Updates to geometry and photon reconstruction II

Detector meeting, 11/05/2023

Renaming v0B and cleaning it up

Moved v0B into v0A to create panic and confusion

- Cleaner to number things in the order they are actually looked at
- In debugging last week's problems, found a number of GEANT4 volume overlap-related issues, and a general recipe to find them (see below)
- Geometry cleaned up and uploaded to git

Running the Geant4 Overlap Check

Create the following file as `overlap.mac`

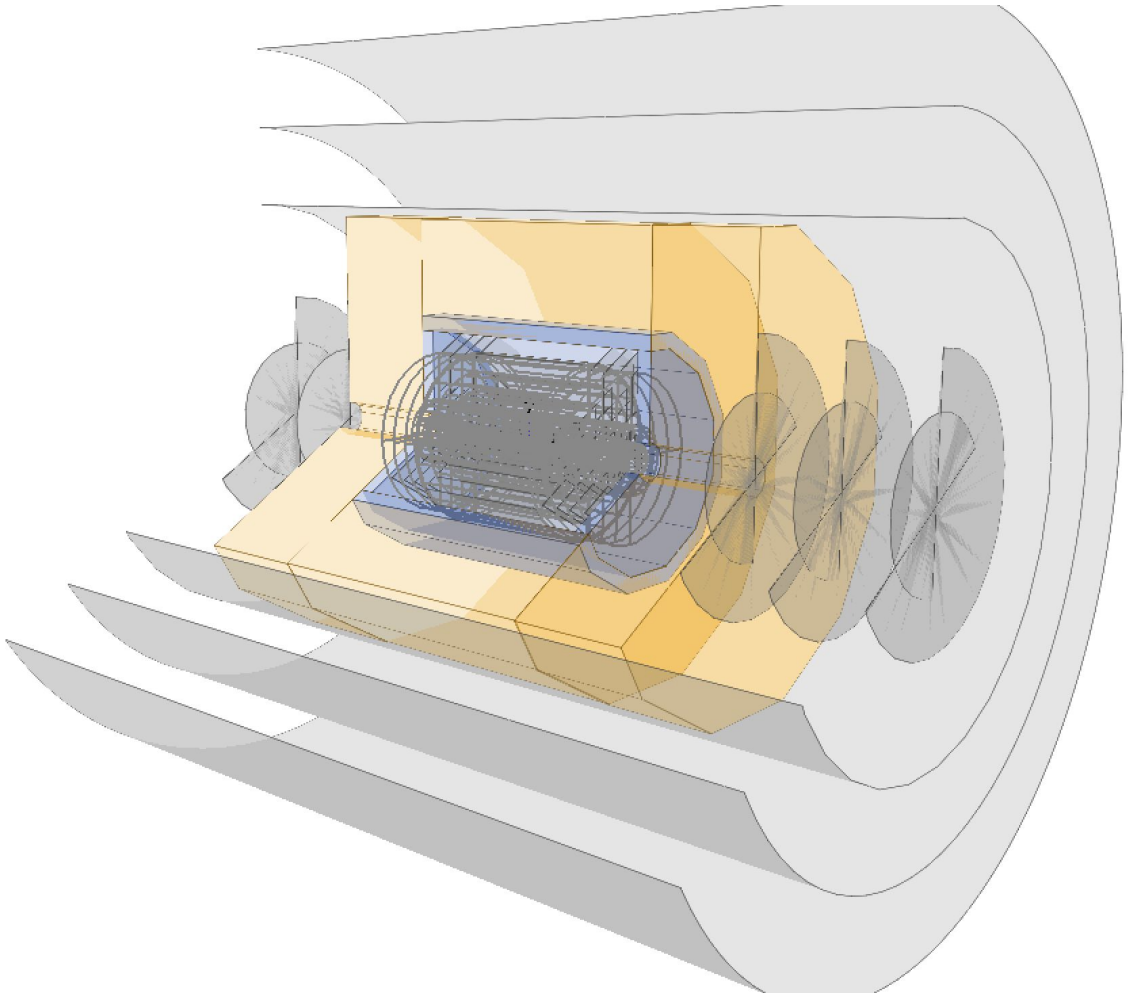
```
/geometry/test/run
exit
```

And then we run `ddsim` with this macro file, and dump the output to a text file for easy browsing

```
ddsim --compactFile FCCee_o1_v05/FCCee_o1_v05.xml \
      --runType run \
      --macroFile overlap.mac > overlapDump &
```

Muon Spectrometer status

Swapping the Yoke for the MS causes some issues at reco level because pandora is hardcoded (?) to expect a certain types of *DetType* inputs.

