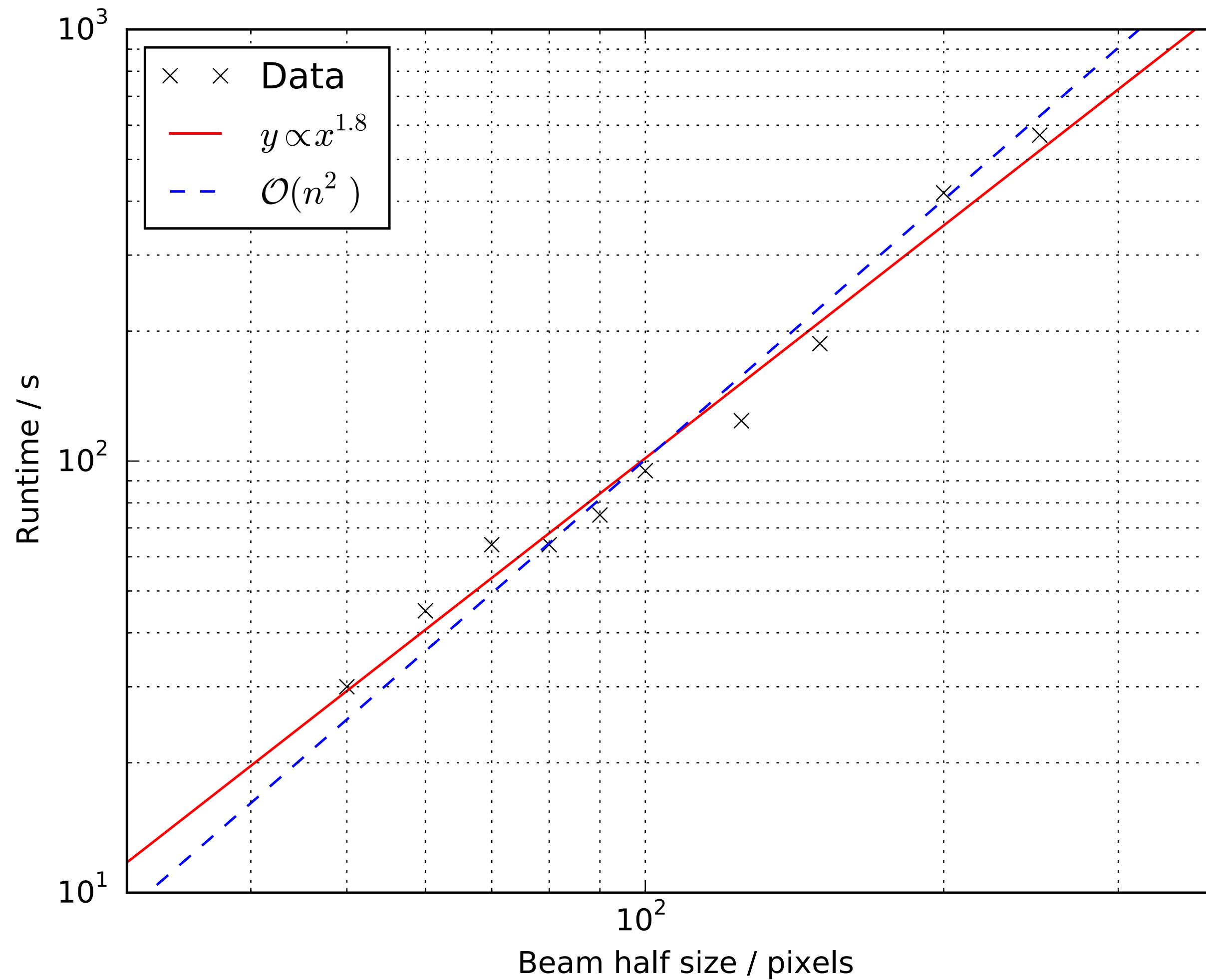


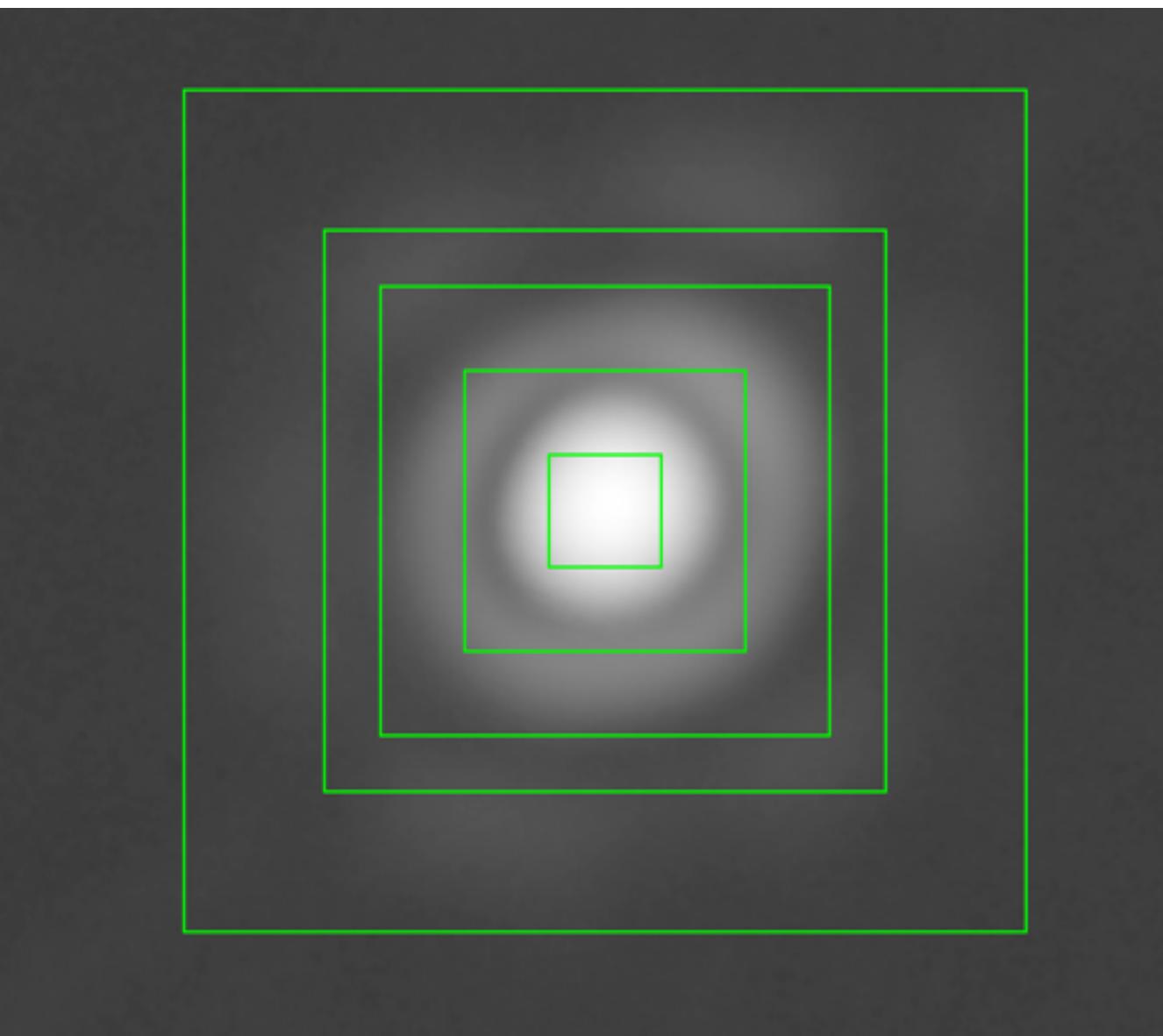
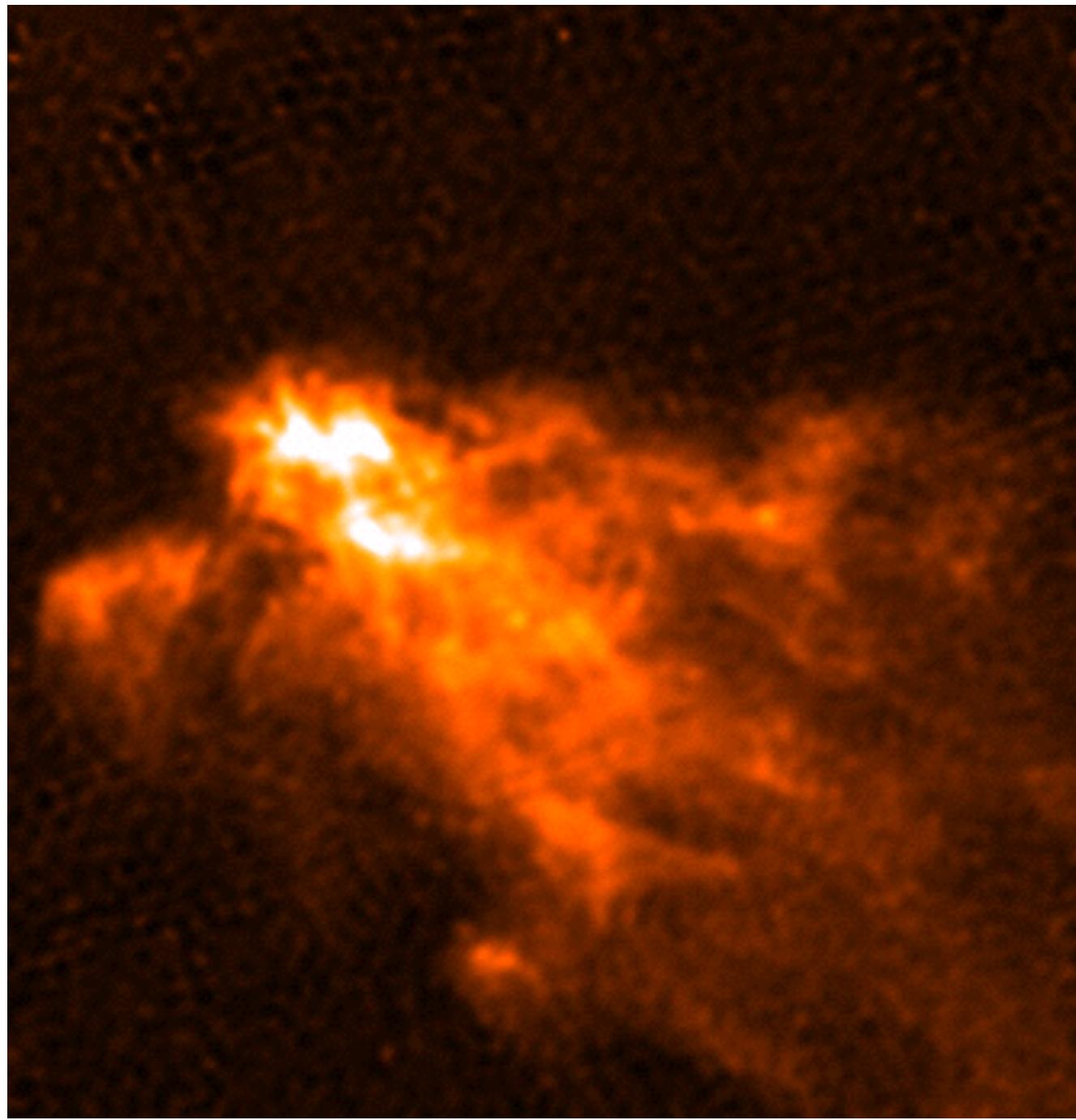
# Code

