May 12, 2021

Update on SiD ECal MAPS Simulations

Jim Brau
University of Oregon

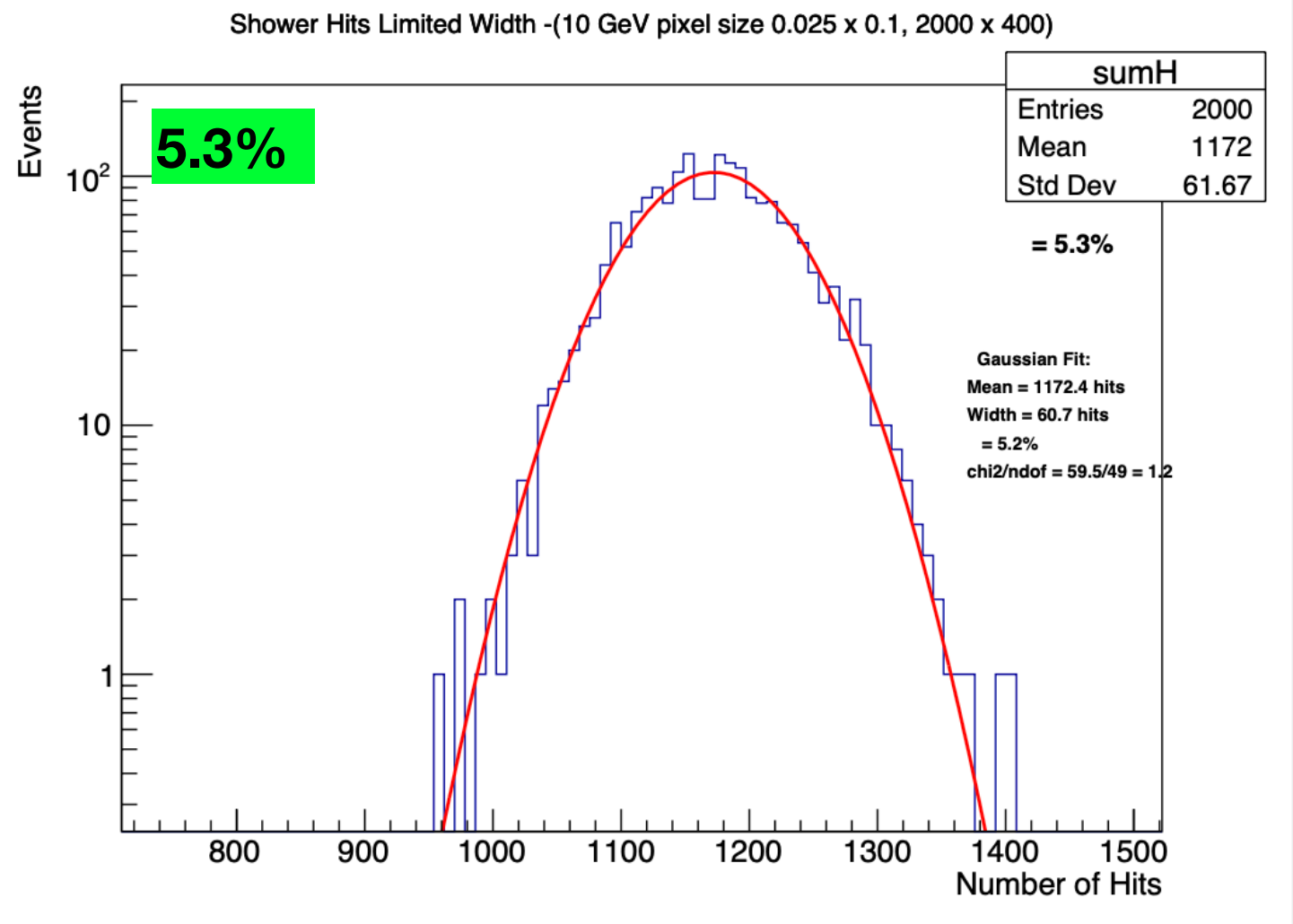
Introduction

- Multiple scattering between two sensors in a tungsten gap limits hit matching to distinguish mip related hits to mip-less hits, as I discussed in an earlier optimization meeting.
- I have looked more closely at performance of the single sensor configuration. This is focus of today's presentation.
- Note - for two sensors bending of low energy electrons in magnetic field is not a significant effect (see later slide).

10 GeV electrons

Hit Counts

All Hits: 5.3%

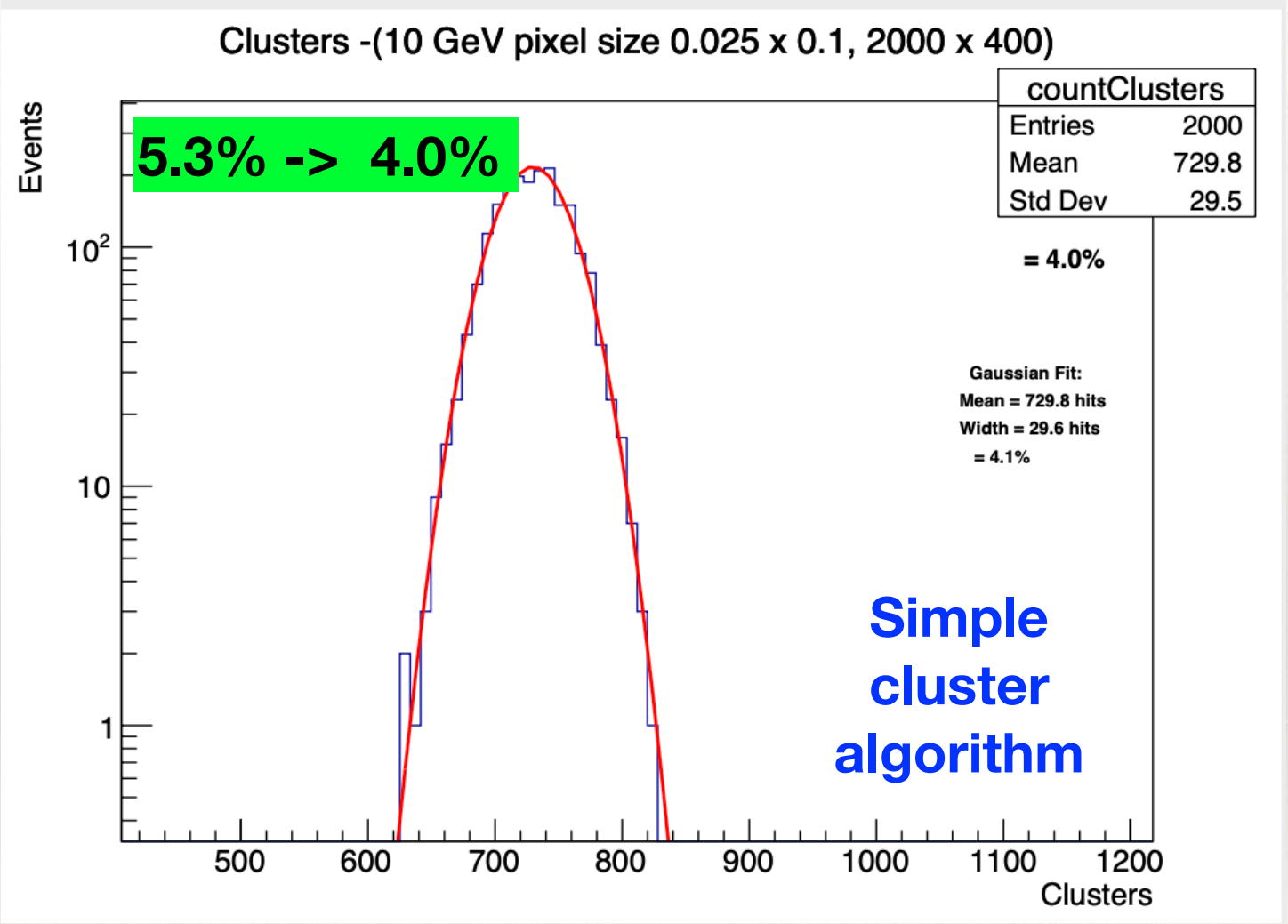


Hits > 1 keV (272 e's)

10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%



Hits > 1 keV (272 e's)

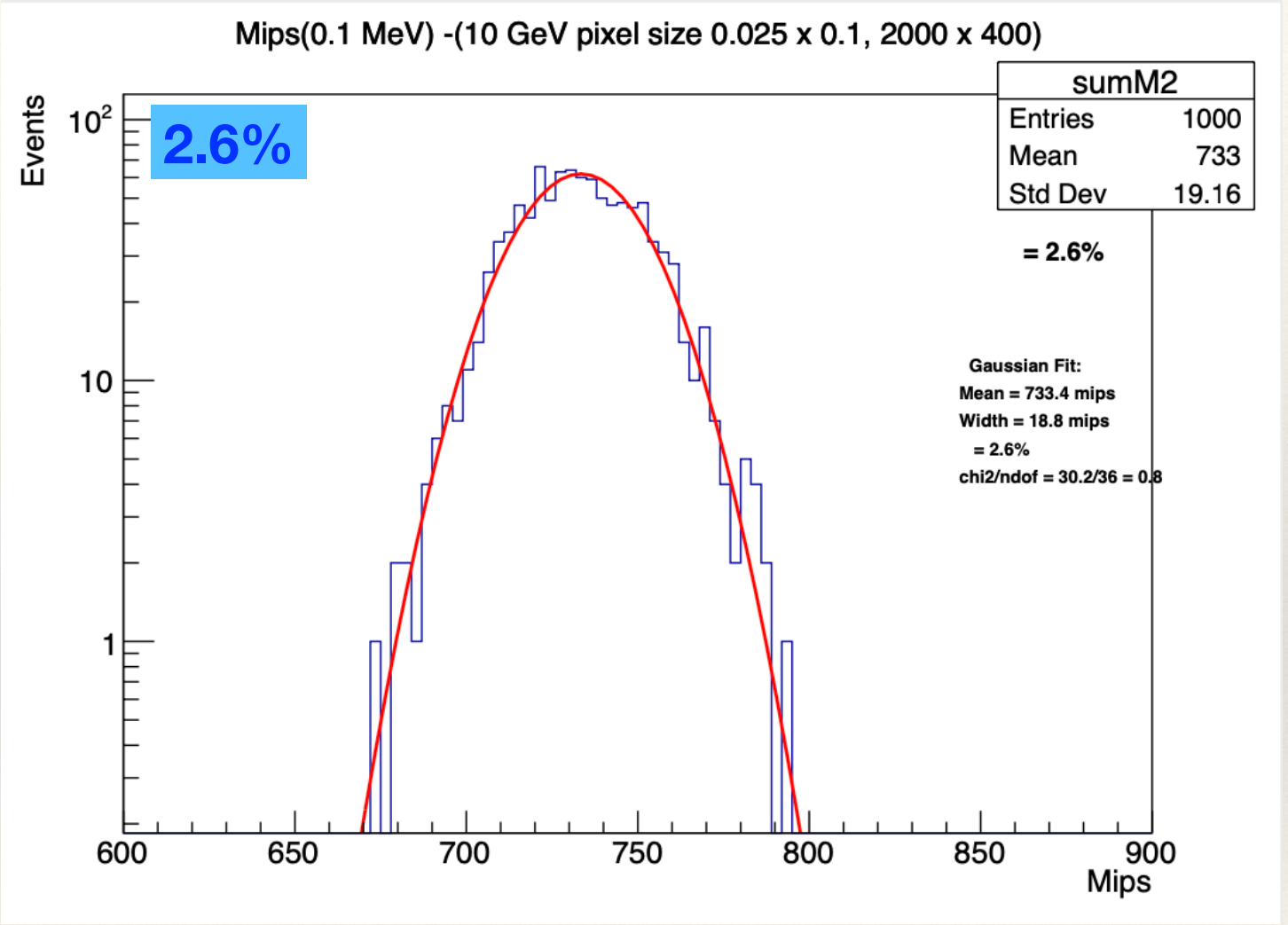
10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%

