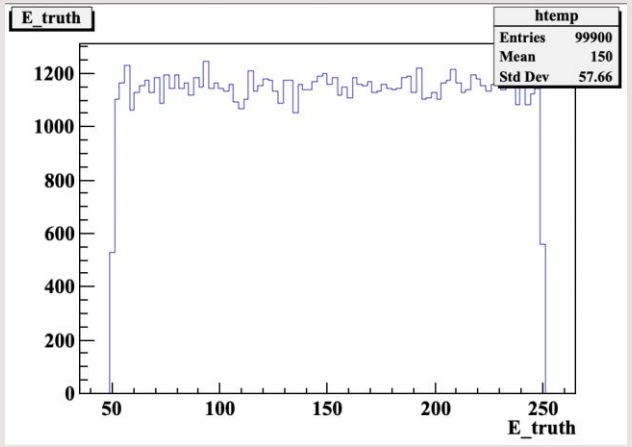
ECAL Energy Calibration Updates

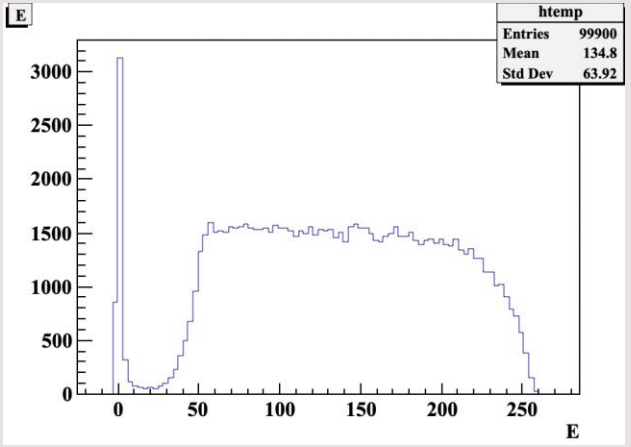
11–18 September 2024

Rose Powers (Princeton)

Where we left off…

- Initially aiming to develop ECAL energy calibration from **photon PFOs**
- Using v2 photonGun samples (/ospool/uc-shared/project/futurecolliders/data/fmeloni/DataMuC_MuColl10_v0A/v2/reco/photonGun*)
- Badly behaved dataset, resolution was strange… upon further inspection, a huge collection of PFOs were being assigned ~0 energy or even E<0 (lovely example below)





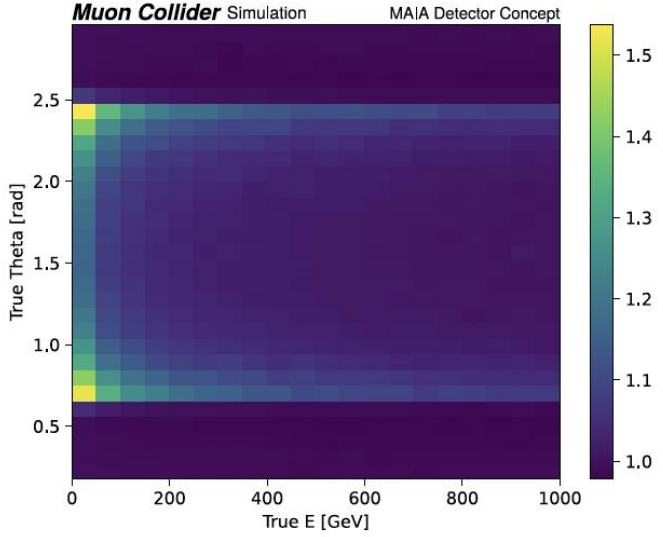
- Ultimately due both to bad angular range (my fault) and spurious cluster fragmentation (Pandora's fault)
- So… followed Federico and Elise's advice and switched to **jets**

Jets resolve this issue

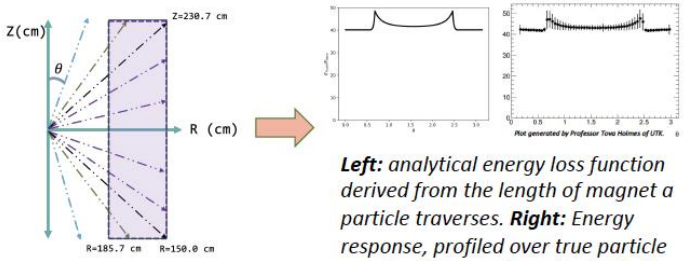
- Switching from photon PFOs to photonic jets circumvents reliance on Pandora clustering
- This more robust method yields an accurate ECAL calibration map! Panel from my USMCC poster below:

Energy Response in the Electromagnetic Calorimeter (ECAL)

$E_{true} / E_{reconstructed}$ *for photons, using jets as reconstructed objects*



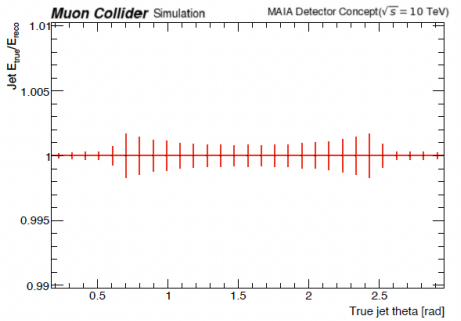
- Symmetric, non-linear **theta-dependence**
  - Introduced by solenoid position
- **2D calibration** needed
  - Energy-dependent and theta-dependent
- Shape of theta-dependence results directly from solenoid geometry:

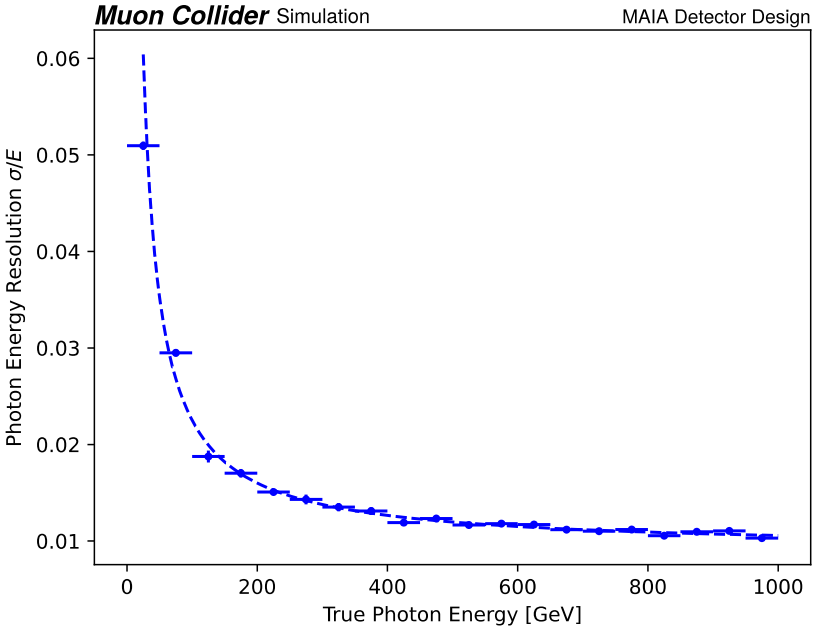


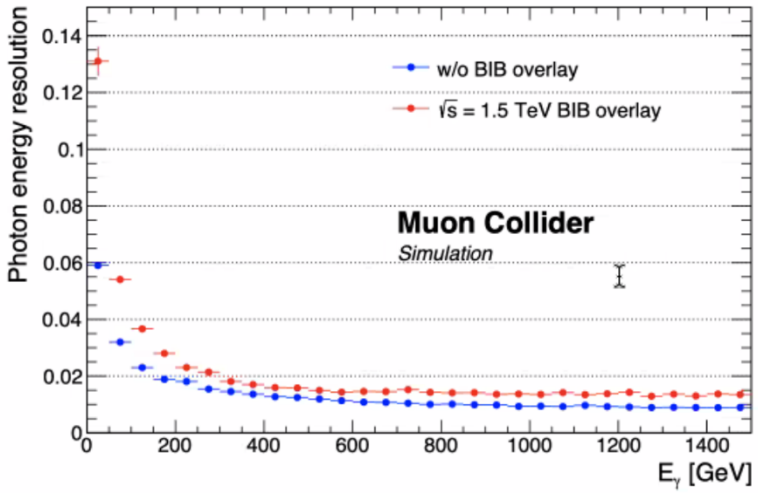
Left: *analytical energy loss function derived from the length of magnet a particle traverses.* ***Right:*** *Energy response, profiled over true particle energy. (Disregard constant offset).*

Response and resolution

- Post-calibration response plots indicate calibration works (at least on the sample it was derived from, somewhat circular but a first step)
- More excitingly, we finally get a resolution curve for 10TeV samples that rivals our photon resolution from EPJC!