- All code for tests/analysis is at:
- <https://github.com/badders/spire-hires-testing>
- CSV files containing filtered observation lists inside **obs-lists** subdirectory
- Statistics on full archive in **stats** subdirectory

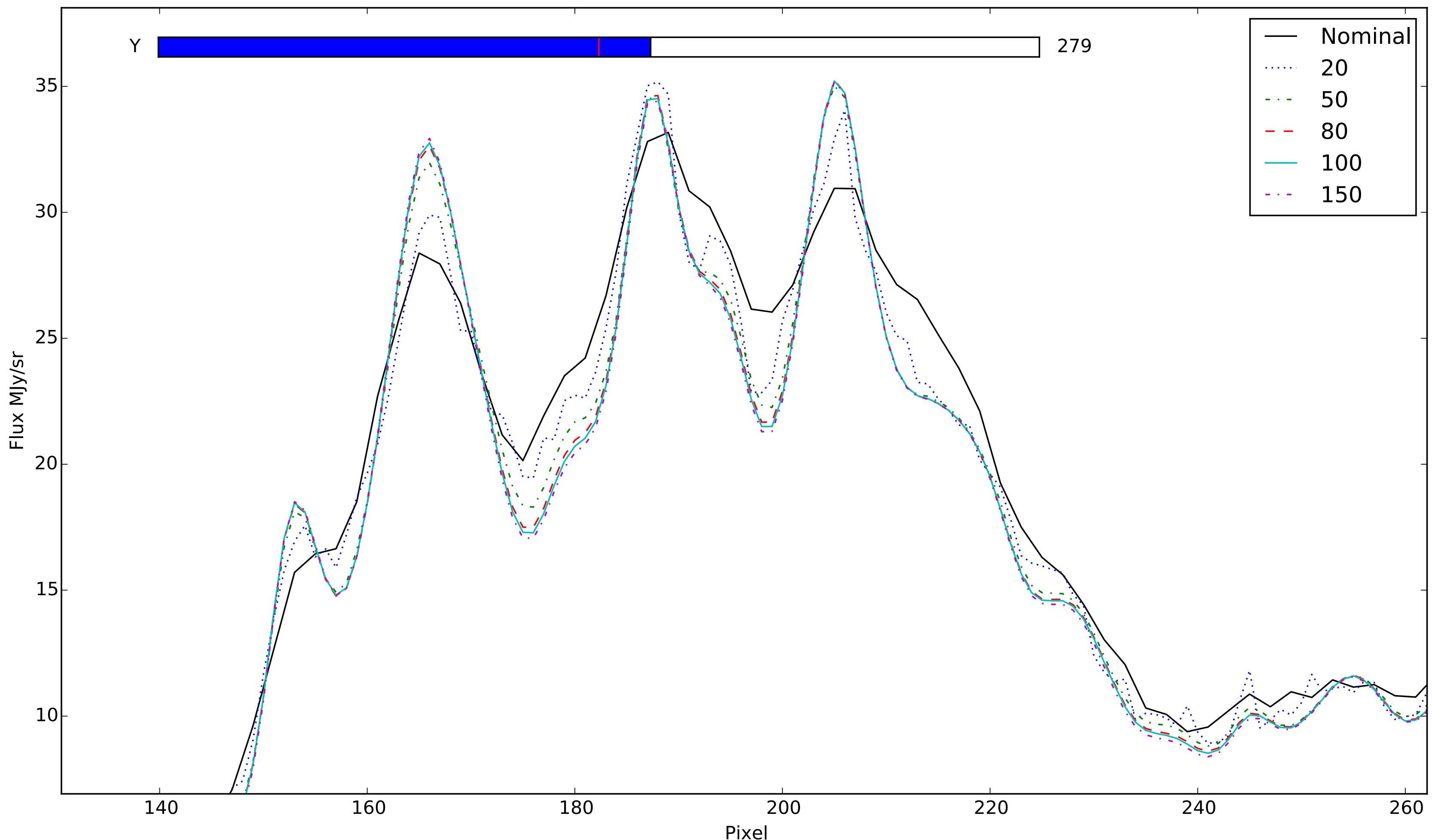
# HiRes Time Complexity - Beam Size



- Approximately quadratic time in terms of beam width
- Approximately linear in terms of beam area



