Detection and Correction of Artifacts in NIF target Alignment

CASIS 2014

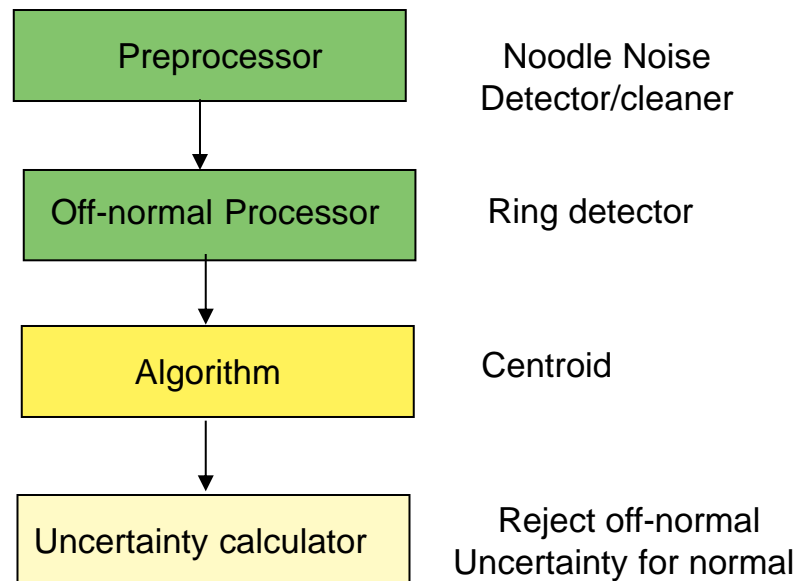**May 21**

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What artifacts?

- **Off-normal (Ring)**
- **Non random noise (Noodle)**

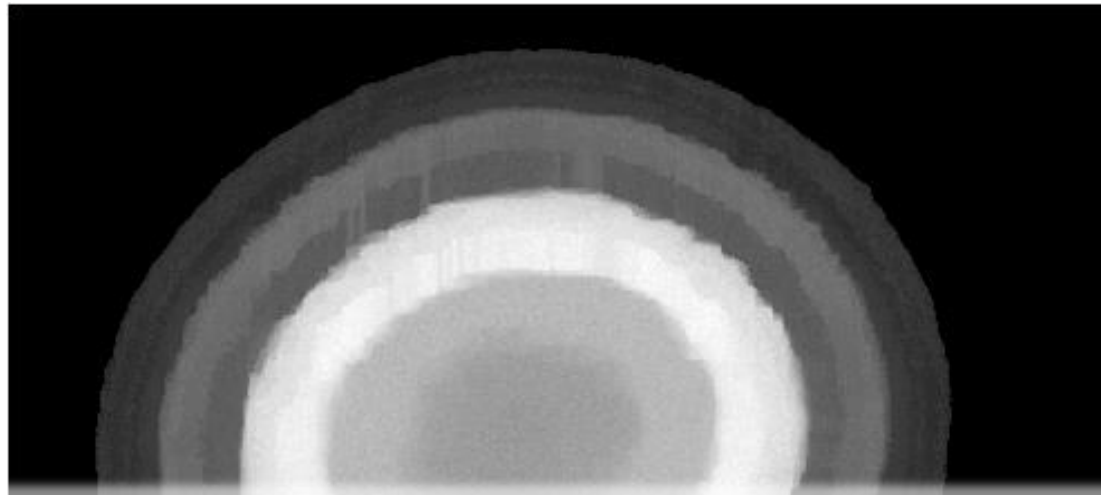|	
Preprocessor	Noodle Noise Detector/cleaner
Off-normal Processor	Ring detector
Algorithm	Centroid
Uncertainty calculator	Reject off-normal Uncertainty for normal

