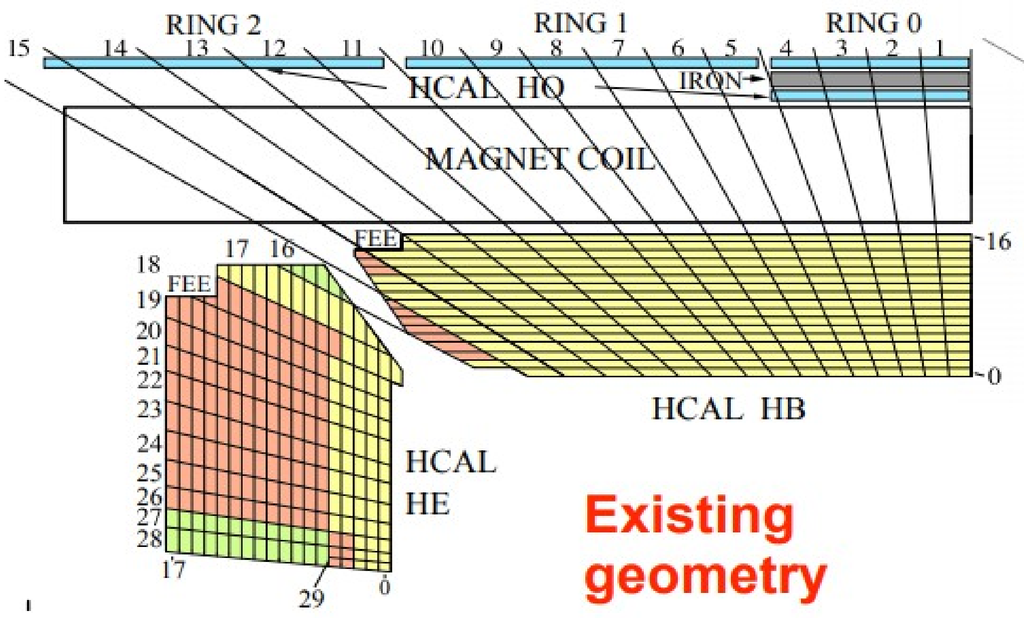
HE phase 1 calibration

V.Gavrilov (ITEP)

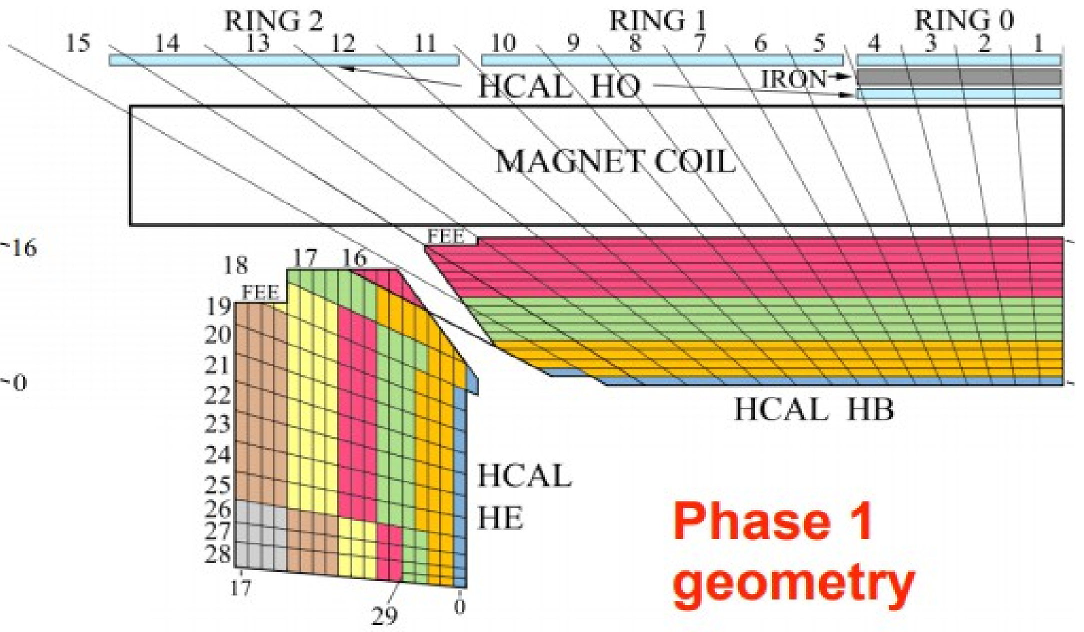
RDMS 2018

HE phase 1 layout

- Replace hybrid photodiode (HPD) photosensors with **silicon photomultipliers (SiPM)**.
- Replace QIE8-based 1.8 gbps readout electronics with **QIE11-based 4.8 gbps** electronics.
    - Including new control and calibration modules
- 6-7 depth longitudinal segmentation



