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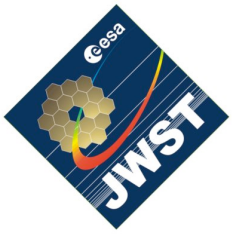

NIRSpec Technical Note
NTN-2012-011

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PREP-DET-CHECK
Data analysis and result evaluation

Abstract:

This brief technical note will guide the reader through the step necessary for the analysis of the data acquired with the PREP-DET-CHECK procedure during the TV2 NIRSpec campaign. It also provides figures, plots and statistics to compare the results with the performance measured during DCL and TV1 testing.

1 INTRODUCTION

Add some bla bla here on prep-det-check
All the example shown here are derived with same software and number of input exp (10)

Section 2 : PREP-DET-CHECK part 1 – Bias & Dark Measurements
Section 3: PREP-DET-CHECK part 2 – Gain Measurement

2 PREP-DET-CHECK – BIAS MEASUREMENT

The present section will guide you through the measurement of the detector system performance with data acquired as part of the PREP-DET-CHECK (part 1) procedure. The data consist of ten dark exposures of 88 groups.

STEP-1 –create a working directory

```
mkdir TEST_BIAS
cd TEST_BIAS
```

STEP-2- start IDL in NIRSpec mode

```
start_nirspec
```

STEP-3- check if the REF_DATA is defined and point to the proper location

```
print,getenv('REF_DATA')
```

the result should look something like:

/Users/msiriann/Library/Software/JWST_C/var/FPA104_T3850/

If REF_DATA is not a variable, define it as in the following example (changing path where appropriate):

```
setenv,'REF_DATA=/Users/msiriann/Library/Software/JWST_C/var/FPA104
_T3850/'
```

If you are not 100% sure to have the proper set of reference files, move to the proper location and download the most recent set of reference files for the proper FPA and TEMP

```
cd,getenv('REF_DATA'),current=here
copy_reference_files, 104, 38.5
```

be sure to return to the working directory by typing:

```
cd,here
```

STEP-4- Run create dark cube on the 10 exposure. This assume you have access to the archive and can use the NID to point to the exposure raw file.

Let's assume that the 10 dark exposures have NID from 4536 and 4545, we can create the dark cube and associated files with :

```
create_darkcube,indgen(10)+4536,REFDATA=getenv('REF_DATA'),/verbose
,/nodelete
```

Should the archive not be accessible, and you have already copied the raw files of the exposures in a temporary directory (for example called ./RAW_DARKS) you can process the files using the following sintax:

```
create_darkcube,DIRLIST='./RAW_DARKS/',REFDATA=getenv('REF_DATA'),/
verbose,/nodelete
```

In both cases the script will create in the working directory:

- one countrate file (*.cts.fits) for each exposure used as input
- a superbias : BIAS_49X_001.fits for each SCA
- a dark cube: DRKC_49X_001.fits for each SCA
- other intermediate files

STEP-5- once the selected exposures have been processed (note, both SCA 491 and SCA 492 are processed) you can run the following script:

```
prep_det_bias_part1
```

it will assume the files are in the working direcrtory, if this is not the case you can specify the path with :

```
prep_det_bias_part1,wdir="path_to_the_superbias_and_darkcube"
```

The script perform the statistics on the superbias, map of how and warm pixels, and dark count rate image. He will produce and save in the working directory several plots (with maps or histograms) and save text files with the statistics. The complete list of outputs for a single SCA is:

491_1h_dark_stat.txt
491_bad_ref_pixel_dist_.png
491_bad_ref_pixels_stat.txt
491_dark_hist.png
491_dark_ima.png
491_dark_quad_hist
491_dark_quad_hist.png
491_high_total_noise_pixel_mask.png
491_high_total_noise_pixels_stat.txt
491_hot_pixel_mask.png
491_hot_pixels_stat.txt
491_superbias_hist
491_superbias_hist.png
491_superbias_ima.png
491_superbias_stat.txt
491_total_noise_hist
491_total_noise_hist.png
491_total_noise_ima.png
491_totalnoise_stat.txt
491_unreliable_bias_pixel_mask.png
491_unreliable_bias_pixels_stat.txt
491_warm_pixel_mask.png
491_warm_pixels_stat.txt

2.1 Superbias frame

2.1.1 SCA491

- Compare the 491_superbias_ima.png with the figures below.

