Muon Detection Study in the forward region at ePIC (for 2^{nd} Detector)

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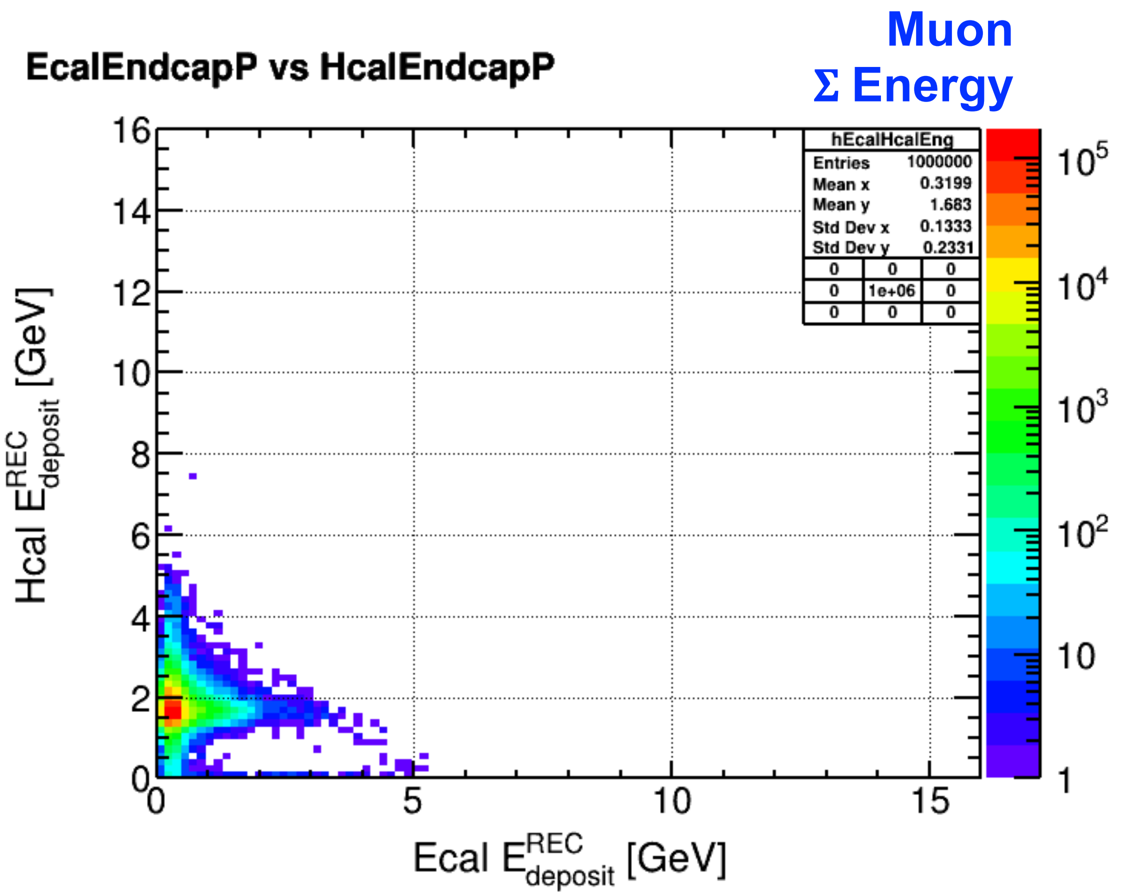
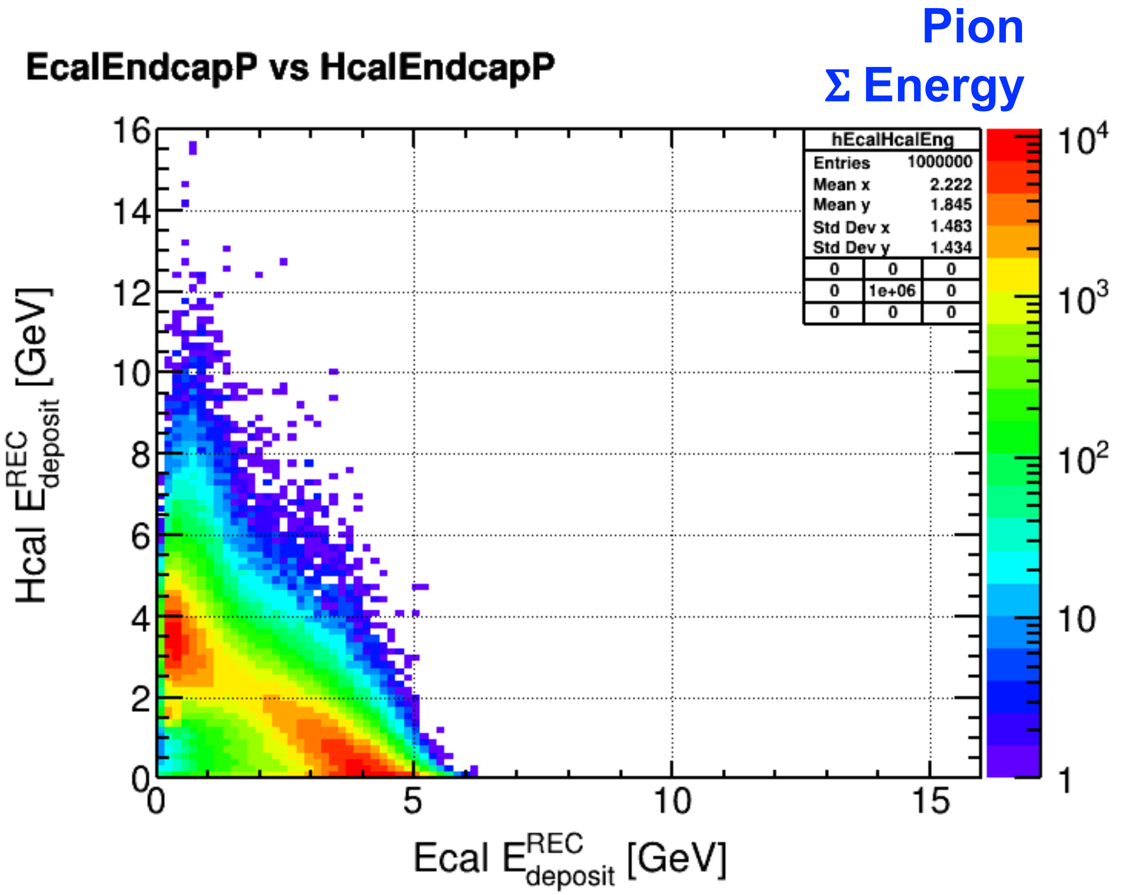
From Last Meeting

