H35DEMO Analog Matrix #2 test

Sample : H35DEMO, Analog matrix #2 wire bonded, glued to FEI4, 200 Ohm-cm

23 rows x 300 columns of pixels, 750um thickness,

Type of pixels

- 100 columns with extra DPTUB for HV and high gain
- 100 columns without extra DPTUB for HV and high gain
- 100 columns without extra DPTUB for HV and low gain

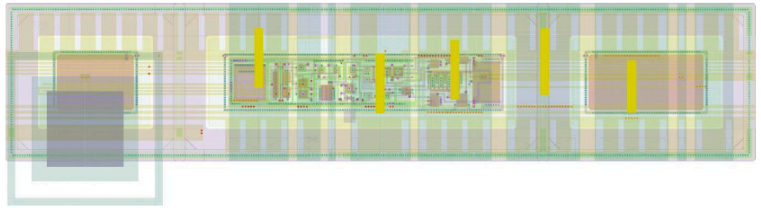


Fig. 22 Layout of the analog pixel with the extra DPTUB and high gain.

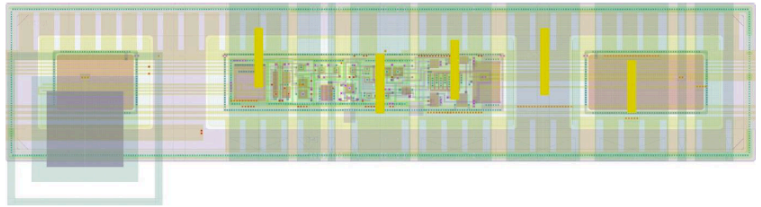
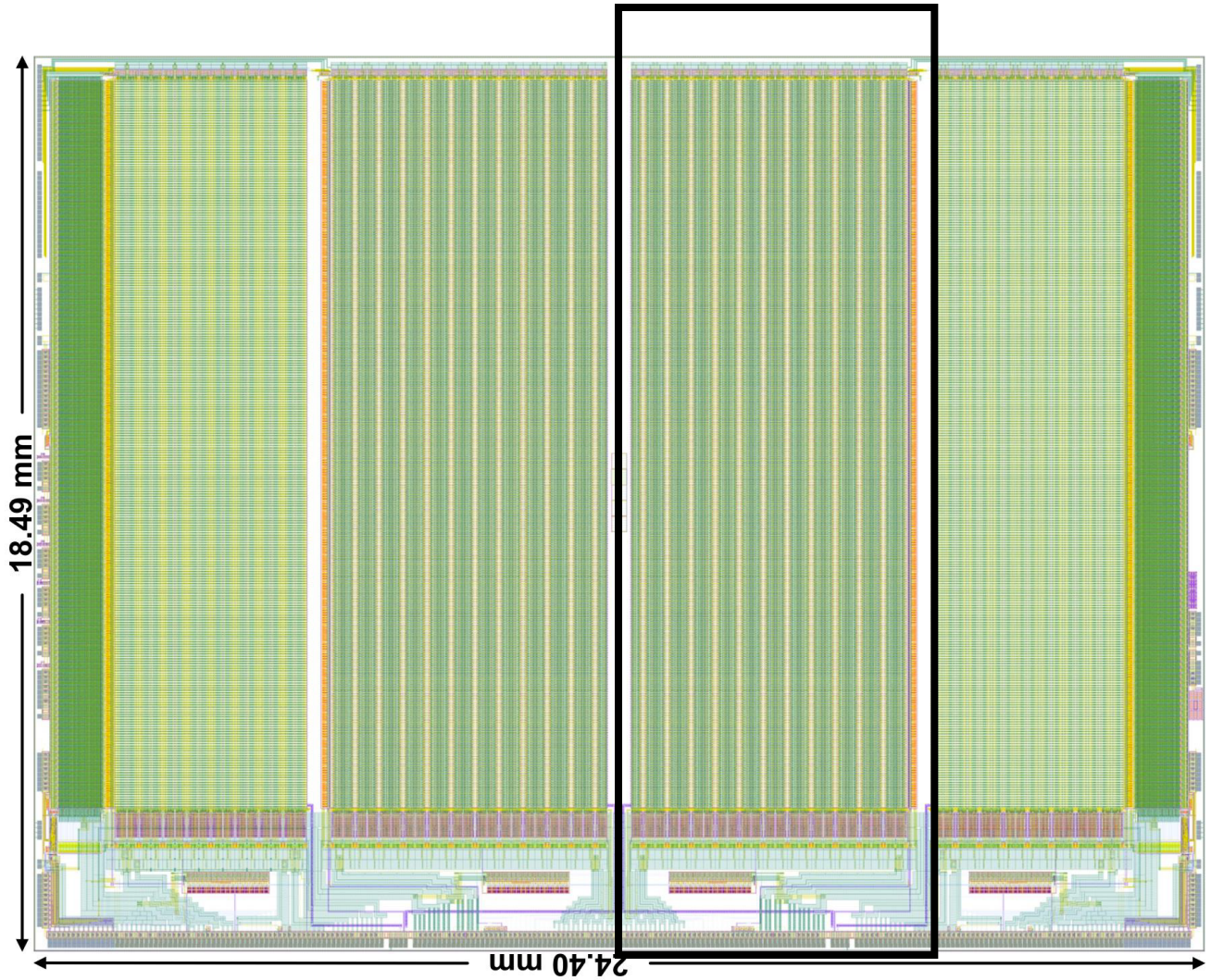
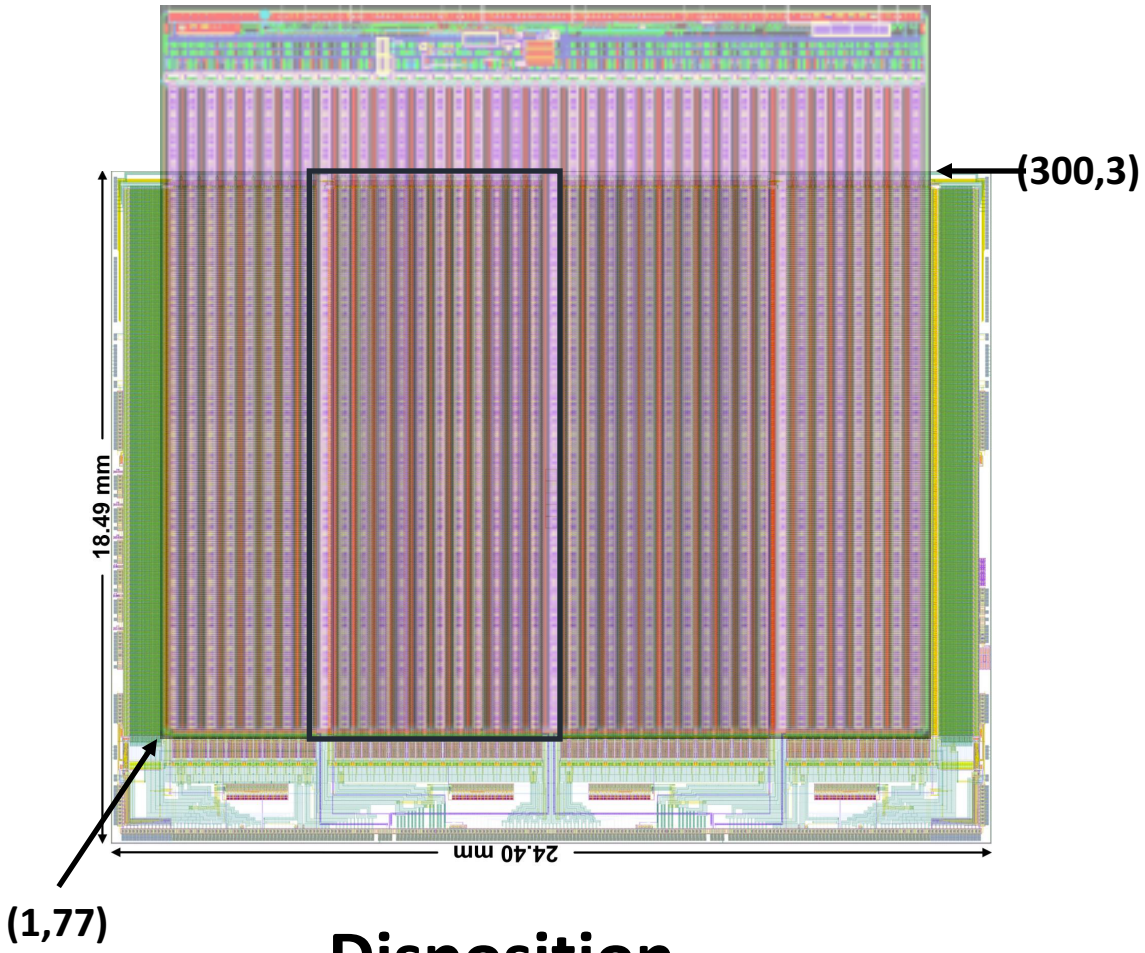


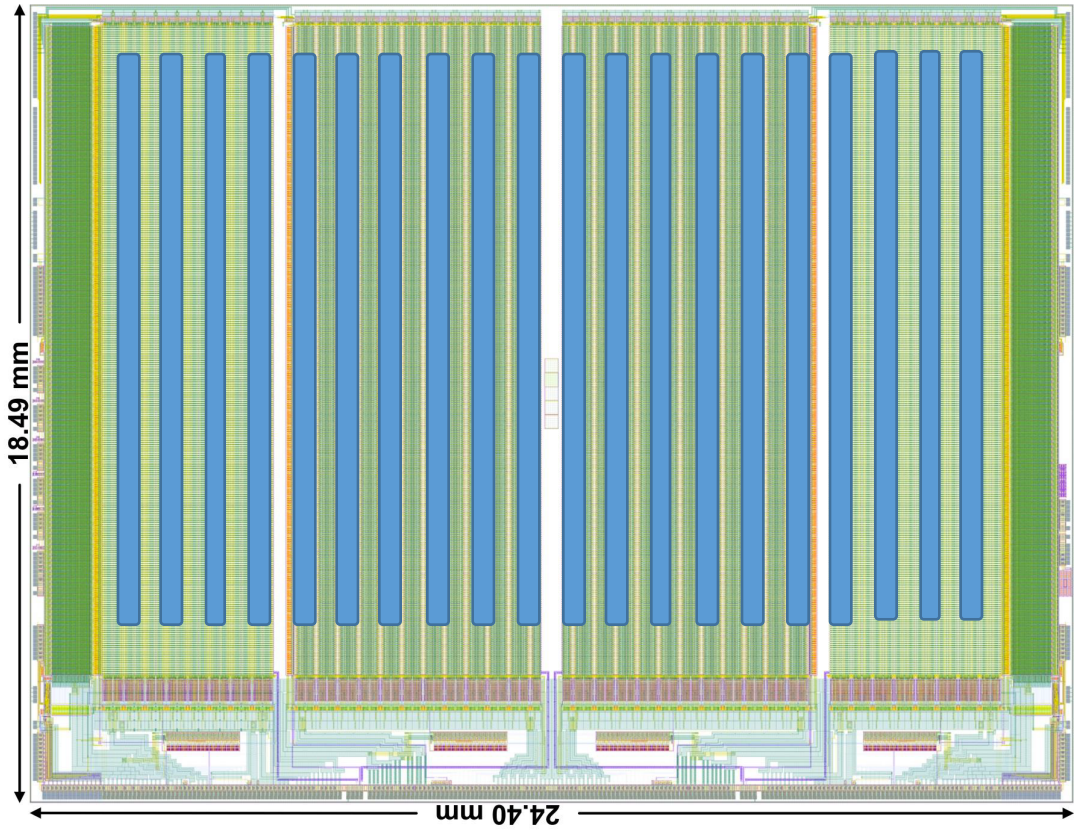
Fig. 23 Layout of the analog pixel without the extra DPTUB and low gain.