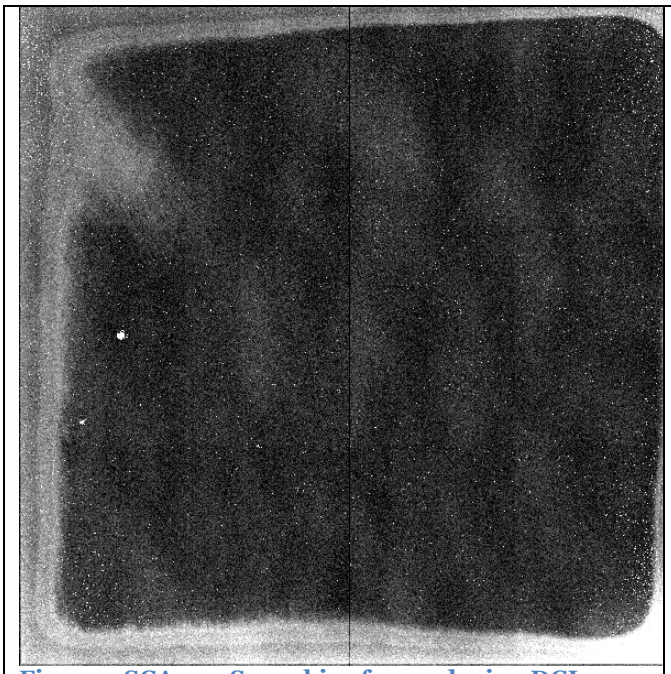


Figure 1 SCA 491 Superbias frame during DCL testing.

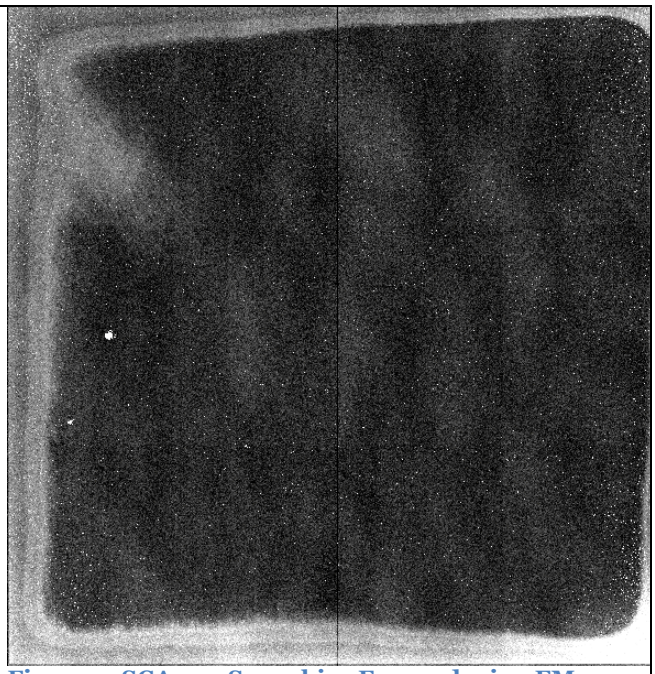


Figure 2 SCA 491 Superbias Frame during FM1

- Compare 491_superbias_hist.png with the figures below.

