The ePIC Barrel Imaging Calorimeter

System Testing and Simulation

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Argonne National Laboratory

BIC General Meeting
February 14, 2025

News Brief

Ramping up fiber testing capabilities at ANL

- Fiber polishing, SciFi measurement setup
- SiPM testing (CAEN: 13360-1350CS / URegina: S14161-3050HS-04)

AstroPix testing front

- AstroPix v4 chip testing
- AstroPix v3 chip testing in preparation for the upcoming beam tests

Beam Test Plans in Japan and CERN by BIC-Korea

Baby BCAL Beam Test Data Analysis and Bench Tests

SciFi Testing Plans at URegina

(Zisis)

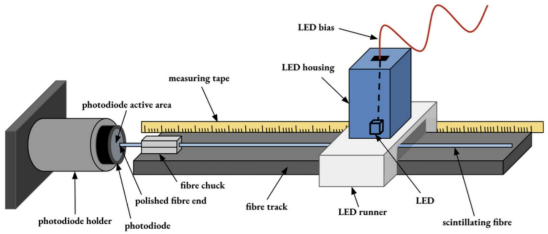
Dedicated Meeting: https://indico.bnl.gov/event/26283/
Fibers arrived to ANL - being shipped to URegina

Fiber Specs

3.1 Technical/Performance Characteristics

A. Light yield: the average response to a Sr-90 source shall be greater than 3.5 photoelectrons measured using a bialkali photomultiplier tube 200 cm from the source, and the opposite end blackened (assessed via methods mutually acceptable to the BSA and Contractor). SiPM
B. Diameter mean value and variation shall be 1.00 +/- 0.01 mm, RMS ≤0.02 mm. Calliper
C. Attenuation length for blue light > 4m. Photodiode
D. Batch to batch or lot to lot variation of light yield <15%.
E. Batch to batch or lot to lot variation of attenuation length <10%.
F. Emission spectrum in blue-green light Spectrophotometer
G. Scintillation decay time <3ns
H. Total length 4900 km
I. Delivery method in canes. Length of fibers 4.55 meters +/- 0.01m. Tape measure

