Calorimetry Status

C. Neubüser[1], J. Faltova, A. Henriques,
C. Helsens, A. Zaborowska, M. Aleksa

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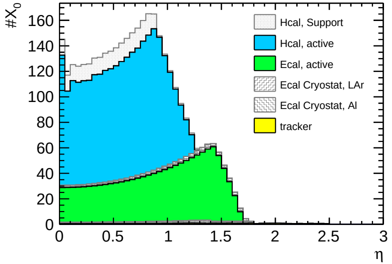
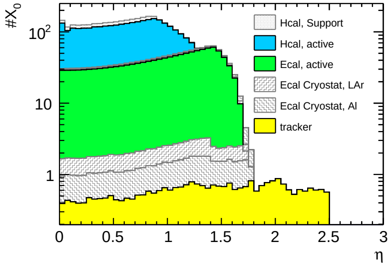
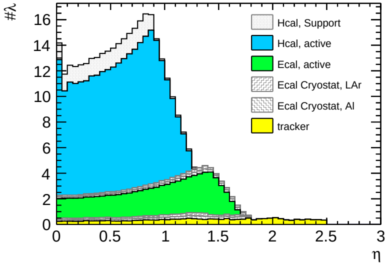
[1] coralie.neubuser@cern.ch

Material scans of FCC-hh Barrel in FCCSW

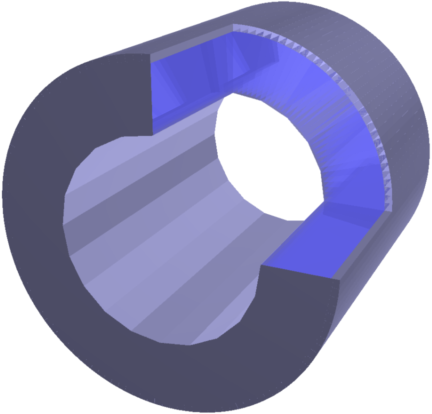
simple tracker + sunny ECal + realistic TileCal design







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



TileCal

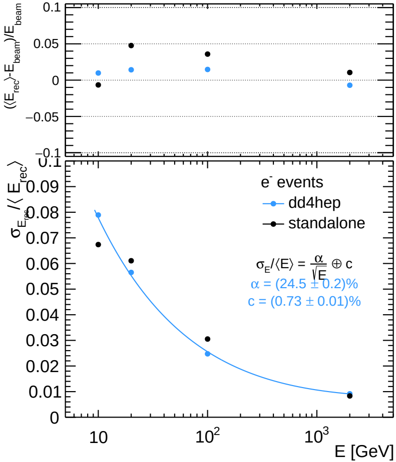
$\Delta\phi \times \Delta\eta$

0.025×0.025

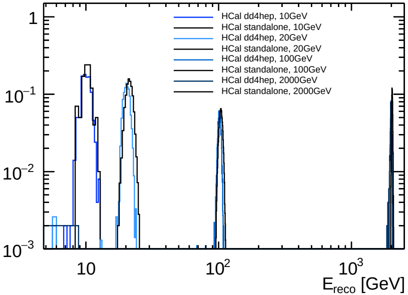
10 longitudinal layers

Comparison Standalone

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



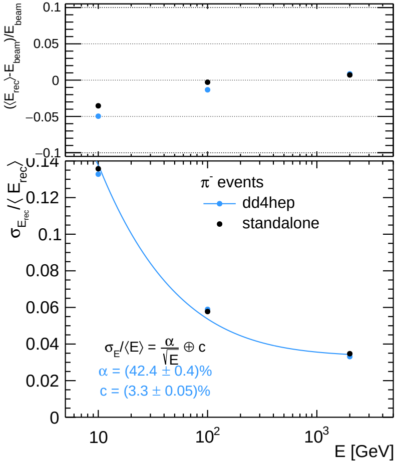
$$E_{reco} = \sum_{i=1}^{hits} E_i / f_{sampling} \quad (1)$$