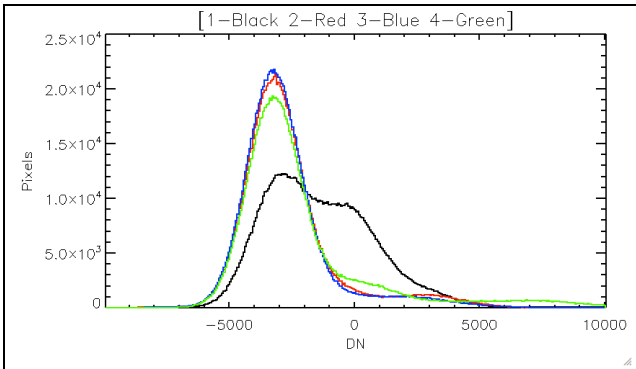


Figure 3. SCA 491 Histogram of superbias pixels output by output from DCL data

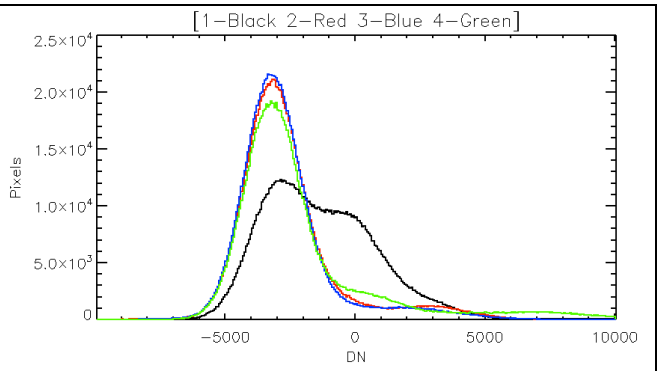


Figure 4 SCA 491 Histogram of superbias pixels output by output from FM1 data

2.1.2 SCA492

- Compare the 492_superbias_ima.png with the figures below.

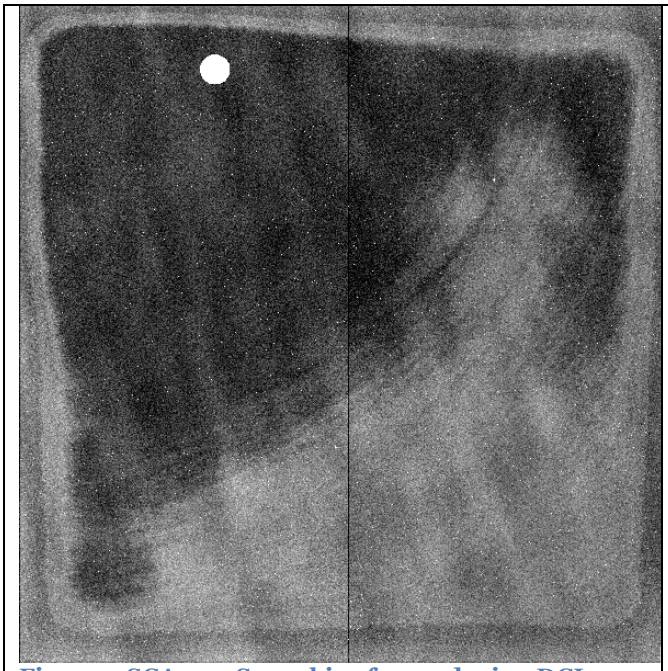


Figure 5 SCA 492 Superbias frame during DCL testing.

Figure 6 SCA 492 Superbias Frame during FM1

- Compare the 492_superbias_hist.png with the figures below.

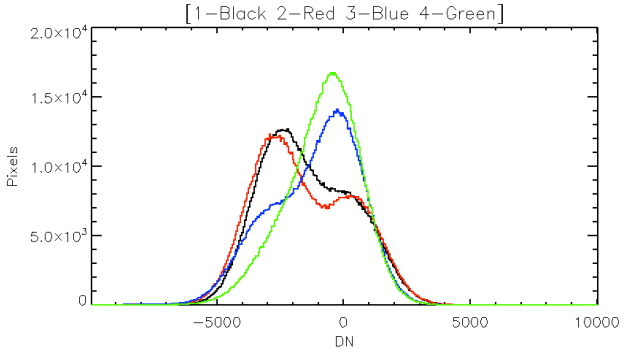


Figure 7. SCA 492 Histogram of superbias pixels output by output from DCL data

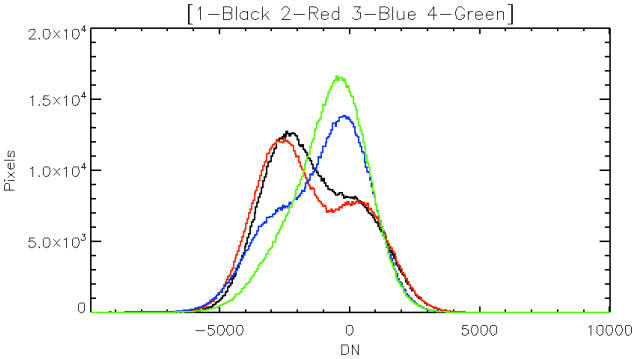


Figure 8 SCA 492 Histogram of superbias pixels output by output from FM1 data

2.2 Total Noise

2.2.1 SCA491

- Compare **491_total_noise_ima.png** with the figures below.

