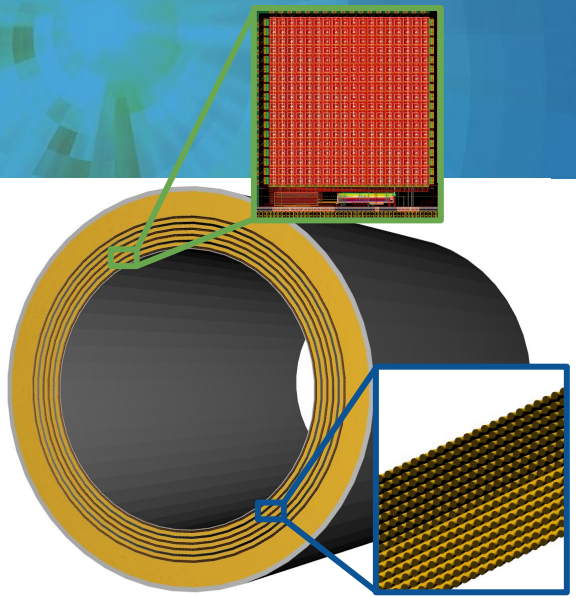
The ePIC Barrel Imaging Calorimeter

Software and Simulation System Testing



Maria Żurek
Argonne National Laboratory

BIC General Meeting
November 22, 2024

System Testing

- New AstroPix bench setup for calibration with Ba133 (made in PHY division at ANL) - results presented on CPAD2024

Performance Test Results (4)

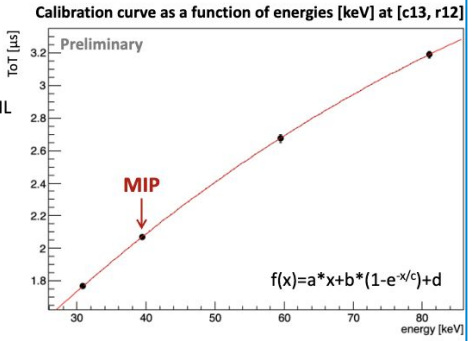
Bobae Kim, CPAD2024

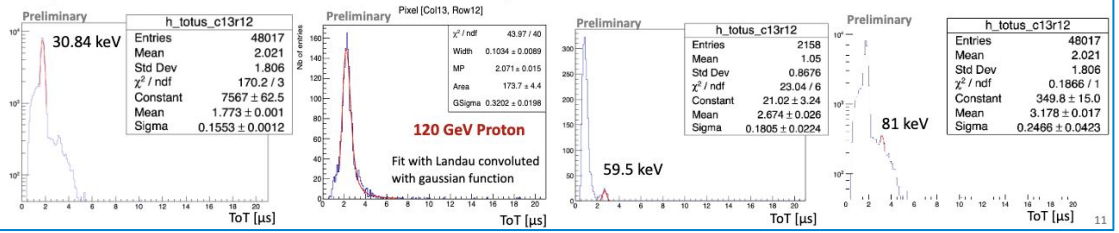
Beam Test of AstroPix_v3 (2)

One example pixel [column 13, row 12] in single layer

- ToT Histograms of measuring gamma energies to obtain a calibration curve
  - Ba-133 (30.84 keV and 81 keV), Am-241 (59.5 keV) at bench test in ANL
- Calibration curve fitted using pol2 or linear+exp. decay functions
- MPV of 120 GeV Proton at pixel [c13,r12] ~ **39.41 keV**
- Paper in progress

	Ba133 (30.84 keV)	Proton (120 GeV)	Am241 (59.5 keV)	Ba133 (81 keV)
$\mu\pm\sigma$ [µs]	1.773 ± 0.1553	2.071 (MPV)	2.674 ± 0.1805	3.178 ± 0.2466
E_{res} (FWHM)	20.6 %	.	15.9 %	18.2 %





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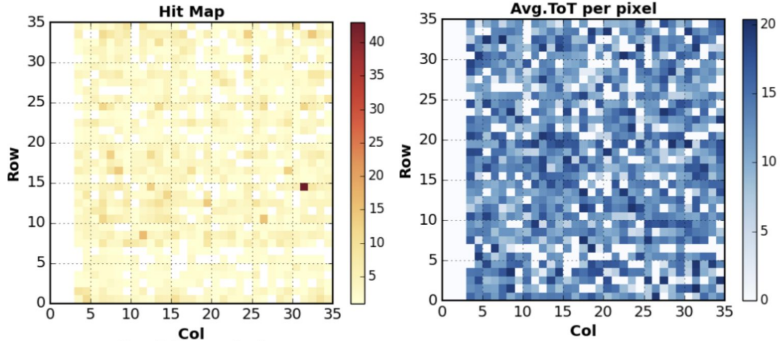
System Testing

