First look at photon reconstruction (w/o BIB)

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The detector

hadronic calorimeter

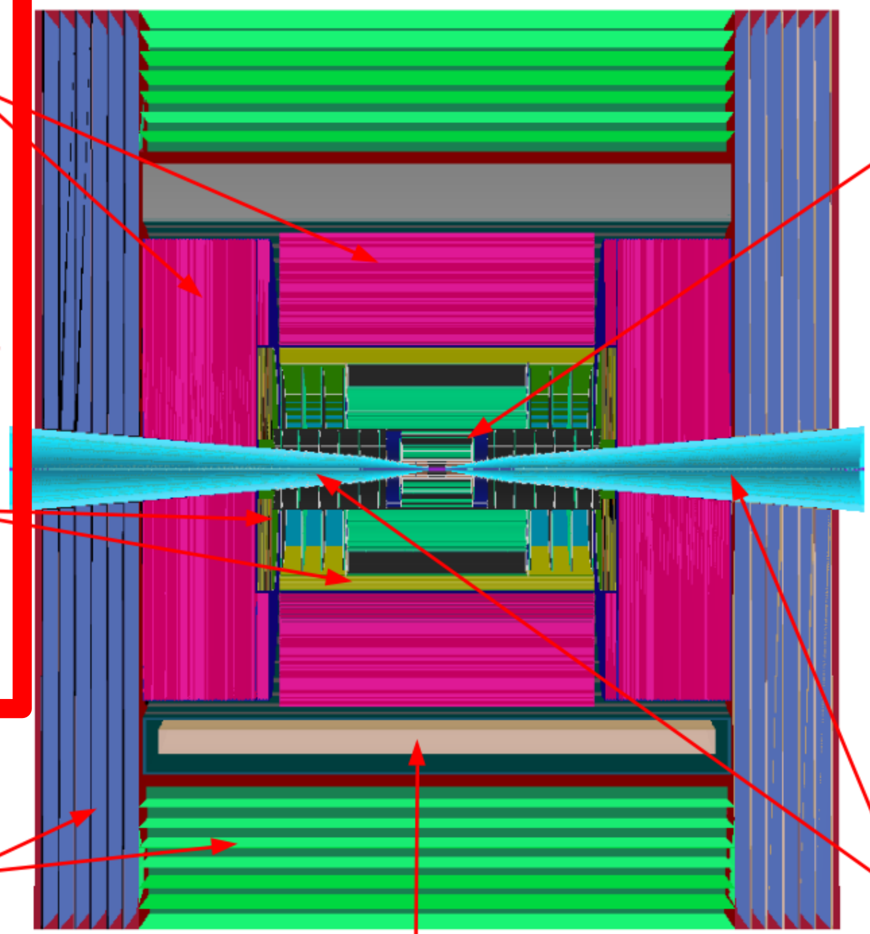
- 60 layers of 19-mm steel absorber + plastic scintillating tiles;
- 30x30 mm^2 cell size;
- 7.5 λ_I.

electromagnetic calorimeter

- 40 layers of 1.9-mm W absorber + silicon pad sensors;
- 5x5 mm^2 cell granularity;
- 22 X_0 + 1 λ_I.

muon detectors

- 7-barrel, 6-endcap RPC layers interleaved in the magnet's iron yoke;
- 30x30 mm^2 cell size.



superconducting solenoid (3.57T)

tracking system

- Vertex Detector:
  - double-sensor layers (4 barrel cylinders and 4+4 endcap disks);
  - 25x25 μm^2 pixel Si sensors.
- Inner Tracker:
  - 3 barrel layers and 7+7 endcap disks;
  - 50 µm x 1 mm macro-pixel Si sensors.
- Outer Tracker:
  - 3 barrel layers and 4+4 endcap disks;
  - 50 µm x 10 mm micro-strip Si sensors.

shielding nozzles

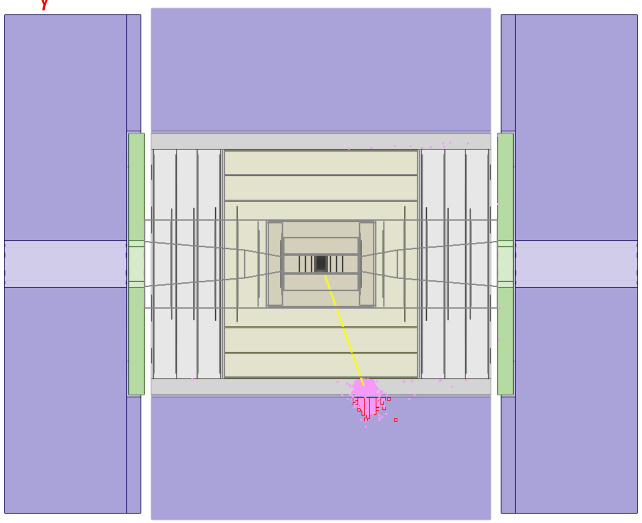
- Tungsten cones + borated polyethylene cladding.