- Some questions were raised
  - Total energy reconstructed* in forward ECAL (too much) and HCAL (less)
    *Used reconstructed hits (calibrated and sampling fraction applied)
  - MIP-like event in pion sample in forward ECAL (less)
    Expected about 37 % of pions will be MIP-like event in ECAL ($e^{-\lambda}$ = e^{-1} = 0.37)

p = 5 GeV and η = 1.74

Reconstructed Energy in Forward



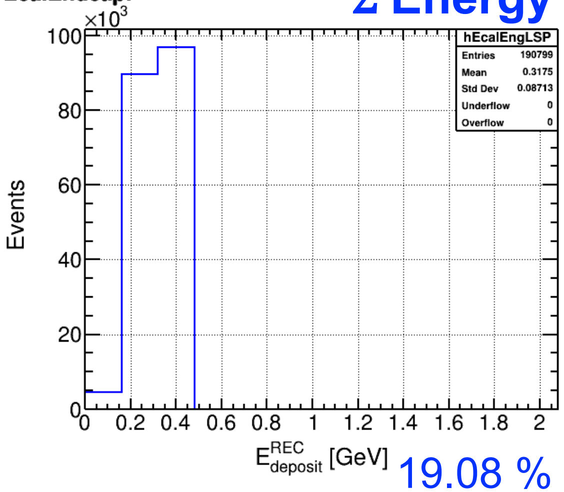


While muon sample has one hot spot, pion sample has three groups;
pions showering from ECAL, pions showering from HCAL, and pions not showering at all (MIP-like)