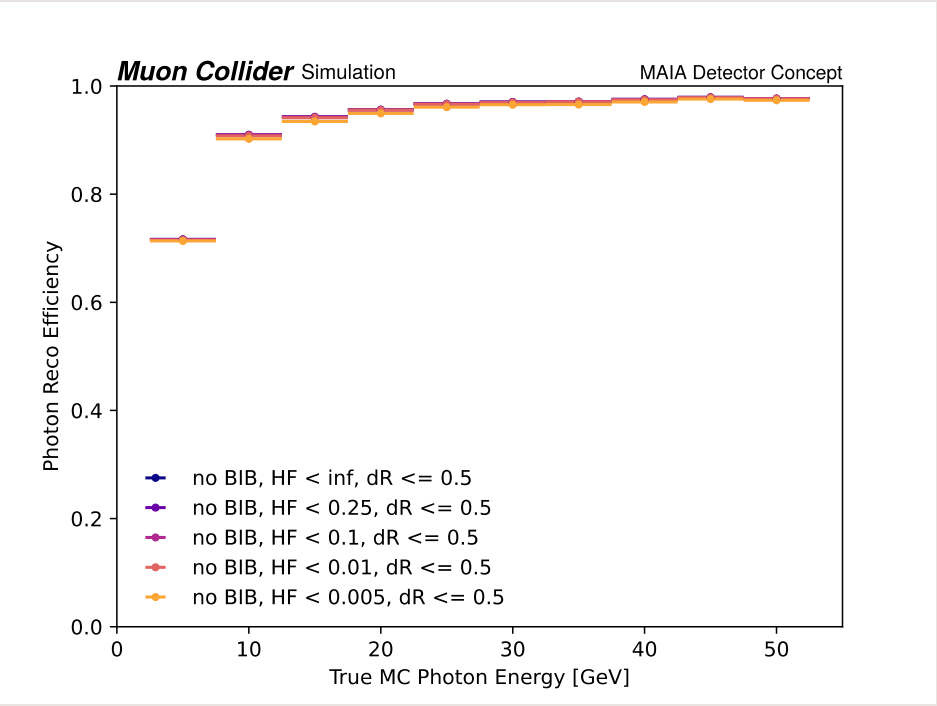


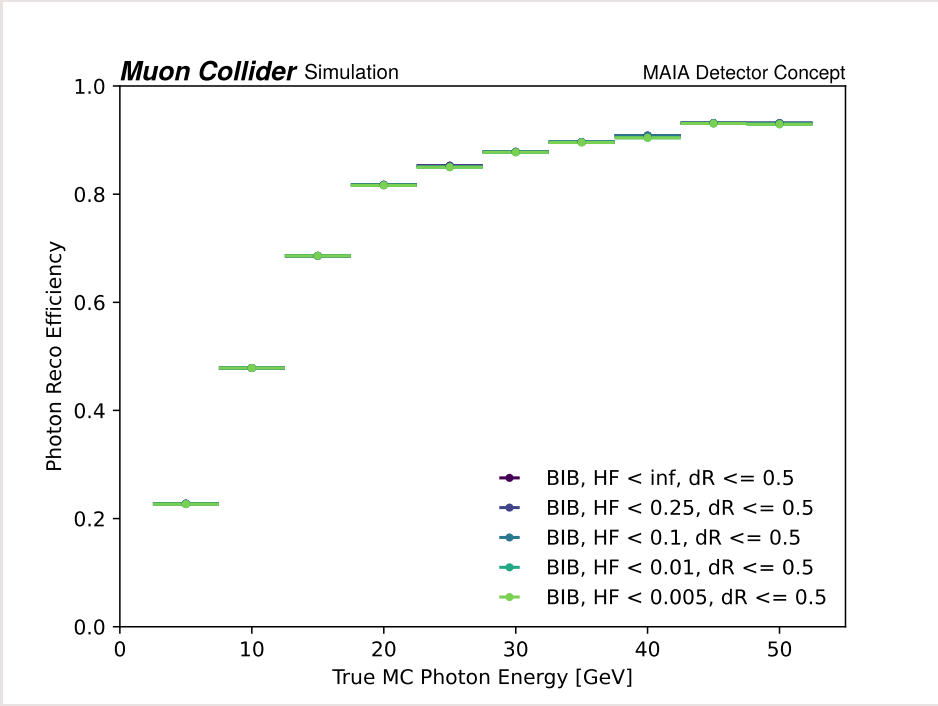
Current work: Photon BIB samples

- Fede sent me the 0-50GeV slice this morning, just beginning to analyze it
- Will attempt to proceed with jets, although I have concerns about a robust method with BIB
- Immediate goals: determine efficiency for jets, apply ECAL energy calibration and see how it affects the BIB sample
- Ultimate goals: repeat resolution study with BIB and achieve comparable results to EPJC