Existing geometry



Phase 1 geometry

HE HPD aging

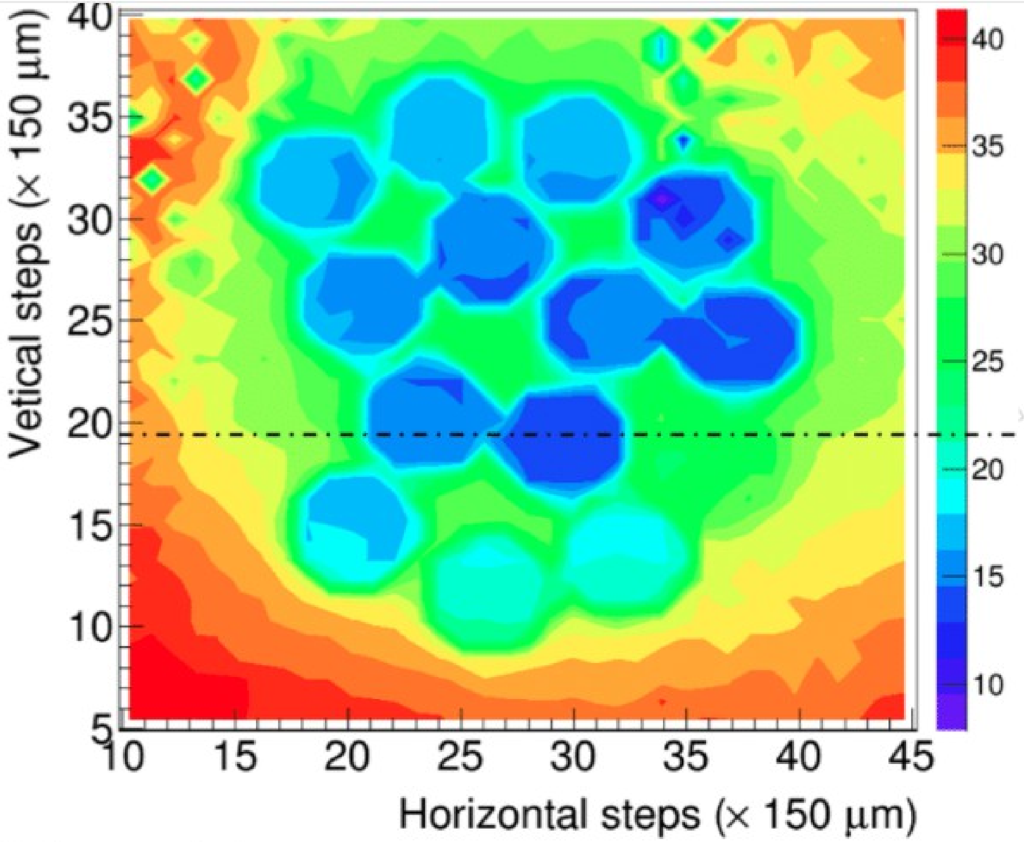


Figure 8: Results of a precise laser scan of the HE HPD which was removed prior to 2017 data taking. The location of the optical fibers is very evident, as is the increased damage for the locations of the clear fibers that come from high rate tiles.

Additional signal decrease wrt tile Raddam

Used for HE energy reco

- QIE11 parameters (adc → fC)
- Pedestals (fC)
- SiPM Non-linearity corrections (vs N_{pe})
- Signal shape (used for removing out of time PU)
- Gains (fC → GeV)
- RespCorr

Initial HE phase 1 calibration

- One HE segment (HE HEP17) was equipped with Phase 1 HW in 2017 data taking
- Calibration of HEP17 channels were performed using PhiSym and IsoTrack methods with 2017 data
- Co60 source data were used to transfere HEP17 calibrations to all other HE chanlles (during winter break 2017-18)

Co-60 sourcing in 2017/18

V. Andreev

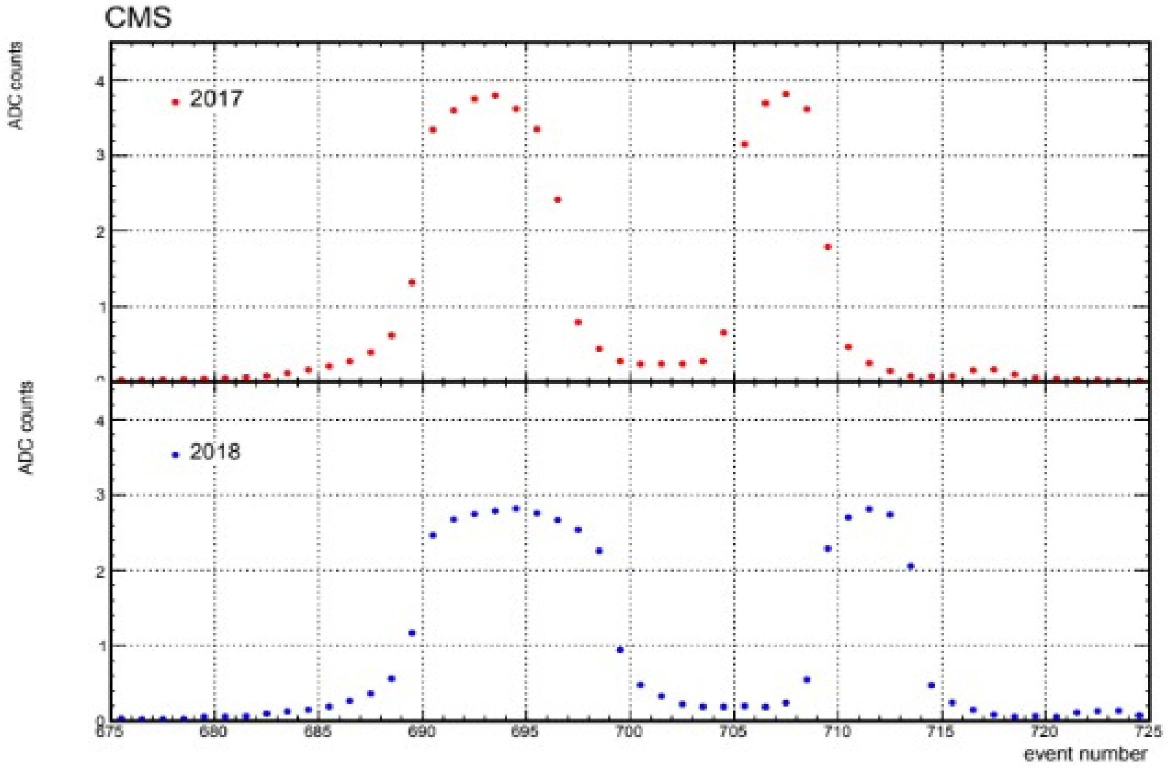


Figure 11: Variation of the background-subtracted source signal during its movement forth and back in the calorimeter. The top panel represents the measurement performed in 2017 while the bottom panel shows the same for 2018.

