Calorimetry Status

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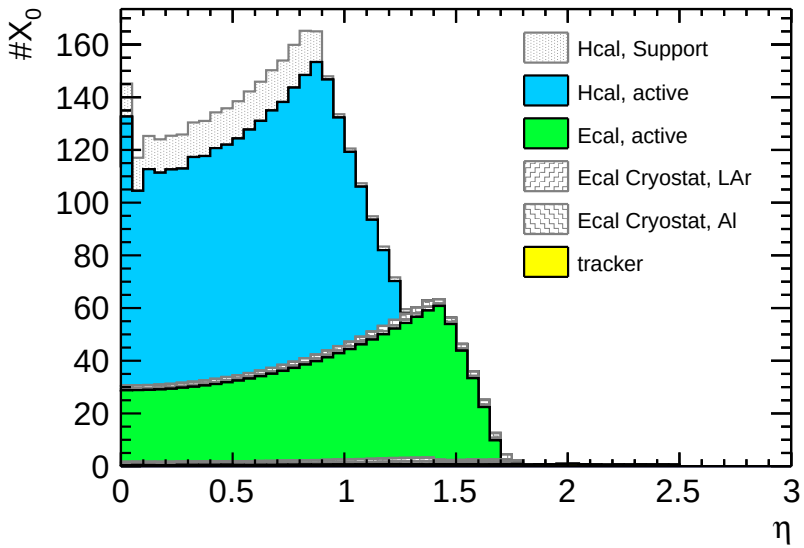
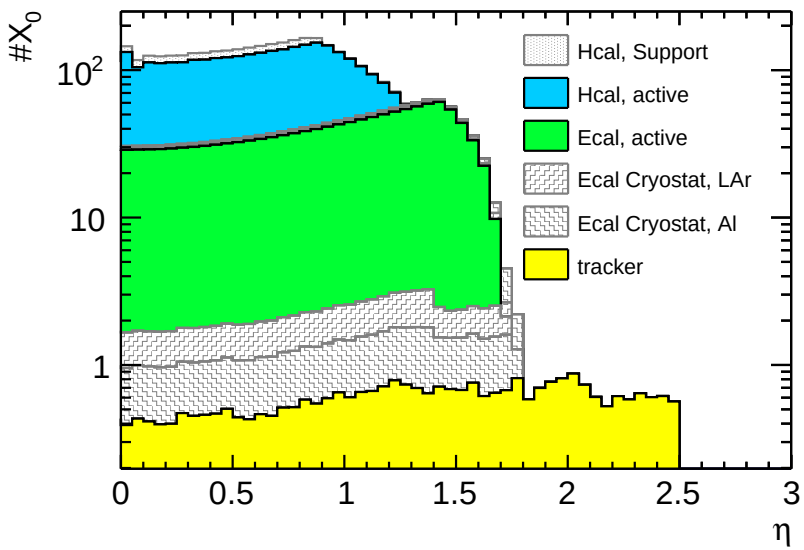
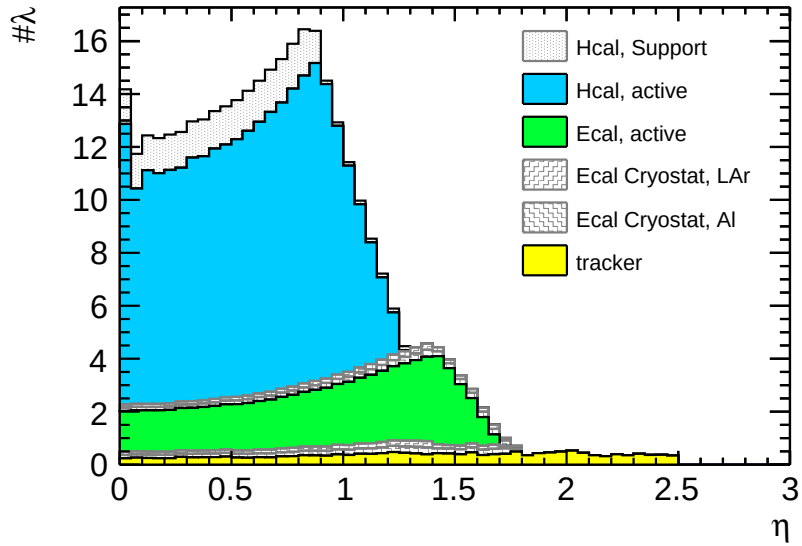
Material scans of FCC-hh **Barrel** in FCCSW

