UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

Update on ePIC Kinematic Reconstruction

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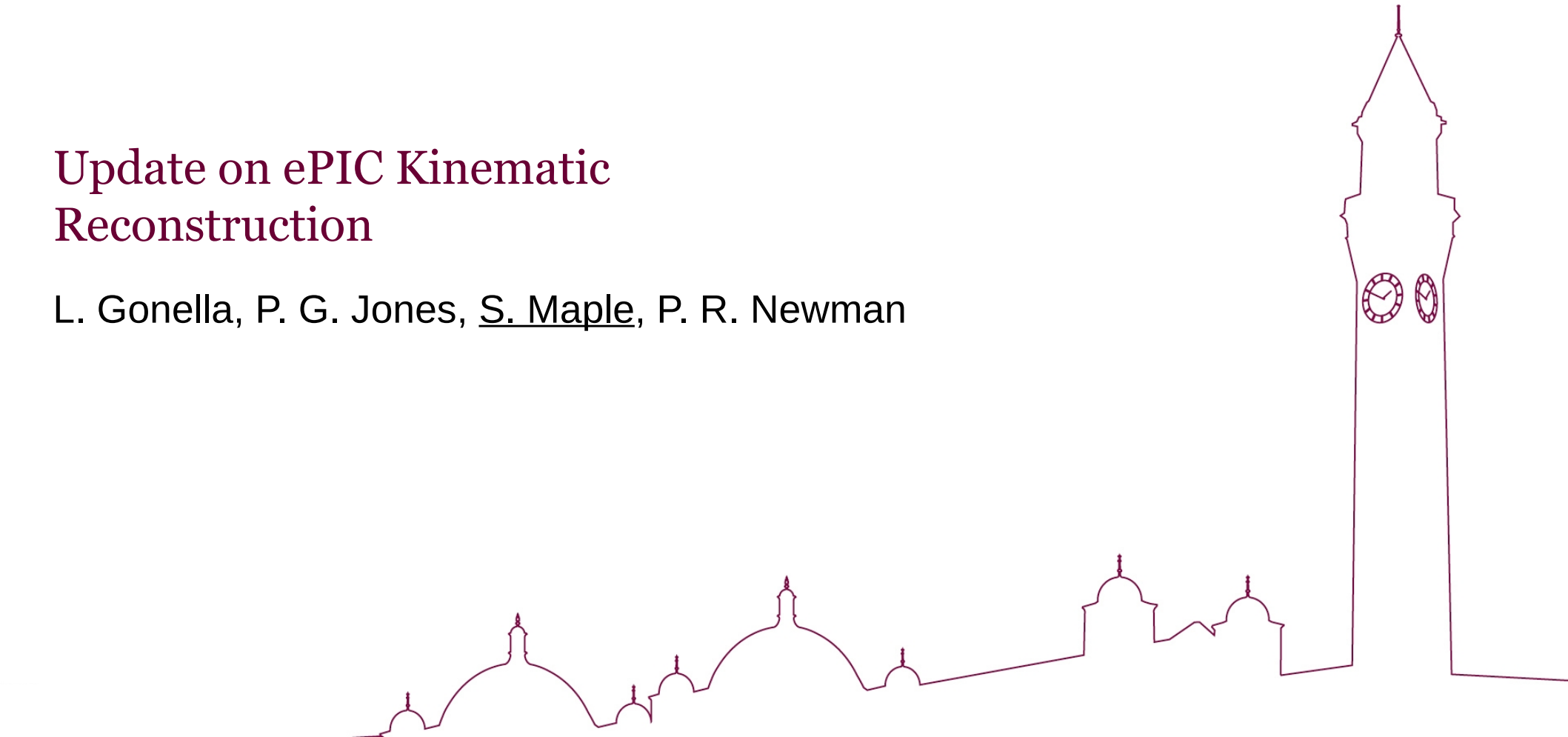
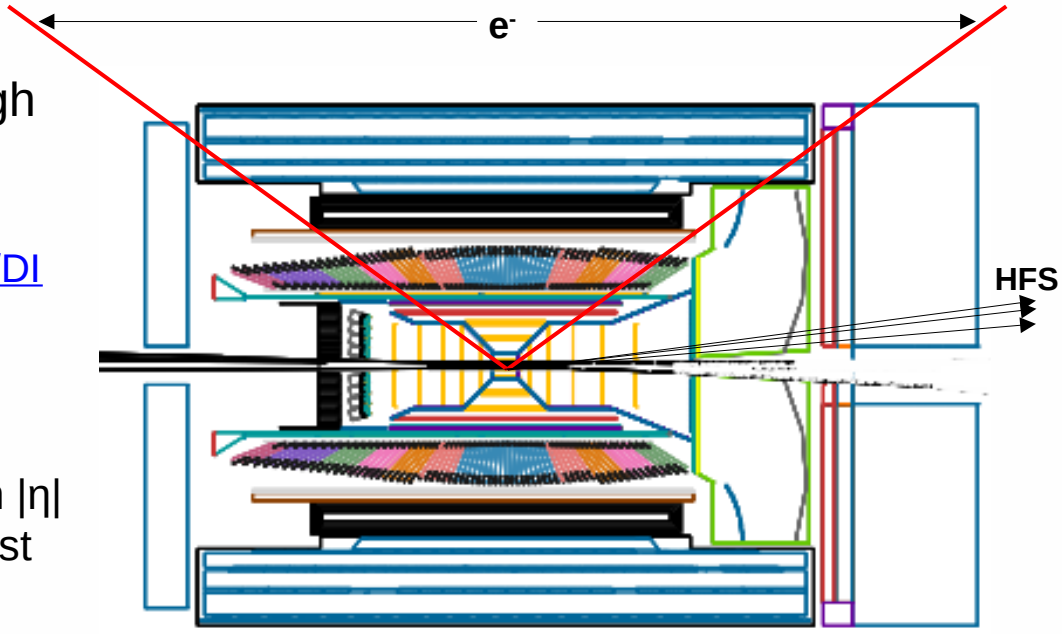


