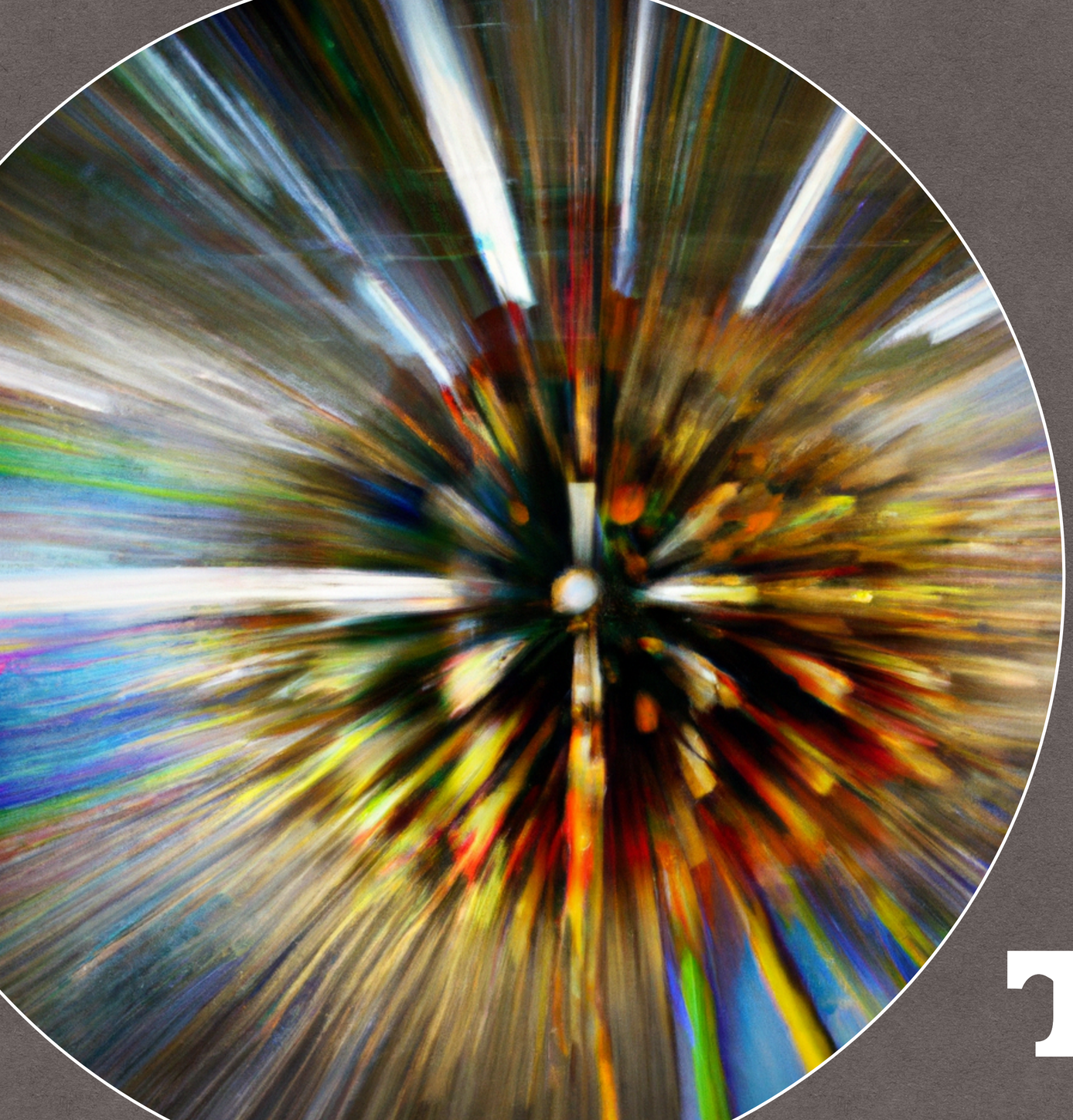


U.S. DEPARTMENT OF ENERGY | Office of Science

10 TeV MuCol

Photon Studies

TOVA HOLMES, U. OF TENNESSEE

10 TEV MUCOL STUDIES

APRIL 4, 2024

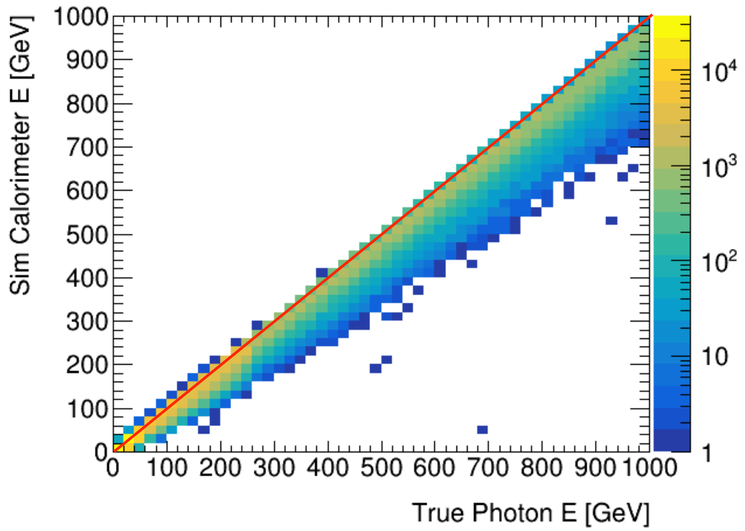
What I did

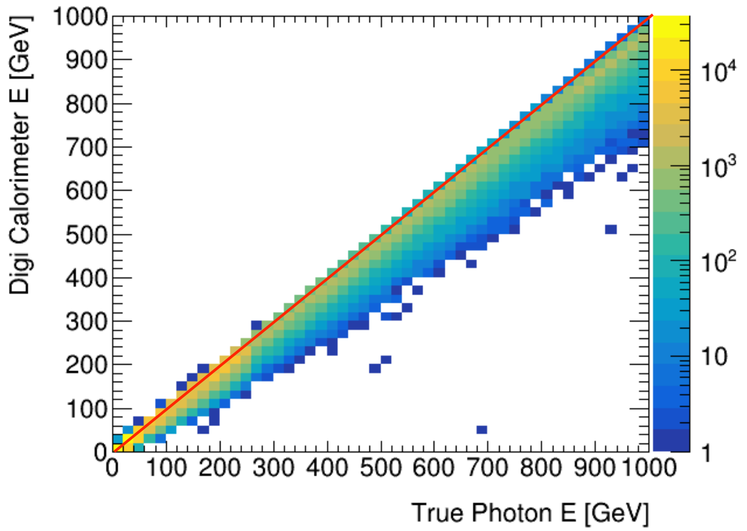
- Ran scripts that re-assessed some of the details of photon reconstruction
  - Using scripts found here: https://github.com/trholmes/mucolstudies
    - In particular, caloStudies.py shows the response at different levels of reco