simple tracker + sunny ECal + TileCal

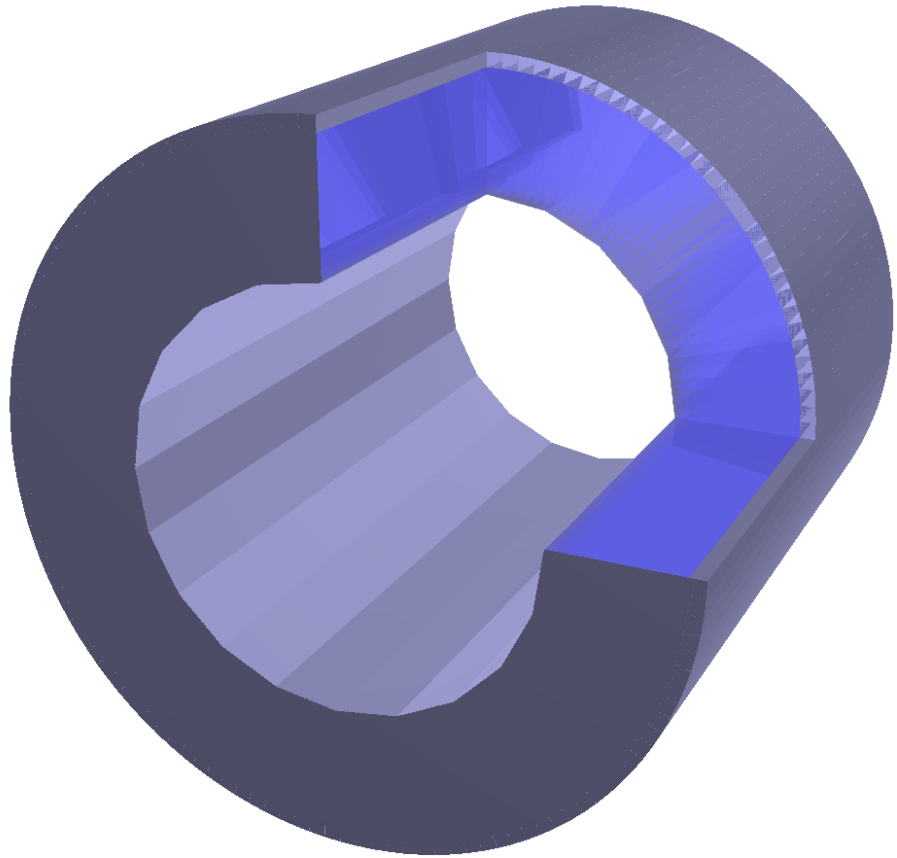






- Barrel only!
- passive calorimeter supports in light grey
- approx. 1.8 $\#X_0$ in front of ECal
- approx. 2 $\#\lambda$ in front of HCal

