ePIC detector performance for inclusive physics

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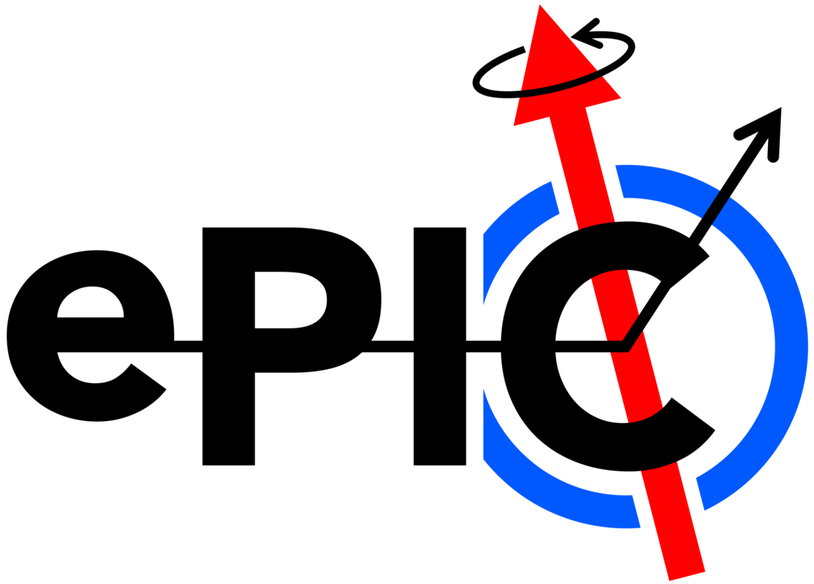


ePIC Collaboration Meeting
July 14-18, 2025

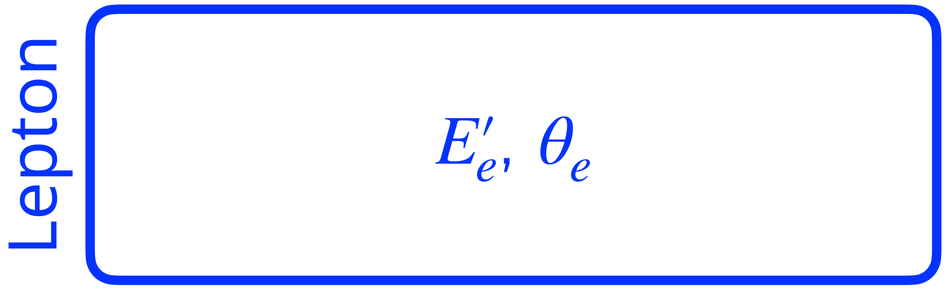
JOHANNES GUTENBERG
UNIVERSITÄT MAINZ

UNIVERSITY OF
BIRMINGHAM

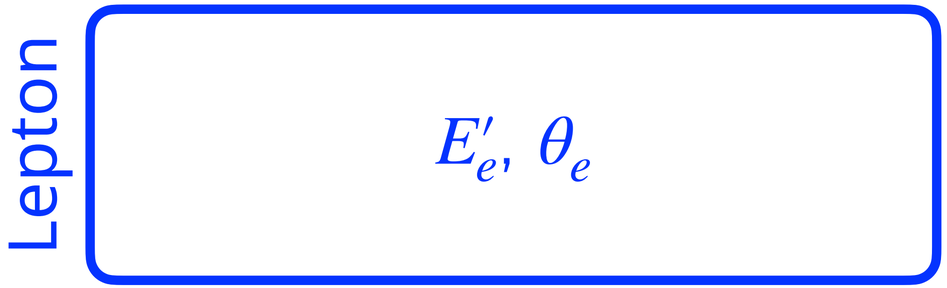
Stony Brook
University

Quick review of inclusive physics needs

Inclusive DIS variable reconstruction



Inclusive DIS variable reconstruction



- Electron
  $Q^2\left(E'_e, \theta_e\right), y\left(E'_e, \theta_e\right)$

Inclusive DIS variable reconstruction

Lepton

$$E'_e,\ \theta_e$$

Hadron

$$\delta_h = \sum_i \left(E_i - p_{z,i}\right)$$

$$P_{T,h} = \sqrt{\left(\sum_i p_{x,i}\right)^2 + \left(\sum_i p_{y,i}\right)^2}$$

