CLIC
Investigator Chip Examination

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Index

- General Idea of CLIC
- What's Pixel Detector
- Investigator Chip
- Sr 90 Experiment
- Test Beam Result

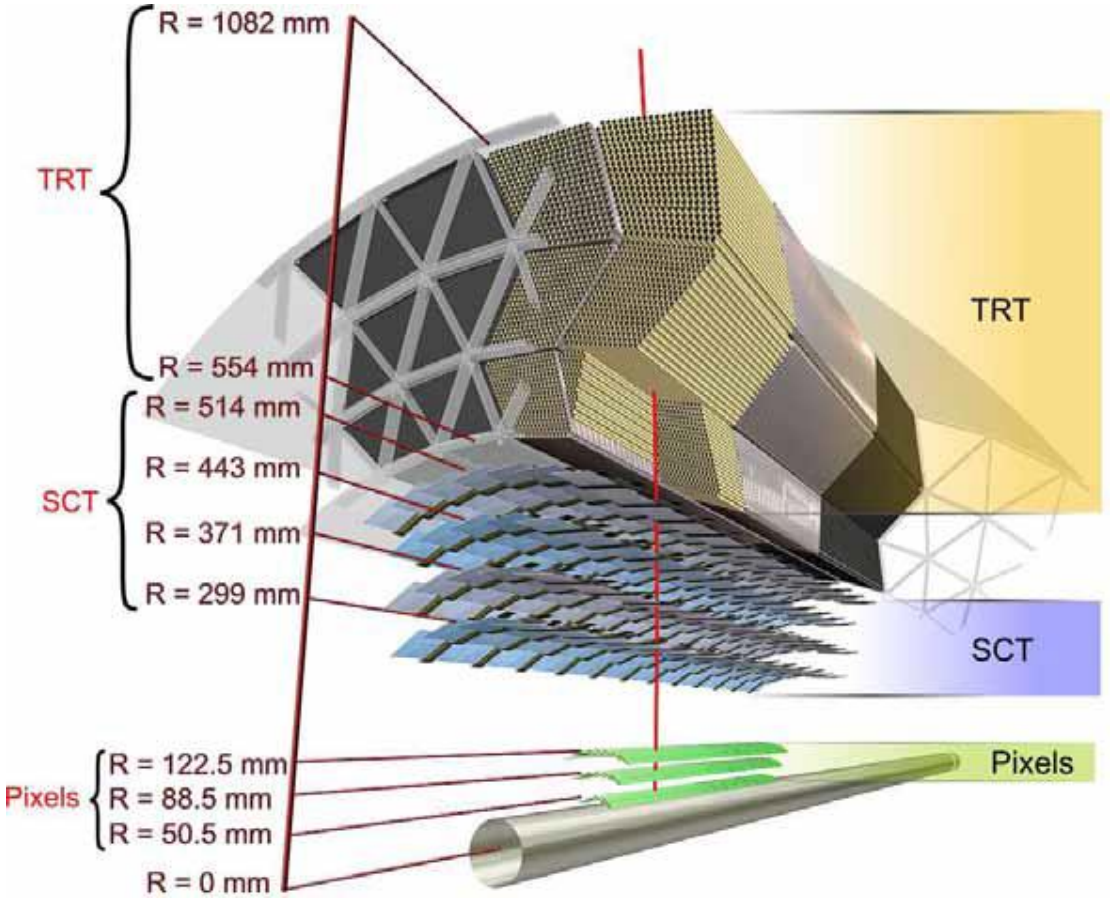
General Idea of CLIC

- Compact Linear Collider
- Particle Energy up to Several TeV
- Accelerating fields as high as 100 MV per meter

What's Pixel Detector

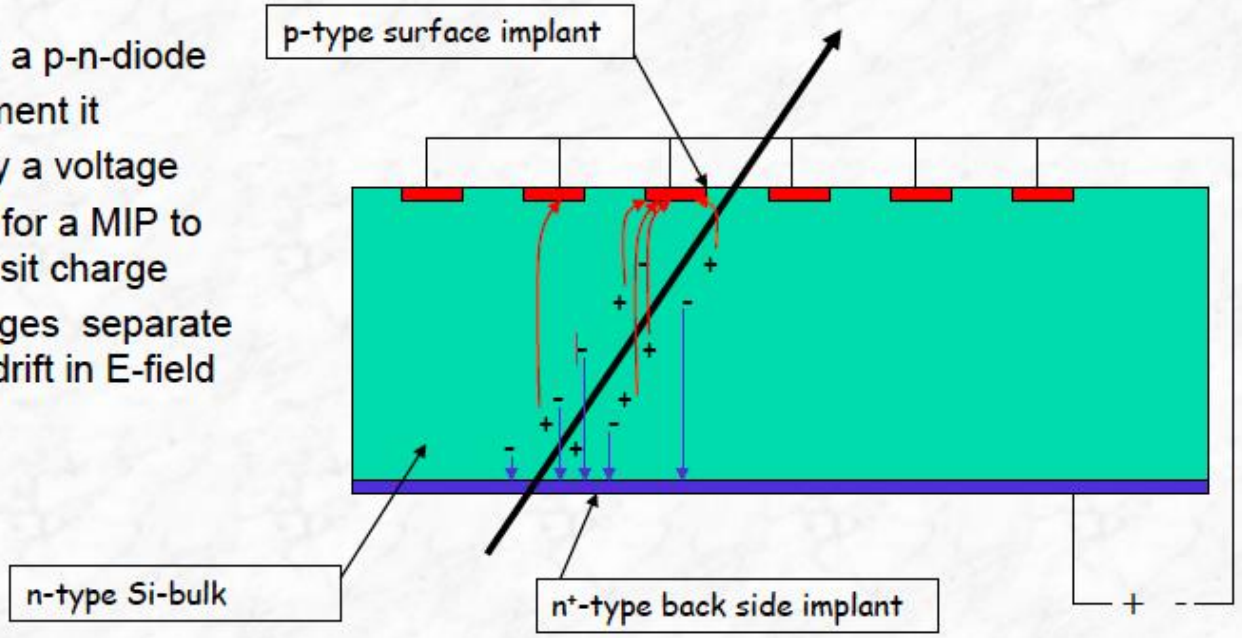
- The most inner layer of the CLIC detector
- About 15mm away from the beam Pipe
- The role to measure the impact parameter of a track