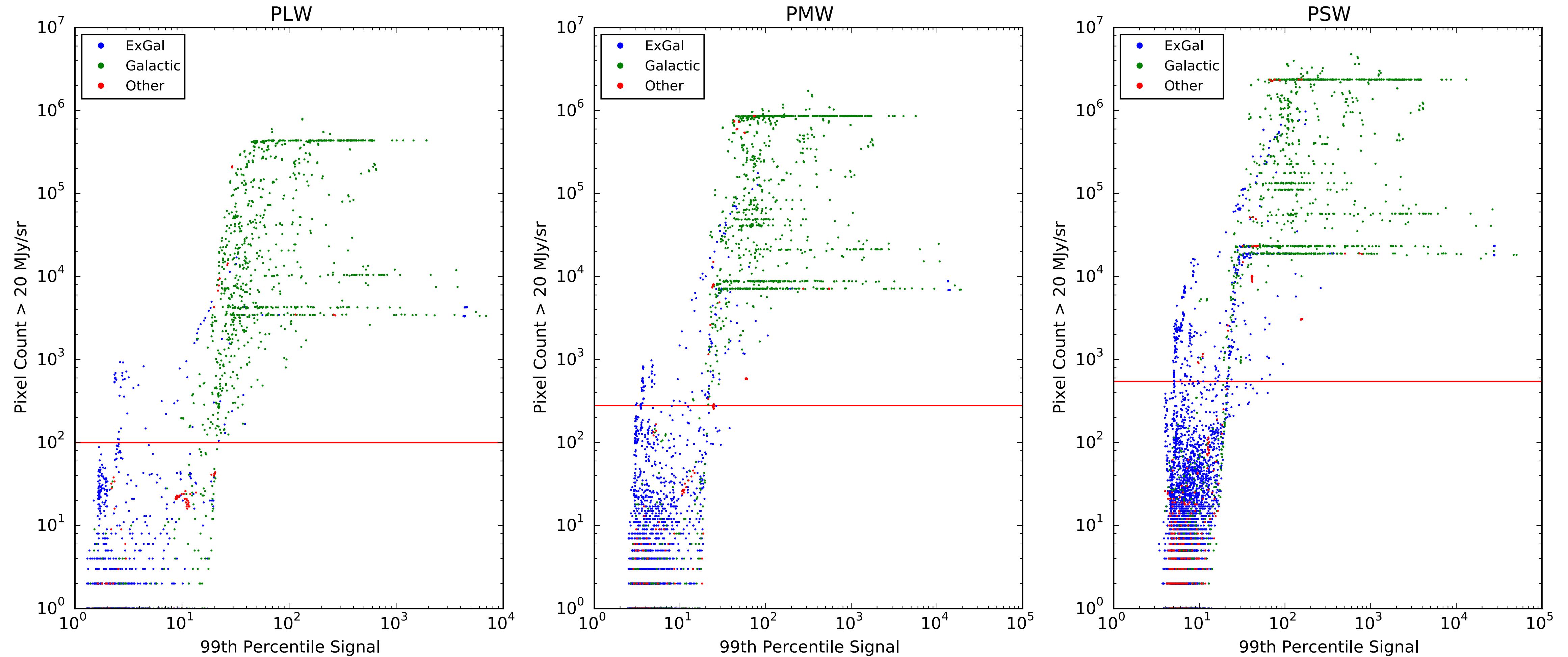
# Varying HiRes input beam size



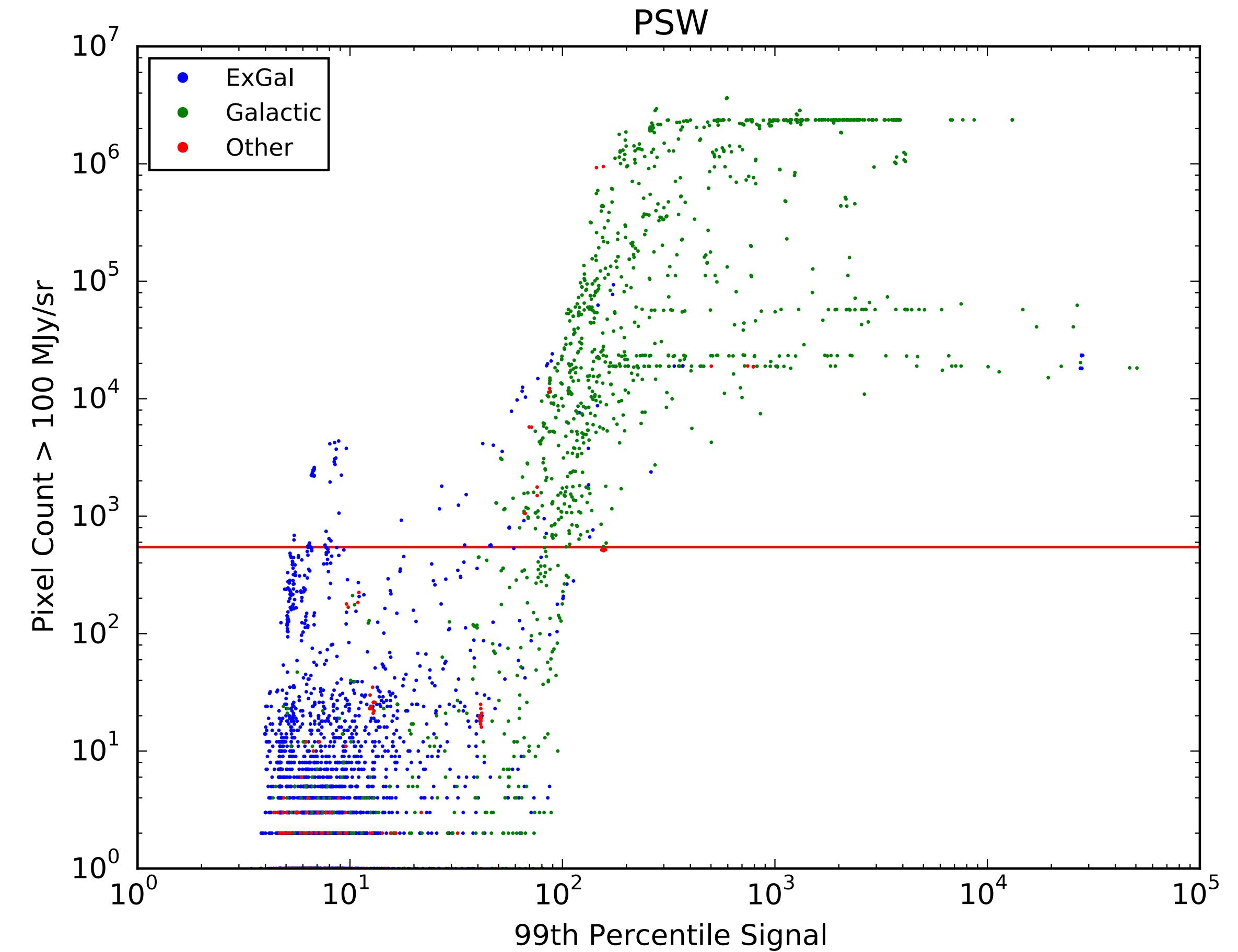
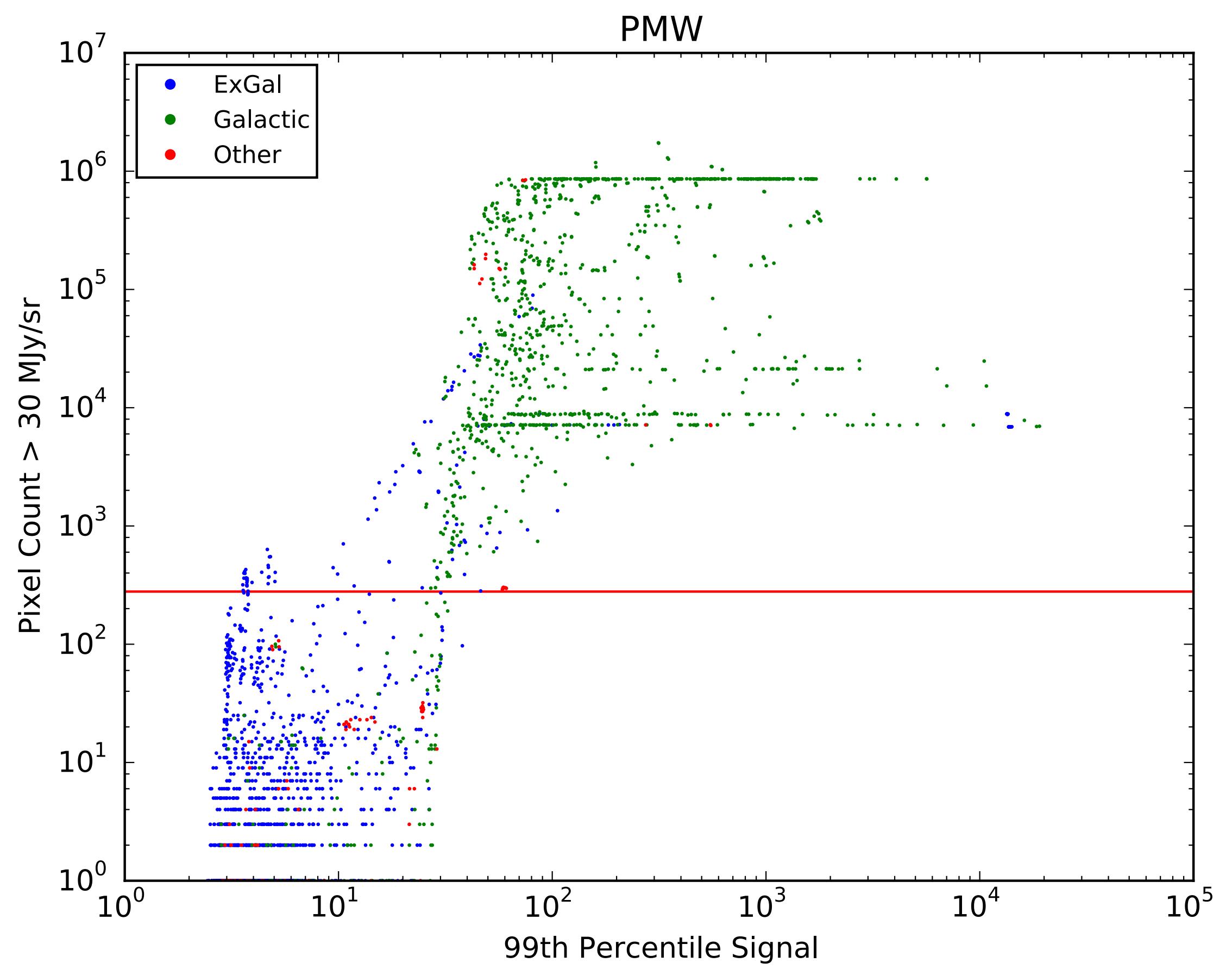
# Beam Size affect on Quality

- < 1st minima introduces artefacts (unsurprisingly)
- 2nd Minima seems noticeably better then using 1st minima in ROI, marginally better than 2nd maxima, but very little - very close to converging here
- Current beam sizes are 80, 60, 40 for PLW, PMW, PSW respectively
- Going to 2nd minima would increase processing time by about half, so need to decide if the quality improvement is worth it - probably not, so enclosing first two maxima should be enough

