BIC Test Beams

TIC meeting Jun 2nd, 2025

Jeongsu Bok (Pusan National University, South Korea)

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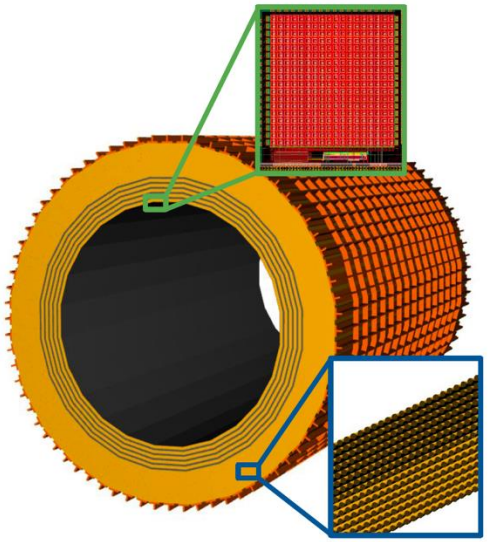
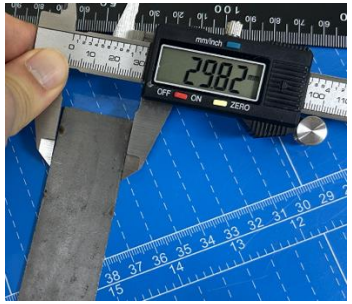
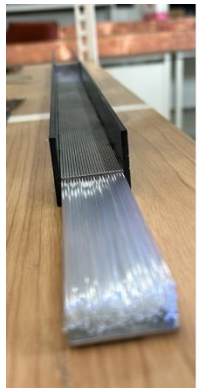


Prototype Module Production in Korea

1) Pb plate preparation

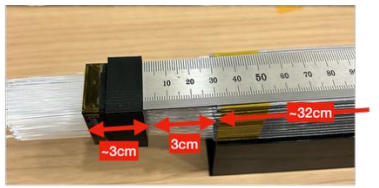


2) Stacking with fiber

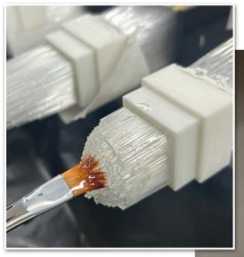


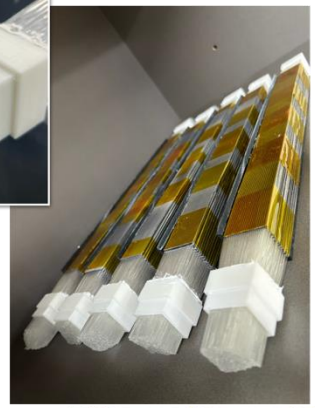
3) Cutting fiber

Epoxy

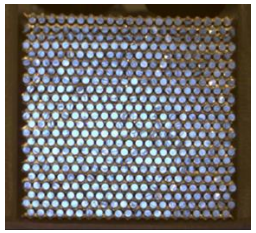


4) curing

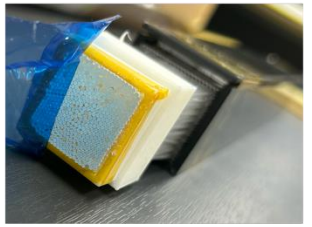


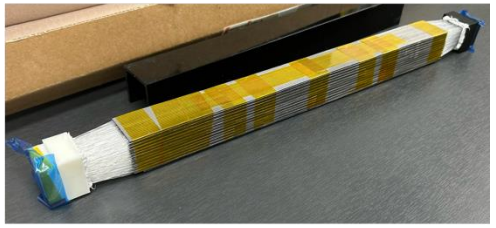


Produced 33 of 32x3x3 cm^3 unit modules for beam test including one for light guide

