Update on direct photon calorimeter

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Luminosity meeting, May 14, 2026

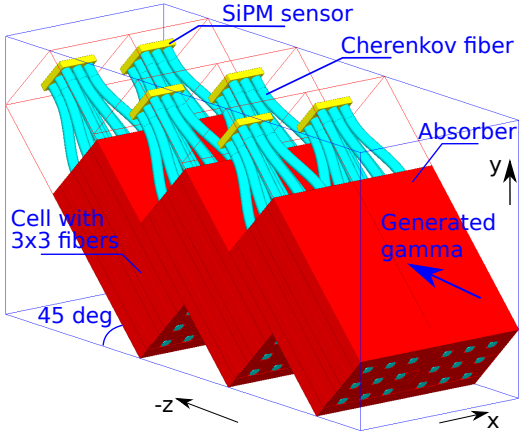
Outline

- More detailed version of setup with inclined fibers relative to incoming γ photons
- Section of lightguide by bent optical fibers towards SiPM sensors
- Estimates will be shown for energy resolution, photon yields per sensor and sensors above a predefined threshold

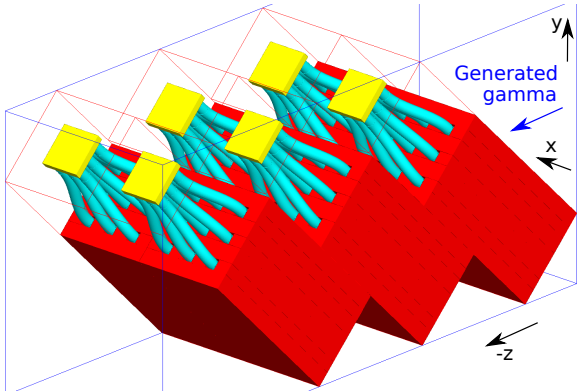
Simulation geometry

- Cherenkov quartz fibers of 1.5 mm diameter in grooves in Cu absorber at 4 mm spacing
- Cells of 15x15x260 mm with 3x3 fibers, absorber and SiPM at 45°, bent fibers are 35 mm long
- 11 cells along x, 16 cells along z, total size is 165 mm (x), 195 mm (y), 513 mm (z)

Front view:



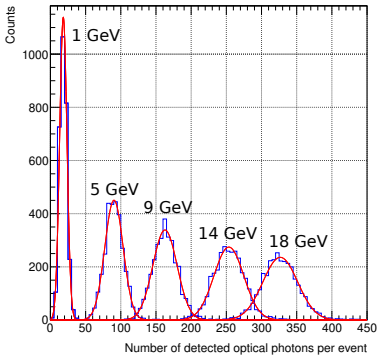
Rear view:



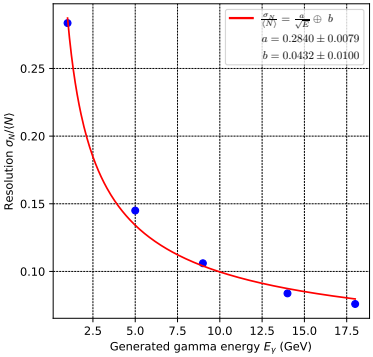
Optical photon yiels and energy resolution

- Geant4 with optics
- Set of γ energies from 1 to 18 GeV
- 3000 γs simulated at each energy
- Yields by optical photons detected by SiPM sensors after 0.4 quantum efficiency
- Energy resolution by sigma/mean in photon yields
- Still $\sim$30%/$\sqrt{E}$ despited 0.7 reduction in the yields due to bent fibers to sensors

Photon yields:

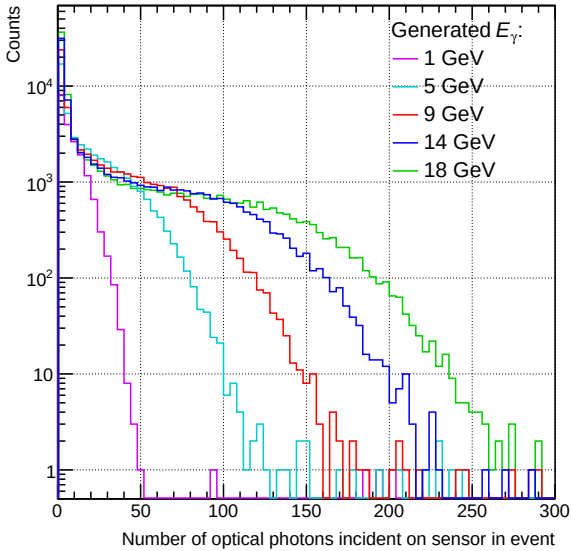


Energy resolution:



Number of photons incident on sensors

- Number of optical photons incident on individual SiPM sensors is calculated for each event
- Plot shows distribution in incident optical photons per sensor in event for all simulated events and all γ energies
- Can expect a signal of tens of photons per sensor



Sensors in event above a threshold

- Threshold of at least 10 optical photons incident on a SiPM sensor
- Plot shows distribution of counts of sensors above the threshold in event
- Even at E_γ = 1 GeV there is always a few sensors above the threshold
- Next steps include:
  - Improvement in reflections in the fibers for better light yield
  - Treatment of photon detection efficiency as a function of wavelength – to convert to counts of photoelectrons
  - Shall proceed with JINST publication