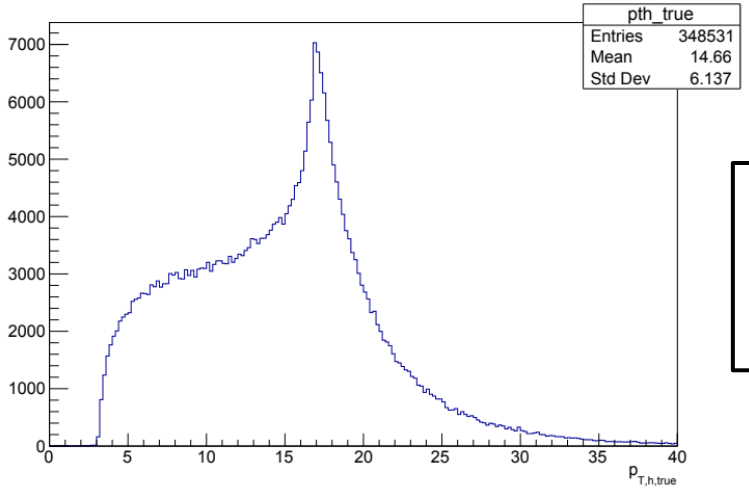
Reconstructing Simulation Output

- 18x275GeV^2 NC DIS events passed through ePIC-Arches geometry, $Q^2 > 100$ GeV^2
  - Files available at http://S3/eictest/EPIC/RECO/22.11.2/epic_arches/DIS/NC/18x275/minQ2=100/
- Perform a basic reconstruction using only Tracker information
  - Choose events where electron is scattered with $|\eta| < 1.3$ and $p_T > 10$ GeV (electron chosen as highest p_T track in ReconstructedChargedParticles)
  - Choose events with $y > 0.01$
  - Only charged component of HFS is reconstructed as only use track information here



