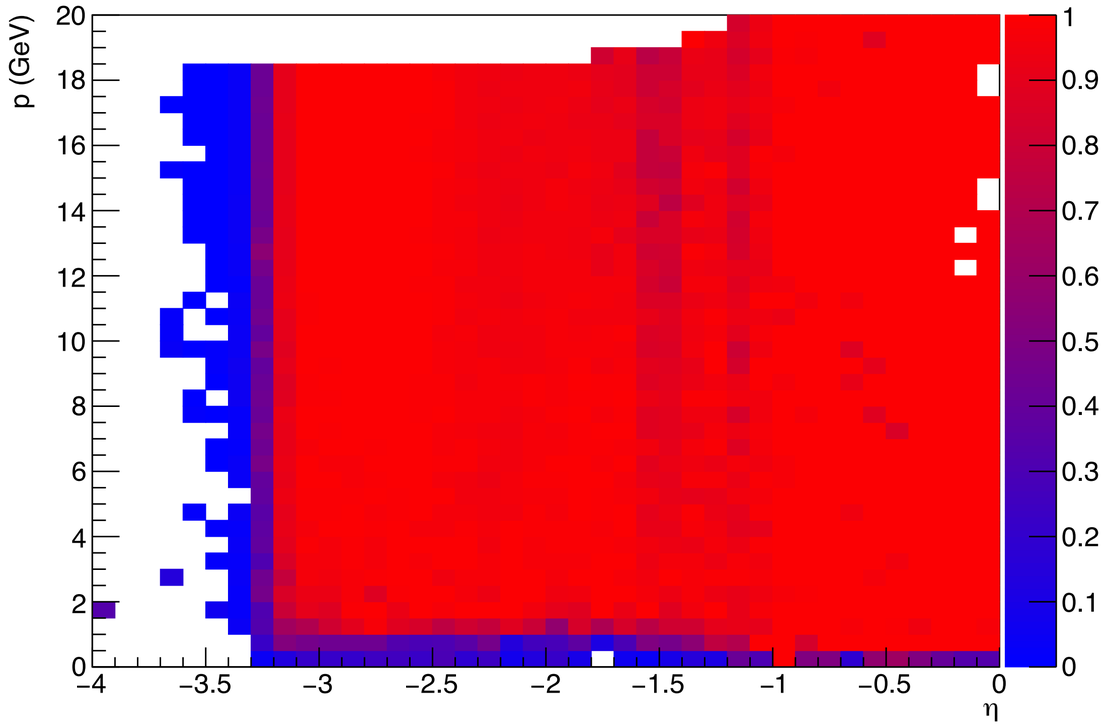
Items of concern

- Efficiency of E/p cut for ePID
  - Poor performance of E/p cut on physics events driven by acceptance

- Difference in calorimeter resolution between single-particle/physics simulations
  - Does not seem like energy splitting with adjacent clusters is big effect