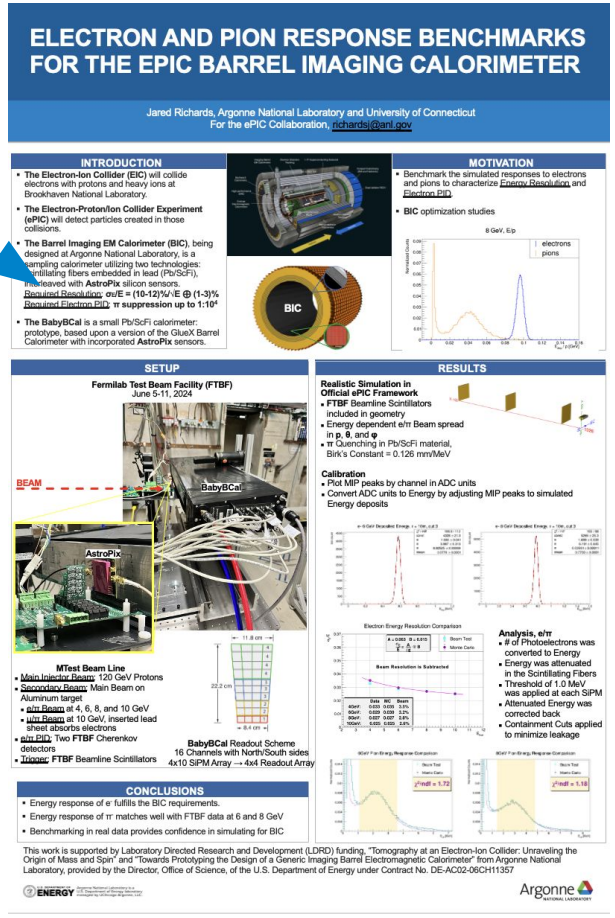
Jared Richards, Henry Klest
CPAD2024

- Concluding analysis of the beam test data with SciFi and AstroPix
- FTBF in FY25 uncertain, definite news in Dec.
  - Tue 26th, 2 PM CT Meeting will discuss that.



Result of **w101s07 chip**
HV: -150V
th: 100 mV
External Clock
source Ba133
10m data taking

- AstroPix with external clock tested for the first time at ORNL (thank you Bobae, and the ORNL team!)



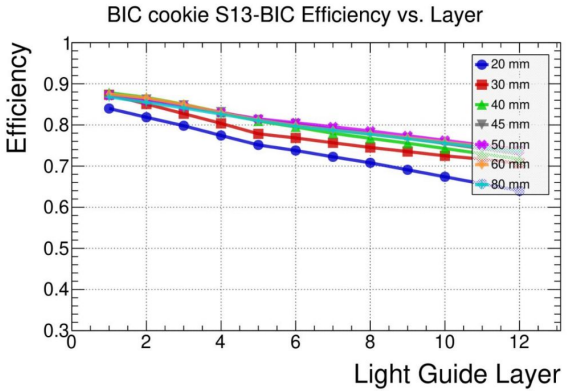
Simulation and Software

- Light Guide Simulation
  - Layer efficiency with single-clad fiber
  - Non-linearity of response from simulations with cross-talk

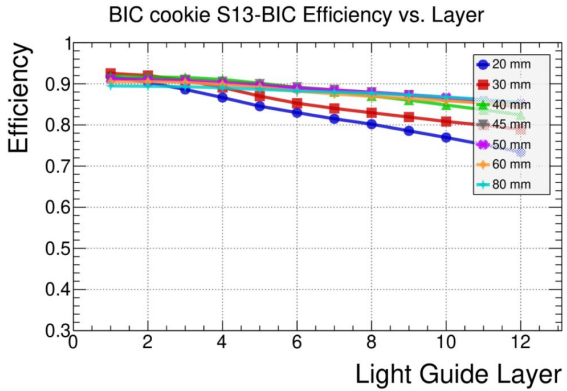
Efficiency

Tegan Beattie, BIC Simulation Meeting, https://indico.bnl.gov/event/24751/

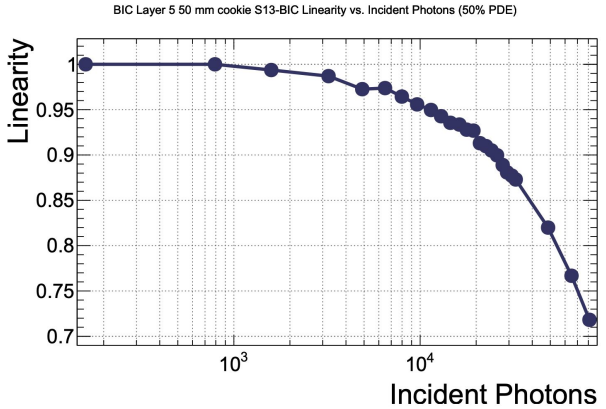
Double-Clad (θ_{max} = 26.7°)



Single-Clad (θ_{max} = 20.4°)



