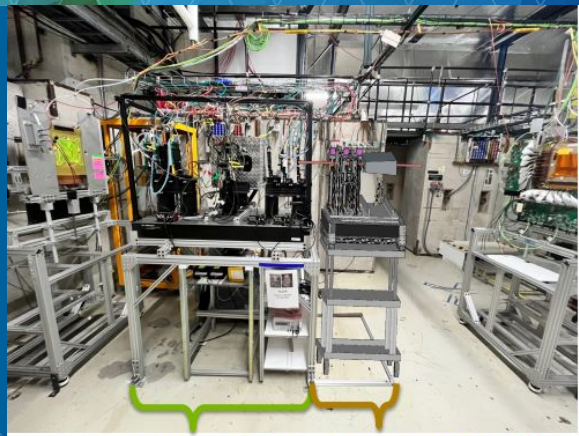
BIC Meeting - R&D

March 1st, 2024

Goals and Objectives



Maria Żurek
PHY, Argonne National Laboratory

Barrel Imaging Calorimetry R&D

FY23 - Generic R&D:
https://www.jlab.org/sites/default/files/eic_rd_prgm/files/2022_Proposals/EIC_R_D_Imaging_Calo_EICGENRandD2022_25.pdf

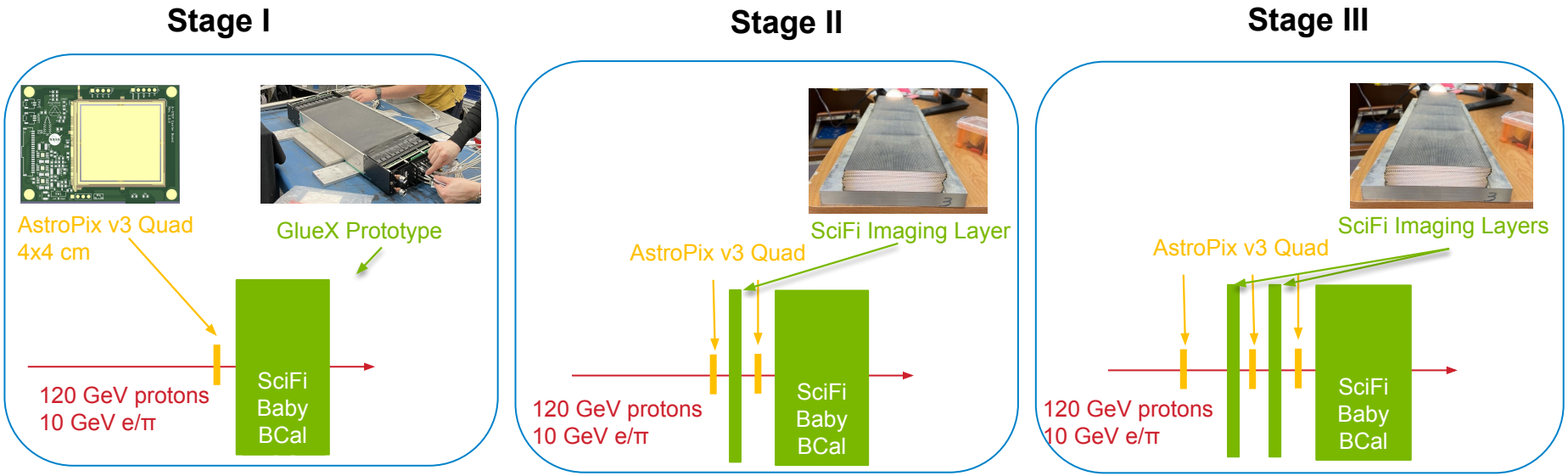
FY24 - Project R&D:
https://wiki.bnl.gov/conferences/images/4/4e/EICProjectRD_FY24_ImagingBarrelCalorimeter.pdf

Detector Day: March 25, 2024

Objectives for today:

- Reminder of goals and milestones
- Status of R&D program components
- Planning critical items before possible FNAL beamtest

Project R&D - Original Plans FY24



- **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**

Project R&D - 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 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. Realistically, not possible.

FY24 R&D Milestones

Milestone	Timeline	Experimental condition
M1: Baby BCAL setup complete in FNAL	Q1 FY24	-
M2: AstroPix chip v3 bench preparations completed	Q1 FY24	bench, source
M3: DAQ for the integrated system of Baby BCal and AstroPix chip ready	Q1 FY24	bench, source, cosmics
M4: Integrated system (Baby BCAL + AstroPix chip) commissioned in FNAL - Mode A	Q1 FY24	cosmics, p, e/π beam
M5: Energy spectrum for e/π measured and benchmarked	Q1-Q2 FY 24	e/π beam

FY24 R&D Milestones

Milestone	Timeline	Experimental condition
M6: SFILs readout with SiPMs installed	Q2 FY24	bench, source, cosmics
M7: SFILs integrated into DAQ	Q2 FY24	bench, source, cosmics
M8: System with SFILs commissioned at FNAL	Q2-Q3 FY24	cosmics, p, e/π beam
M9: Electron/Pion separation benchmarked against FNAL Cherenkov threshold counter	Q2-Q4 FY24	e/π beam
M10: Performance with new generation SiPM compared (SFILs)	Q2-Q4 FY24	e/π beam

FY23 Generic R&D Milestones

Beam test

1. Preparation of online and offline analysis software for the beam test
2. Assembly of the calorimeter module with attached SiPM readout and DAQ
3. Installation of the module in Hall D PS area
4. Participation in the beam test
    a. Test of trigger and DAQ in the beam environment
    b. Relative gain calibration of photosensors
    c. Collection of FADC data (possibly with different electron energies and module incident angle, depending on opportunistic access to the area) with SiPM readout

Data analysis

1. Implementation of the prototype geometry in Geant4
2. Energy and time calibration of the data
3. Extraction of energy resolution and comparison with simulations
4. Implementation of the improved simulation responses in the full barrel ECAL simulation for further performance studies