

# Update for Local Hadron Calibration Performance

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Outline:

Introduction

Cluster moments based on calibration hits

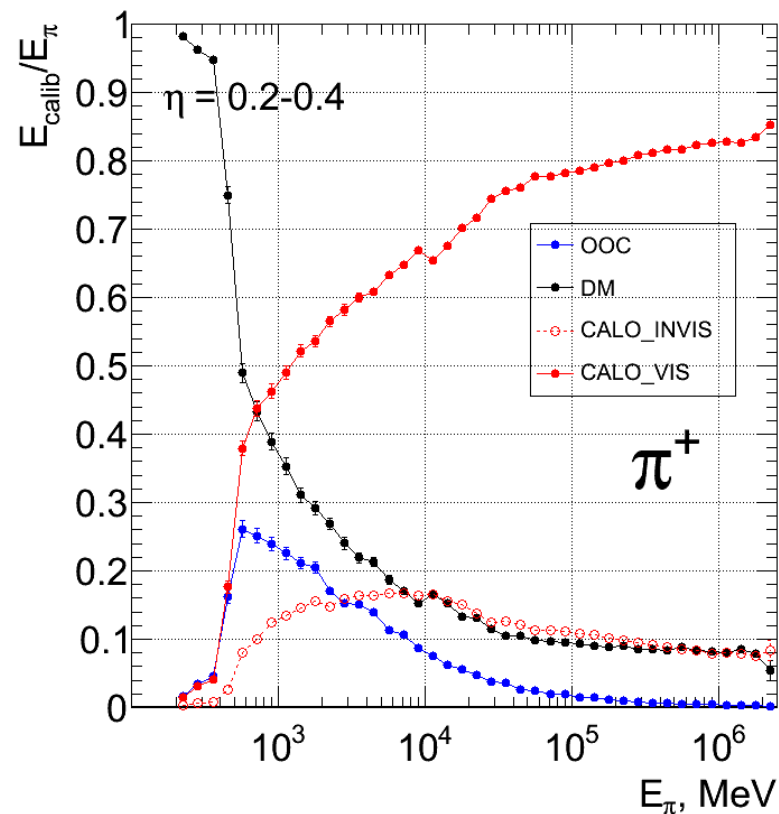
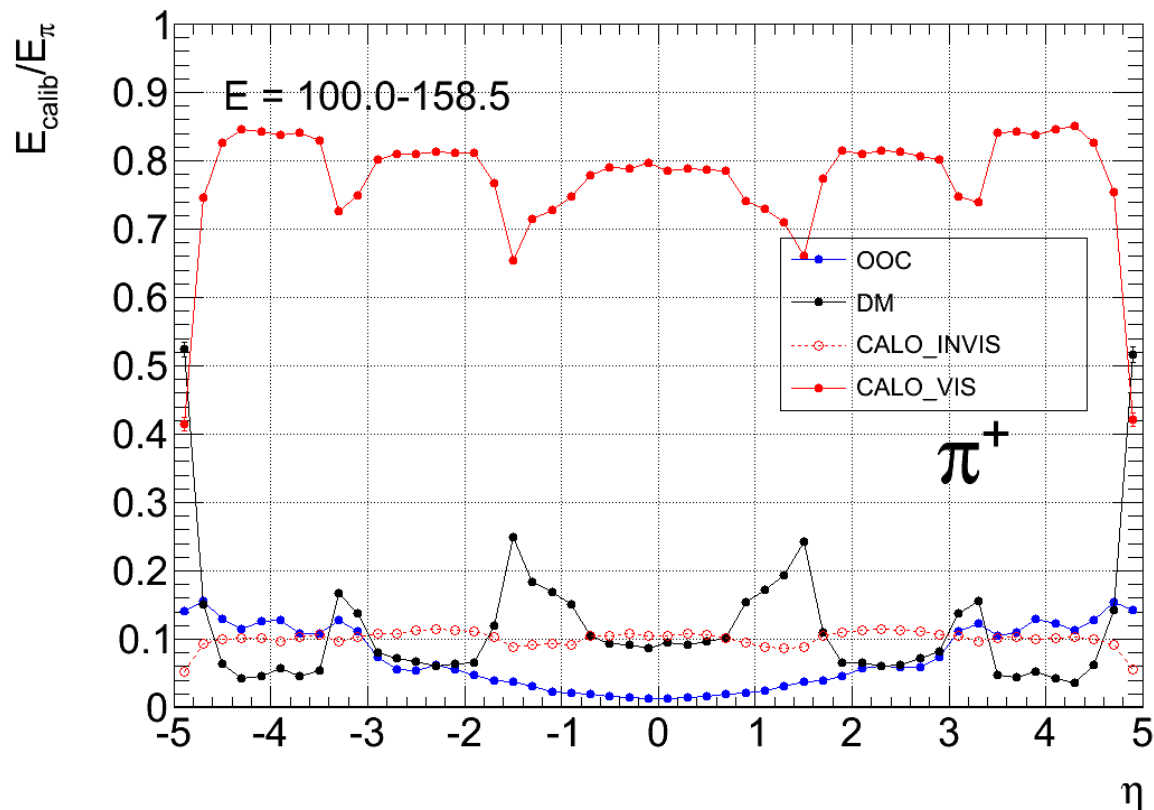
Linearity and classification in 15.3.0

First glance on local hadron calibration in di-jet environment using ParticleID

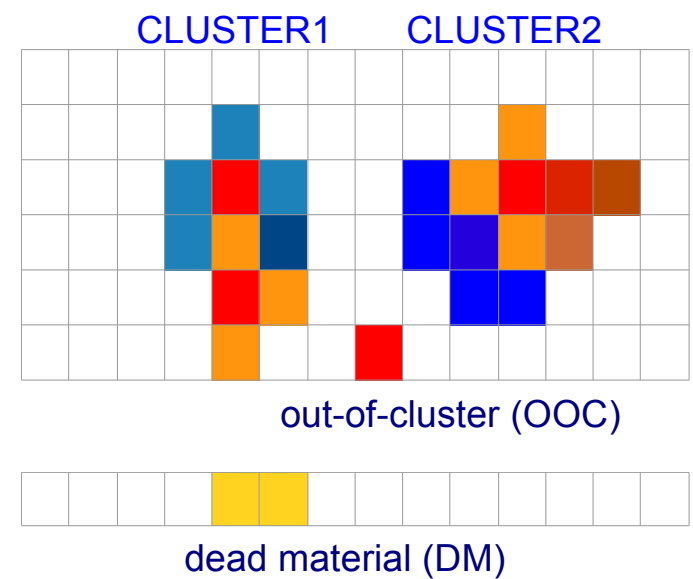
# Introduction

Local hadron calibration goal is to correct cluster energy up to a particle level. It takes care about invisible, out-of-cluster energies and energy deposited in the dead material using visible energy deposited in calorimeter.

Plots show ratio of these energies to the initial pion energy as a function of pion  $\eta$  and coordinate.

