Updates to geometry and photon reconstruction

Detector meeting, 04/05/2023

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 &
```

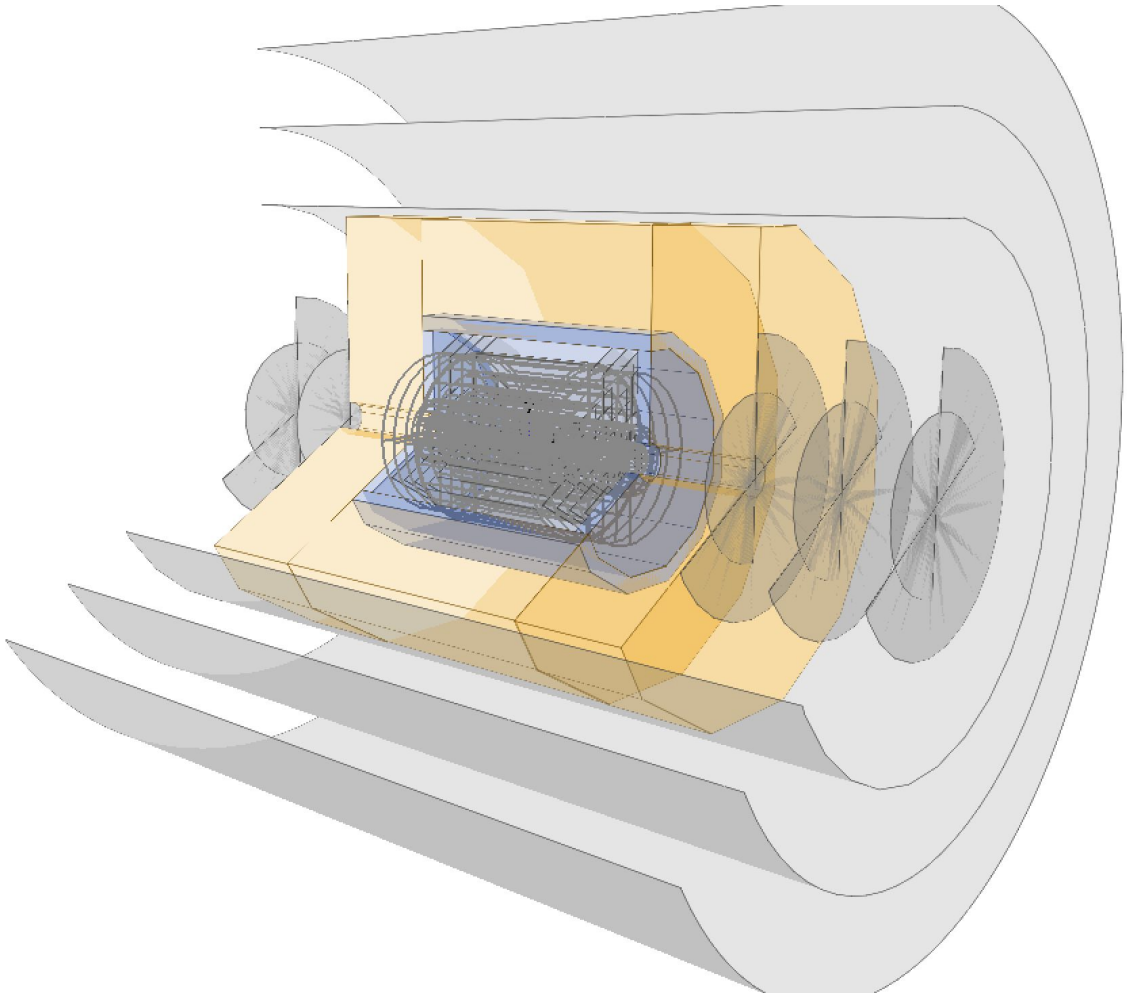
Muon Spectrometer status

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

