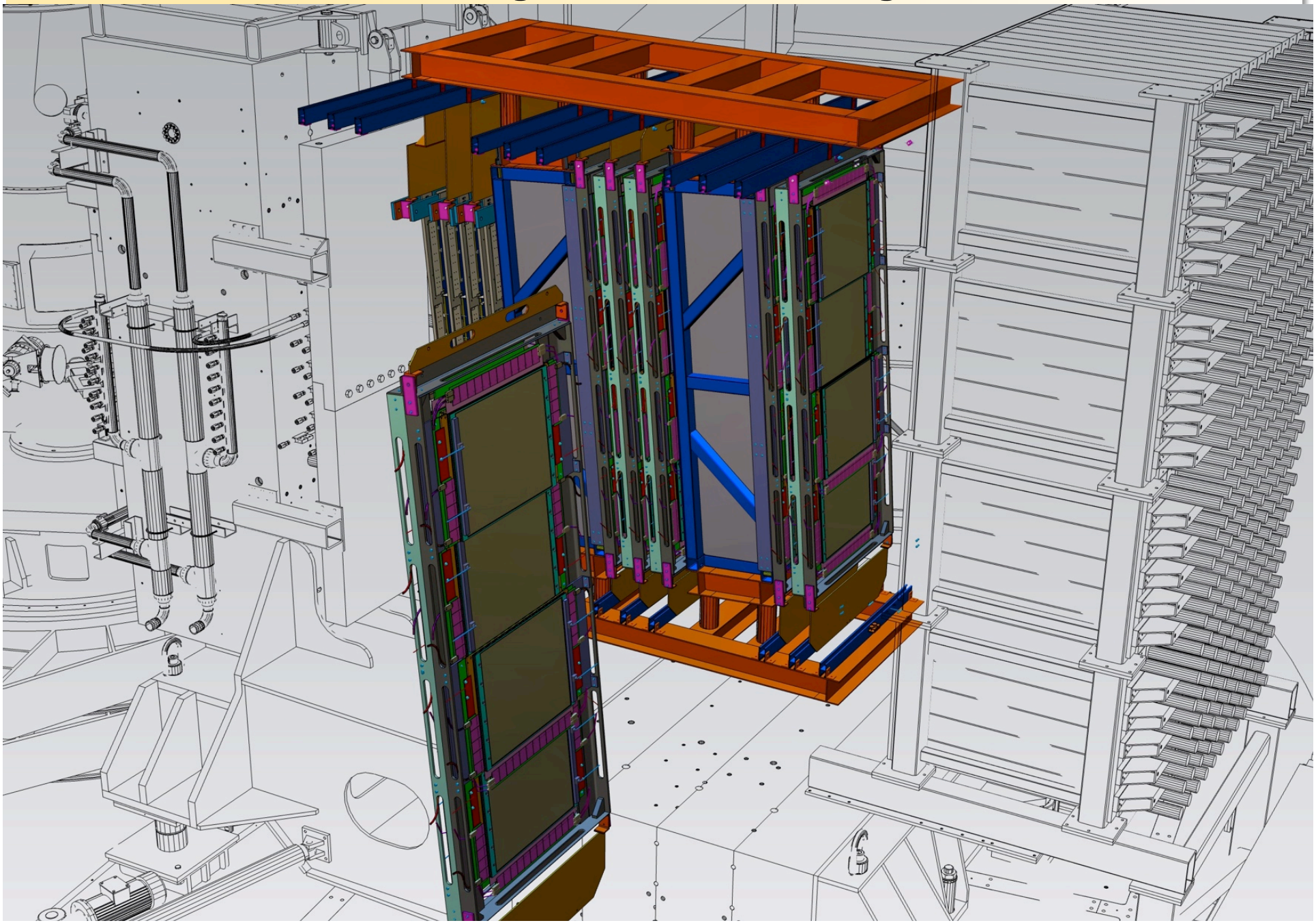
GEM Status update

10/13/2016

Production Status:

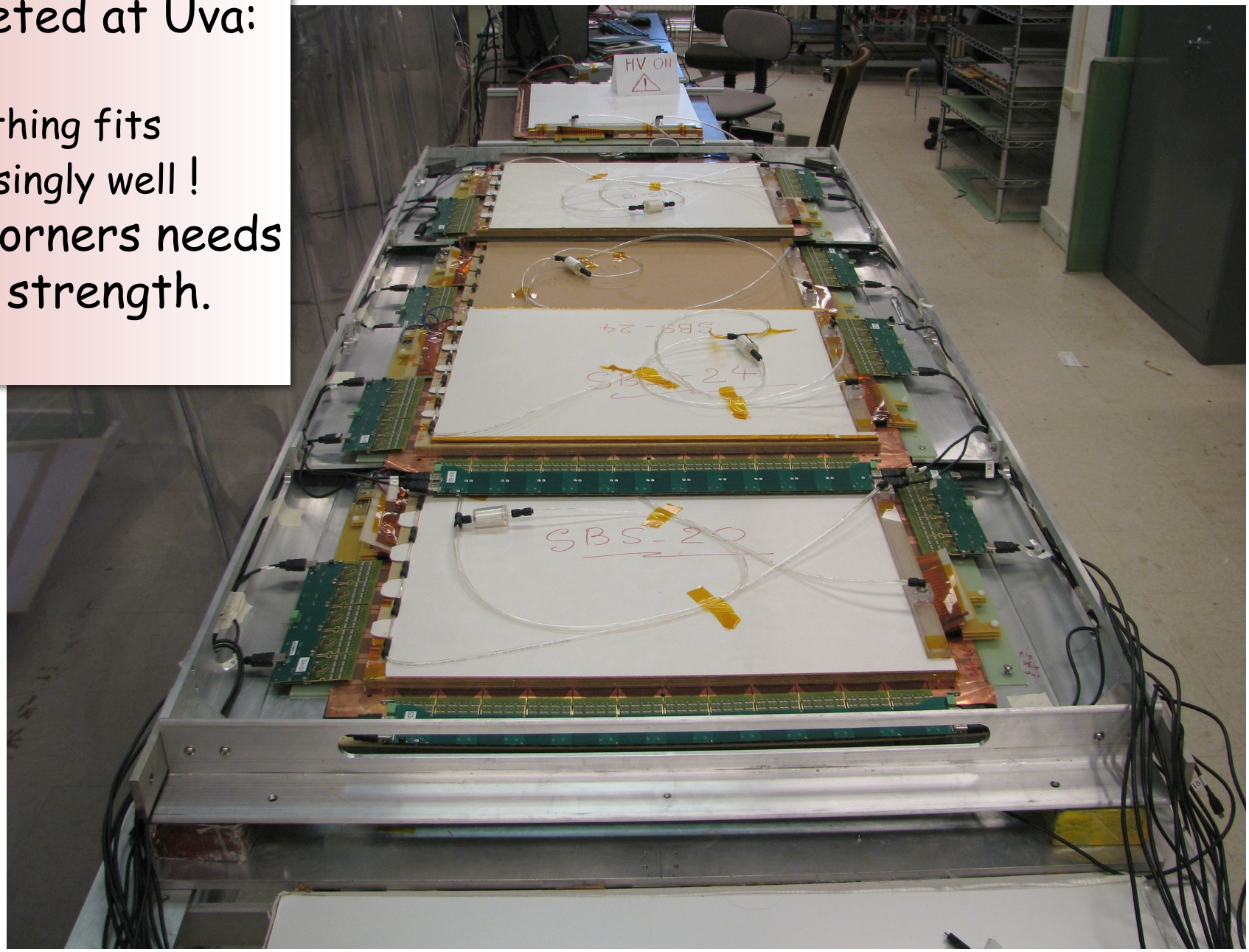
- 35 modules completed; 36 will be completed next week. 34 fully tested:
  - 32 modules 100% operational.
  - 2 modules have one bad sector each. 97% of active area operational.
- # 34 had some HV holding issues after it was mounted on test stand:
  - Could be due to mechanical stress
  - Improved after released from mounting; has been holding HV @ 4.15 kV on the bench for a week.
  - Will be retested on the test stand, will be careful with mounting.
- ~ 1 month unexpected delay due to Varnish going bad.
  - Specific Varnish from a Swiss company, certified by CERN re: chamber aging.
  - Hazardous liquid; so shipping, customs clearance takes 1 month (and ~ $2k).
  - Arrived last week; now we are moving at accelerated speed ~ 3/month (till the next road block).
- Have been waiting for next shipment of RO boards from CERN for over a month; only one more RO left and it has some blemishes.
- Placing the final order of foils (up to 48 modules) this week.
- Expect to complete ~42 by end of January and all 48 by end of April.
- Storage is still a real problem: running out of shelf space and storage not in a clean area: Jlab was trying to provide clean room space by August/September