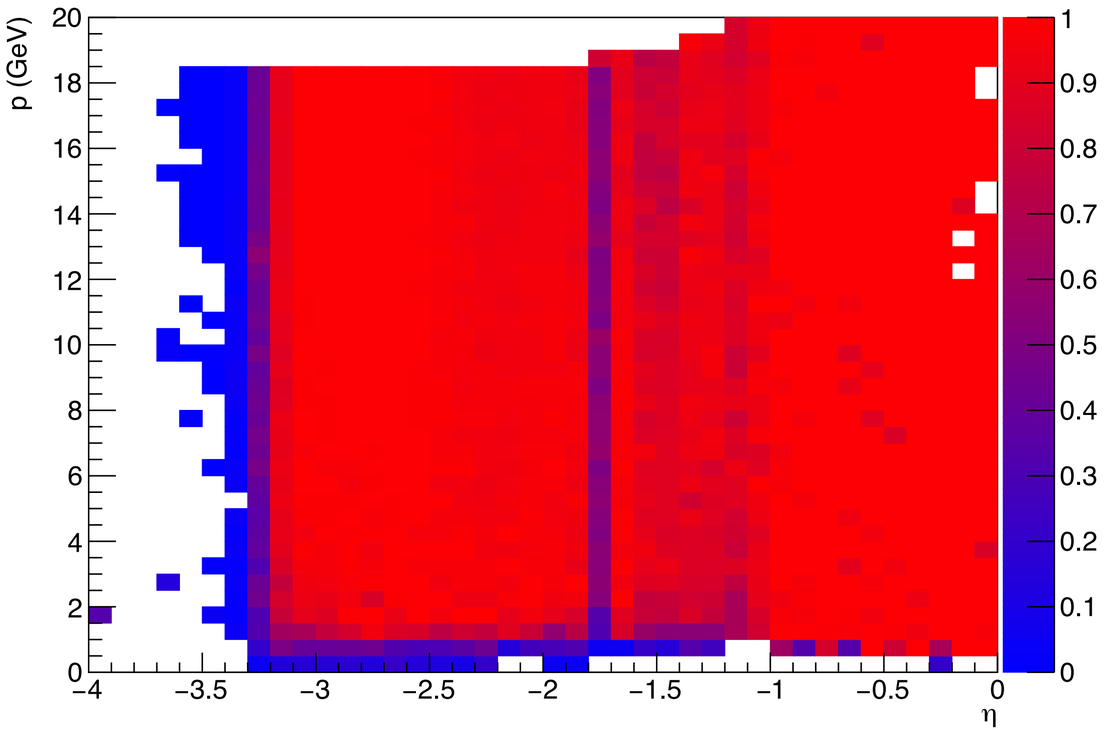
Tracking acceptance

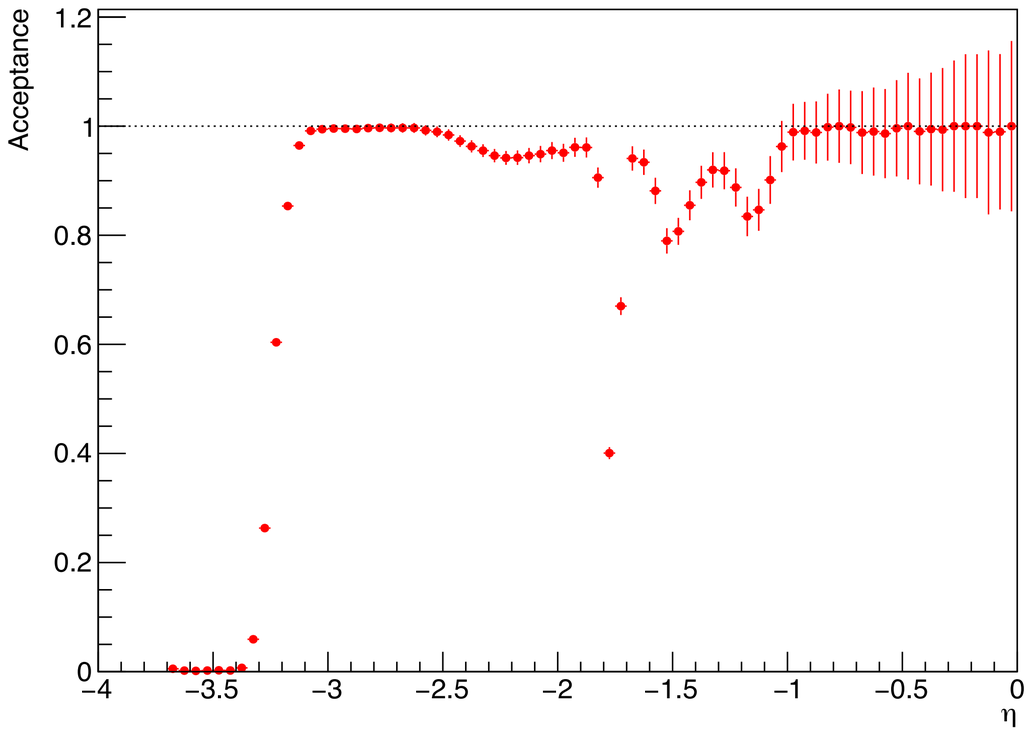
$$\frac{N_{rec}(\eta_{gen}, \phi_{gen})}{N_{gen}(\eta_{gen}, \phi_{gen})}$$



- Require track corresponding to scattered electron (60.9% of events)