Monte Carlo samples

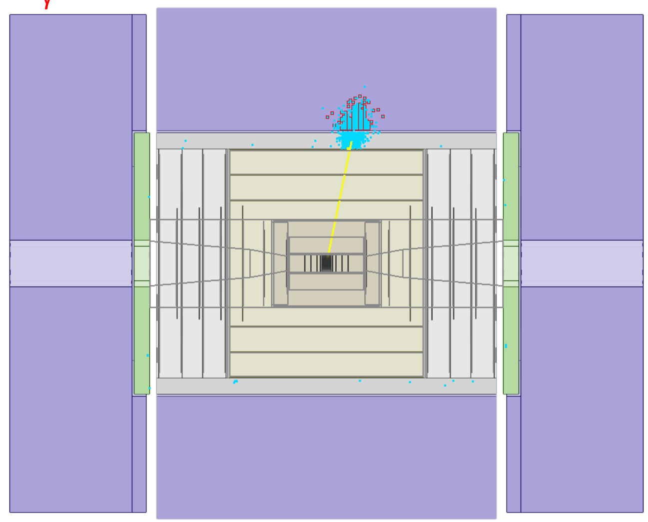
- 100k single photons shot from (0, 0, 0):
  - $1 < E_\gamma < 6000$ GeV;
  - $8° < \theta_\gamma < 172°$;
  - $0° < \phi_\gamma < 360°$;
- 20k $\mu\mu \rightarrow \gamma\gamma$ at $\sqrt{s} = 3$ TeV;
- 10k $\mu\mu \rightarrow \gamma$ + dark photon at $\sqrt{s} = 3$ TeV;
- 20k $\mu\mu \rightarrow \gamma$ + dark photon at $\sqrt{s} = 10$ TeV.