$$\cos\gamma_h = \frac{P_{T,h}^2 - \delta_h^2}{P_{T,h}^2 + \delta_h^2}$$

- Electron
  $Q^2\left(E'_e, \theta_e\right), y\left(E'_e, \theta_e\right)$
- Jacquet-Blondel
  $Q^2\left(\delta_h, P_{T,h}\right), y\left(\delta_h, P_{T,h}\right)$

Inclusive DIS variable reconstruction

Lepton

$$E'_e,\ \theta_e$$

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$$\delta_h = \sum_i \left(E_i - p_{z,i}\right)$$

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- Electron
  $Q^2\left(E'_e, \theta_e\right), y\left(E'_e, \theta_e\right)$
- Jacquet-Blondel
  $Q^2\left(\delta_h, P_{T,h}\right), y\left(\delta_h, P_{T,h}\right)$
- Double-angle
  $Q^2\left(\gamma_h, \theta_e\right), y\left(\gamma_h, \theta_e\right)$

Inclusive DIS variable reconstruction

Lepton

$$E'_e,\ \theta_e$$

Hadron

$$\delta_h = \sum_i \left(E_i - p_{z,i}\right)$$

$$P_{T,h} = \sqrt{\left(\sum_i p_{x,i}\right)^2 + \left(\sum_i p_{y,i}\right)^2}$$

