

SiPM-on-tile thresholds

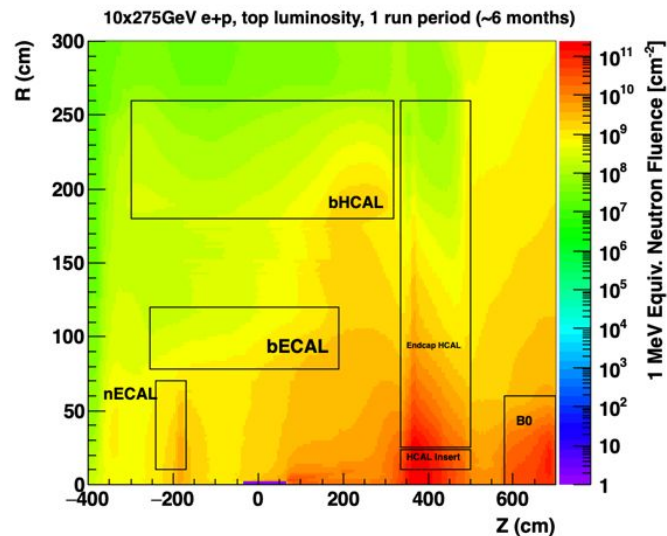
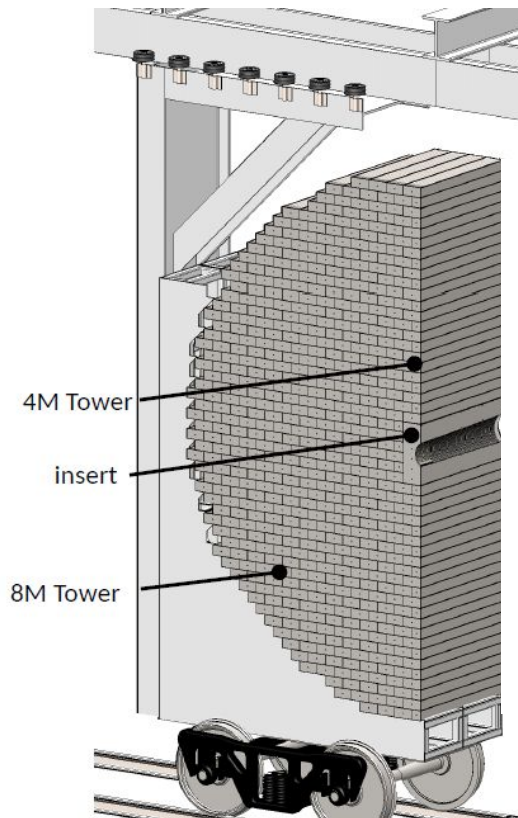
- For most of endcap, SiPMs will be ganged in group of 10 to define a longitudinal segment (5 in first segment).

- In the small area near beampipe ($3.2 < \eta < 4.0$), SiPM will be readout independently in the Insert.

- In both cases, the analog SiPM pulses are transported via PCB to back of HCAL for digitization with HGROC

- In most area, 1.3 mm SiPM will be used, whereas at high radiation area, 3 mm SiPM might be needed as mitigation measure

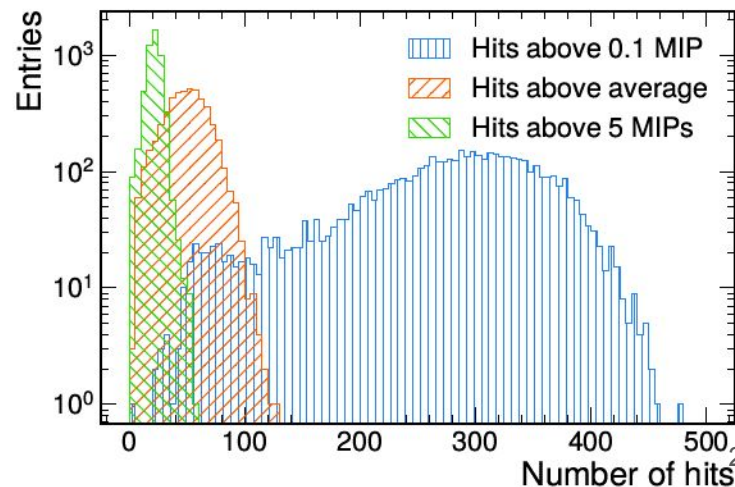
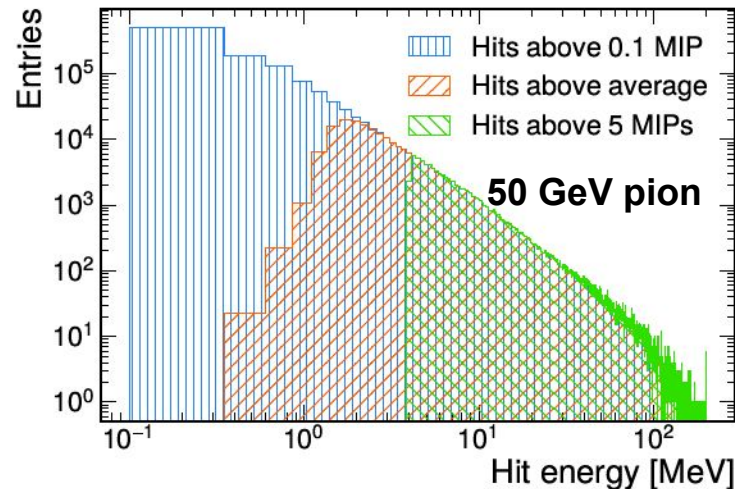
- In most of area, scintillator is 25 cm², 4 mm thick in 4M/8M, and 9-25 cm², 3 mm thick in insert