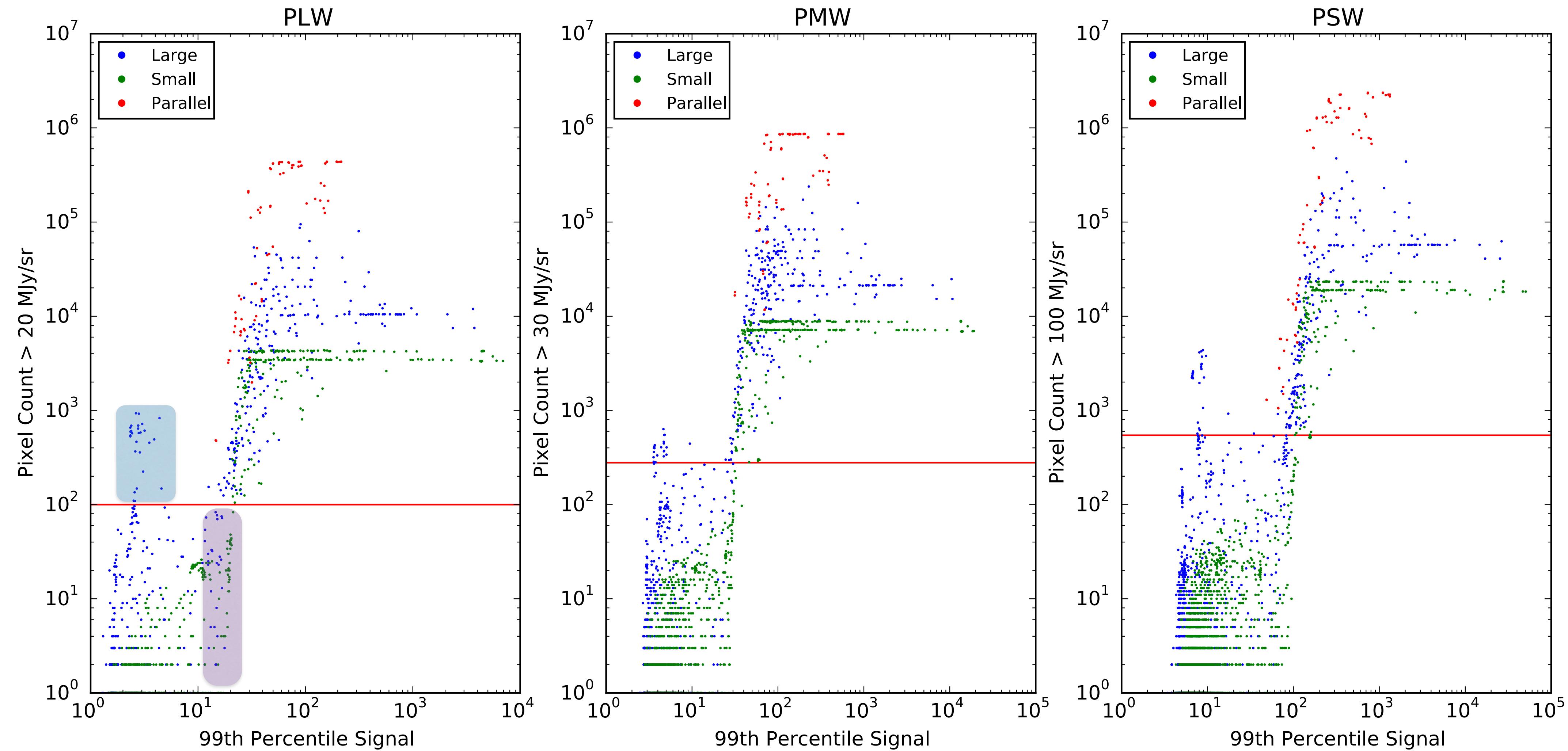
# Thresholds for HiRes



# Updated Brightness thresholds for PMW/PSW



# Thresholds for HiRes

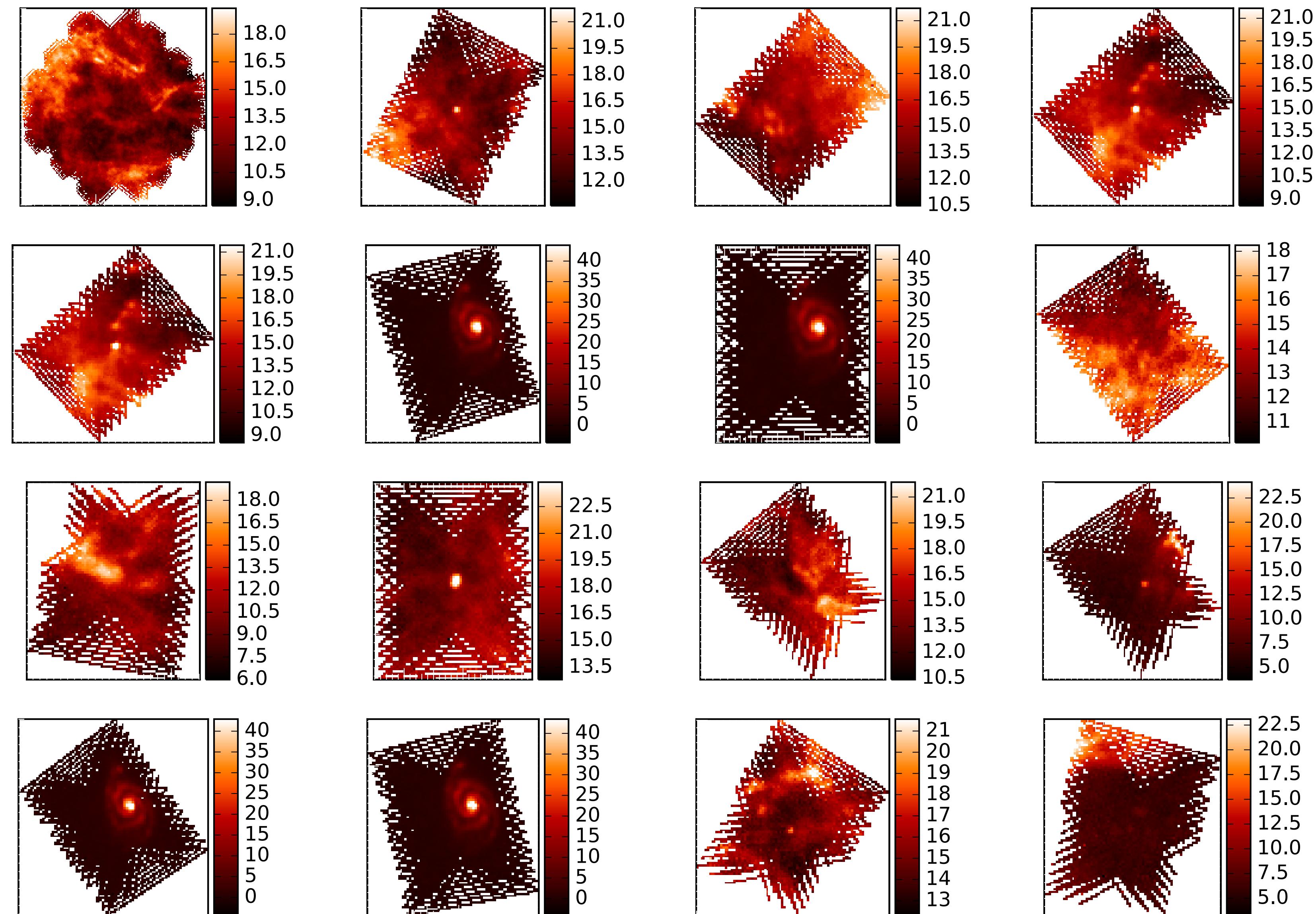


- From previous work by Chris and my own undergraduate project work suggests that HiRes starts to make sense around a 99th percentile SNR of 20
- Statistics on entire archive suggest this correlates roughly with around 100 pixels (PLW) being greater than 20 MJy/sr
- Area scaled for PMW/PSW but also need a different threshold - from statistics this looks to be 30 MJy/sr and 100 MJy/sr respectively for PMW/PSW

# Below threshold but high SNR ( $\text{pix\_gr\_20} < 100$ and $\text{SNR} > 17$ )

Obs Ids (Right then down)

1342268378  
1342255087  
1342254493  
1342266693  
1342237513  
1342224023  
1342210935  
1342240284  
1342224973  
1342239913  
1342210542  
1342247978  
1342265305  
1342229204  
1342268390  
1342239795



- Observations are very low brightness and/or very small FOV
- Kepler SN observation is large, but very dim (top left) with an SNR of only about 2
- M51 observations are short exposure and small FOV, very dim apart from galactic center (these are actually supernova observations)
- Visual inspections suggests only on areas with per pixel brightness of around 20 MJy/sr benefit from HiRes (PLW)
- OK to ignore, HiRes can still always be applied by the user, or specific observations can be added to the list where appropriate

# Above threshold but Low SNR ( $\text{pix\_gr\_20} > 100$ and $\text{SNR} < 5$ )

Obs Ids (Right then down)