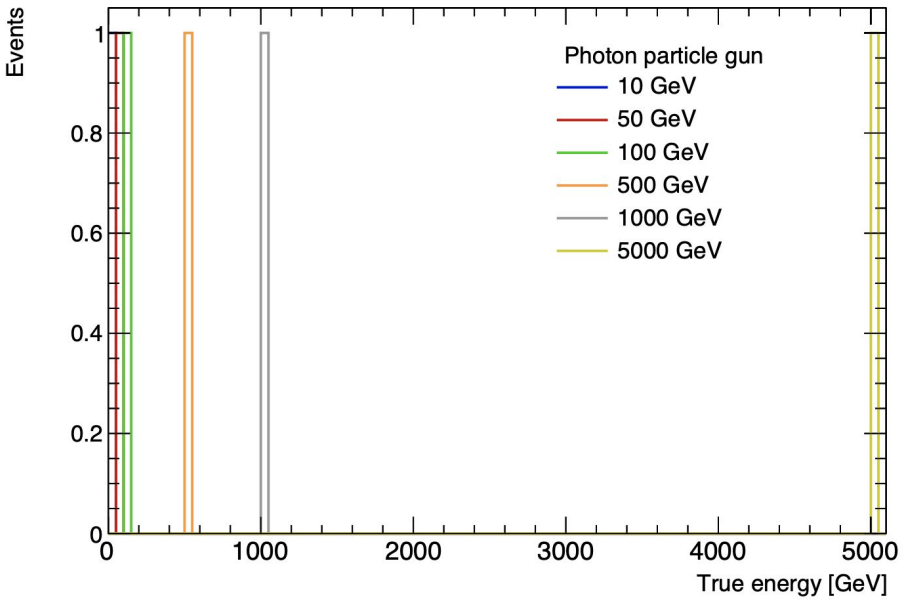


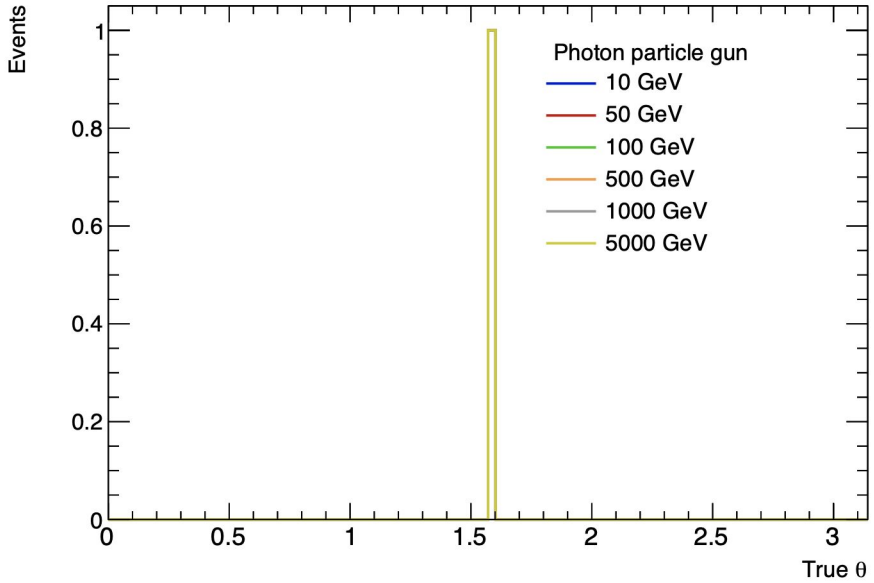
Postponed push to git for this reason. Will likely give geometry different name.

Still todo:

- Add magnetic field, see discussion
- Fix endcaps

Particle gun inputs: photons



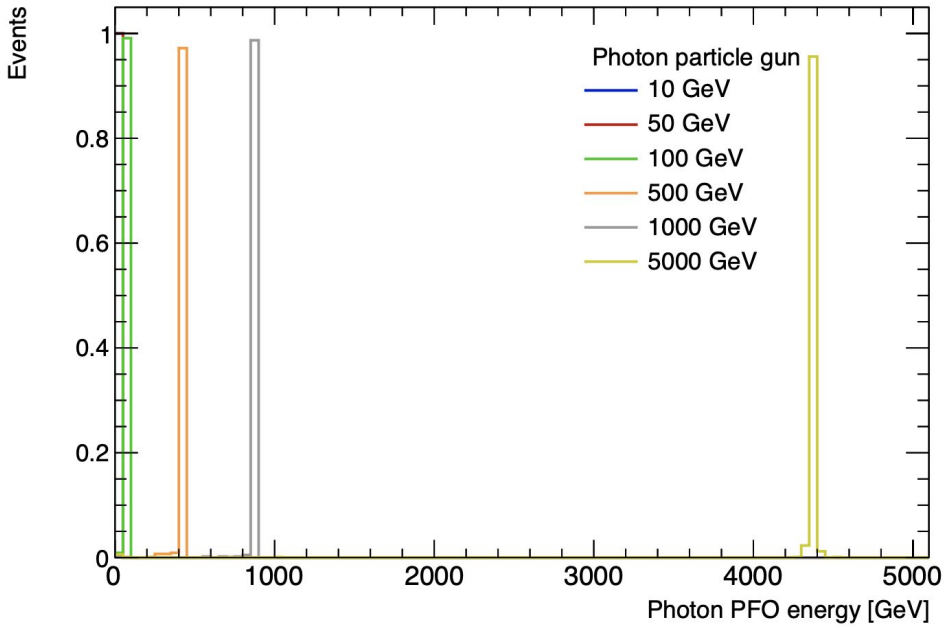


Goal: test hermeticity and energy resolution of calorimeter.

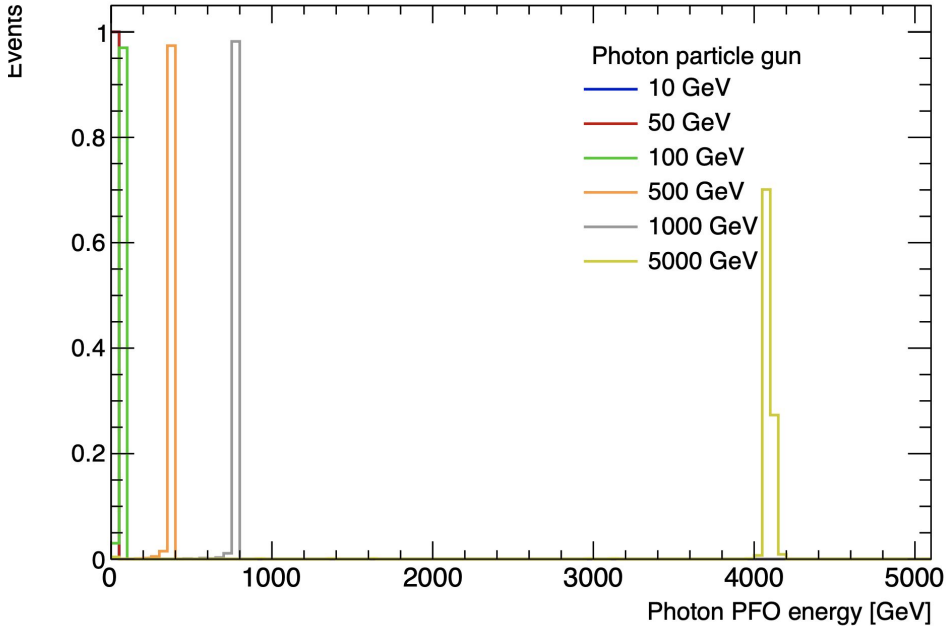
Shot monochromatic particle gun sample at 90 degrees wrt to beam axis.

Study with and without BIB.