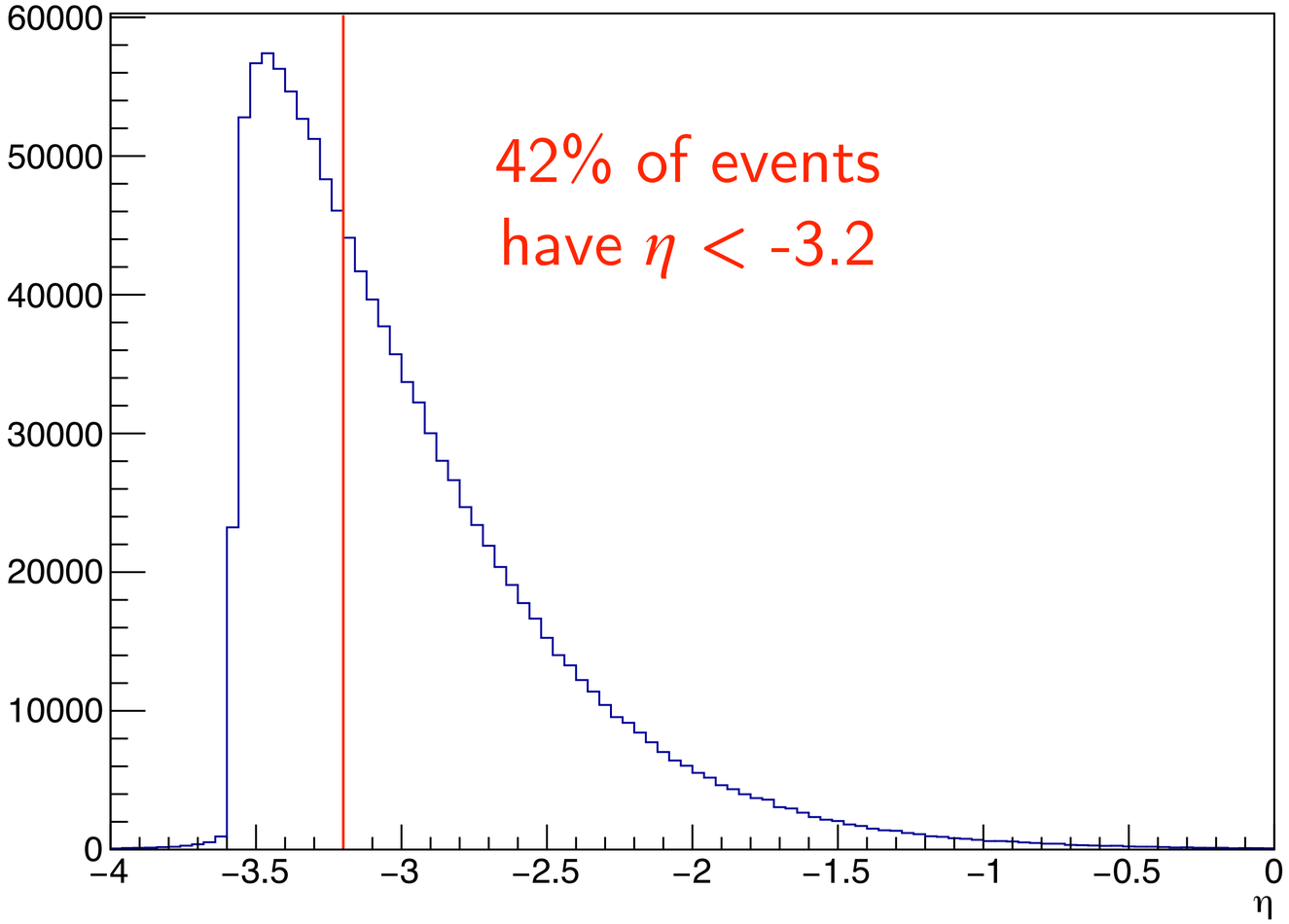
Tracking + calorimeter acceptance





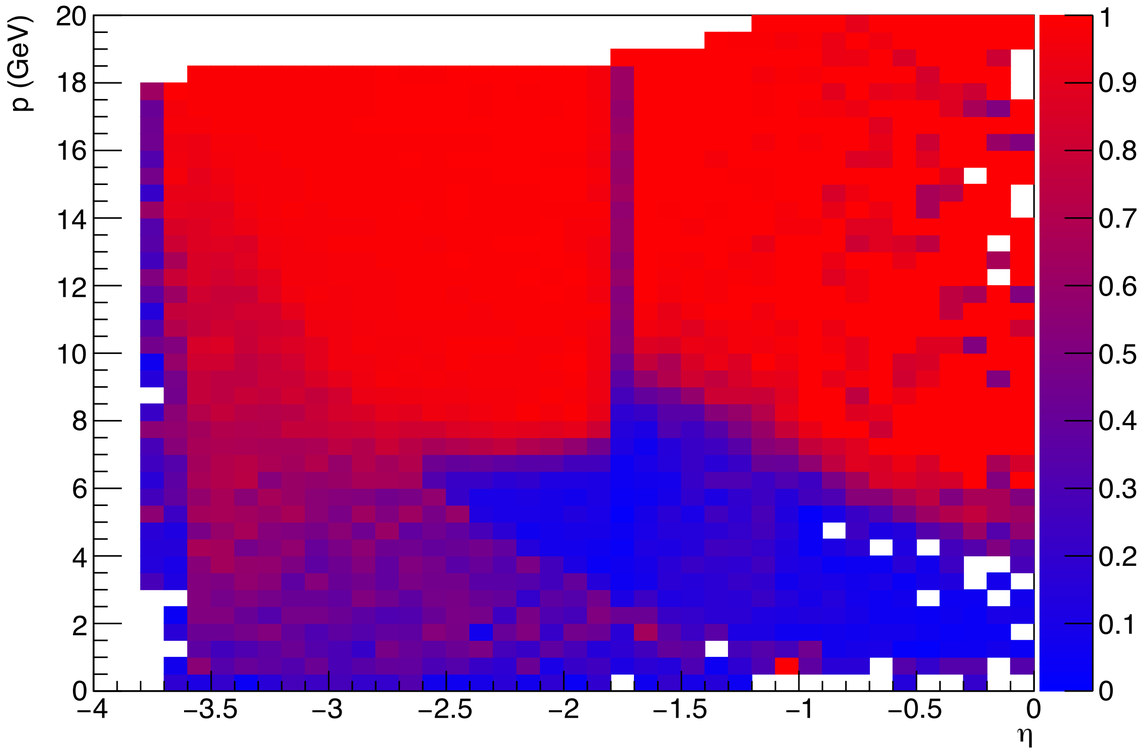
- Require track corresponding to scattered electron (60.9% of events)
- Additionally require track matches a calorimeter cluster (60.3% of events)
- Tracks matched to clusters in afterburner software
  - EEMC: $\Delta x, \Delta y < 4$ cm
  - BECAL: $\Delta\eta, \Delta\phi < 0.05$

