

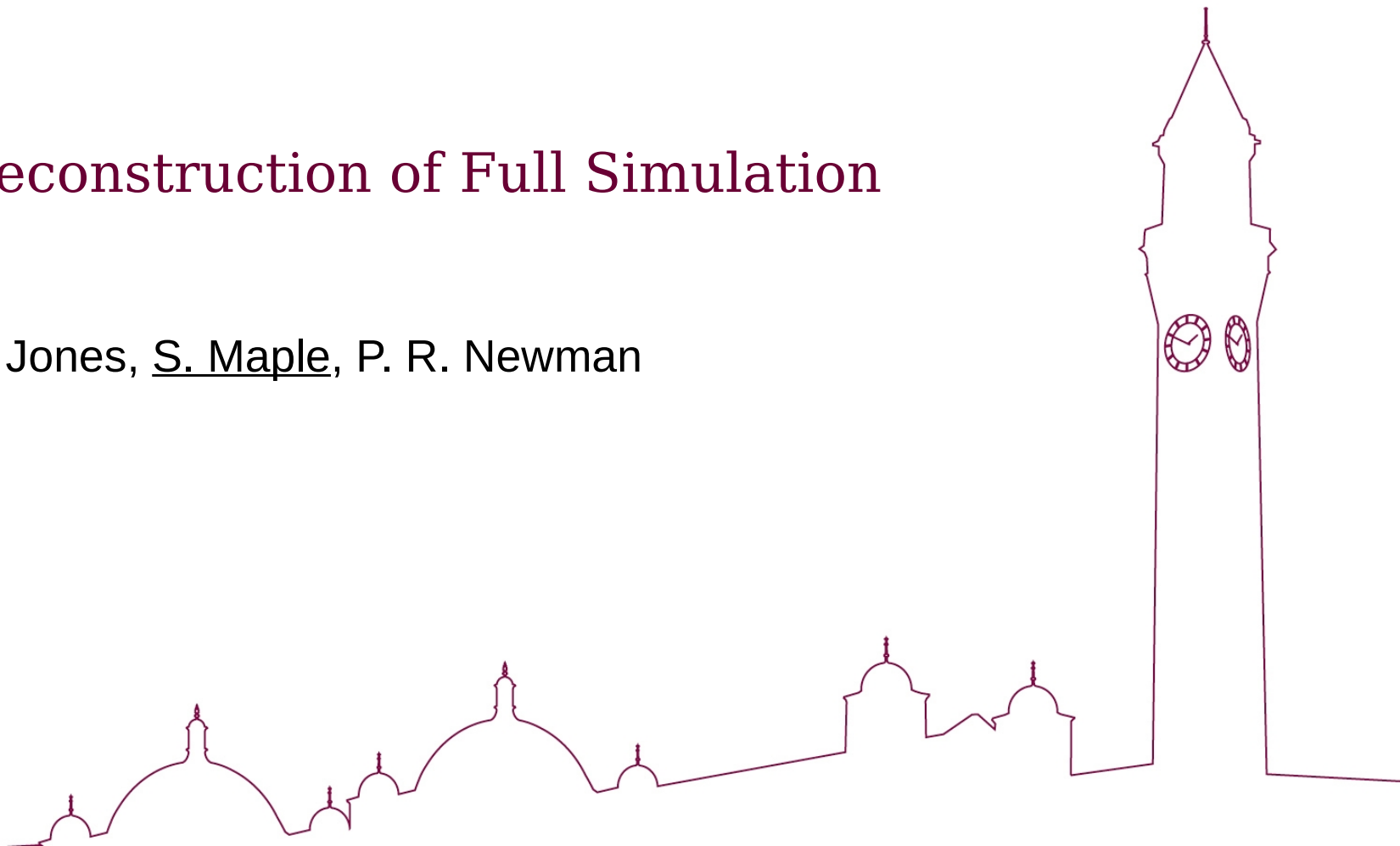


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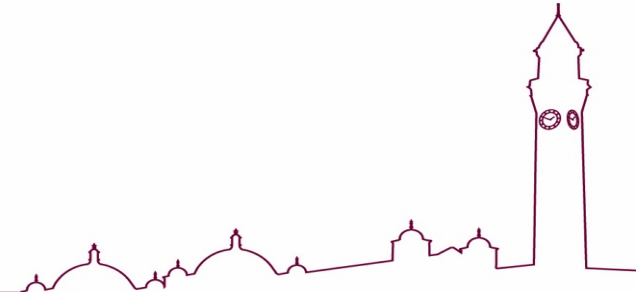
Kinematic Reconstruction of Full Simulation output