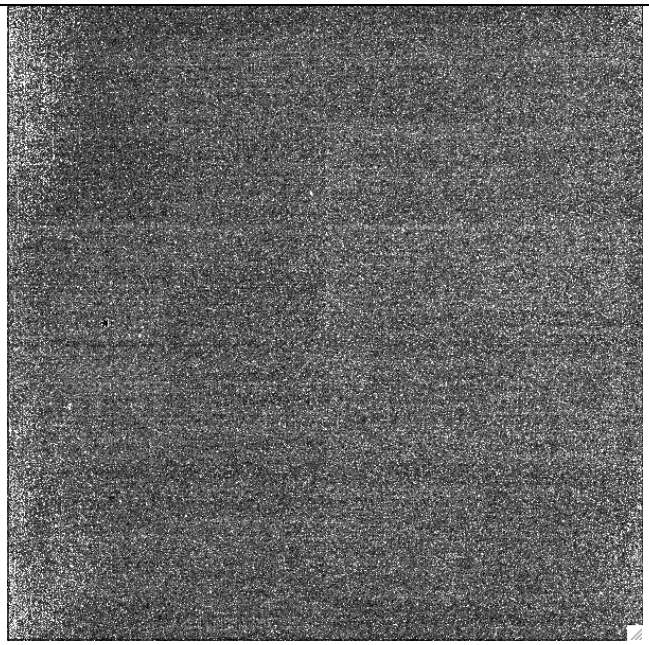


Figure 9 SCA 491 Total Noise Map during DCL testing.

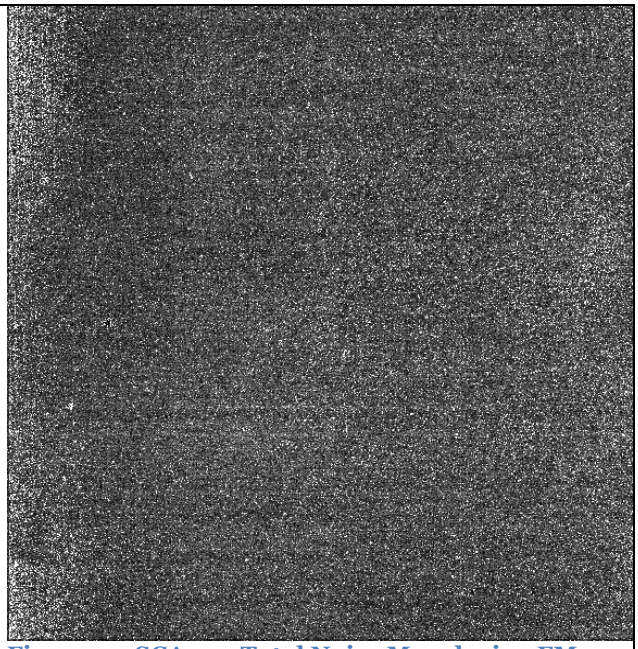


Figure 10 SCA 491 Total Noise Map during FM1

- Compare **491_total_noise_hist.png** with the figures below.

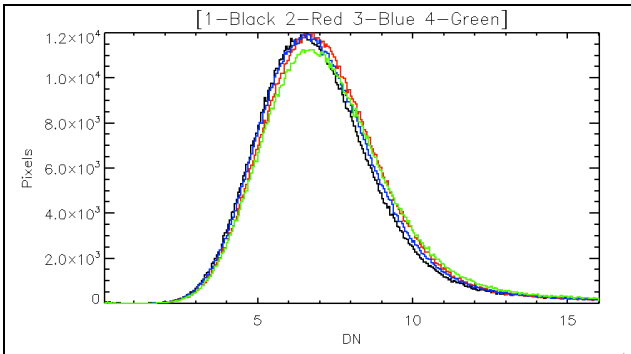


Figure 11. SCA 491 Histogram of Total noise output by output from DCL data

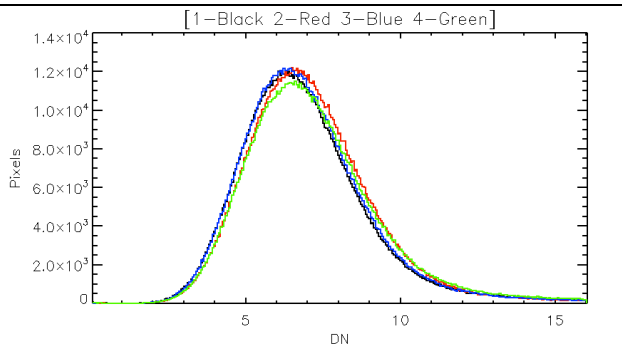


Figure 12 SCA 491 Histogram of Total noise output by output from FM1 data

2.2.2 SCA492

- Compare the **492_total_noise_ima.png** with the figures below.

