VIP2B Testing

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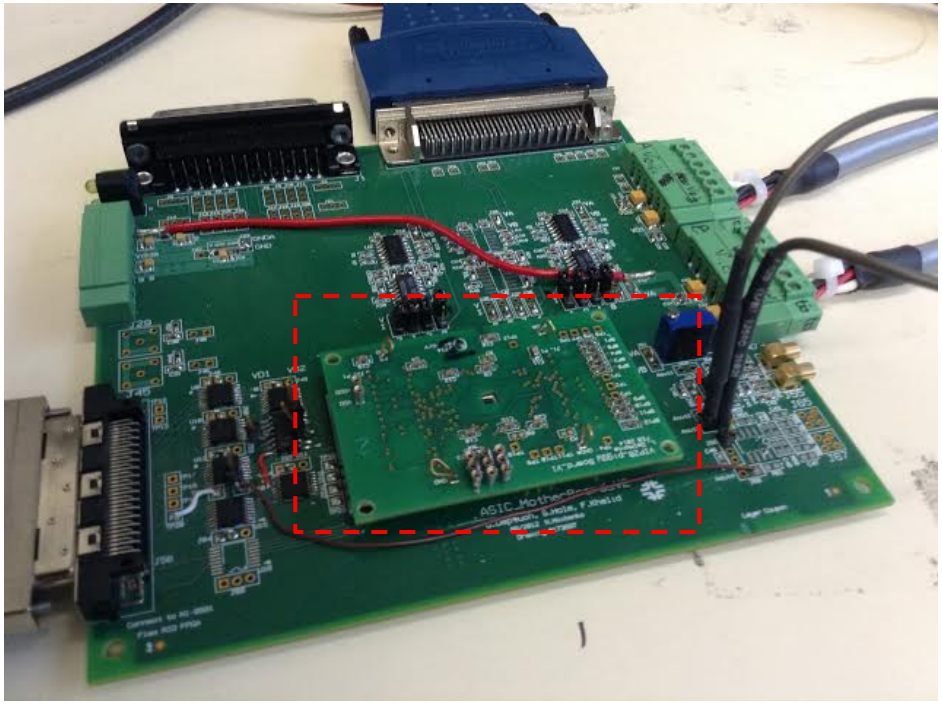
Outline

- About the VIP2B Chip
- Setup
- Gathering Data
- Results & Analysis :
  - 1st dataset
  - 2nd data set
  - Comparison
- Summary

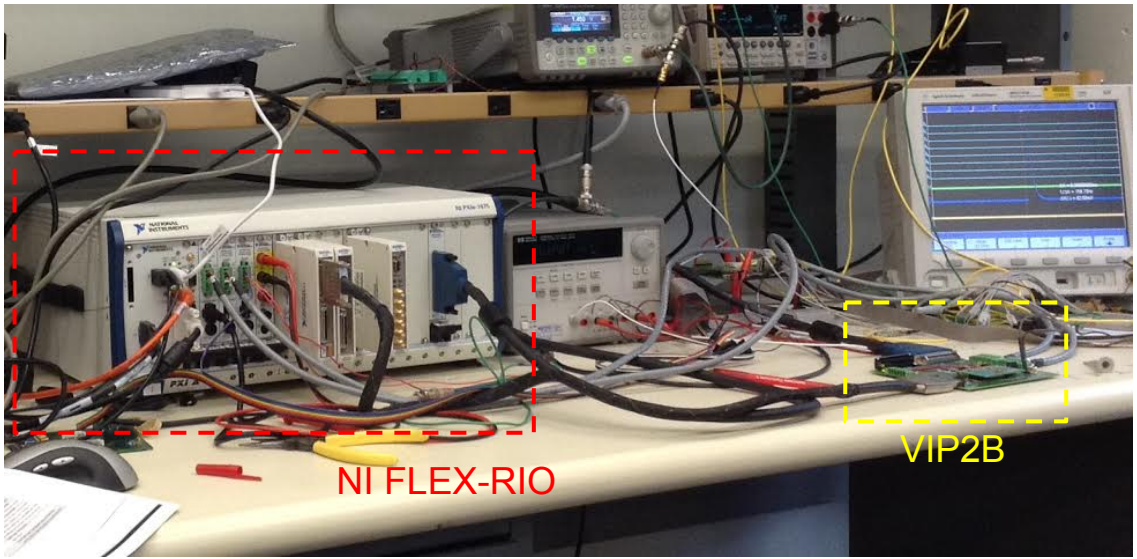
About the VIP2B

- Vertically integrated chip consisting of 2 stacked Silicon wafers
- Used for detection of relativistic particles for tracking purposes in HEP experiments
- This technology enables higher densities of electronics per unit area without the use of nano-scale processes
- 192x192 grid of pixels



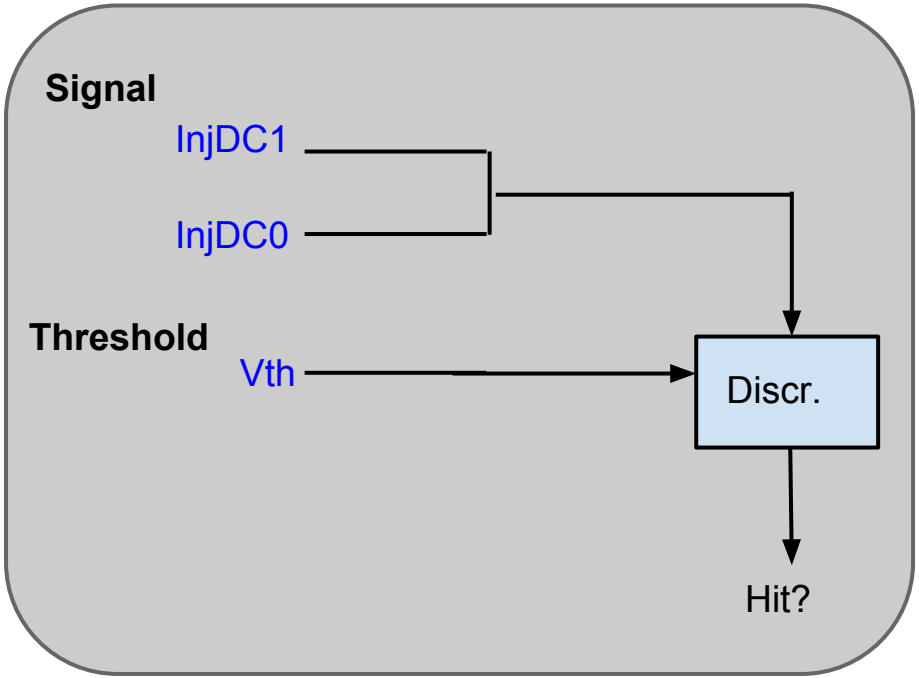
Setup

- NI Flex-Rio FPGA system
- Data taken using Labview
- Analysis done in
  - Labview
  - Matlab

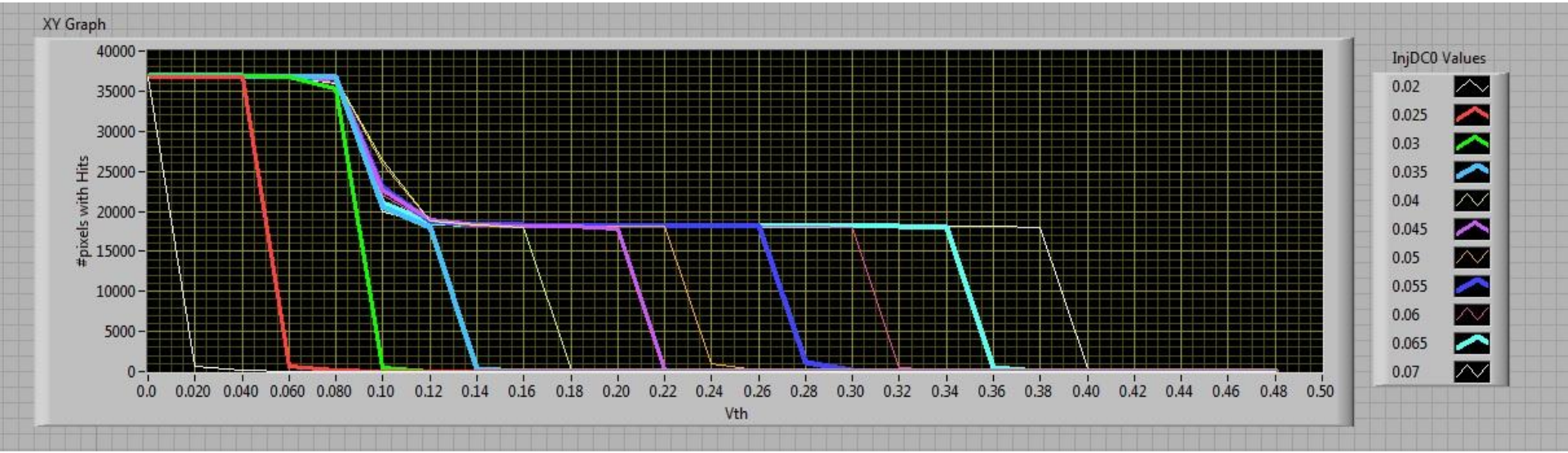


Gathering Data

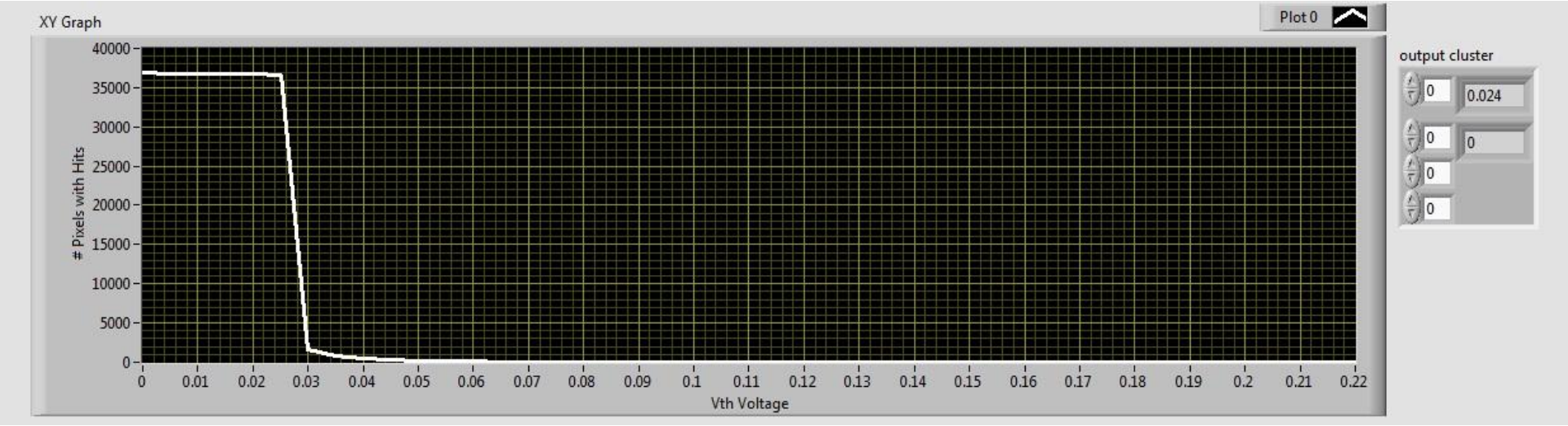
- We vary InjDC0 to vary the signal pulse. (InjDC1 always kept at zero)
- If the signal is larger than a set threshold value, the discriminator will count this as a hit.
- When a pulse is injected to the chip, a “hit” is returned. (32 bit binary word)
- First 16 bits are the XY position of the pixel that turned on



Vth vs #Pixels hit (Various InjDC0)



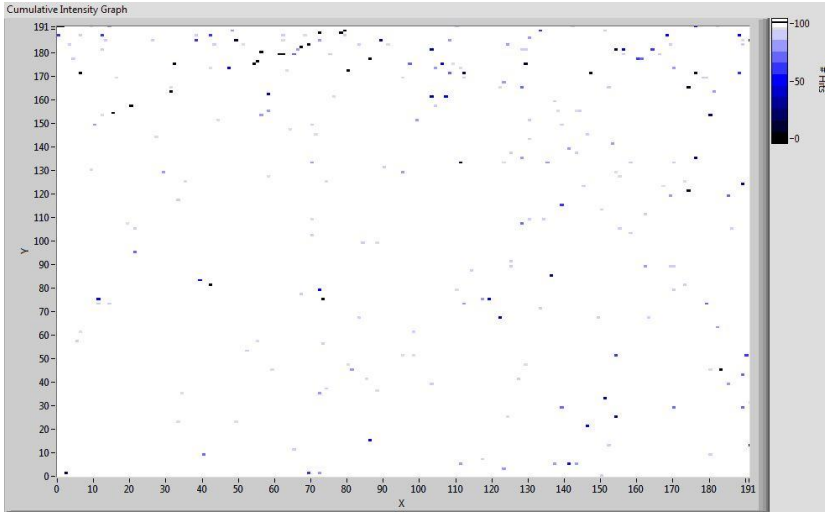
Vth vs # Pixels Hit (InjDC0 = 0.024)



Intensity Graphs for InjDC0 = 0.024
(1st Dataset)

Vth = 0.01 : 0.0025 : 0.1
100 Trials

Y-pos

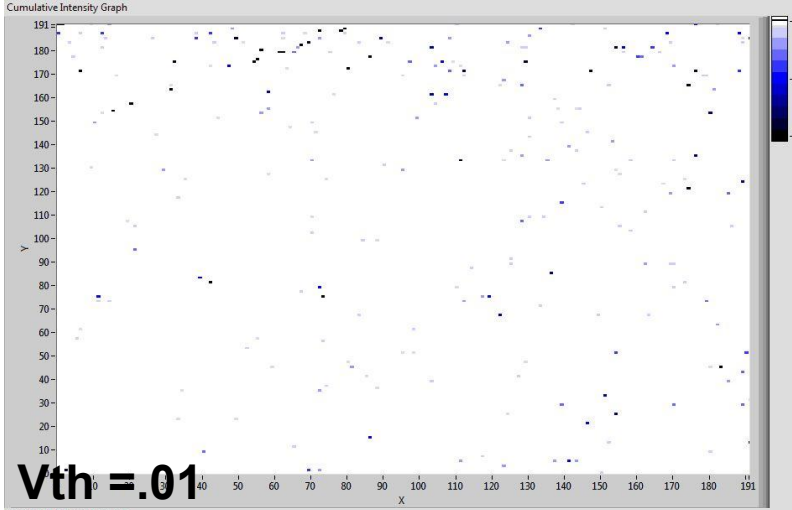


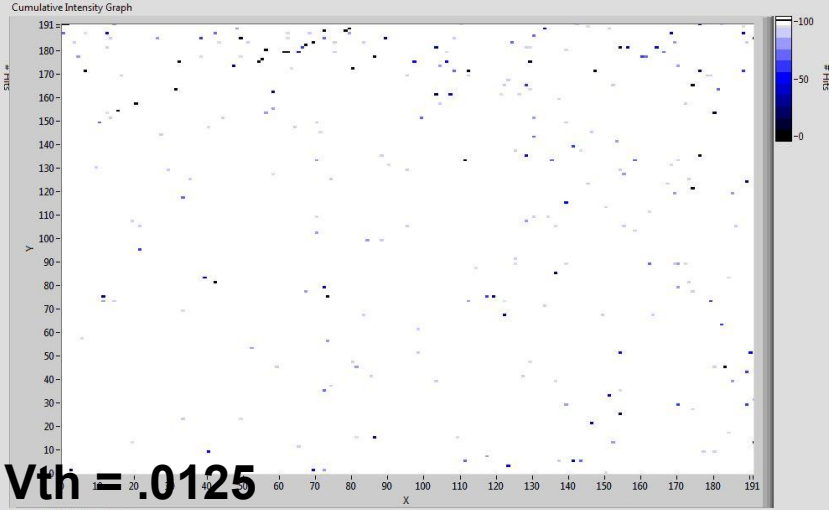
X-pos

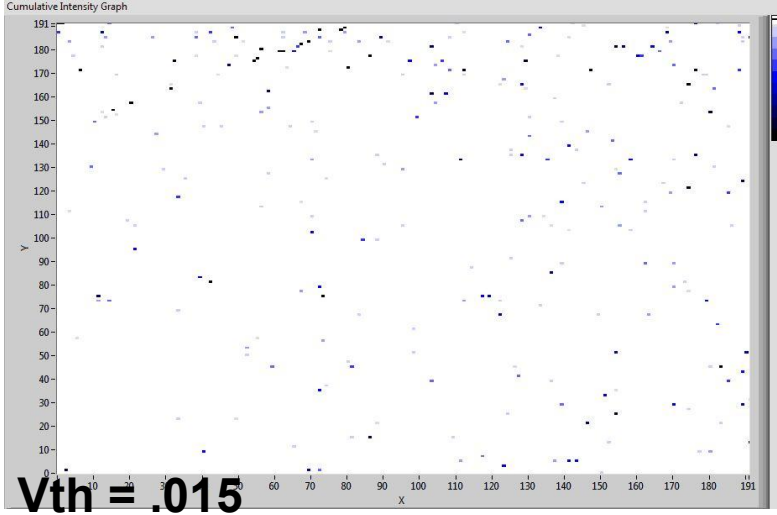
Color represents number of chip hits

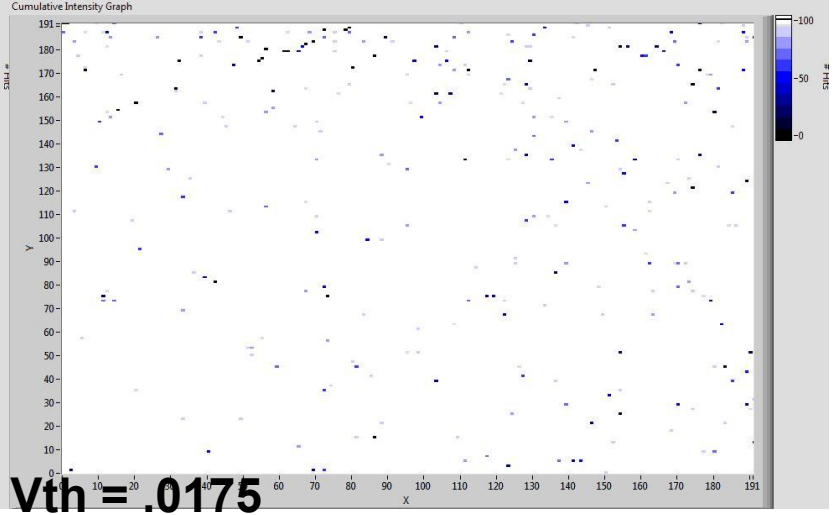
White is close to 100, black is close to 0

Each intensity graph is over a single Vth value









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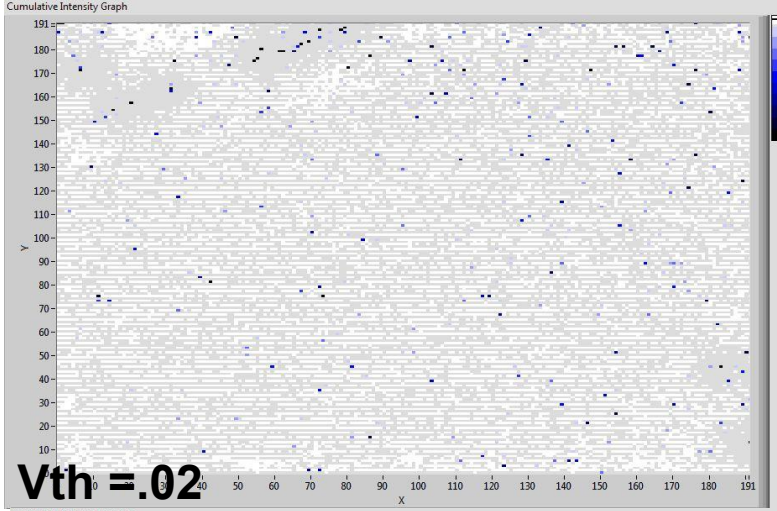