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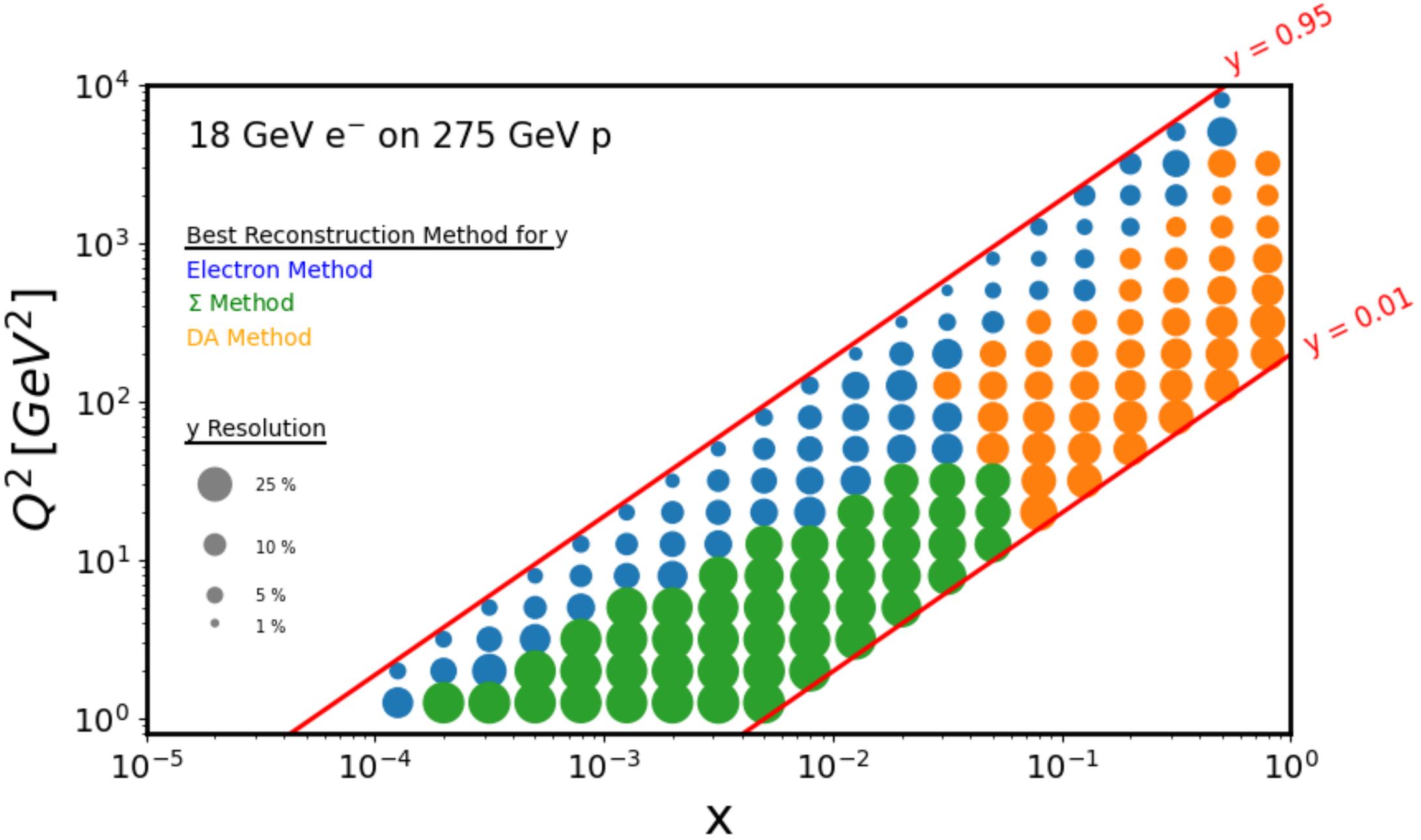
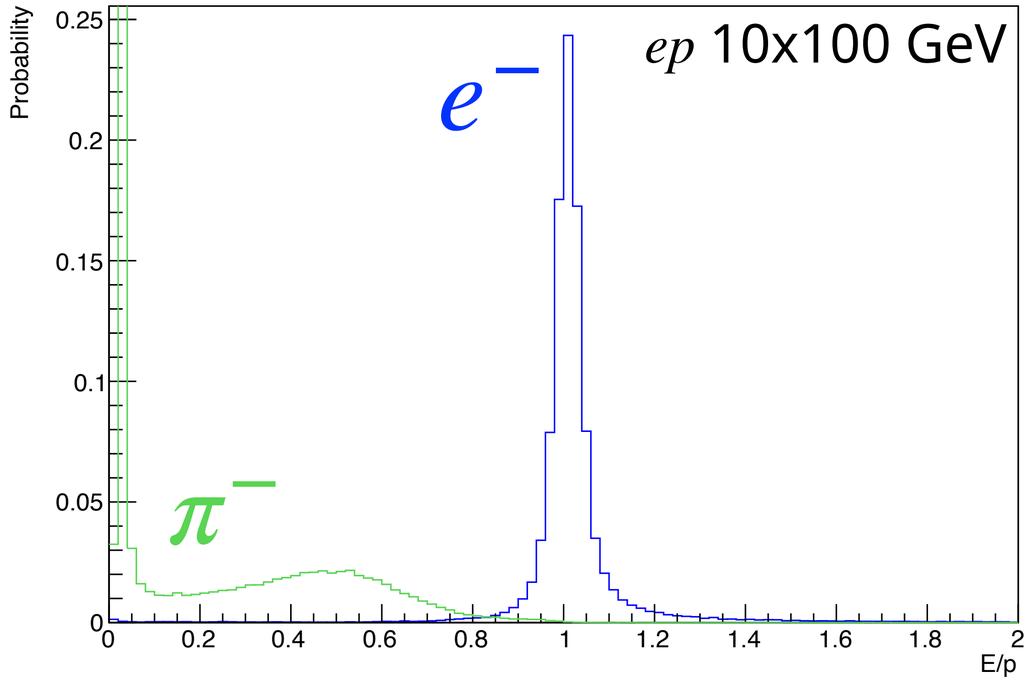
- Electron
  $Q^2\left(E'_e, \theta_e\right), y\left(E'_e, \theta_e\right)$
- Jacquet-Blondel
  $Q^2\left(\delta_h, P_{T,h}\right), y\left(\delta_h, P_{T,h}\right)$
- Double-angle
  $Q^2\left(\gamma_h, \theta_e\right), y\left(\gamma_h, \theta_e\right)$
- $e\Sigma$
  $Q^2\left(E'_e, \theta_e\right), y\left(E'_e, \theta_e, \delta_h\right)$

