Transverse Shower via Clustering of the TB 2016 data

TAU group meeting

23/08/17

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Updates

physics run:

electron run R741 @ 5 GeV w/ charge Divider

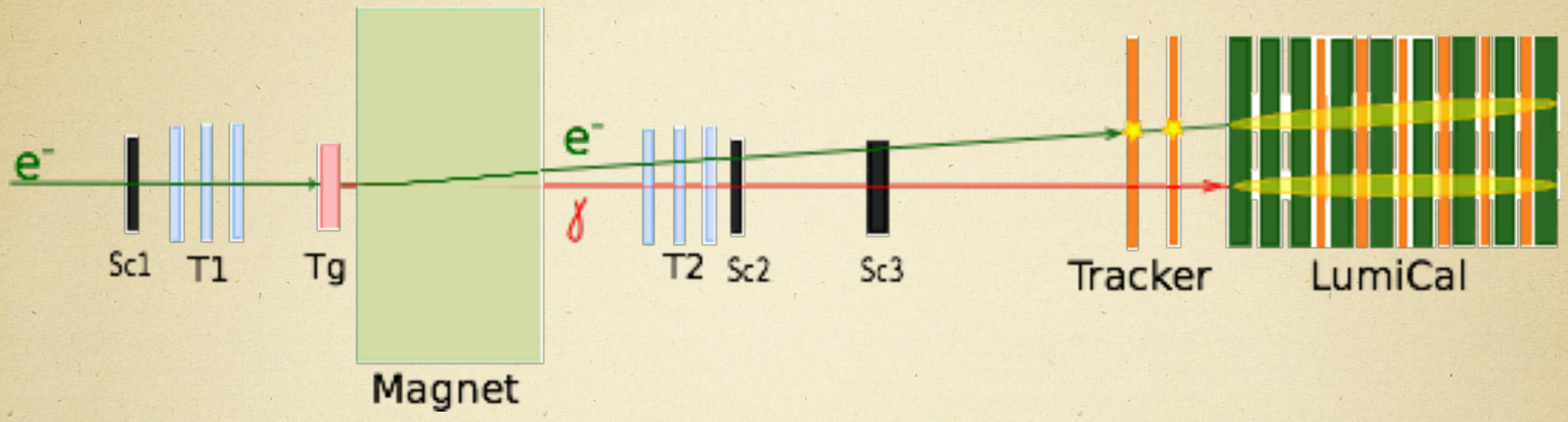
electron run R638 @ 5 GeV w/o charge Divider

Clustering algorithm used:

Linking neighboring pads

- **NEW corrected APV Maps: some channels were switched -> Now the distribution look more smoother**
- **Re-trained Neural Network to distinguish between noise and signal: discovered patterns of noise were introduced to trainings**
- **Non-linear calibration: varying the position of threshold**
- **Varying the shooting area of pad**

Experiment layout

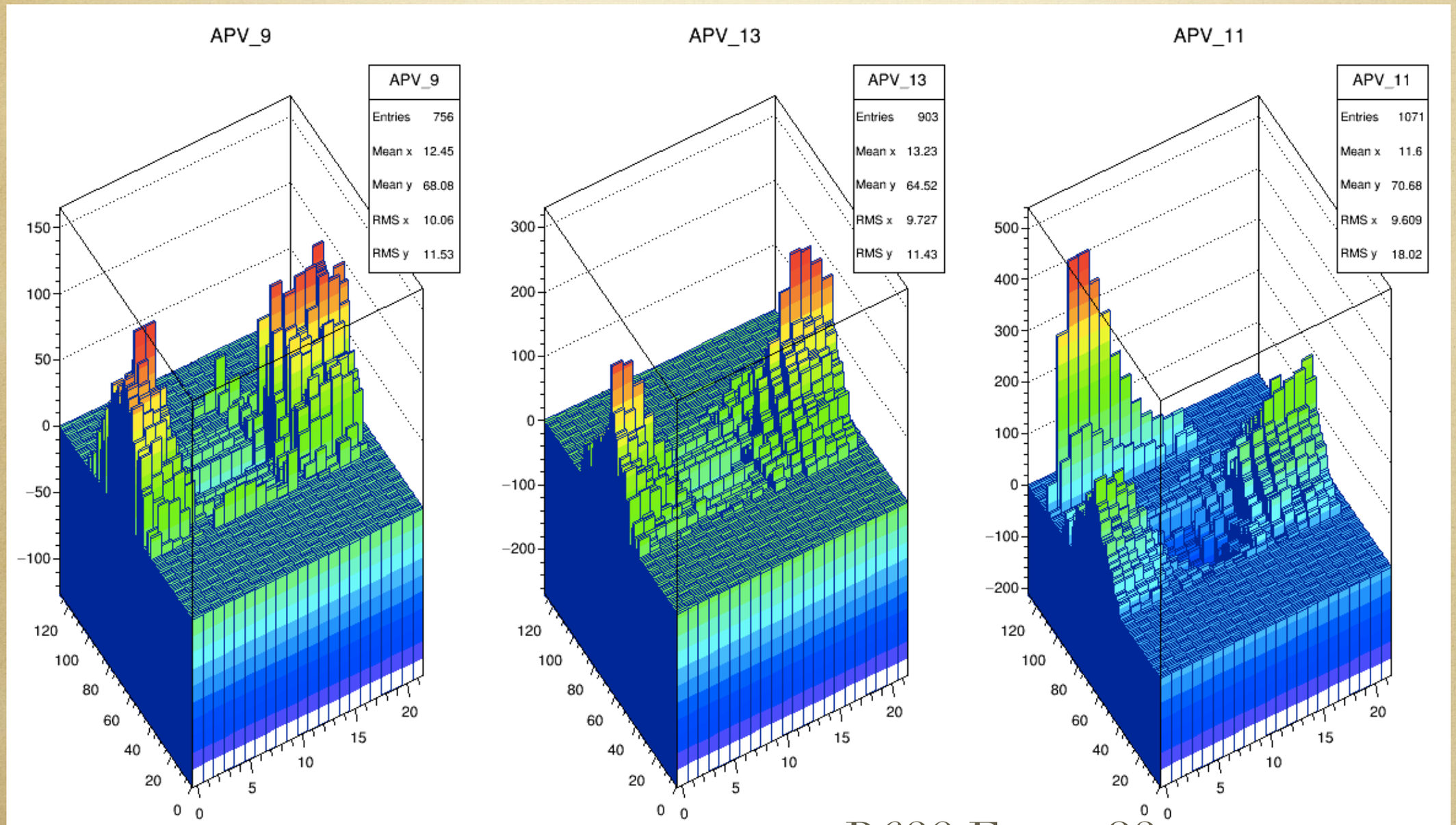


Performed:

- electron beam with 5 GeV, no target, no magnetic field
- with or w/o charge divider

Re-training NN

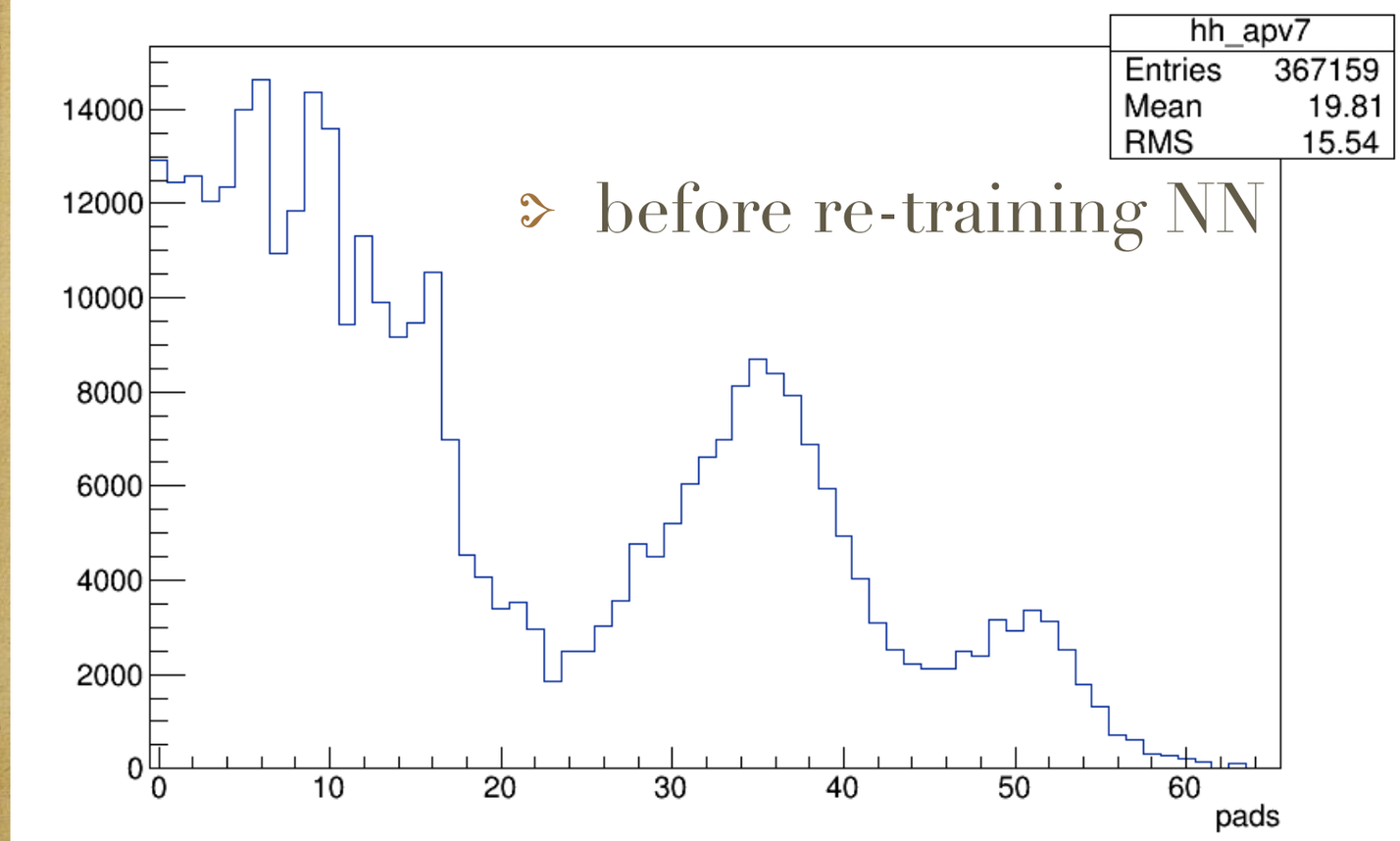
- Some obvious patterns of noise were treated by NN as signal