Photon PFO: energy

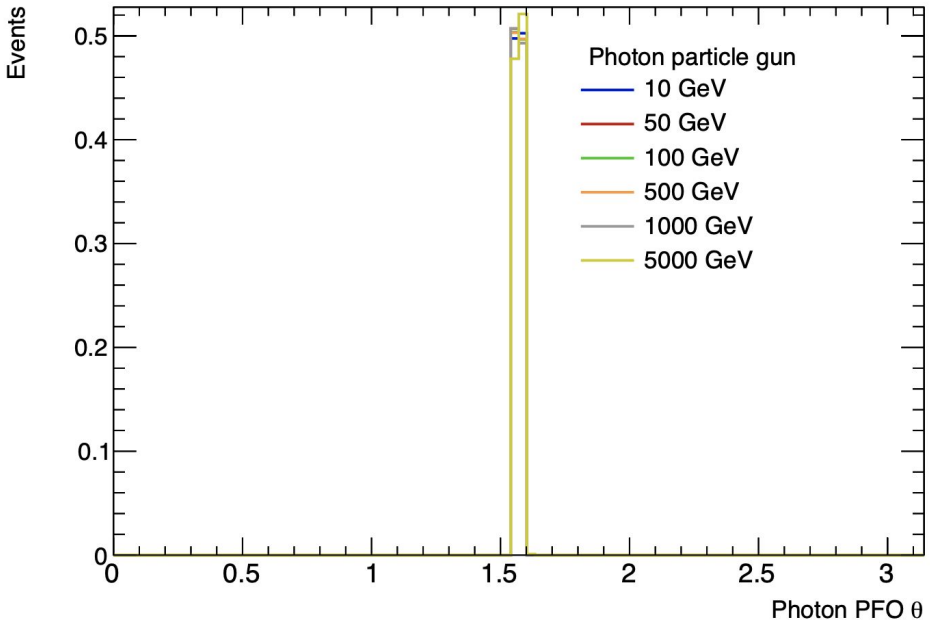


With BIB overlay

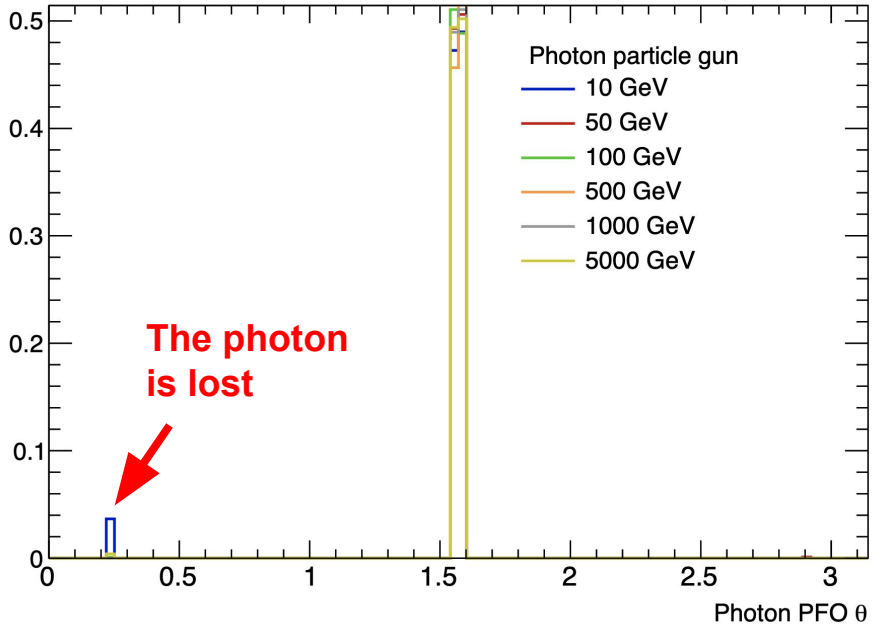


Applied delta R matching and looked at reco PFO (particle flow object) quantities

Photon PFO: theta

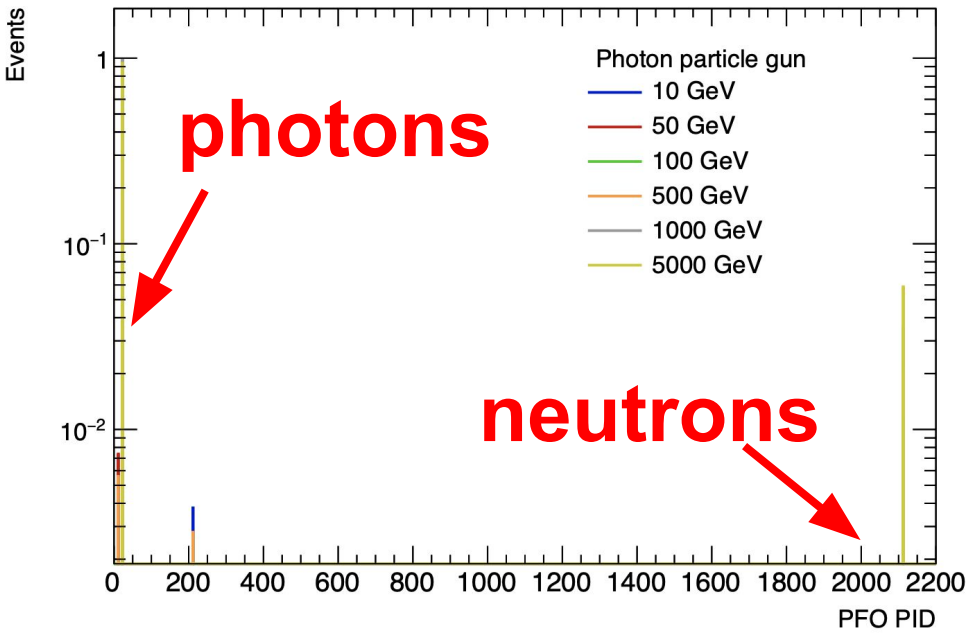


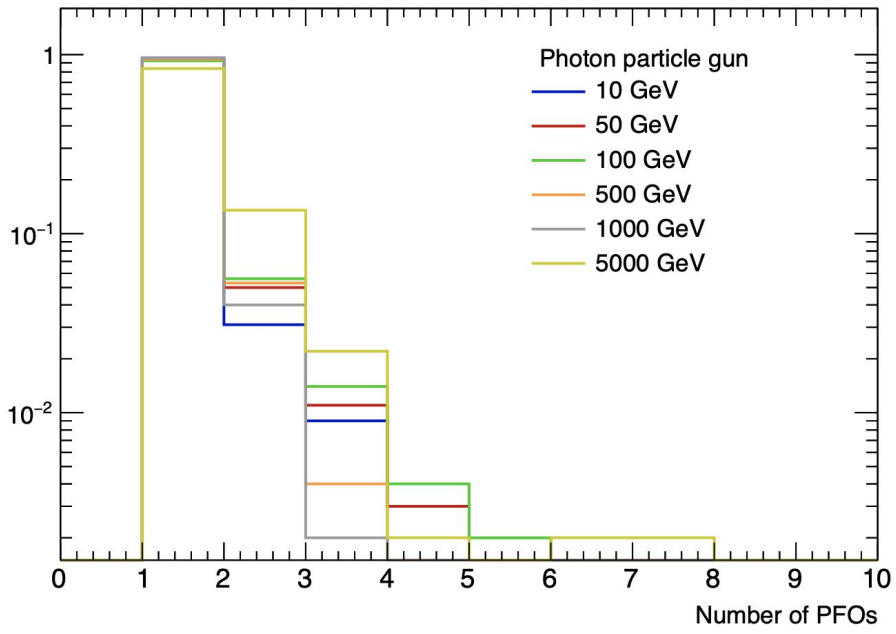
With BIB overlay



Applied delta R matching and looked at reco PFO (particle flow object) quantities

Photons?