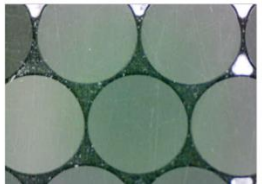


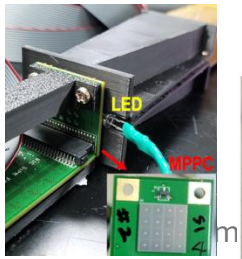
완성본

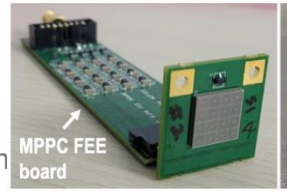


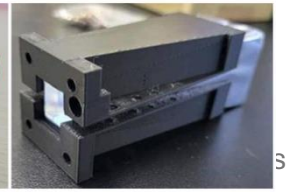


5) polishing





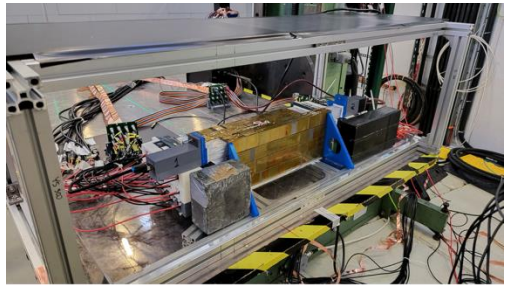


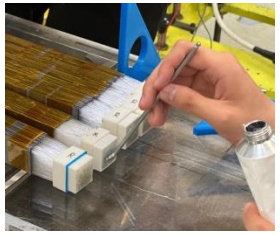


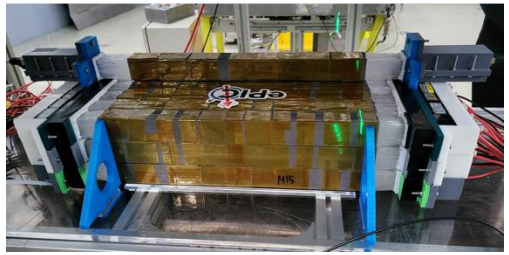
6) Connect with PMT or Light Guide + SiPM

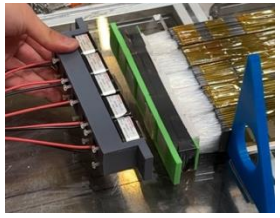
First beam test in Aug 2024 at CERN PS T10