TileCal



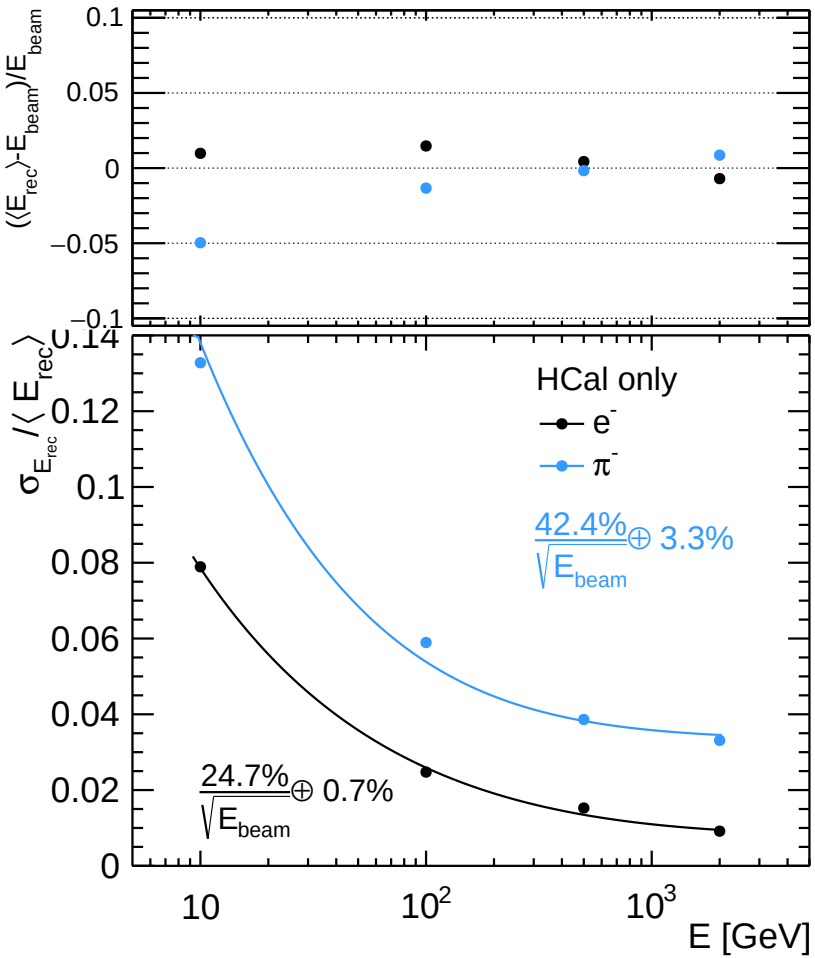
$\Delta\phi \times \Delta\eta$

0.025×0.025

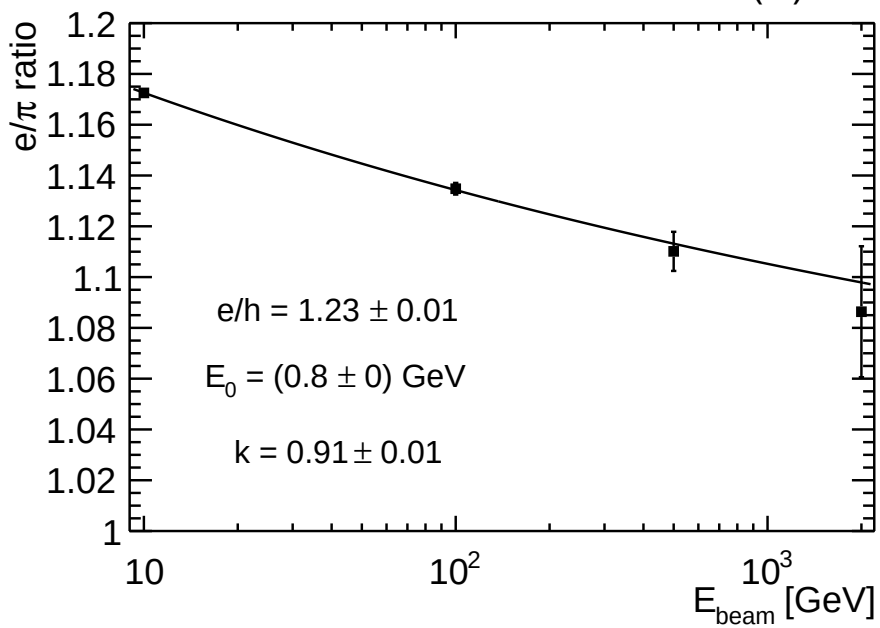
10 longitudinal layers

TileCal non-compensation

10,000 events per energy,
FTFP_BERT, $\eta = 0.36$



$$e/\pi = \frac{e/h}{1 - \left[1 - \left(\frac{E_{beam}}{E_0}\right)^{1-k}\right](1 - e/h)} \quad (1)$$



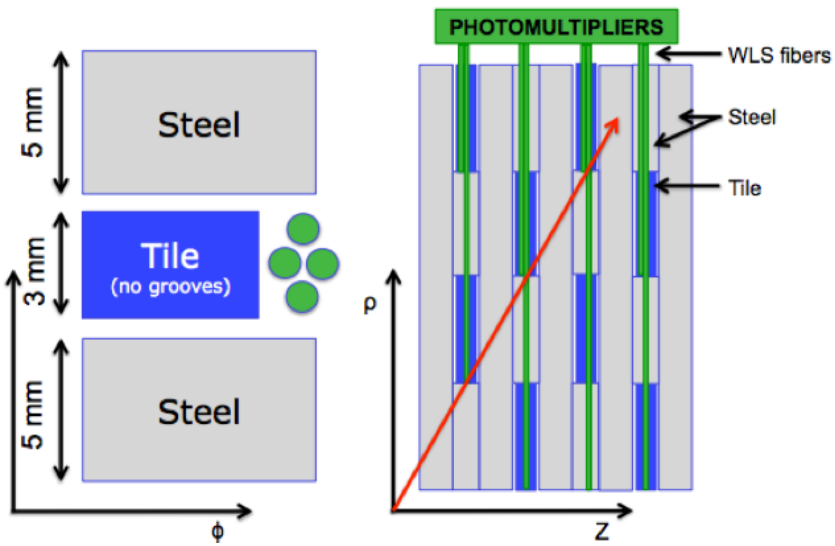
- E_0, k energy threshold/ multiplicity of π^0 production
- increasing EM fraction with increasing energy

How can we achieve compensation?

suppression of EM response

Compensation by larger Fe/Sci ratio
–> checked with Fe/Sci ratio of 6 (4.6)
–> degraded resolution (worse sampling frequency, smaller sampling fraction)
–> increased geometrical effects

