

Forward Ecal Reco Software

BG challenge : π^0 /gamma separation with and without BG
→ We cannot answer without having realistic π^0
& gamma reconstruction code

We'll need π^0 reco code in day1 for 1st calibration.

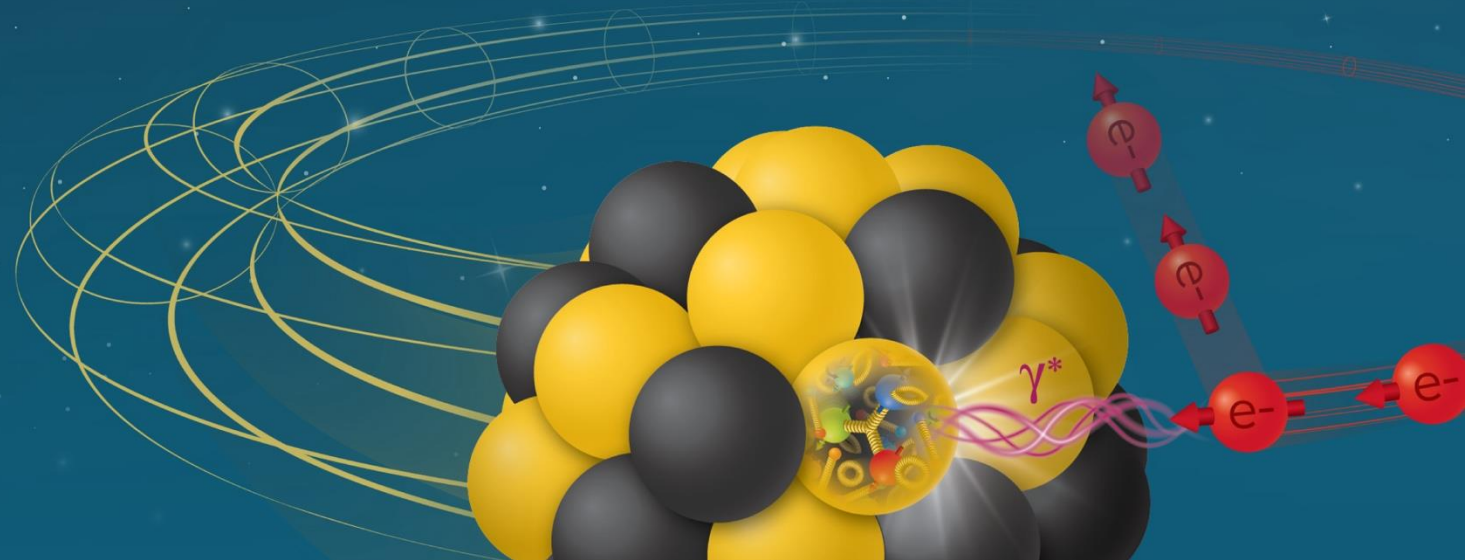
Akio Ogawa(BNL)