Mip Counts

All Mips: 2.6%



Mips > 0.1 MeV

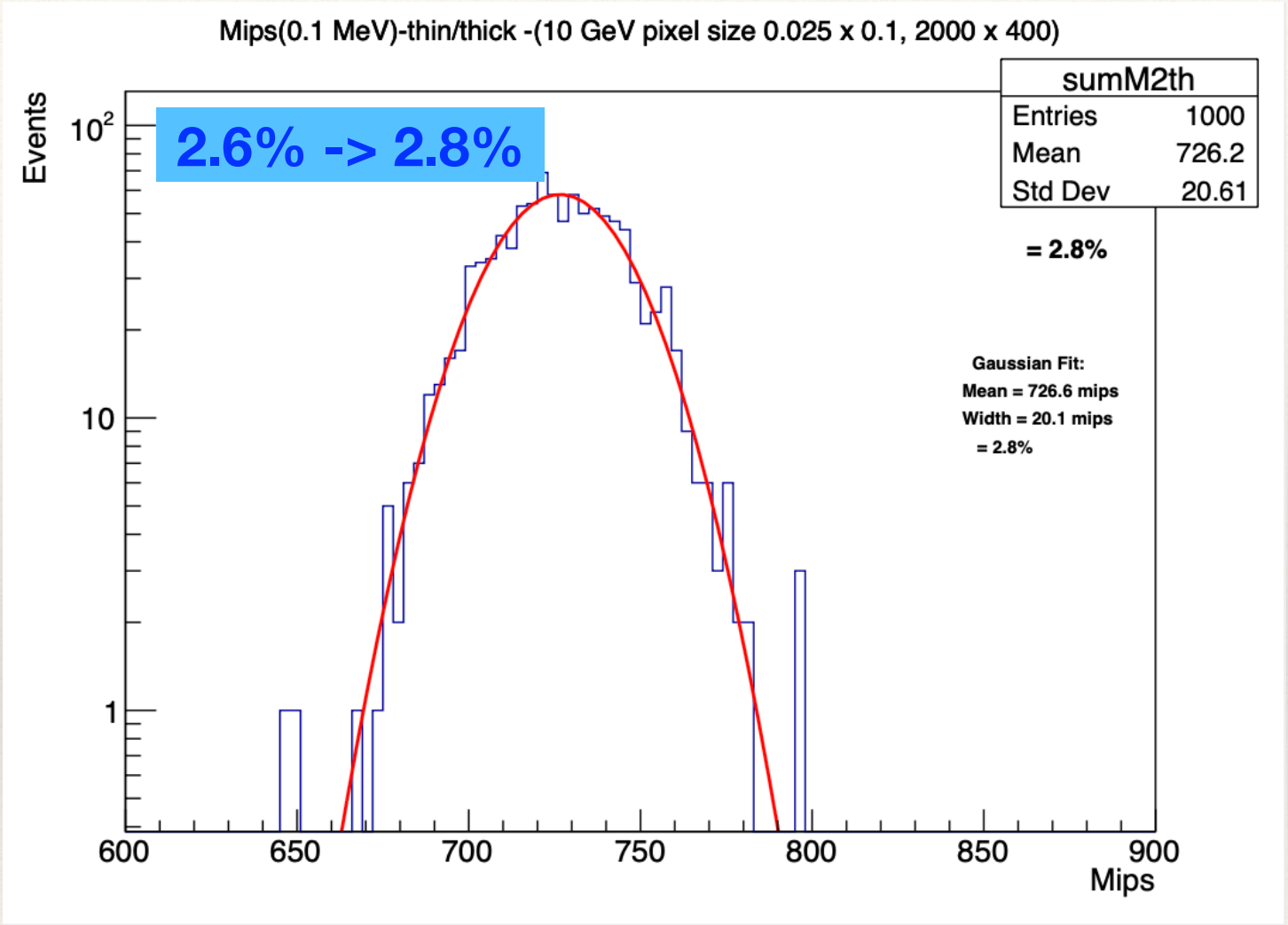
10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%

Mip Counts

All Mips: 2.6%
20+10 layers: 2.8%



Mips > 0.1 MeV

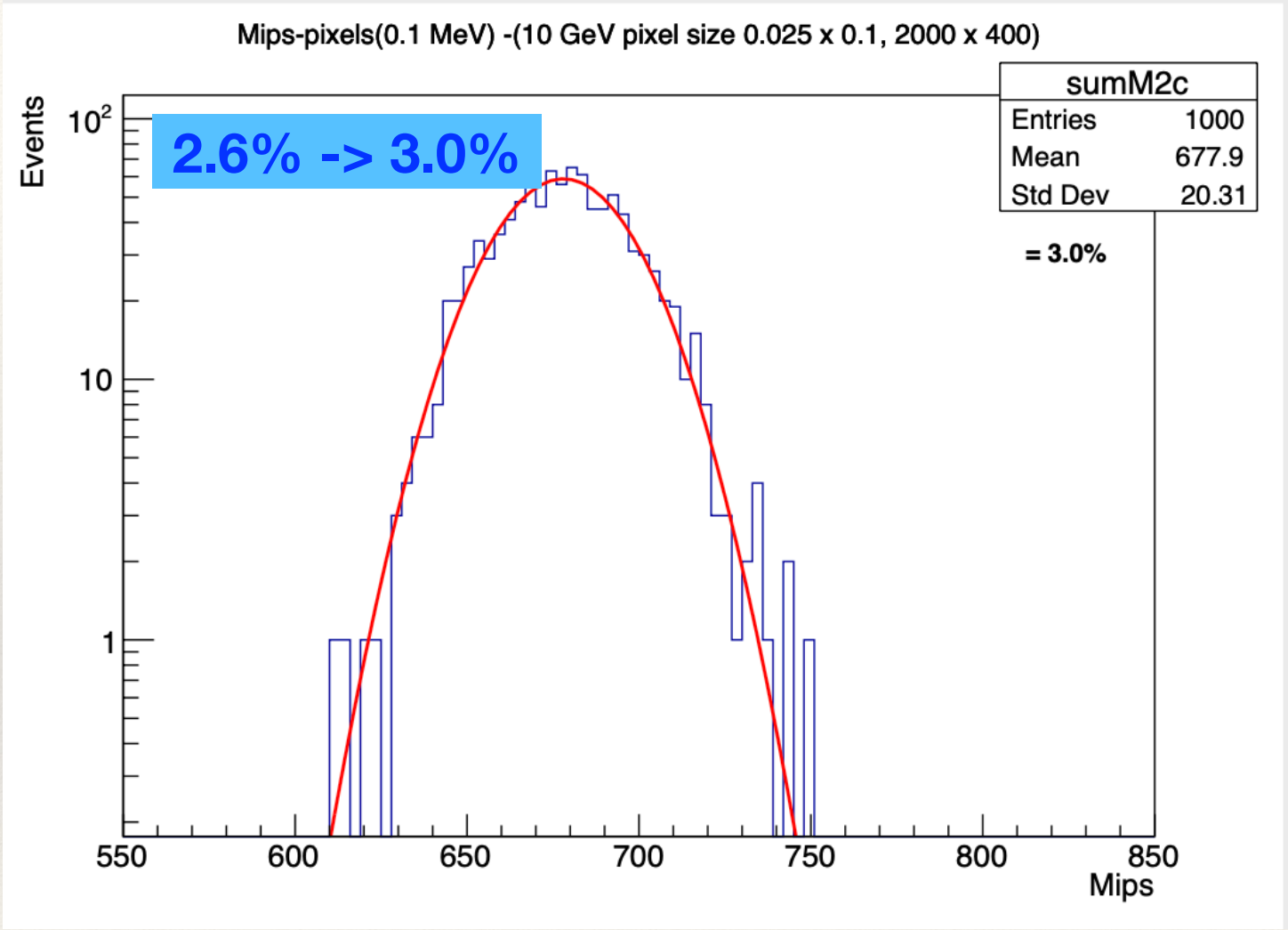
10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%

Mip Counts

All Mips: 2.6%
20+10 layers: 2.8%
Pixels: 3.0%



Mips > 0.1 MeV

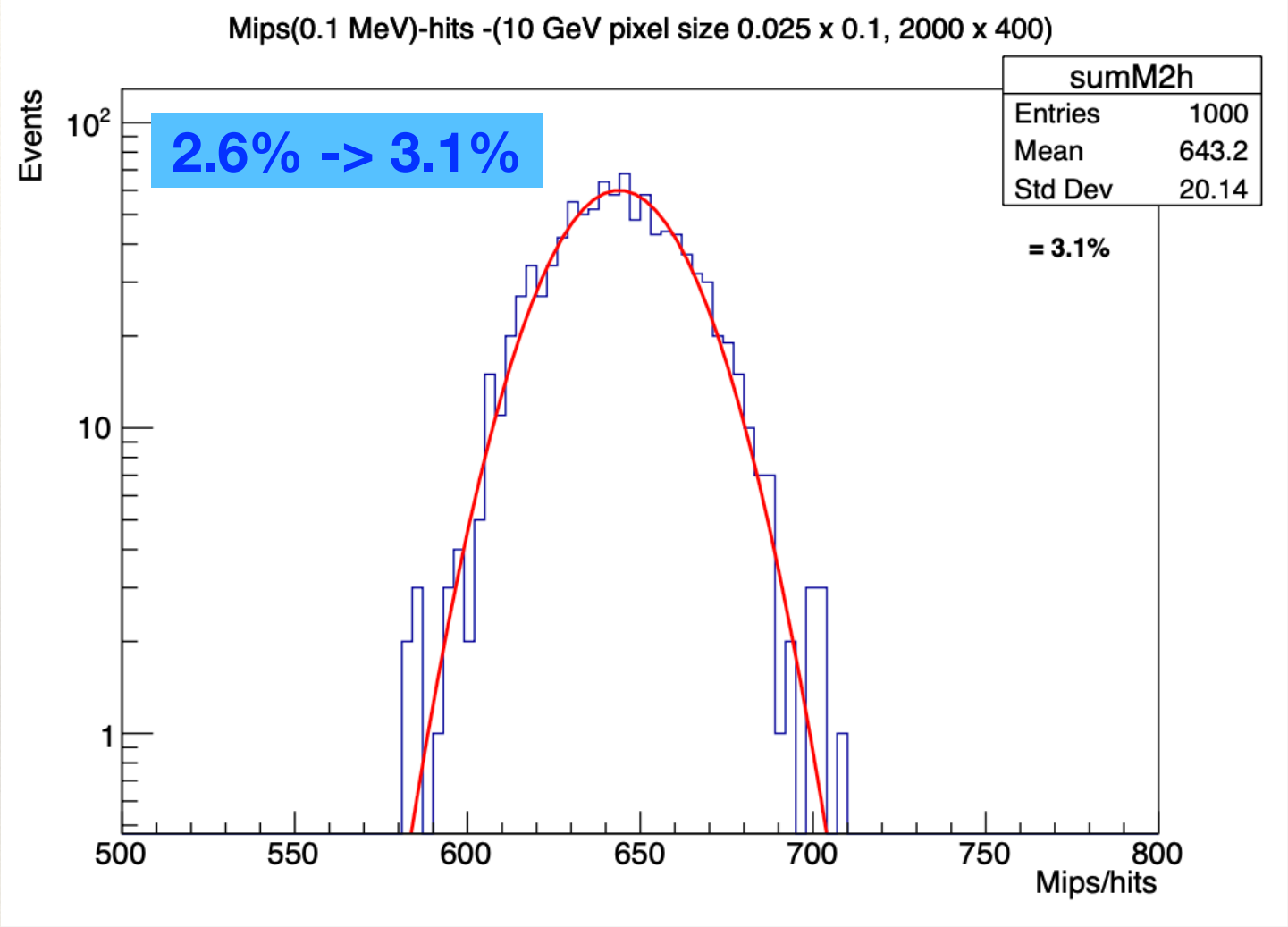
10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%

