Introduction and Outline

- What follows has been an attempt to discover what effects hot pixels (i.e. pixels which repeatedly fire regardless of input) have on the tracking efficiency of the sensor:
- For the purposes of this study a 'track' is recorded when three or more pixels in separate layers all record hits with the same timestamp in the same bunch train.
- Similarly a 'confirmed track' is recorded when there is a hit recorded in the fourth layer with the same timestamp in the same bunch train (i.e. there are four pixels in separate layers all record hits with the same timestamp in the same bunch train).
- The tracking efficiency of the sensor stack is then the number of confirmed tracks as a percentage of all tracks.
- The objective of this study has been to investigate how the tracking efficiency changes when hits from potential hot pixels are ignored.

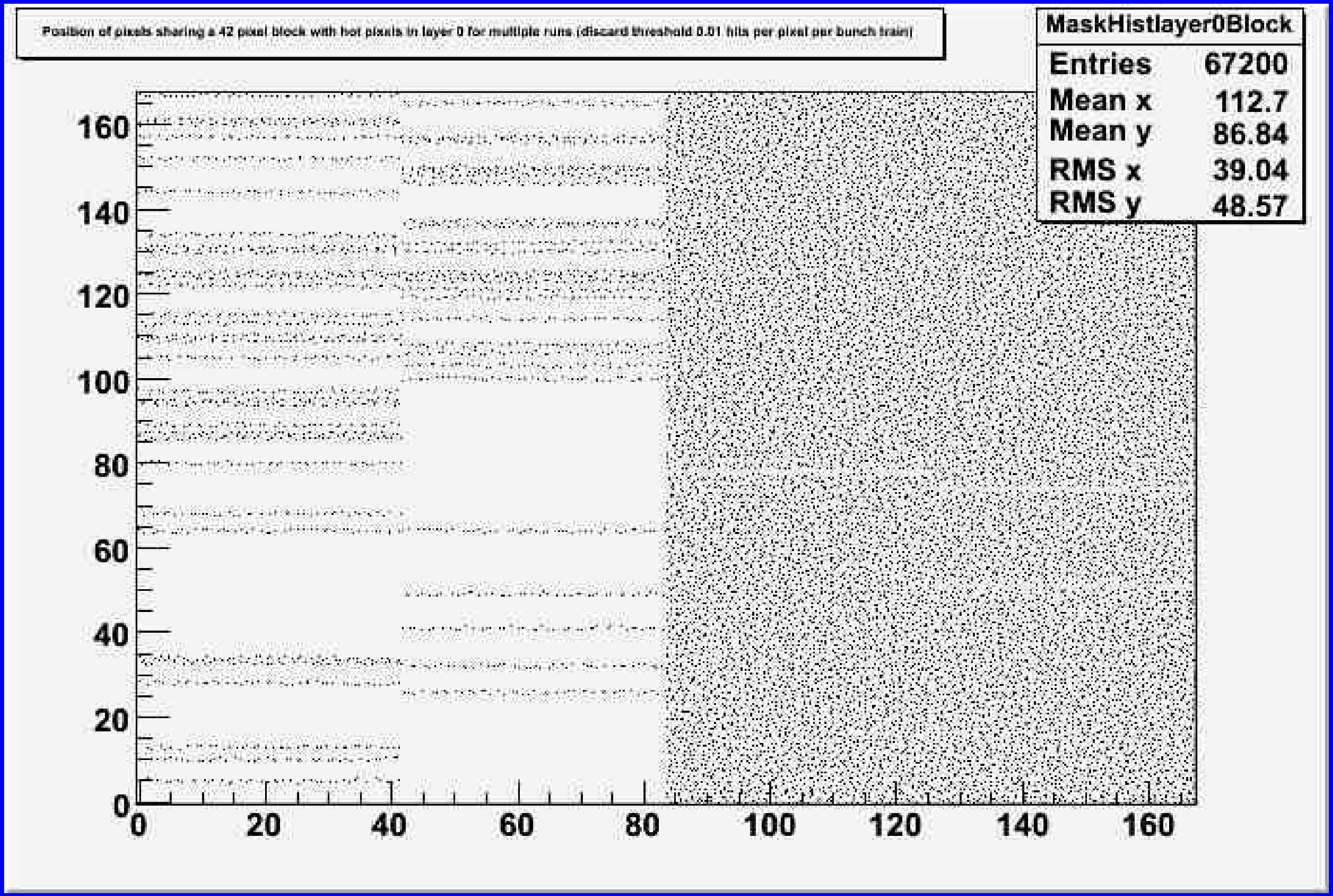
Criteria for ignoring pixels

- The process by which pixels were selected to be ignored was as follows:
- If the number of hits on a particular pixel per bunch train exceeded a certain number (known as the *discard threshold*) the location of that pixel was stored in a 3D histogram (the preliminary mask).
- Preliminary masks were produced for a specific range of discard thresholds for all mpsBeam runs in shower studies (runs 490047, 490048, 490058, 490061, 490062, 490063, 490064 and 490065).
- These preliminary masks were compared and if the same pixel was over the discard threshold in two or more runs then the pixel was declared a hot pixel for this discard threshold and its location was recorded on another 3D histogram called the basic mask.

Criteria for ignoring pixels

- A single hot pixel can render an entire group of pixels unreliable by monopolizing the memory for those pixels. With this in mind a new 3D histogram was created from the basic mask which recorded not only the locations of hot pixels (as defined previously), but also the locations of all pixels which share a row, layer and region with a hot pixel. This new 3D histogram was called the final mask, these histograms were produced for a range of discard thresholds.
- An example of a final mask (for a single sensor layer and a discard threshold of 0.01 hits per pixel per bunch train) is shown on the next slide.

