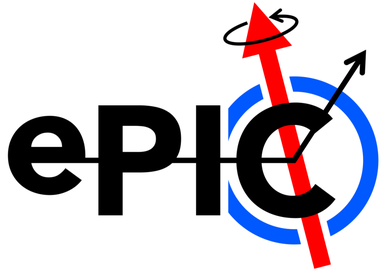
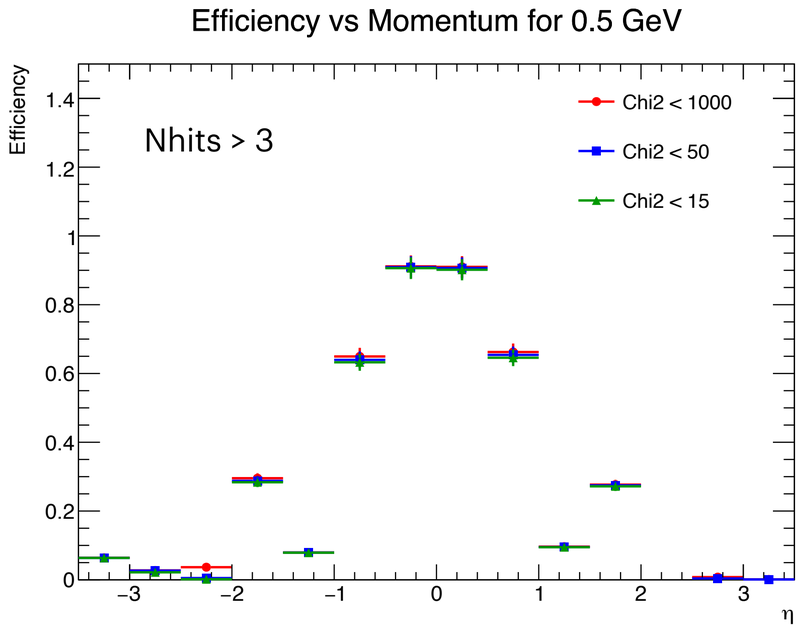
EIC Tracking Meeting: Role of χ^2 in track finding

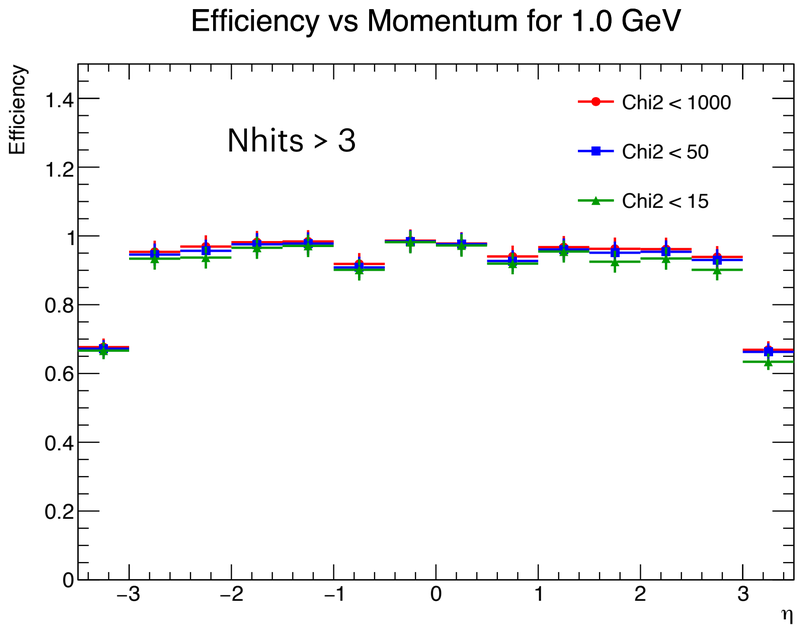
ePIC Tracking WG Meeting,
Vassu Doomra, UC Berkeley
April 2, 2026