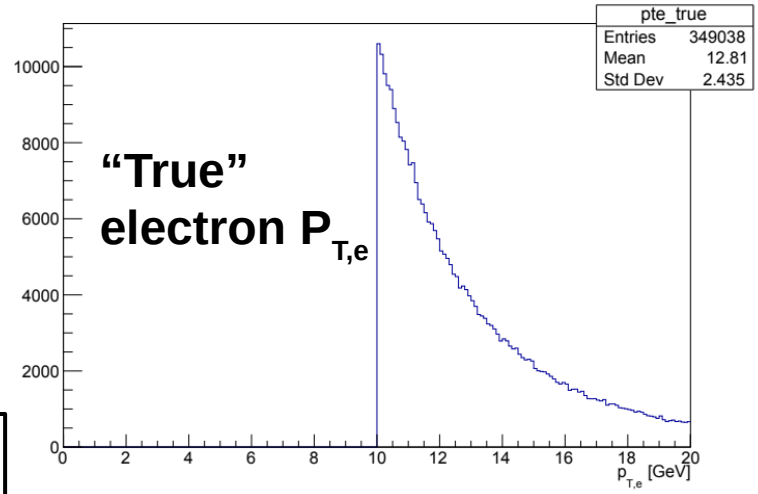
Crossing Angle Correction

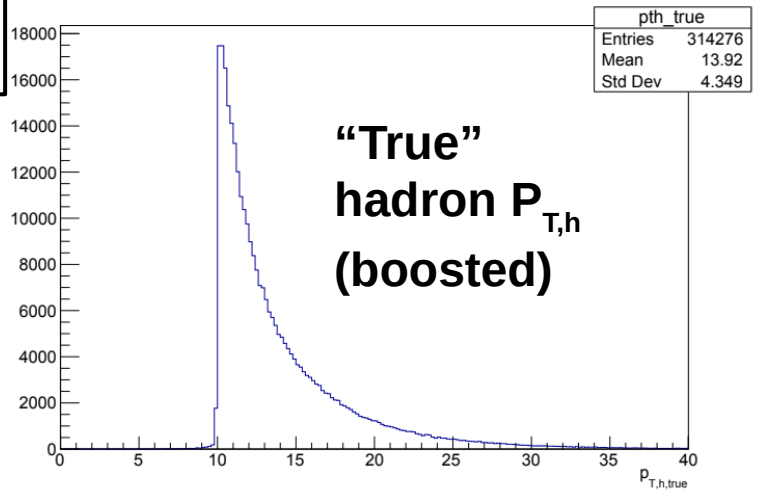
- Correcting for crossing angle is necessary to properly reconstruct using HFS information



"True" hadron $P_{T,h}$ (no boost)

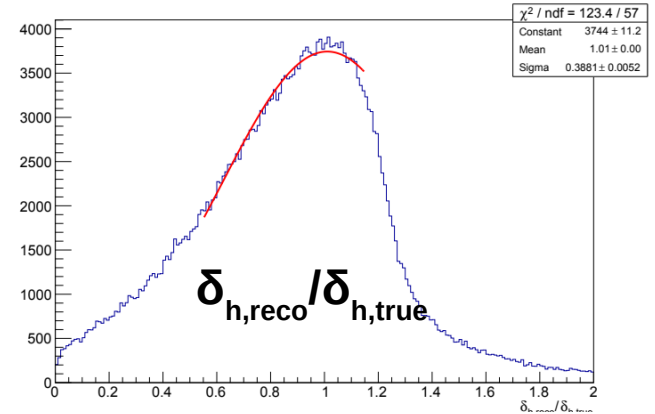
$p_T^2 = Q^2/(1-y) \rightarrow$ min p_T for $Q^2 > 100 GeV^2$ should be 10GeV

