Progress with the Preshower in Particle Flow

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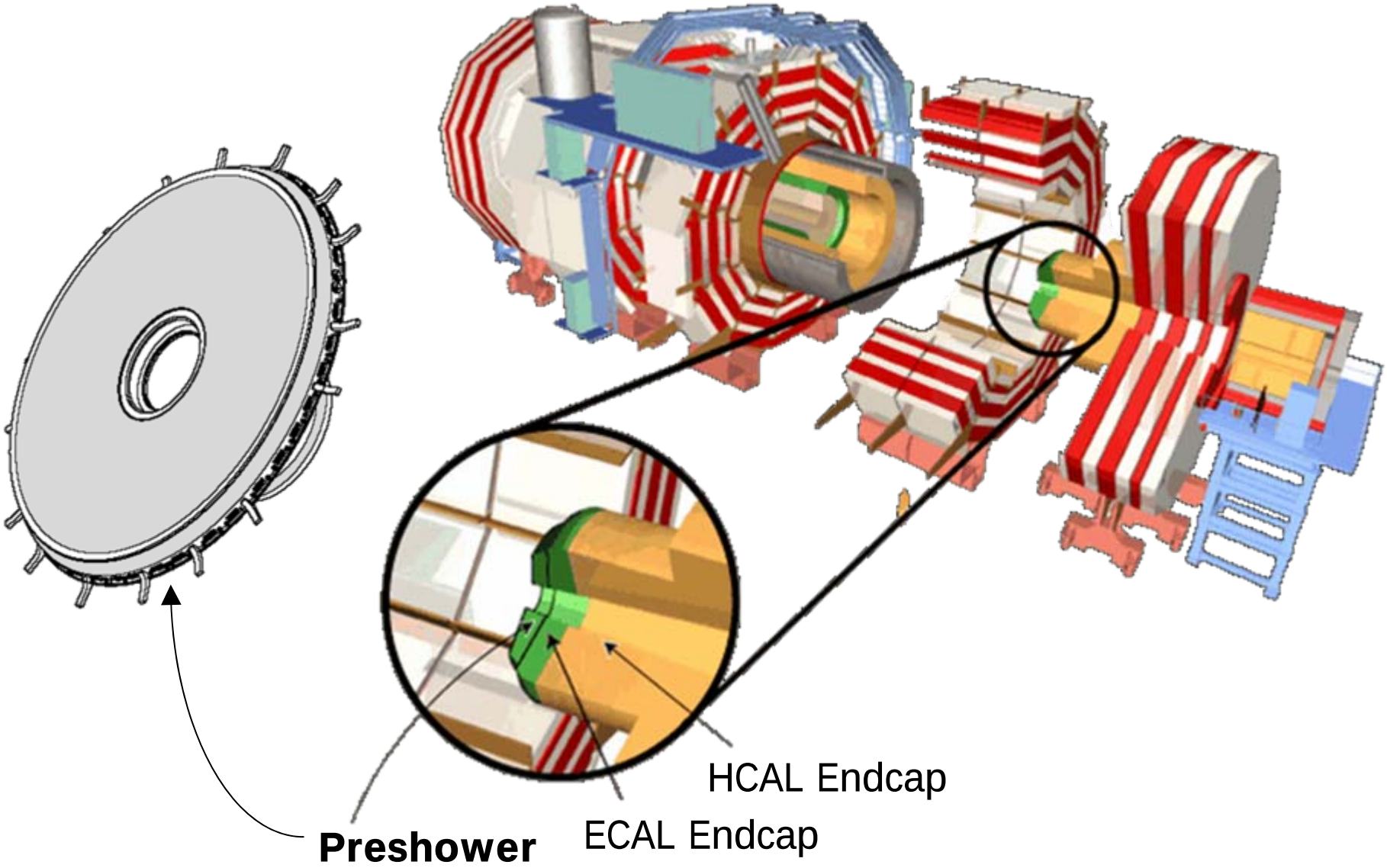
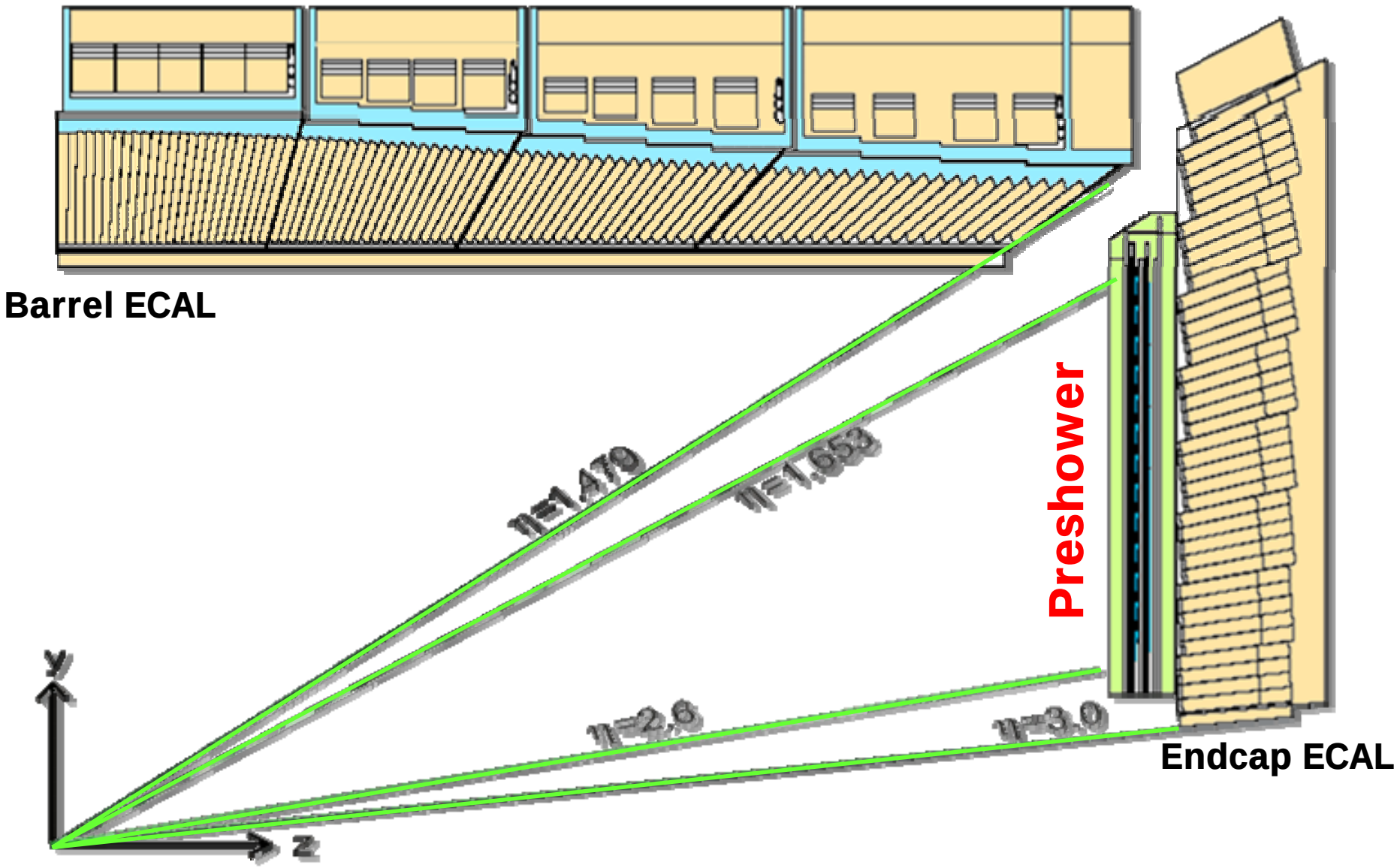
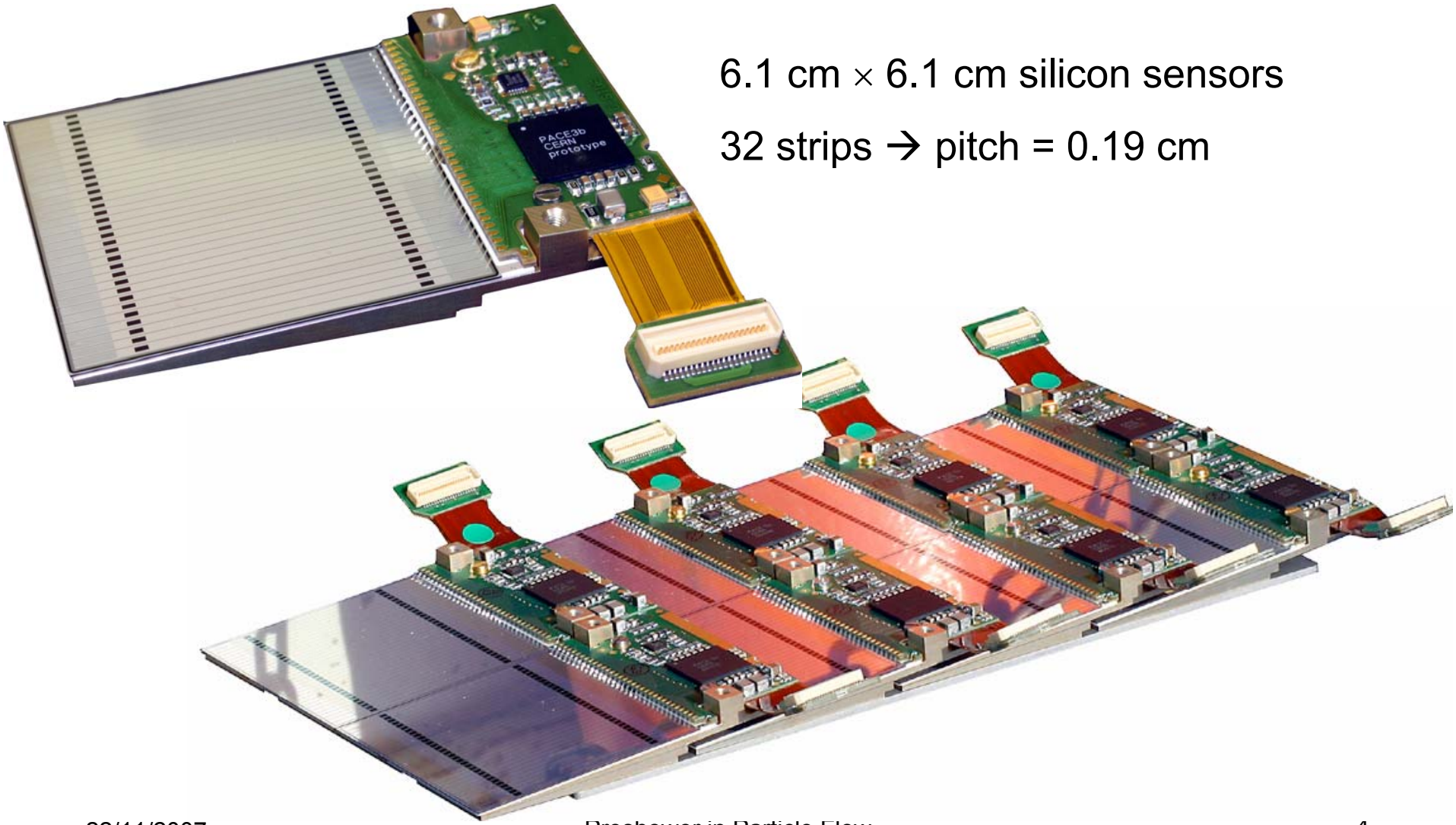
Particle Flow and Tau Id meeting, 22/11/2007