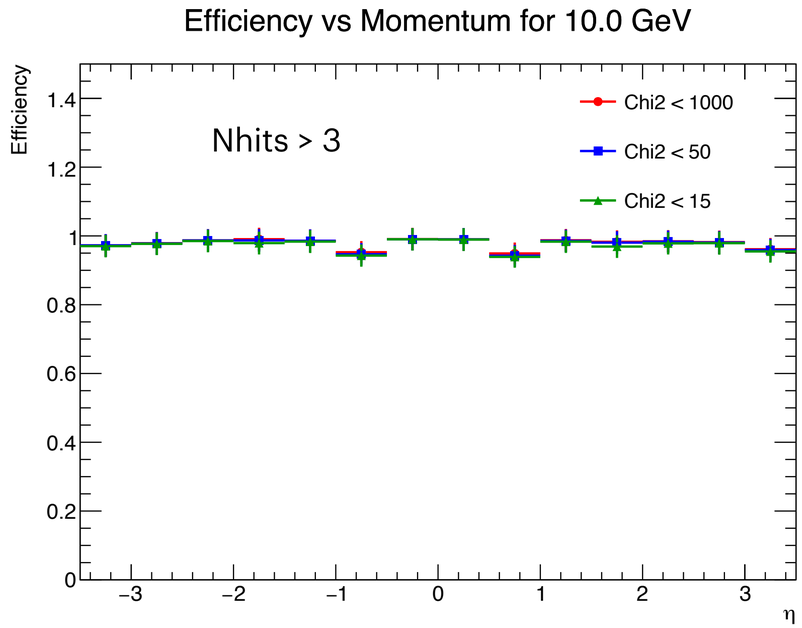


Berkeley
UNIVERSITY OF CALIFORNIA

Recap from single pion simulations

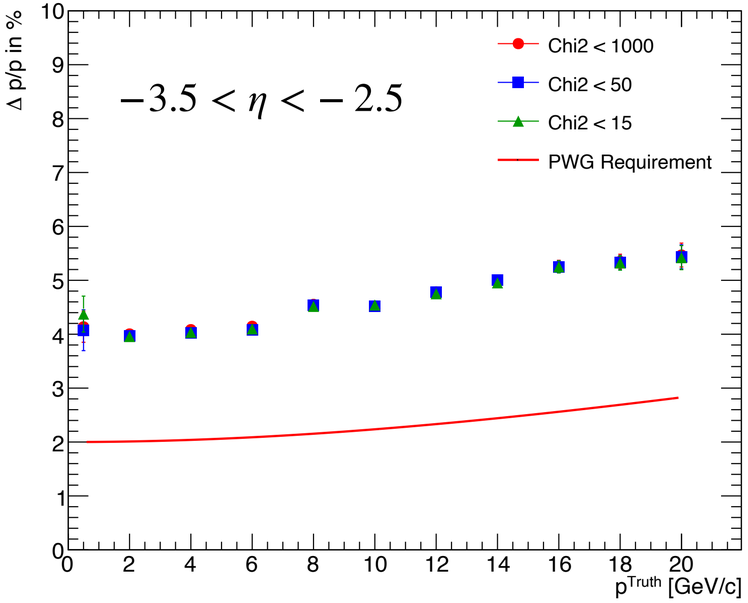


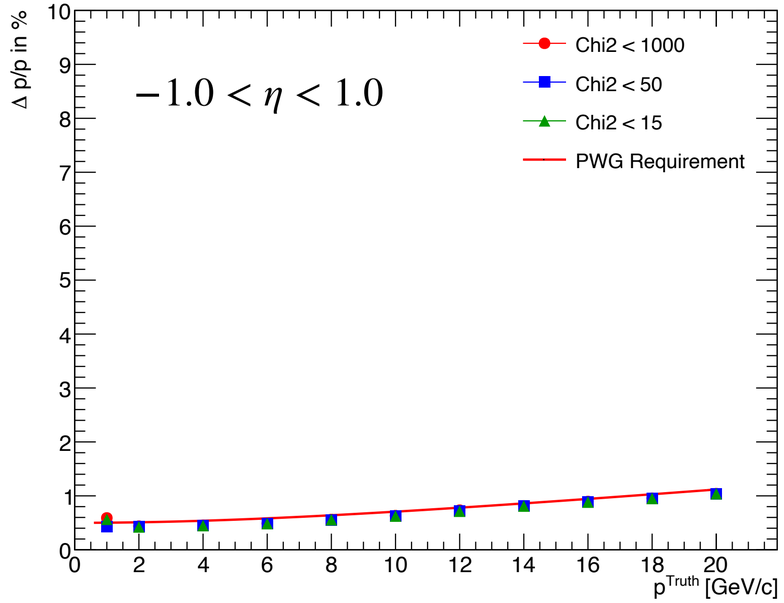


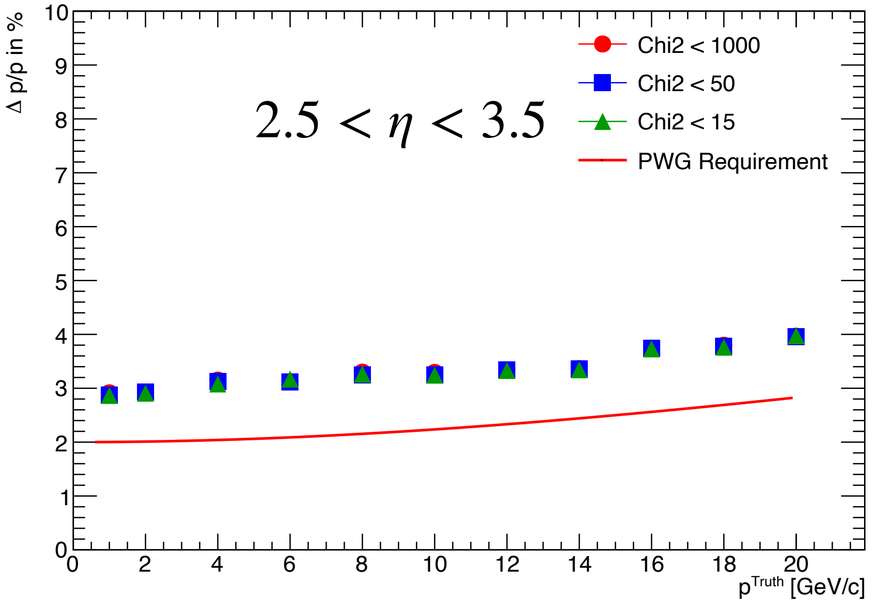


In terms of track reconstruction efficiency, we observe no significant difference across the three χ^2 cutoffs.

Momentum Resolution: Single pion simulations







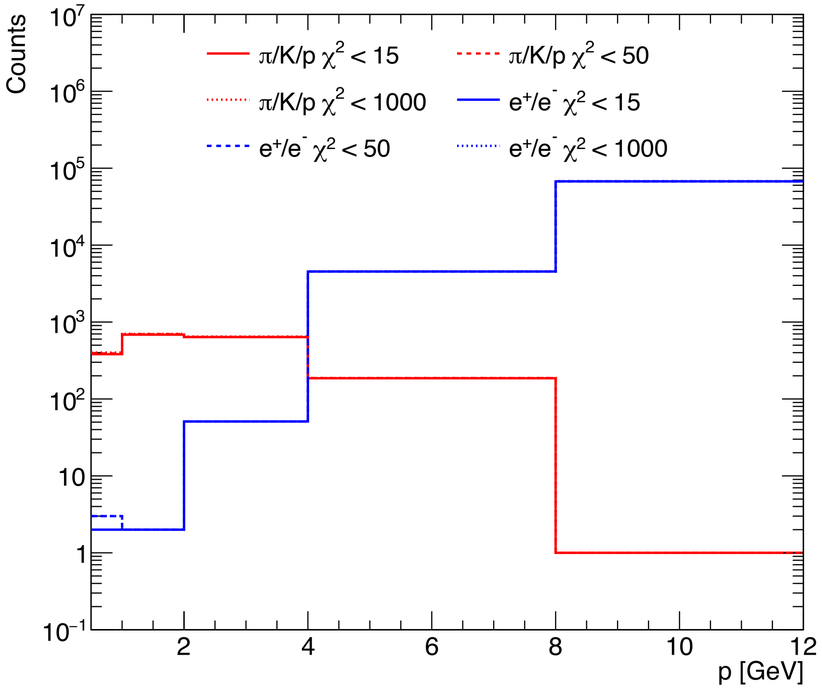
From single-pion simulations, we find that the χ^2 cut has a negligible impact on both the track reconstruction efficiency and the momentum resolution.

Looking at the DIS Events: 10 x 275 GeV Configuration

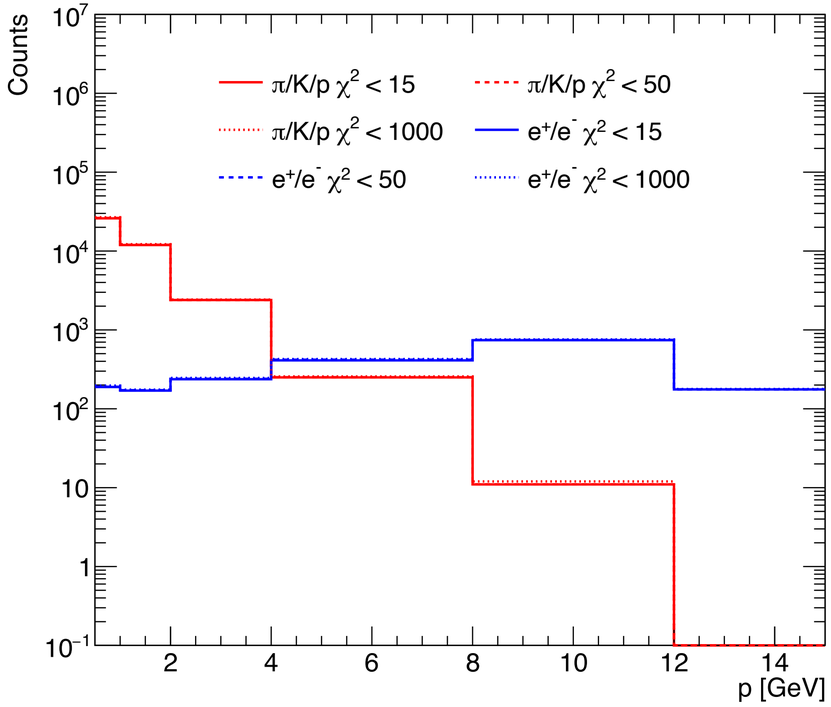
Note: These results are with the 5 microns Au coating: Both Geant4 simulation and the material map for reconstruction (Feb 2026 Campaign)