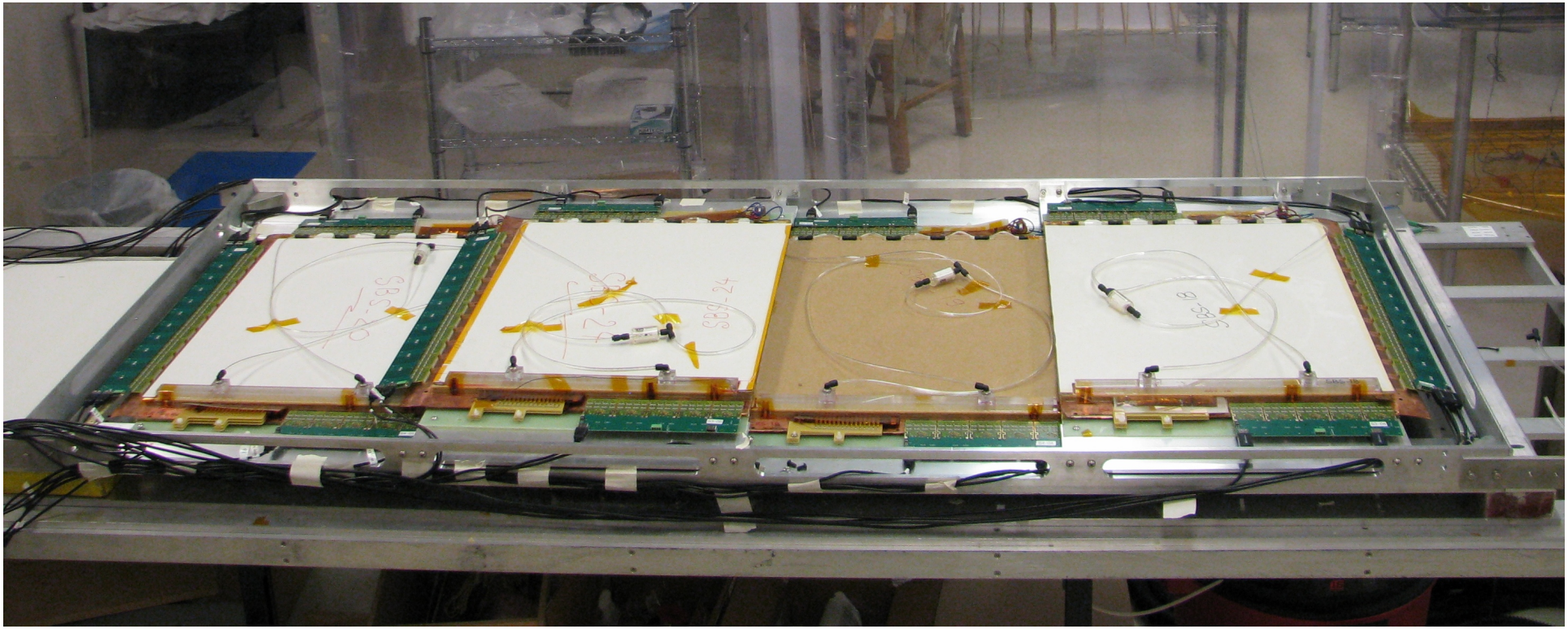
Work in Progress: GEM holding frame



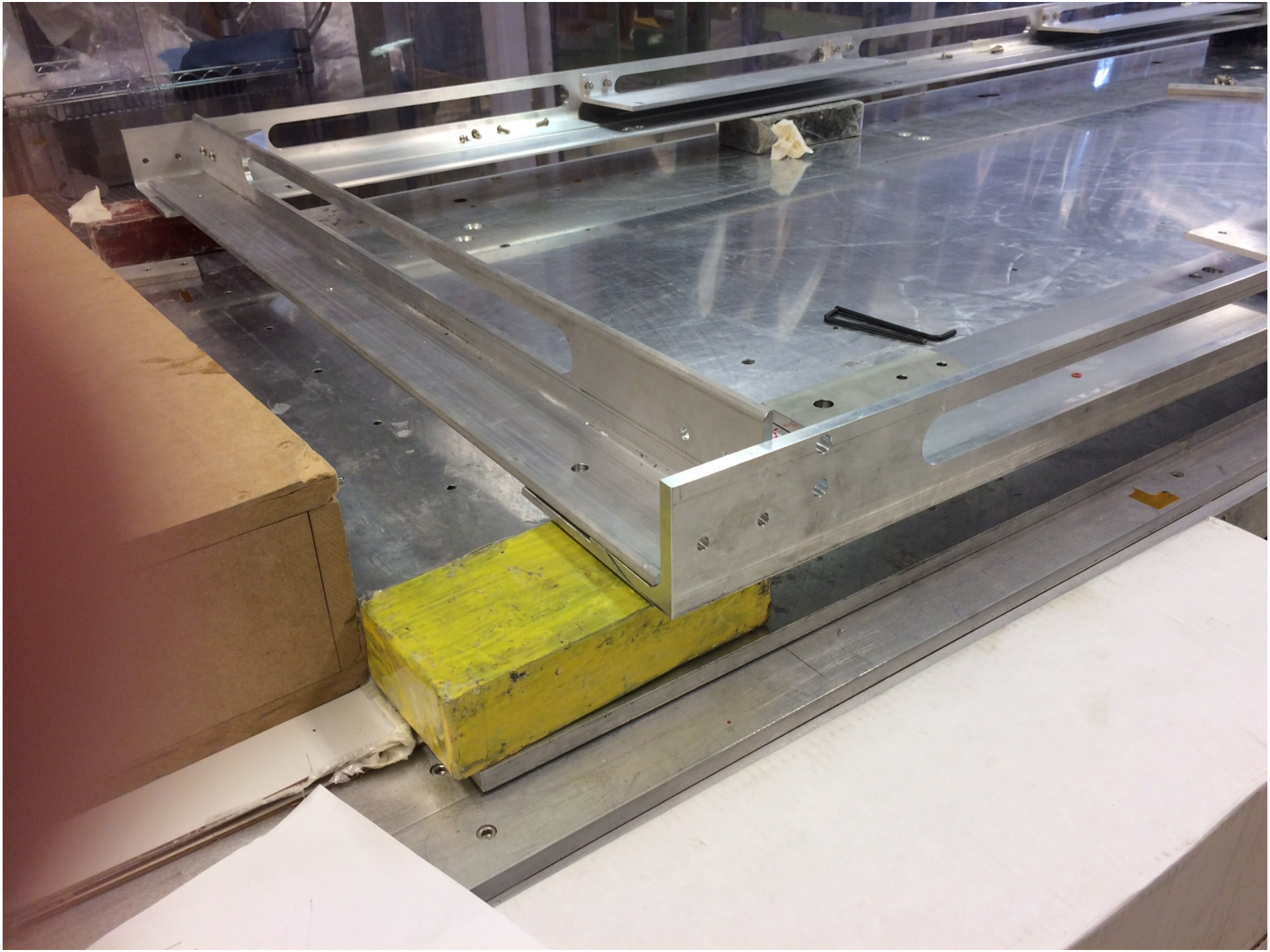
First Holding frame completed at Uva:

- Everything fits surprisingly well !
- But corners needs more strength.



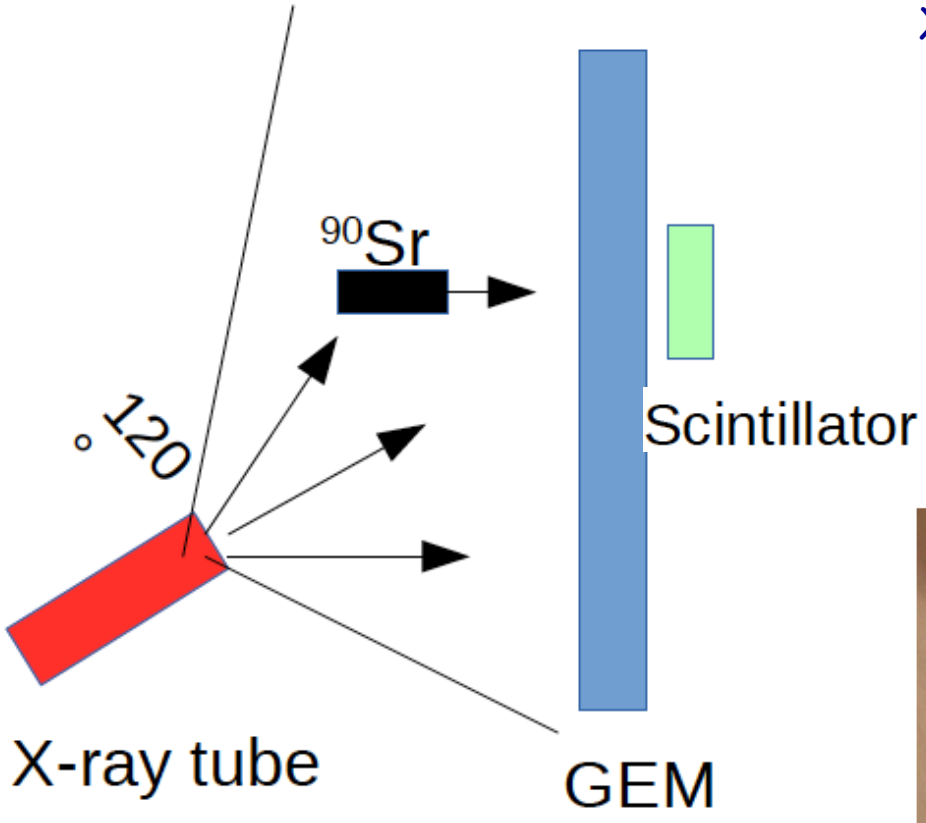



increase size




New suggested bolt locations for couppling

Testing the modules

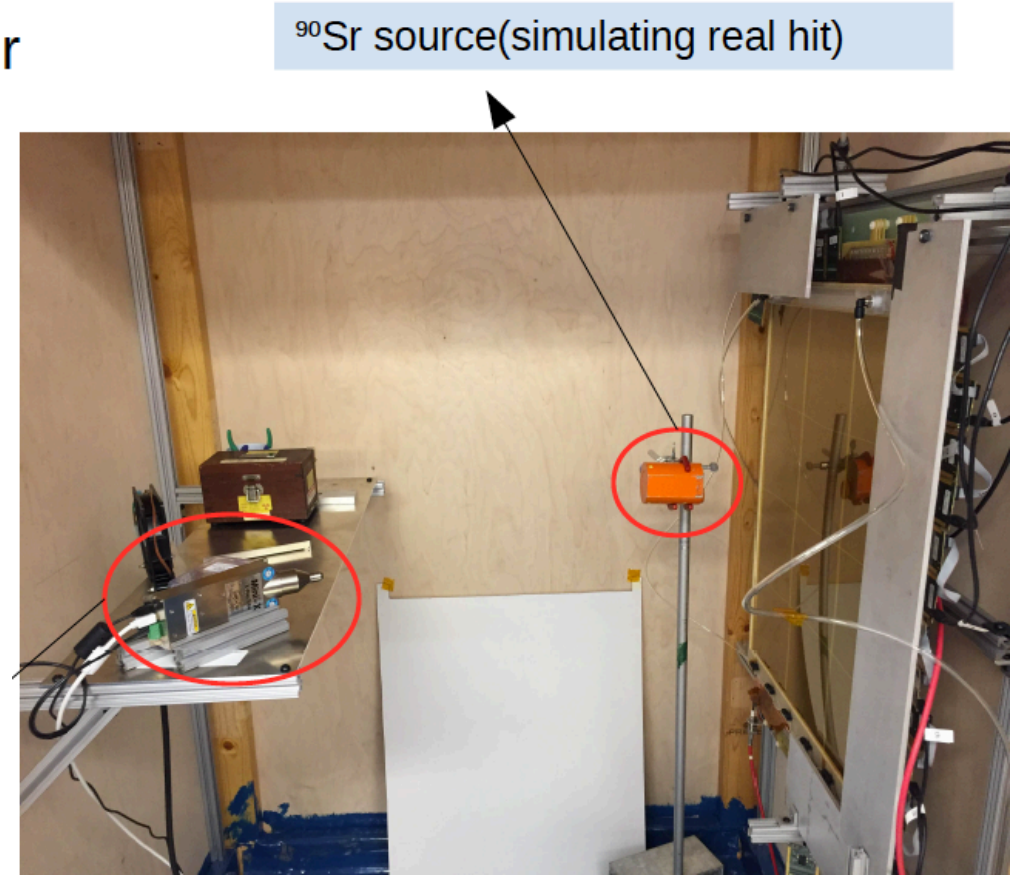


X-ray generator specification:

- Photon energy range: up to 50 keV
- Output flux: 100 MHz/cm^2 on the surface of GEM (conversion rate ~0.5% to electrons for ionization to happen)
- Angular distribution: uniform within 60°

This setup provides:

- Charge deposition in GEM: up to 3.4x10^{11} e$^-$/cm^2/s , equivalent to ~7MHz/cm^2 MIP.



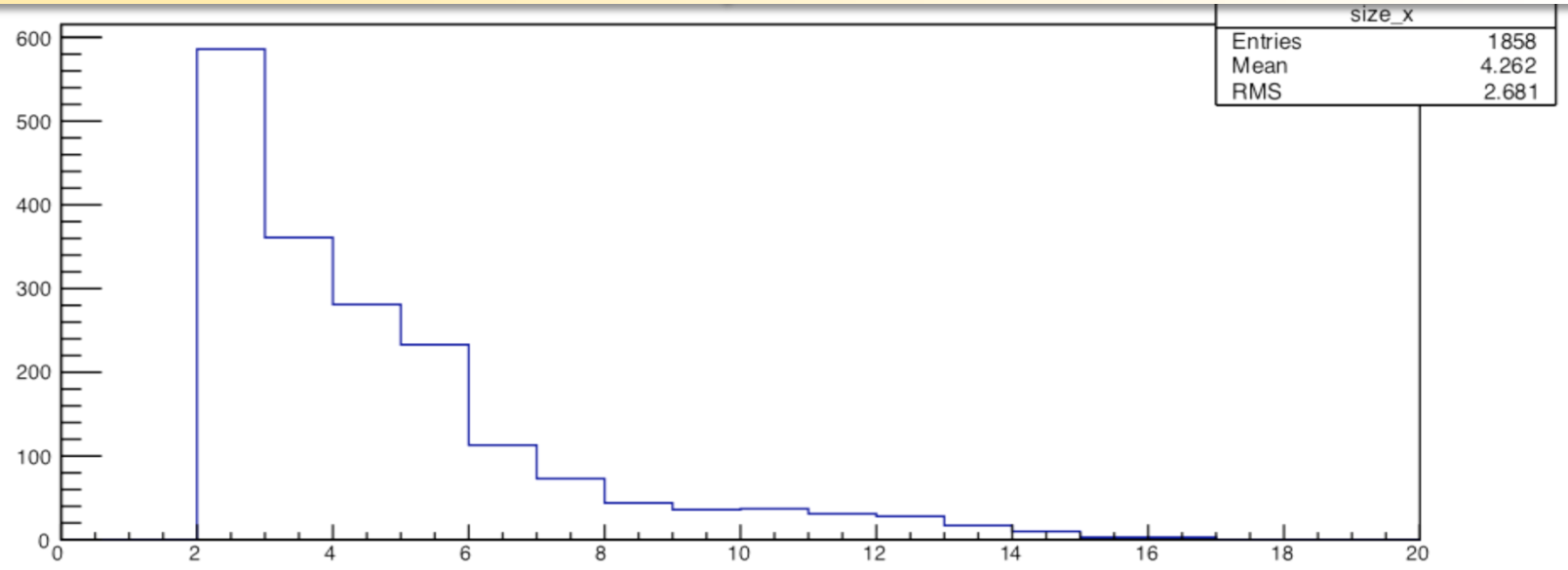
GEM simulation-X-ray data comparison: Status:

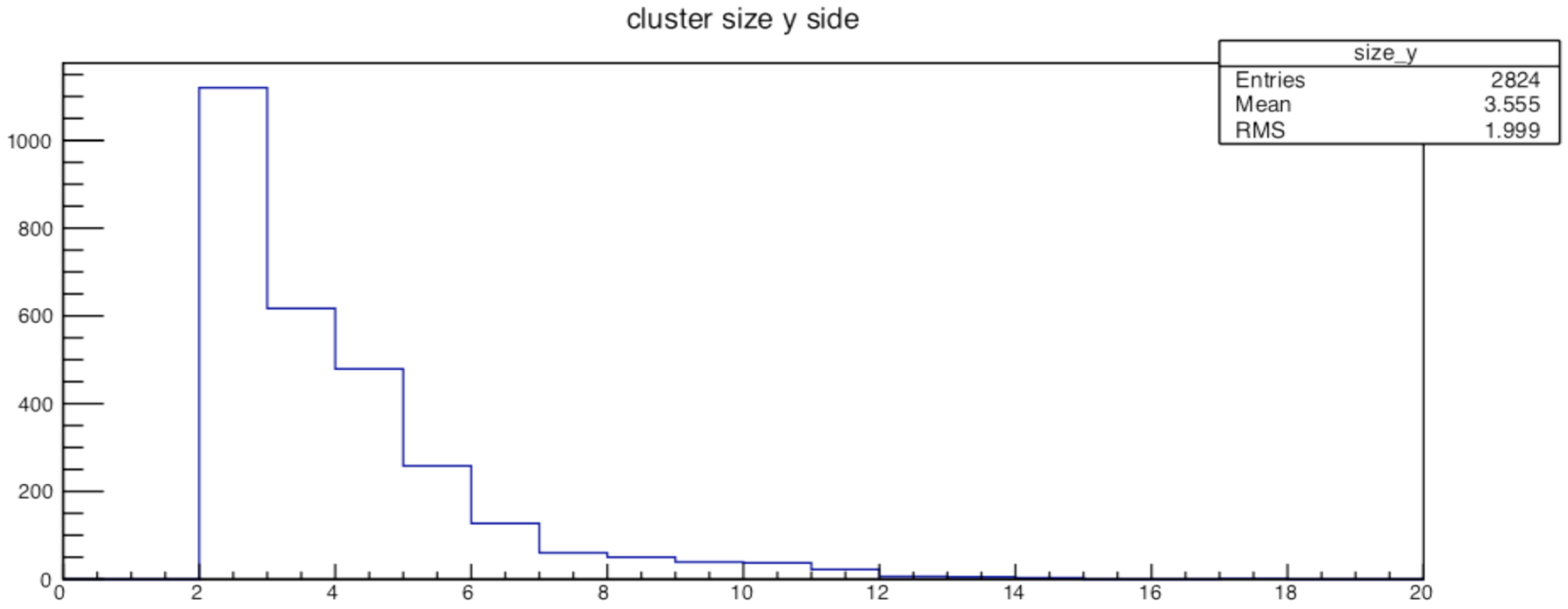
- All simulation codes (SBS, SoLID) based on the work Evaristo did.
- Simulation really well done.
- All tools for the comparison now ready: simulating and comparing to x-ray, (10 kV, 20 kV and 40 kV Bremsstrahlung), ^{90}Sr, and pRad data.
- Most parameters are in good agreement with data.

- However….

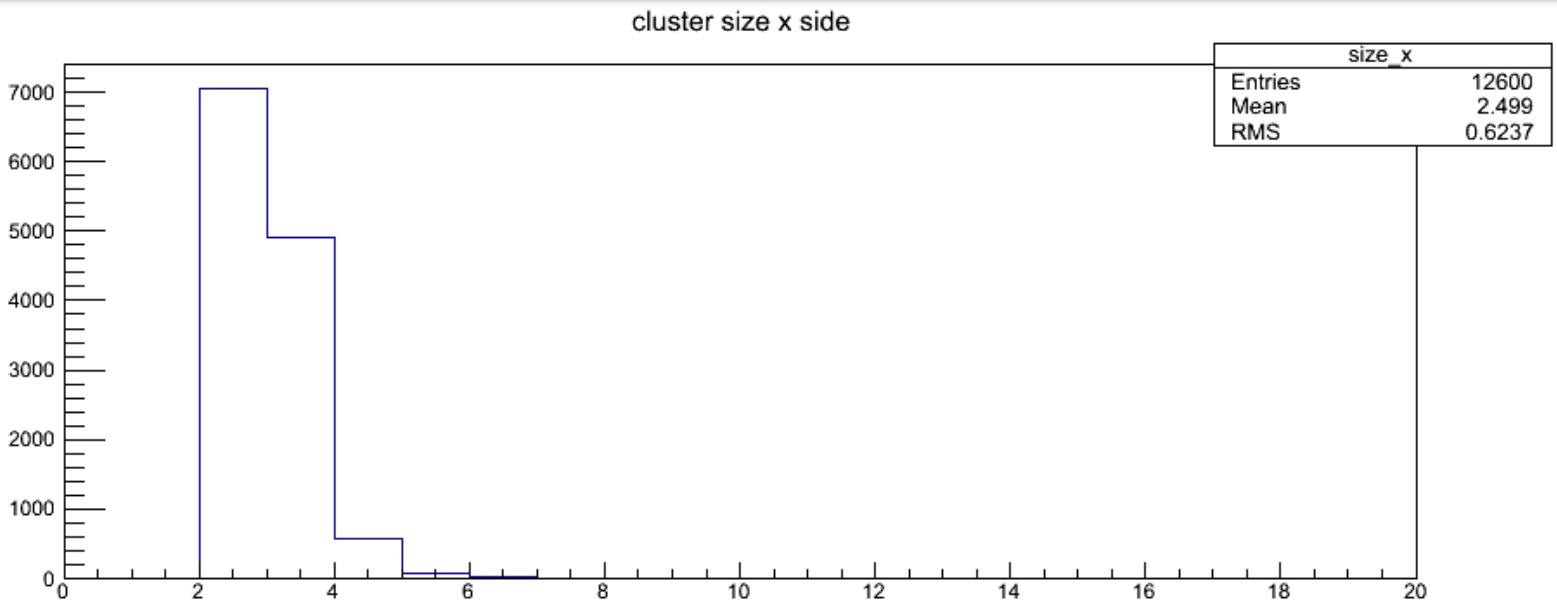
- The cluster size from simulation is limited to about 2-3, both for small amplitude MIP signals and for very large amplitude x-ray signals: this is not what we see with data: for MIPS it is ~ 2-3; but for x-ray data it is about ~4-5 or more.
- Data shows cross-talk: effectively increasing multiplicity by a significant amount; not modeled in simulation

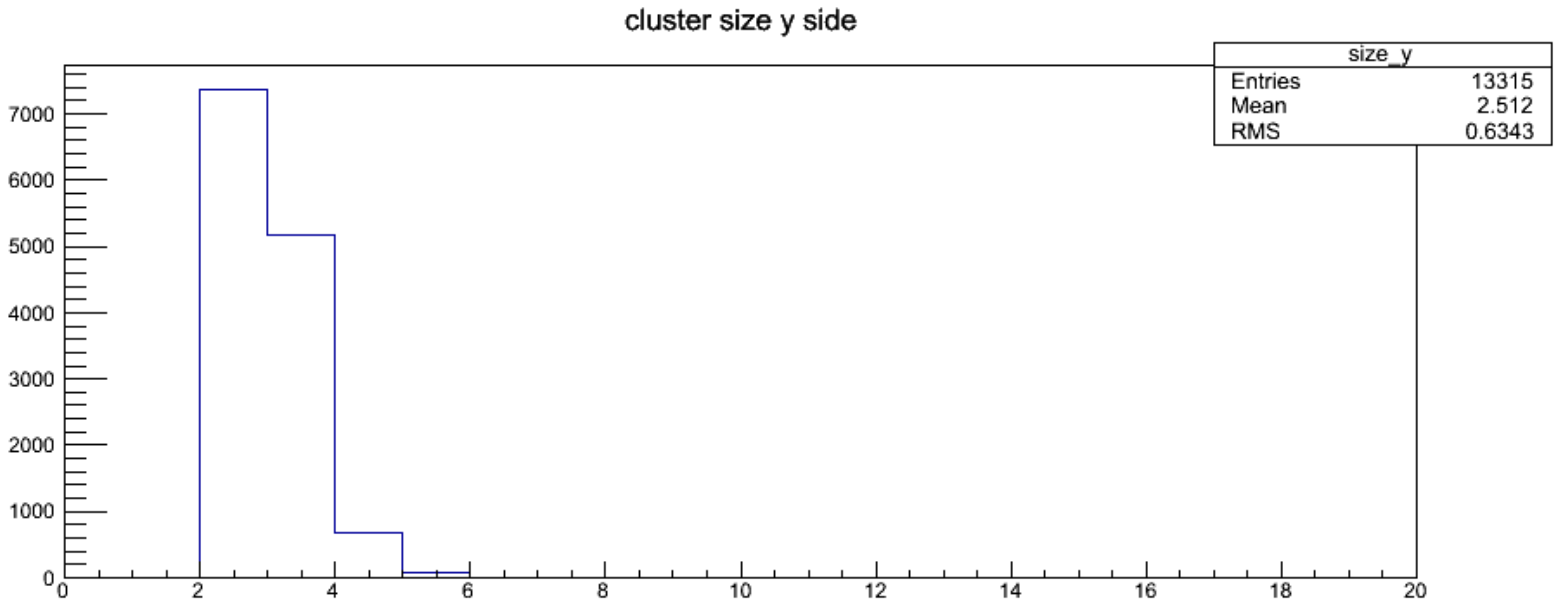
X-ray data


size_x
Entries 1858
Mean 4.262
RMS 2.681
600
500
400
300
200
100
0
0
2
4
6
8
10
12
14
16
18
20

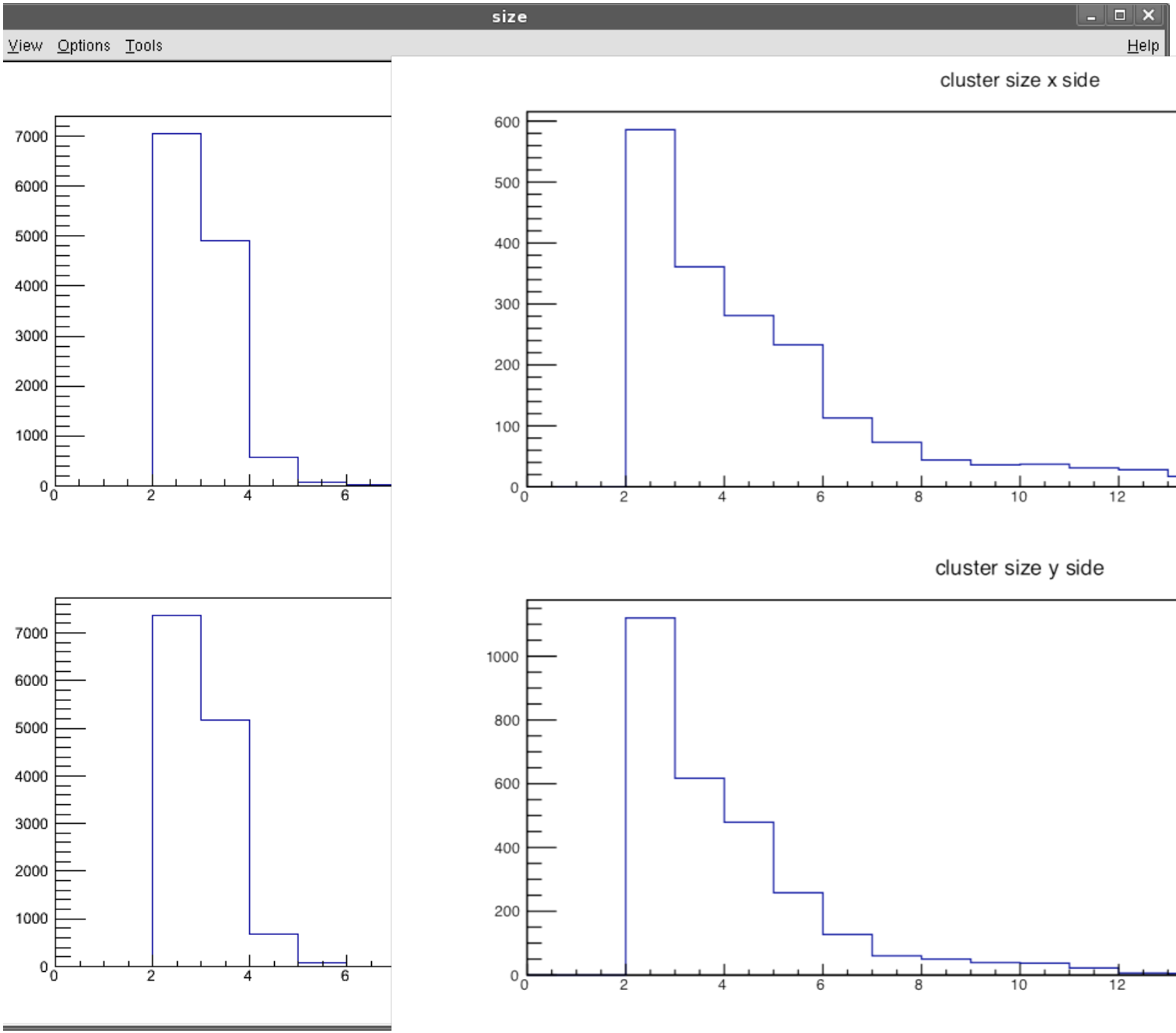

cluster size y side
size_y
Entries 2824
Mean 3.555
RMS 1.999
1000
800
600
400
200
0
0
2
4
6
8
10
12
14
16
18
20