HCAL Endcap
ECAL Endcap
Preshower


Barrel ECAL
Preshower
Endcap ECAL
η=1.479
η=1.653
η=2.6
η=3.0
y
z

Preshower μ-modules on a type-1 ladder



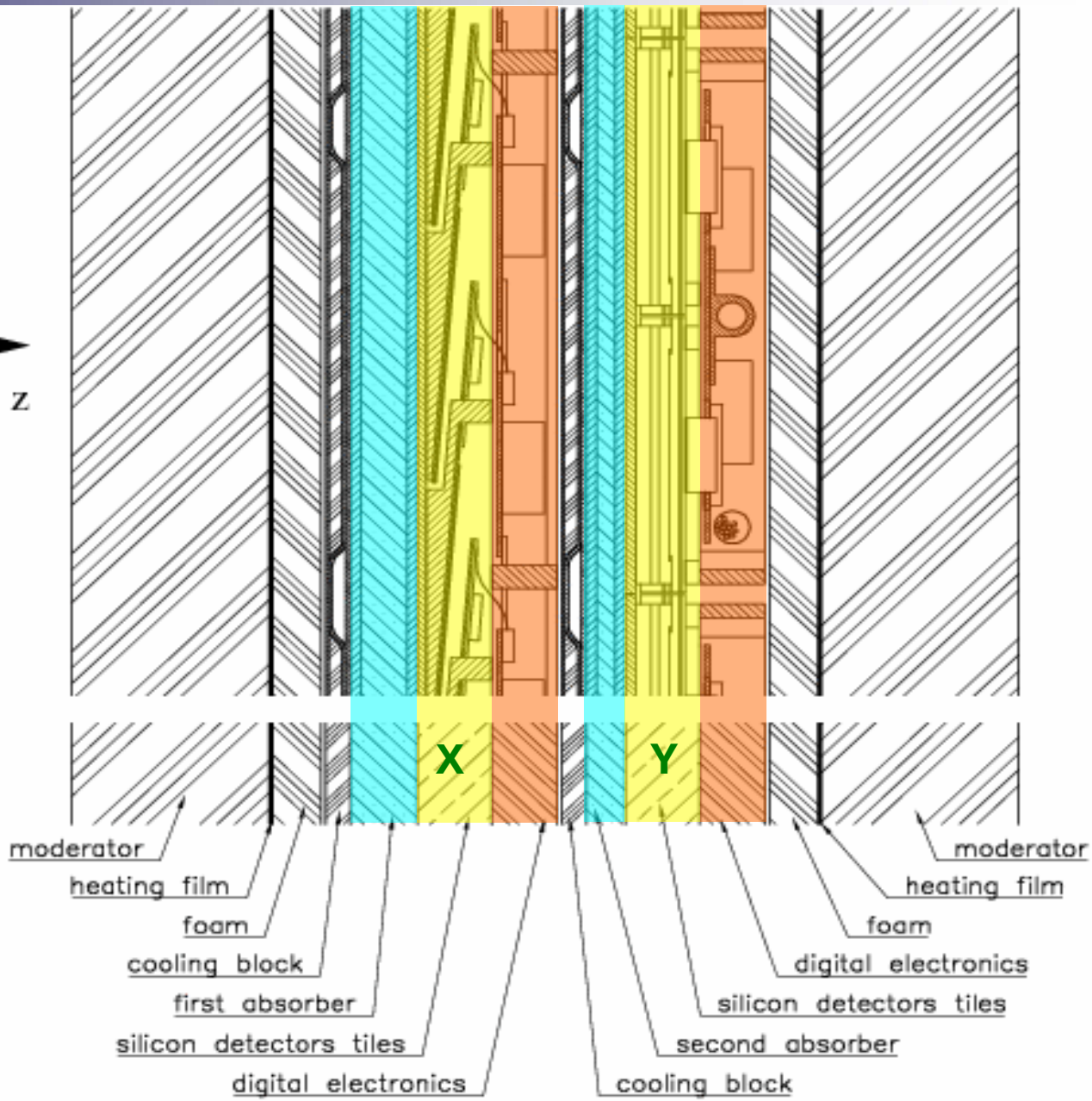
6.1 cm × 6.1 cm silicon sensors

32 strips → pitch = 0.19 cm

Preshower
side-cut

X plane (PS1)
@ z=303
vertical strips
behind $2X_0$

Y plane (PS2)
@ z=307
horizontal strips
behind $3X_0$



Preshower in Particle Flow

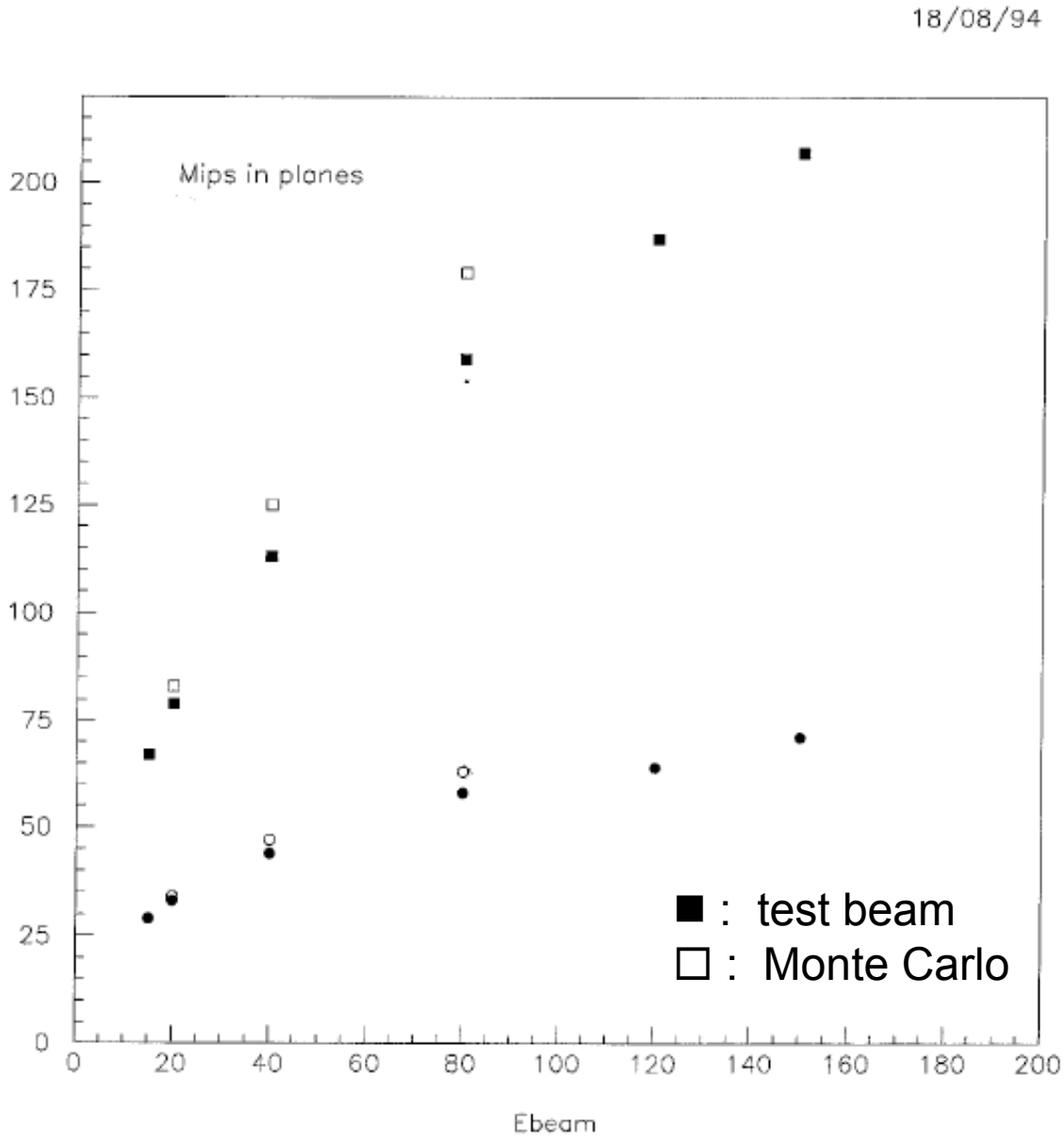
It was recently updated by Michel Della Negra

look at his talk in the PF Workshop (october 2007, Paris):

http://indico.cern.ch/getFile.py/access?contribId=9&sessionId=7&resId=0&materialId=slides&confId=19501

exercise:

- try to reproduce an old (1994…) plot of **# of MIPs** in the two preshower planes for various particle energies



software versions used

- CMSSW_1_6_7
- Particle Flow V02-06-00
  - DataFormats/ParticleFlowReco
  - DataFormats/ParticleFlowCandidate
  - RecoParticleFlow

run configurations

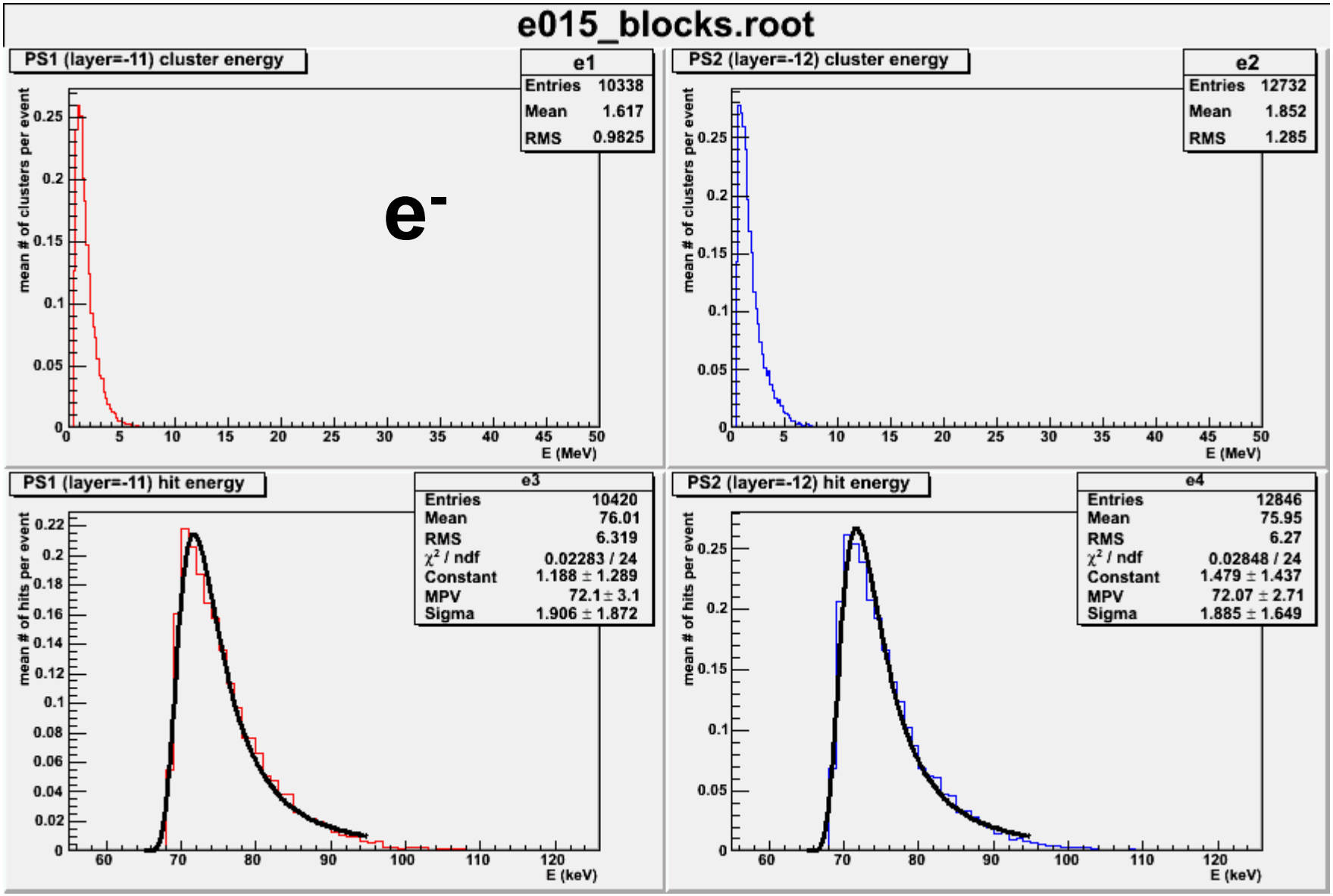
- full simulation of 5000 events per run
- $\eta \in [1.653, 2.6]$
  range covered by the Preshower
- $\varphi \in (-\pi, \pi)$
- particle types: e^-, γ, μ^-, π^-
- energies (GeV): 15, 20, 40, 80, 120, 150