Low E/p efficiency due to tracking acceptance



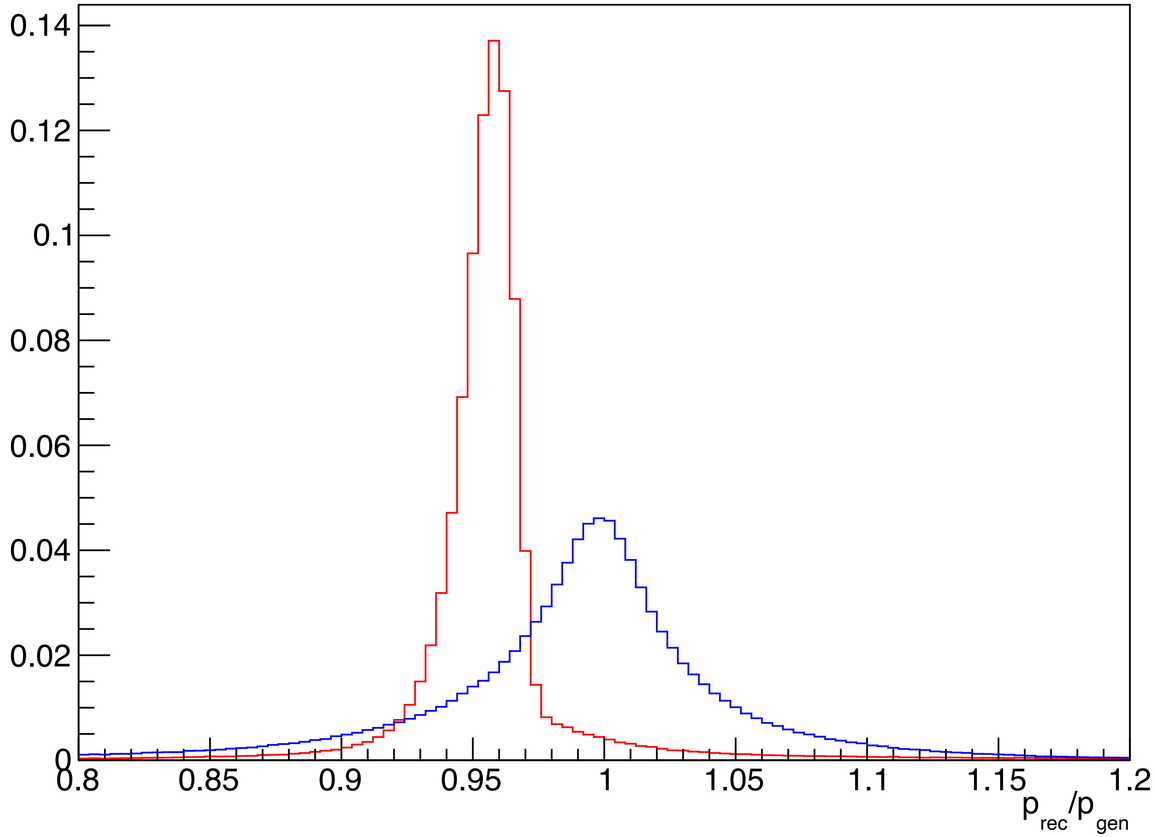
- Observed that only ≈50% of physics events identified electron candidate with E/p cut
- This is due to missing tracks, not calorimeter energy

Trying to get calorimeter-only acceptance



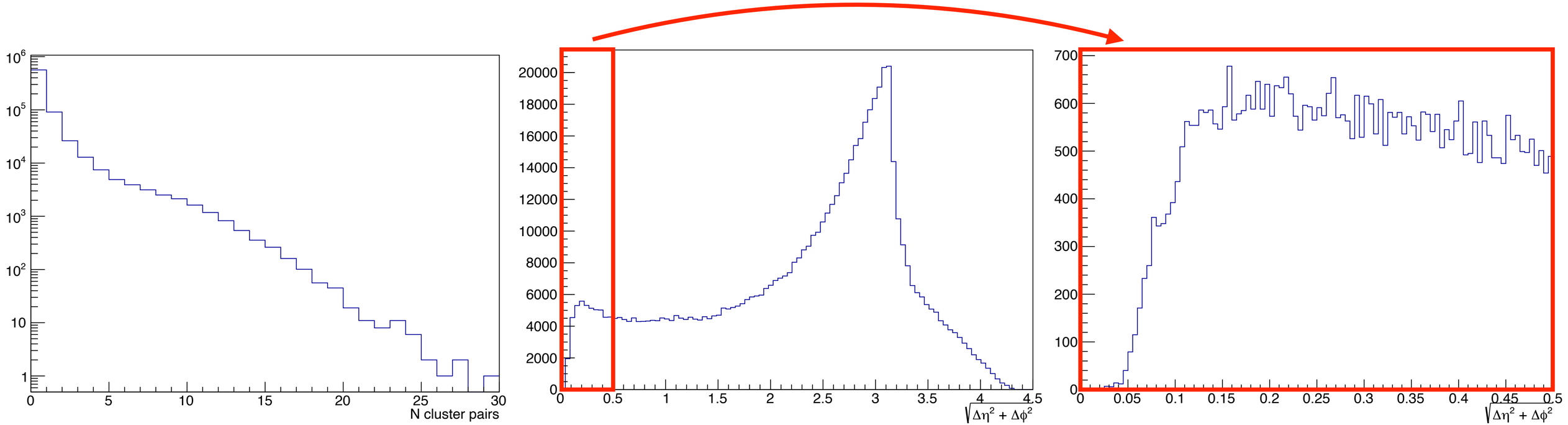
- Fun4all associates truth particle with each cluster, but this information is not correct
- Attempted to match clusters to truth scattered electron information:
  - Closest matched cluster with $\Delta\eta, \Delta\phi < 0.05$
- Extends acceptance to $\eta <$ -3.5, but gaps appear at mid-η, low p
- Likely a problem with matching condition, not calorimeter