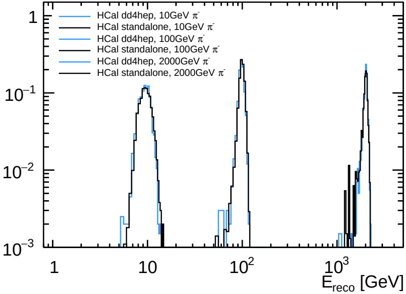
- standalone: $f_{sampling} = 2.5\%$
- DD4hep: $f_{sampling} = 3.2\%$

Comparison Standalone

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



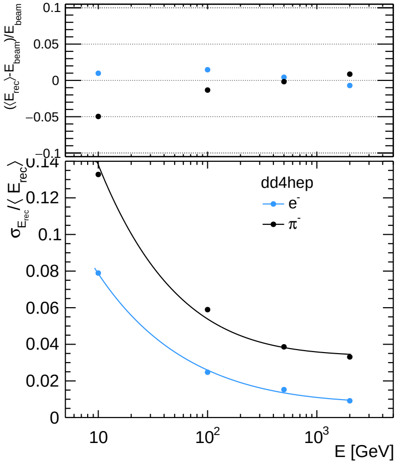
$$E_{reco} = \sum_{i=1}^{hits} E_i / a \qquad (2)$$



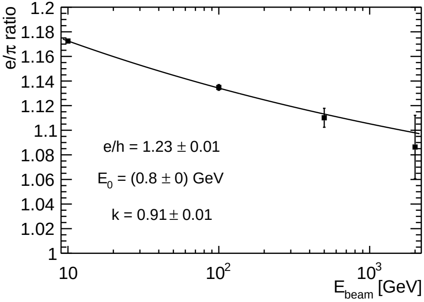
- standalone: $a = 2.3\%$
- DD4hep: $a = 2.9\%$

Non-compensation

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



$$e/\pi = \frac{e/h}{1 - \left[1 - \left(\frac{E_{beam}}{E_0}\right)^{1-k}\right](1 - e/h)} \qquad (3)$$



- 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

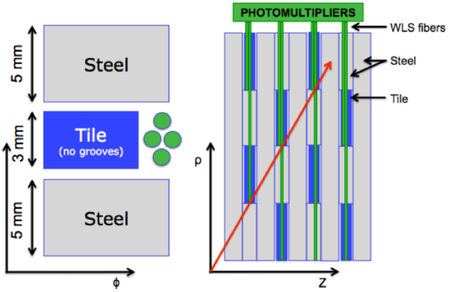
–> checked with Fe/Sci ratio of 6 (4.6)

–> degraded resolution (worse sampling frequency, smaller sampling fraction)

–> increased geometrical effects

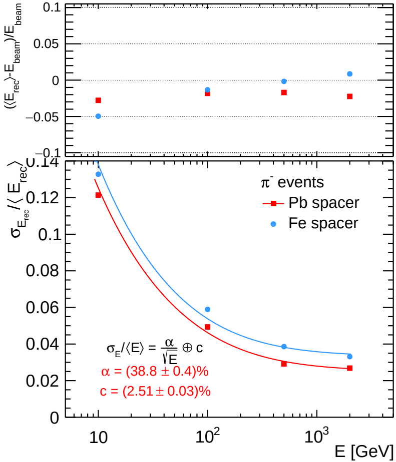
Compensation by higher Z absorber

–> spacer of HCal in Pb with X_0=0.6 cm (Fe: X_0=1.8 cm)



Test of Pb spacers

10,000 pi^{-} events per energy,
FTFP_BERT, $\eta = 0.36$

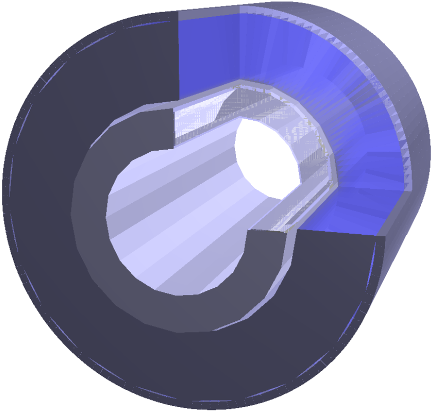


$$E_{reco} = \sum_{i=1}^{hits} E_i / 2.4\% \qquad (4)$$

- constant and stochastic term as well as non-linearities reduced

–> looks promising!