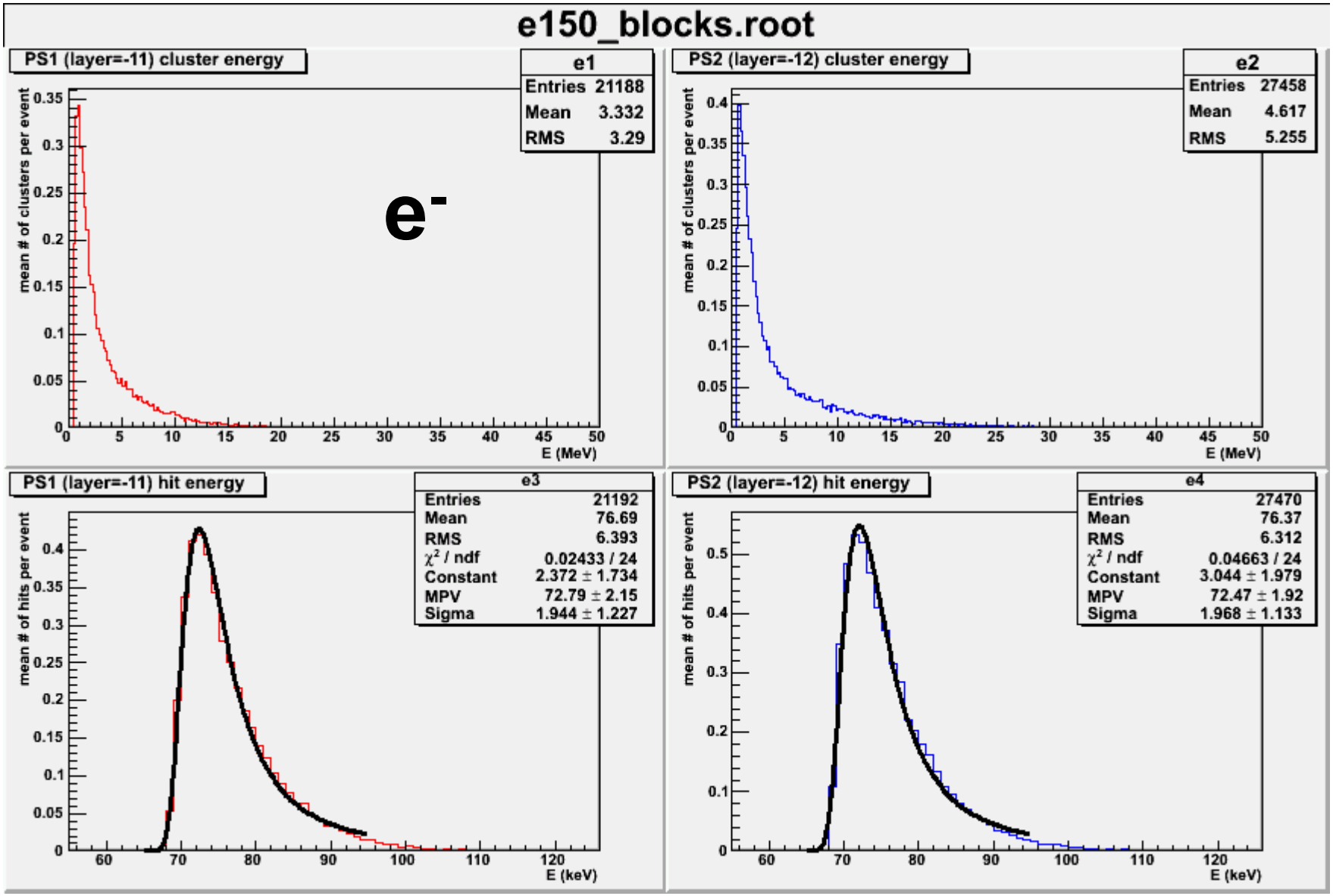
first results

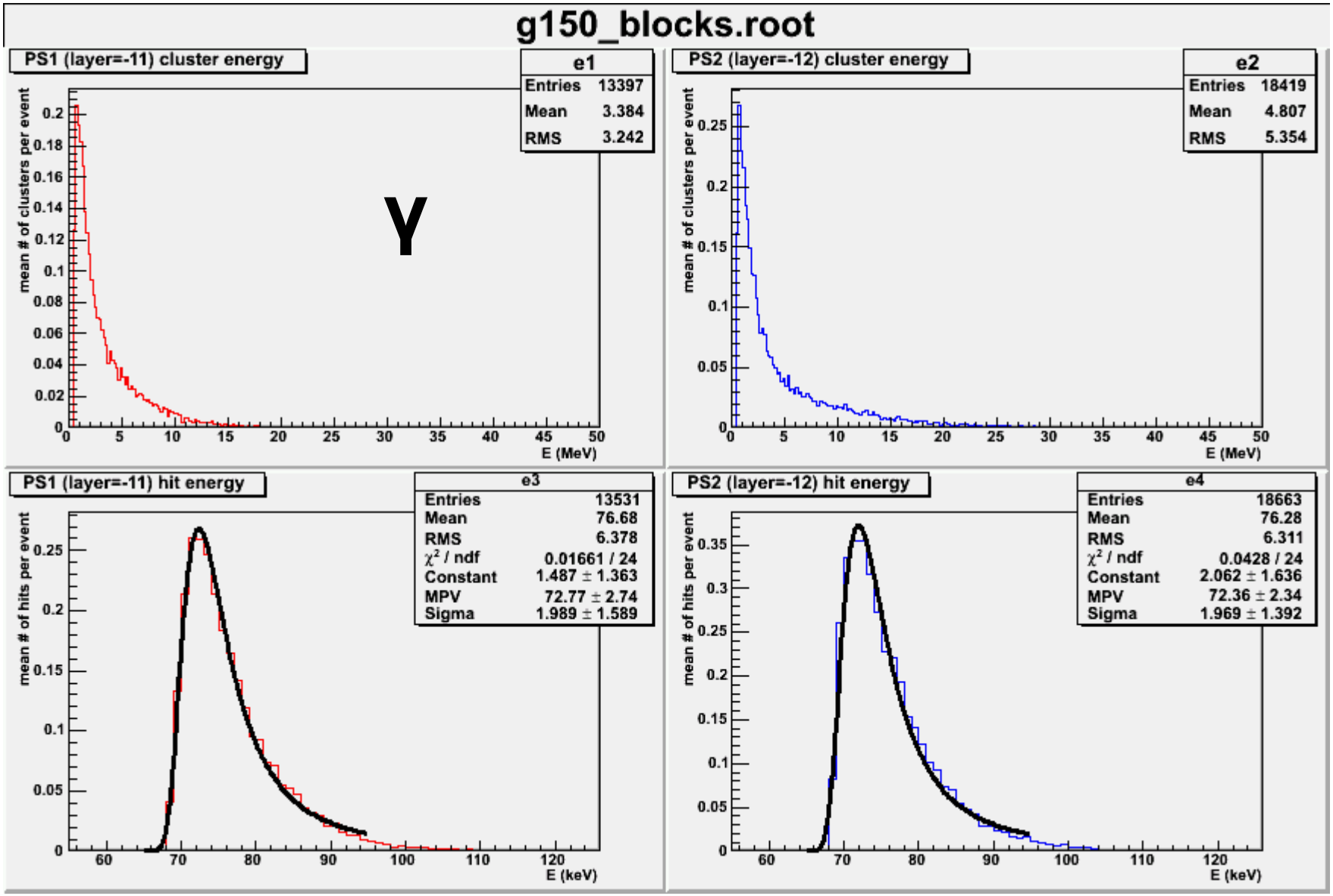
- using PFBlockProducer → blocks.root
- using PFRootEvent and a ROOT macro to access blocks.root
- looking at the branches
  recoPFClusters_particleFlowCluster_PS_Rec.obj
  and
  recoPFRecHits_particleFlowCluster_PS_BLOCK.obj