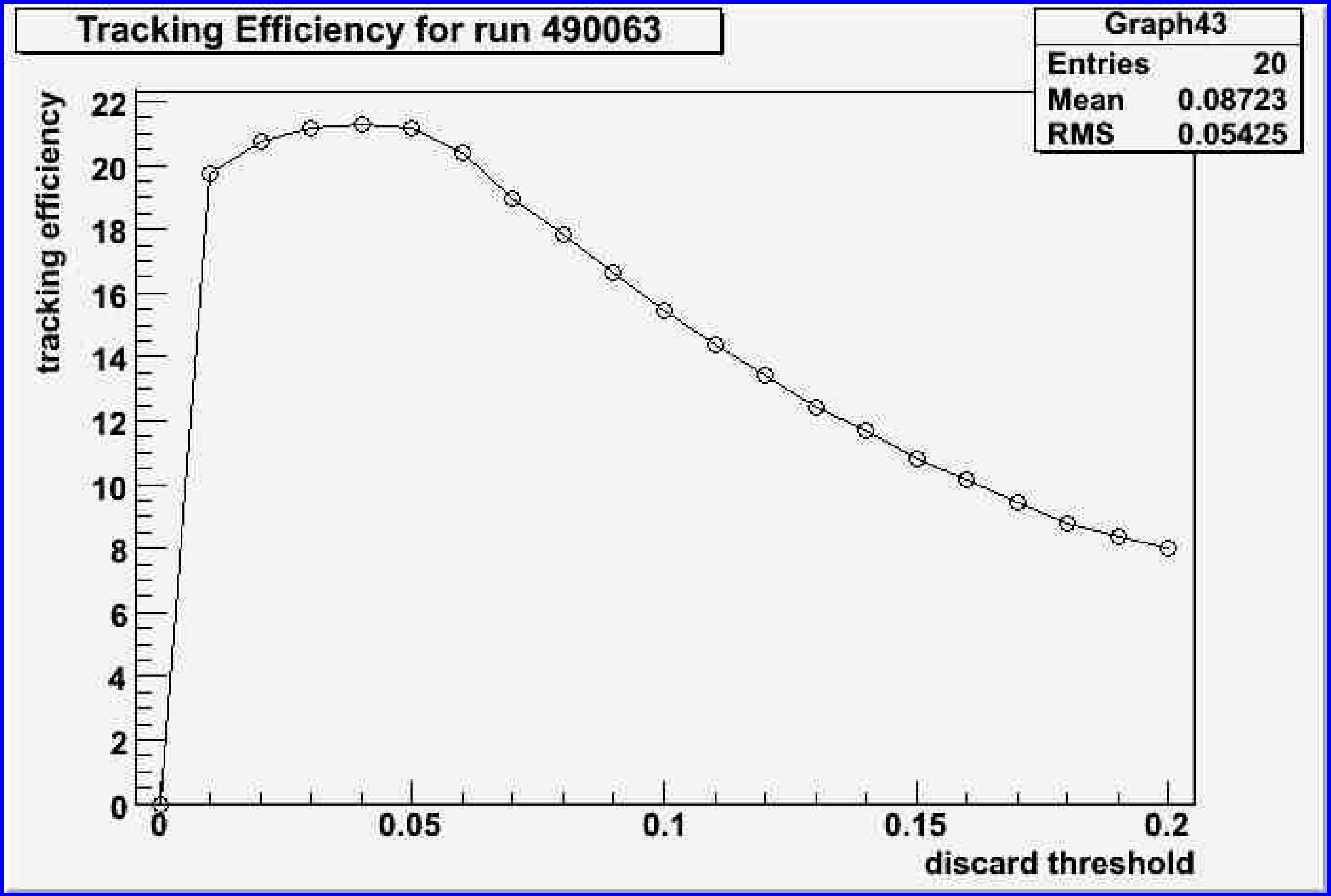
A 2D example of a final mask histogram



Using the final mask Histograms

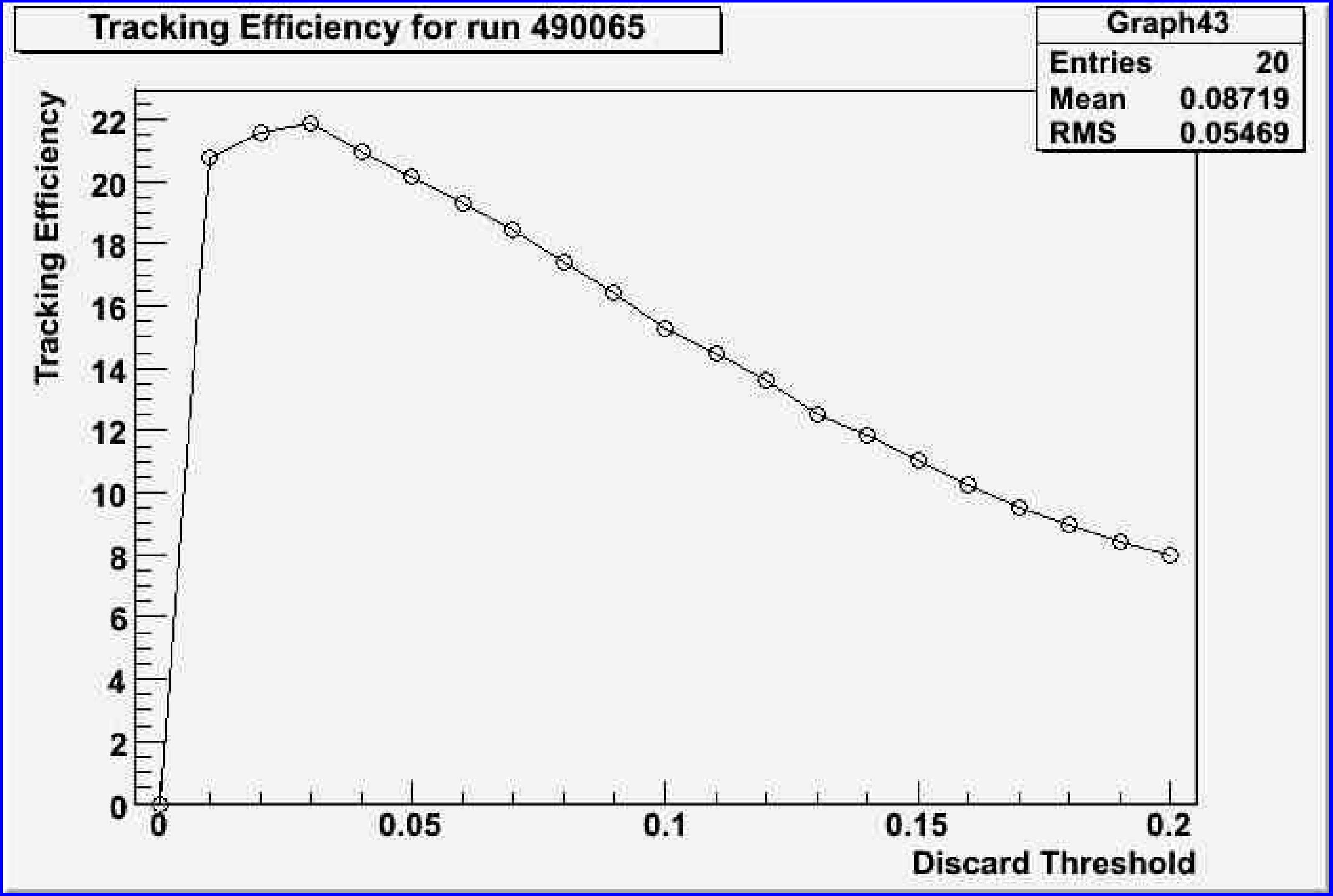
•Once final mask histograms had been produced for a range of discard thresholds the tracking efficiency of each run was calculated. Each time the tracking efficiency was calculated a final mask for a particular discard threshold was loaded and all hits from pixels recorded in that mask are discarded.
This was used to produce graphs showing how the tracking efficiency of the sensor stack varies with the discard threshold applied. A sample of these graphs is shown in the next few slides (note: points showing zero on these graphs represent occasions when there were no tracks, confirmed or otherwise, after the discard threshold was applied).