HE Raddam during 2017

V. Andreev

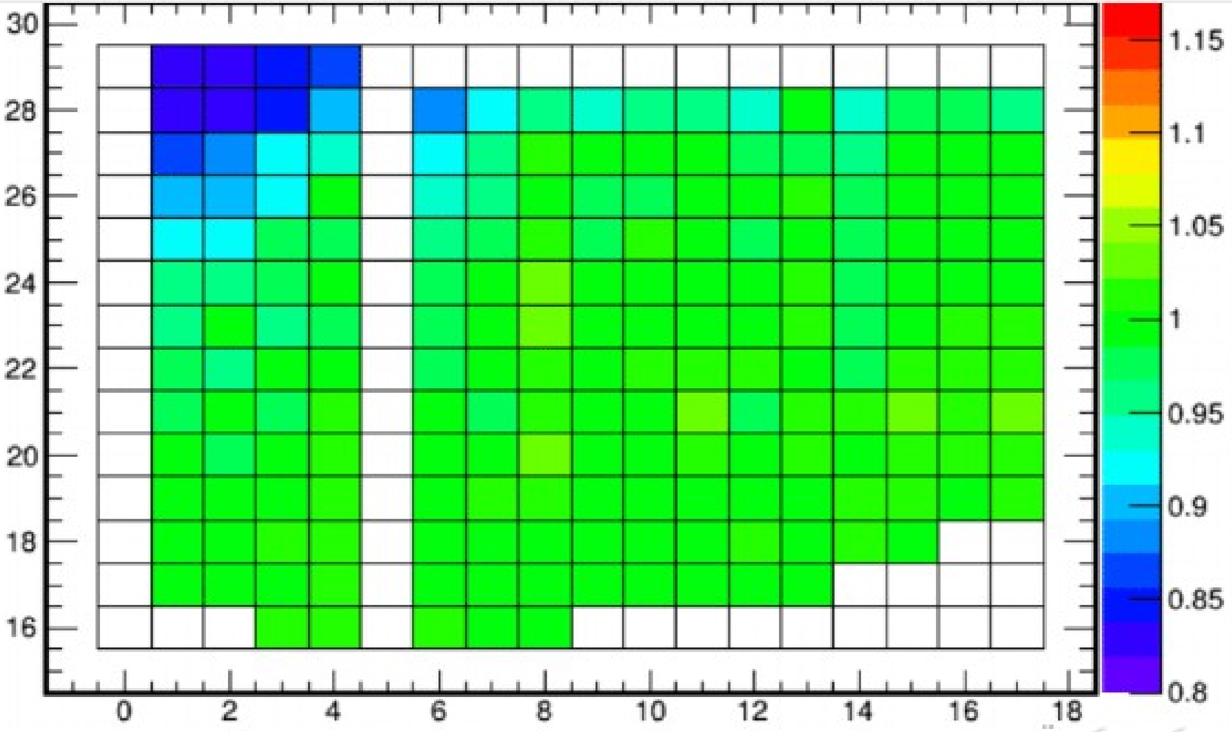
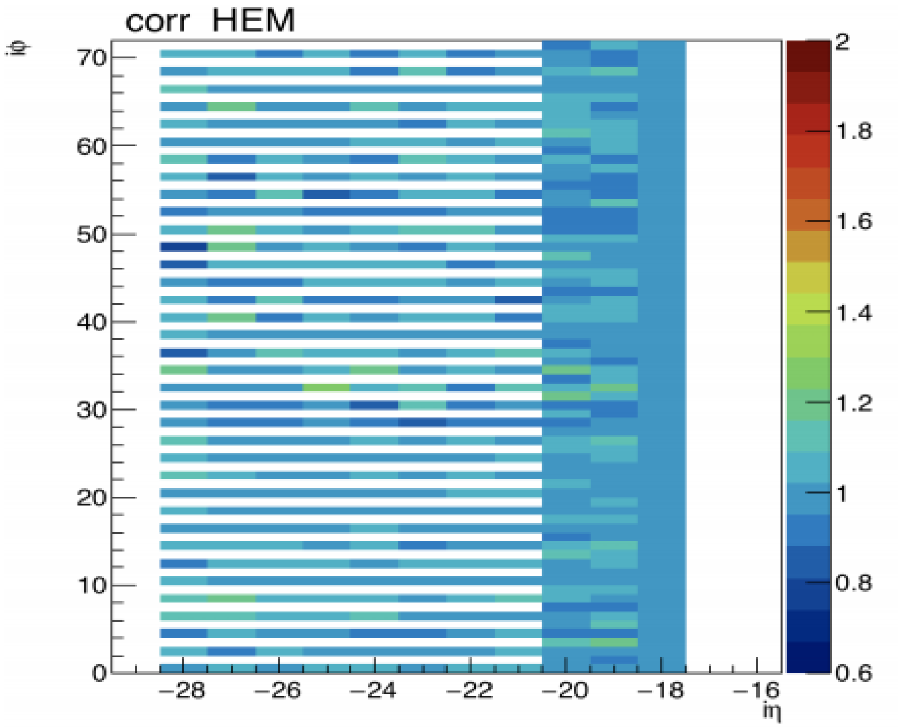


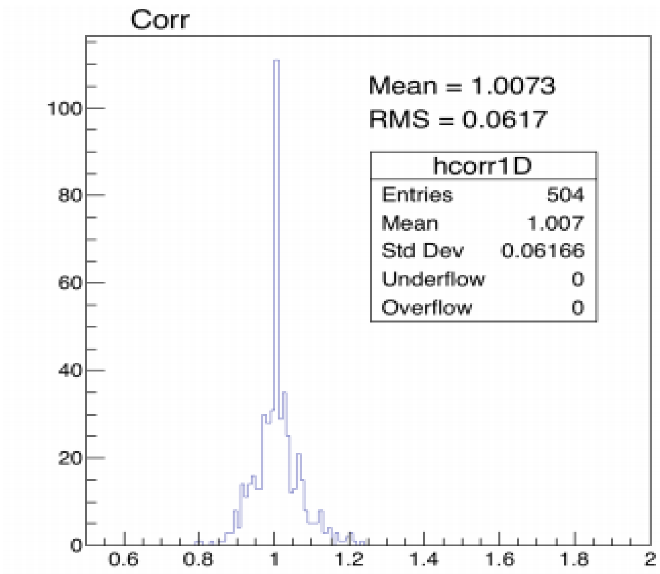
Figure 12: Ratio of Co-60 source signals observed in 2018 and 2017, corrected for source decay lifetime, as a function of the pseudorapidity index (16-29) and layer number (1-17) of scintillator tiles in HE.