Sensor gluing



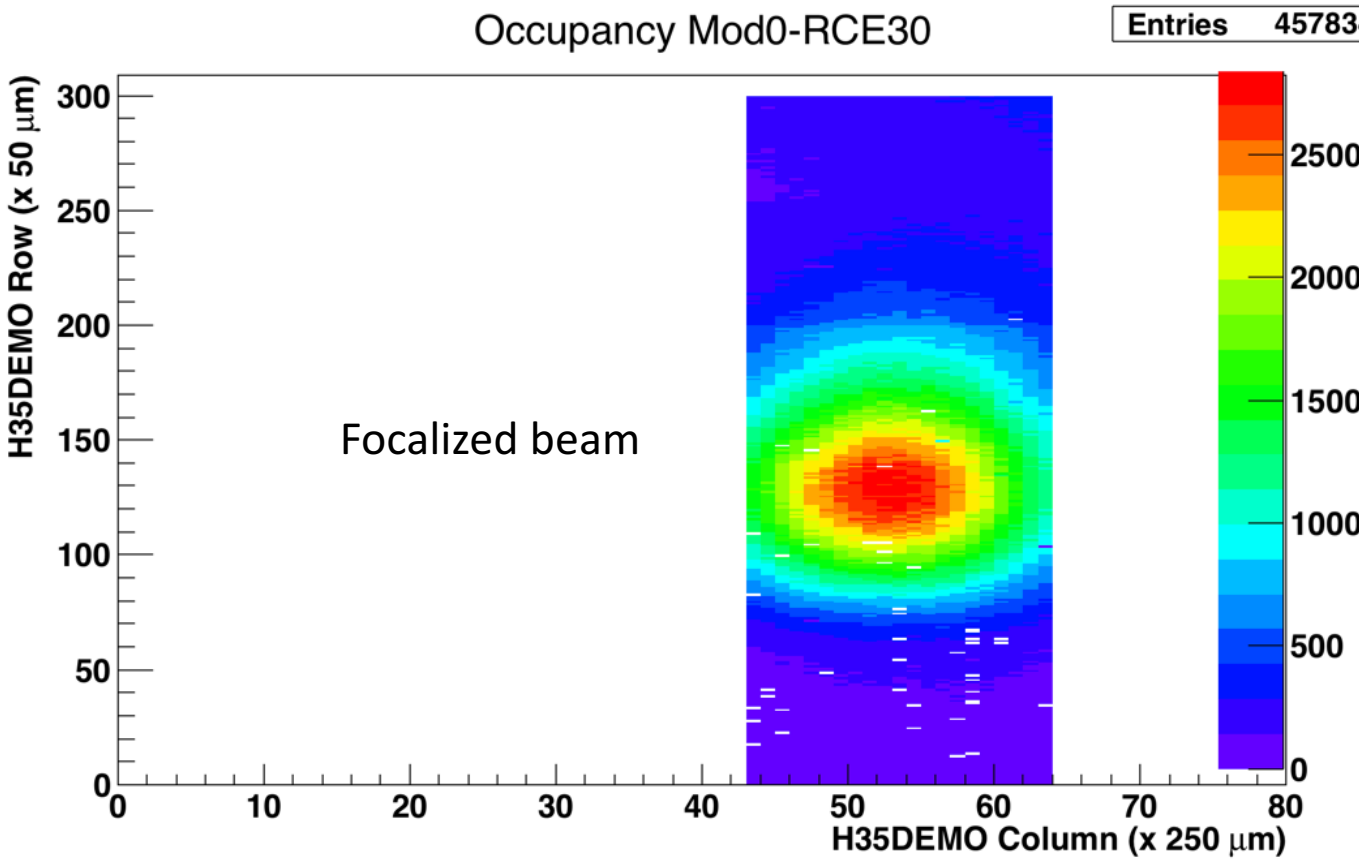
Disposition

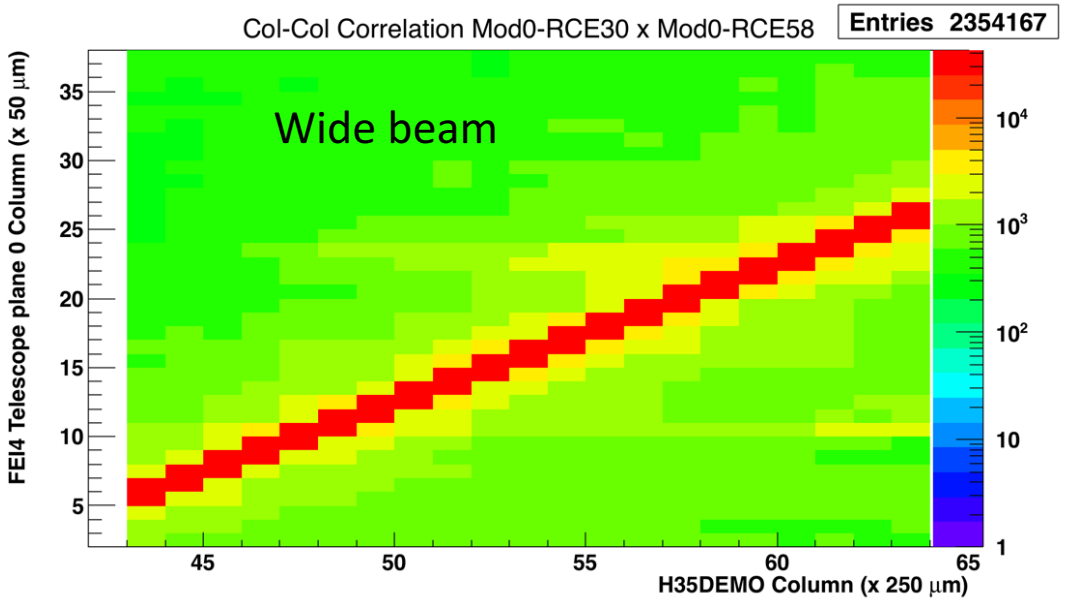


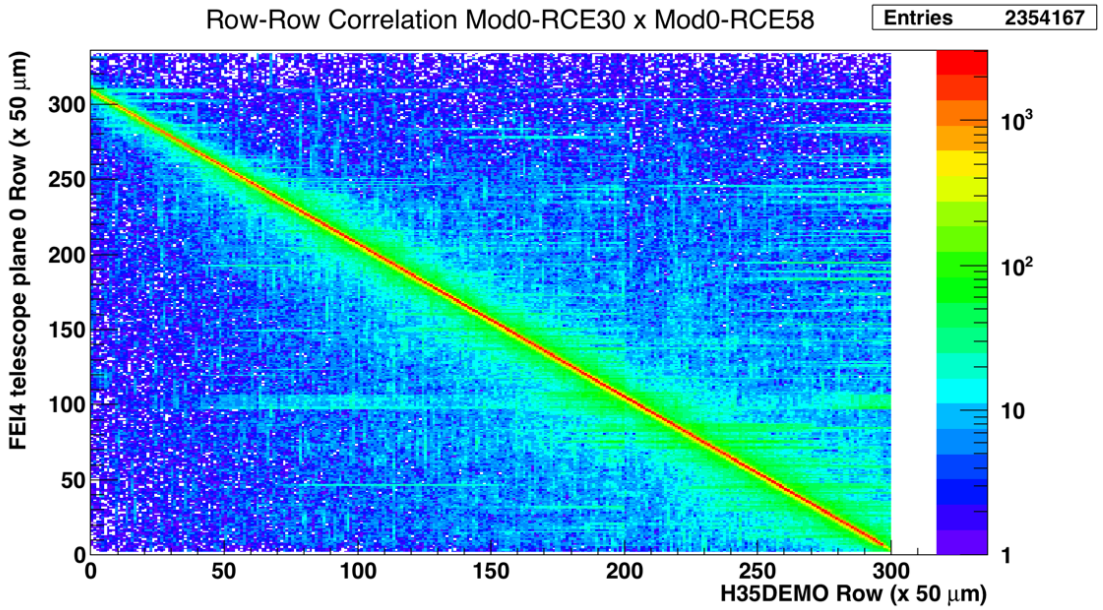
Glue pattern, Araldite 2011
20 lines with500um need tip, 3 bar pressure, 1mm/s
Stopping at 500um from edge of matrix to avoid glue on bondinf pads

