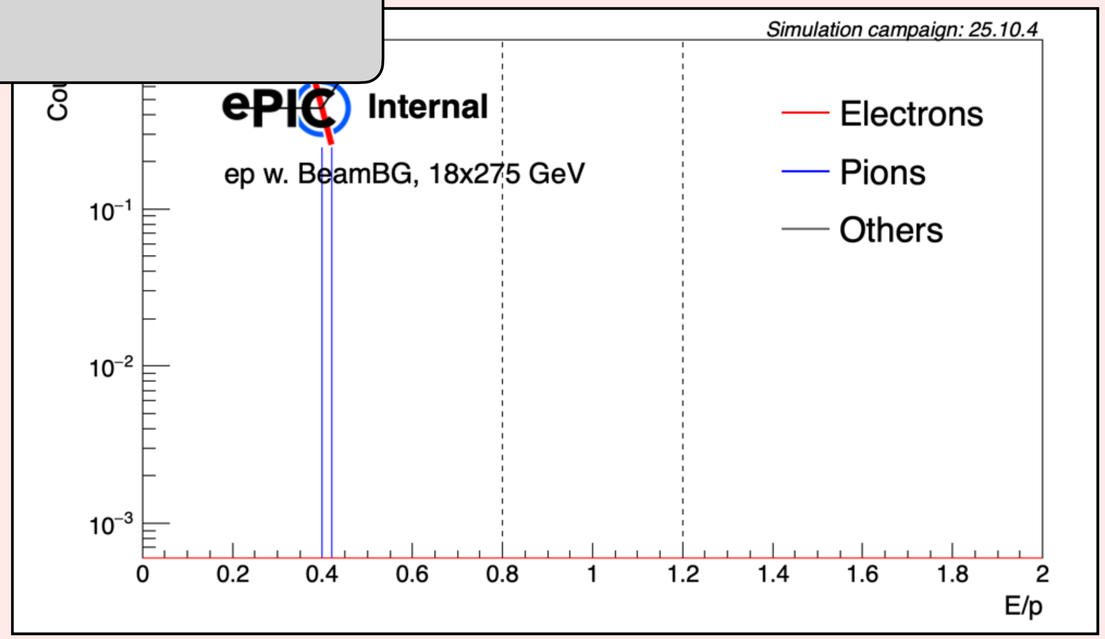
Number of scattered electrons



Select events with 0 DI

Impact on HFS reconstruction?





Implementation to EICrecon

- Fix boost.h ..
- More flexible beam energy selection in kinematic reconstruction
- Update selection algorithm in ElectronReconstruction
- Store HFS information for later analysis
- Benchmark
- See Derek’s slides for detailed plan