1342247216

1342236240

1342245412

1342245510

1342246580

1342238251

1342236234

1342237553

1342237550

1342234749

1342246632

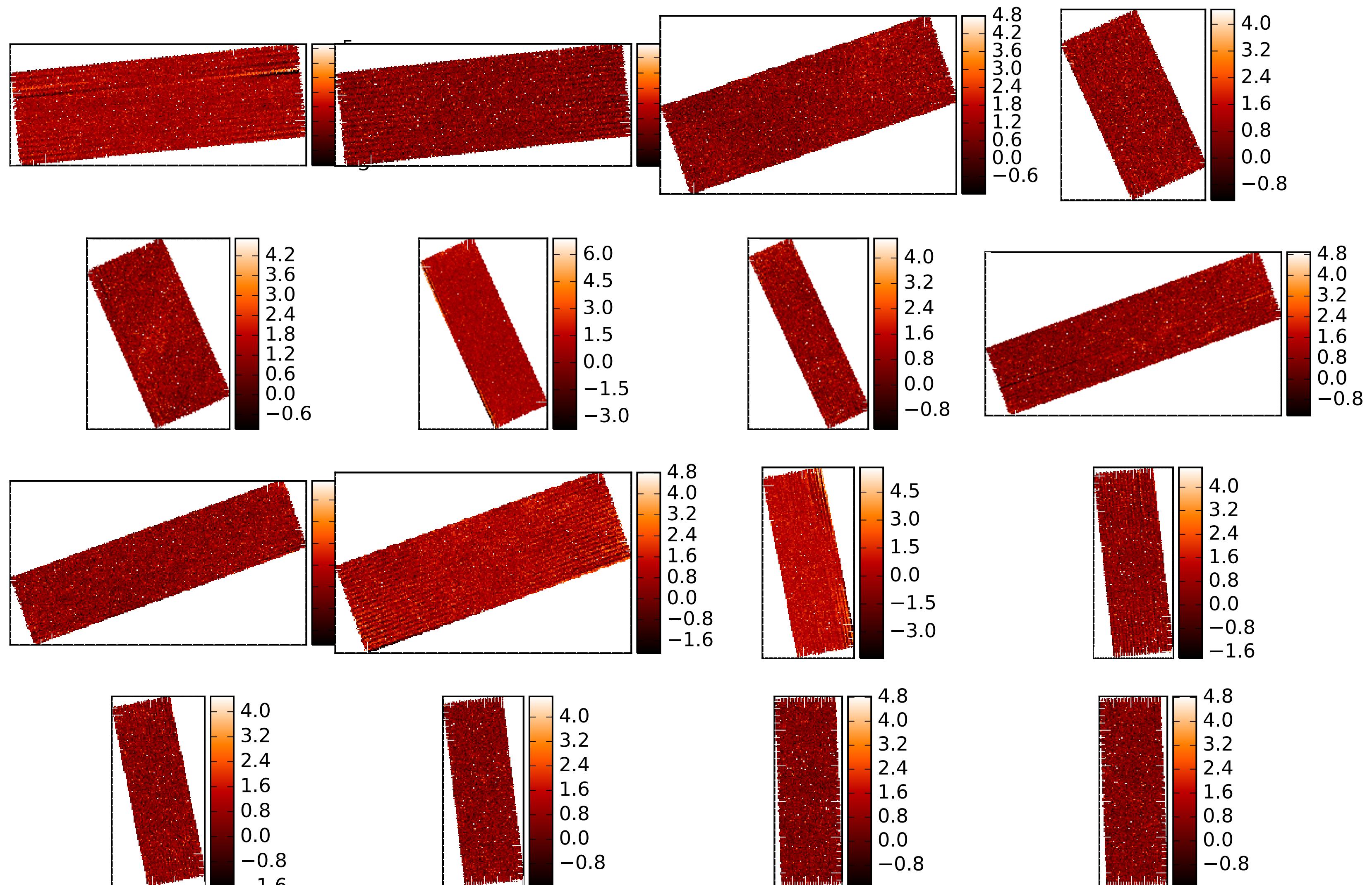
1342237563

1342236232

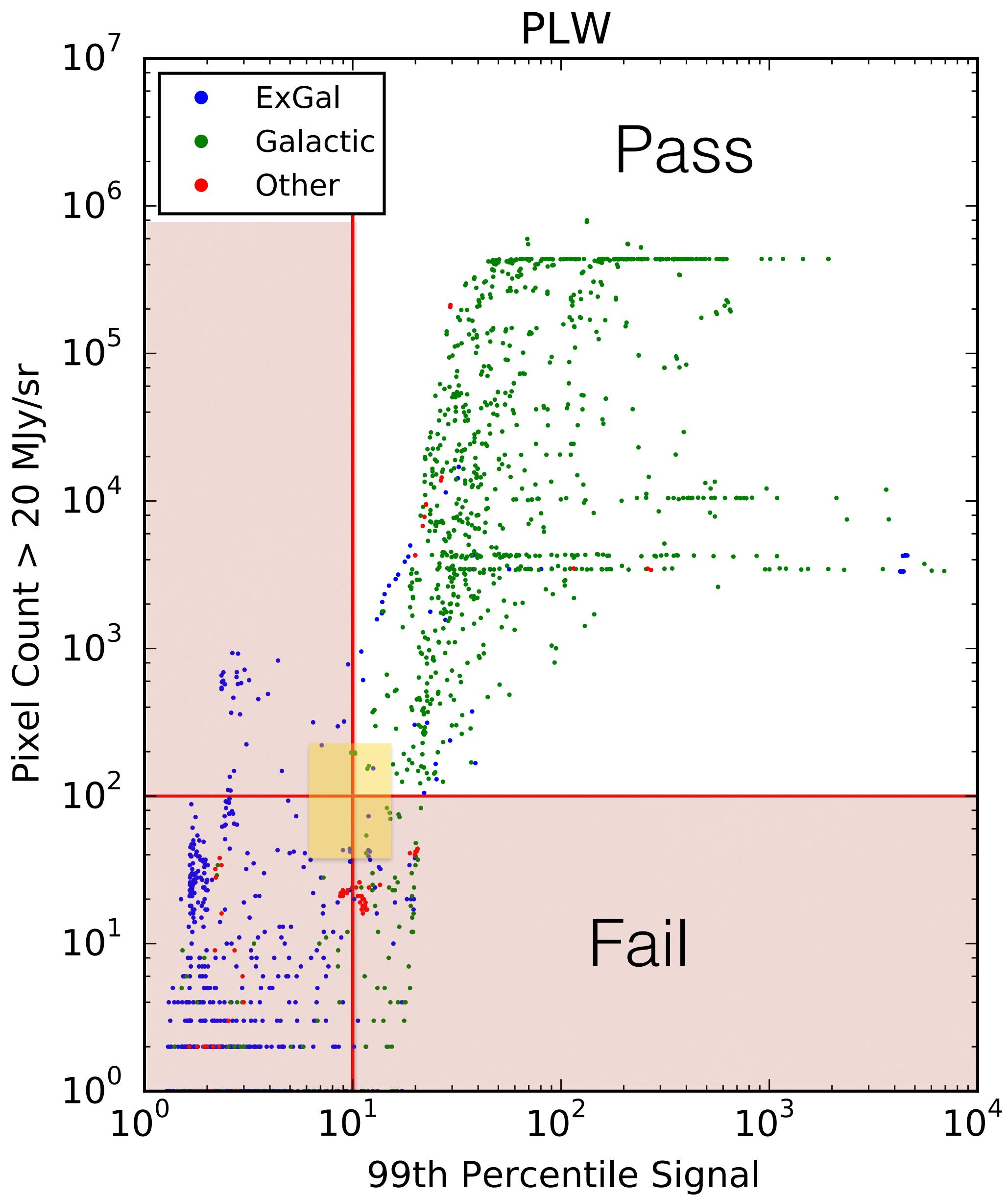
1342245413

1342232365

1342245512



- Observations are very large FOV but dim, but as we are counting the pixels they just rise above our threshold test
- Don't want more complicated testing such as bright pixel proximity etc, suggest adding a second threshold of 99th percentile SNR as both this and the pixel count tests are both computationally very quick. Suggest 99th percentile signal of 10, 15, and 30 for PLW, PMW, PSW