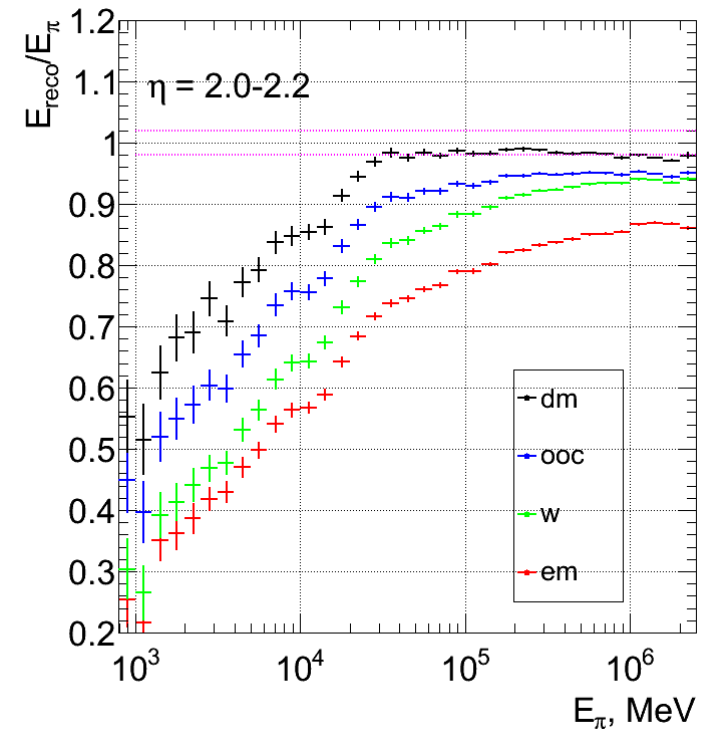
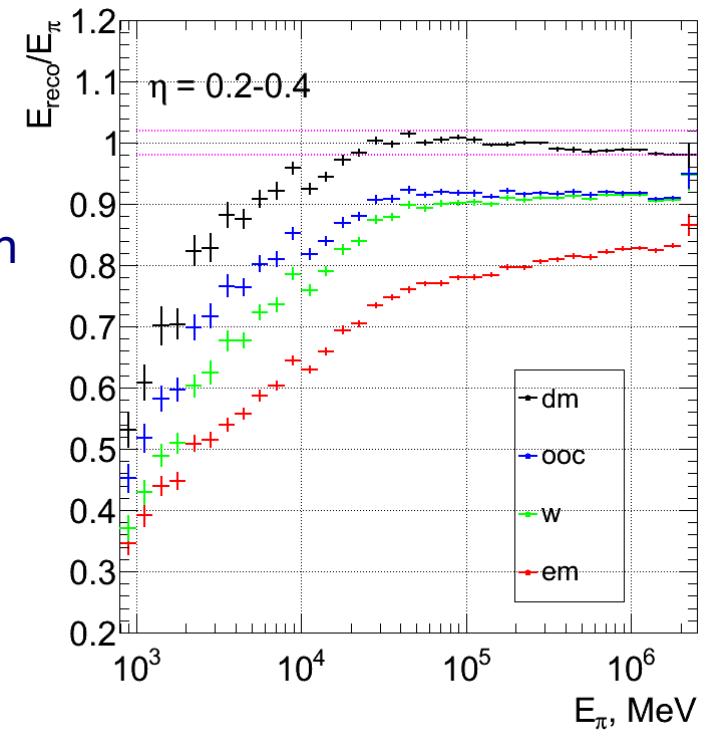
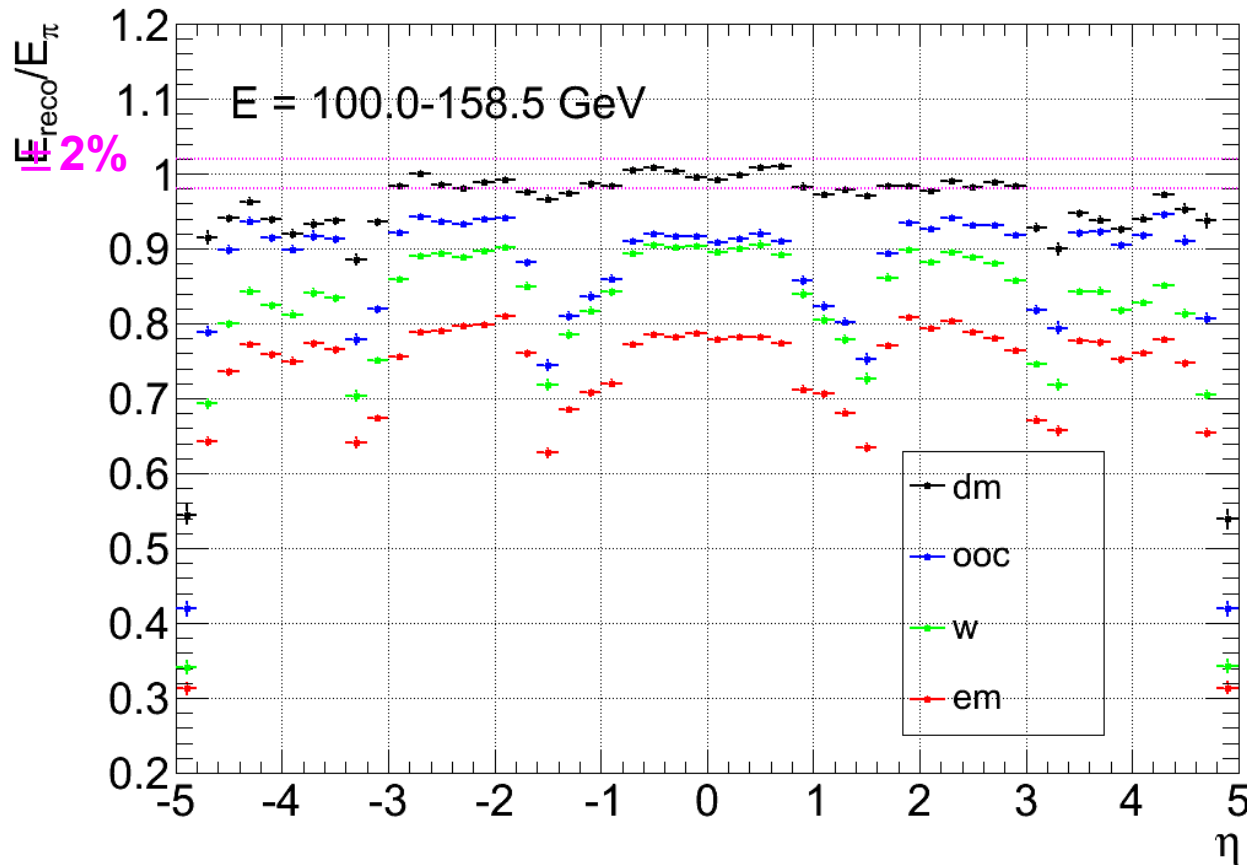


- For out-of-cluster and dead material corrections the association of calibration hits outside clusters to nearby clusters is needed
- Current procedure:
  - Angle between cluster axis and calibration hit is used
  - $O(1)$  in barrel region,  $O(0.2)$  in FCAL region
  - No assignment for noisy clusters
- **For out-of-cluster hits**
  - ➔ assign fractional energy of each calibration hit to all clusters within angular range
  - ➔ proportional to cluster energy
- **For dead material calibration hits**
  - ➔ assign fractional energy of each calibration hit to all clusters within angular range
  - ➔ weight factor depends on distance to the cluster and cluster energy in specified samplings (**PreSamplerB** for upstream material, **EMB3+TileBar0** for material between barrel and tile, et.)
- Assigned Out-of-cluster and dead material energies are stored as cluster moments
- Requirement for assignment procedure:
  - For single particles: fraction of OOC and DM energy assigned to clusters should be close to 1.
  - For jets : to provide right (truth) jet energy for reconstructed jets made out of calibration hits? See Paola's talk