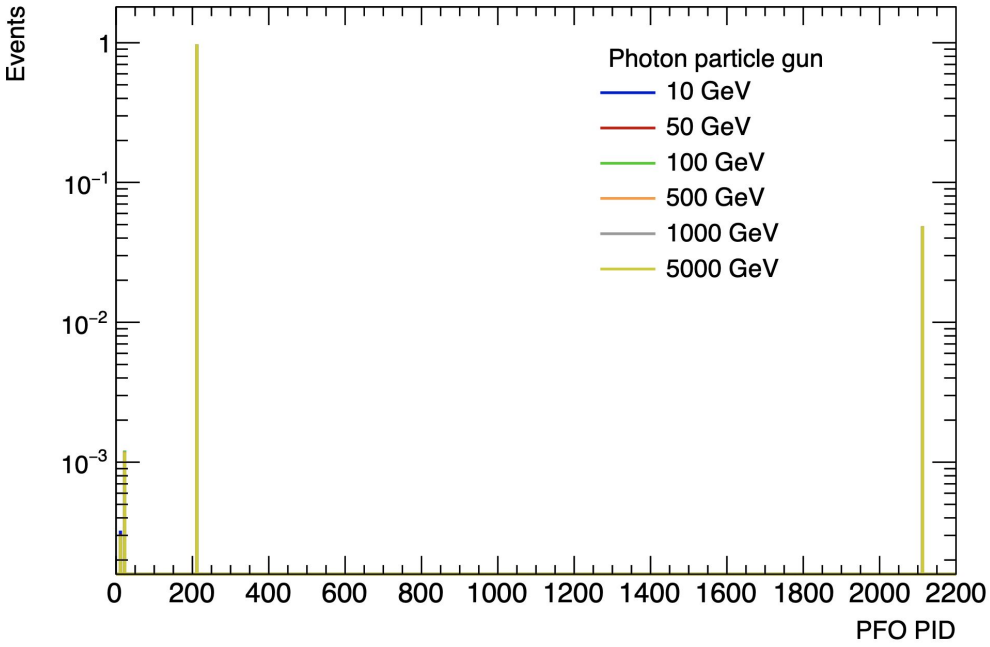




Photons leaking into HCAL are reconstructed as both a both and a neutron (or seldom as some meson)

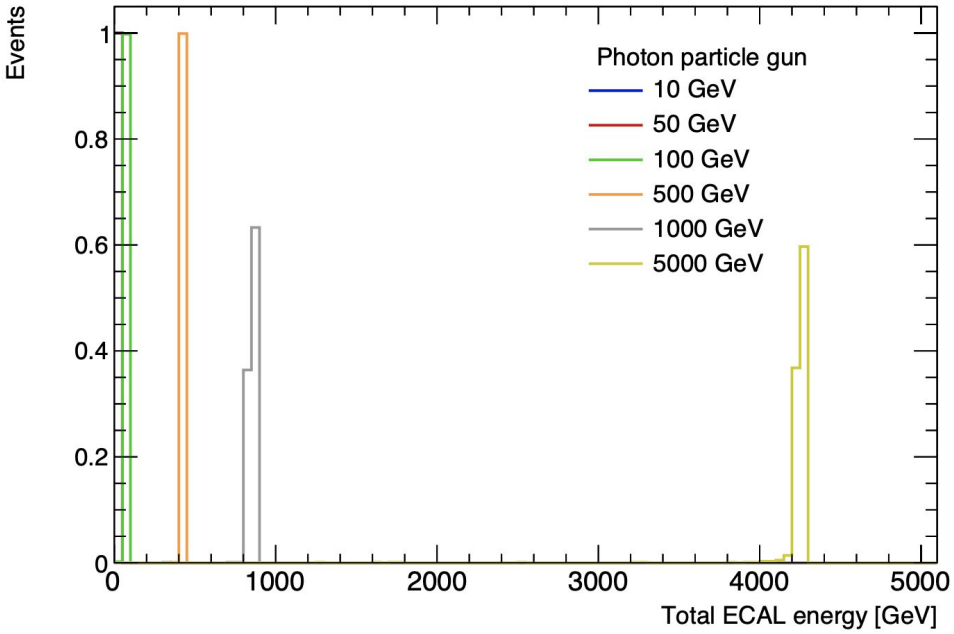
In 10% of the cases, more than 1 PFO is reconstructed

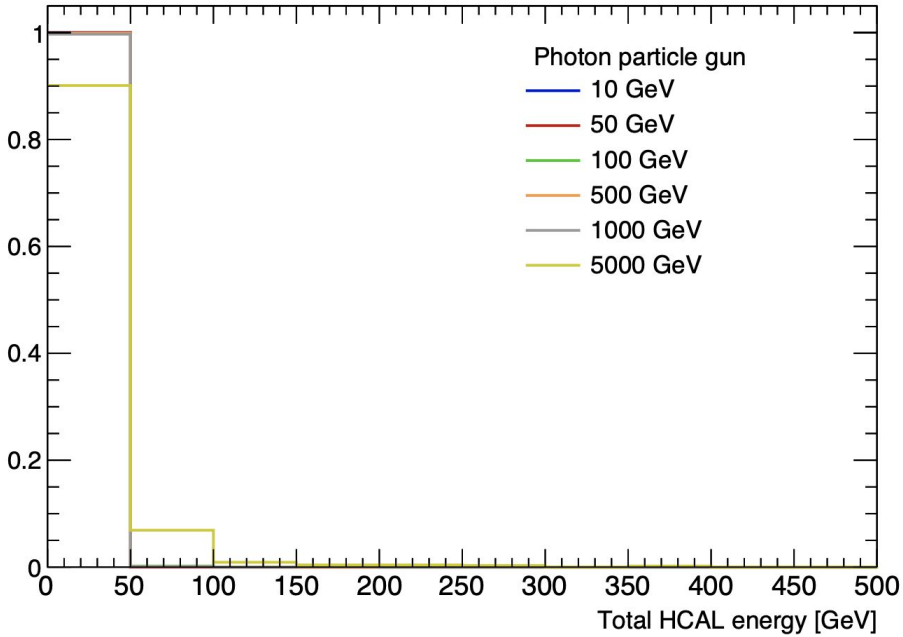
PFO identification with BIB



Presence of BIB degrades PID significantly (only 0.1% is correctly identified)

