Track Efficiency and Jets: First Look

Brian Page

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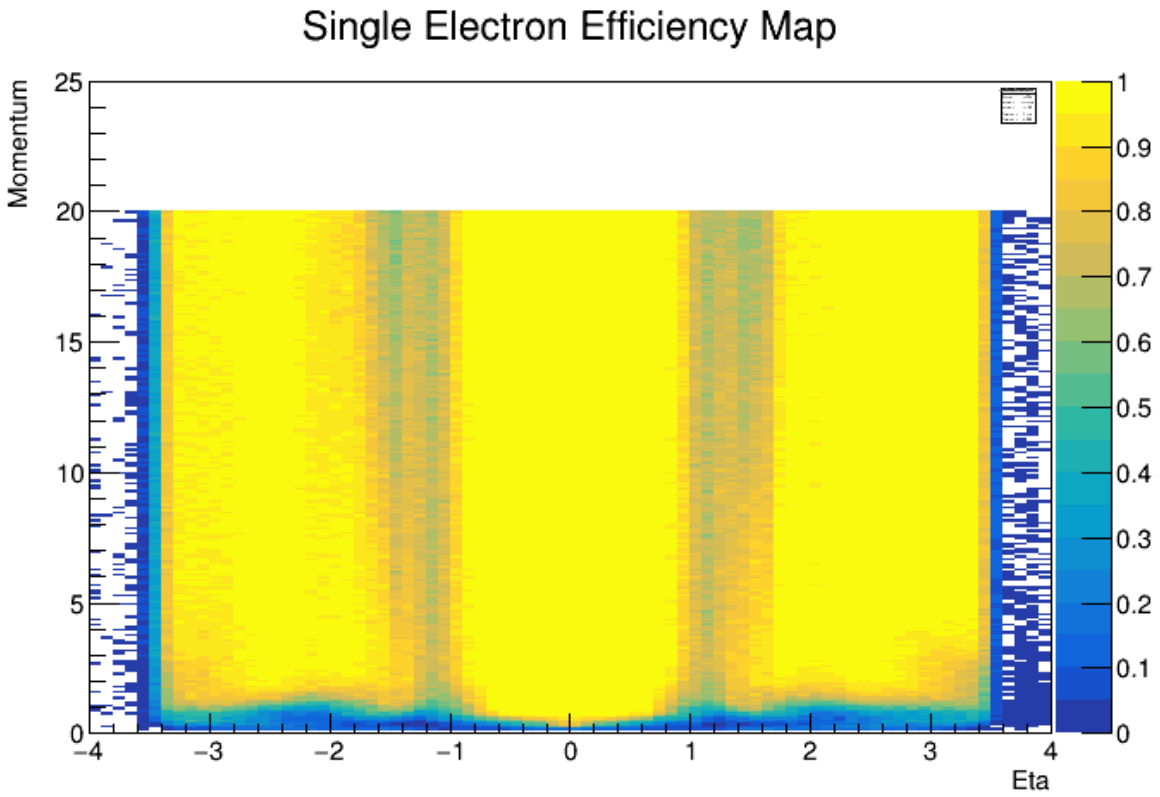
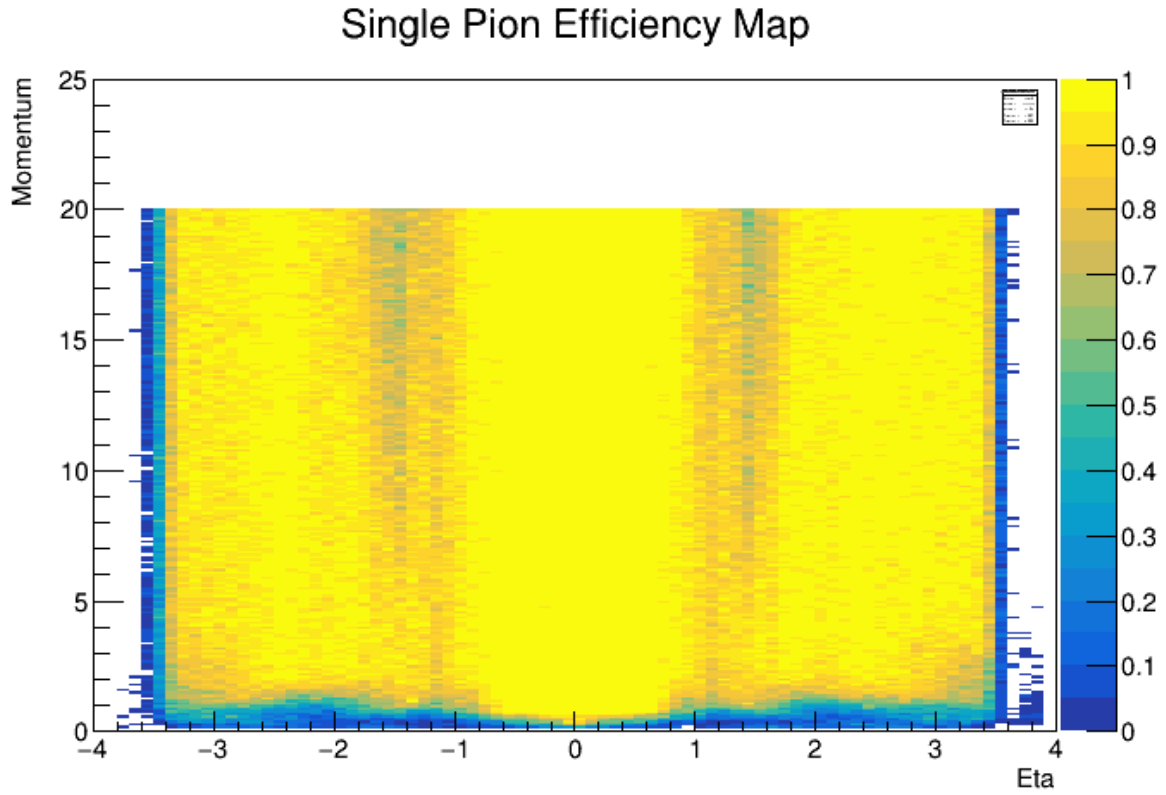
Single Particle Efficiencies