Graphical inspection

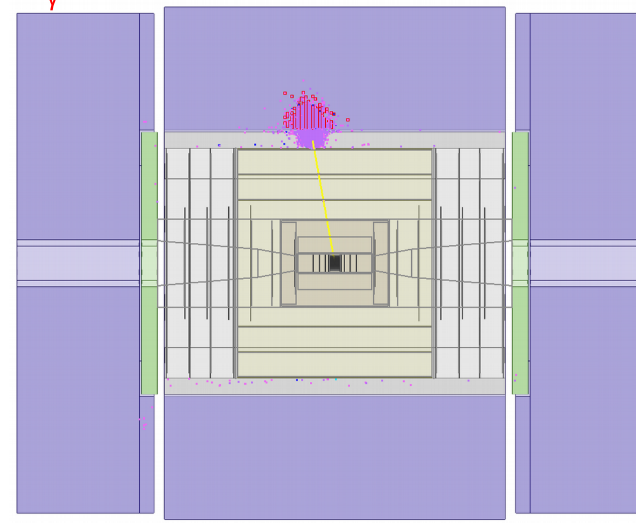
E_γ = 1 TeV



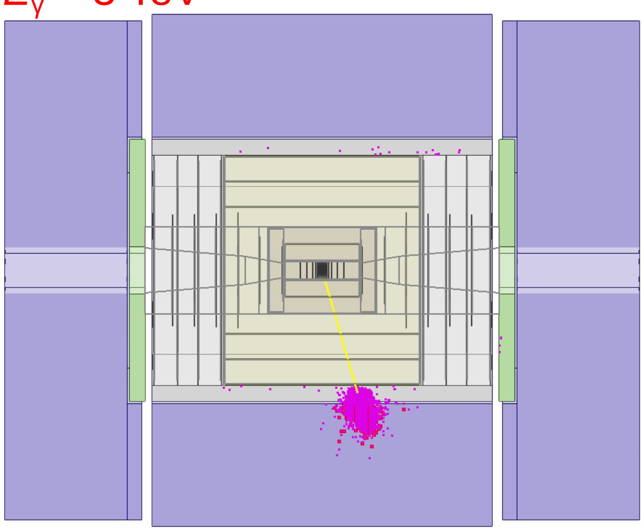
E_γ = 1.5 TeV



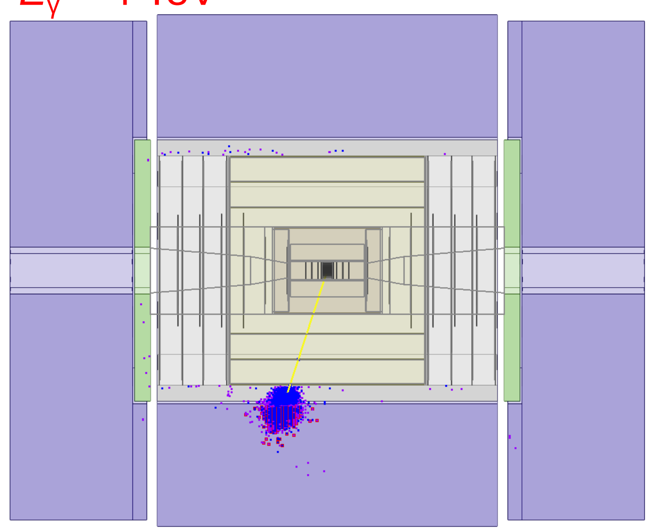
E_γ = 2 TeV



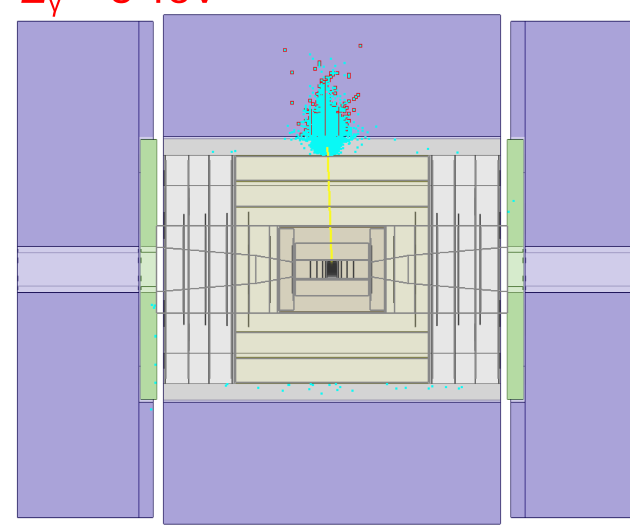
E_γ = 3 TeV



E_γ = 4 TeV



E_γ = 5 TeV

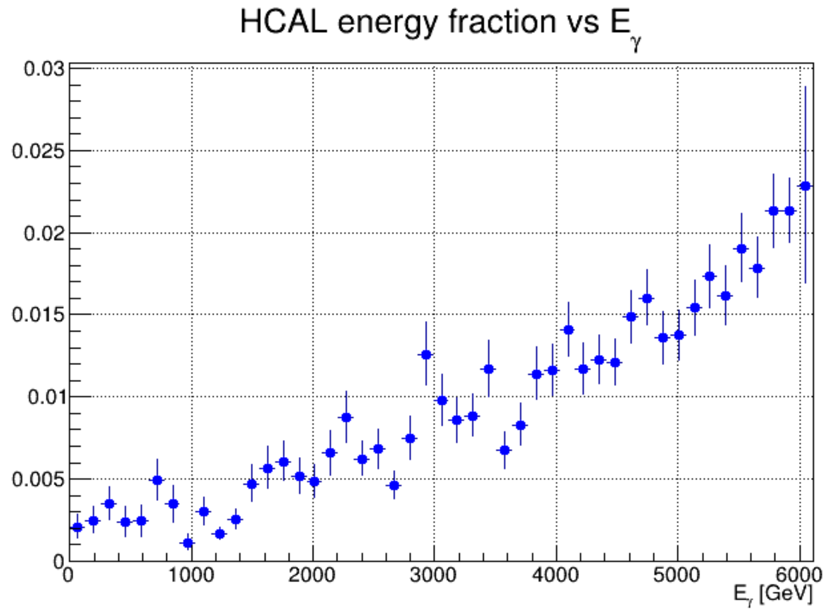


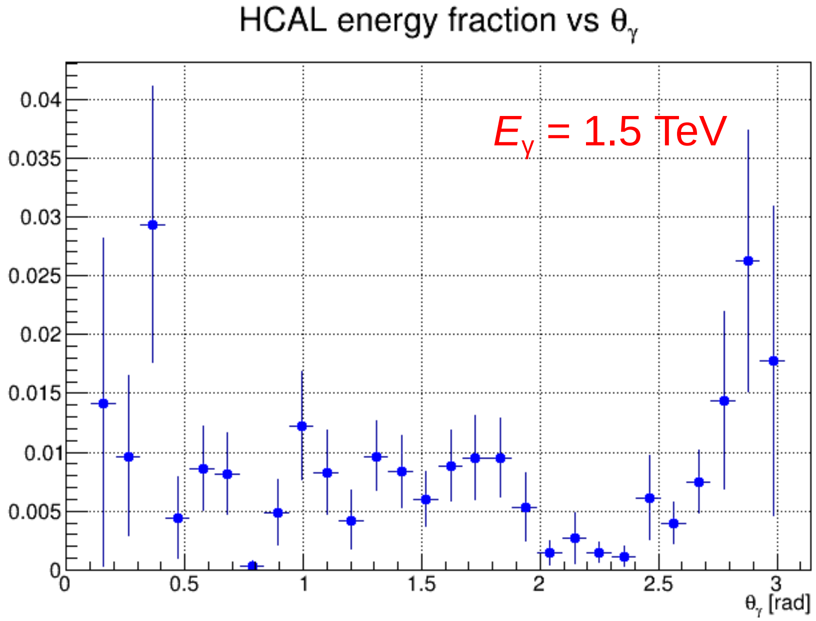
Photon reconstruction

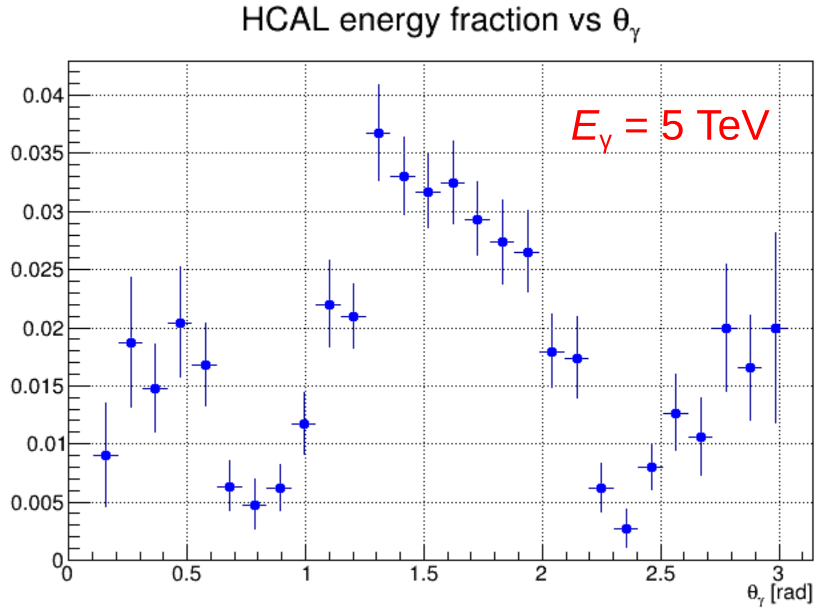
- The electromagnetic showers from high-energy photons ($E_\gamma \gtrsim$ 50 GeV) spill into the HCAL.
- With the current default Pandora settings, high energy photons are reconstructed as two nearby clusters in the ECAL and HCAL, which are identified as a photon plus a neutron.
- There already exist dedicated algorithms in Pandora to improve the reconstruction of the high-energy photons (arXiv:1603.00013) that might be worthwhile have a look at.
- For the time being, I'm clustering the reconstructed photon and neutron using the FASTJET package (k_t algorithm with R = 0.5).