Total energy in calorimeters





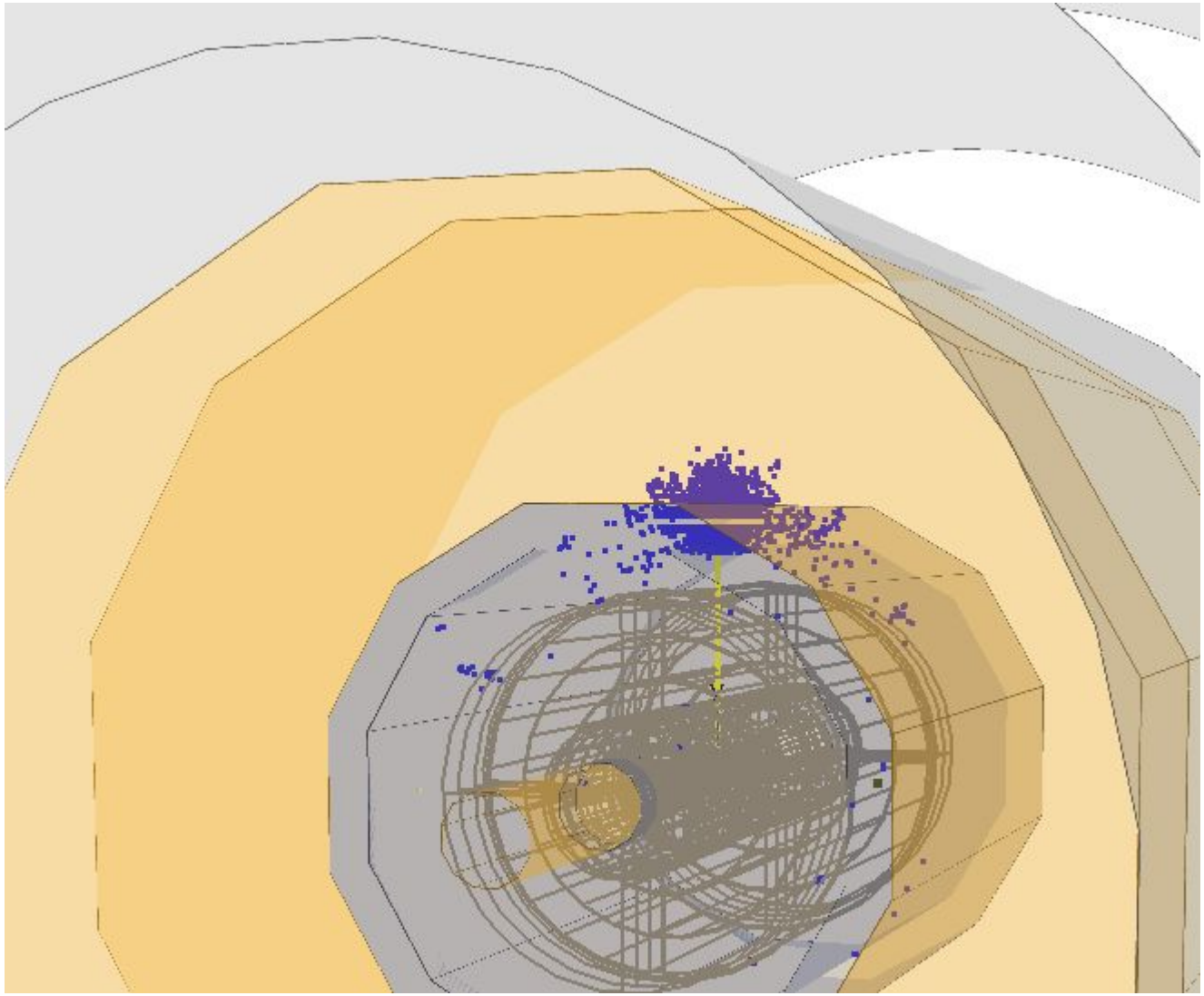
HCAL sumE [GeV]

Decided to look at energy in cells.

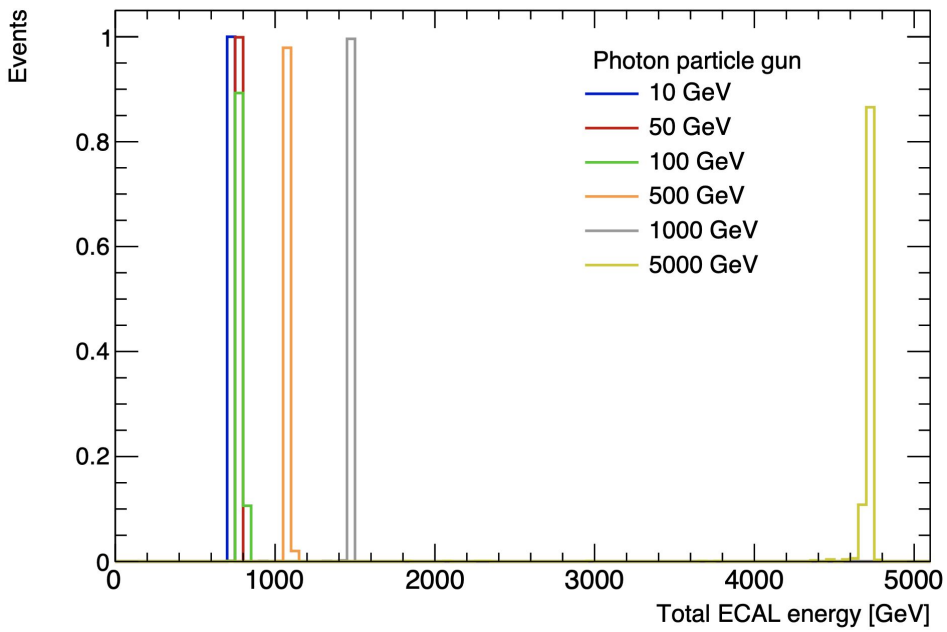
Leakage in HCAL relatively small. Keep in mind these histograms are using the “default” calibration (which is off).