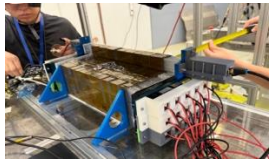
Pb/SciFi module assembly

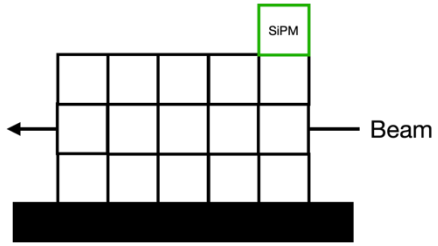




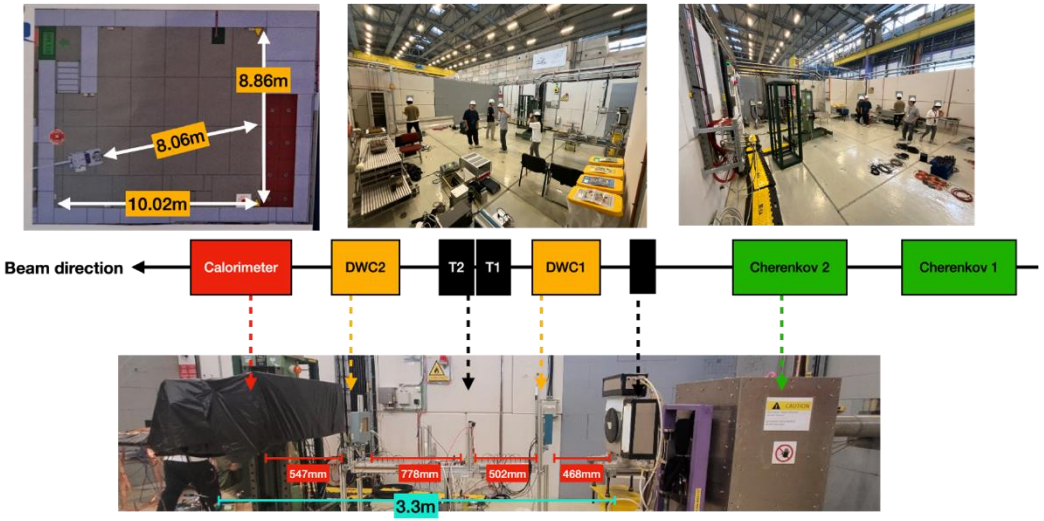




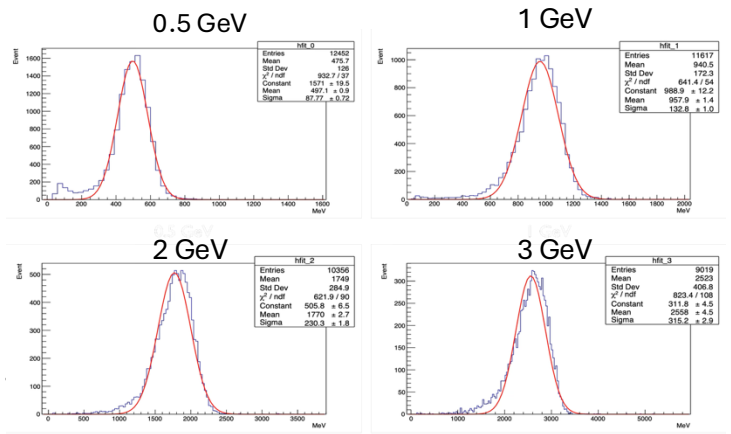




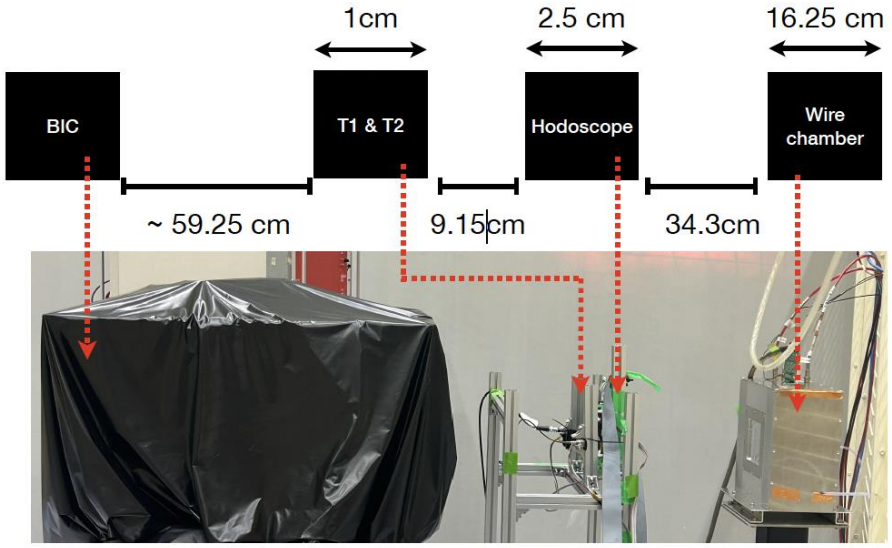
Glass PMT
(R11265-100)

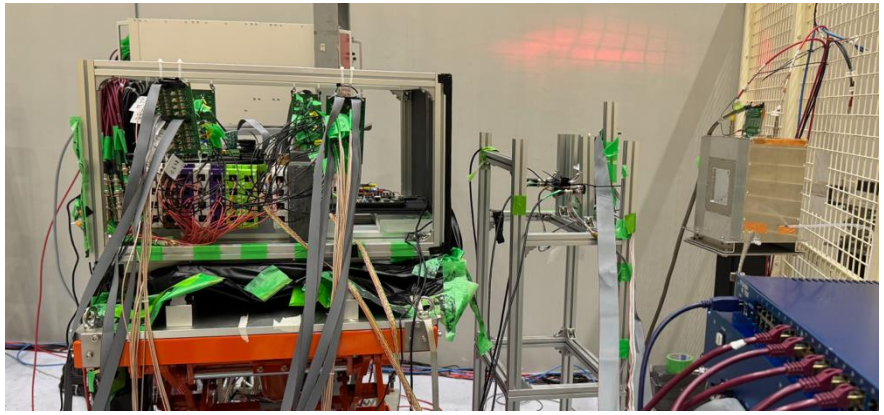


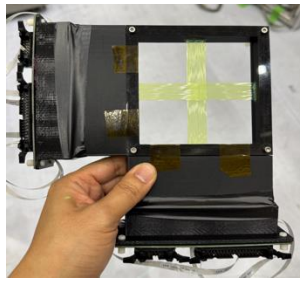
Successfully collected data from the prototype produced in Korea using our DAQ system for 0.5,1,2,3 GeV electron beams
17 participants from 5 institutions

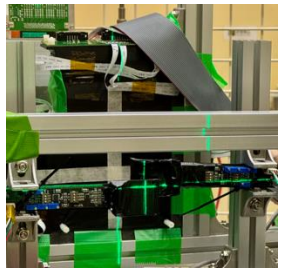


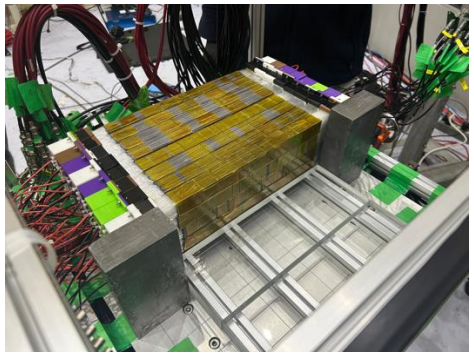
Second beam test in Mar 2025 at KEK PF-AR