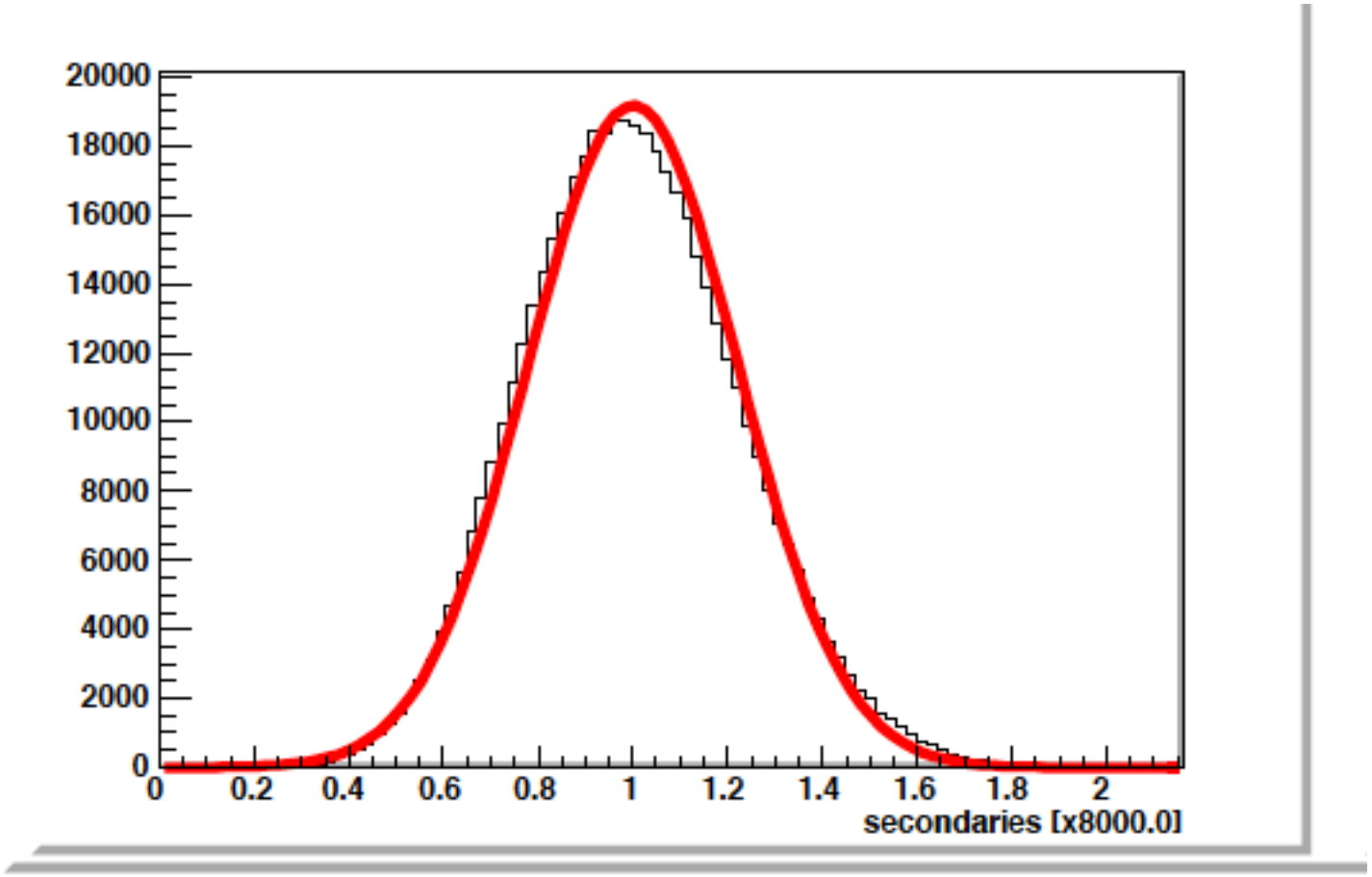
X-ray Sim


cluster size x side
size_x
Entries 12600
Mean 2.499
RMS 0.6237
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20


cluster size y side
size_y
Entries 13315
Mean 2.512
RMS 0.6343
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20

X-ray Sim and data




20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
secondaries [x8000.0]

In a first approach, the spatial distribution of the hit charge collected was assumed to be the sum of Gaussian distributions centered at each projection (x_i^r, y_i^r, z_i^r)[5] of the original pair production point (x_i, y_i, z_i) in the drift gap:

$$G_{hit}(x,y) = \sum_{i=1}^{n_{ion}} G_i \exp\left\{-\left((x-x_i^r)^2 + (y-y_i^r)^2\right)\right\} / (2\sigma_s^2(i)) \tag{8.5}$$

Therefore, Eq. 8.5 has been replaced by[6]:

$$G_{hit}(x,y) = \sum_{i=1}^{n_{ion}} G_i \cdot H\left((f\cdot\sigma_s^2(i)) - ((x-x_i^r)^2 + (y-y_i^r)^2)\right), \tag{8.6}$$

where $H()$ is the properly normalized Heaviside step function (zero for negative values, 1 for positive) and $f = 3$.