The ATLAS Inner Detector



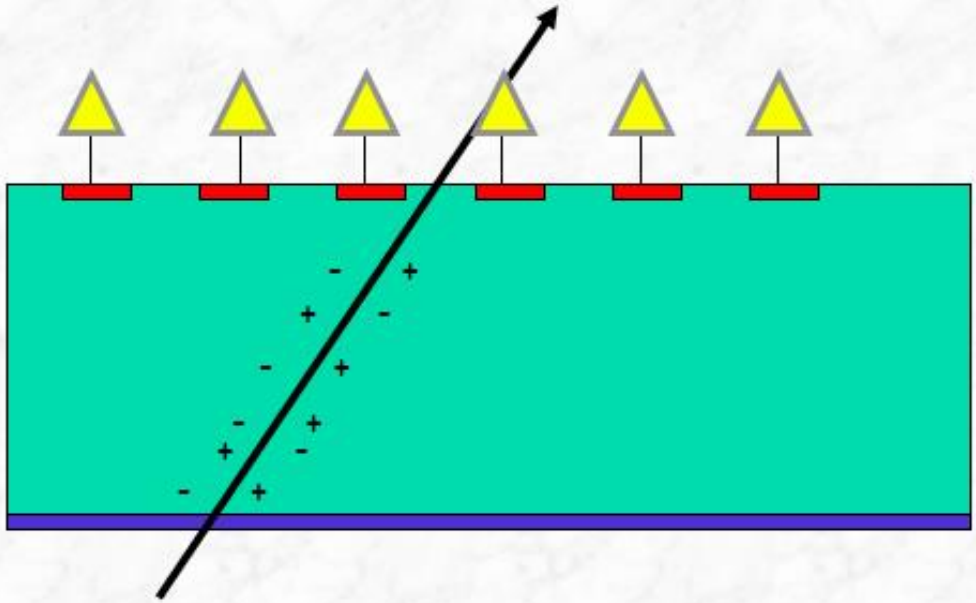
A Basic Silicon Detector

- Take a p-n-diode
- Segment it
- Apply a voltage
- Wait for a MIP to deposit charge
- Charges separate and drift in E-field



Signal

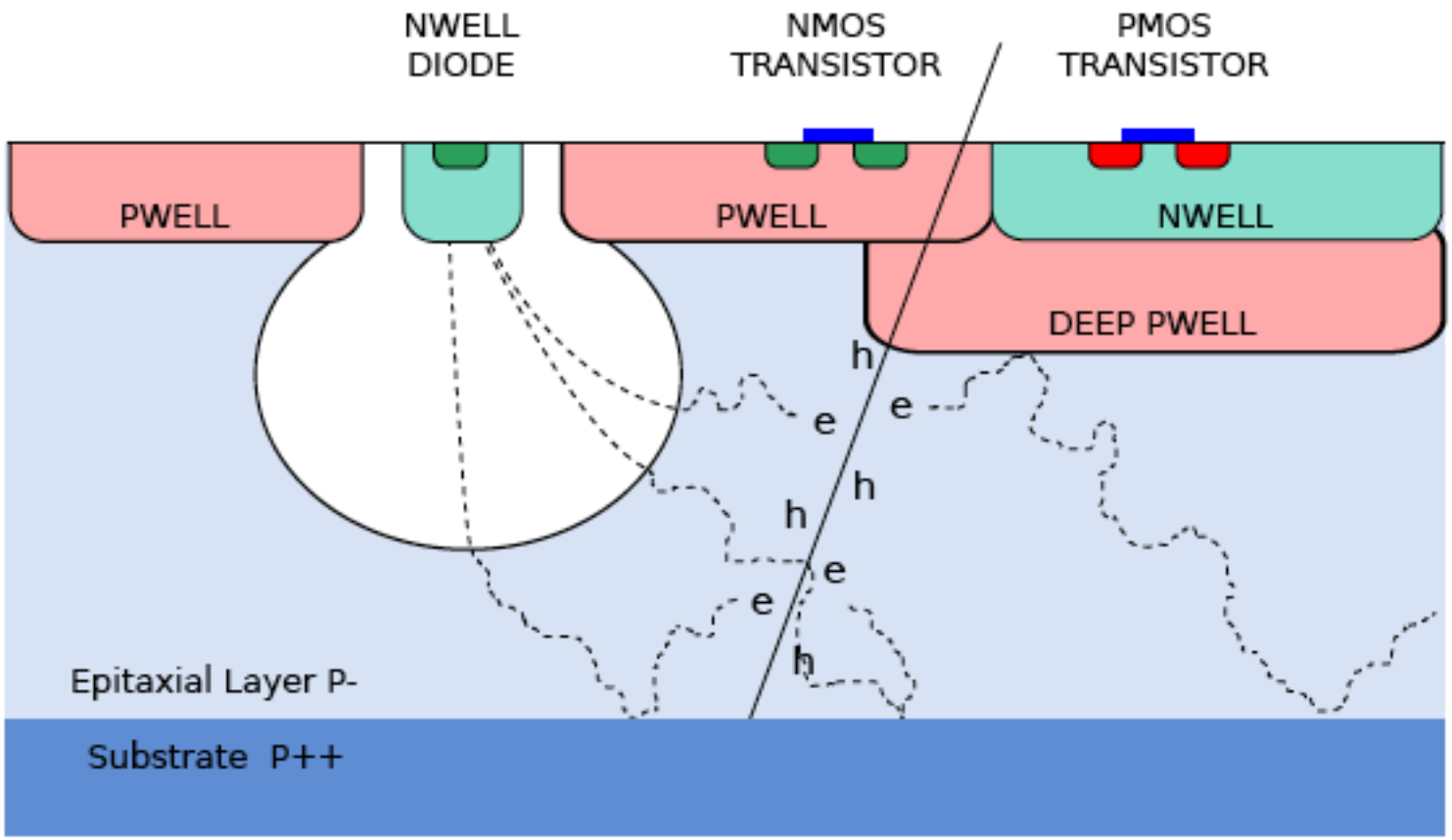
- Depleted piece of Si, a MIP generates e^-h^+-pairs…
- e^-h^+-pairs separate in E-field, and drift to electrodes
- Moving charges -> electric current pulse
- Small current signal is amplified, shaped and processed in ASICs ("chips") on read-out electronics



Investigator Chip (Monolithic)

- Monolithic = sensor + read out chip
- New Technology
- Pro : Thinner than regular pixel detector
- Easier to produce (normal detector is hard to assemble when pixels get really small)
- Con : limited read out speed and more difficult to optimize