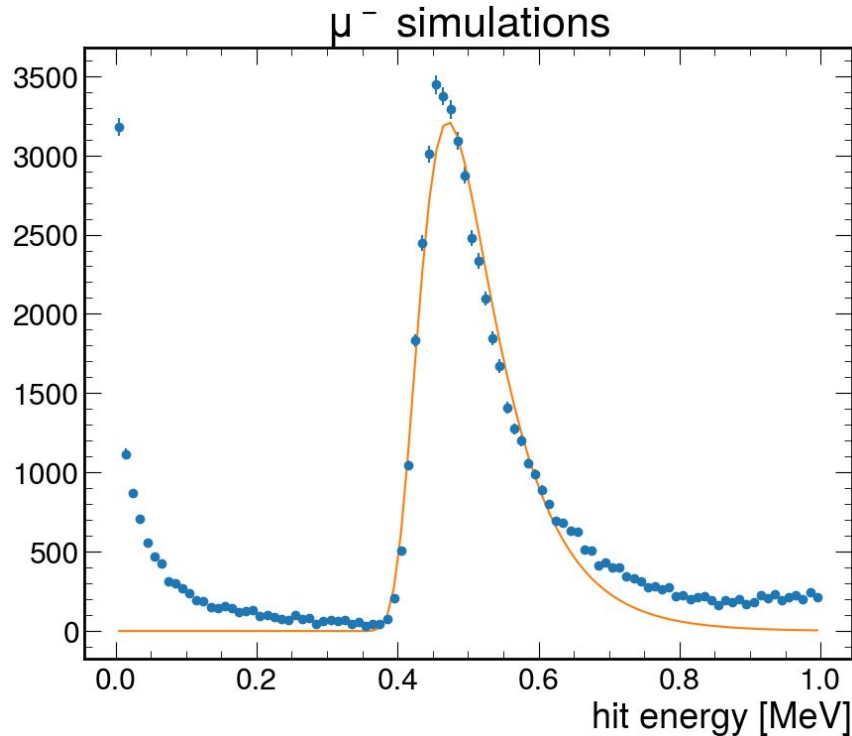
** 1e12 n/cm² is likely a limit based on CMS HGCal design 1

Thresholds for insert (single tile readout)

- Main motivation: preserve ability to measure MIP-like depositions:
Threshold should be < 0.5 MIP per tile
- SiPM for insert will be operated at relatively low operating voltage due to rad damage constraints: +2V (like CMS HGCal & STAR)
- 1 MIP MPV ~ 0.5 MeV in 3 mm thick scintillator
- Single-cell MIP with 3 mm thick tile is ~ 15 pixels at +2V with 1.3 mm SiPM (measured in lab) or ~ 70 pixels with 3 mm SiPM.
- Range is ~ 0.3 MIP to ~ 200 MIP per cell for 50 GeV pion or ~ 4.5 pixel to 3000 pixels with 1.3 mm SiPM
- 14160-1315PS model at +2V yields gain of $\sim 1e5$



MIP most probable value is ~ 0.5 MeV for 3 mm scintillator



FTFP_BERT list

Threshold should be below 0.5 MIP
this value to capture peak, but
preferably at 0.1 to 0.3 MIP to capture
energy distribution from shower and
maximize topology info

Thresholds for 4M/8M towers

(10 tiles ganged in a segment)

- Main motivation: preserve ability to measure MIP-like depositions:
threshold should be 1 MIP total per segment (i.e. sum of 5 or 10 SiPMs)
- SiPM for 4M/8M towers will be operated at $\sim 4\text{V}$ for most area
- 1 MIP $\sim 0.7\text{ MeV}$ in 4 mm thick scintillator
- Single-cell MIP with 4 mm thick tile is ~ 13 pixels at 3.5V with 1.3 mm SiPM or ~ 50 pixels with 3 mm SiPM (measured in lab).
- Range TBD from simulations.
- 14160-1315PS model at +4V yields gain of $\sim 3\text{e}5$