First beam spot image and correlation

- Bias : 160V, Defaults DAC settings

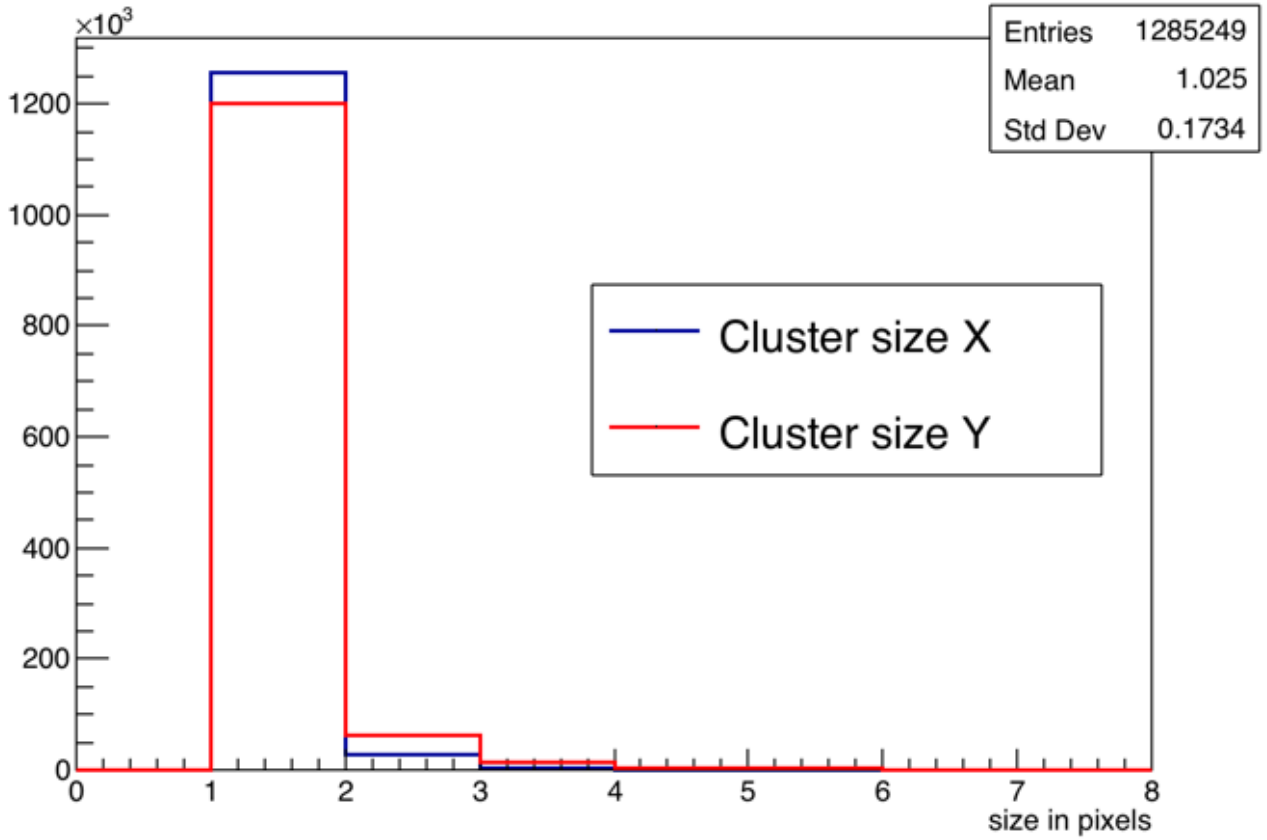


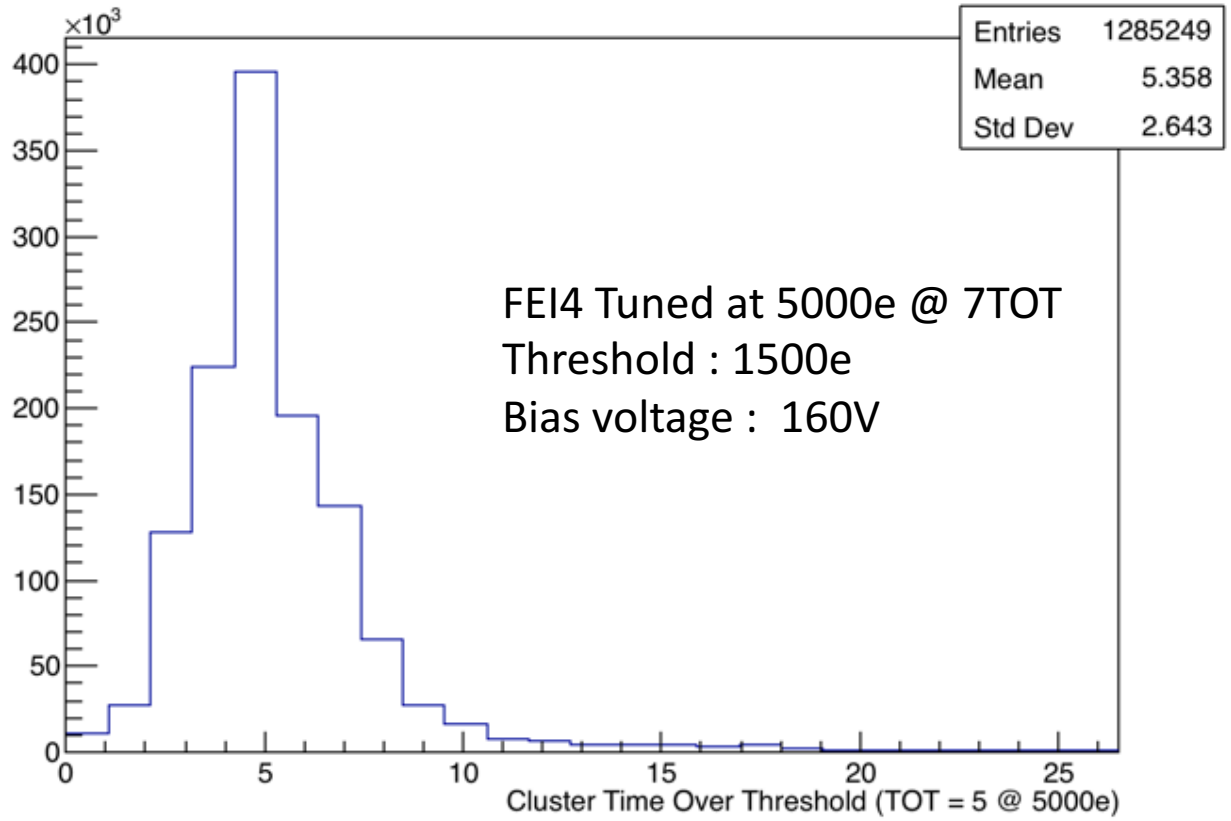




Noise occupancy << 1e-5

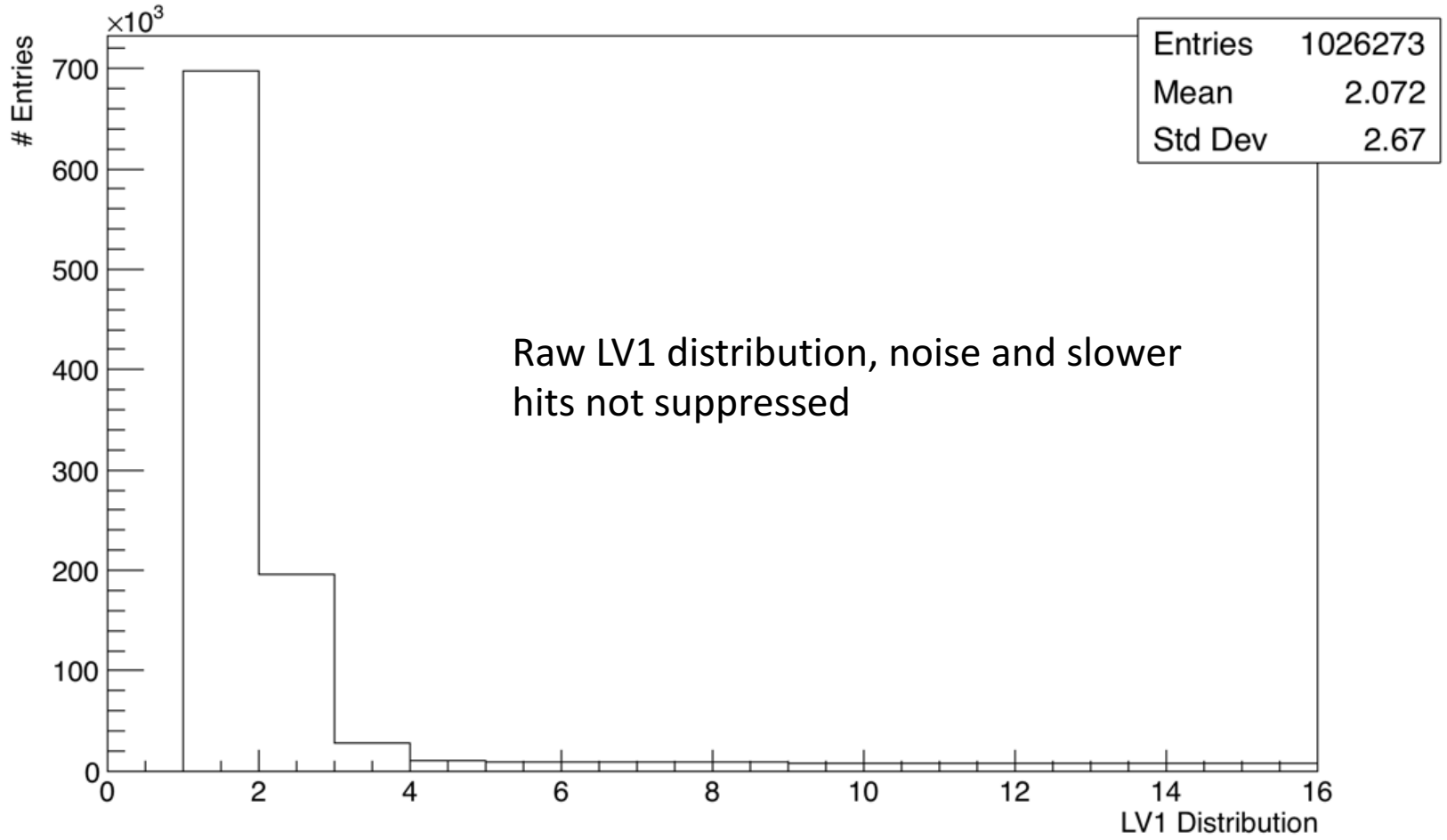
Cluster properties



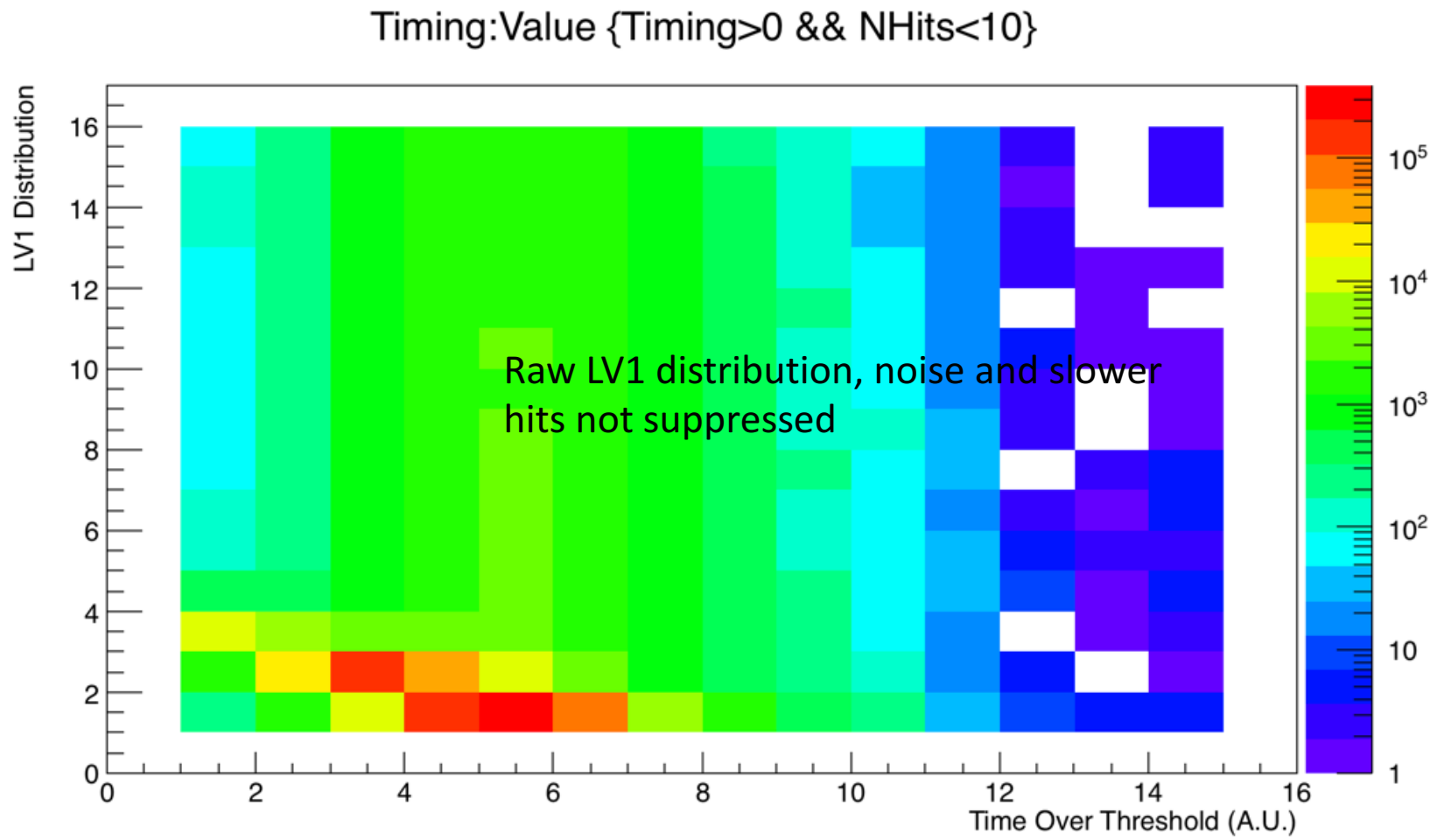