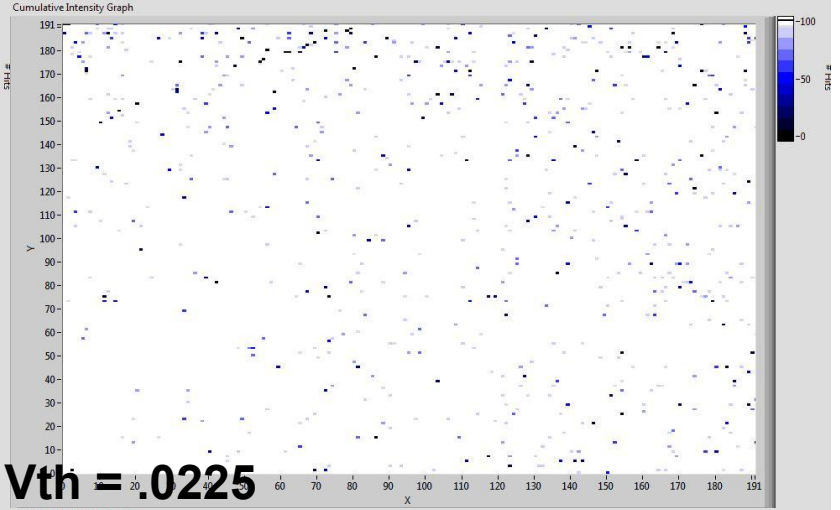

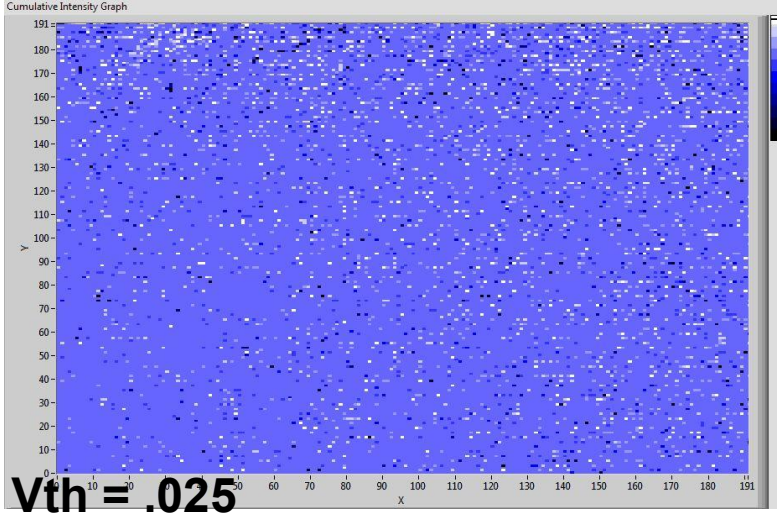

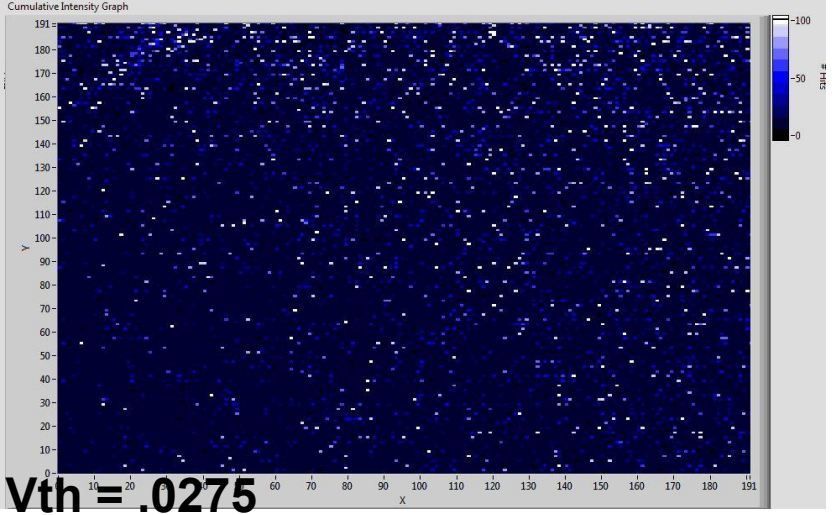

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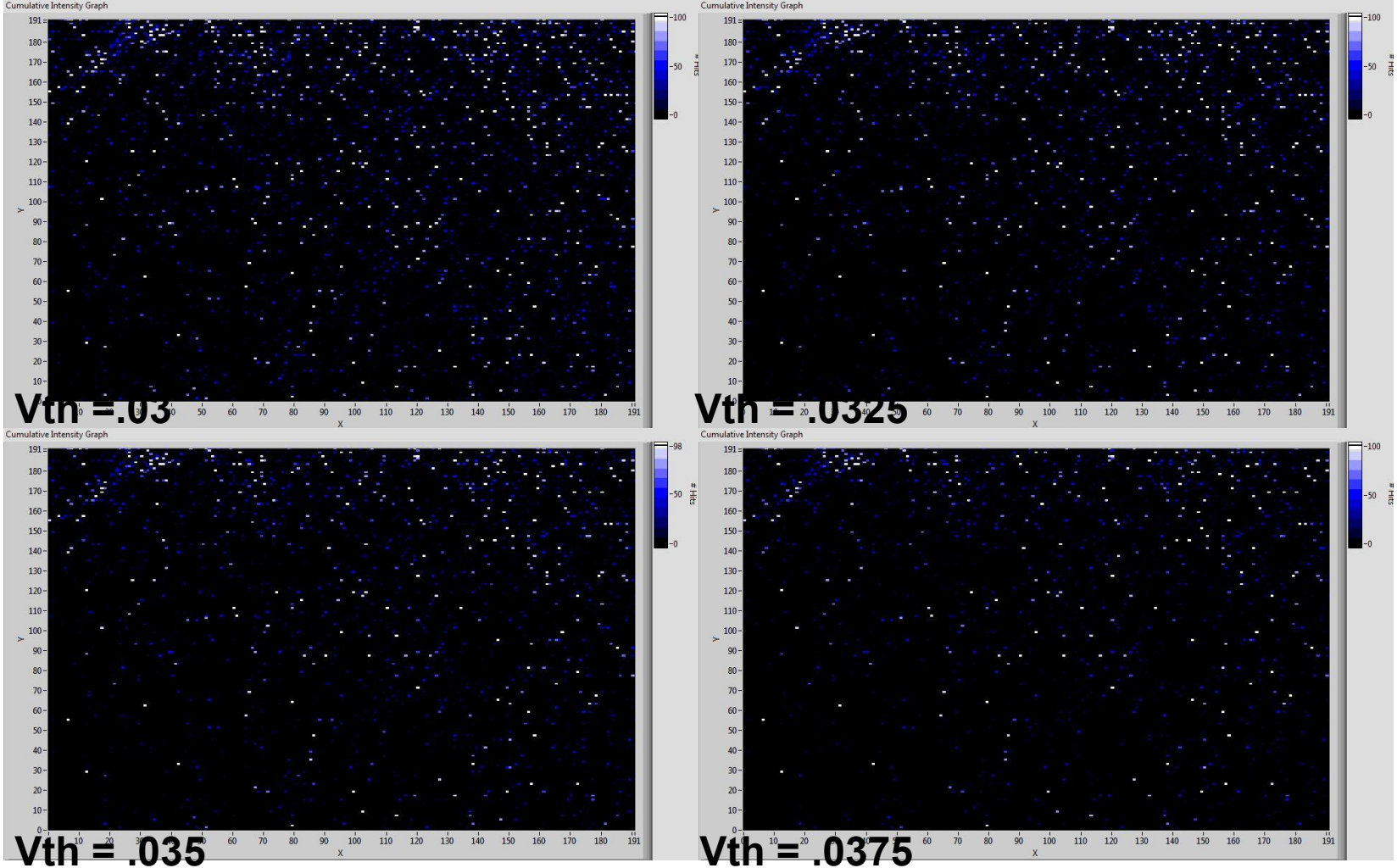

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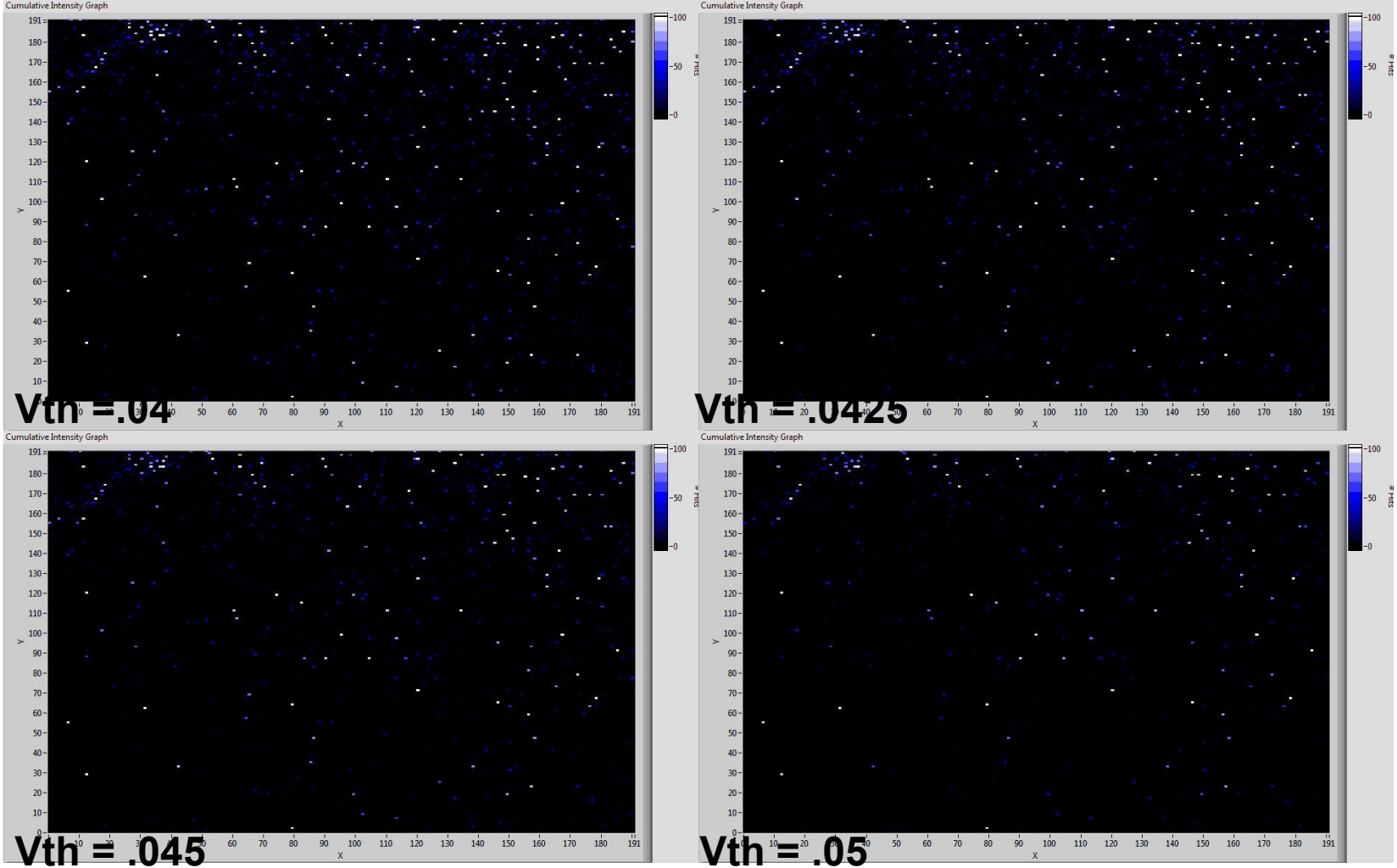

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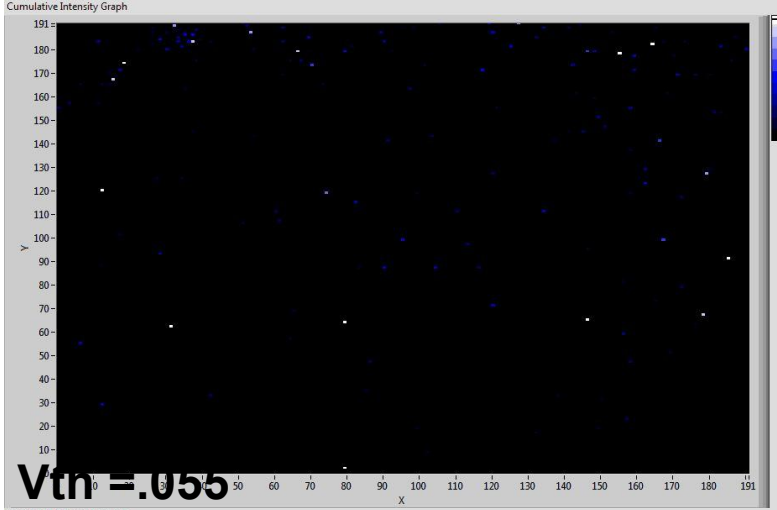