Fraction of γ energy in the HCAL

$10° < \theta_\gamma < 170°$

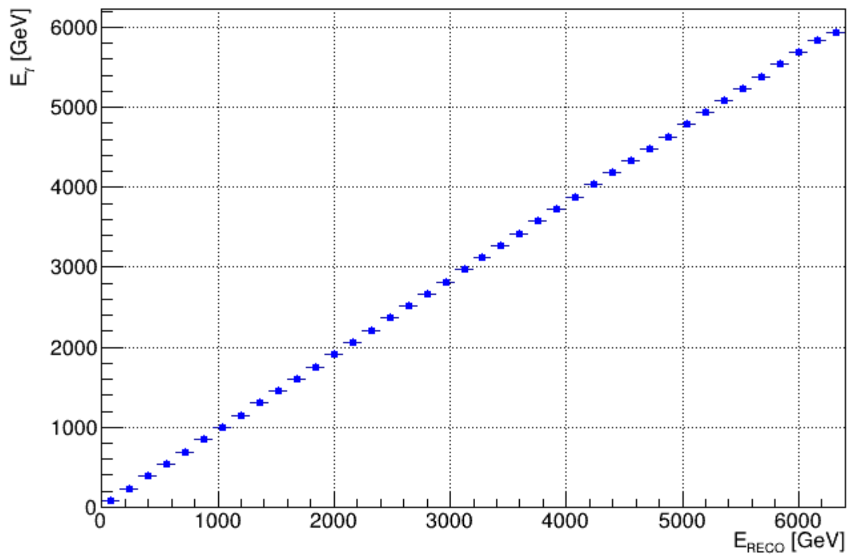


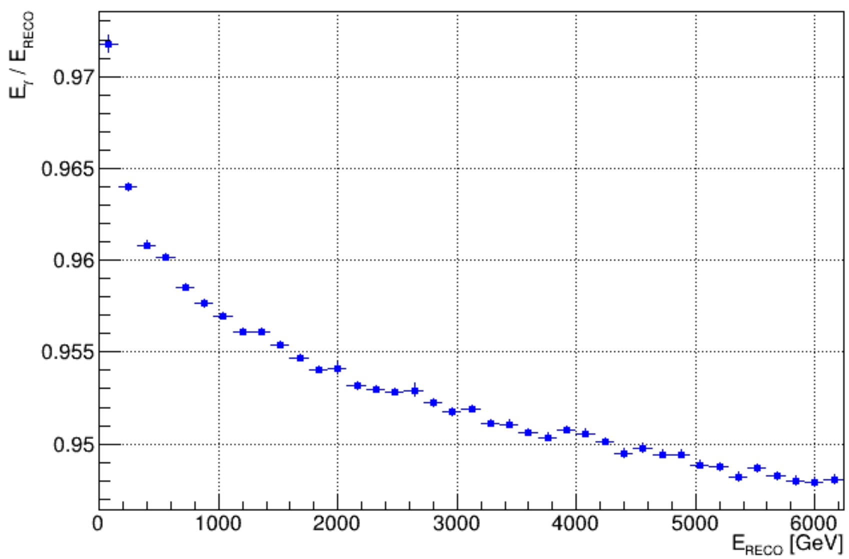


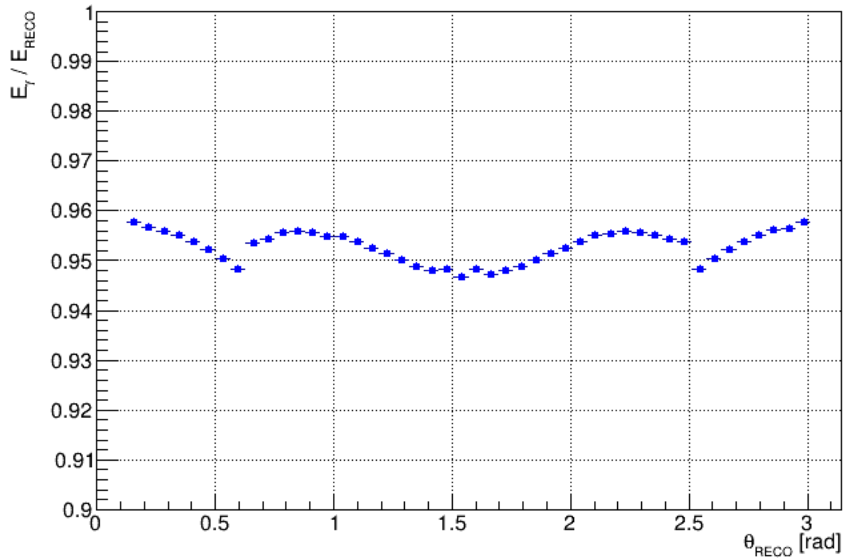


Reconstructed photon energy

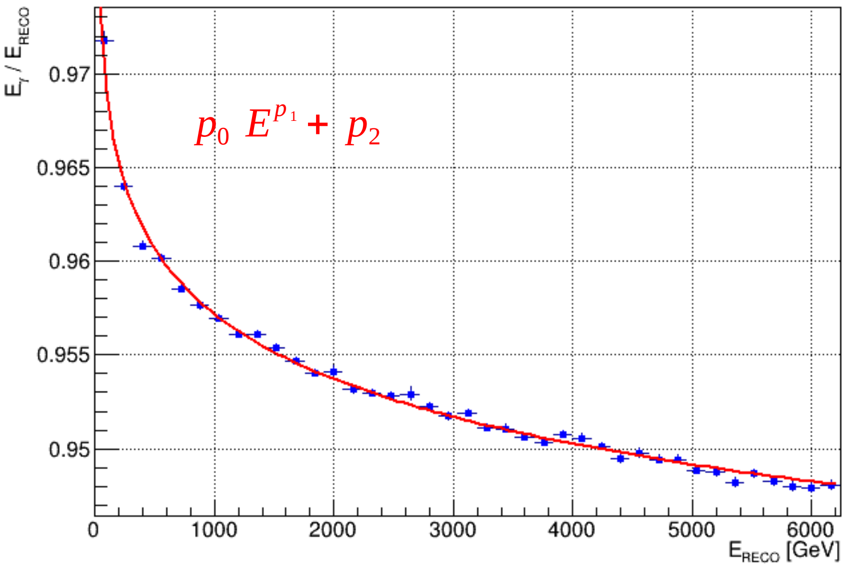