Momentum resolution



- Calorimeter reconstruction has better resolution, but large bias
- Bias *not observed* in resolution obtained in single-particle simulations
- Hypothesis: caused by energy split between lepton cluster and adjacent cluster(s)

Cluster separation



- Examine separation between cluster associated with lepton track, and all other clusters (in that calorimeter)
- Many events do not have second cluster
- For those that do, relatively few events have small cluster separation
- Unlikely that this is cause of bias

Summary

- Poor efficiency of E/p cut caused by limited tracking acceptance
  - Need explicit acceptance correction
  - Extend acceptance to lower η with calorimetry

- Energy splitting with adjacent clusters does not seem to be the cause of bias in calorimeter momentum reconstruction
  - Incorrect calibration? ...?

Follow-up questions:

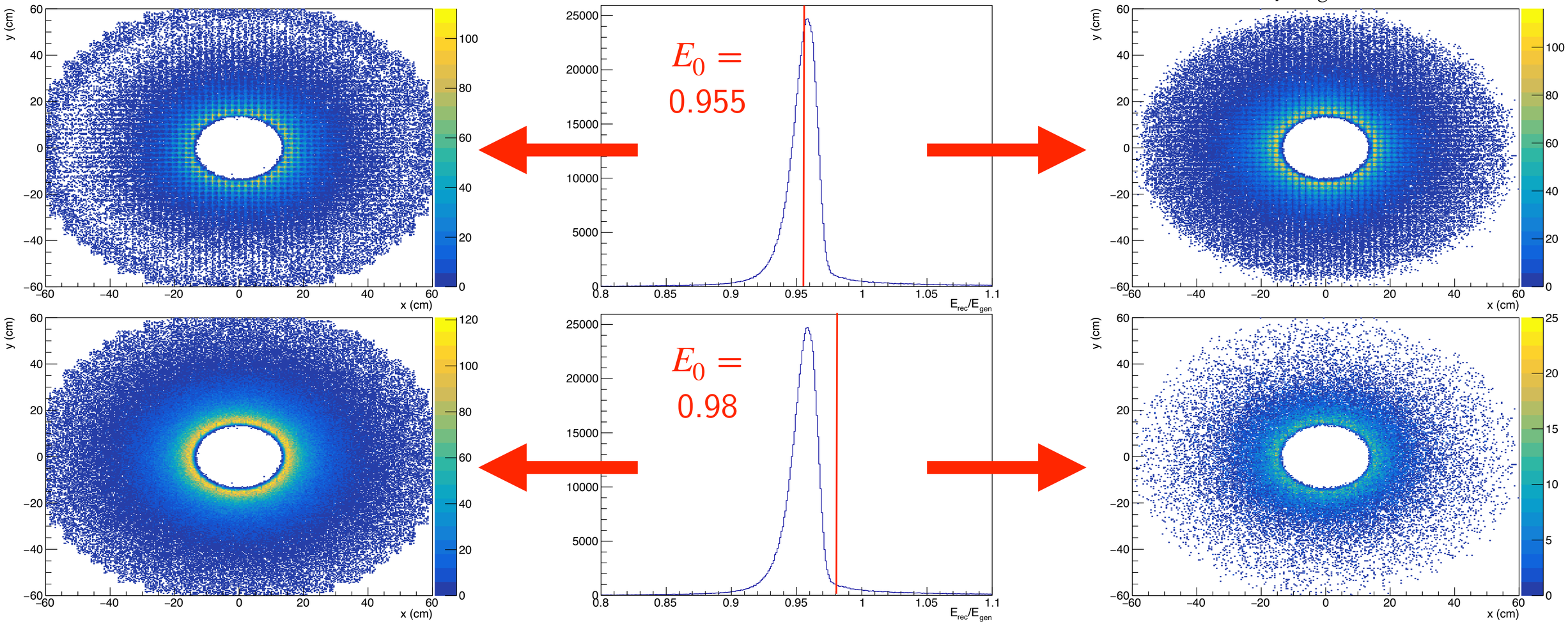
- Do events with poor energy reconstruction correspond to tracks projected to crystal edges?

- Does the bias in energy reconstruction depend on η or p?

