EMCal LEDs Testing

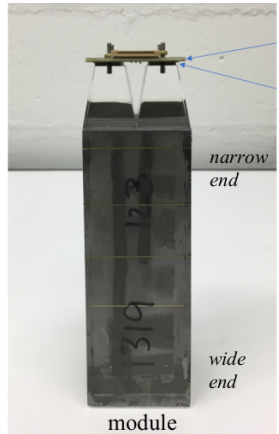
Apurva Narde

University of Illinois Urbana-Champaign

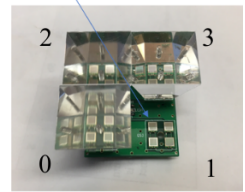
April 5, 2023

Introduction

- Each block has four towers (readout channels) with four SiPMs (Silicon Photomultipliers) each, resulting in a total of:
  - 24,576 readout channels
  - 98,304 SiPMs
  - 16.5 million fibers.
- There are 1,560 scintillating fibers extending along the length direction are embedded in the block.
- Each tower represents 1 ADC (Analog-to-digital converter) readout channel and is equipped with a light guide coupled to 4 SiPMs that collect the light from the fibers.



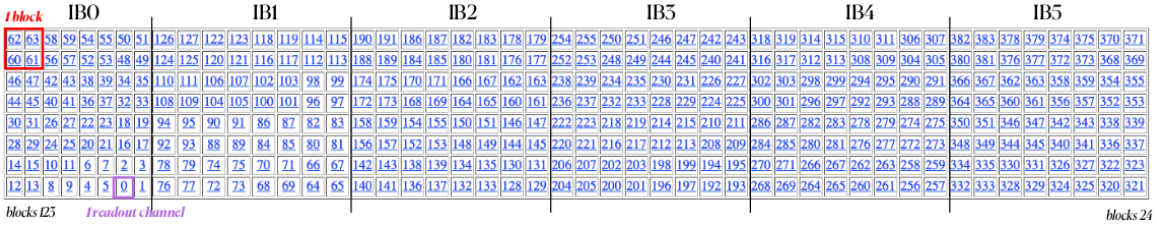
module



4 towers per block
with channel ordering

Readout Channels and Interface Board

- There are $96 \times 4 = 384$ distinctive ADC channels in each sector.
- No physical boundary between neighboring readout towers within a block.
- Channels are organized into groups of 64, each group (6 total) controlled by an interface board (IB).

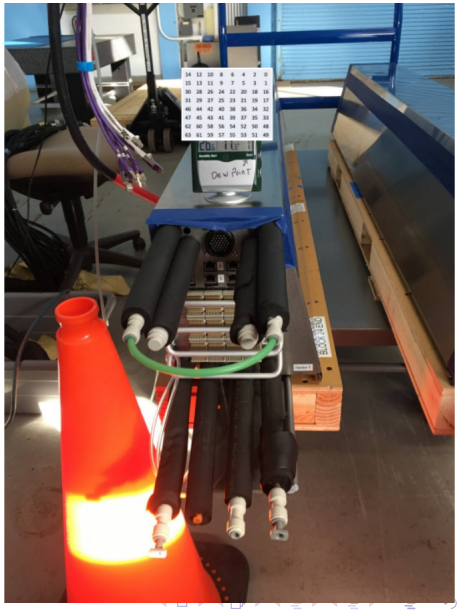


LEDs Testing

- Electronics to readout chain: Signal $\rightarrow$ SiPM $\rightarrow$ Readout.
- LED's go in place of "Signal".
- Test pulse circumvents the SiPM and goes directly to readout.
- Test pulses act as the ideal response whereas LEDs are used to measure the performance of the SiPMs.

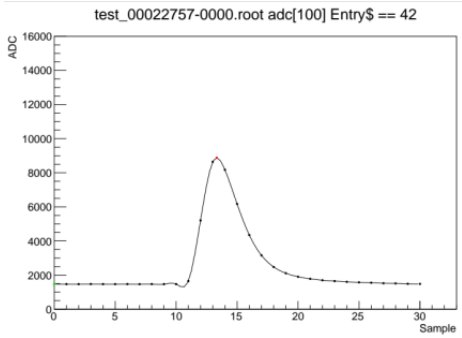
LEDs Testing

- Goal is to pulse LEDs and preamplifier independently to test the SiPMs.
- The light output of the SiPM is determined by the width of the drive pulse.
- There are 2 copies of the drive pulse sent to each sector covering 3 IBs each.
- The drive pulse comes from a fanout board that makes identical copies in 1 ns steps starting round 20 ns.



Example LED Pulse

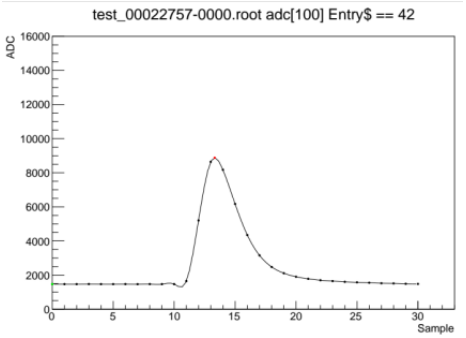
- The light is not guaranteed to come out with exactly the same time structure (delta function) as from particles.
- The amplitude of the LED is determined by the width of the drive signal (tpwidth).

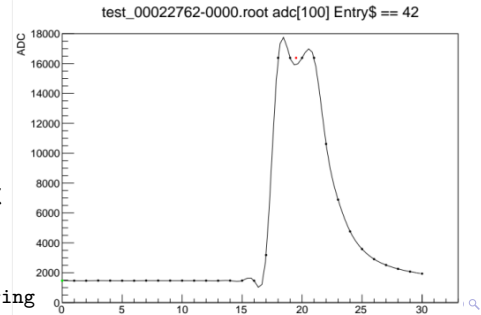


https://indico.bnl.gov/event/16532/#1-thoughts-on-led-monitoring

Example LED Pulse

- The light is not guaranteed to come out with exactly the same time structure (delta function) as from particles.
- The amplitude of the LED is determined by the width of the drive signal (tpwidth).
- You can drive the ADC to saturation, which was done in the beam tests to confirm the channel is alive.
- A value of tpwidth (50) saturates almost all channels.





https://indico.bnl.gov/event/16532/#1-thoughts-on-led-monitoring

Summary

- Goal is to pulse LEDs and preamplifier independently to test the performance of the SiPMs.
- We have LED data from pre-installation.
- Aim to have LED data from post-installation soon.
- Goal is to compare the performances of the SiPMs both before and after installation.