

ECAL Energy Calibration Updates

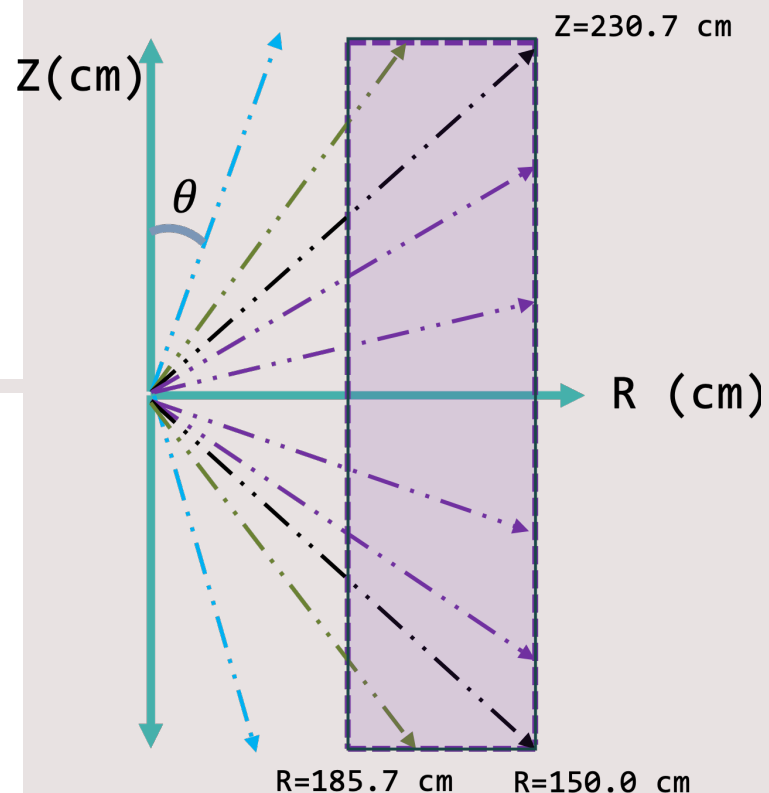
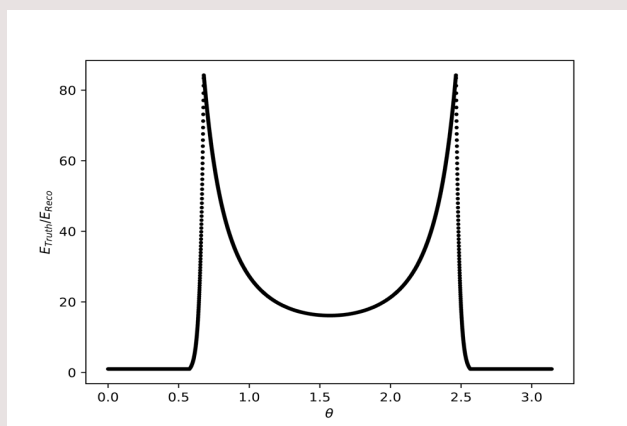
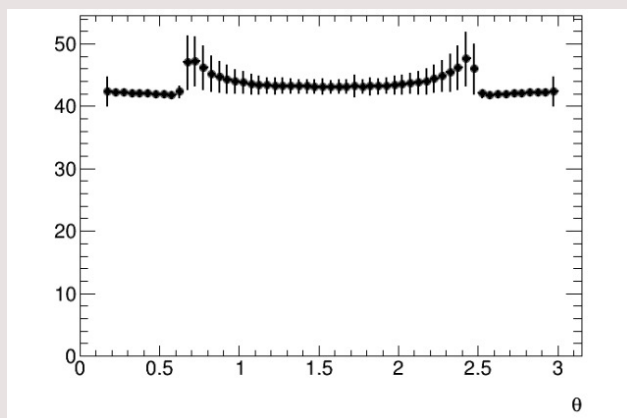
22 May 2024

5/22/24



Review of Last Time

- Developed first-principles analytic energy loss function in the solenoid
- Matched the shape of Tova's profile plots but obviously needed fitting