Tegan Beattie, BIC Simulation Meeting, https://indico.bnl.gov/event/24753/

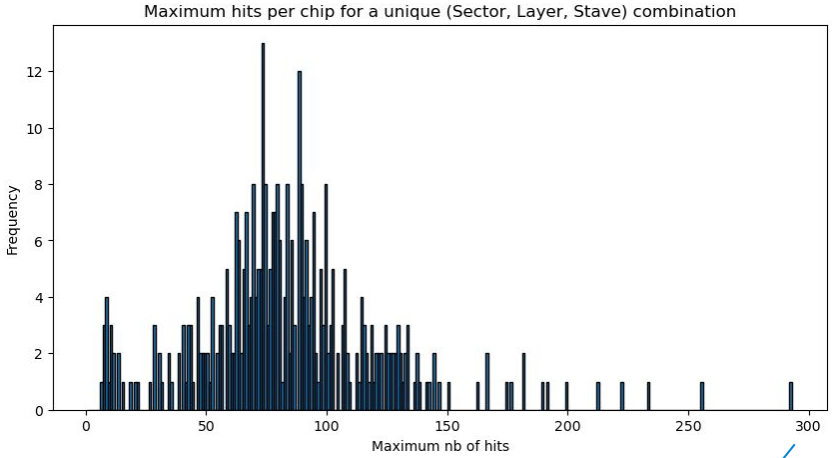


Simulation and Software

- AstroPix Occupancies (max buffer size)

Pythia, DIS NC, 18x275, Q2 > 1000

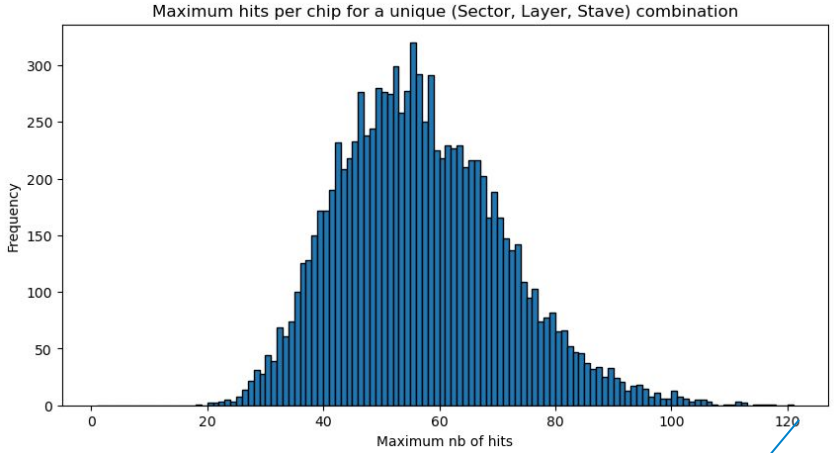
Max nb of pixels fired per chip



up to ~300 hits (extreme)

e at η = -1.4 (18 GeV)

Max nb of pixels fired per chip



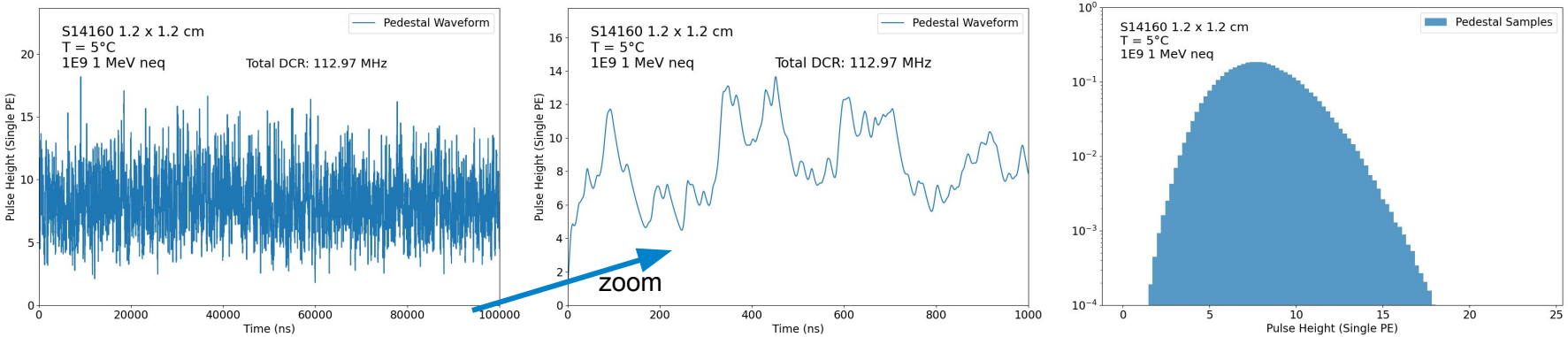
up to 120 hits

Simulation and Software

SiPM simulations

- Simulations of the expected pedestal position and sigma realistic SiPM DCR and signal shape
- Scenarios for different SiPM families, irradiations and operating temperatures tested
- Based on the pedestal sigma, the threshold (4-sigma) is being placed on a readout cell

Analysis by Henry Klest



Example simulated baseline and pedestal for S14160 SiPMs at 5 ºC irradiated 1e+09 1-MeV neutron equivalent dose

1E9 1-MeV neq/cm^2 irradiation **at 5 ºC** (INFN Bologna results): Pedestal sigma = 2 phe

1E9 1-MeV neq/cm^2 irradiation **at room temperature** (UC Davis results): Pedestal sigma = 5.38 phe

1E10 1-MeV neq/cm^2 irradiation **at room temperature** (UC Davis results): Pedestal sigma = 9 phe