Electron selections

Testbeam cern May 2018

Amine Elkhalii
elkhalii@uni-wuppertal.de

AHCAL Analysis Workshop

Tokyo, 10th August, 2018

BERGISCHE
UNIVERSITÄT
WUPPERTAL

Motivation

Muon data

- Pedestal extraction.
- MIP Calibration.
- High/Low Gain Intercalibration.

LED run

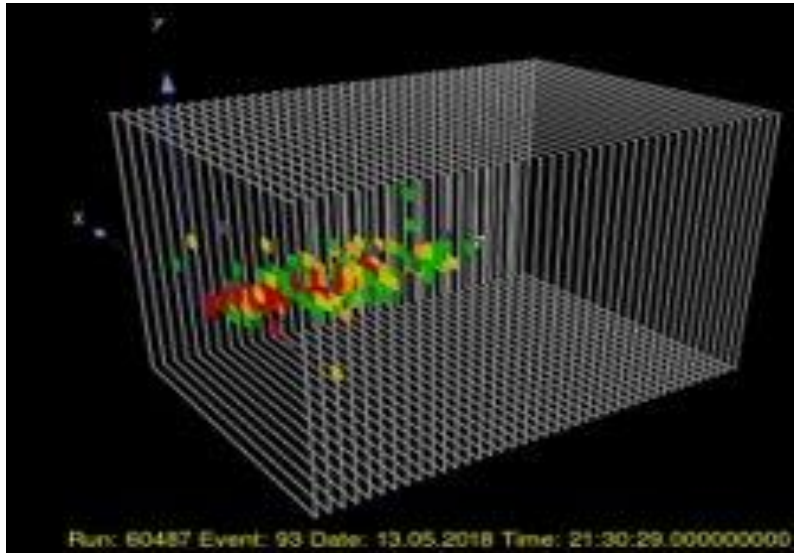
- Gain Calibration.
- High/Low Gain Intercalibration.

Electron data

- Cross check the calibration constants.
- Shower profile.
- EM performance of the detector.

Electron selection

- Clean electron beam.
- Reject the muons and hadrons.



Electron selection

- Clean electron beam.

- Reject the muons and hadrons.

→ Center of gravity

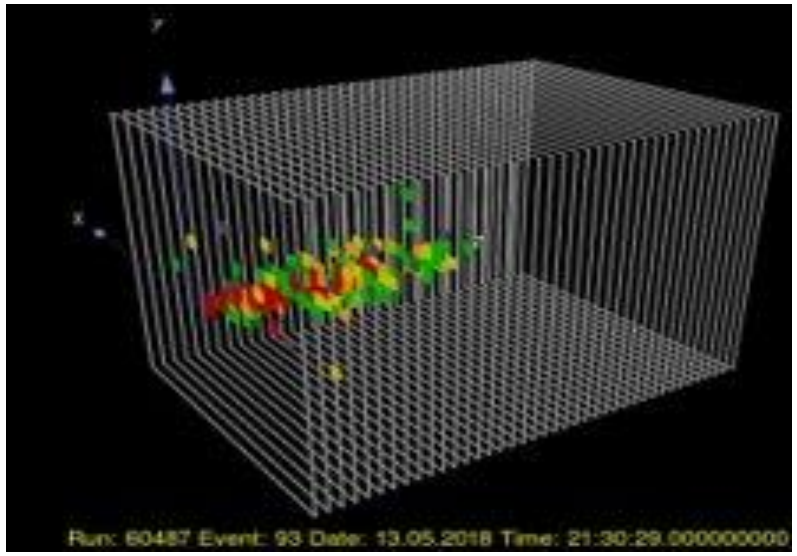
in the z-direction :

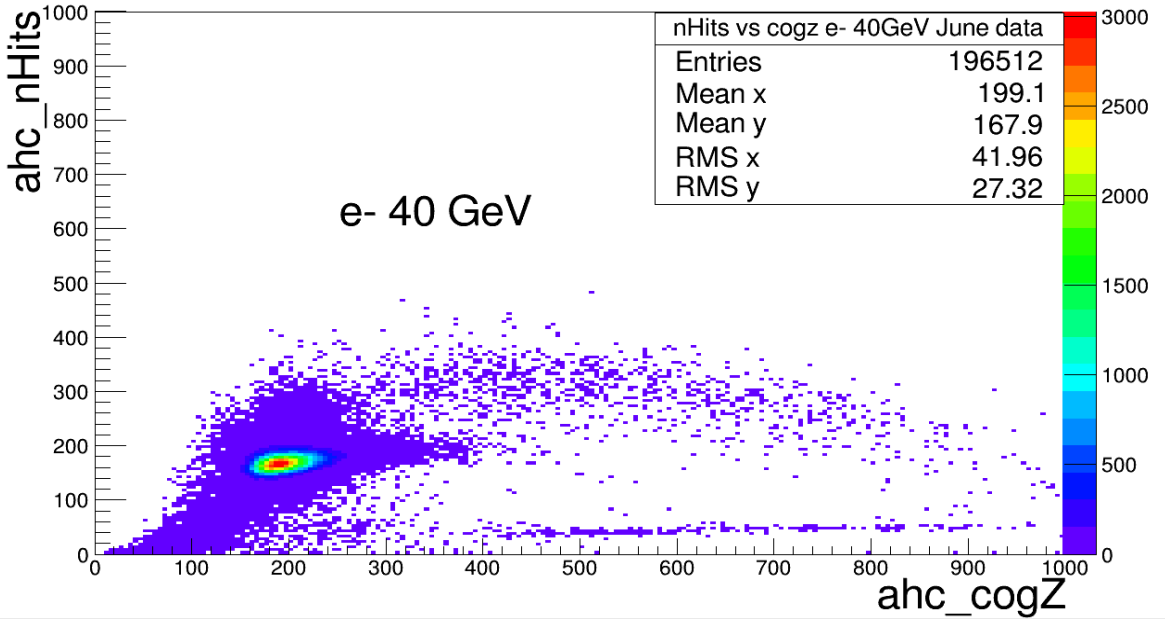
$$z_{\mathrm{cog}} = \frac{\sum_{i=1}^{N_{\mathrm{hits}}} E_i \cdot z_i}{\sum_{i=1}^{N_{\mathrm{hits}}} E_i}$$

E_i : energy deposit in the active cell.

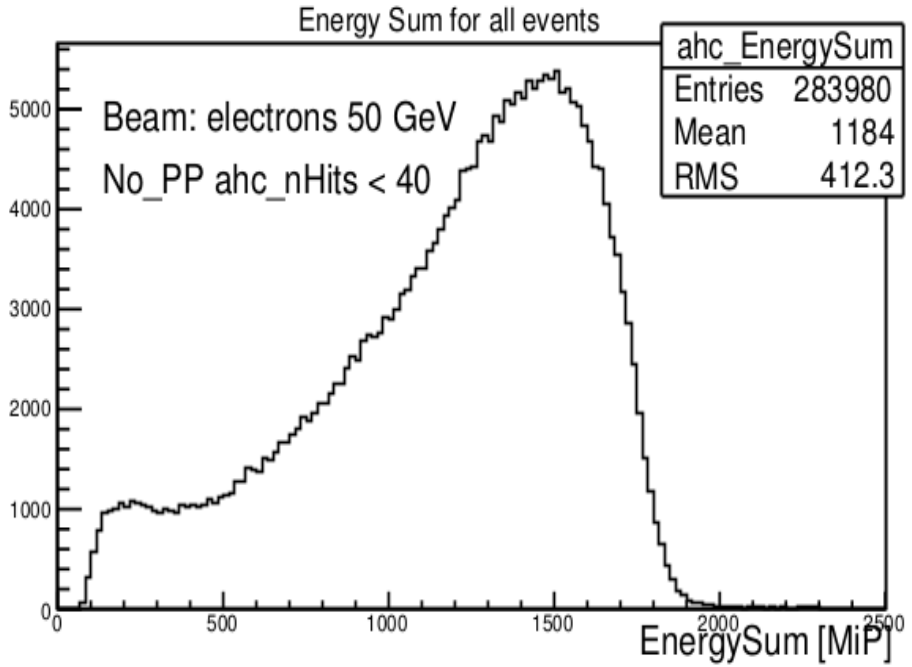
z_i : position of the active cell.

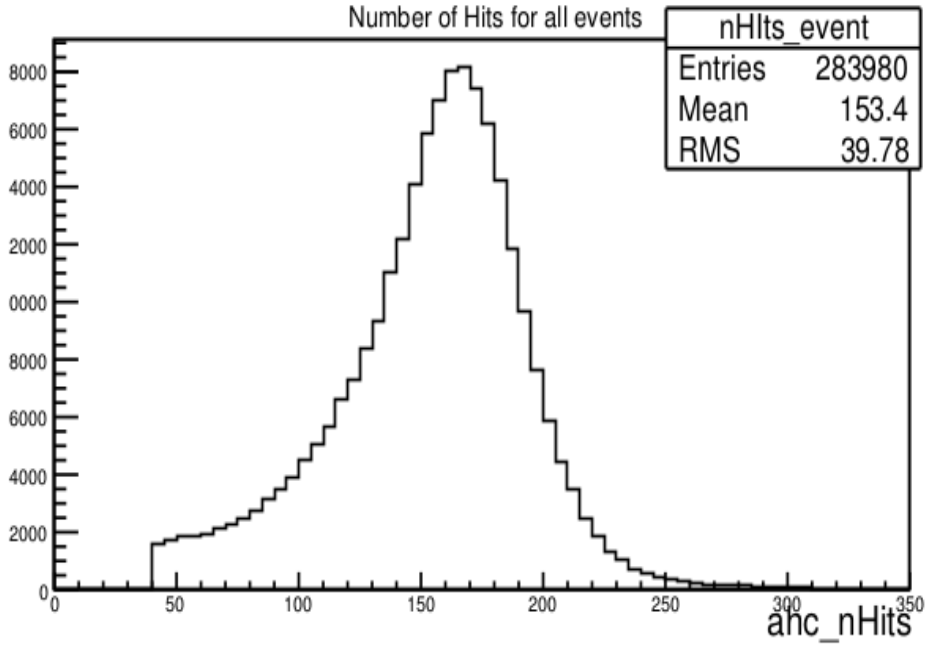
N_{hits} : number of active cells.