Mip Counts

All Mips: 2.6%
20+10 layers: 2.8%
Pixels: 3.0%
Hits: 3.1%



Mips > 0.1 MeV

Hits > 1 keV (272 e's)

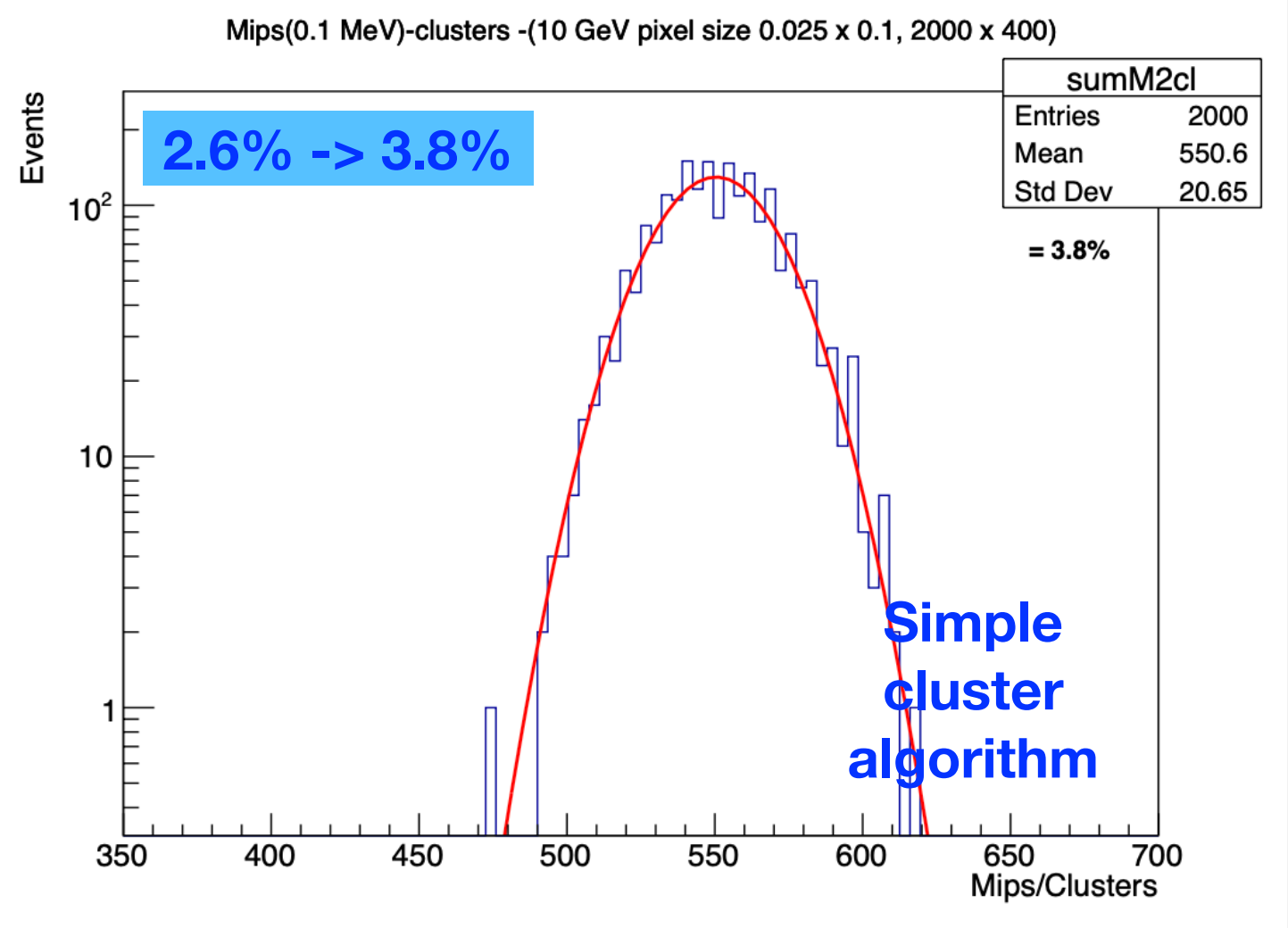
10 GeV electrons

Hit Counts

All Hits: 5.3%
Clusters: 4.0%

Mip Counts

All Mips: 2.6%
20+10 layers: 2.8%
Pixels: 3.0%
Hits: 3.1%
Clusters w/ mips: 3.8%



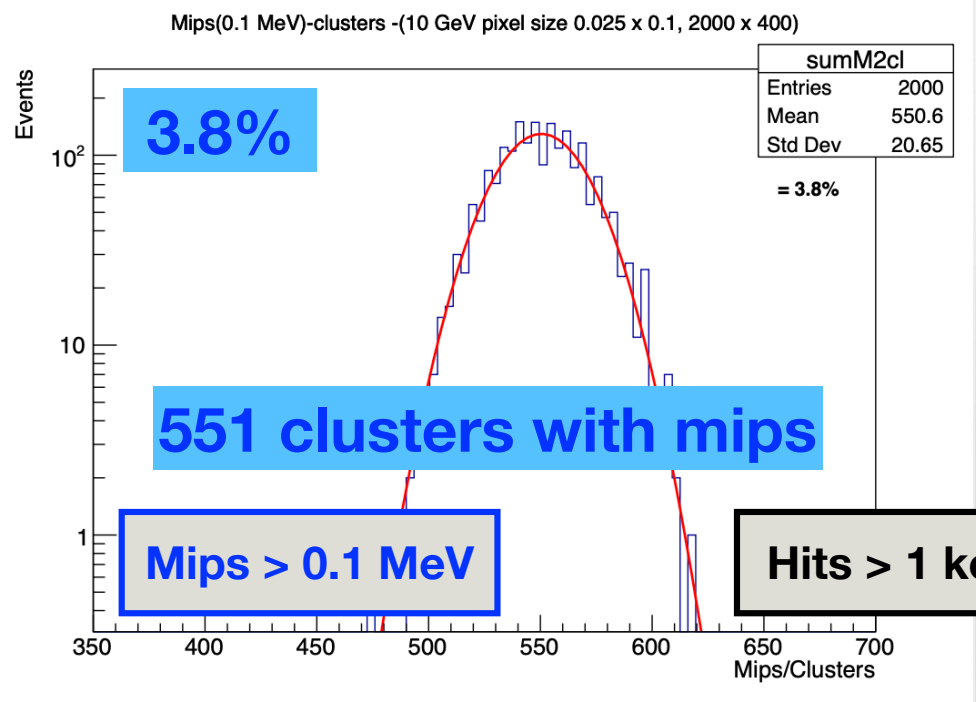
Mips > 0.1 MeV

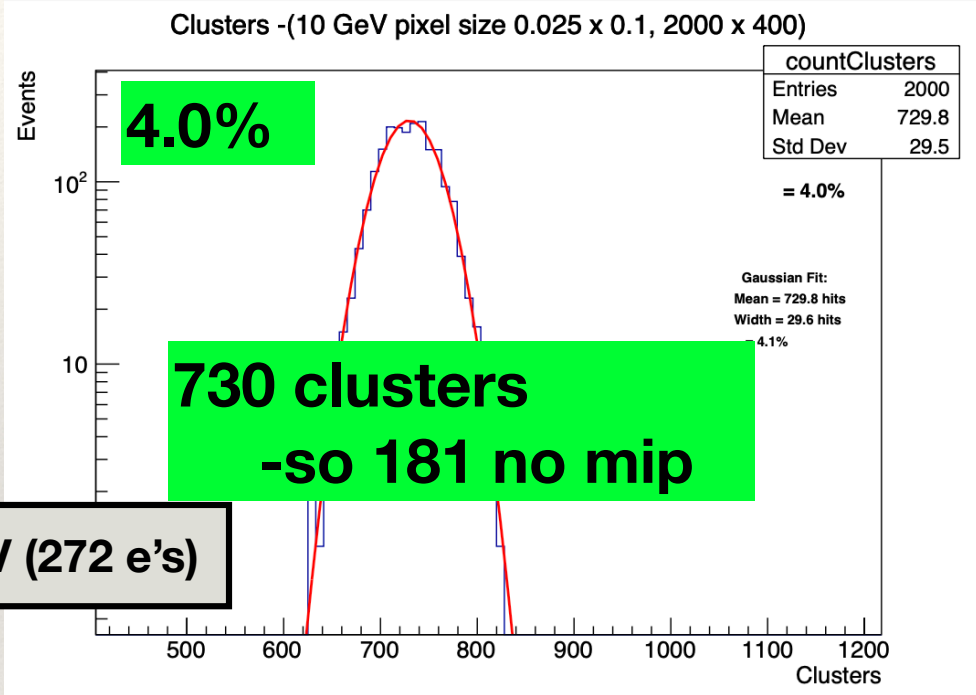
Hits > 1 keV (272 e's)