FEI4 Tuned at 5000e @ 7TOT
Threshold : 1500e
Bias voltage : 160V

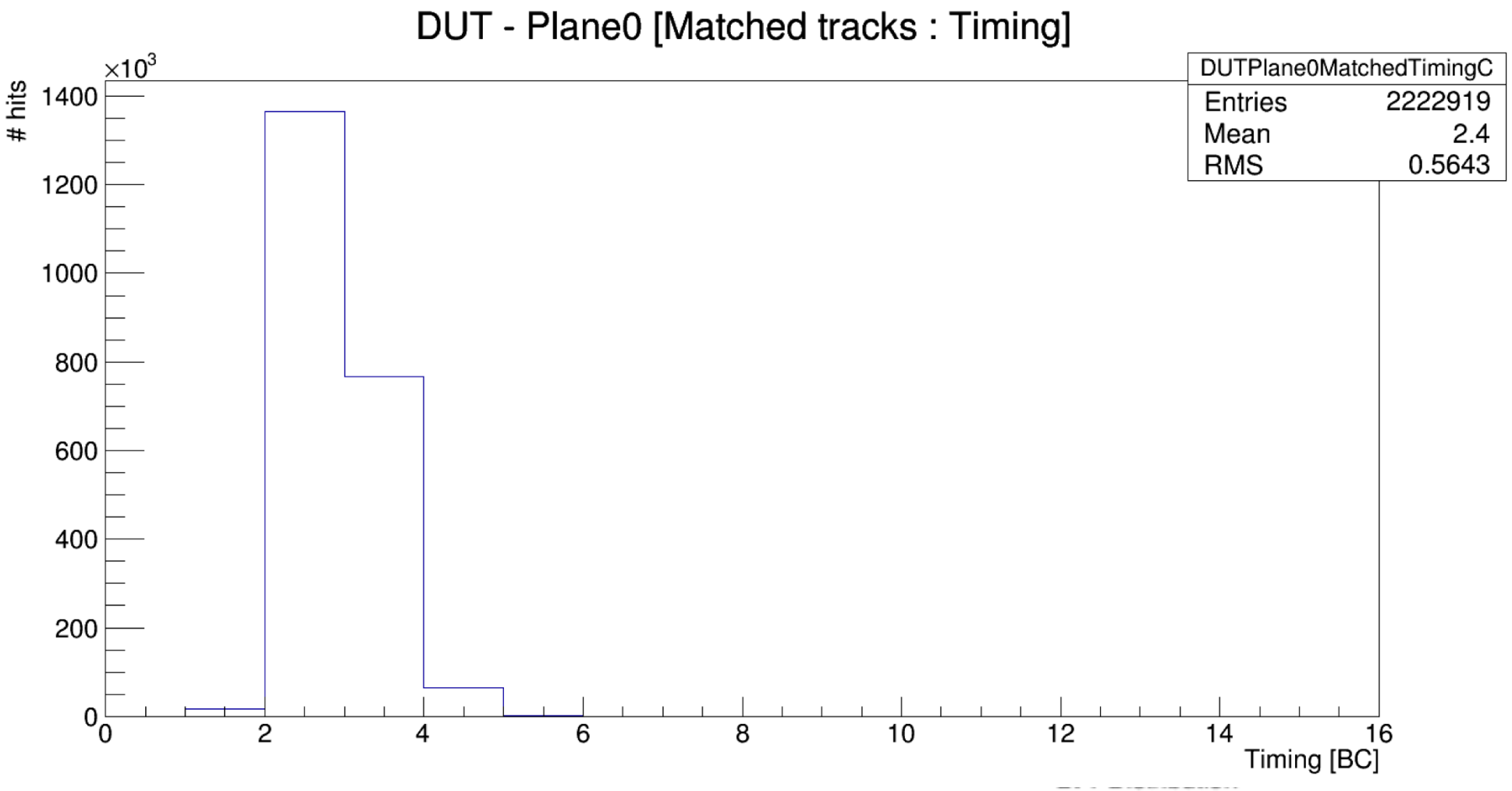
Timing properties



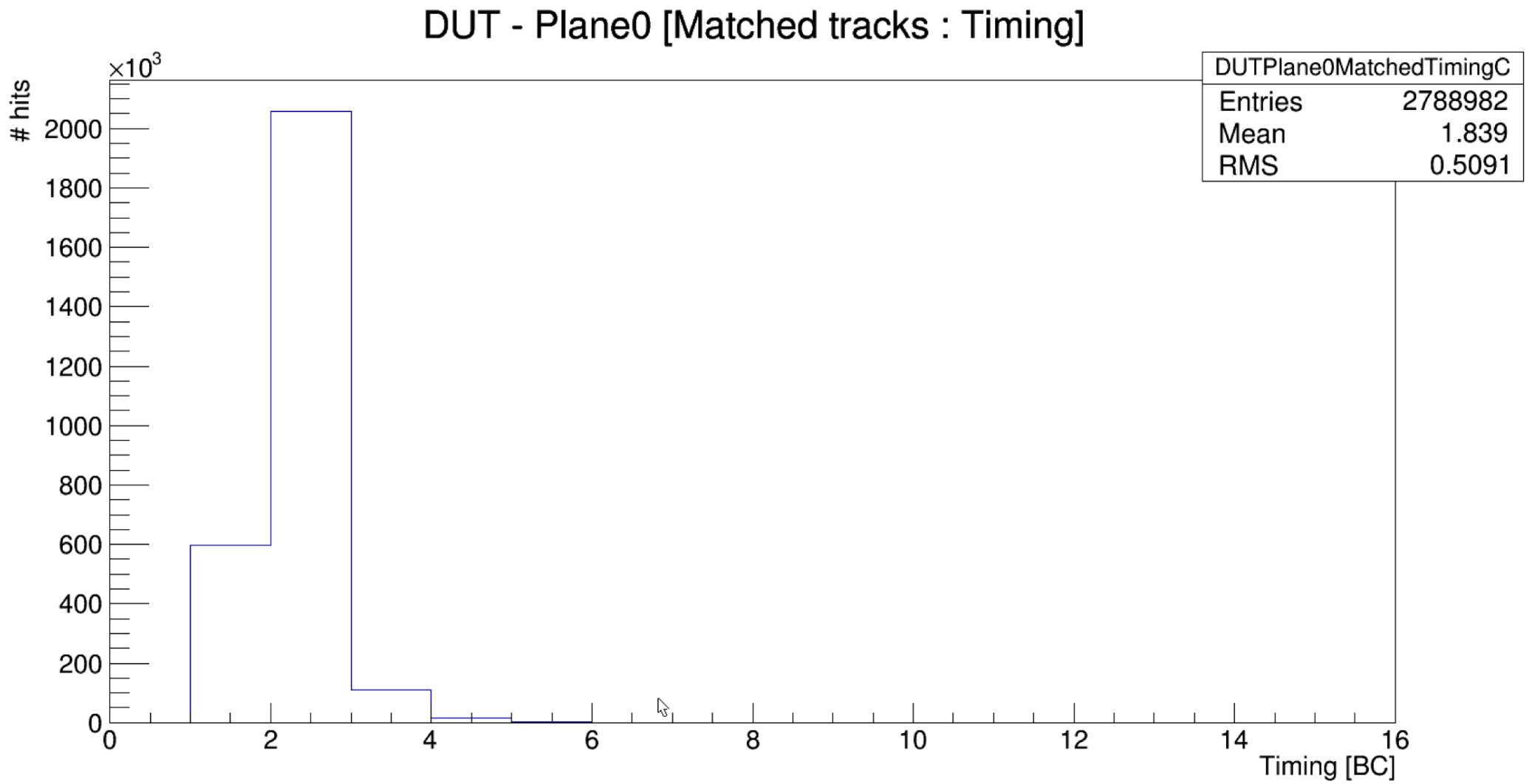
Timewalk


Timing:Value {Timing>0 && NHits<10}
LV1 Distribution
Time Over Threshold (A.U.)
Raw LV1 distribution, noise and slower hits not suppressed