Comparison of the Reco Momentum Spectra

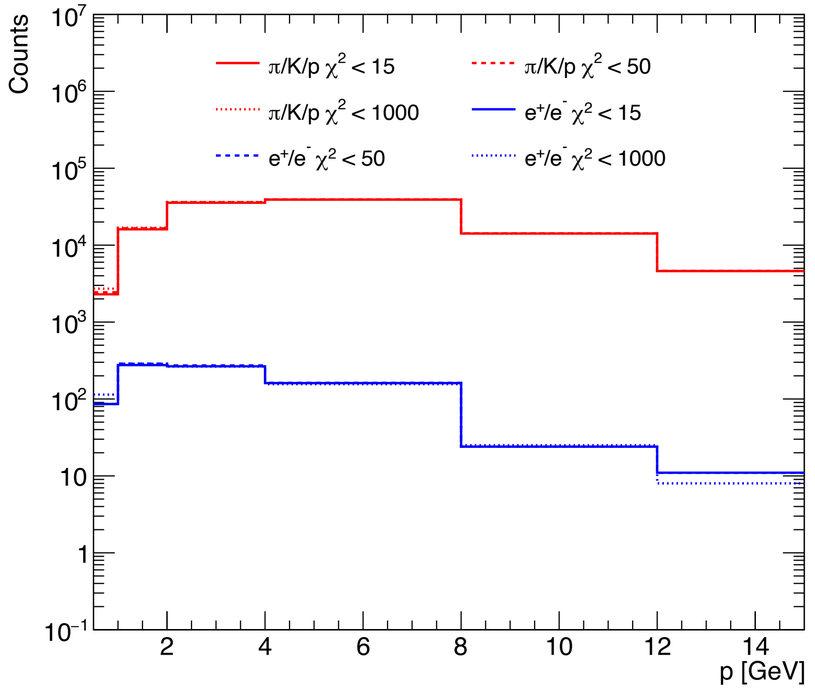
$-3.5 < \eta < -2.5$



$-1.0 < \eta < 1.0$



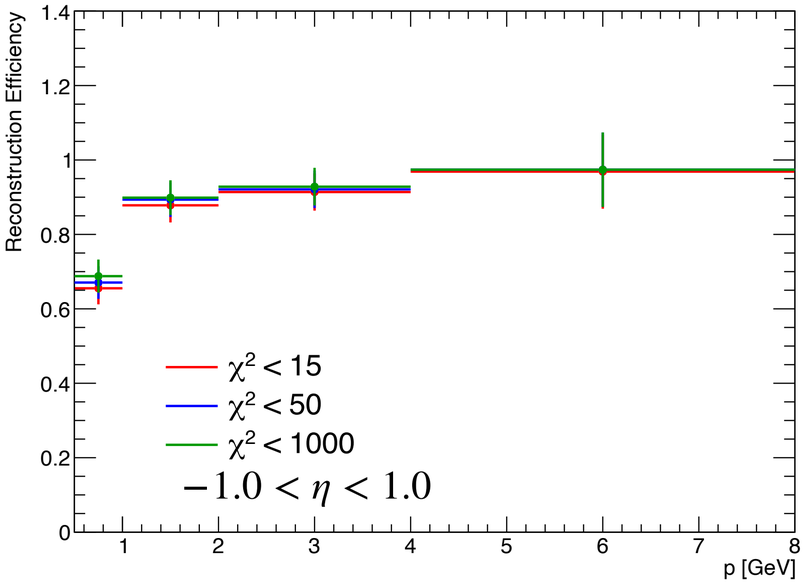
$2.5 < \eta < 3.5$



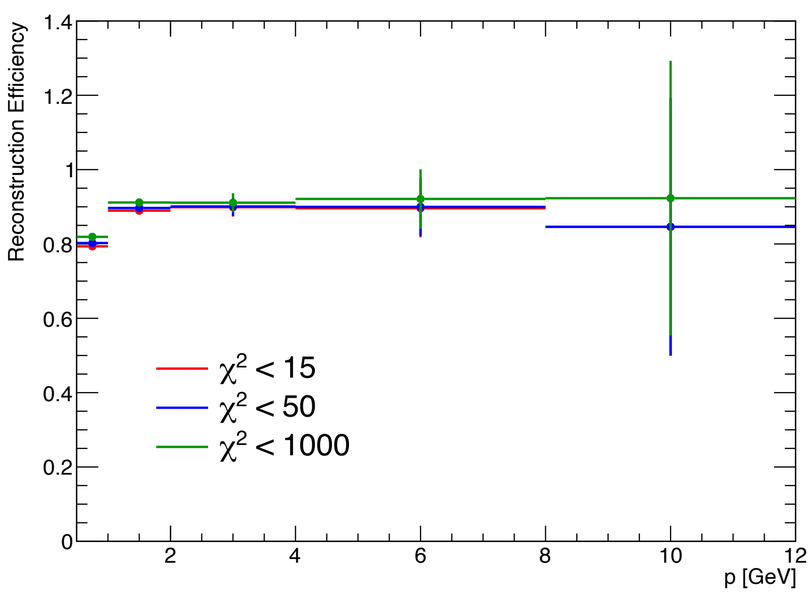
This illustrates the dominant particle species as a function of momentum in different η regions

Reconstruction efficiency (π/K/p)