Intercalibration of HE channels with 2018 collision data

N. Lychkovskaya

Map of corrections for HE-, depth1



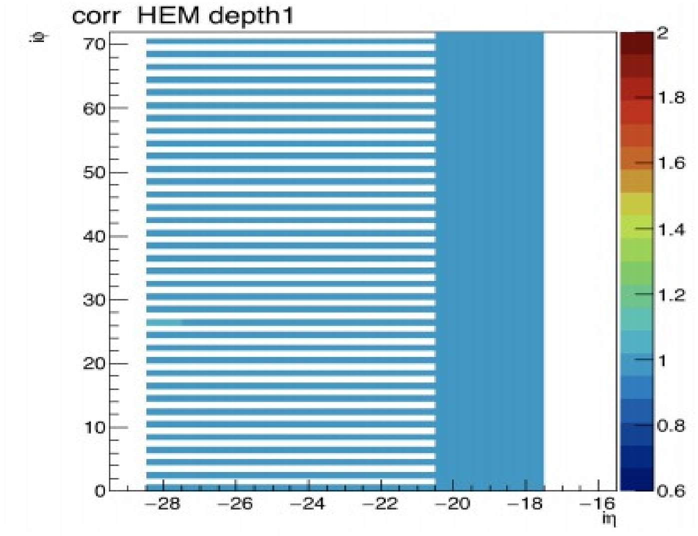


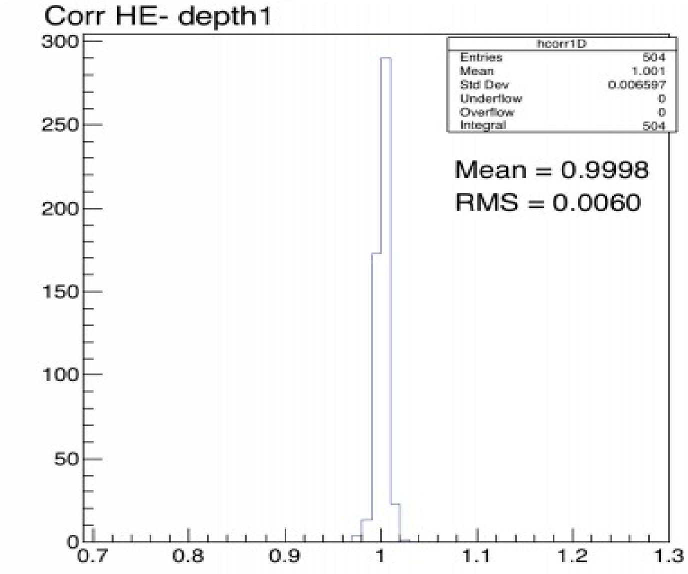
RMS = 6.2%
(precision of Co60 calibration)

Validation of correction with later data

N. Lychkovskaya

RunD 2018 Iterative phi sym correction
HE- depth1

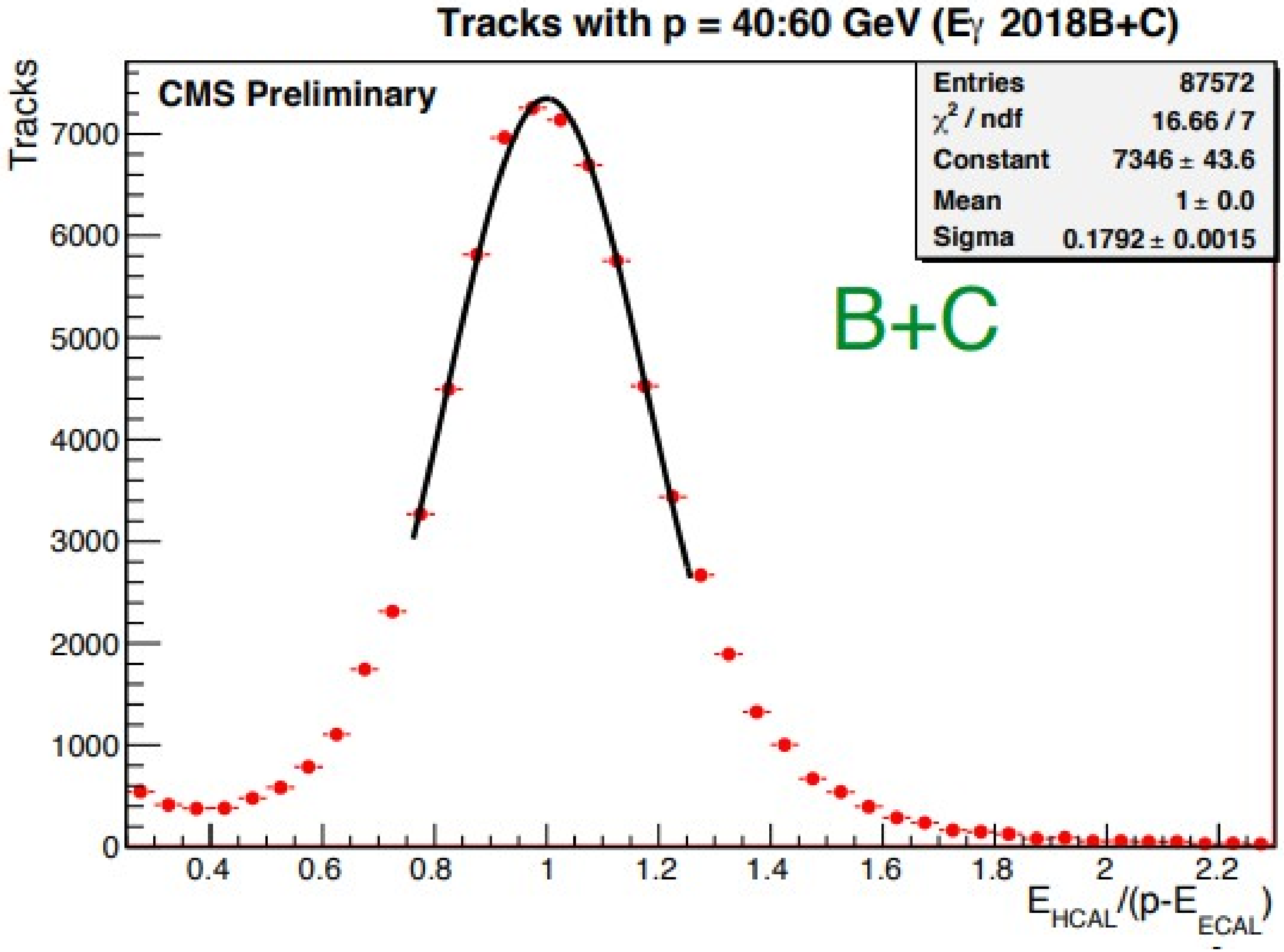




RMS = 0.6%
(stability of calibration)