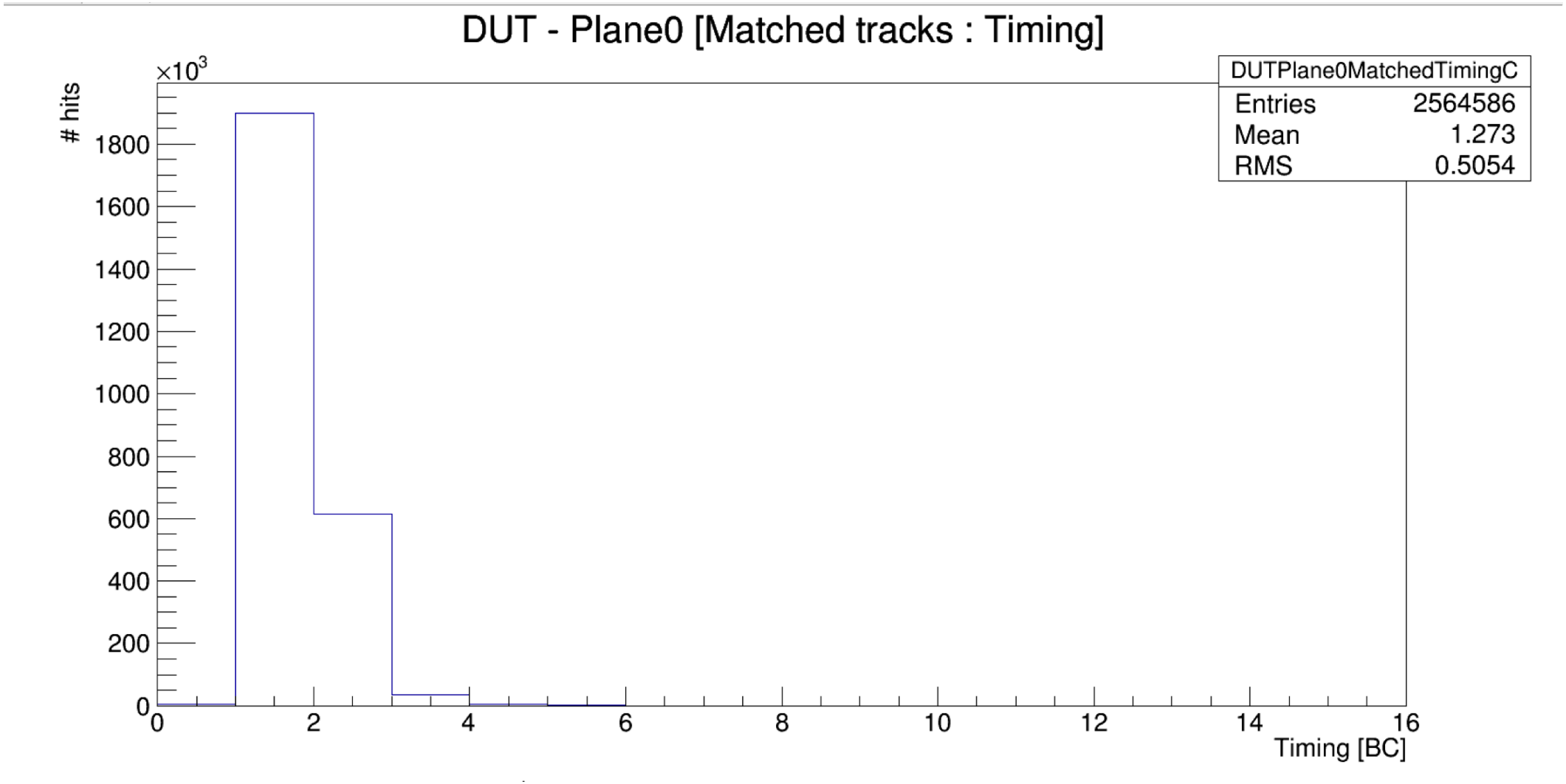
On track LV1 Distribution : Low Gain + no extra DPTUP



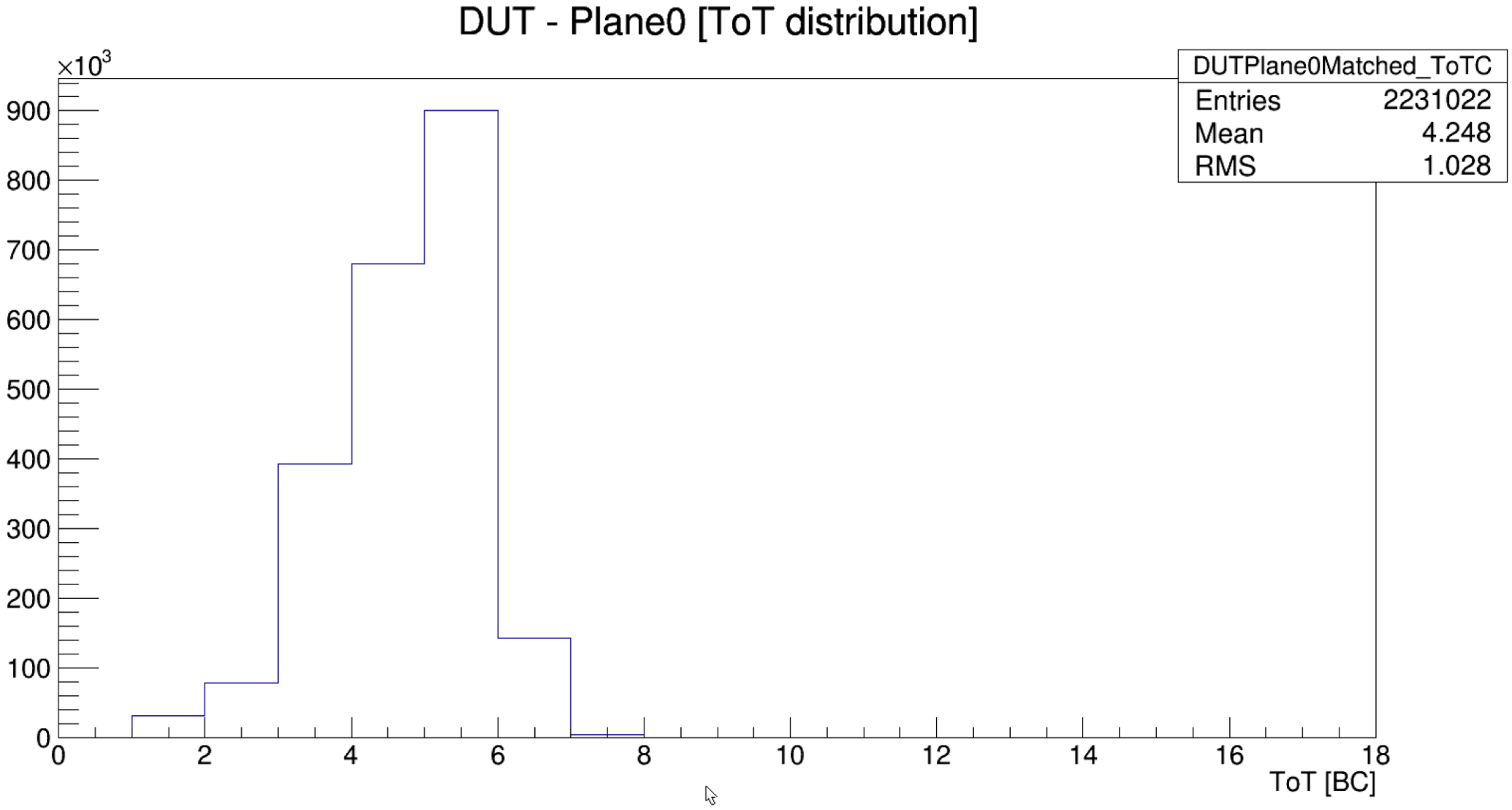
On-Track LV1 Distribution : High Gain + no extra DPTUP



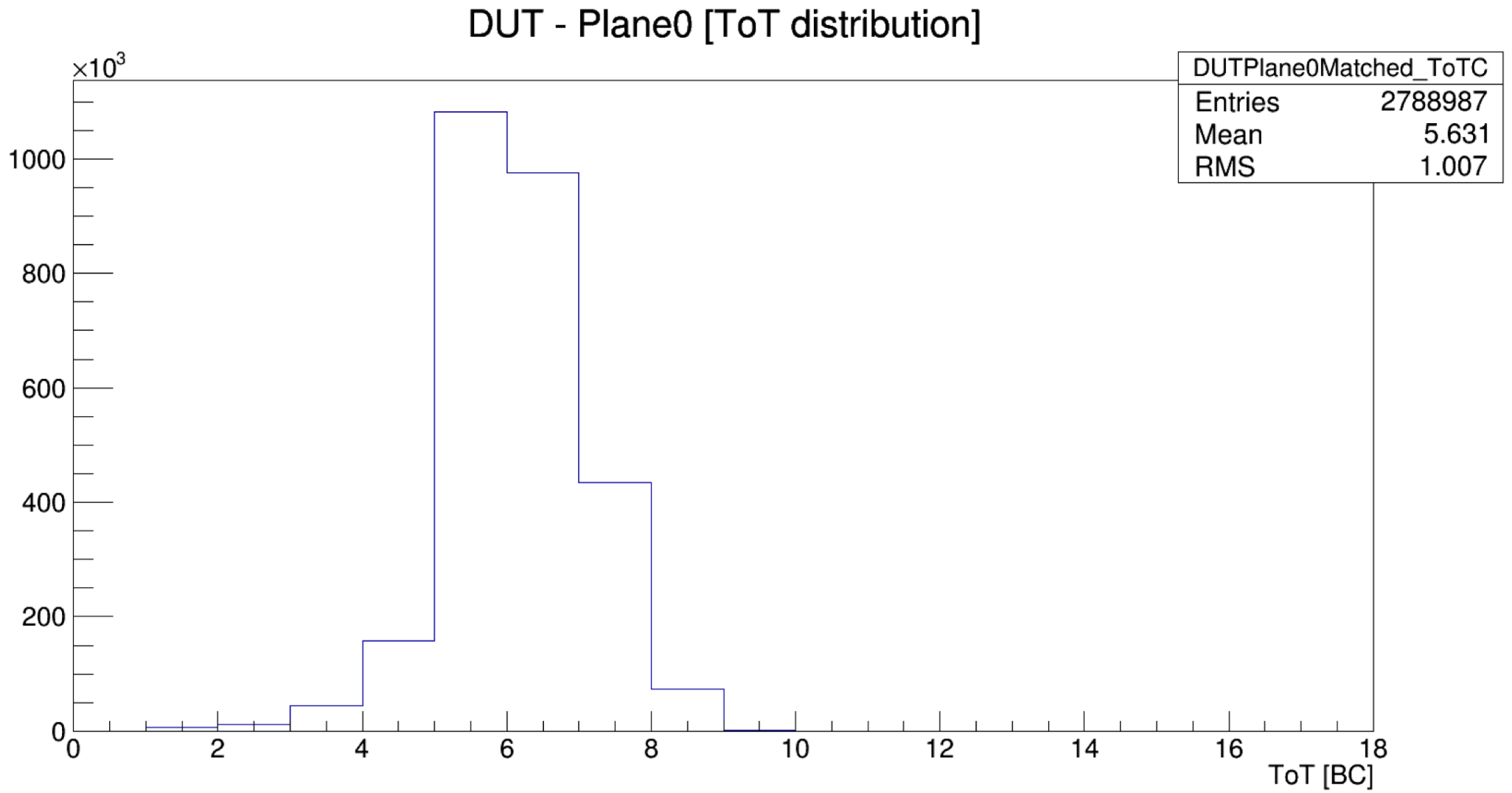
On-Track LV1 Distribution : High Gain + extra DPTUP