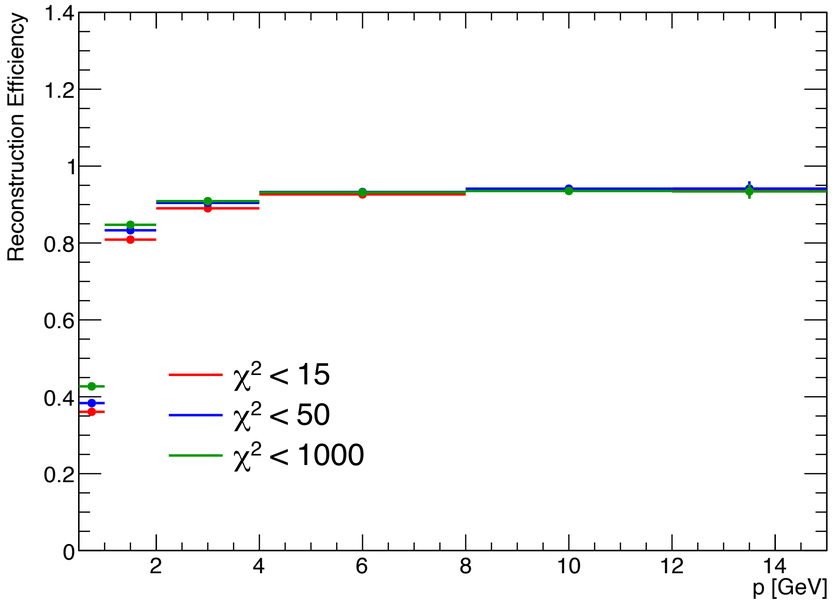
$-3.5 < \eta < -2.5$



$-1.0 < \eta < 1.0$



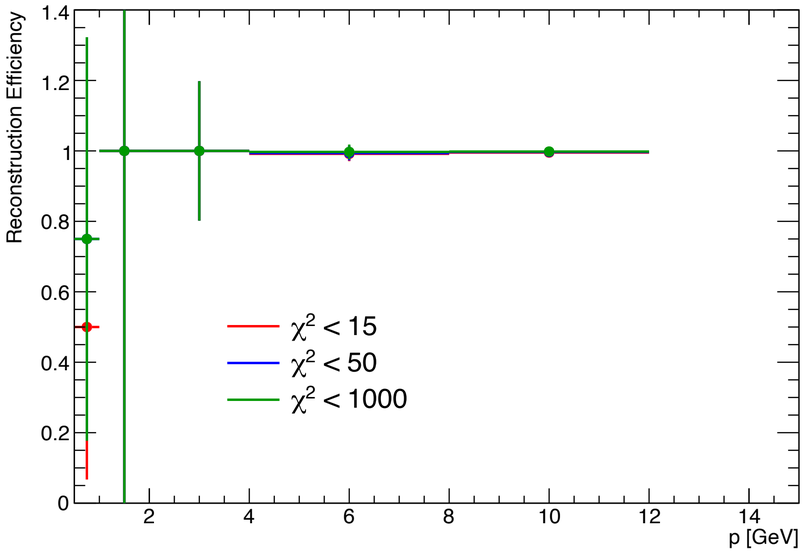
$2.5 < \eta < 3.5$



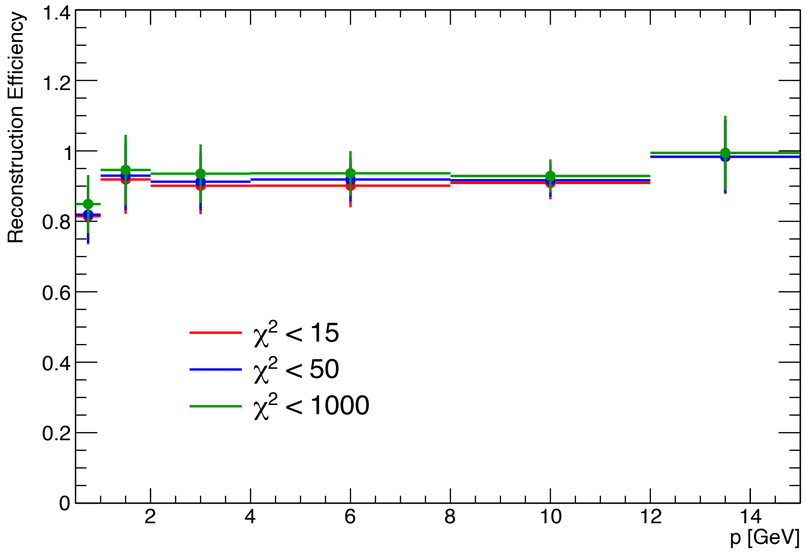
No significant χ^2 dependence!

Reconstruction efficiency (electrons)

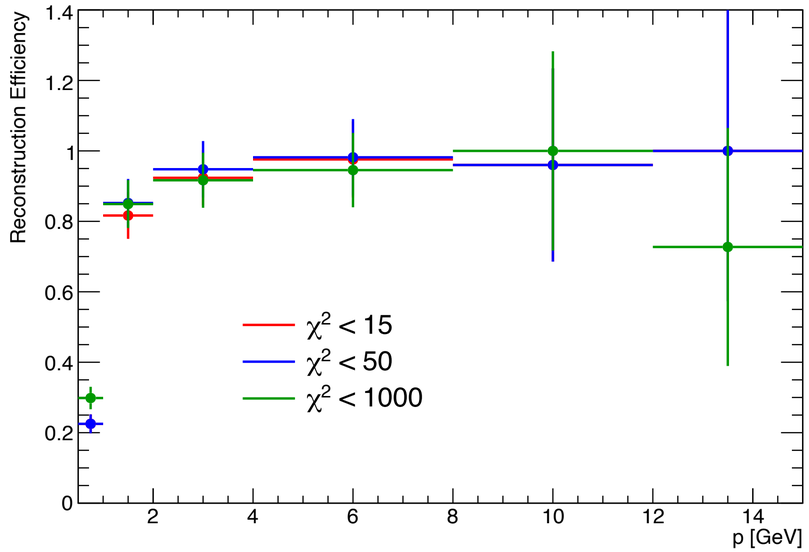
$-3.5 < \eta < -2.5$



$-1.0 < \eta < 1.0$

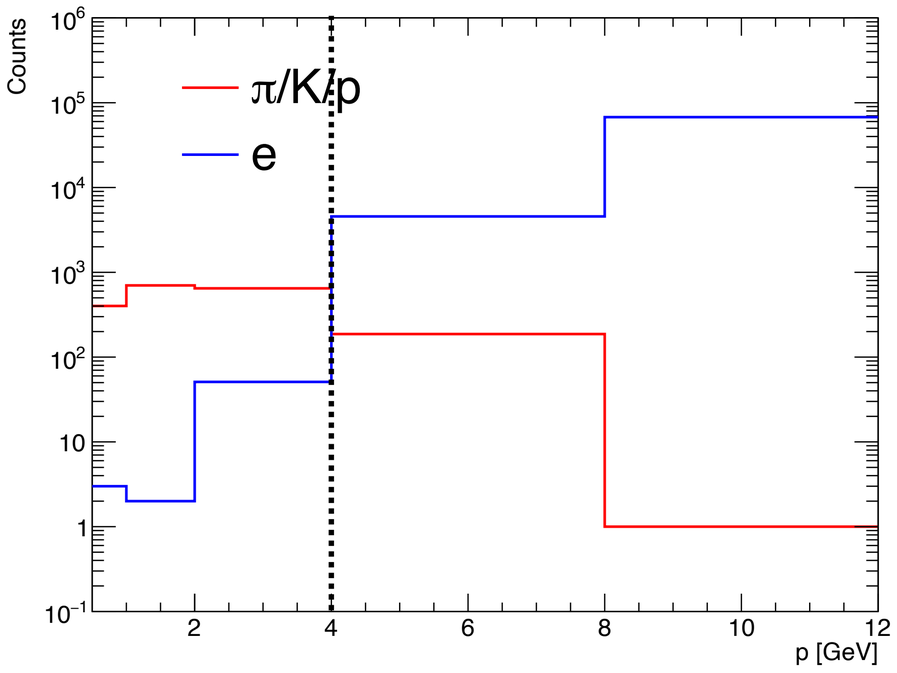


$2.5 < \eta < 3.5$



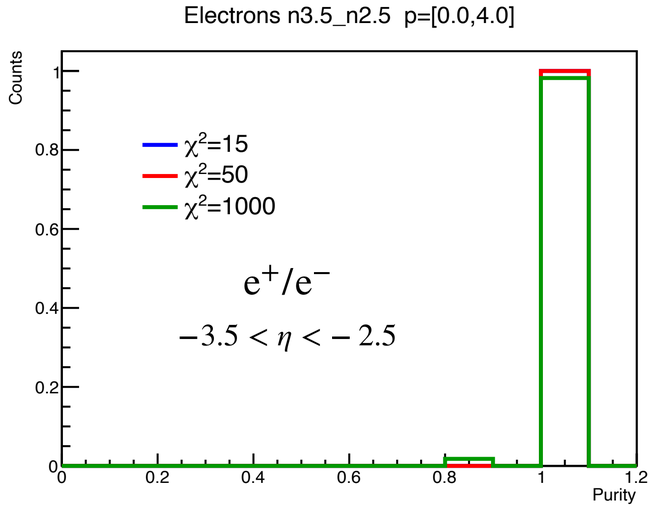
No significant χ^2 dependence!