    - And studyObjectResolution.py makes plots of resolution for any chosen object
- Files, accessed on 4/3:
  - /data/fmeloni/DataMuC_MuColl10_v0A/reco/photonGun

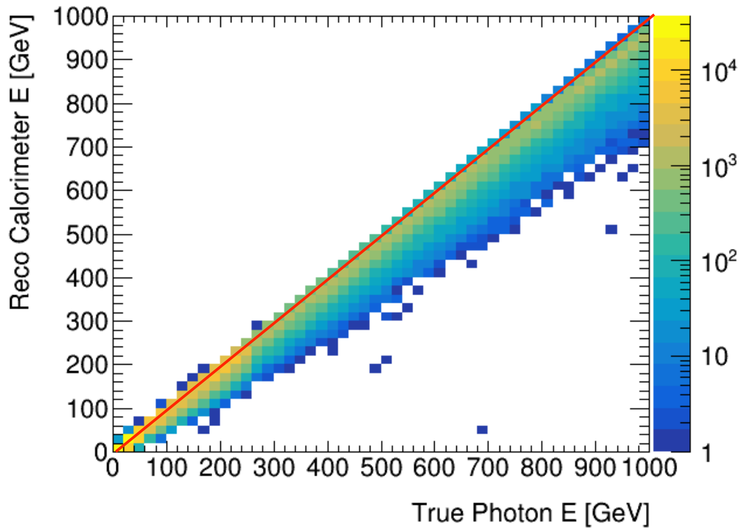
Understanding challenges in photon calibration

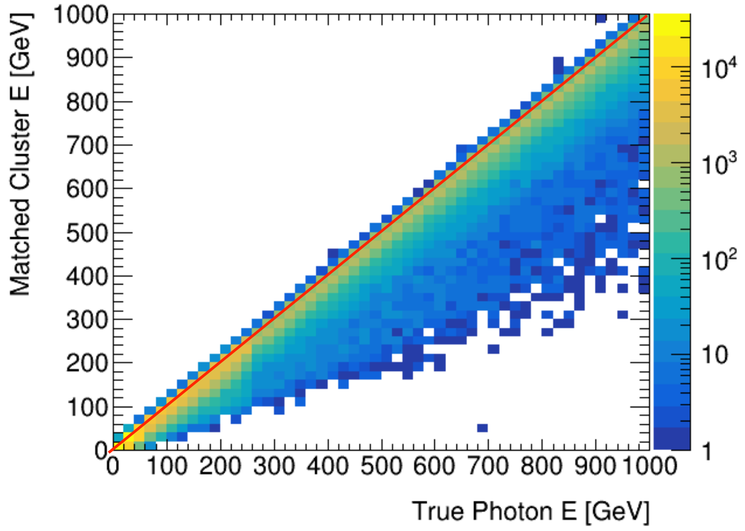
- What calibration stages are there?
  - First we have a flat sim->digi scaling factor that is currently the same everywhere
  - Then at the PFO cluster stage, we re-calibrate using the E_reco dependent response curves that Fede and I made