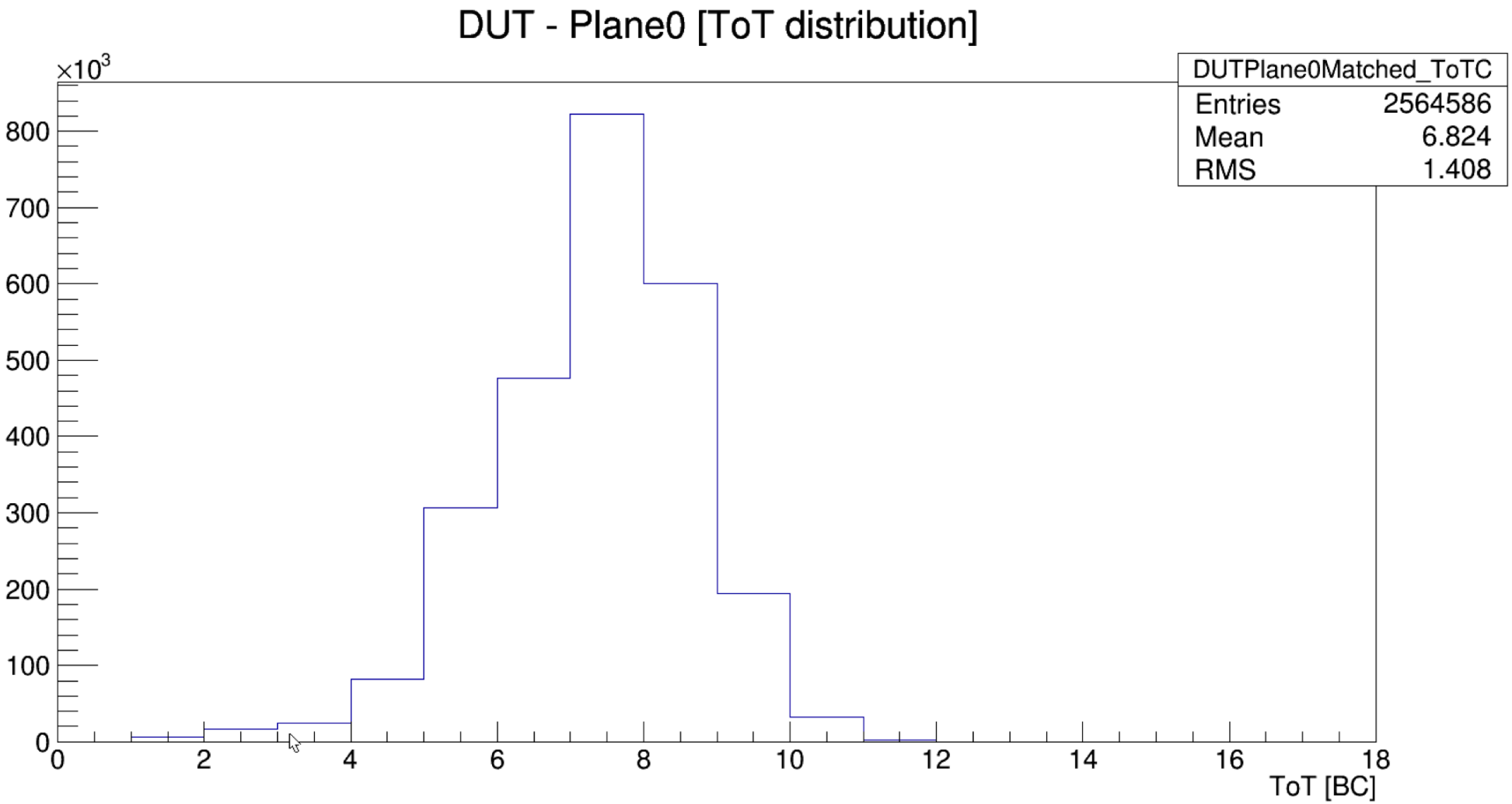
On-Track TOT Distribution : Low Gain + no extra DPTUP



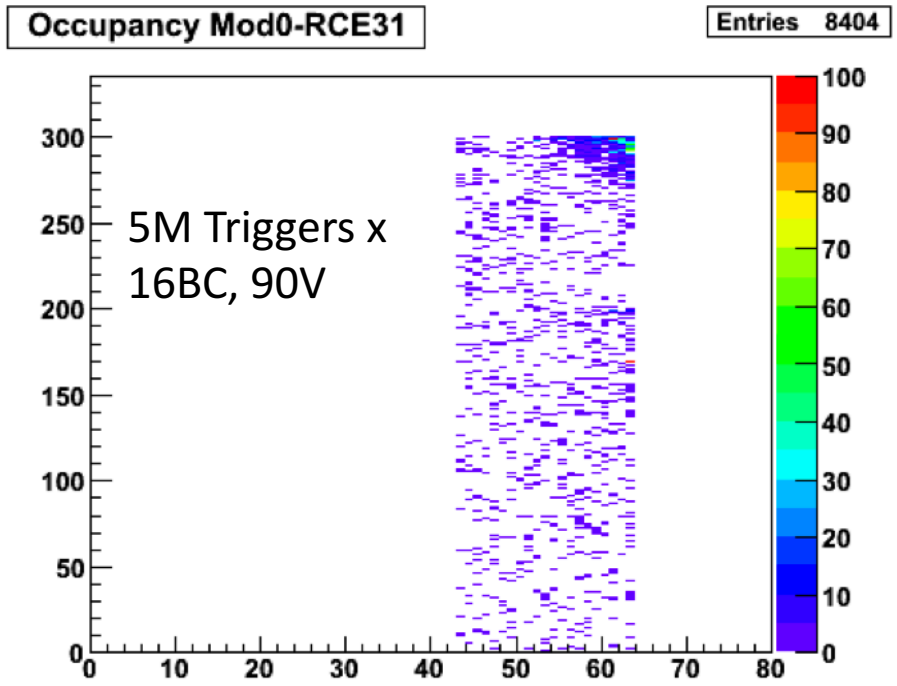
On-Track TOT Distribution : High Gain + no extra DPTUP



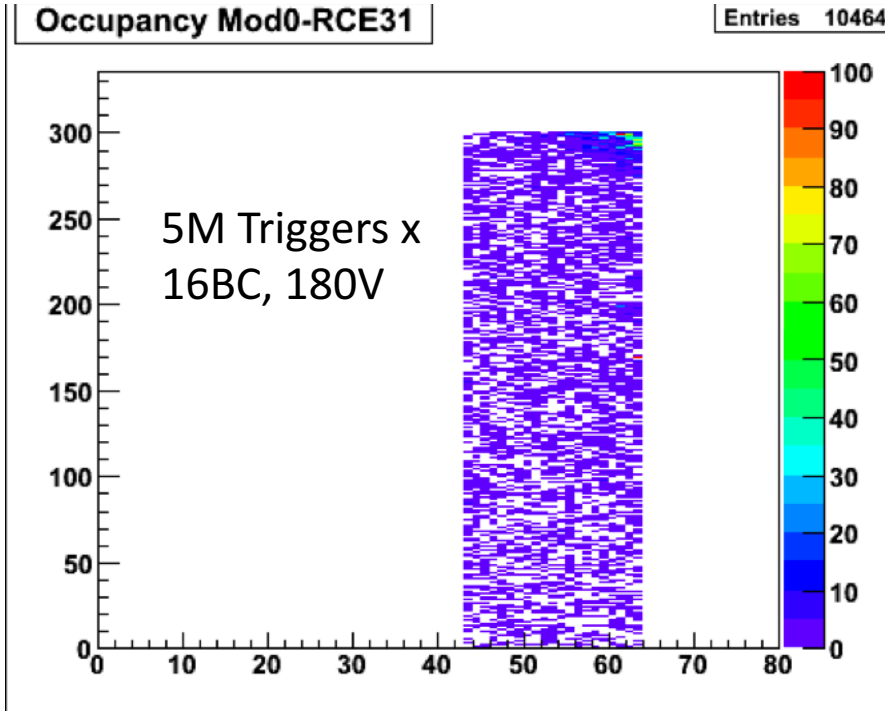
On-Track TOT Distribution : High Gain + extra DPTUP



Noise occupancy



Noise occupancy very low, <1e-6, but noisier pixel at the corner of the low Gain and first High-gain matrix