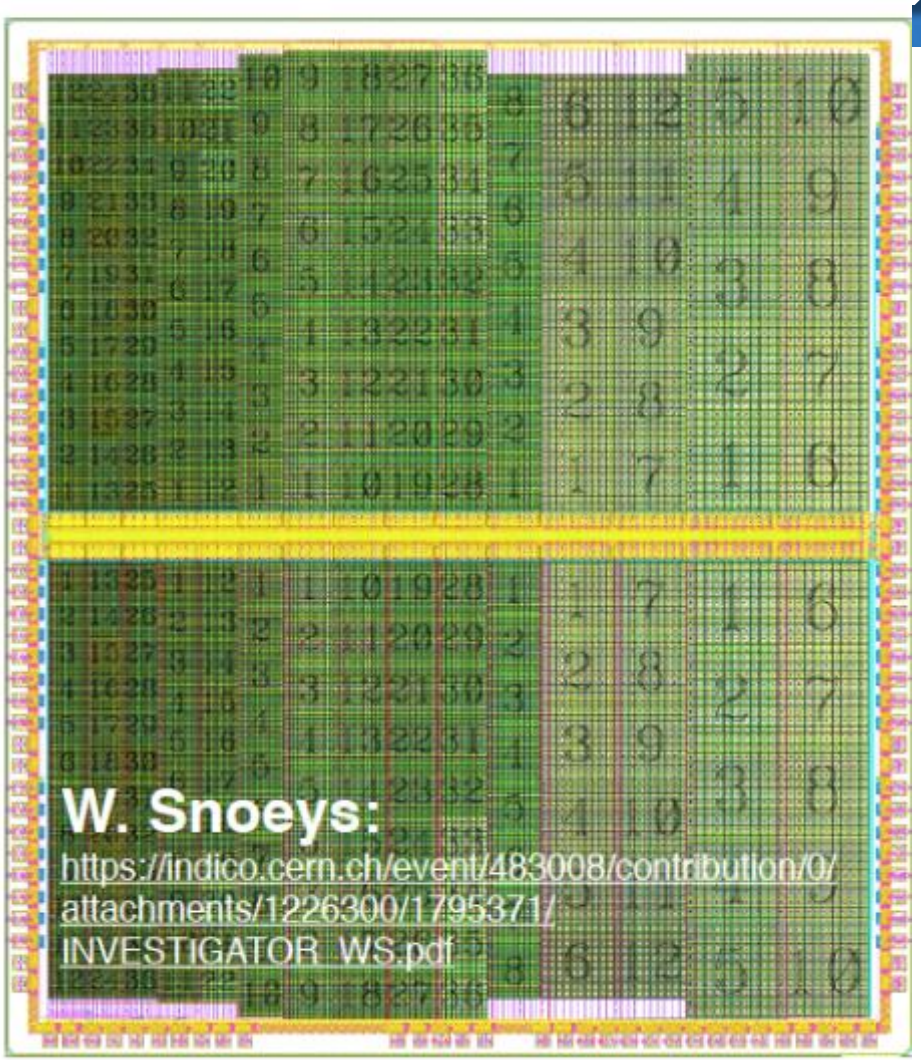
Investigator Chip (Monolithic)



Investigator test-chip

- 168 mini-matrices
- Pixel matrices with 8x8 active pixels
- Analog readout of each active pixel
- Active pixels surrounded by dummy pixels

- Matrices have different pitch and pixel layout

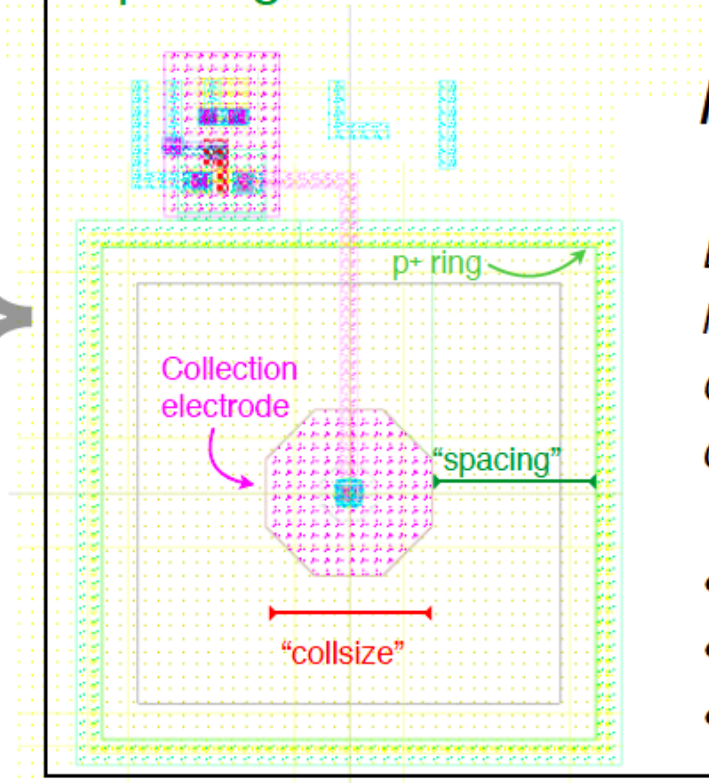


Investigator test-chip

Different pitch values per mini-matrice:

Pitch [um]
20
25
28
30
40
50

For each pitch-size the "collsize" and the "spacing" are varied:



Investigator:

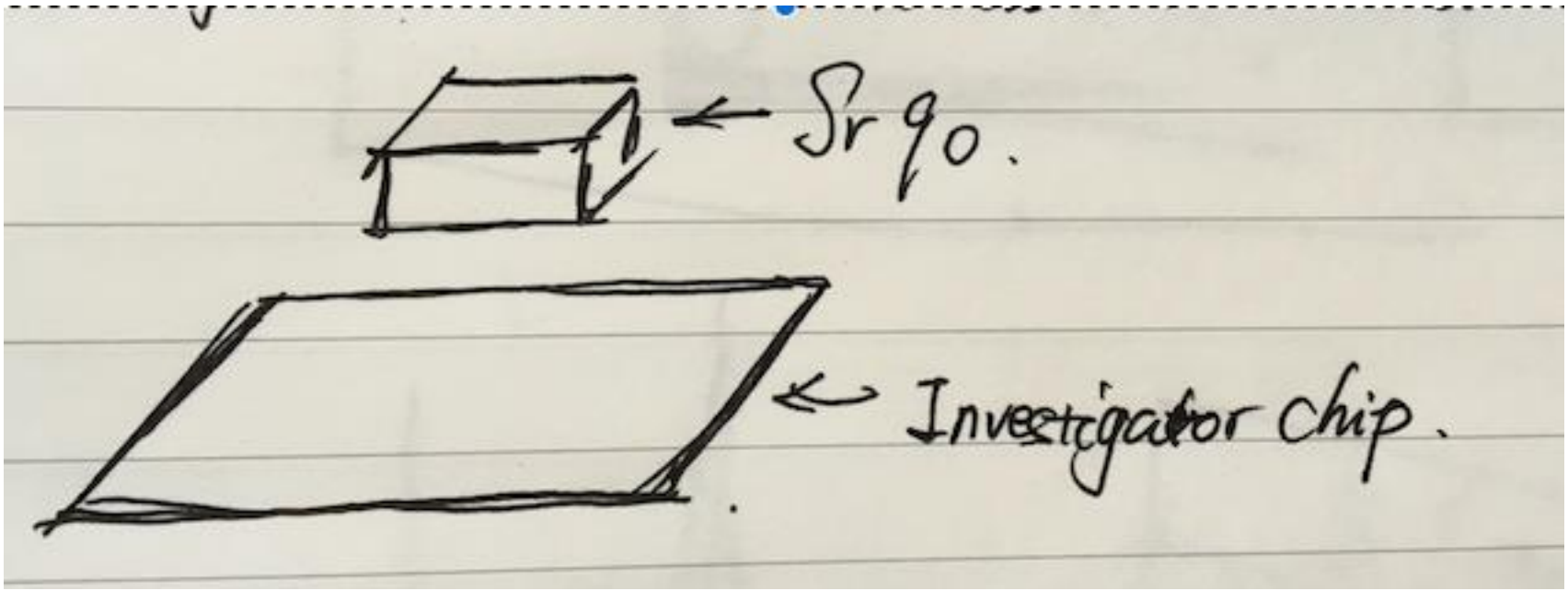
Different mini-matrices with different combinations of:

- *Pitch*
- *Collsize*
- *Spacing*

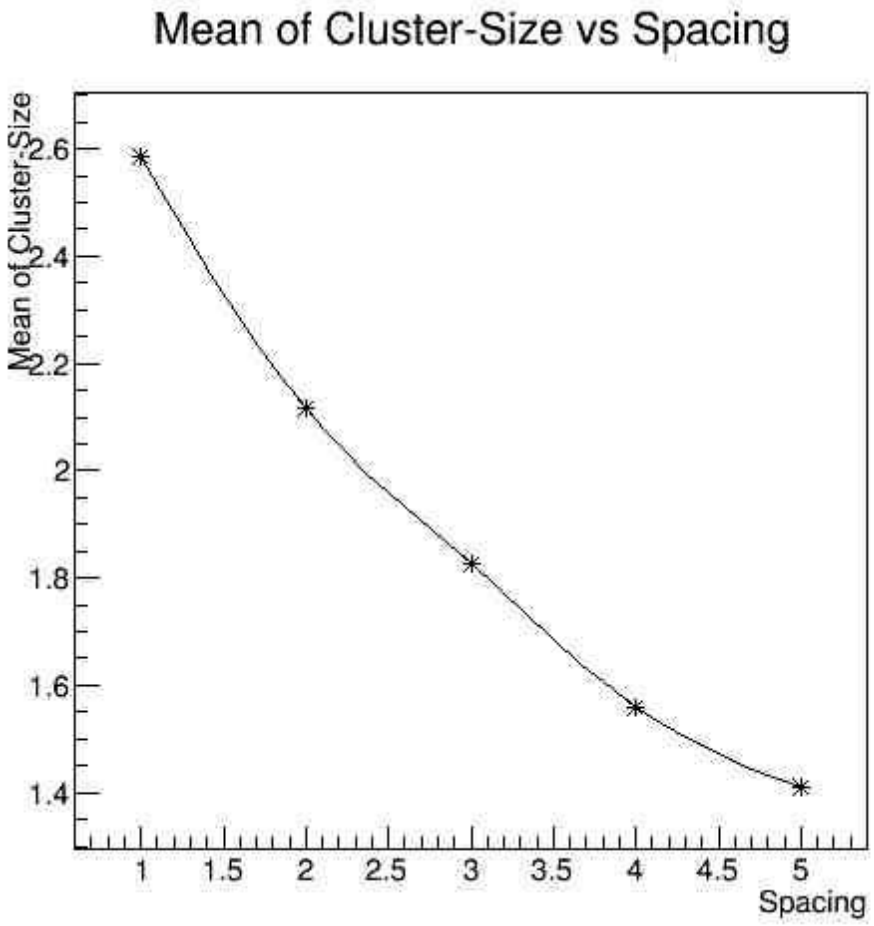
Sr 90 Exposure Experiment

- Radioactive Source Above the Chip (Sr 90)
- Cannot get too much information about the resolution or efficiency
- Cluster Size
- Cluster Signal
- Seed Signal