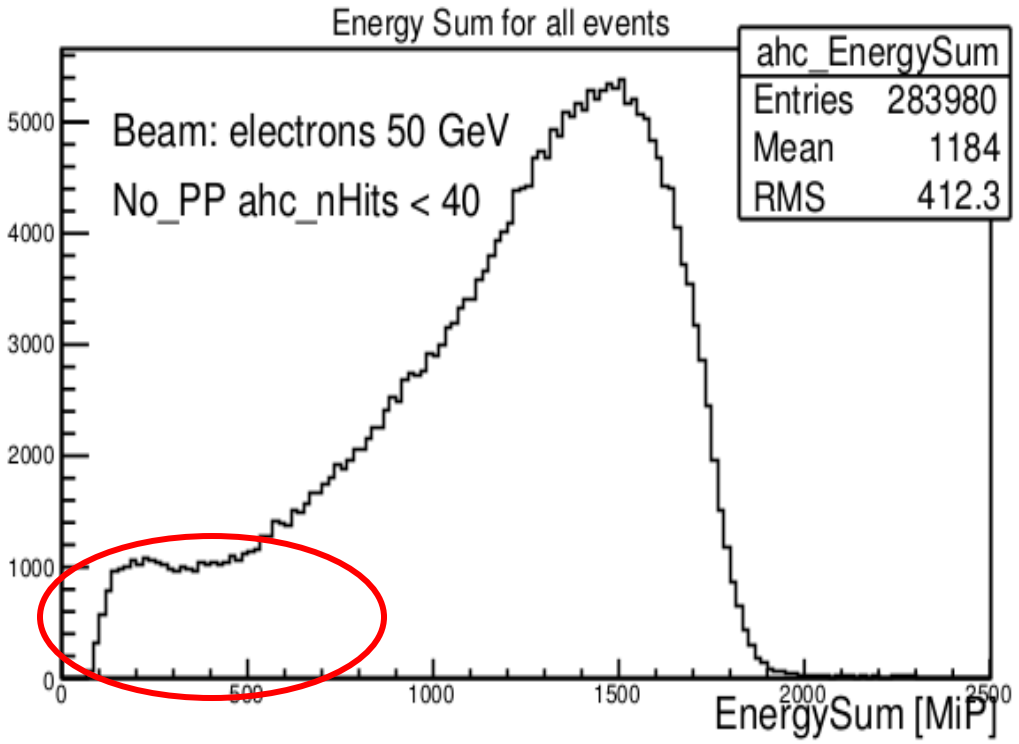


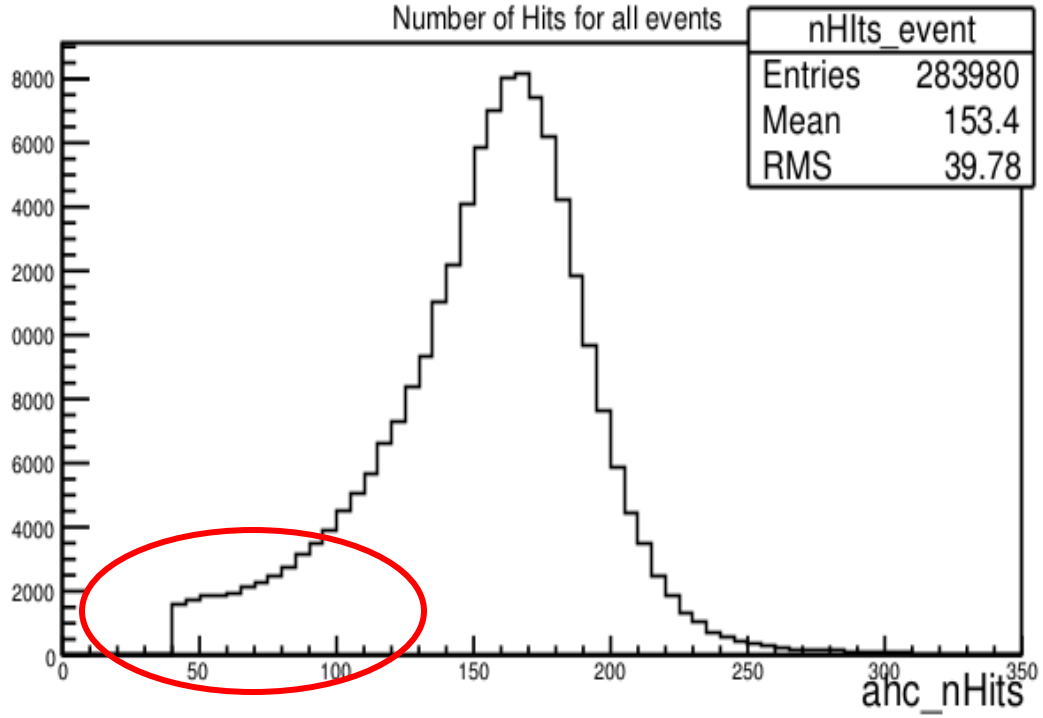
Energy_sum and nHits distribution: e- 50GeV





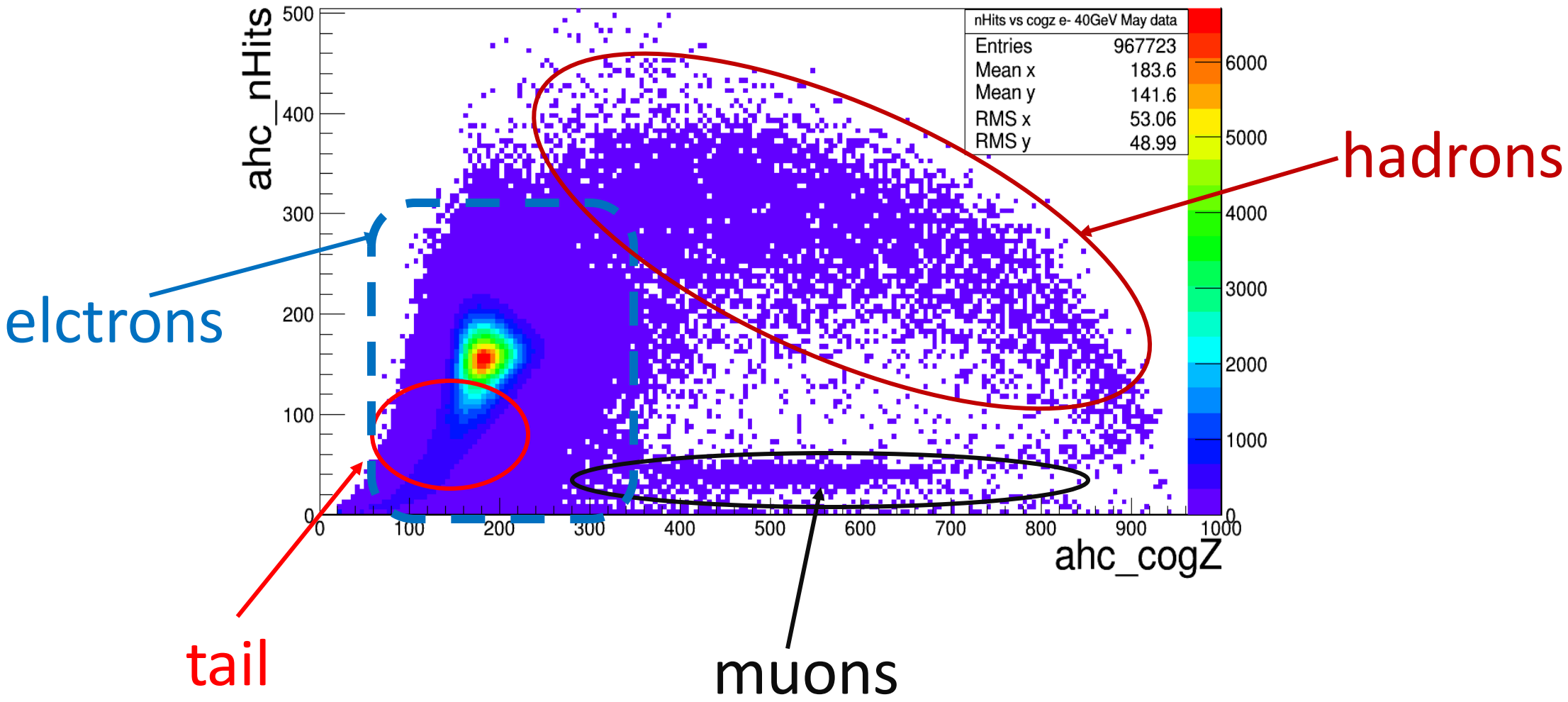
Energy_sum and nHits distribution: e- 50GeV