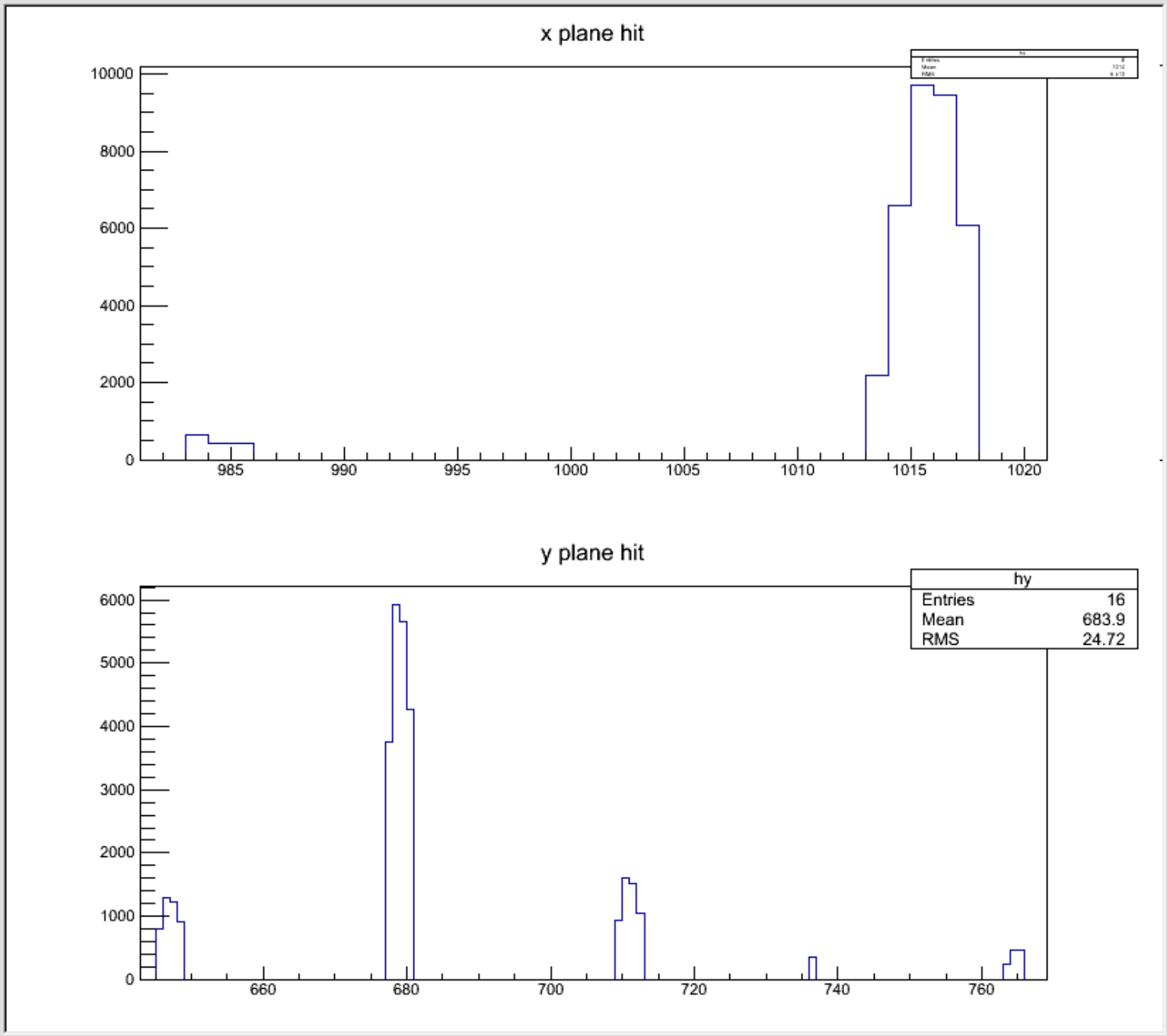
Next Event

Next

Previous Event

Previous

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

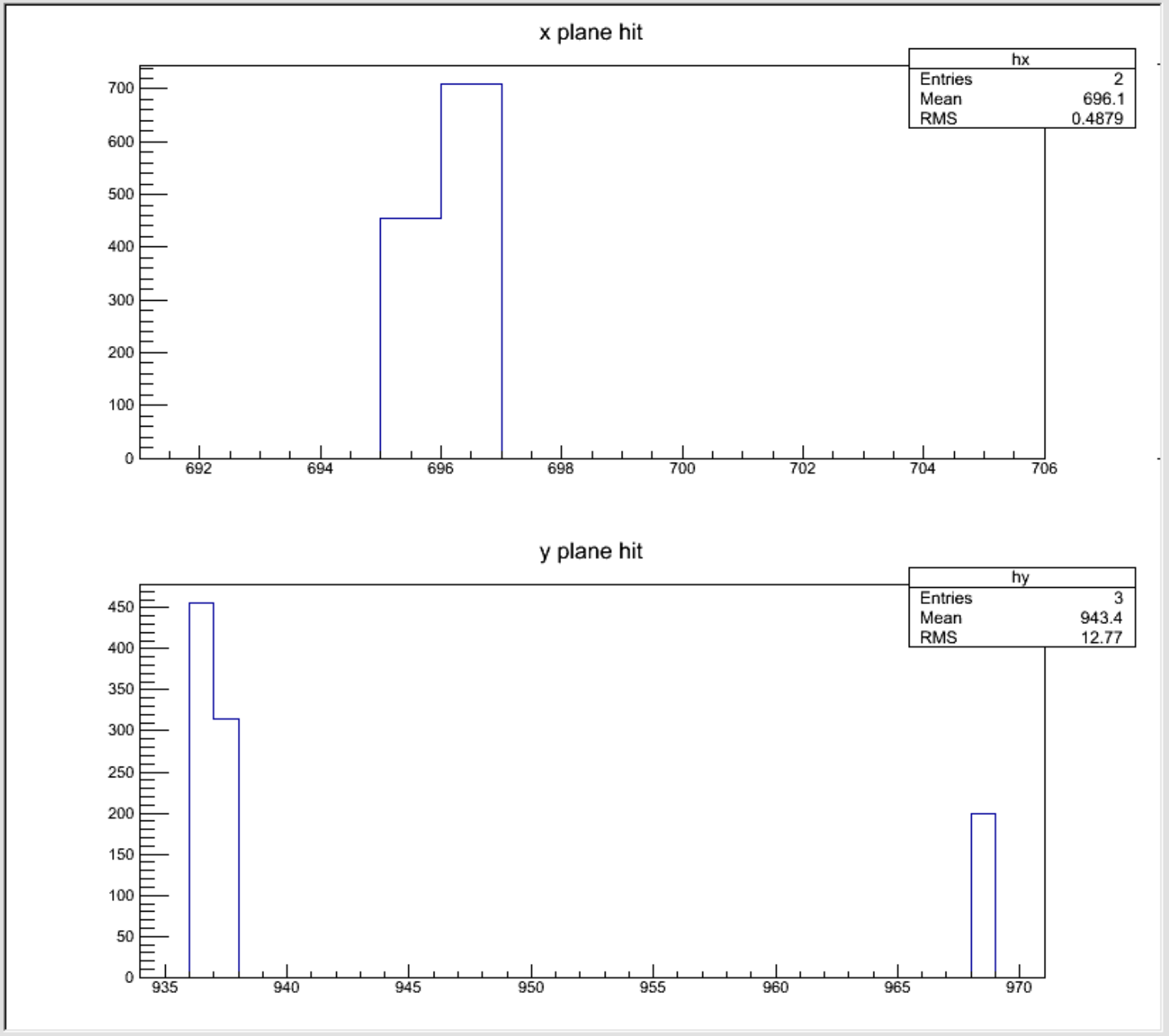


File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous



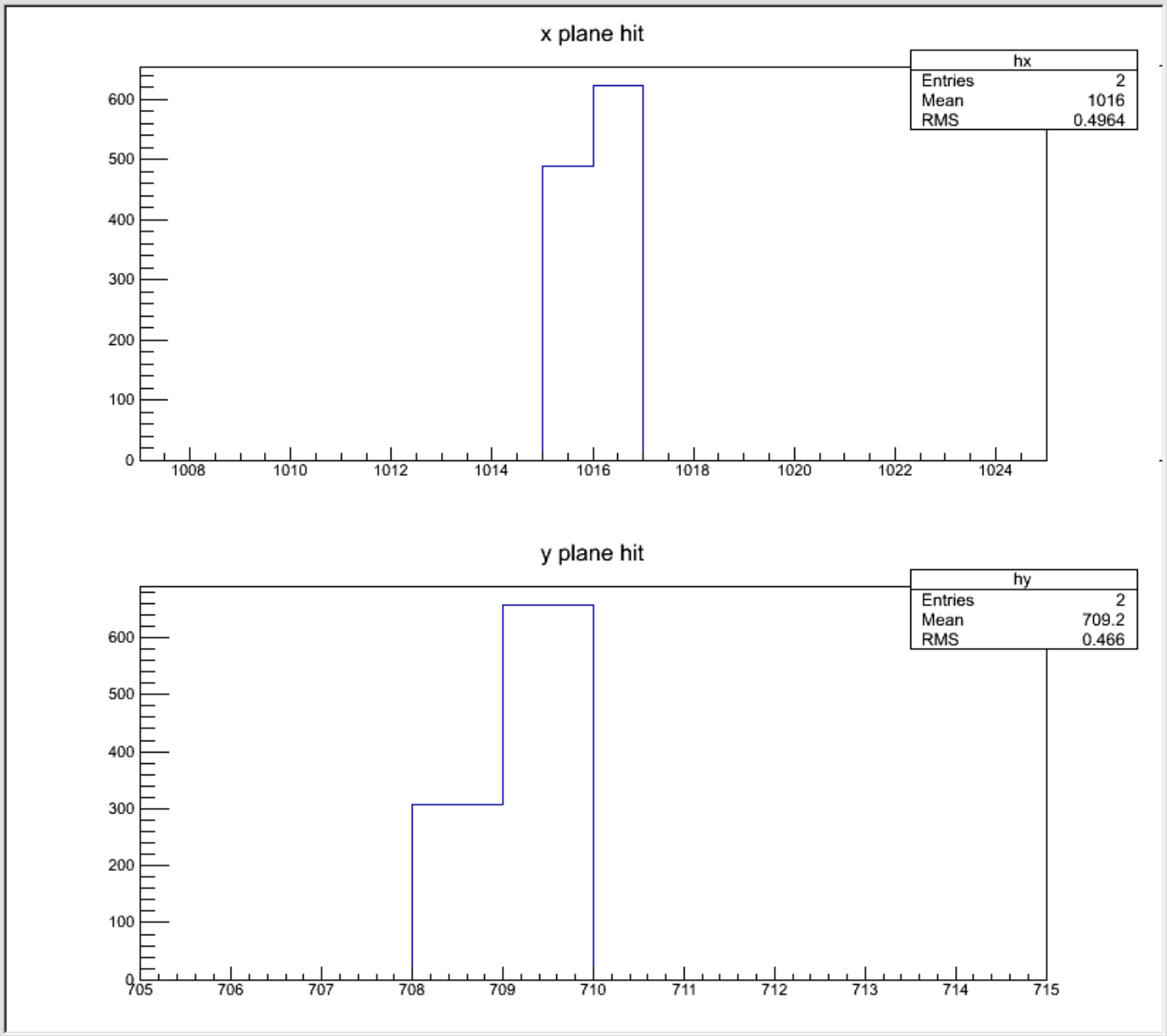
Viewer

File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous



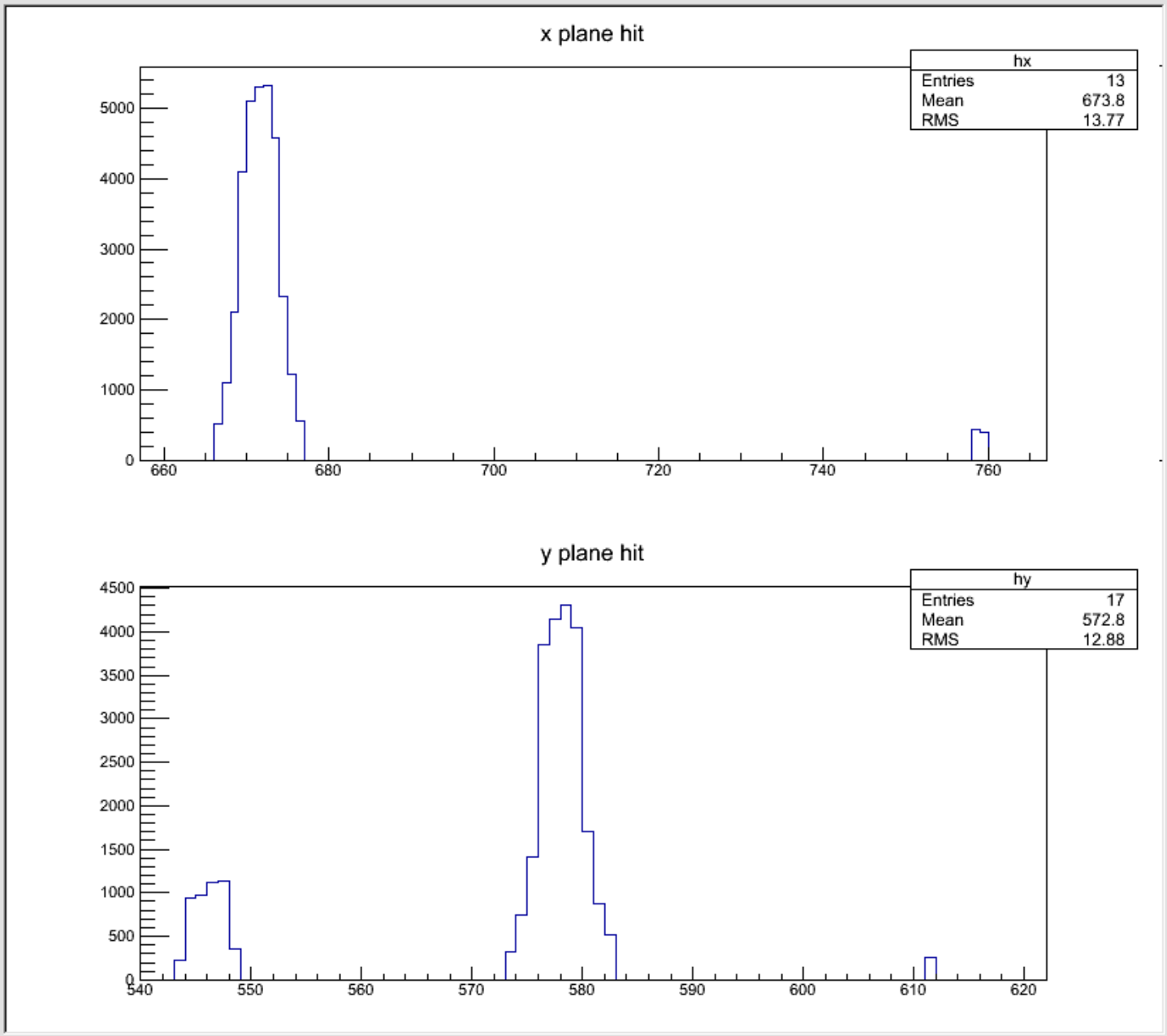
Viewer

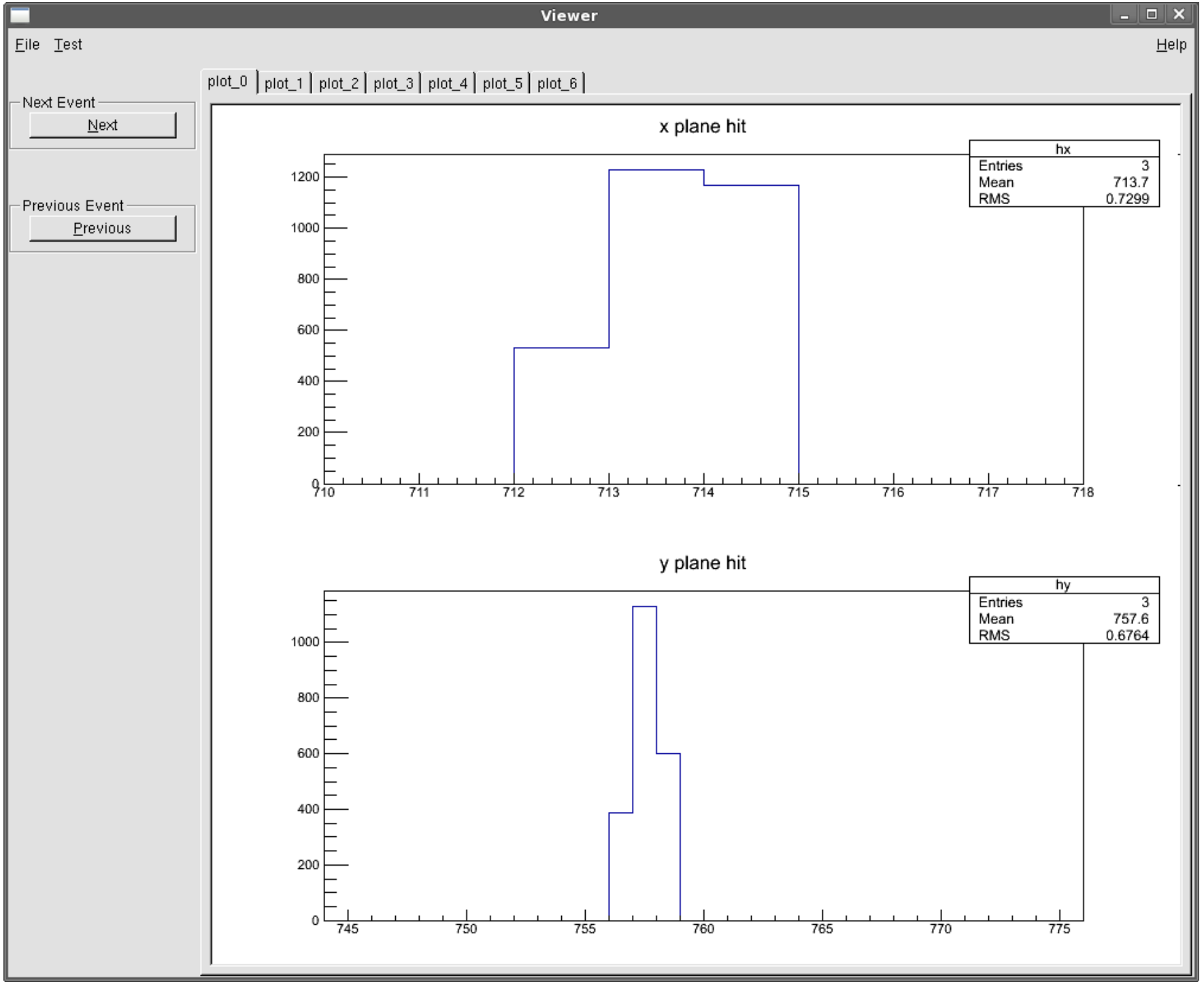
File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous




Viewer
File Test
Help
plot_0 plot_1 plot_2 plot_3 plot_4 plot_5 plot_6
Next Event
Next
Previous Event
Previous
x plane hit
hx
Entries 3
Mean 713.7
RMS 0.7299
1200
1000
800
600
400
200
0
710 711 712 713 714 715 716 717 718
y plane hit
hy
Entries 3
Mean 757.6
RMS 0.6764
1000
800
600
400
200
0
745 750 755 760 765 770 775