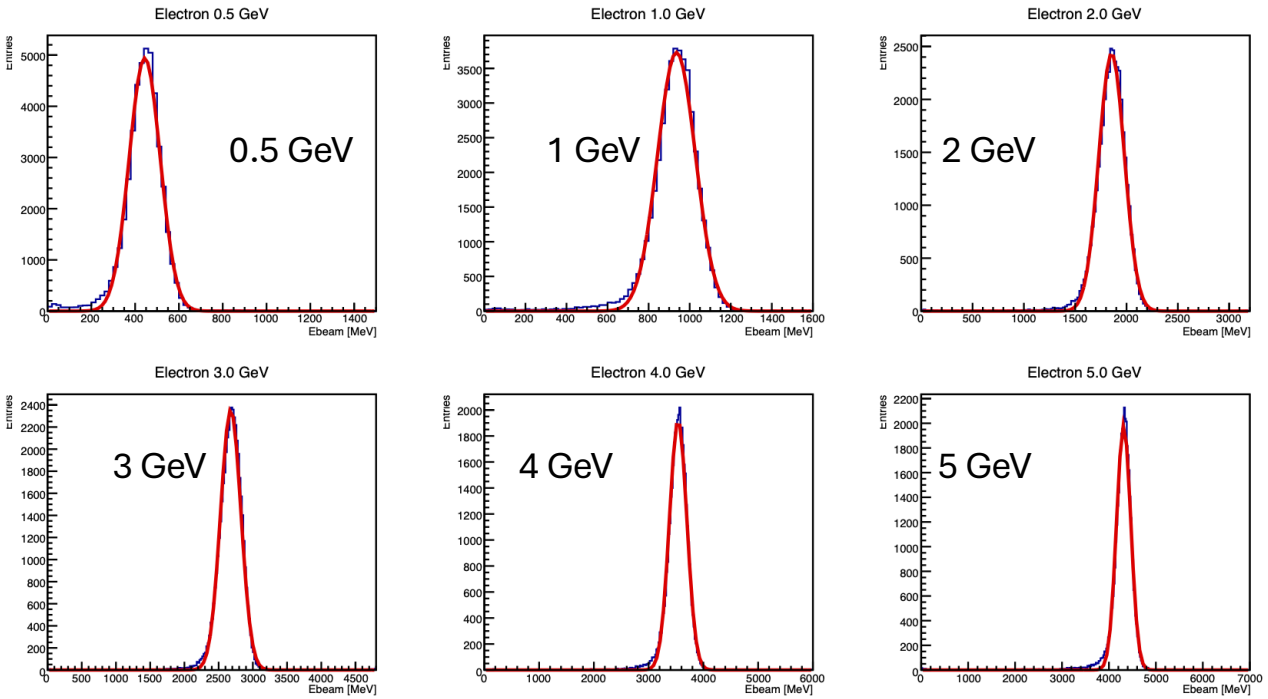


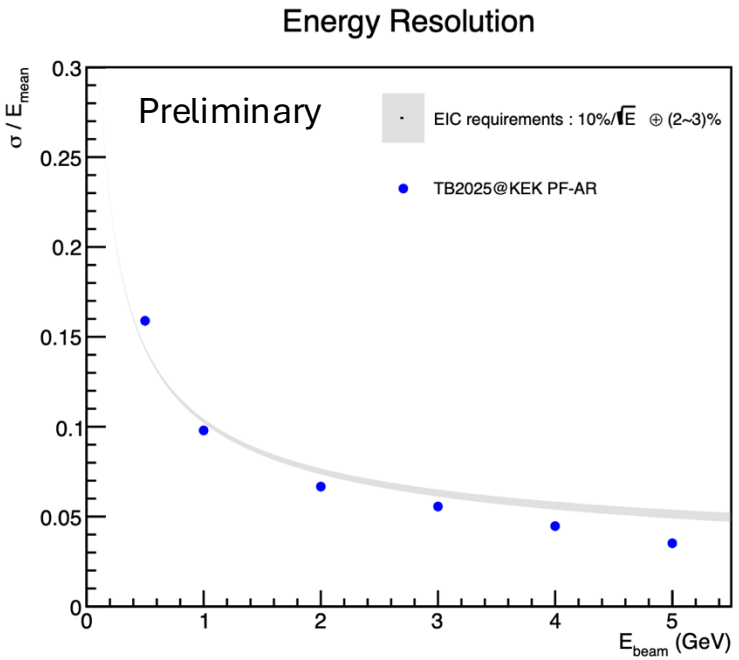


Detector setup

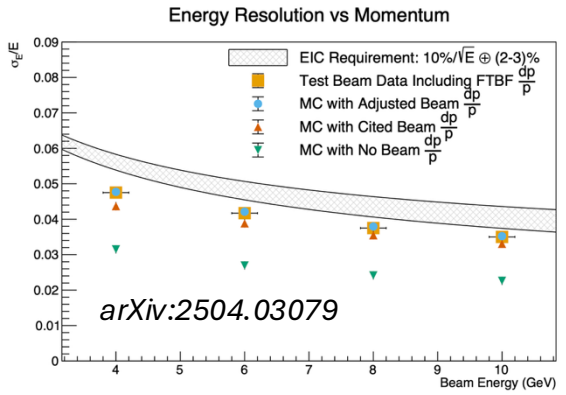
- Wire Chamber
- Hodoscope, Trigger
- Pb/SciFi 4x8 setup (32(w)x12(h)x24(d) cm^3) (previously 3x5)
- Data taking for 4x7 with AstroPix
- AstroPix layer setup