10 GeV electrons

2.6% -> 3.8%

5.3% -> 4.0%

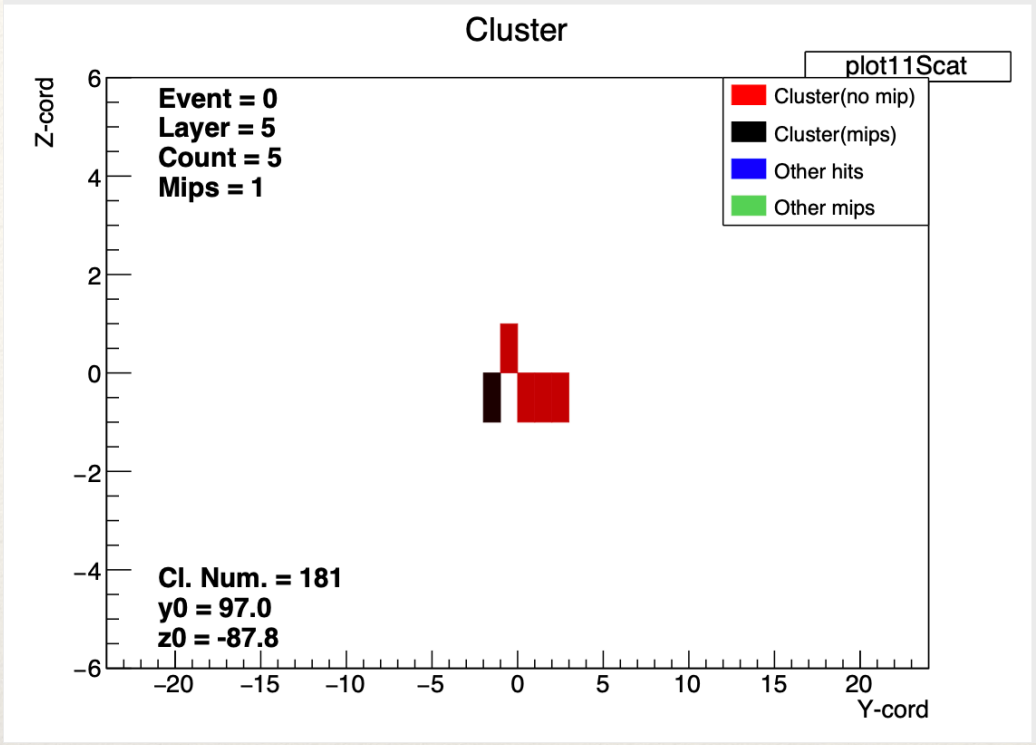


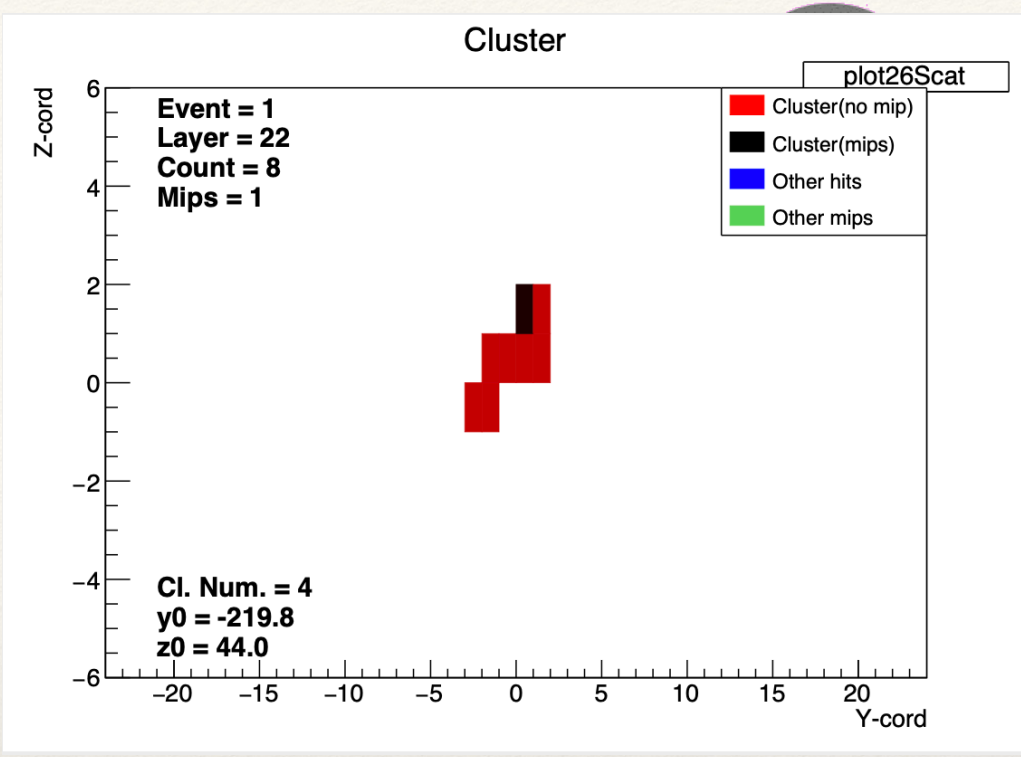


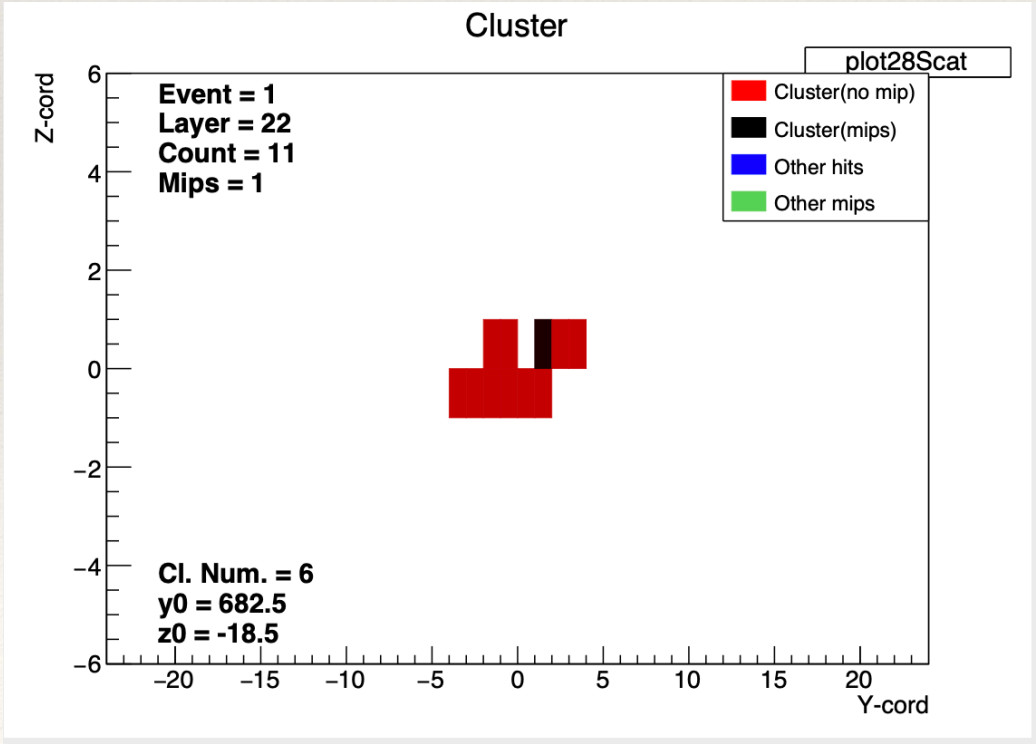
Simple cluster algorithm

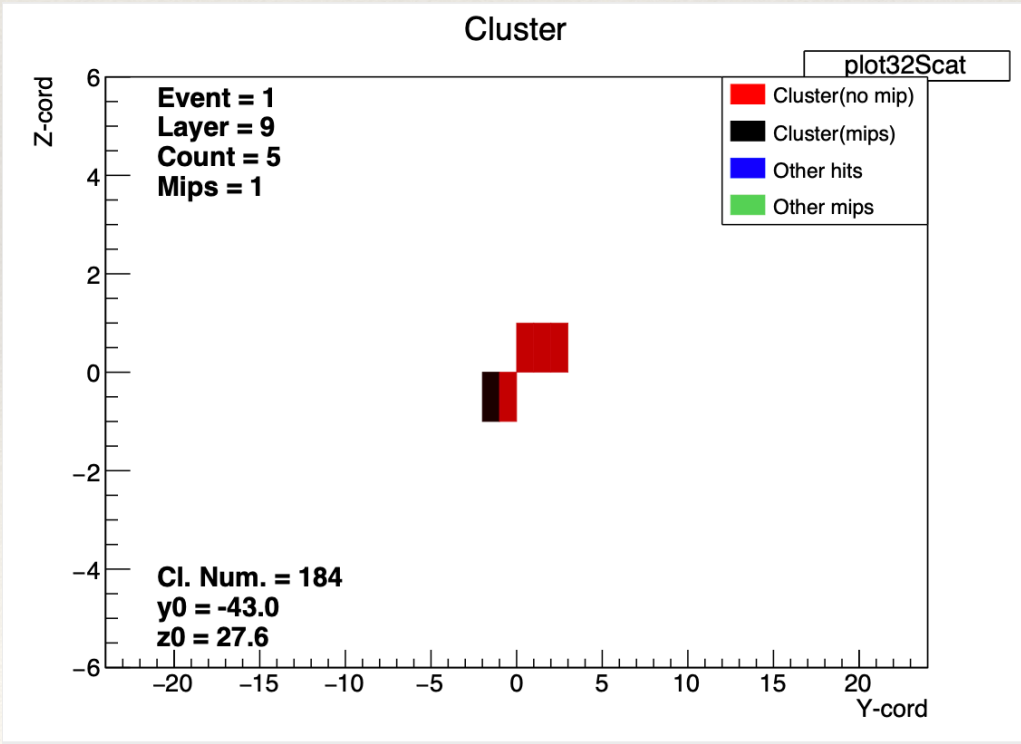
But both depend on my simple cluster algorithm.