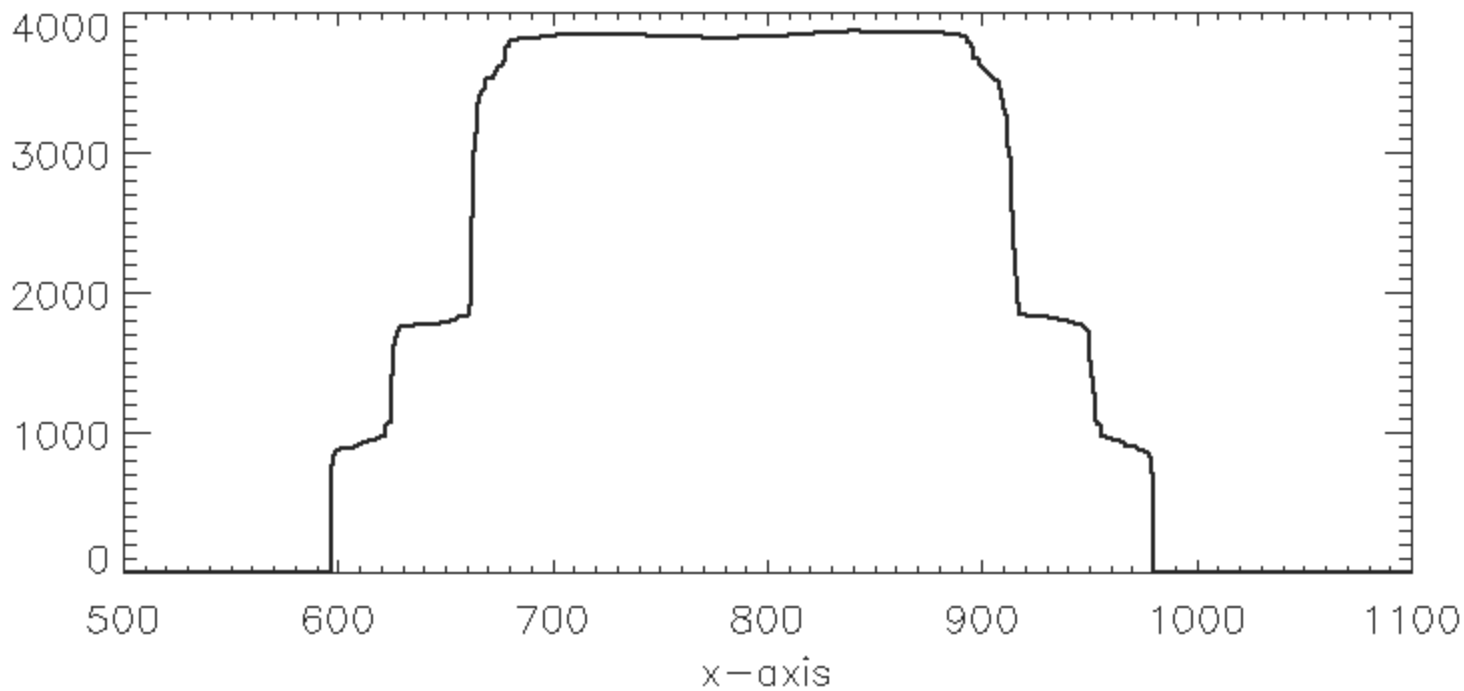The ring should be detected as Off-normal and rejected Noodle should be detected and corrected.
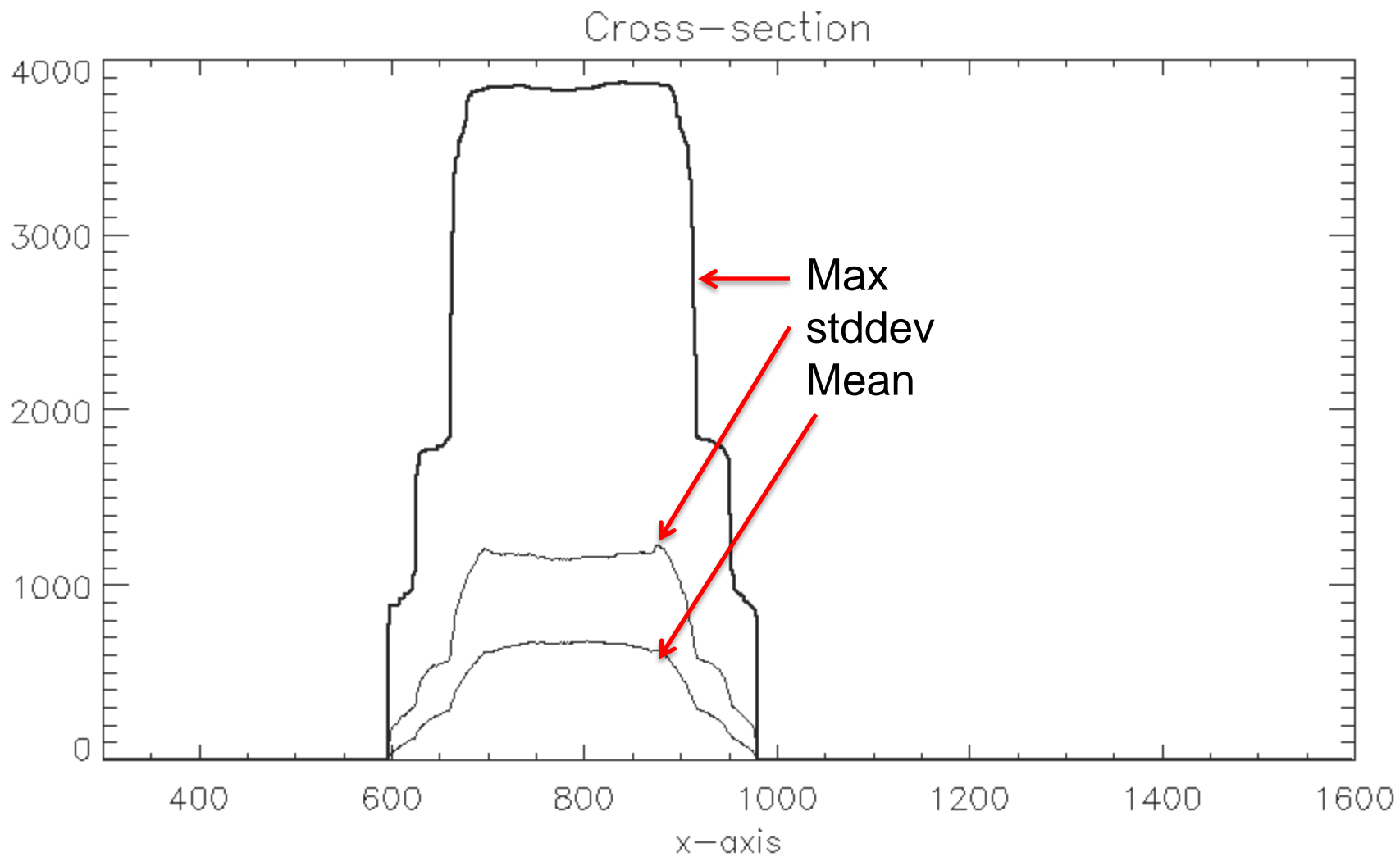
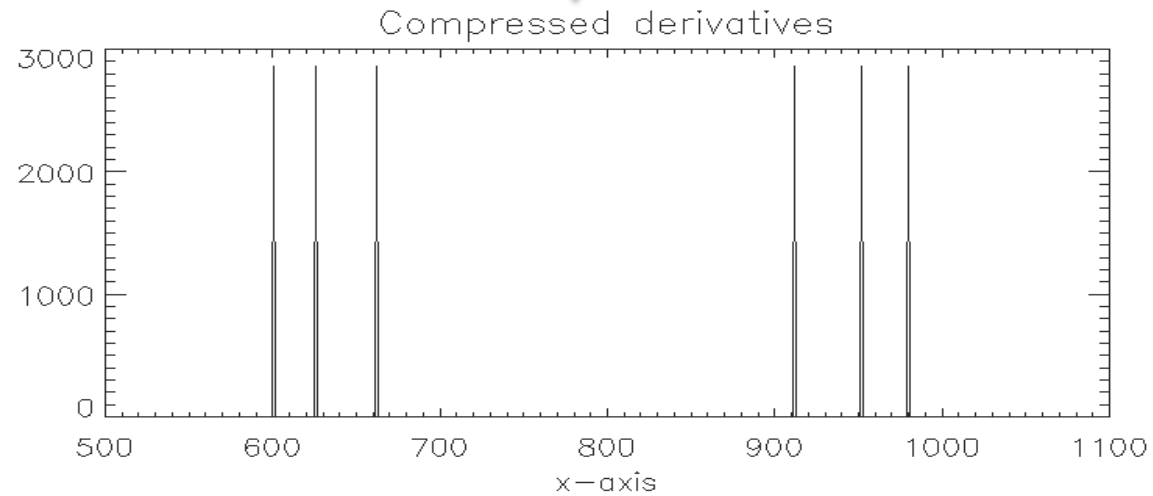# Bright