Forward Ecal Software coordinator

Calorimeter Meeting

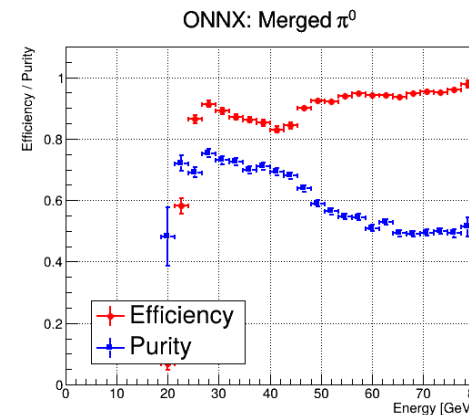
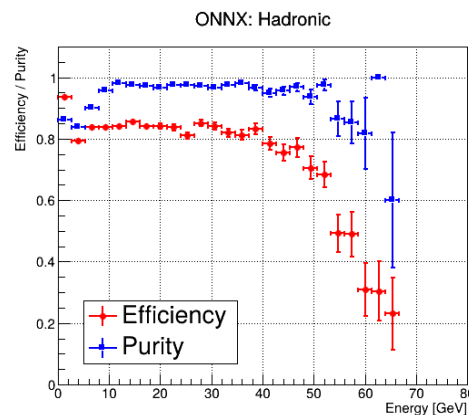
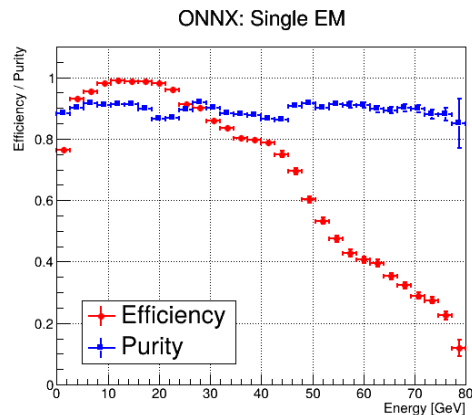
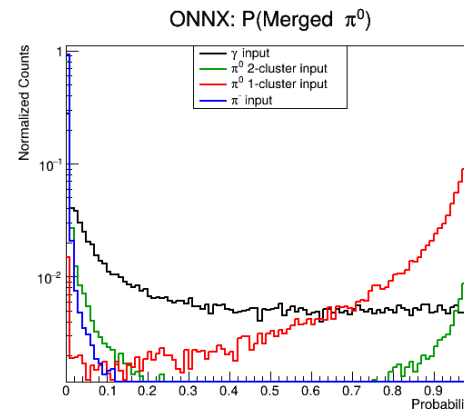
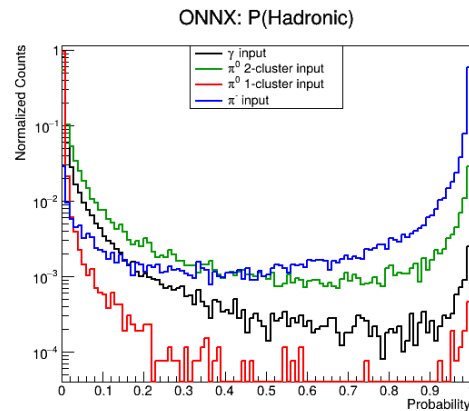
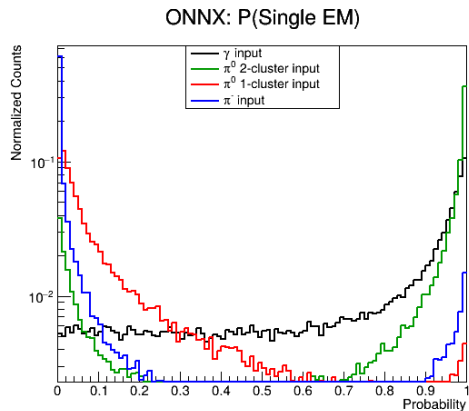
July 22, 2026