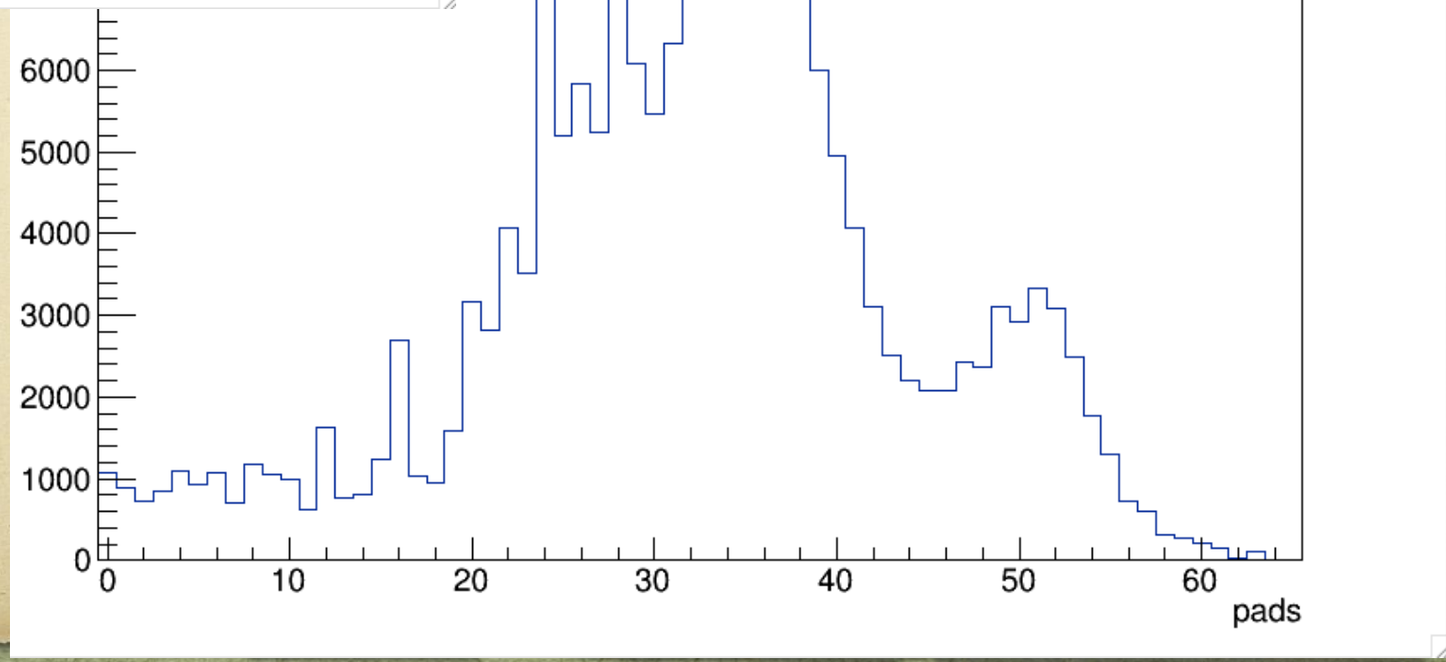
- R638 Event 23

run R638 @ 5 GeV w/o charge Divider, APV 7

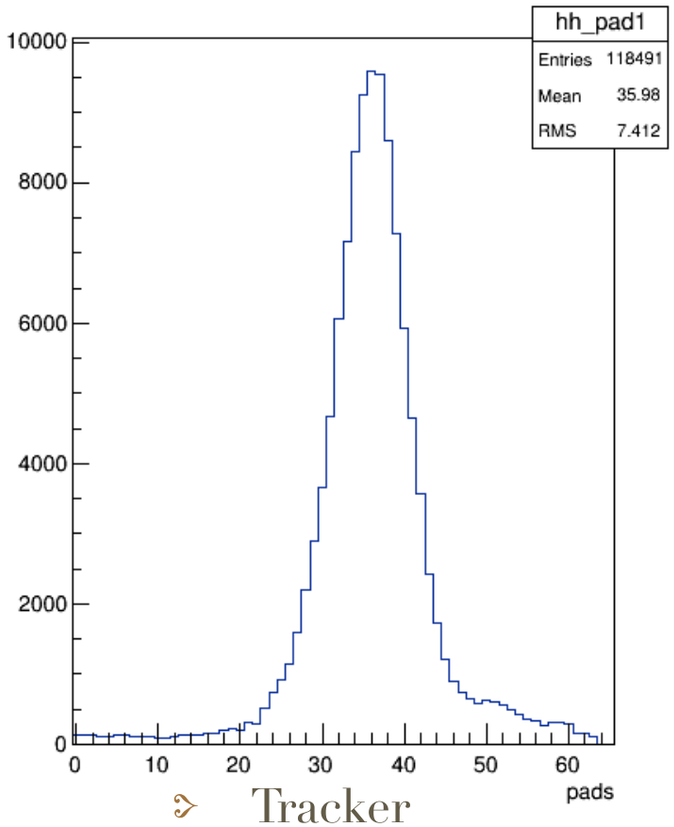
- before re-training NN



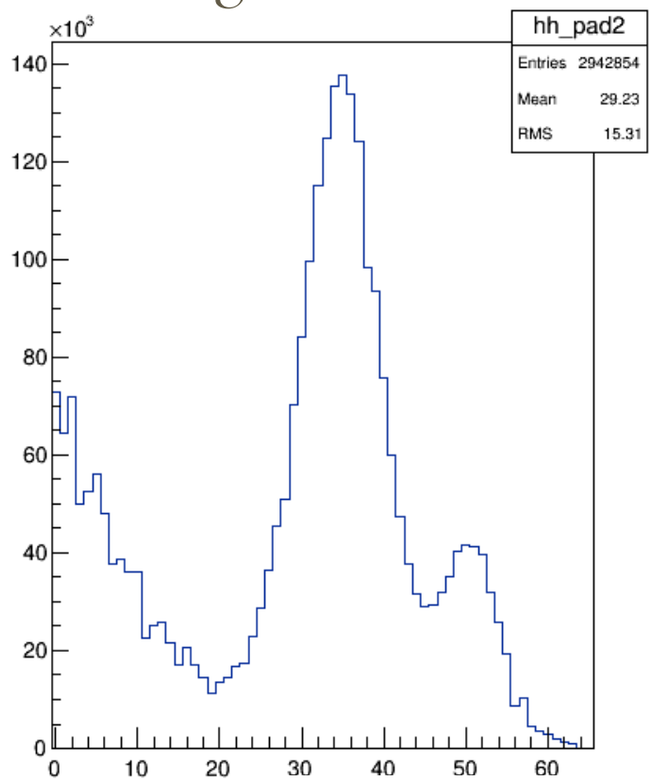
- after re-training NN



before re-training NN



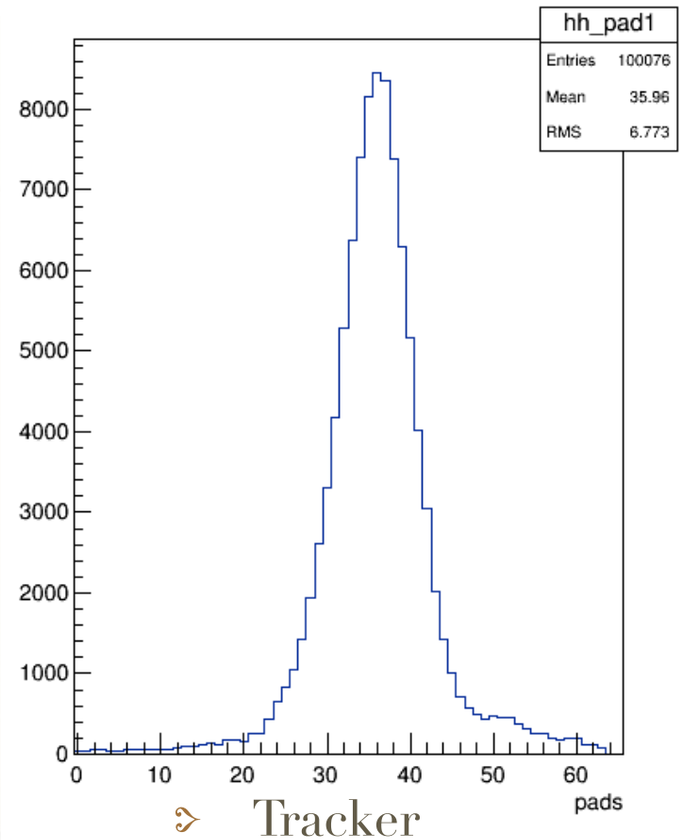
Tracker



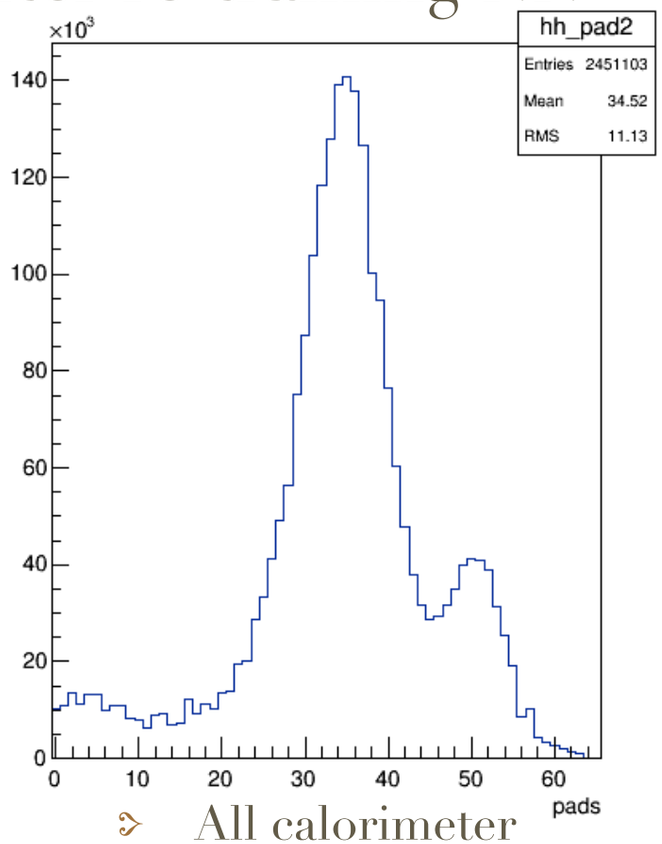
All calorimeter

run R638 @ 5 GeV
w/o charge
Divider

after re-training NN

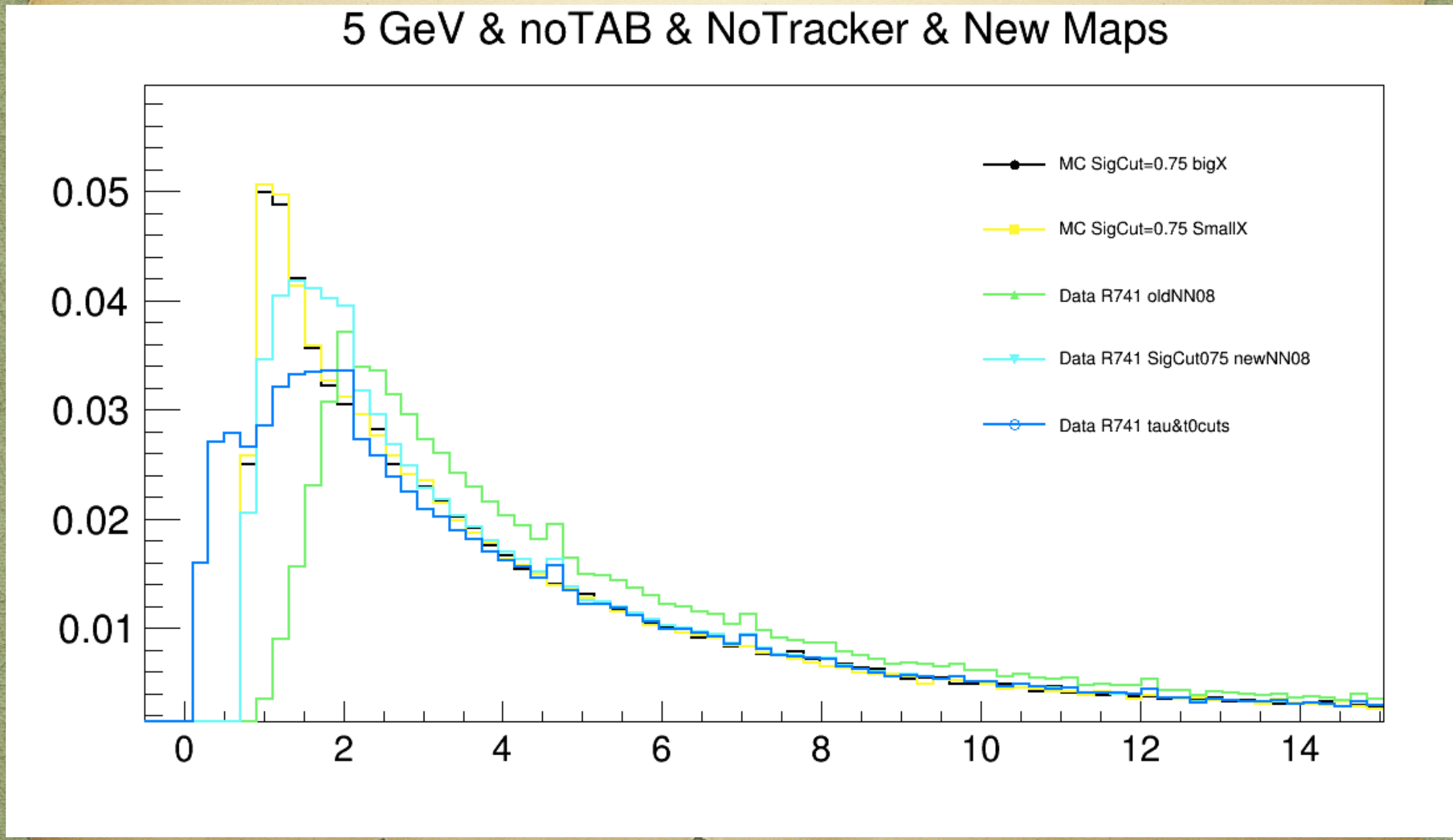


Tracker

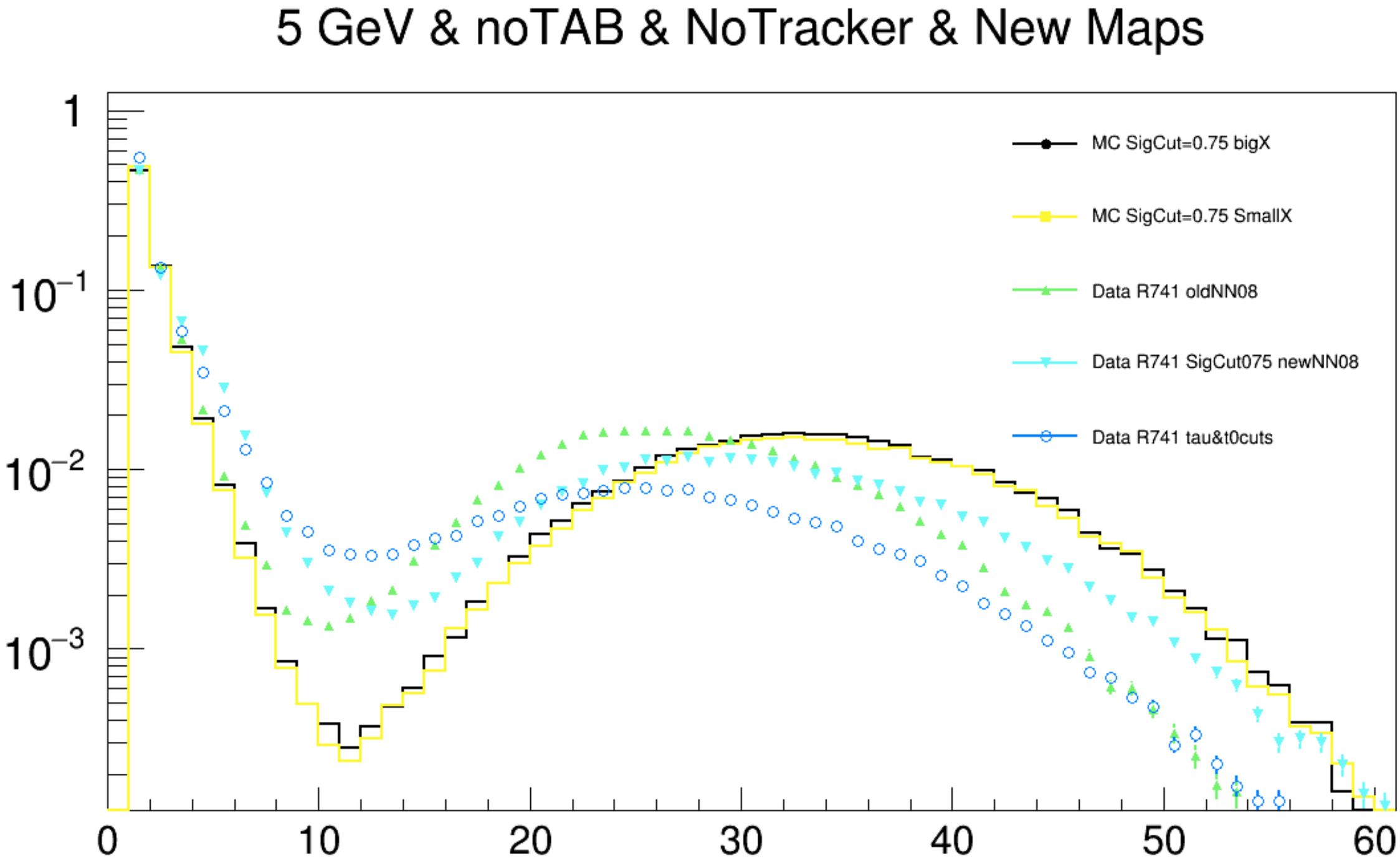


All calorimeter

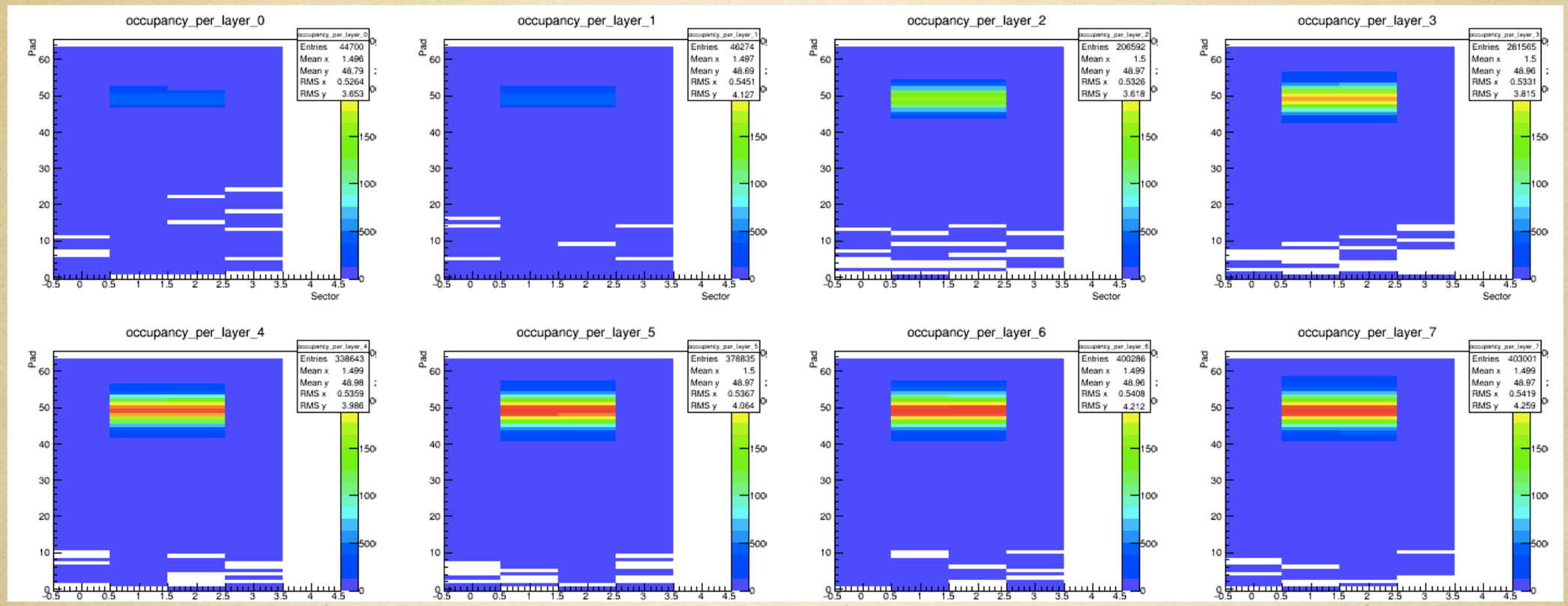
Signal distribution for one layer vs pads, new NN