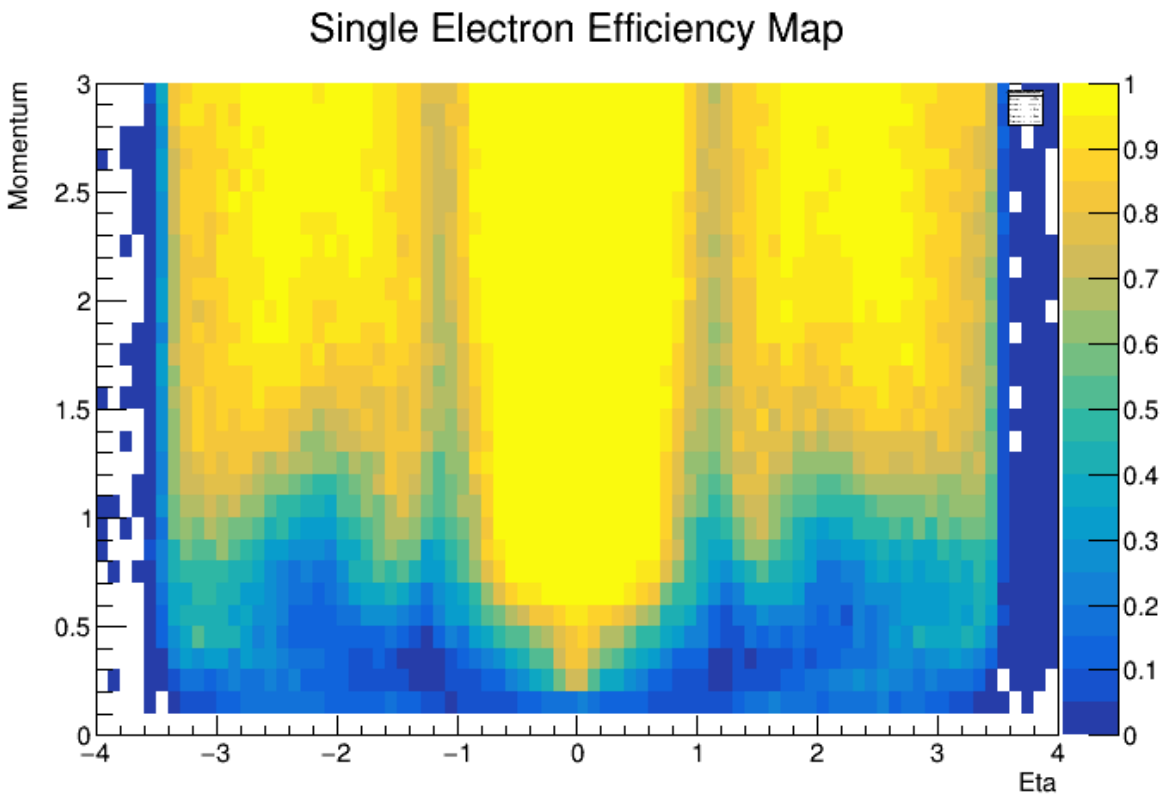


- Get electron and pion tracking efficiencies from single particle simulation – fun4all simulations currently residing on S3
- Particles thrown flat in eta and momentum

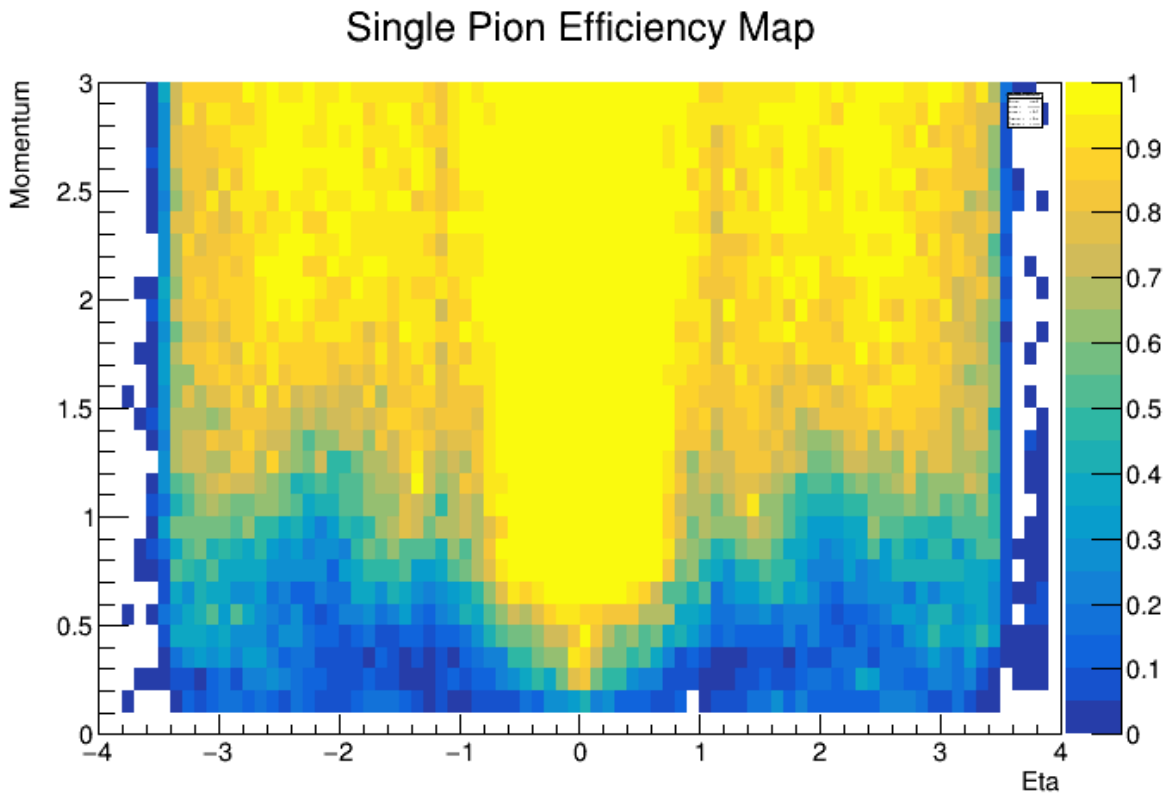


- True track momentum vs eta plotted for thrown tracks and reconstructed tracks – efficiencies are ratio
- Technical point: reconstructing tracks with ‘TrackSource = 0’ – would be good to look at hit points along the track

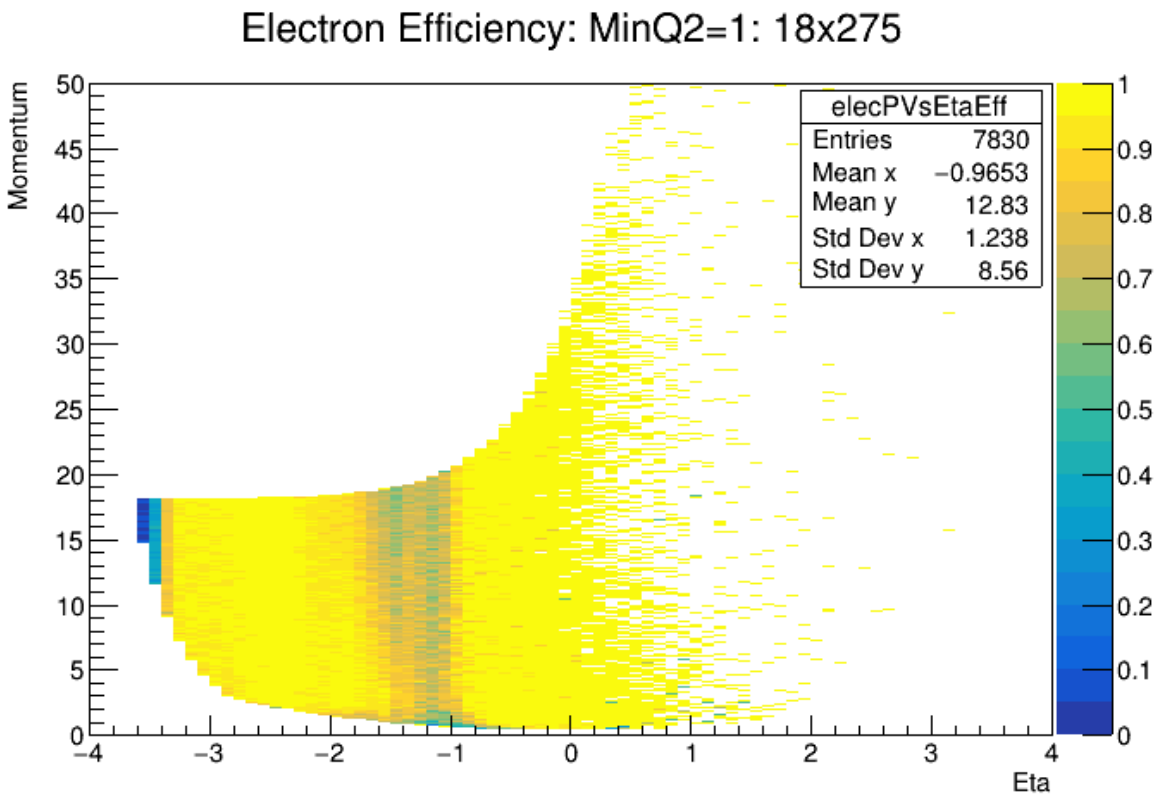
Single Particle Efficiencies (Zoomed In)