Compensation by higher Z absorber
–> spacer of HCal in Pb: X_0=0.6 cm, λ=17.59 cm (Fe: X_0=1.8 cm, λ=16.77 cm)
–> λ_{eff} of HCal Barrel increases to 20.87 from 20.59 cm ($\eta = 0.36$)



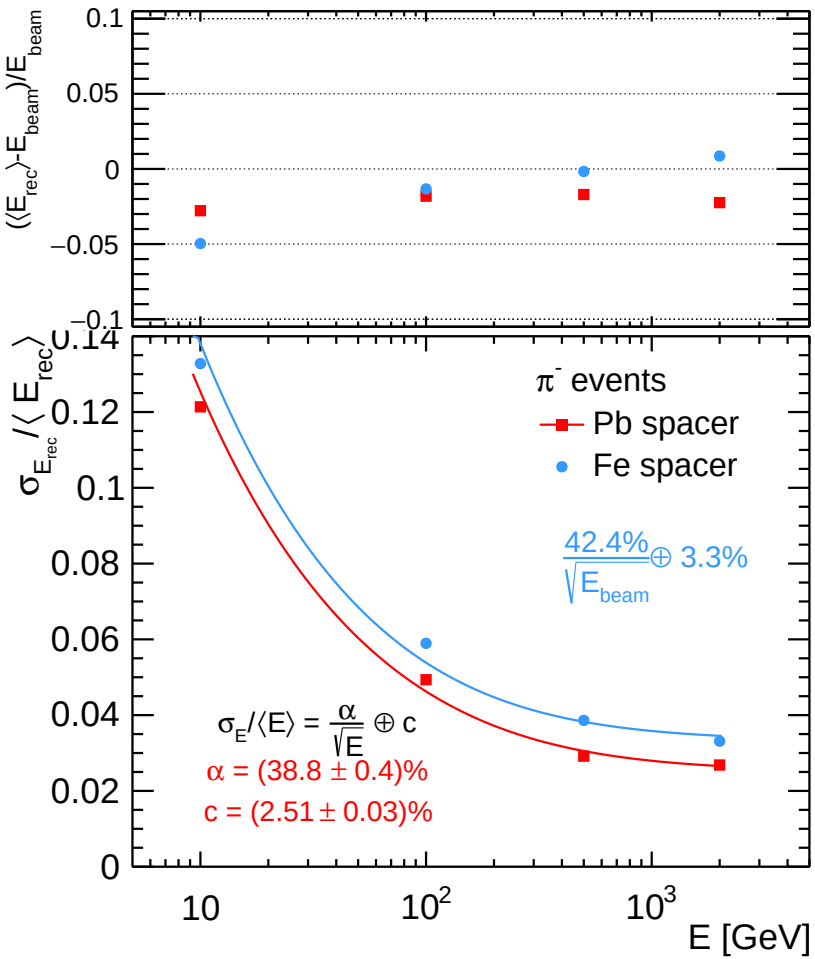
Expected compensation

- Fe:Sci ≈ 20:1
- Pb:Sci ≈ 4-5:1

Test of Pb spacers

10,000 π^- events per energy,
FTFP_BERT, $\eta = 0.36$

$$E_{reco} = \sum_{i=1}^{hits} E_i / a \qquad (2)$$



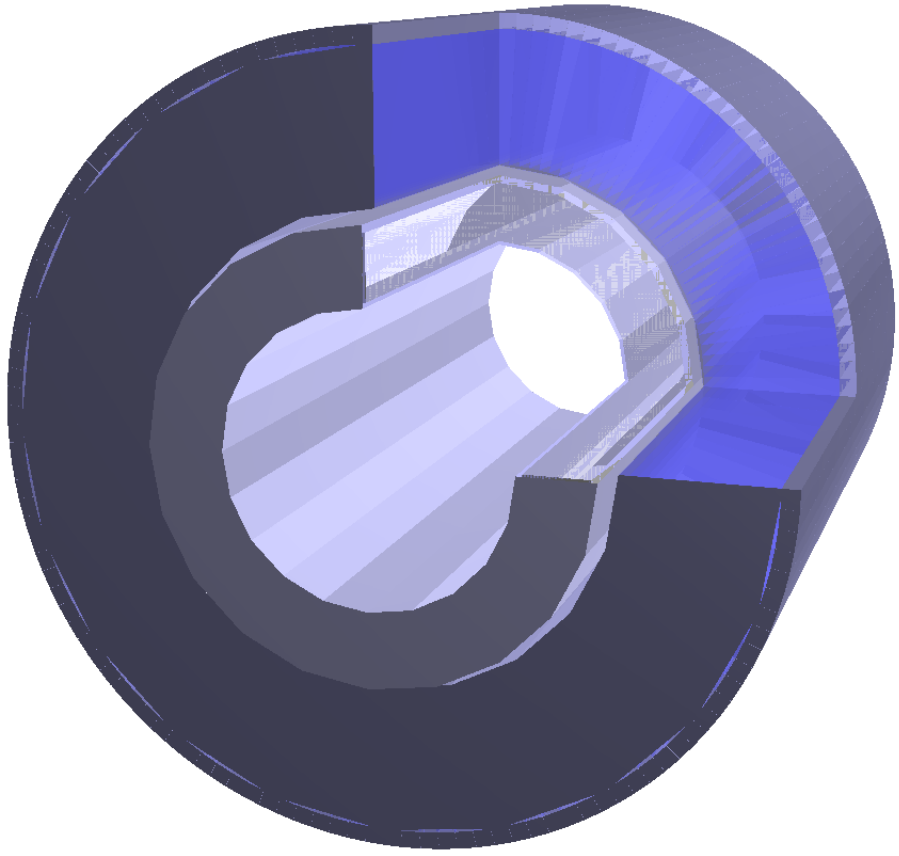
- $a = 2.4\%, 2.9\%$
- constant and stochastic term as well as non-linearities reduced