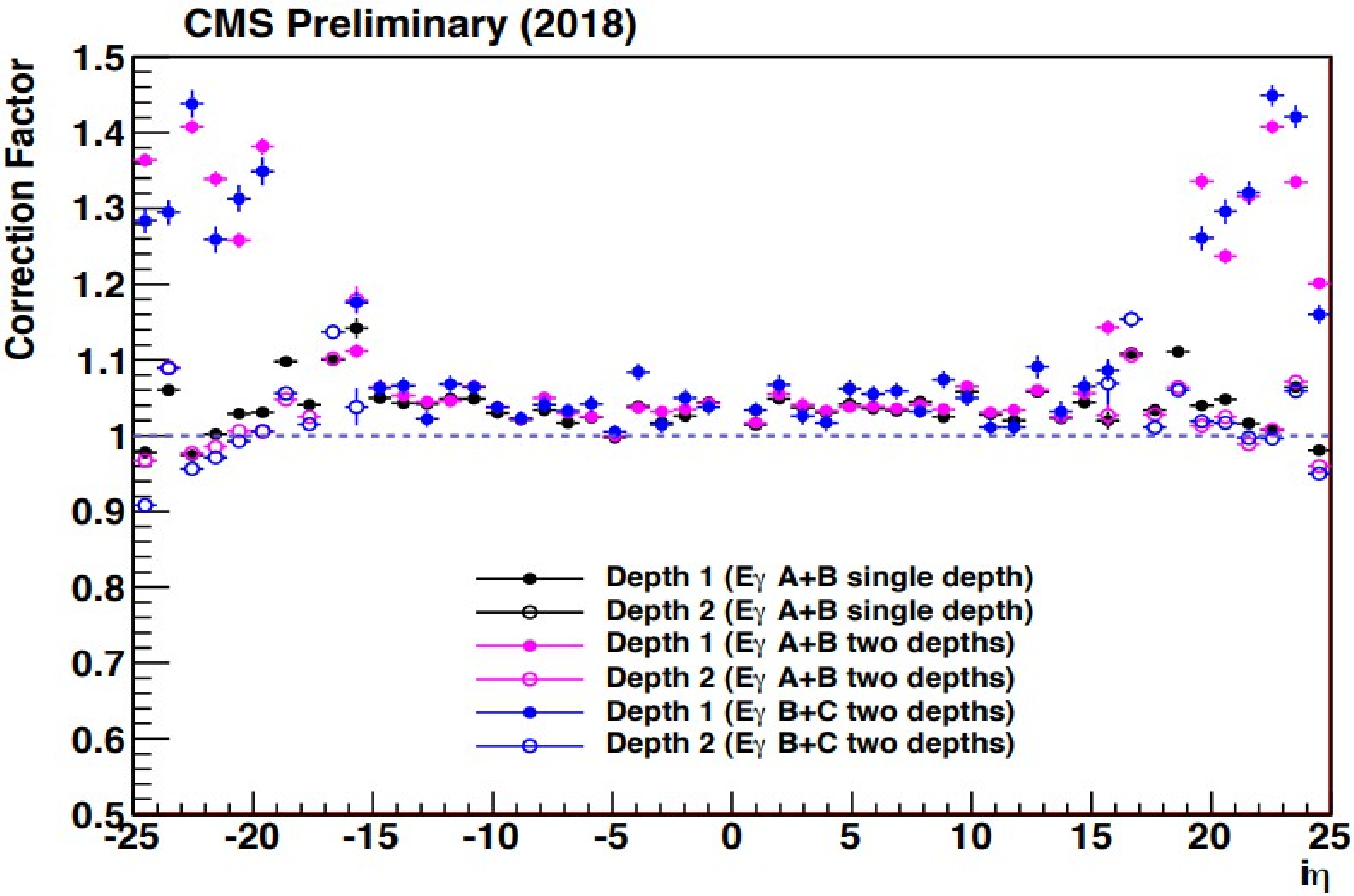
Energy scale with IsoTrack

Sunanda Banerjee
and calibation team



IsoTrack: dependence on η

Sunanda Banerjee and calibation team

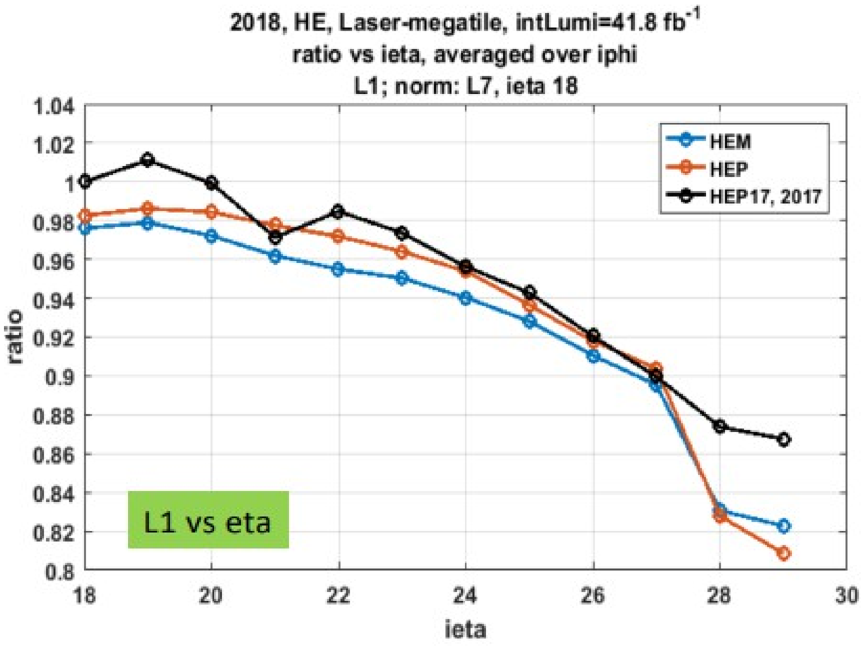


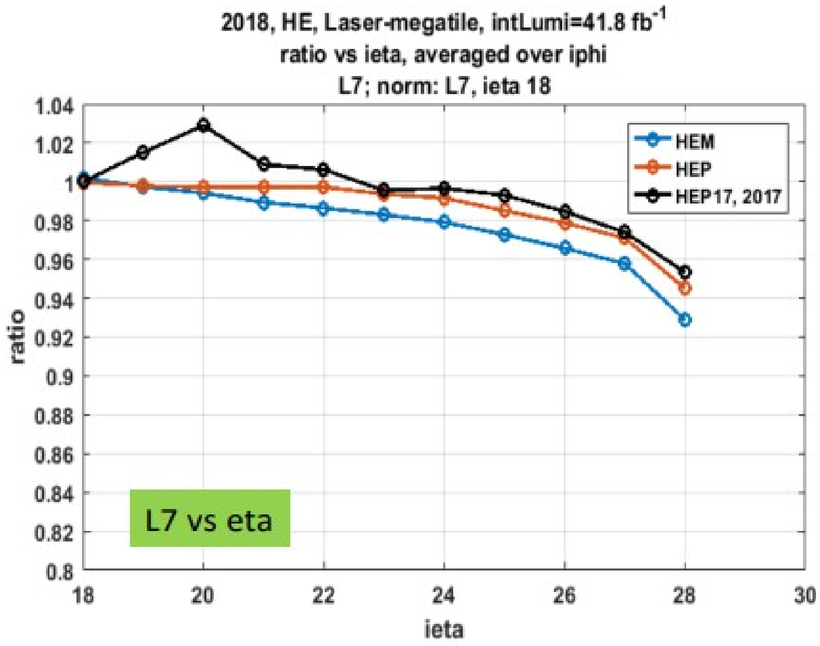
D1 calibration not yet final in HE

HE radidation damage

P. de Barabaro, V. Epshteyn

Average RadDam vs eta, 2018 and 2017, 41.8 fb^{-1}





Within 1-2%, results are consistent between 2017 HEP17 data and entire HE 2018 data (for same amount of Int. Lumi.)

In 2018 Raddam corrections are applied after each of 10/fb based on extrapolation of 2017 results

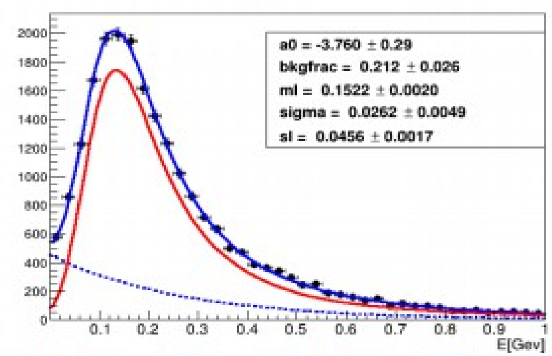