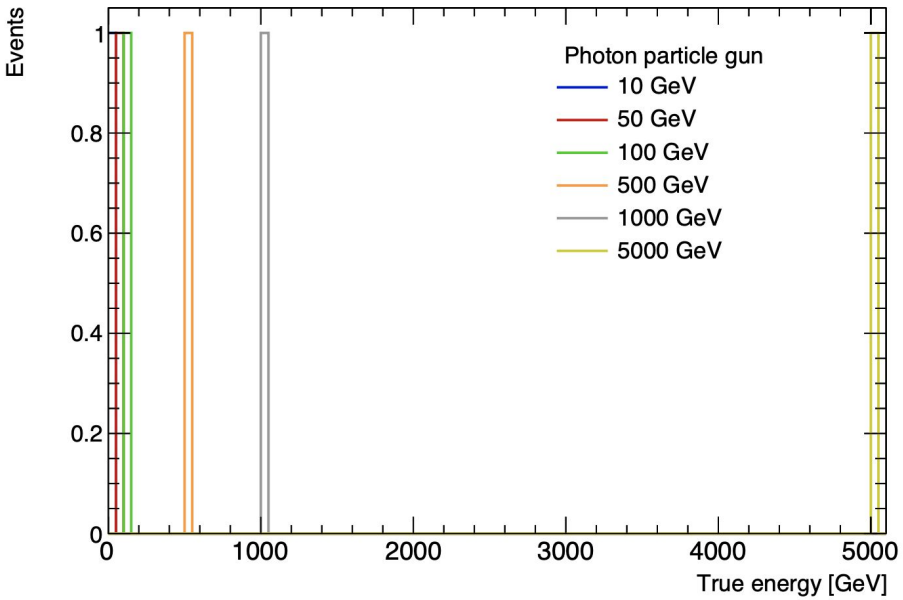
Postponed push to git for this reason. Will likely give geometry different name.

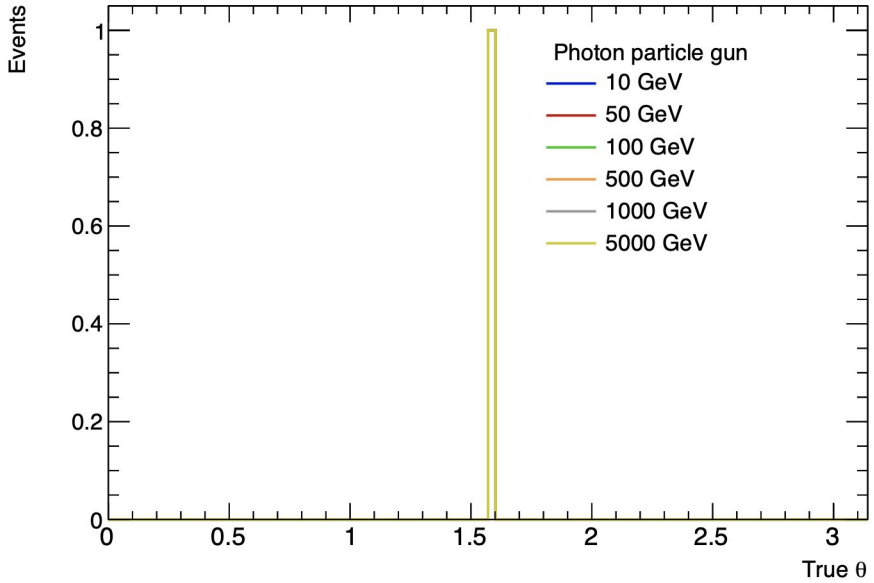
Still todo:

- Add magnetic field, see discussion