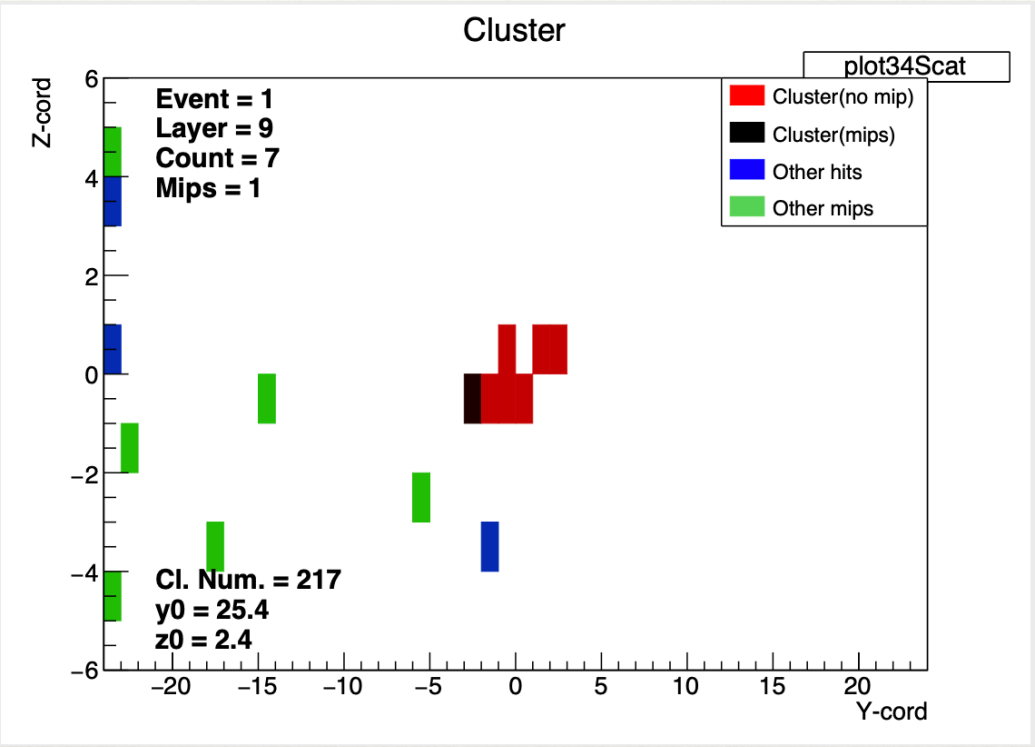
Can we do better?

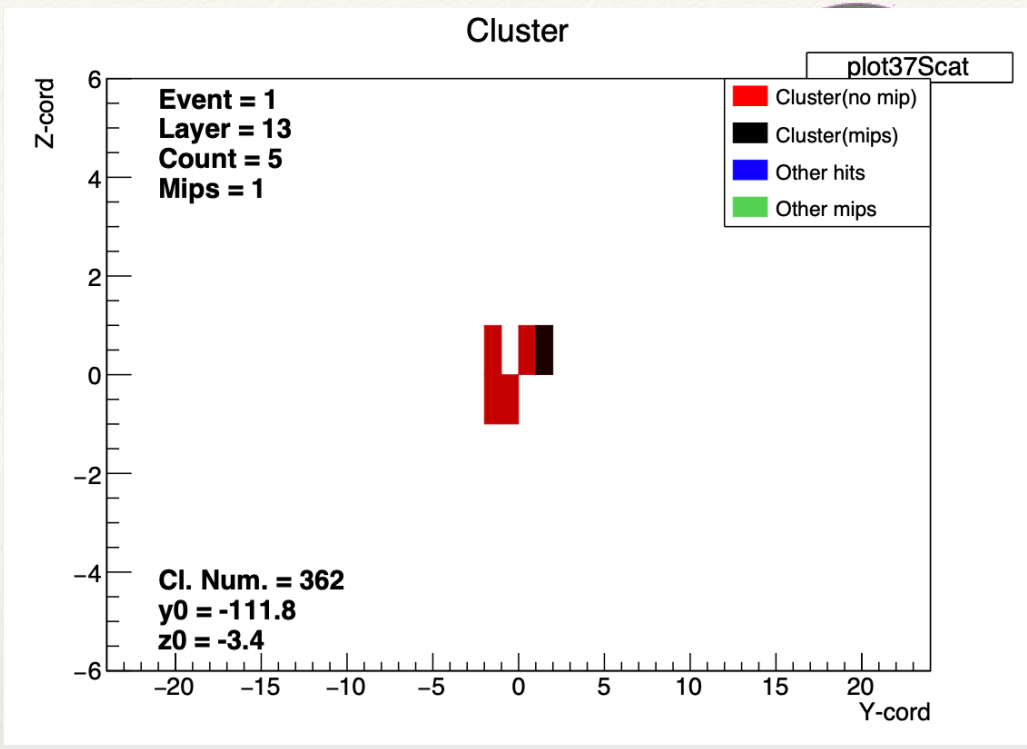

Cluster
plot11Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 0
Layer = 5
Count = 5
Mips = 1
Cl. Num. = 181
y0 = 97.0
z0 = -87.8
Z-cord
Y-cord

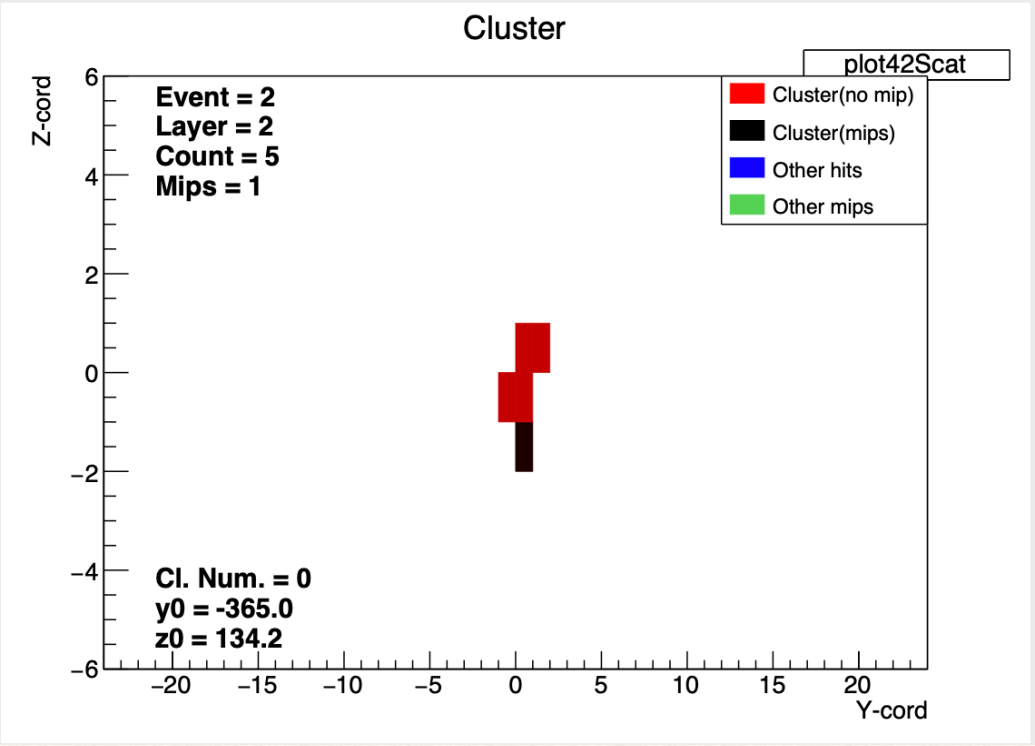

Cluster
plot26Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 1
Layer = 22
Count = 8
Mips = 1
Cl. Num. = 4
y0 = -219.8
z0 = 44.0
Z-cord
Y-cord

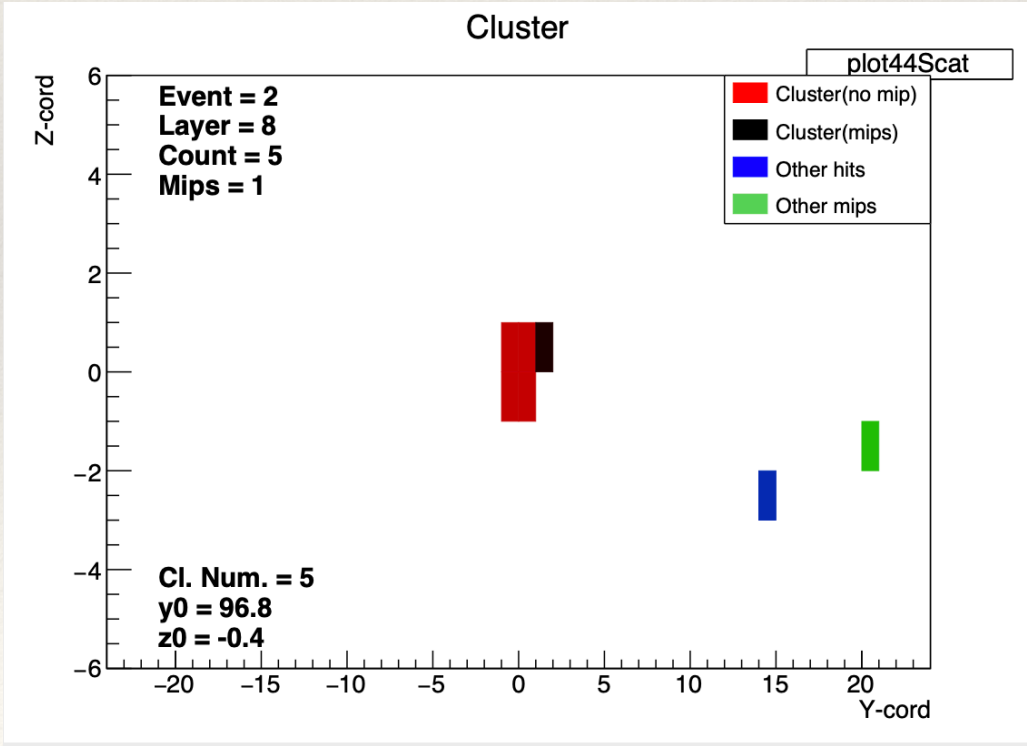

Cluster
plot28Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 1
Layer = 22
Count = 11
Mips = 1
Cl. Num. = 6
y0 = 682.5
z0 = -18.5
Z-cord
Y-cord

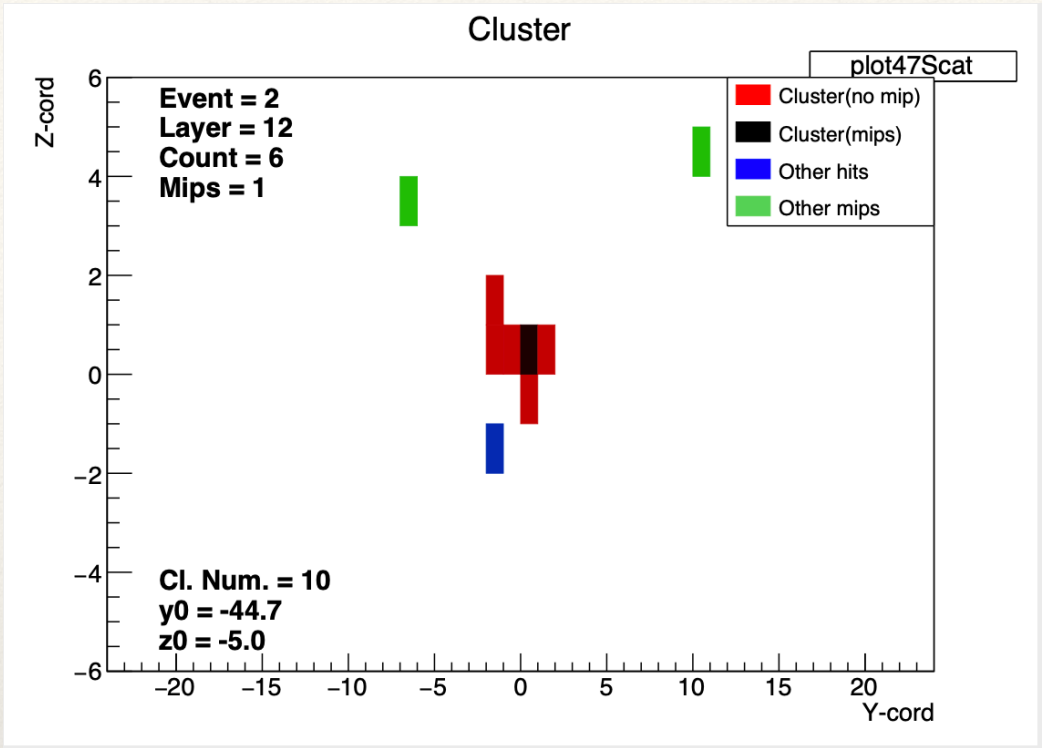

Cluster
plot32Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 1
Layer = 9
Count = 5
Mips = 1
Cl. Num. = 184
y0 = -43.0
z0 = 27.6
Z-cord
Y-cord