Electron-Ion Collider



Ecal Cluster Categorization using ML

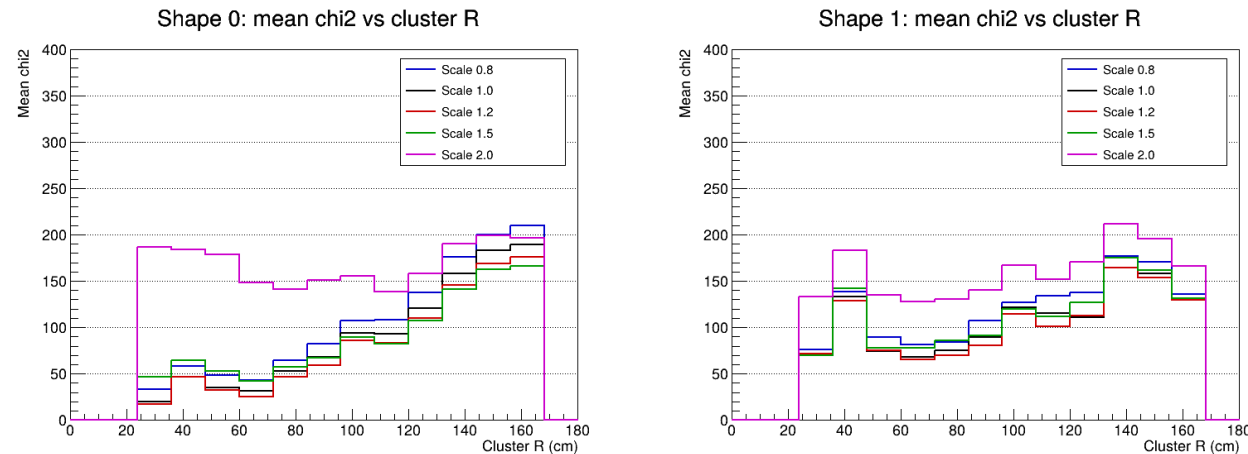
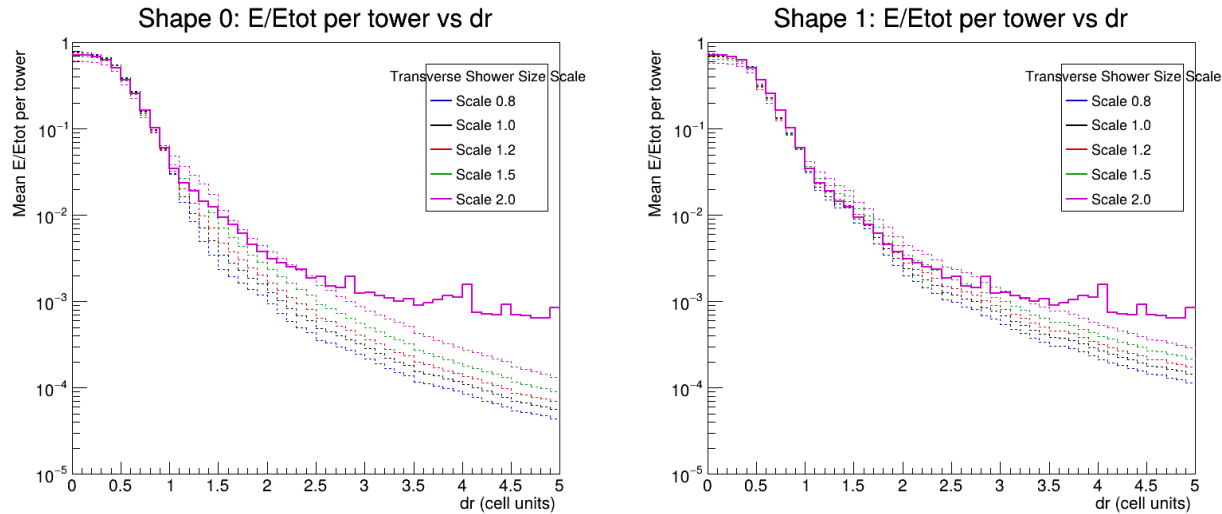
- Fixed Cluster Shape parameters (<https://github.com/eic/ElCrecon/pull/2683> & <https://github.com/eic/ElCrecon/pull/2742>)
- ONNX + Catboost (started with ROOT TMVA but it was suggested to use these instead)
- 3 way categorization : Single EM shower, Merged pi0, Hadron
- 34 input variables : Cluster Energy, x, y, # of hits, Radius, Dispersion, SigmaMin, SigmaMax, 5x5 tower energies, energy outside 5x5



- Trained to equal sample of gamma, pi0, pi- MC samples of 0-80GeV
 - Pi0 samples at low energy with 2 clusters
→ single EM shower (training) sample
 - Purity is for this (unrealistic) MC sample mix
 - Naturally, it gets very hard to tell single gamma (or electron) from merged pi0 at high energy. It requires careful studies to quote efficiency & purity numbers
- Still need to reconcile with old study of
“~5% π^0 contamination @ 50GeV π^0 ”
→ No final answer to BG challenge question yet