- Fix endcaps



Particle gun inputs: photons

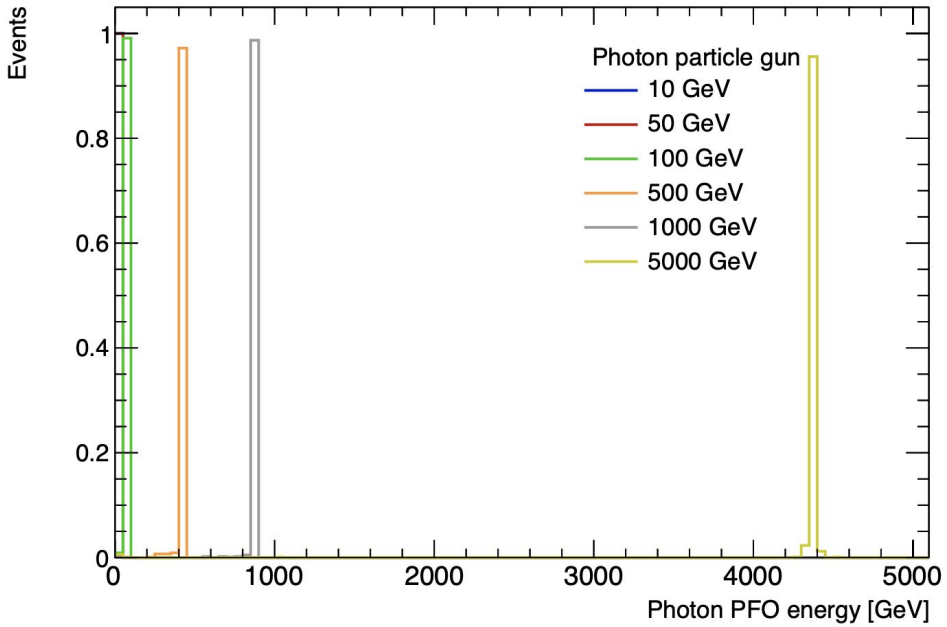


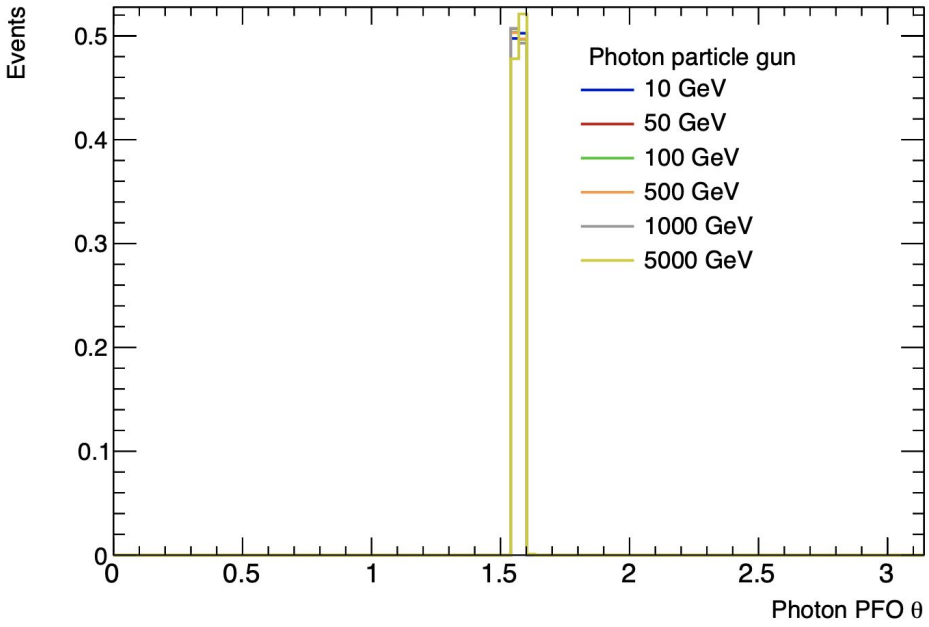


Goal: test hermeticity and energy resolution of calorimeter.