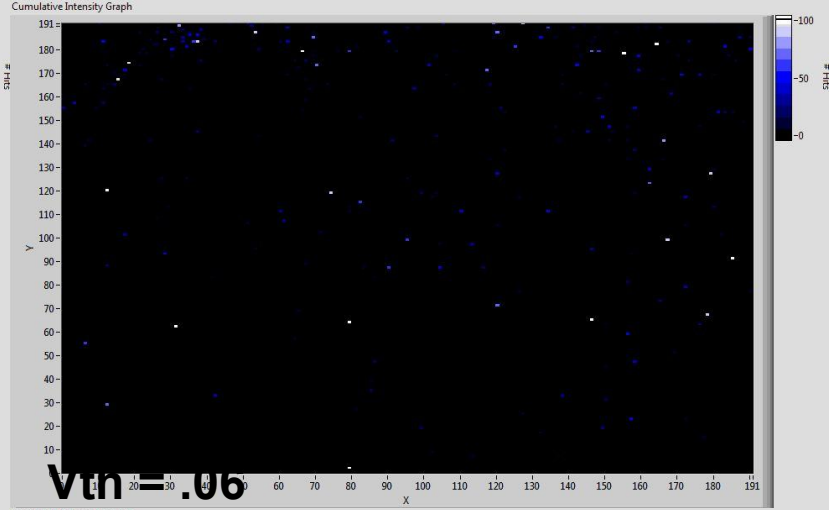

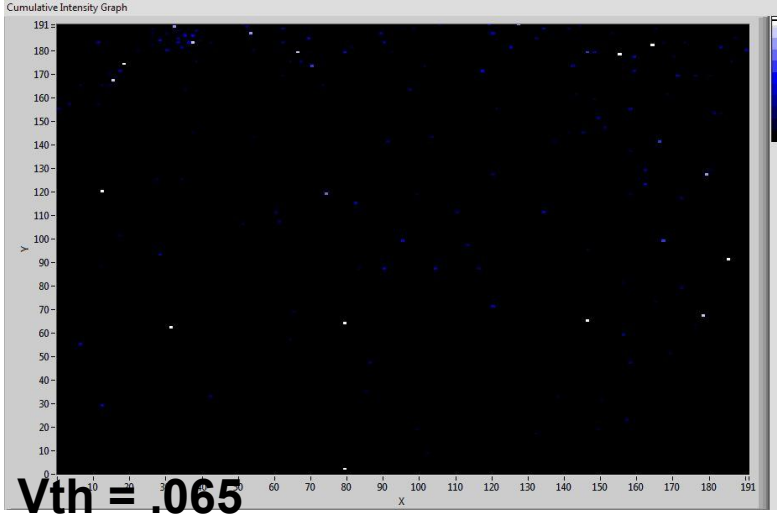

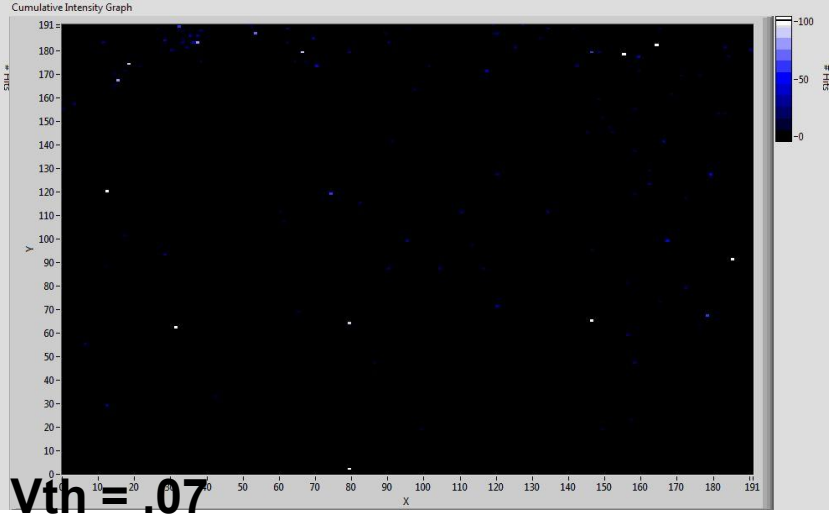

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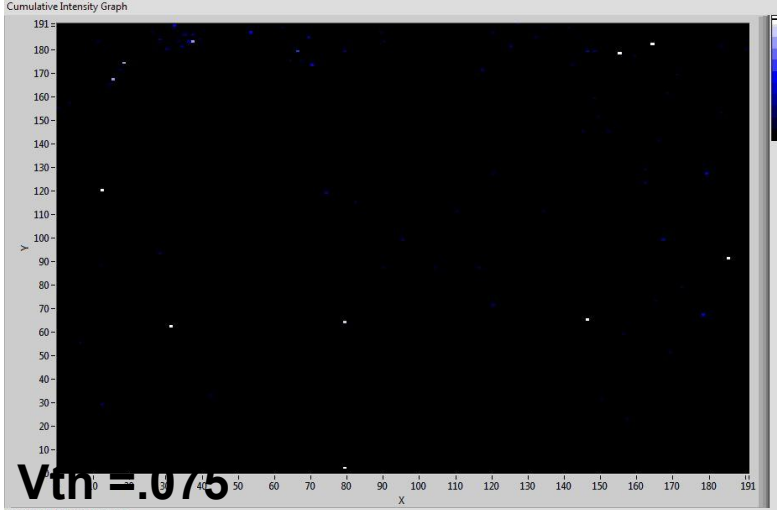
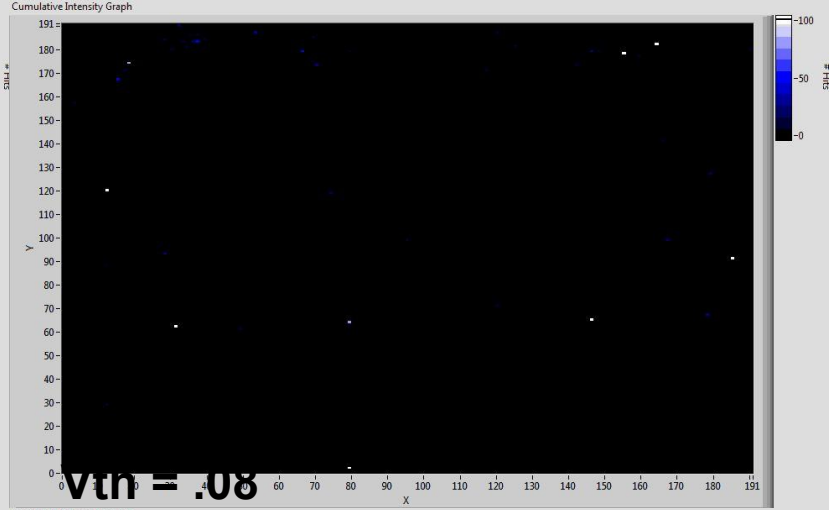
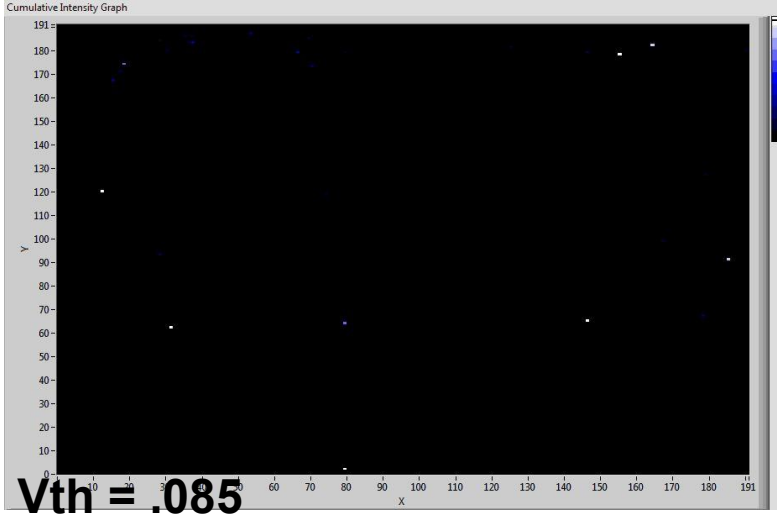
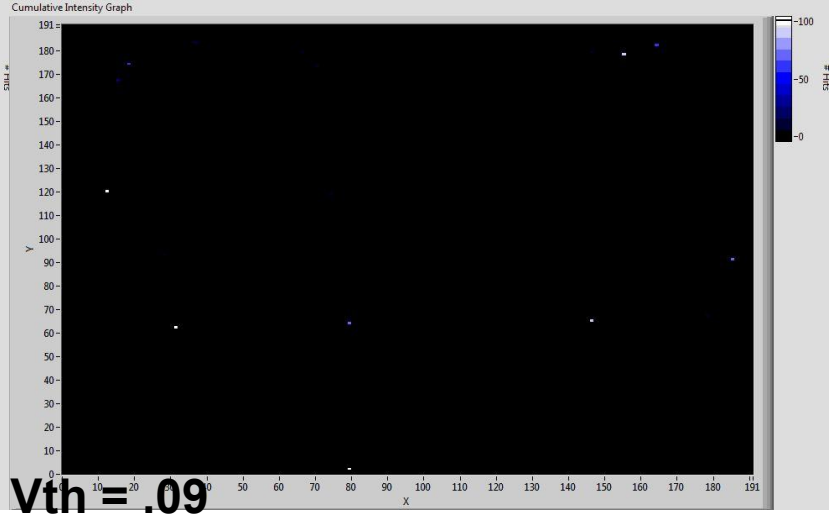
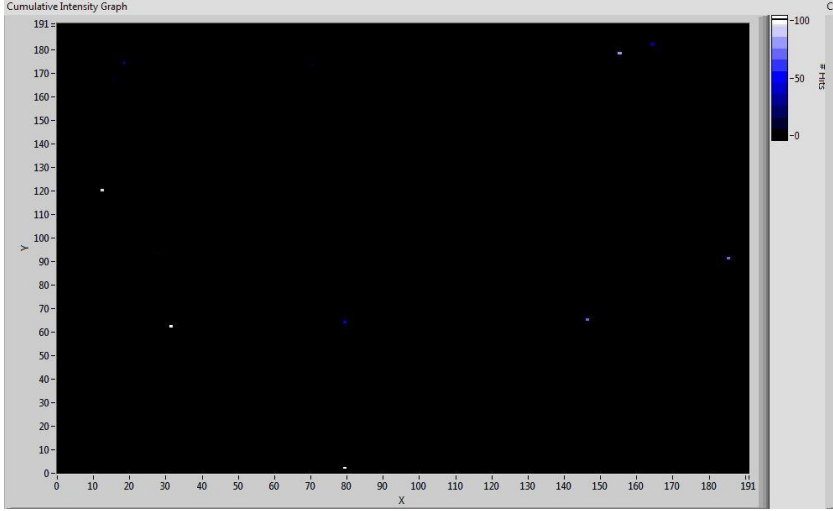




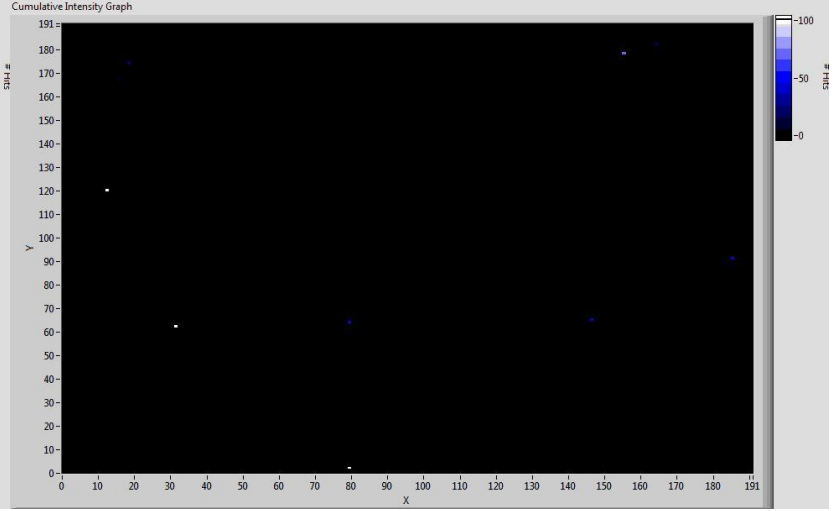




Intensity Graphs for InjDC0 = 0.024



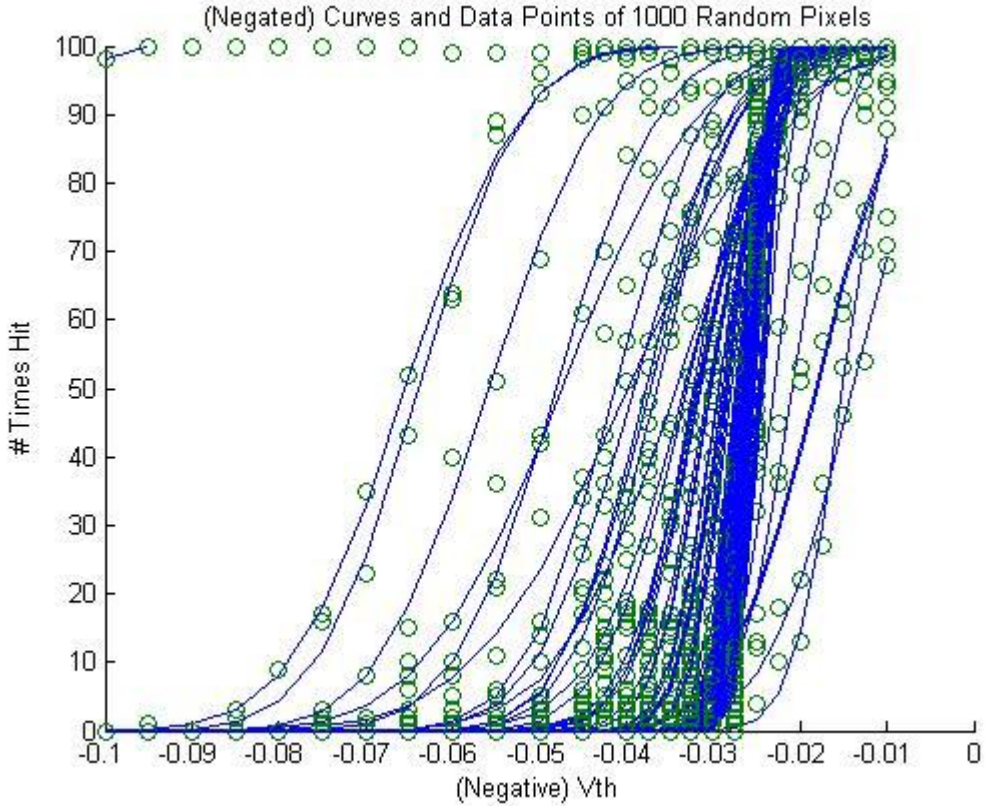
Vth =.095



Vth = .1

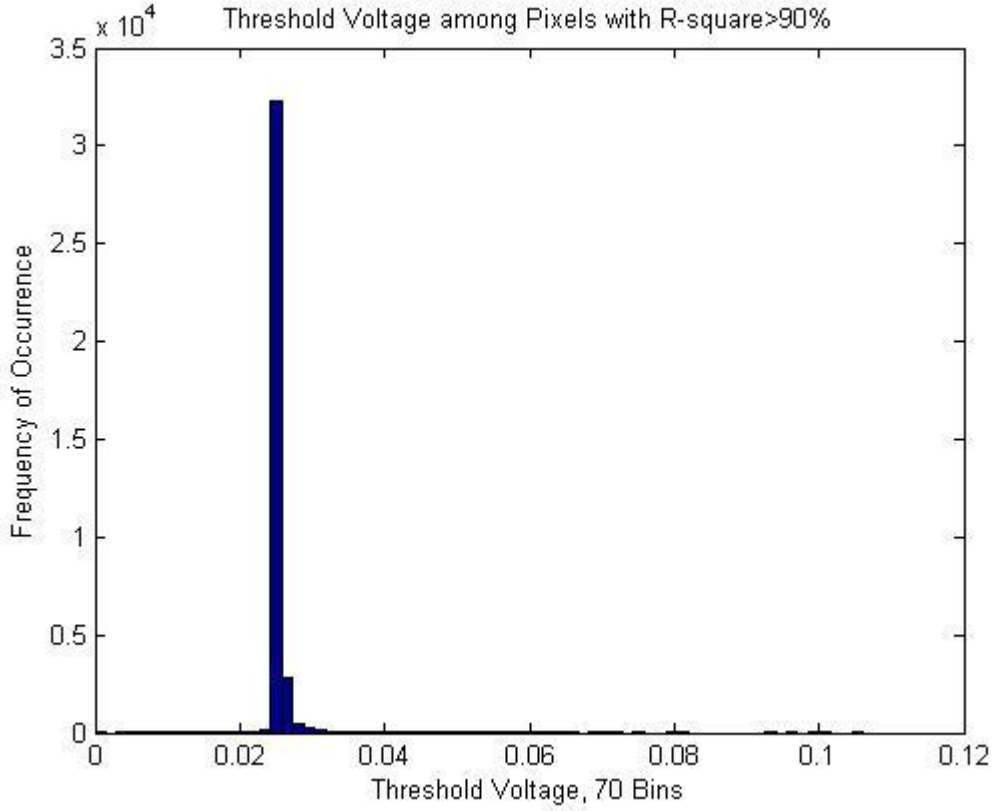
Intensity Graphs for InjDC0 = 0.024

Analysis: s-curves for each pixel



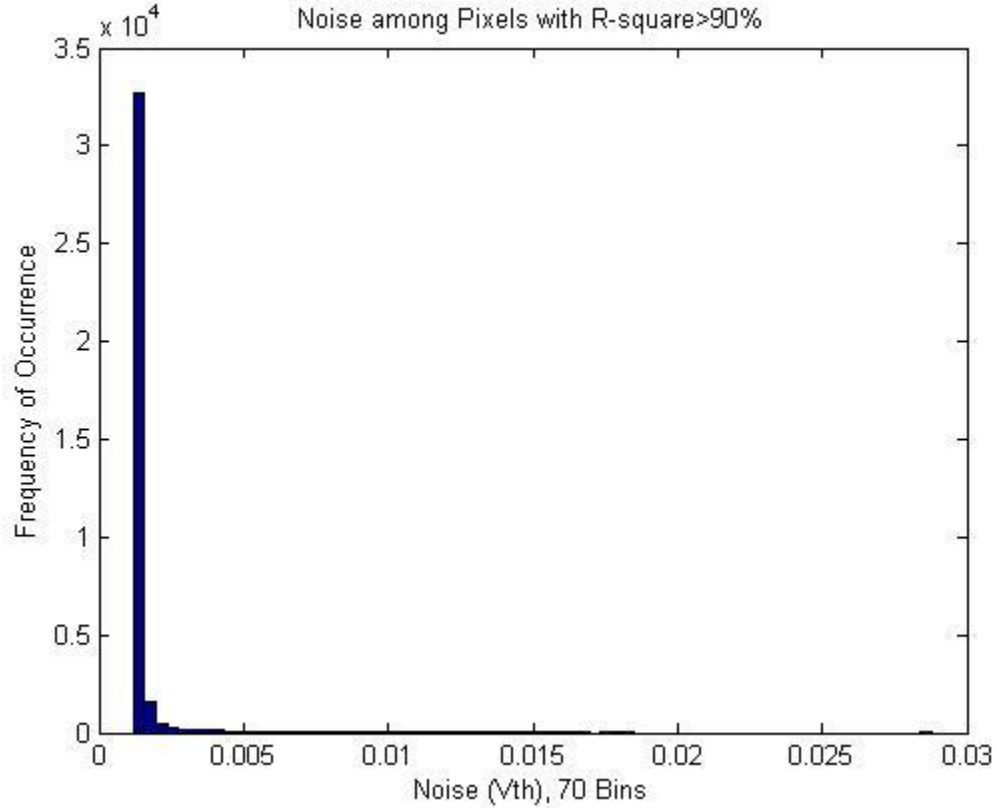
Fit with Cummulative Gaussian.

Threshold Voltages



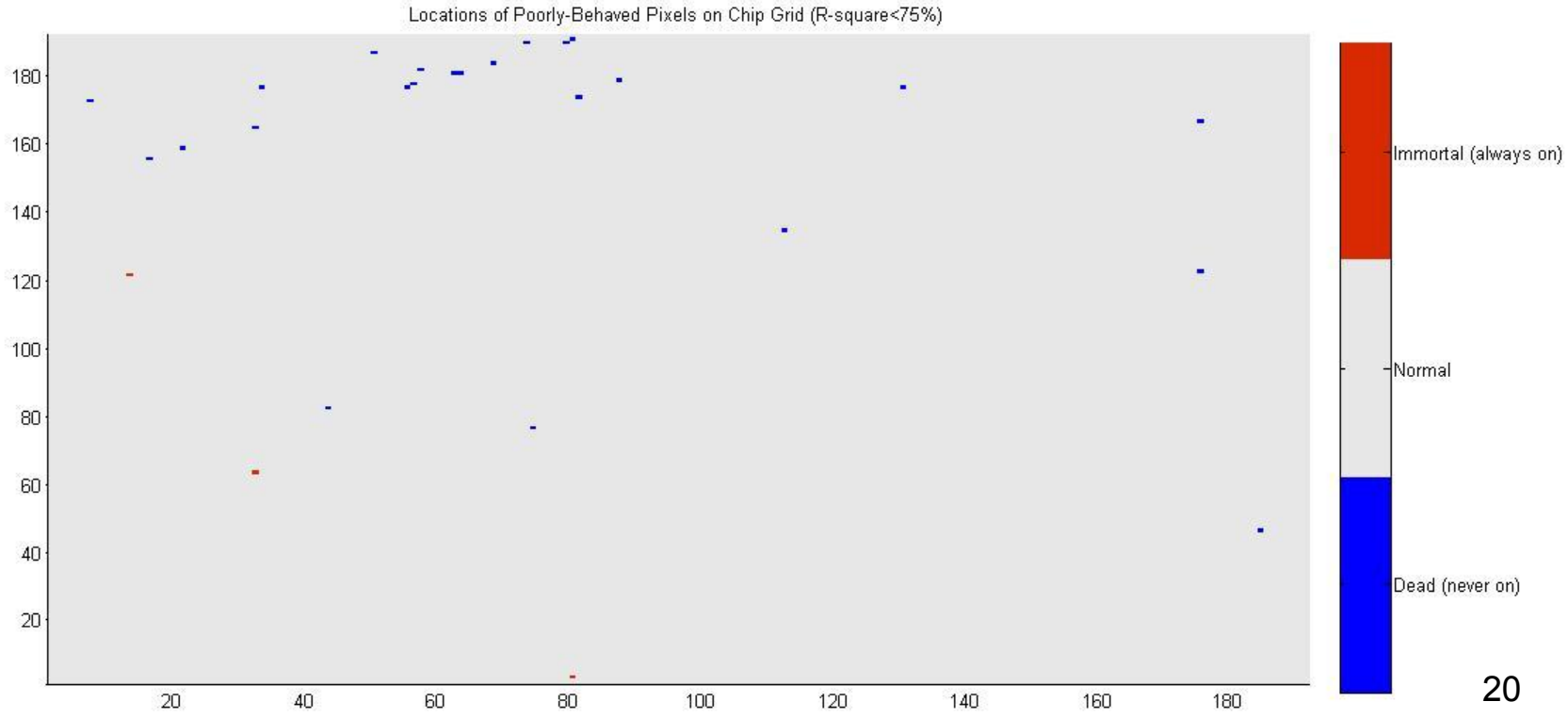
Mean of the Gaussian:
Threshold voltage

Noise

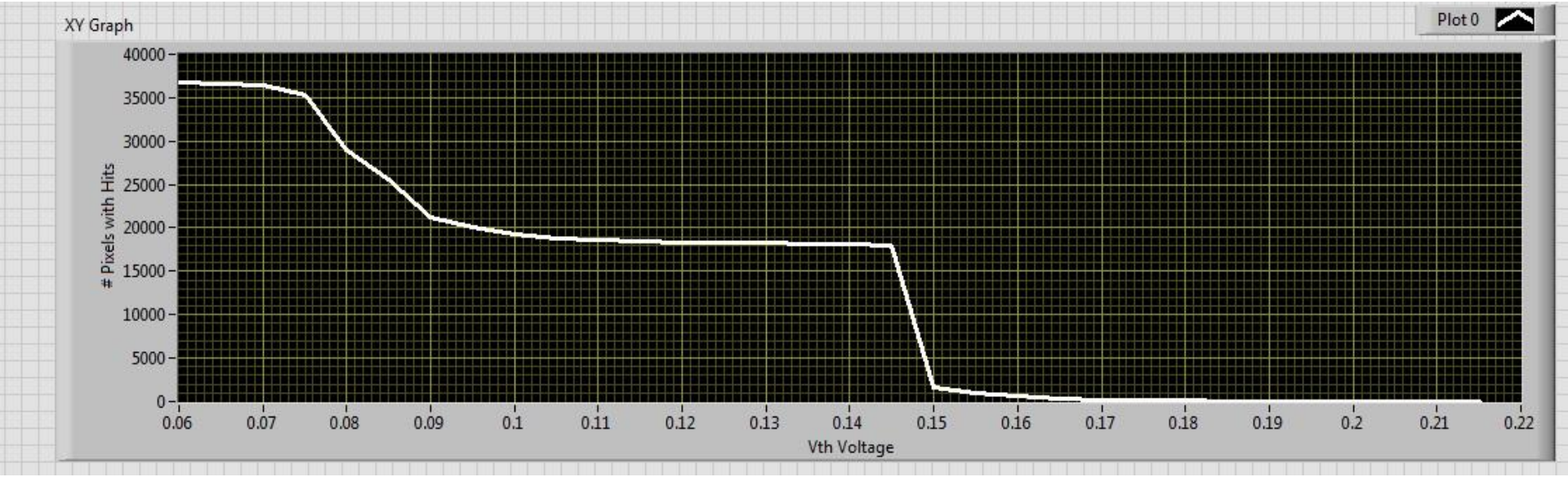


Std dev of Gaussian: Noise

Malfunctioning Pixels



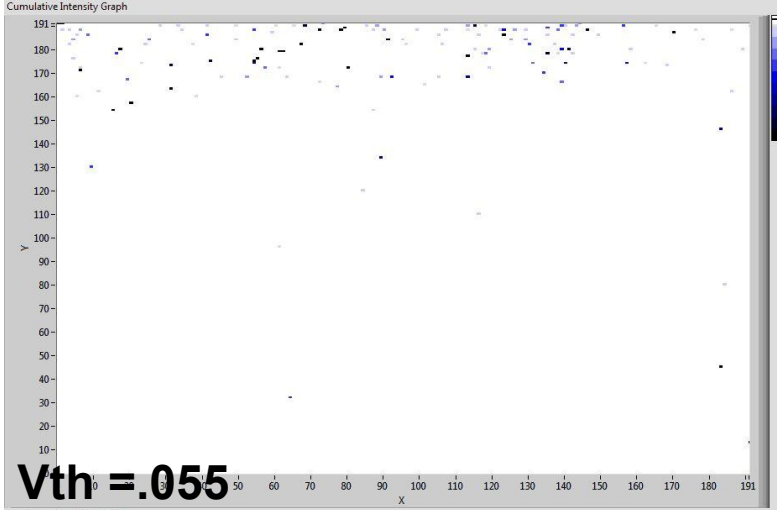
Vth vs #Pixels hit (INjDC0=.04)

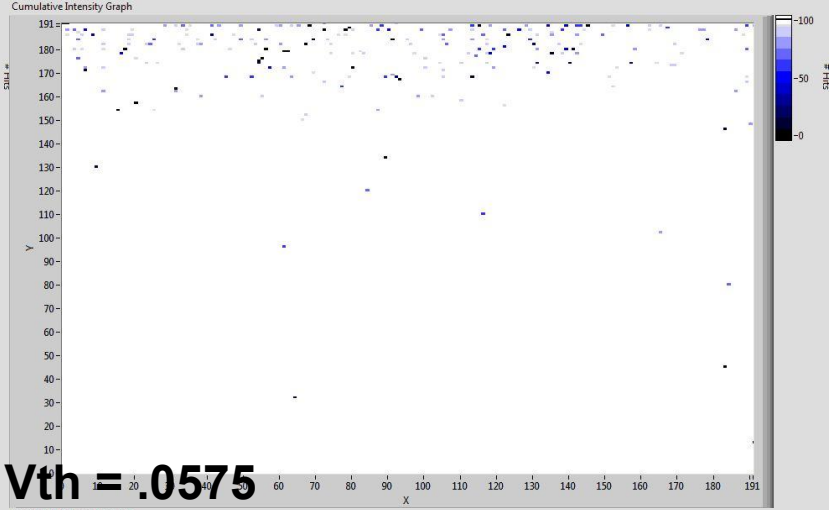


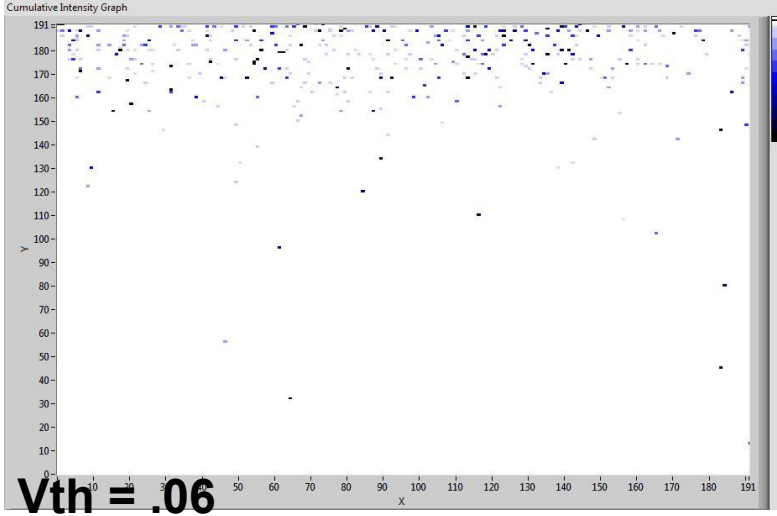
Halfway drop?