Muon signals in HE

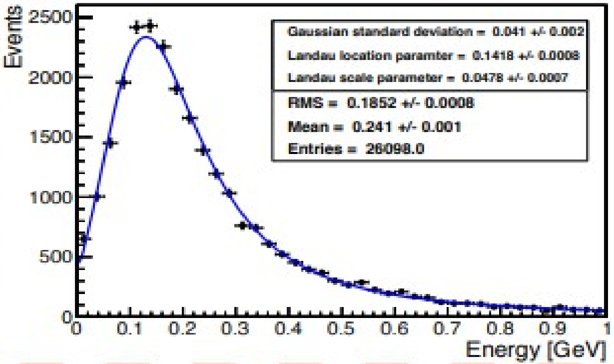
N. Lu

Landau location parameter: ml
Landau scale parameter: sl
Gaussian width: sigma

Adel Terkulov used a exponential function to model the background. This fit function agrees with data better

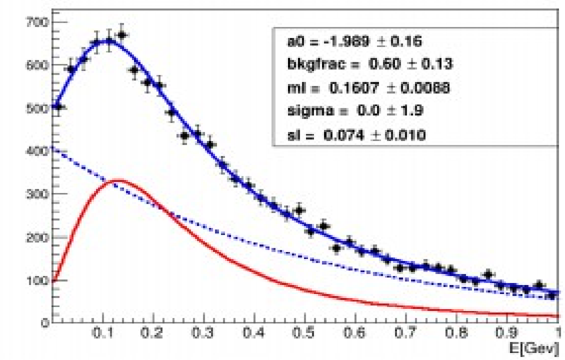
ieta= 21

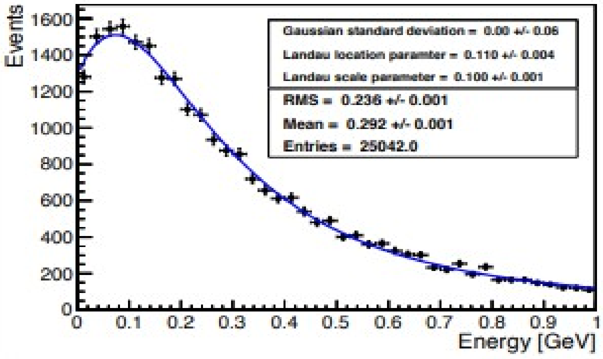

energy for ieta=21 depth=1 phi=1-72 15<=nvertex<16



pileup correction for depth1

ieta= 25


energy for ieta=25 depth=1 phi=1-72 15<=nvertex<16



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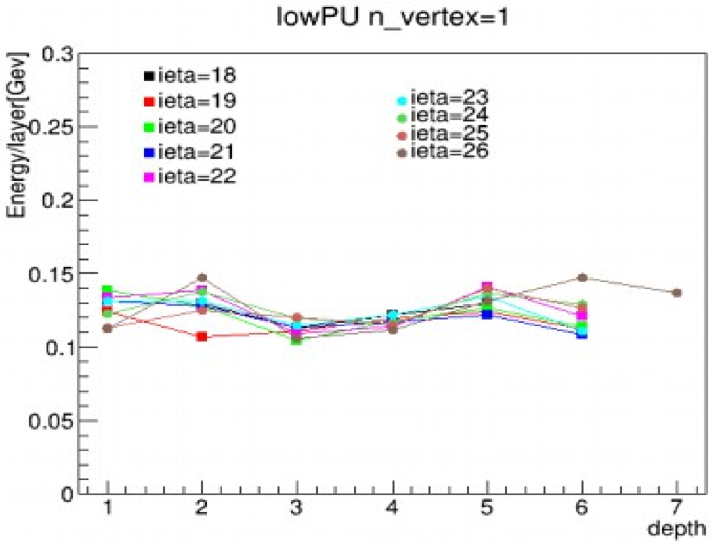
pileup correction for depth1