Shot monochromatic particle gun sample at 90 degrees wrt to beam axis, no BIB.

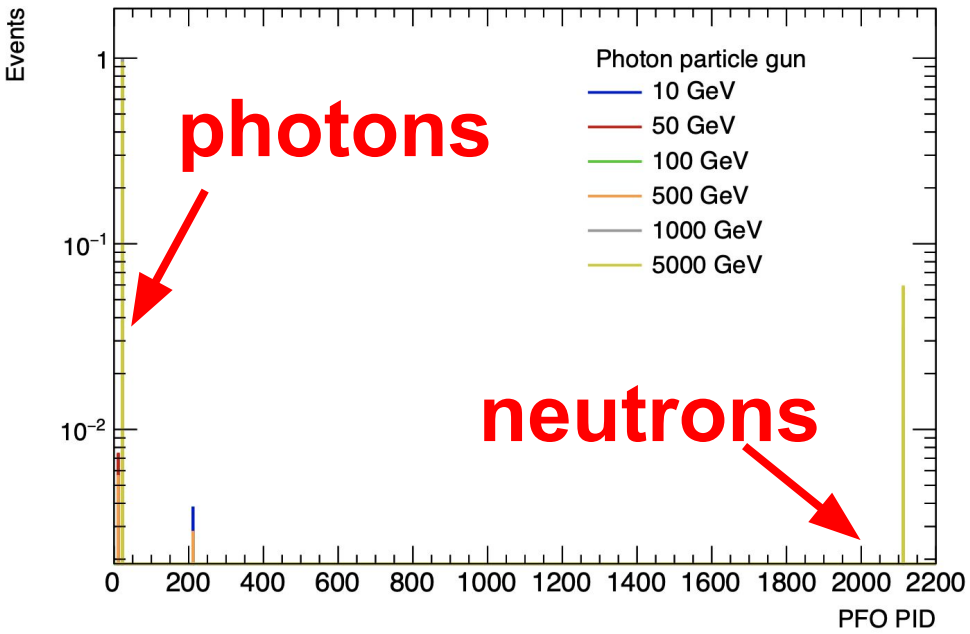
Photon PFO

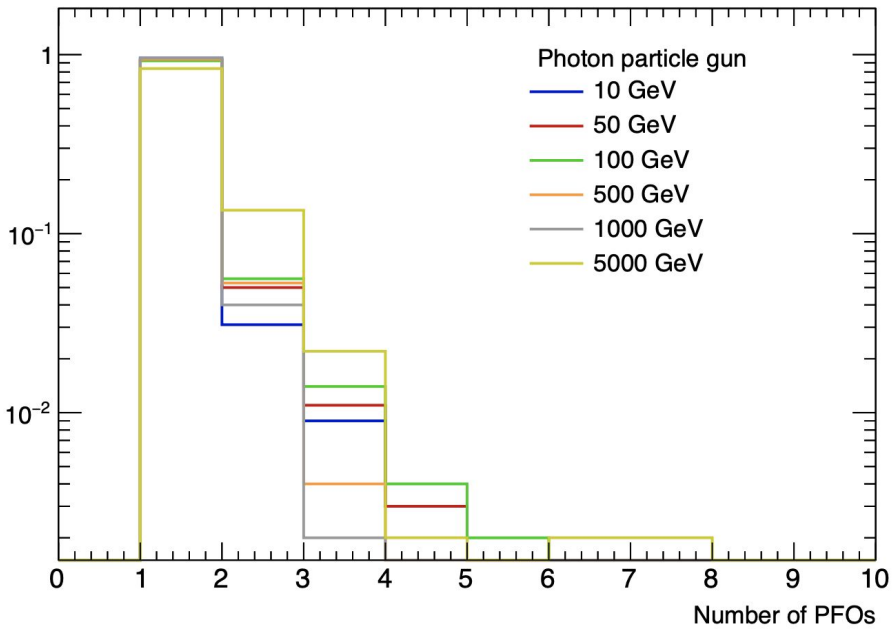




Applied delta R matching and looked at reco PFO (particle flow object) quantities