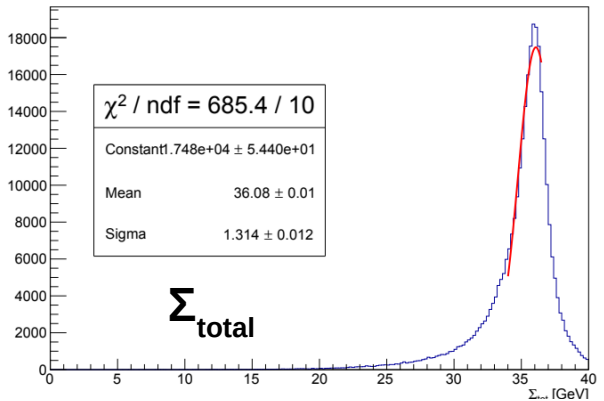


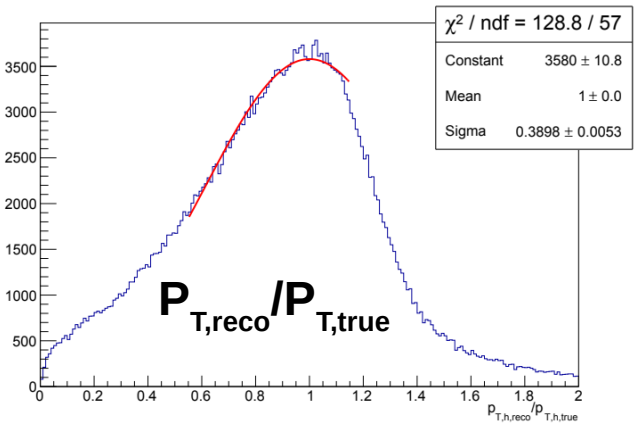


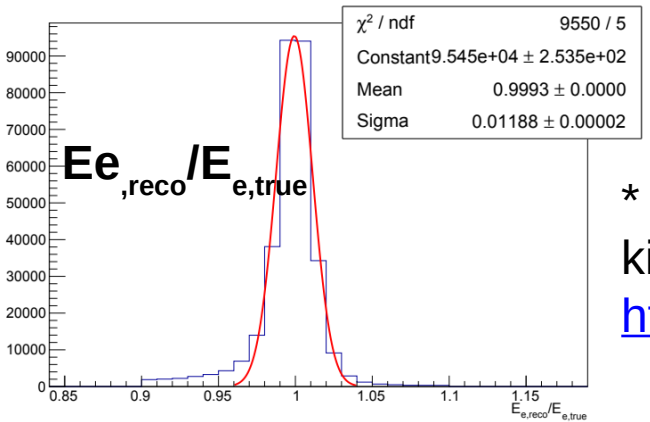
Kinematic Reconstruction

- P_T and δ_h of HFS is underestimated (no neutral particles included in HFS) → Apply calibration so that reconstructed/true histogram peaks at 1







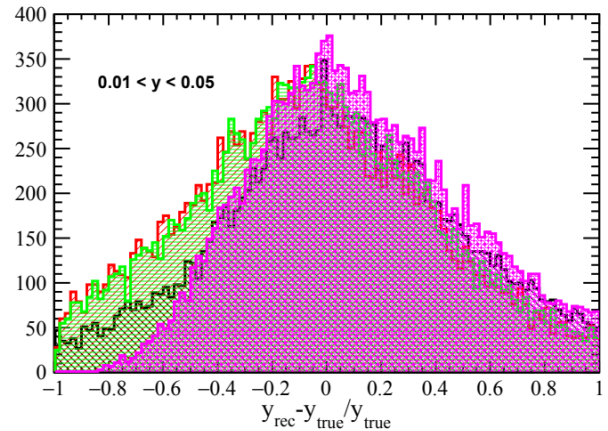


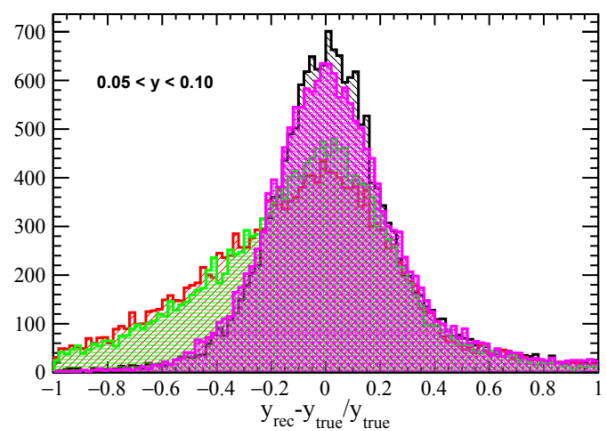
Conventional kinematic reconstruction performed using basic detector information