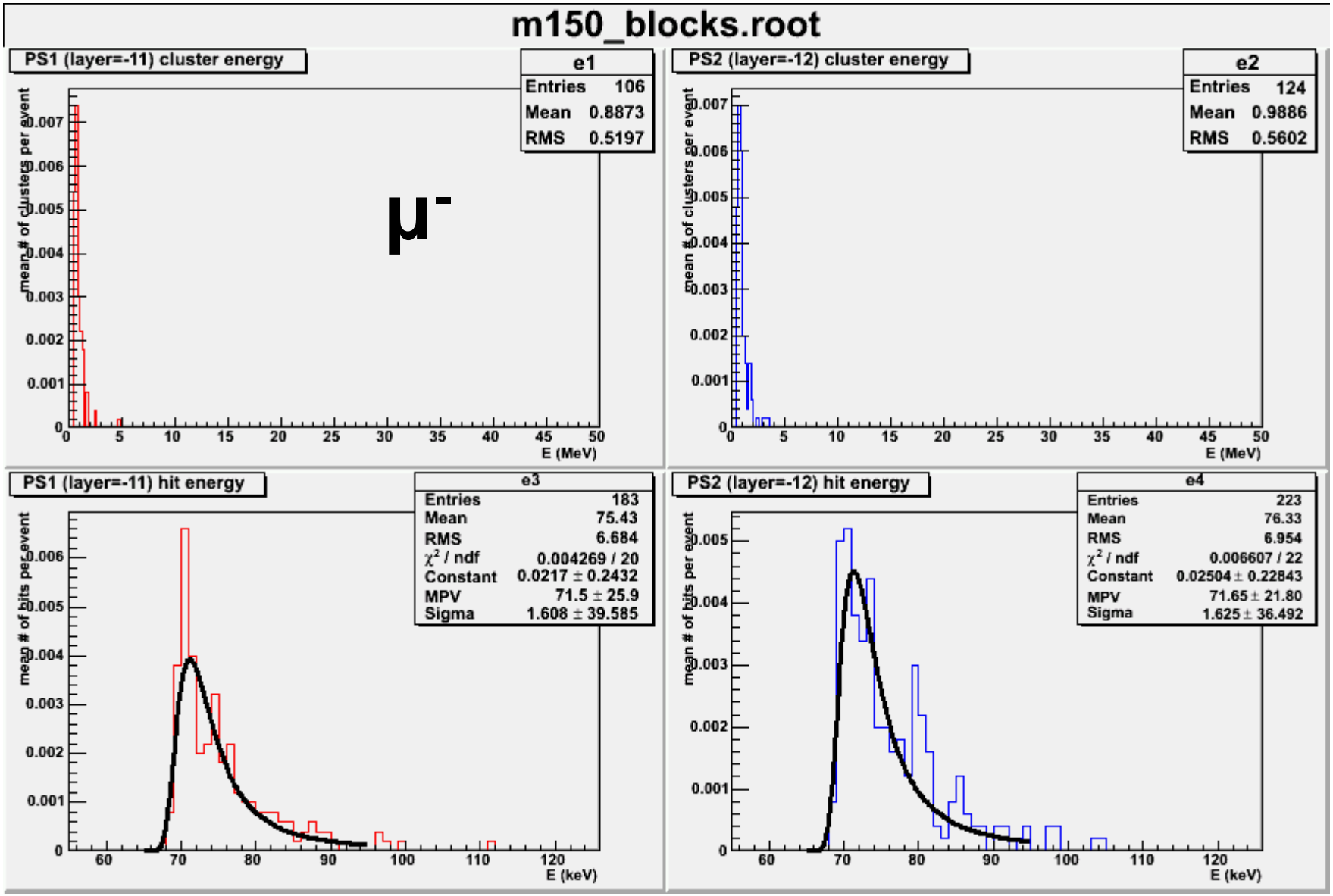
first results

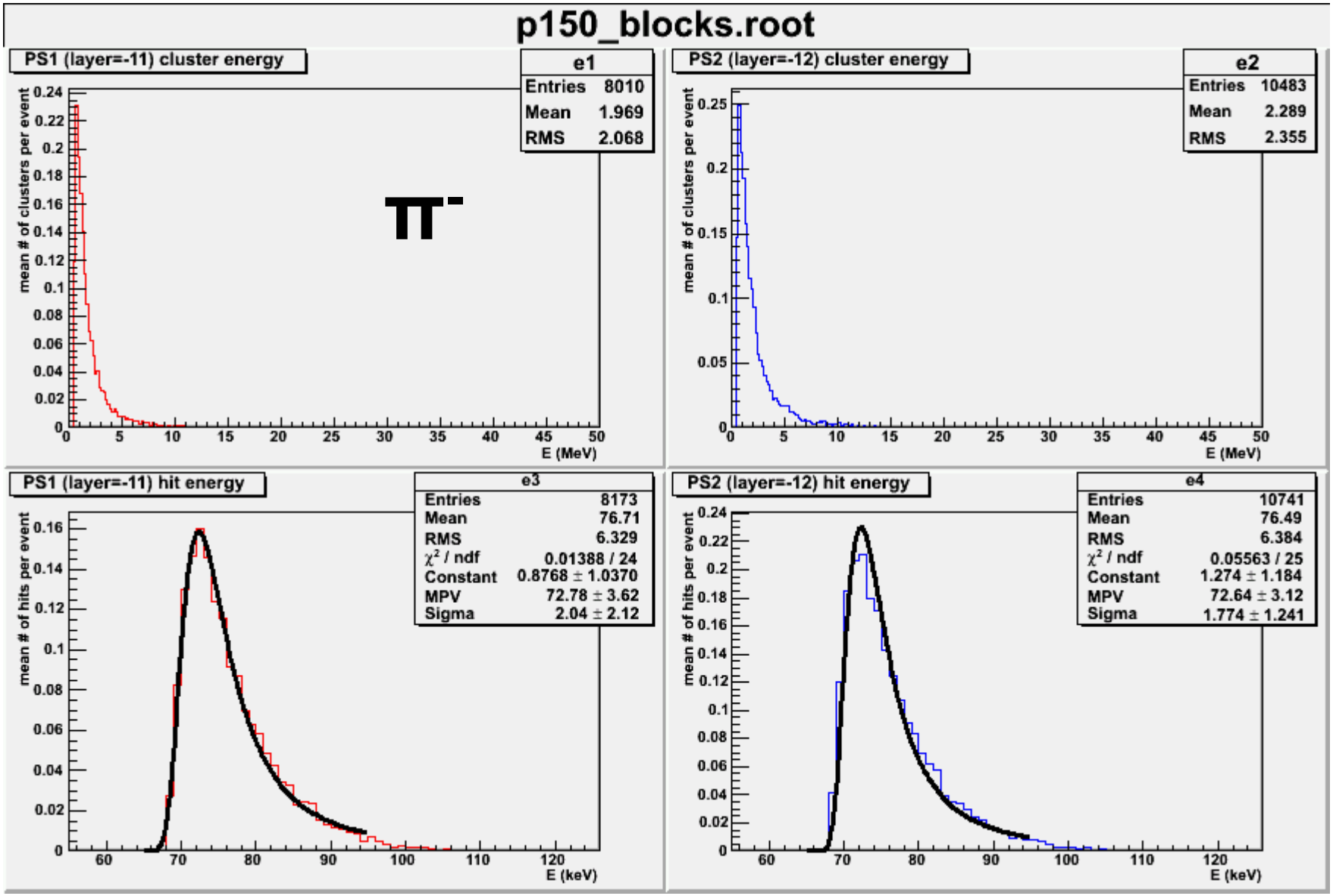
- All quantities are studied separately for PS1 (X) and PS2 (Y):
- Plots made on a per run basis
  - mean # of clusters per event vs $E_{cluster}$
  - mean # of hits per event vs E_{hit}
- Summary plots for each particle type:
  - mean # of clusters vs E
  - mean cluster E vs E
  - total cluster E vs E
  - # of MIPs vs E
- These results can be found at http://cern.ch/pyannis/pf_plots

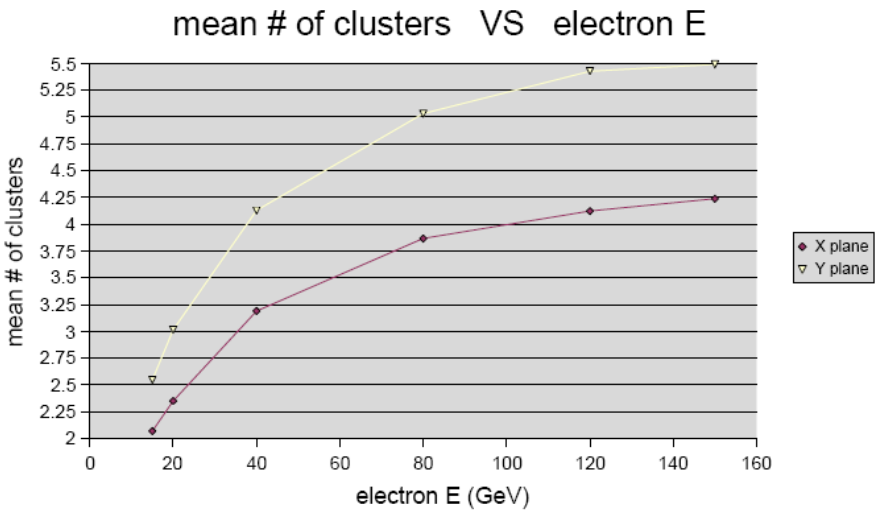

e015_blocks.root
PS1 (layer=-11) cluster energy
e1
Entries 10338
Mean 1.617
RMS 0.9825
e-
mean # of clusters per event
E (MeV)
PS2 (layer=-12) cluster energy
e2
Entries 12732
Mean 1.852
RMS 1.285
mean # of clusters per event
E (MeV)
PS1 (layer=-11) hit energy
e3
Entries 10420
Mean 76.01
RMS 6.319
χ² / ndf 0.02283 / 24
Constant 1.188 ± 1.289
MPV 72.1 ± 3.1
Sigma 1.906 ± 1.872
mean # of hits per event
E (keV)
PS2 (layer=-12) hit energy
e4
Entries 12846
Mean 75.95
RMS 6.27
χ² / ndf 0.02848 / 24
Constant 1.479 ± 1.437
MPV 72.07 ± 2.71
Sigma 1.885 ± 1.649
mean # of hits per event
E (keV)

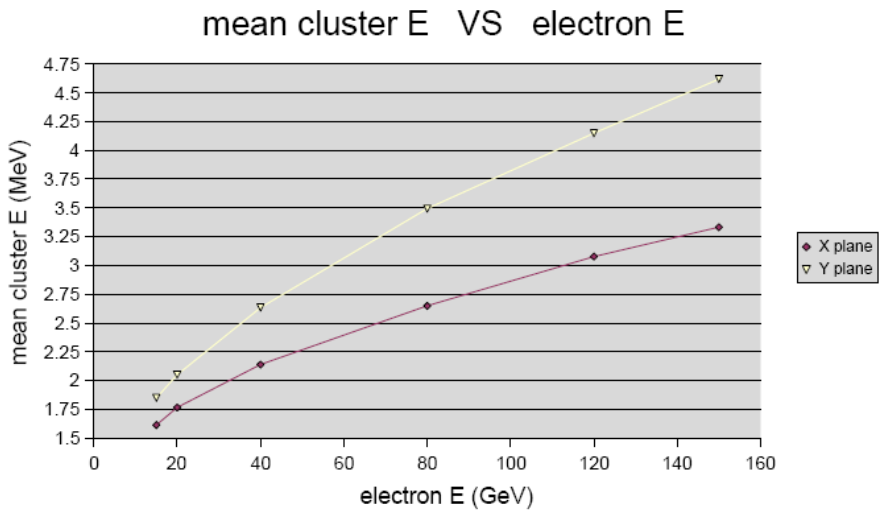

e150_blocks.root
PS1 (layer=-11) cluster energy
e1
Entries 21188
Mean 3.332
RMS 3.29
e-
mean # of clusters per event
E (MeV)
PS2 (layer=-12) cluster energy
e2
Entries 27458
Mean 4.617
RMS 5.255
mean # of clusters per event
E (MeV)
PS1 (layer=-11) hit energy
e3
Entries 21192
Mean 76.69
RMS 6.393
χ² / ndf 0.02433 / 24
Constant 2.372 ± 1.734
MPV 72.79 ± 2.15
Sigma 1.944 ± 1.227
mean # of hits per event
E (keV)
PS2 (layer=-12) hit energy
e4
Entries 27470
Mean 76.37
RMS 6.312
χ² / ndf 0.04663 / 24
Constant 3.044 ± 1.979
MPV 72.47 ± 1.92
Sigma 1.968 ± 1.133
mean # of hits per event
E (keV)

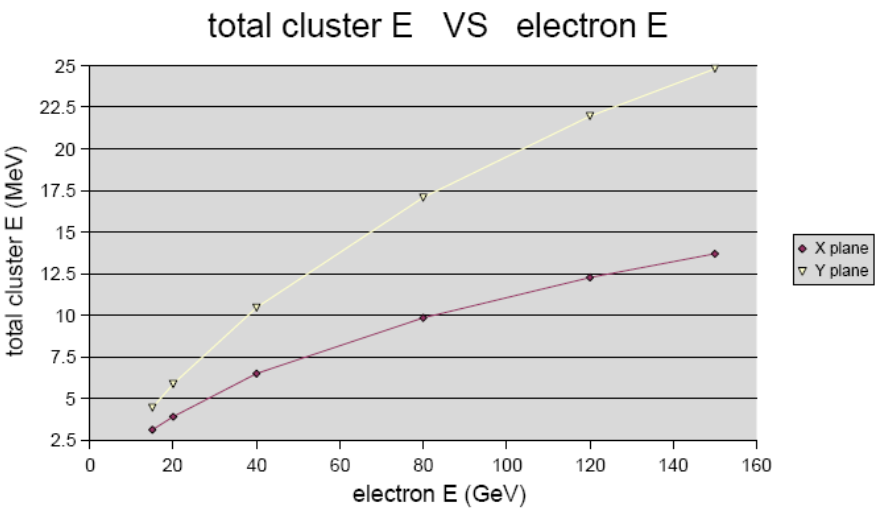

g150_blocks.root
PS1 (layer=-11) cluster energy
e1
Entries 13397
Mean 3.384
RMS 3.242
mean # of clusters per event
E (MeV)
Y
PS2 (layer=-12) cluster energy
e2
Entries 18419
Mean 4.807
RMS 5.354
mean # of clusters per event
E (MeV)
PS1 (layer=-11) hit energy
e3
Entries 13531
Mean 76.68
RMS 6.378
χ² / ndf 0.01661 / 24
Constant 1.487 ± 1.363
MPV 72.77 ± 2.74
Sigma 1.989 ± 1.589
mean # of hits per event
E (keV)
PS2 (layer=-12) hit energy
e4
Entries 18663
Mean 76.28
RMS 6.311
χ² / ndf 0.0428 / 24
Constant 2.062 ± 1.636
MPV 72.36 ± 2.34
Sigma 1.969 ± 1.392
mean # of hits per event
E (keV)