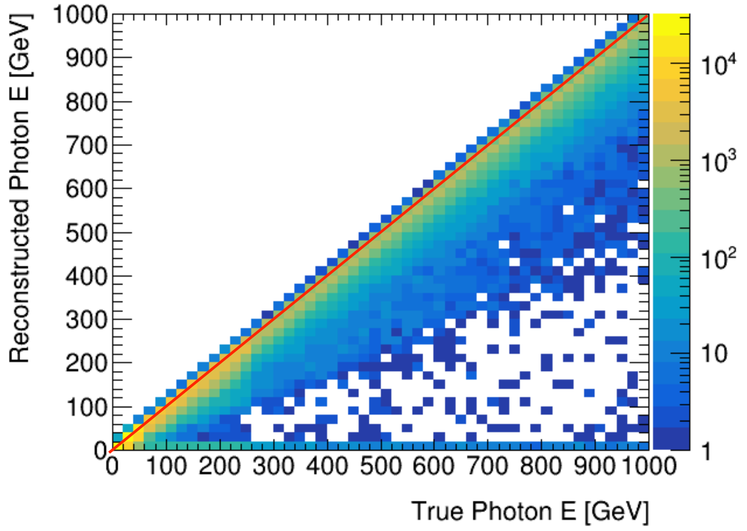
Measured Energies





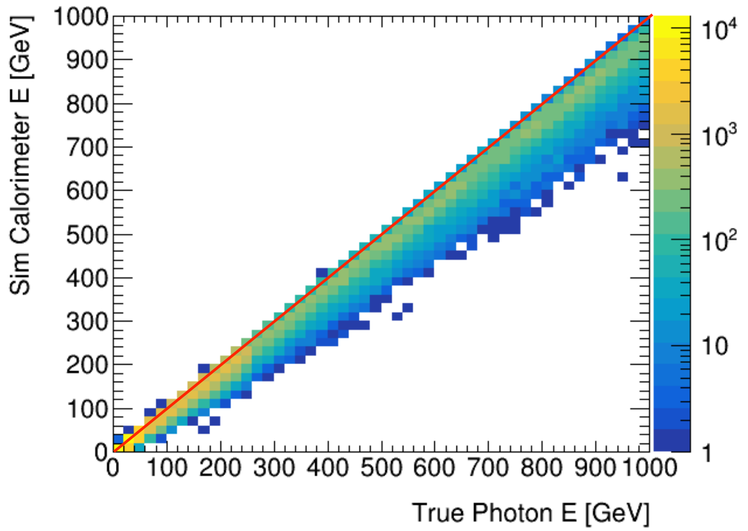


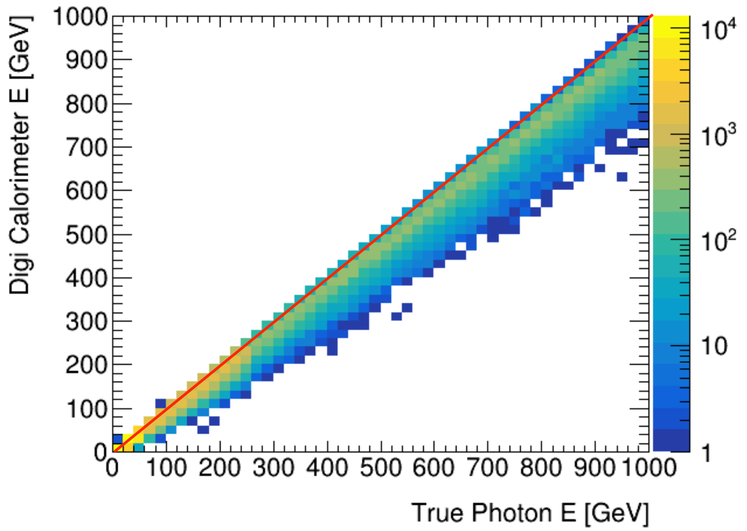


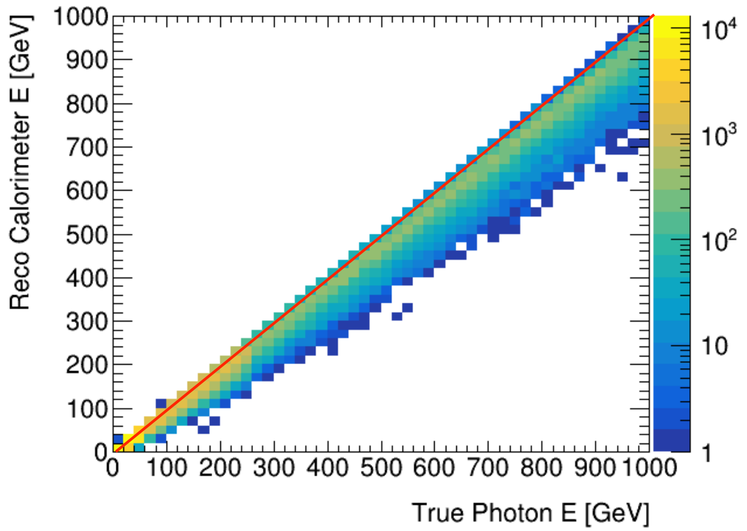


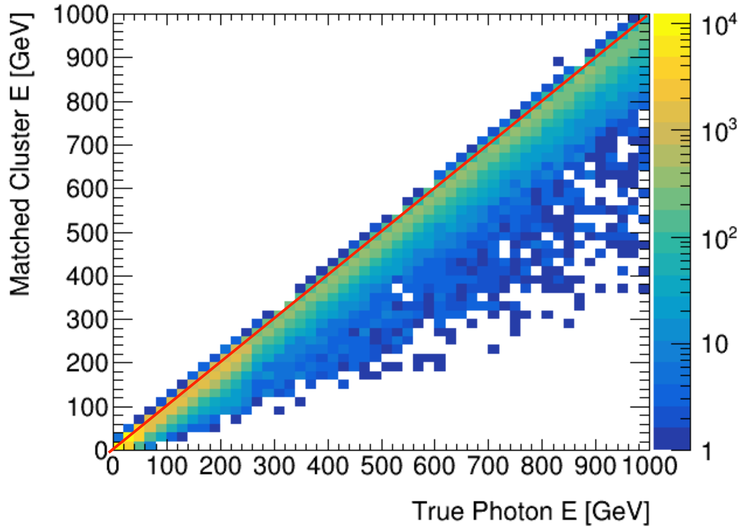
- Interesting that there are some very off-axis ones now even at the Sim level
- Also interesting that photon is not the same as cluster. The key difference is that the reco photon requires the pfo object to have type photon