Most single hit from pions as beam was on

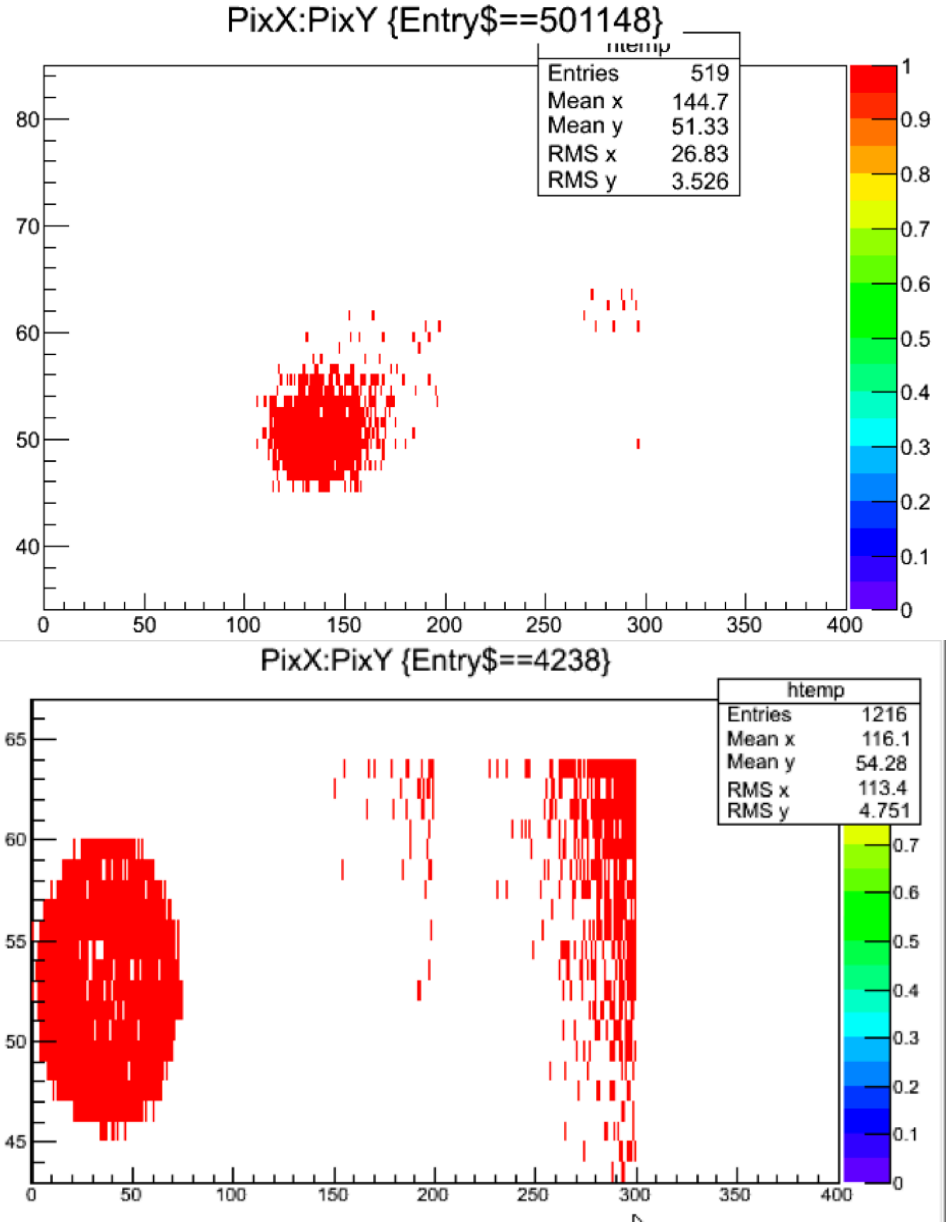
Strange hits : Nuclear interaction from bulk

Huge cluster with > 500, even > 1000 hits can be observed during data taking

These are most probably due to high energy deposition due to a nuclear interaction in the bulk of the sensor (750um thick)

These have sufficient energy to diffuse to the depleted zone, these hits have very late TOT. This would be compatible with TCAD results for 200Ohmcm top biased sensor, showing a deep low field region in the bulk.

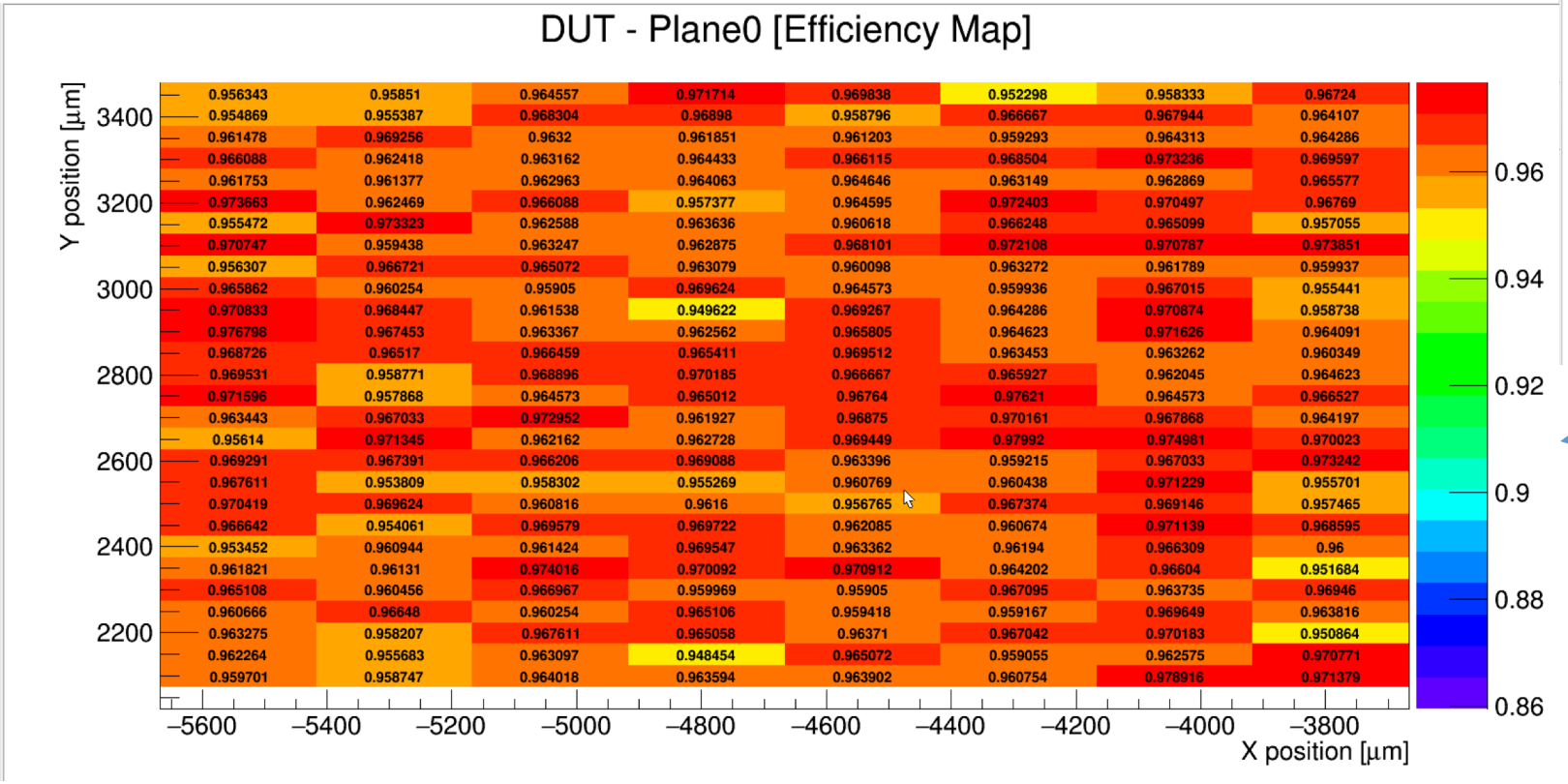
These are not observed when taking data with muons, but the statistics is much lower.