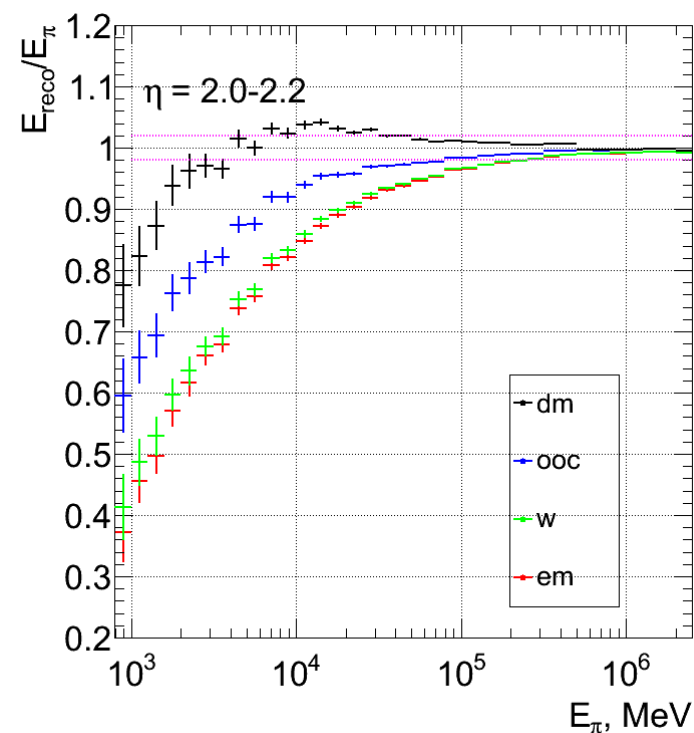
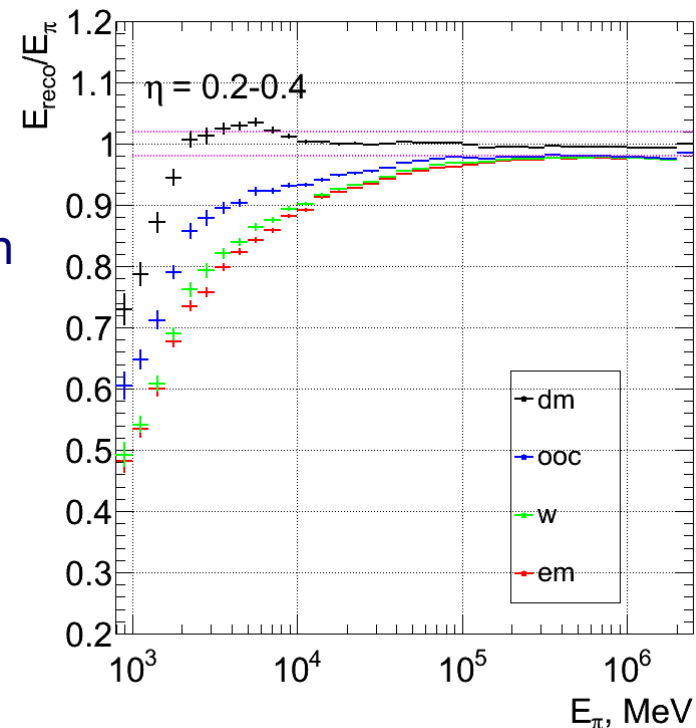
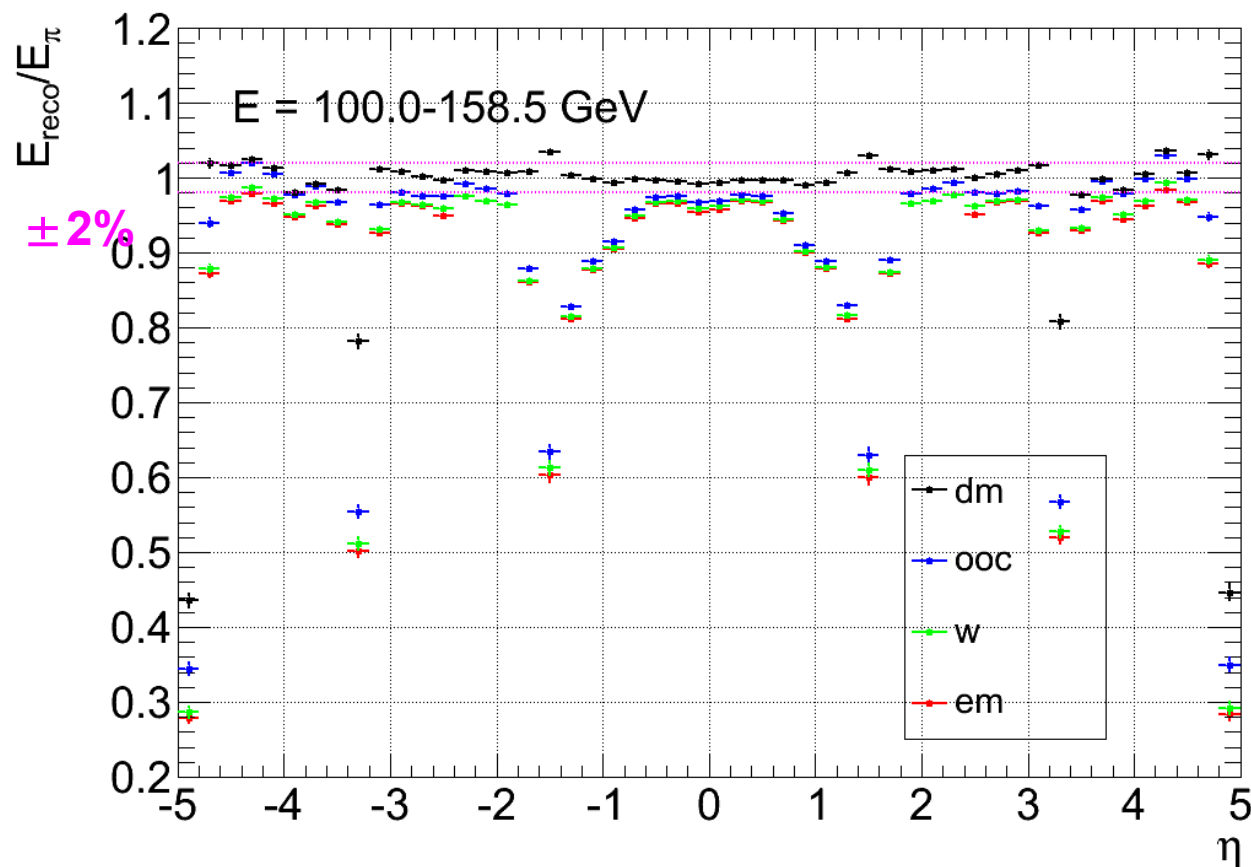
# Linearity for charged pions (15.3.0)

- Reconstructed pion energy after each step of local hadron calibration normalized to the truth pion energy
  - as a function of pion eta (bottom left)
  - as a function of pion energy (right)
- Linearity stays well within 2% for  $|\eta| < 3.0$  and  $E > 25$  GeV



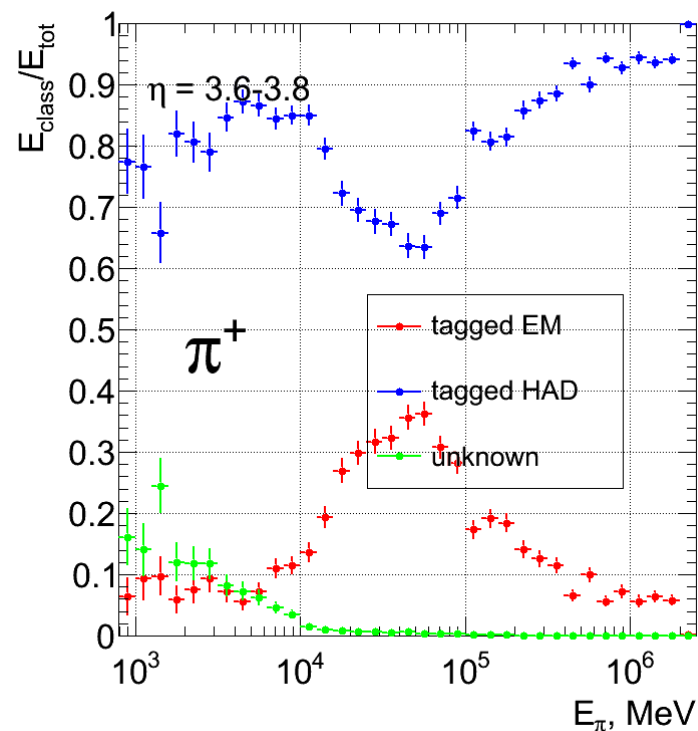
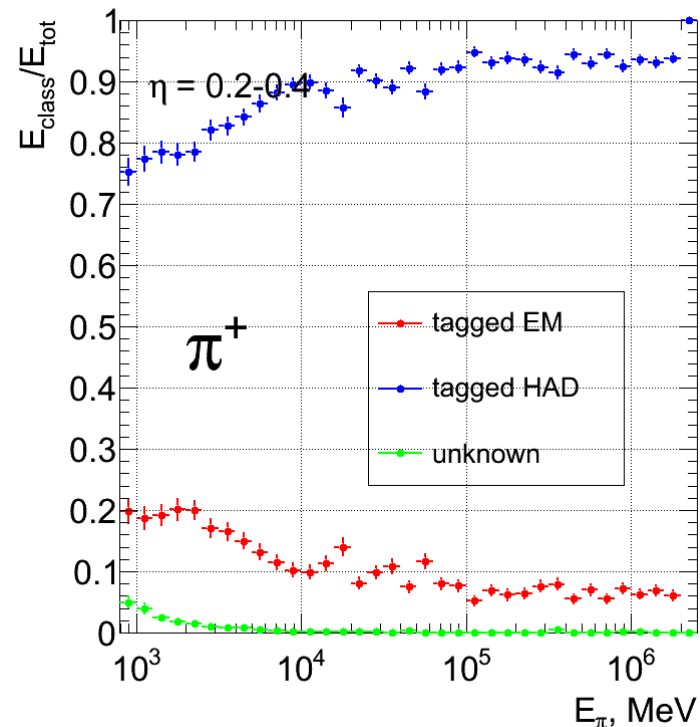
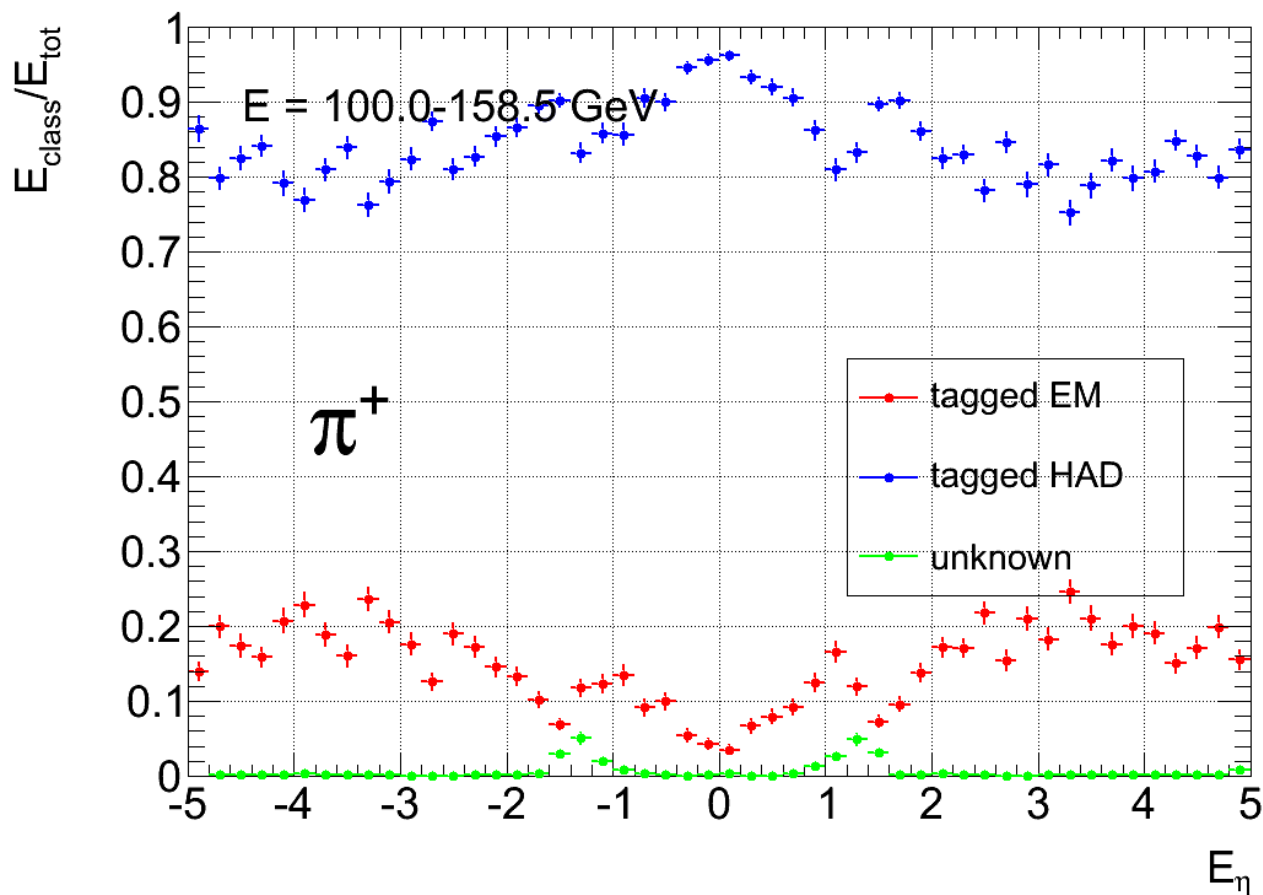
# Linearity for neutral pions (15.3.0)