–> looks promising!
–> further look into electrons
–> investigation of full Pb structure

Arguments pro Pb

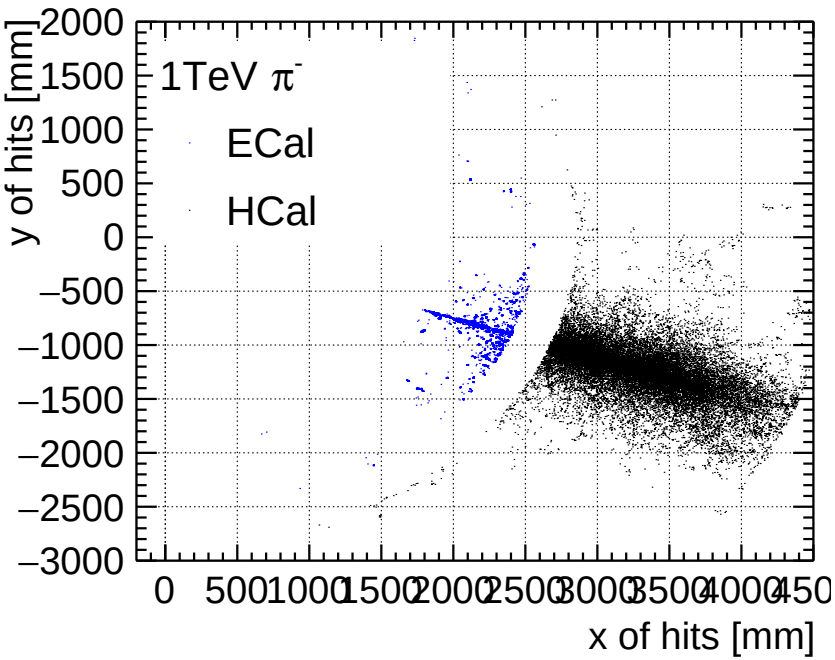
- Pb structures constructible!
- higher Z material not an issue for timing (50ns in SPACAL), nor muons (measured in tracker)
- steel structure not needed as return yoke