- Zoom in to better see low momentum behavior

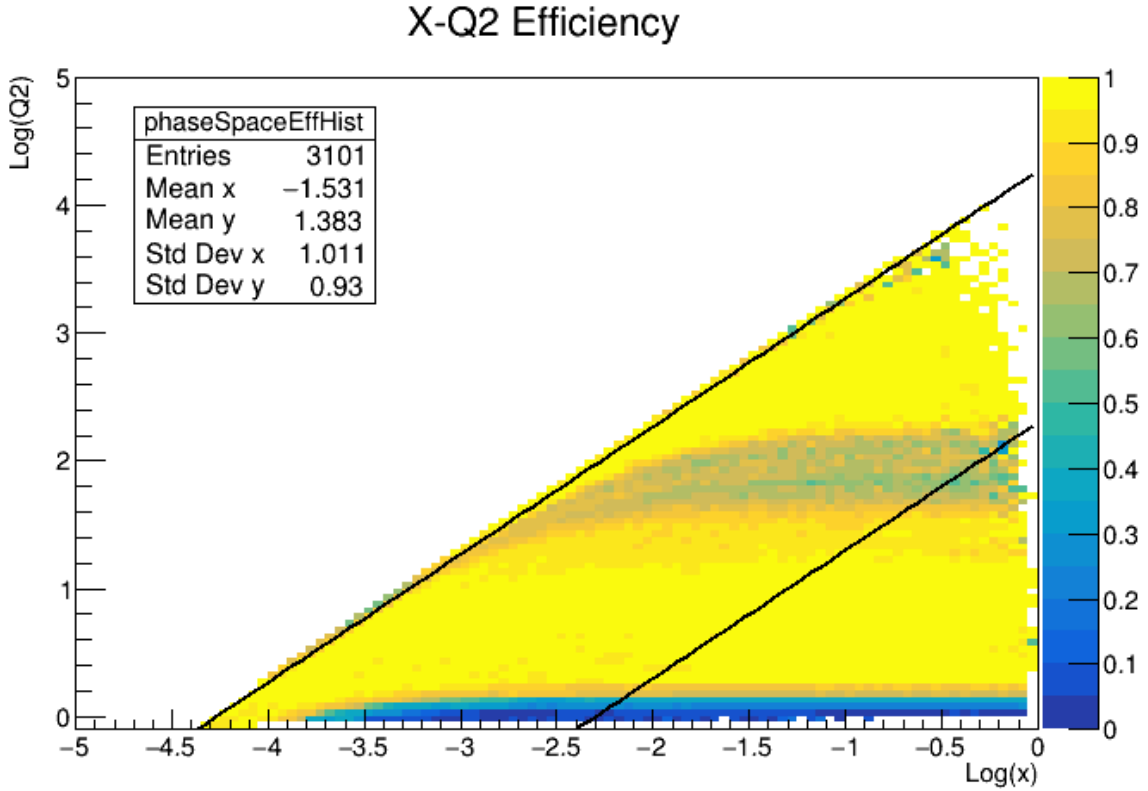


Electron Efficiency and Phase Space Impact

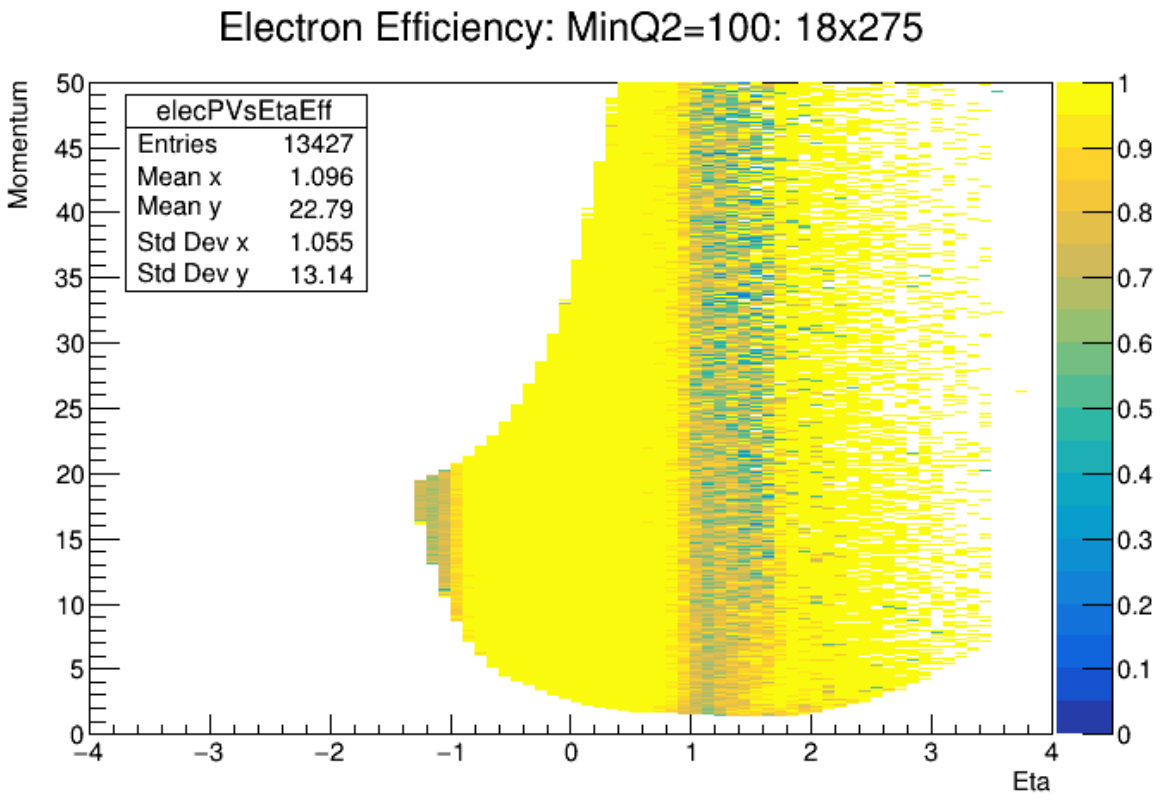


- Assume electron track finding efficiency corresponds 100% to kinematic reconstruction – see how inefficiency maps onto x-Q2 plane
- This is NOT the final electron finding efficiency or kinematic reconstruction performance