EICrecon/src/algorithms/reco/InclusiveKinematicsElectron.cc

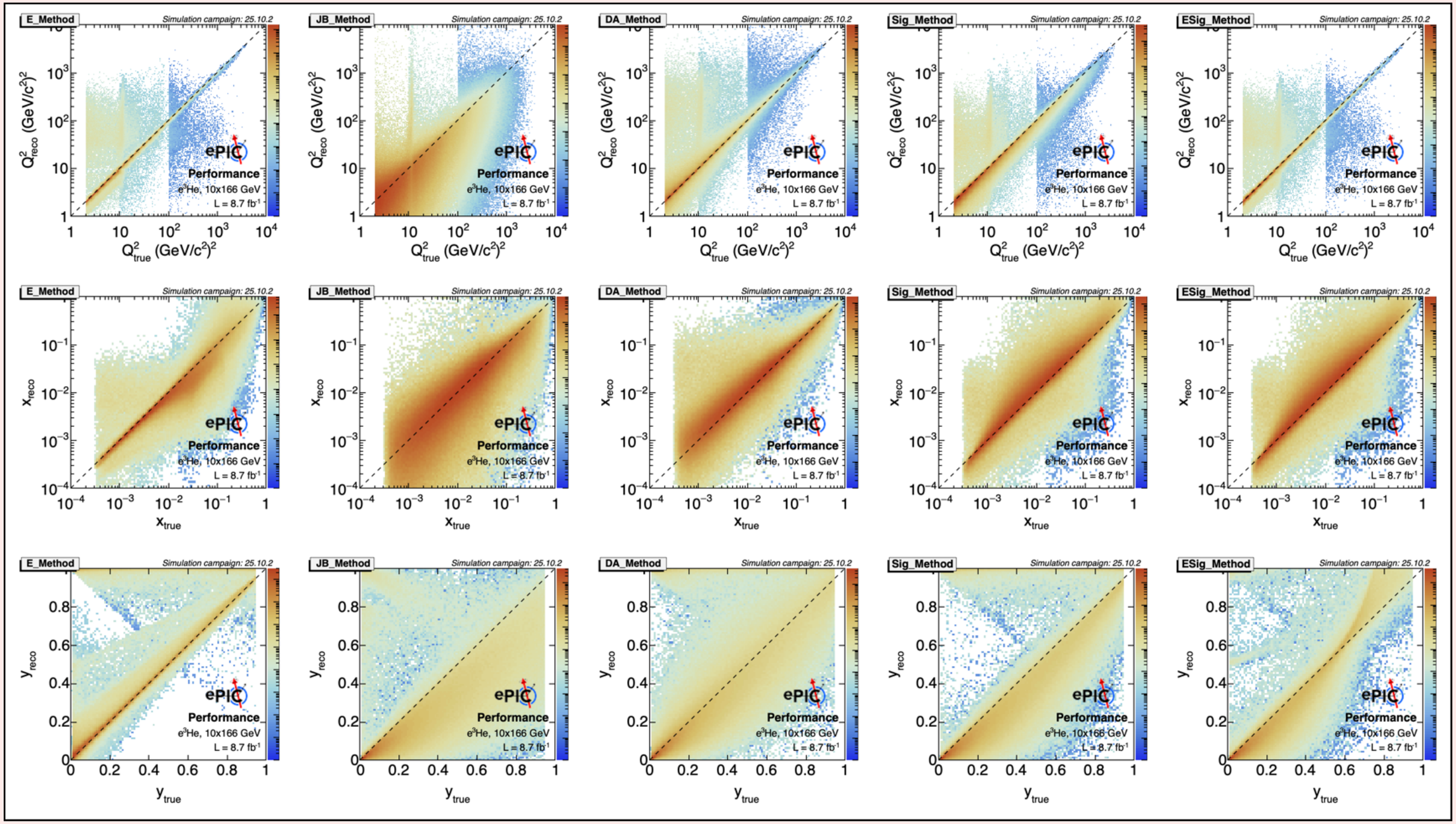
```
79      // Get incoming electron beam
80      const auto ei_coll = find_first_beam_electron(mcparts);
81      if (ei_coll.empty()) {
82        debug("No beam electron found");
83        return;
84      }
85      const PxPyPzEVector ei(round_beam_four_momentum(ei_coll[0].getMomentum(),
86                                                      m_particleSvc.particle(ei_coll[0].getPDG()).mass,
87                                                      {-5.0, -10.0, -18.0}, 0.0));
88
89      // Get incoming hadron beam
90      const auto pi_coll = find_first_beam_hadron(mcparts);
91      if (pi_coll.empty()) {
92        debug("No beam hadron found");
93        return;
94      }
95      const PxPyPzEVector pi(round_beam_four_momentum(pi_coll[0].getMomentum(),
96                                                      m_particleSvc.particle(pi_coll[0].getPDG()).mass,
97                                                      {41.0, 100.0, 275.0}, m_crossingAngle));
```

Summary

- Current eID algorithm is efficient at most region except for at transitioning areas between barrel and endcaps
- ep Pythia 8 samples are missing clusters in reconstructedparticlecollection
- Starting to look at pion contamination from photoproduction and effect from beam background
- More software developments are underway (eFinder & EICrecon)
- Requested to do: dp/p resolution for electrons!

Thank you!

Slide++: Kinematic reconstruction - qualities



Slide++: Kinematic reconstruction - algorithms selection