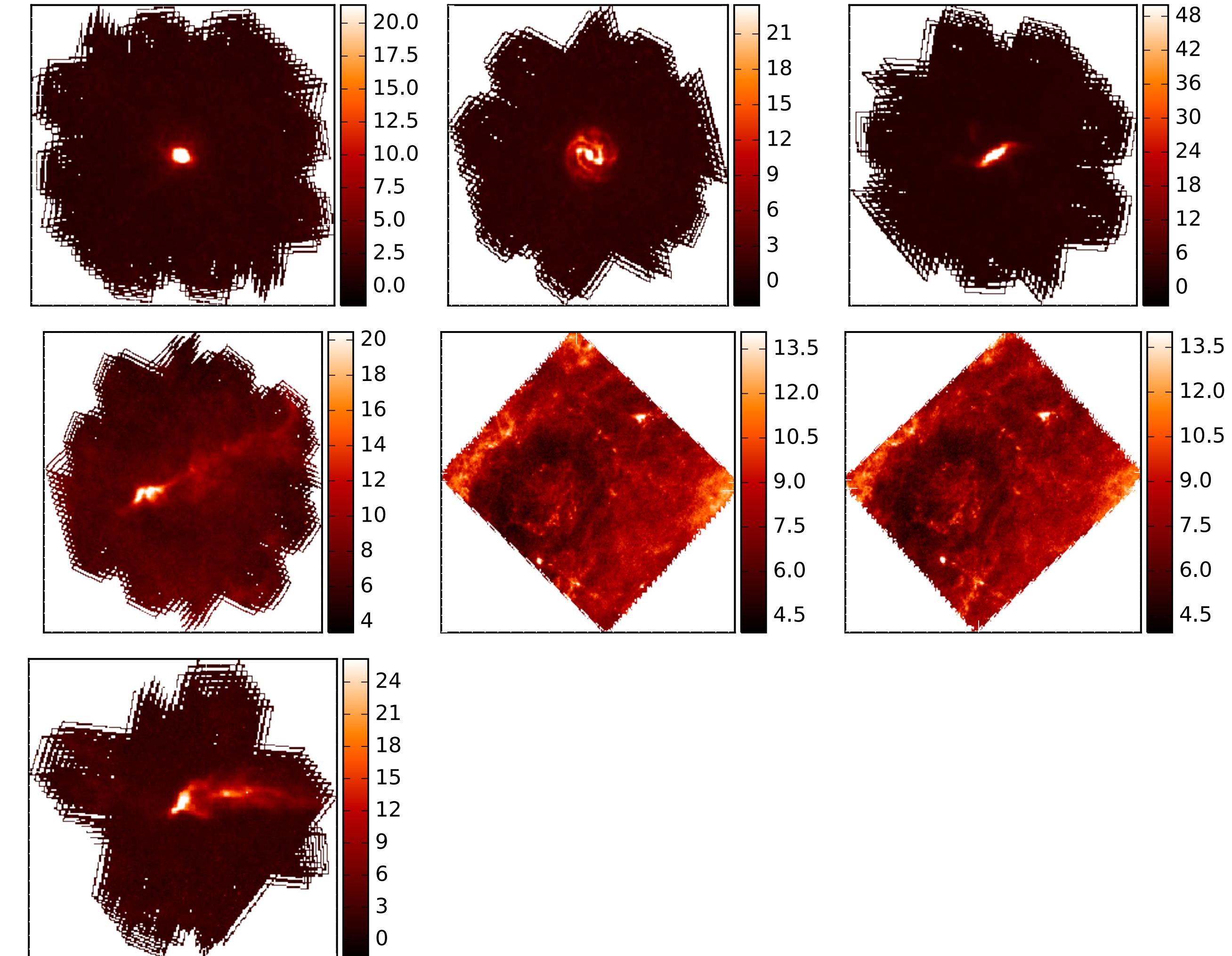
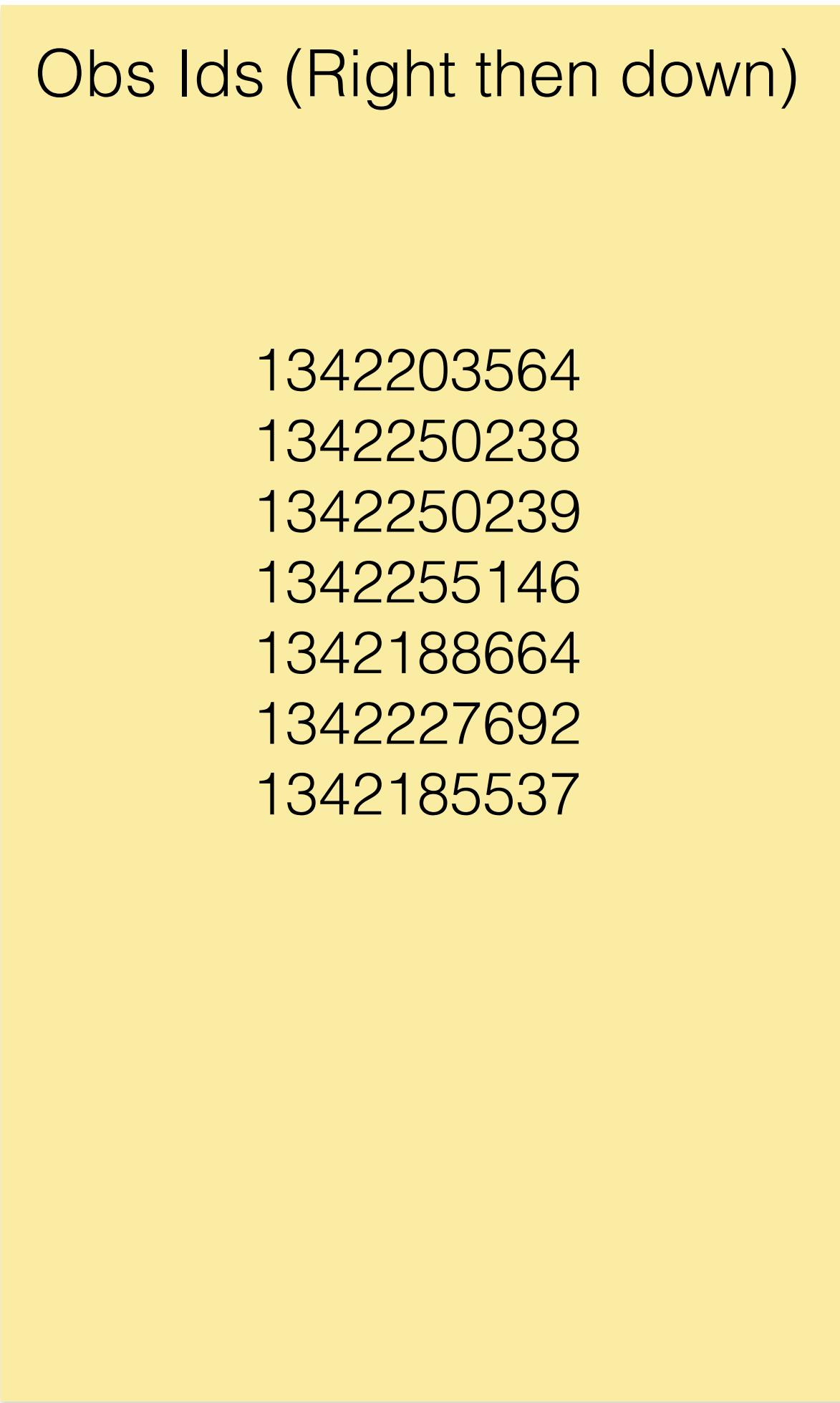


With suggested thresholds:

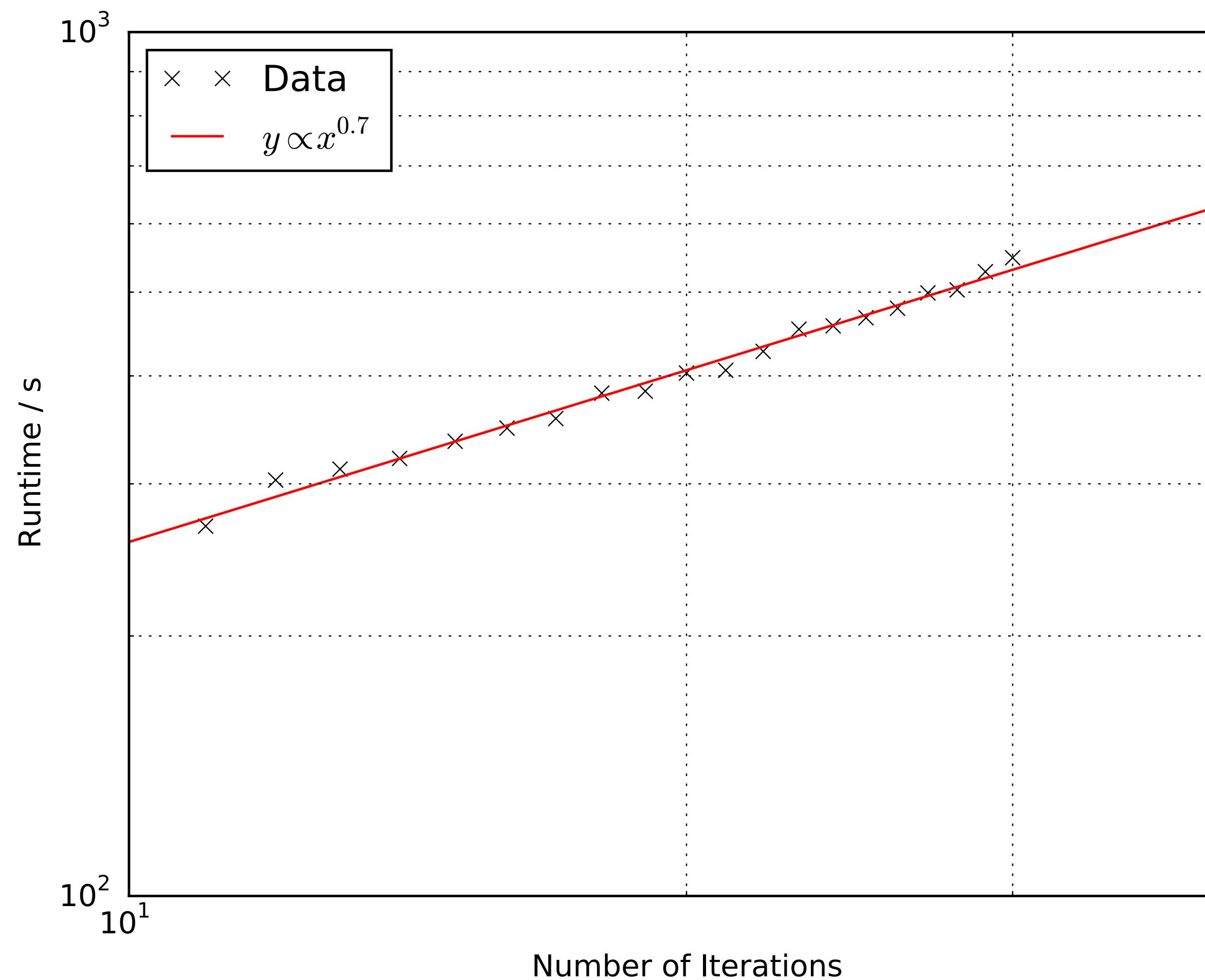
| Band | Pass | Fail |
|------|------|------|
| PLW  | 1012 | 4873 |
| PMW  | 1132 | 4753 |
| PSW  | 972  | 4913 |

| Number Bands | Pass |
|--------------|------|
| 3            | 956  |
| 2            | 71   |
| 1            | 106  |