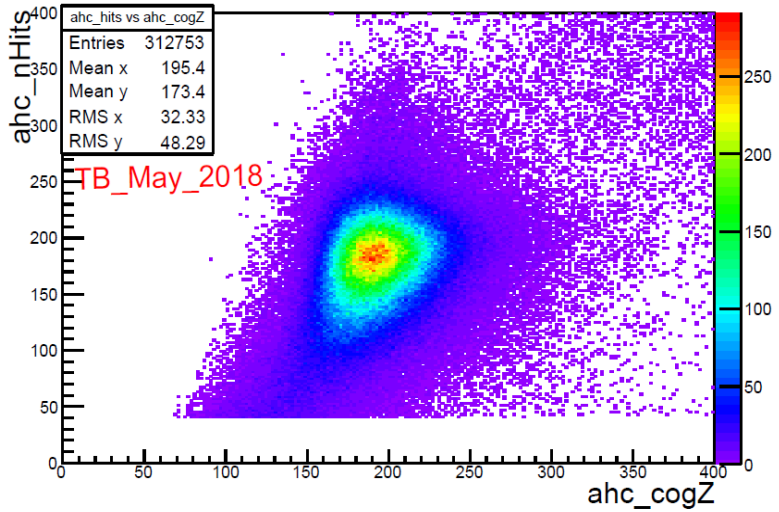


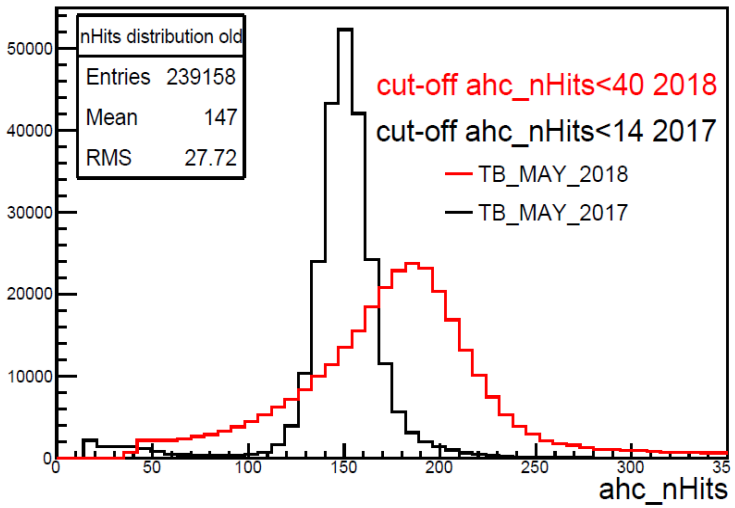
- tail at low energy.
- asymmetric energy and hits distributions.

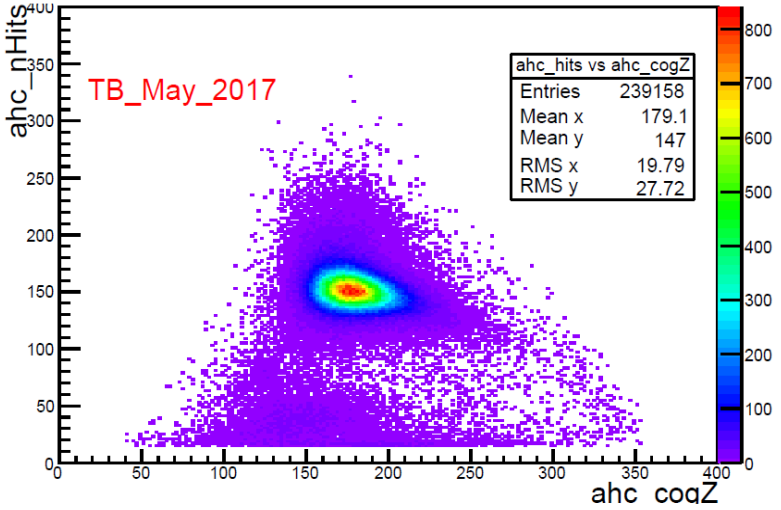
NHits vs cogZ :

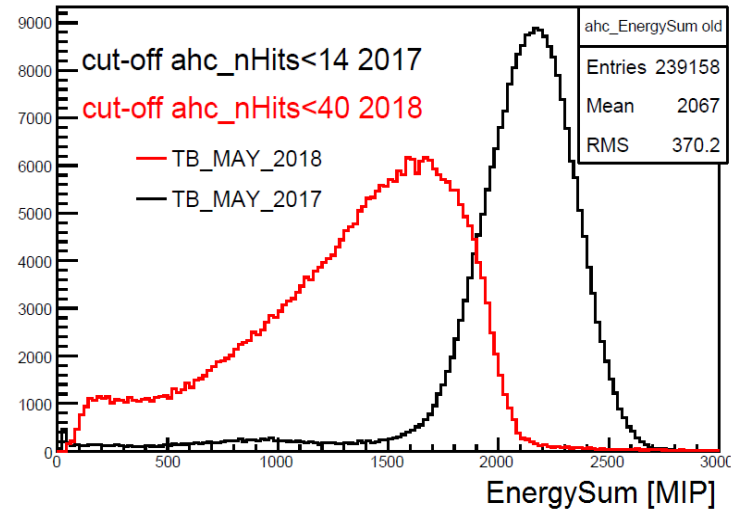


Comparison May data of 2017 and 2018 :









- We observe an asymmetry of the distribution which is not the case for the previous test-beam with the small prototype.
- We compare only the shape of the distribution.
- Probably the contamination is due to a shower produced before the detector !!

Electron selection: several ideas!

First:

- Choose two samples, good and bad by using the nHits vs cogZ.
- Plot the energy_sum distribution for both samples.
- Check if the energy distribution is symmetric for the good sample.

Second:

- Look to the energy distribution for different regions in I and J variables.
- Check if the tail is reduced by selecting a small region .

Third:

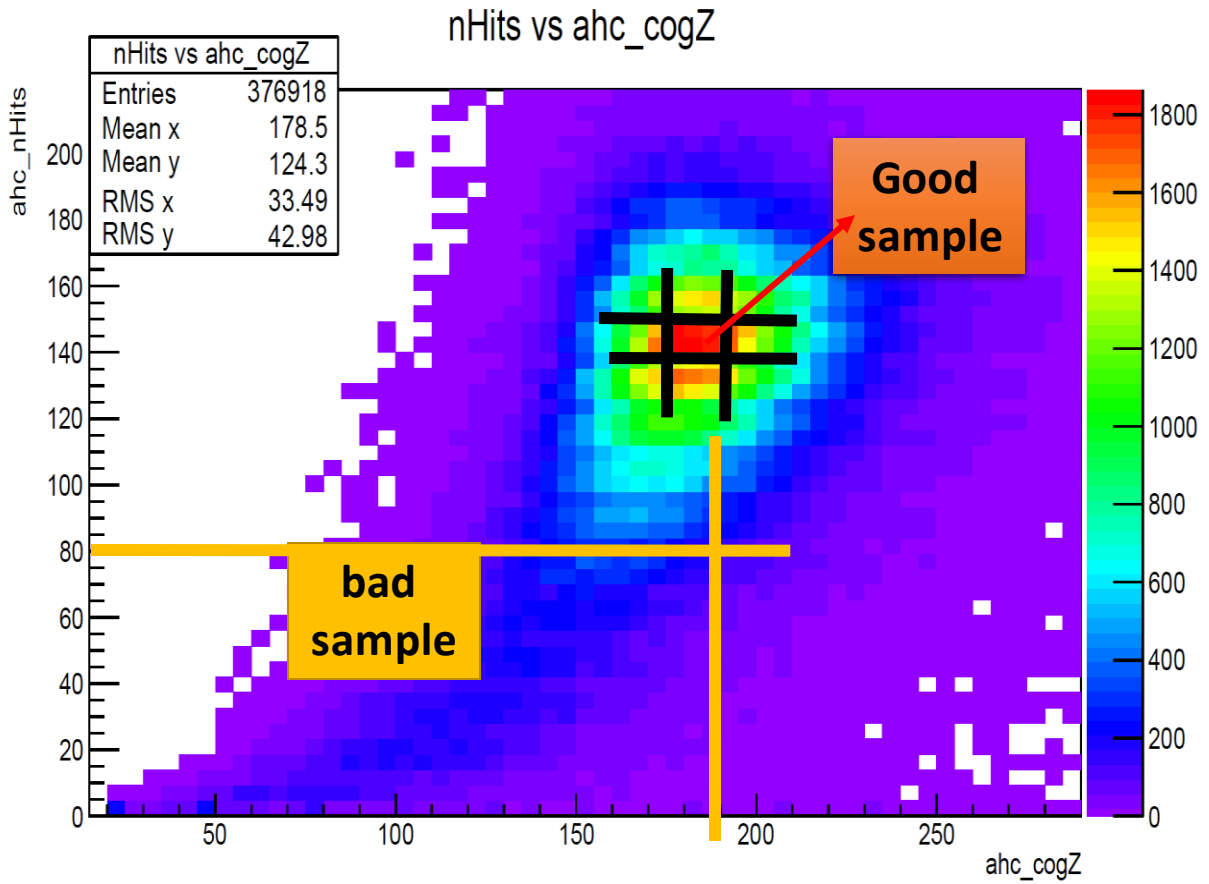
- Compare the energy_sum distribution between the run in the middle of the UBH and middle of layer.
- Check if the gaps between the two slabs has correlation with the tail.

Fourth:

- Cut the event which shower before the detector.

  ➡ by cuting in the first layer and also the 5th layer which have the maximum energy deposit.