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Procedure

- Reconstructed detector simulation files on S3 at ATHENA/RECO/Canyonlands-v2.1/DIS/NC for $5 \times 41 \text{ GeV}^2$ and $18 \times 275 \text{ GeV}^2$
- Files containing events with minimum $Q^2 = 1, 10, 100 \text{ GeV}^2$
- Inclusive kinematic quantities x, y, Q^2 obtained from reconstruction files for: Truth, Electron method, JB Method, DA method
- Quantities calculated from ReconstructedParticles separately for Sigma and e-Sigma methods

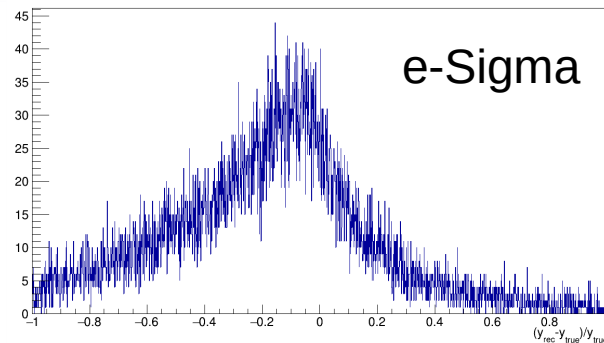
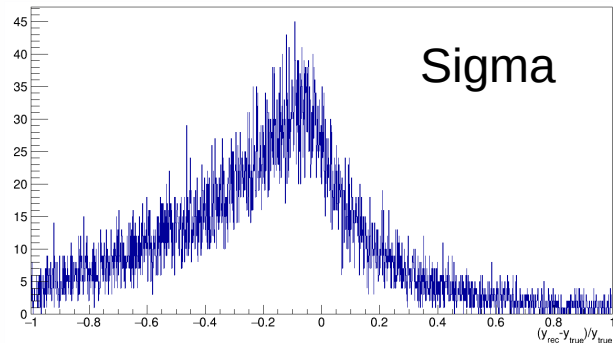
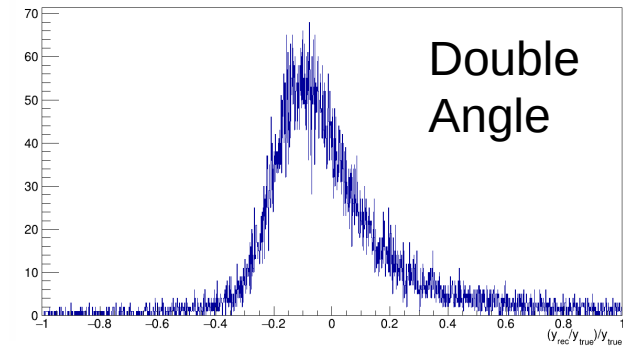
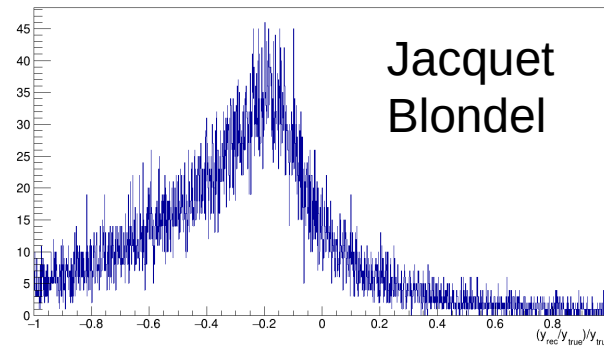
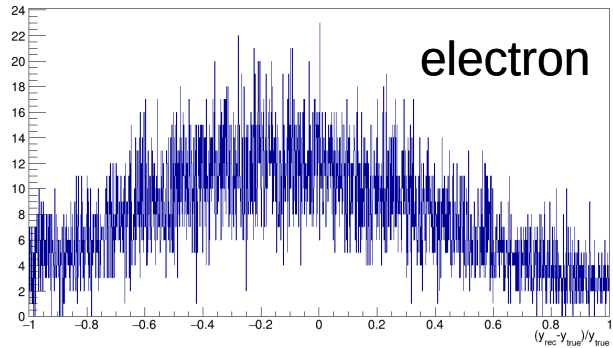