- Reconstructed pion energy after each step of local hadron calibration normalized to the truth pion energy
  - as a function of pion eta (bottom left)
  - as a function of pion energy (right)
- Linearity stays well within 2% for  $|\eta| < 3.0$  and  $E > 3$  GeV



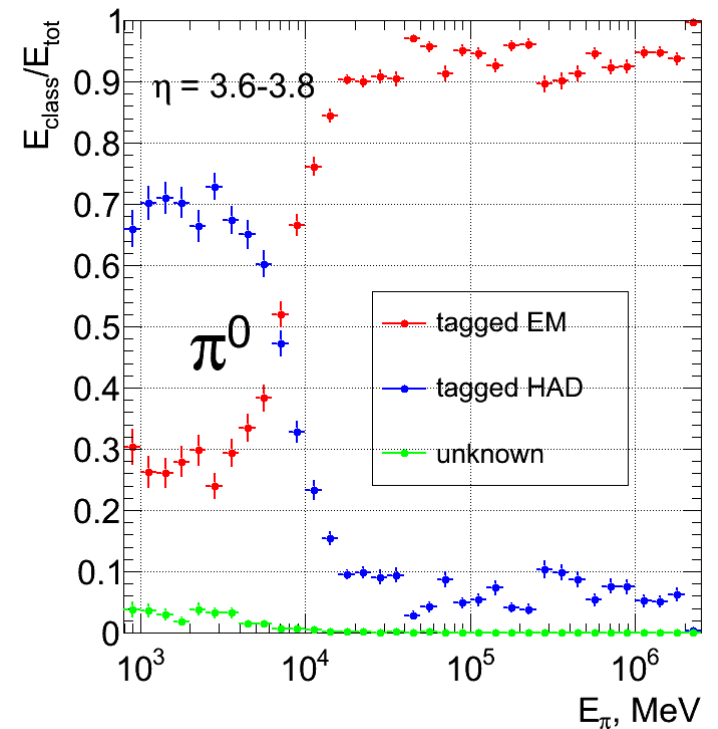
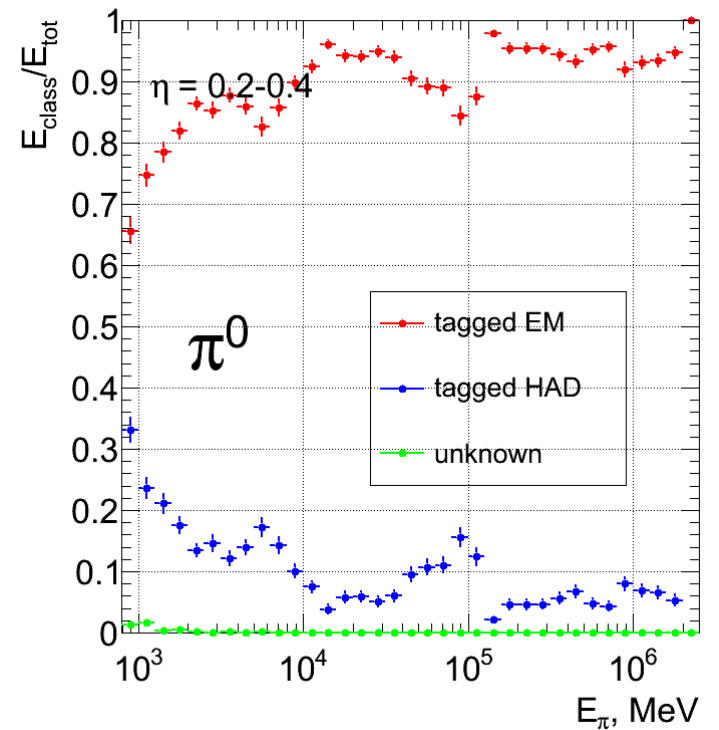
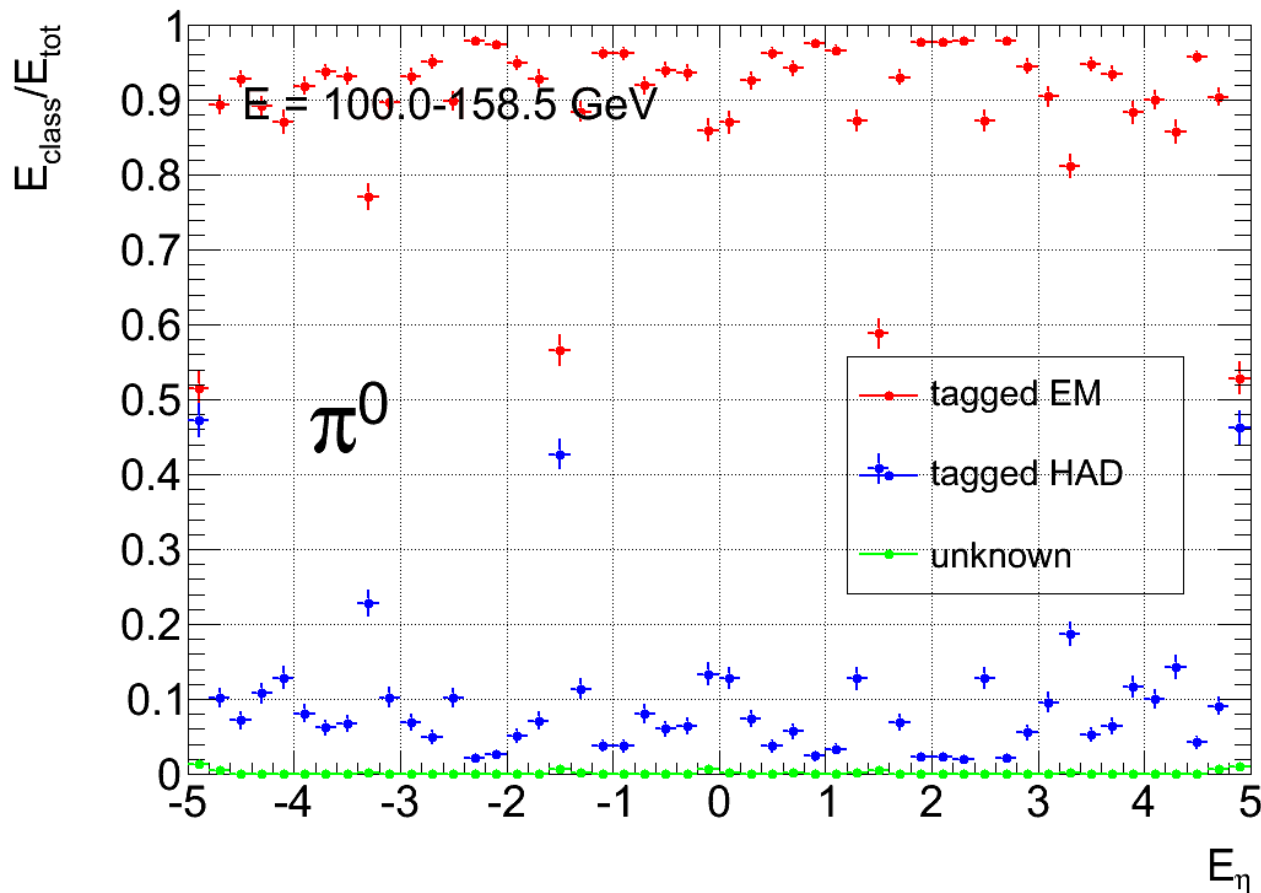
# Classification: charged pions (15.3.0)