Sr 90 Exposure Experiment

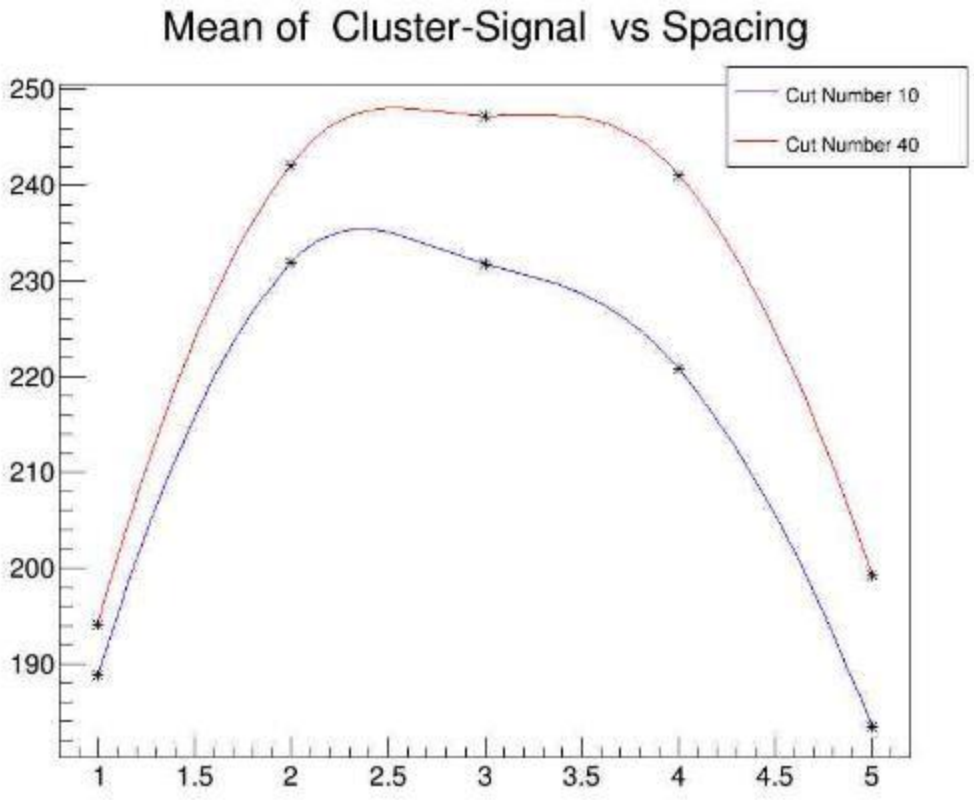


Sr 90 Exposure Experiment



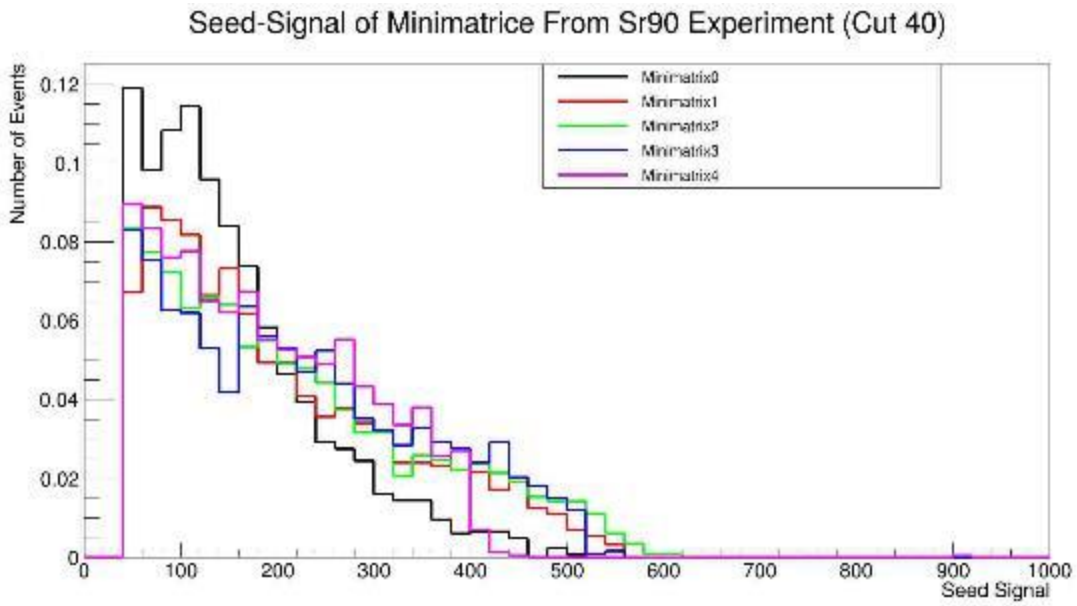
As the spacing increases, the cluster size increases as well.