Reconstruction

- Truth kinematics, electron method, JB method and DA method calculated in Juggler (see <https://eicweb.phy.anl.gov/EIC/juggler/-/tree/master/JugReco/src/components>)
- InclusiveKinematicsTruth calculates “true” x , y , Q^2 from mcparticles branch
- ReconstructedParticles branch contains list of particles with charged particles being reconstructed from tracks and neutrals from calorimeters
- InclusiveKinematicsElectron uses 4-vector approach with the scattered electron to calculate x , y , Q^2 from ReconstructedParticles branch (4-vectors used to make LI so no boosts required)
- InclusiveKinematicsJB/DA apply boost to correct for crossing angle, then calculate as usual from scattered electron and HFS
- Sigma and e-Sigma method are calculated in a similar manner to JB/DA (Using ReconstructedParticles and a boost) however this is applied to the already filled reconstruction files on S3

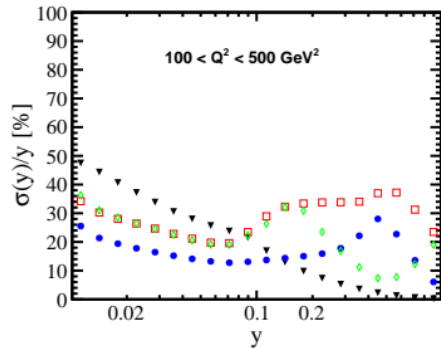
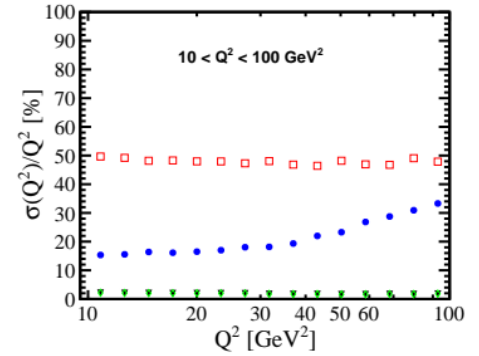
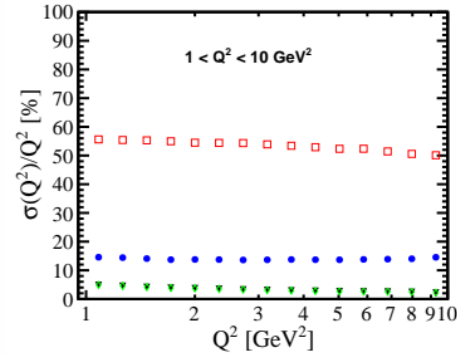
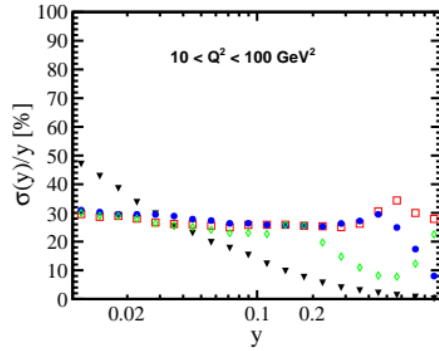
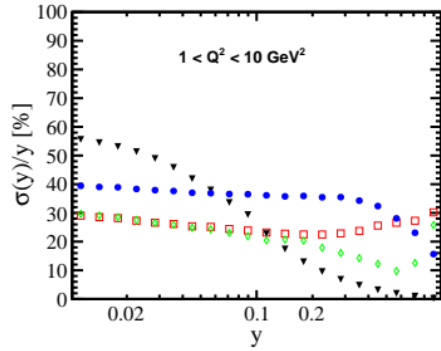
Extracting Resolutions

- Histograms filled with $(y_{\text{rec}} - y_{\text{true}})/y_{\text{true}}$ for different y bins (or x - Q^2 bins)
 - Histogram limits between -1 and 1 (tails of distributions cut off for >100% difference)
- “ y resolution” is RMS of the distribution