Photons?

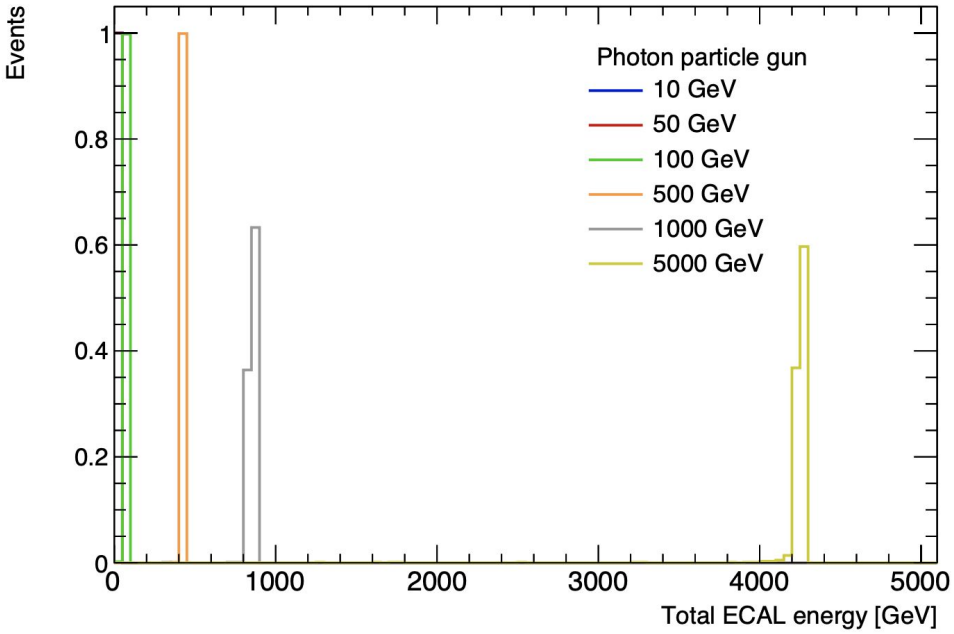


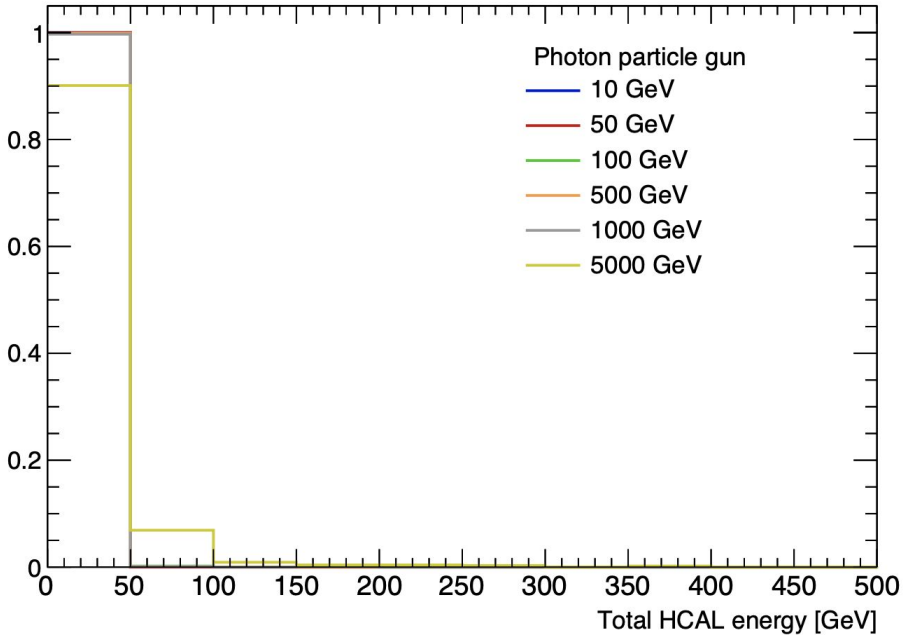


Photons leaking into HCAL are reconstructed as both a both and a neutron (or seldom as some meson)

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