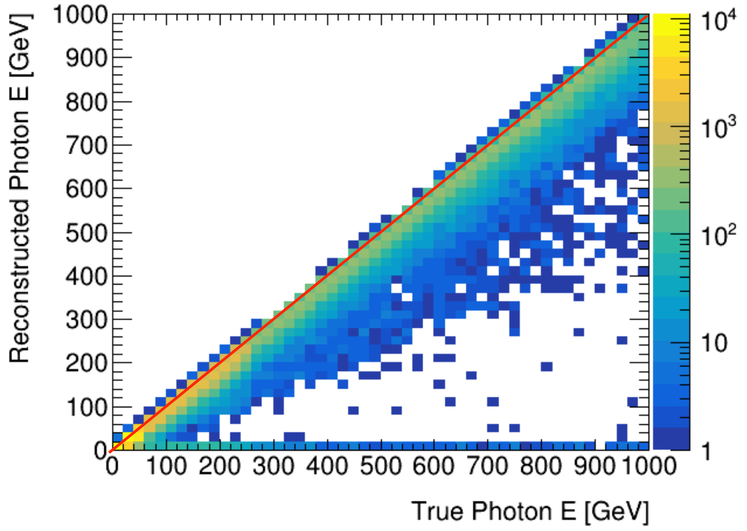
Measured Energies - eta < 1.1





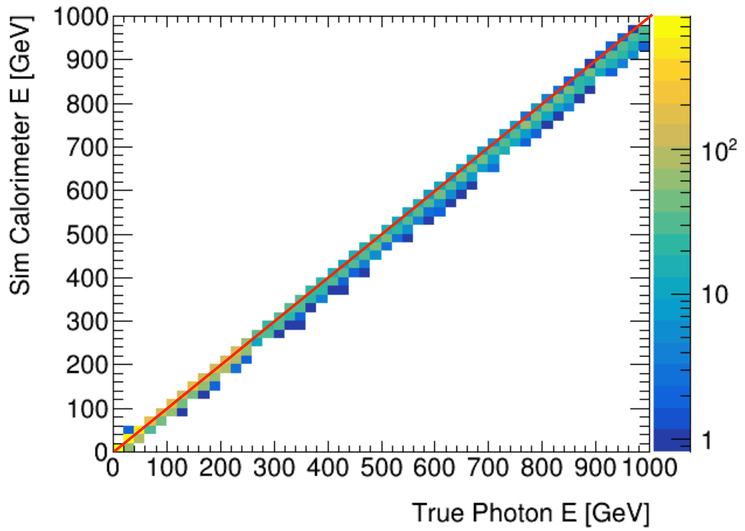


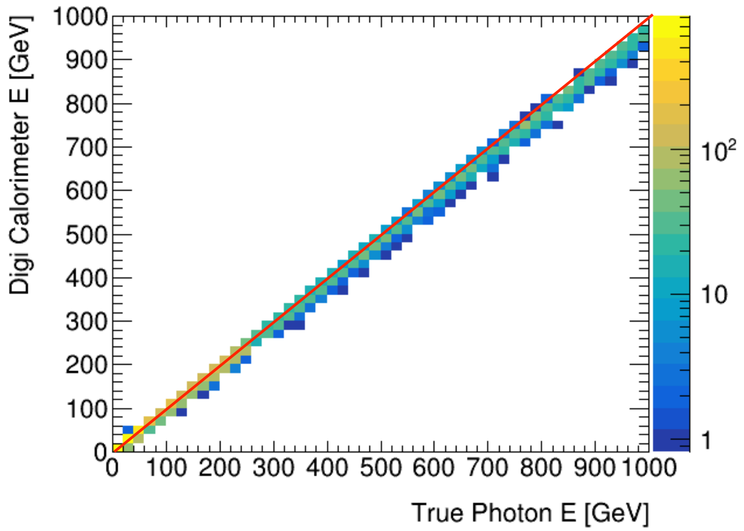


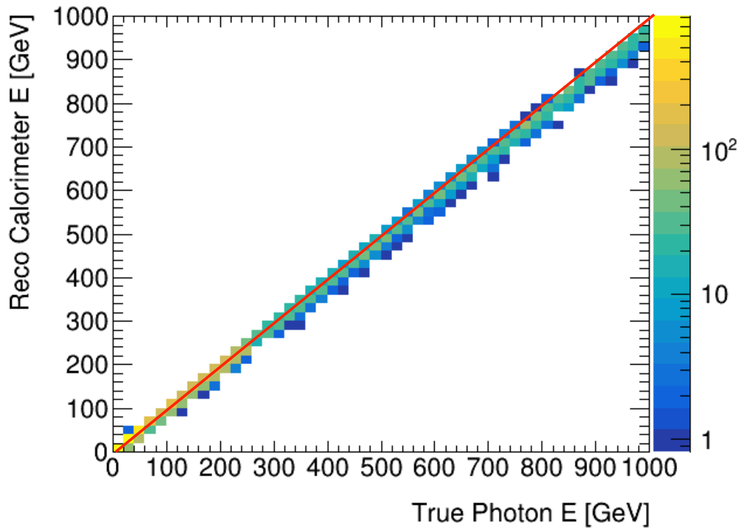


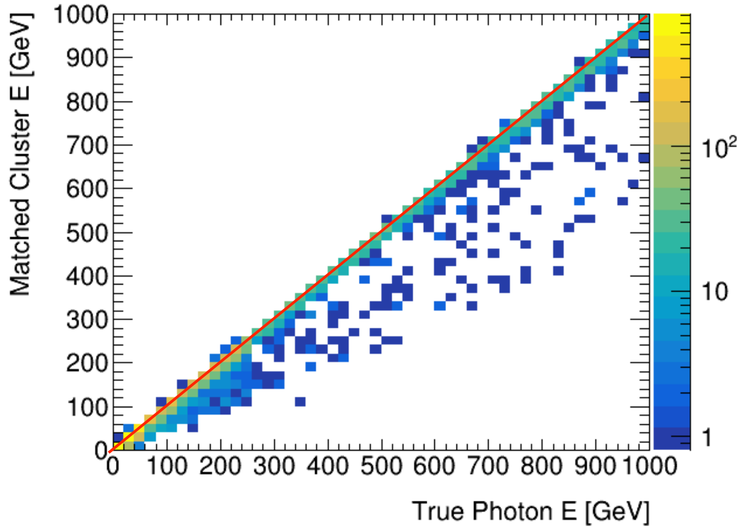
- Clearly smaller proportion directly on-diagonal than in the full population.
- This means that issues begin at the Sim stage (which is already plotted here with the flat calibration factor applied offline, to have a slope of 1).