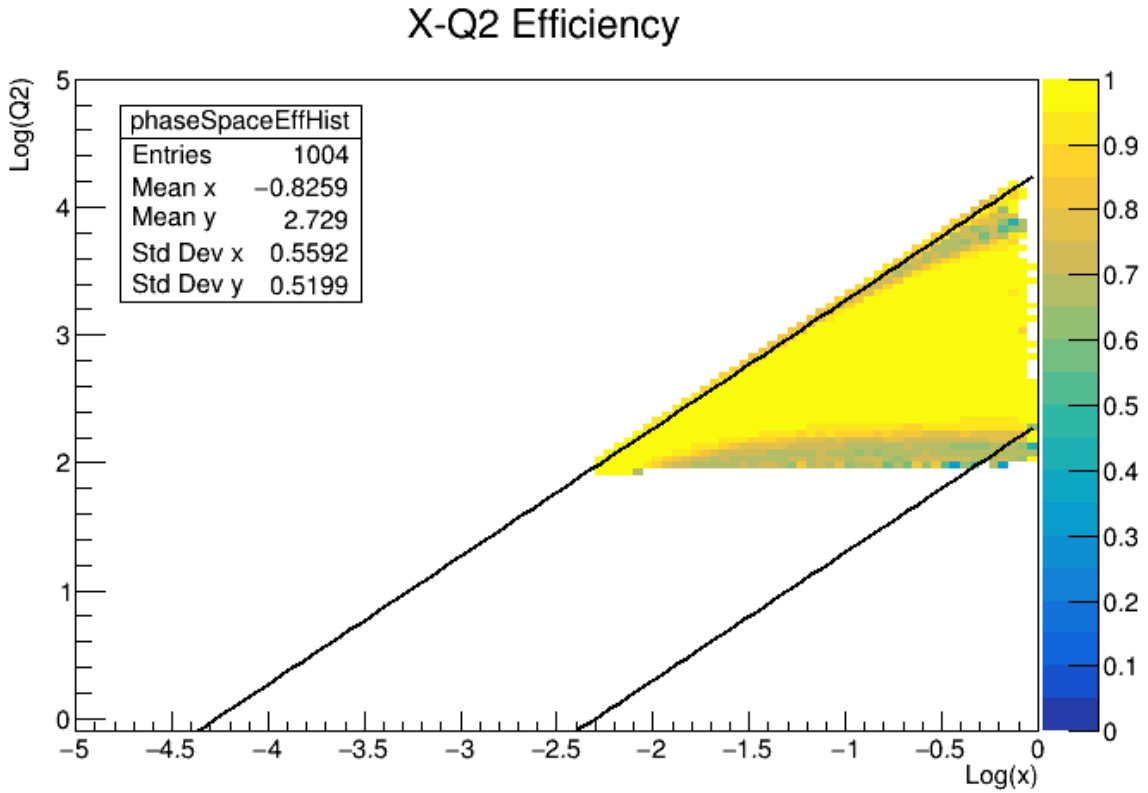
- Used single-particle simulation to get track efficiencies, now apply these to DIS simulation (Pythia8)
- See the efficiency for detection of the scattered electron as a function of momentum and eta



Electron Efficiency and Phase Space Impact (High Q2)



- At high Q2, electrons start scattering into forward part of the detector and hit inefficiency band starting at eta = 1
- This maps to the high Q2 – high x region of phase space



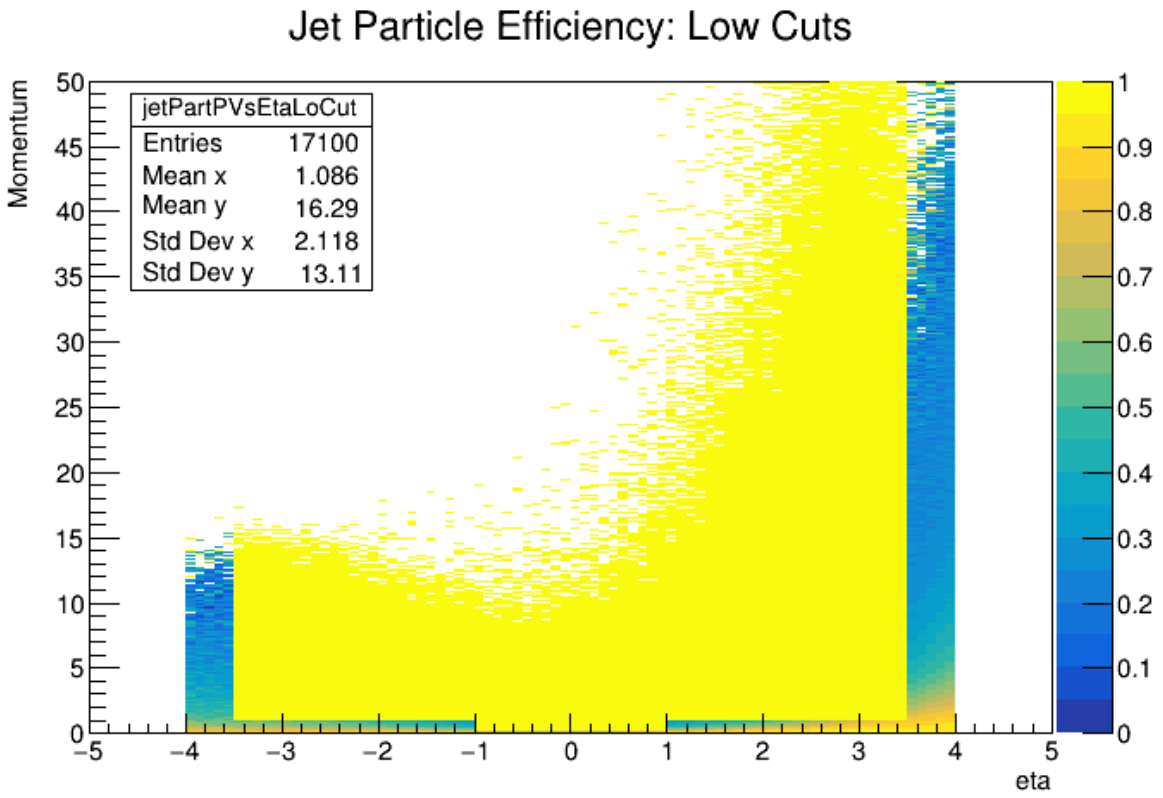
Impact on Jet Reconstruction

- Look at impact that tracking efficiency _only_ has on jet reconstruction
  - Drop tracks based on the Momentum Vs Eta efficiency maps
  - Assume tracks that are found are reconstructed perfectly – no momentum smearing
  - Assume all other particles (photons, neutral hadrons) are found with 100% efficiency and reconstructed perfectly