Photodiode Station



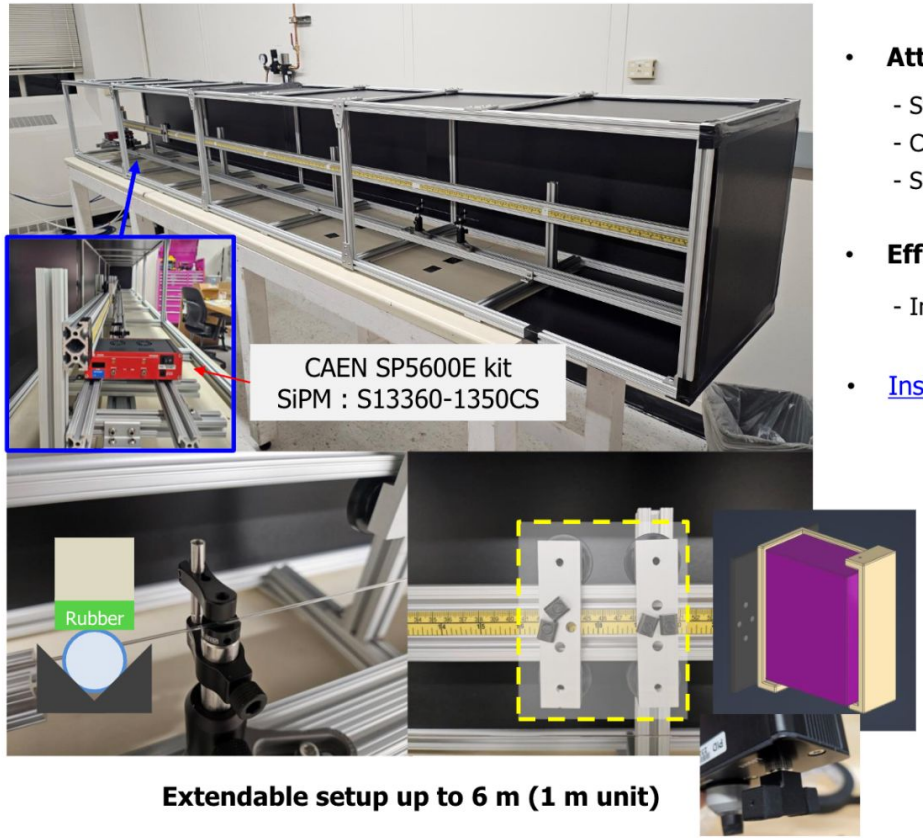
Npe Station - Setup PMT

- puck board and runner
- Stronger ^{90}Sr
- Ambient light control
- Coincidence with PMT

SciFi Testing Setup

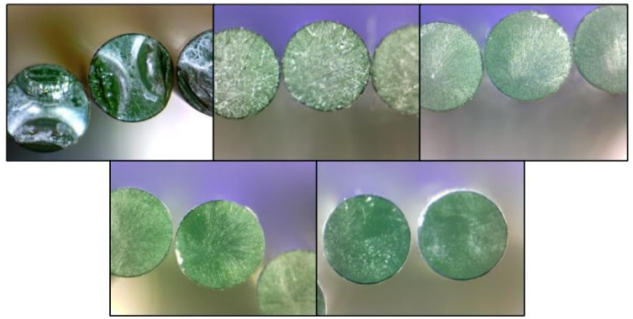
Current status of SciFi setup and Fiber polishing

(Seoyun, Bobae)



Extendable setup up to 6 m (1 m unit)

- **Attenuation Length Measurement** (SCSF-78)
  - Stability Test, Reproductivity Test
  - Compare results with setup done in Korea.
  - Sample Measurement - 3.0m, 3.8m, 4.5m, 5.5m (Single & Double Clad)
- **Effective Speed Measurement**
  - Install SiPM on both end of fiber, measure timing difference.
- Instruction & Logs (On Working)

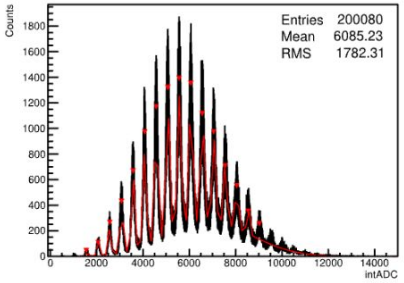


Polished Fiber Surfaces
(Sandpaper -> Polishing Film)

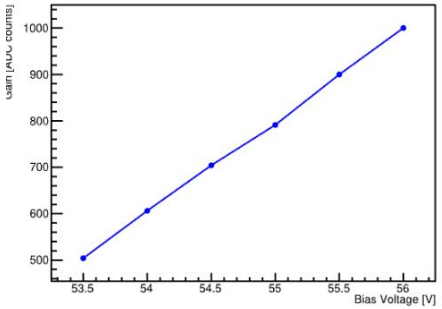
SiPM Testing

CAEN: 13360-1350CS / URegina: S14161-3050HS-04

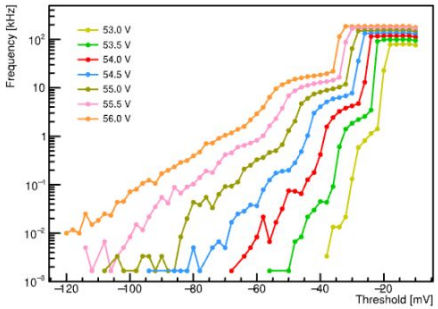
(Seoyun, Bobae)