Run 490063



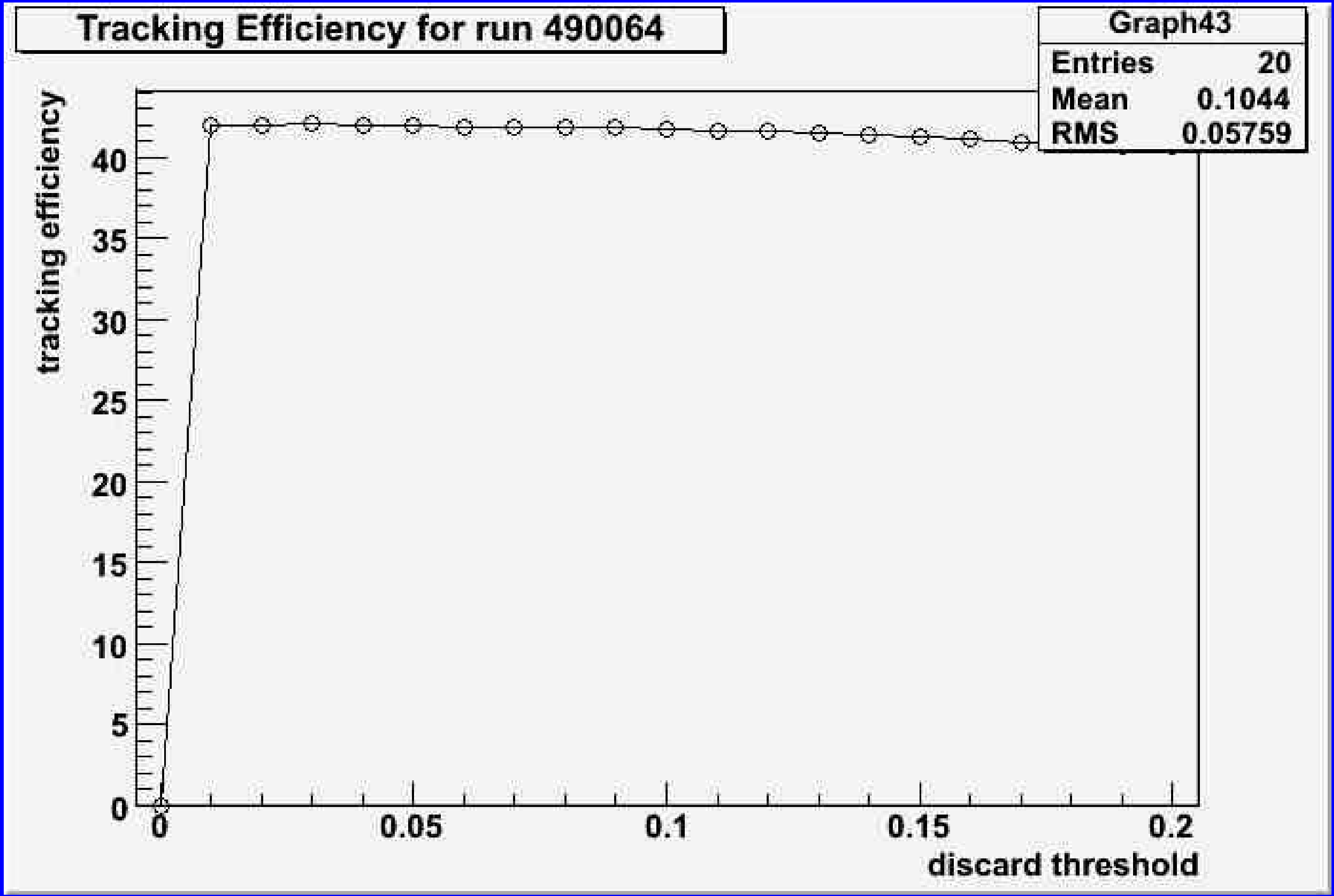
Increasing proportion of pixels discarded