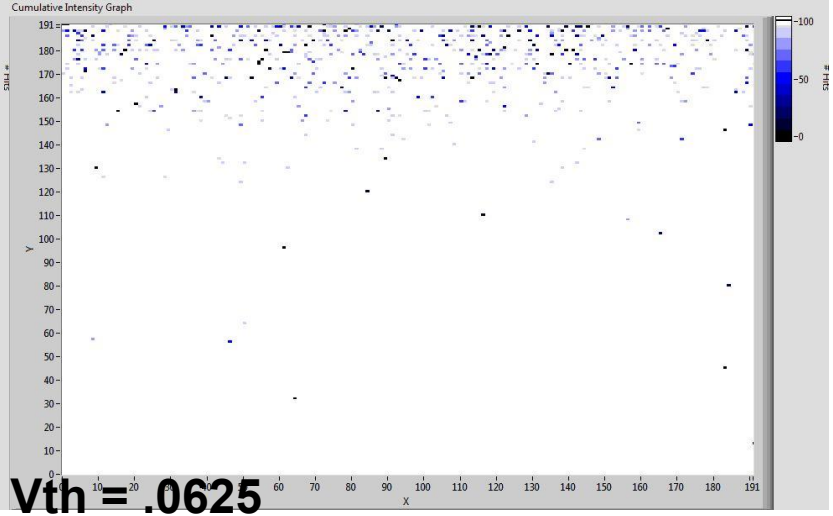
Intensity Graphs for InjDC0 = 0.04
(2nd Dataset)

Vth = 0.055 : 0.0025 : 0.1975
100 Trials

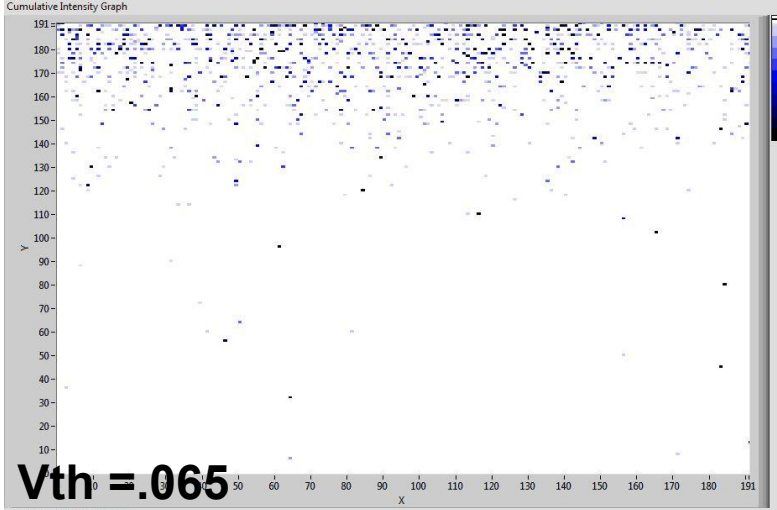


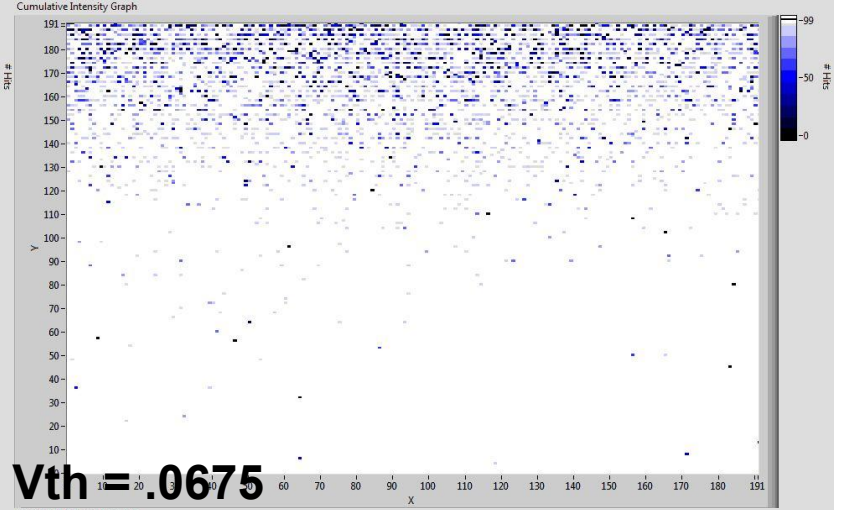


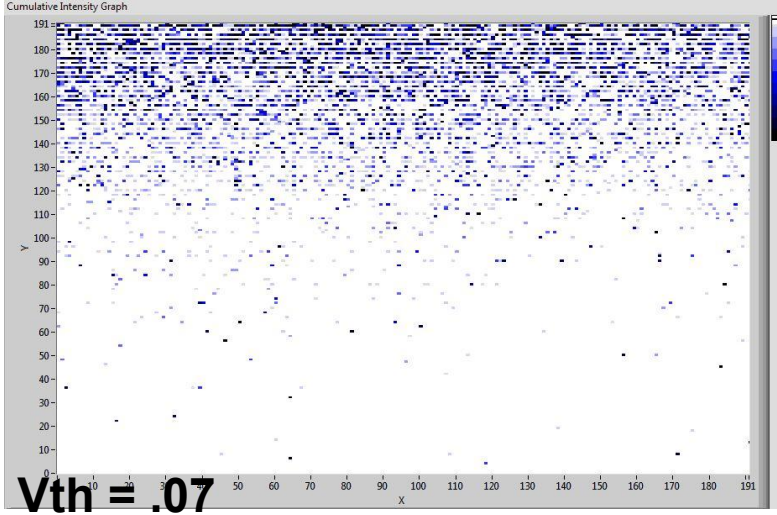


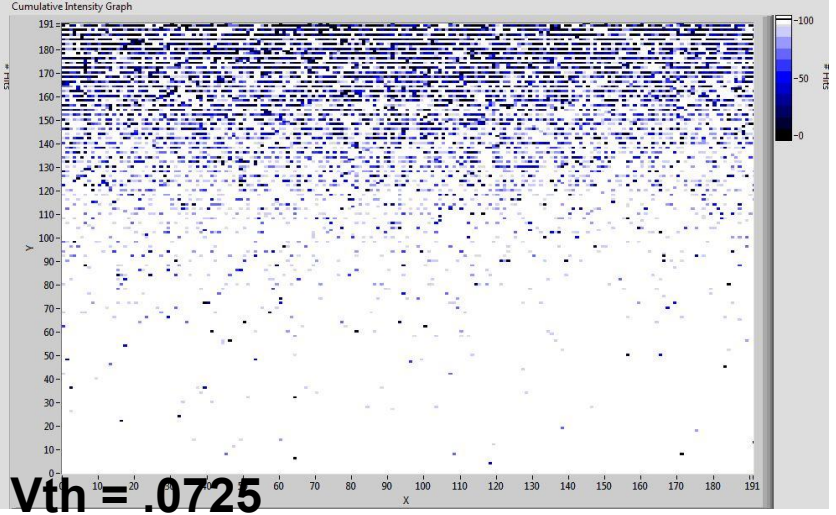


Intensity Graphs for InjDC0 = 0.04









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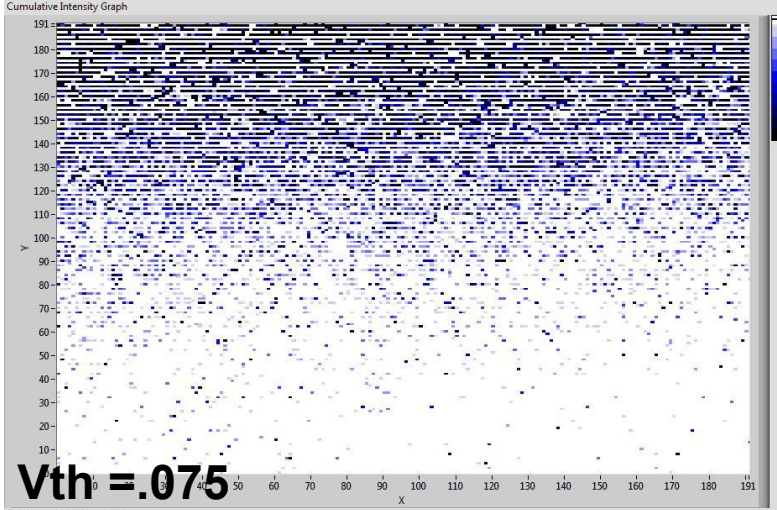

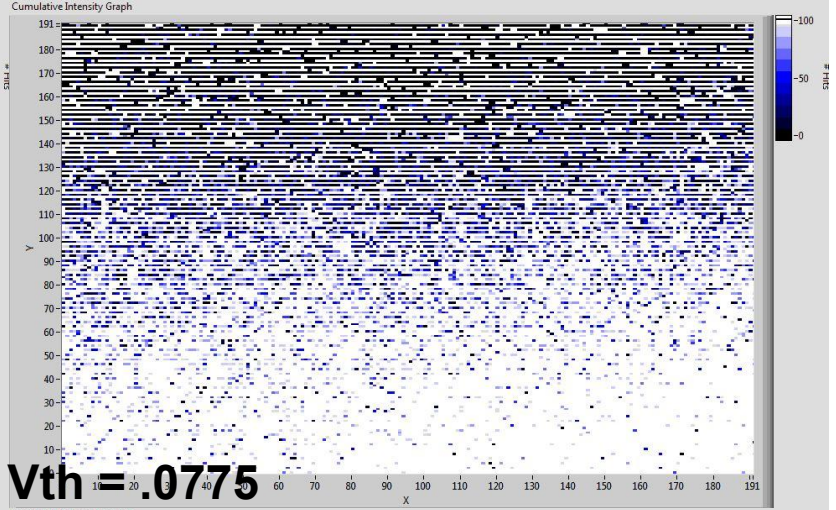

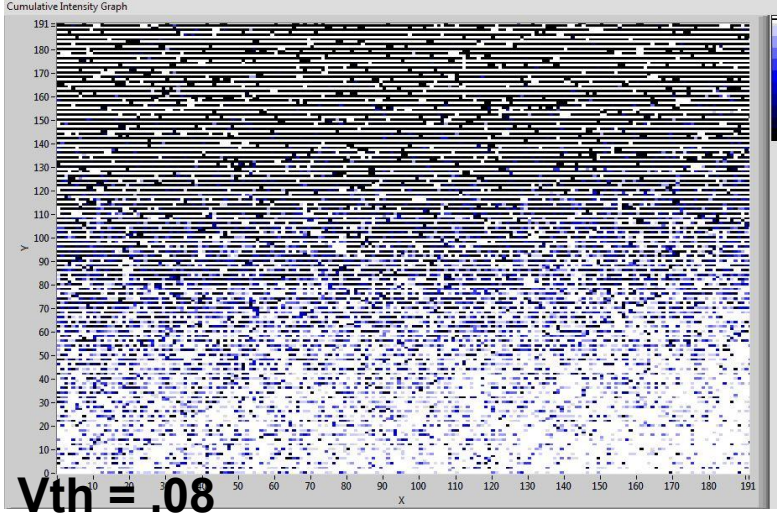

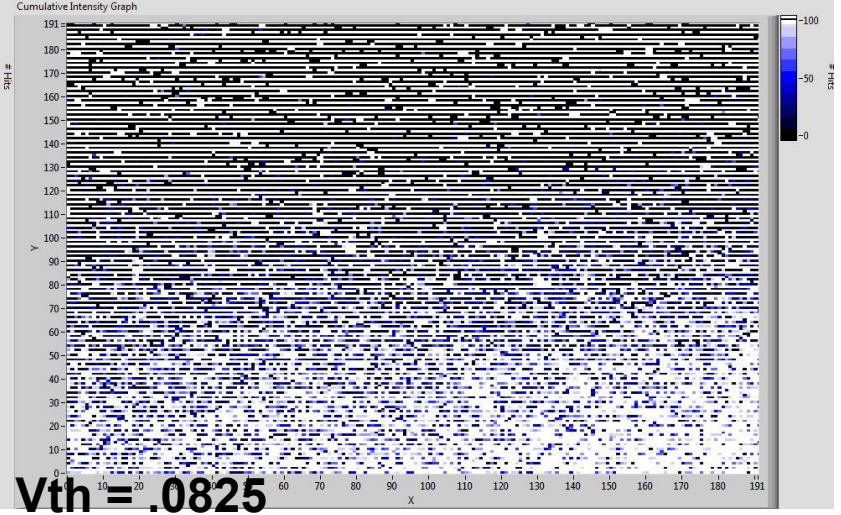

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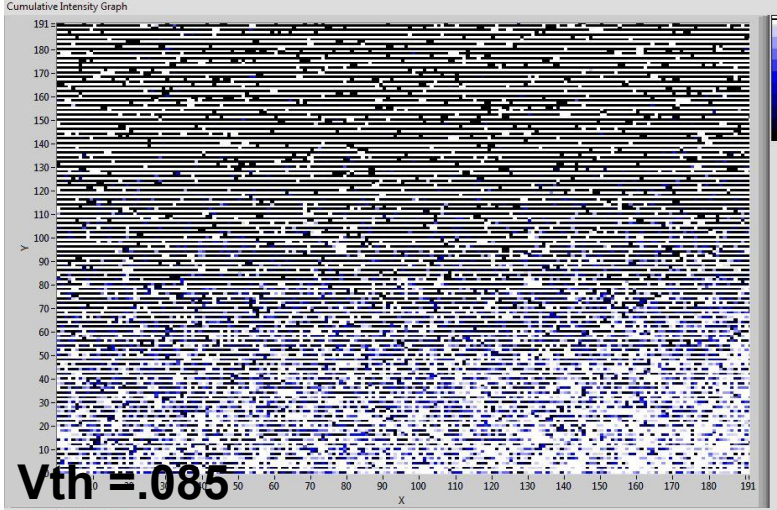

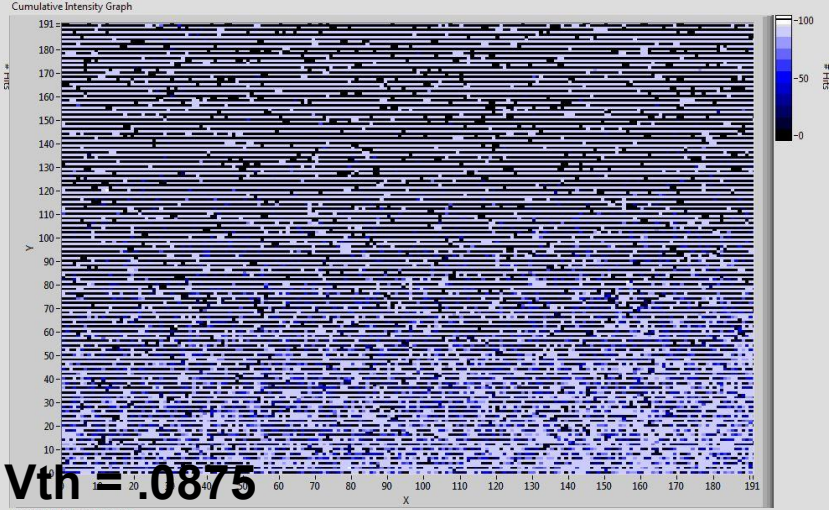

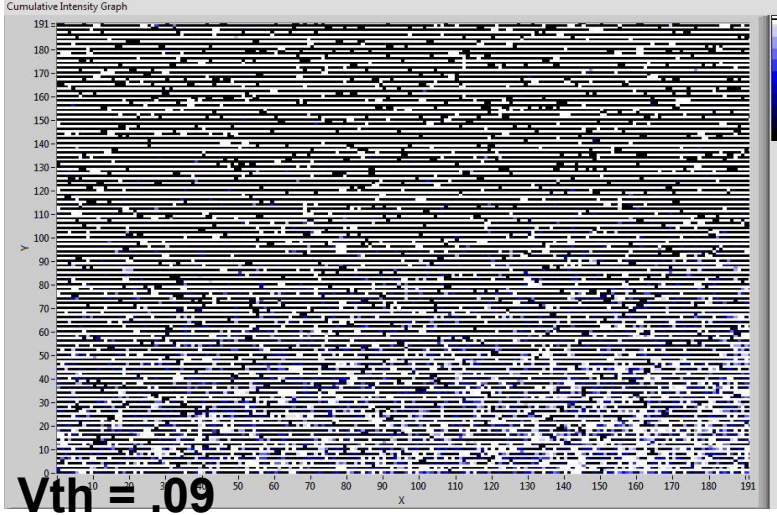

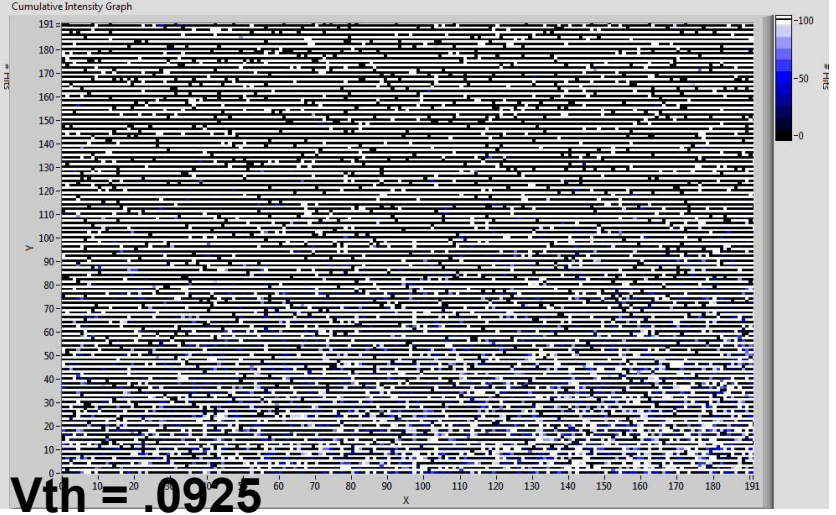

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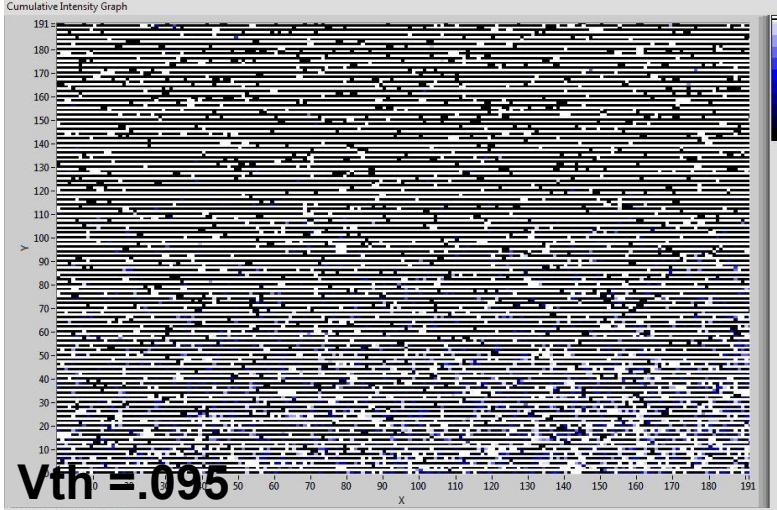