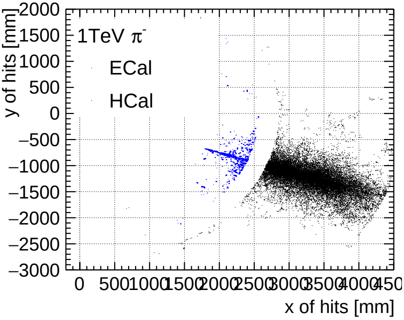
–> further look into electrons

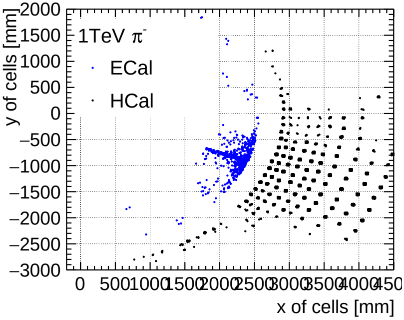


LAr ECal + TileCal

E+HCal first simple reco

from Geant4 depositions (hits) to energy in Calorimeter cells



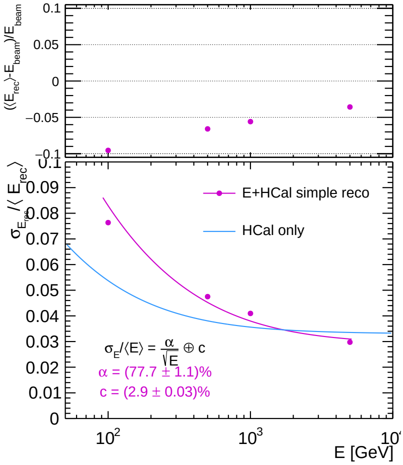


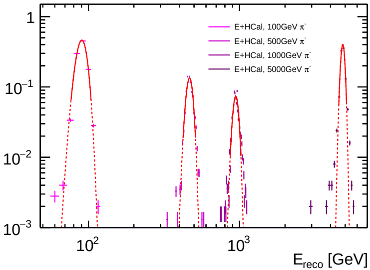
- HCal cells' energy threshold : 1keV
- no noise

E+HCal first simple reco

Resolution and Linearity for π^-

$$E_{reco} = \sum_{i=1}^{hitsECal} E_i/b + \sum_{j=1}^{hitsHCal} E_j/c \quad (5)$$

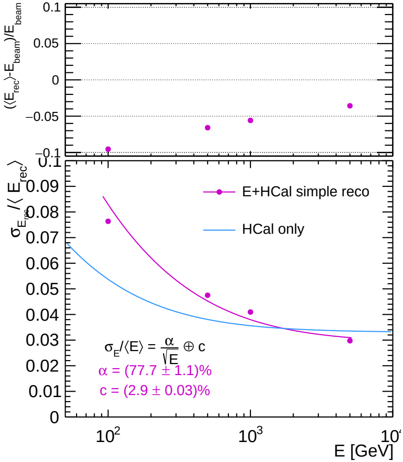




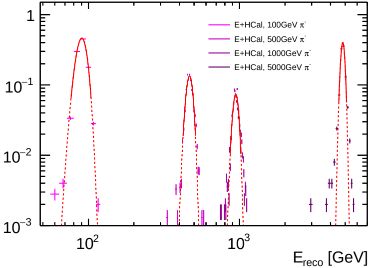
- $b = 16.8 - 21.5\%$ (EM scale) 8 layer ECal option
- $c = 2.9\%$
- missing energy of up 10 %
- 0.25 $\#\lambda$ / 1.5 X_0 passive material between E and HCal

E+HCal first simple reco

Resolution and Linearity for π^-



$$E_{reco} = \sum_{i=1}^{hitsECal} E_i/b + \sum_{j=1}^{hitsHCal} E_j/c \quad (6)$$



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

next steps

–> longitudinal profiles for energy correction
–> topo-clusters like in ATLAS as input for PFA

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-like particle flow

Backup Material