- Energy fraction of single charged pion classified as electromagnetic (●), hadronic (●) or unknown (●)
  - as a function of pion eta (bottom left)
  - as a function of pion energy (right)



# Classification: neutral pions (15.3.0)

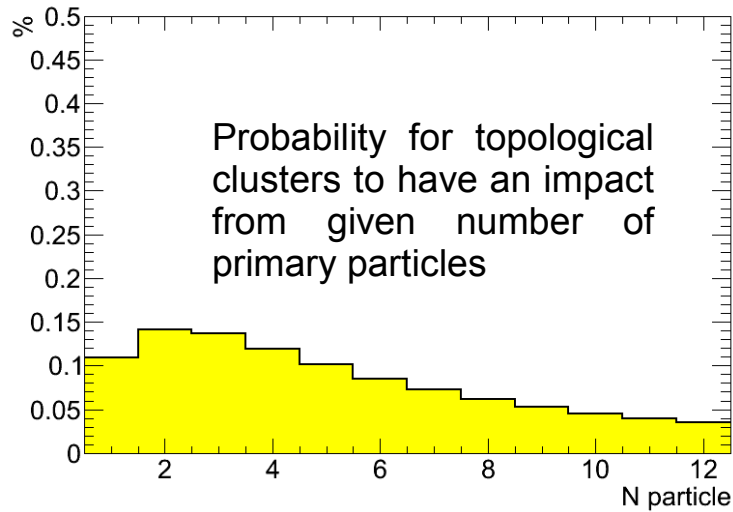
- Energy fraction of single neutral pion classified as electromagnetic (●), hadronic (●) or unknown (●)
  - as a function of pion eta (bottom left)
  - as a function of pion energy (right)



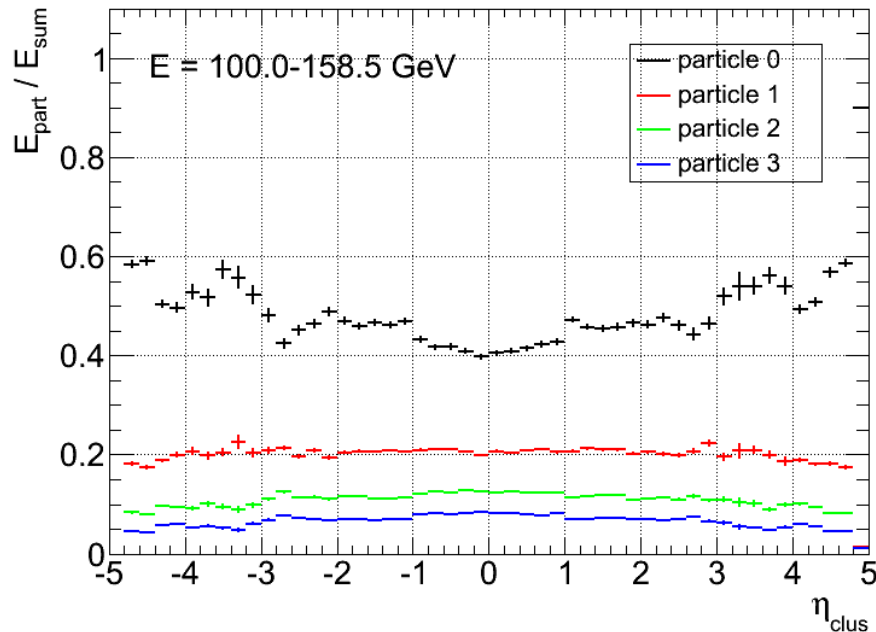
# Particle Impact on TopoCluster's in jet environment

(simulation with ParticleID)

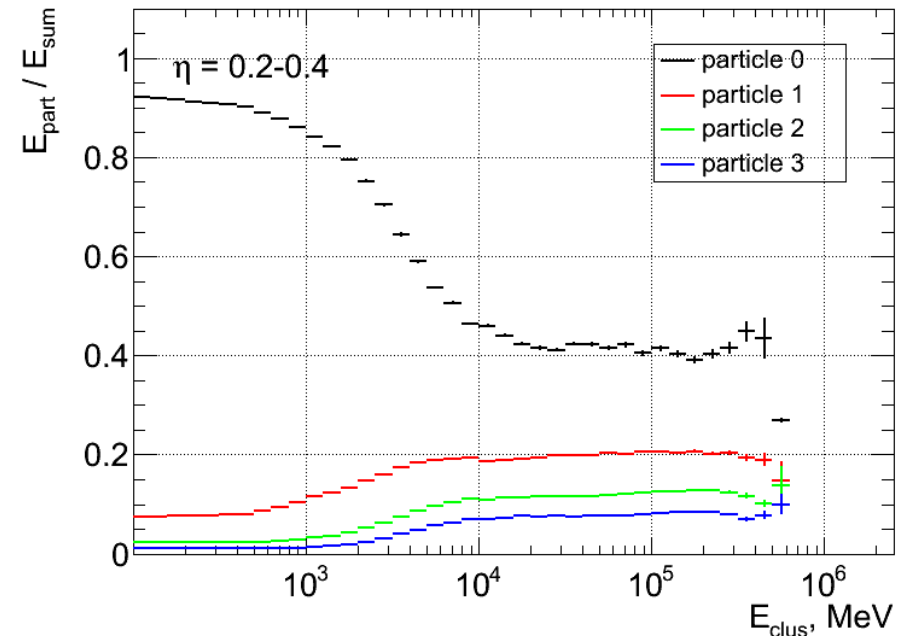
Number of particles in cluster



- For high energetic ( $>10$  GeV) clusters in J4 environment only 40% of cluster energy is caused by most energetic particle, the rest of cluster energy is due to other particles
  - Corrected for extra particles from  $\pi_0 \rightarrow \gamma\gamma$ : photons with same vertex are accounted as single particle