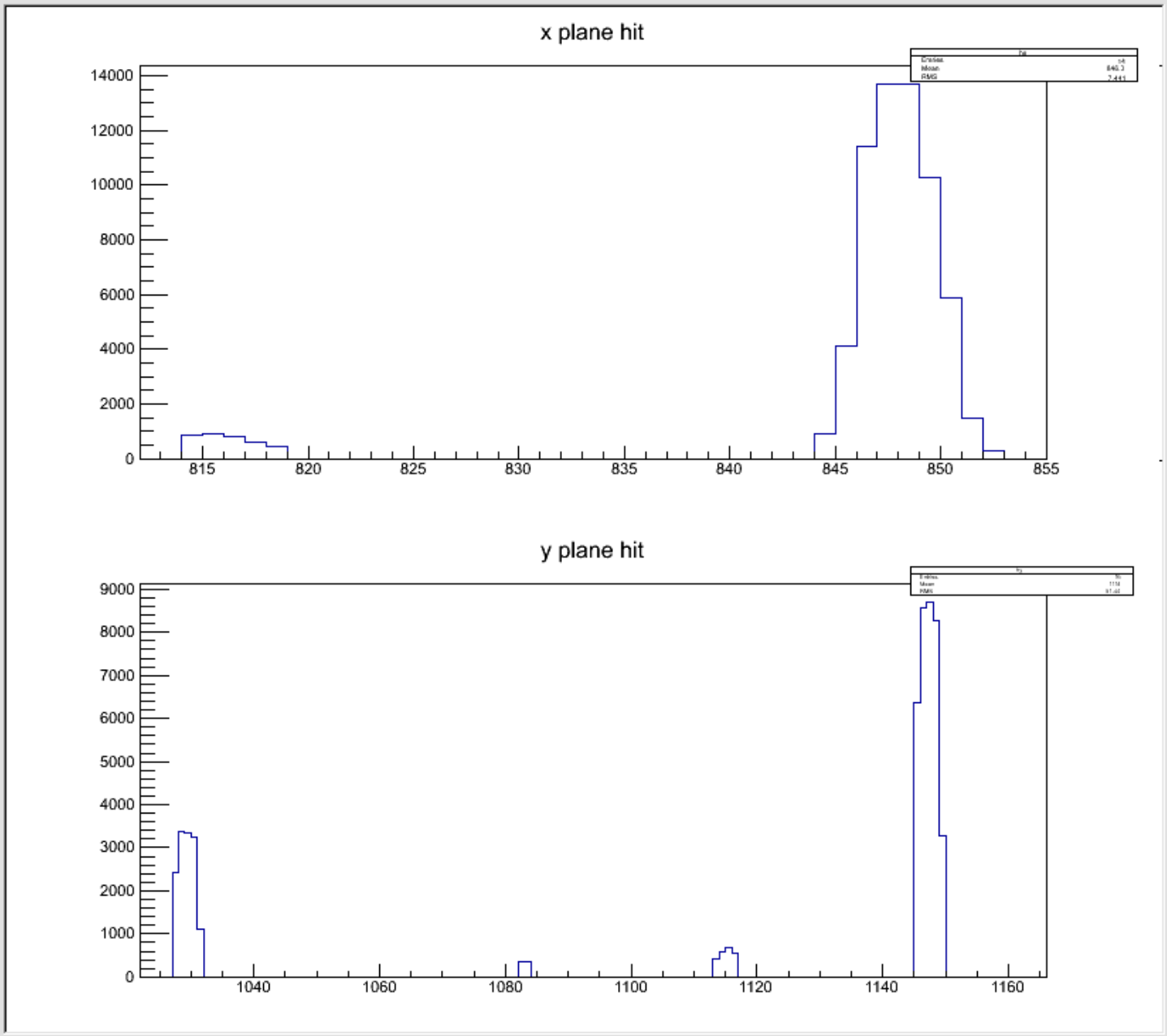
Viewer

File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous



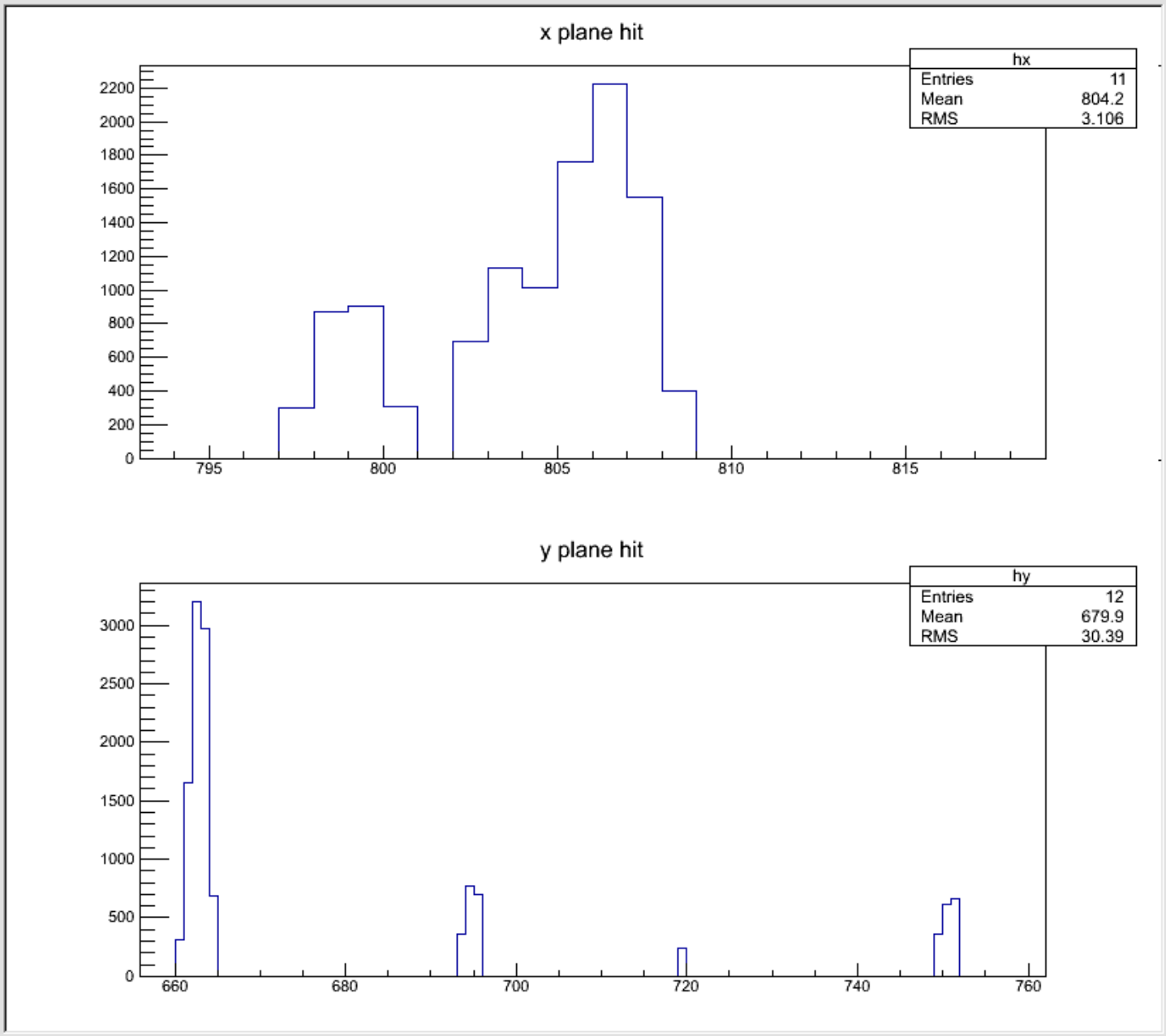
Viewer

File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous



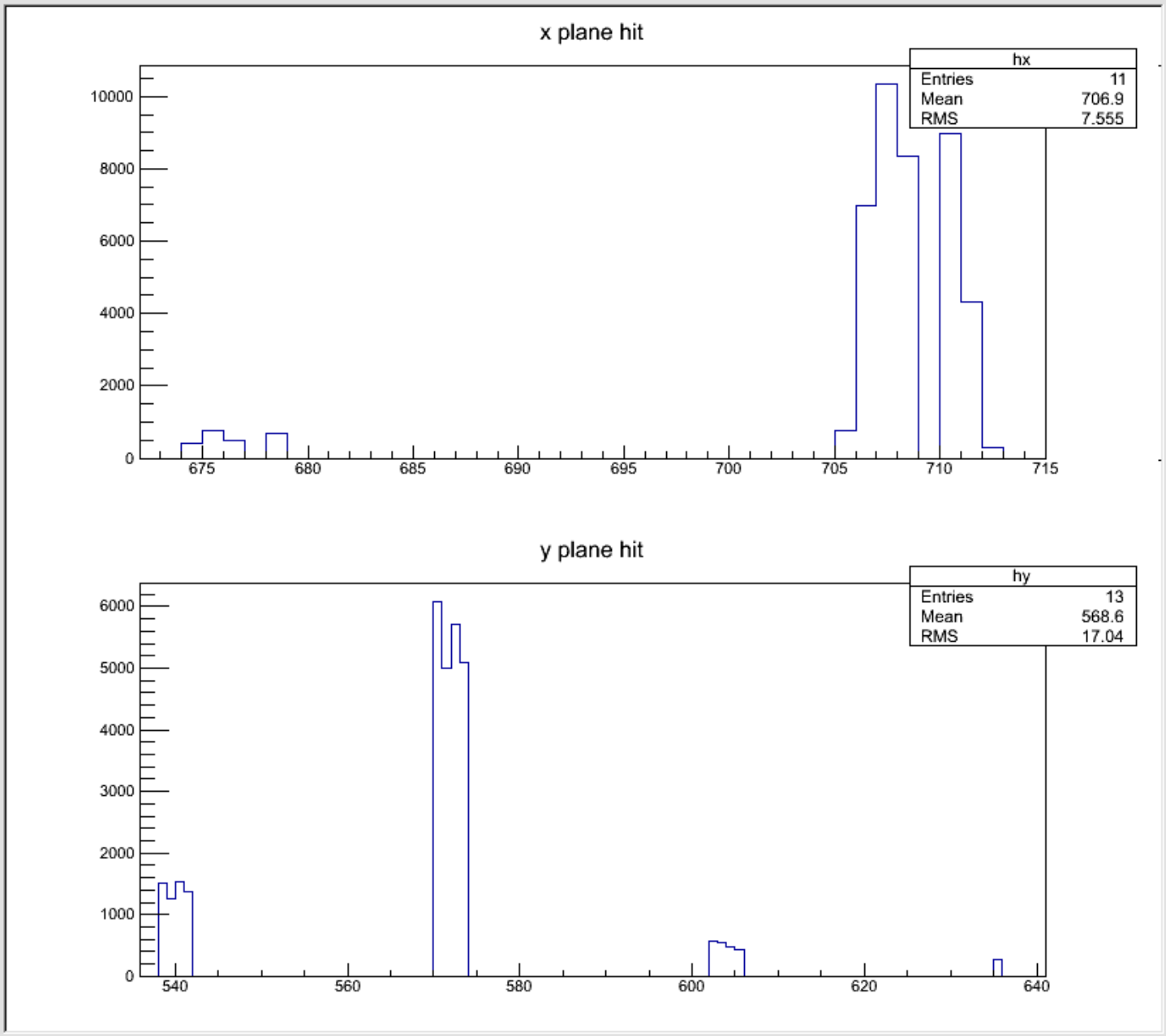
Viewer

File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

Next Event
Next

Previous Event
Previous



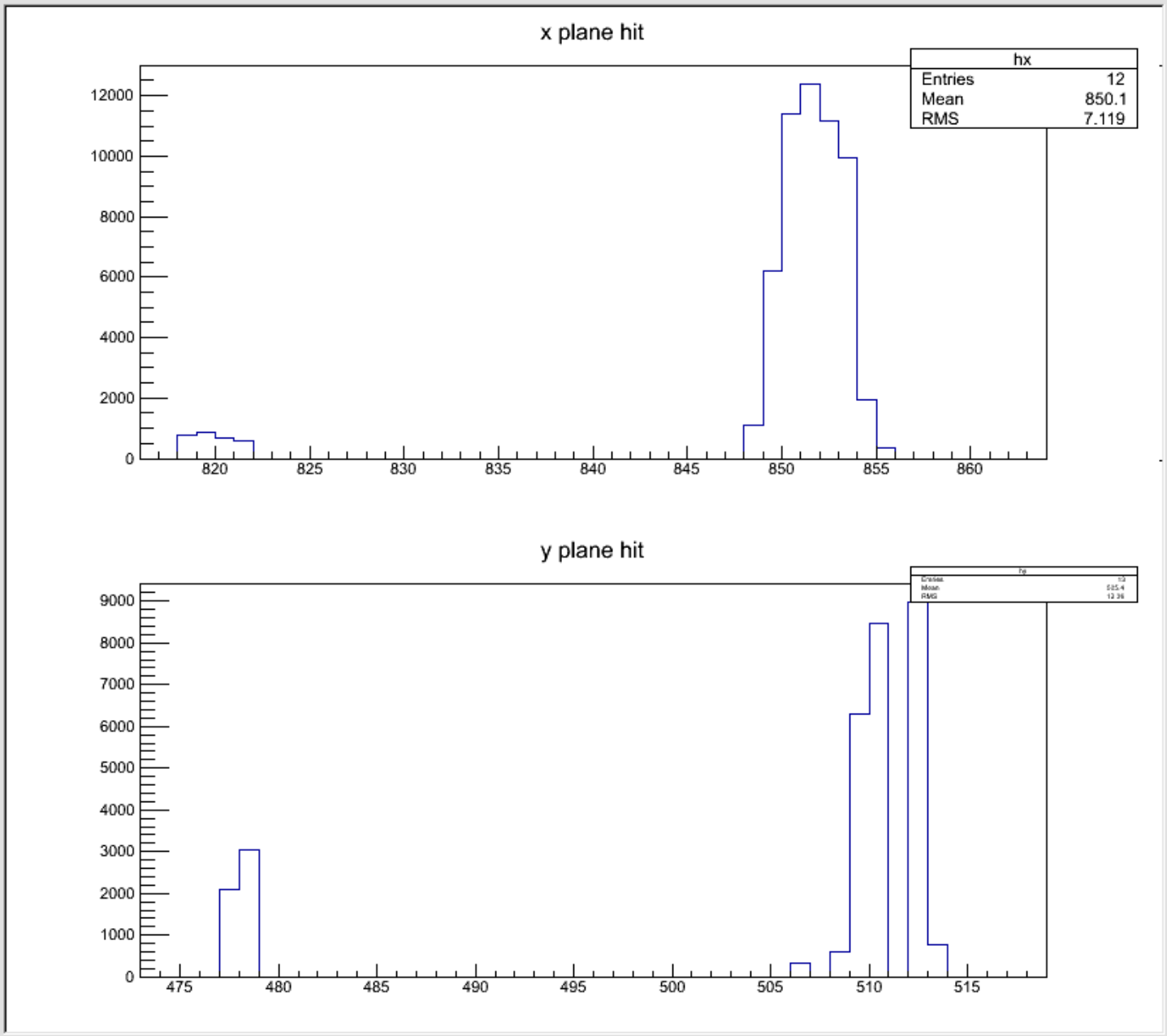
Viewer

File Test Help

plot_0 | plot_1 | plot_2 | plot_3 | plot_4 | plot_5 | plot_6