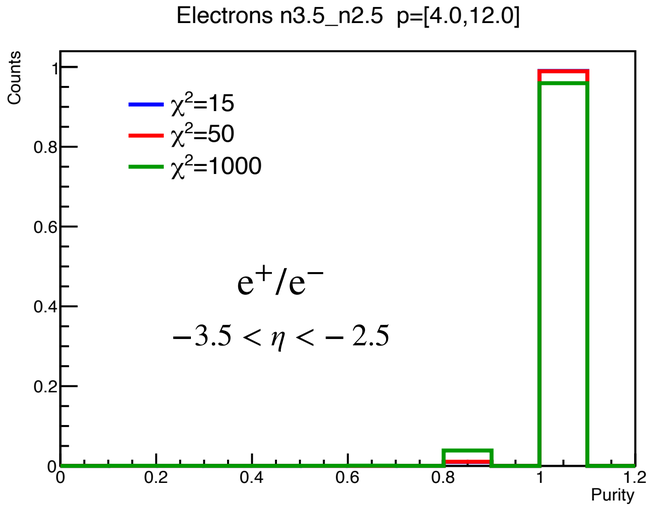
Purity Distributions

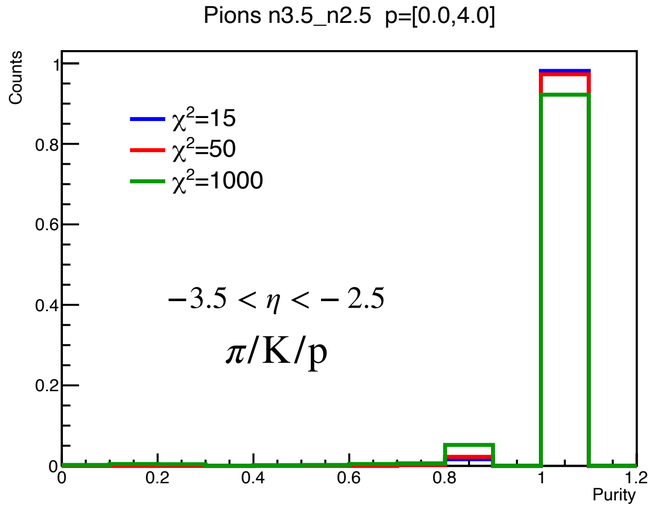


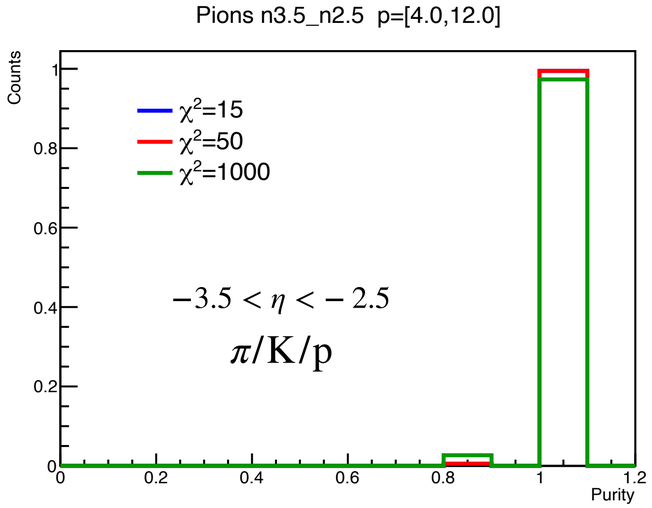
$$-3.5 < \eta < -2.5$$

$$\text{Purity} = \frac{N_{\text{Hits}}^{\text{primary}}}{N_{\text{Hits}}^{\text{Total}}}$$









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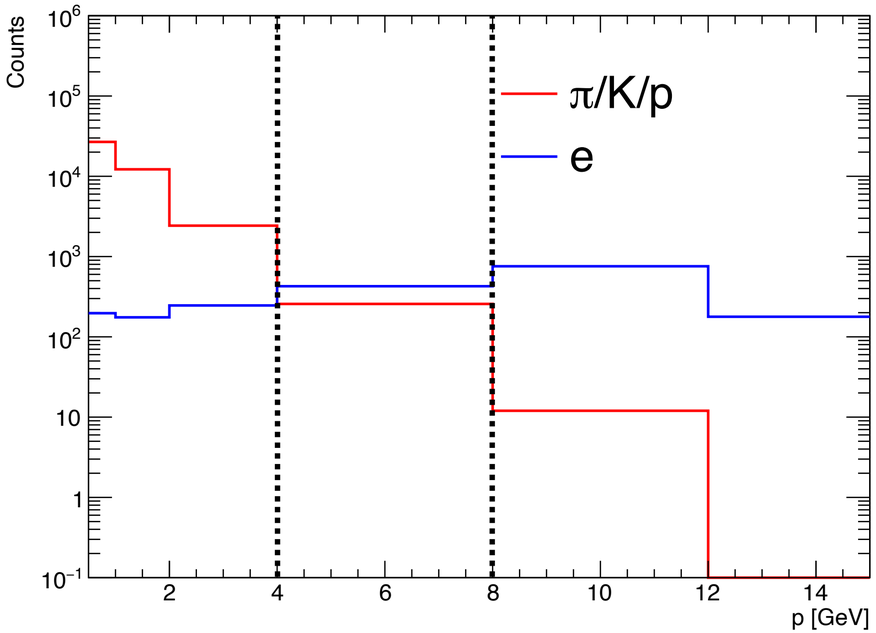
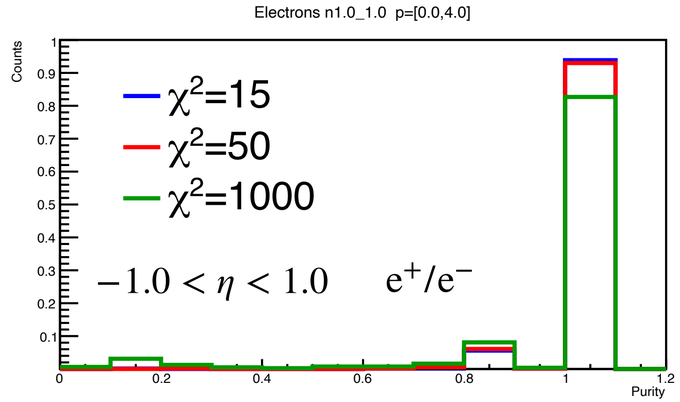
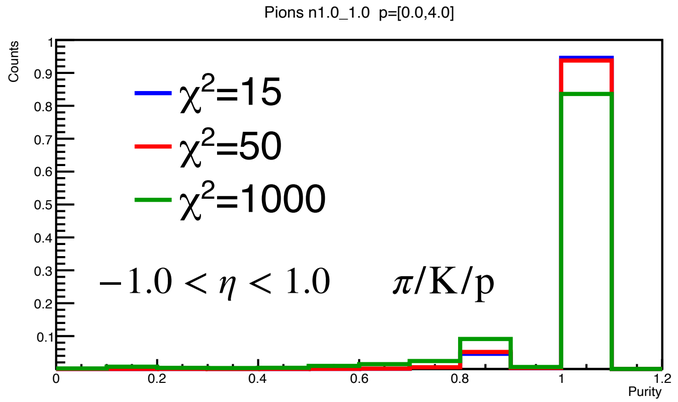