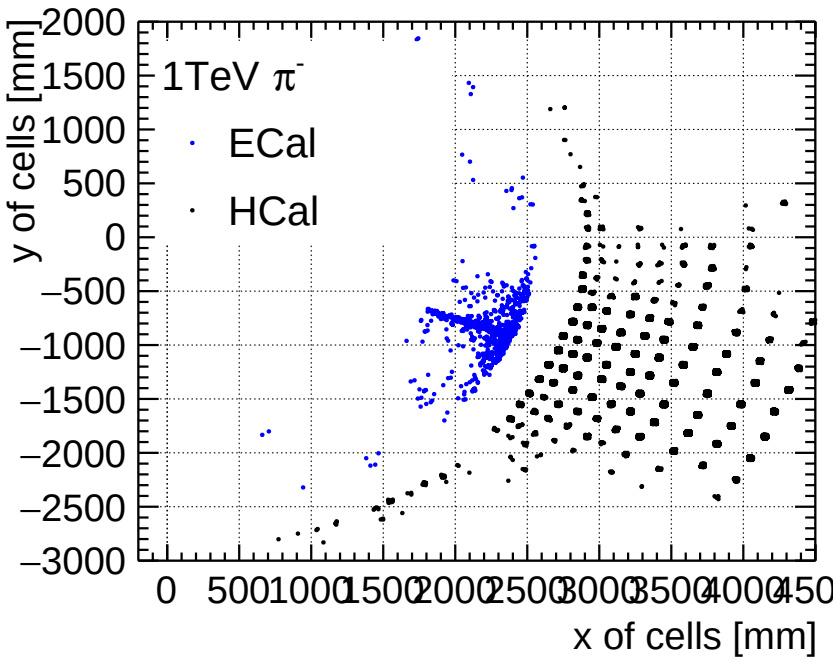
LAr ECal + TileCal



E+HCal first simple reco

from Geant4 depositions (hits) to energy in Calorimeter cells

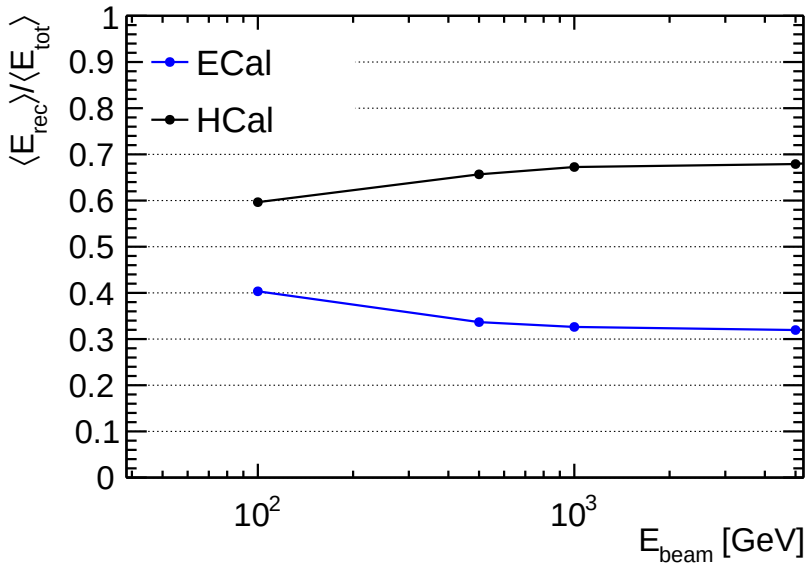


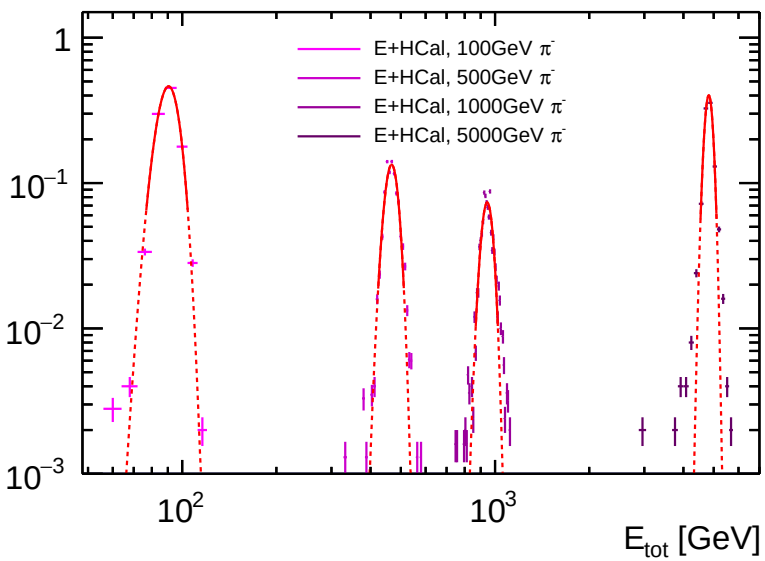


- HCal cells' energy threshold : 1keV
- no noise

E+HCal first simple reco

Response to 10,000 π^- events per energy, FTFP_BERT, $\eta = 0.36$





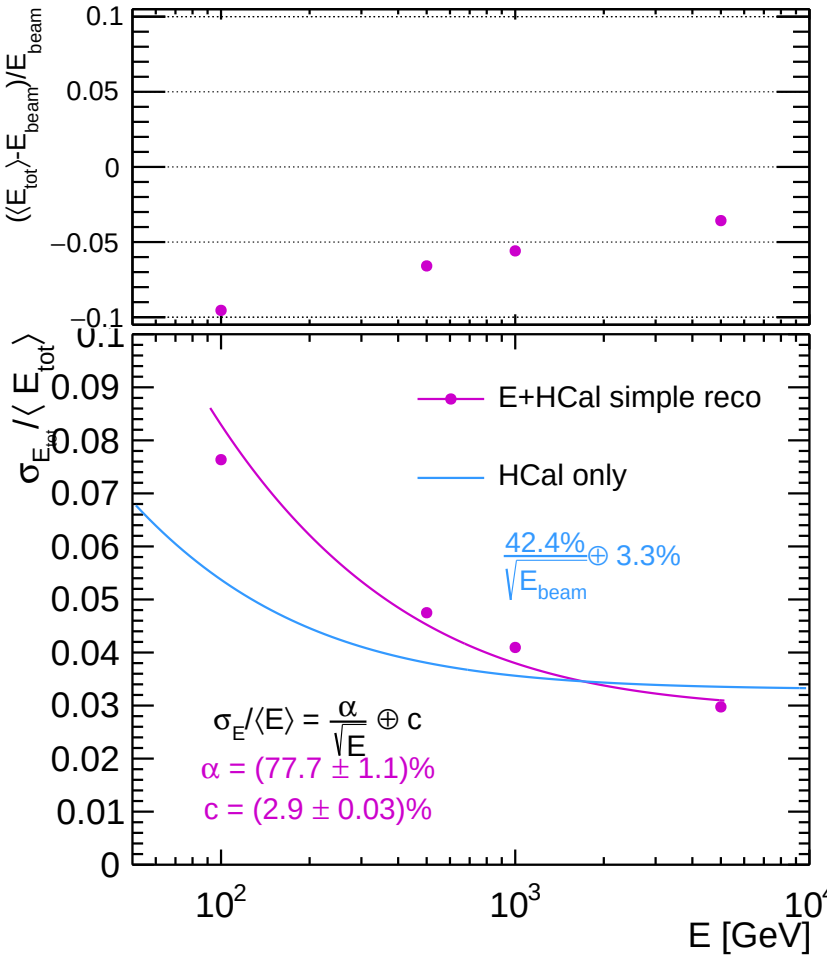
$$E_{tot} = E_{rec}\,(ECal) + E_{rec}\,(HCal) \quad (3)$$