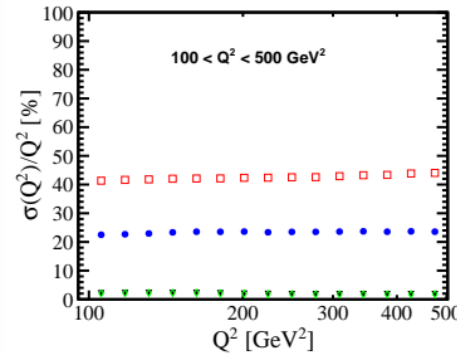
→ $Q^2 > 100 \text{ GeV}^2$
→ $0.01 < y_{\text{true}} < 0.0126$
(y binned logarithmically)

Canyonlands-v2.1 Resolutions (18x275 GeV²)



18x275 GeV² e⁻ on p

- ▼ Electron method
- ◻ JB method
- Double Angle method
- ◊ e- Σ method



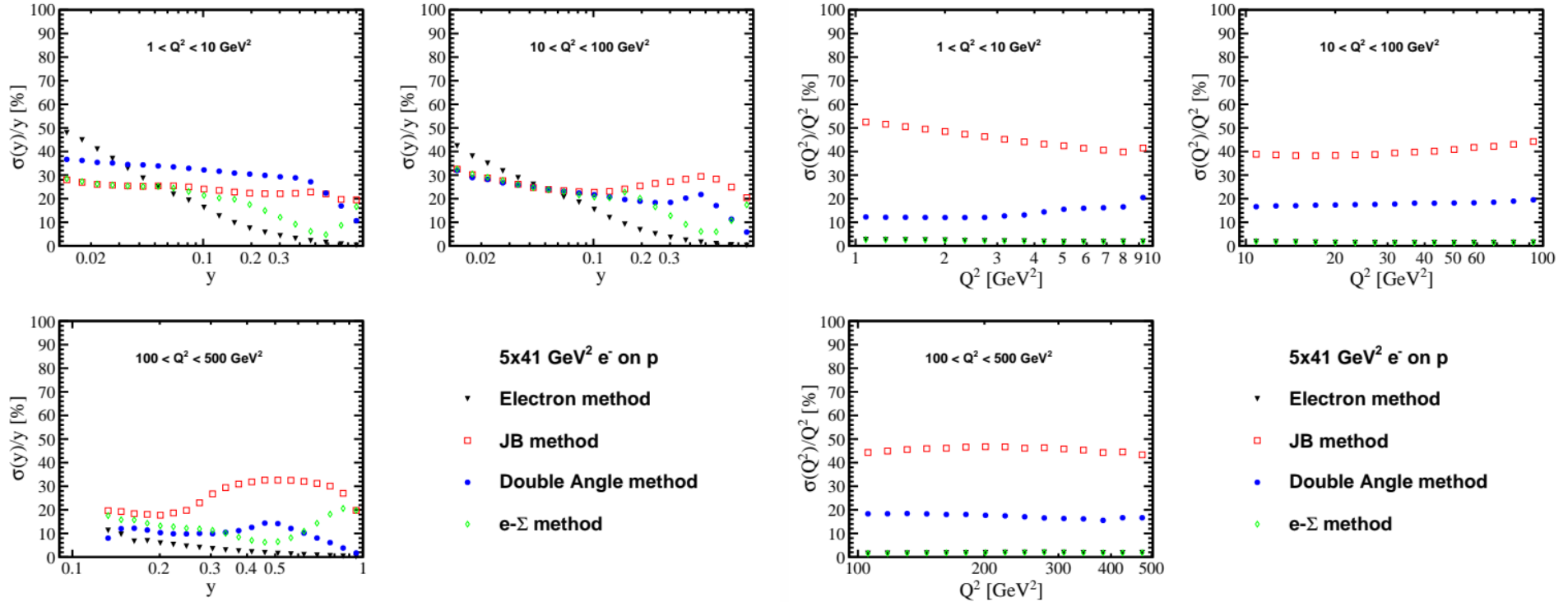
18x275 GeV² e⁻ on p

- ▼ Electron method
- ◻ JB method
- Double Angle method
- ◊ e- Σ method

Y resolutions vs y (log scale)

Q^2 resolutions vs Q^2 (log scale)