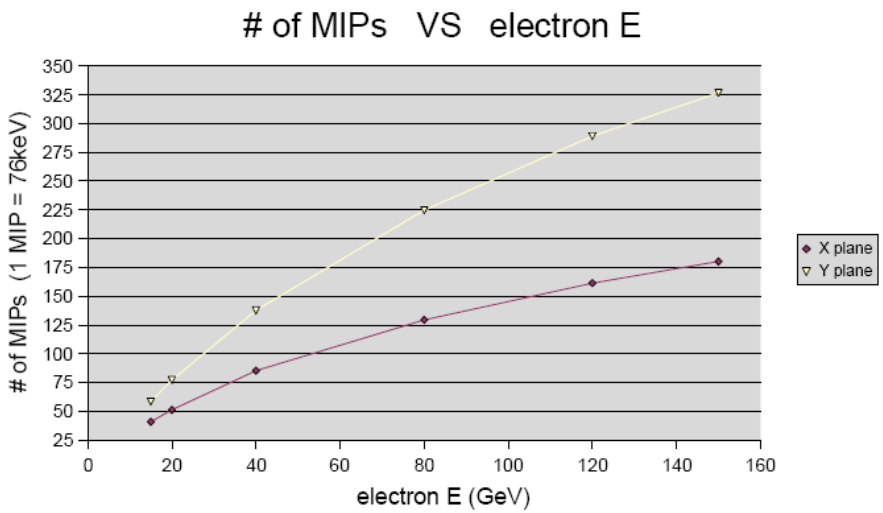

m150_blocks.root
PS1 (layer=-11) cluster energy
e1
Entries 106
Mean 0.8873
RMS 0.5197
μ-
mean # of clusters per event
E (MeV)
PS2 (layer=-12) cluster energy
e2
Entries 124
Mean 0.9886
RMS 0.5602
mean # of clusters per event
E (MeV)
PS1 (layer=-11) hit energy
e3
Entries 183
Mean 75.43
RMS 6.684
χ² / ndf 0.004269 / 20
Constant 0.0217 ± 0.2432
MPV 71.5 ± 25.9
Sigma 1.608 ± 39.585
mean # of hits per event
E (keV)
PS2 (layer=-12) hit energy
e4
Entries 223
Mean 76.33
RMS 6.954
χ² / ndf 0.006607 / 22
Constant 0.02504 ± 0.22843
MPV 71.65 ± 21.80
Sigma 1.625 ± 36.492
mean # of hits per event
E (keV)

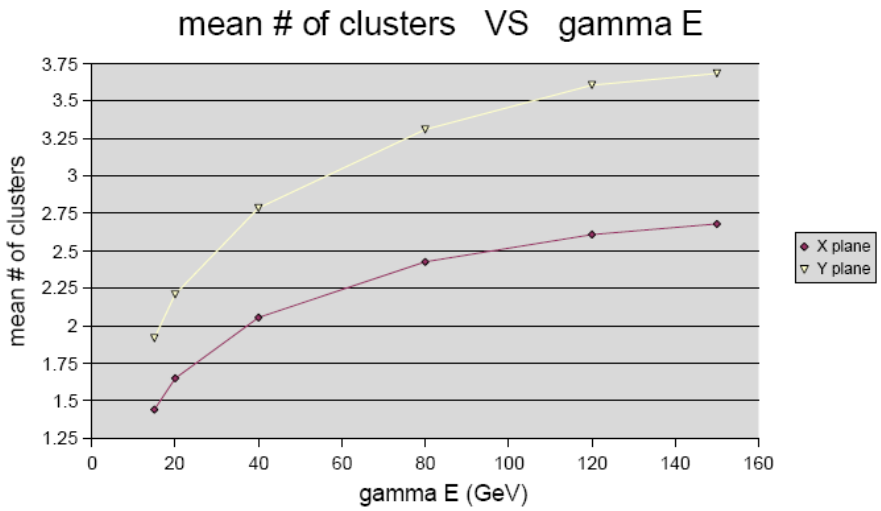

p150_blocks.root
PS1 (layer=-11) cluster energy
e1
Entries 8010
Mean 1.969
RMS 2.068
π-
mean # of clusters per event
E (MeV)
PS2 (layer=-12) cluster energy
e2
Entries 10483
Mean 2.289
RMS 2.355
mean # of clusters per event
E (MeV)
PS1 (layer=-11) hit energy
e3
Entries 8173
Mean 76.71
RMS 6.329
χ² / ndf 0.01388 / 24
Constant 0.8768 ± 1.0370
MPV 72.78 ± 3.62
Sigma 2.04 ± 2.12
mean # of hits per event
E (keV)
PS2 (layer=-12) hit energy
e4
Entries 10741
Mean 76.49
RMS 6.384
χ² / ndf 0.05563 / 25
Constant 1.274 ± 1.184
MPV 72.64 ± 3.12
Sigma 1.774 ± 1.241
mean # of hits per event
E (keV)

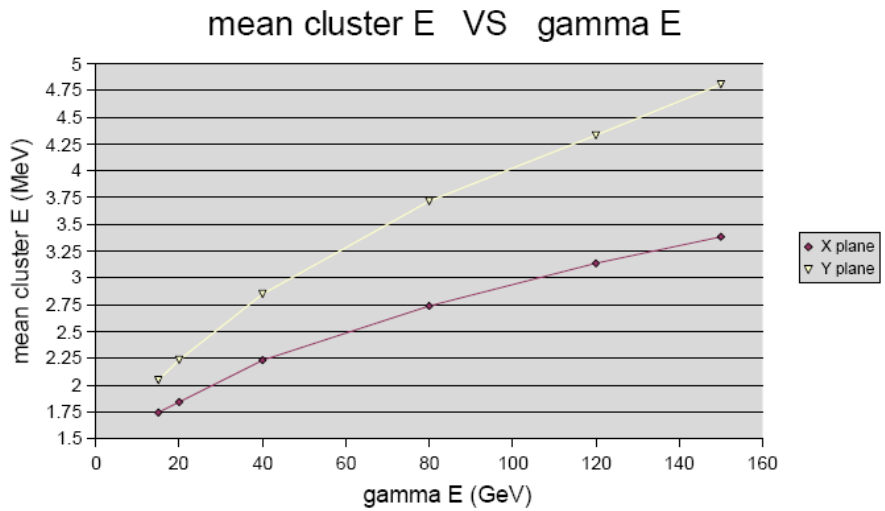

mean # of clusters VS electron E
mean # of clusters
electron E (GeV)
X plane
Y plane

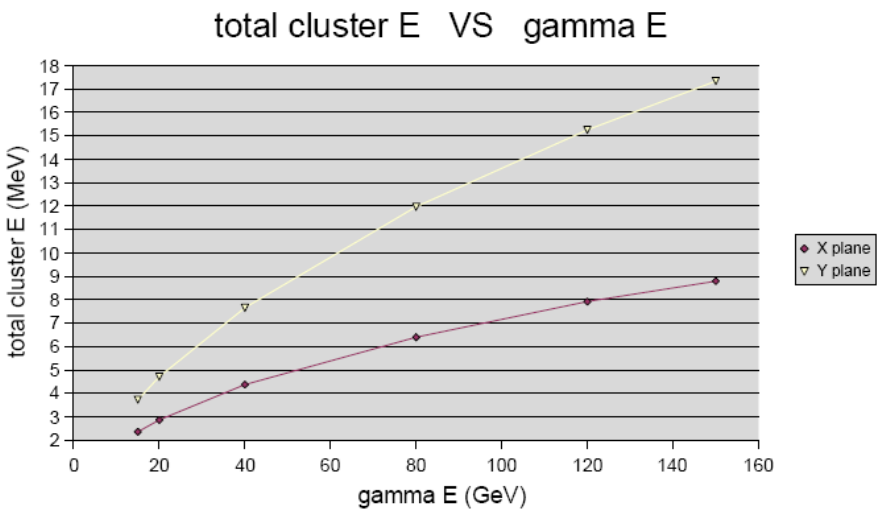

mean cluster E VS electron E
mean cluster E (MeV)
electron E (GeV)
X plane
Y plane

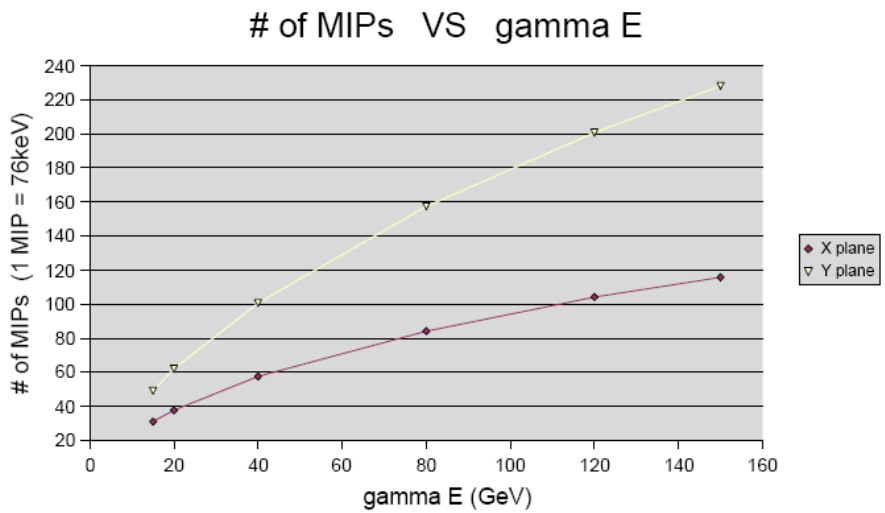

total cluster E VS electron E
total cluster E (MeV)
electron E (GeV)
X plane
Y plane