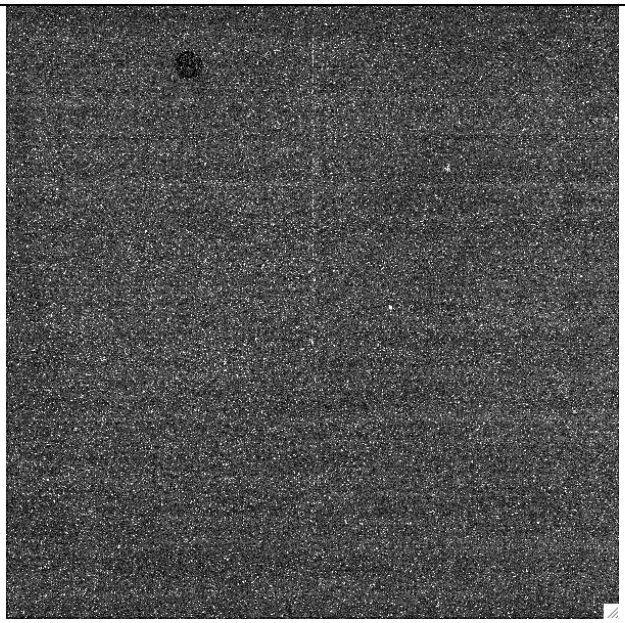


Figure 13 SCA 492 Total Noise Map during DCL testing.

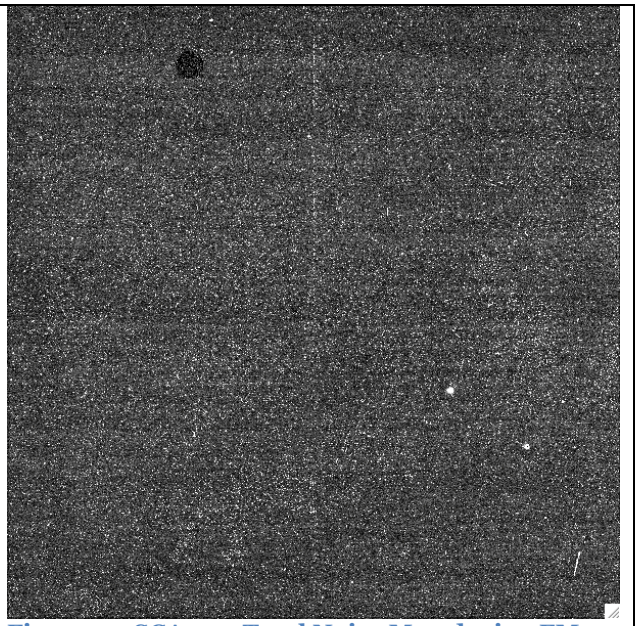


Figure 14 SCA 492 Total Noise Map during FM1

- Compare **492_total_noise_hist.png** with the figures below.