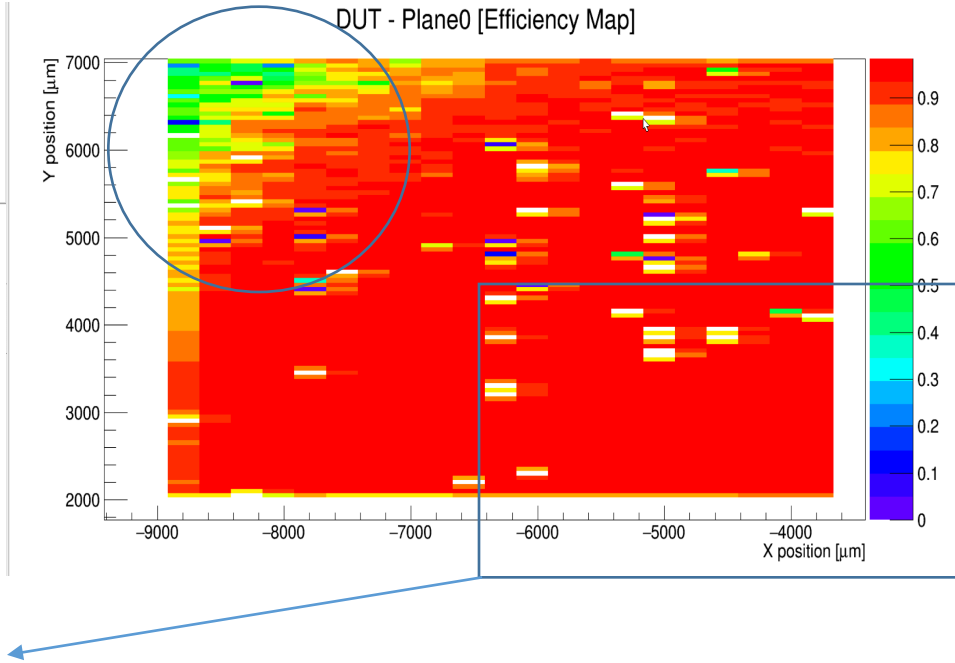


Efficiency Matrix 1 : Low gain

96-97% in the good area with proper coupling

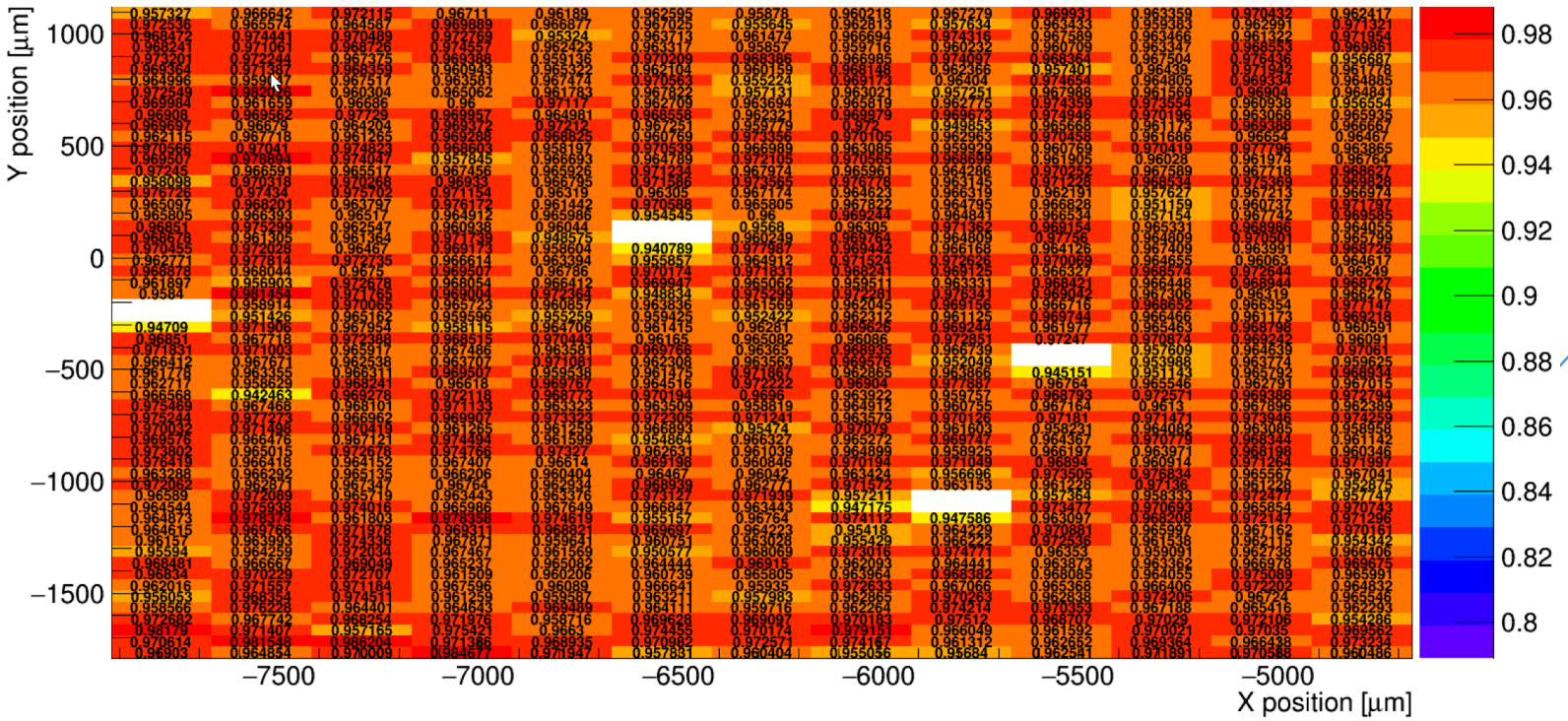
Low glue region

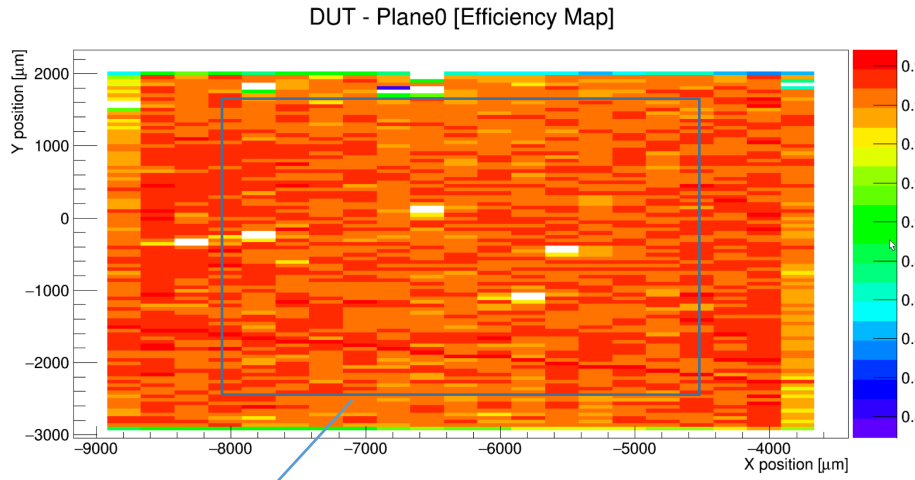




Efficiency Matrix 2 : High gain , no extra DPTUB

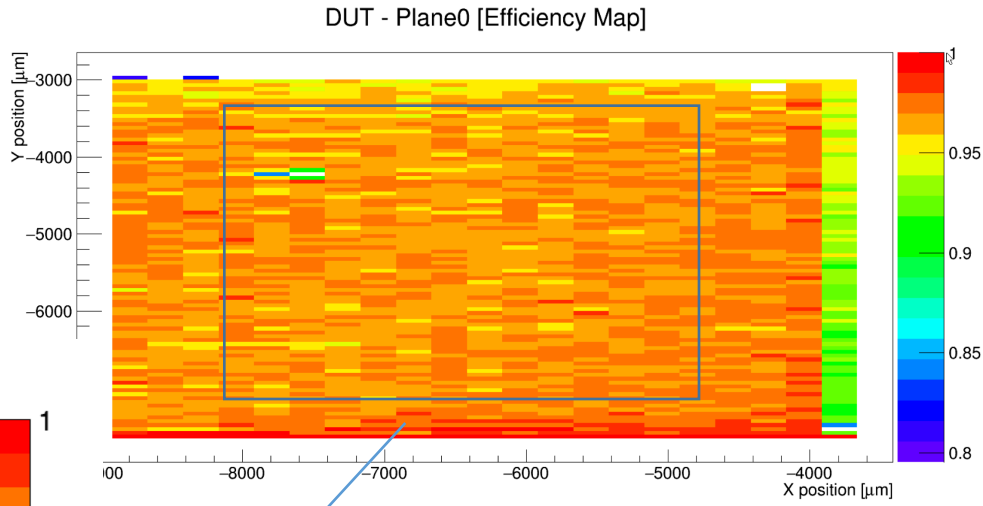
96-97% in the good area with proper coupling

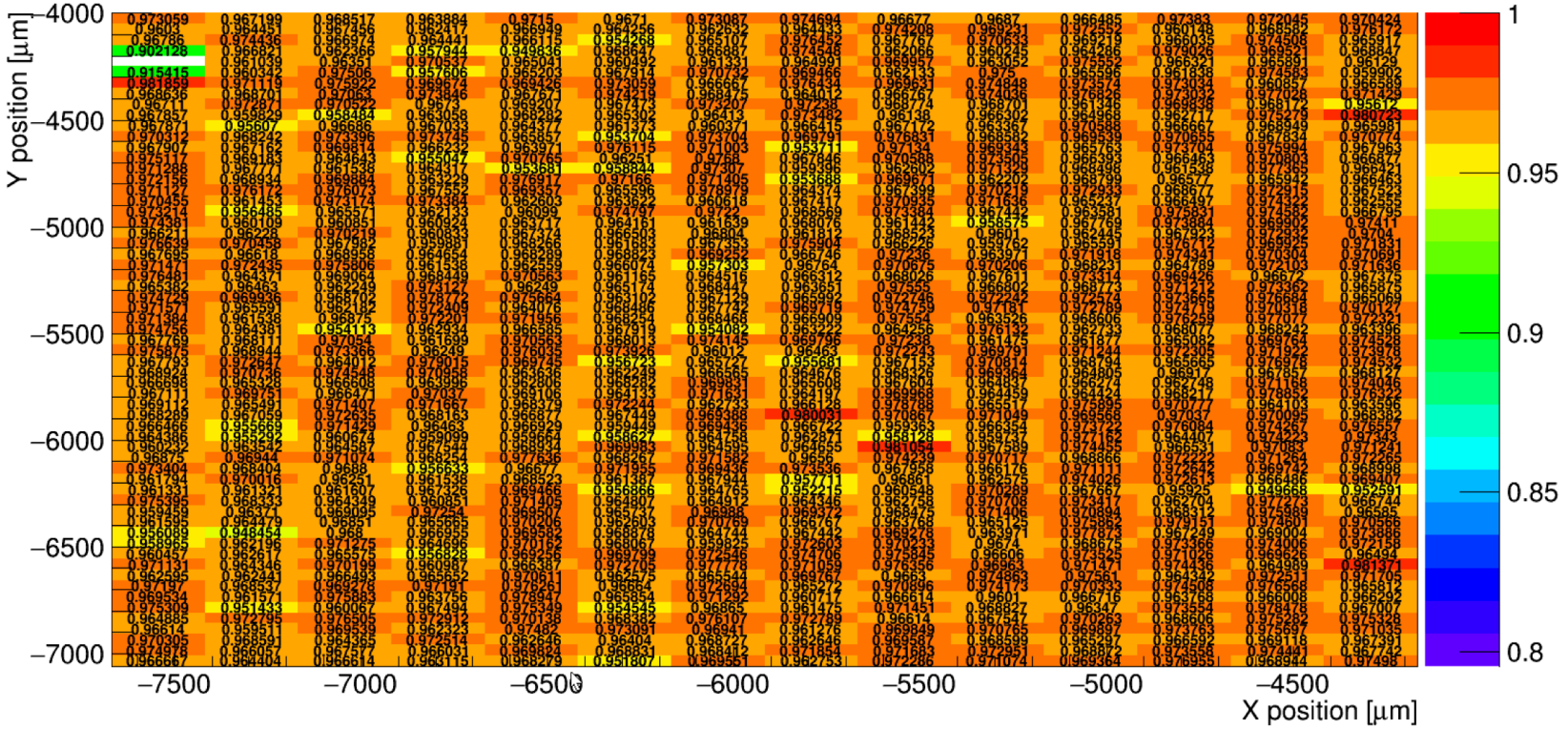




Efficiency Matrix 3 : High gain , extra DPTUB

96-97% in the good area with proper coupling





Summary

- Good performance from the #2 Analog matrix
  - Low noise, within specification
  - Resolution similar to planar sensor
  - Timing very comparable to planar sensor, High gain with no extra DPTUP performing the best
  - On track TOT spectrum show no tail due to small charge/chage sharing
- Efficiency 96-97% for most of the matrix at 180V bias
  - Big events may cause problem with desynchronization
  - Glue coupling might be insufficient , but TOT spectrum not showing this
  - Furth improvement In reconstruction might improve this
- More assembly in preparation, with thinner glue layer, thin sensors