Electron energy response in Mar. 2025 at KEK

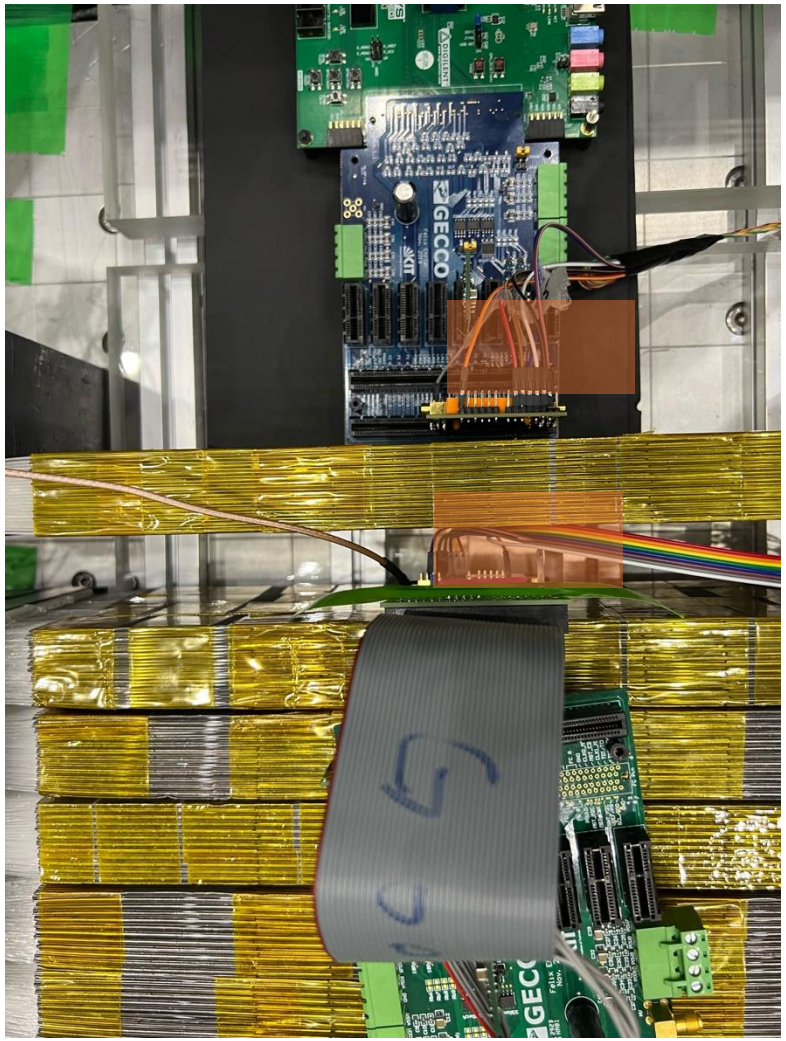


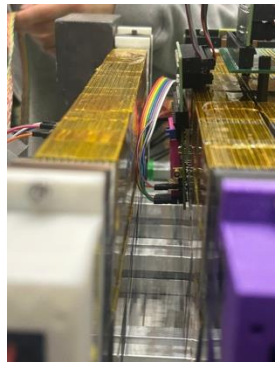


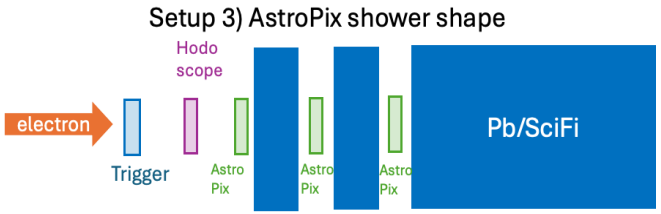
4x7 setup of 32x3x3cm^3 unit modules: 32x12x21cm^3 ~ 15.2X_0
Energy resolution below EIC requirement 10%⊕2~3% from 1 GeV
The result at 4 GeV including KEK dp/p is below 5% like the baby-bcal result (including FTBF dp/p) at 4 GeV (*arXiv: 2504.03079*)



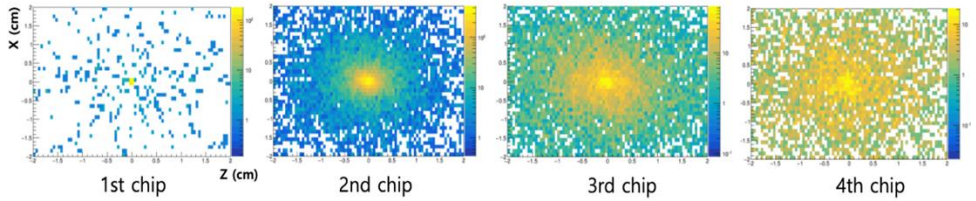
AstroPix data taking between Pb/SciFi layers