$N(\theta) =$

$$\begin{cases} 0 & \theta < 0.577, \theta > \pi - 0.577 \\ 25.93 |\sec \theta| - 16.86 \csc \theta & 0.577 < \theta < 0.678, \pi - 0.678 < \theta < \pi - 0.577 \\ 4.01 \csc \theta & 0.678 < \theta < \pi - 0.678 \end{cases}$$

$$\begin{cases} \theta < 0.577, \theta > \pi - 0.577 \\ 0.577 < \theta < 0.678, \pi - 0.678 < \theta < \pi - 0.577 \\ 0.678 < \theta < \pi - 0.678 \end{cases}$$

Then we expect to model our ratio of E_{truth} to E_{reco} as

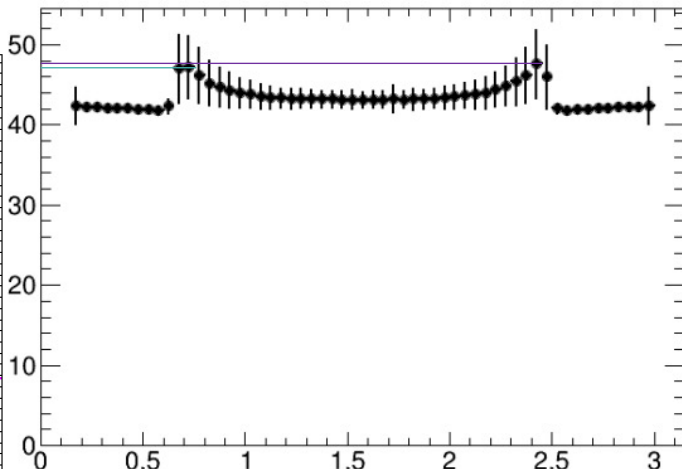
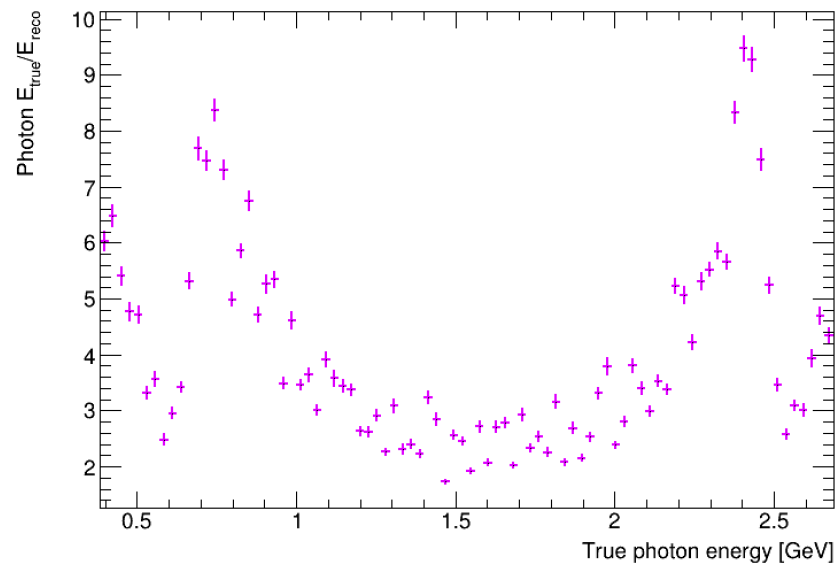
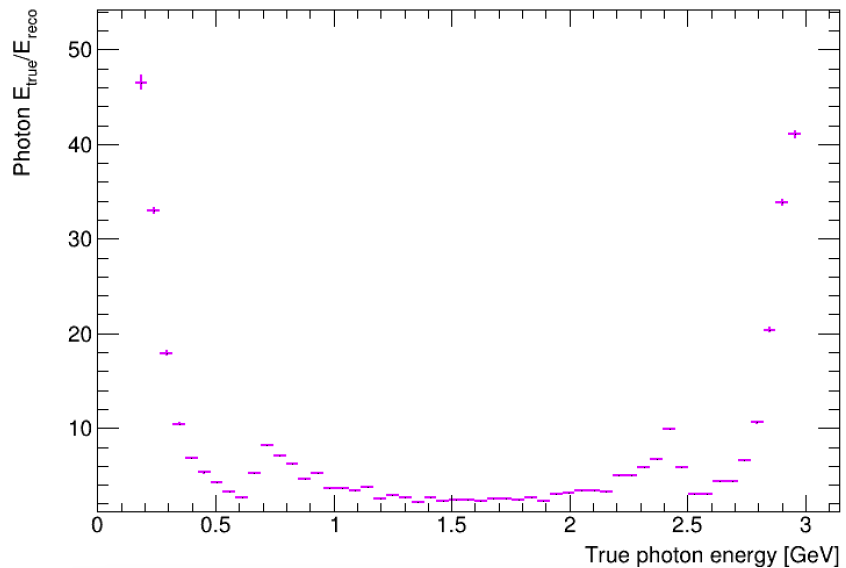
$$\frac{E_{\text{truth}}}{E_{\text{reco}}} = 2^{N(\theta)}$$

