Barrel Electromagnetic Calorimeter

Current ANL AstroPix Telescope Setup   Planned BIC Setup
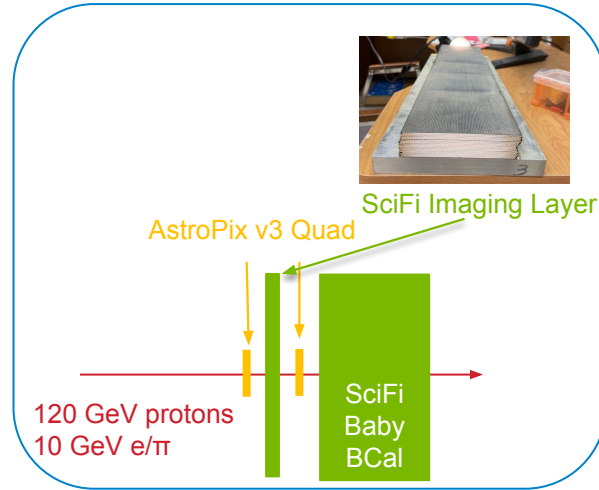
Barrel ECal - FTBF Original Plans FY24

Stage I

AstroPix v3 Quad
4x4 cm

GlueX Prototype

SciFi
Baby
BCal

120 GeV protons
10 GeV e/π

Stage II

AstroPix v3 Quad

SciFi Imaging Layer

SciFi
Baby
BCal

120 GeV protons
10 GeV e/π

Stage III
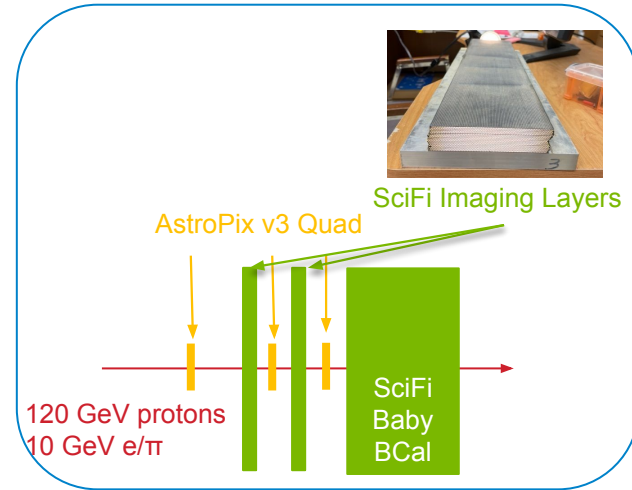
AstroPix v3 Quad

SciFi Imaging Layers

SciFi
Baby
BCal

120 GeV protons
10 GeV e/π
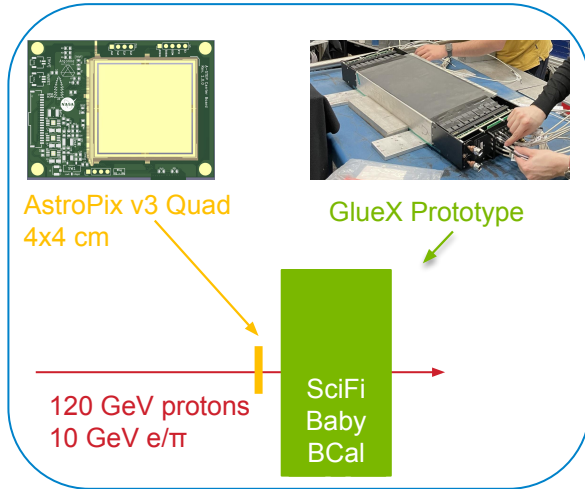
- **Prior to installation at FTBF:** characterize used AstroPix v3 Quad sensor on the bench; take cosmics with Baby BCal, develop and test integrated readout system

- **At the FTBF with proton and e/π beam:**
  - Every stage requires **commissioning** of the whole system in the beam: MIPs - **120 GeV protons**
  - **2 important benchmarks** with Baby BCal and integrated system: benchmark **response to pions** in simulations, evaluate e/π separation (with Cherenkov FTBF detector) - **10-5 GeV e/π beam**

Barrel ECal - FTBF Original Plans FY24

FTBF Beam original estimated schedule (**1 full week each**, i.e. 2 weeks of half-day shifts), **together with ATLAS Telescope program** (Experiment T1224 in MTest 6.2 Enclosure):

- Stage 1: Estimated Winter '23 , Stage 2: Estimated Spring '24, Stage 3: Estimated Summer '24

If only Spring '24 is available → proton (MIPs commissioning) and e/π beam (5-10 GeV) needed

- Try to use cosmics, as much as possible, to integrate AstroPix & Baby BCAL. However, we need to also commision the readout system in high-occupancy environment of the beam (MIPs).

- Realistically we will be probably able to run in stage I and maybe II.

- First physics benchmark will be to test the response to pions (we can fold it in the simulation and benchmark e/π response). The e/π benchmark with Cherenkov will depend on how much time we can potentially get with e/π beam.

We try to consider alternatives - we need beam test + Cherenkov/PID detector (need to know momentum of the beam, and identify pions)

- CERN(?) - Do not have any experience in beamtest there + significant logistical endeavour with transporting the whole setup. Any advice?

- JLab(?) - Maybe Hall C/A? Started exploring with the hall leaders, but doesn't look very promising as of now.

Thresholds for Barrel ECal

Subsystem	Region	Channel Count	Threshold on summed Energy [keV, MeV]
AstroPix	Barrel	~360M pixels	15 keV
ScifiPb	Barrel	5760	5 MeV

https://github.com/eic/EICrecon/blob/main/src/detectors/BEMC/BEMC.cc

Thresholds for AstroPix:
3 MeV / 8192 ADC channels * 41(channels) = ~**15 keV** ✅
Threshold for SciFi:
1500 MeV / 16384 ADC channels * 5(channels) = ~0.5 MeV; 0.5 MeV/10% (fsam) = **5 MeV** ✅

EcalBarrelScFiRecHits and EcalBarrelImagingRecHits can be taken as the estimate for the rates.

The SciFi response currently implemented as true dE (not 2-side attenuated). The calculated rates using EcalBarrelScFiRecHits will be **per-side of the SciFi/Pb calo**. The total rate from the system should be taken as **2 x the estimated rate**.

Thresholds (RecoHit), pedestal mean and sigma (Digi) has been revisited (and out into the spreadsheet)
https://github.com/eic/EICrecon/pull/1078