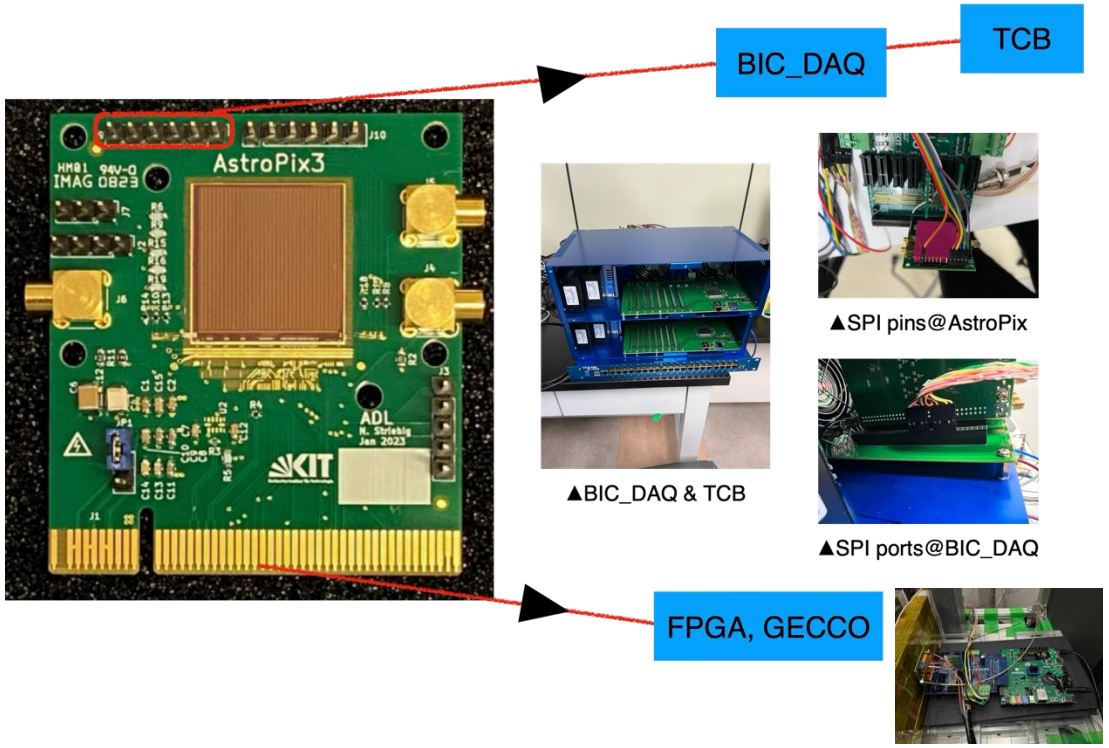


First data taking of AstroPix between Pb/Scifi prototype layers for BIC
Data taken using the GECCO + FPGA development board and our DAQ simultaneously



GEANT4 simulation using 0.5 GeV electron for intervened silicon layer between Pb/SciFi prototype modules. It is slightly different setup, and will be updated soon.

AstroPix to DAQ with common clock

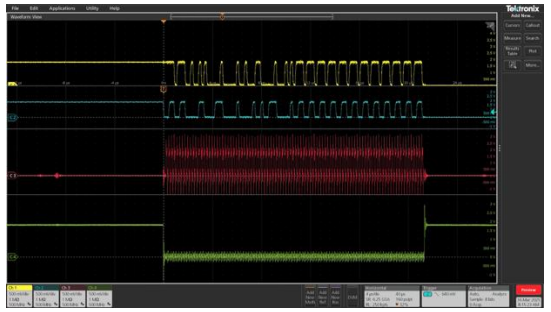


▲BIC_DAQ & TCB

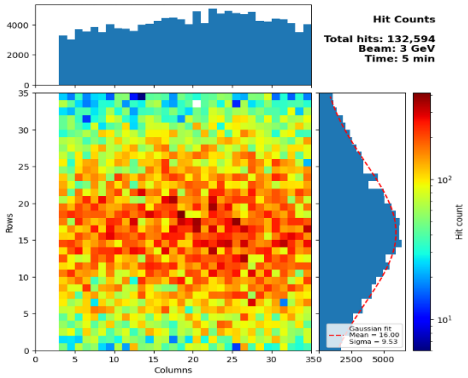
▲SPI pins@AstroPix

▲SPI ports@BIC_DAQ

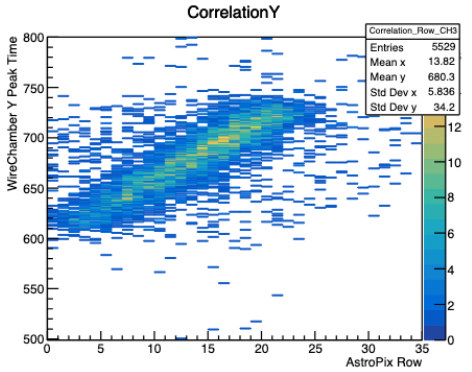
Hits on AstroPix chip were recorded in our DAQ and GECCO+FPGA development board setup simultaneously



Signal in the DAQ from the pins



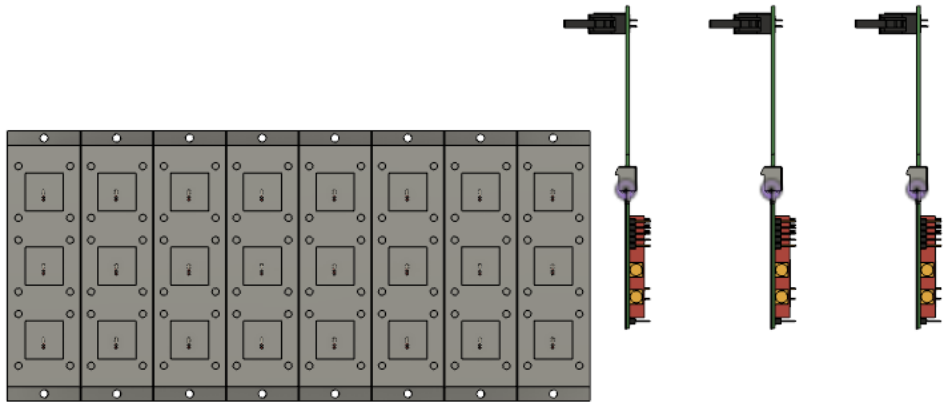
Signal through FPGA (in front of Pb/SciFi)