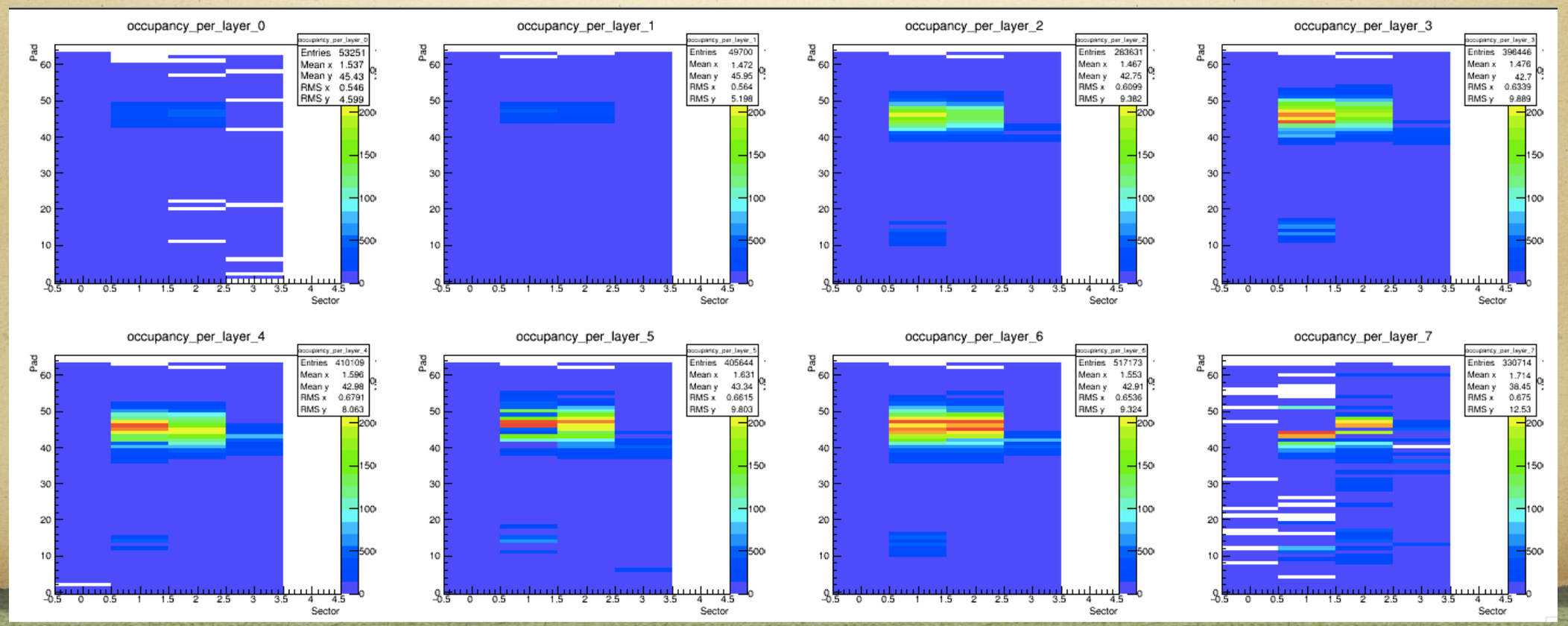


Custer size: MC vs Data



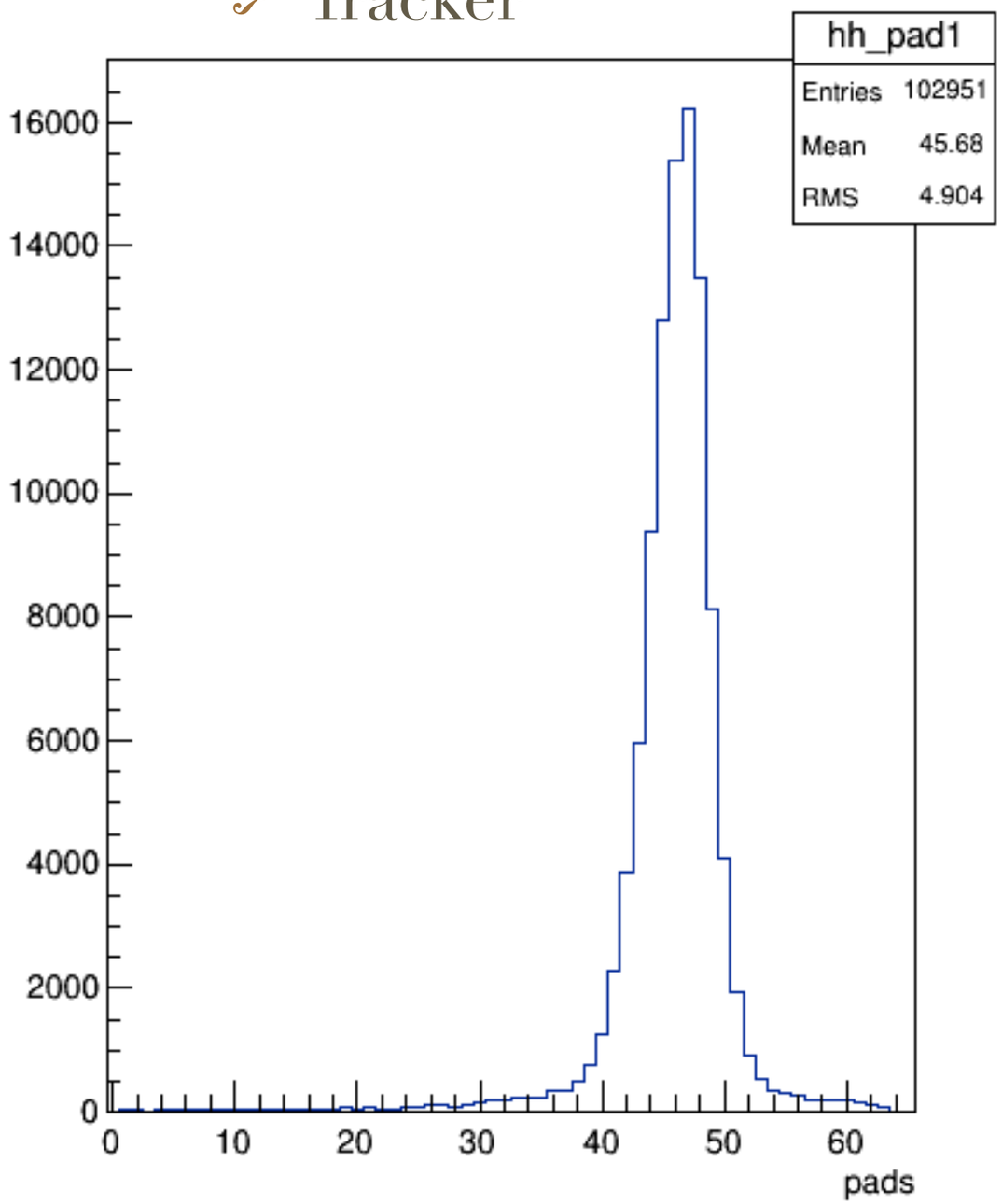
Occupancy Data and MC



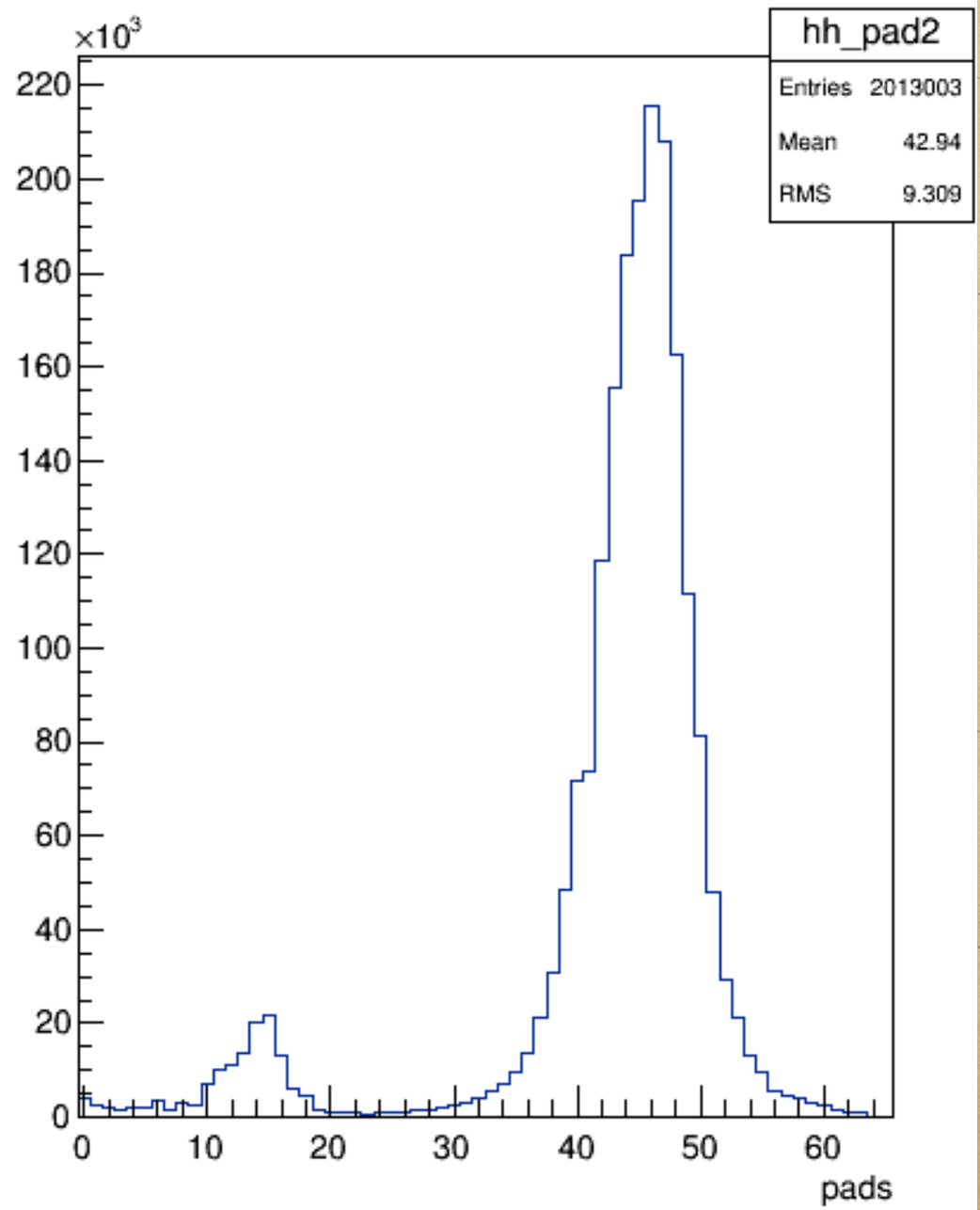


Occupancy Data, run R741 @ 5 GeV w/ charge Divider

- Tracker

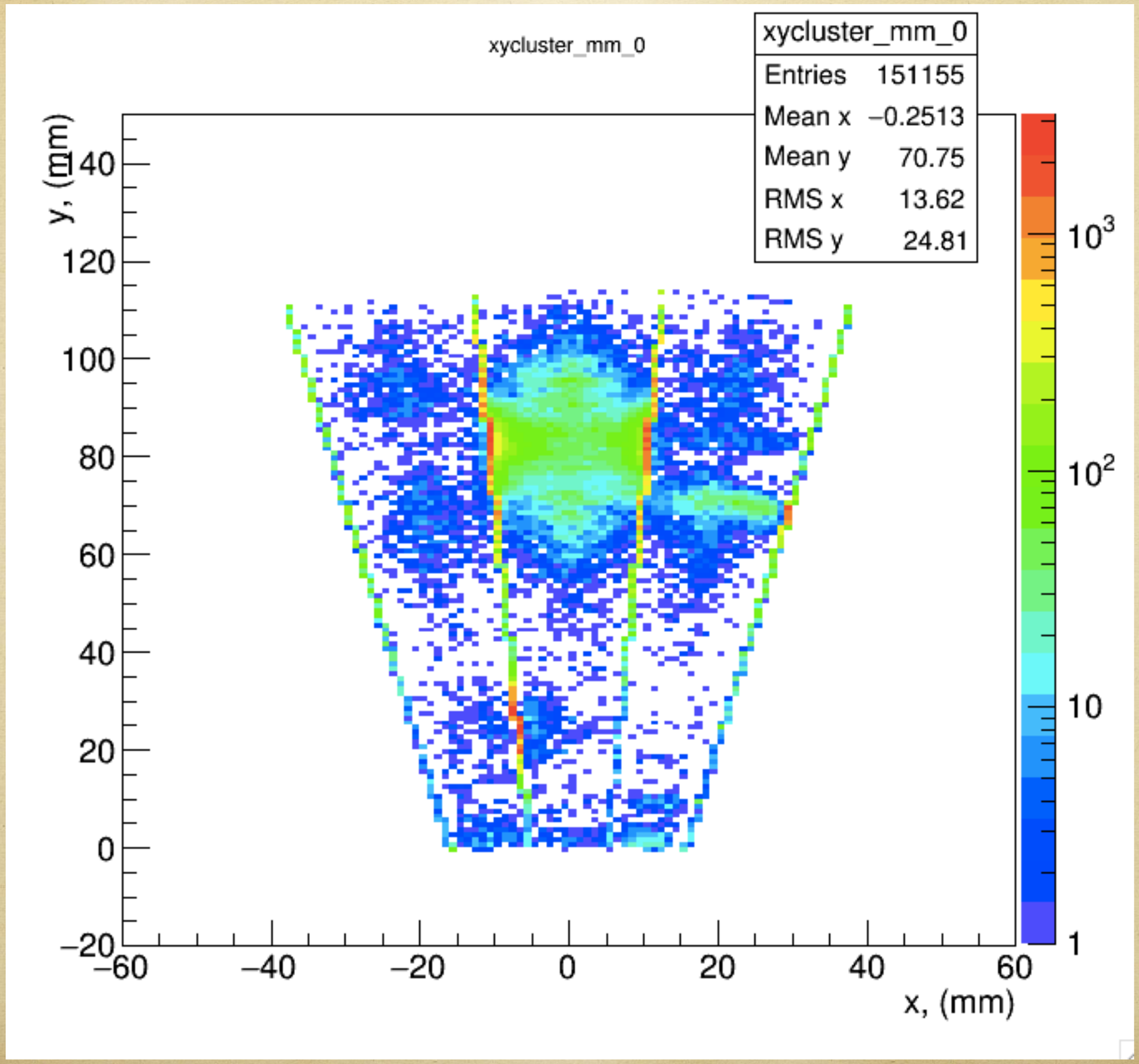


- All calorimeter



Clustering Algorithm

- Linking neighboring pads:
  Looks for the closest neighbors (with distance no more then 1 pad in any direction) and then collects them to the cluster
- Very simple