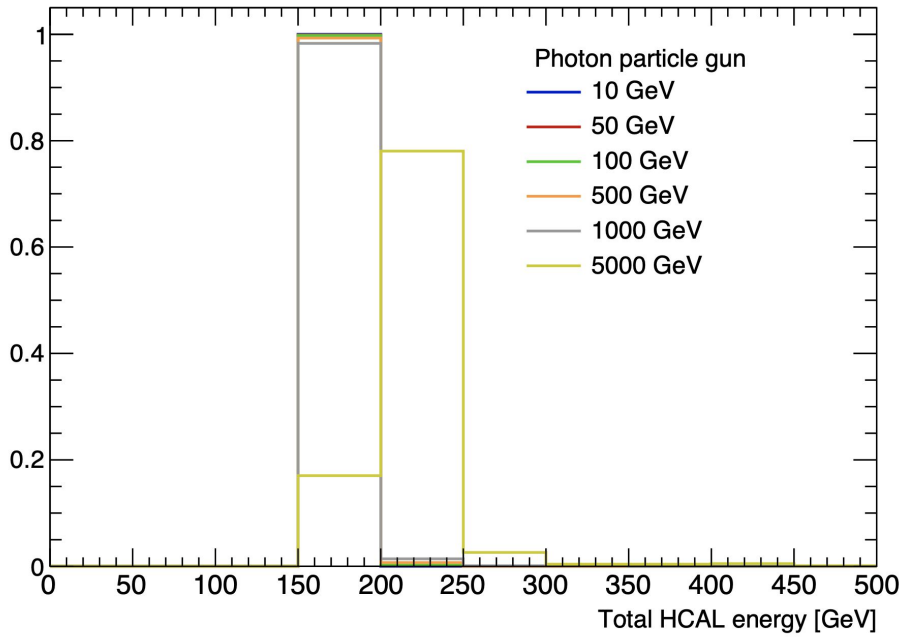
Event display of a 5 TeV photon

No BIB



Total energy in calorimeters with BIB



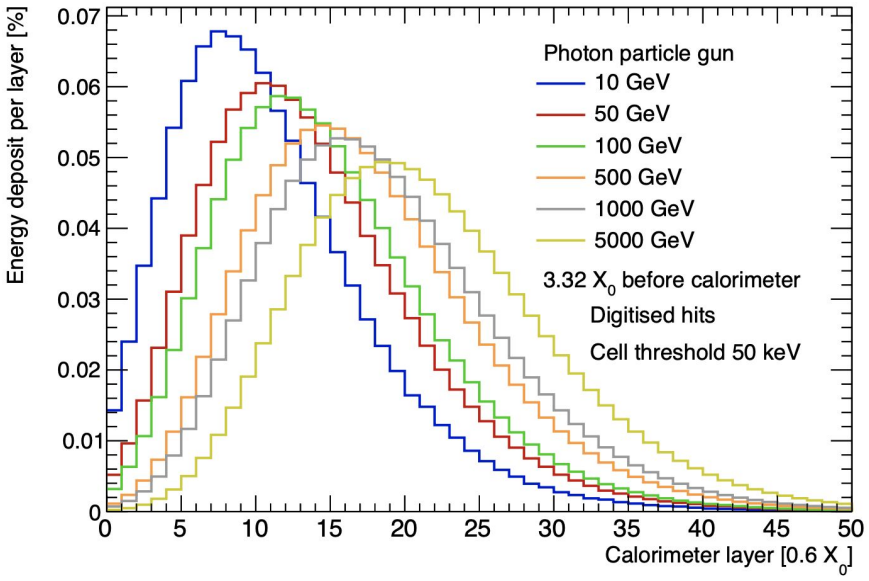


Look at energy in cells with BIB overlay.

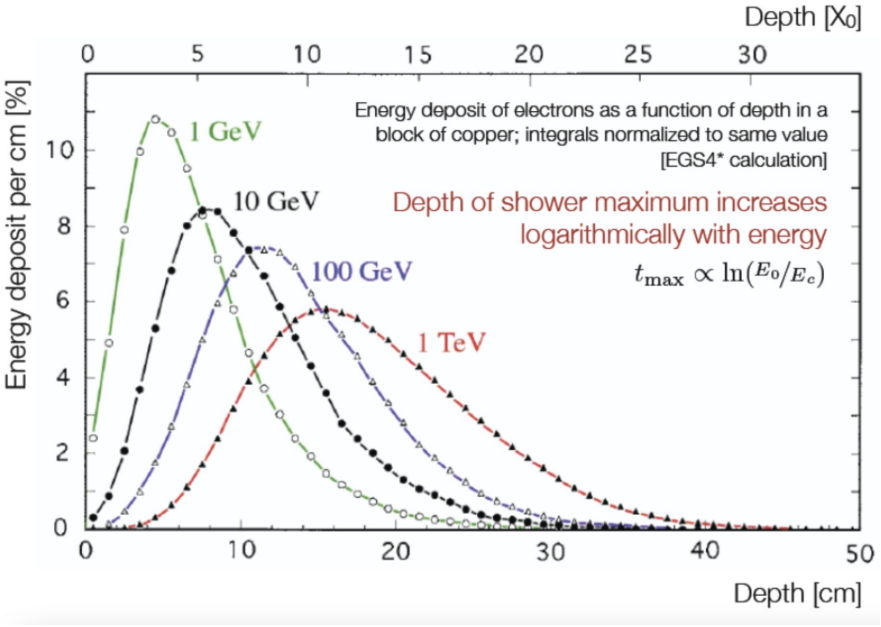
Can clearly see the the BIB plateau in both calorimeters

Looking at shower evolution

MuColl_10TeV



Reference

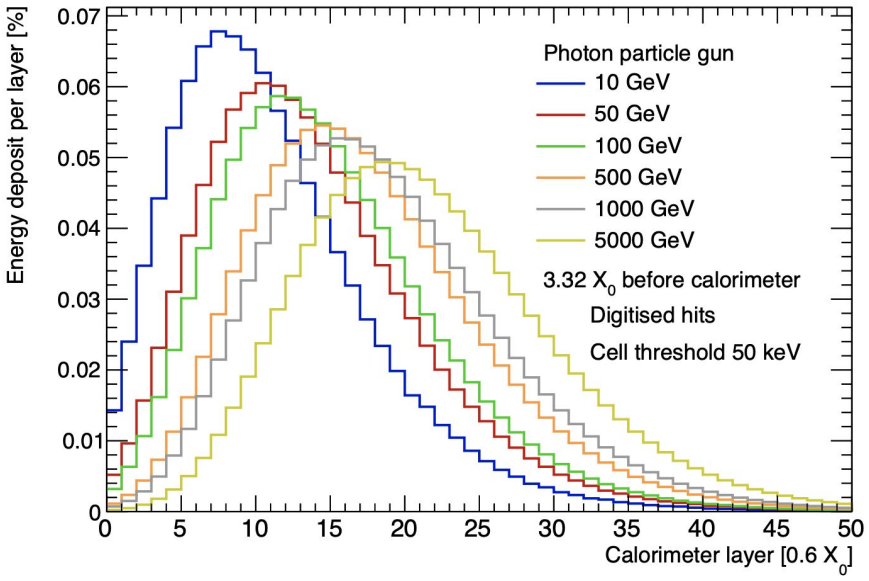


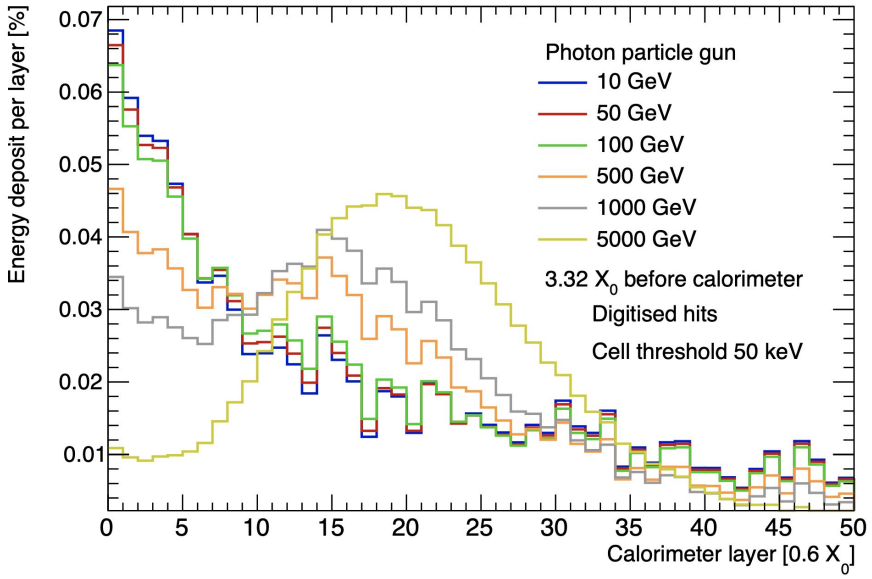
Checked detailed shower evolution.