$$-1.0 < \eta < 1.0$$

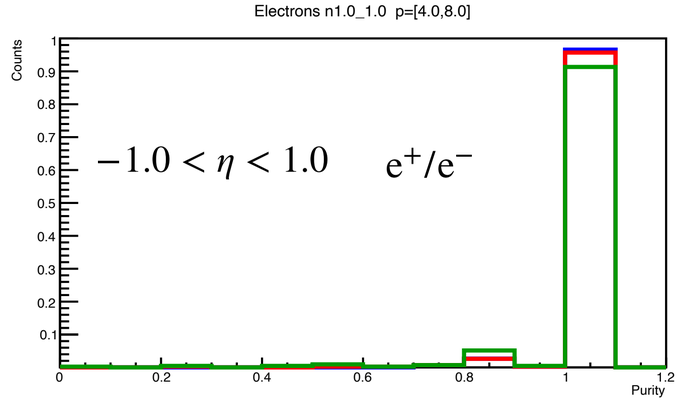
$$\text{Purity} = \frac{N_{\text{Hits}}^{\text{primary}}}{N_{\text{Hits}}^{\text{Total}}}$$

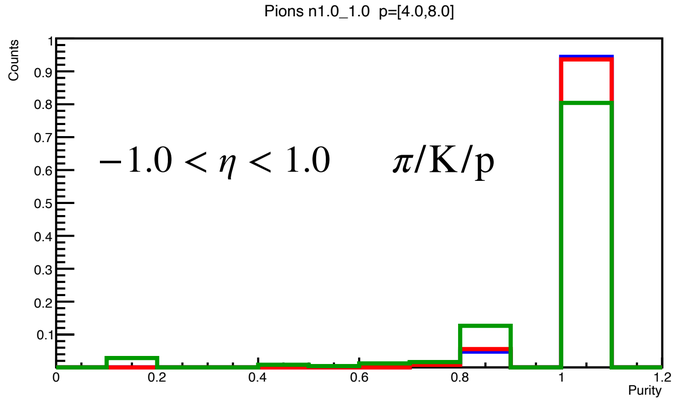
$0 < p < 4\,\text{GeV/c}$



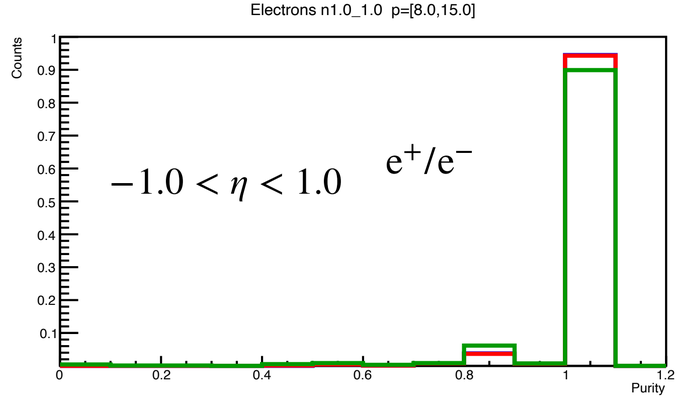


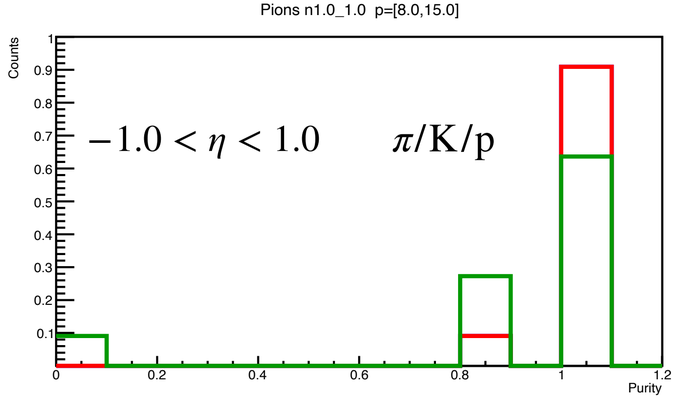
$4 < p < 8\,\text{GeV/c}$





$8 < p < 15\,\text{GeV/c}$





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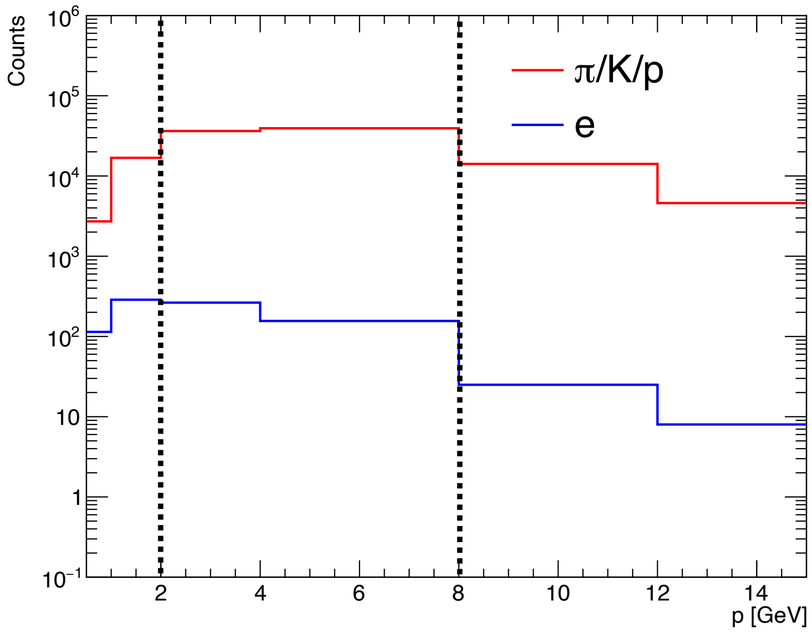