This week's goals

- Recreate the angular response plot using the v2 samples
- Fit the analytical function to the response
- Implement calibration and see if we see improvement
- Files used: /data/fmeloni/DataMuC_MuColl10_v0A/v2/reco/photonGun* (on the Snowmass cluster)

New response plot

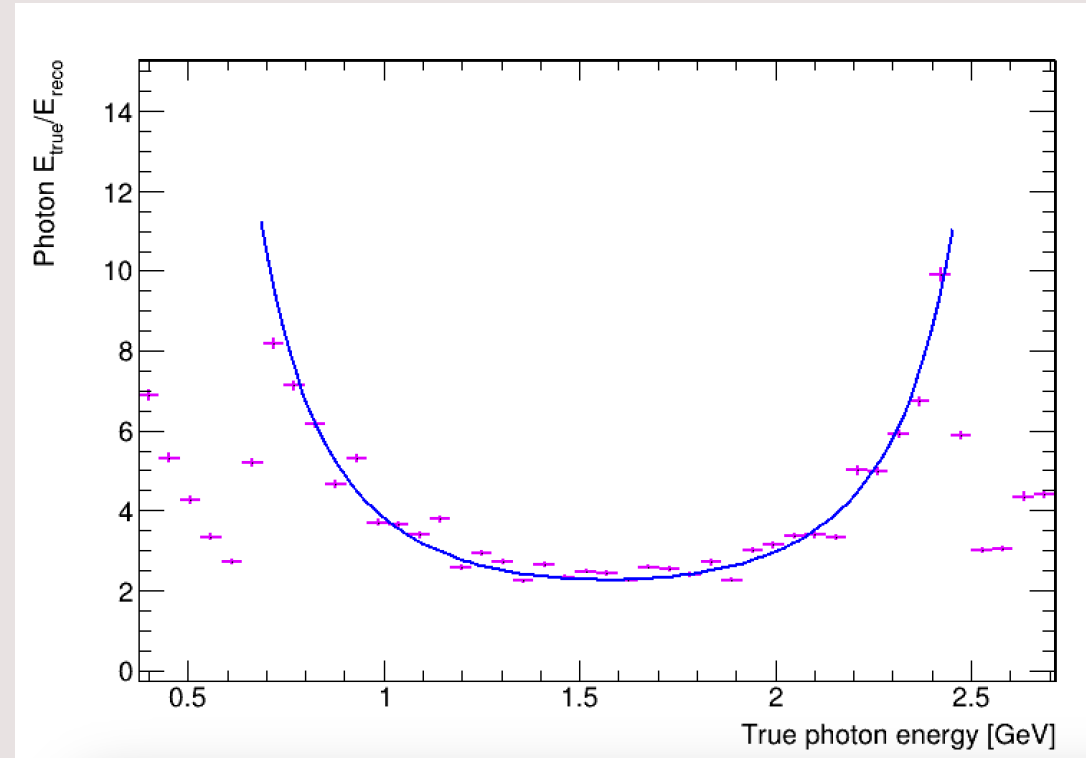
- In the **barrel** region and transition regions, the response is consistent
- Global offset factor of ~ 42 fixed by new digi calo (in barrel region)
- However, weird new behavior in **forward** regions (energy loss spikes)
- Slight unevenness between two transition regions matches previous profile plot (zoom in and see guiding lines)



(For comparison)