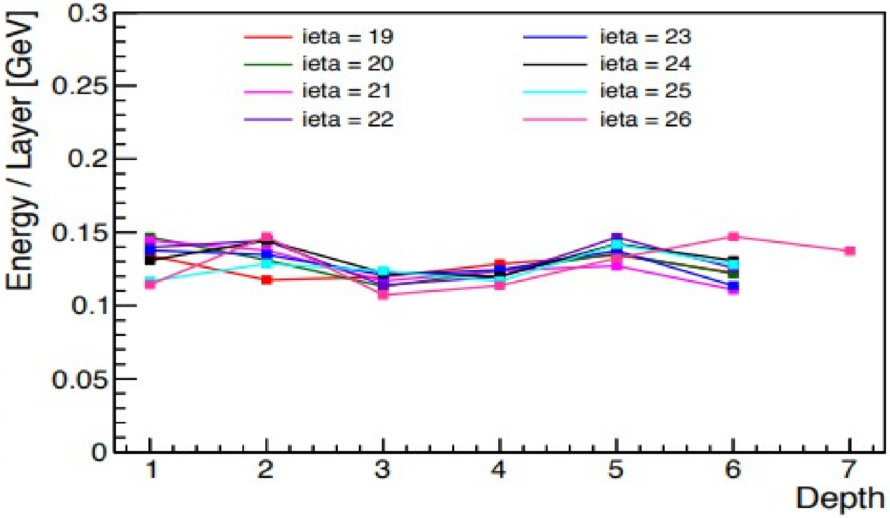
Muon peak position at low PU

TOTEM run results

Adel Terkulov

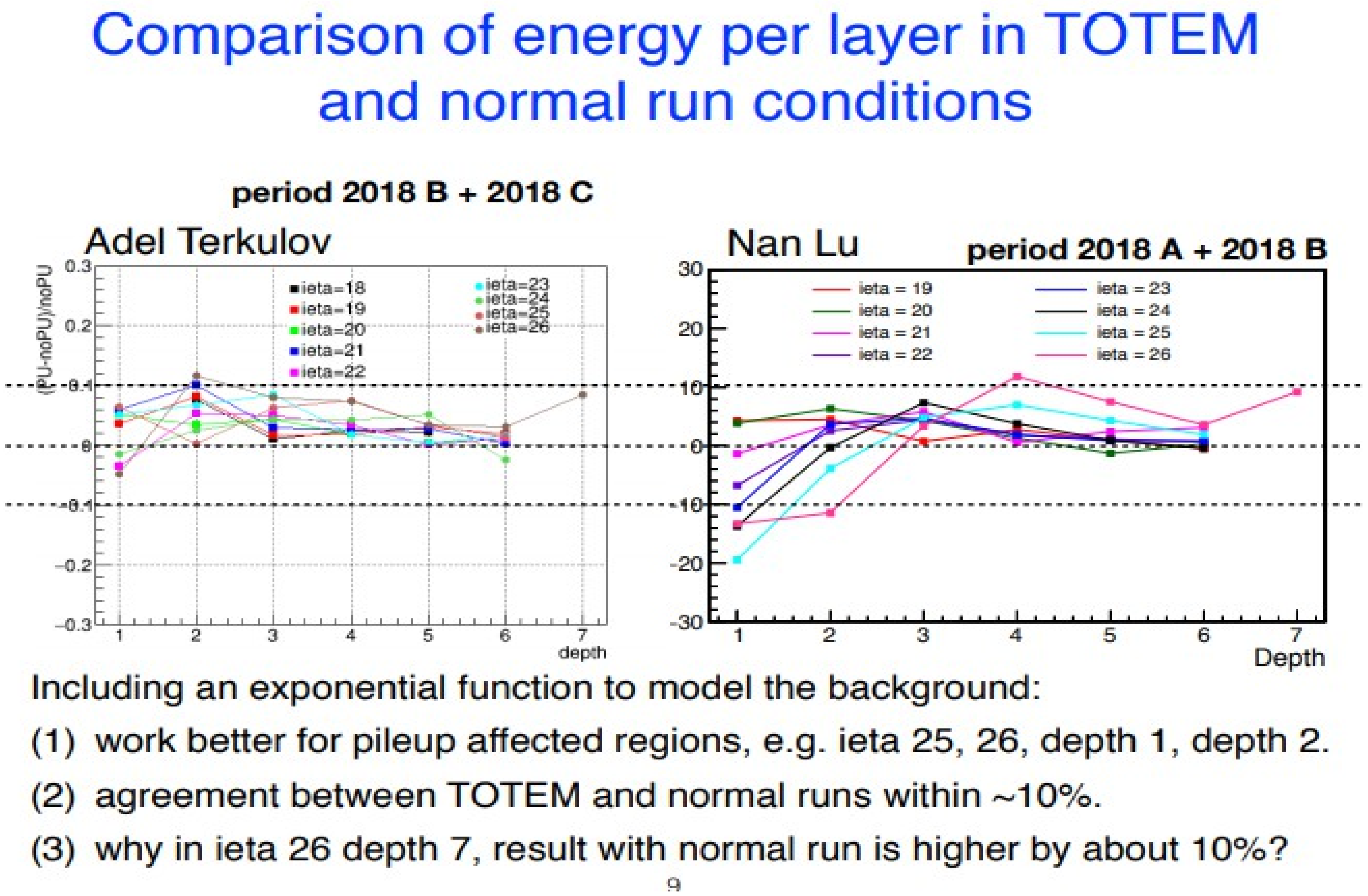


Nan Lu



Difference between the two results: 9%~0.1%
better agreement in high ieta regions.
The difference needs to be understood.

Comparison low and high PU results



Comparison of energy per layer in TOTEM and normal run conditions

Including an exponential function to model the background:

(1) work better for pileup affected regions, e.g. ieta 25, 26, depth 1, depth 2.

(2) agreement between TOTEM and normal runs within ~10%.

(3) why in ieta 26 depth 7, result with normal run is higher by about 10%?