Some photon efficiency plots (low E)

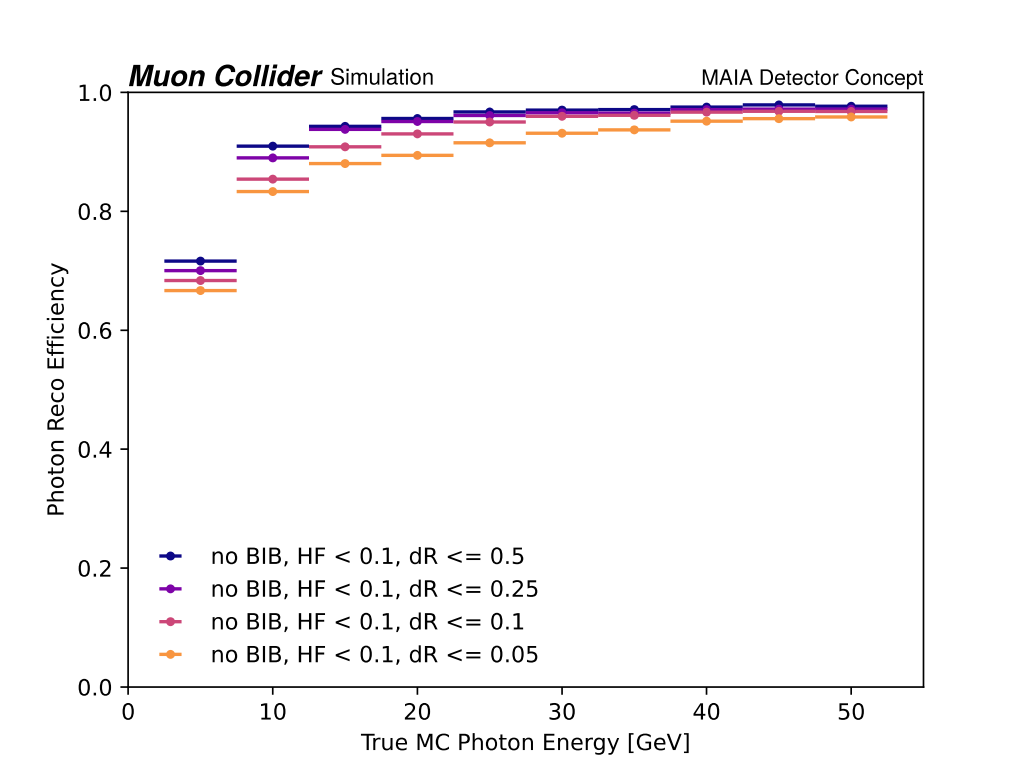
- Before diving into BIB sample resolution, Kylie suggested I look at efficiency
- Photon reco efficiency wity PFO objects (not jets), for BIB and no-BIB
- Varied dR matching condition and maximum hadronic energy fraction
- First, HadFrac: looking for threshold at which efficiency starts to drop