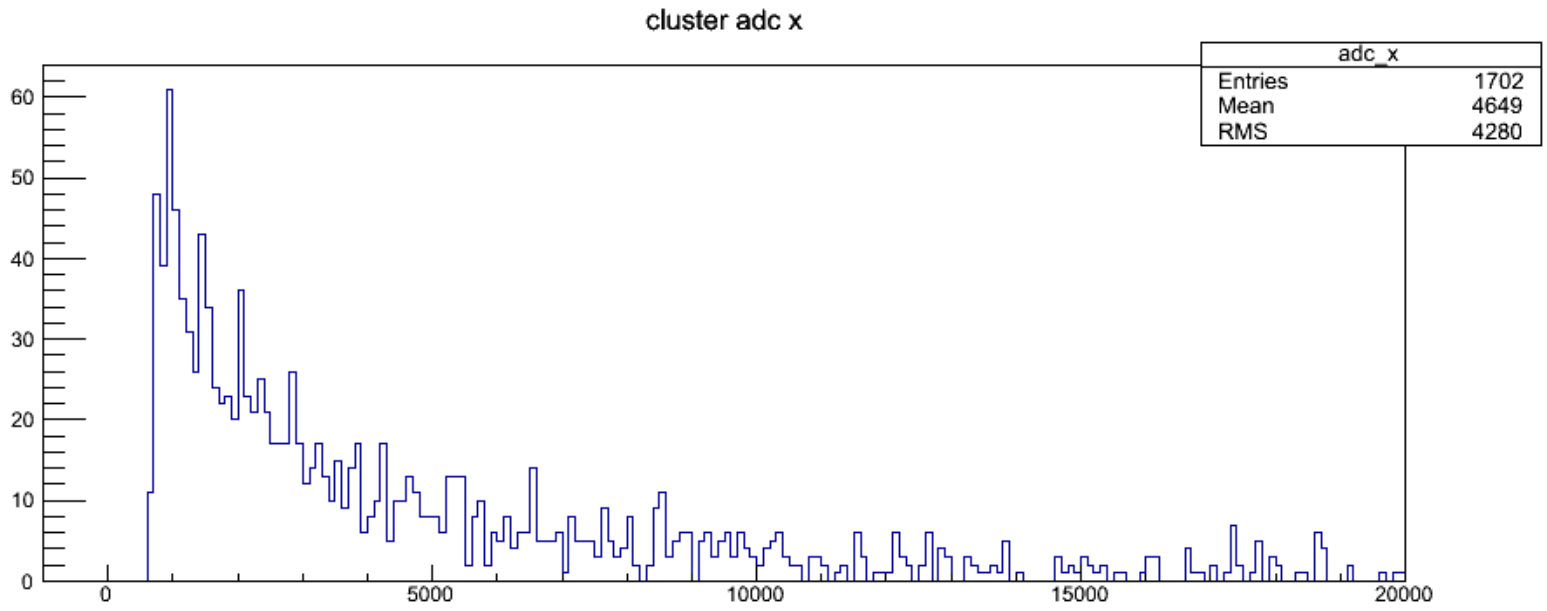
Next Event
Next

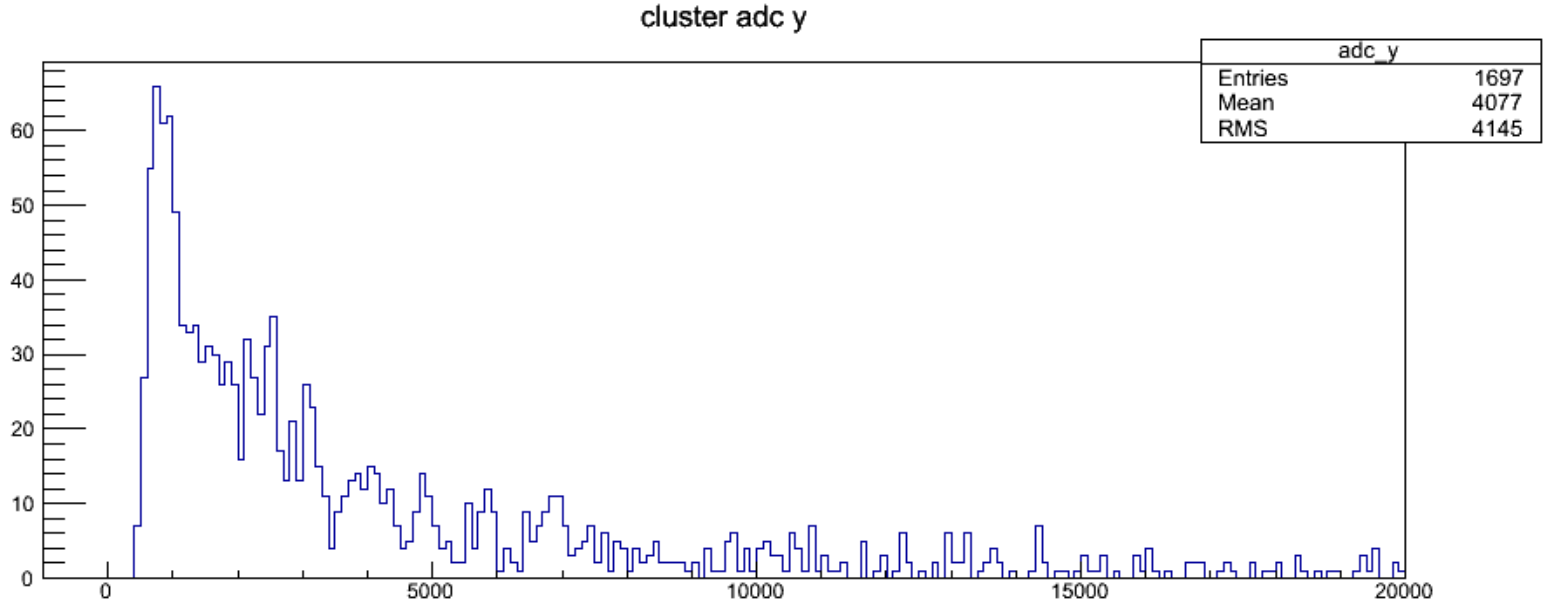
Previous Event
Previous



adc

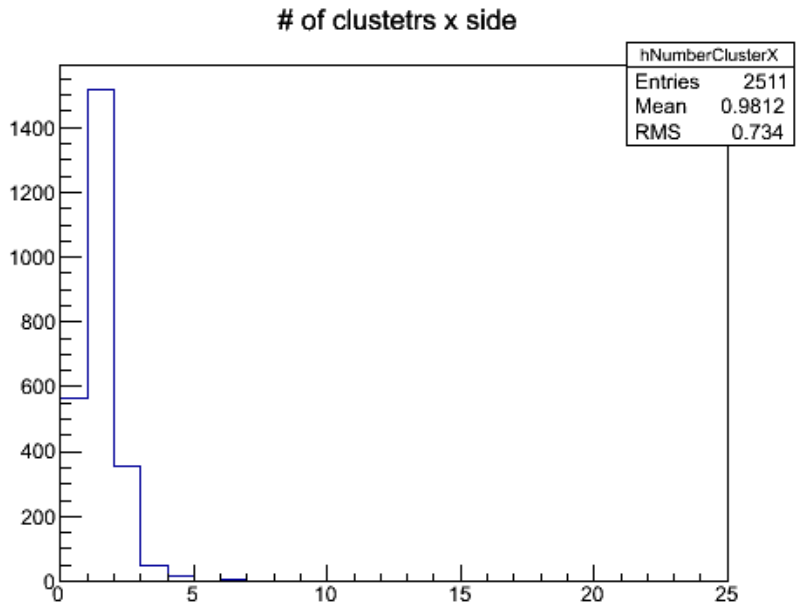
File Edit View Options Tools Help

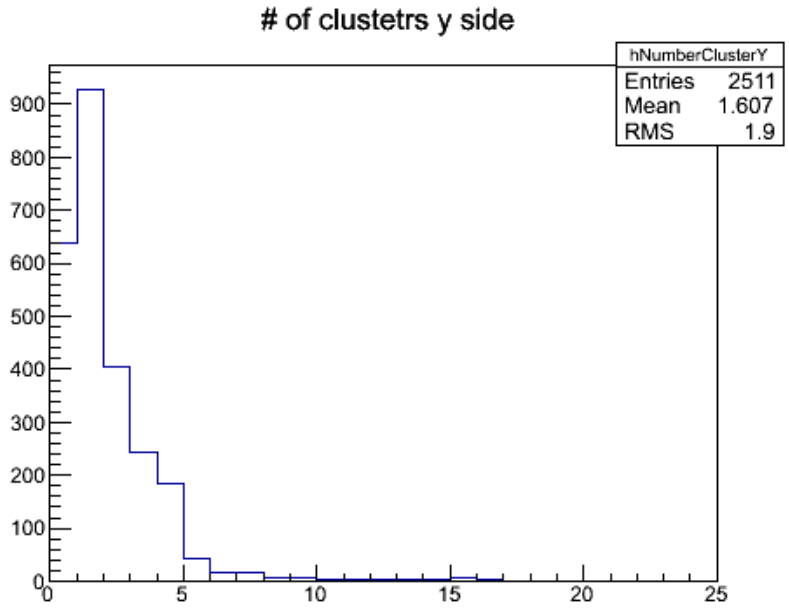


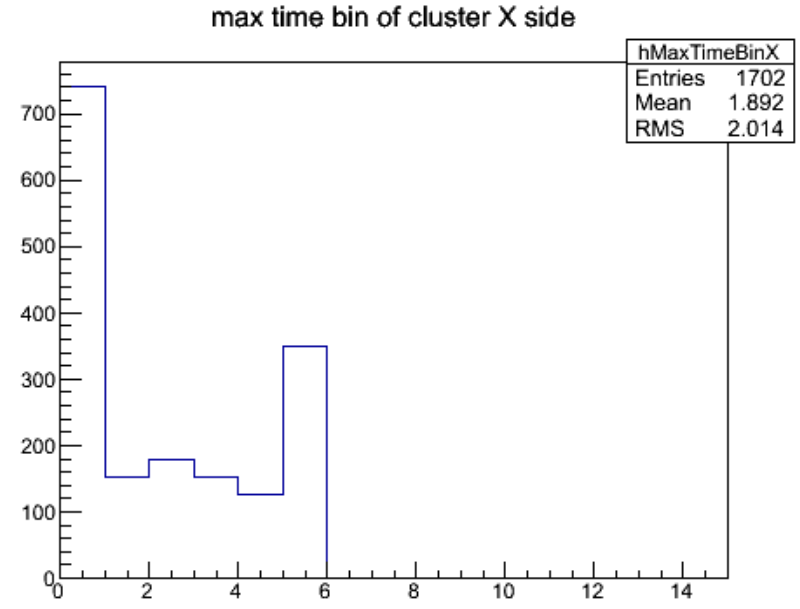


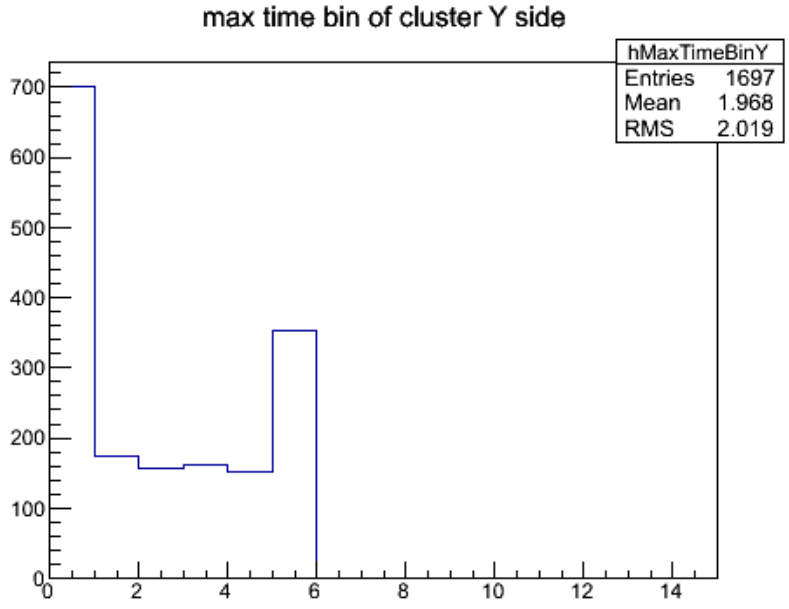
time bin

File Edit View Options Tools Help



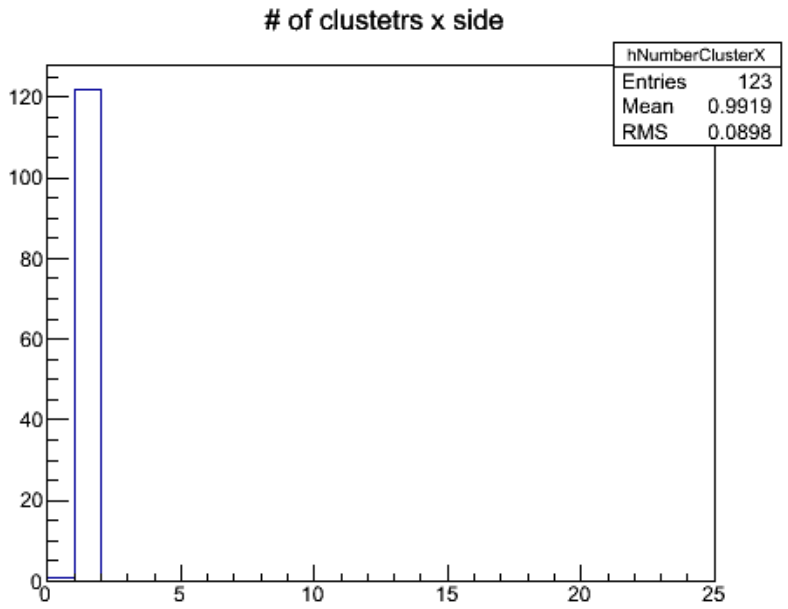


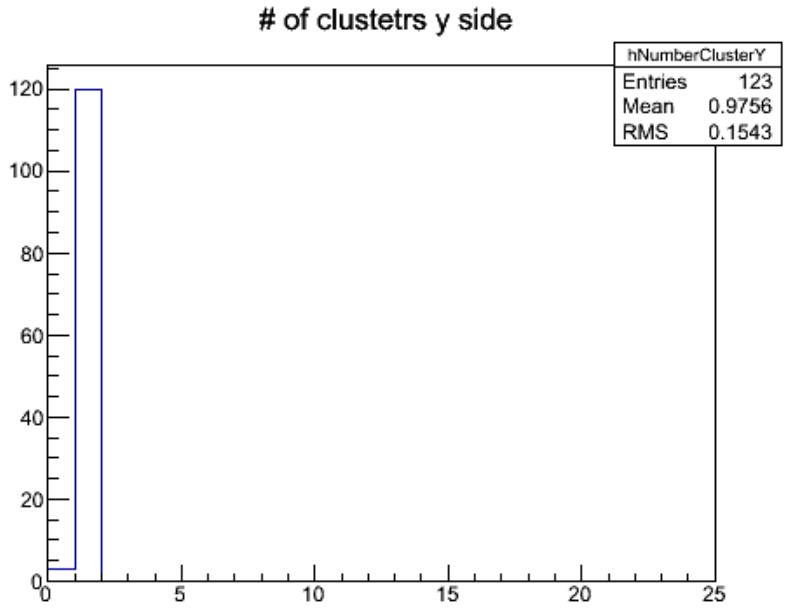