noodle (noise) and ring (off-normal) images
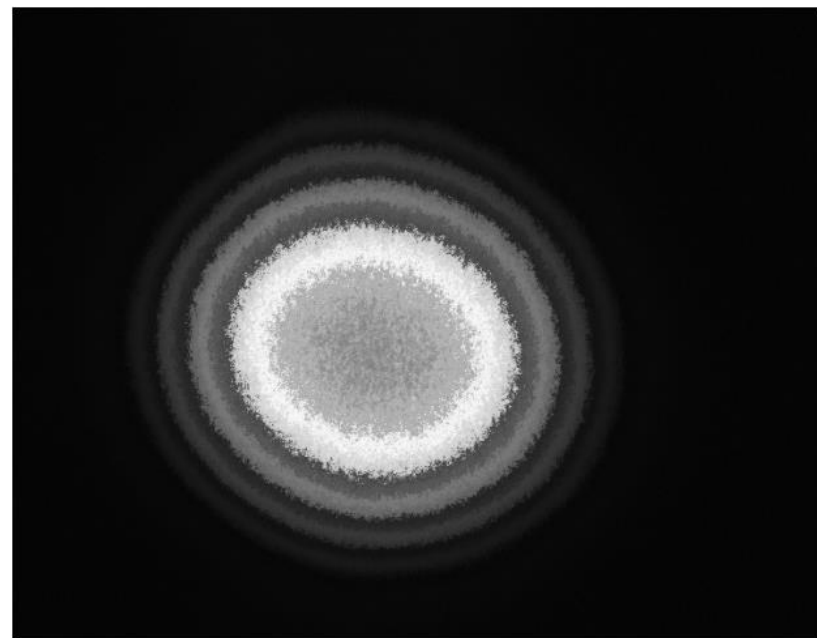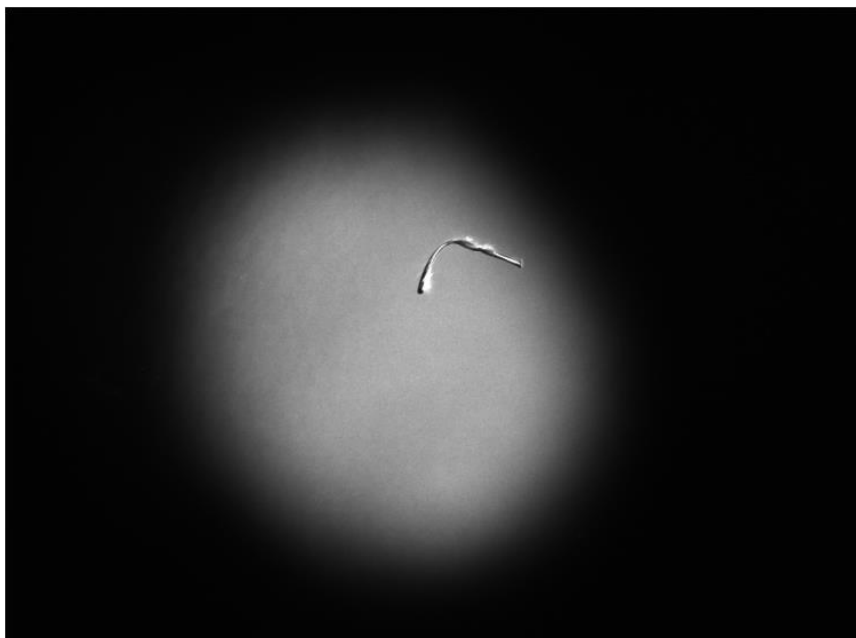
How do we detect ring ?
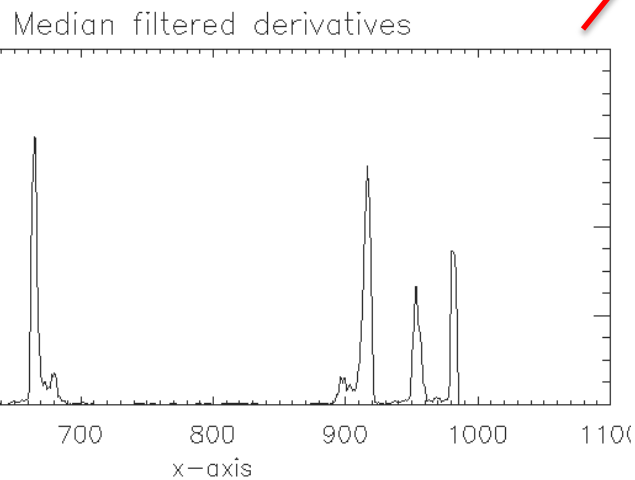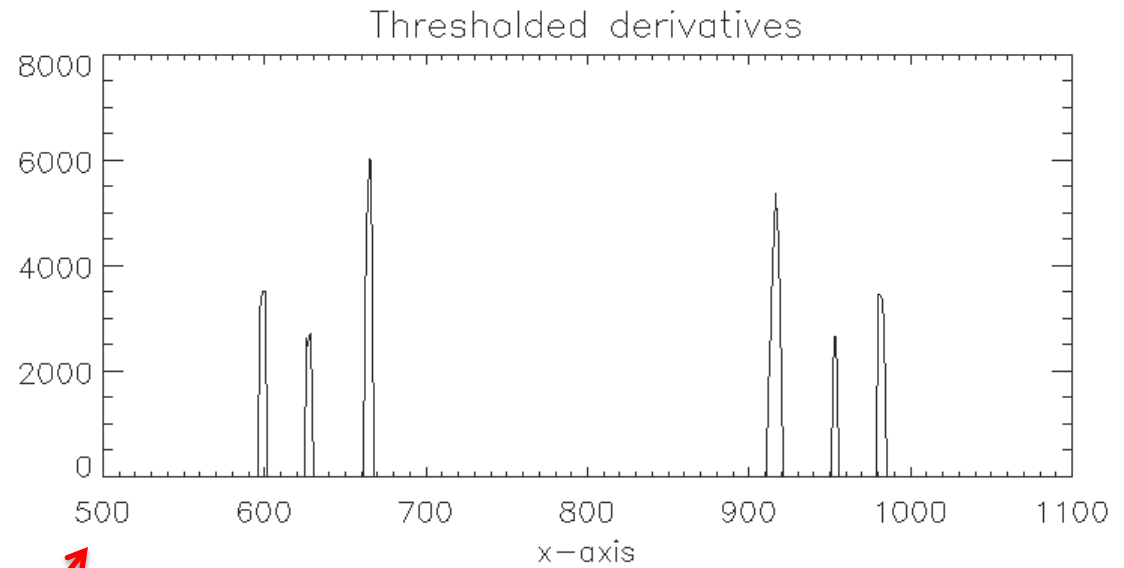