Sr 90 Exposure Experiment



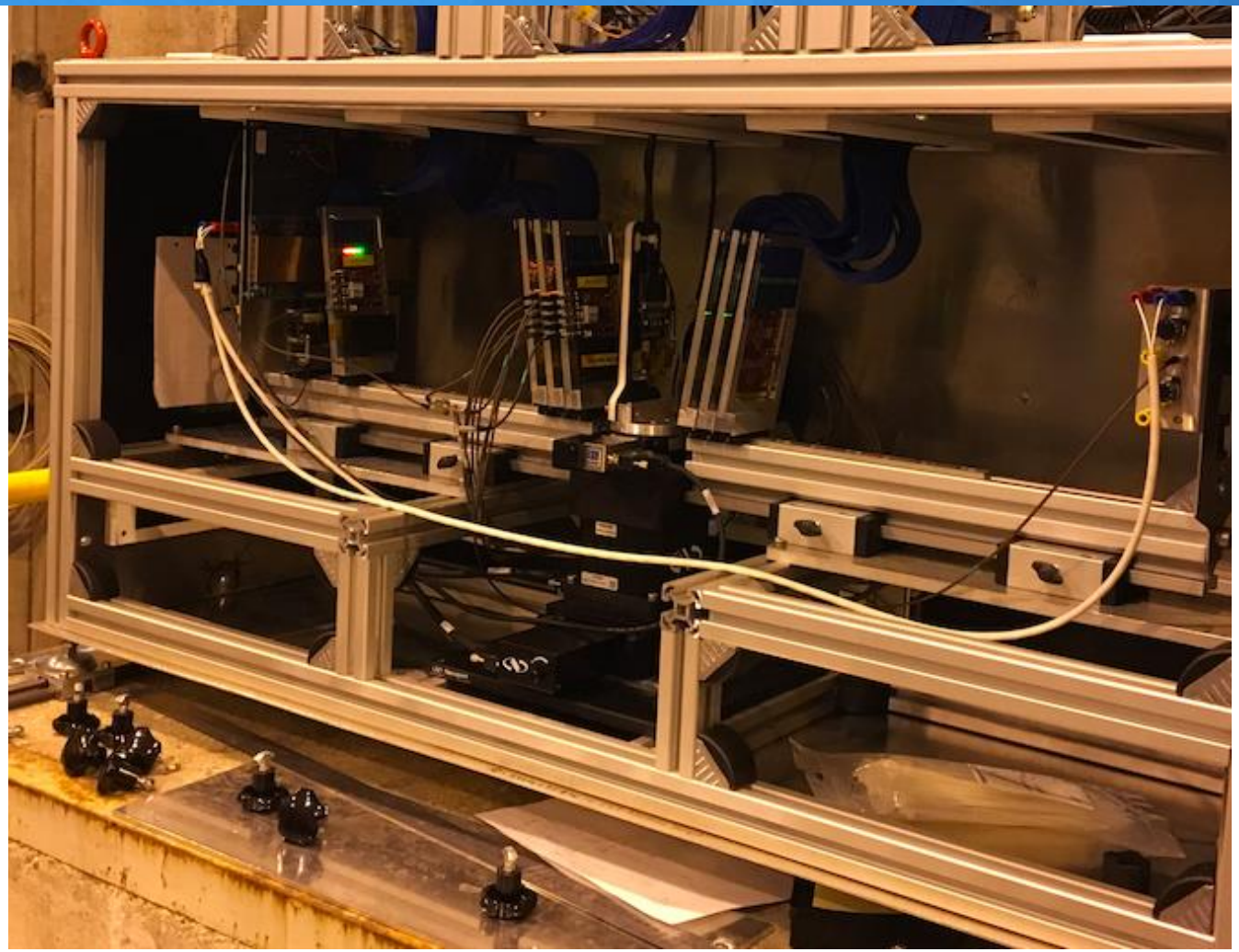
At cut 40,
MM0 < MM4 < MM2

Sr 90 Exposure Experiment

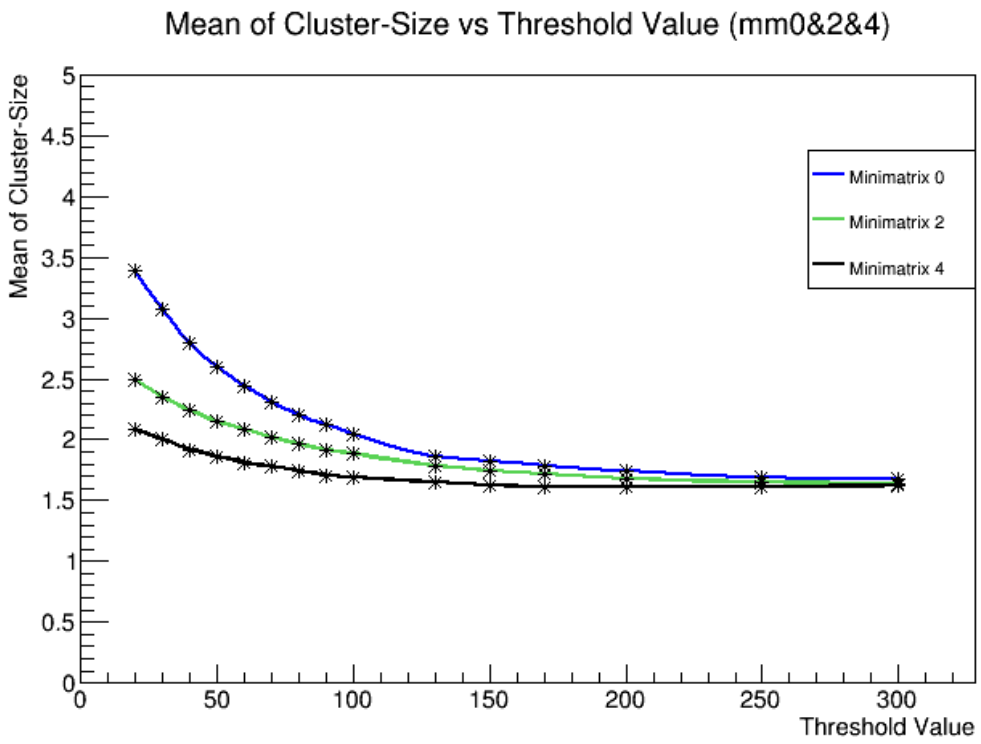


Test Beam Results

- Run in SPS
- Energy up to 400 GeV
- Test With Telescope



Test Beam Results

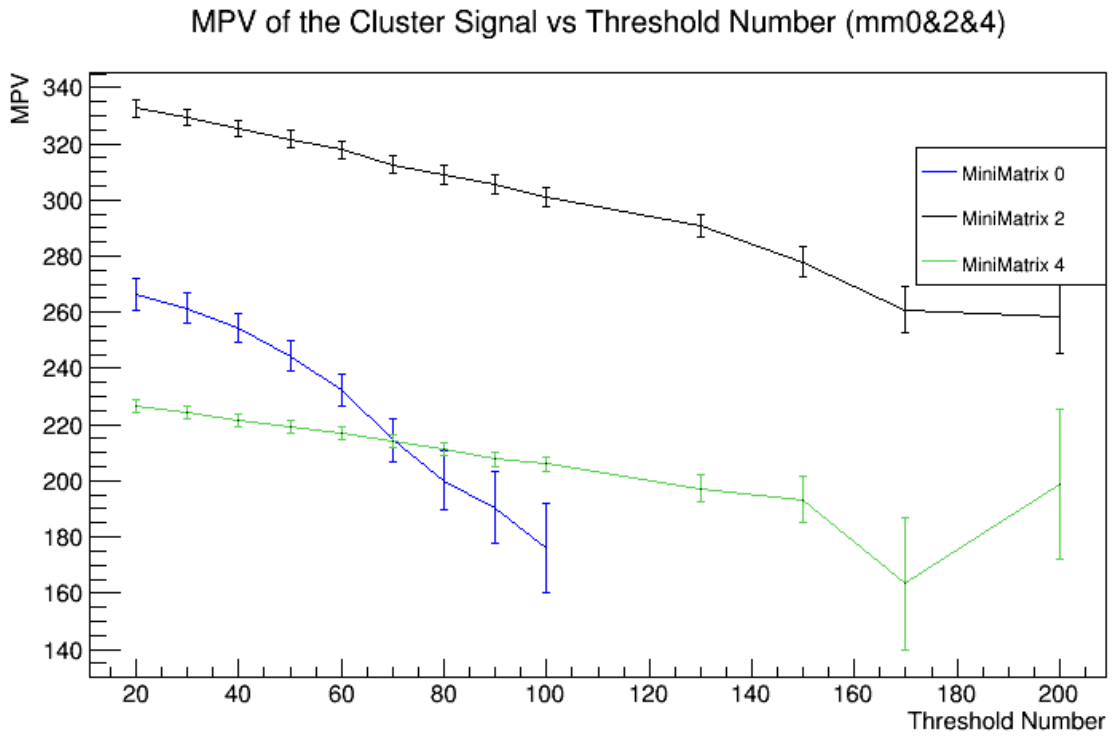


As the spacing increases,the cluster size increases.This is consistent with the results we get from the Sr 90 Experiment.

However, the absolute value of the Mean of Cluster Size from the test beam data is higher than the one in Sr 90 Experiment.

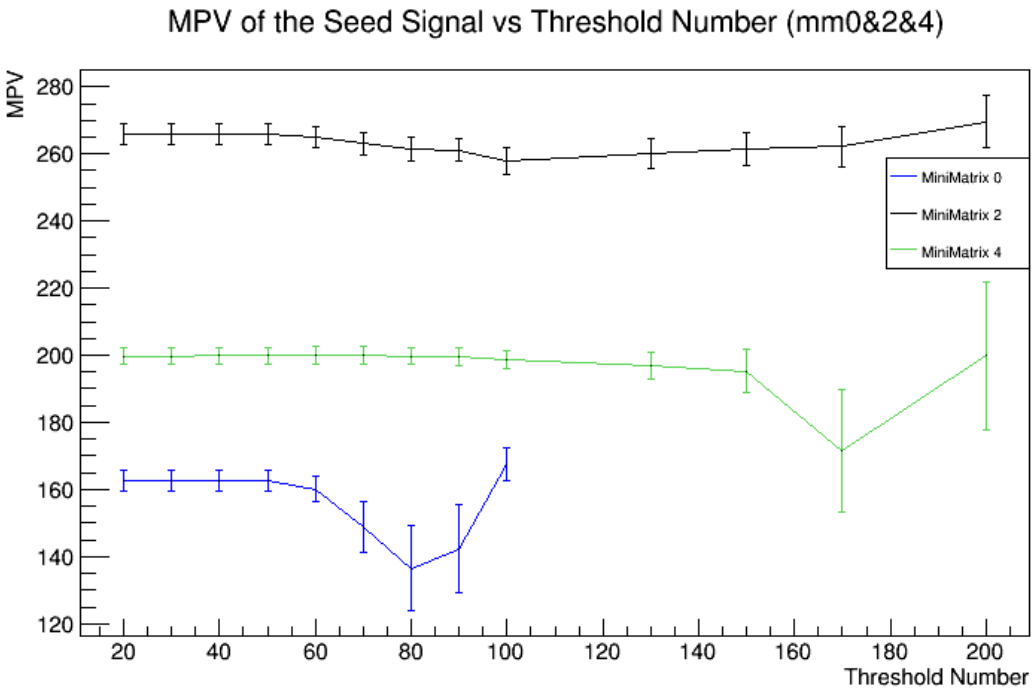
The difference of energy of the particles might be the reason.