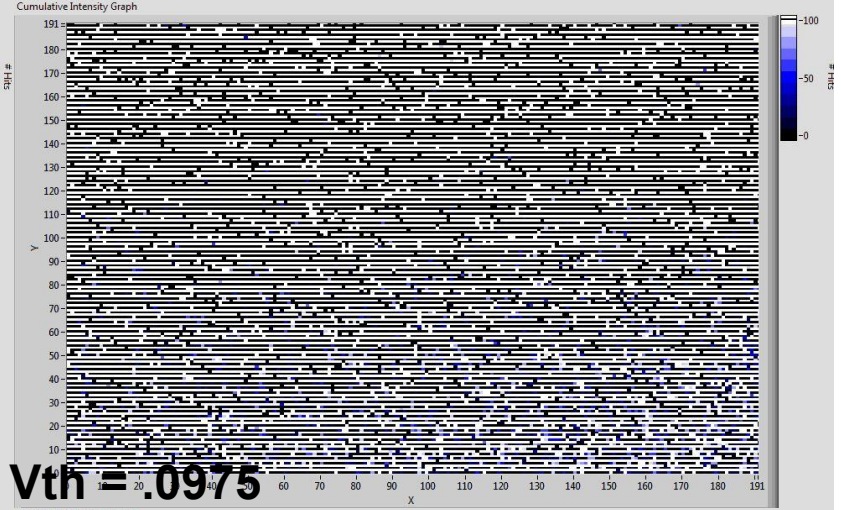

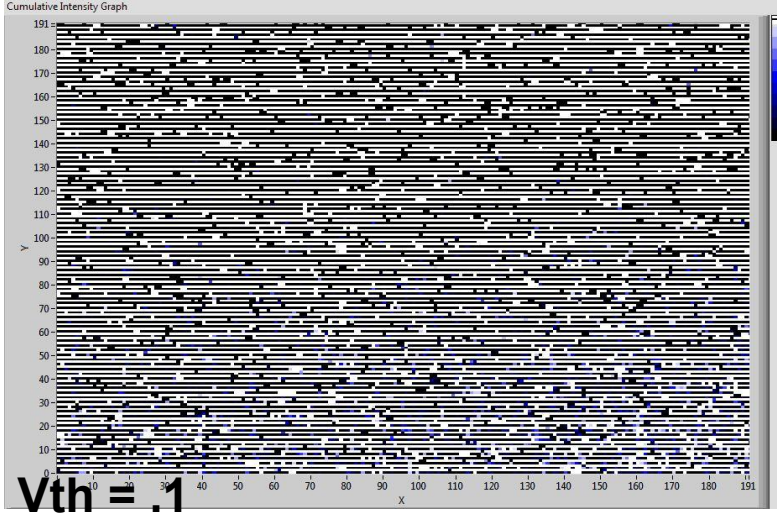

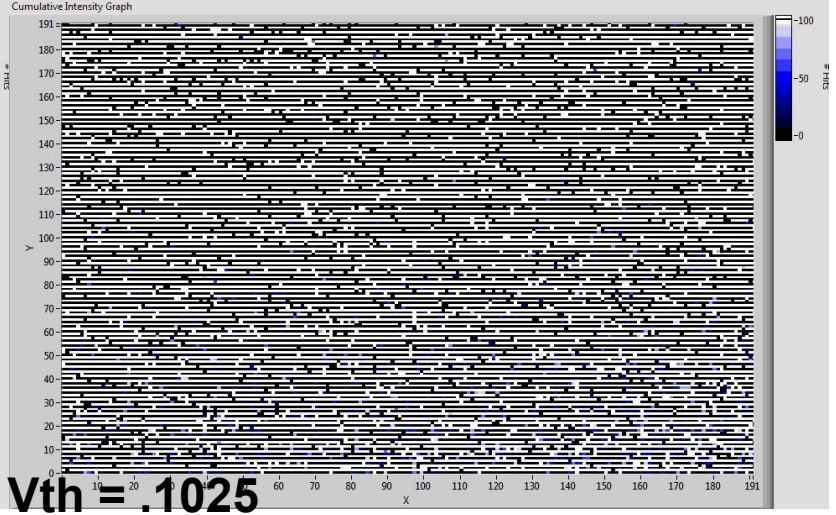

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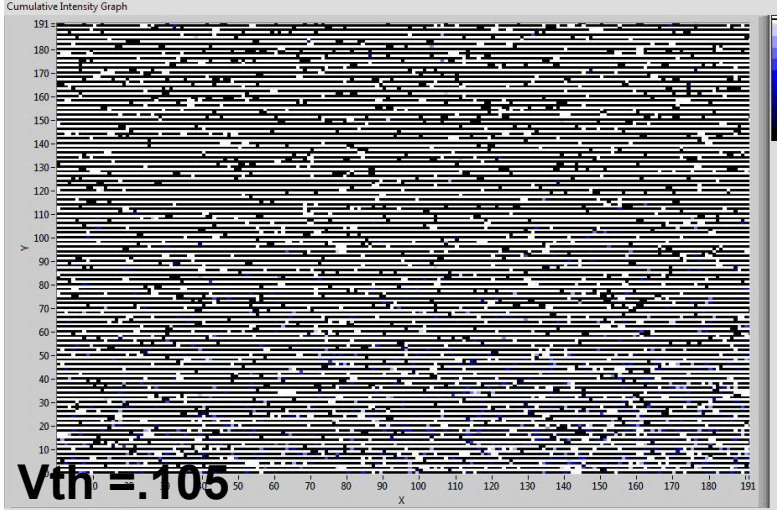

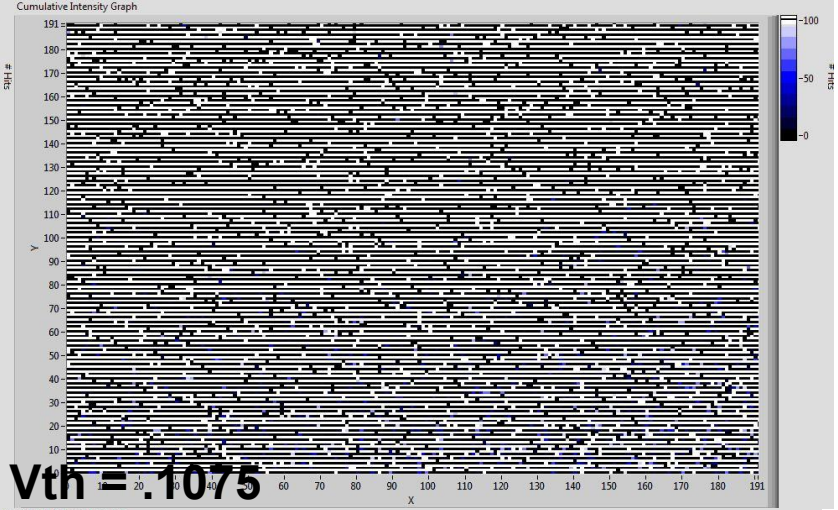

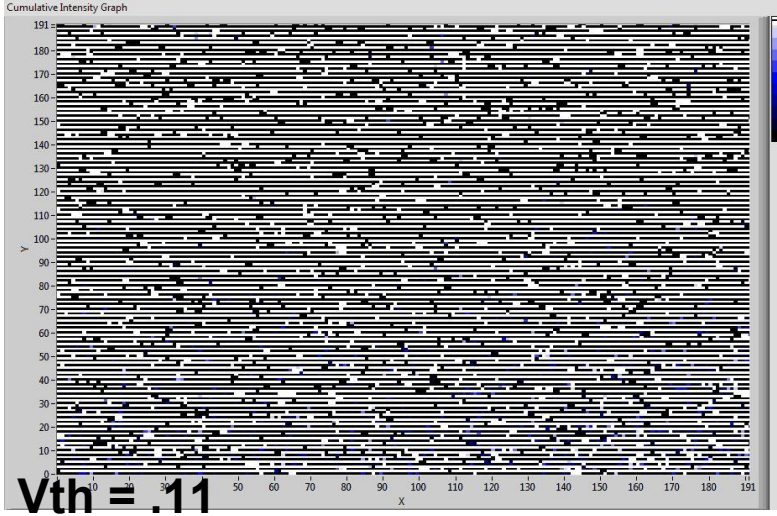

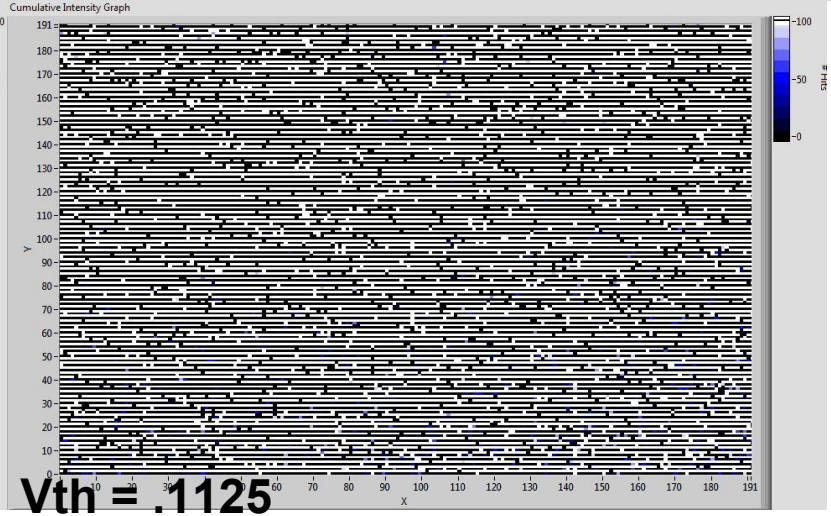

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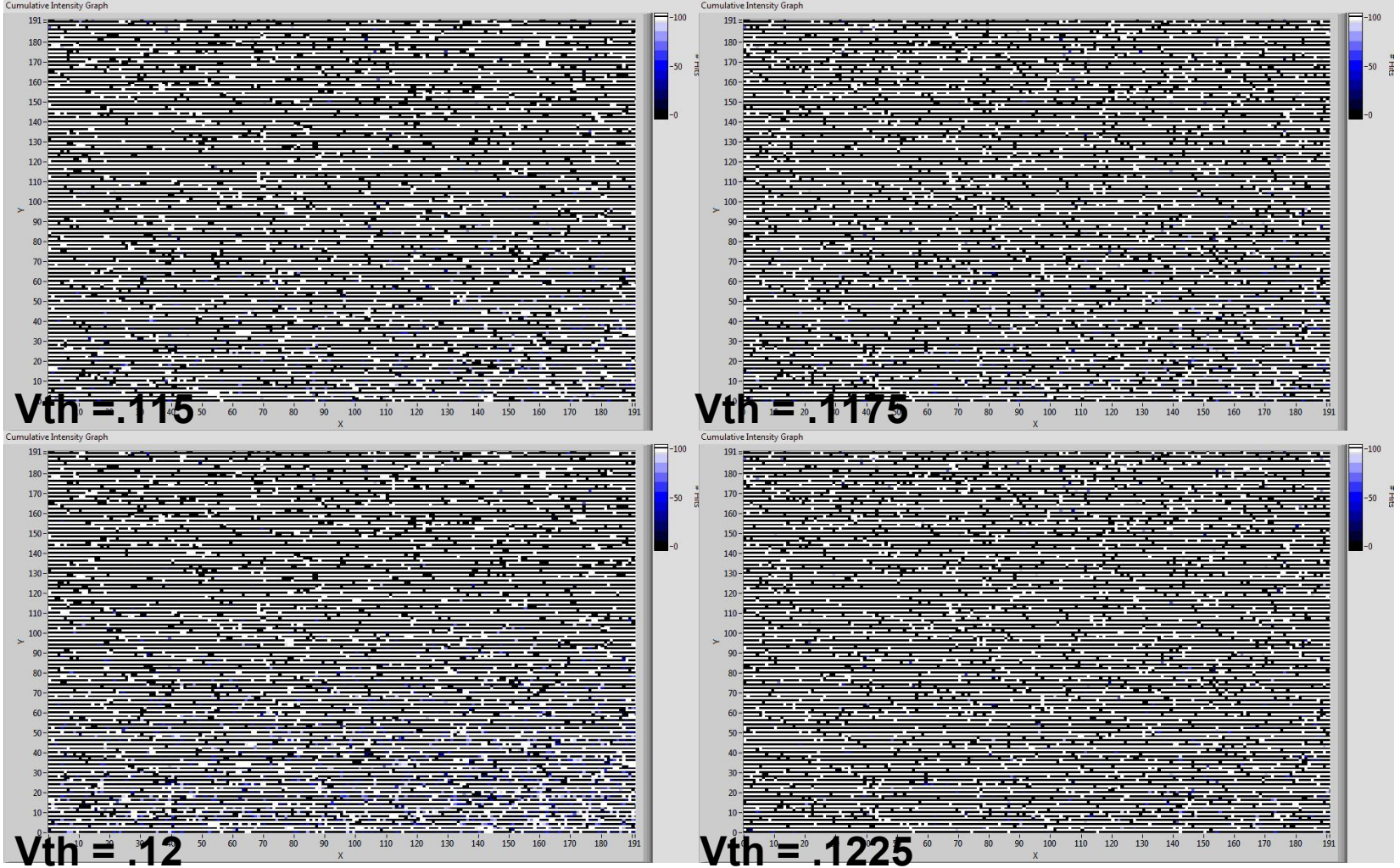

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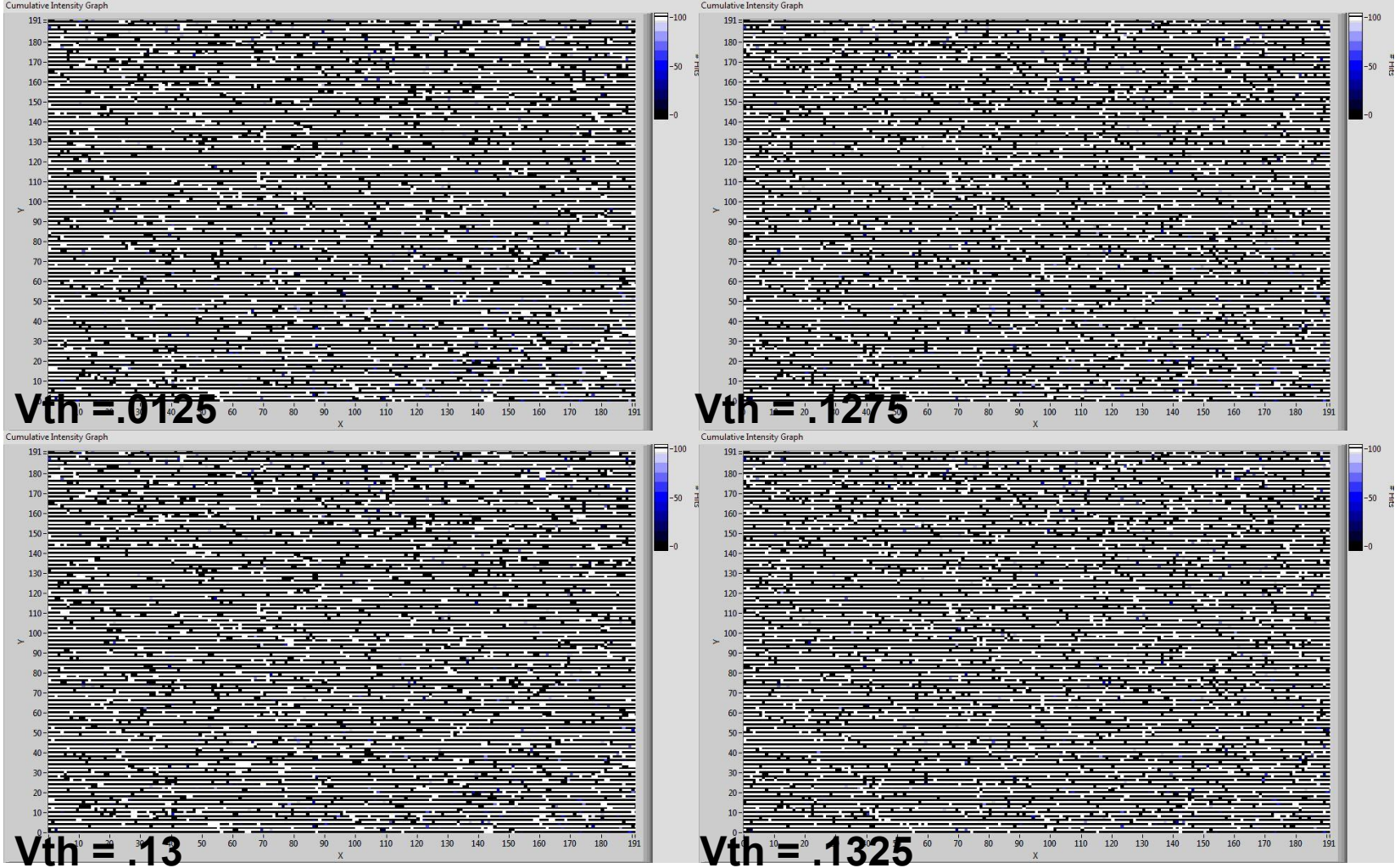
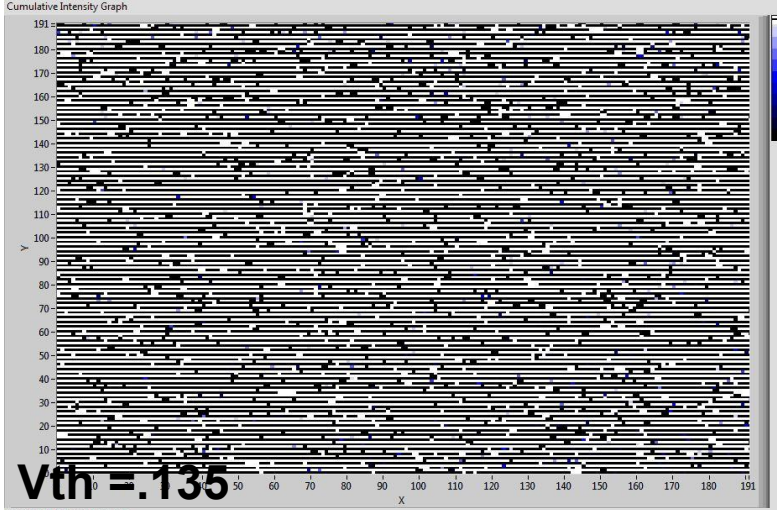
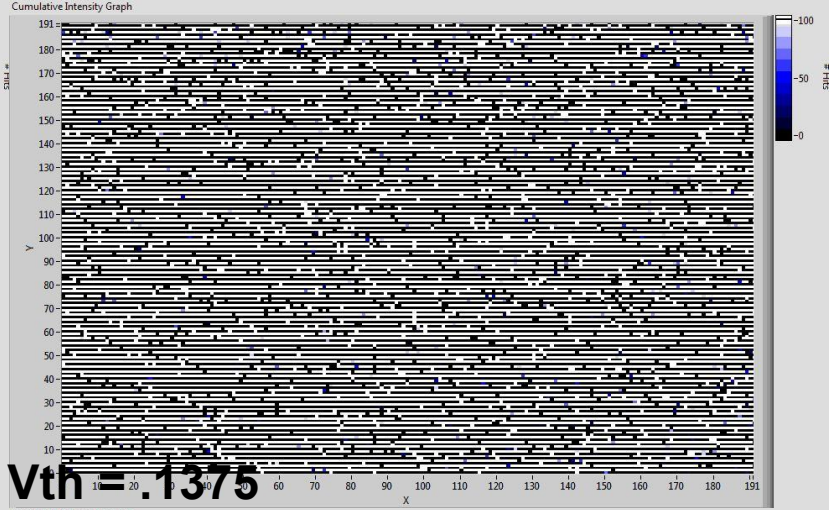
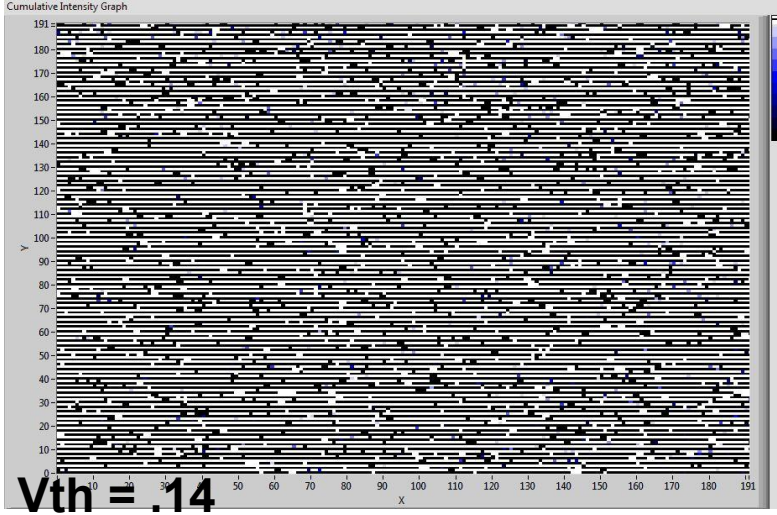
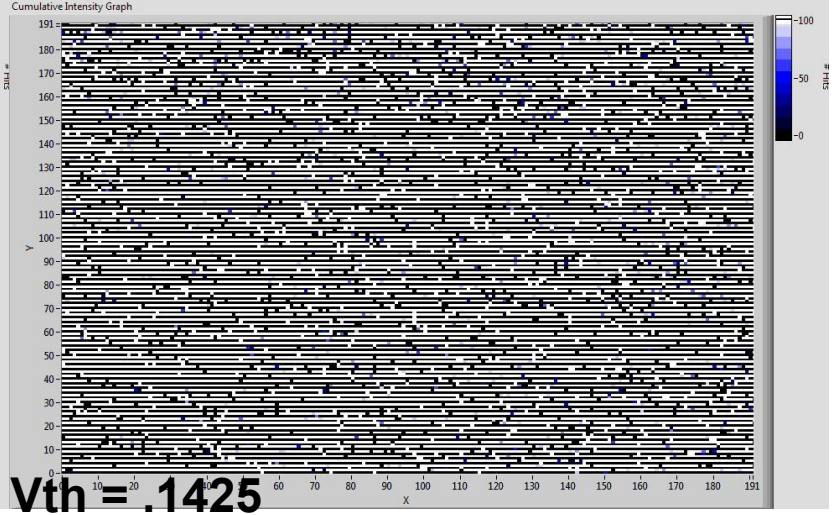