Cross-section

Which cross-section is best?
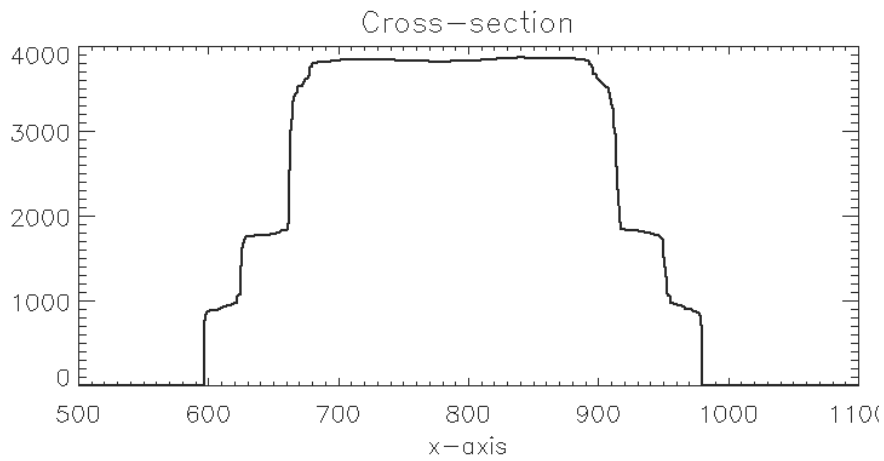
Compressed Peak locations
 601   626   662   912   952   980
Number of peaks   6,   3 rings detected

Measure equidistant rings

Cross-section
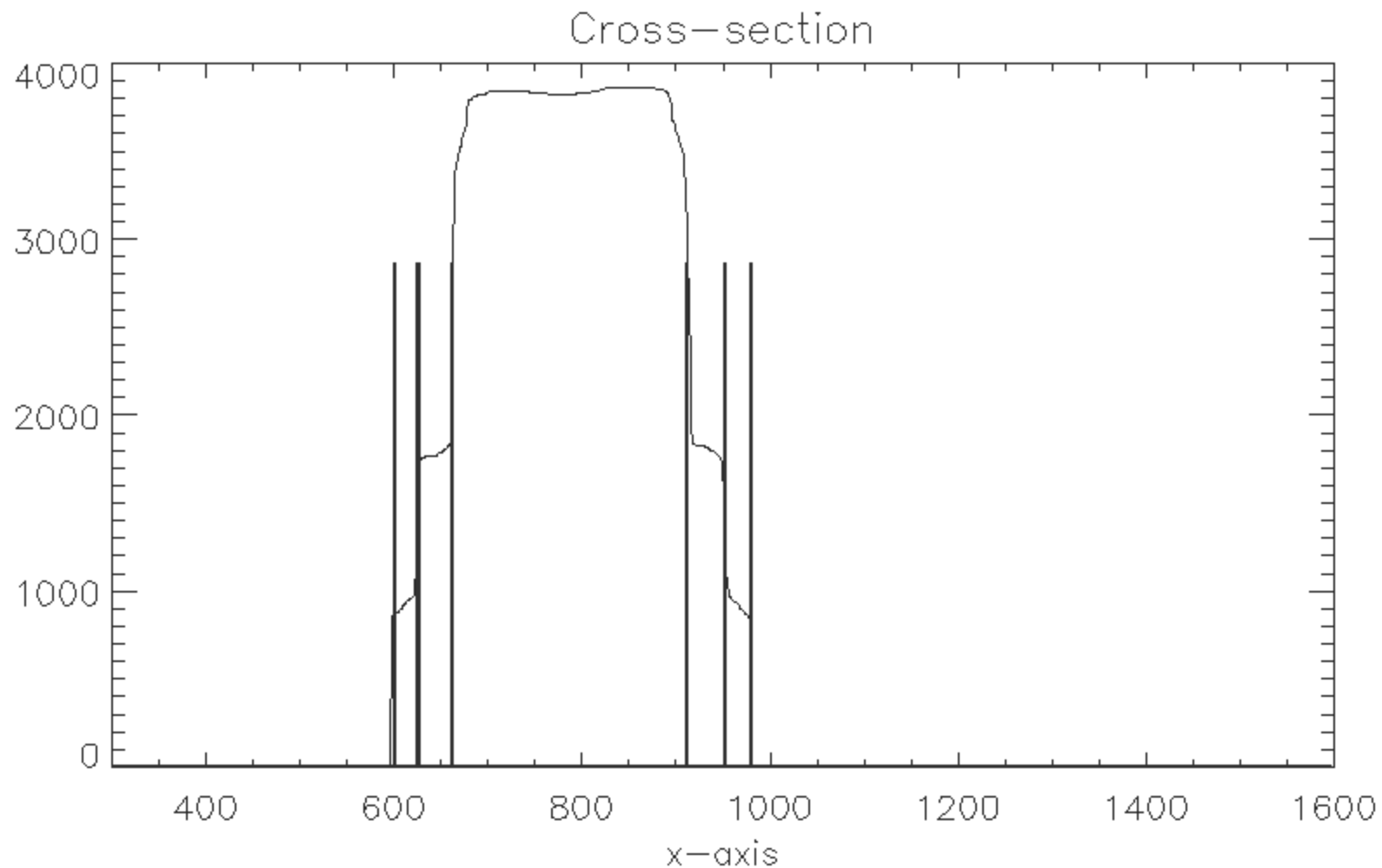
Ring detected, uncertainty = 700