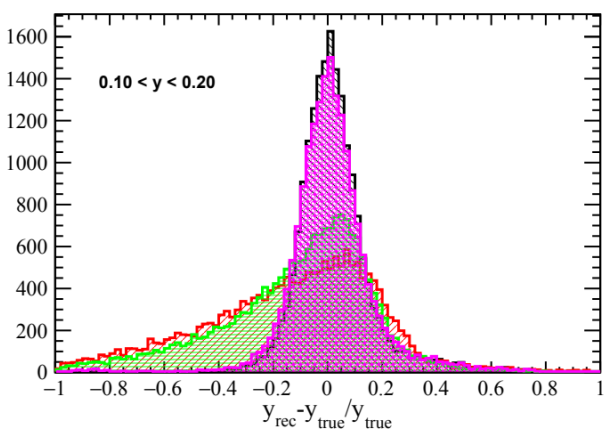
Kinematic fitting performed using parametrised gaussian widths of reco/true distributions

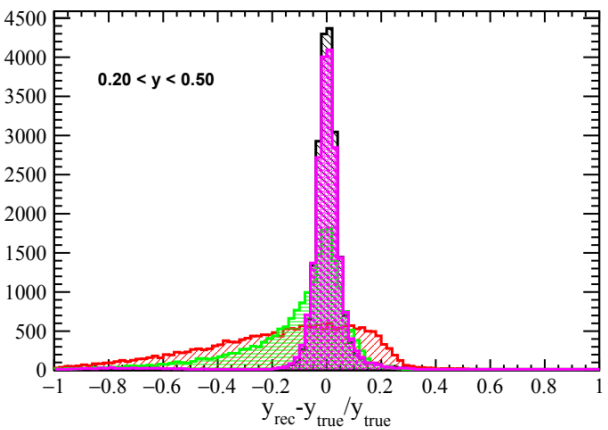
* for more information on kinematic fitting see slides here https://indico.bnl.gov/event/18190/

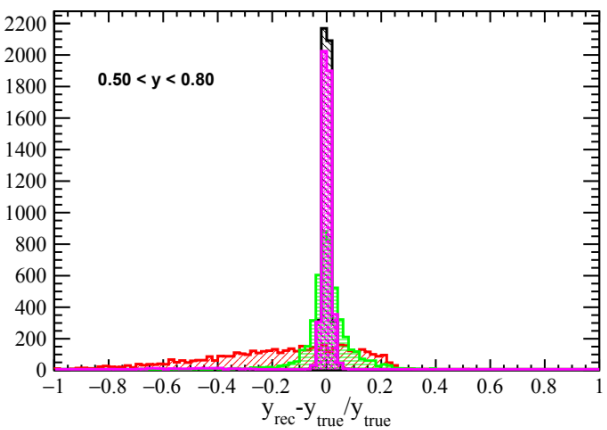
Resolution on y (Tracker only reconstruction)