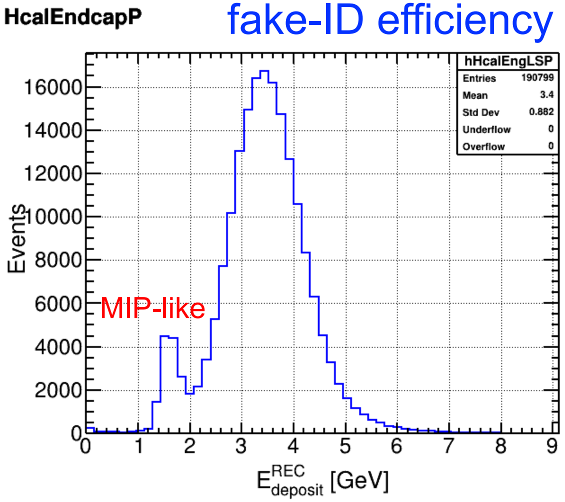
p = 5 GeV and η = 1.74

Pion Sample – Σ Energy

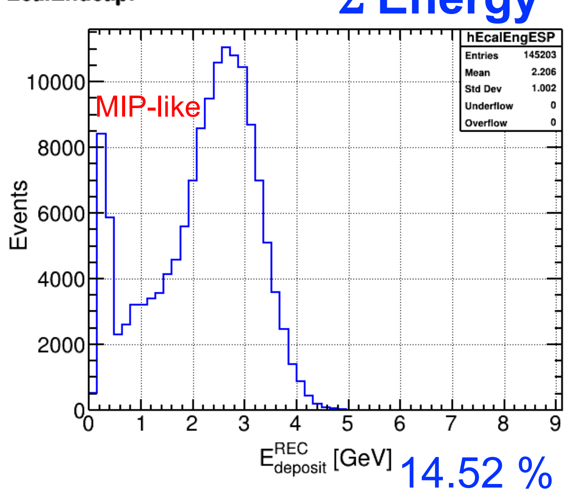
MIP-like in ECAL
Σ Energy



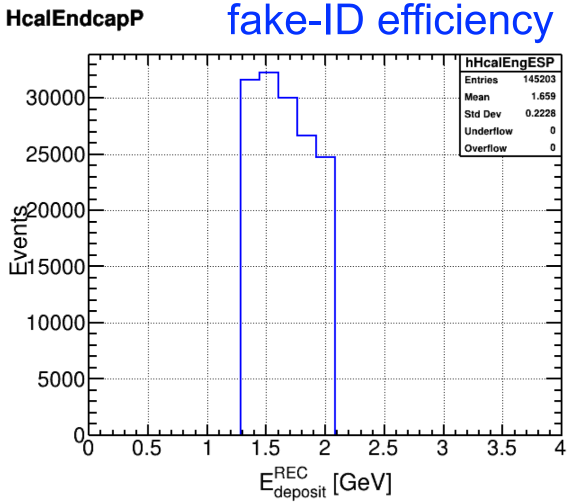
19.08 %
fake-ID efficiency



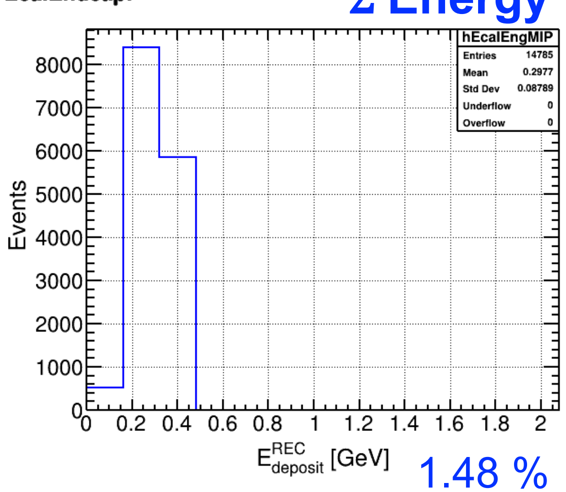
MIP-like in HCAL
Σ Energy



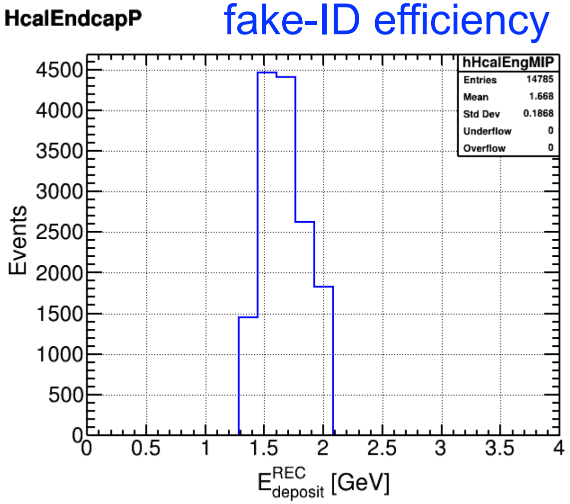