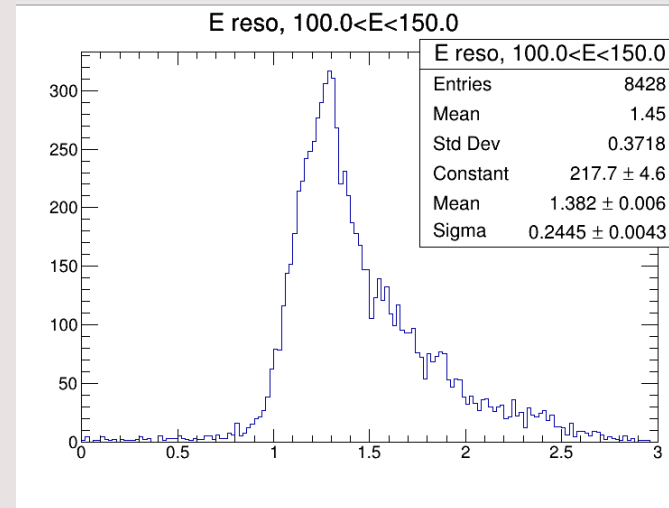
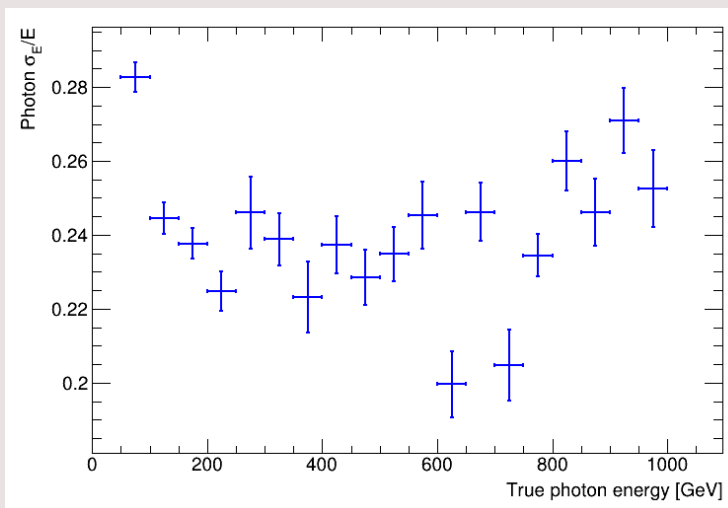
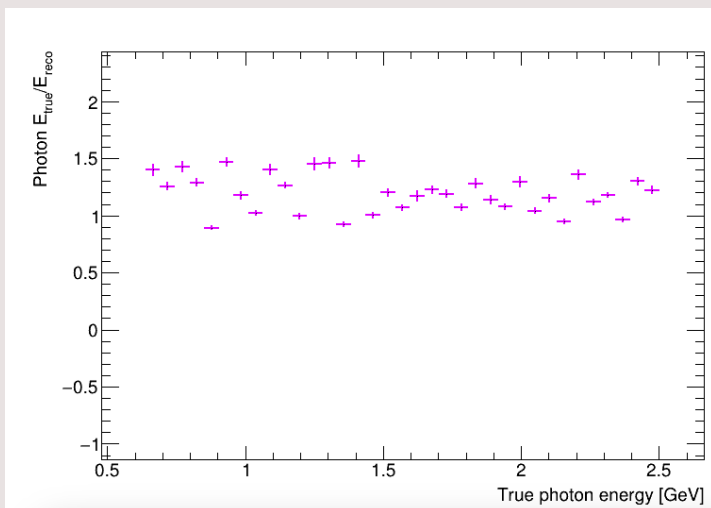
Fitting the analytical function

- Used TFit with a constant coefficient as the only parameter
- Fit restricted to the relatively well-behaved barrel region
- Modeled as $A(2^{(4.01 \csc \theta)})$, fit gives $A=0.14053$

