Imaging Calorimetry for ePIC

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Electromagnetic Calorimetry

All physics processes require the detection of the scattered electron for the momentum or energy reconstruction and particle identification.
The main tasks of the barrel electromagnetic calorimeter are:

- Detect the scattered electrons and separate them from pions
- Require moderate energy resolution
- Particle Identification: separate secondary electrons and positrons from charged hadrons.

Major challenge: Space Limitation inside the solenoid

ECal Technologies

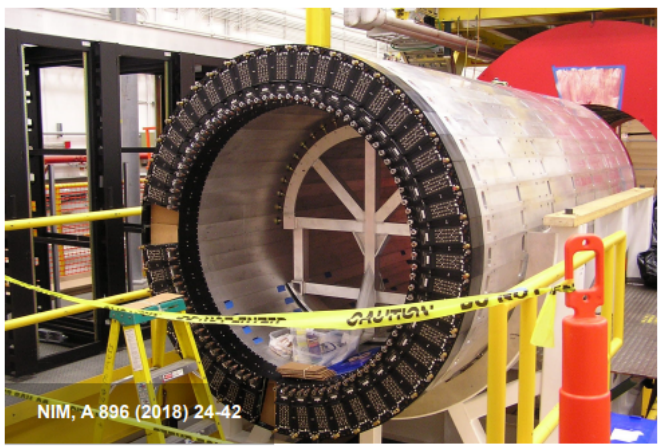
- **$PbWO_4$ crystal**:
  - good energy resolution
  - high granularity to detect and identify electrons, photons, and pions
  - prohibitively expensive
  - needs precise temperature control
- **Scintillating Glass**
  - resolution comparable with lead tungstate
  - not sensitive to temperature
  - energy leakage

- **Absorber/Scintillating Fibers: W/ScFi**:
  - consists of many scintillating fibers embedded in an absorber material which is then gathered at the front or the back (or both) and read out with photosensors
  - Too low electron-pion separation for barrel
  - energy resolution too low
- **Pb/Sc Shashlyk**:
  - a stack of absorber and scintillator plates
  - cannot meet electron-pion separation requirement

None of these technologies is a good solution for the Barrel Electromagnetic Calorimetry requirement for EIC.

We can do better!

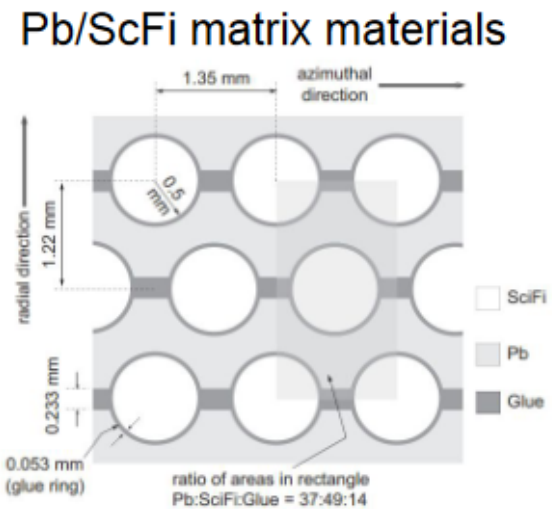
Combining the Pb/ScFi technology for GlueX Calorimeter and the AstroPix sensors we can do better.



Pb/ScFi Technology

- The fibers are embedded into a heavy material: lead
- The resolution depends of the fiber density and the absorber material.
- Energy resolution :

$\sigma = 5.2\%/\sqrt{E} \oplus 3.6\%$

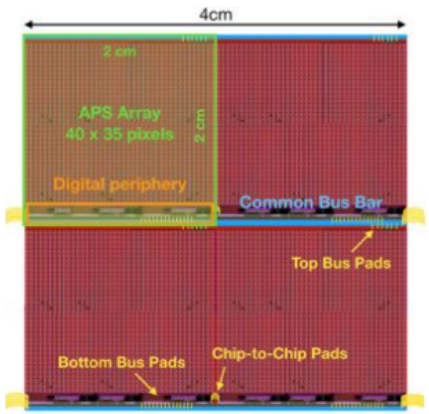


AstroPix Sensors

Developed for NASA AMEGO-X space mission).