$$2.5 < \eta < 3.5$$

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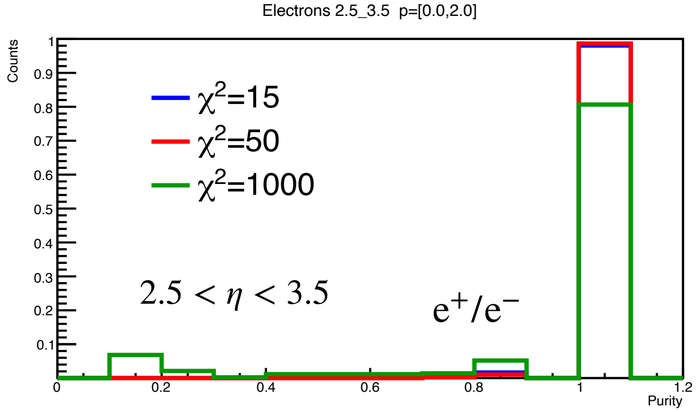
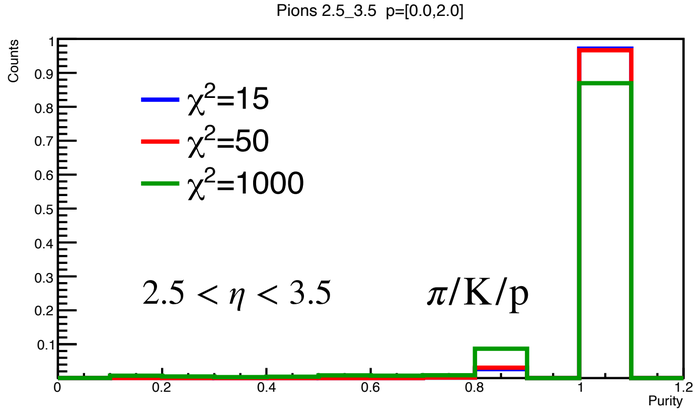
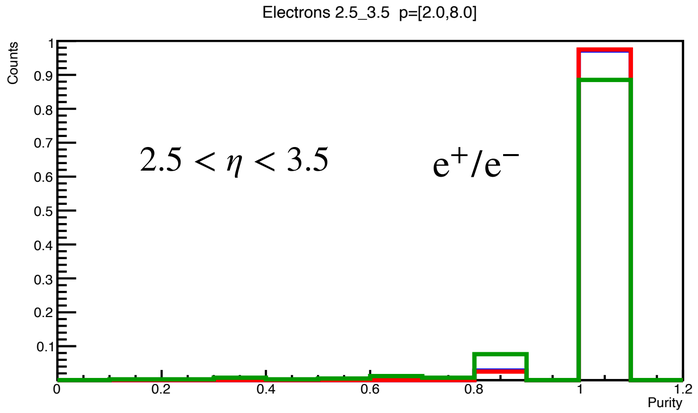
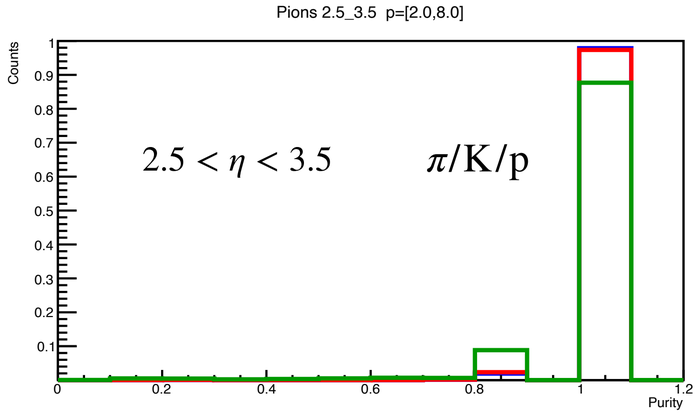
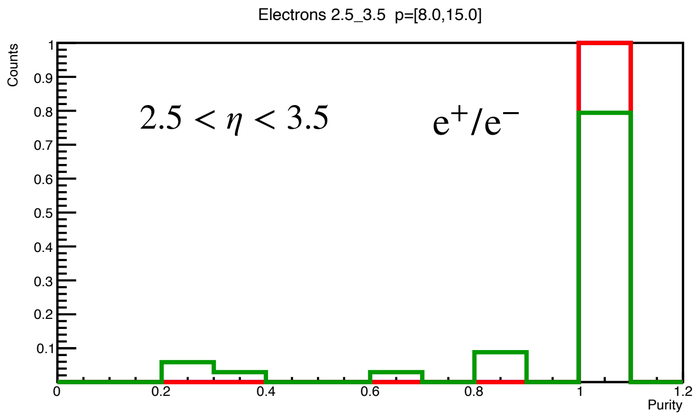
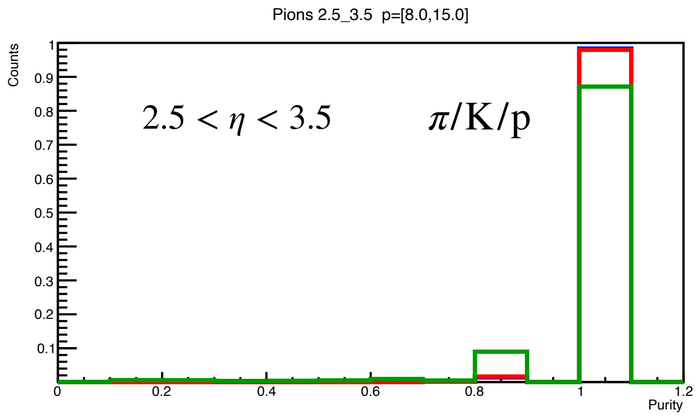












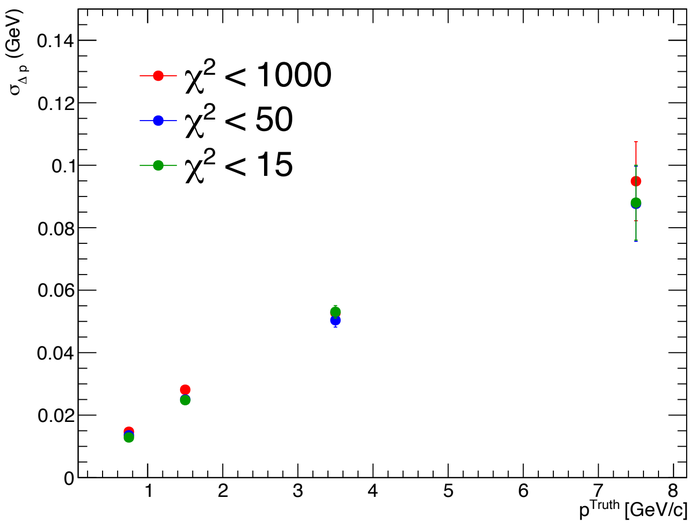
Momentum Resolution Plots (π/K/p)

- In contrast to single-particle simulations (fixed momentum), DIS has limited statistics, requiring wide momentum bins; the resolution is shown at the bin-averaged p, which only approximates the true momentum dependence.

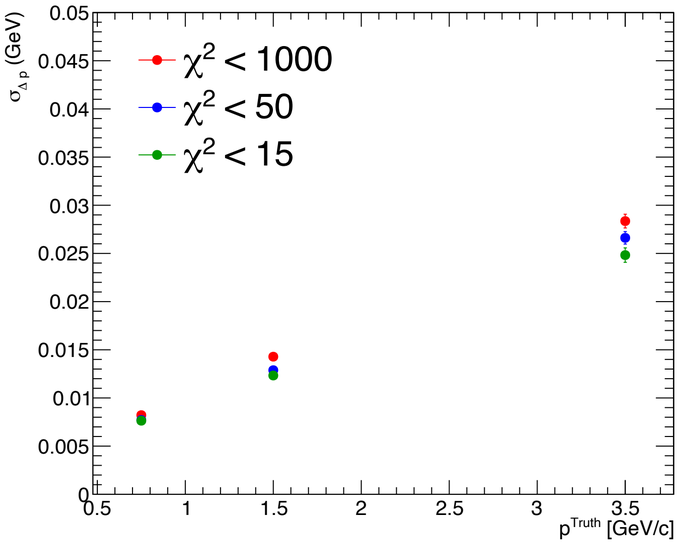
- The goal is a relative comparison between different χ2 cuts, so despite these limitations, the comparison remains value.