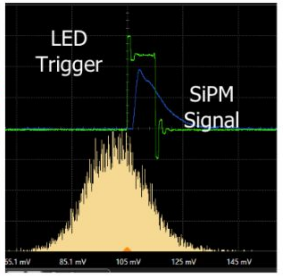


ΔADC (Gain) vs Voltage

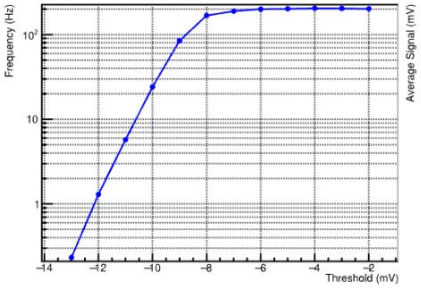


Threshold vs Frequency

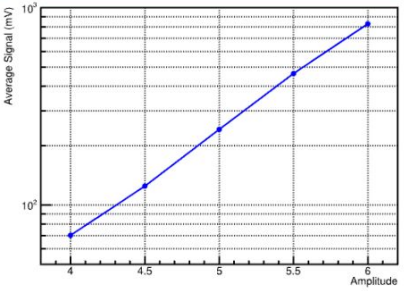


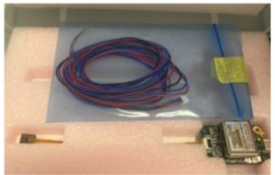


Threshold vs Frequency, No Source



LED Amplitude vs Signal (39.5 V)



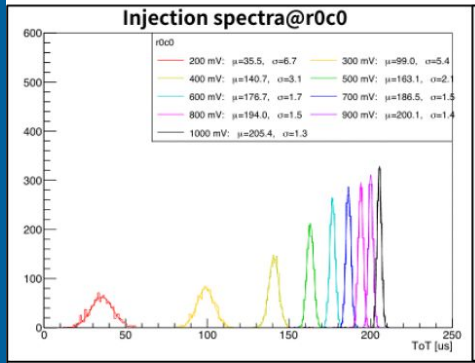


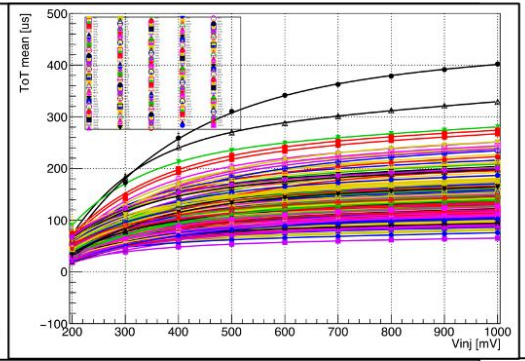
- Another SiPM from Hamamatsu has arrived
- C13367-6050EA
- Planning to test operation

AstroPix Testing Front (1)

v4 chip testing

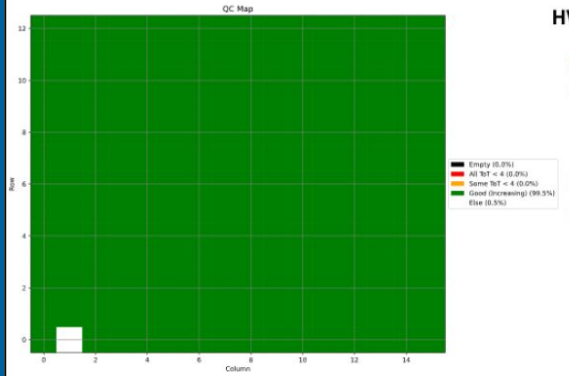
(Yoonha, Bobae)





- Optimized the configuration for v4 testing ✅
- Injection scan (HV = -200 V, threshold = 130 mV)✅
- Noise scan✅
- Source test with Ba-133 source: in progress

Quality check for each pixels



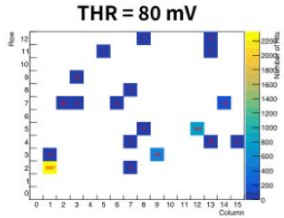
HV = -200 V, THR = 130 mV

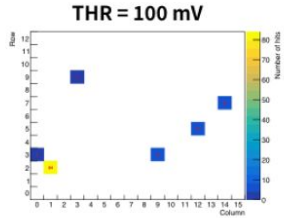
Good pixel (99.5%)
:mean ToT > 4 and increases with V_{inj}