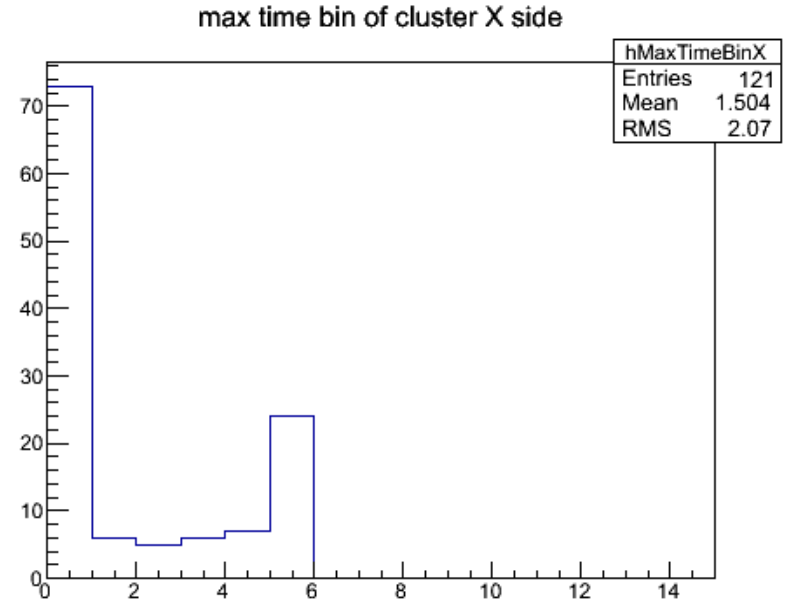


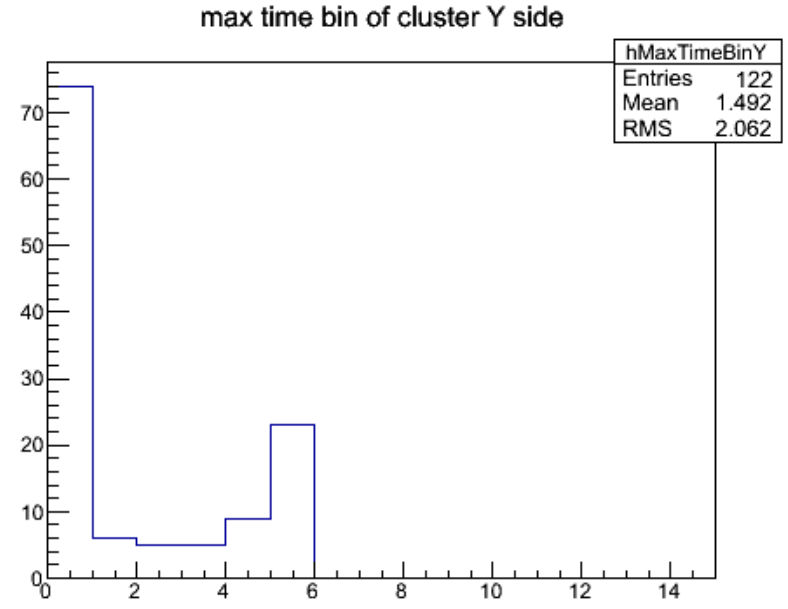
time bin

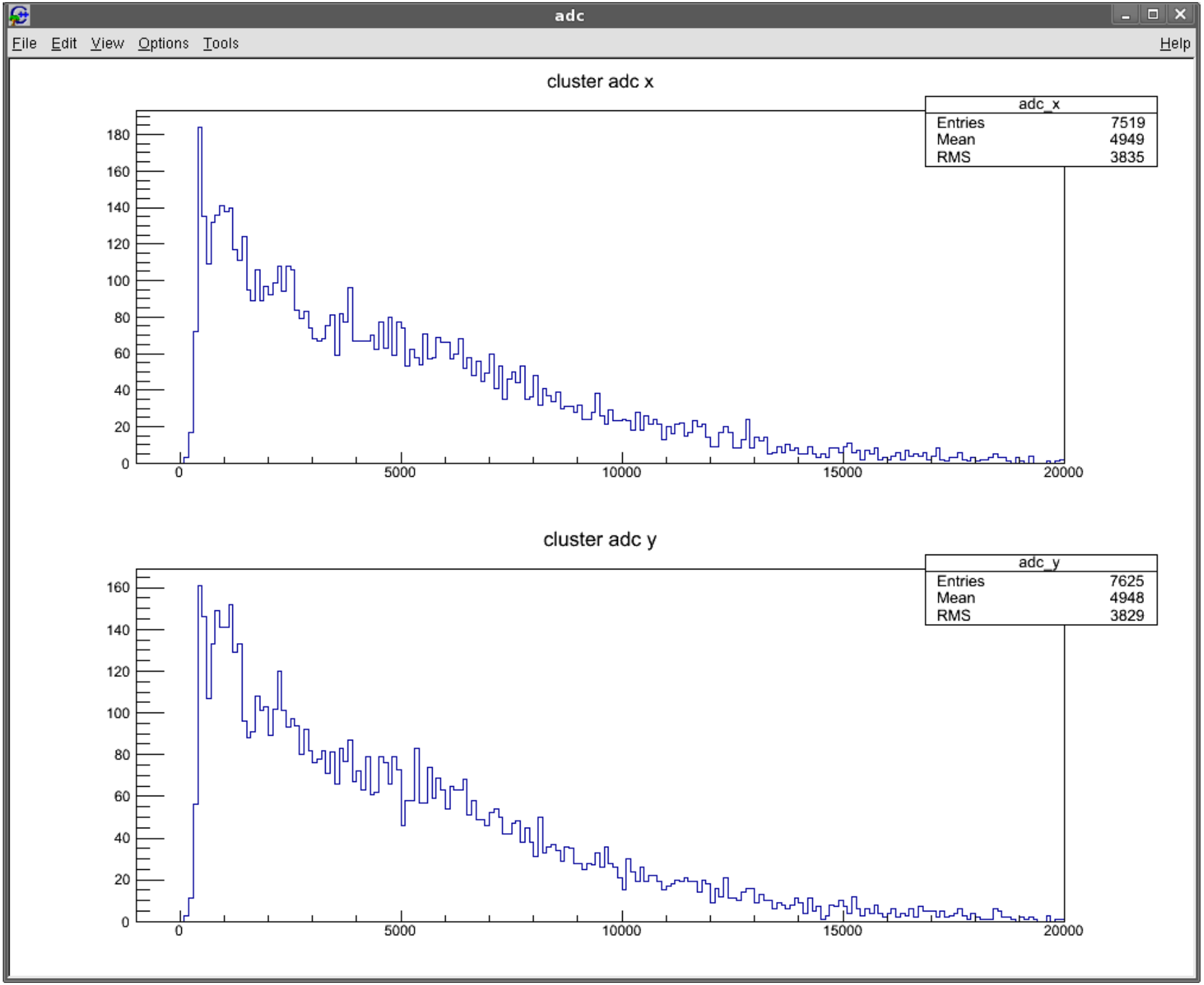
File Edit View Options Tools Help










adc
File Edit View Options Tools Help
cluster adc x
adc_x
Entries 7519
Mean 4949
RMS 3835
0 20 40 60 80 100 120 140 160 180
0 5000 10000 15000 20000
cluster adc y
adc_y
Entries 7625
Mean 4948
RMS 3829
0 20 40 60 80 100 120 140 160
0 5000 10000 15000 20000

X-ray Sim: with Gaussian Avalanche model