- Consistent with expectations, can be used to optimise calo depth

Looking at shower evolution with BIB

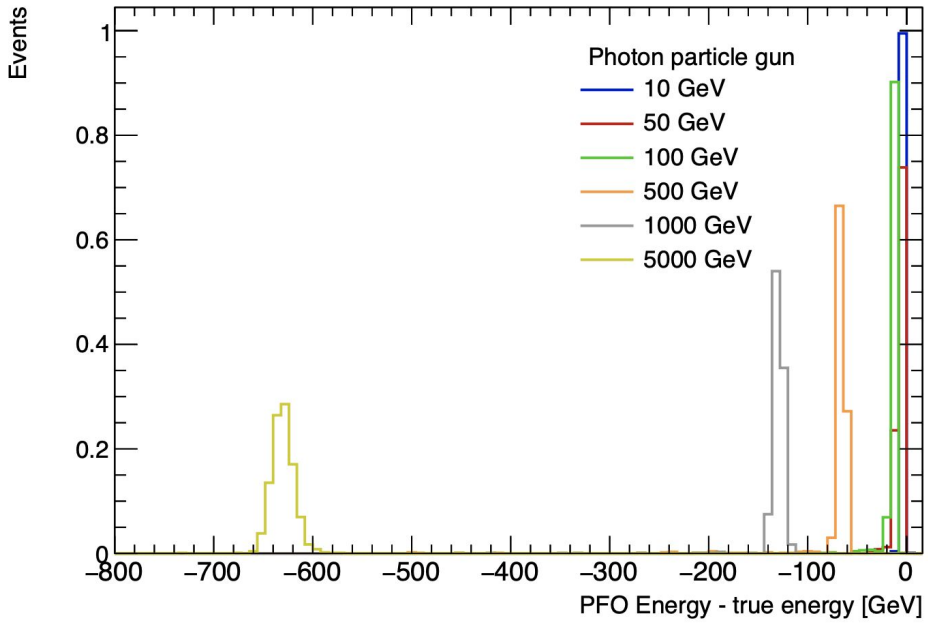
MuColl_10TeV

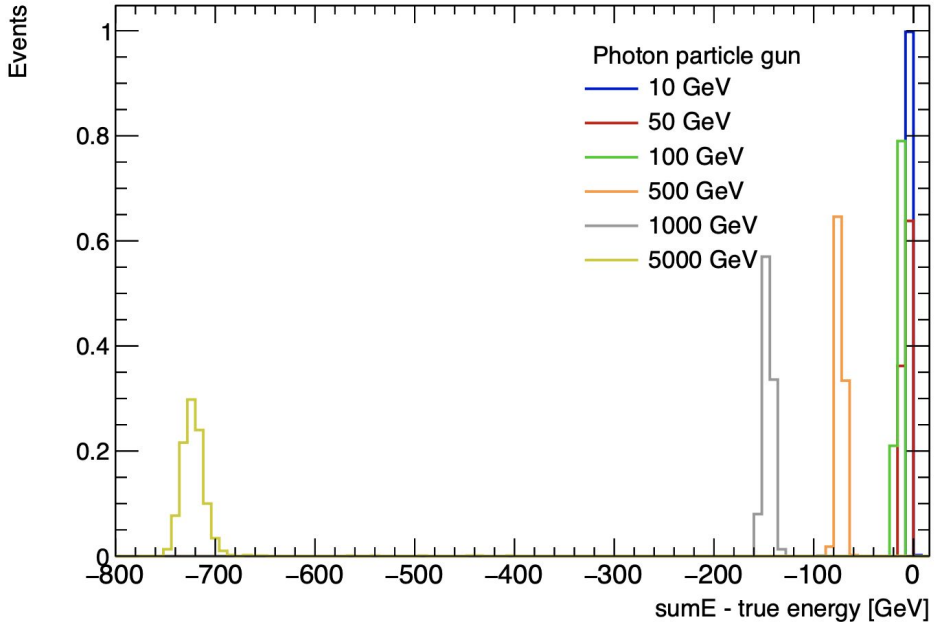




- Mostly as a cross-check, since the plot integrates over full calorimeter, while the shower is focused in specific location

Calibration





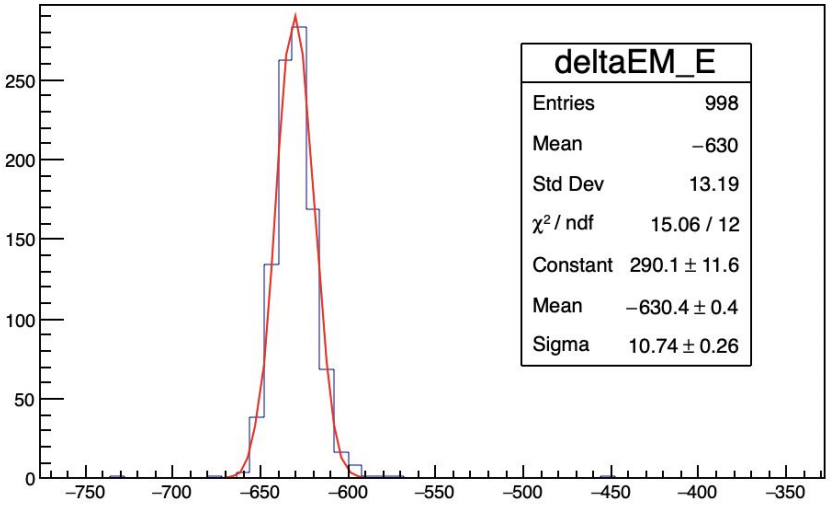
Tested both vanilla PFO reconstruction (left) and “simplistic” reco, i.e. photon = sum of ECAL and HCAL energy (right).

Energy resolution

Apologies for the plots from the TBrowser…

50 GeV

5 TeV



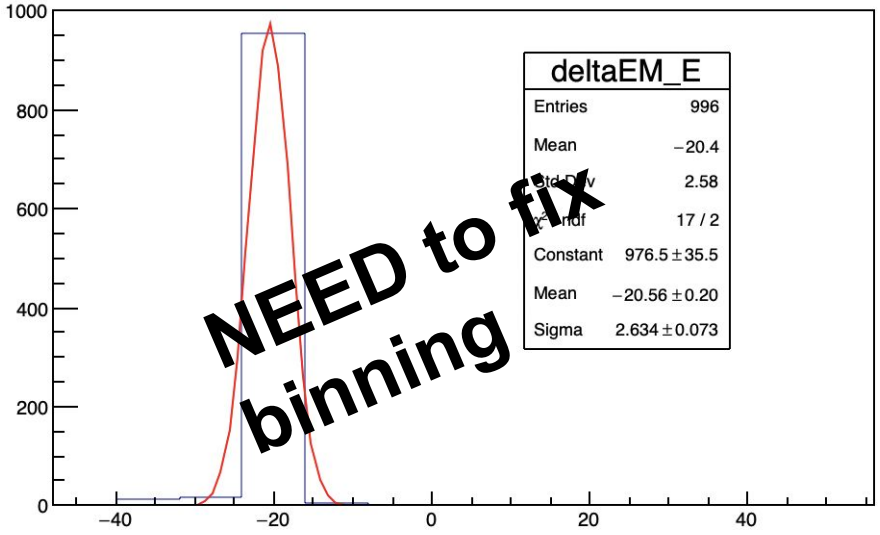
NEED to fix binning
σ/E = 10.5% @ 50 GeV