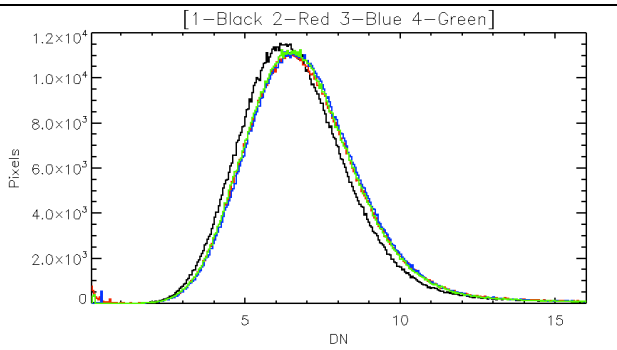


Figure 15. SCA 492 Histogram of Total noise output by output from DCL data

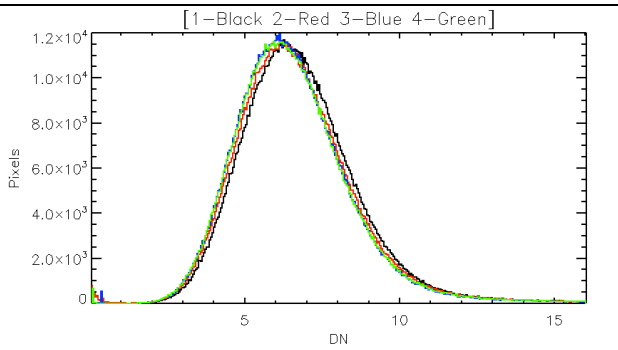


Figure 16 SCA 492 Histogram of Total noise output by output from FM1 Data

2.3 Dark Current

2.3.1 SCA491

- Compare **491_dark_ima.png** with the figures below.

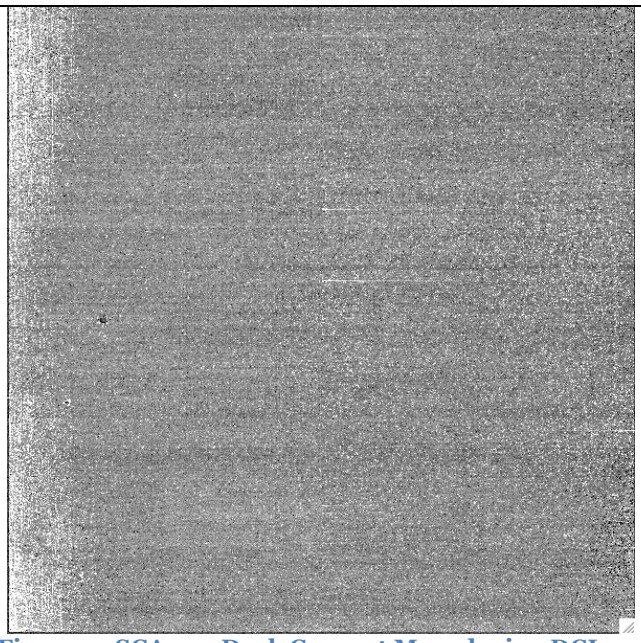


Figure 17 SCA 491 Dark Current Map during DCL testing.

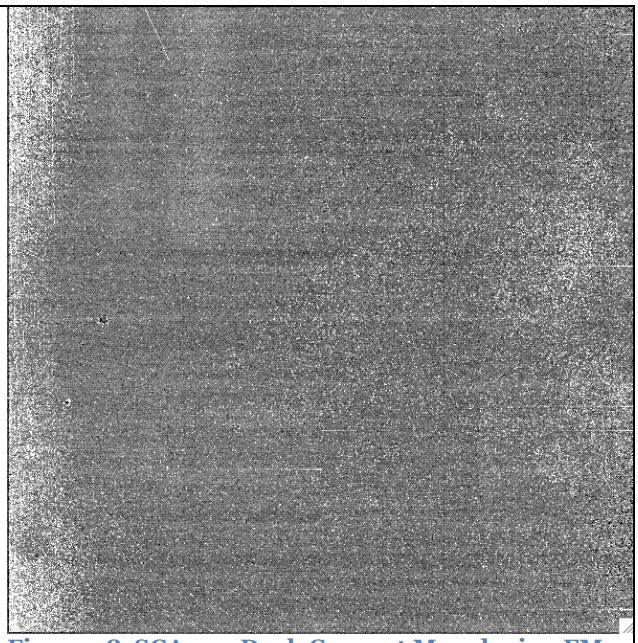


Figure 18 SCA 491 Dark Current Map during FM1

- Compare **491_dark_hist.png** with the figures below.