$$E_{tot} = \sum_{i=1}^{hitsECal} E_i/b + \sum_{j=1}^{hitsHCal} E_j/c \quad (4)$$

- $b = 16.8 - 21.5\%$ (EM scale)
  8 layer ECal option
- $c = 2.9\%$

E+HCal first simple reco

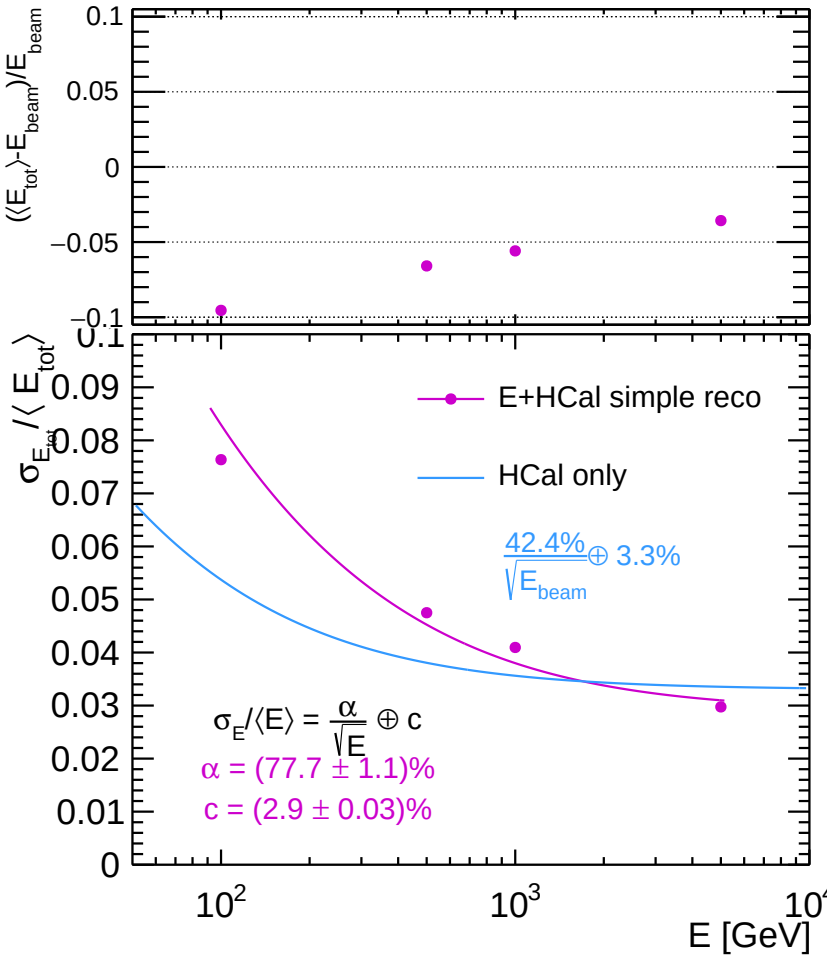
Resolution and Linearity for π^-



- low energies degraded resolution: impact different sampling, gap between Calos
- missing energy of up 10 %
- 0.25 $\#\lambda$ / 1.5 $\#X_0$ passive material between E and HCal
- highest energy (5TeV) pi^- containment in HCal