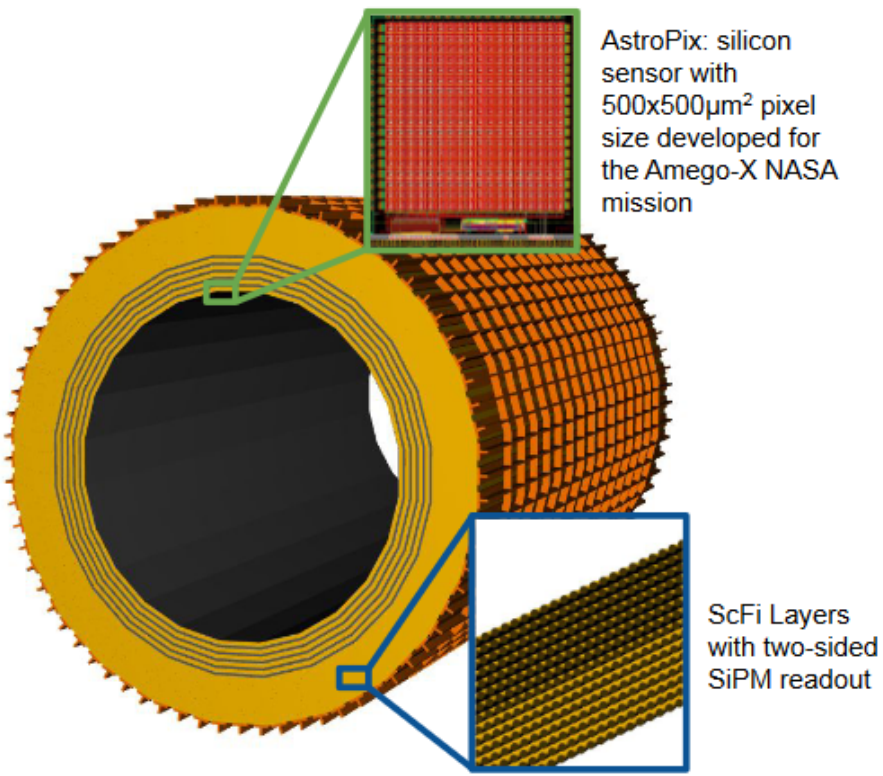
Key Features:

- Very low power dissipation
- Good energy Resolution
- 500 μm pixel size



ePIC Imaging Barrel ECal

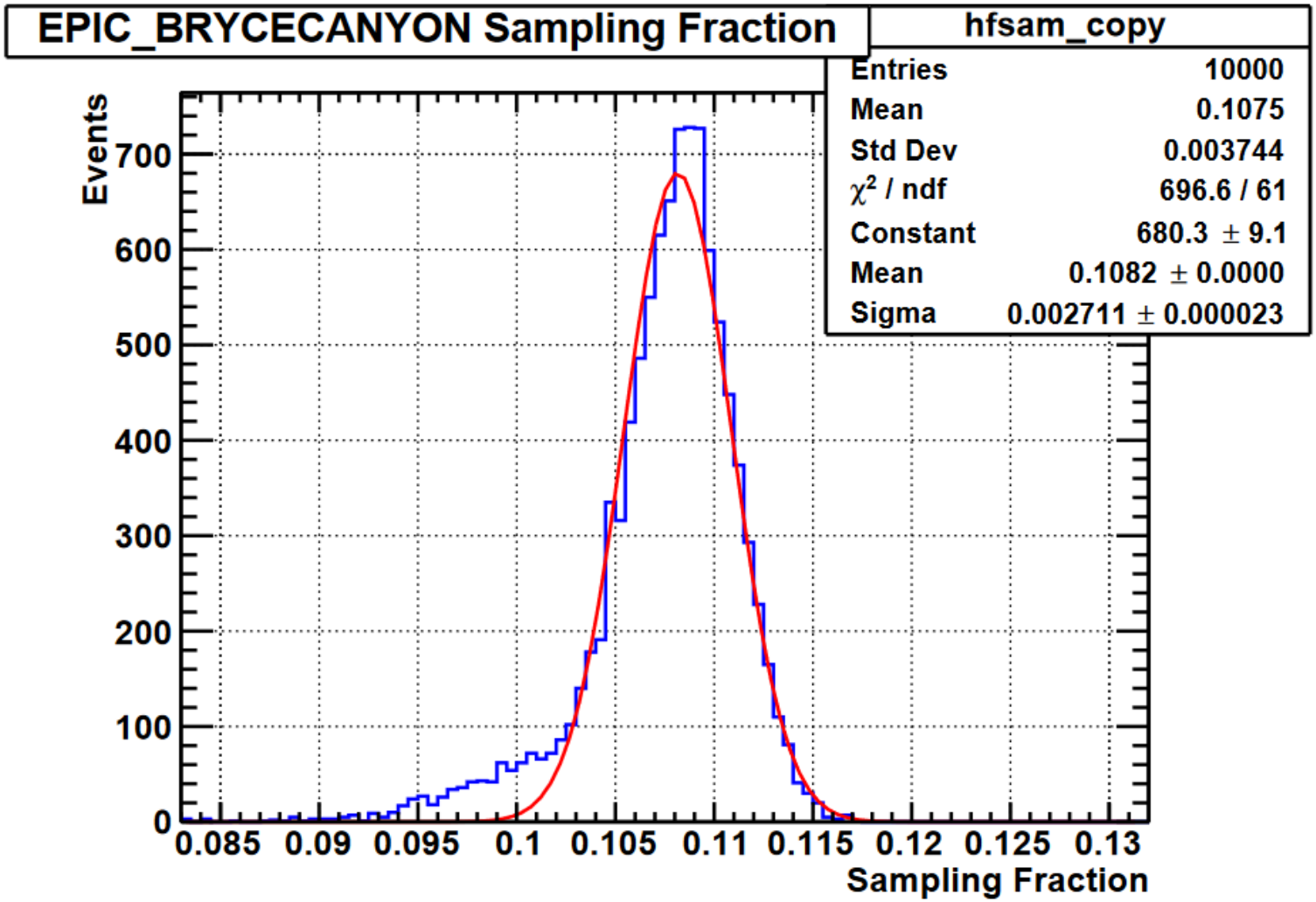
- Combination of Pb/SciFi calorimeter with a silicon tracker to precisely measure the energy profile and exact position of each particle inside electromagnetic showers.
- with 4 layers of Astropix sensors interleaved with 3 Pb/ScFi layers followed by a large section of Pb/ScFi section