Good and bad events selection:



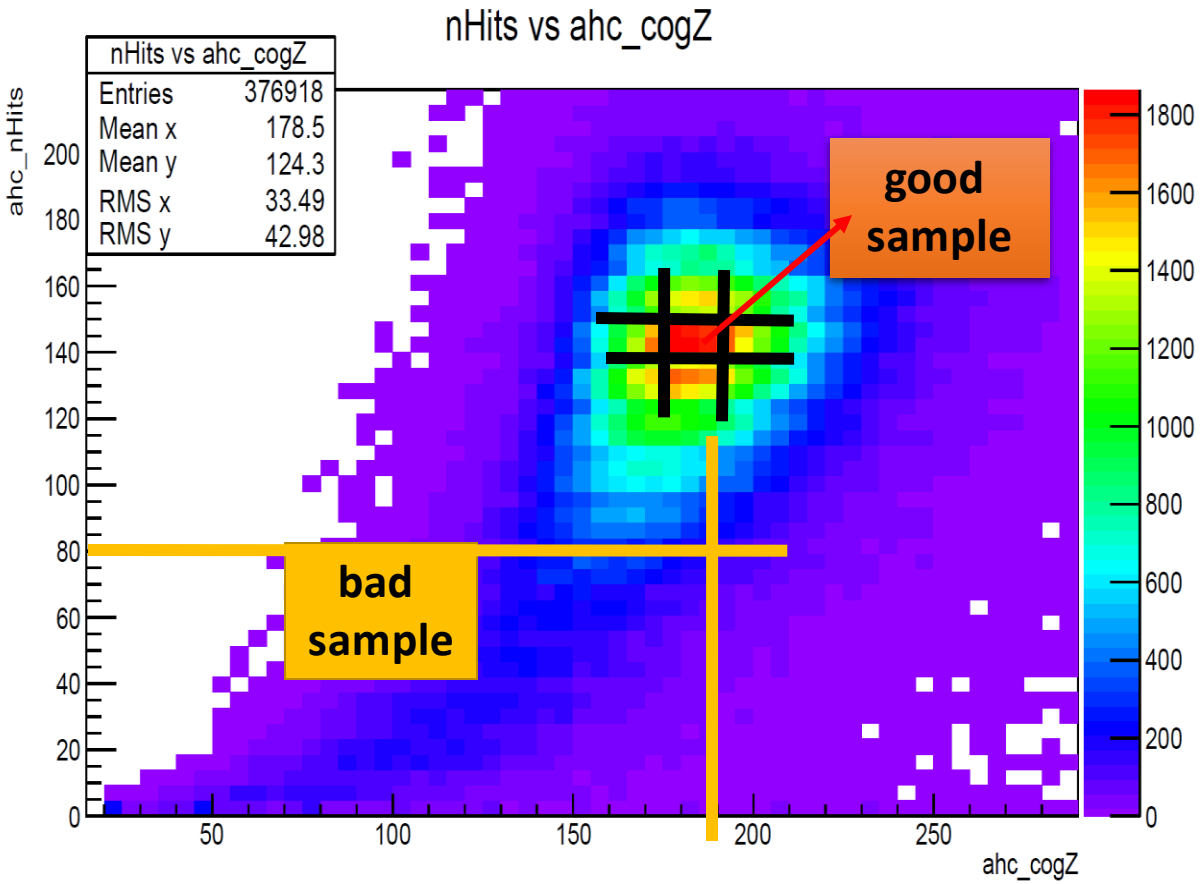
Sample 1 : bad

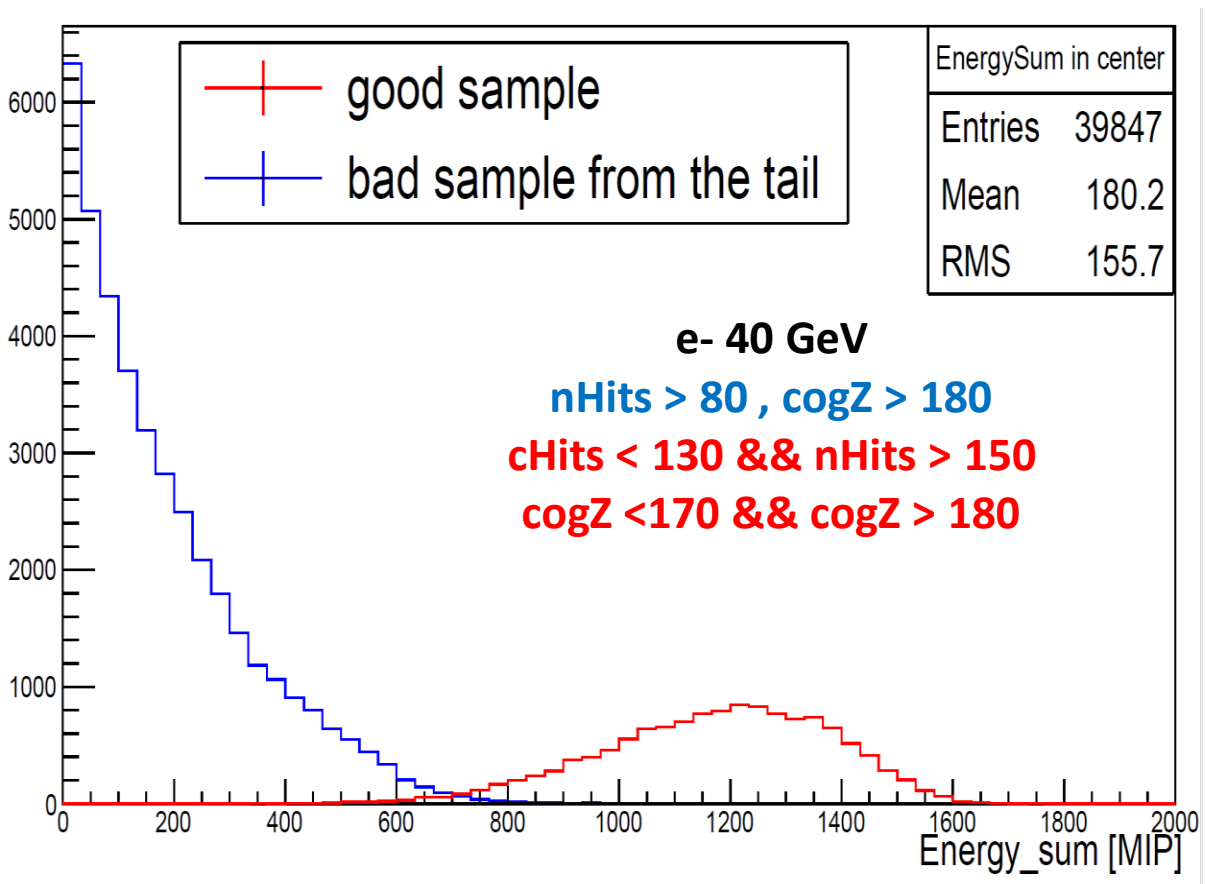
- **nHits > 115**
- **cogZ > 180**

Sample 2 : good

- **nHits < 130 && nHits > 150**
- **cogZ < 170 && cogZ > 180**

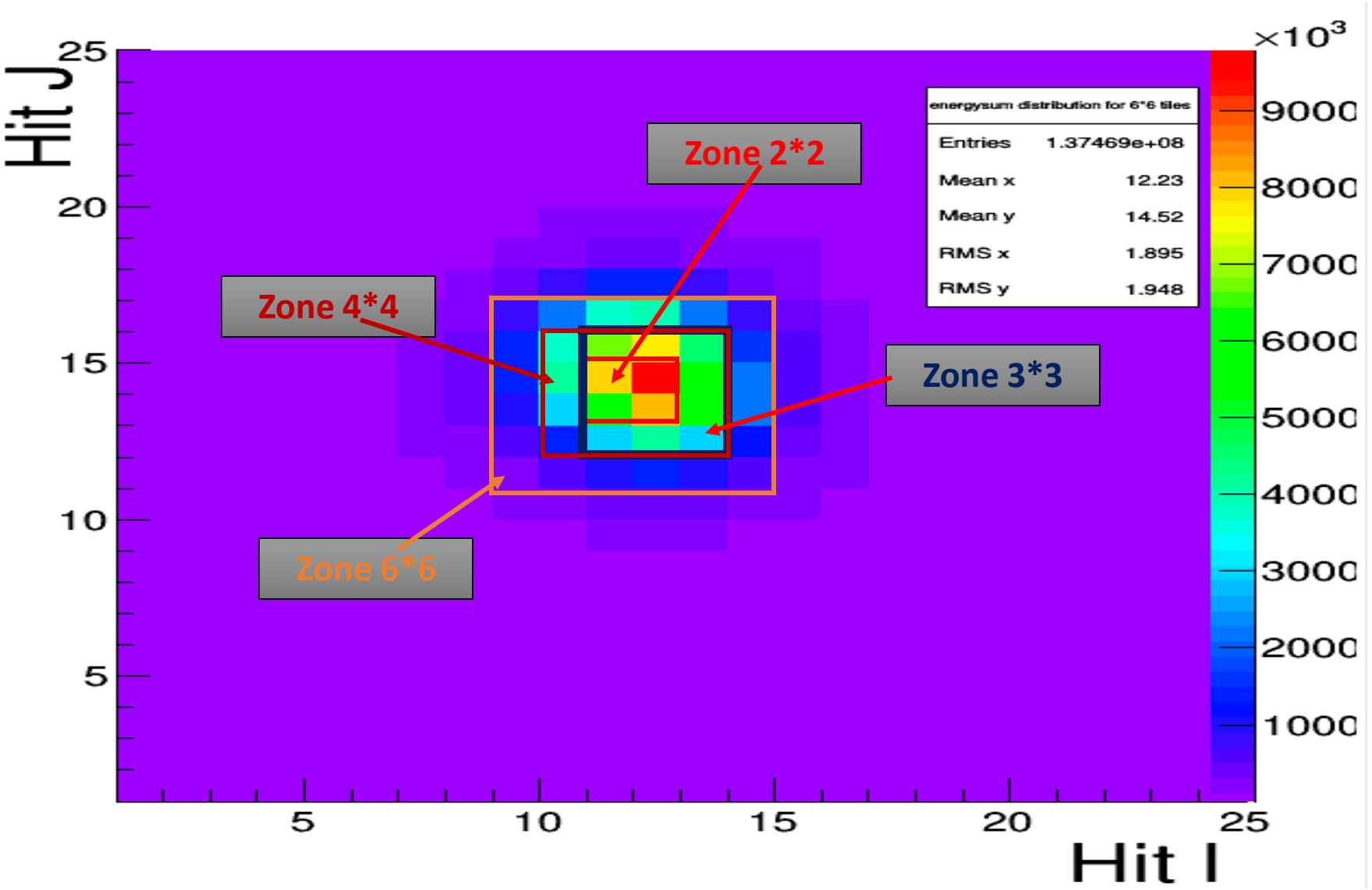
Good and bad events selection:



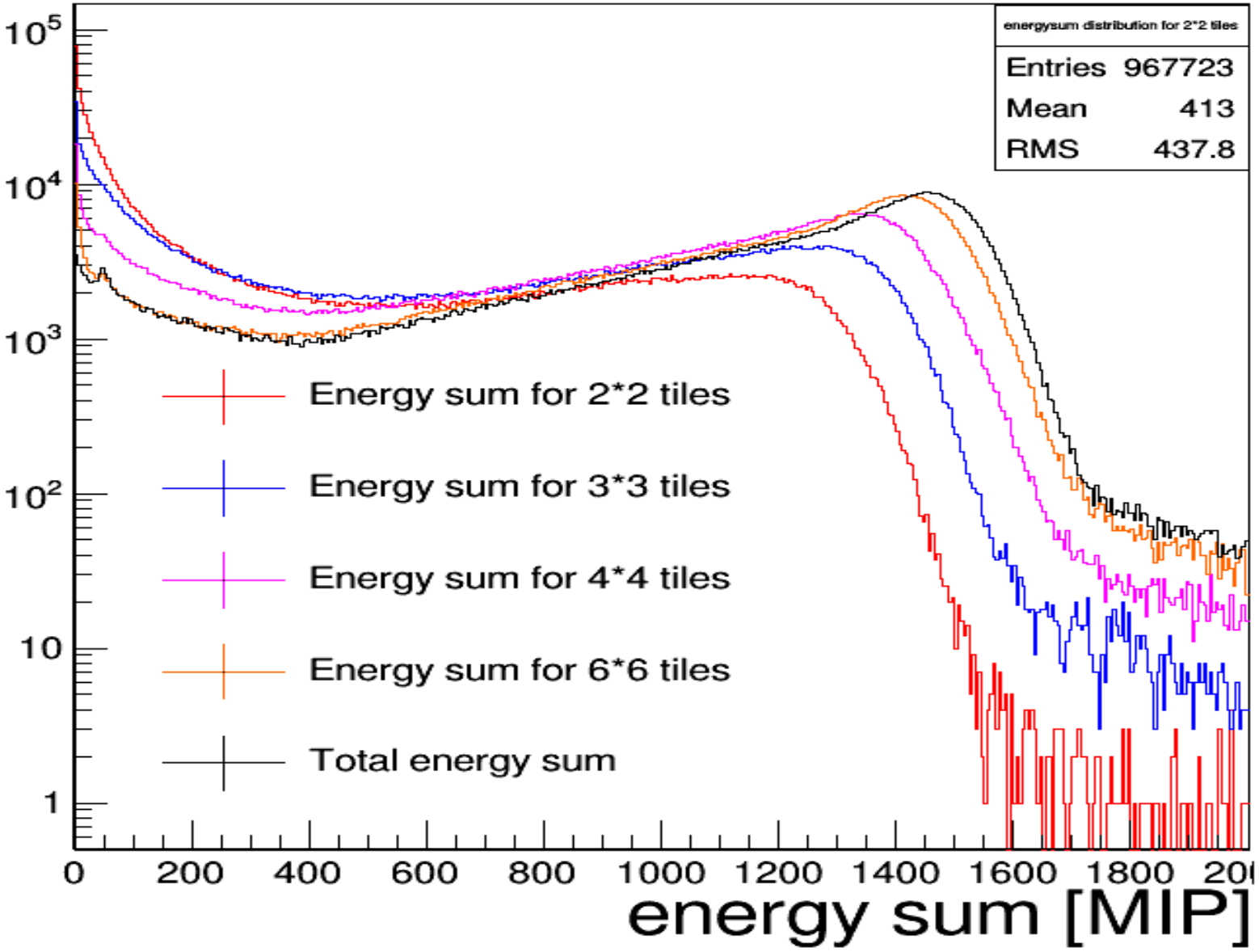


- Asymmetric distribution even with a hard event selection.
- No physics shape for the tail.

Electron selection for different region in hitI and hitJ:



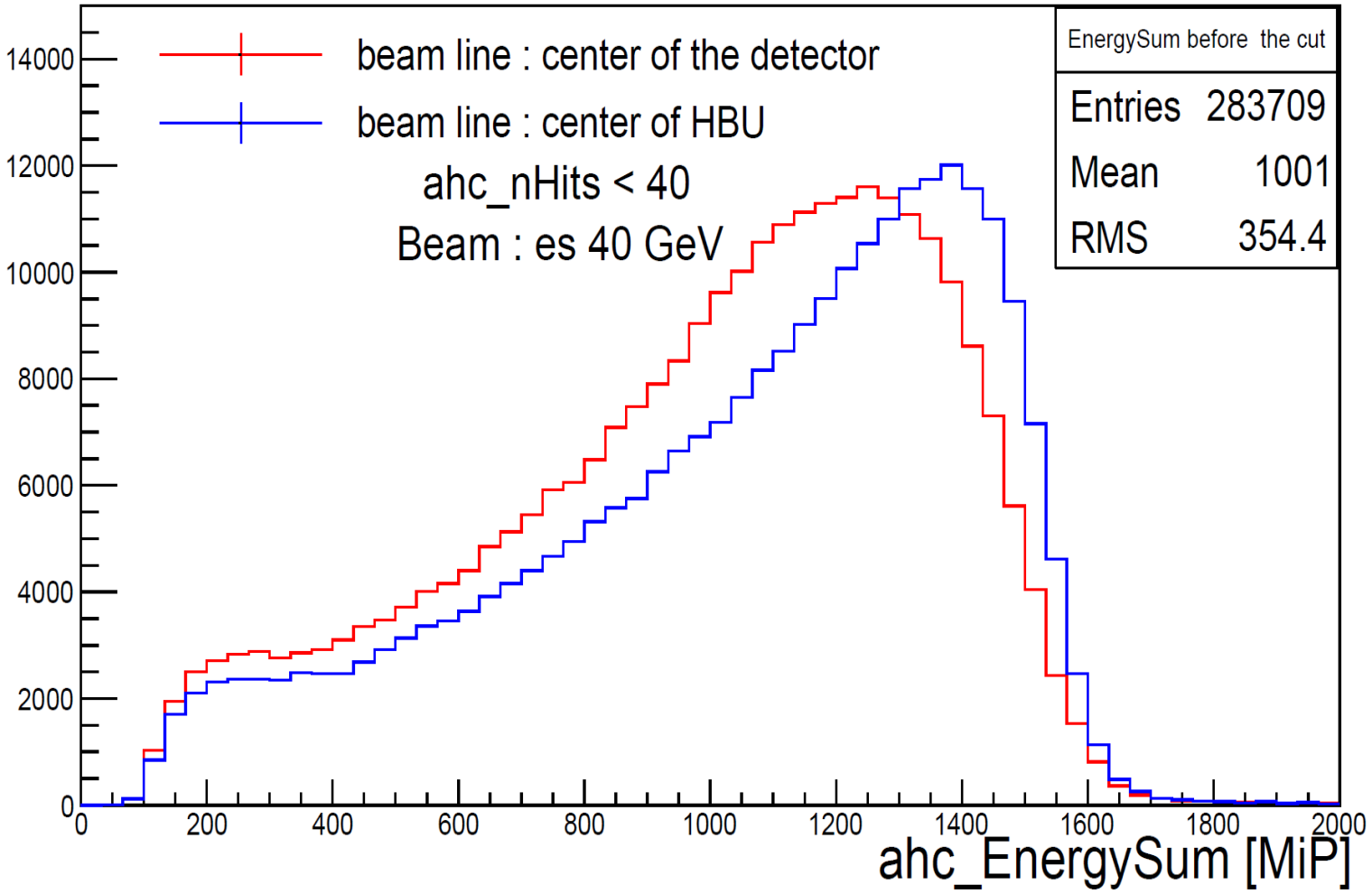
Electron selection for different region in hitI and hitJ:



- Selection in different hitI and hitJ region doesn't help to remove the tail.