14.52 %
fake-ID efficiency



MIP-like in ECAL **&** HCAL
Σ Energy



1.48 %
fake-ID efficiency

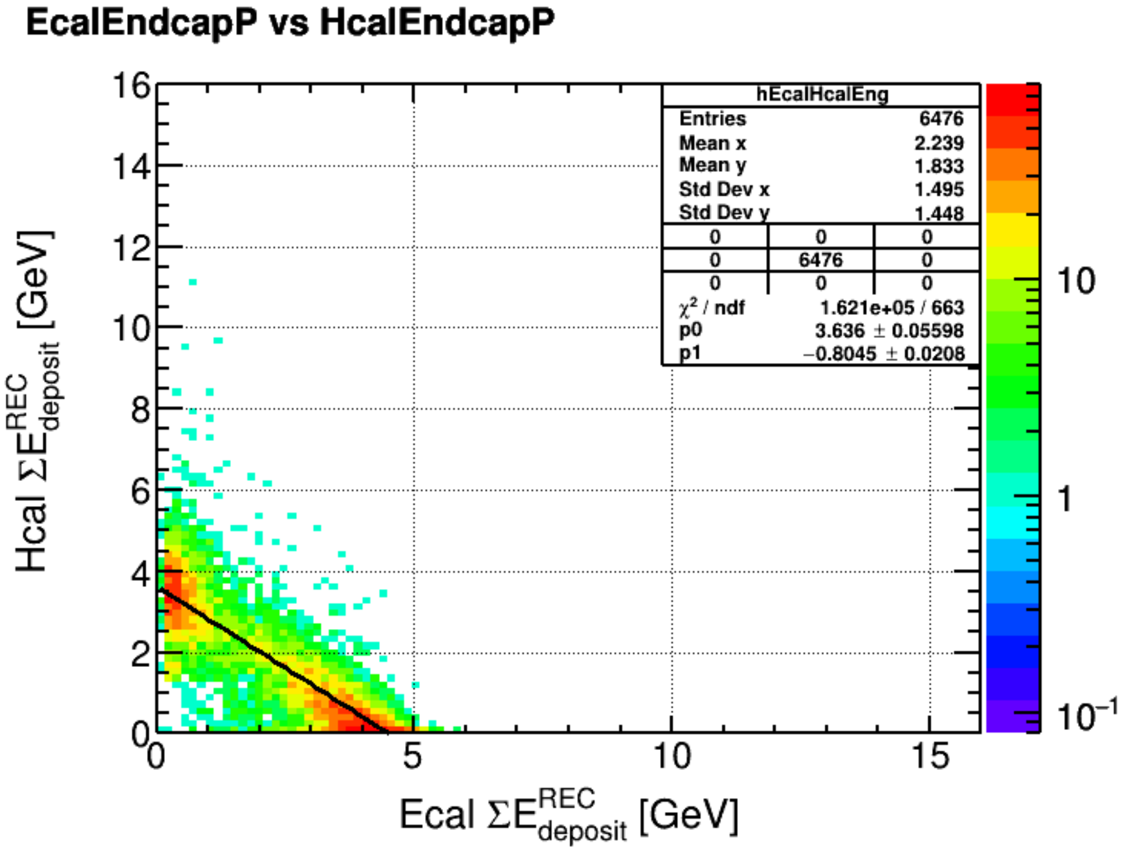


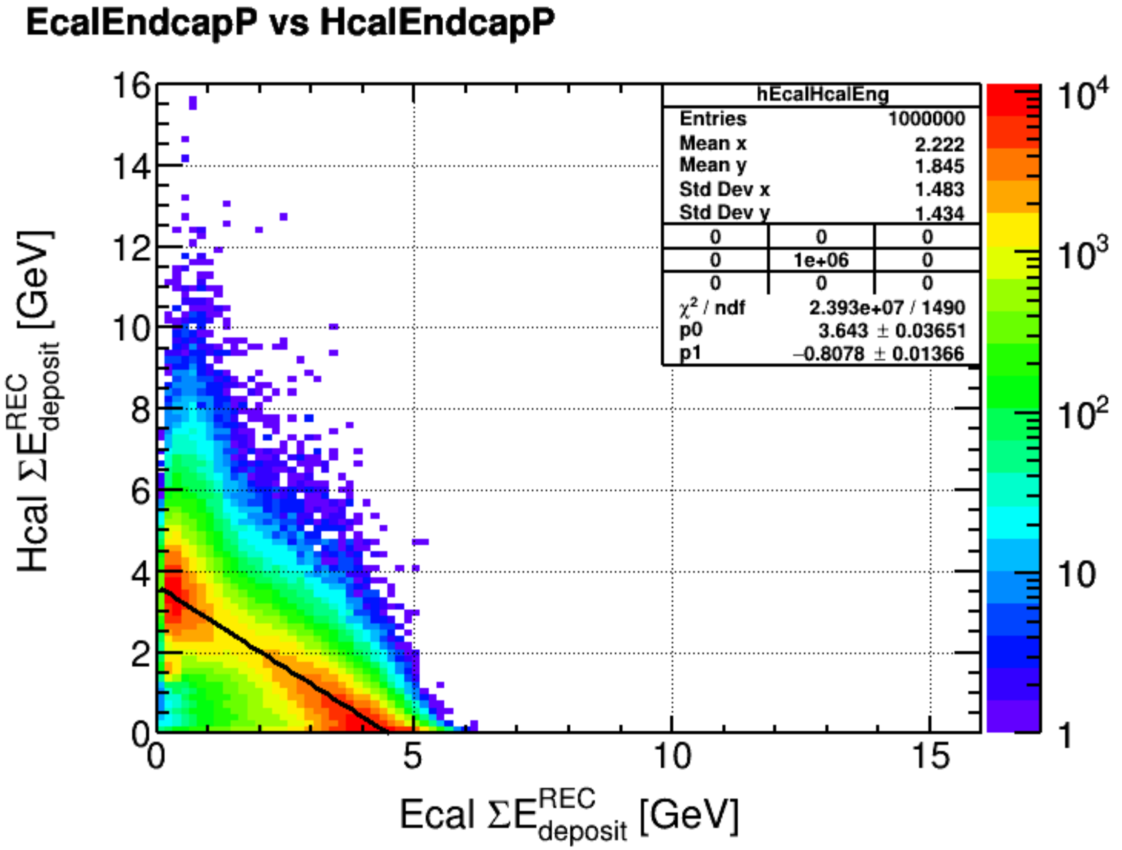
To Understand Forward ECAL Better

- ❑ Compare with ePIC official simulation campaign single particle event
- ❑ Check material scan
- ❑ Check detector implementation