Test Beam Results



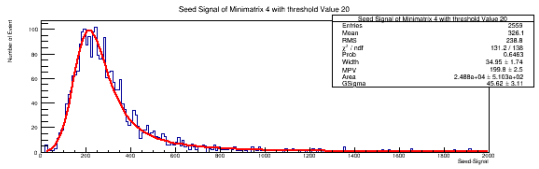
It's not as systematic as we thought.It seems like we can optimize the spacing to get a better cluster signal. (Need Calibration to confirm)

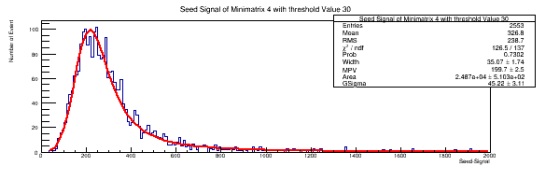
Test Beam Results

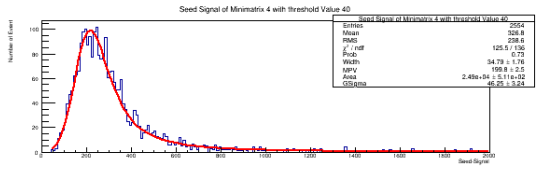


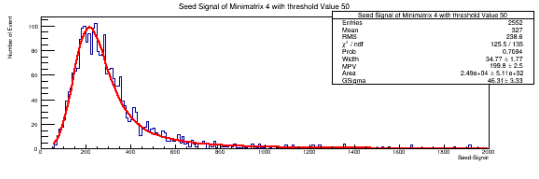
MiniMatrix 2 gives the largest signal, which is consistent with the result of Sr 90 Experiment.

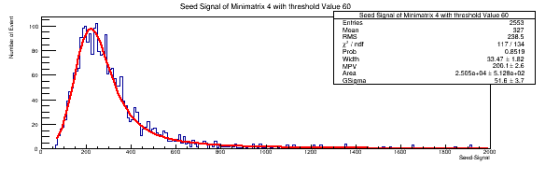
For mm4, using threshold value of 150, we start to cut the signal.

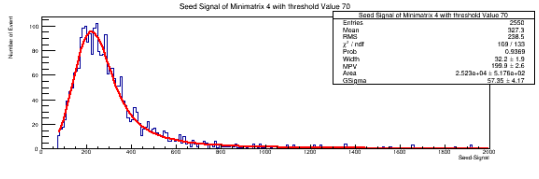

Seed Signal of Minimatrix 4 with threshold Value 20
Seed Signal of Minimatrix 4 with threshold Value 20
Entries 2559
Mean 326.1
RMS 238.8
χ² / ndf 131.2 / 138
Prob 0.6463
Width 34.95 ± 1.74
MPV 199.8 ± 2.5
Area 2.488e+04 ± 5.710e+02
GSigma 45.62 ± 3.11
Number of Event
Seed Signal

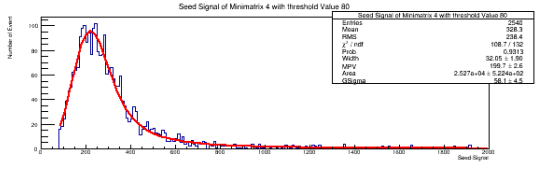

Seed Signal of Minimatrix 4 with threshold Value 30
Seed Signal of Minimatrix 4 with threshold Value 30
Entries 2553
Mean 326.8
RMS 238.7
χ² / ndf 126.5 / 137
Prob 0.7302
Width 35.67 ± 1.74
MPV 199.7 ± 2.5
Area 2.487e+04 ± 5.103e+02
GSigma 45.22 ± 3.11
Number of Event
Seed Signal

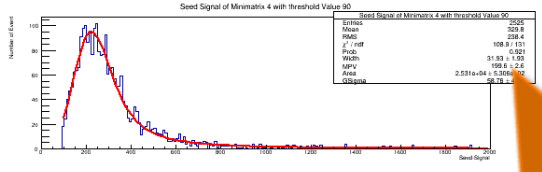

Seed Signal of Minimatrix 4 with threshold Value 40
Seed Signal of Minimatrix 4 with threshold Value 40
Entries 2554
Mean 326.6
RMS 238.6
χ² / ndf 125.5 / 136
Prob 0.73
Width 34.79 ± 1.76
MPV 199.8 ± 2.5
Area 2.49e+04 ± 5.11e+02
GSigma 46.25 ± 3.24
Number of Event
Seed Signal

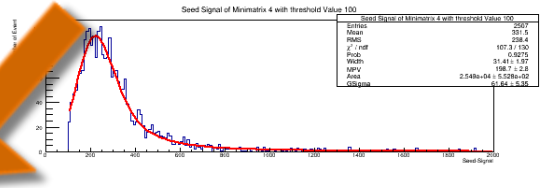

Seed Signal of Minimatrix 4 with threshold Value 50
Seed Signal of Minimatrix 4 with threshold Value 50
Entries 2552
Mean 327
RMS 238.6
χ² / ndf 125.5 / 135
Prob 0.7094
Width 34.77 ± 1.77
MPV 199.8 ± 2.5
Area 2.49e+04 ± 5.11e+02
GSigma 46.31 ± 3.33
Number of Event
Seed Signal