No visible χ^2 dependence

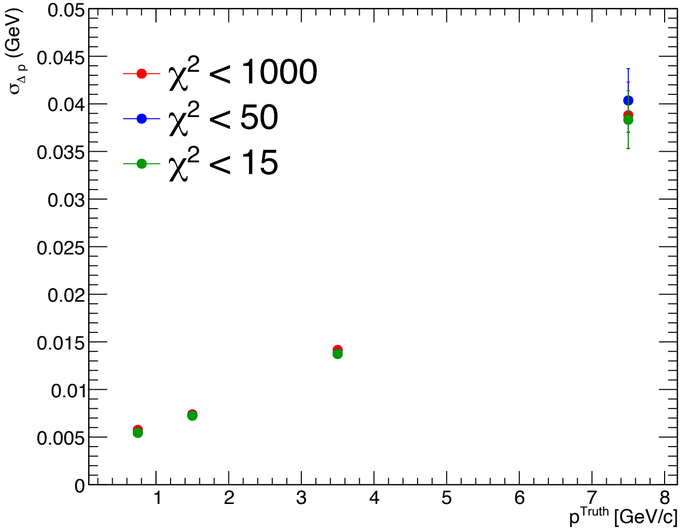
$-3.5 < \eta < -2.5$



$-2.0 < \eta < -1.0$



$-1.0 < \eta < 1.0$



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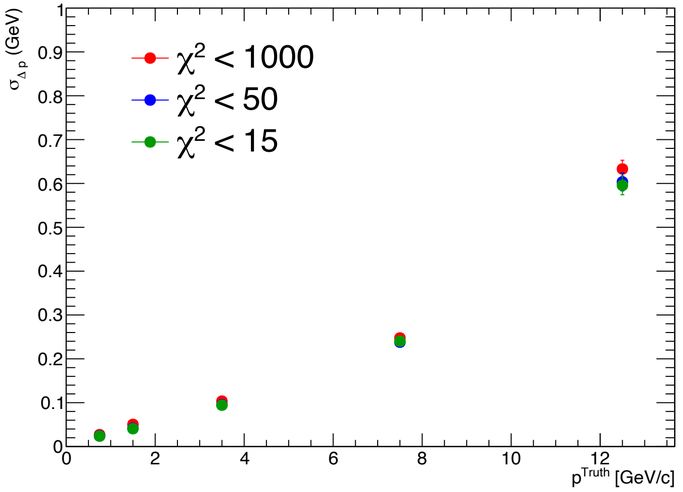

Momentum Resolution Plots (Electrons)

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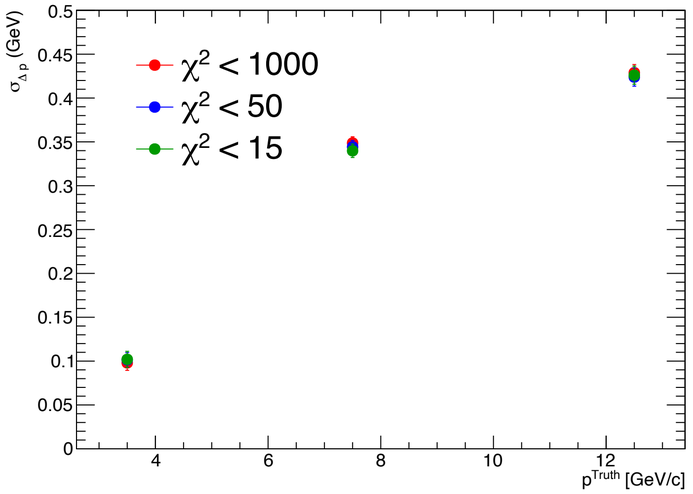

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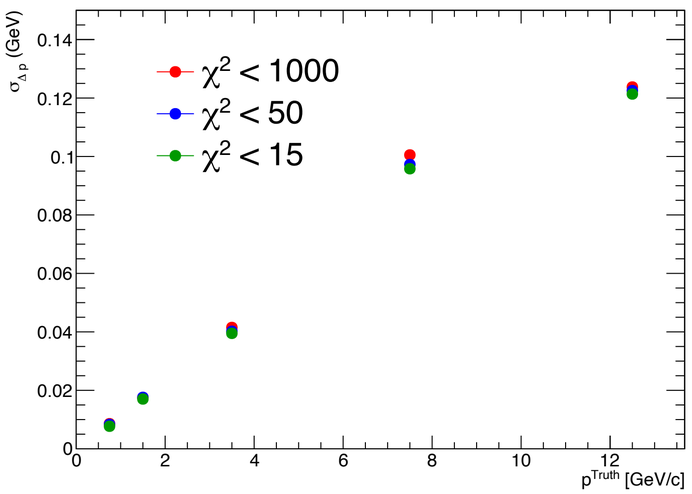

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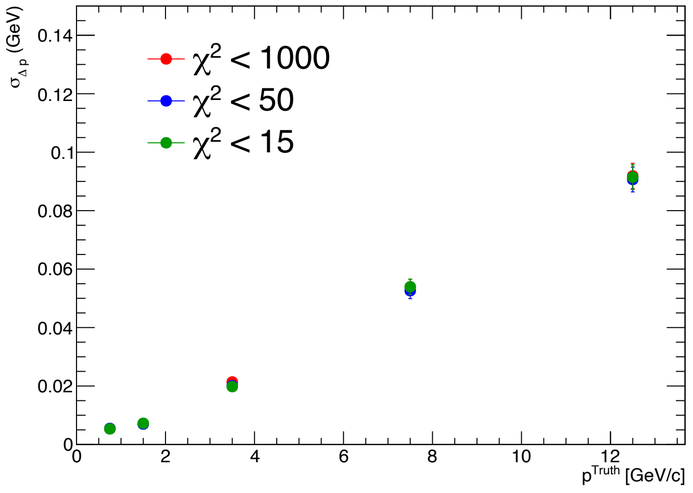

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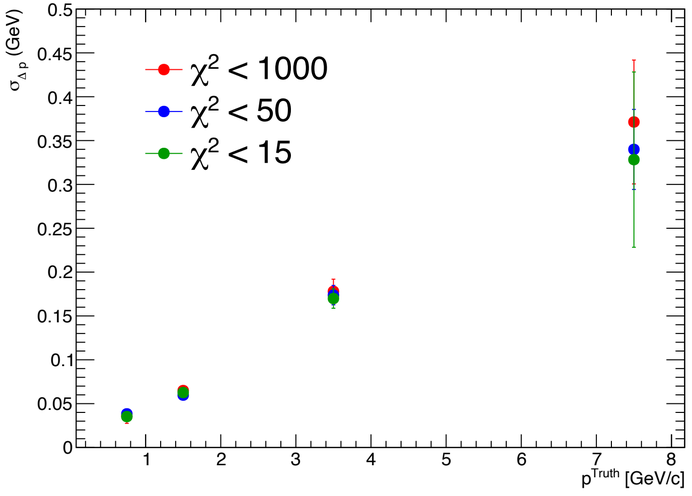

Summary & Outlook

- No significant dependence of momentum reconstruction efficiency or resolution on the χ^2 cut (from single-particle and DIS simulations).

- Purity improves with tighter χ^2 cuts.

- Final choice of χ^2 cutoff will be determined using DIS + background studies