Energy distribution for different beam position:

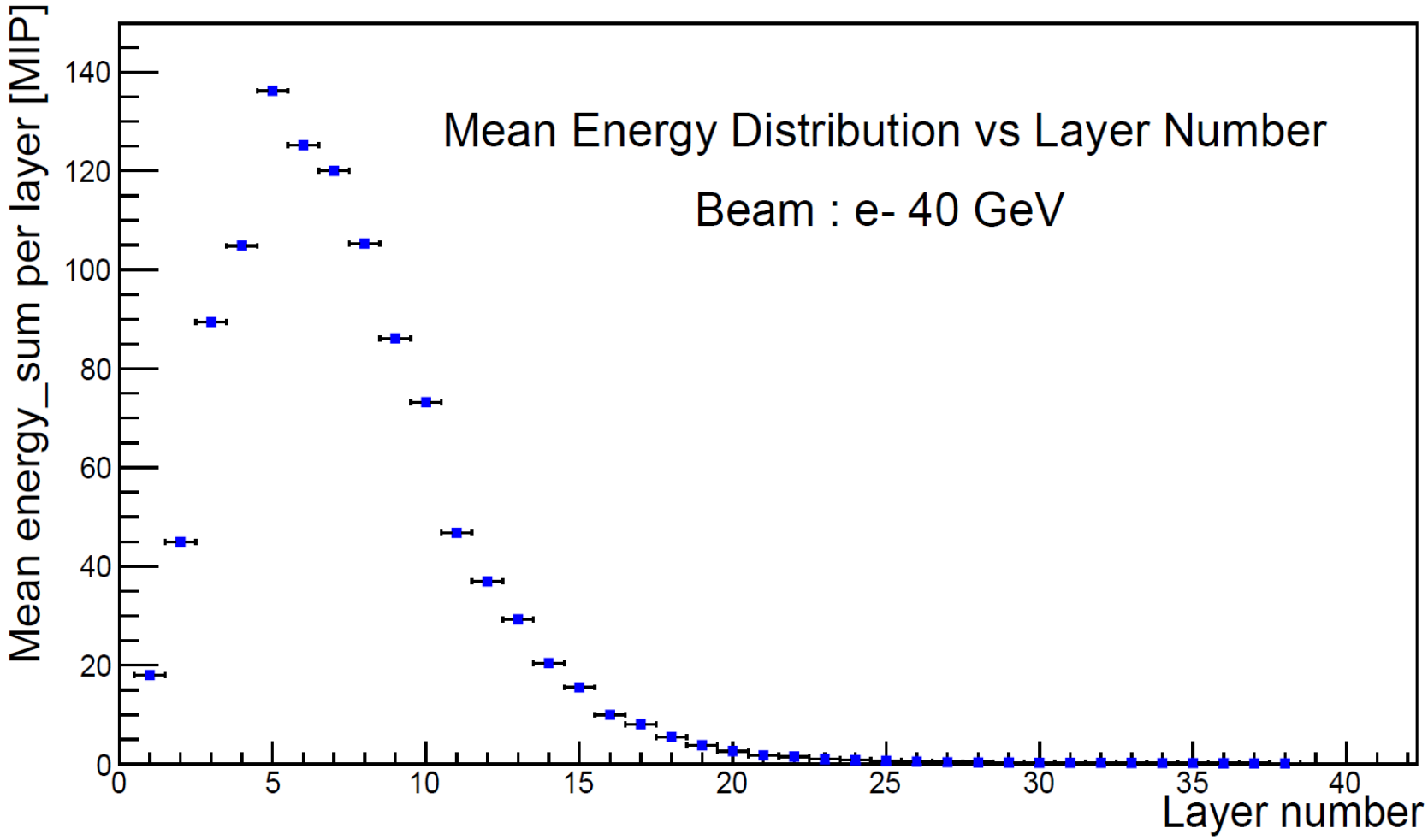
- Comparison between the energy_sum distribution for beam line in the middle of the HBU and center of the detector.



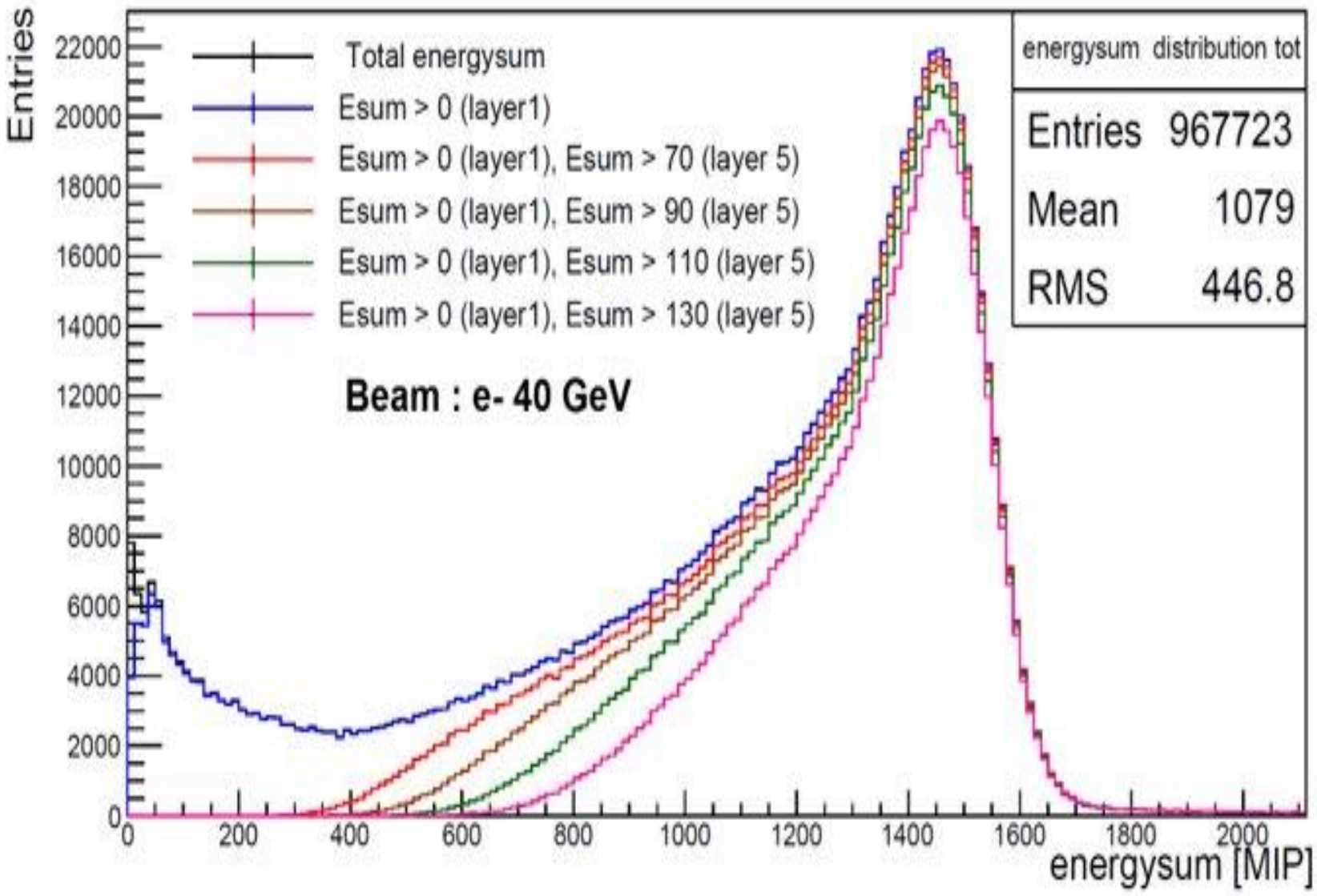
- The tail in the left of the distribution still present for both cases.
- The gaps between the slabs affects the energy distribution, because we missed some events which goes through the gaps.

Longitudinal shower profile :

- The EM shower shape is observed.
- Maximum energy deposit of the EM shower is in layer 5.



