

SiPMs Meeting - June 14, 2023

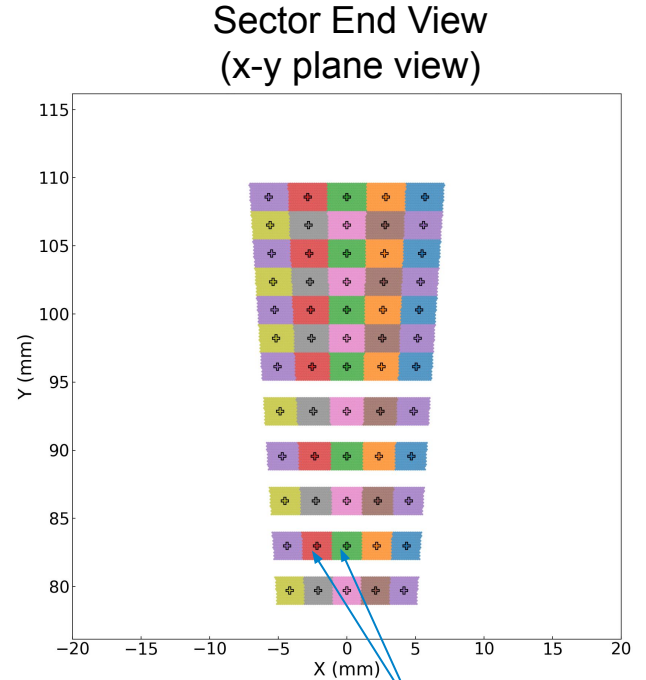
Barrel ECal SiPMs Requirement

Maria Zurek
Argonne National Laboratory



Number of SiPMs

- 12 readout layers on each sector end
- 5 readout cells per layer
- We plan to use 4 of 6x6mm² SiPM in each channel, as in GlueX
- Total number of SiPM is:
 - 12 (layers) * 5 (cells/layer) * 2 (ends) * 48 (sectors) = 5760 readout cells
 - 5760 (cells) * 4 (SiPMs/cell) = **23,040 SiPMs**

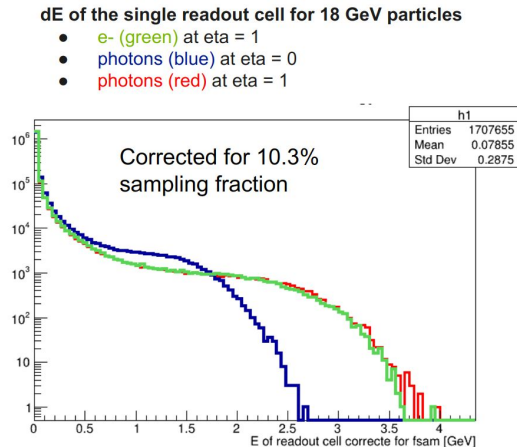


Readout **Cell**
Layer = 5 cells

The area 1 light guide is attached

Pixel Size

- Defined by **photoelectron statistics** and **maximal energy** to be measured
 - Maximal fraction of the total shower energy deposited in a longitudinal layer of **$\sim 1.5 X_0$ size** (approximately the readout layer depth) will be **$\sim 15\%$** (from longitudinal shower profile) **at $\eta = 0$**
 - With a steeper impact angle, the effective thickness of one SciFi/Pb layer will be longer, so the energy deposit per layer will be larger.
 - The most extreme case for us would be **50 GeV electrons at $+1.31$** (30 deg impact)
 - Assuming that we have $\sim 30\%$ ($15\%/\sin(30 \text{ deg})$) of max deposit for 50 GeV electrons at $\eta = 1.31$ this gives us **$\sim 15 \text{ GeV}$**



dE in single readout cell

Example for 18 GeV photons at $\eta = 0$ and $\eta = 1$ (~ 41 deg impact)

- Max dE at $\eta = 0$: $\sim 2.7 \text{ GeV}$ ($18 \text{ GeV} * 15\%$)
- Max dE at $\eta = 1$: $\sim 4.1 \text{ GeV}$ ($18 \text{ GeV} * 15\%/\sin(41 \text{ deg})$)

Pixel Size

- Defined by **photoelectron statistics** and **maximal energy** to be measured
 - GlueX reports ~ 660 phe/GeV
 - Assuming that we will get 1000 phe/GeV (assuming ~ 1.5 larger SiPM phe efficiency):
 - $15 \text{ GeV} * 1000 \text{ phe/GeV} = 15000 \text{ phe}$
 - We have 57600 pixels in 4 6x6 mm SiPMs:
 - $15000/57600 = \sim 26\%$ (max ratio)
- 4 6x6mm² SiPMs with 50 um pixel per should be just right: HPK S13360-6050PE

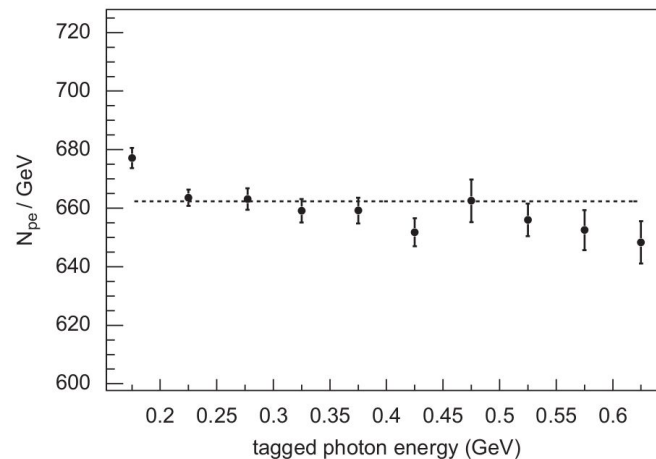


Fig. 16. The number of photoelectrons per GeV per end of the BCAL module is shown as a function of energy. A one parameter fit is plotted (dashed line). For more details see the text.