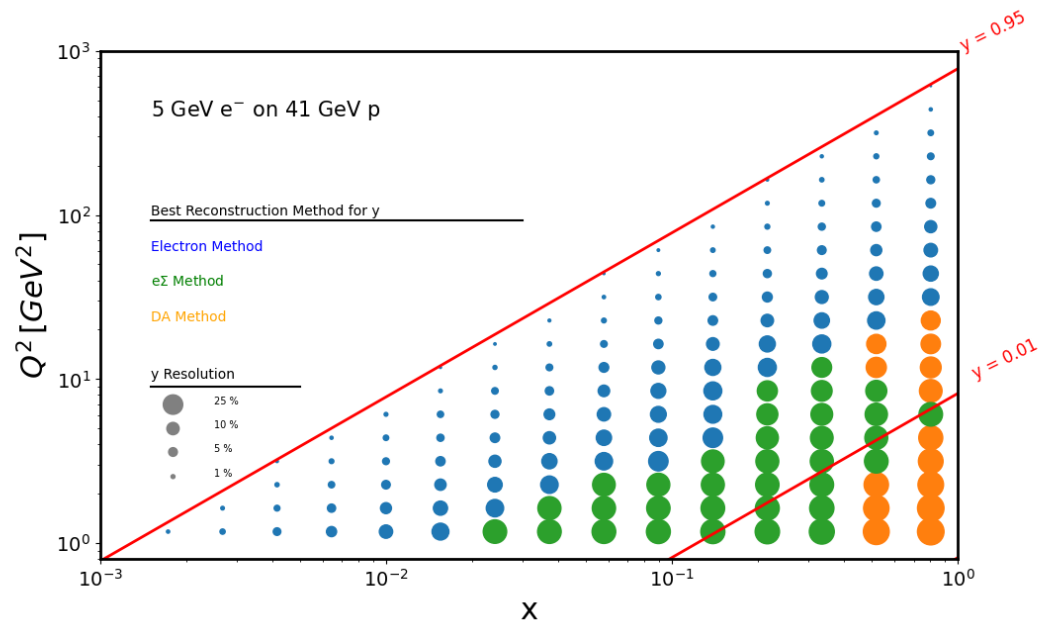
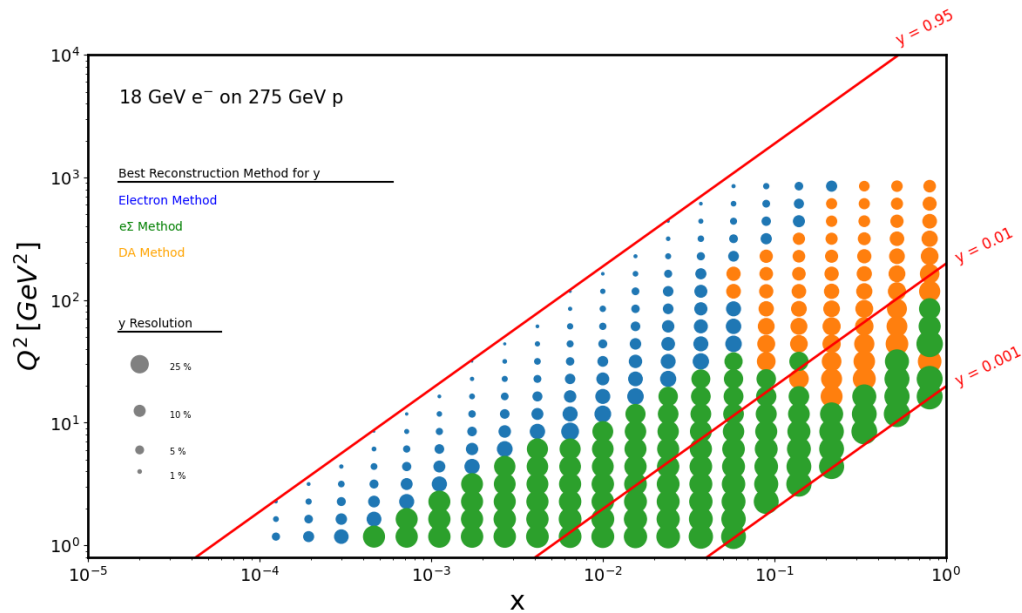
Canyonlands-v2.1 Resolutions (5x41 GeV²)



Y resolutions vs y (log scale)