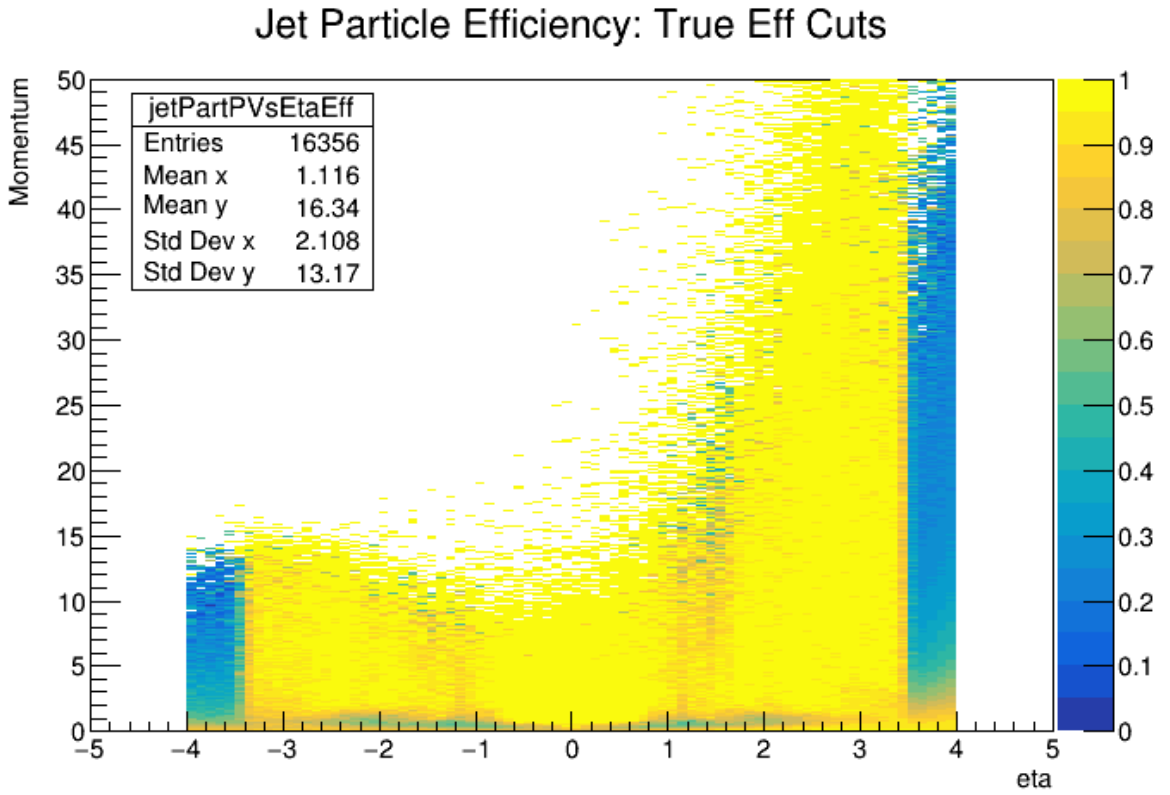
- Compare jet reconstruction using two efficiency maps
  - 'Lo Cut' map has zero track efficiency for (|eta| < 1 && p < 200 MeV) and for (1 < |eta| < 3.5 && p < 1 GeV) and for (|eta| > 3.5)
  - 'True Efficiency Cut' map is the one obtained from the single particle simulation – low momentum efficiency is low but not zero and additional inefficiencies around eta +/- 1-2

- The two maps allow to gauge the relative importance of low momentum efficiency as compared to inefficiencies around eta = 1

Jet Particle Efficiency: Q2 > 1: 18x275

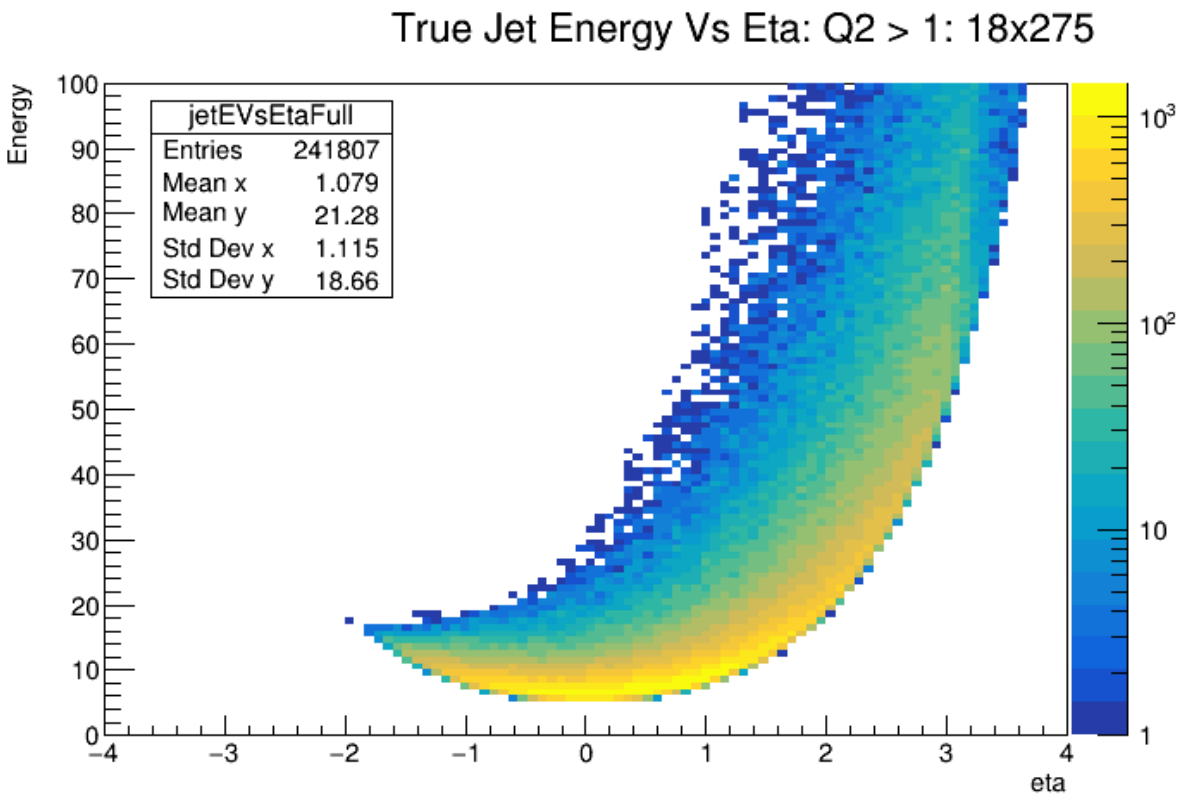


- Lo cut map to the left removes all tracks at low momentum and beyond eta of 3.5
- Perfect efficiency everywhere else