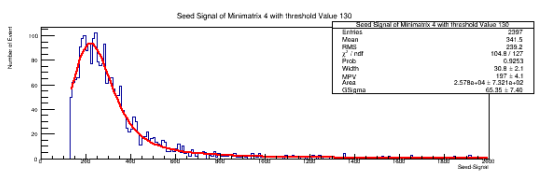

Seed Signal of Minimatrix 4 with threshold Value 60
Seed Signal of Minimatrix 4 with threshold Value 60
Entries 2553
Mean 327
RMS 238.5
χ² / ndf 117 / 134
Prob 0.8519
Width 33.47 ± 1.82
MPV 200.1 ± 2.6
Area 2.505e+04 ± 5.128e+02
GSigma 51.6 ± 3.7
Number of Event
Seed Signal

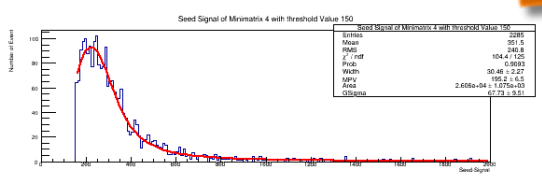

Seed Signal of Minimatrix 4 with threshold Value 70
Seed Signal of Minimatrix 4 with threshold Value 70
Entries 2550
Mean 327.3
RMS 238.5
χ² / ndf 109 / 133
Prob 0.9369
Width 32.2 ± 1.9
MPV 199.9 ± 2.6
Area 2.523e+04 ± 5.176e+02
GSigma 57.35 ± 4.17
Number of Event
Seed Signal

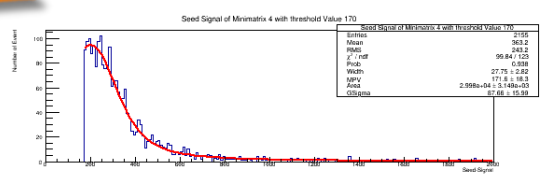

Seed Signal of Minimatrix 4 with threshold Value 80
Seed Signal of Minimatrix 4 with threshold Value 80
Entries 2540
Mean 328.3
RMS 238.4
χ² / ndf 108.7 / 132
Prob 0.9313
Width 32.05 ± 1.99
MPV 199.7 ± 2.6
Area 2.527e+04 ± 5.224e+02
GSigma 58.1 ± 4.5
Number of Event
Seed Signal

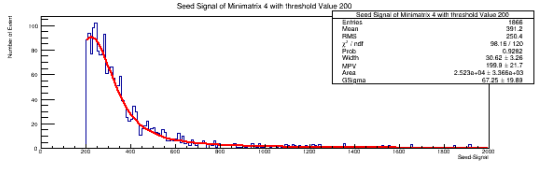

Seed Signal of Minimatrix 4 with threshold Value 90
Seed Signal of Minimatrix 4 with threshold Value 90
Entries 2525
Mean 329.8
RMS 238.4
χ² / ndf 108.9 / 131
Prob 0.921
Width 31.93 ± 1.93
MPV 199.6 ± 2.6
Area 2.531e+04 ± 5.306e+02
GSigma 58.78 ± 4.
Number of Event
Seed Signal

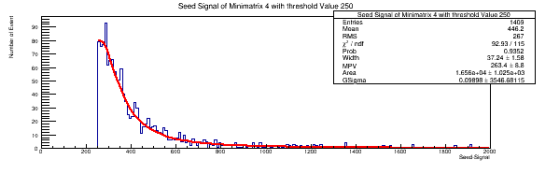

Seed Signal of Minimatrix 4 with threshold Value 100
Seed Signal of Minimatrix 4 with threshold Value 100
Entries 2507
Mean 331.5
RMS 238.4
χ² / ndf 107.3 / 130
Prob 0.9275
Width 31.41 ± 1.97
MPV 198.7 ± 2.8
Area 2.548e+04 ± 5.528e+02
GSigma 61.64 ± 5.35
Number of Event
Seed Signal

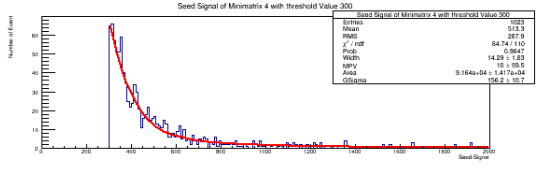

Seed Signal of Minimatrix 4 with threshold Value 130
Seed Signal of Minimatrix 4 with threshold Value 130
Entries 2397
Mean 341.5
RMS 239.2
χ² / ndf 104.8 / 127
Prob 0.9253
Width 30.8 ± 2.1
MPV 197 ± 4.1
Area 2.578e+04 ± 7.321e+02
GSigma 65.35 ± 7.46
Number of Event
Seed Signal


Seed Signal of Minimatrix 4 with threshold Value 150
Seed Signal of Minimatrix 4 with threshold Value 150
Entries 2285
Mean 351.5
RMS 240.8
χ² / ndf 104.4 / 125
Prob 0.9093
Width 30.46 ± 2.27
MPV 195.2 ± 6.5
Area 2.665e+04 ± 1.075e+03
GSigma 67.73 ± 9.51
Number of Event
Seed Signal


Seed Signal of Minimatrix 4 with threshold Value 170
Seed Signal of Minimatrix 4 with threshold Value 170
Entries 2135
Mean 363.2
RMS 243.2
χ² / ndf 95.64 / 123
Prob 0.938
Width 27.75 ± 2.62
MPV 171.8 ± 18.3
Area 2.998e+04 ± 3.148e+03
GSigma 87.66 ± 15.99
Number of Event
Seed Signal


Seed Signal of Minimatrix 4 with threshold Value 200
Seed Signal of Minimatrix 4 with threshold Value 200
Entries 1866
Mean 391.2
RMS 250.4
χ² / ndf 98.18 / 122
Prob 0.9282
Width 30.62 ± 3.26
MPV 199.9 ± 21.7
Area 2.523e+04 ± 3.366e+03
GSigma 67.25 ± 19.89
Number of Event
Seed Signal


Seed Signal of Minimatrix 4 with threshold Value 250
Seed Signal of Minimatrix 4 with threshold Value 250
Entries 1469
Mean 446.2
RMS 267
χ² / ndf 92.93 / 115
Prob 0.9352
Width 37.24 ± 1.58
MPV 263.4 ± 8.8
Area 1.658e+04 ± 1.025e+03
GSigma 0.09898 ± 3546.68115
Number of Event
Seed Signal


Seed Signal of Minimatrix 4 with threshold Value 300
Seed Signal of Minimatrix 4 with threshold Value 300
Entries 1023
Mean 513.3
RMS 287.9
χ² / ndf 84.74 / 110
Prob 0.9647
Width 14.29 ± 1.83
MPV 10 ± 59.5
Area 9.164e+04 ± 1.417e+04
GSigma 156.2 ± 10.7
Number of Event
Seed Signal


CLIC