Total energy in calorimeters





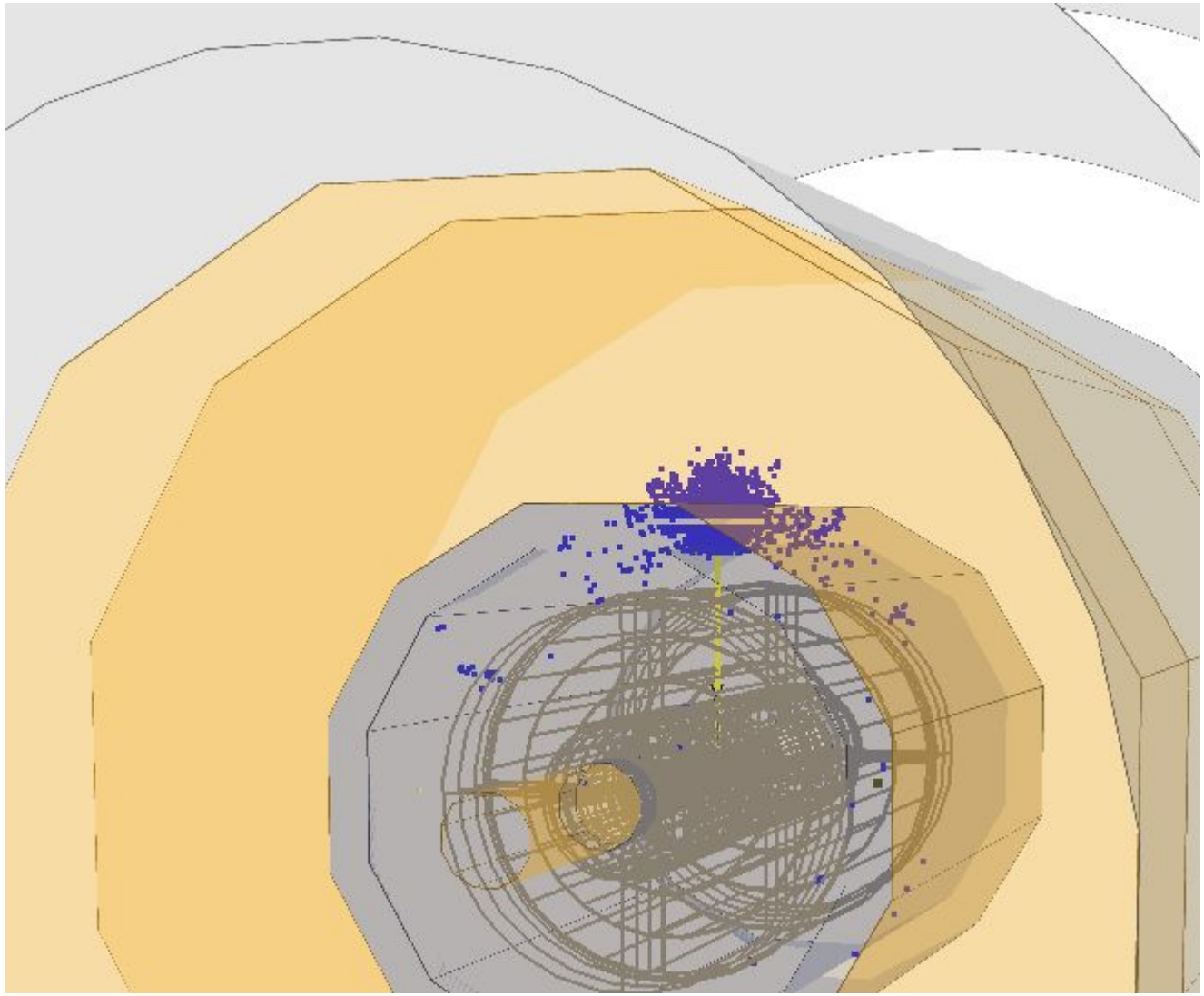
HCAL sumE [GeV]

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).

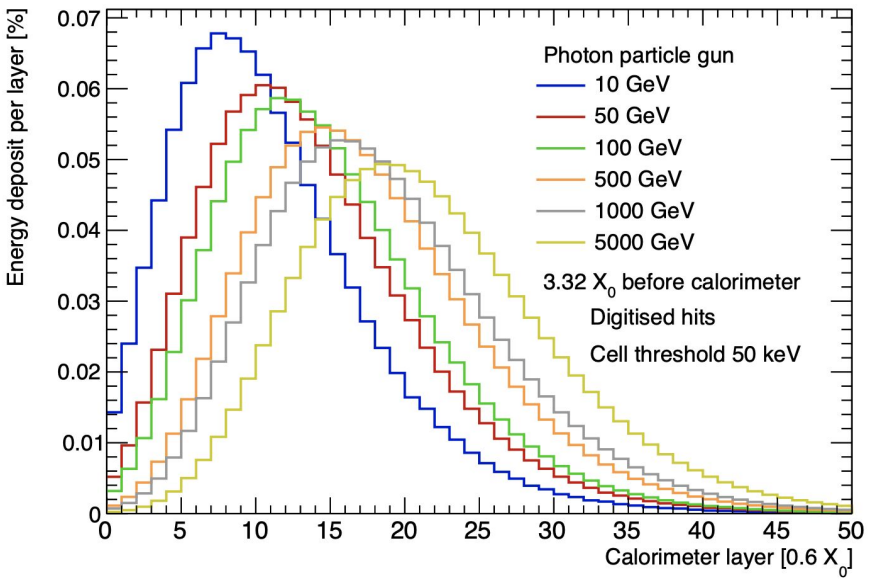
Event display of a 5 TeV photon