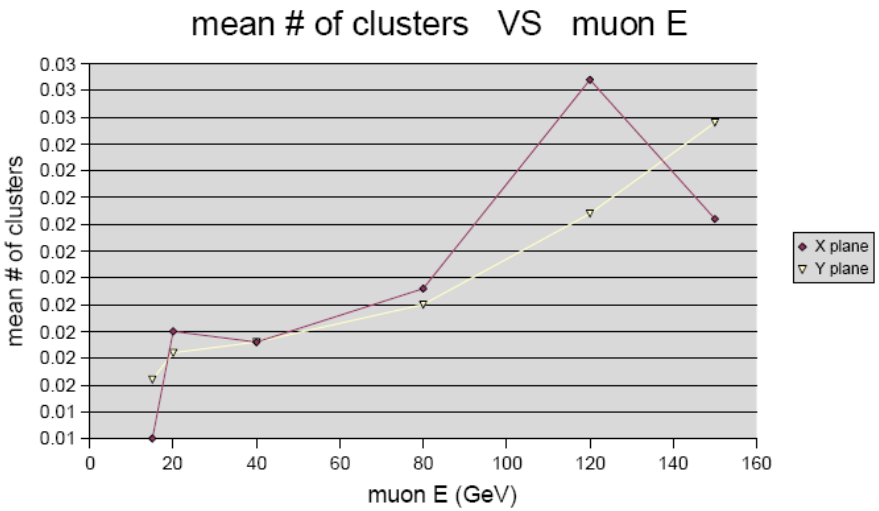

# of MIPs VS electron E
# of MIPs (1 MIP = 76keV)
electron E (GeV)
X plane
Y plane

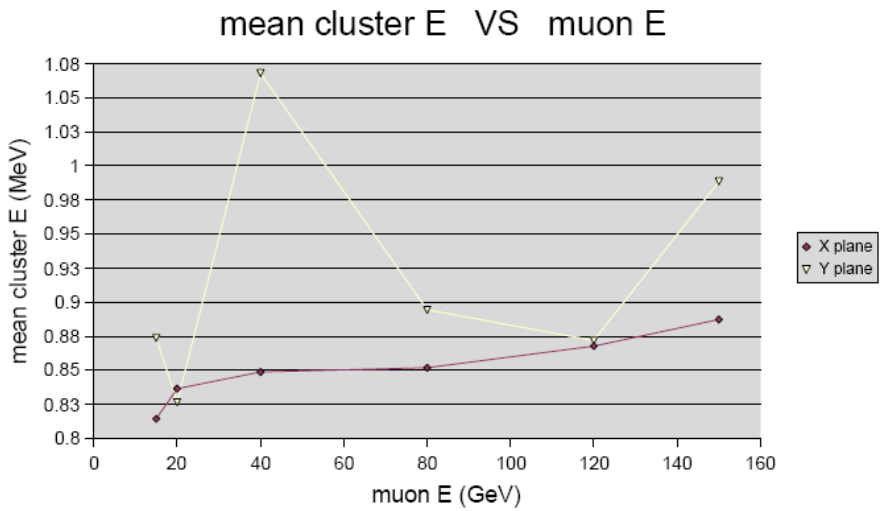

mean # of clusters VS gamma E
mean # of clusters
gamma E (GeV)
X plane
Y plane

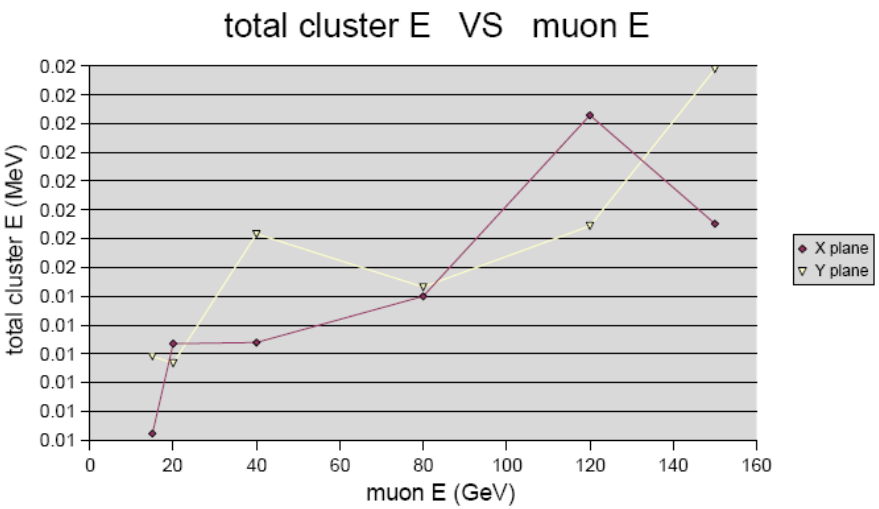

mean cluster E VS gamma E
mean cluster E (MeV)
gamma E (GeV)
X plane
Y plane

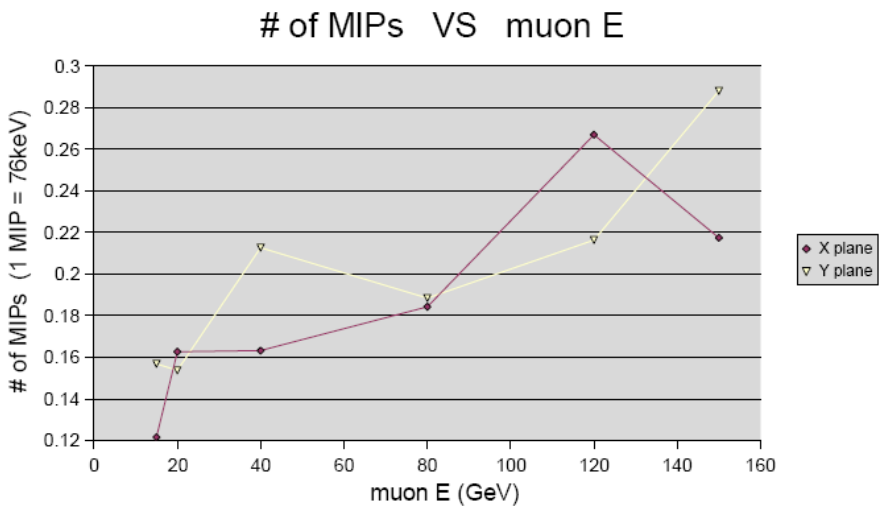

total cluster E VS gamma E
total cluster E (MeV)
gamma E (GeV)
X plane
Y plane

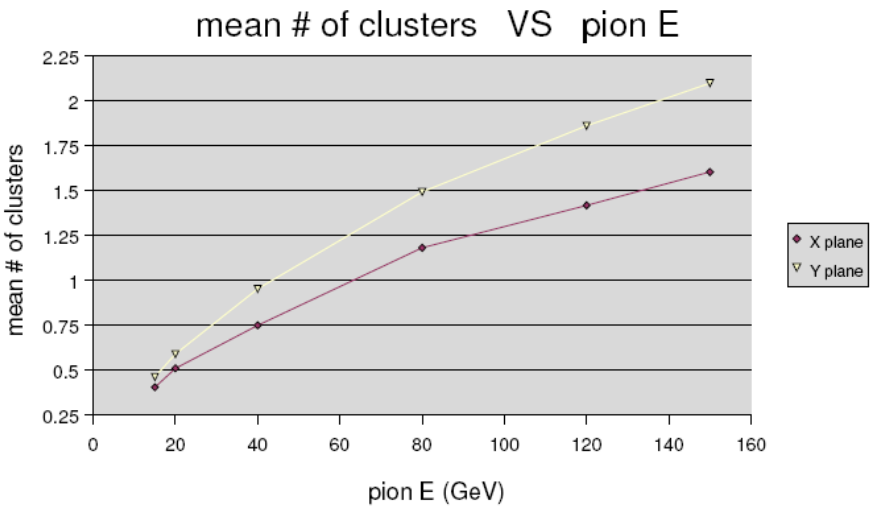

# of MIPs VS gamma E
# of MIPs (1 MIP = 76keV)
gamma E (GeV)
X plane
Y plane

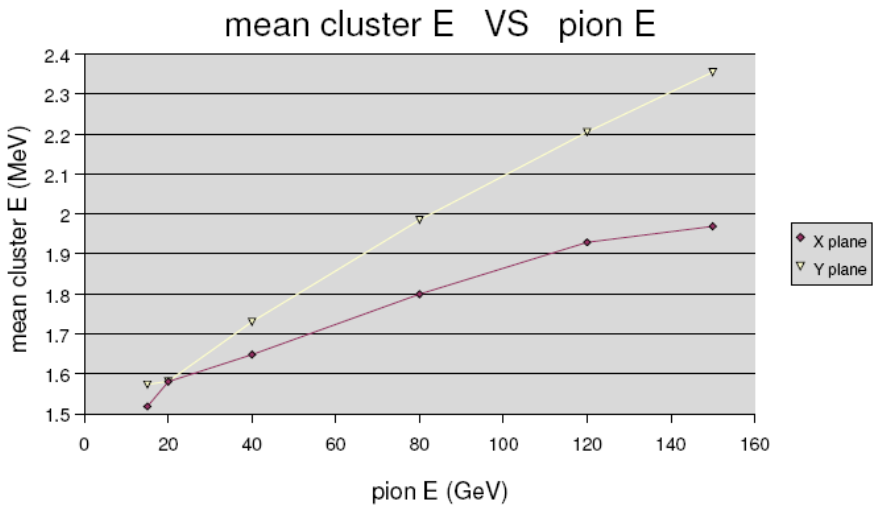

mean # of clusters VS muon E
mean # of clusters
muon E (GeV)
X plane
Y plane

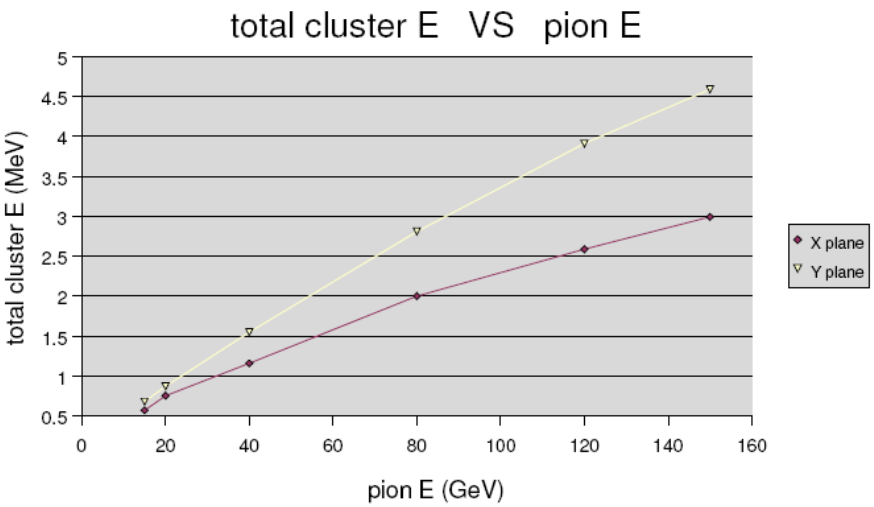

mean cluster E VS muon E
mean cluster E (MeV)
muon E (GeV)
X plane
Y plane

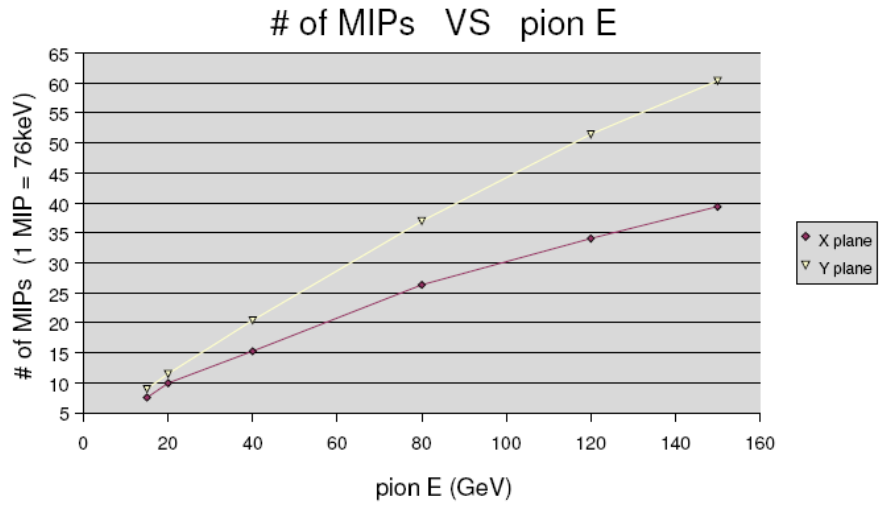

total cluster E VS muon E
total cluster E (MeV)
muon E (GeV)
X plane
Y plane


# of MIPs VS muon E
# of MIPs (1 MIP = 76keV)
muon E (GeV)
X plane
Y plane

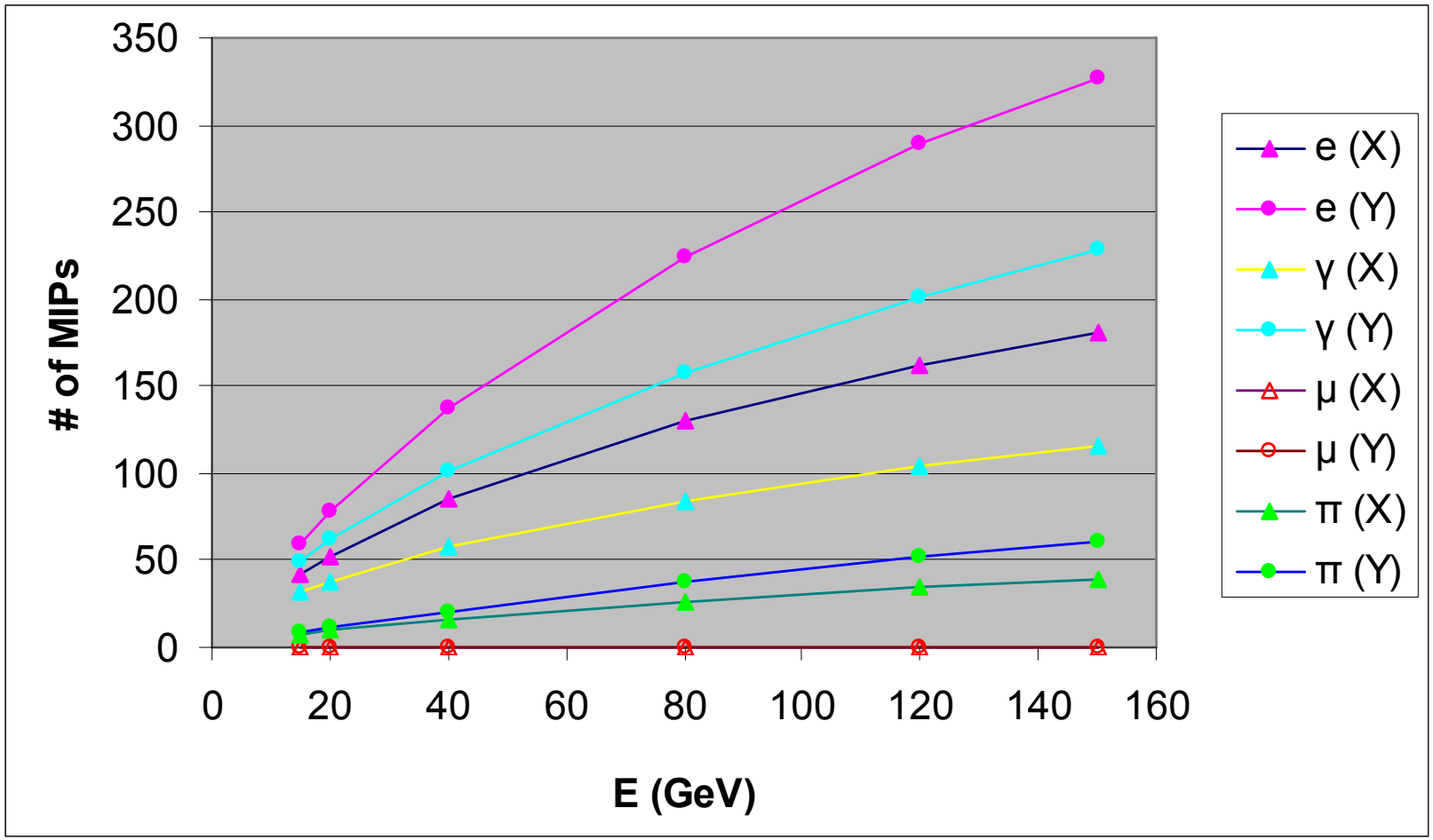

mean # of clusters VS pion E
mean # of clusters
pion E (GeV)
X plane
Y plane


mean cluster E VS pion E
mean cluster E (MeV)
pion E (GeV)
X plane
Y plane


total cluster E VS pion E
total cluster E (MeV)
pion E (GeV)
X plane
Y plane


# of MIPs VS pion E
# of MIPs (1 MIP = 76keV)
pion E (GeV)
X plane
Y plane

of MIPs vs E


350
300
250
200
150
100
50
0
# of MIPs
0
20
40
60
80
100
120
140
160
E (GeV)
e (X)
e (Y)
γ (X)
γ (Y)
μ (X)
μ (Y)
π (X)
π (Y)

conclusions

- the first results from this exercise are satisfactory
  - CMSSW and PF software installation
  - running the full software chain
  - reasonable results in plots, for instance
    - hit energy deposition spectra peak at 76keV and follow the Landau distribution
    - # of MIPs for gammas are as expected compared to electrons
- More things to do…
  - study various distributions such as multiplicities
  - check the clustering looking at the event display
  - include in PFAlgo the energy of the Preshower
  - test with the Fast Simulation too
  - compare with H2 test beam data (when they become available…)