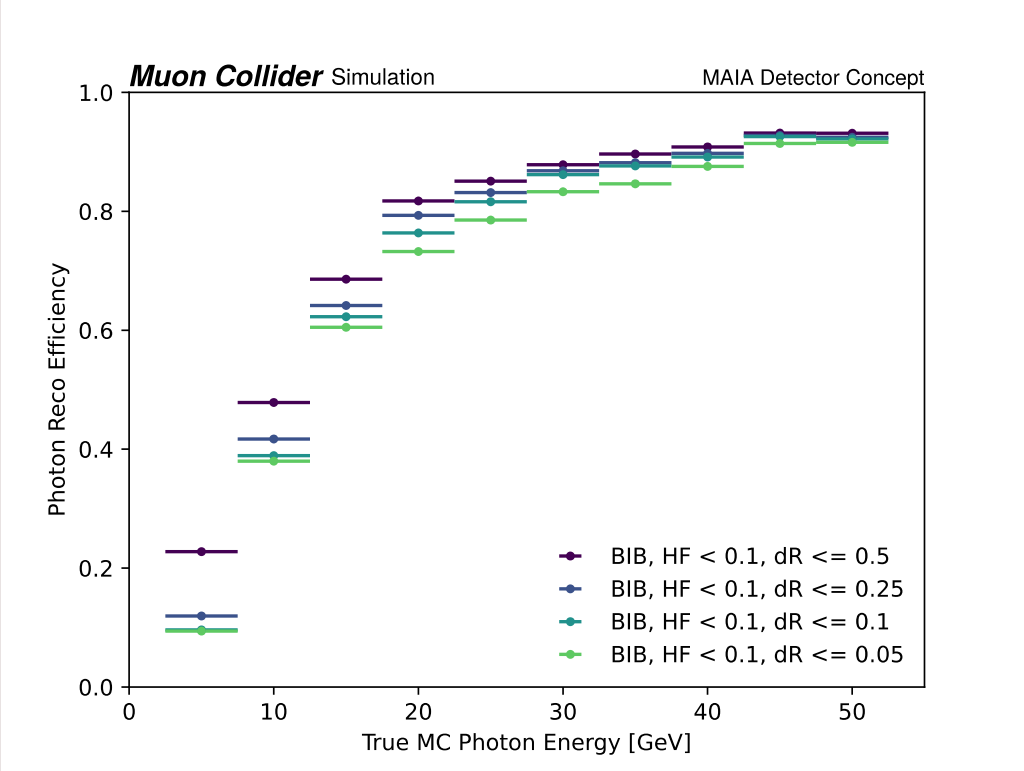




Efficiency continued: dR variation

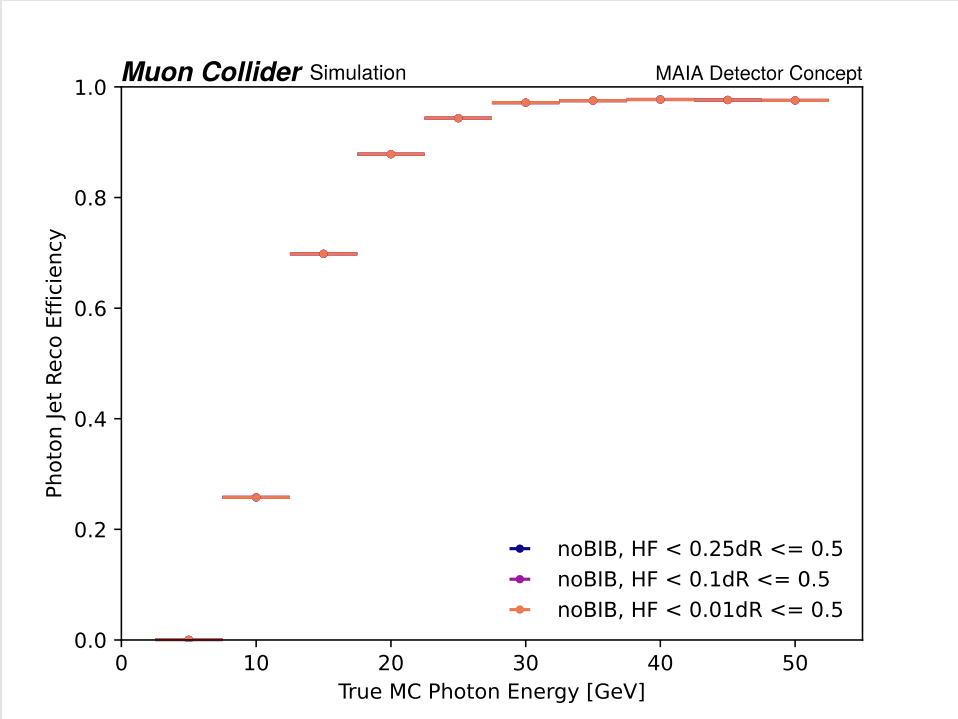
- Now, holding maxHadFrac constant at 0.1 (the last value before efficiency starts to decrease), vary maximum dR





More efficiency, but with jets: hadronic E fraction

- Varied maxHadFrac again, but this time with jets
- Jet efficiency for very low energies is lower across the board
- Explored a narrower range, based off what was seen in the last study



BIB version coming soon… currently running ☺

Next…

- I am in the process now of finishing the HF BIB plots and repeating the dR efficiency plots for jets
- Ultimately, my goal is to determine tighter cuts on dR and hadFrac to make it possible to use jets for resolution studies with BIB
- After efficiency studies are done, will repeat reso studies, beginning with energy response and calibration for BIB sample