Projected track positions at EEMC

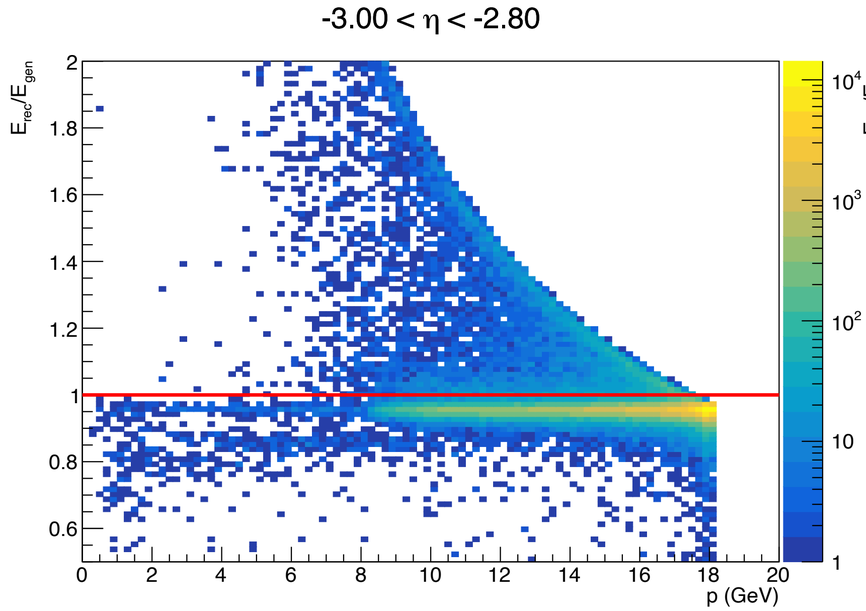
$E_{rec}/E_{gen} < E_0$

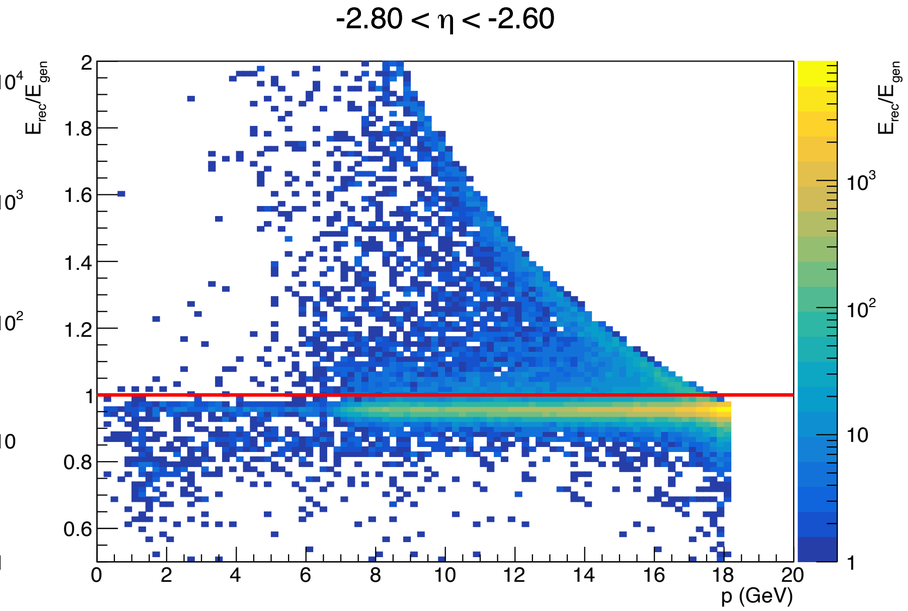
$E_{rec}/E_{gen} > E_0$

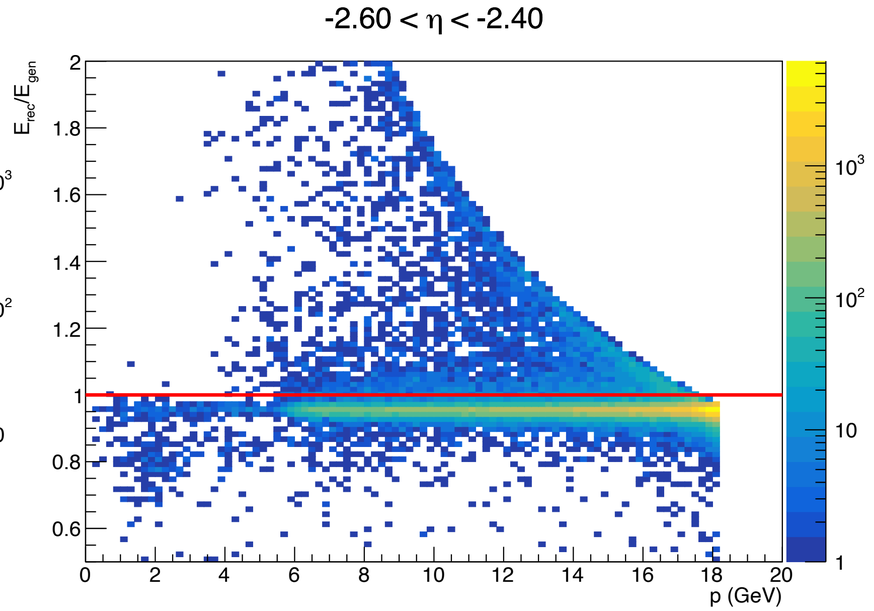


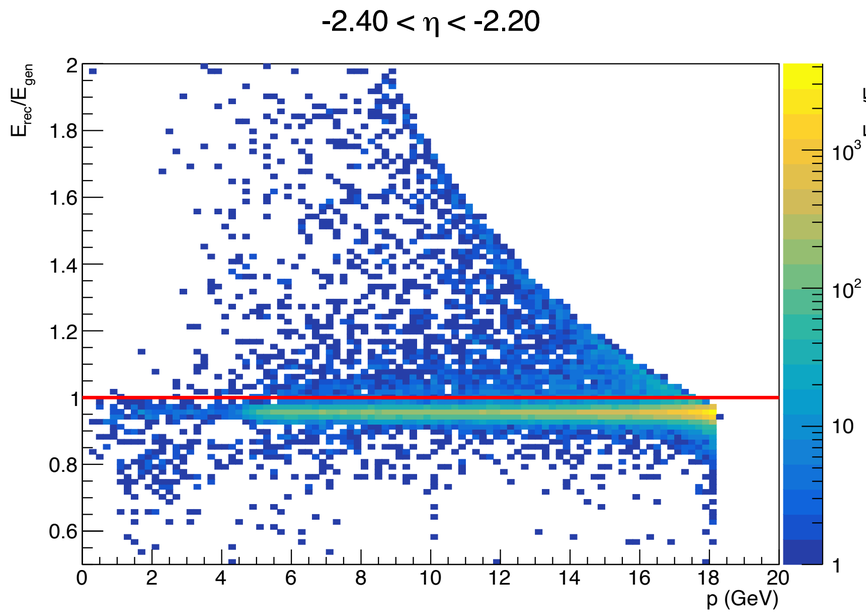