EM Shower Shape Fitting

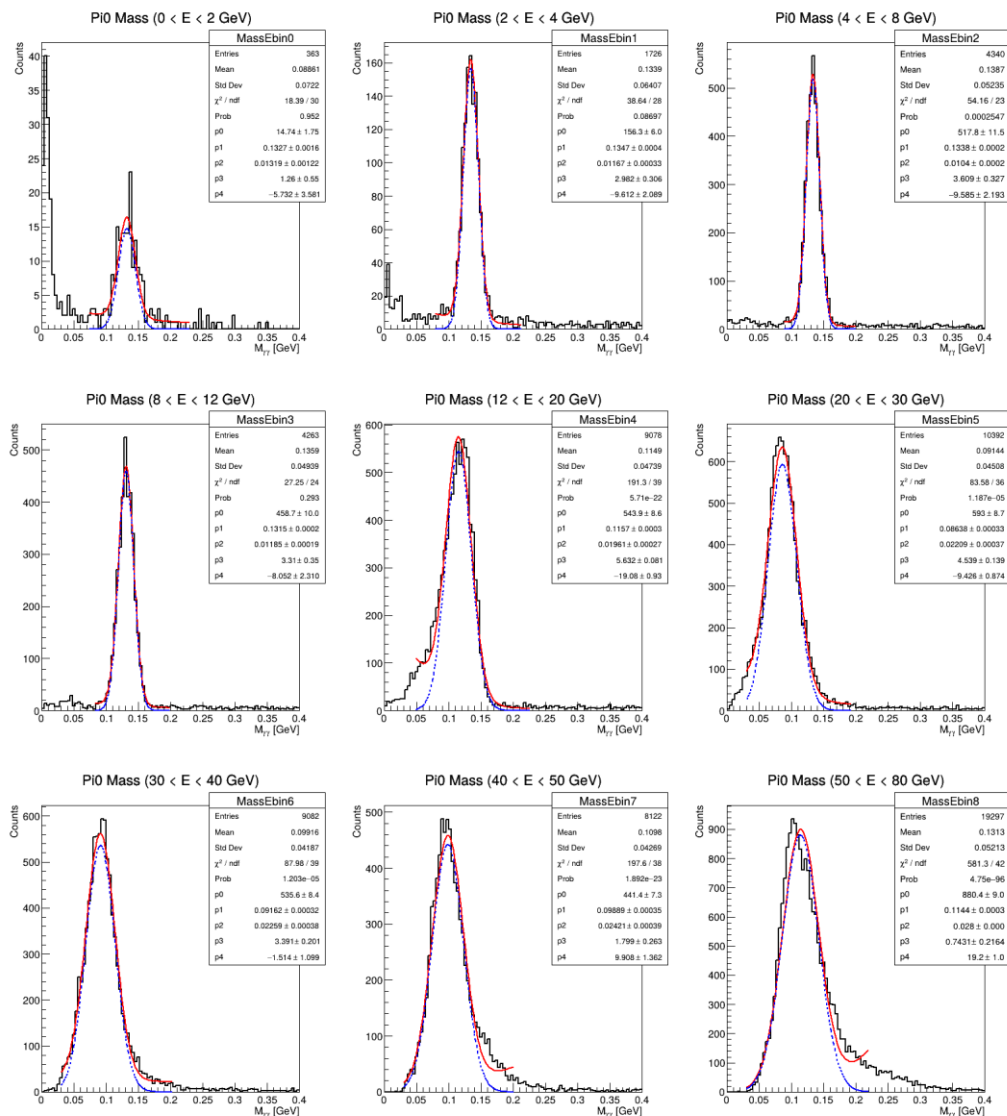
- Shower Shape 0 : fixed shower shape (ported from STAR FMS)
- Shower Shape 1 : 6 z slices based on 3d shower shape → take out incident angle ($\sim R$) dependence



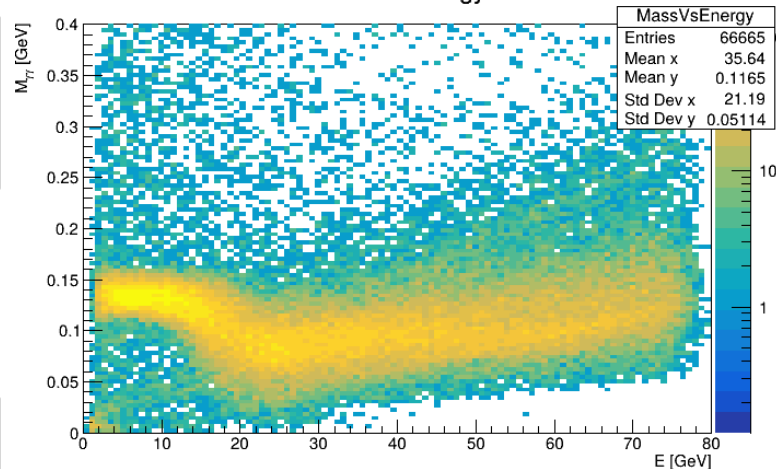
- Transverse shower size scaling adjusted
→ ~ 1.2
→ Flatter chi2 over R (???)
- Fit with 1 EM shower or 2 EM showers depending on cluster categorization
- This should give better position resolution for gamma/electron than (log) weighted mean cluster center (to be checked)
- Feed to pi0 reconstruction at $>15\text{GeV}$
- ML “fit” without shower shape model tried not working well (yet)

Pi0 reconstruction for day 1 calibration

Pure pi0 samples



Mass vs Energy



Ready for <15GeV pi0
For day1 calibration

Mass dips down ~20GeV
With cluster "Split"=true

PYTHIA 10x275GeV Q2>1