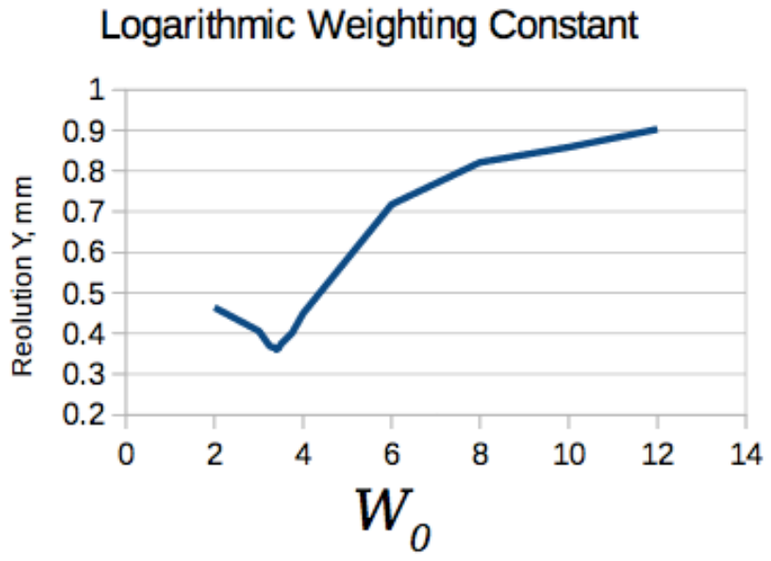

xycluster_mm_0
xycluster_mm_0
Entries 151155
Mean x −0.2513
Mean y 70.75
RMS x 13.62
RMS y 24.81
y, (mm)
140
120
100
80
60
40
20
0
−20
−60
−40
−20
0
20
40
60
x, (mm)
10^3
10^2
10
1

Cluster Position Reconstruction in Simulations

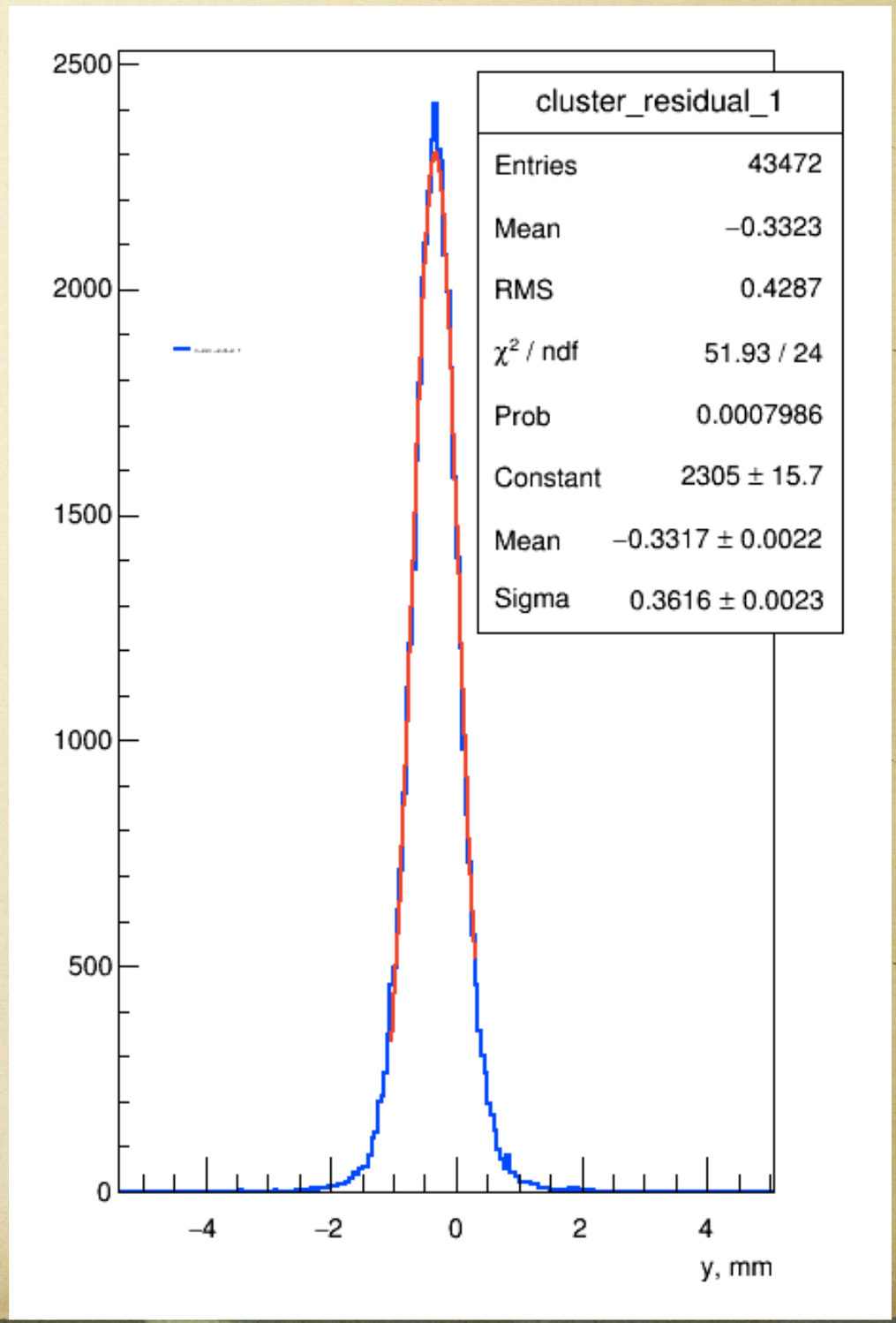
Logarithmic weighting:

$$Y_s = \frac{\sum_n n w_n}{\sum_n w_n},$$

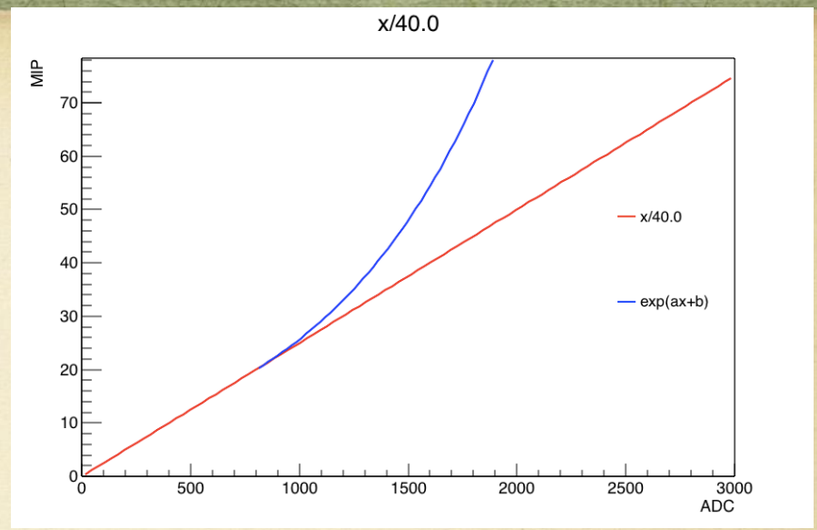
$$w_n = max\left\{0; W_0 + \ln\frac{E_n}{\sum_n E_n}\right\}$$