p = 5 GeV and η = 1.74

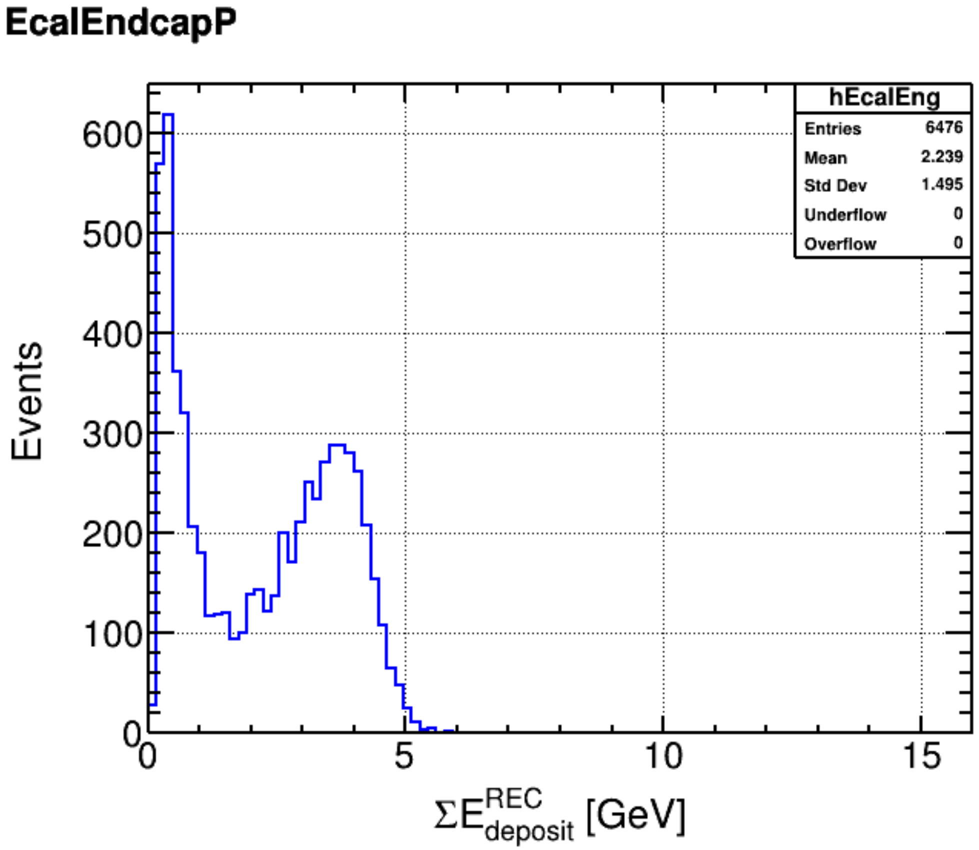
Reconstructed Energy in Forward

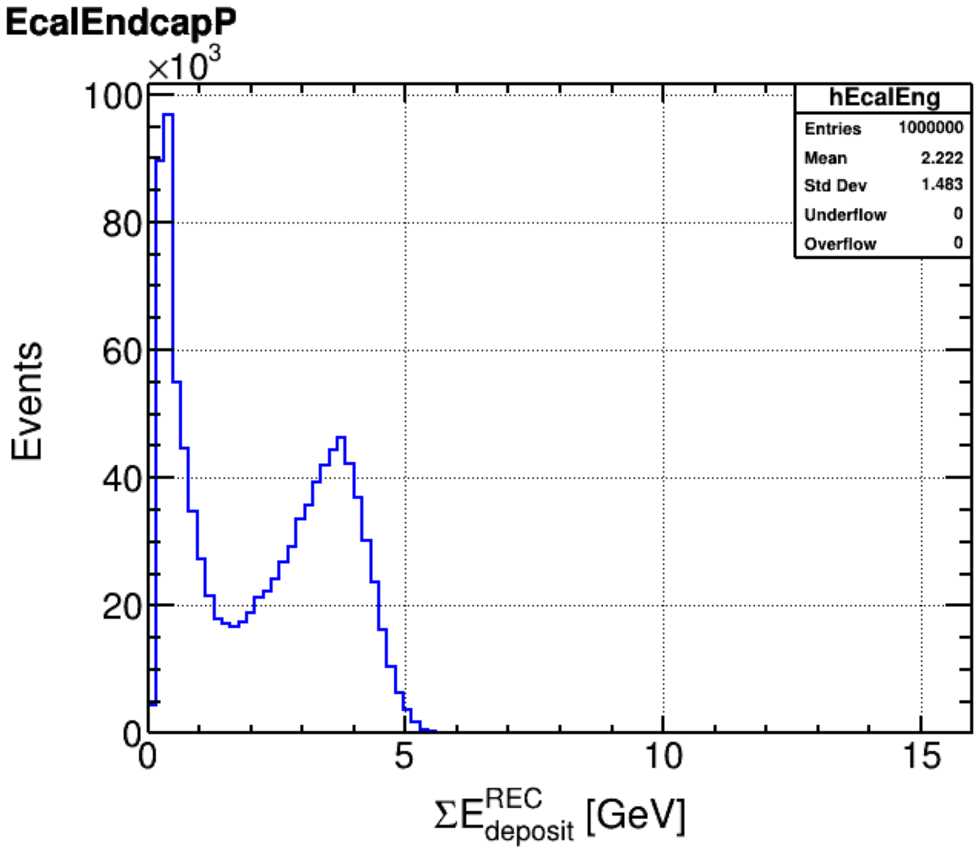




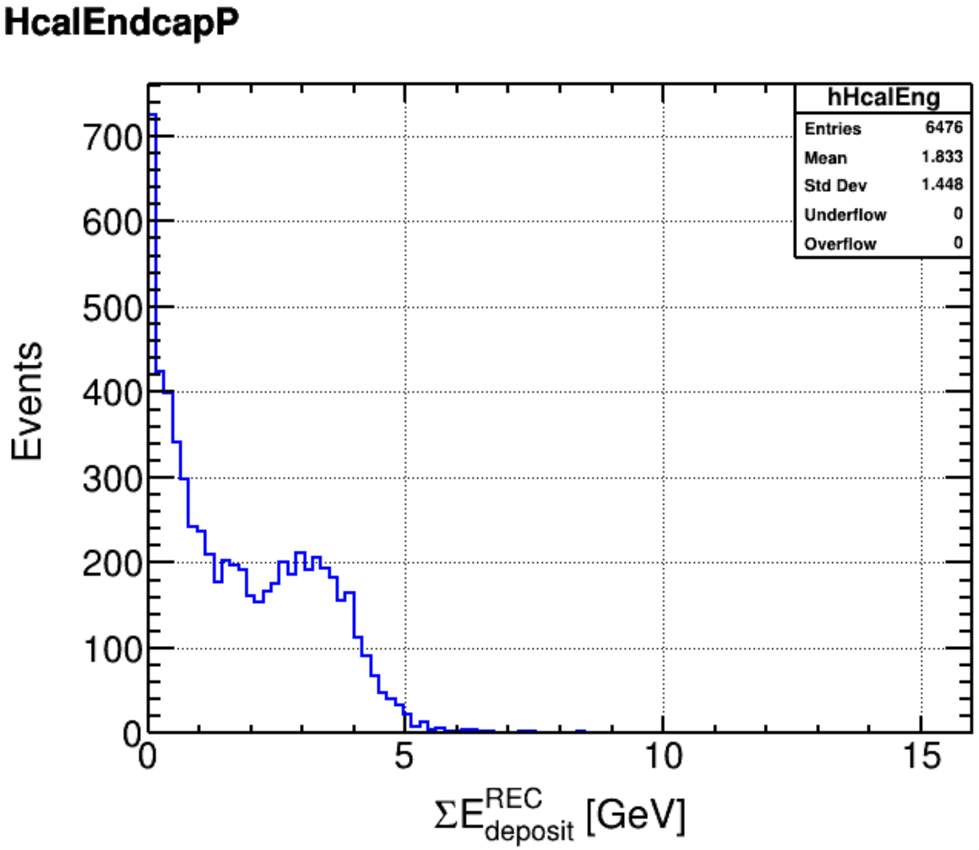
To fit a linear function to E_{HCAL} vs. E_{ECAL} to extract energy sharing parameter