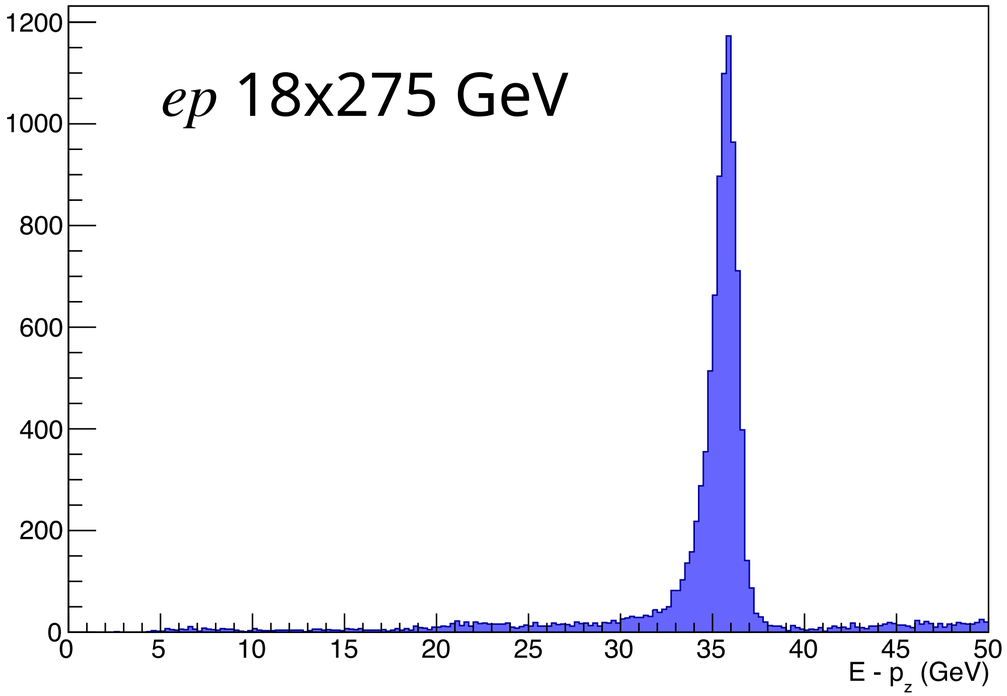
Inclusive DIS variable reconstruction



Electron identification

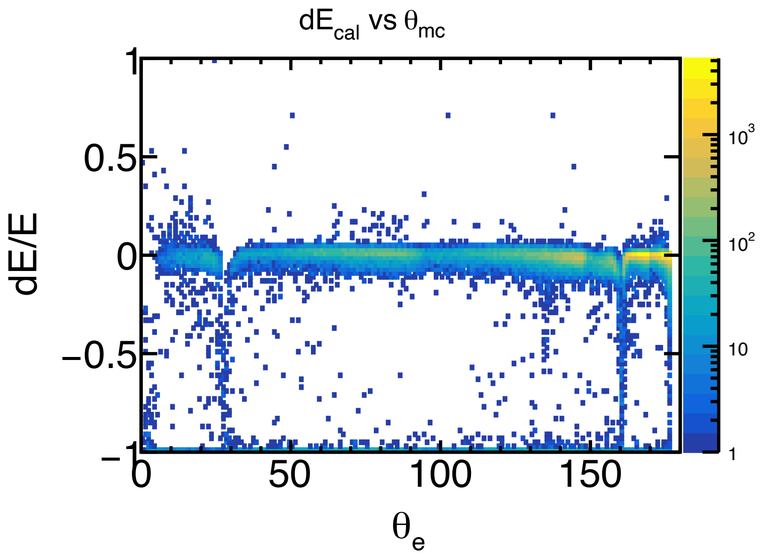
- $E/p \approx 1$ for e^-, smaller for π^-, hadrons
- Total $\delta = \Sigma(E - p_z) \approx 2E_e$, smaller for QED ISR, photoproduction events)
- Cluster isolation
- PID detectors (critical at low electron energies)
- Calorimeter shower shape
  (see Ciprian's talk later this session)