Intensity Graphs for InjDC0 = 0.04

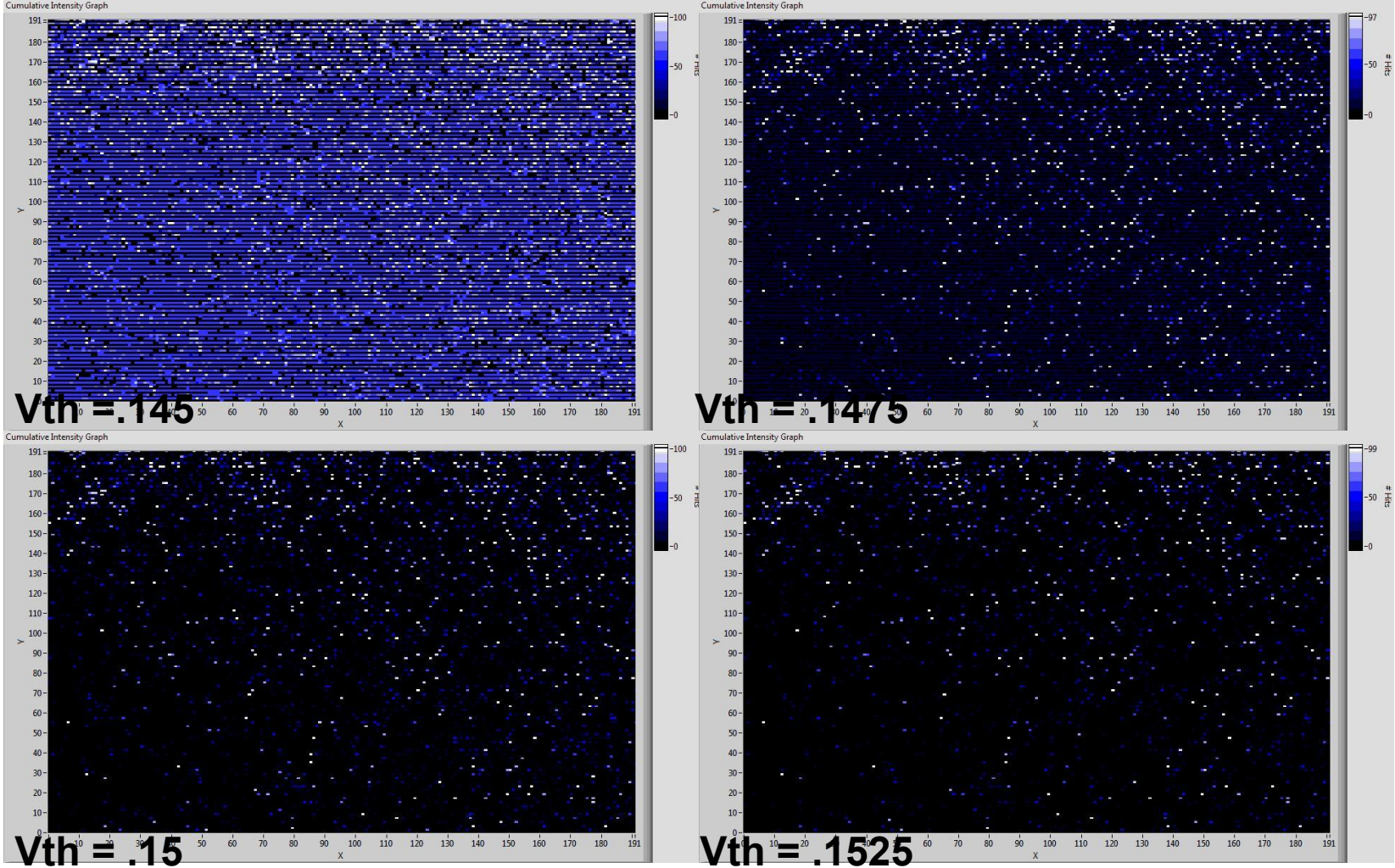




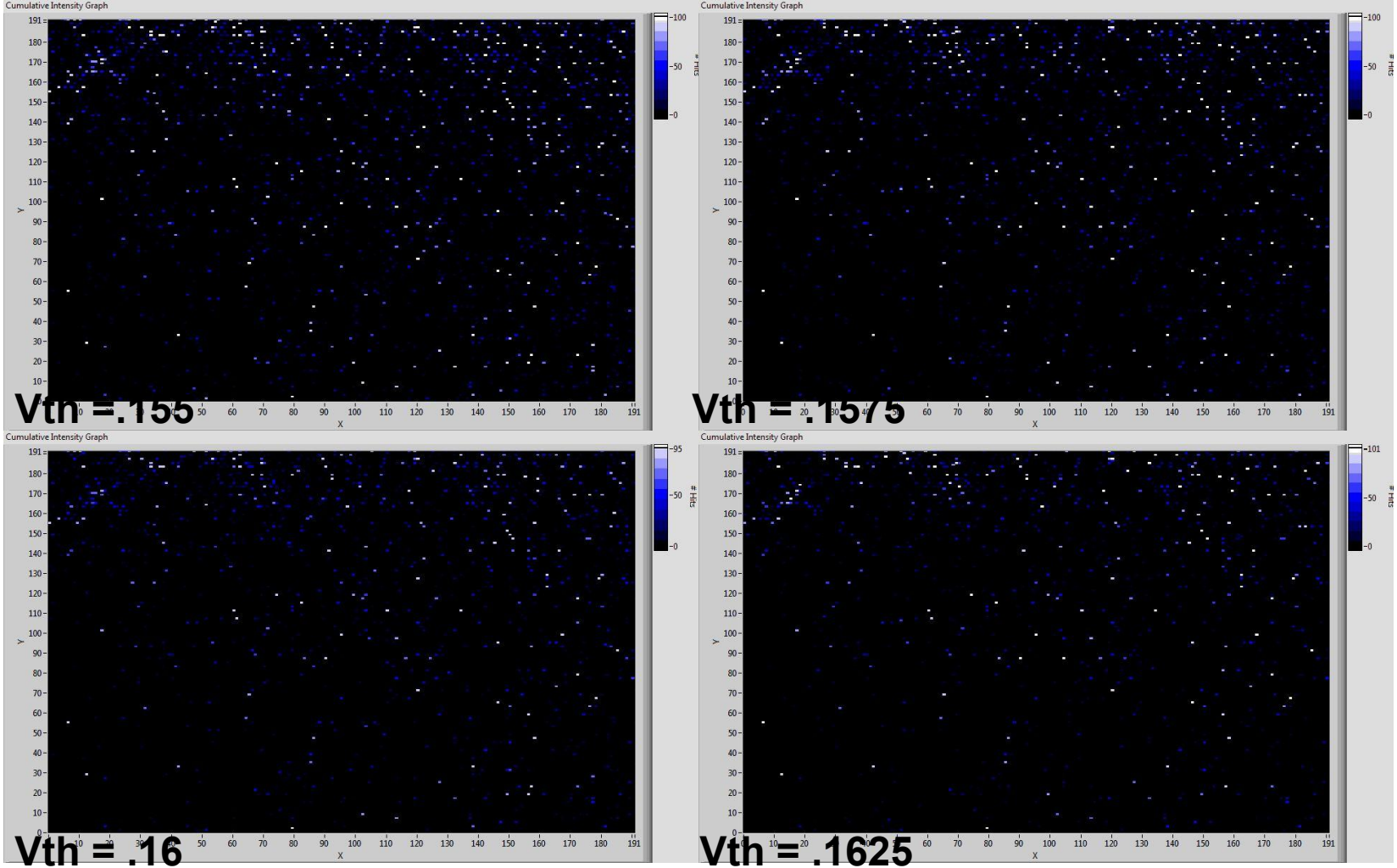




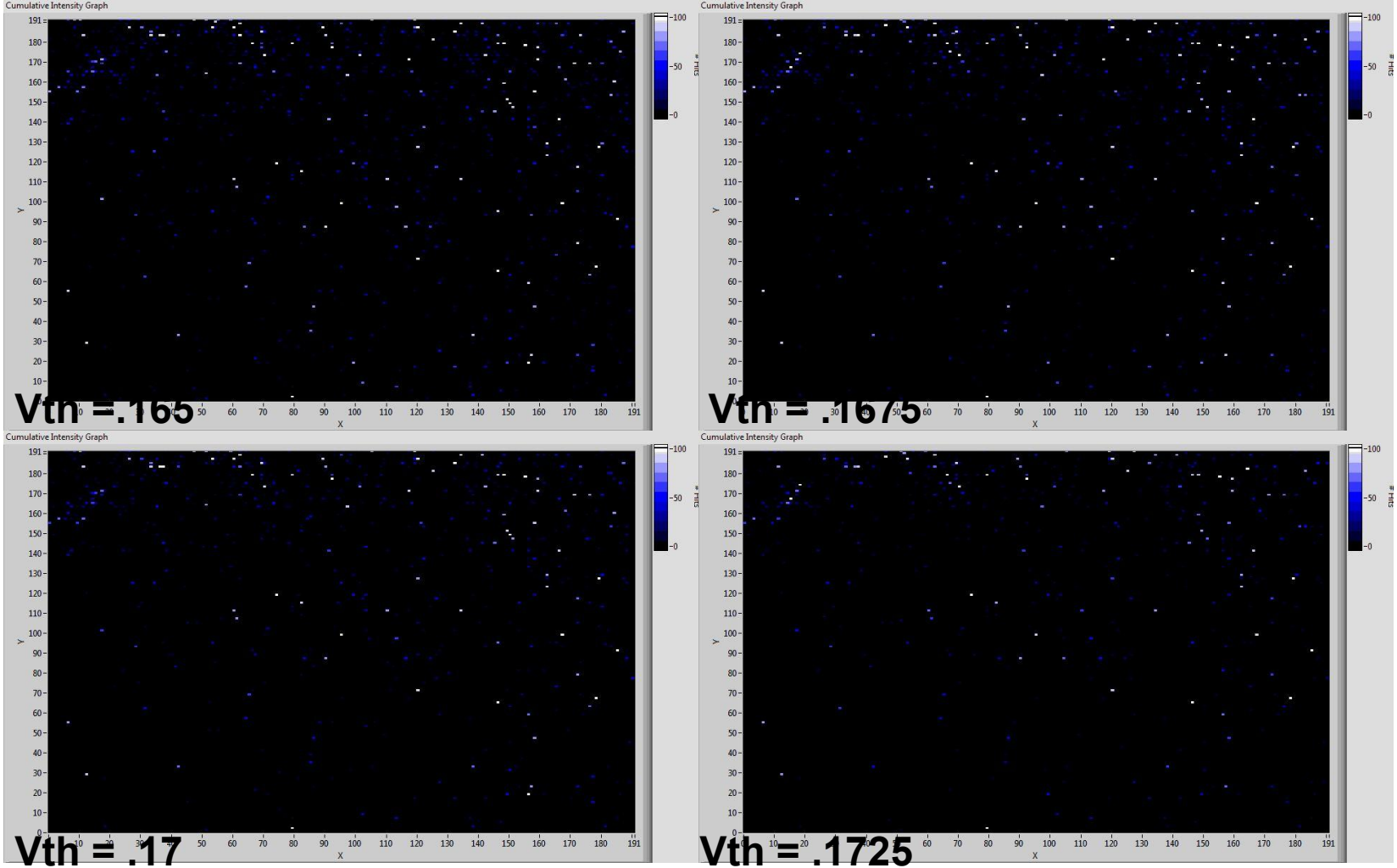
Intensity Graphs for InjDC0 = 0.04



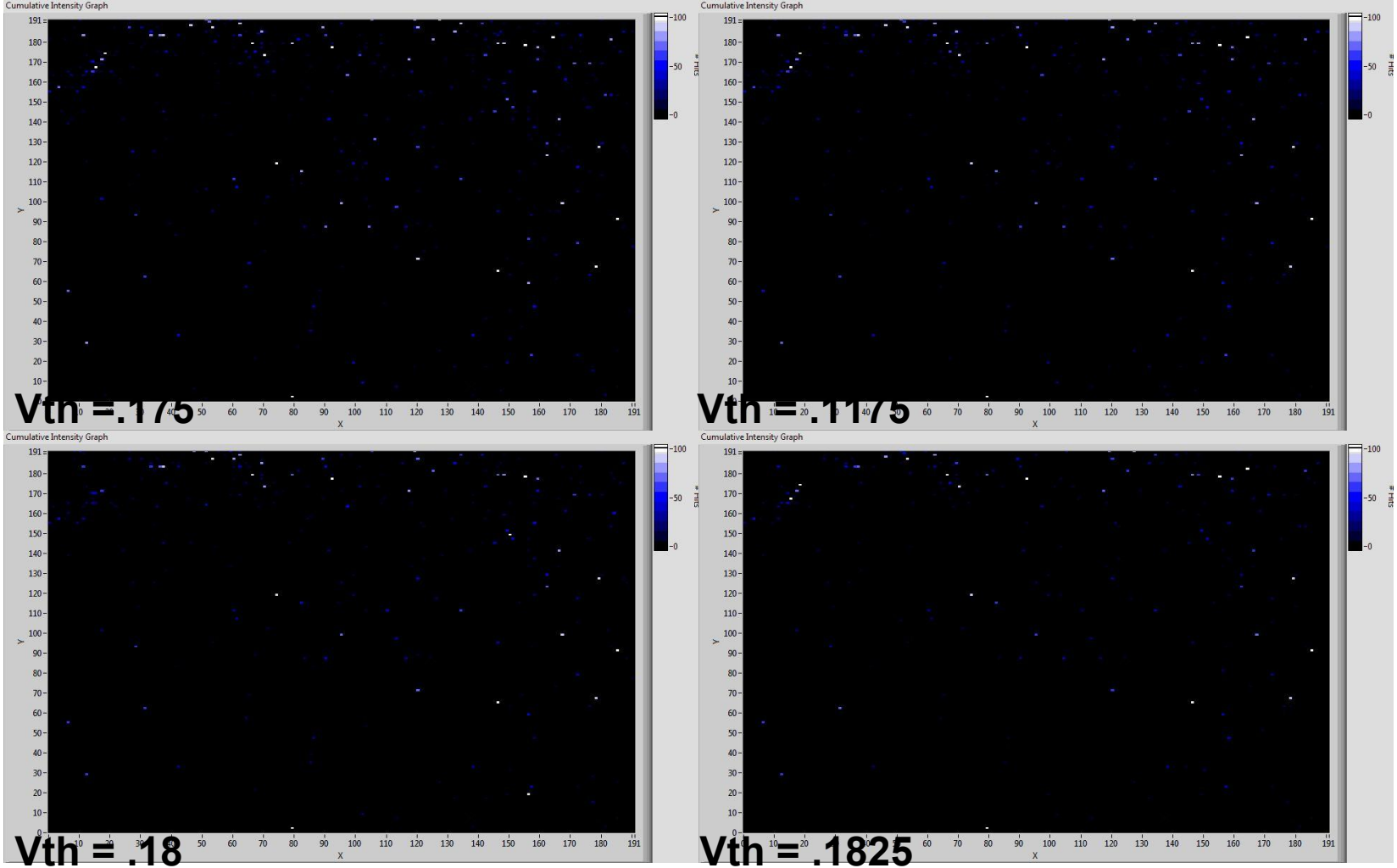
Intensity Graphs for InjDC0 = 0.04



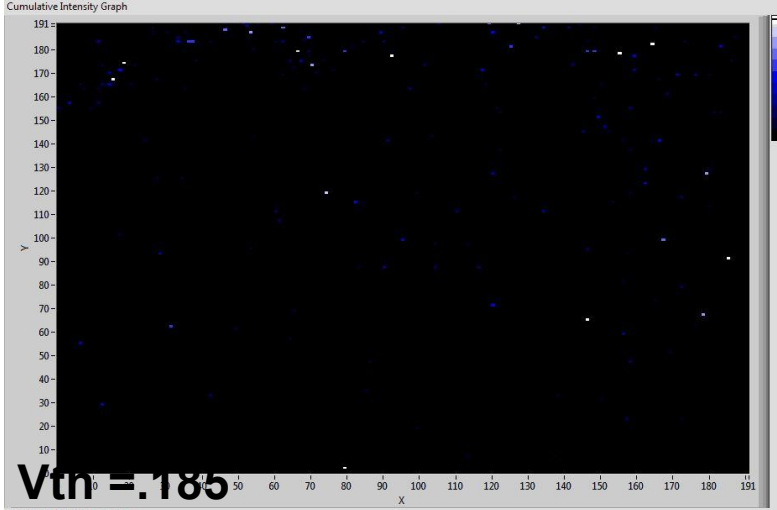
Intensity Graphs for InjDC0 = 0.04

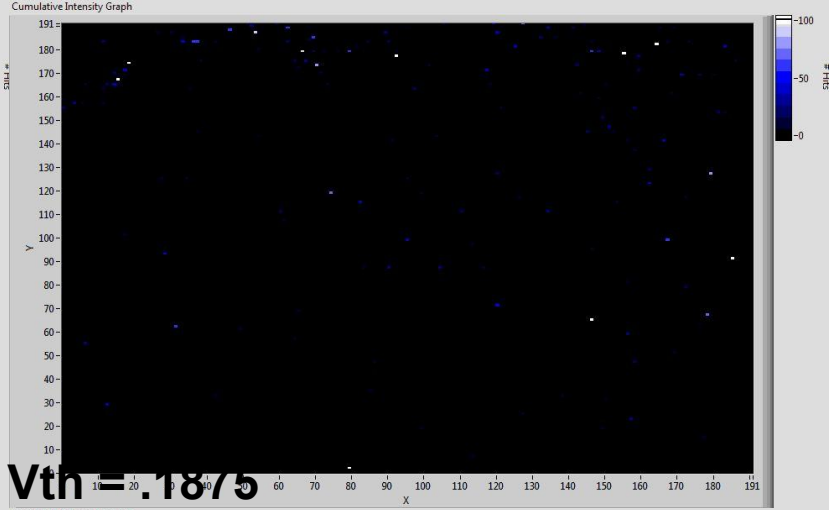


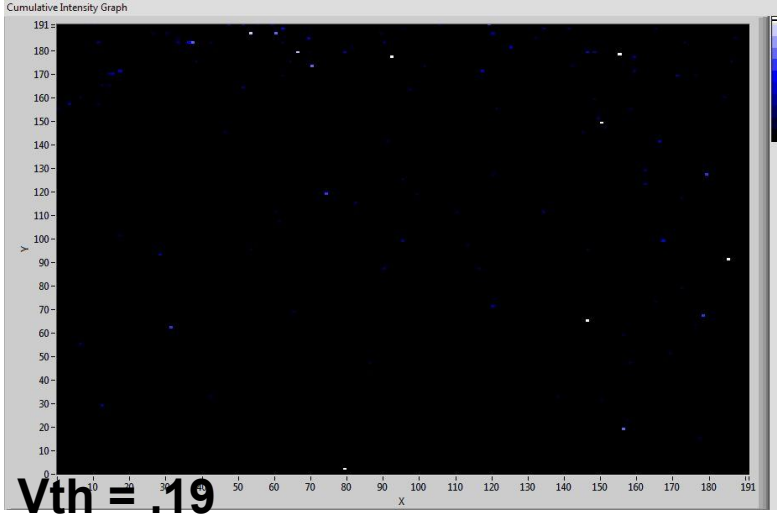
Intensity Graphs for InjDC0 = 0.04

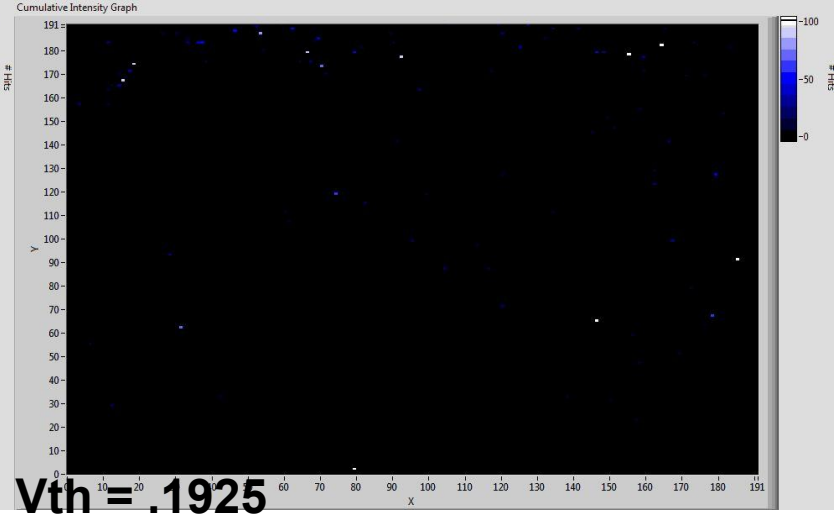


Intensity Graphs for InjDC0 = 0.04

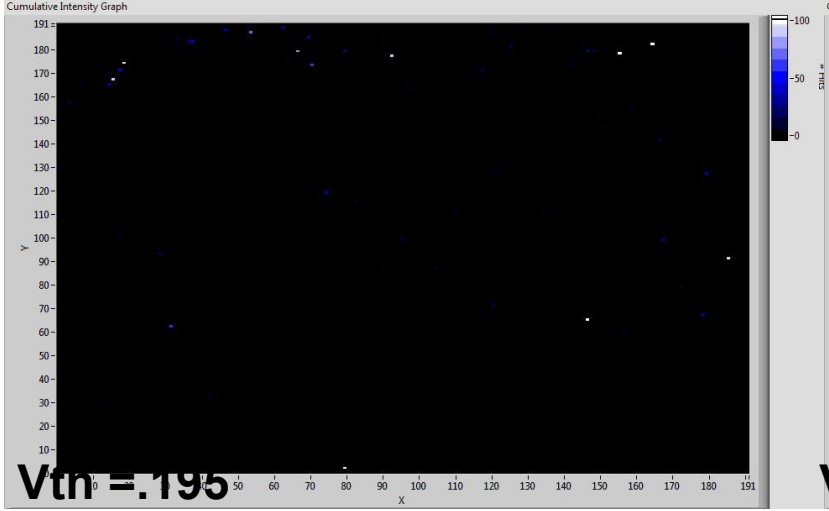




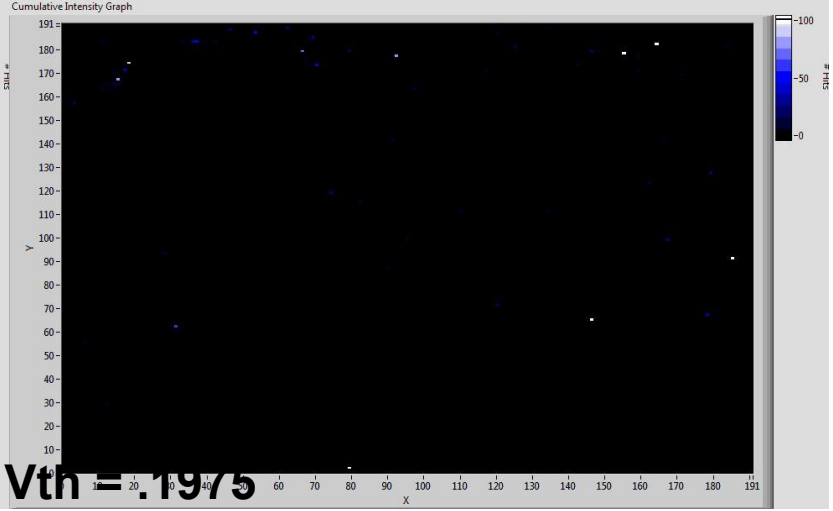




Intensity Graphs for InjDC0 = 0.04



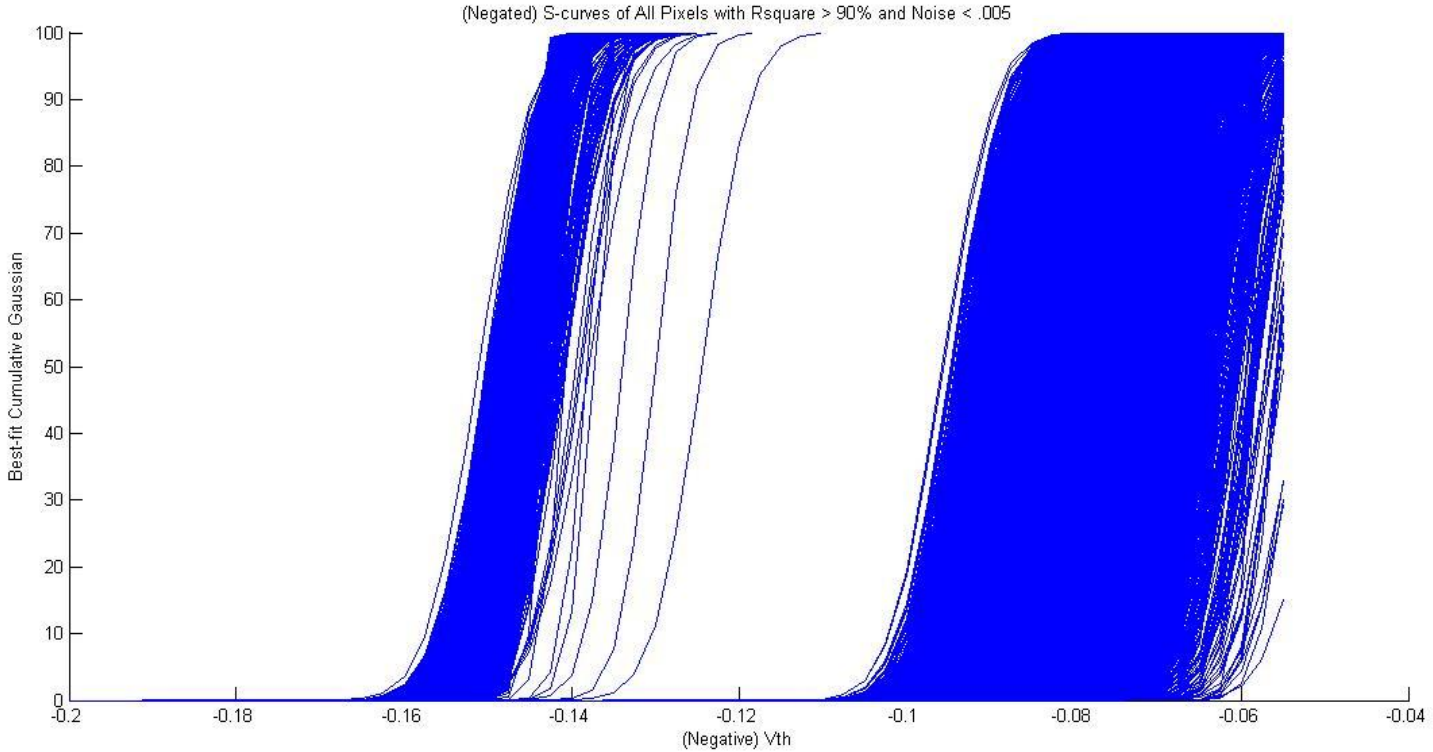
Vth =.195



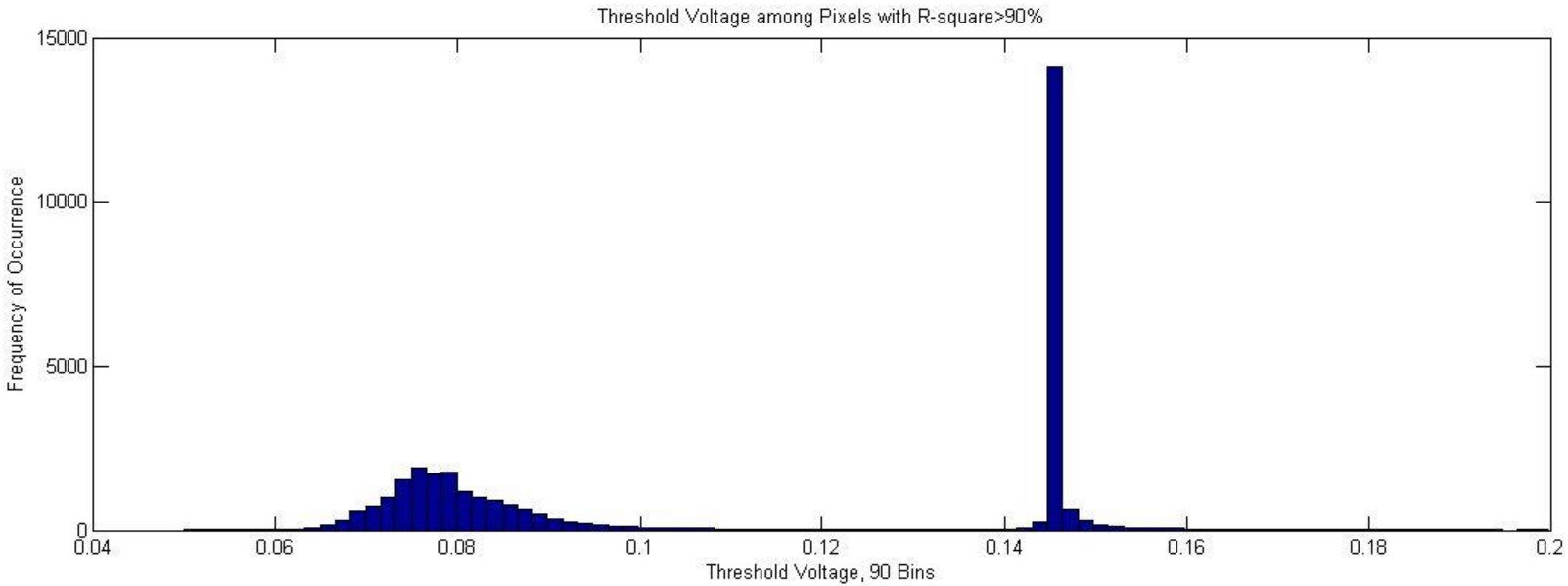
Vth = .1975

Intensity Graphs for InjDC0 = 0.04

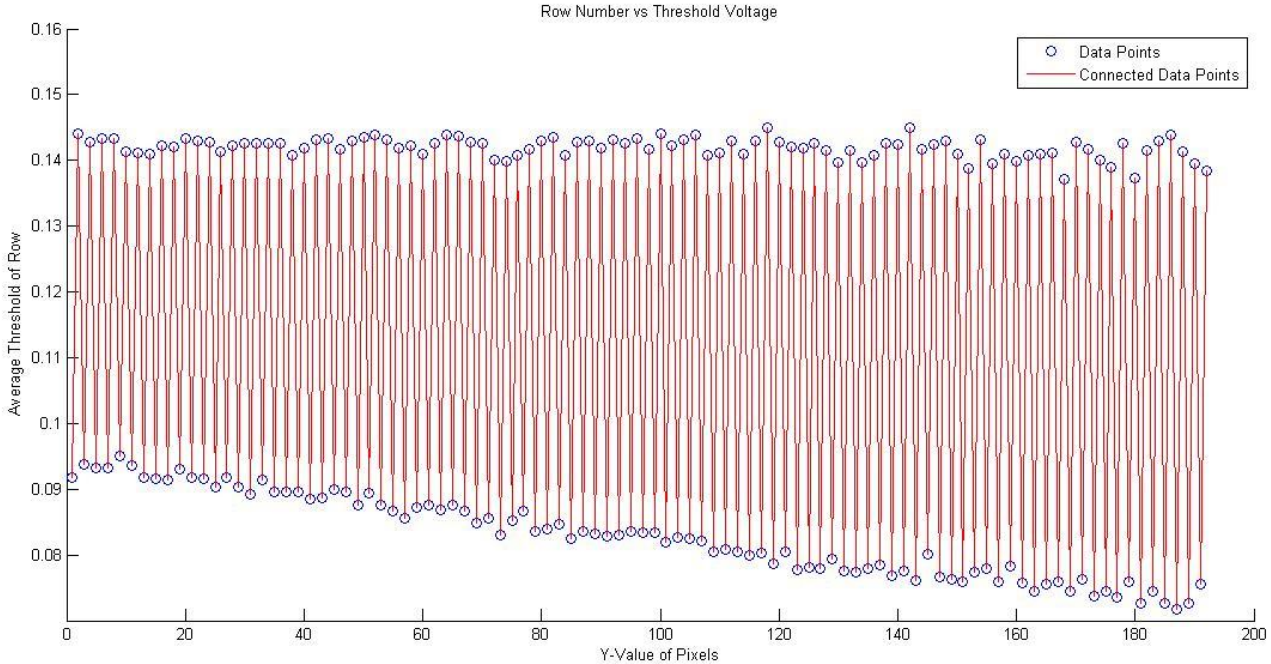