E+HCal first simple reco

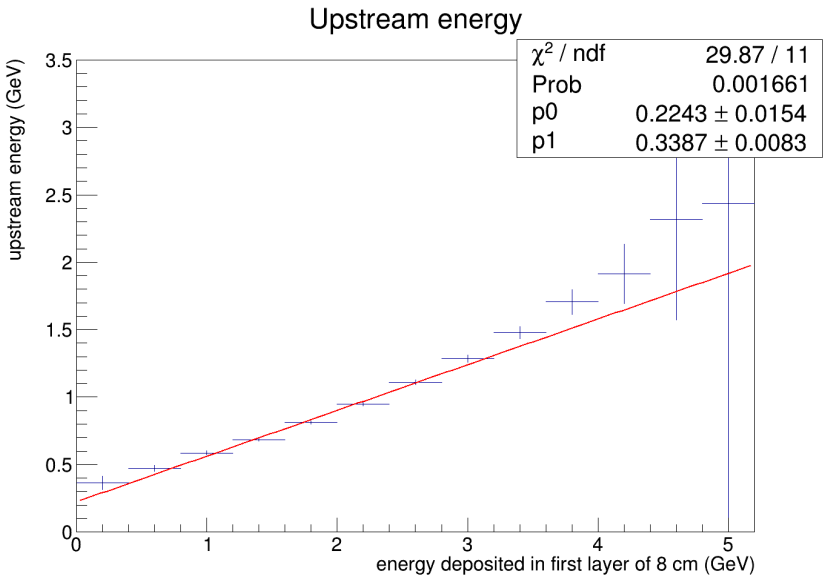
Resolution and Linearity for π^-

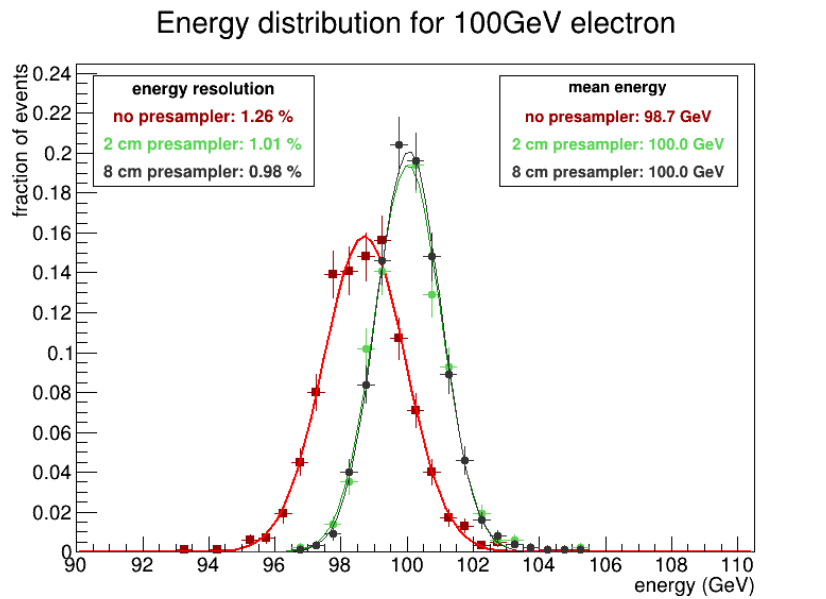


Next steps

- Energy correction (longitudinal profile / correlation of lost and measured energy)
- Topo-clustering ongoing –> input for PFA

Energy correction in **ECAL only** for material in front





Example for 100 GeV e^-:

$$E_{ECal} = E_{upstream} + E_{rec} \qquad (5)$$

- $E_{upstream} = p_0 + p_1 \cdot E_{1stLayer}$
- improvement in energy resolution from 1.26 to 0.98 %

–> correction over full energy range ongoing

–> similar approach for correction of combined energy reconstruction

FCC Week - plans for Calo talks

ECAL I

Baseline ATLAS-like LAr ECal

- inclined/sunny Barrel design
- sampling fraction – energy reconstruction
- single electron resolution
- sliding window algorithm for single electron/photon reconstruction

+ discussion of Silicon ECal options: HGCal-like and Digital

HCAL I

Baseline ATLAS-like TileCal

- new highly granular Barrel design
- sampling fraction
- non-compensation (e/h ratio)
- single particle resolutions
- topo-cluster algorithm for single hadrons (+ jets)

+ discussion of ATLAS particle flow

Thank You!