Bright and dark noodle
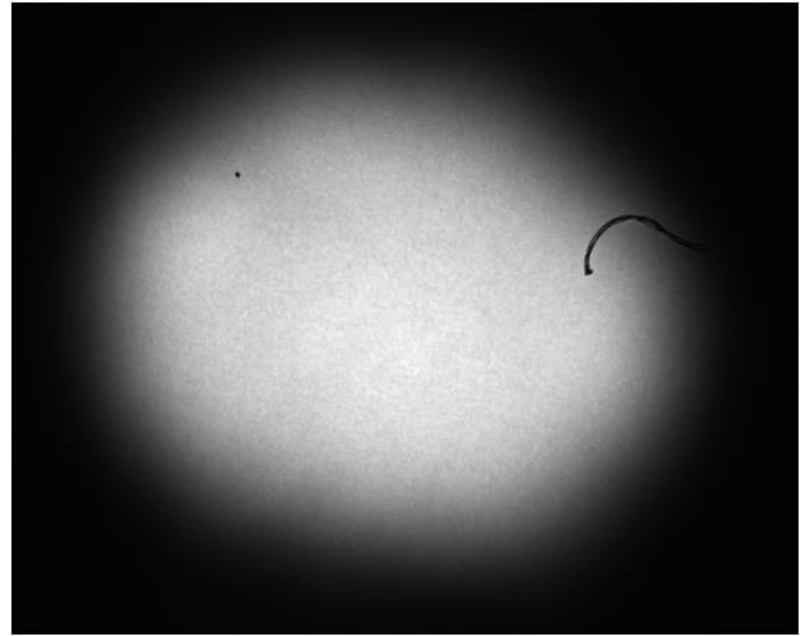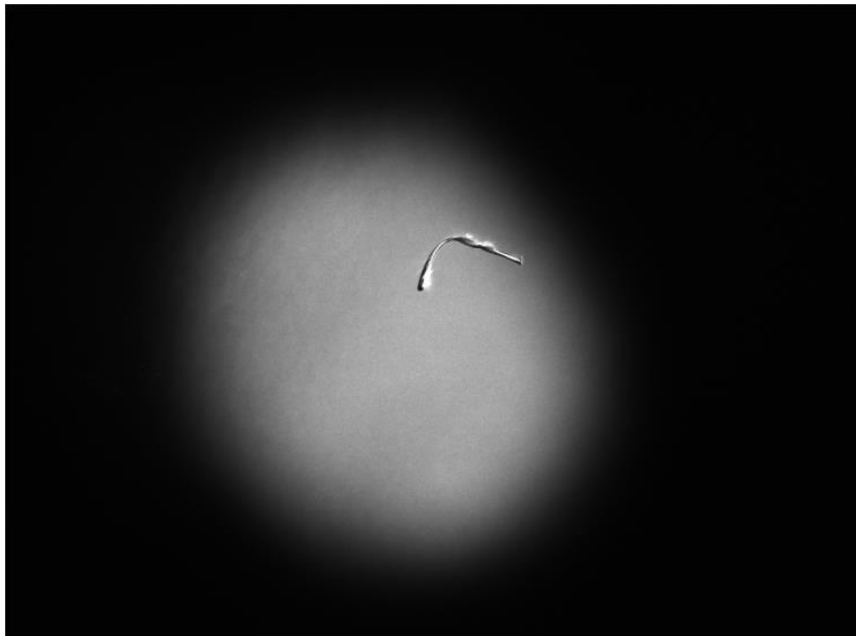
Effects of Noodle

- **Elevation of maximum value (False maxima)**
- **Shift in weighted centroid location (depends on position of noise)**
- **Modification in spot size (systematic change)**
- **Interpolation error due to insufficient data points**