- Crystal edges *visible* for projections above/below $E_{rec}/E_{gen} = 0.955$
- Crystal edges *not visible* for projections above/below $E_{rec}/E_{gen} = 0.98$
- Edges only impact *width*, not *mean*?

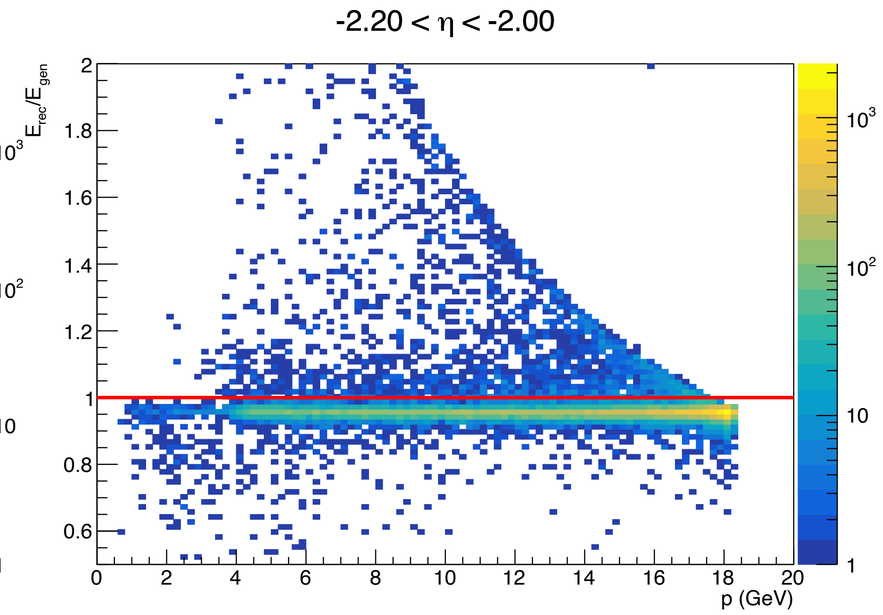
(η, p) dependence of bias (EEMC region)