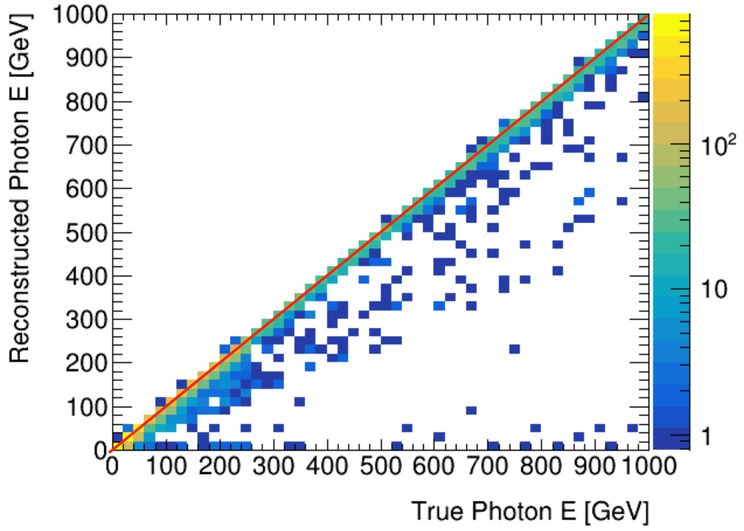
Measured Energies - 1.1 eta < 1.2





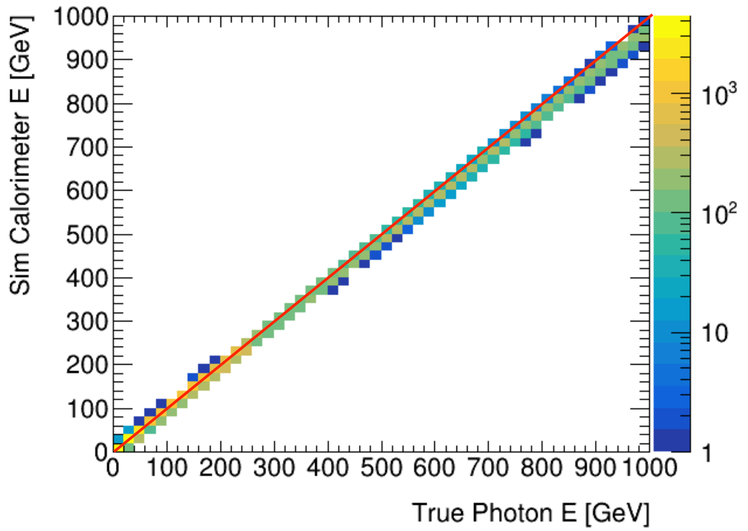


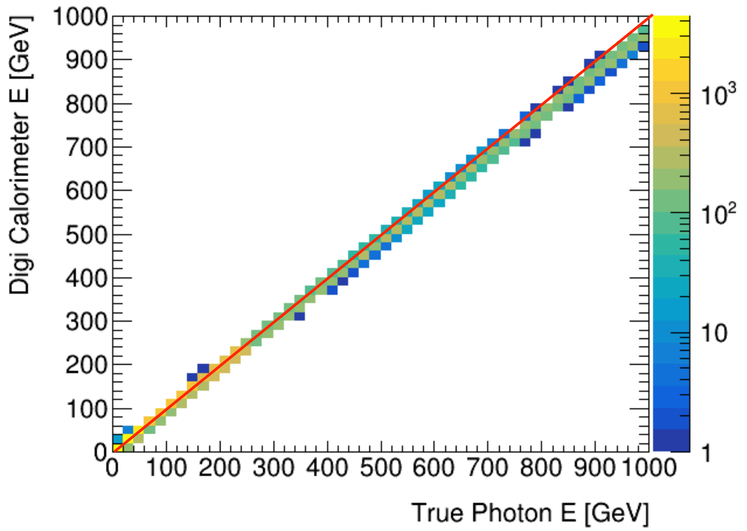


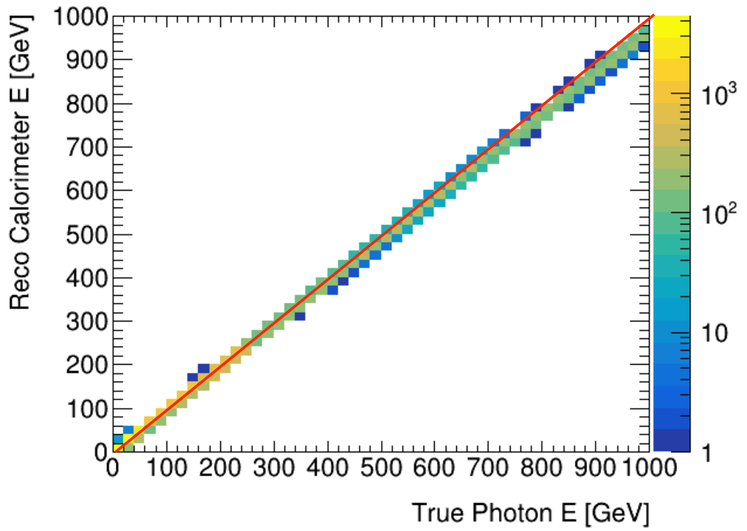


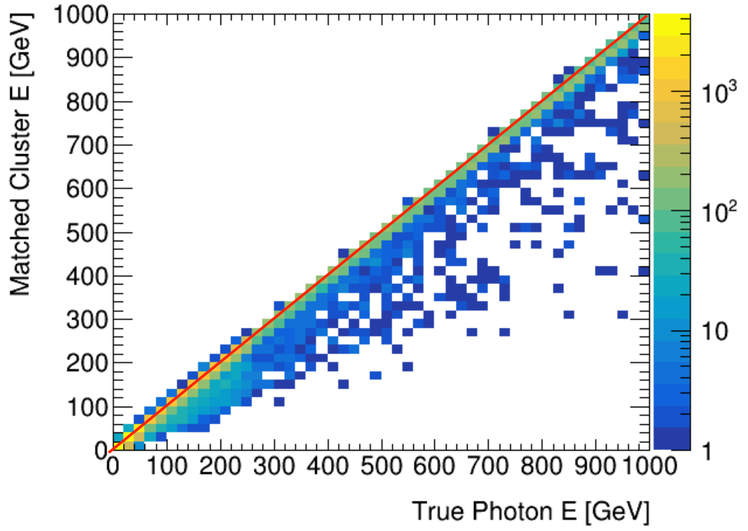
- In the transition region we don't have this issue
- Still some issues with clustering and photon ID, but rare
- See the cluster-level calibration improving the slope slightly at high E