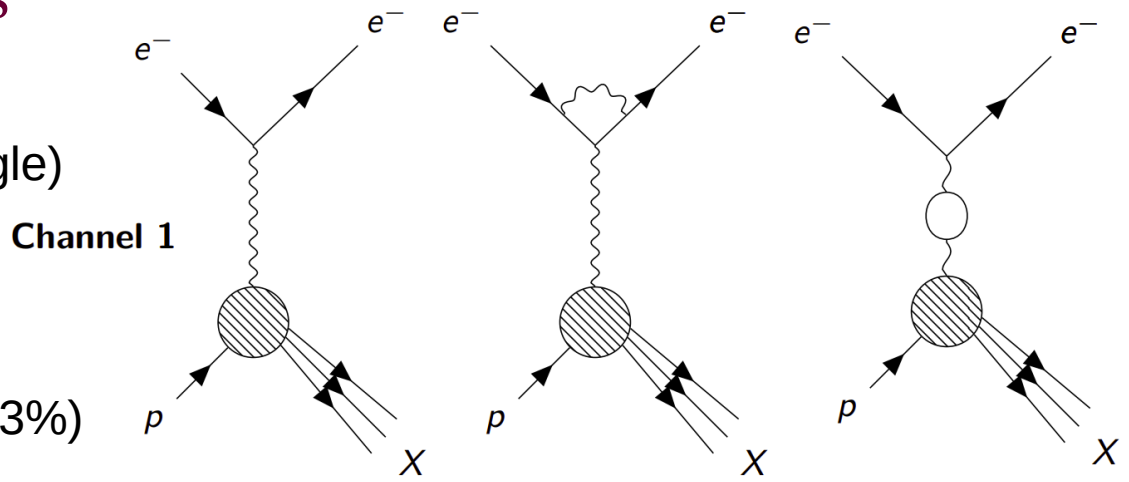


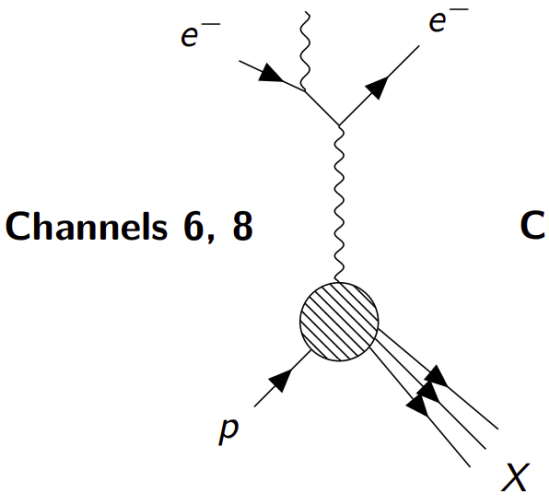
- All methods perform similarly in lowest y bin (0.01<y<0.05)
- **Electron method** generally shows best performance in y bins with y>0.05, with the **kinematic fit** method demonstrating similar performance

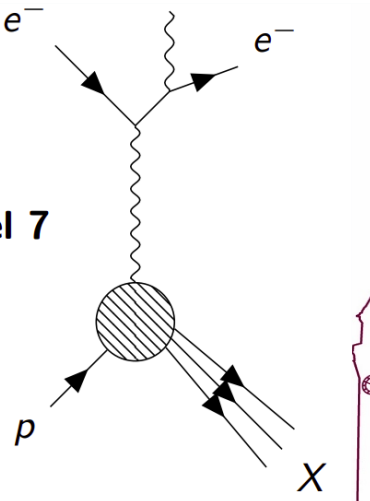
Electron method **e-Σ method** **JB method** **Kinematic Fit**

Radiative Event Simulations

- Djangoh 4.6.10 used to generate 18x275 GeV^2 e-p events (no xAngle)
  - ISR/FSR=ON
  - Q^2>100GeV^2
  - W>2GeV
- Channel 1: Non Radiative NC (~53%)
- Channel 6: ISR (~28%)
- Channel 7: FSR (~18%)