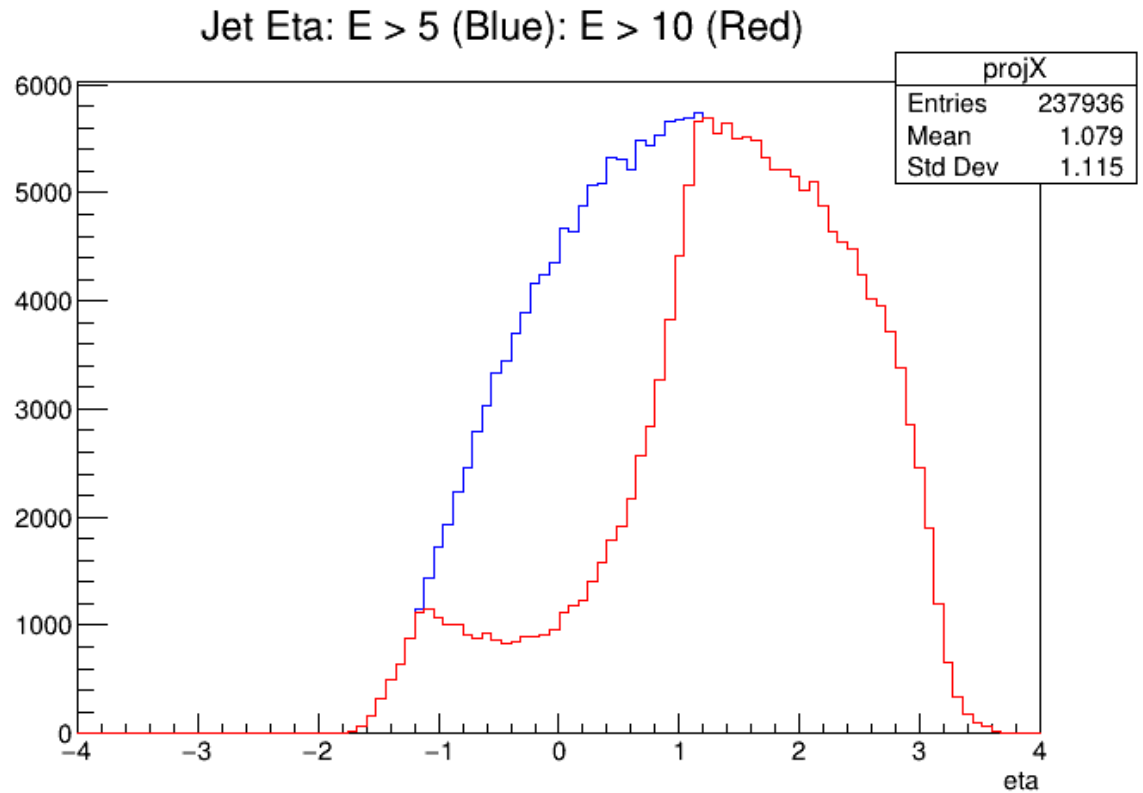


- True efficiency map from single particle simulation has some acceptance for low momentum tracks but also has inefficiencies between |eta| 1 and 2 for all momenta