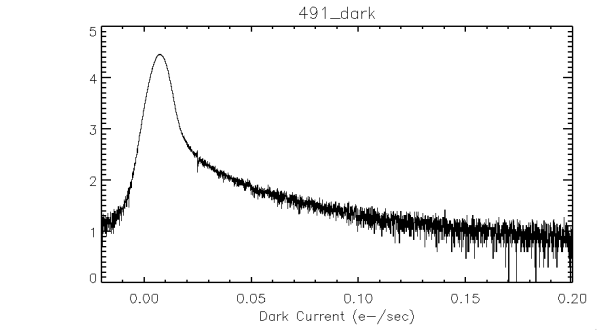


Figure 19. SCA 491 Histogram of Dark Current from DCL data

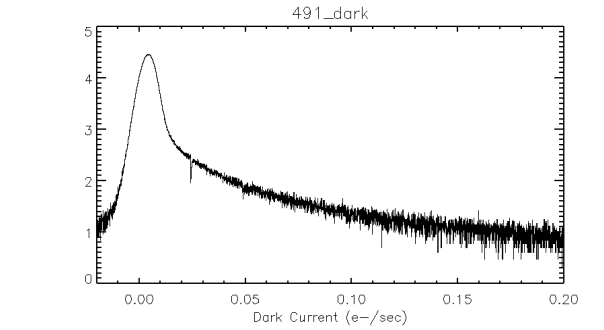


Figure 20 SCA 491 Histogram of Dark Current from FM1 data

- Compare **491_dark_quad_hist.png** with the figures below.

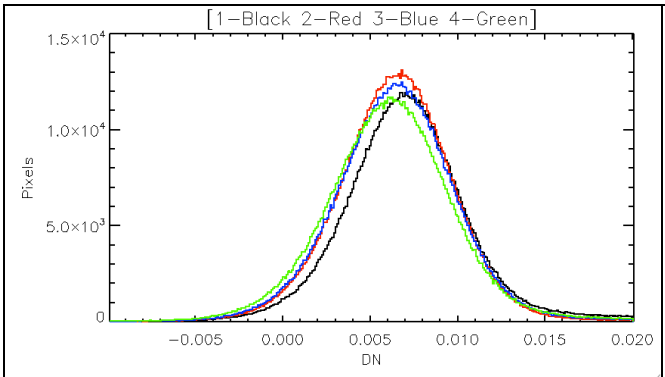


Figure 21. SCA 491 Histogram of Dark Current output by output from DCL data

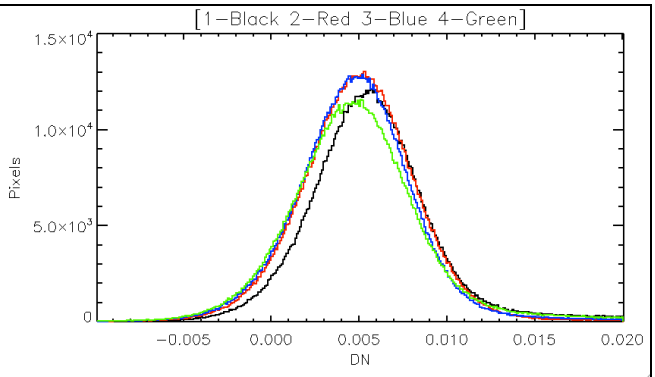


Figure 22 SCA 491 Histogram of Dark Current output by output from FM1 data

2.3.2 SCA492

- Compare **492_dark_ima.png** with the figures below.

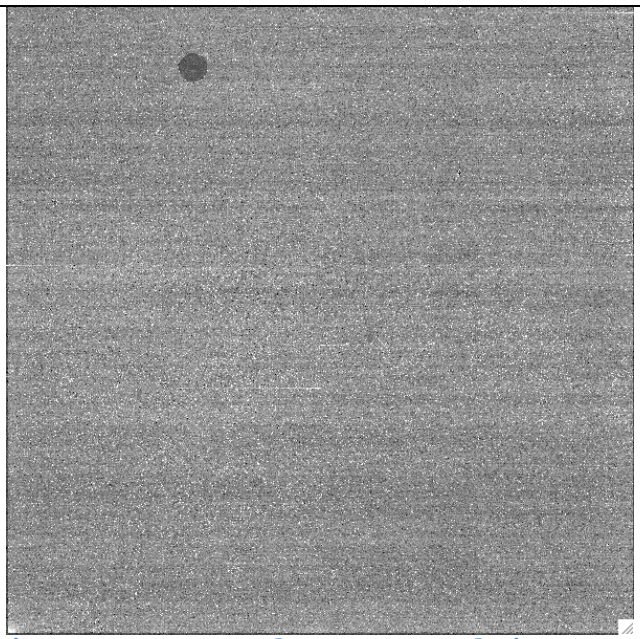


Figure 23 SCA 492 Dark Current Map during DCL testing.