Absorber thickness for different HE layers

Ieta 25

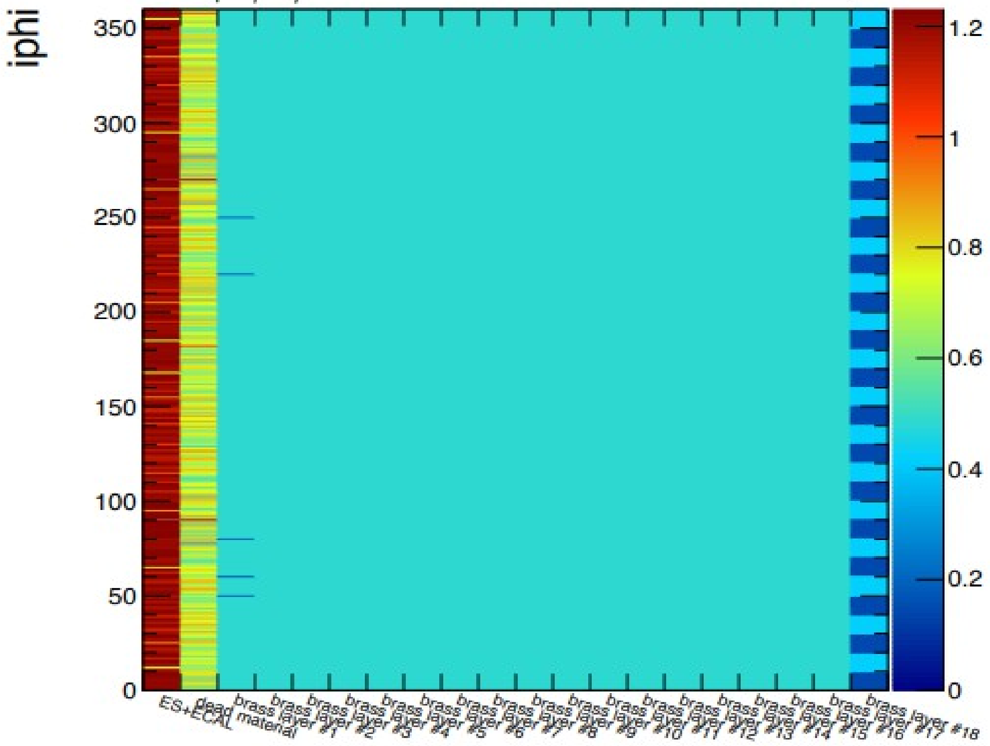
F. de Guio

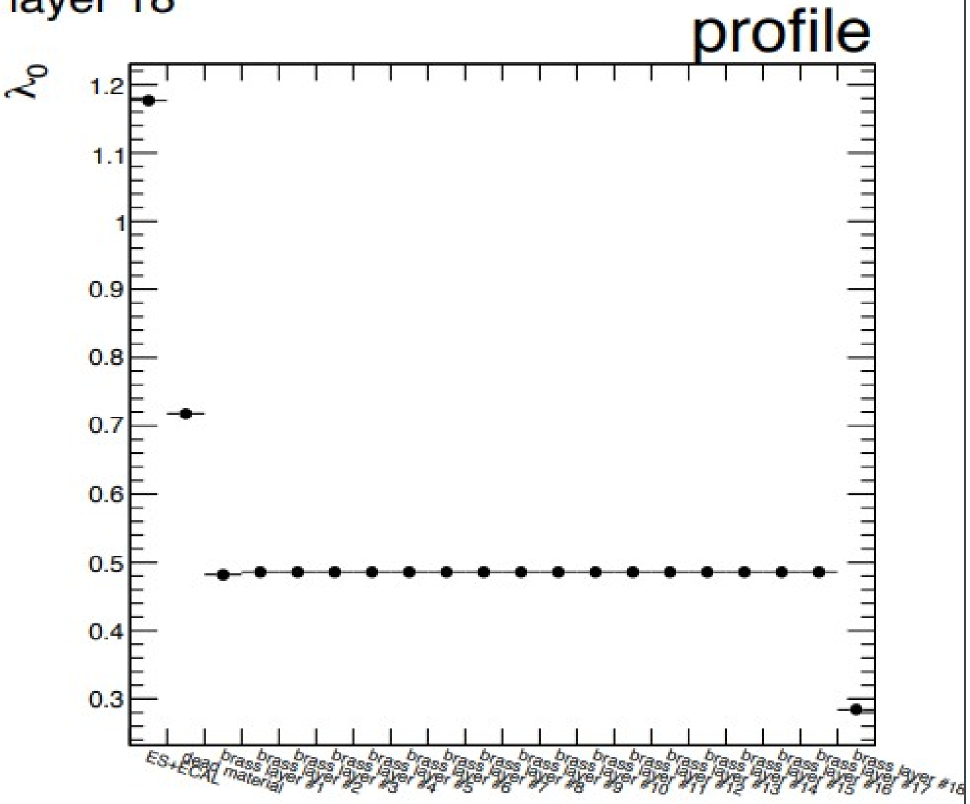
Scint layer 0

Scint layer 1

Scint layer 2

Scint layer 18

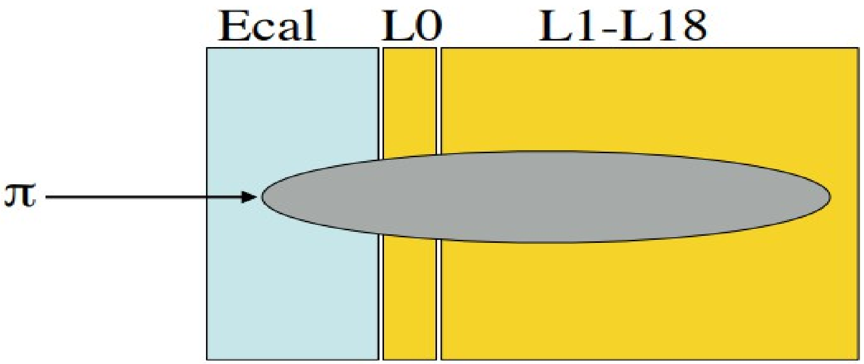




Expected validation of HE D1 calibration with muons

A useful cross check

F. de Guio



- Select hadrons that start showering in Ecal
- Use isotrack to calibrate E/p leaving L0 floating wrt the other depths
- Compare a coefficient obtained from this method and the MIP based method

Plan for 2018 ReReco calibrtion

- PhiSim — intercalibration over phi at each eta-depth
- Muons — intercalibration over depth at each eta
- IsoTrack — energy scale vs eta
- Raddam — Laser and collision data, two phi groups for i_eta 28 and 29 (due to non uniform dose map)