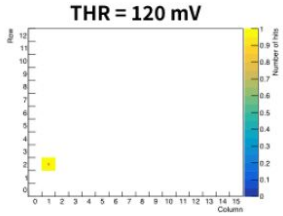
Else (r0c1)
:mean ToT > 4, but not increases with V_{inj}

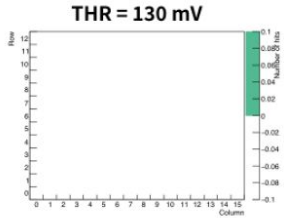
- Multiple injection scans on r0c1,
- but the **results varied each time**(next page)

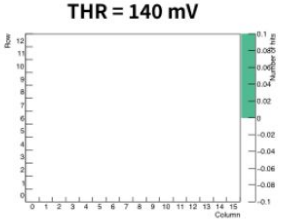
HV = -200, Noise maps with various THR











15 seconds per each pixel

black curtain to block external light

r0c1 is not a noisy pixel

AstroPix Testing Front (2)

v3 testing in preparation for the BIC-Korea's beam test

(Yoonha, Bobae)

- List of Astropix items related to the upcoming beam test from the Argonne side.
- Yoonha plans to hand-carry them when returning to Korea.

- 10 v3 single chips selected as good after IV measurement

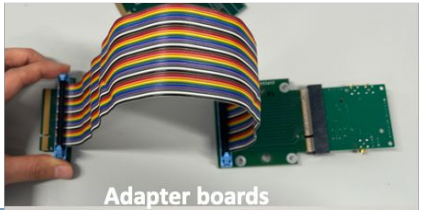
- 2 voltage cards / 2 injection cards / 2 config cards

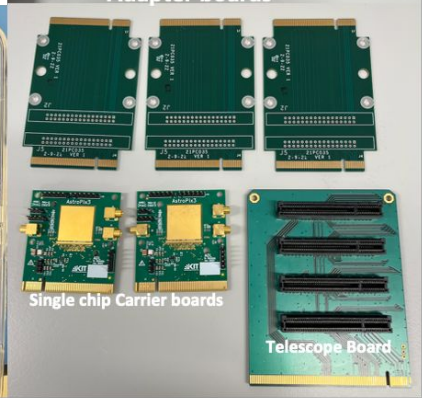
- 2 v3 single chip carrier boards

- 4 adapter boards

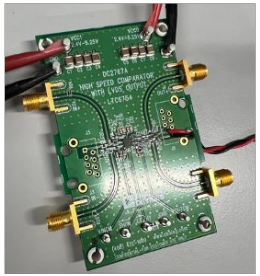
- 1 telescope board

- 1 v4 single chip

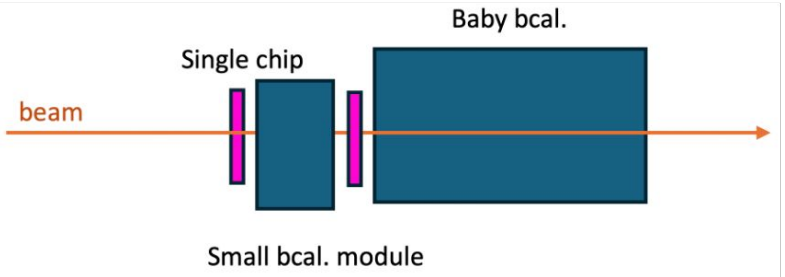




- External clock testing at ANL
  : in progress
- Dry-run with sw: in progress
  - ASTEP (used in FANL beam test last year)
  - astropix-python
- Looking for proper output from carrier board for synchronize event from calorimeter



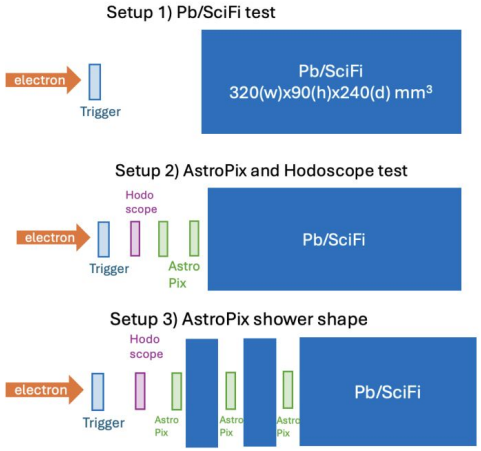
DC2767A analog board
High speed comparator
With LVDS output
LTC6754