# thumbnails of Observations closest to thresholds (pix\_gr\_20 within 50 to 200 and SNR within 5 to 15)

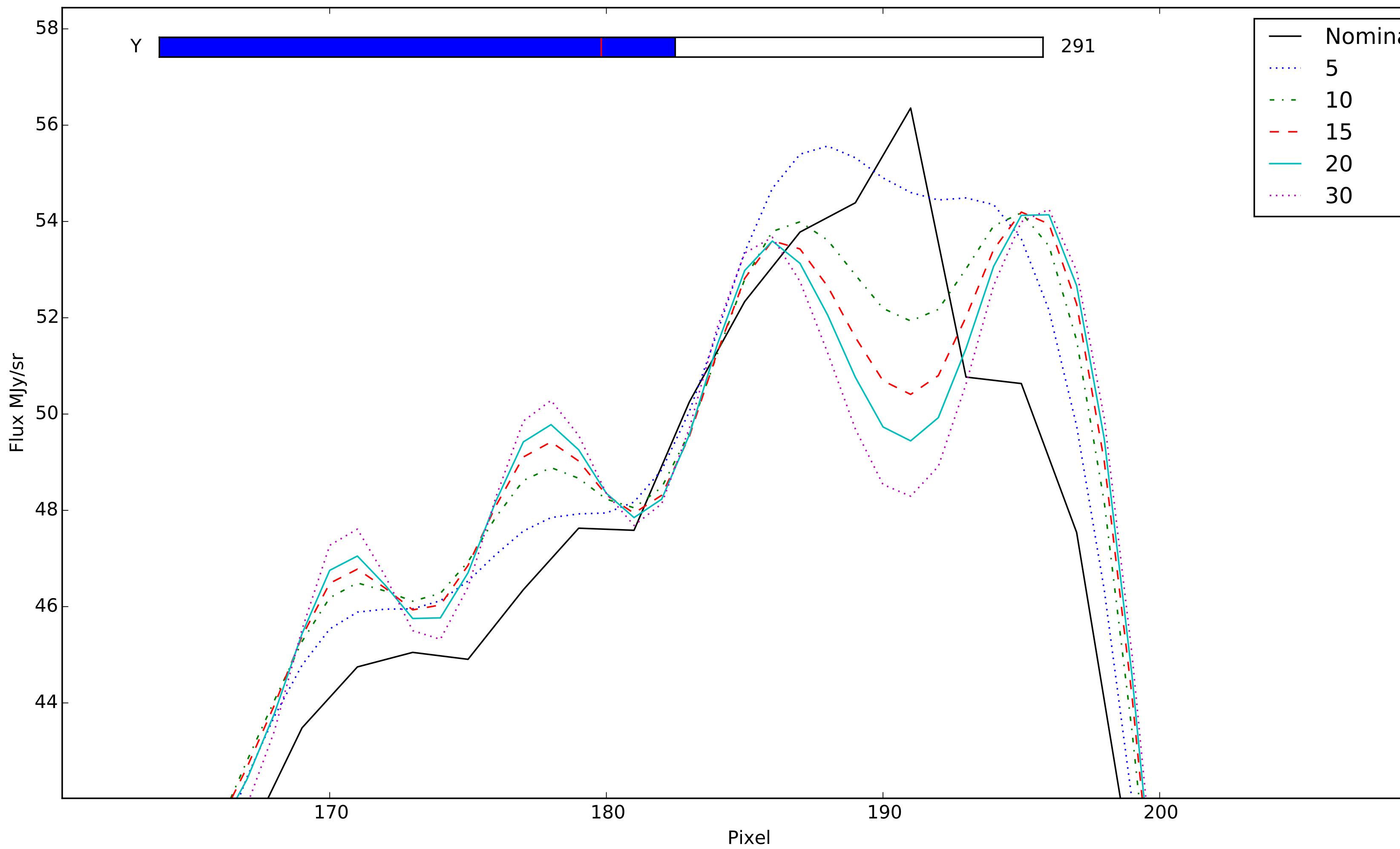


# HiRes Time Complexity - Iterations

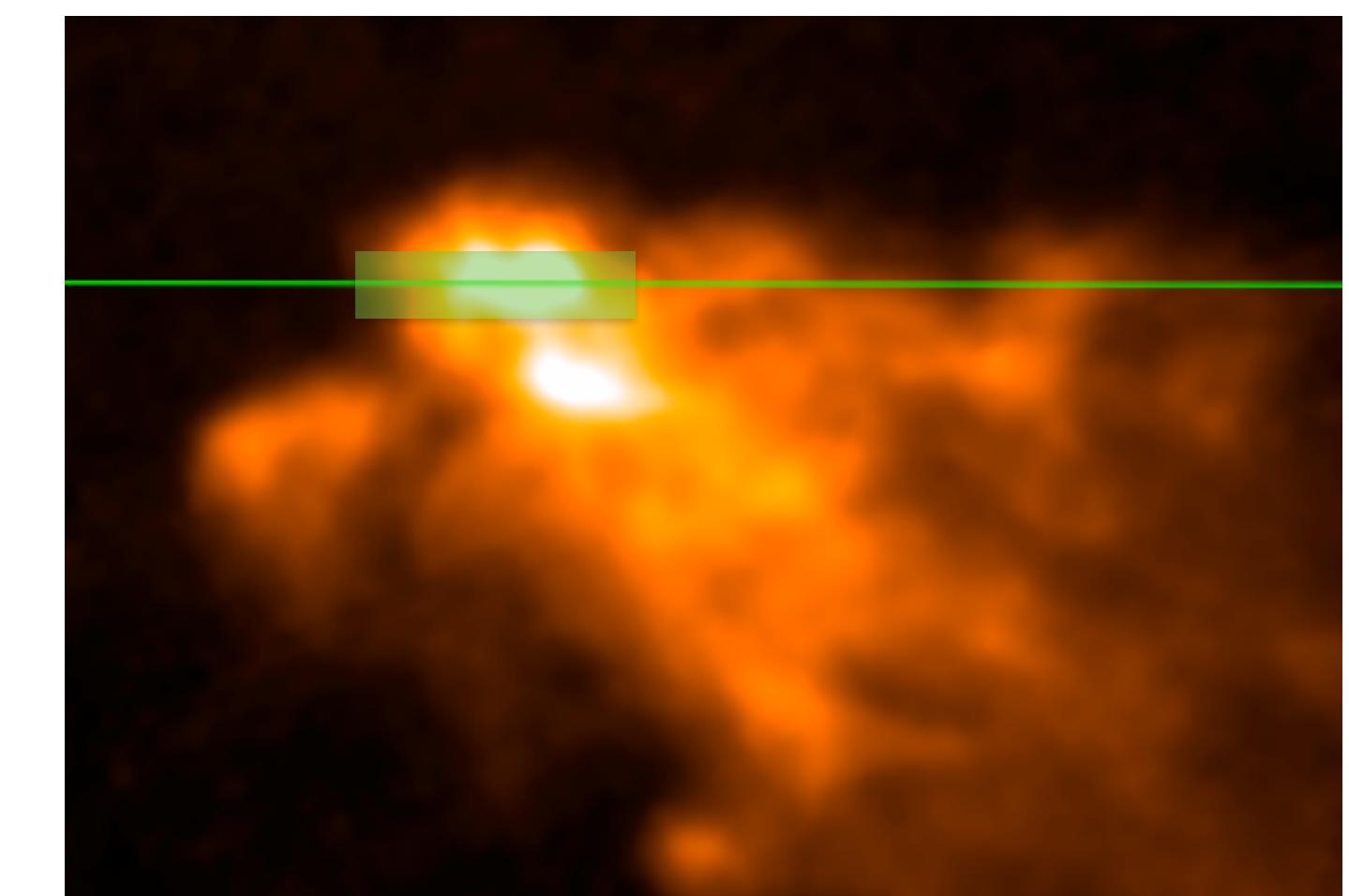


Slightly better  
than linear

# Number of HiRes Iterations



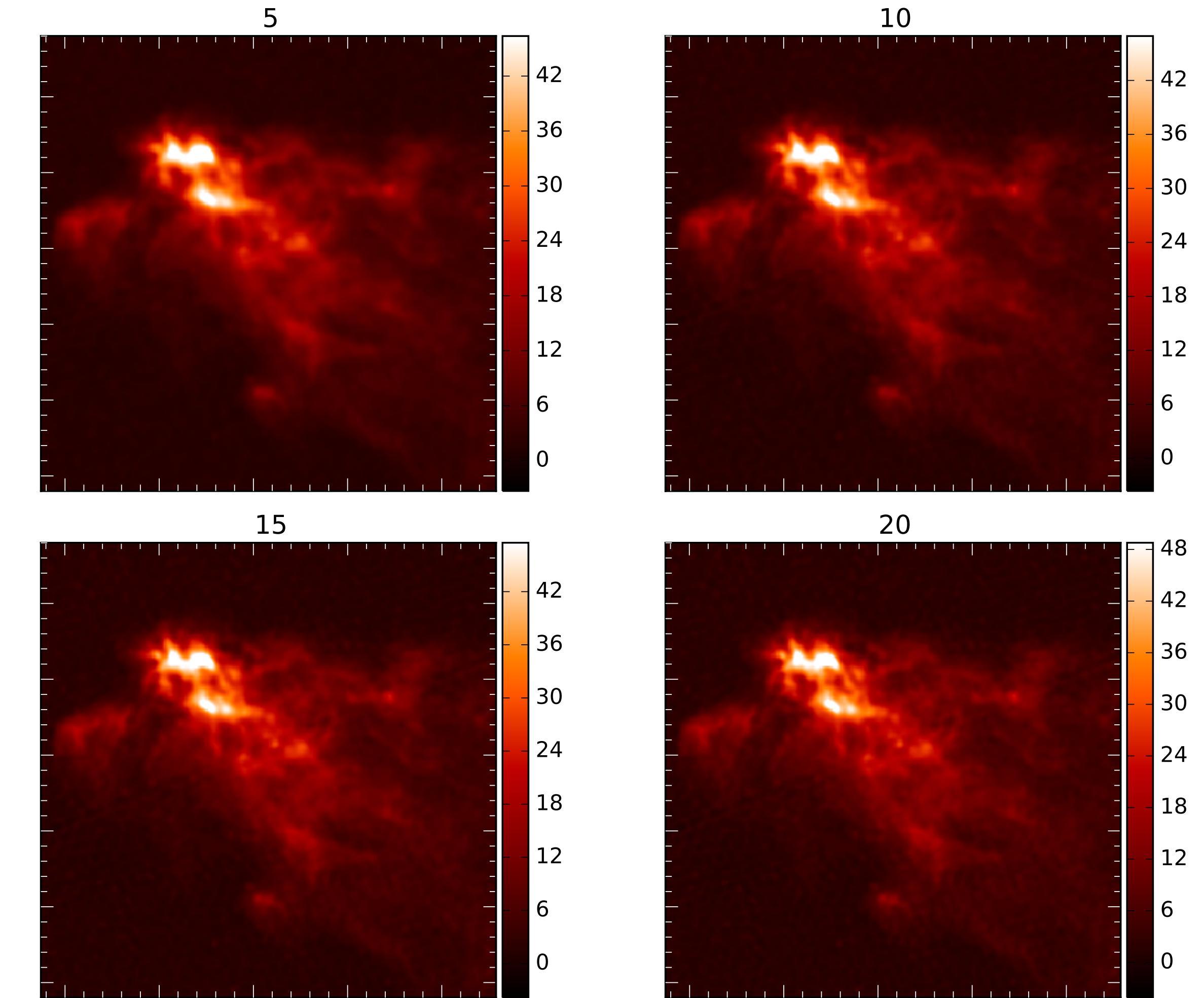
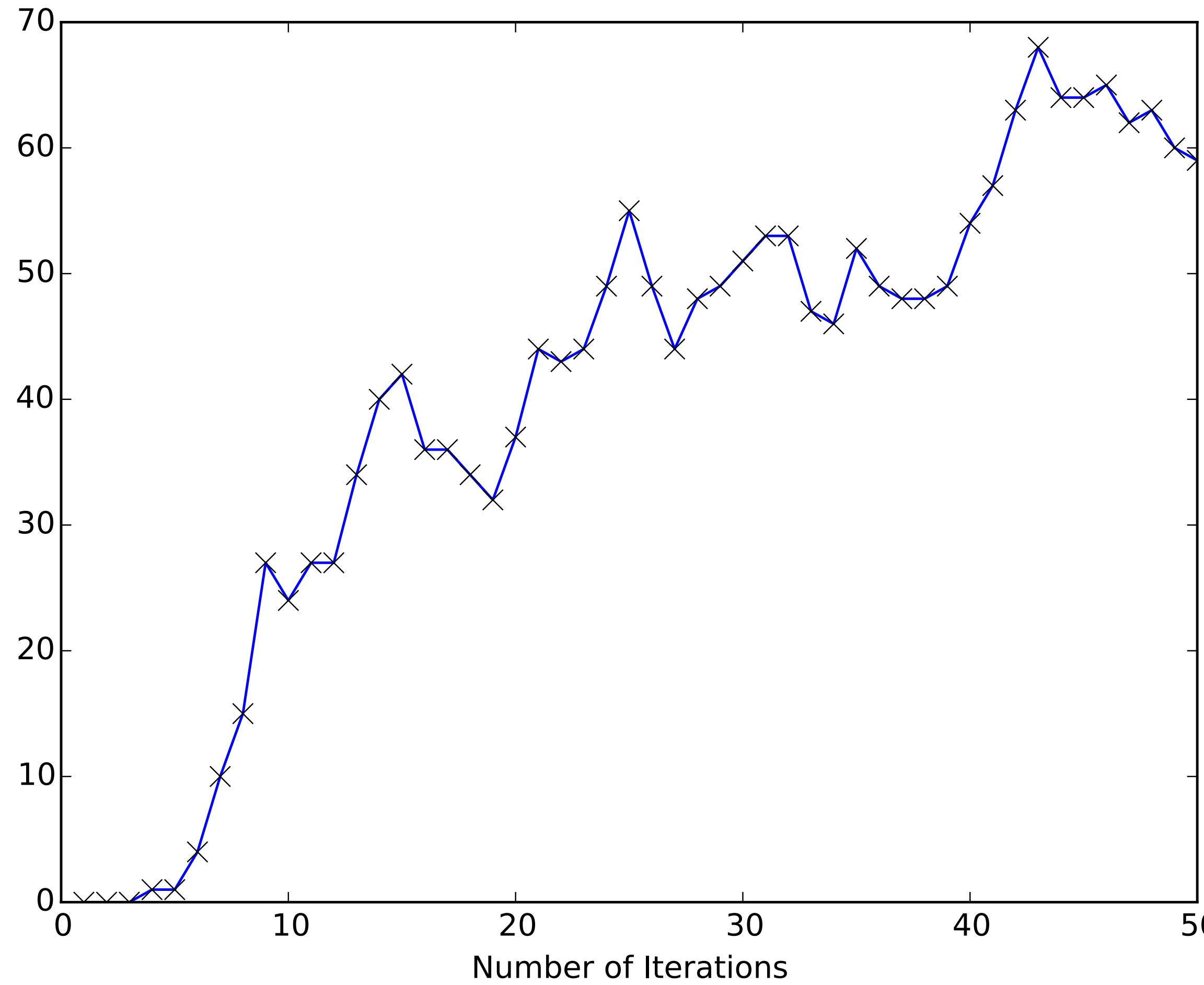
Obsid: 1342249237

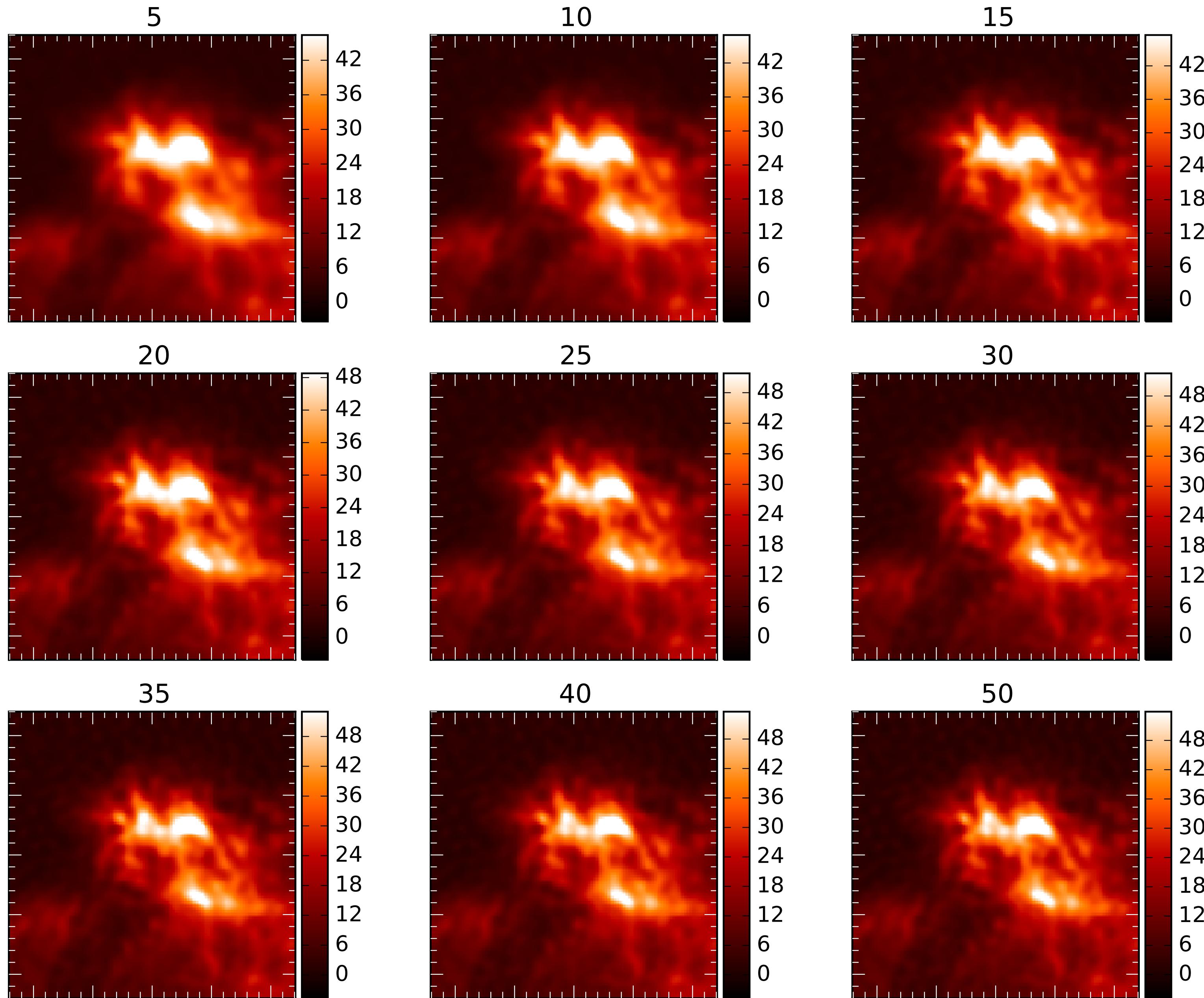


# Number of HiRes Iterations

Obsid: 1342249237

RMS Pixel Difference from nominal





Obsid: 1342249237  
Zoomed to 0.25 degree  
region

At 20 iterations it appears that some detail is introduced that wasn't shown at 15 iterations (although is apparent on the profile - might be due to scaling on these images), and is further visible at higher iterations.

- Difference rapidly increases from 5-15 iterations, but then rate of change of image differences becomes small
- Small difference from 15-20 iterations (20 current default) but doesn't appear to be adding structure, just enhancing that which is already clear at 15 iterations - previous work in the map making report needs to be checked to see if this is useful or not.
- Time complexity suggests we can save around 1/4 to 1/5th of the processing time by dropping down to 15 iterations.

# Recommendations

- The default beam sizes seem appropriate, going smaller could be risky but using larger beams gives no benefit
- Using the thresholds picked here a list of observation ids will be generated that can be used in the pipeline. This list can then be altered for edge cases where appropriate