Primary particles impact on topological cluster as a function of cluster  $\eta$

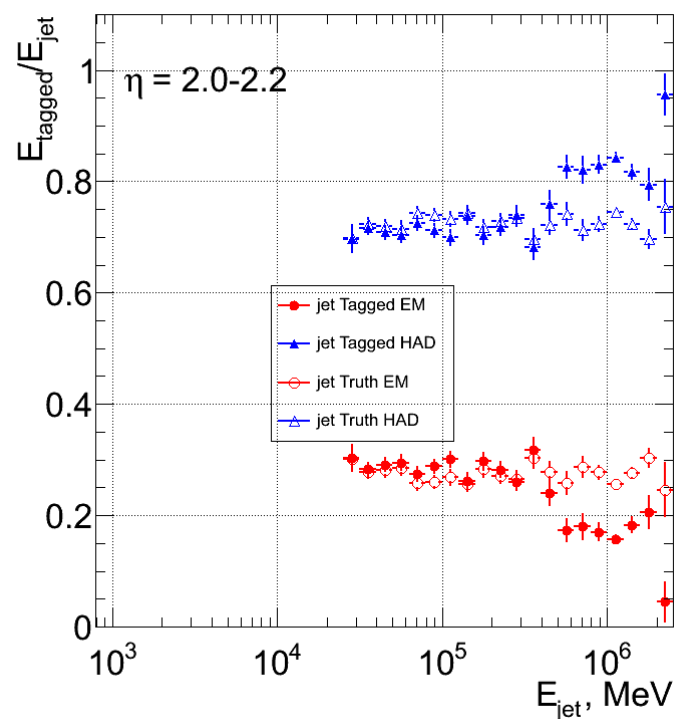
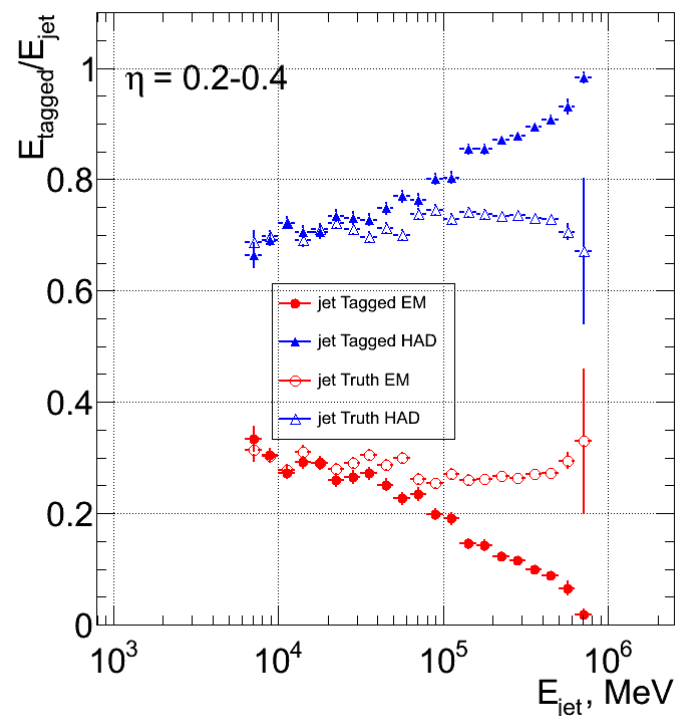
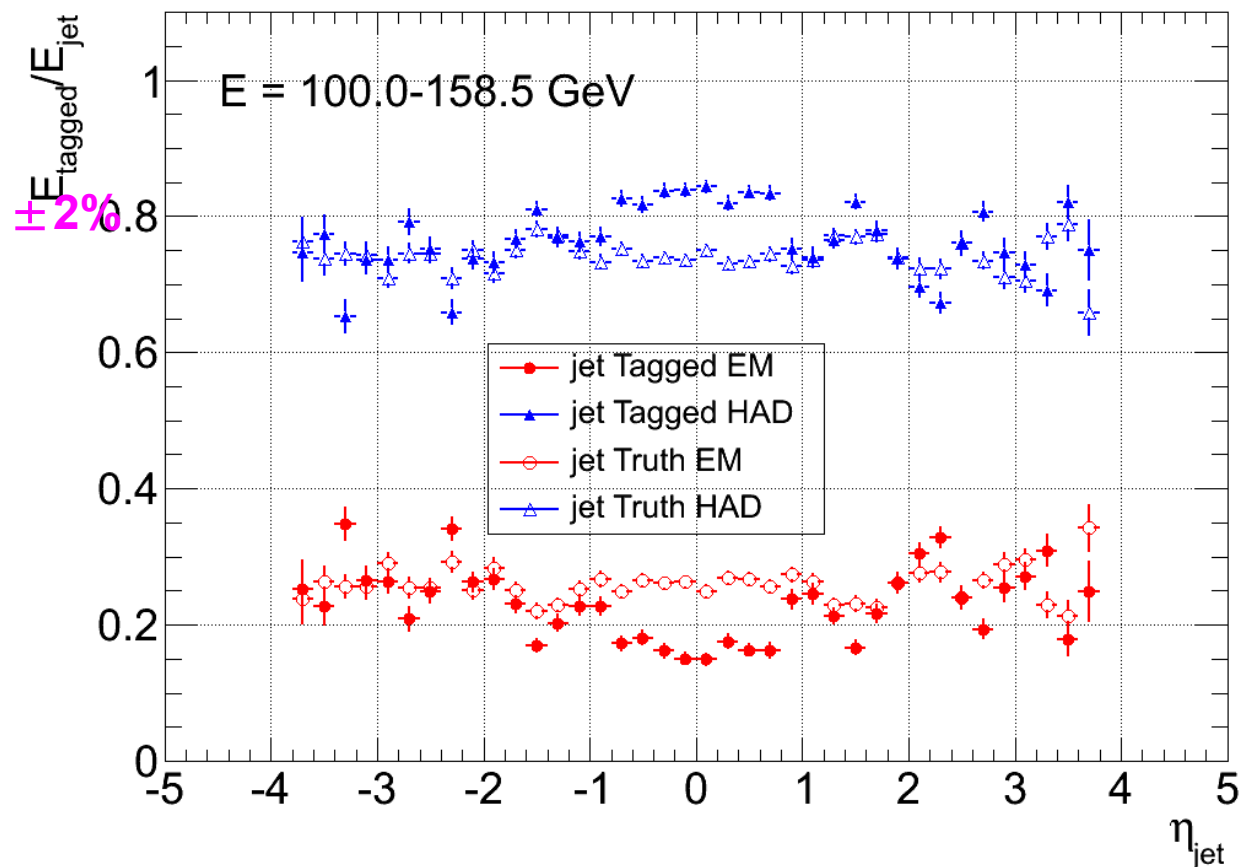


Primary particles impact on topological cluster as a function of cluster energy



# Classification performance in J4 environment (simulation with ParticleID)

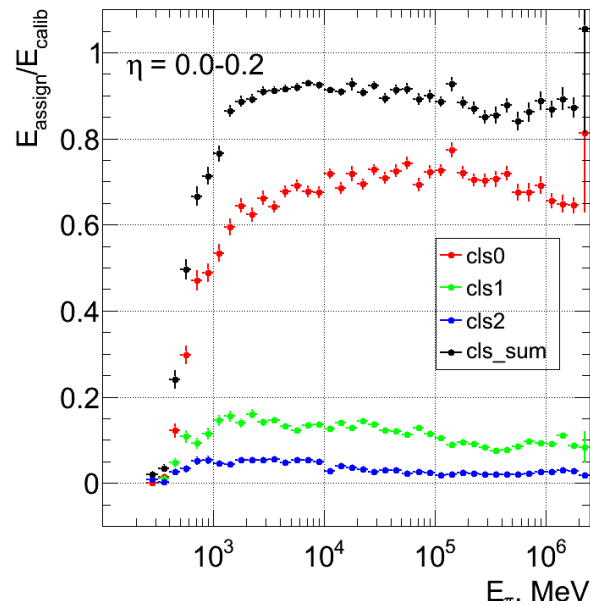
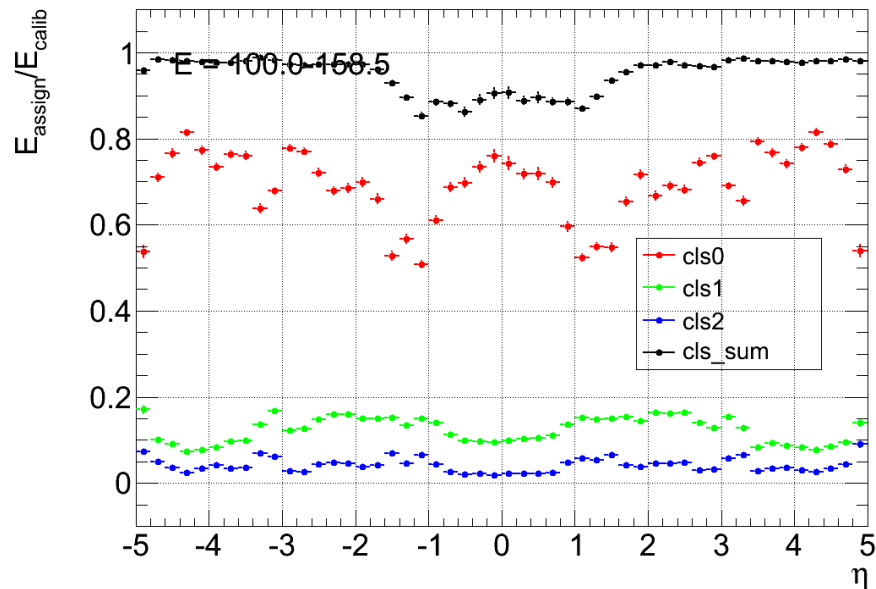
- Kt4LCTopoJet energy fraction classified as EM (●), classified as HAD (▲); Truth EM jet energy fraction (○), Truth HAD jet energy fraction (△)
- as a function of jet eta (bottom left)
- as a function of jet energy (right)