Maxima changes with Noodle or spurious noise

Effect on Maxima

Spot size for 65% energy
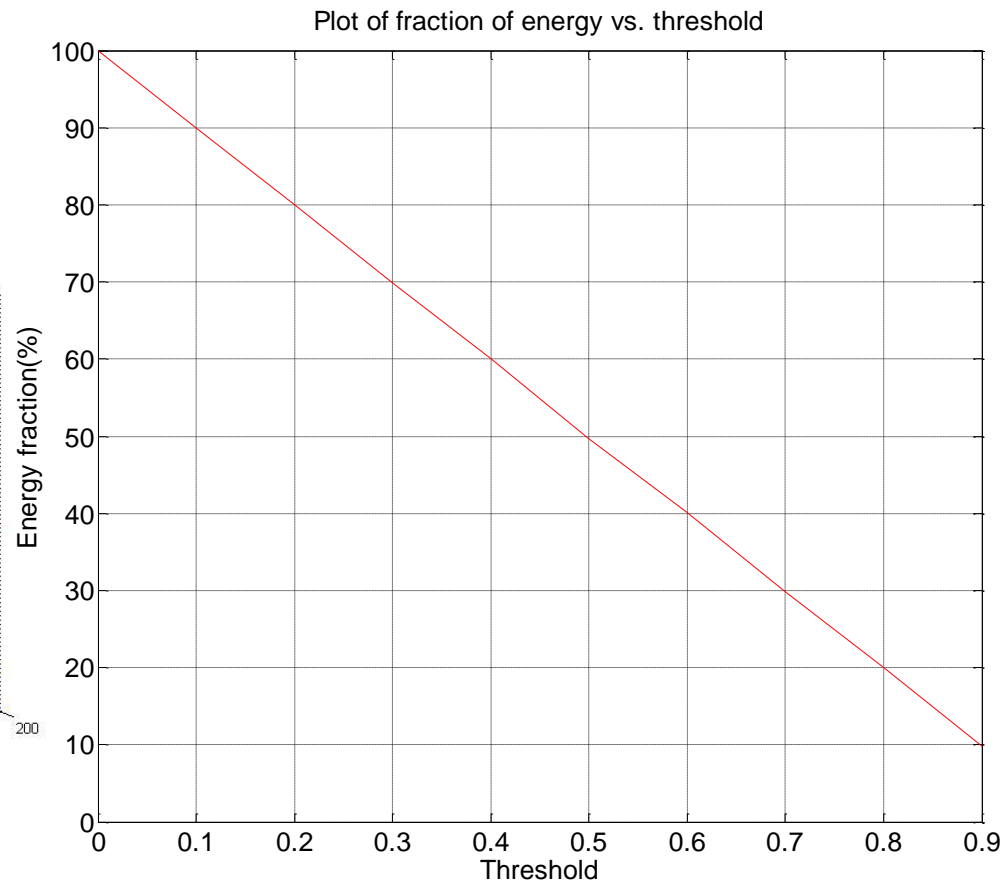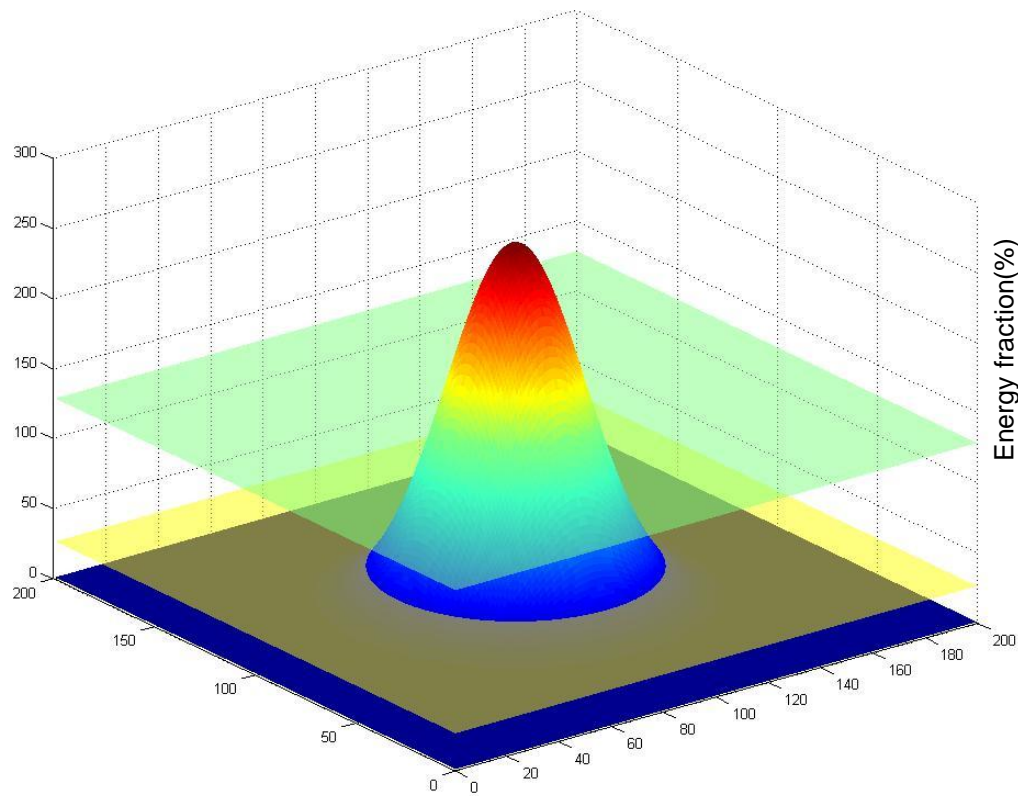
False maxima caused by "Noodle" shifts the starting energy fraction to a lower energy (77%)

```
100% energy spot_size=      287412
100% of enclosed energy wo bkg  1.17233e+08
spot size =  118054  fraction=    0.772904   T= 593.943 (cent)
spot size =  92673  fraction=     0.672914   T=  712.732
spot size =  71433  fraction=     0.567825   T=  831.520
spot size =  53610  fraction=     0.461385  T=   950.309
spot size =   38398  fraction=     0.354831  T=  1069.10
```
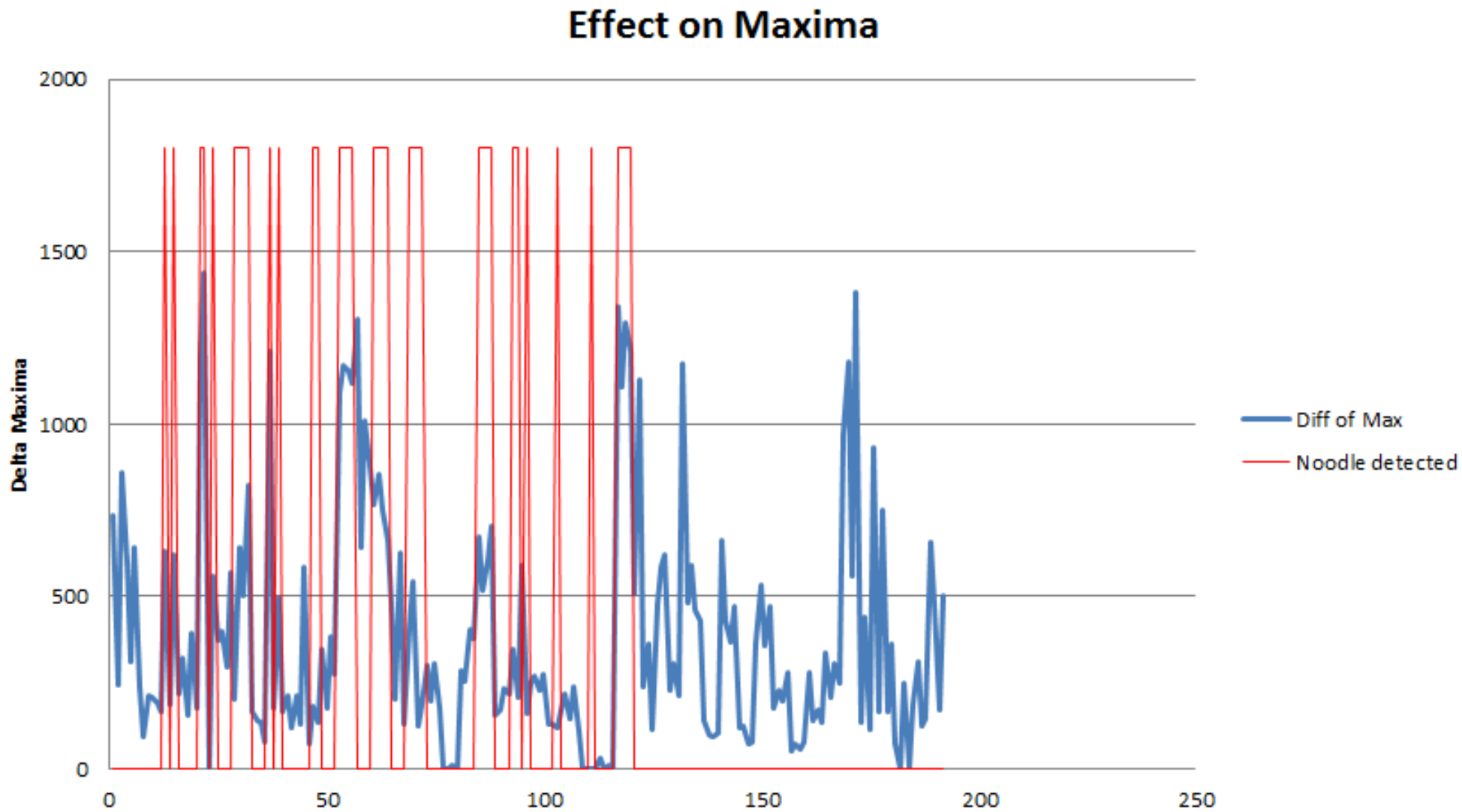
Interpolation for energy =   65.0000%