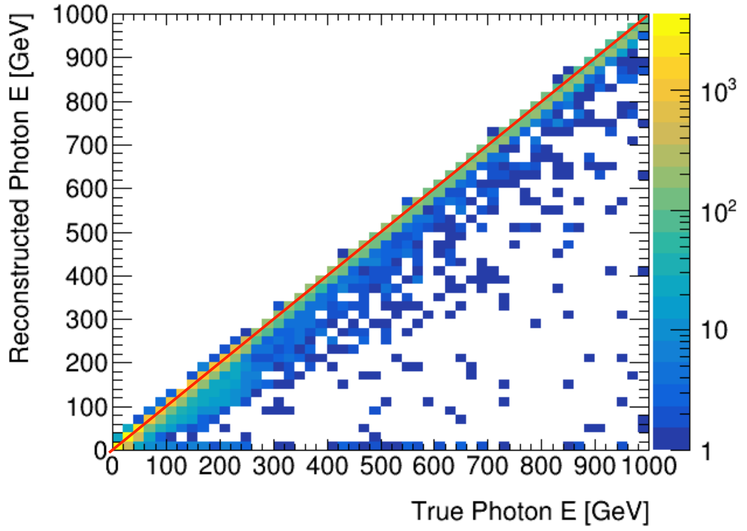
Measured Energies - eta > 1.2





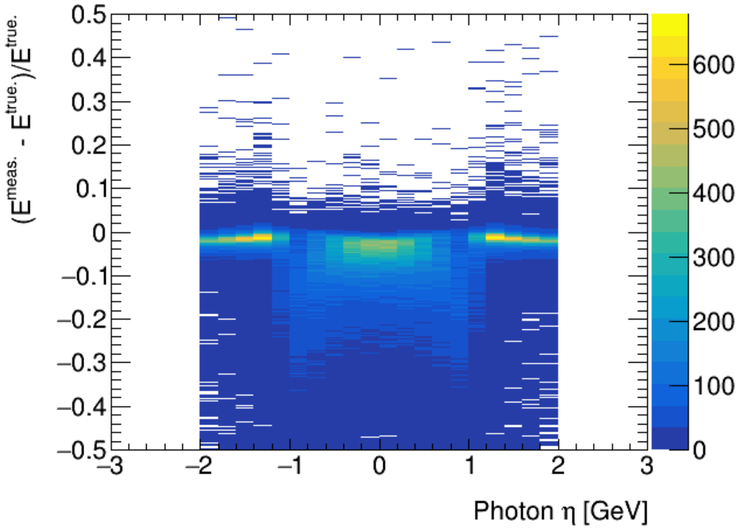


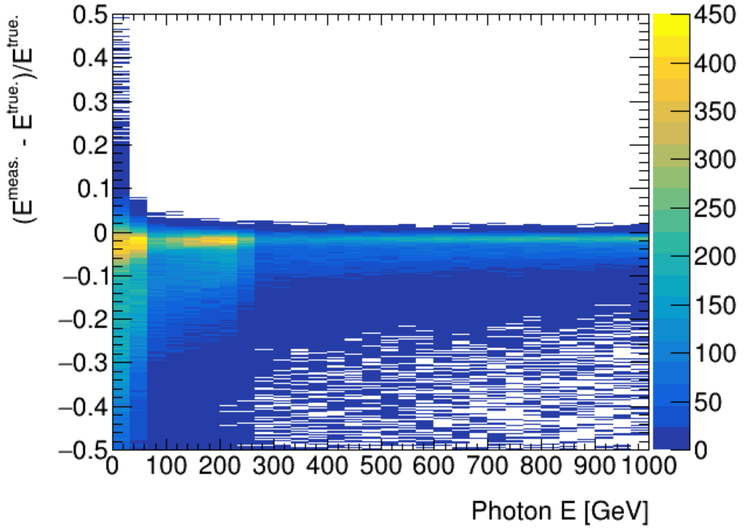


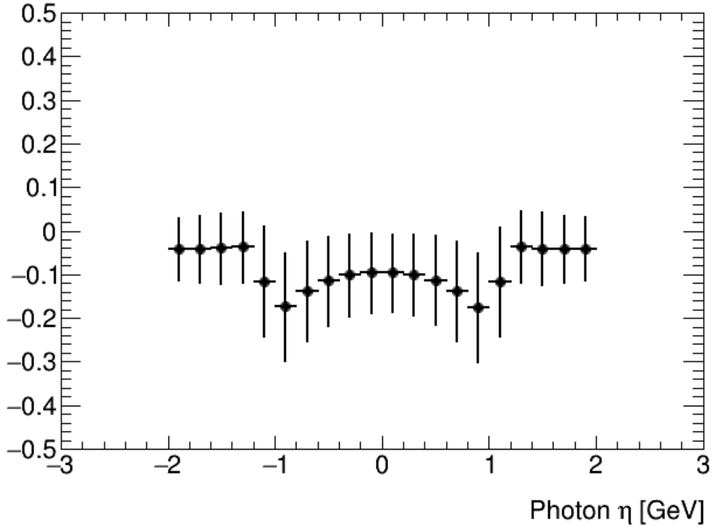


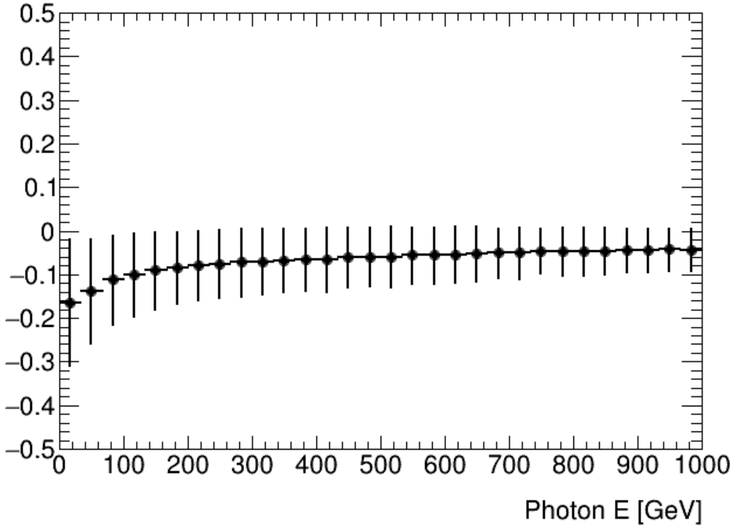
- Endcaps look similar to transition region