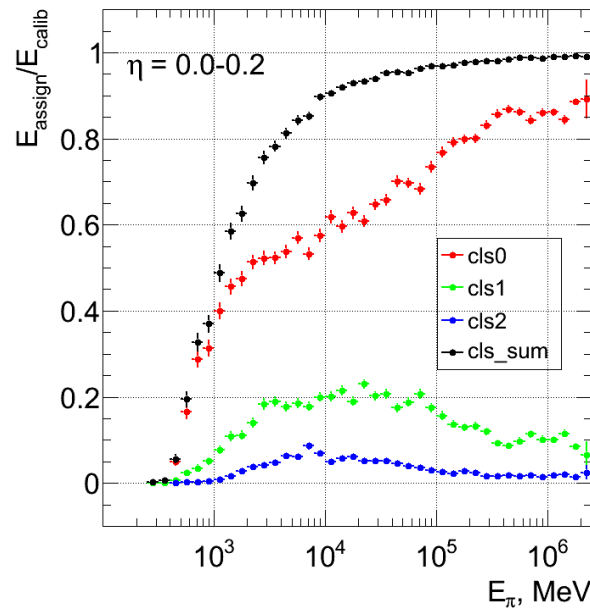
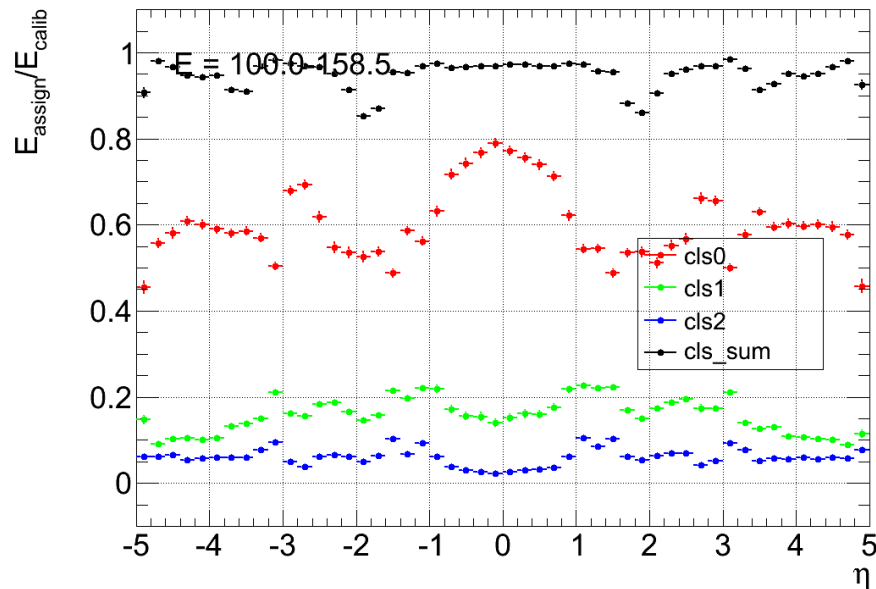
## Backup slides:

- Level of OOC and DM energy assigned to clusters in single pion events
- Comparison of linearity in 15.2.0 and 15.3.0
- Linearity for charged pions at calibration hit level

# Assigned OOC/DM energies for single pions

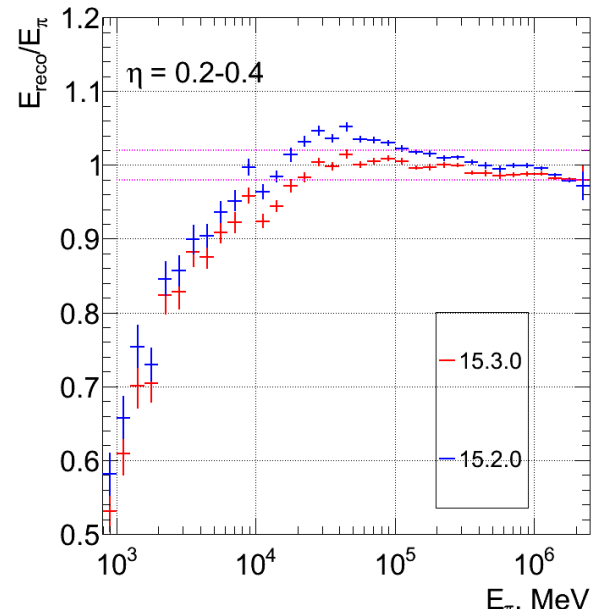
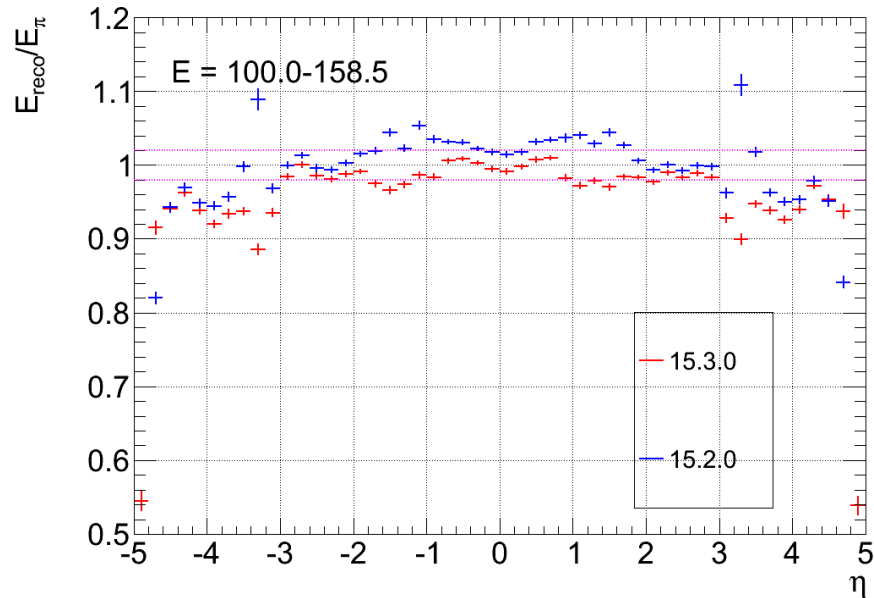


Ratio of out-of-cluster (OOC) energy assigned to clusters to the total OOC energy as a function of pion  $\eta$  (left) and energy (right).

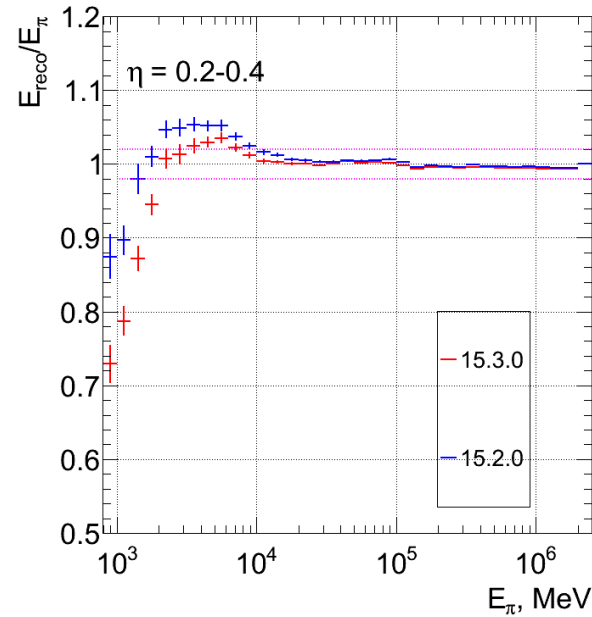
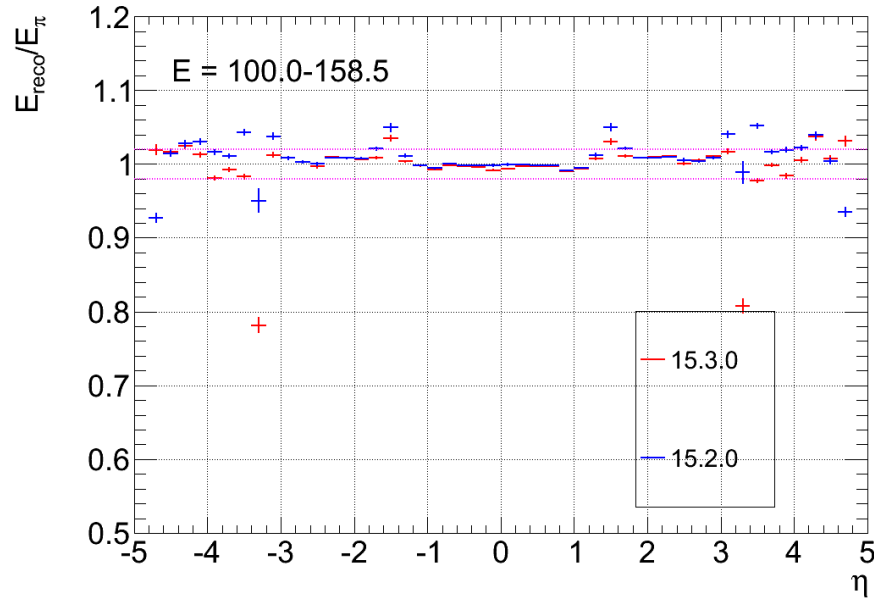


Ratio of dead material (DM) energy assigned to clusters to the total DM energy as a function of pion  $\eta$  (left) and energy (right).