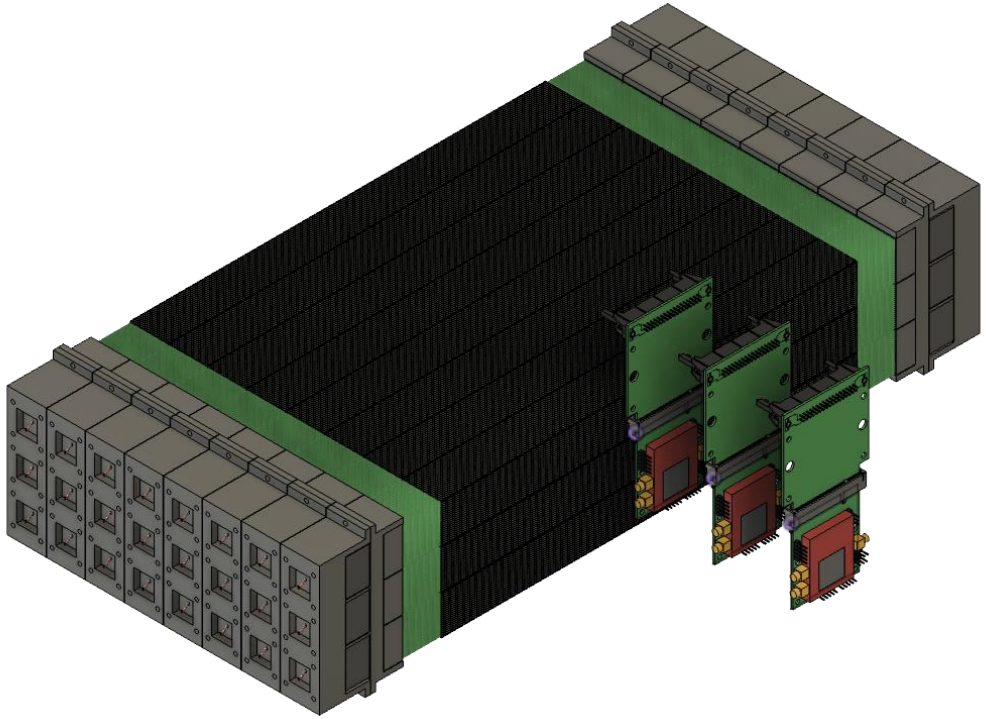


Initial look of correlation of hit position at AstroPix and drift time at Wire Chamber using common trigger clock