$10° < \theta_\gamma < 170°$



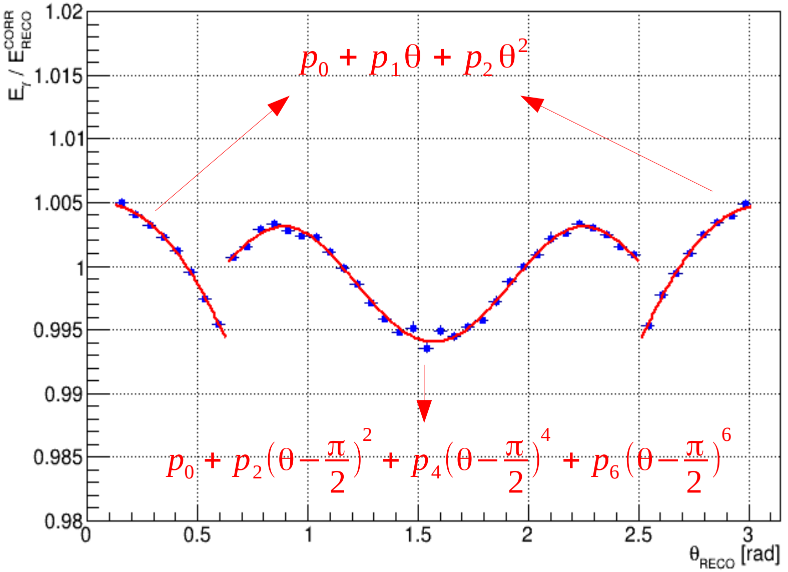




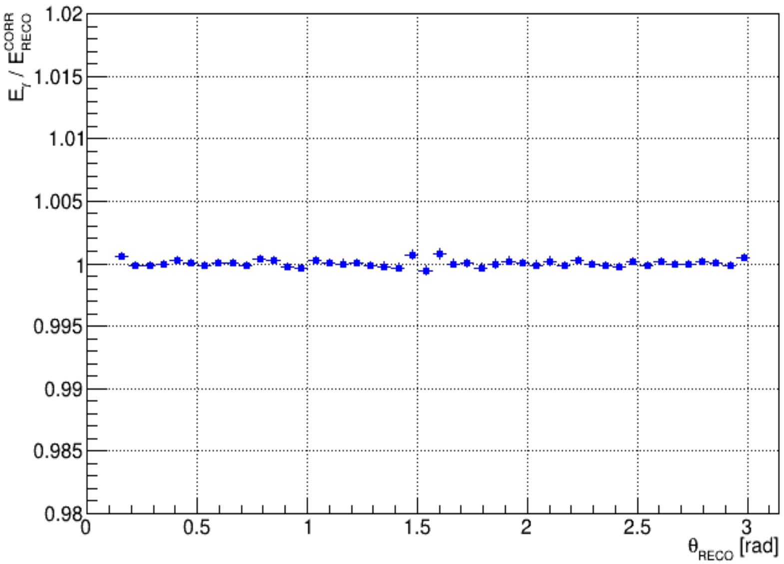
Photon energy corrections



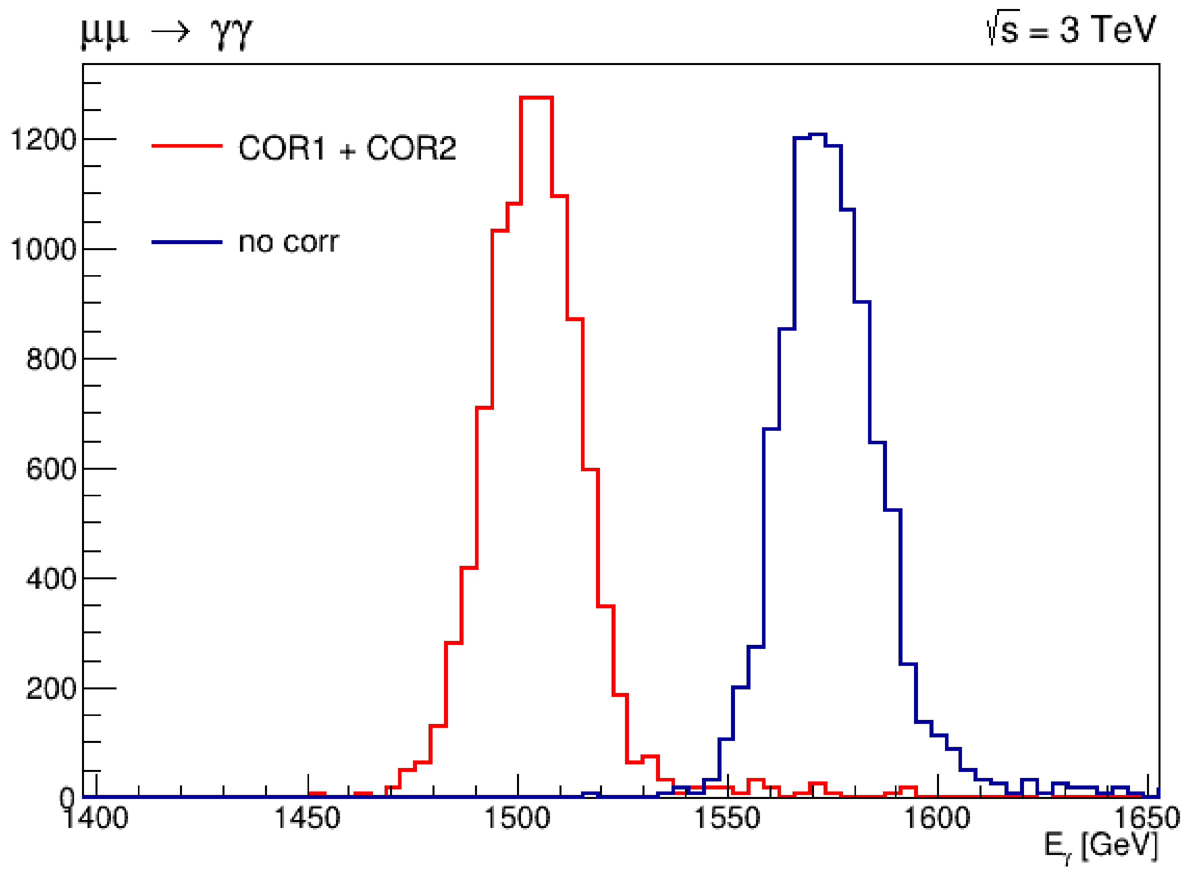
COR1



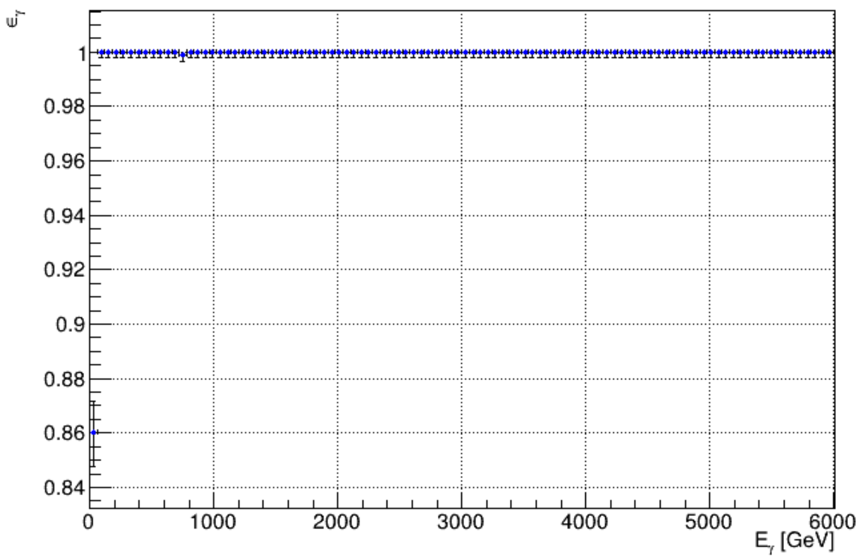
COR2