# Linearity: 15.3.0 .vs. 15.2.0



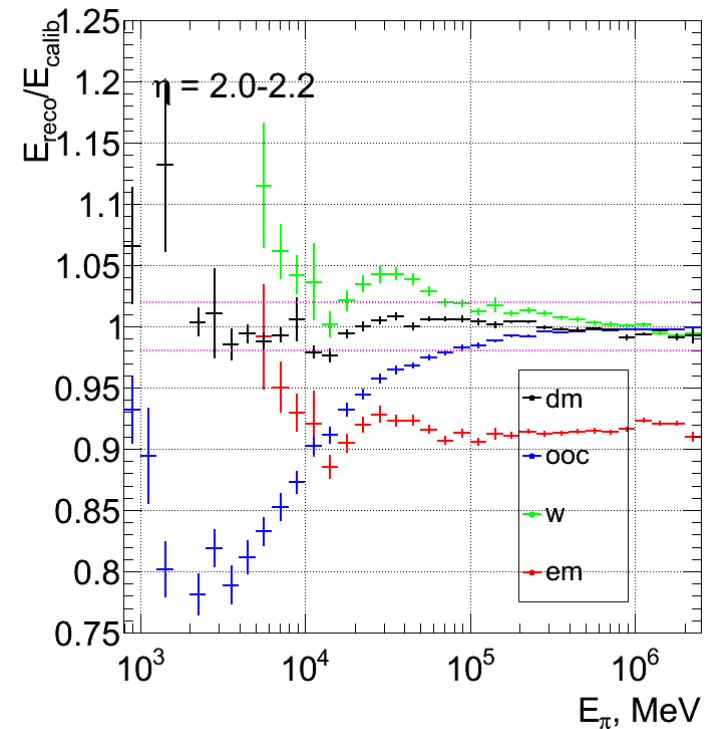
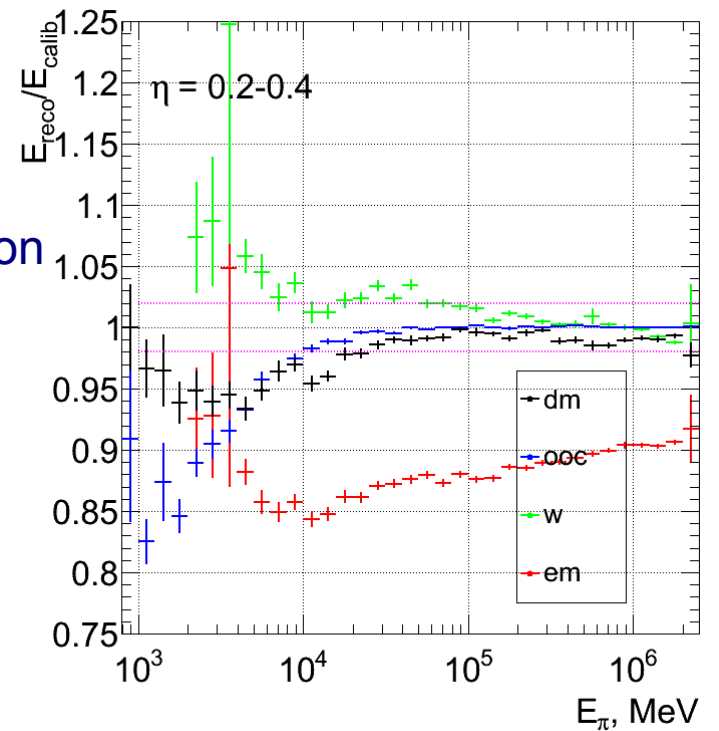
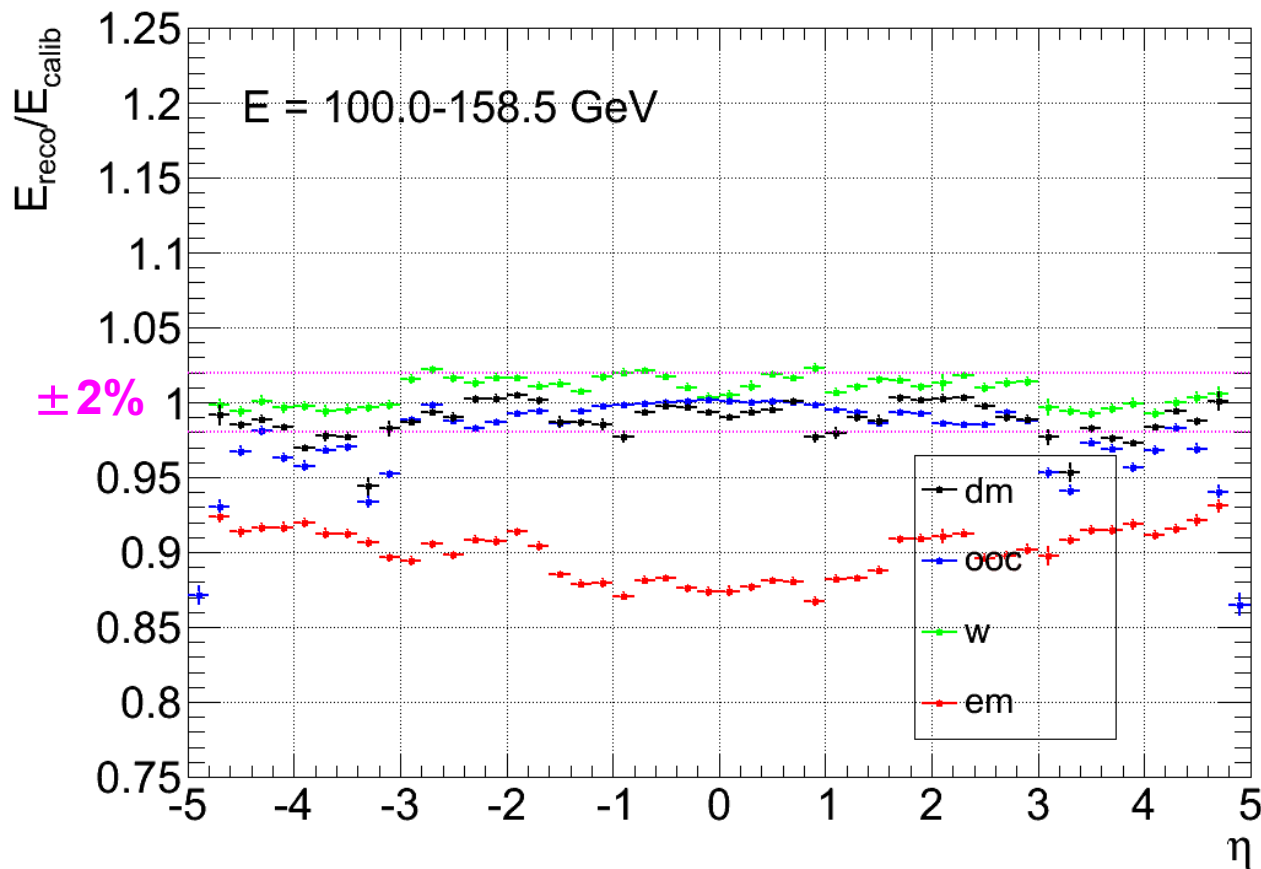
Reconstructed energy after local hadron calibration (last step) for charged (top) and neutral (bottom) single pions in releases 15.3.0 and 15.2.0



# Linearity for charged pions (15.3.0)

## calibration hit level

- Reconstructed pion energy after each step of local hadron calibration normalized to the calibration hit energy
- as a function of pion eta (bottom left)
- as a function of pion energy (right)
- “ideal previous step”



# Linearity for neutral pions (15.3.0)

## calibration hit level

- Reconstructed pion energy after each step of local hadron calibration normalized to the calibration hit energy
  - as a function of pion eta (bottom left)
  - as a function of pion energy (right)
  - “ideal previous step”