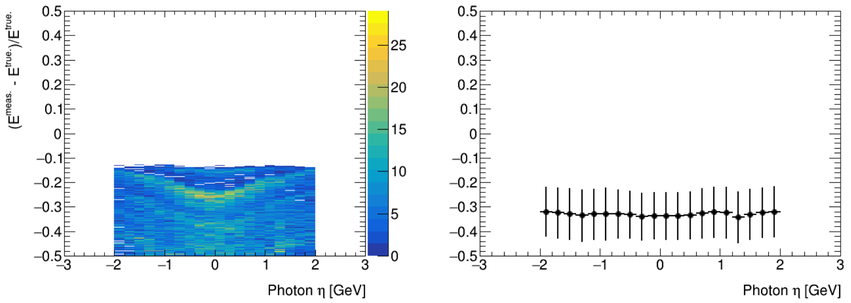
Closer look at reco photons







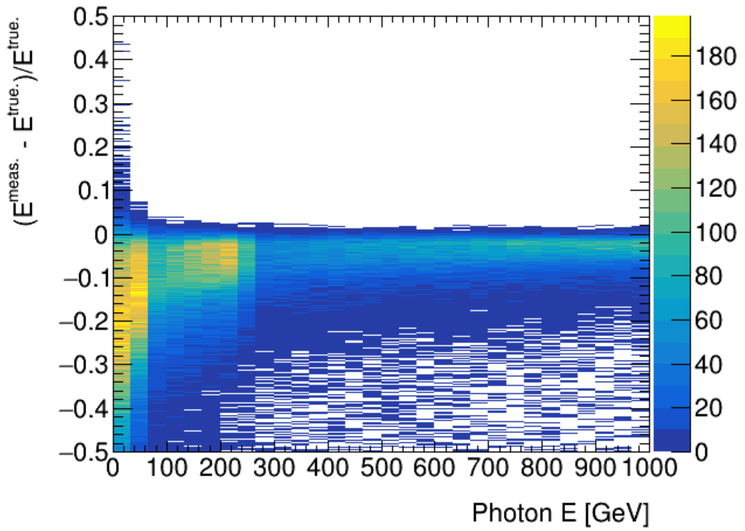


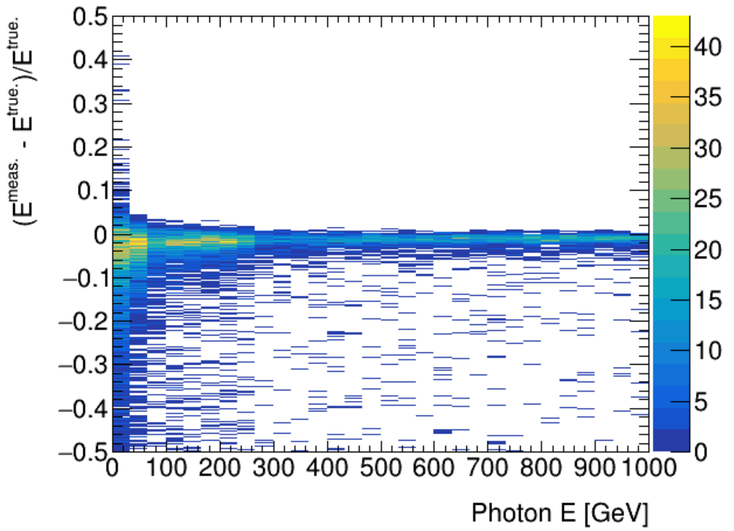


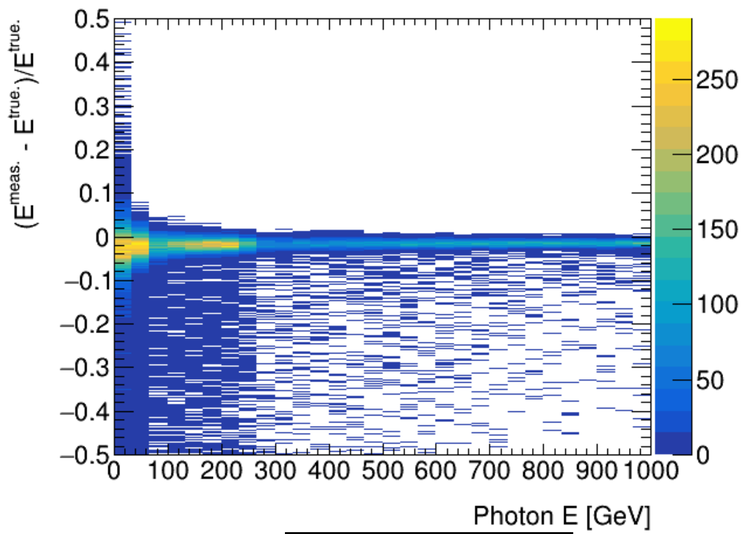
- Reco energies clearly show an eta trend within the barrel
- Has change a LOT since the 11/8 samples, where the eta profile was flat
  - The large spread in energy in old samples was because they were made before we did the cluster-level calibration, so the response at low E was very off.
  - What was the curvy shape due to in the old samples? I think this is just a signature of the way we sliced the sample, but haven't 100% confirmed.

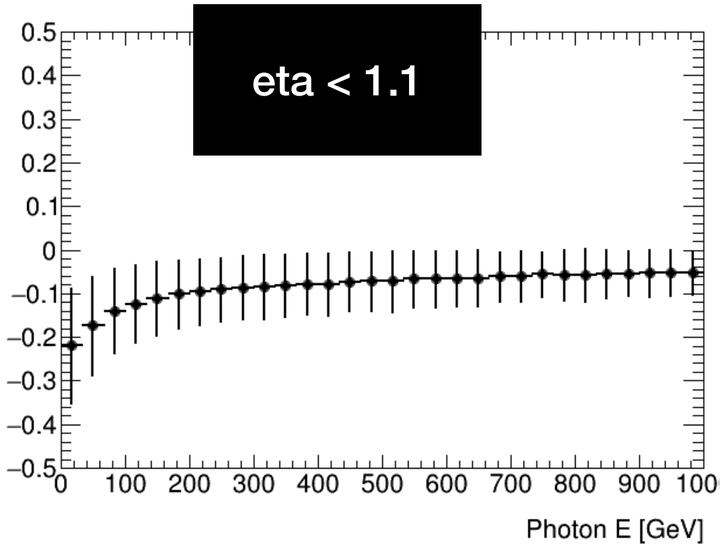
Closer look at reco photons

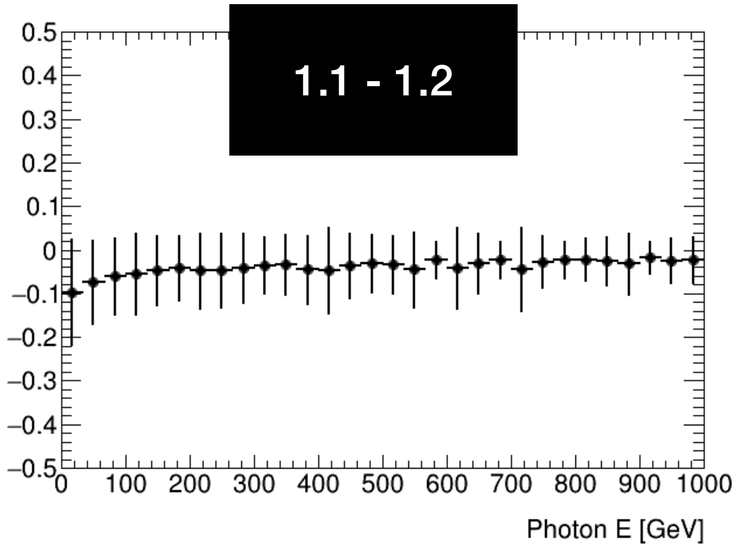