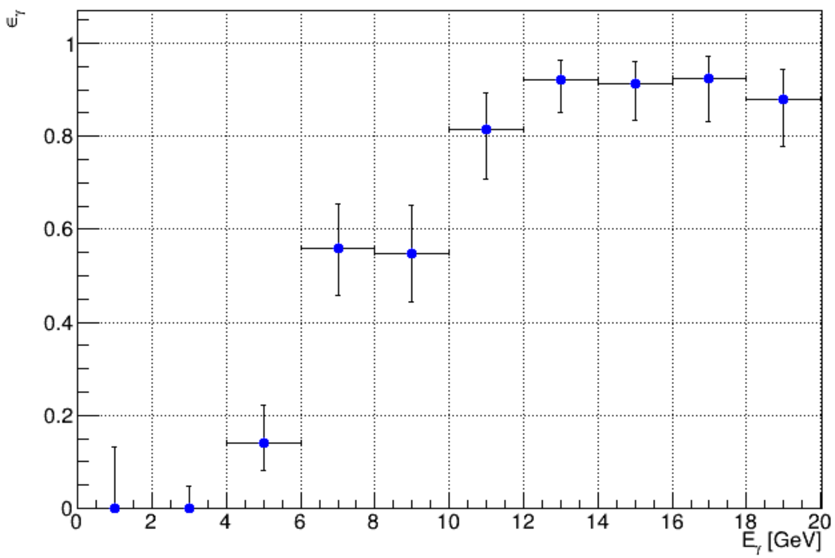


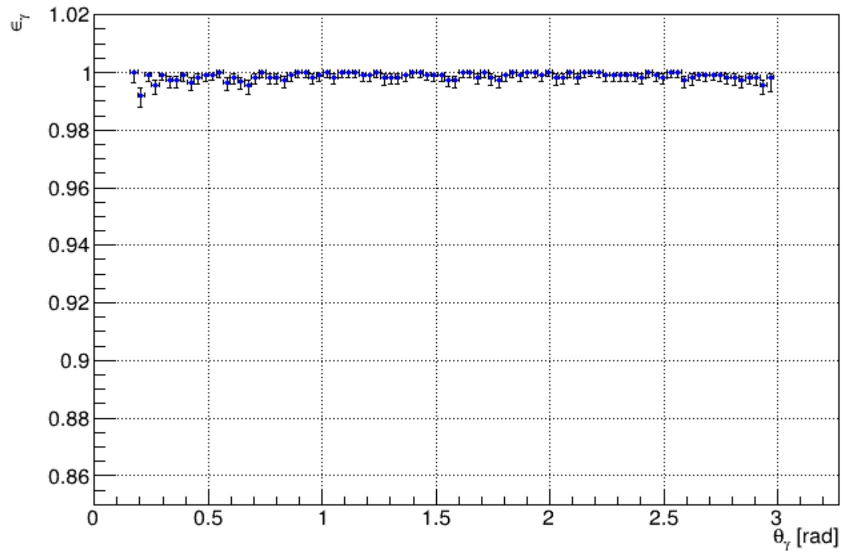
Energy corrections test



Photon reconstruction efficiency

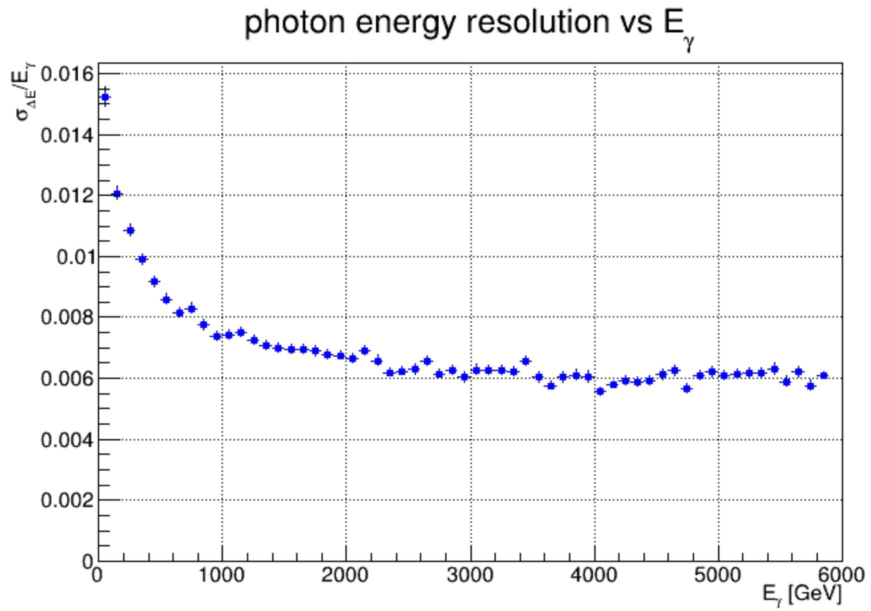




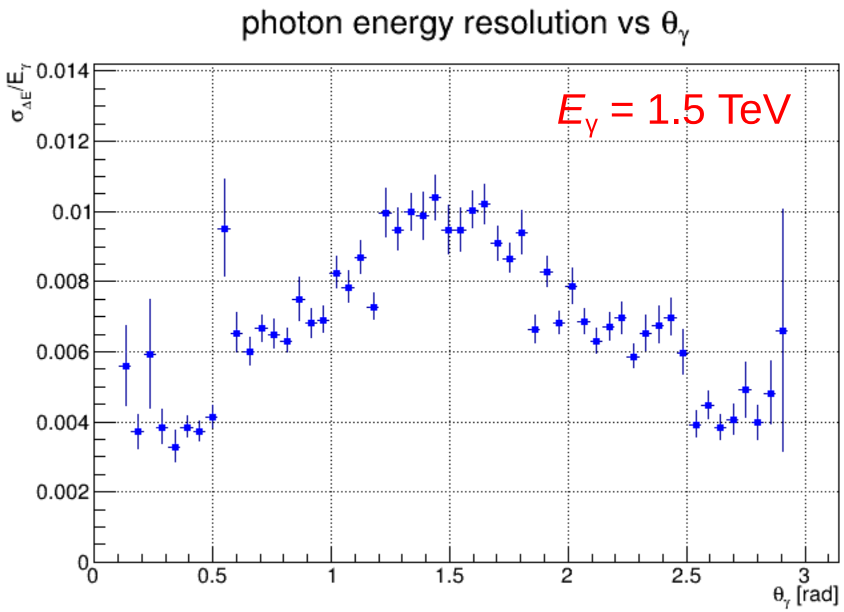


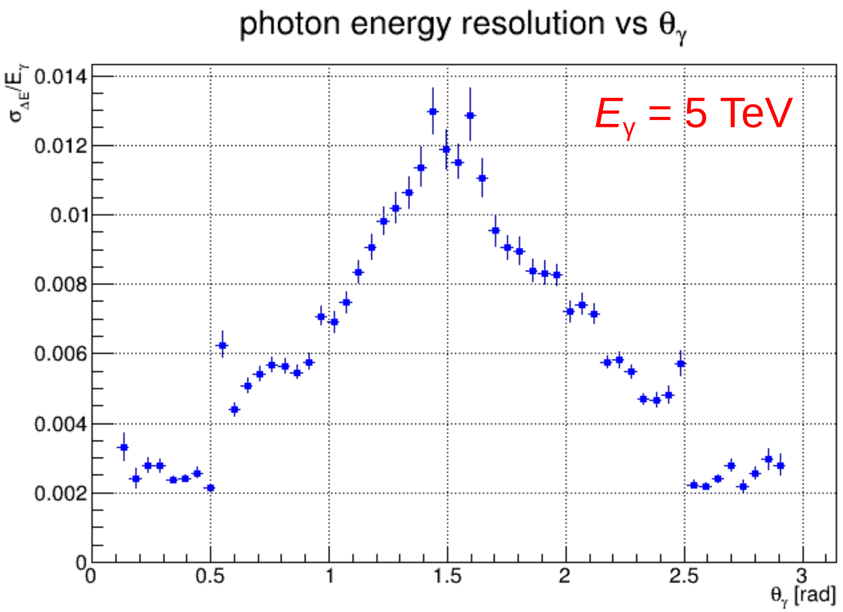