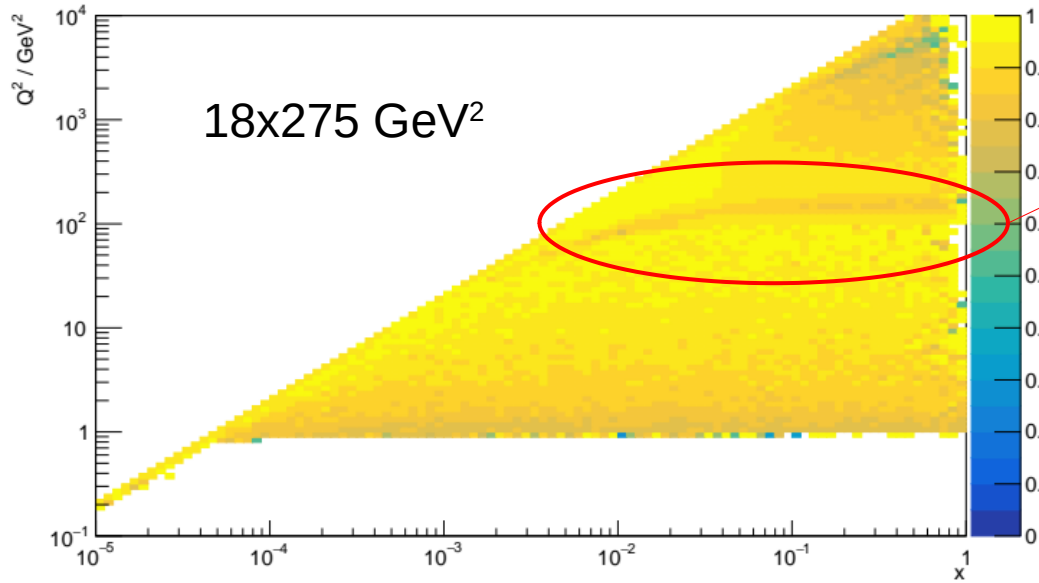
Q² resolutions vs Q² (log scale)

Canyonlands-v2.1 Resolutions (x-Q²)

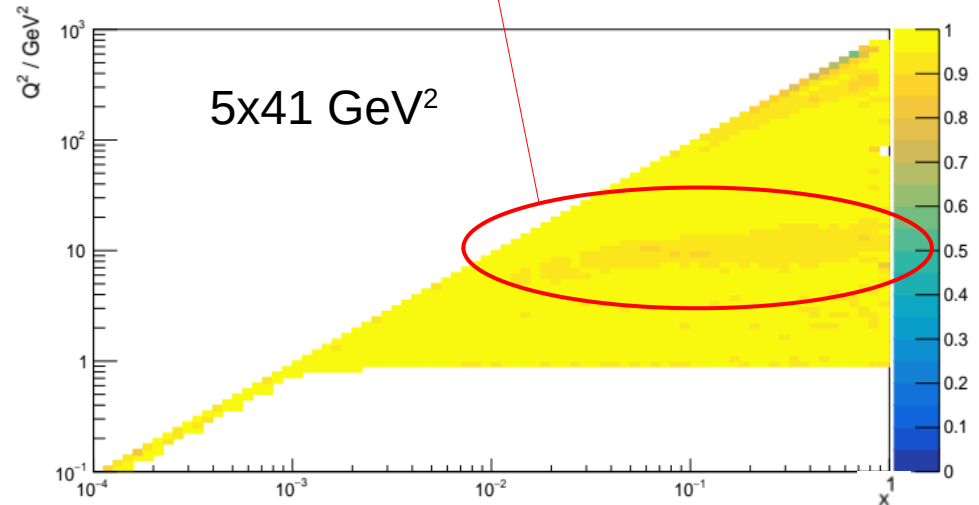


Reconstruction Efficiencies (Canyonlands-v2.1)