#####spot_size=   87673.9

The centroid threshold is biased by high maxima from Noodle

After filtering range expands

Fraction energy vs spot size
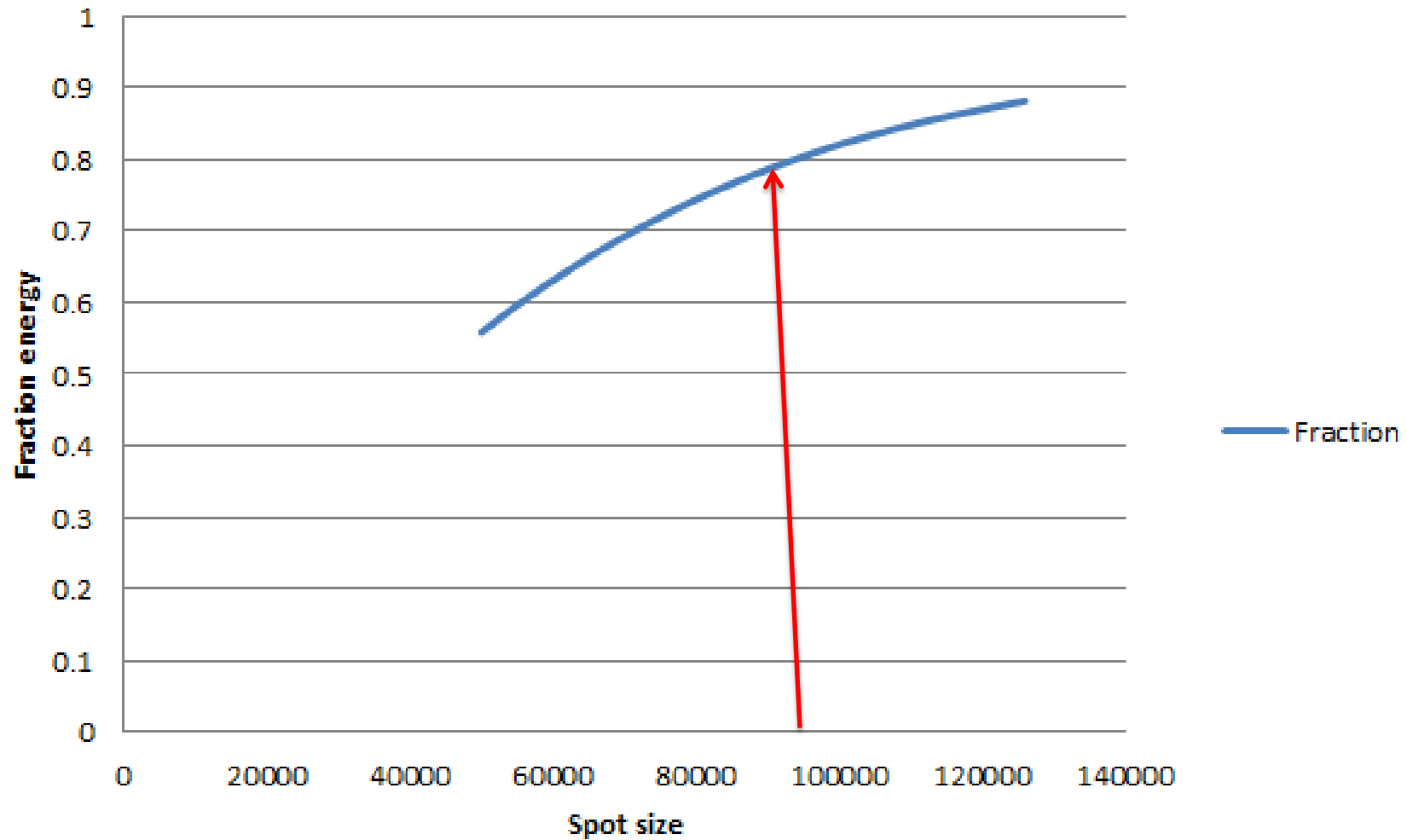
| Image name	No filter (spot size)	Max detect filtered image for spot size	Max detect unfiltered image used	Comments
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_175464475_139191 088108600_Gim1.tiff	934.590 513.580 4095 (0)	941.510 509.259 1514 (103863)	941.657 509.229 1514 (104250)	**spot size failed, centroid shift**
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_180064803_139191 120927400_Gim1.tiff	935.057 512.162 4095 (71330.8)	937.089 510.701 1934 (74181)	937.267 510.650 1934 (74308)	Lower spot size estimate
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_181965991_139191 239569100_Gim1.tiff	933.749 510.927 4095 (0)	940.607 506.439 1528 (102732)	940.751 506.417 1528 (103145)	Spot size failed
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_182566314_139191 271849200_Gim1.tiff	934.482 511.273 4095 (70991)	936.697 509.641 1902 (73875)	936.879 509.590 1902 (74005)	Lower spot size estimate
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_183066614_139191 301860400_Gim1.tiff	934.892 512.777 4095 (54523)	935.249 512.393 2246 (55735)	935.448 512.346 2246 (55736)	Lower spot size estimate
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_183666963_139191 336782500_Gim1.tiff	933.841 512.517 4095 (47650)	933.252 512.495 2458 (48418)	933.462 512.443 2458 (48331)	Lower spot size estimate
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_184167313_139191 371762200_Gim1.tiff	933.235 512.853 4095 (50856)	932.029 513.545 2375 (51762)	932.238 513.495 2375 (51714)	Lower spot size estimate
B235_AA_BEAM_TO_T AS_CPP_140208_focus _check_BEAM_2014_02 _08_185067828_139191 423295900_Gim1.tiff	933.623 513.492 4095 (65630)	931.094 515.471 2228 (67556)	931.260 515.431 2228 (67610)	Lower spot size estimate

NIF

How do we detect Noddle?