No BIB

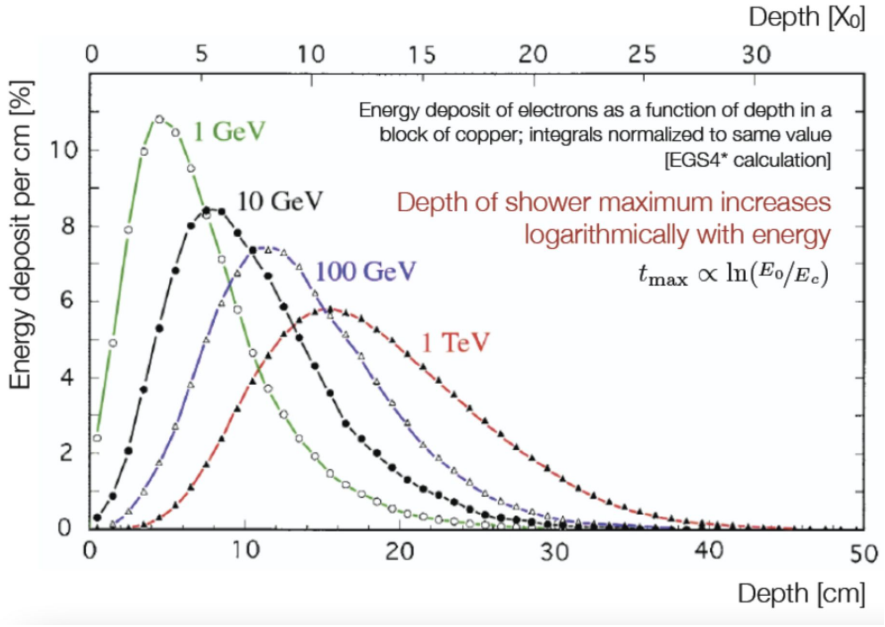


Looking at shower evolution

MuColl_10TeV



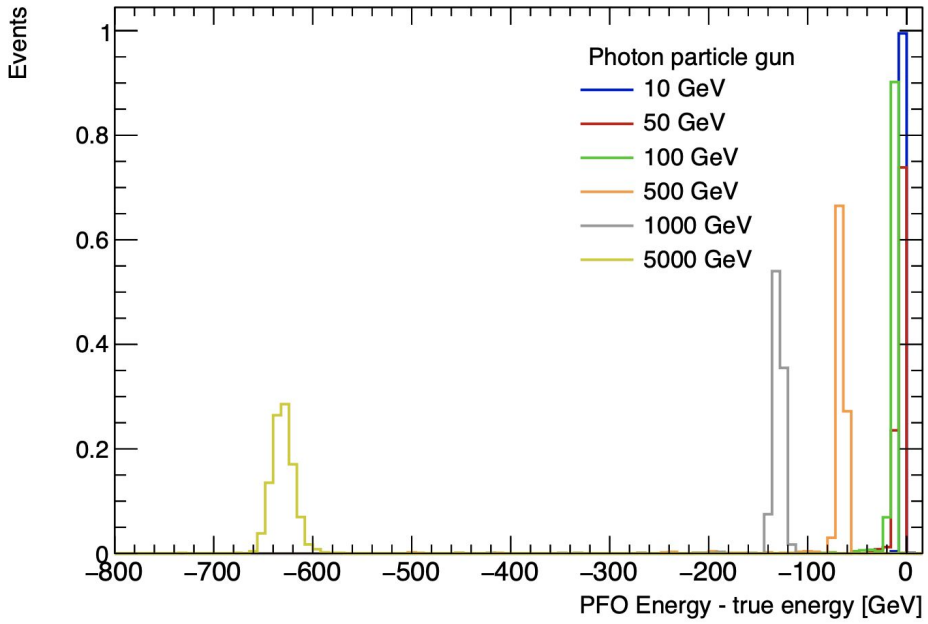
Reference

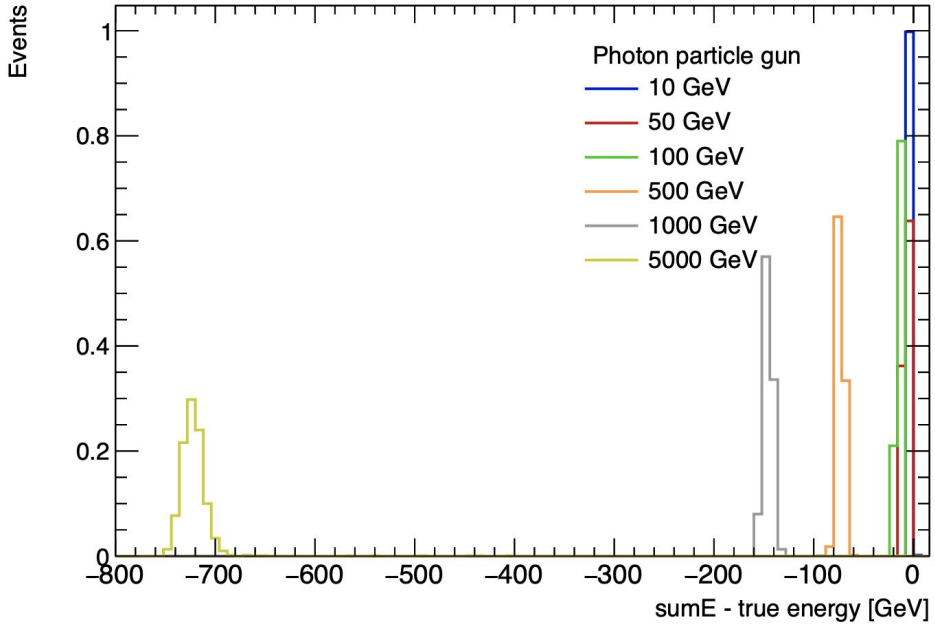


Checked detailed shower evolution.