Run 490065



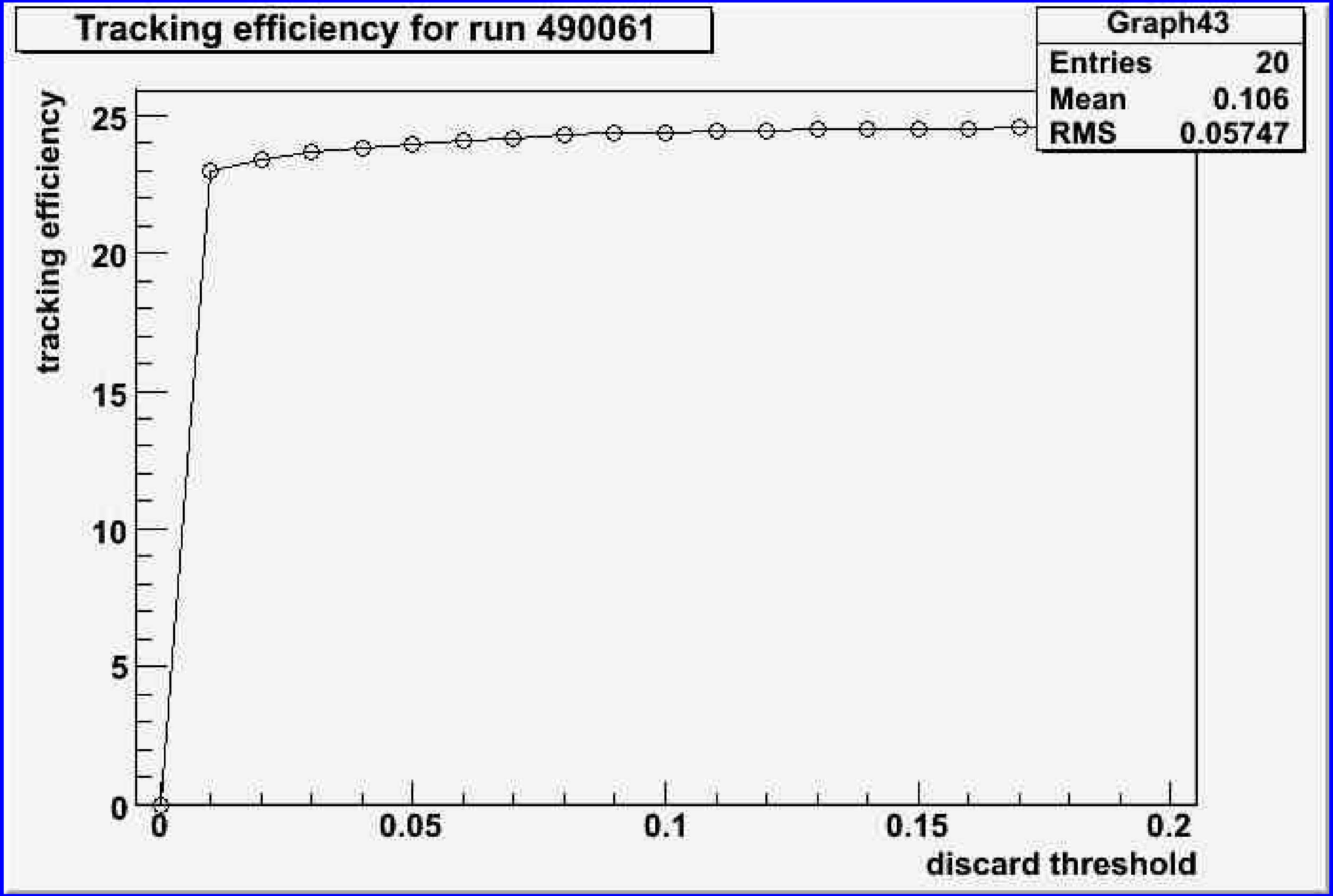
Tracking Efficiency for run 490065
Graph43
Entries 20
Mean 0.08719
RMS 0.05469
Tracking Efficiency
22
20
18
16
14
12
10
8
6
4
2
0
0
0.05
0.1
0.15
0.2
Discard Threshold