Analysis: s-curves per pixel



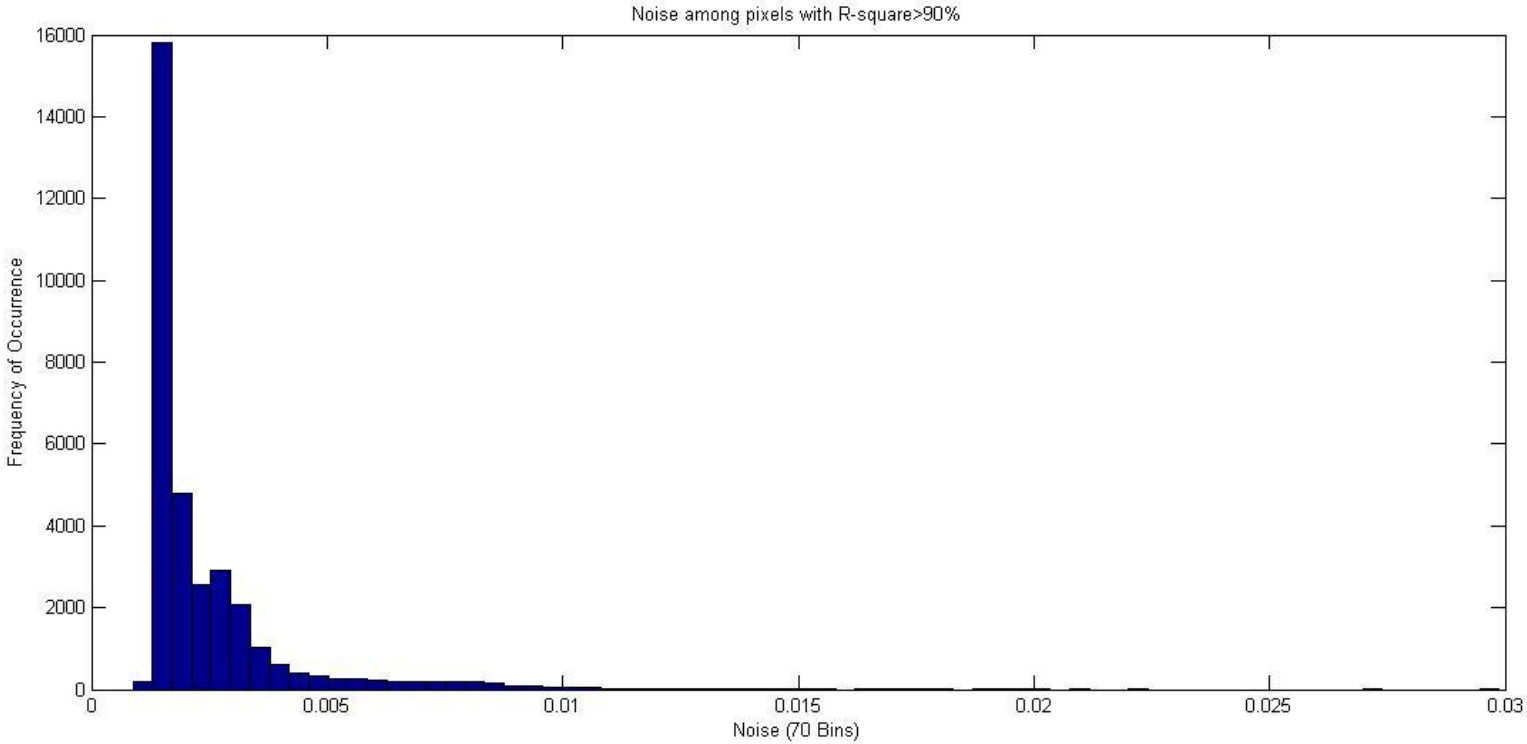
Threshold Voltages



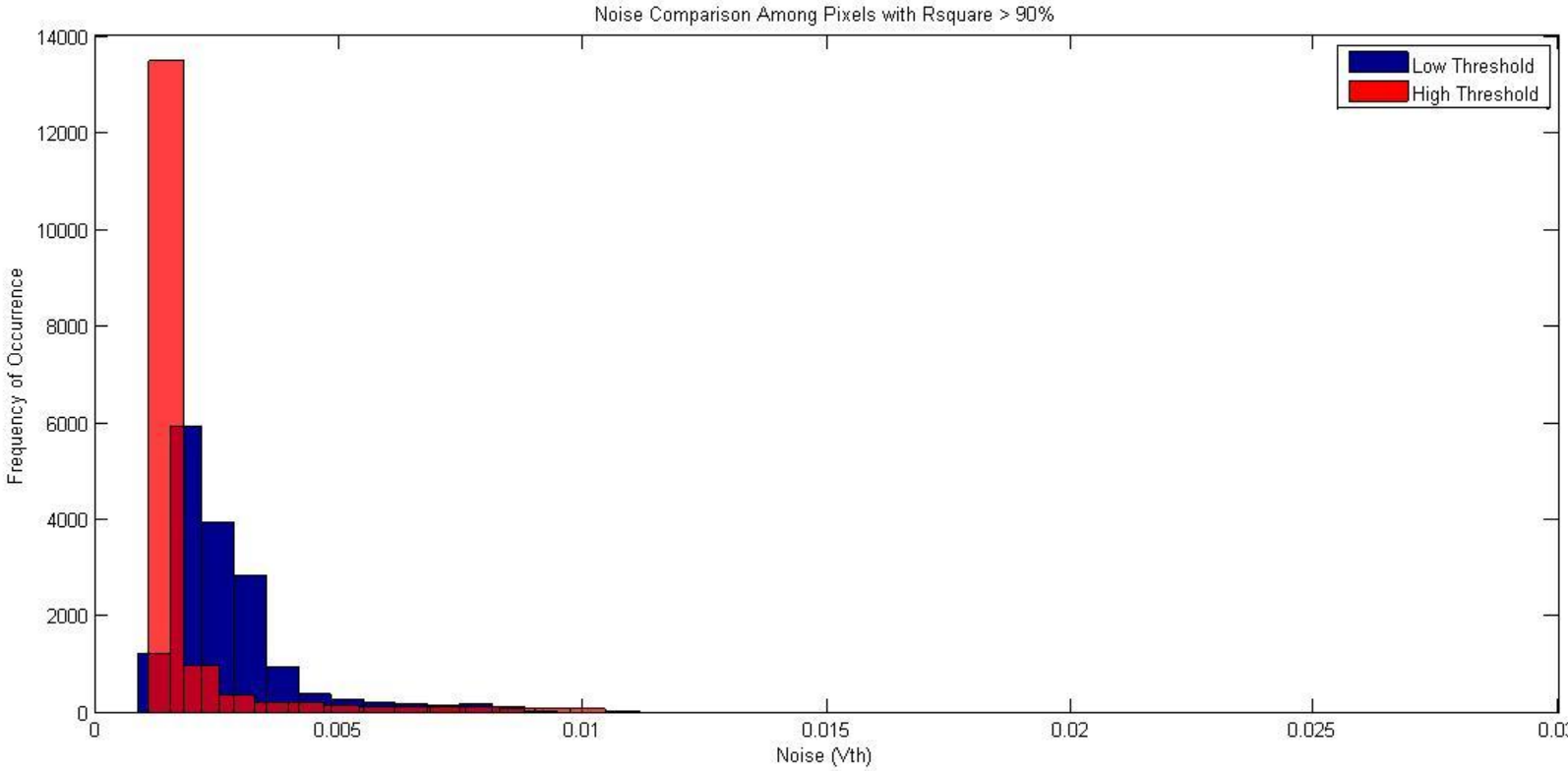
Threshold Voltages
(averaged across a row / x-axis)



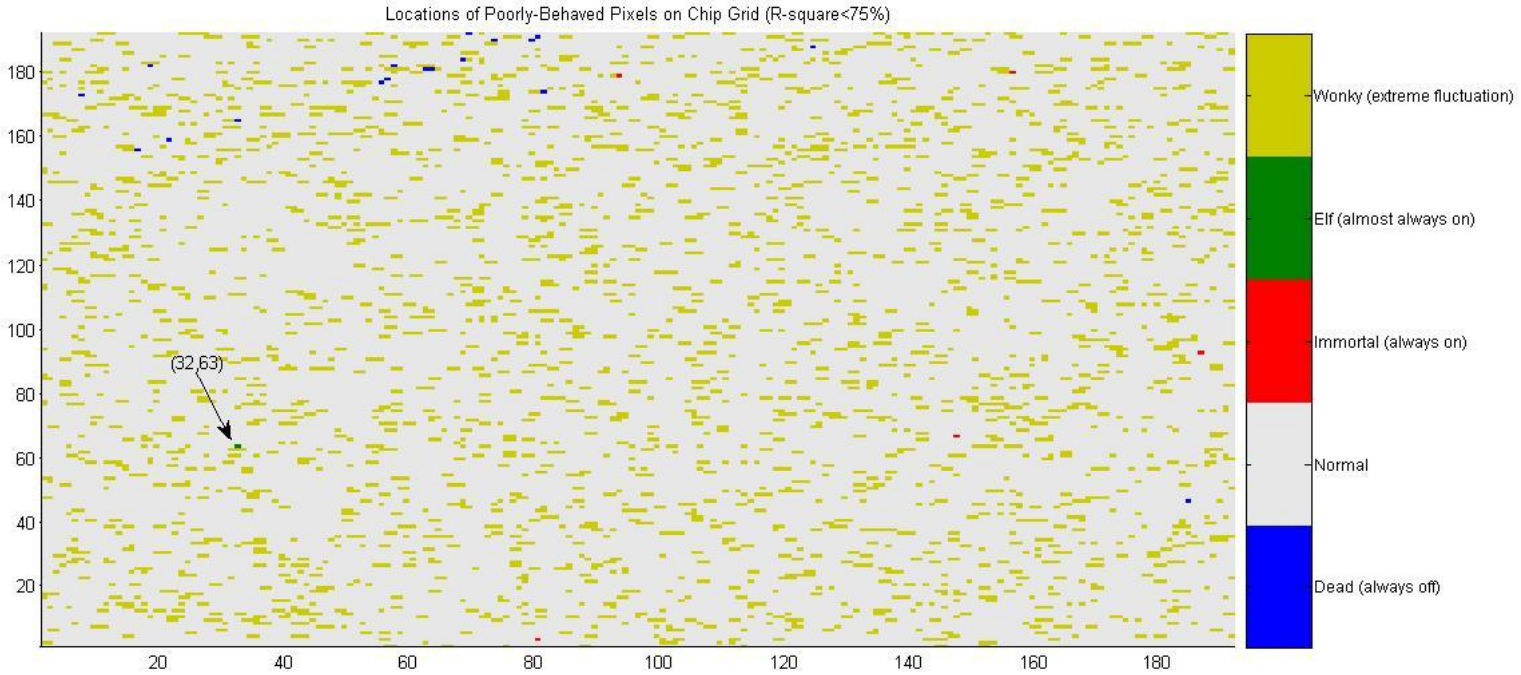
Noise


Noise among pixels with R-square>90%
Frequency of Occurrence
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.005
0.01
0.015
0.02
0.025
0.03
Noise (70 Bins)

Noise
(comparison between two thresholds)



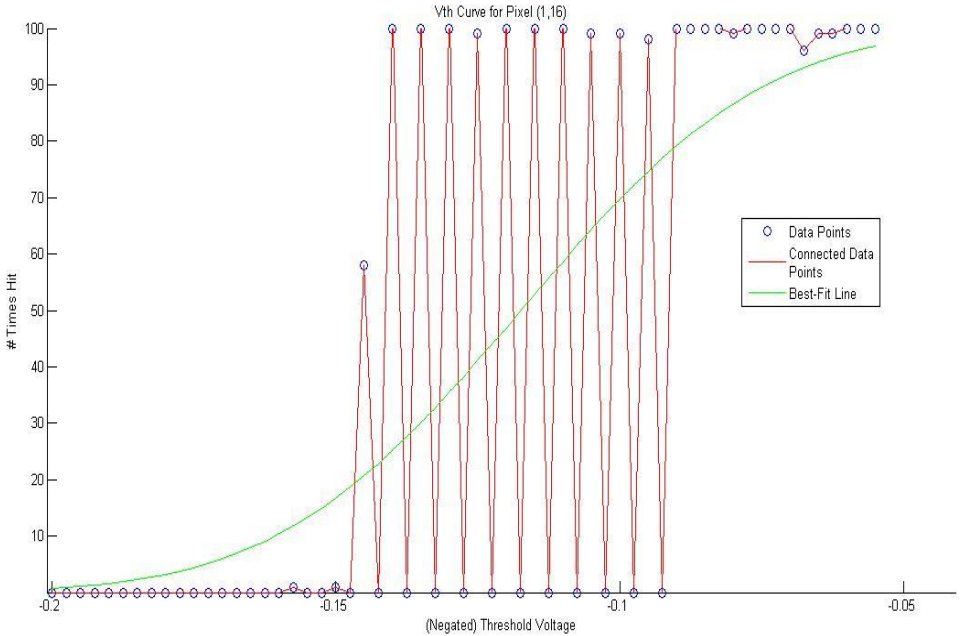
Malfunctioning pixels



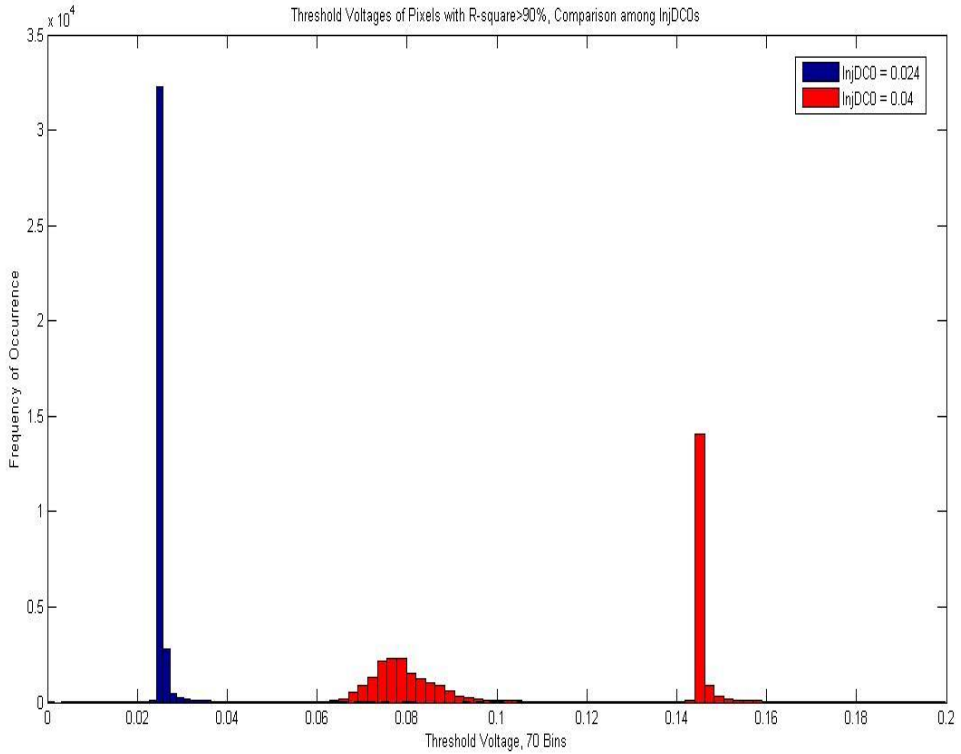
Extreme fluctuation: example pixel

Around the threshold region the #hits jumps back and forth between 100 and 0.

We believe this is because we took data sets on separate days, and these pixels have variable threshold values, but they are not actually malfunctioning.

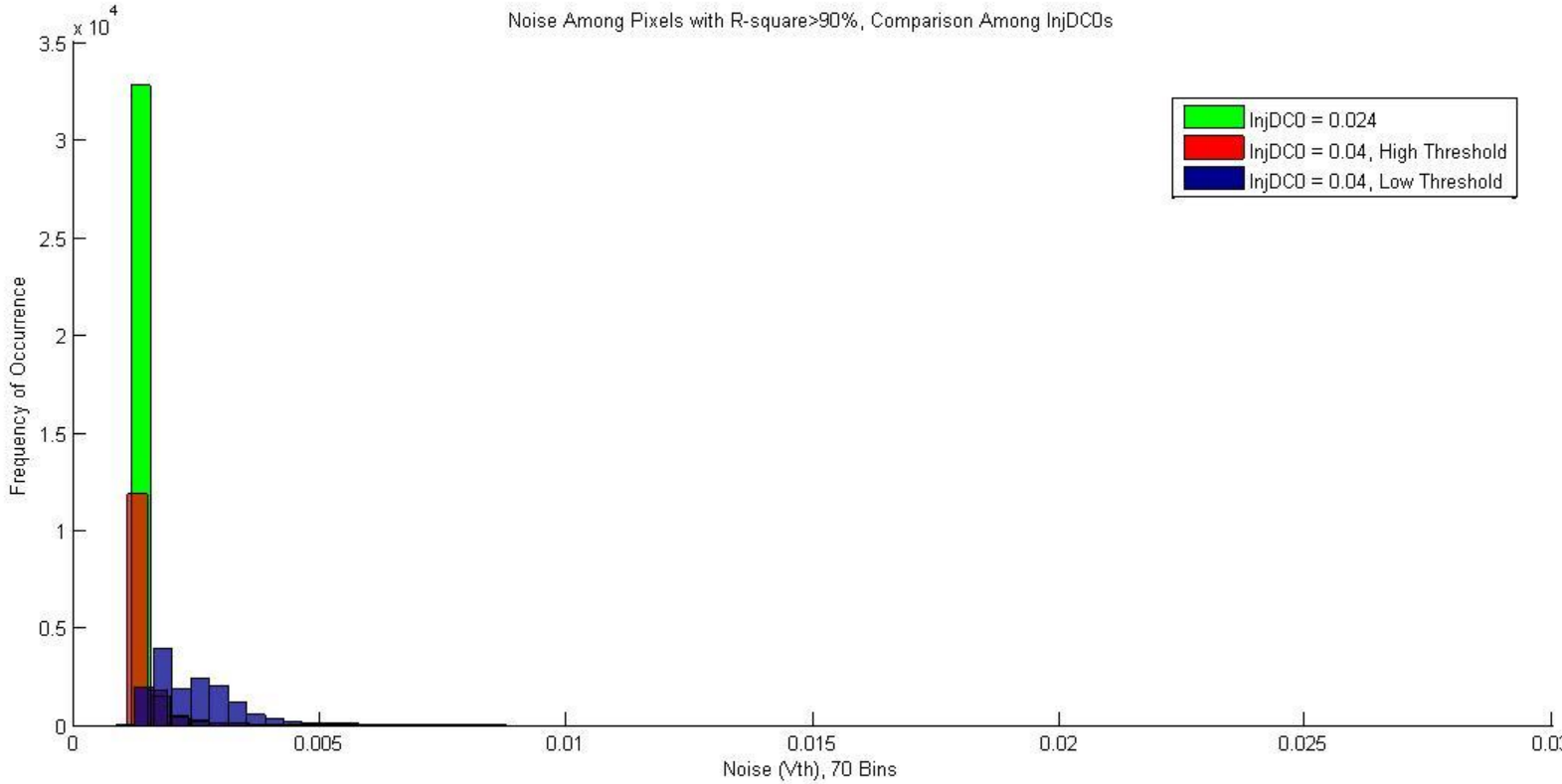


Threshold voltages