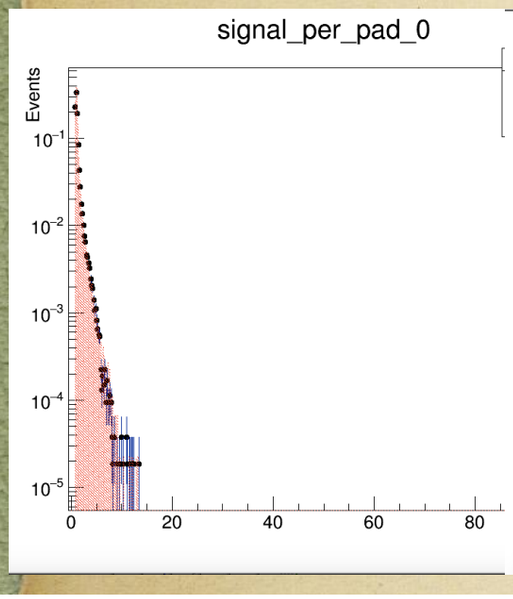


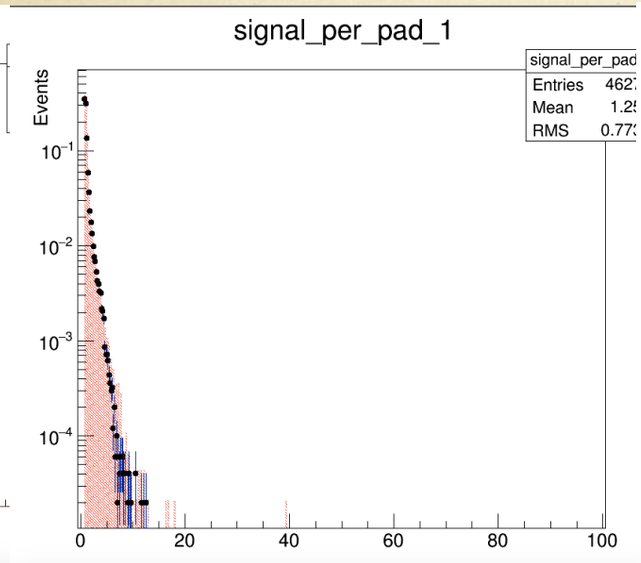
At W0= 3.4 Y resolution is 0.36 mm

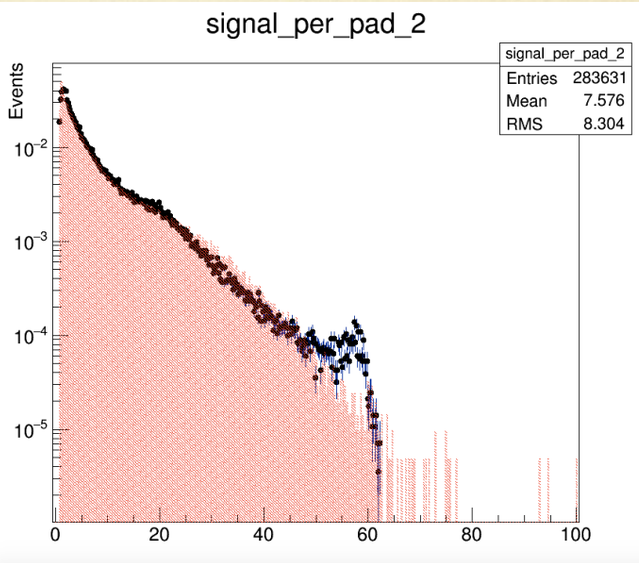


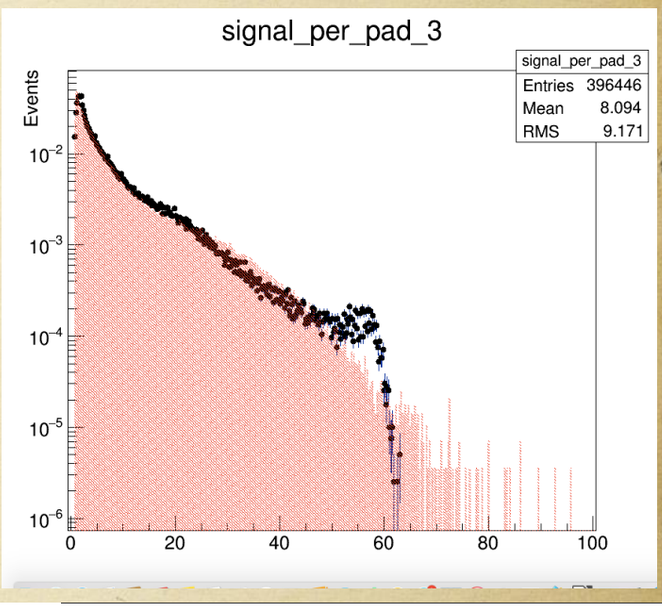
Non-linear calibration

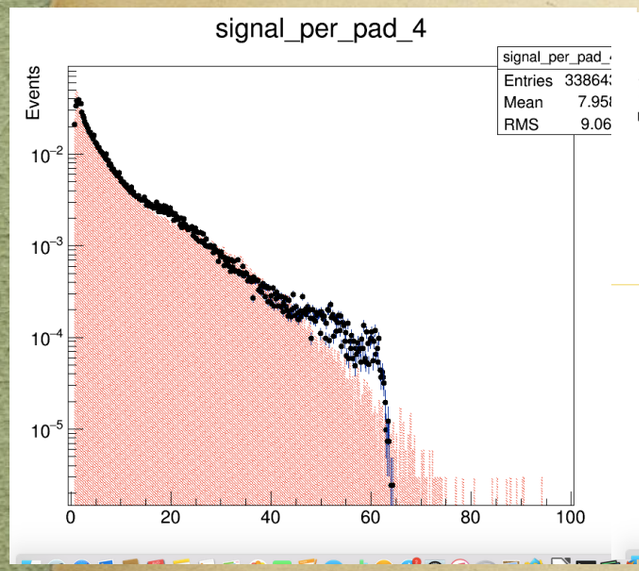


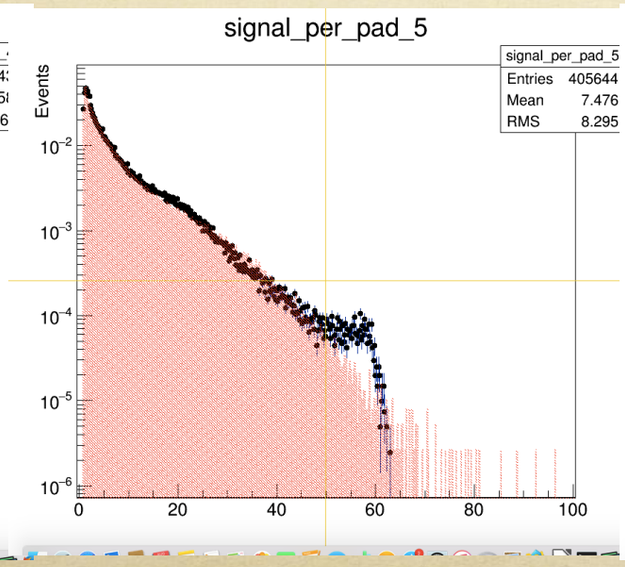


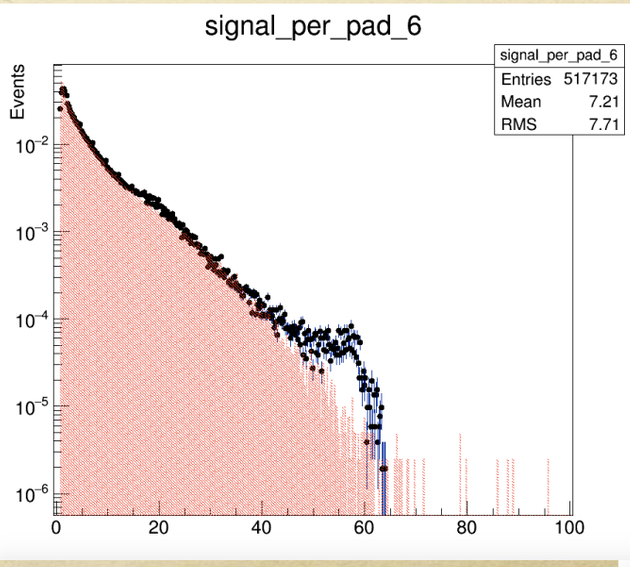


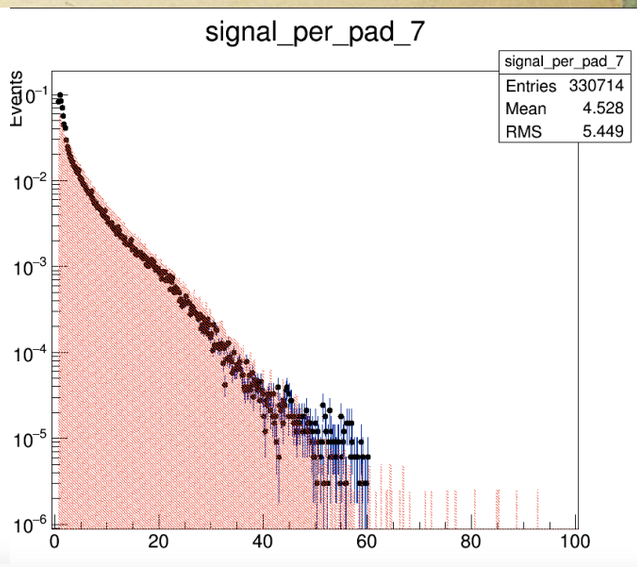