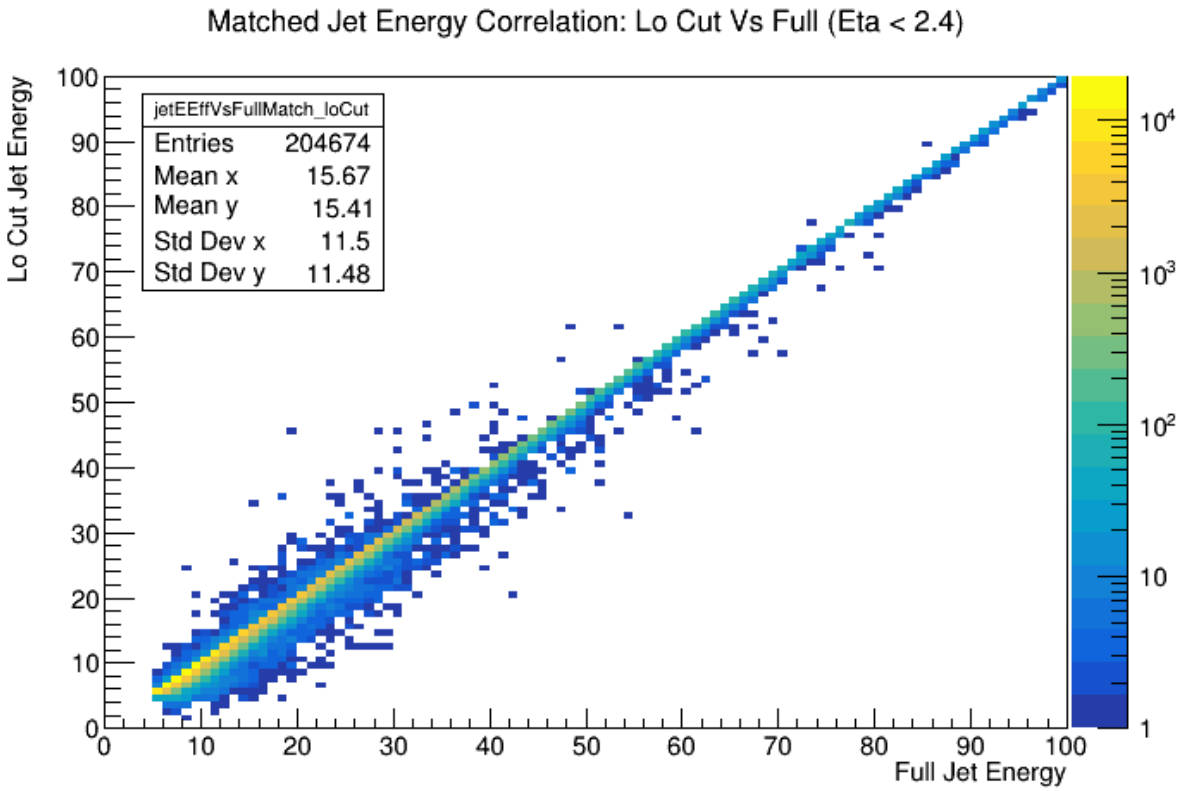
Jet Eta Spectra: 18x275



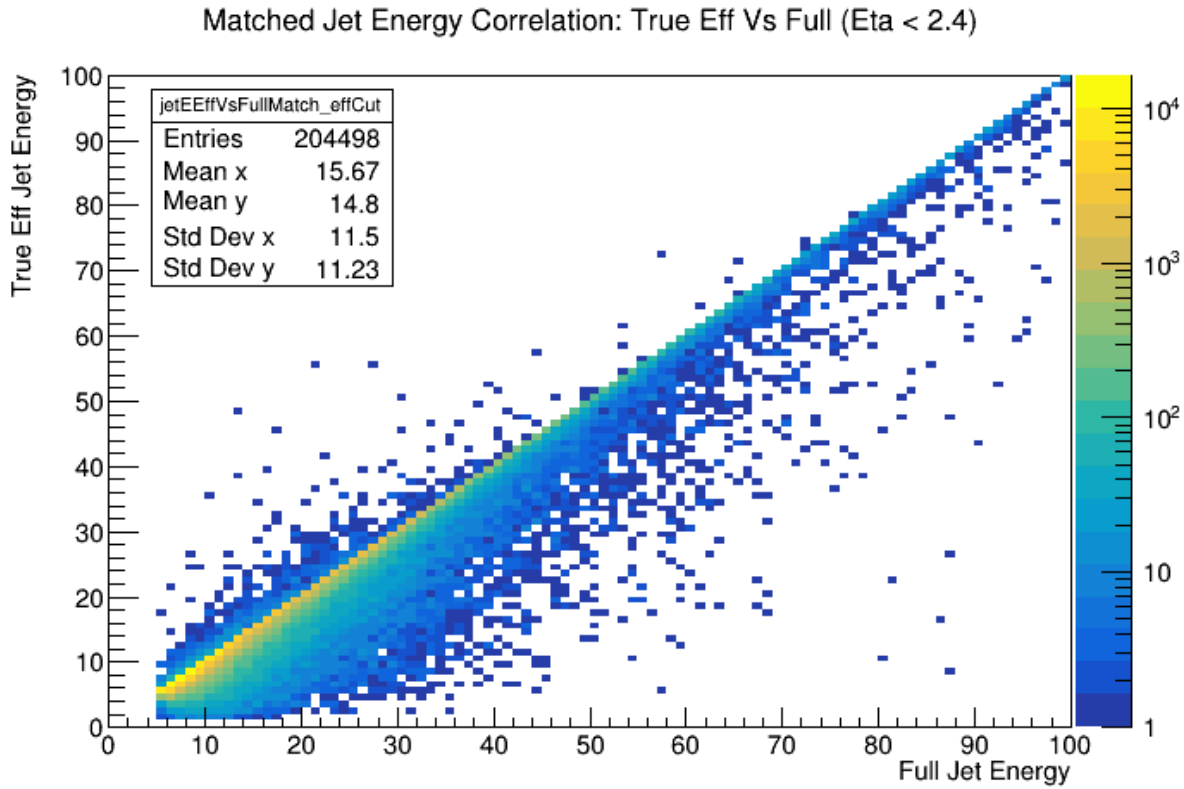
- Note that the maximum of the jet distribution is directly in the region where we see the band of inefficiency for all momenta



Jet Energy Correlation: Q2 > 1: 18x275

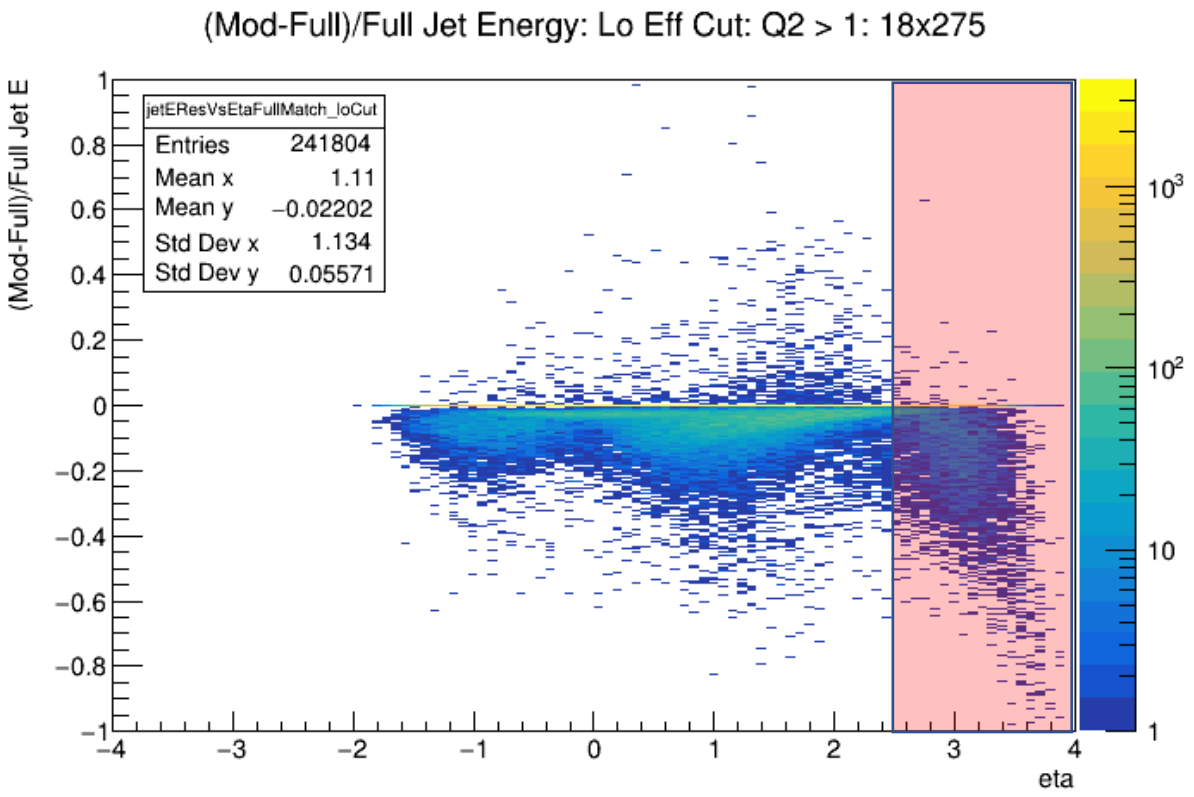


- For each true jet with an energy greater than 5 GeV, find the altered jet closest in eta-phi space
- Plot the altered vs true jet energy for the matched pair