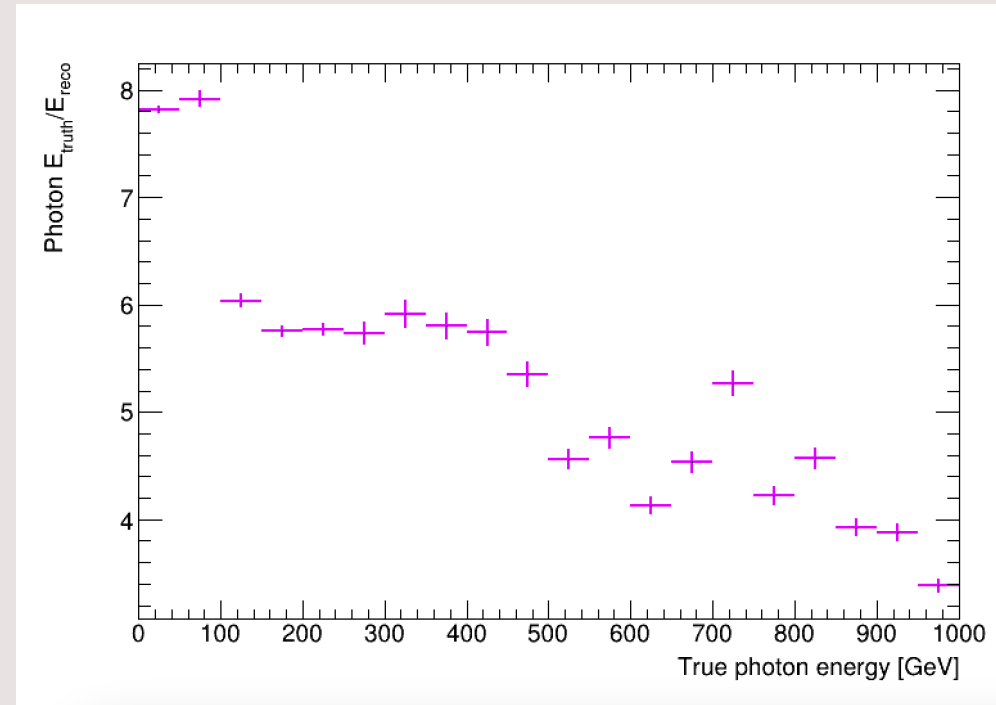
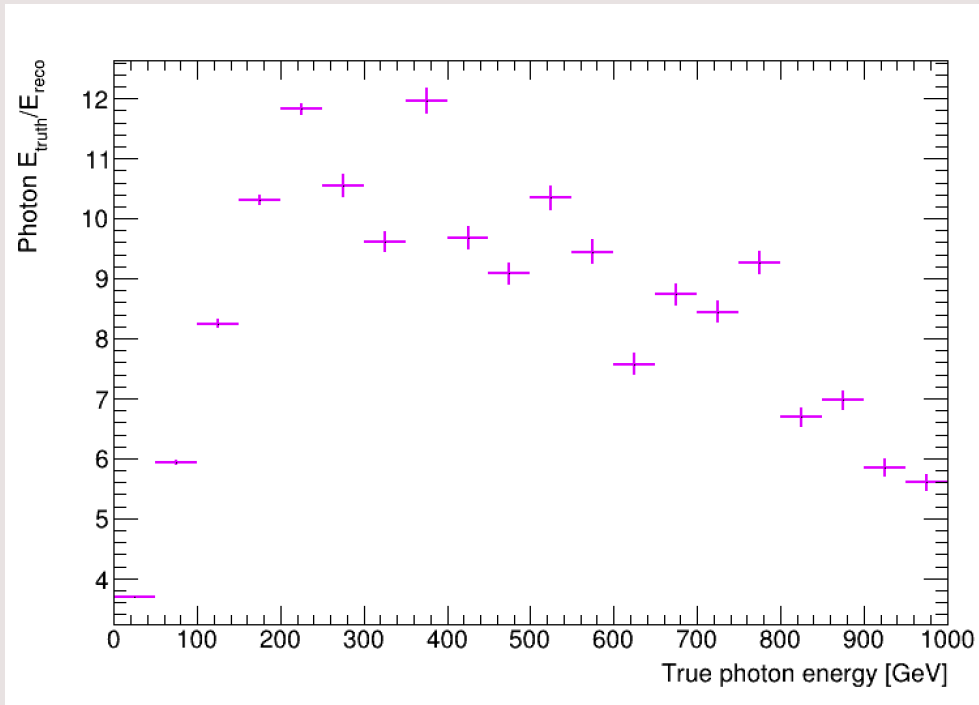


First attempt at energy correction

- Used fitted function to correct for energy loss, restricting to barrel region
- Response looks much better, but...
- Viewer discretion advised for resolution v. energy plot



Response wrt energy doesn't see as drastic of an improvement as response wrt angle



Next Steps

- Examine theta response for individual energy slices instead of just profiling
- Understand if there is a secondary energy dependence that needs to be considered
- Try to determine why we see energy loss spiking in endcap regions for v2