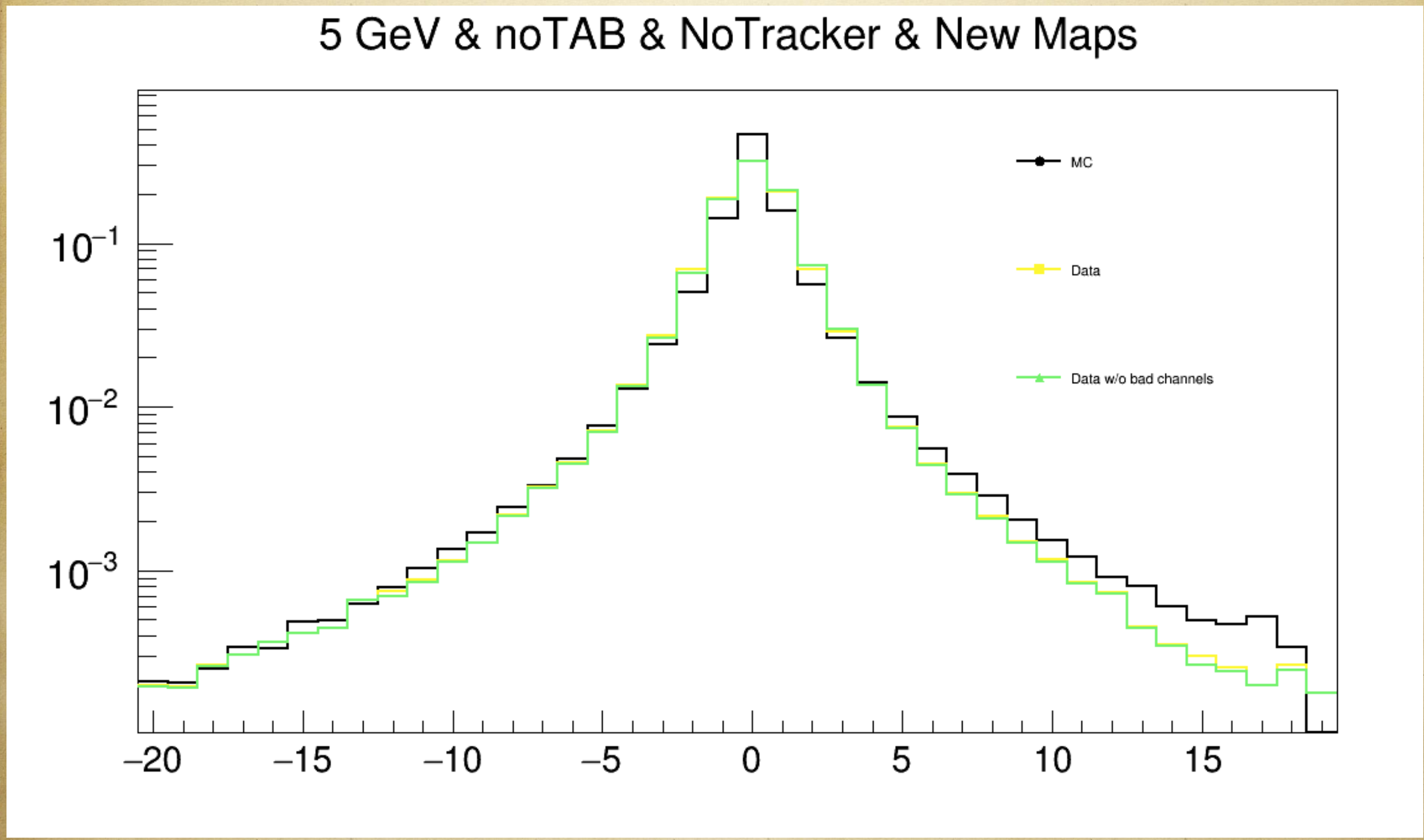




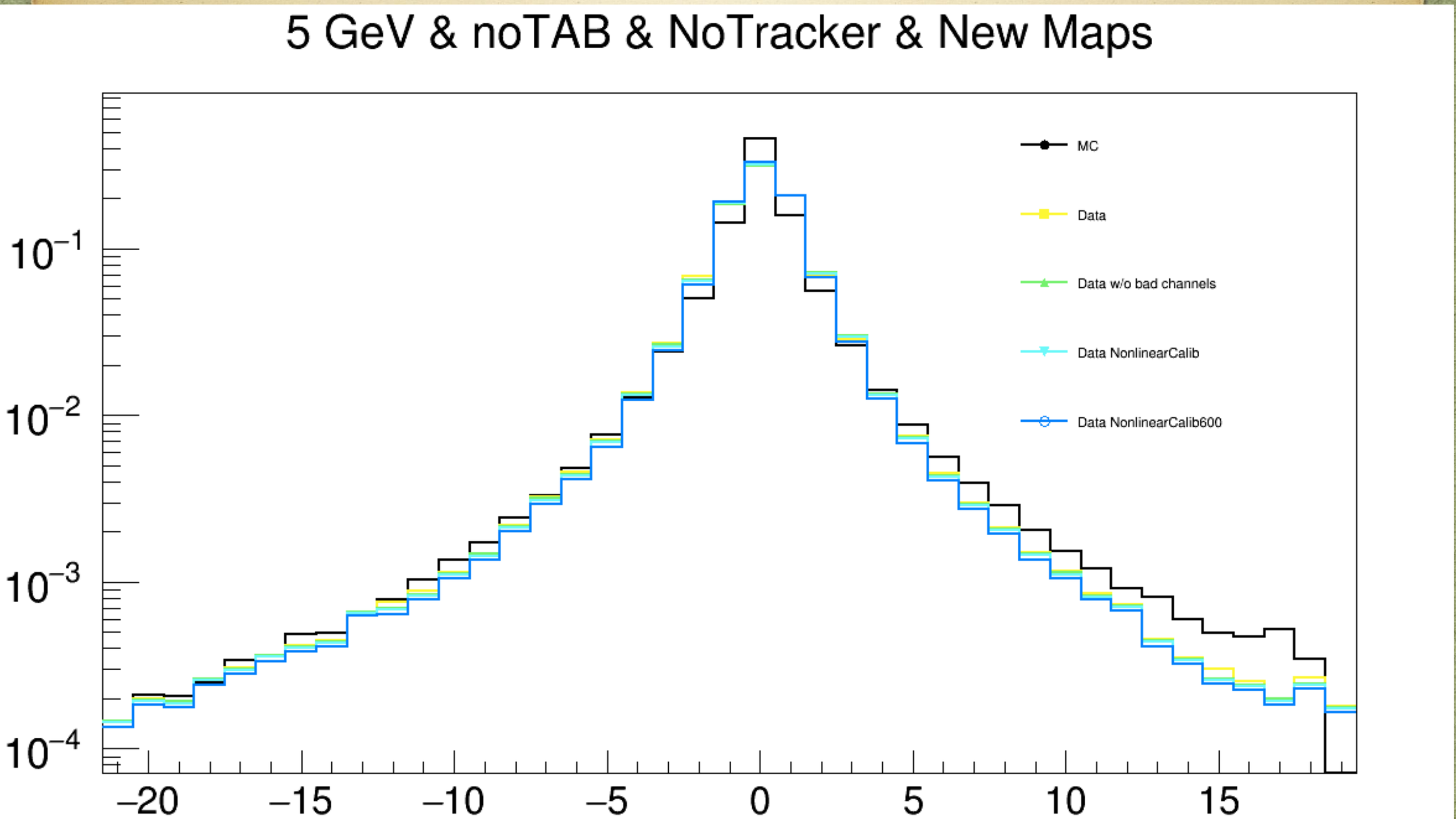


- the best agreement is for threshold 700 ADC

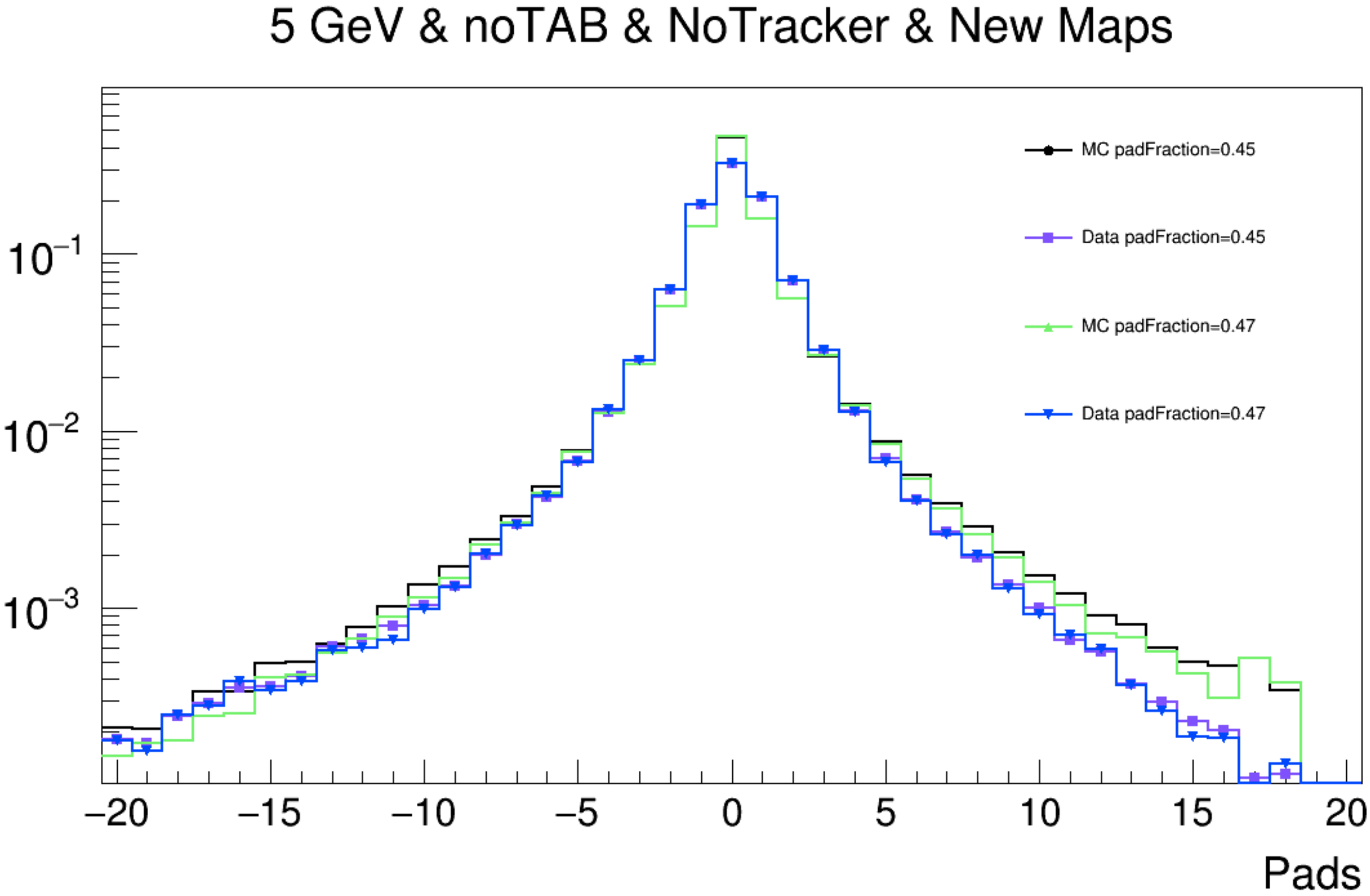
Towers distribution w/o bad channels



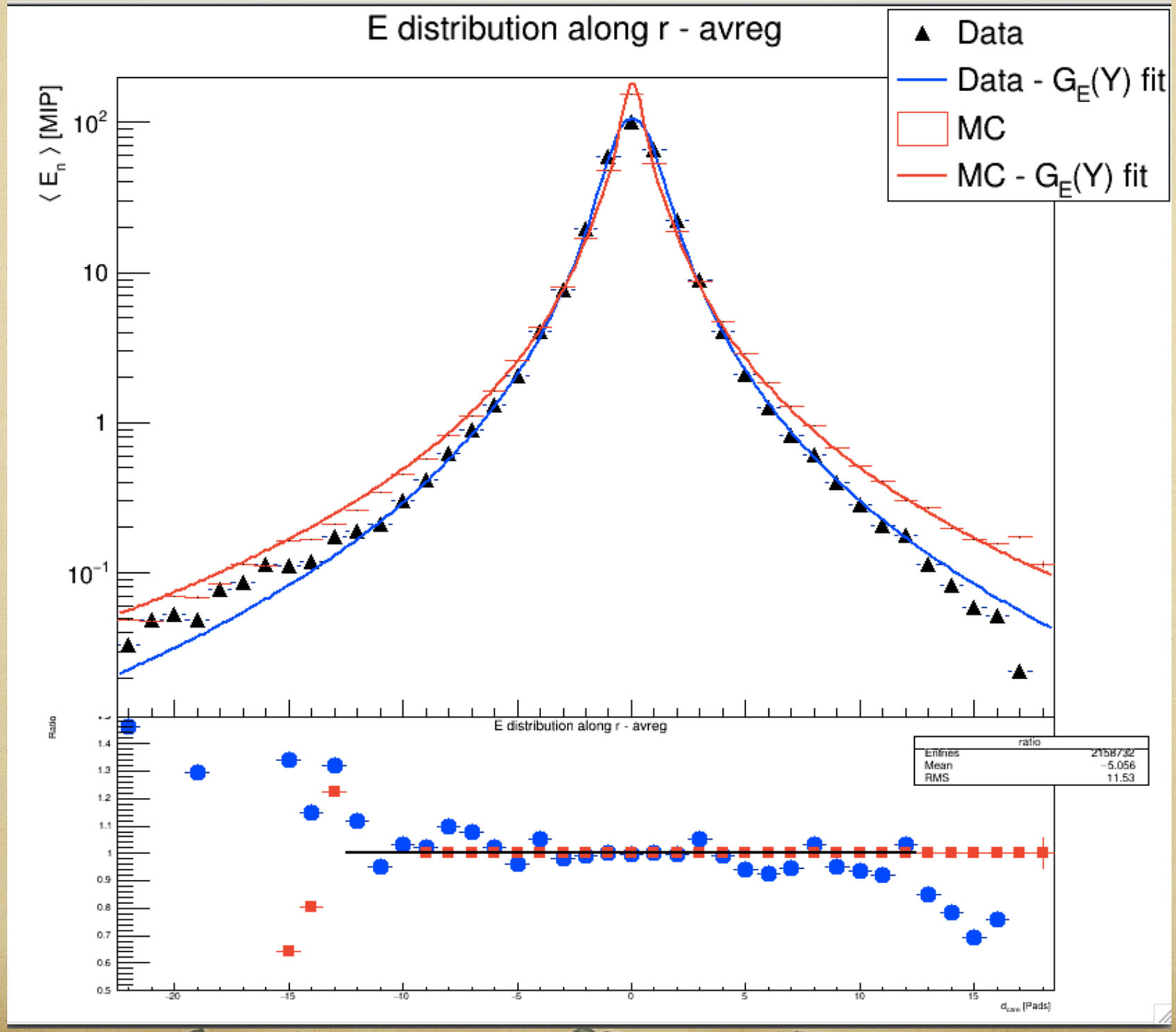
Towers distribution vs the threshold of Nonlinear calibration



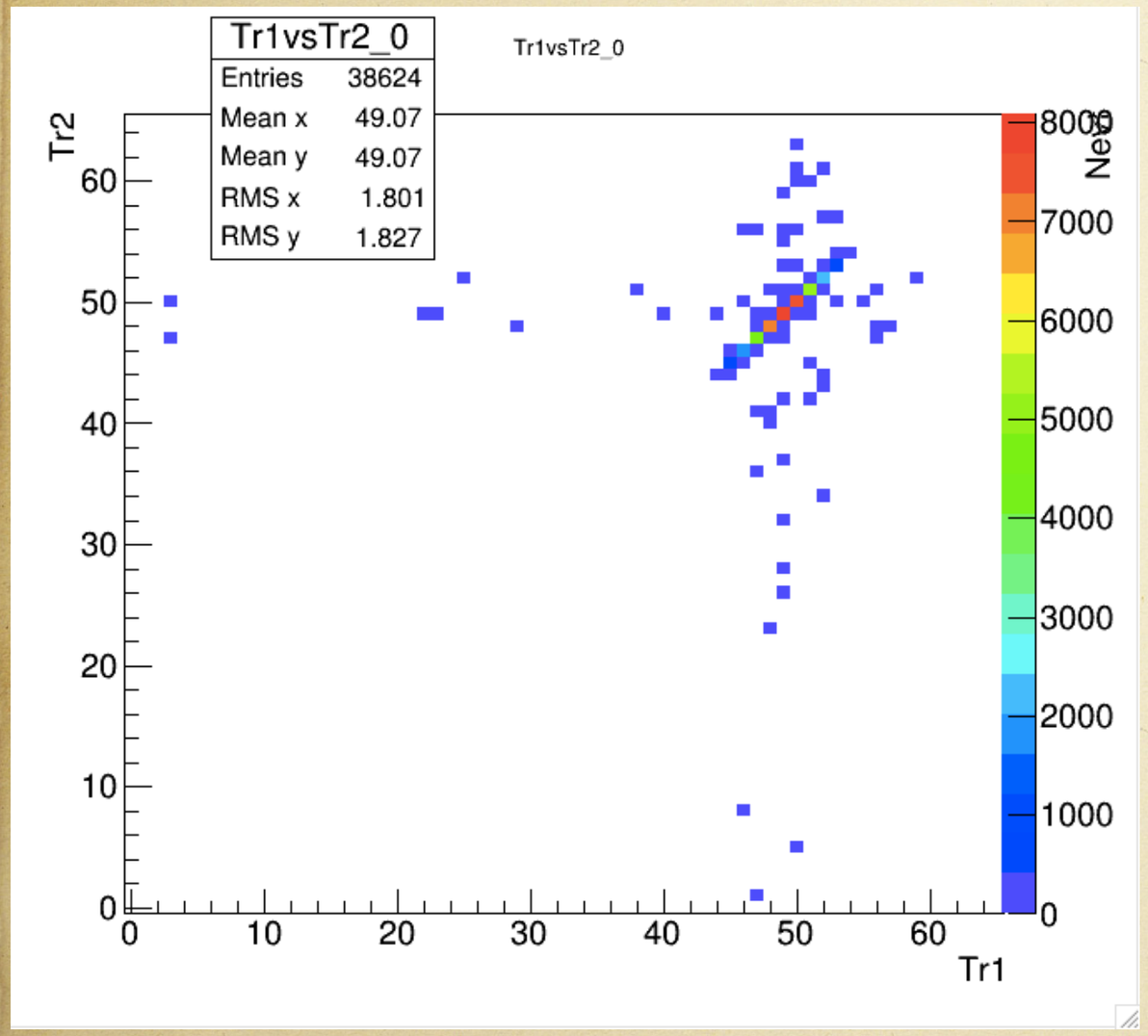
Towers distribution, depending on shooting area in the pad