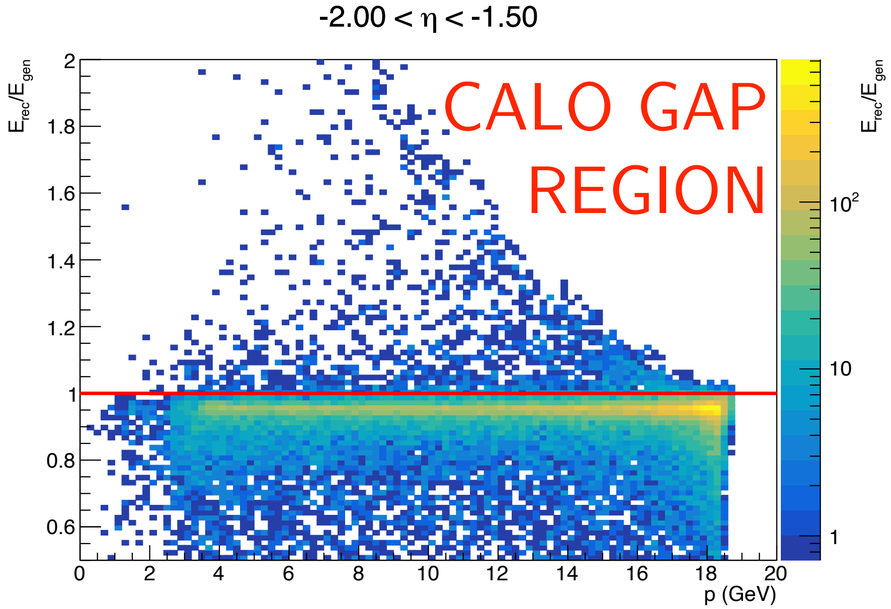


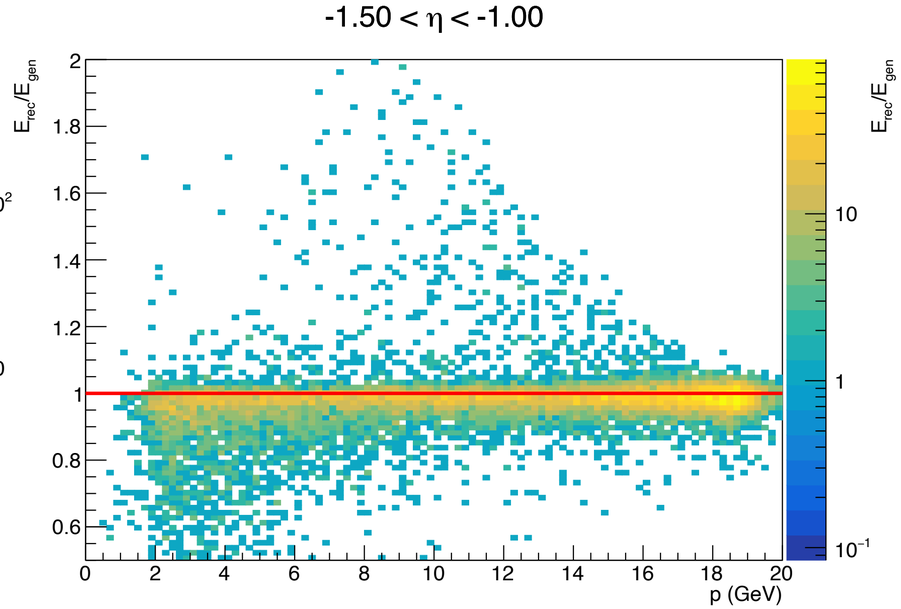


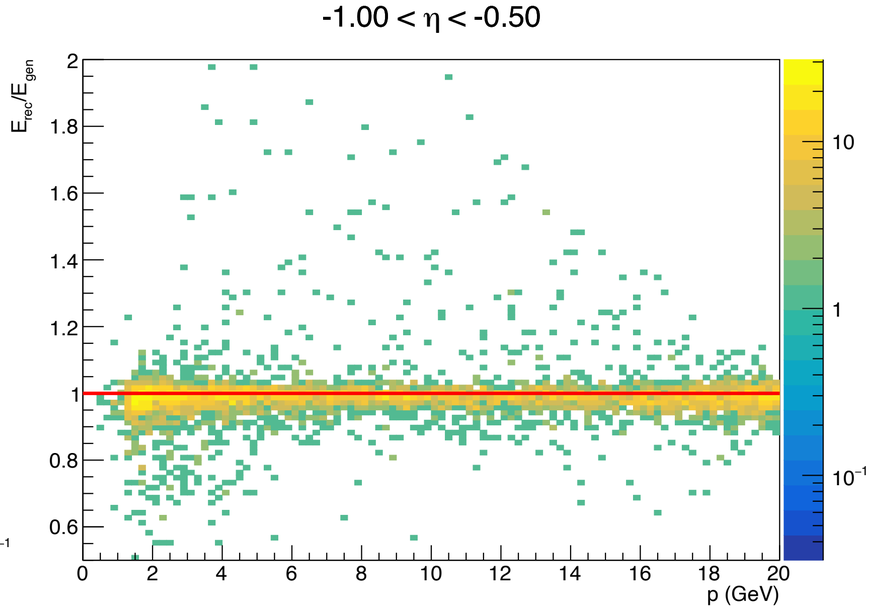


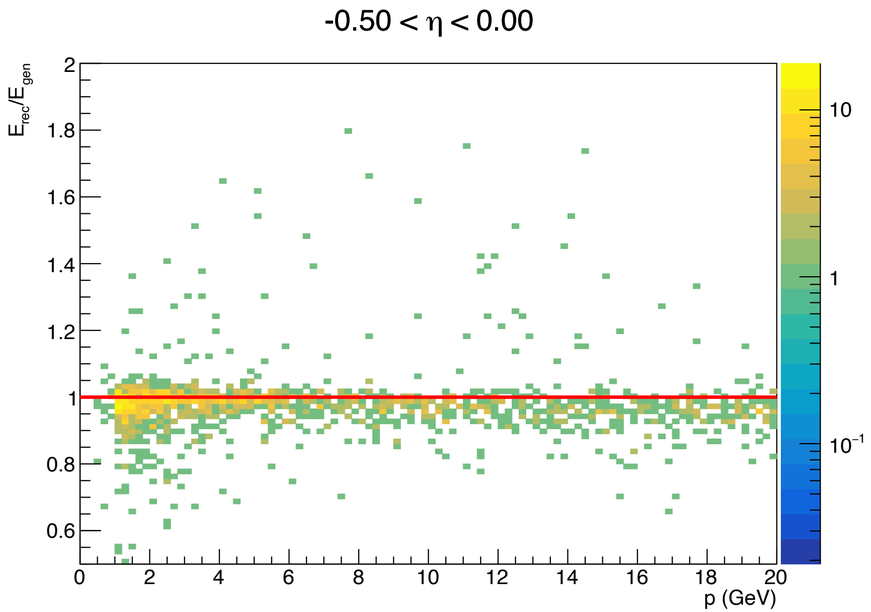
- Peak position around $E_{rec}/E_{gen} \approx 95\%$ constant with (η, p)
- $E_{rec}/E_{gen} > 1$ tail grows with decreasing η, but p dependence is constant

(η, p) dependence of bias (BECAL region)









- BECAL region shows smaller bias, still constant in p
- Statistics are limited due to η distribution from PYTHIA