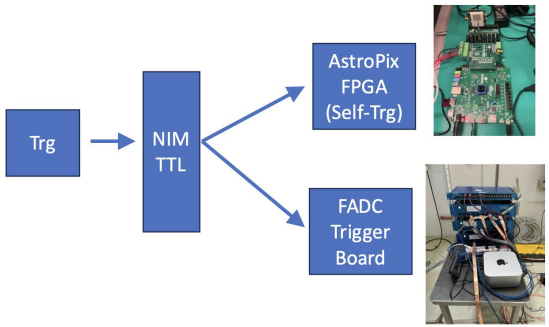
Beam Tests

News from BIC-Korea

(Jeongsu)



- **March 19-24 at KEK**
  - 1-5 GeV Electron
  - May have another chance to apply in May, Oct-Dec
  - 350Hz in 8x8mm^2 at 3GeV
  - ($\Delta p/p$) max~10% , may cause ~2.5% additional constant term
- **Program**
  - Energy response of deeper (240mm) prototype
  - integrated system
  - AstroPix test: sync between chips (if possible), energy response
  - Calibration of separated Pb/SciFi modules
- **July 23-30 at PS T10**
  - AstroPix+Pb/SciFi event matching
  - Electron, pion, muon



Trg#1 AstroPix data...
Trg#3 AstroPix data...
+...

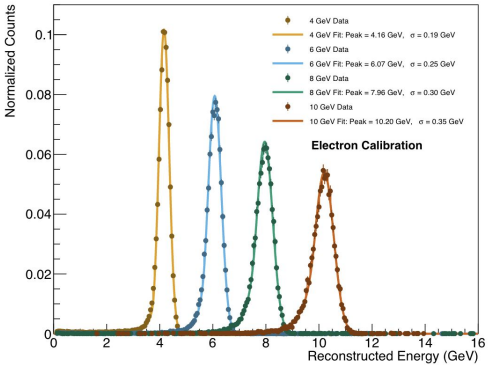
Trg#1 FADC data
Trg#2 FADC data
Trg#3 FADC data
+...