Plan for July at CERN PS T10

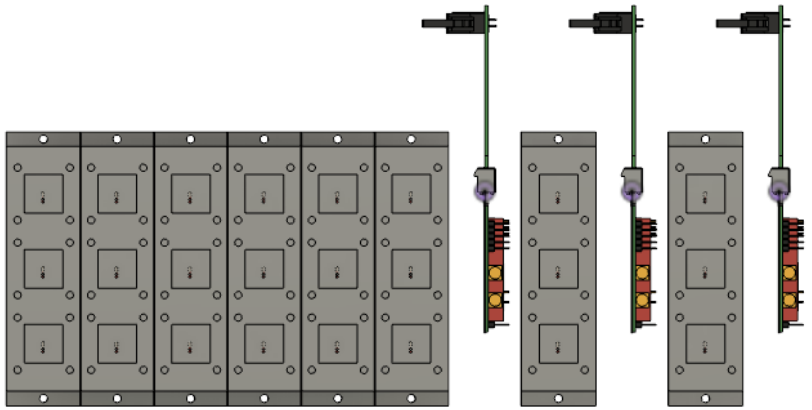
Planned T10 setup (1) Pb/SciFi setup

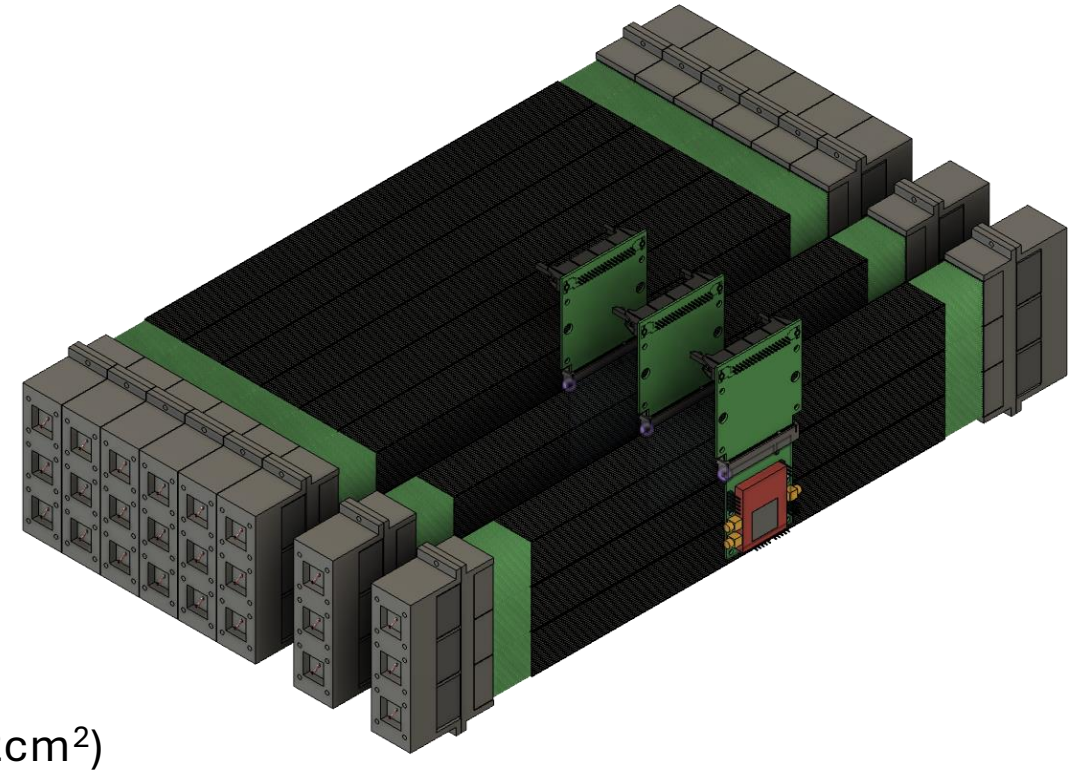




32(w)x9(h)x24(d) cm^3 setup (3x8 matrix of unit modules)
Several modules can be replaced by SiPM + Light Guide for comparison
Program: energy response using electrion, pion // confirm data acquision

Planned T10 setup (2) Imaging Layer setup





3+3+3x6 setup, intervened with AstroPix v3 chips (2x2cm^2)
Program: imaging layer test using electron, pion // energy response confirmation

Timeline in July at CERN PS T10

- Beam time: July 23th ~ 30th
  - 23rd: Preparation of Pb/SciFi setup, calibration
  - 24th: Pb/SciFi test with electron
  - 25th: Pb/SciFi test with pion
  - 26th: Prepare the Imaging layer setup
  - 27th: Test with the Imaging layer setup
  - 28th: Test with the Imaging layer setup
  - 29th: Test with SiPM modules

Remaining tasks toward July beam test

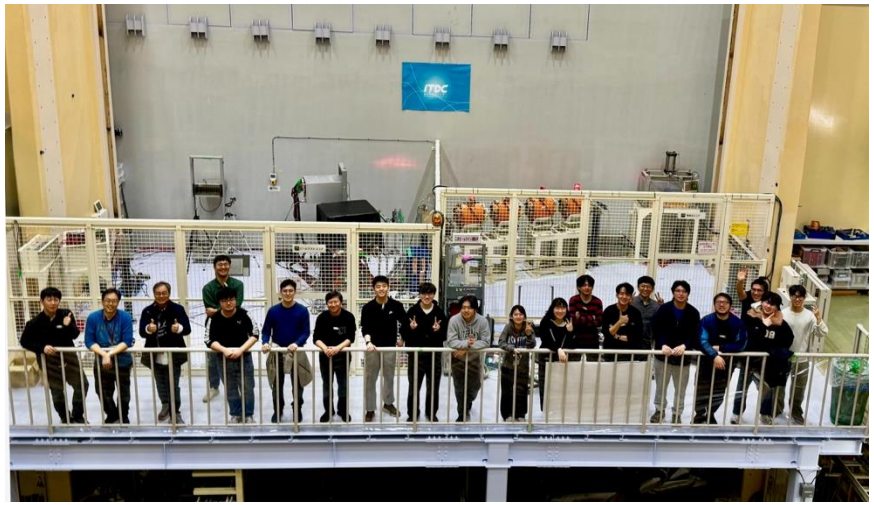
- Confirm multi-hit capability with common trigger clock
- Simulation
- SiPM+Light Guide preparation and test

Further Plan after July beam test at CERN

- After confirming syncronized data taking with AstroPix hits, we will aim shower imaging.
- Preparing a prototype bulk sector with shorter length (70cm).
- More coverage of imaging layer with more AstroPix’s (quad, 9-chip)
- DAQ based on HGCROC type

Summary

- From previous beam tests,
  - Electron energy resolution
  - Syncronized data taking for AstroPix and Pb/SciFi
- BIC beam test plan in July at CERN
  - Advanced tests with more AstroPix's
  - Electron pion comparison
  - SiPM + Light Guide
- In Future
  - A (shorter) bulk sector with SiPM+LG
  - 3D Shower imaging



20 participants from 6 institutions in March 2025 at KEK PF-AR Testbeam

Backup: Setup for Imaging layer setup

- Initial idea for positioning AstroPix and Pb/SciFi