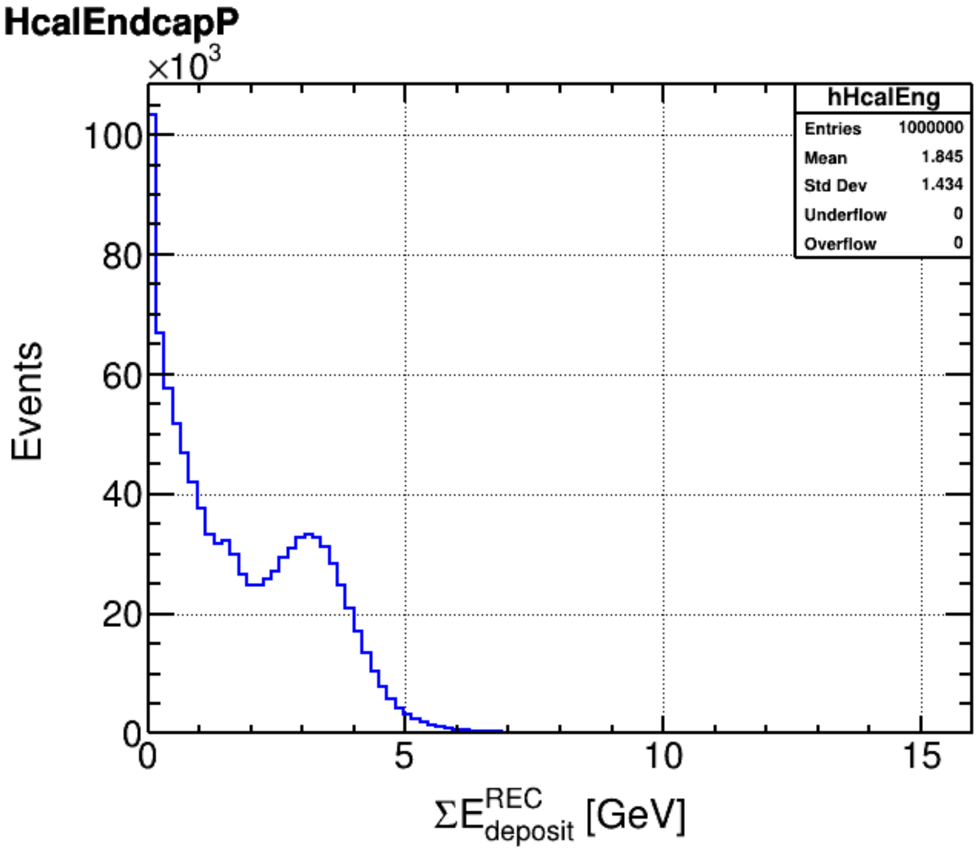
Reconstructed Energy in Forward ECAL





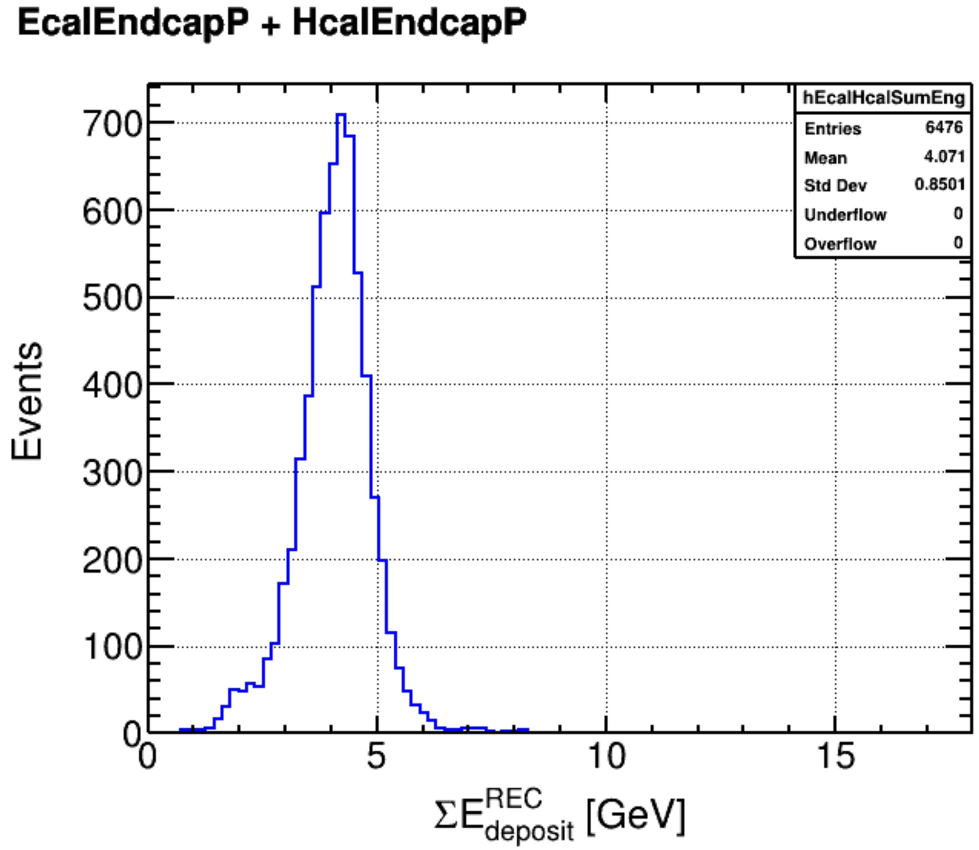
Reconstructed Energy in Forward HCAL

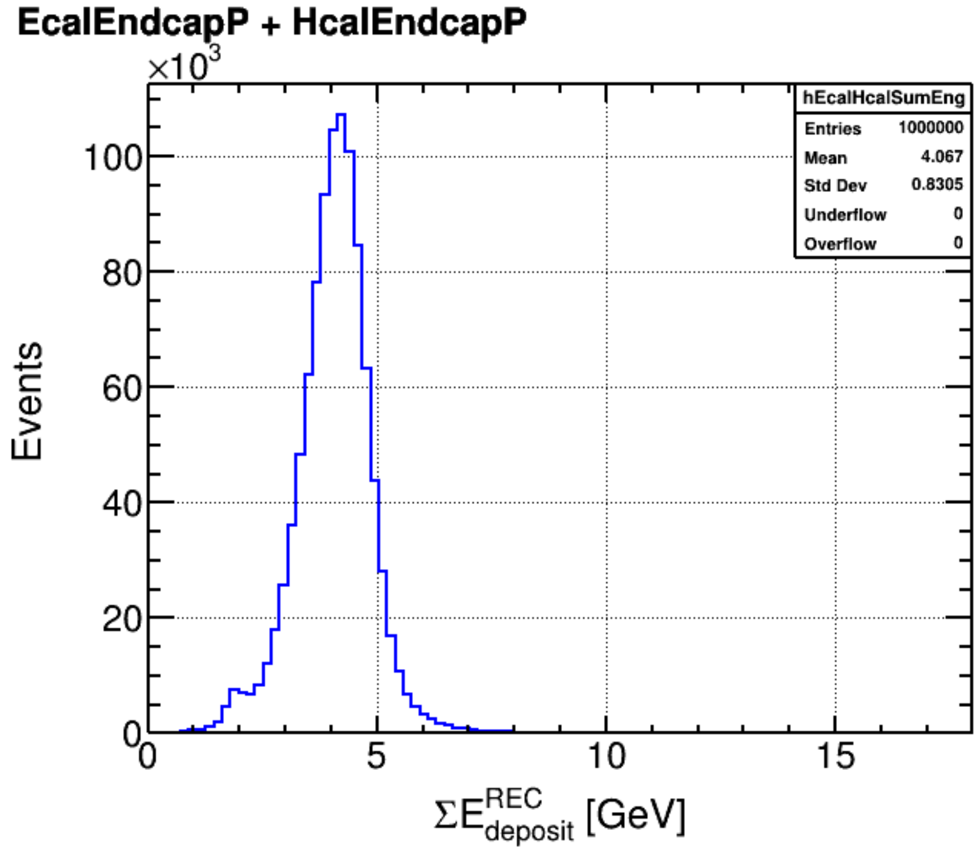




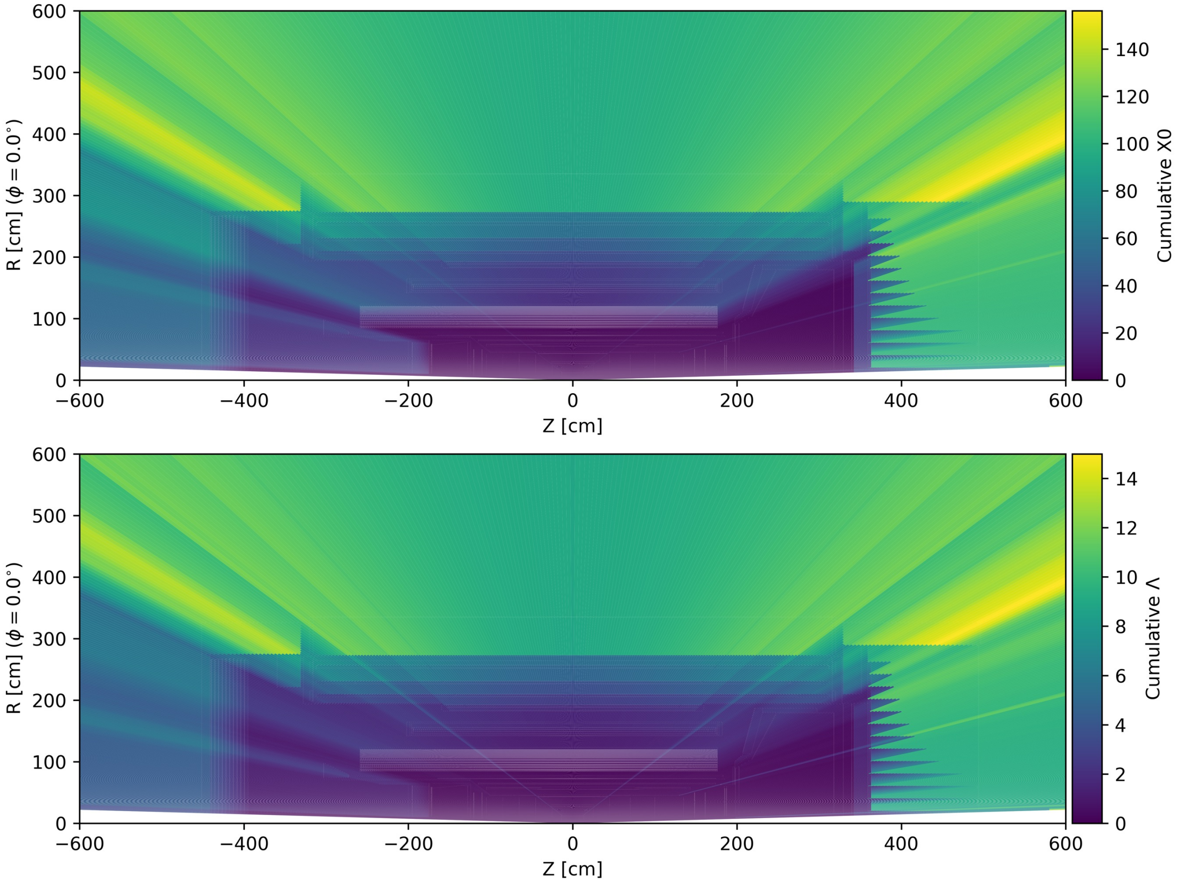
w/o energy sharing parameter

Sum of Reconstructed Energy



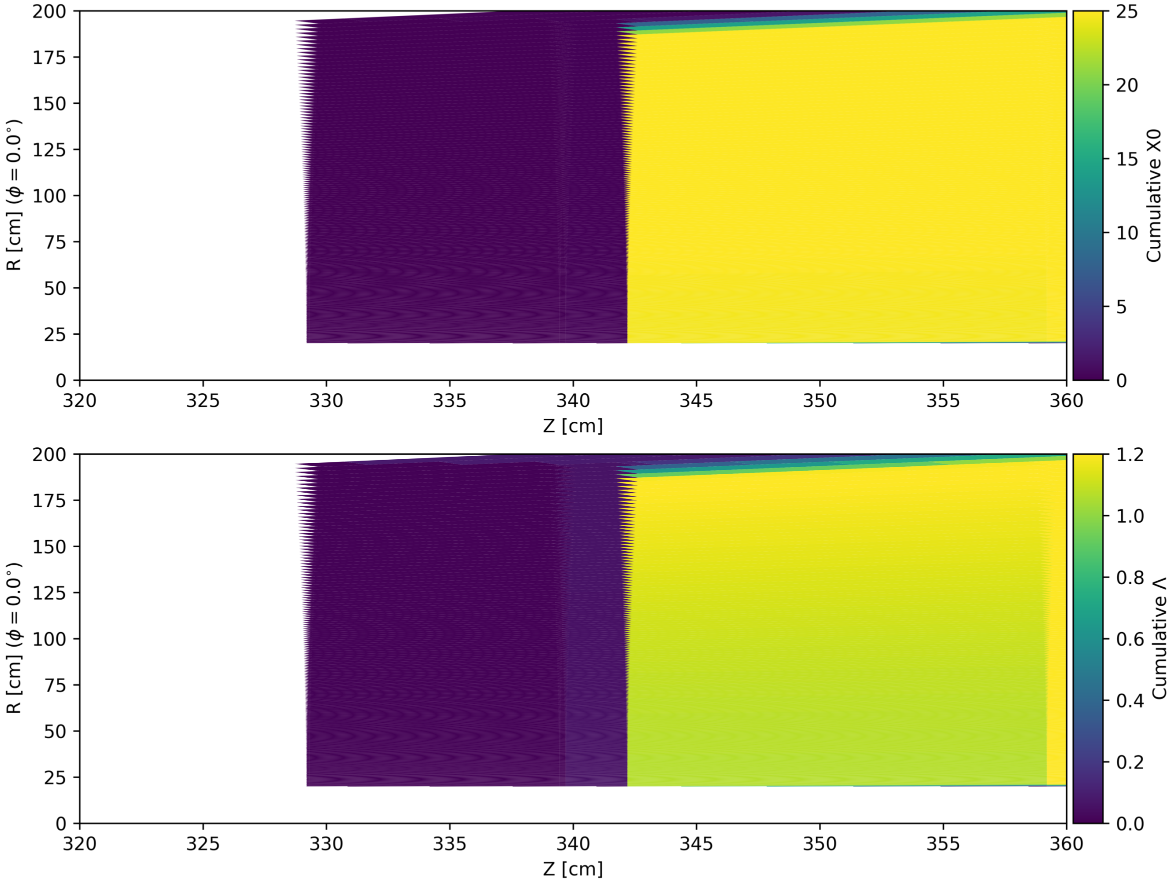


Material Scan – ePIC craterlake



Thanks to Chao Peng https://github.com/eic/epic/pull/780

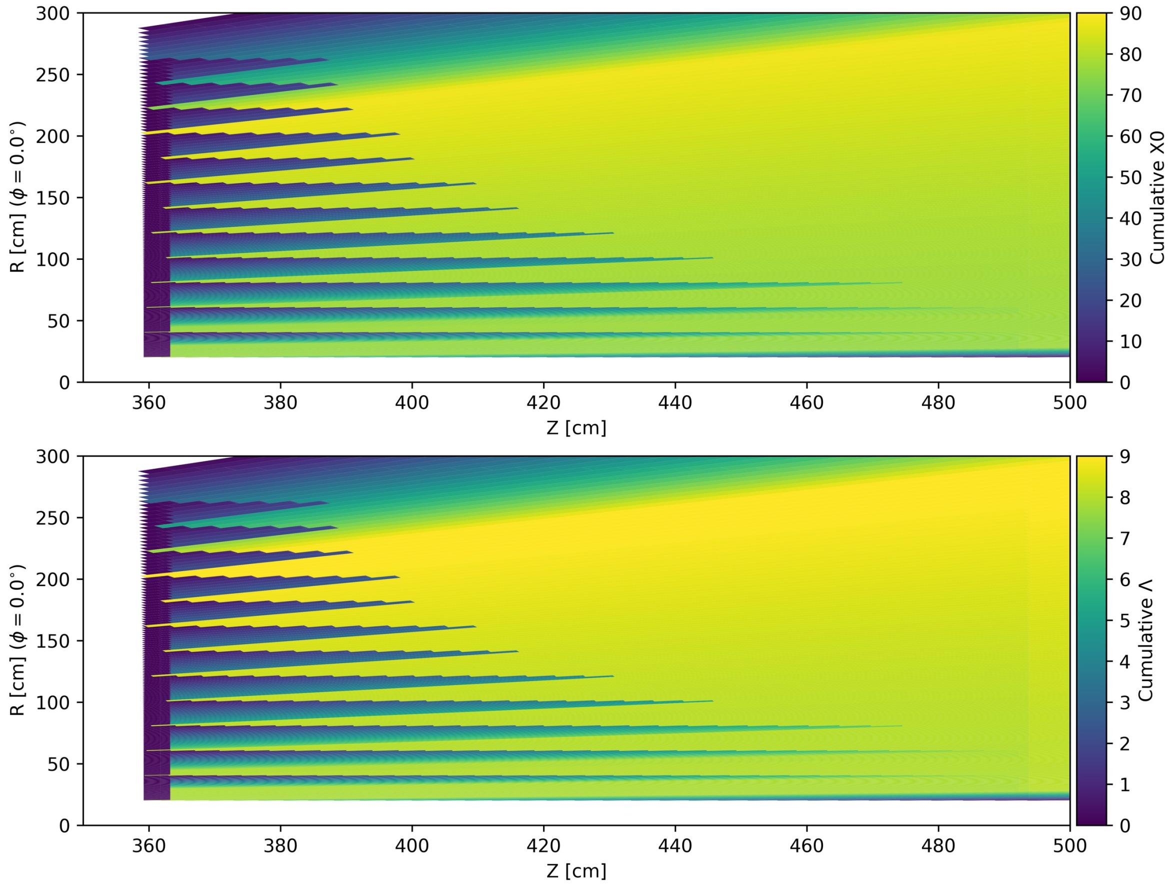
Material Scan – Forward ECAL