$-$

$=$
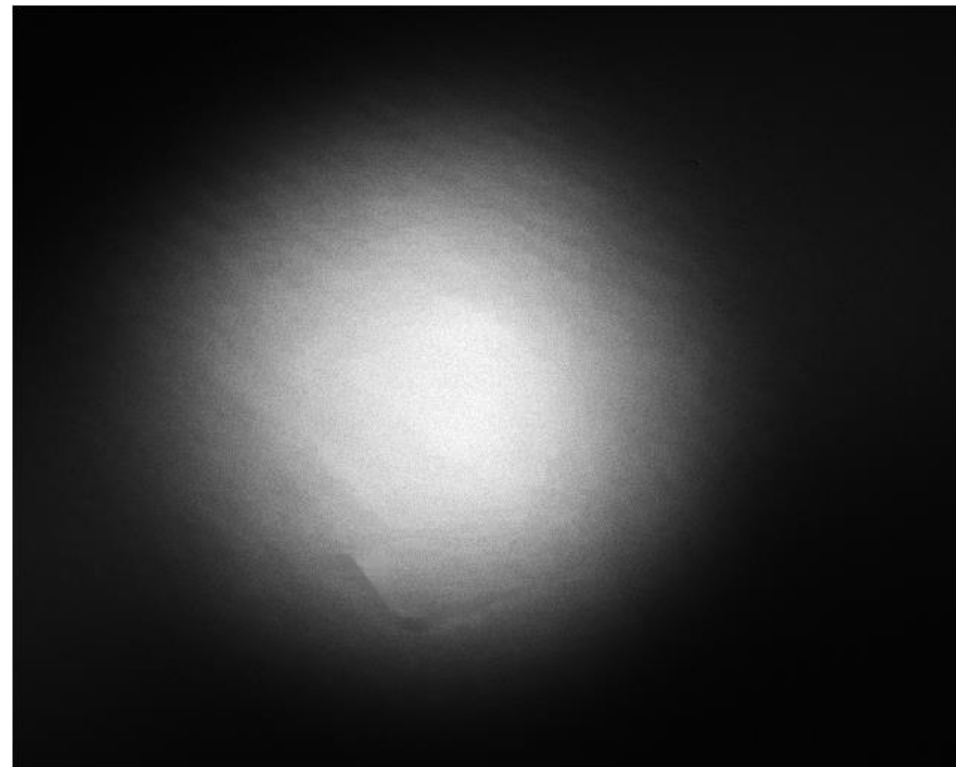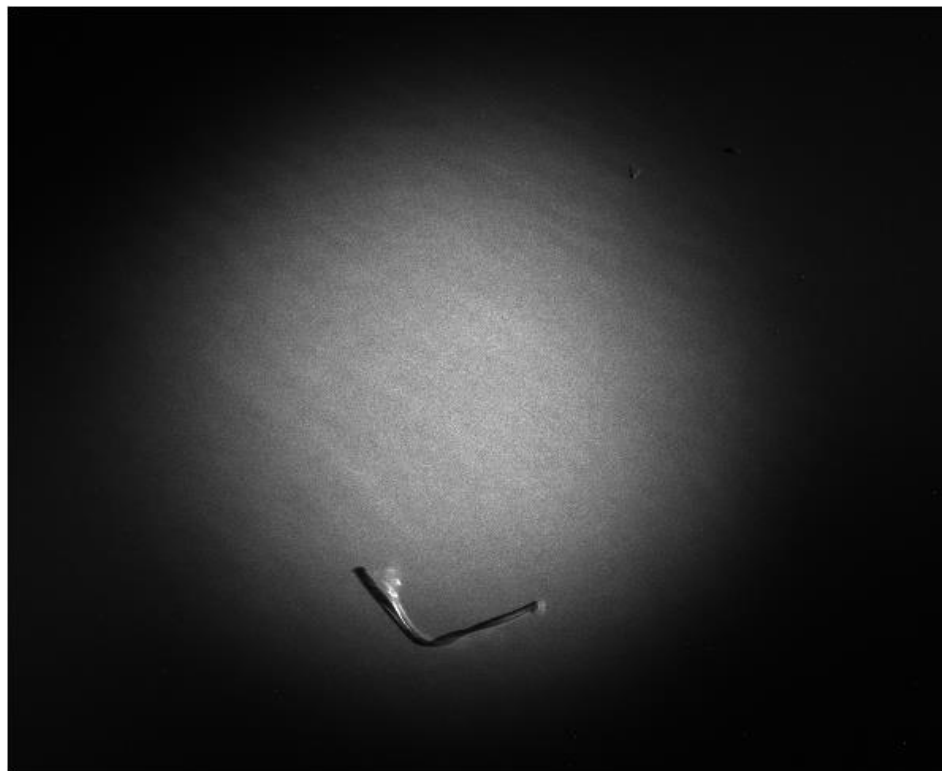
Two **1-d filtering** is performed
Pixel replaced if the difference > 300
Maxima = 4905 after filtering = 2906

Noodle measurement: feature detection

1. Noodle size > 50 pixels
2. Perimeter/Noodle_size < 0.7
3. X-size, Y-size = should not be too small
4. Blob_limit < 2000
5. Rect_ang_ness = is it square or more like a rectangle
6. Solidness > 0.85 (to detect how hollow the pattern is? Measured by how many pixels are lost compared to the Noodle size after 5 pixel median filtering applied)

Perimeter/area ratio   0.4
Noodle detected in Noodle detector 123 X 55
Noodle size 1507

Is it a Noodle?
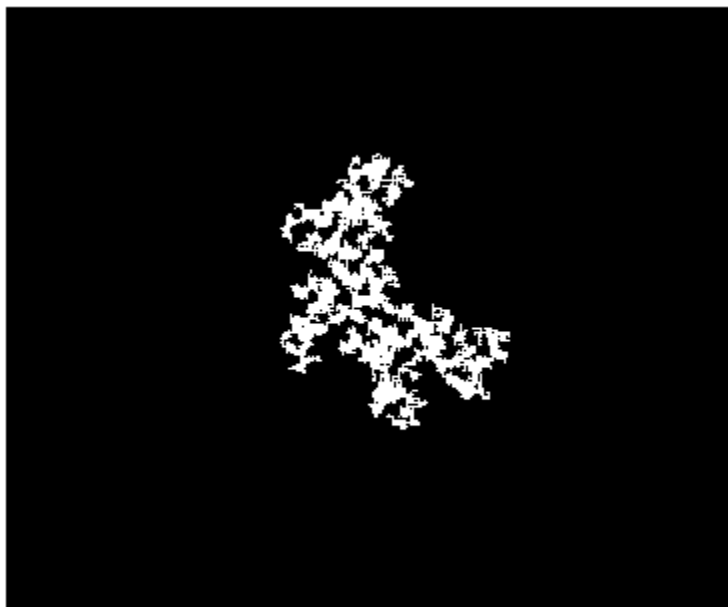
Measure size of noodle,
Perimeter/area ratio   0.741703
Noodle size=   1204
Noodle detected 121 X   52 with noodle size 1204
Solid_ness = 0.711159

NO

Perimeter/area ratio   0.4
Noodle detected in 123 X 55
Noodle size 1507
Solid_ness= 0.978766

YES

Summary

- **How do we detect ring?**
- **How do we detect Noodle noise?**
- **What are the effect of Noodle on (a) Maxima (b) Centroid (c) Spot size (d) interpolation failure**
- **How do we clean Noodle noise?**