Run 490064



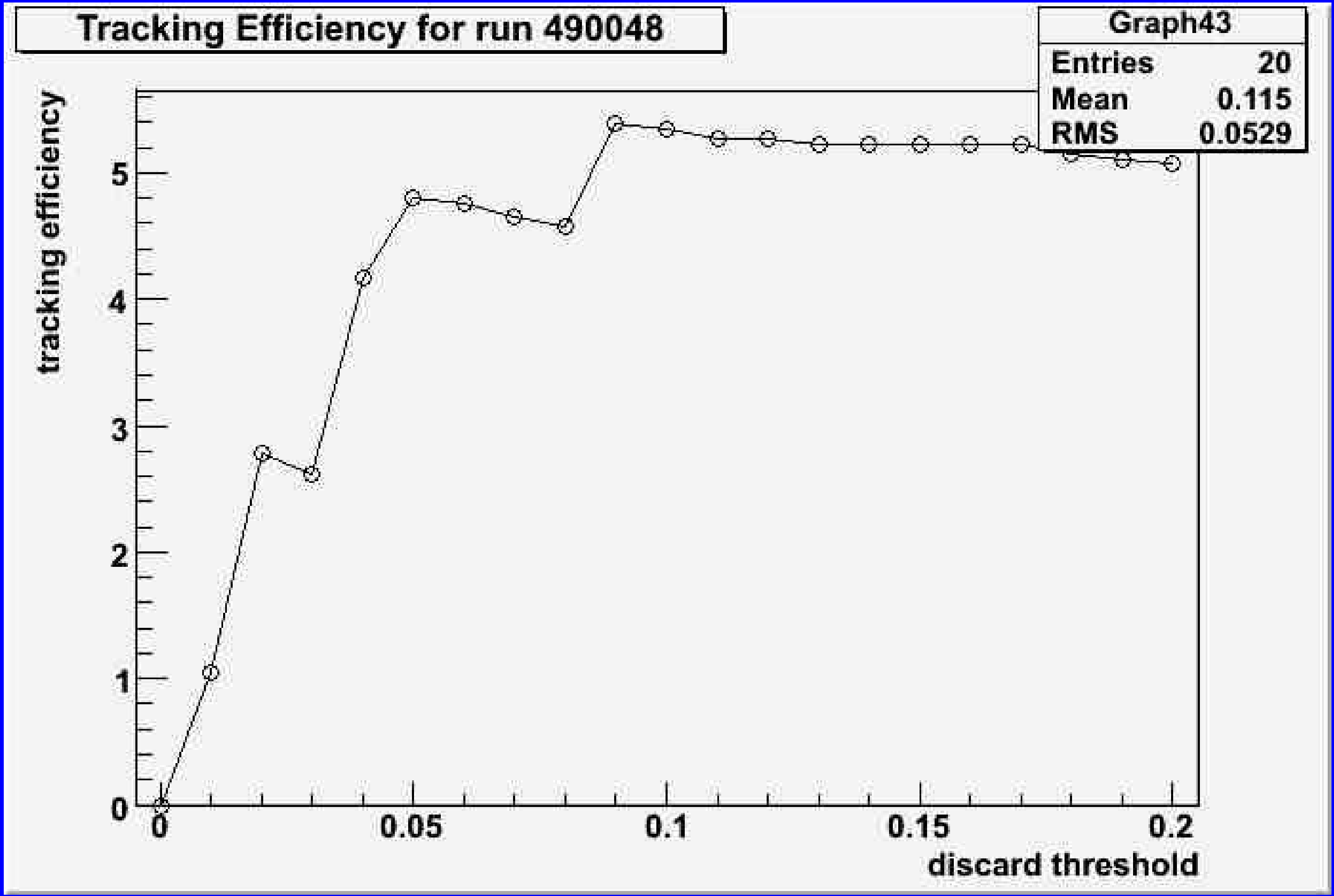
Tracking Efficiency for run 490064
Graph43
Entries 20
Mean 0.1044
RMS 0.05759
tracking efficiency
0
5
10
15
20
25
30
35
40
0
0.05
0.1
0.15
0.2
discard threshold

490061



Tracking efficiency for run 490061
Graph43
Entries 20
Mean 0.106
RMS 0.05747
tracking efficiency
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
discard threshold