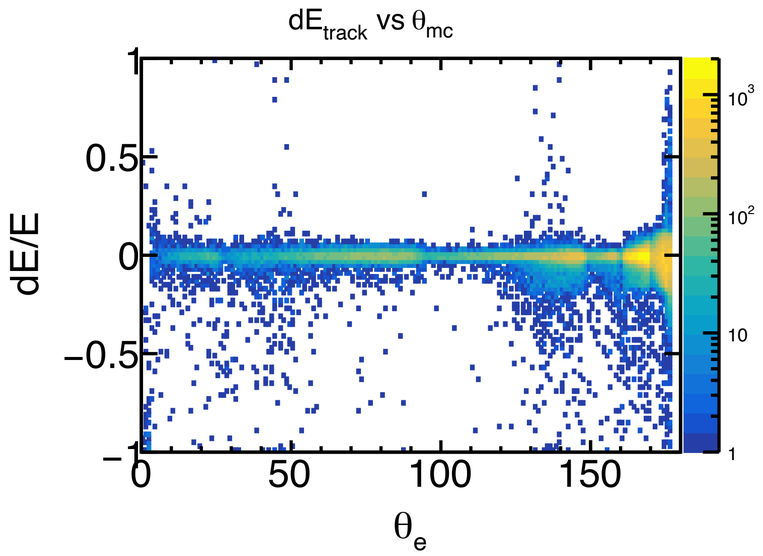


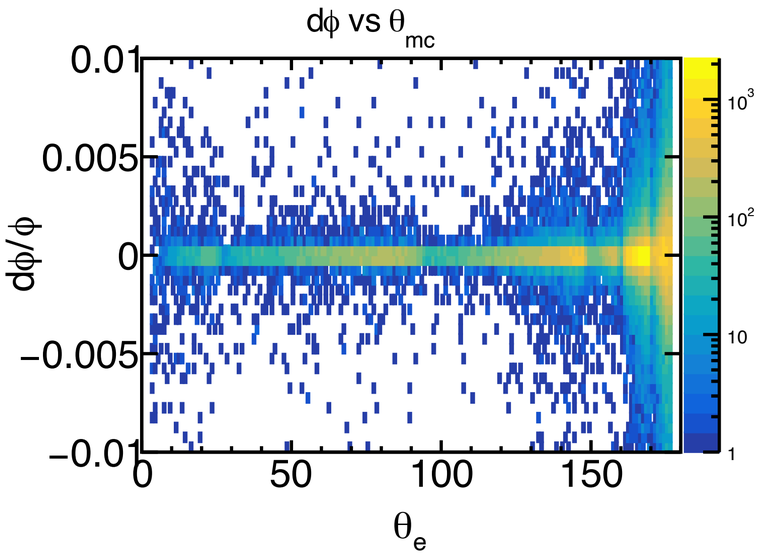


Low-level detector benchmarks

Electron resolution & acceptance

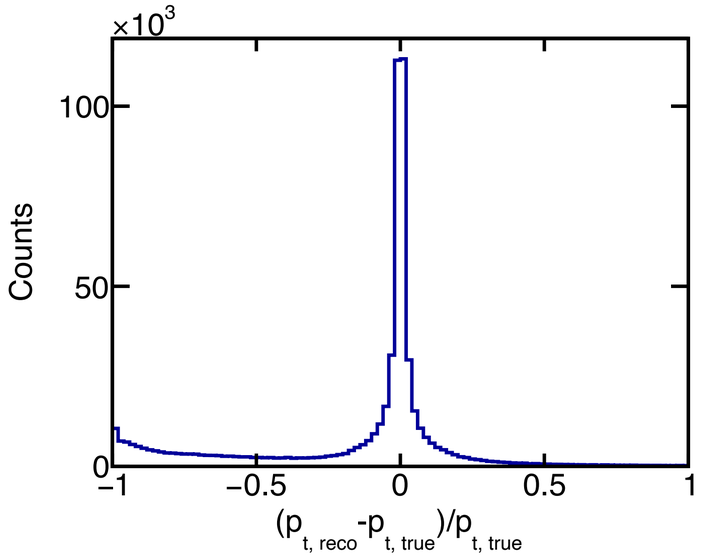


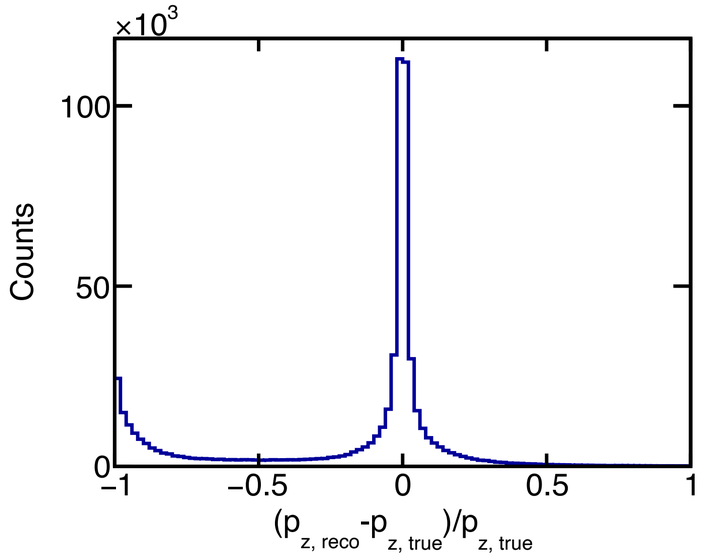


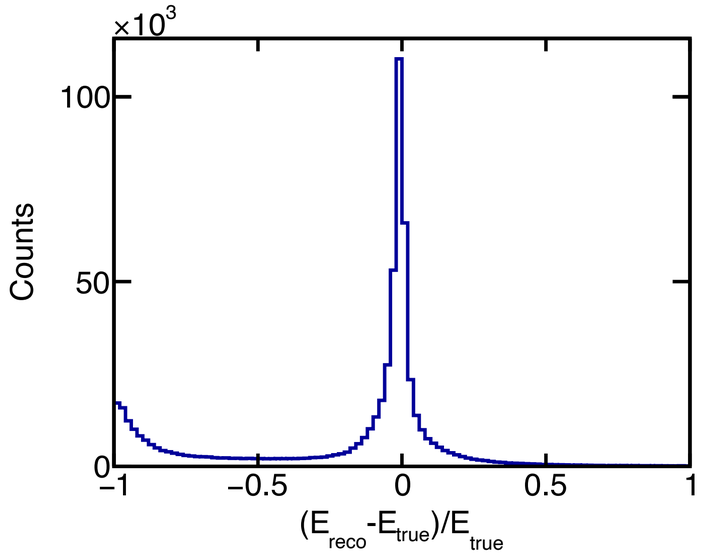


- Acceptance will determine kinematic coverage
  - Special attention to negative η limit (min Q^2 of central detector) and detector gaps
- Resolution will limit kinematic resolution, determine binning
  - Special attention to evolution of tracking, calorimeter resolutions for decreasing η < -1

Hadronic final state resolution & acceptance







- Acceptance will determine kinematic coverage
  - At low-y, optimal reconstruction methods all use HFS information
- Resolution will limit kinematic resolution, determine binning

Benchmark summary

Quantity	Relevant for…
Electron $\Delta E/E, \Delta p/p, \Delta\theta/\theta, \Delta\phi/\phi$	Electron ID, kinematic reconstruction
Hadron $\Delta P_{T,h}/P_{T,h}, \Delta\delta_h/\delta_h, \Delta\gamma_h/\gamma_h$	Kinematic reconstruction
Total $\Delta\delta/\delta$	Electron ID/background rejection

Some higher-level benchmarks:

- Kinematic acceptance & resolution of x, y, Q^2
- E/p for various charged particle species
- Electron efficience & purity