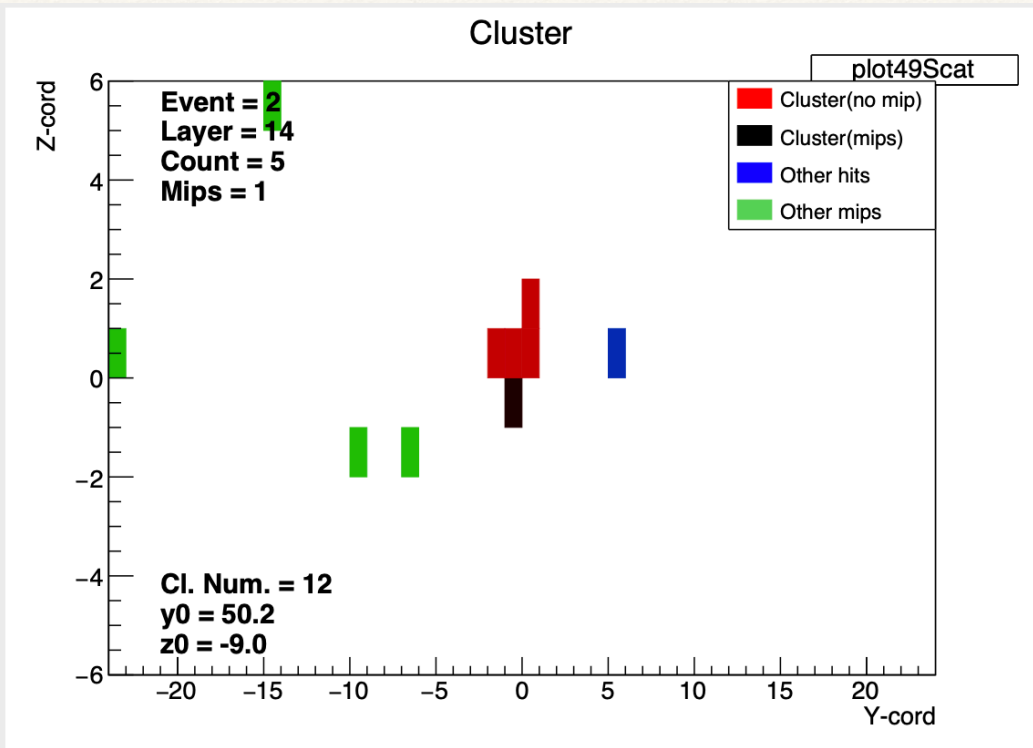

Cluster
plot34Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 1
Layer = 9
Count = 7
Mips = 1
Cl. Num. = 217
y0 = 25.4
z0 = 2.4
Z-cord
Y-cord

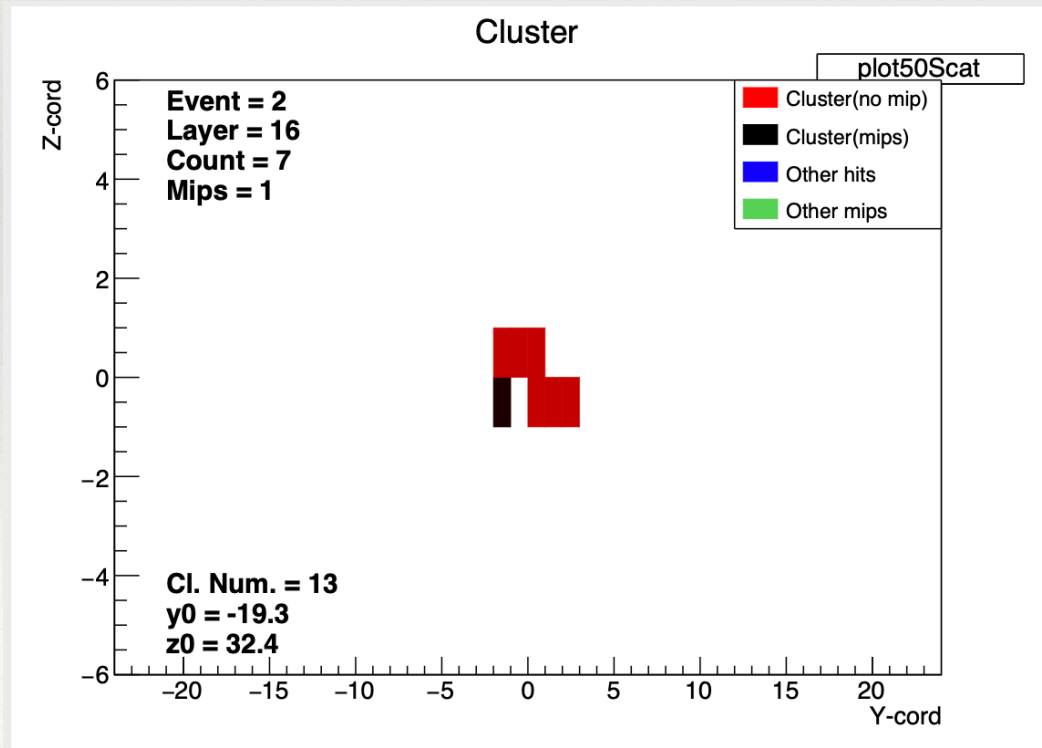

Cluster
plot37Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 1
Layer = 13
Count = 5
Mips = 1
Cl. Num. = 362
y0 = -111.8
z0 = -3.4
Z-cord
Y-cord

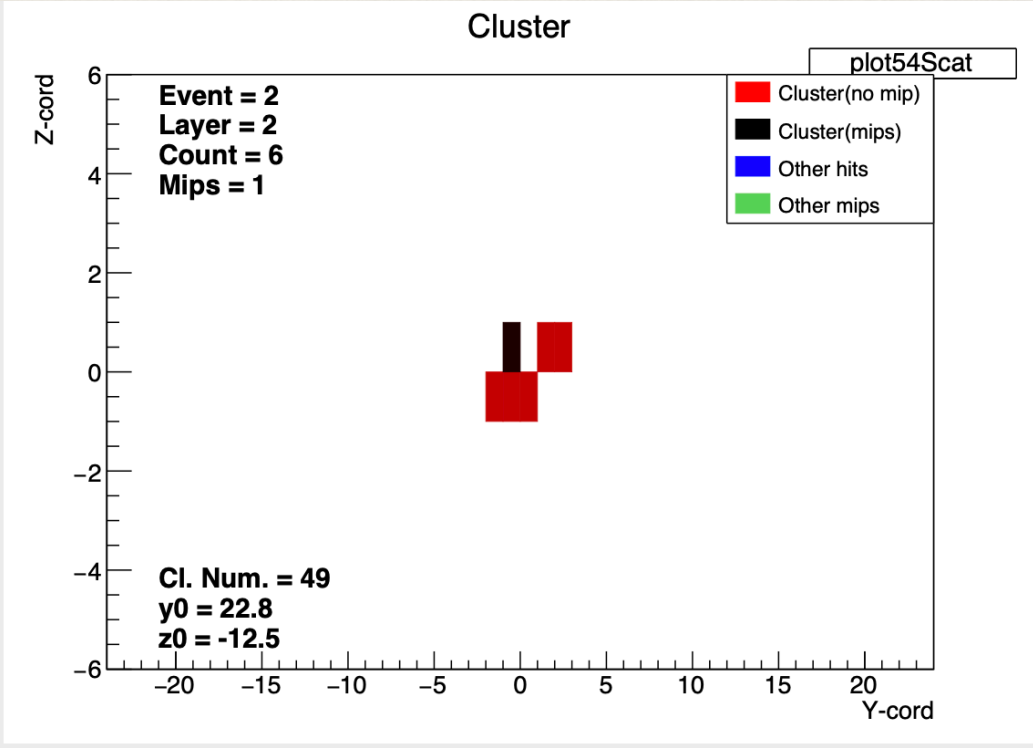

Cluster
plot42Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 2
Layer = 2
Count = 5
Mips = 1
Cl. Num. = 0
y0 = -365.0
z0 = 134.2
Z-cord
Y-cord

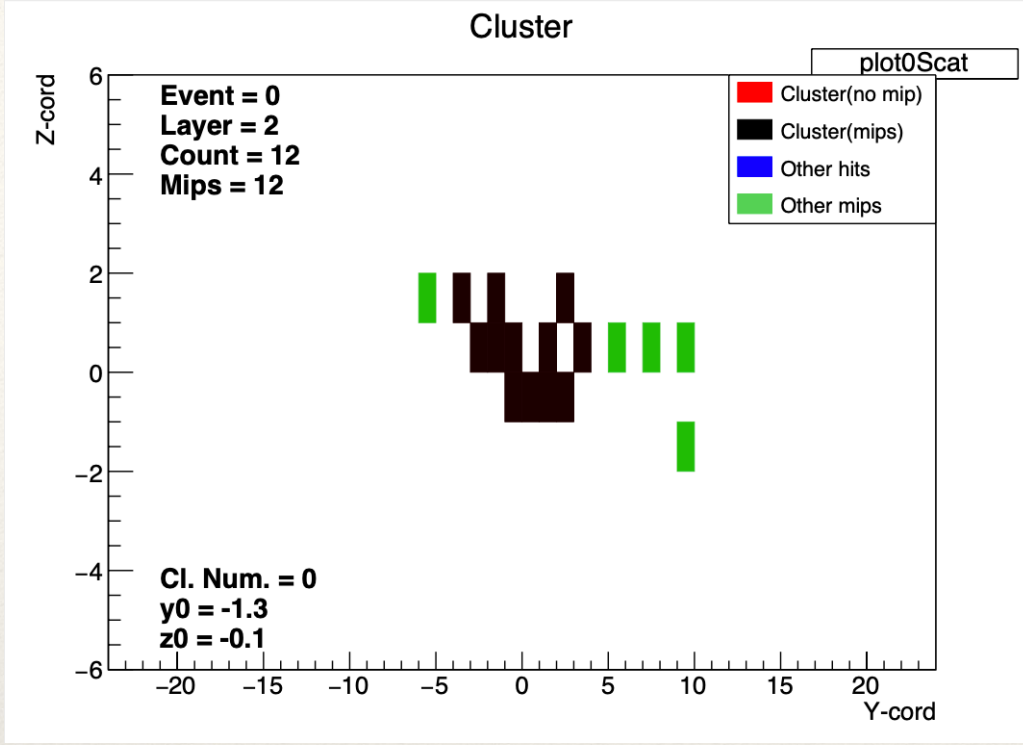

Cluster
plot44Scat
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Event = 2
Layer = 8
Count = 5
Mips = 1
Cl. Num. = 5
y0 = 96.8
z0 = -0.4
Z-cord
Y-cord