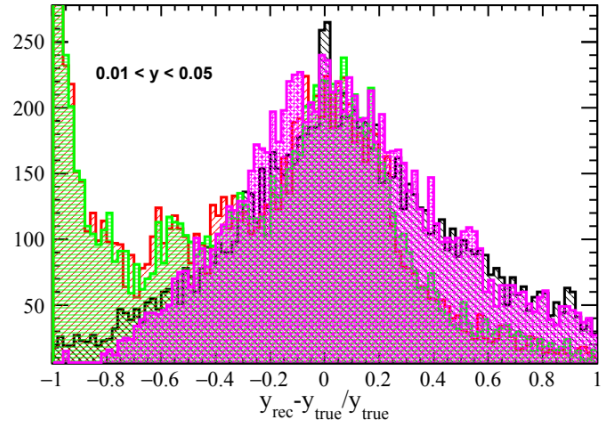


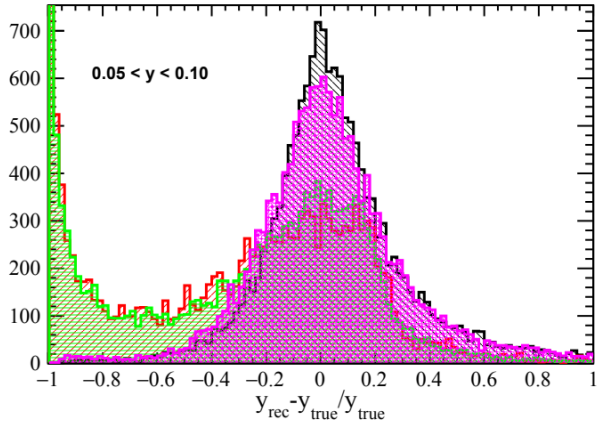


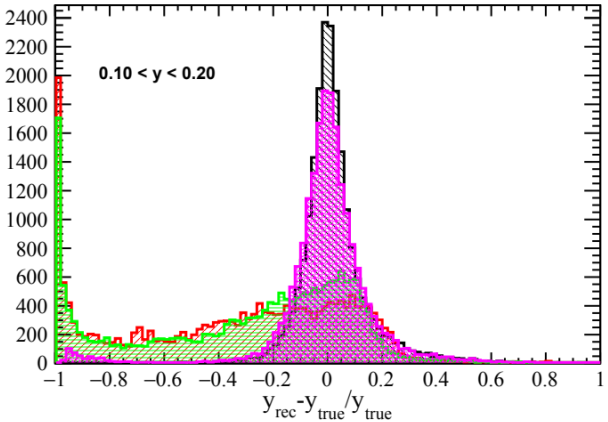


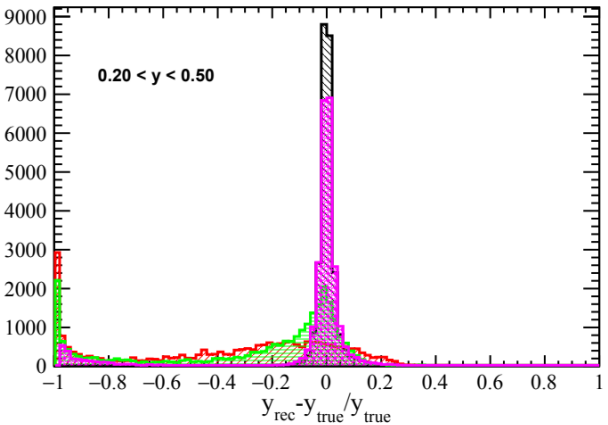
- **Events passed through EPIC arches geometry and reconstructed with EICRecon → reconstructed using tracks only as before**

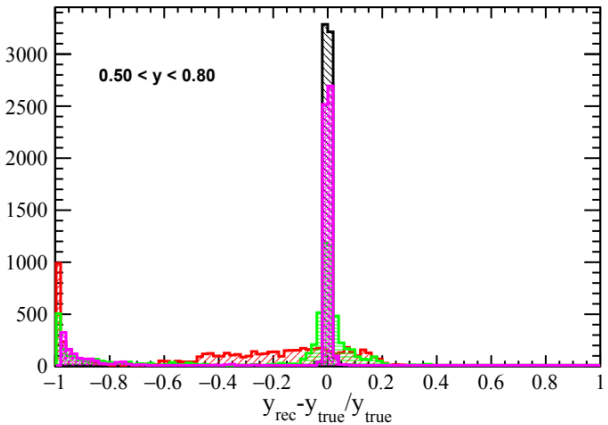
Resolution on y (Tracker only reconstruction)