Aluminum cover, air gap (10.15 cm), PCB, light guide (2.5 cm), and Scintillating material (17 cm)

- WScFi
- 30 cm length
- 1 layer
- 20 cm < r < 195 cm
- 329.2 cm < z < 359.2 cm
- 23 X_0 (ref. X_0 = 7 mm) and 2.5 cm × 2.5 cm in transverse direction
- According to Zhongling Ji, in DD4hep/Geant4 it uses a homogeneous structure – energy sampling fraction is 100 %. Since real forward ECAL has a sampling fraction of 3 %, it rescaled energy in EICRecon

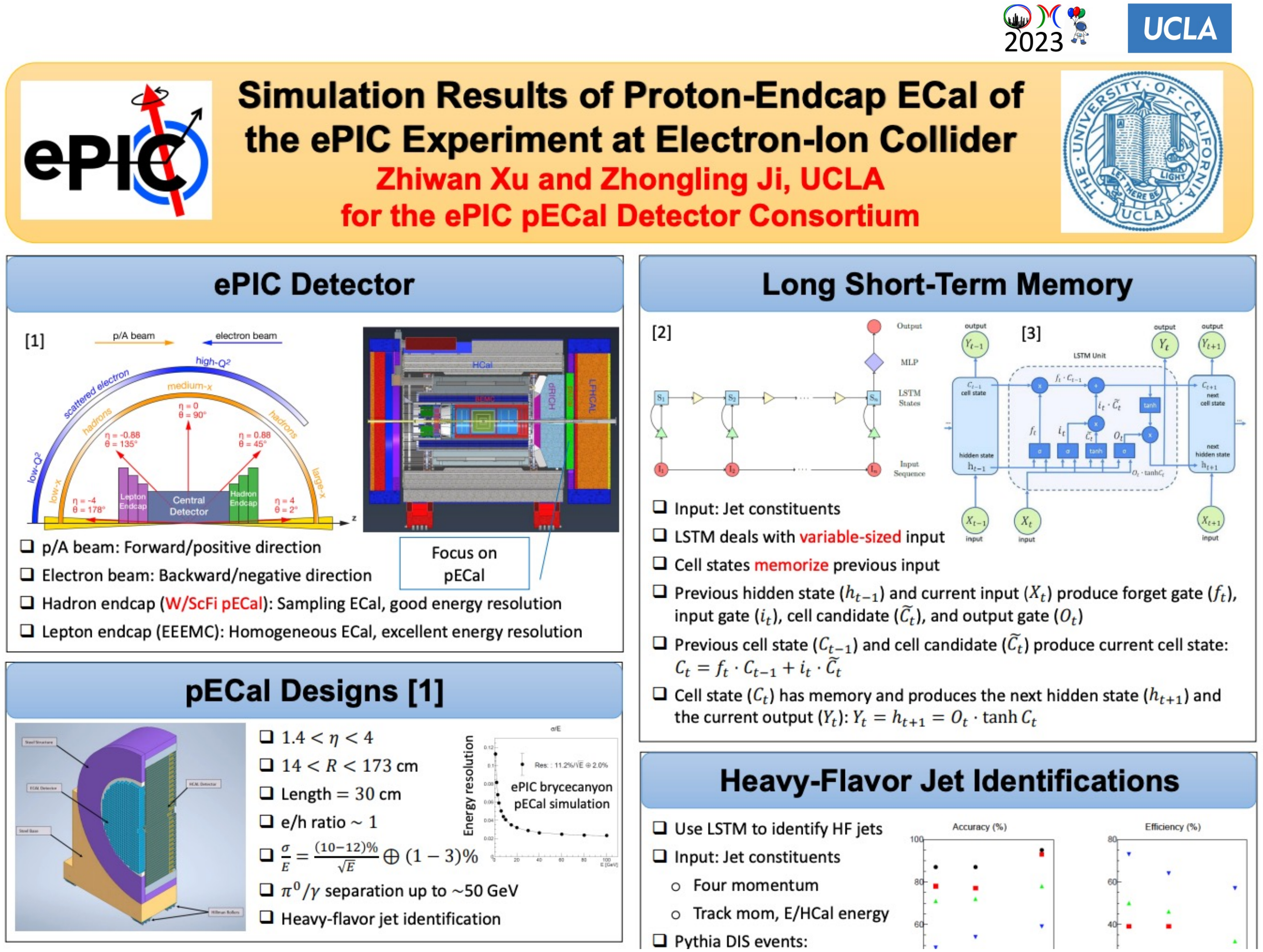
Material Scan – Forward HCAL



- Steel-plastic scintillator sandwich
- 134.54 cm length
- r_{max} = 289.56 cm
- 359.2 cm < z < 493.74 cm
- 6.5 λ/λ_0 and 5 cm × 5 cm in transverse direction
- SiPM signals from tiles in 5-10 consecutive layers are summed up before digitization

Next Steps

- Questions on forward ECAL simulation
  - Continue communicating with Zhongling Ji (postdoc, UCLA)
- Next move,
  - Discussed with Maria Zurek
  - Layer by Layer in HCAL (depth-dependent)
  - Shower or not? (wide distribution)
  - Energy/Position/# of hit titles per layer



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