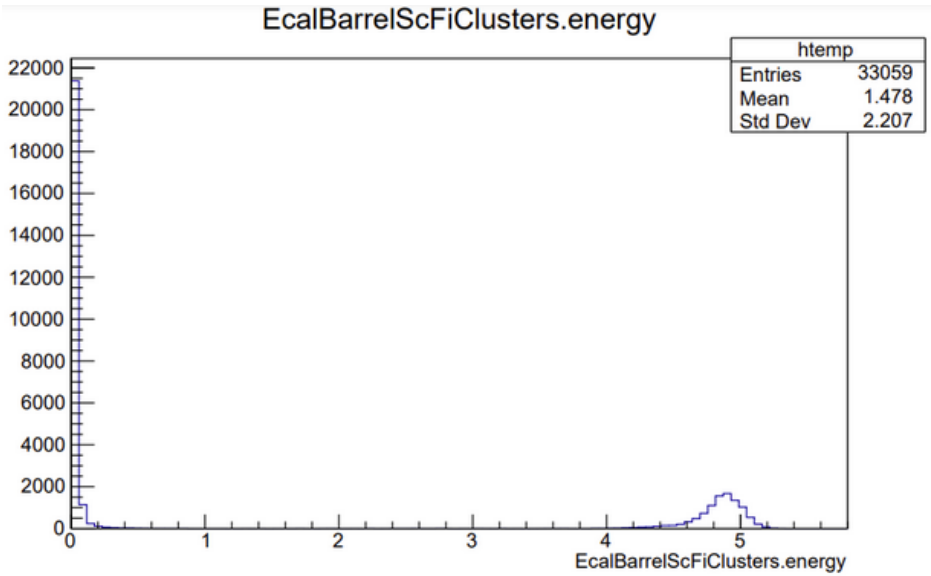
✓Excellent energy resolution
✓Low-energy electron-pion separation
✓Position resolution due to the silicon layers

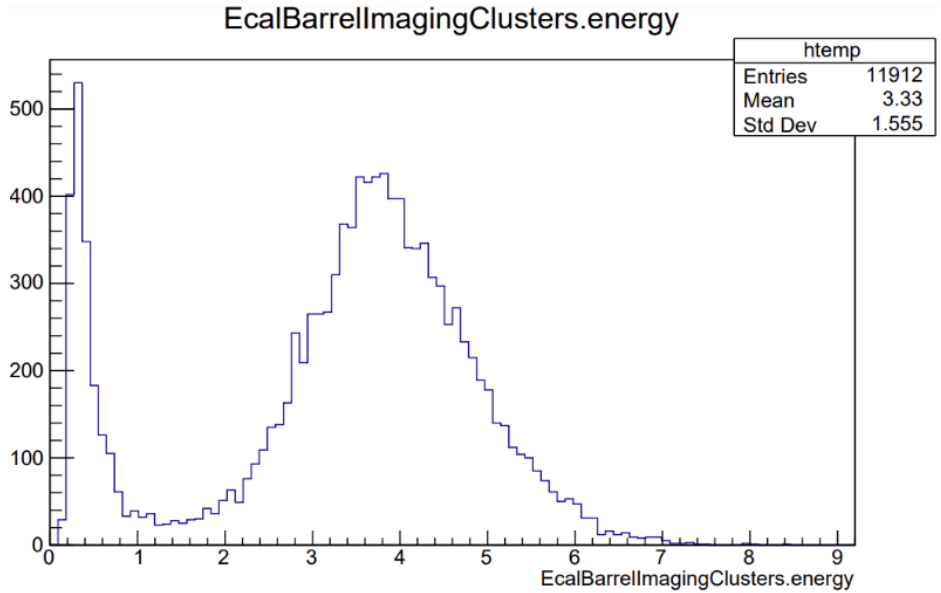
Sampling Fraction

The sampling fraction is the fraction of total energy released in the active material.



Energy Reconstruction for 5 GeV





Short Term Goal

- Improve the reconstruction plots (in progress)
- Run simulations to determine background rates at the sensors.

Thank you...