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

Calibration



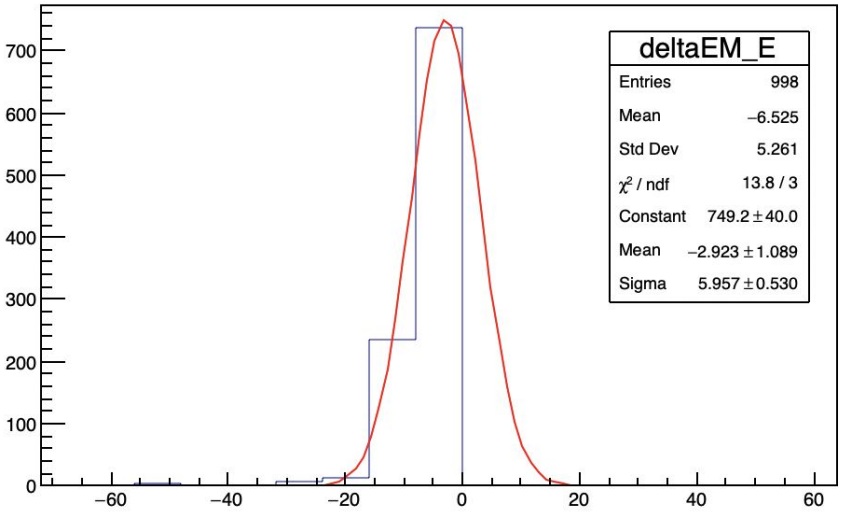


Tested both vanilla PFO reconstruction (left) and “simplistic” reco, i.e. photon = sum of ECAL and HCAL energy (right).

Energy resolution

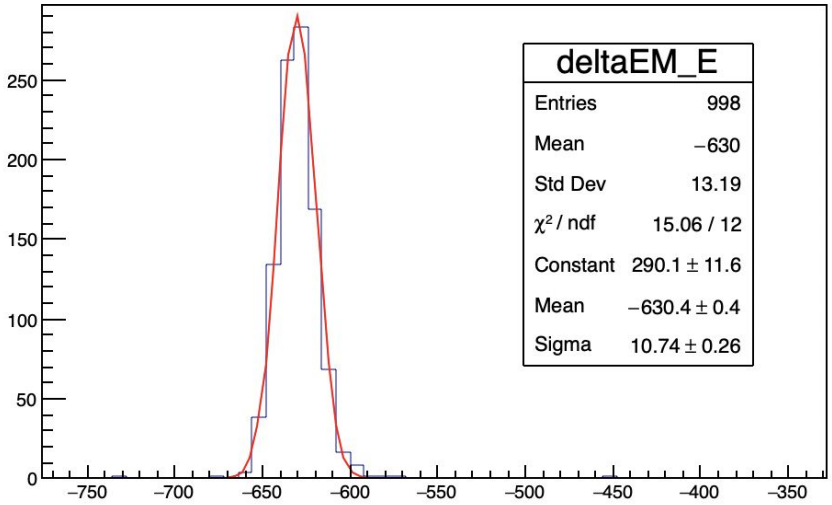
Apologies for the plots from the TBrowser…

50 GeV



ΔE (PFO, truth) [GeV]

5 TeV



ΔE (PFO, truth) [GeV]

σ/E = 10.5% @ 50 GeV

σ/E = 0.003% @ 5 TeV

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 without BIB

- Pandora's reconstruction not necessarily optimal (but not too bad either)
  - Need to derive calibration
  - Study efficiencies
  - Repeat study with BIB

Thank you!

10 TeV detector geometry (MuColl10_v0B)

Geometry currently in github, for reference