σ/E = 0.002% @ 5 TeV

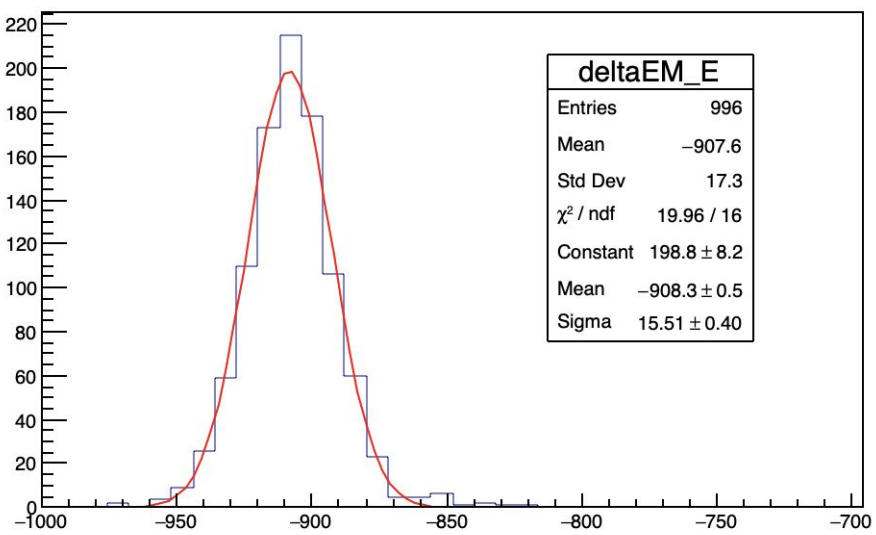
Energy resolution with BIB

Apologies for the plots from the TBrowser…

50 GeV



5 TeV



σ/E = 0.003% @ 5 TeV
σ/E = 0.002% @ 5 TeV (No BIB)

Summary

Continuing to update detector layout

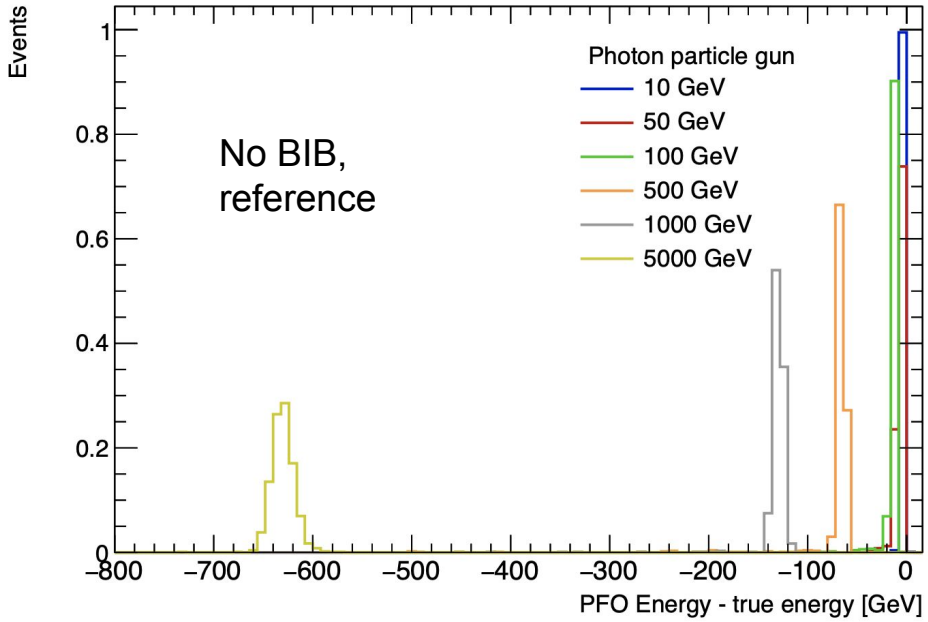
- v0A good for simulation and tests (re-sim and upload to cluster in progress)
- Now continuing with Muon Spectrometer and addition of toroidal magnetic field

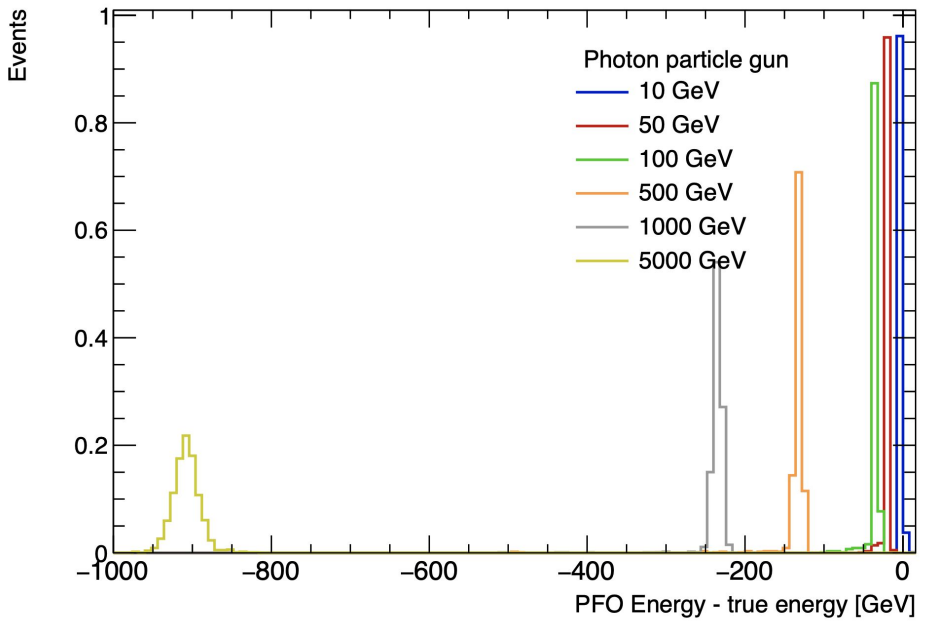
First look at photon reconstruction with BIB

- Pandora's reconstruction not necessarily optimal (especially with BIB)
  - Need to derive calibration
  - Study efficiencies and resolutions (with proper fits)

Thank you!

Calibration





Tested vanilla PFO reconstruction.

“Simplistic” reco, i.e. photon = sum of ECAL and HCAL energy doesn’t make sense with BIB.

10 TeV detector geometry (MuColl10_v0B)

Geometry currently in github, for reference