- These plots confirm that the overall calibration we're using is way off for central eta

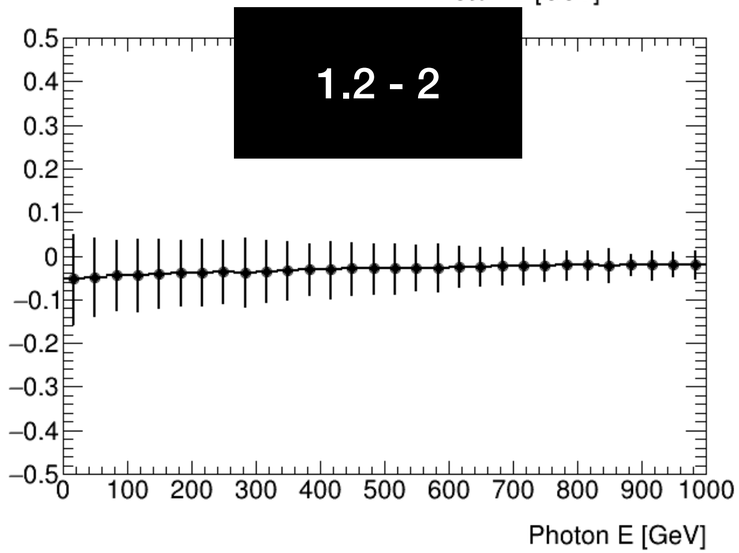












Thoughts

- The flat sim->digi scaling is clearly not working well in the barrel, and the cluster-level calibration isn't fixing the problem
- What should we do next?
  - To really fix the problem, need eta/z dependent sim->digi scaling, and need to re-derive constant and then re-derive the cluster-level calibration
  - Clearly some big changes were introduced that we don't understand. Seems to have affected barrel calibration in particular. Was a setting changed?
    - We really shouldn't overwrite old samples, but preserve a history including the configs we used to run them
  - What our the time-optimal solution?