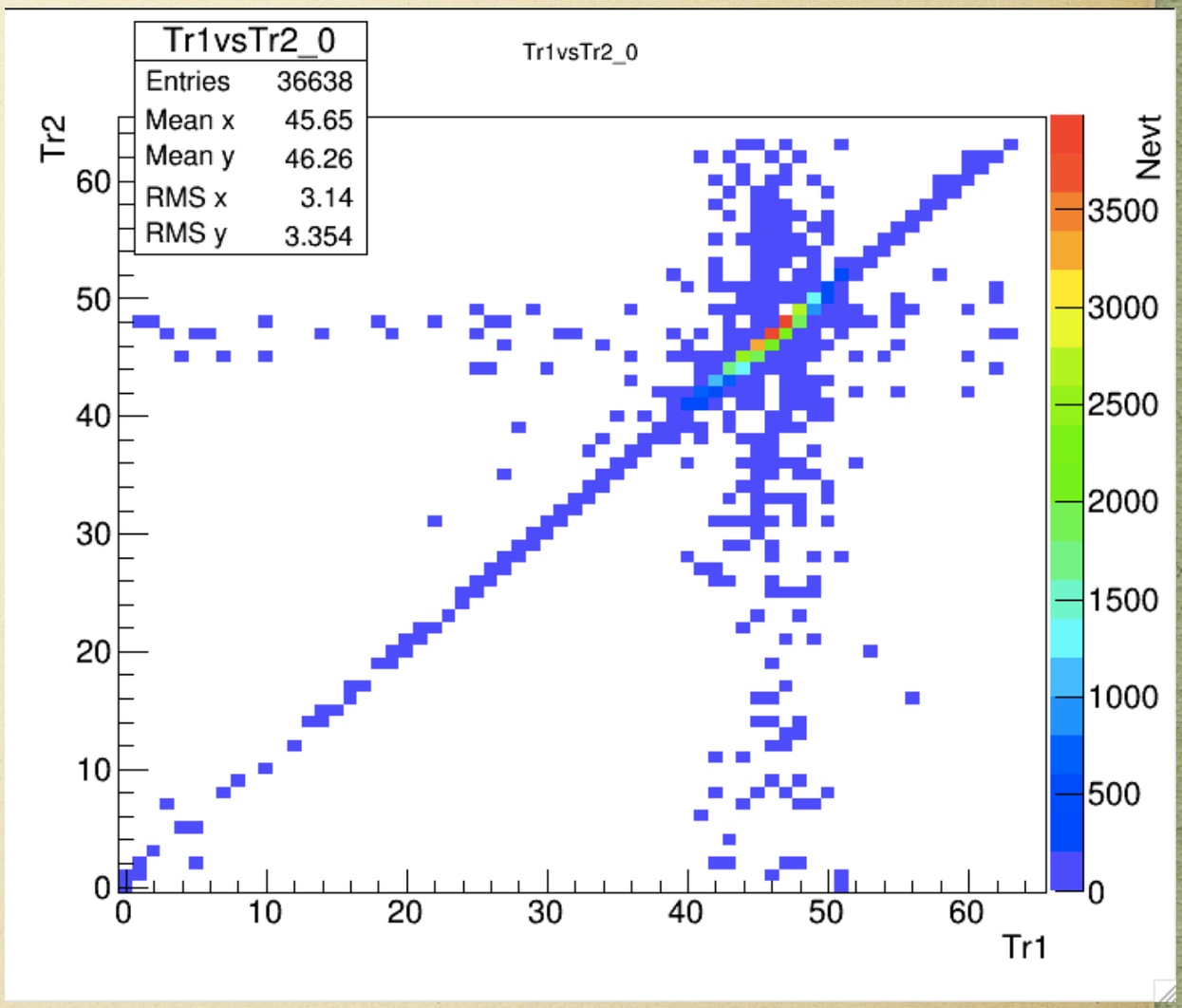


Preliminary results on MR

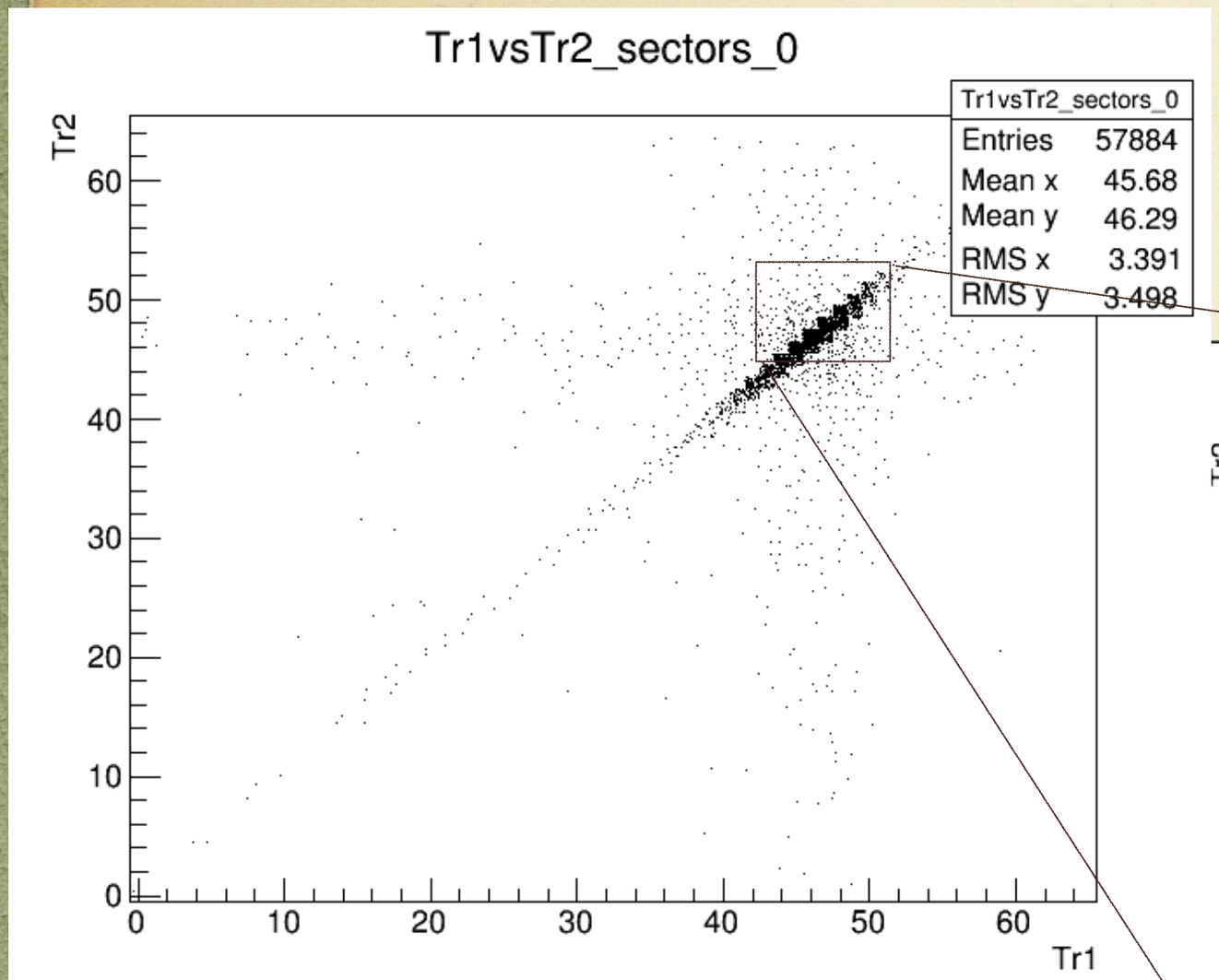


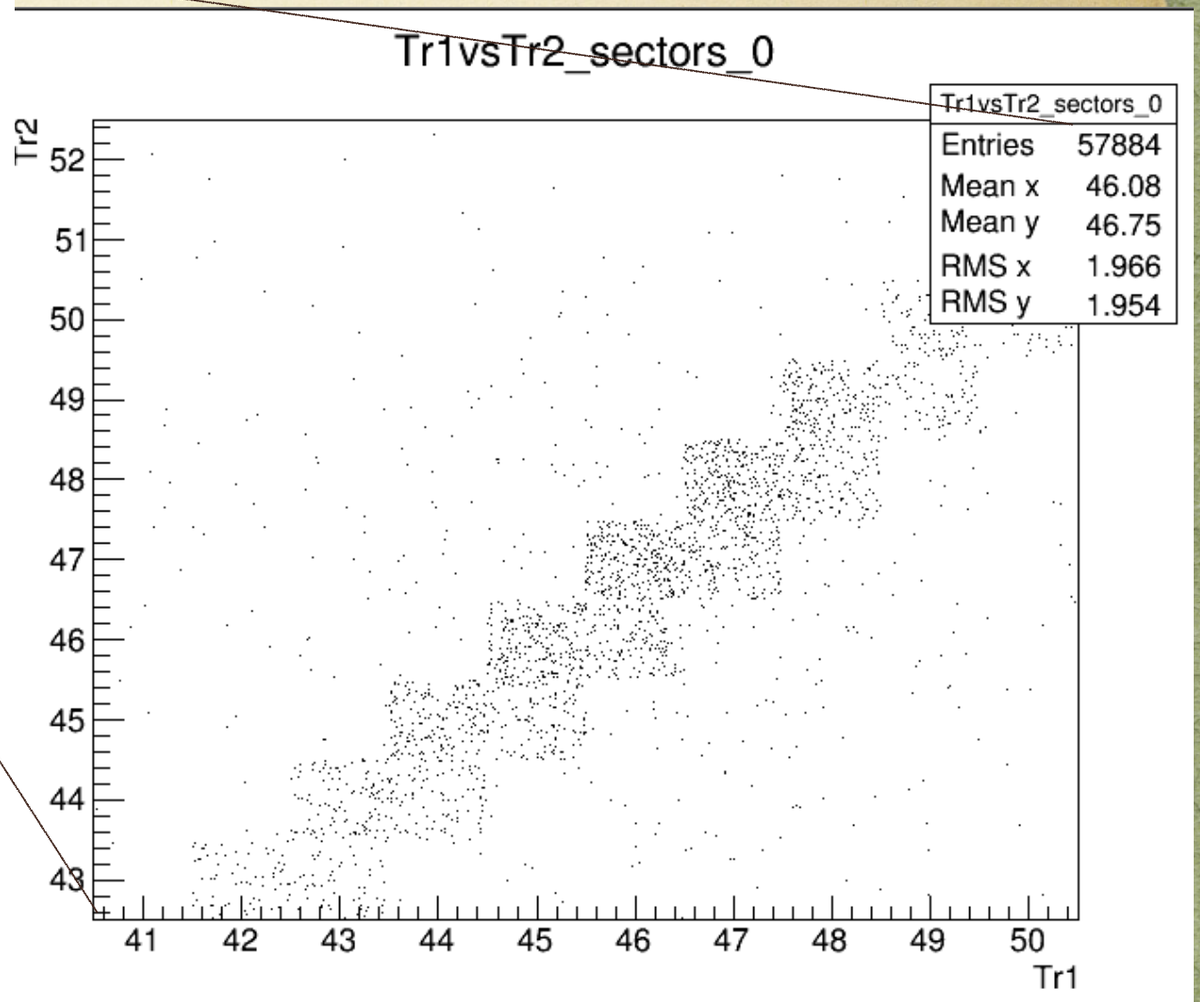
Hits in Tr1 and Tr2 MC vs Data



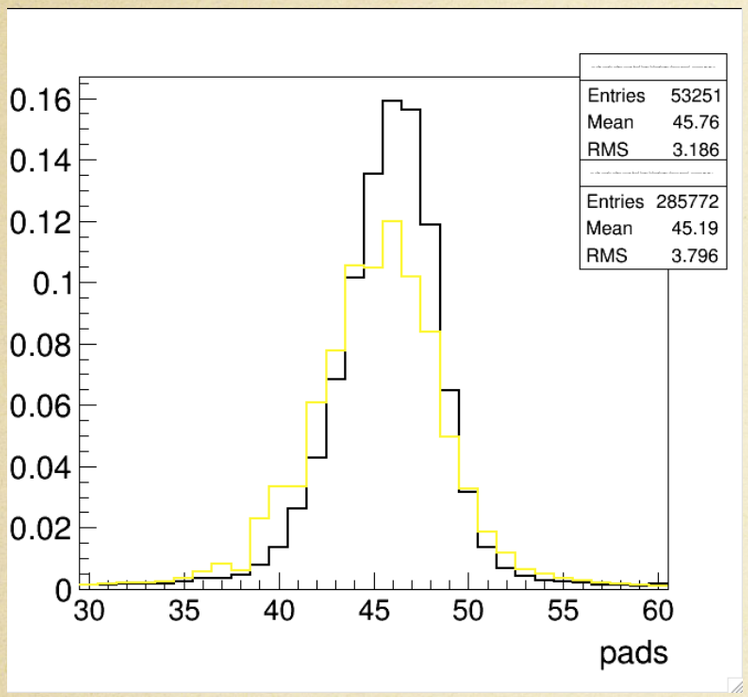


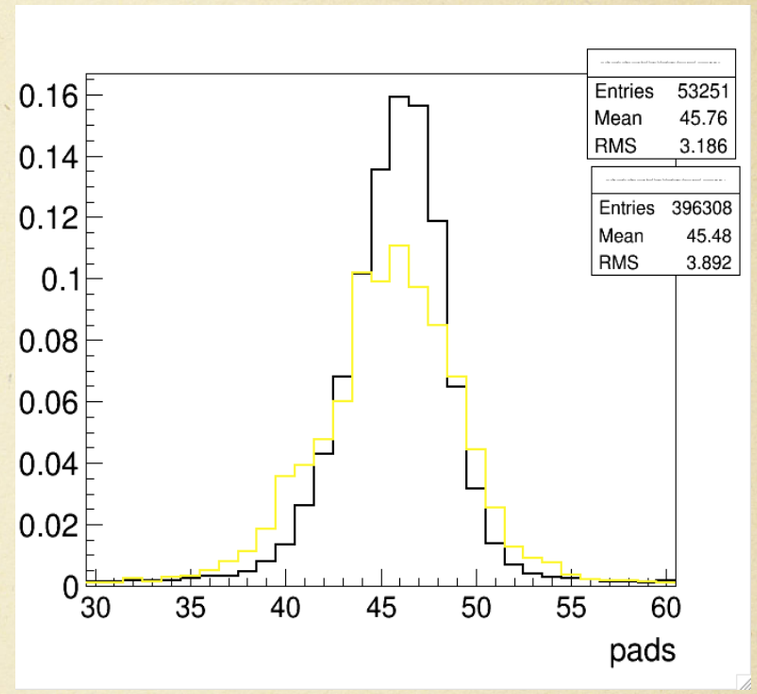
Hits in Tr1 and Tr2, Data

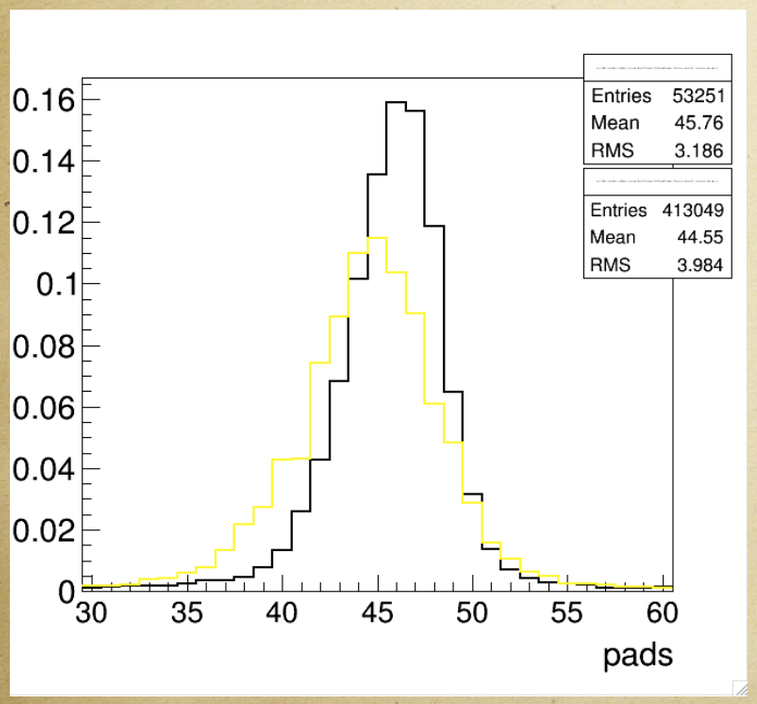


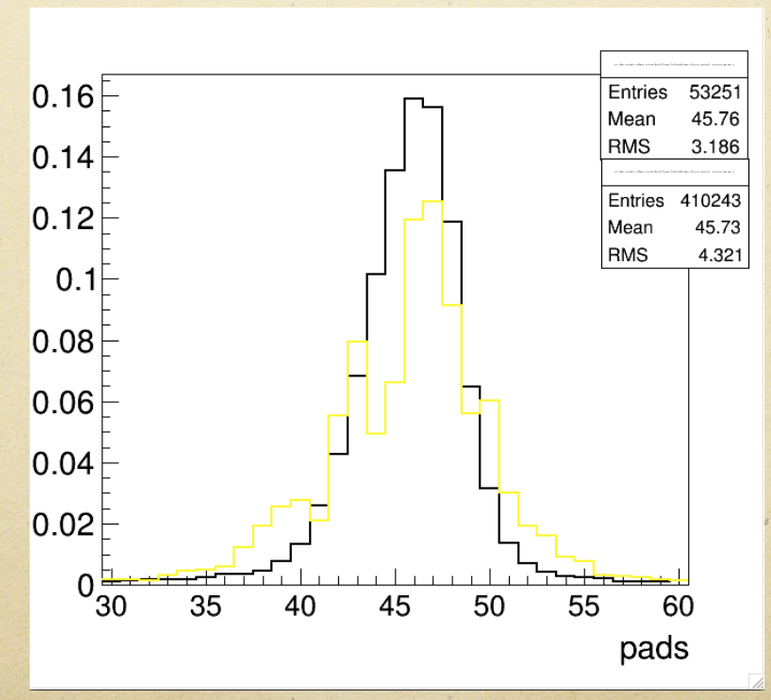


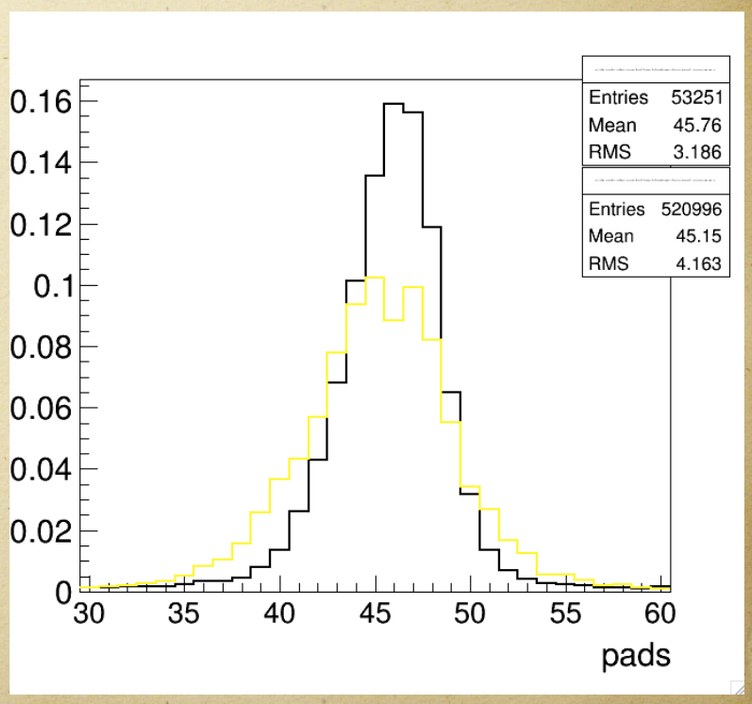
Checking Alignment via occupancy in Tr1 vs certain layer in Calorimeter



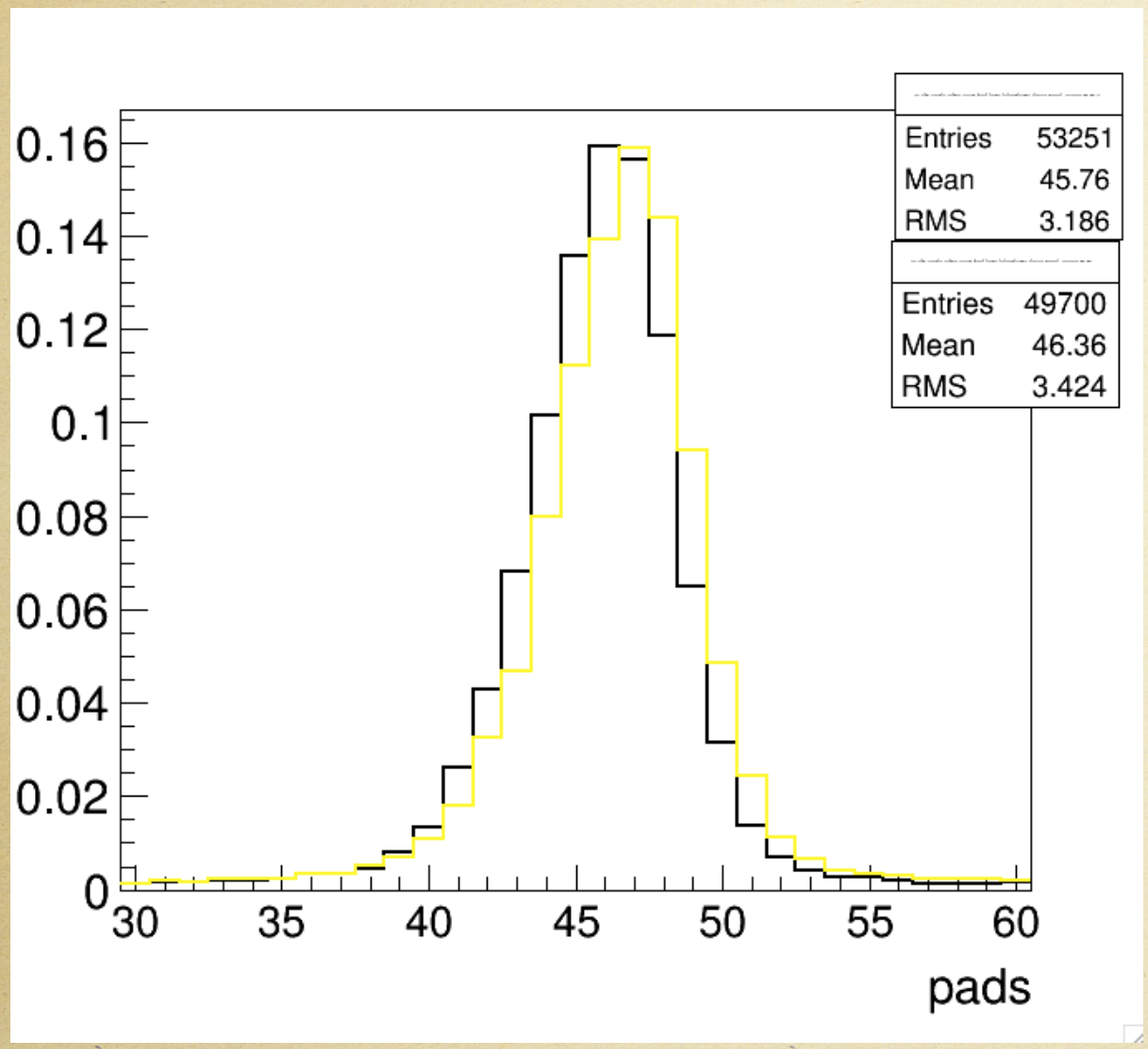








Checking Alignment via occupancy in Tr1 vs Tr2



Tr1	45.76
Tr2	46.36
CAL1	45.19
CAL2	45.48
CAL3	44.55
CAL4	45.73
CAL5	45.15

Outlook

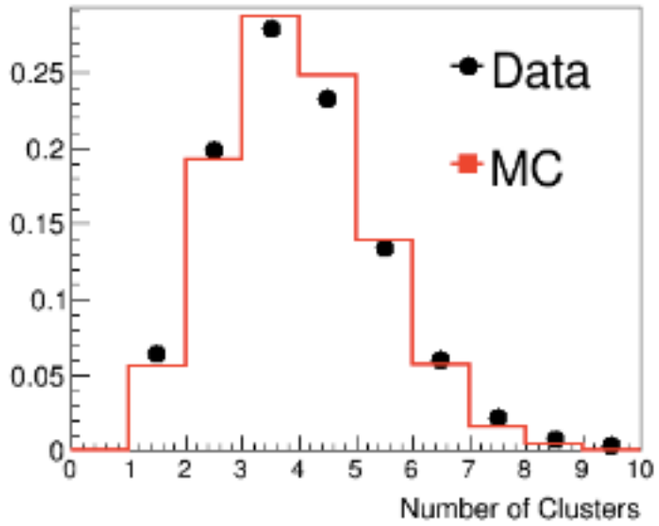