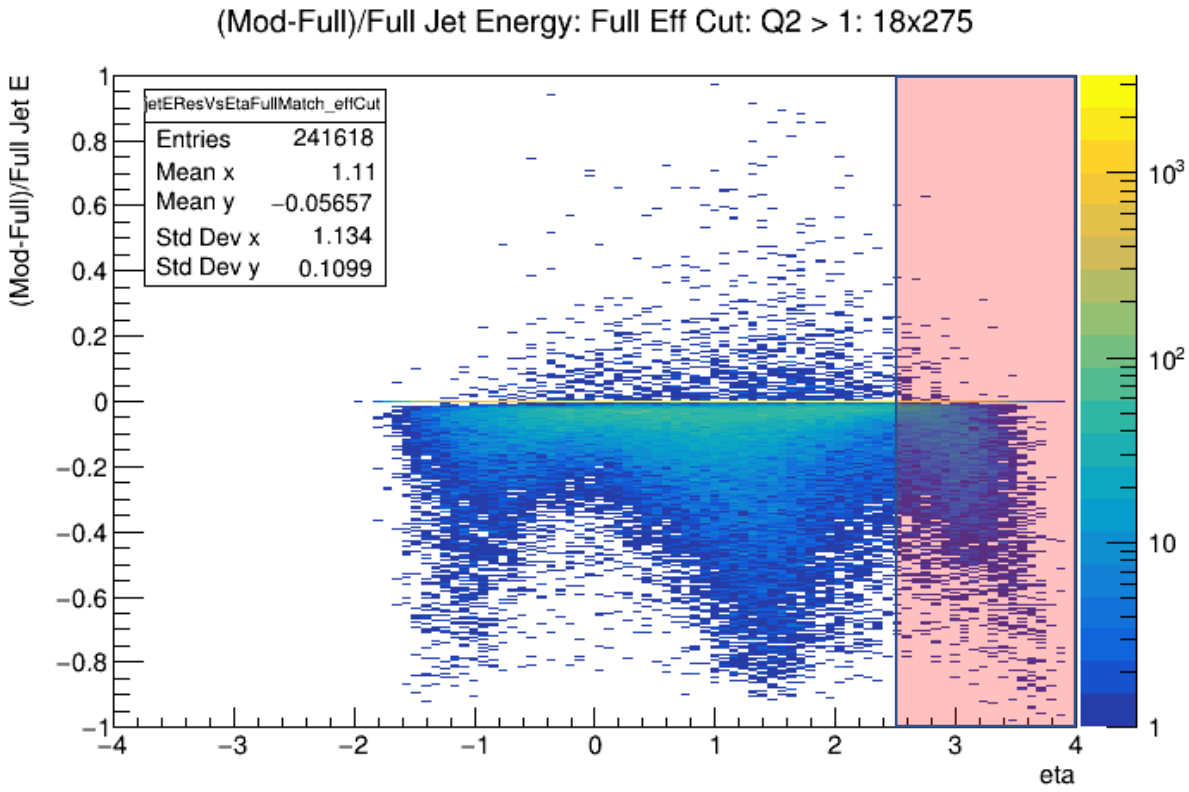


- See that the deviations are much less pronounced for the Lo Cut map as opposed to the true inefficiency map
- Note: Require jet eta < 2.4 to avoid edge of tracking acceptance at eta = 3.5

Jet Energy ‘Resolution’: Q2 > 1: 18x275

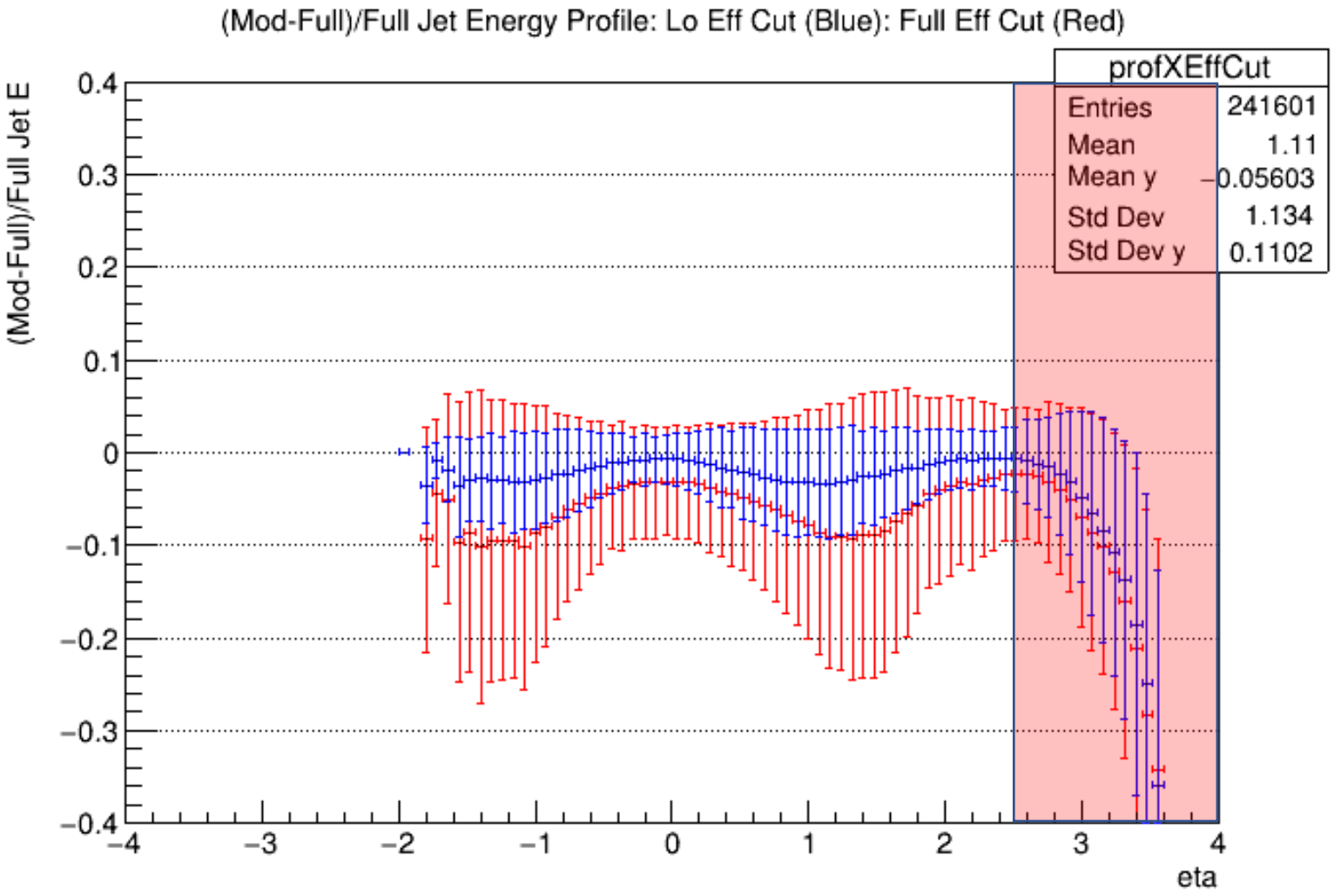


- For each matched jet pair look at the (Modified – True)/True jet energy as a function of eta
- Red boxes show region where resolution is influenced by tracker acceptance limit



- See much larger deviations for the true efficiency map plot
- Largest excursions are centered around the inefficiency bands at 1 < |eta| < 2

Jet Energy ‘Resolution’: Q2 > 1: 18x275



- Take profiles from previous page to get a better idea of the shift and scatter
- Blue is for the ‘Lo Cut’ map while Red is for the true efficiency map

Summary

- Looked at the impact of tracking efficiency on electron finding / kinematic reconstruction and on jet reconstruction
- Used realistic efficiencies obtained from single particle simulations generated using fun4all currently on S3 – also used artificial efficiency map to isolate effects from low momentum inefficiencies
- See that low momentum inefficiencies have some effect on jet reconstruction, but they are much less than the deviations caused by band at $1 < \text{eta} < 2$ (and to a lesser extent the band at negative eta)
- These bands will impact other observables that depend on the classification of the hadronic final state (event shapes, kinematic reconstruction, etc) – should look into these as well
- It will be important to minimize the dead areas due to service routing and support cones in both the forward and backward regions