$10° < \theta_\gamma < 170°$

Photon energy resolution

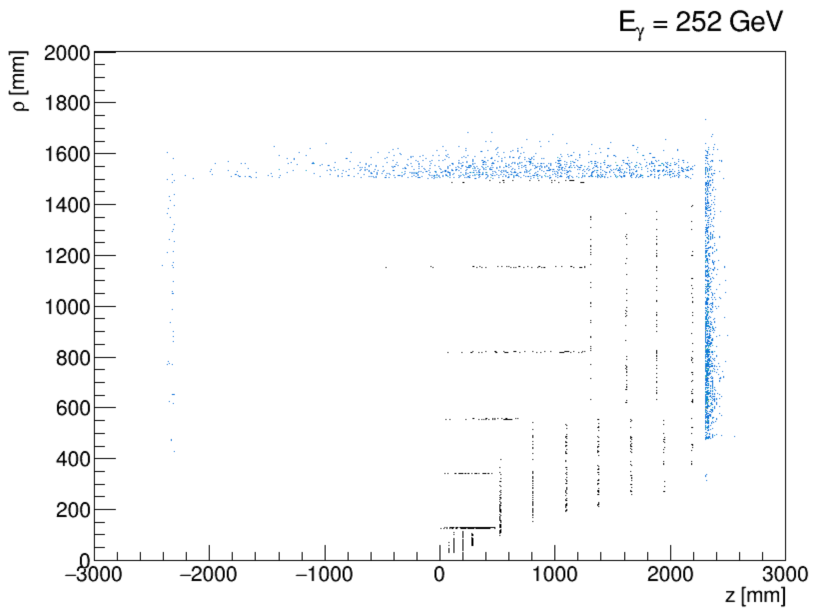


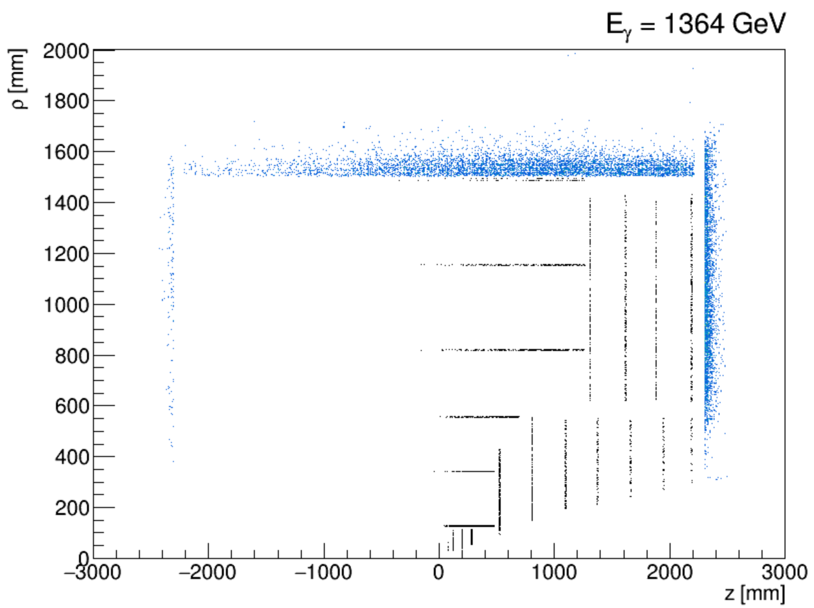
$10° < \theta_\gamma < 170°$

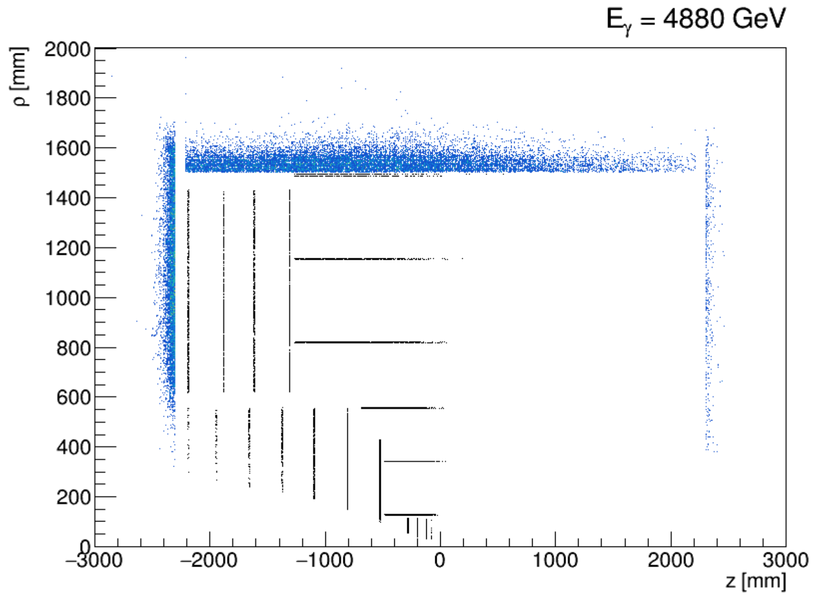




Photons showering in the nozzles







Conclusions

- It appears that with the current detector we can already reconstruct photons with high efficiency up to E_γ = 5 TeV.
- But the study presented here is preliminary, it's not taking into account the BIB yet, which is going to change the game.