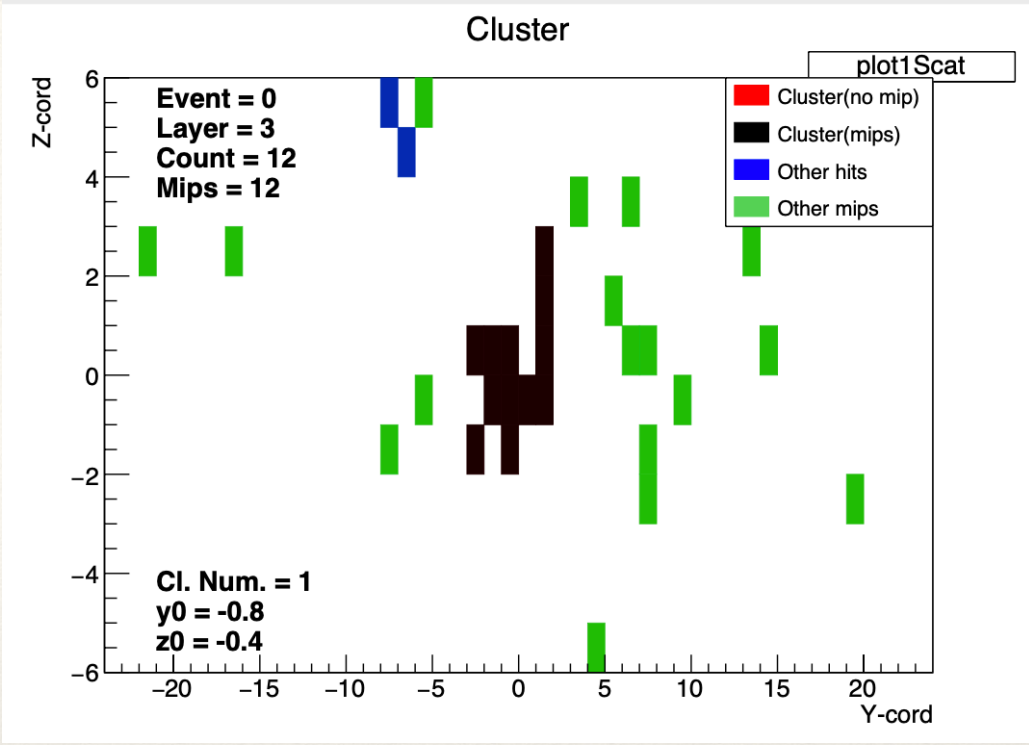

Cluster
plot47Scat
Event = 2
Layer = 12
Count = 6
Mips = 1
Cl. Num. = 10
y0 = -44.7
z0 = -5.0
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord

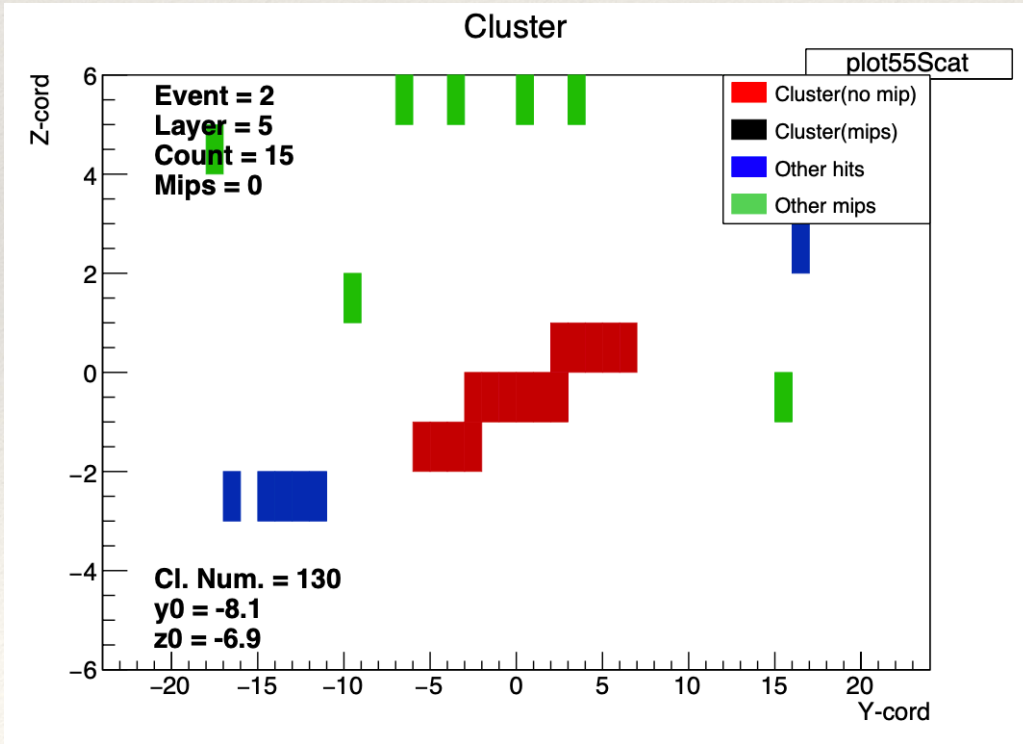

Cluster
plot49Scat
Event = 2
Layer = 14
Count = 5
Mips = 1
Cl. Num. = 12
y0 = 50.2
z0 = -9.0
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord

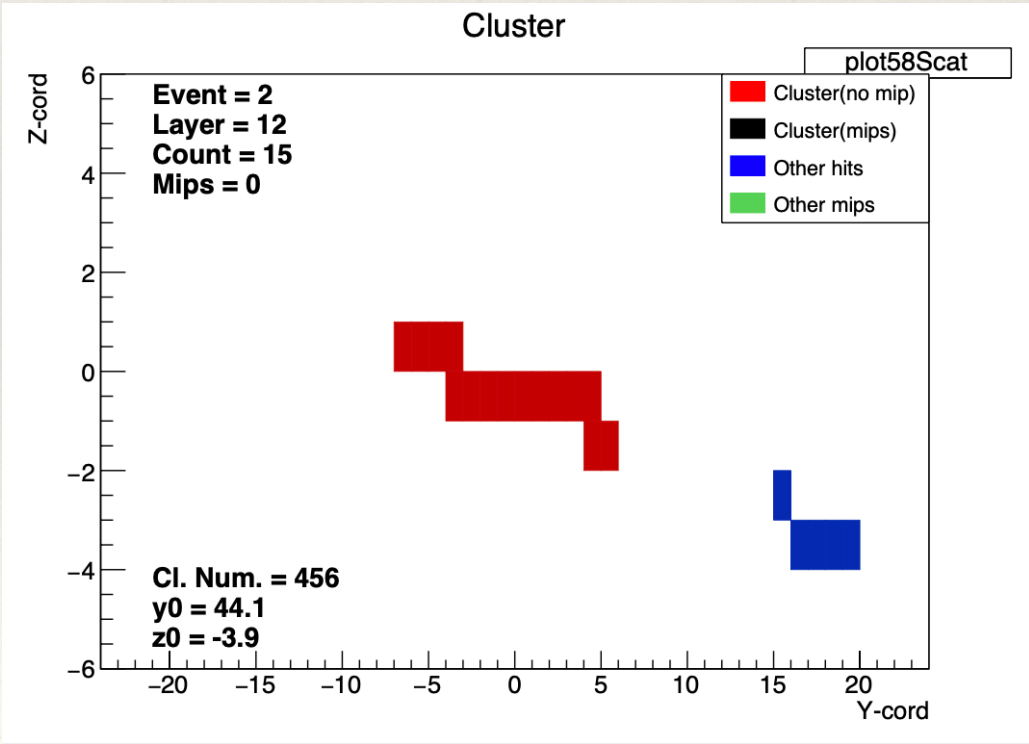

Cluster
plot50Scat
Event = 2
Layer = 16
Count = 7
Mips = 1
Cl. Num. = 13
y0 = -19.3
z0 = 32.4
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord

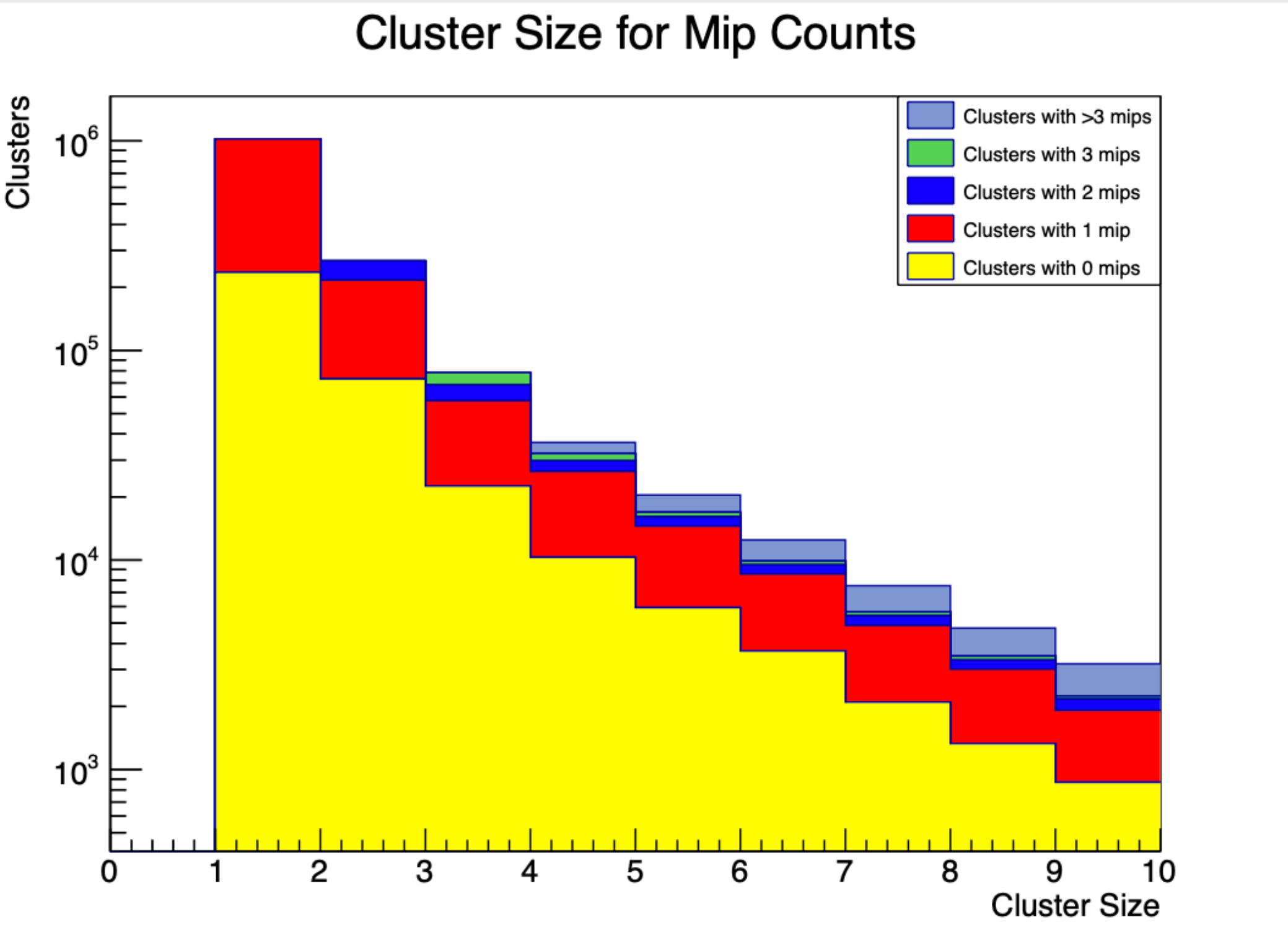

Cluster
plot54Scat
Event = 2
Layer = 2
Count = 6
Mips = 1
Cl. Num. = 49
y0 = 22.8
z0 = -12.5
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord

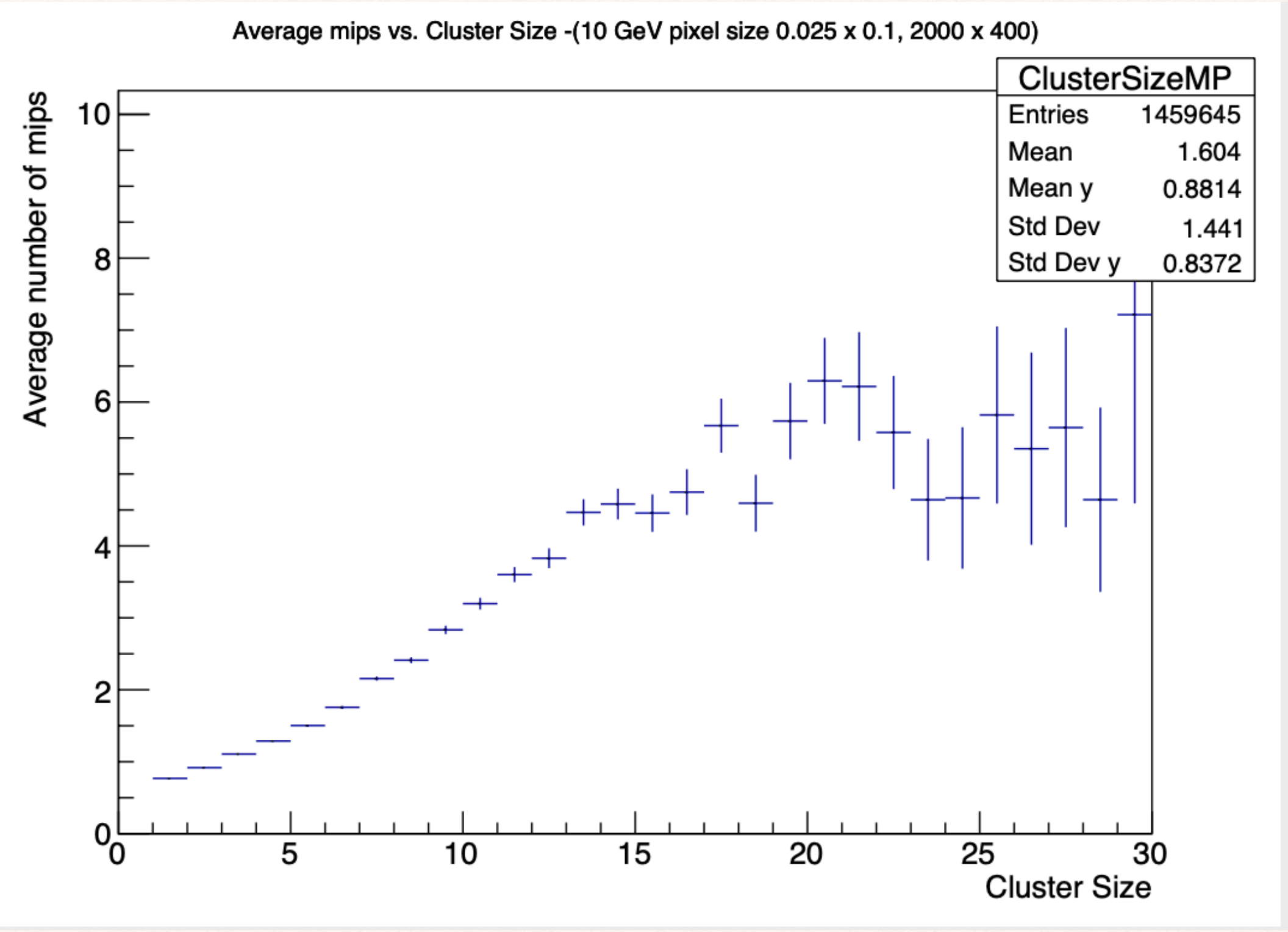

Cluster
plot0Scat
Event = 0
Layer = 2
Count = 12
Mips = 12
Cl. Num. = 0
y0 = -1.3
z0 = -0.1
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord


Cluster
plot1Scat
Event = 0
Layer = 3
Count = 12
Mips = 12
Cl. Num. = 1
y0 = -0.8
z0 = -0.4
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord


Cluster
plot55Scat
Event = 2
Layer = 5
Count = 15
Mips = 0
Cl. Num. = 130
y0 = -8.1
z0 = -6.9
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord

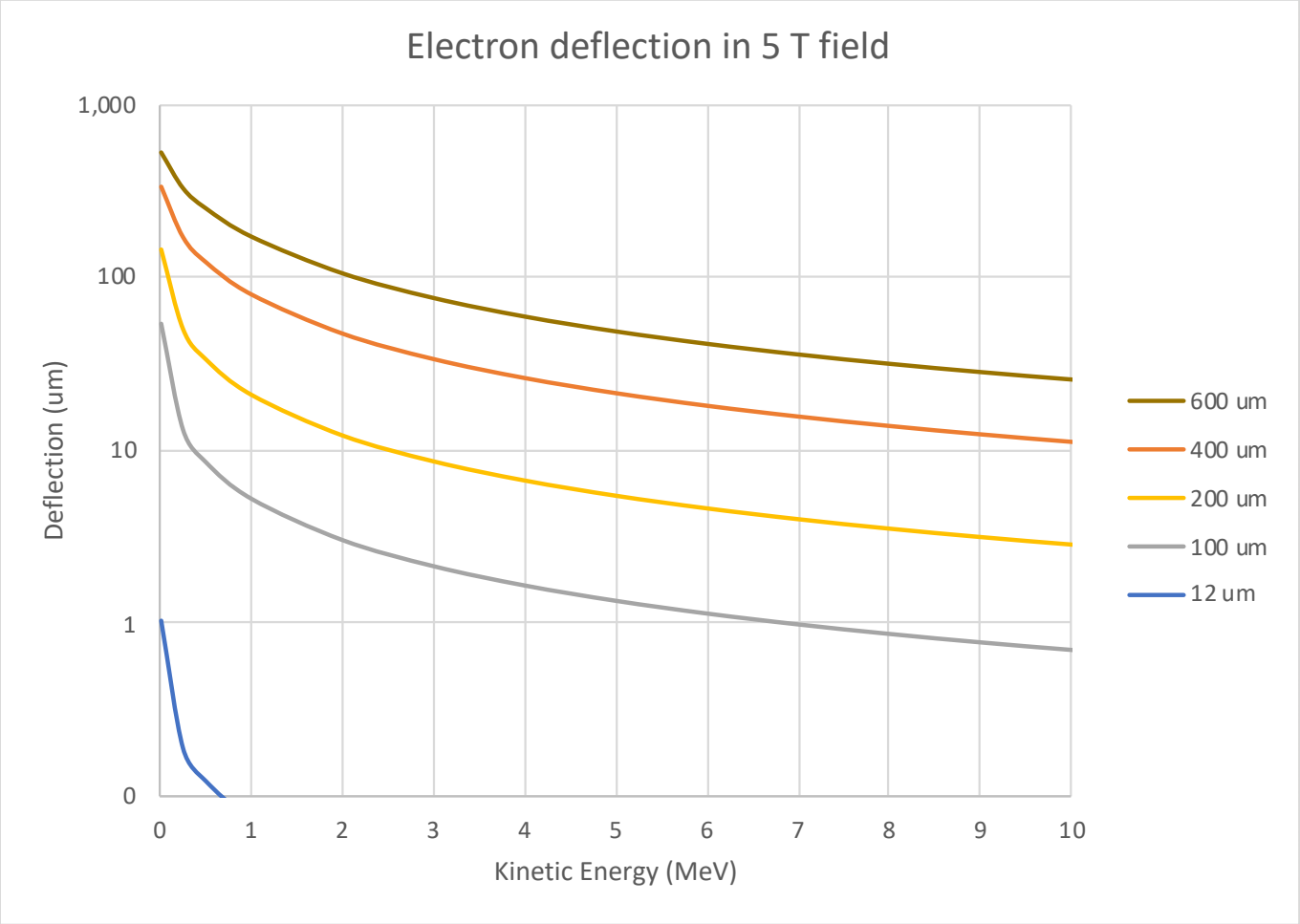

Cluster
plot58Scat
Event = 2
Layer = 12
Count = 15
Mips = 0
Cl. Num. = 456
y0 = 44.1
z0 = -3.9
Cluster(no mip)
Cluster(mips)
Other hits
Other mips
Z-cord
Y-cord


Cluster Size for Mip Counts
Clusters
10^6
10^5
10^4
10^3
Clusters with >3 mips
Clusters with 3 mips
Clusters with 2 mips
Clusters with 1 mip
Clusters with 0 mips
0
1
2
3
4
5
6
7
8
9
10
Cluster Size


Average mips vs. Cluster Size -(10 GeV pixel size 0.025 x 0.1, 2000 x 400)
ClusterSizeMP
Entries 1459645
Mean 1.604
Mean y 0.8814
Std Dev 1.441
Std Dev y 0.8372
Average number of mips
Cluster Size
0
2
4
6
8
10
0
5
10
15
20
25
30

Old News

On April 14 I discussed multiple scattering between sensors in a tungsten gap; Andy raised question of deflection of electrons in magnetic field. I calculated it for SiD:



Summary

- We have a better understanding of the limitations of resolution at the mip level for single sensor.
- A simple cluster algorithm has been investigated and shows the complexities of distinguishing mip related clusters from mip-less clusters
- The magnetic field would be a minor issue in matching clusters between two sensors within a gap; multiple scattering is much more significant.