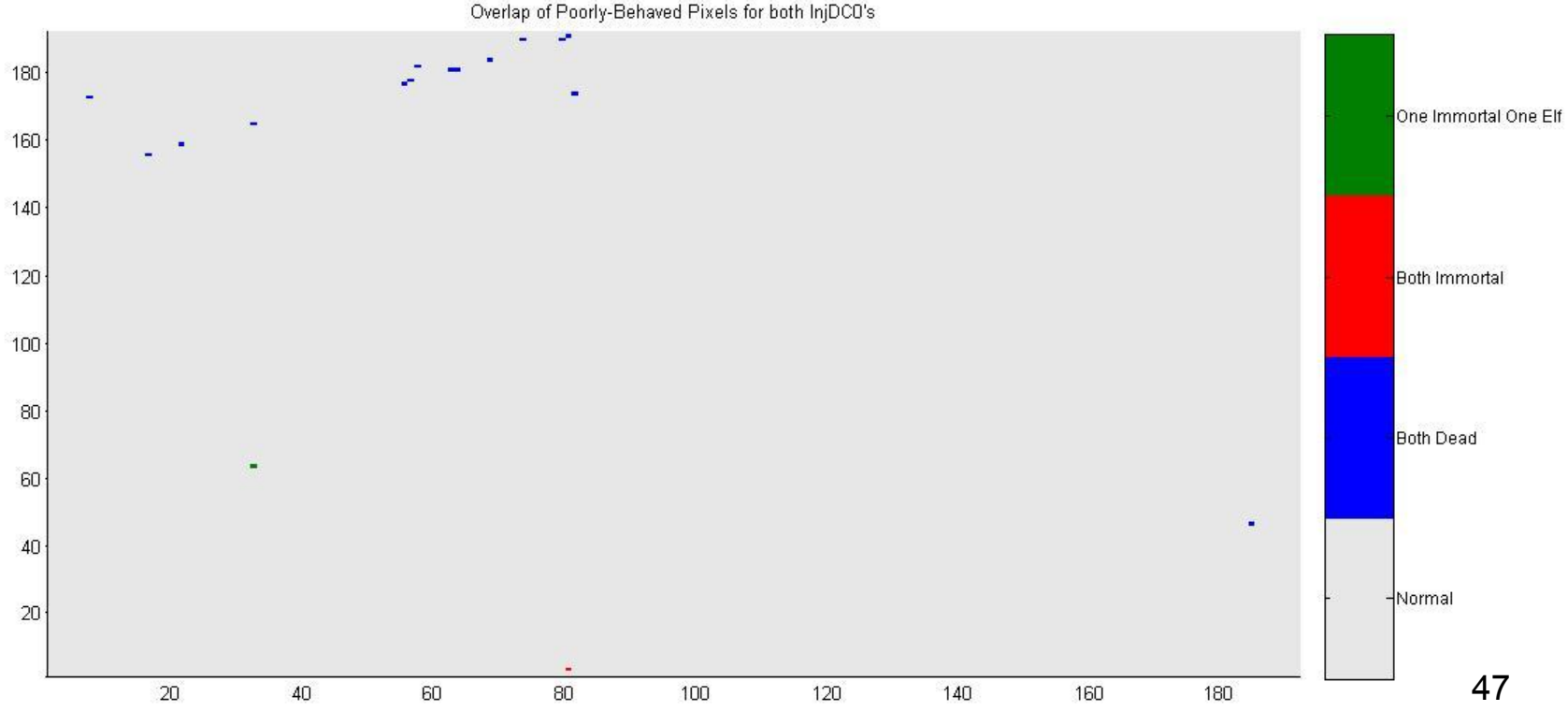


High threshold in the second dataset behaves similarly to the first dataset, implying that this is the group of pixels that are working properly

Noise


Noise Among Pixels with R-square>90%, Comparison Among InjDC0s
x 10^4
3.5
3
2.5
2
1.5
1
0.5
0
Frequency of Occurrence
0
0.005
0.01
0.015
0.02
0.025
0.03
Noise (Vth), 70 Bins
InjDC0 = 0.024
InjDC0 = 0.04, High Threshold
InjDC0 = 0.04, Low Threshold

Malfunctioning Pixels
(malfunction present for both Vth)



Summary

- Measured number chip hit versus threshold voltage
- Observed halfway drop in number of chip hits for certain InjDC0 values
- Measured number hits per pixel in 100 trials for each threshold value (Intensity Graphs) (InjDC0 = 0.024, 0.04)
- For InjDC0 = 0.04, we observed that every other row had significantly fewer hits
- Compared data from two InjDC0 values
- Parasitic coupling in rows?