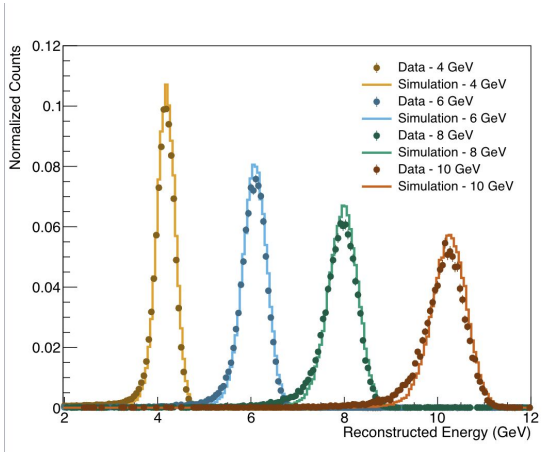
Analysis and Simulation Front

Henry, Jared

Working on conclusions from the data analysis from FY24 FTBF beam test

- Electron and pion response tested
- Comparisons with simulations





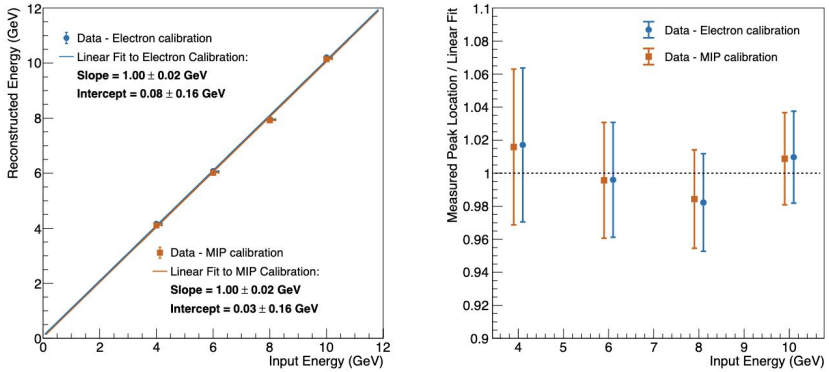
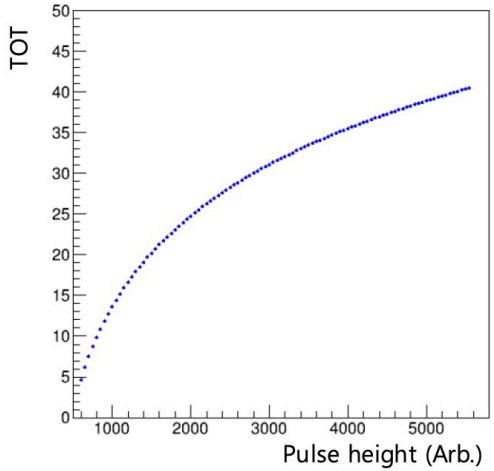


Figure 9. Comparison of the two calibration methods on the linearity of the calorimeter. Left: reconstructed peak positions compared to the nominal beam energy. Right: Ratio of data points to the linear fit. The uncertainty on the data points includes the uncertainty from the fit. The MIP and electron points are offset horizontally for clarity. It can be seen that the two calibration methods are in good agreement with one another.

Analysis and Simulation Front

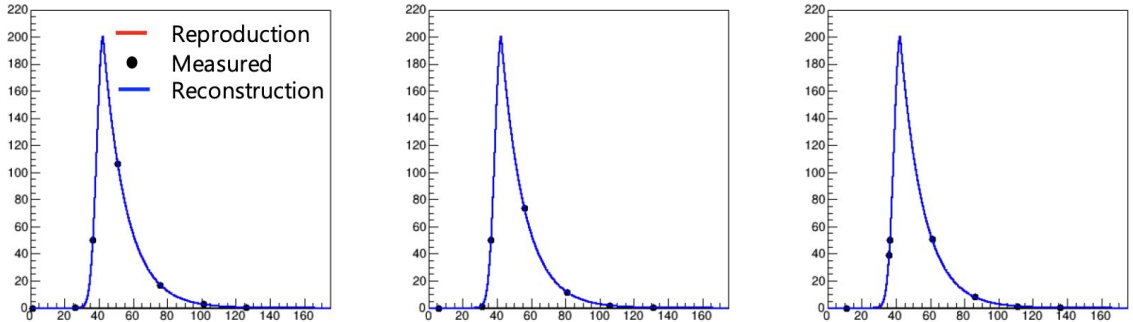
Minho

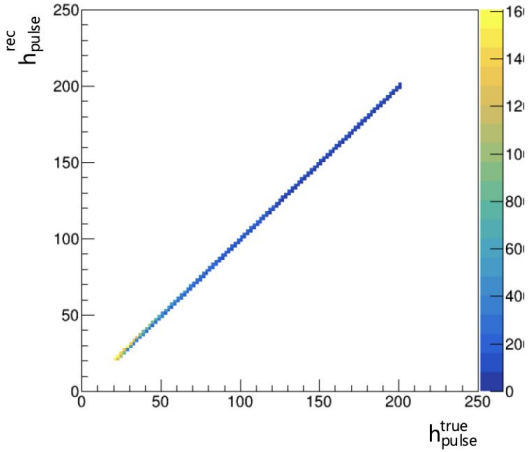


Working on studies of more realistic reconstruction and digitization

- Energy reconstruction in different energy ranges with of pulse size and ToT, ToA thresholds

Remind (TOA thr $<$ h_{pulse} $\leq$ TOT thr)





Reminder

Simulation Meetings: Tue 2 PM CT https://indico.bnl.gov/category/551/

Testing Meetings: Tue 8 AM CT https://indico.bnl.gov/category/606/