Scattered Electrons Reconstructed / Generated



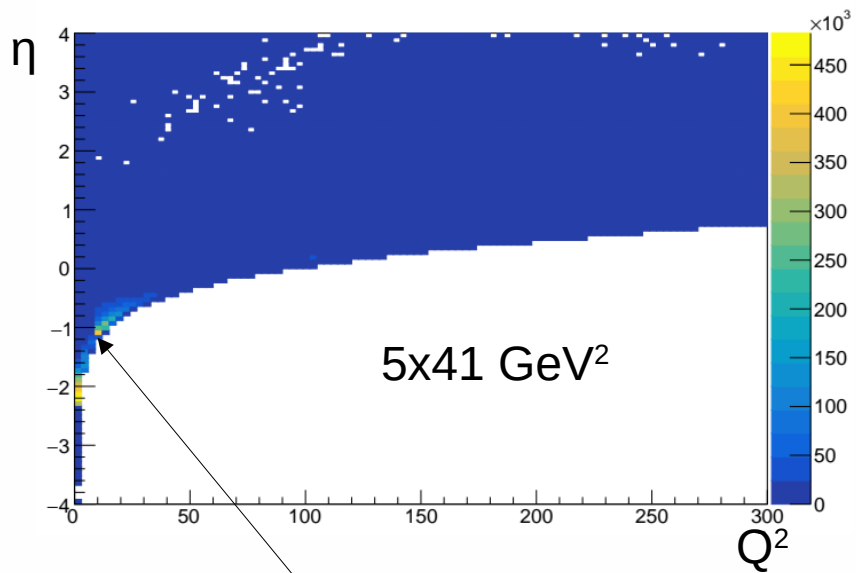
Transition from barrel to disks
in tracker at $\eta \sim 1.1$
→ Next slide



Reconstruction Efficiency 18x275 GeV² and
5x41 GeV²

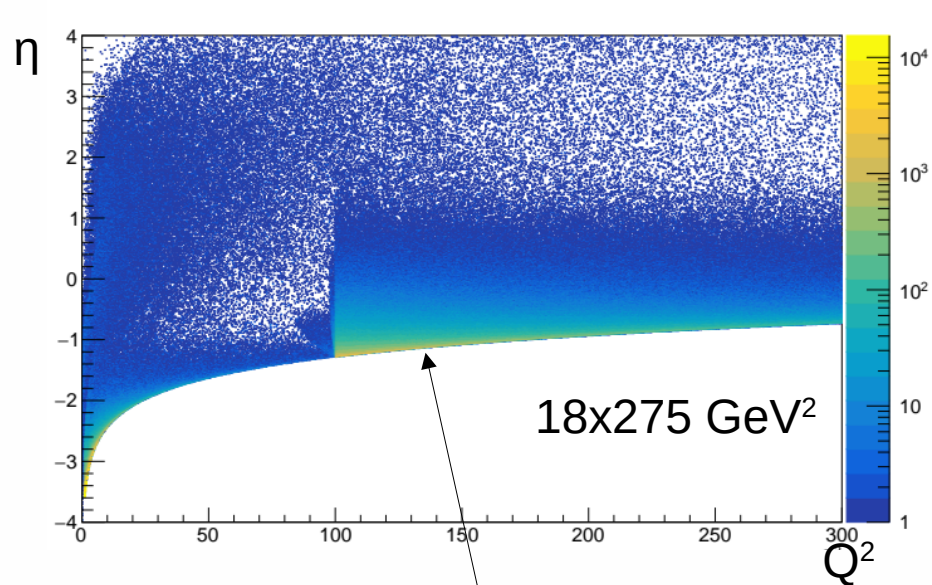
→ Good acceptance down to $Q^2 > 1 \text{ GeV}^2$

Each bin represents scattered electrons with the associated η for an event with the associated Q^2



Eta -1.1 at $Q^2 \sim 10 \text{ GeV}^2$

Events generated using Pythia8 with minimum Q^2 of 1, 10, 100 GeV^2



Eta -1.1 at $Q^2 \sim 150 \text{ GeV}^2$



Summary

- Approach to kinematic reconstruction from Full Simulation output files described
- Q^2 and y resolution plots presented, and show that for the Canyonlands-v2.1 configuration a resolution of 30% or less should be achievable across the whole y - Q^2 range if the best reconstruction method is chosen
- Y resolution shown as a function of x - Q^2 , the electron method wins at high y as expected, the e-Sigma method wins at low y low Q^2 and the DA method at low y high Q^2
- Scattered electron can be measured with good efficiency down to $Q^2=1\text{GeV}^2$ using only the tracker – some loss in efficiency in regions where the tracker services are located
- Next Steps:
 - Not yet leveraging the negative ECAL for scattered electron information: include in reconstruction
 - Machine learning approaches to reconstruction to be benchmarked and compared for latest ATHENA detector descriptions