- NN was retrained and it resolved the issue with cluster size agreement MC vs Data and in the signal distribution in one pad
- The cluster position was used to build shower in transverse direction
- The discrepancy in the core of transverse shower between MC and Data is probably coming from misalignment of stack of the detectors

Back up

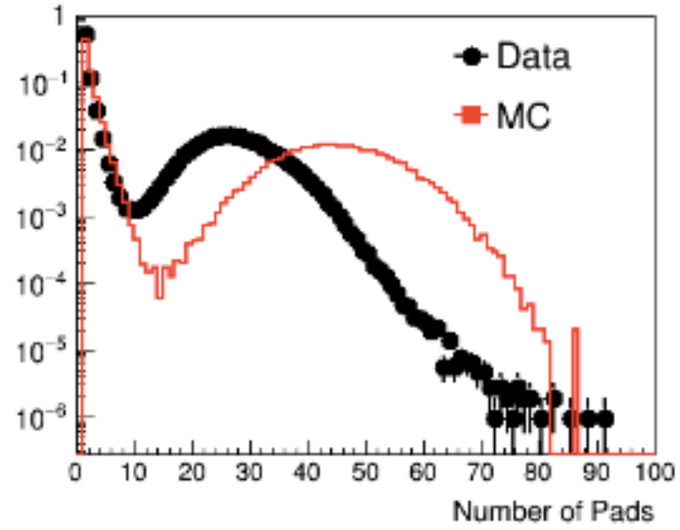
Identification of Particle Signal with Neural Network

Clusters: MC vs Data

5 GeV electron beam

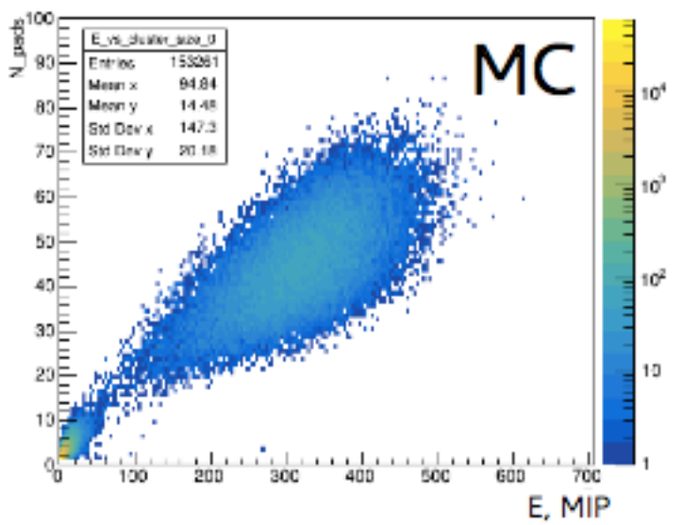


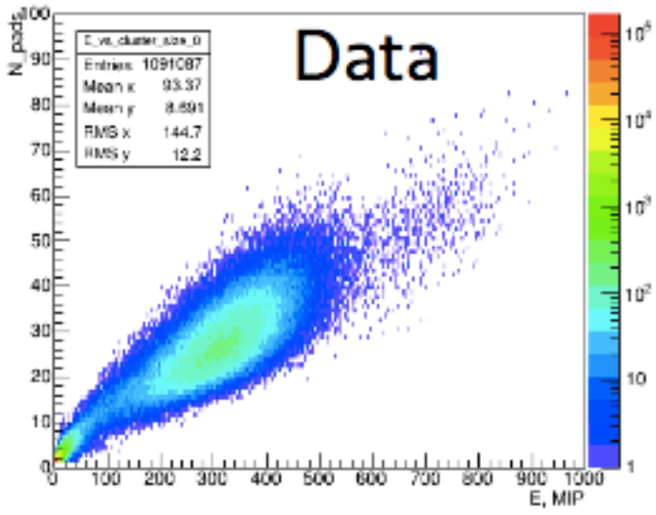
Number of clusters



Custer size

Simulation does not take into account electronic noise, which might explain the difference in cluster size





Custer energy vs size