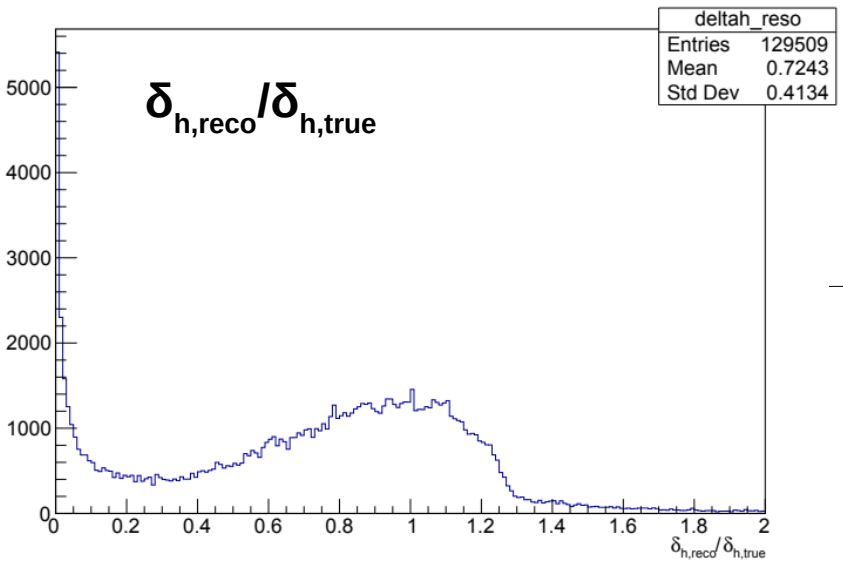
- Similar trend in performances as seen with no ISR/FSR present
- Reconstruction methods using hadron information tend to understimate y
  → **Why?**

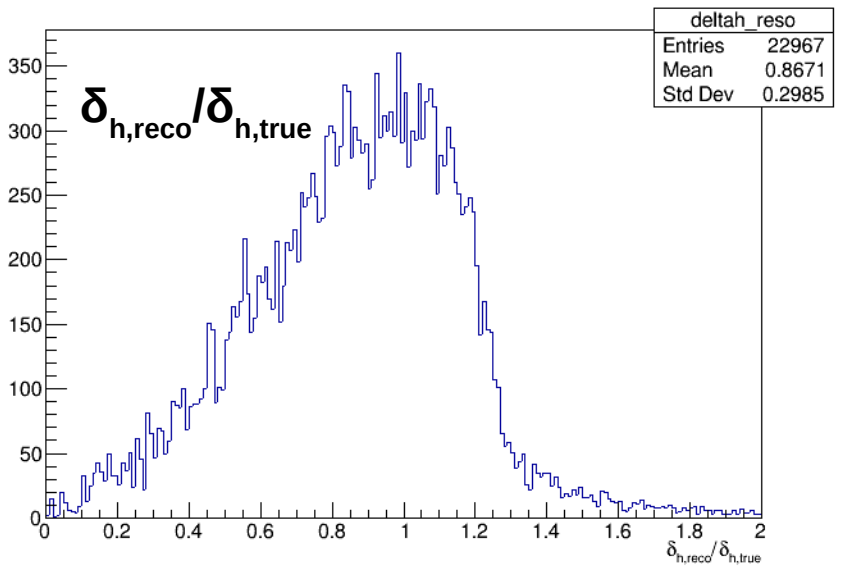
Electron method **e-Σ method** **JB method** **Kinematic Fit**

Why is y underestimated?

- By cutting out events with QED radiation we recover the distribution seen in the simulations with Pythia8 files
  - Either some E-pz contribution being missed when reconstructing HFS, or beam electron energy before ISR is being used for truth beam electron? → further investigation required

Removing radiative events (events with final state y that have electron as parent)





Summary

- Simulations of ePIC full detector with non-radiative NC-DIS data performed and particles reconstructed using trackers only
  - Q^2, x, y reconstructed using conventional reconstruction methods and kinematic fit based approach
  - Electron method outperforms JB and e-Σ down to y~0.01, kinematic fit shows similar performance
- Djangoh 18x275GeV^2 sample generated, simulated and reconstructed
  - Similar overall trend as for non radiative events
  - Under-estimation of y when using HFS info → need to look carefully at where truth and reconstructed values are being taken from