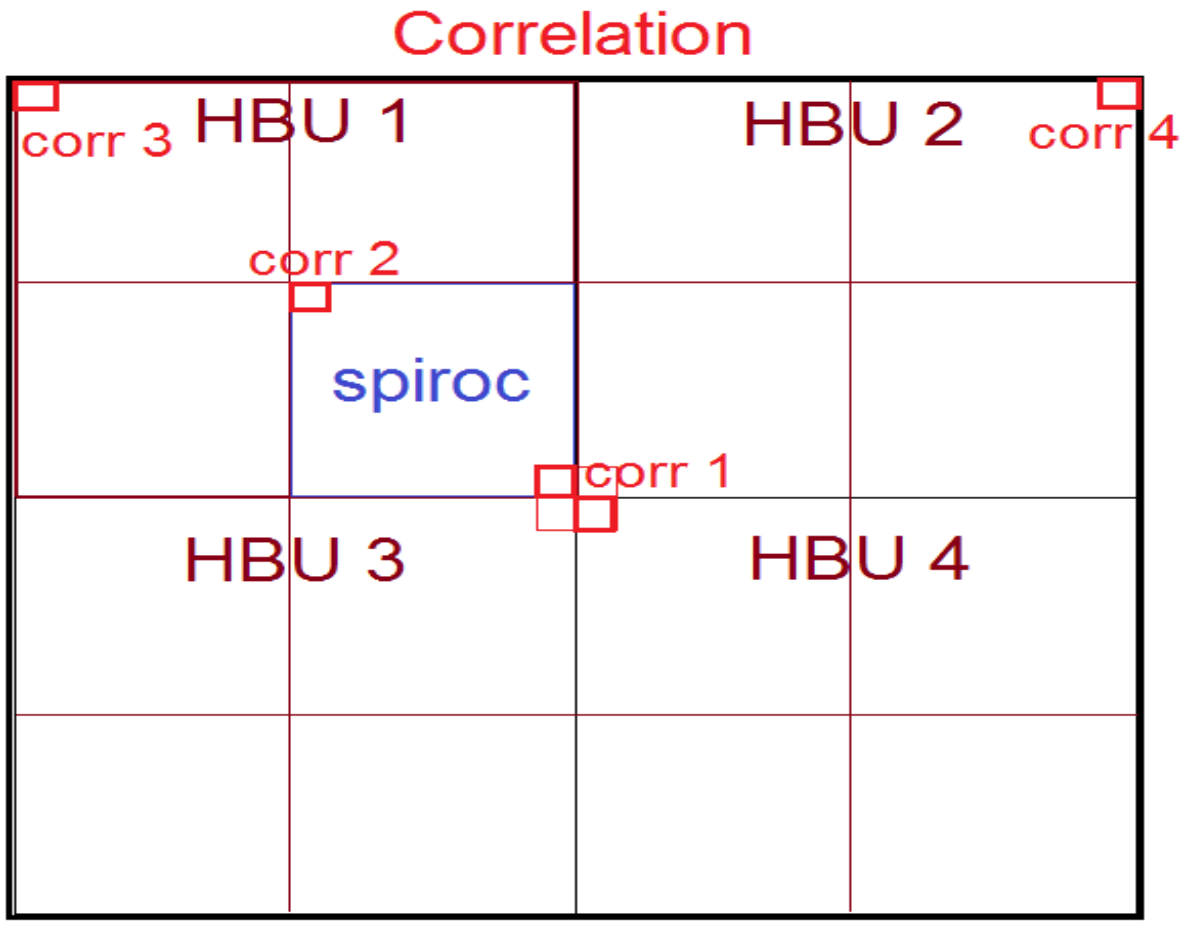
Electron selection with different cuts:



- First cut is in layer 1:
  to reject the events which doesn't deposit energy in the 1st layer.
- Second cut in layer 5:
  to reject the events which shower earlier.
- Even by hard selections, I couldn’t remove the complete tail.

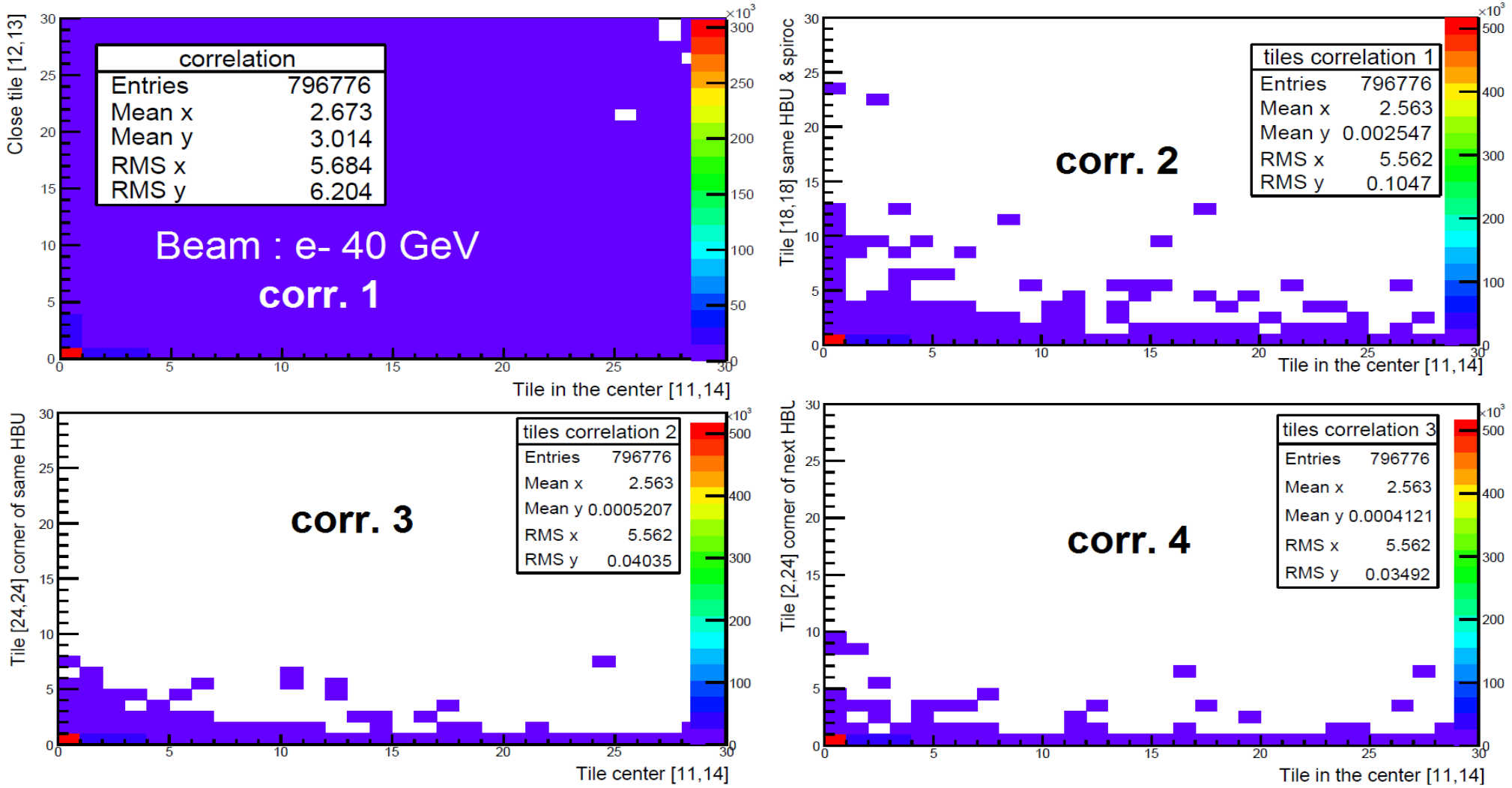
Energy correlation:

- Check the energy correlation between center and neighbors tiles.
- Neighbors tiles can be from the same spiroc, same HBU and neighbors slab.



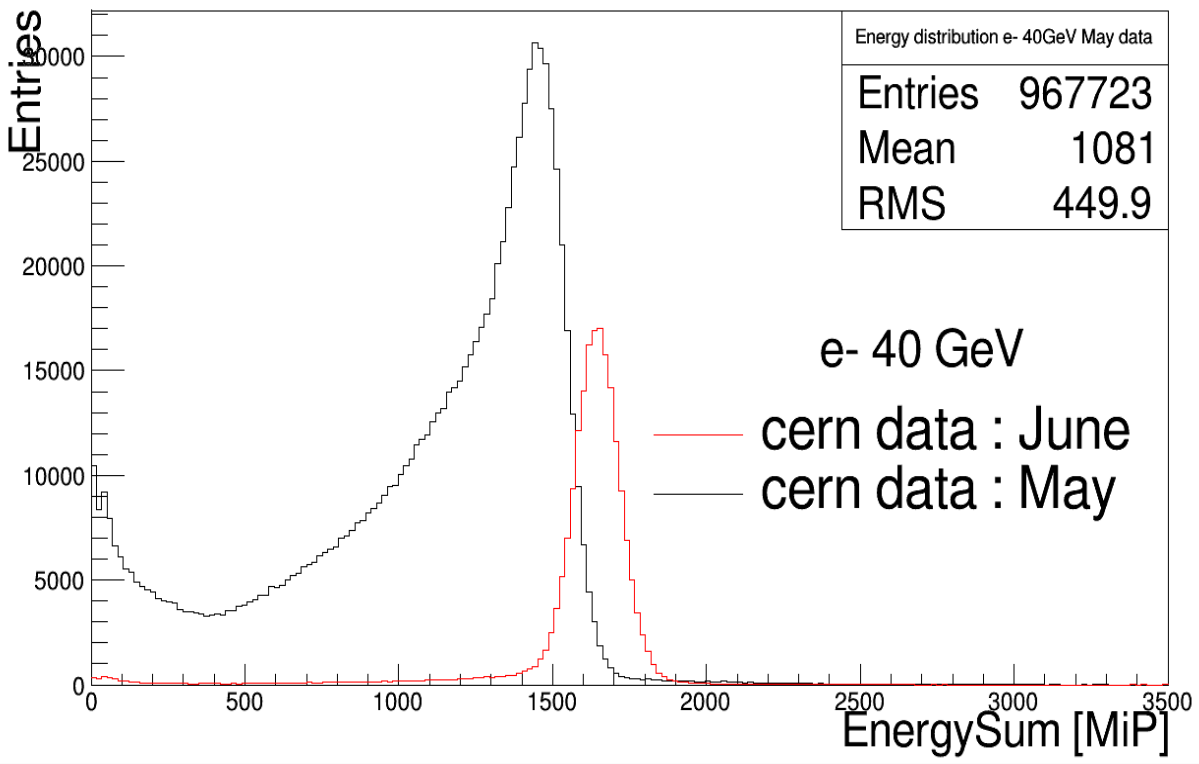
Energy correlation:

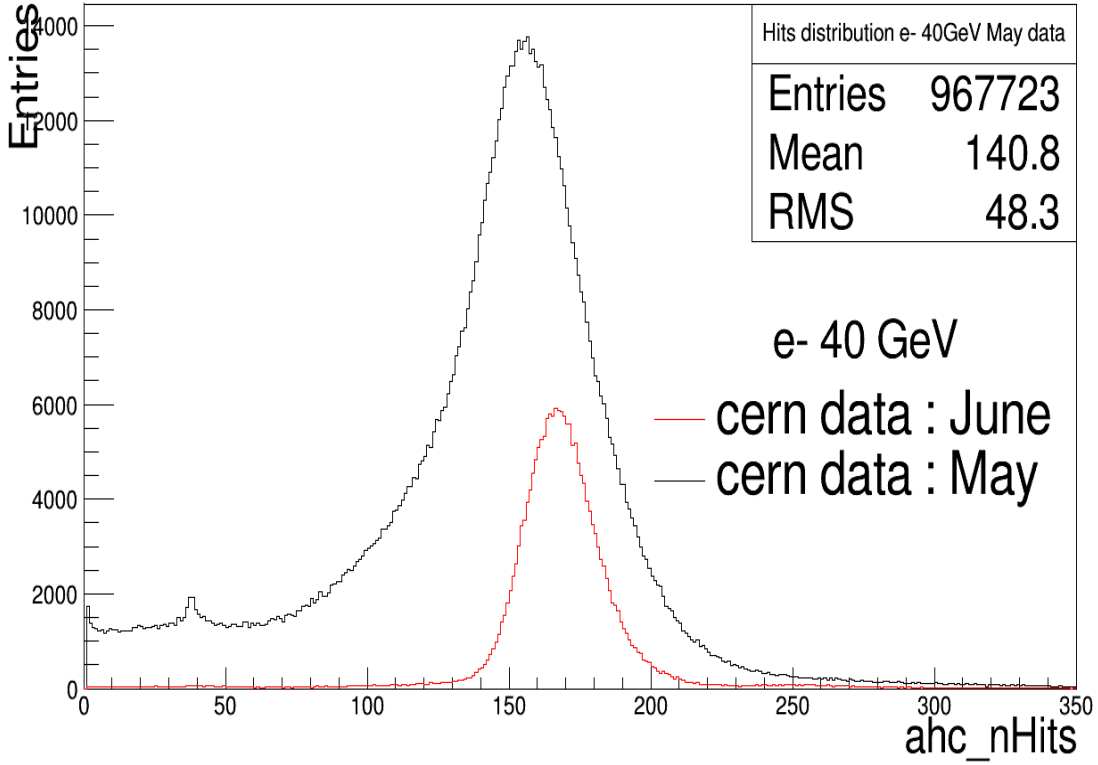
- We don't observe any correlation for the 4 cases.



Comparaison of the electrons data: May and June/July:

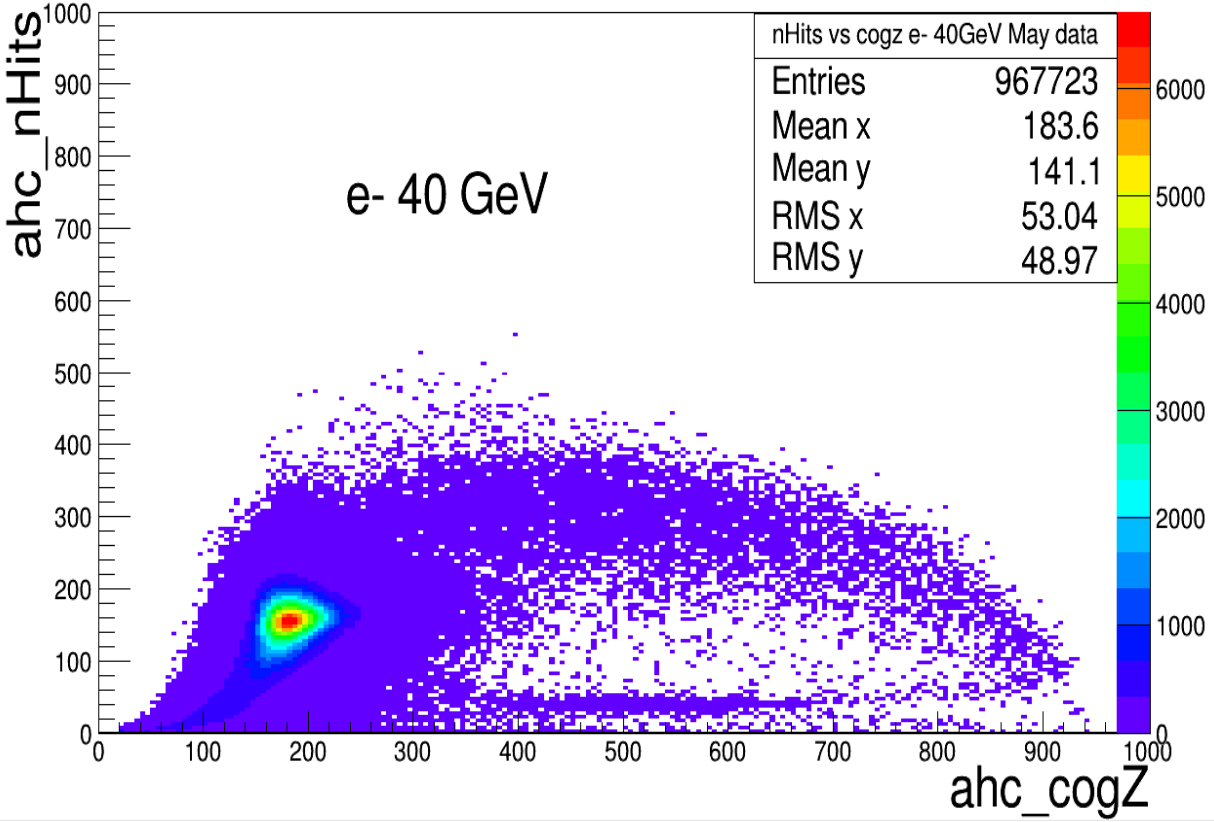
- We couldn't understand the source of the tail from May data.
- Likely that the tail disappeared in the June/July data.
- Later we noticed that the electrons beam was dirty.

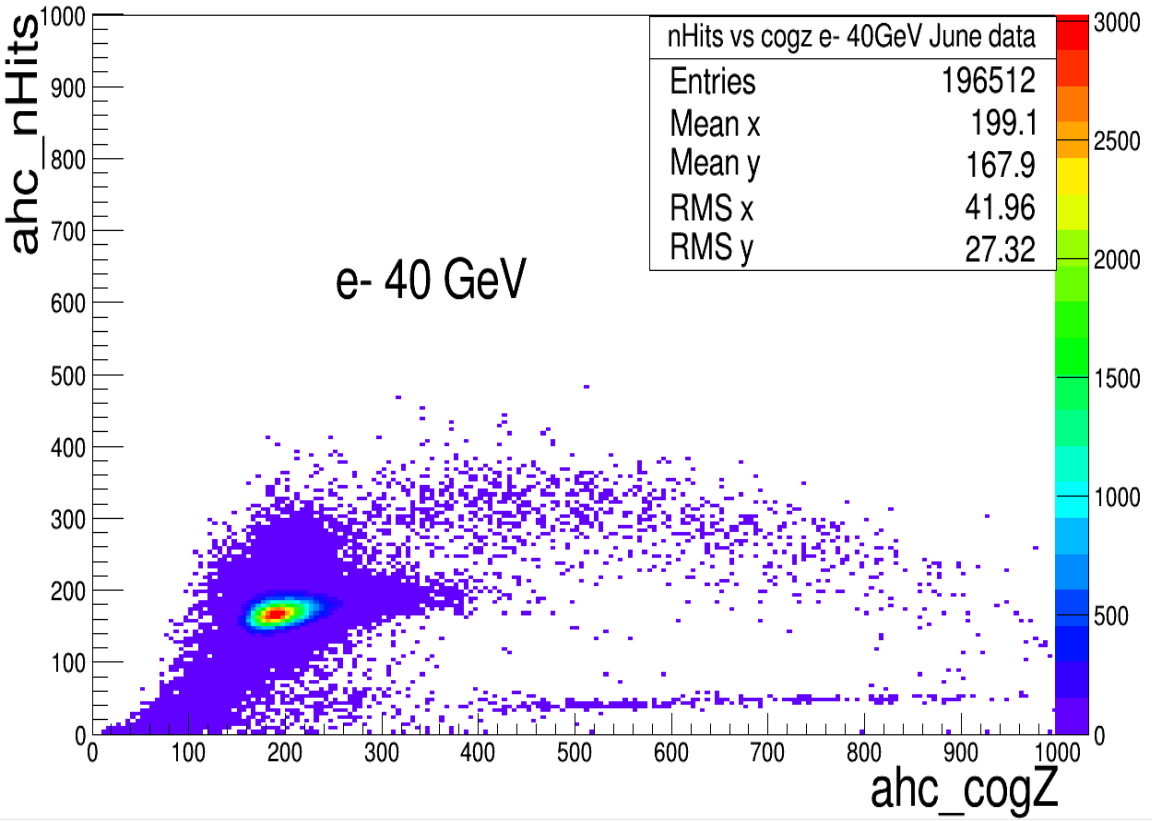




Comparison of the electrons data: May and June/July:

- We couldn't understand the source of the tail from May data.
- Likely that the tail disappeared in the June/July data.
- Later we notice that the electrons beam was dirty.





Conclusion:

- **After several selection methods, we couldn't remove the tail from the energy distribution.**
- **The reason of this tail was from the e- beam which was dirty.**
- **Unfortunately we should forget about the May data since our June/July data looks quite good.**
- **Now our data looks much better, we can start the cross check of our calibrations parameters and also studying the EM performance of our detector.**

THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS?

BACK UP

Electron selection for different region in hitI and hitJ:

June/July data