Run 490048

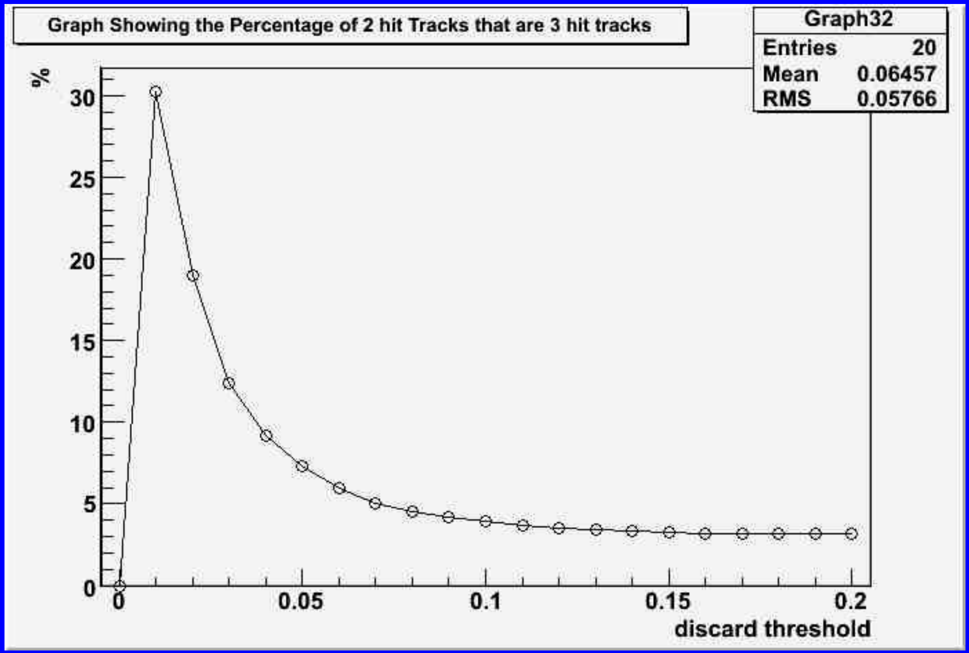


Tracking Efficiency for run 490048
Graph43
Entries 20
Mean 0.115
RMS 0.0529
tracking efficiency
discard threshold
0
1
2
3
4
5
0
0.05
0.1
0.15
0.2

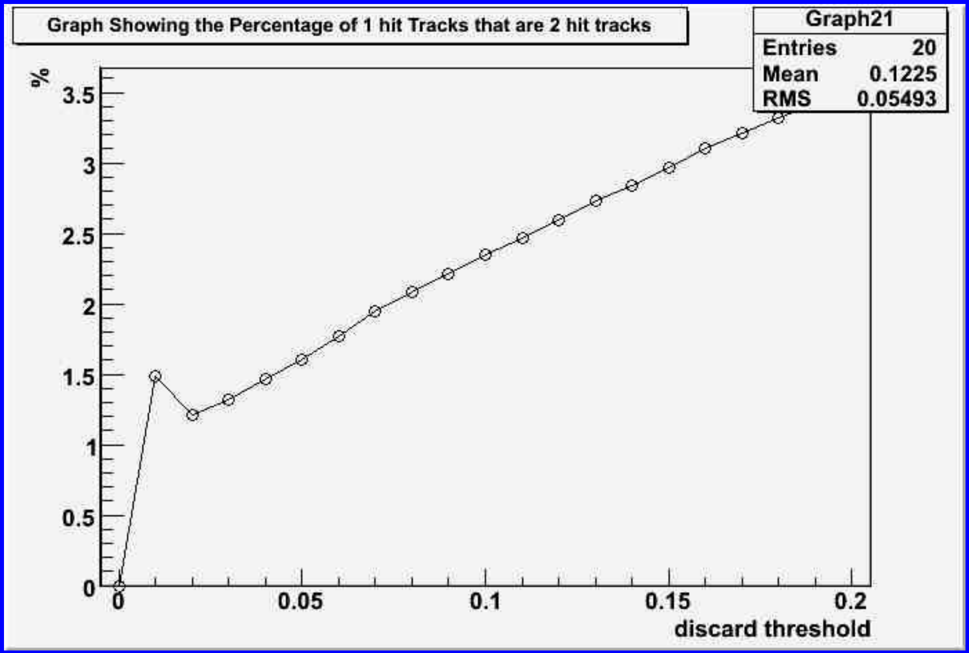
Preliminary Analysis

- Analysis of these results is still ongoing.
- Initially at least there seems to be some good news; if all the tracks were caused by random pixel firings then the (apparent) tracking efficiency would increase with masking threshold. There are very few runs which show this behaviour strongly and several runs show the opposite behaviour.
- This implies that at least some of the potential tracks so far identified are from a non random source.
- This study also produced several graphs showing the number of three hit tracks as a percentage of the number of two hit tracks and the number of two hit tracks as a percentage of one hit tracks (in the same terms tracking efficiency is the number of four hit tracks as a percentage of the number of three hit tracks). These graphs may prove useful in interpreting what might be causing hits within the sensor.
- There are some examples of these graphs on the following slides.

Run 490065



Graph Showing the Percentage of 2 hit Tracks that are 3 hit tracks
Graph32
Entries 20
Mean 0.06457
RMS 0.05766
%
30
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
discard threshold



Graph Showing the Percentage of 1 hit Tracks that are 2 hit tracks
Graph21
Entries 20
Mean 0.1225
RMS 0.05493
%
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
discard threshold