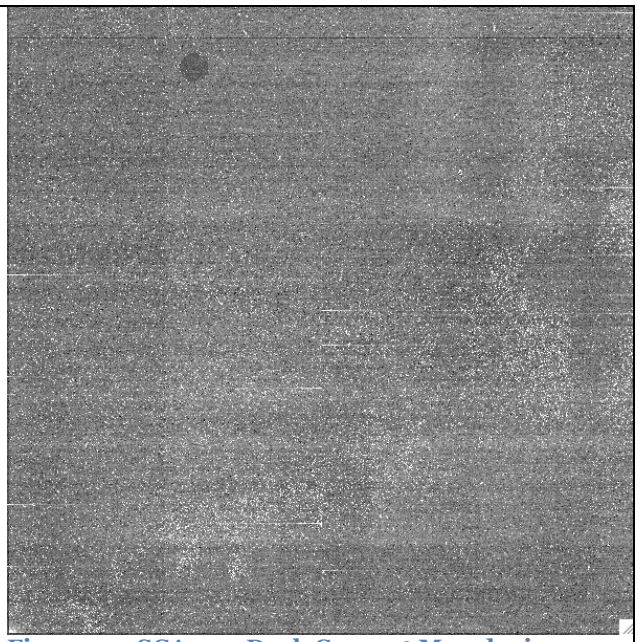


Figure 24 SCA 492 Dark Current Map during FM1

- Compare **492_dark_hist.png** with the figures below.

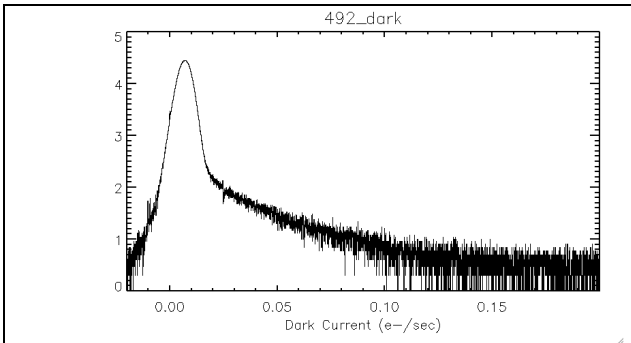


Figure 25. SCA 492 Histogram of Dark Current from DCL data

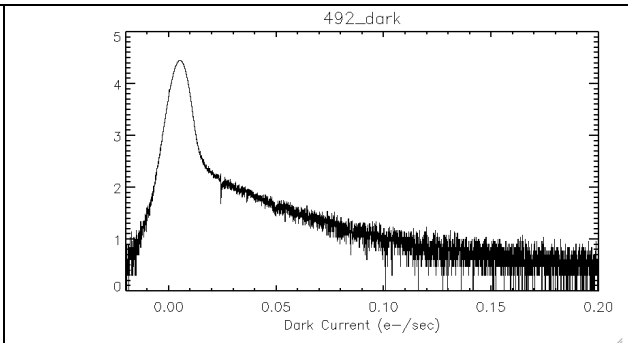


Figure 26 SCA 492 Histogram of Dark Current from FM1 data

- Compare **492_dark_quad_hist.png** with the figures below.

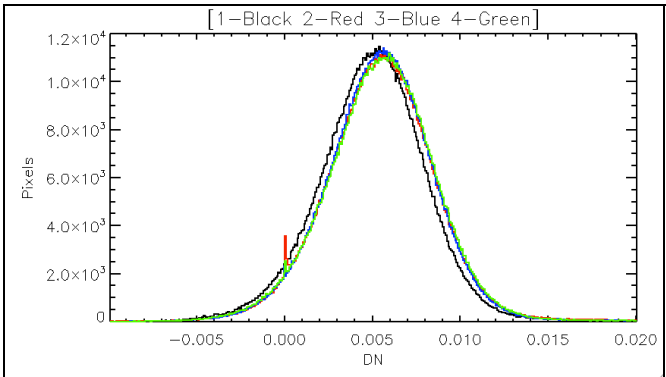


Figure 27. SCA 492 Histogram of Dark Current output by output from DCL data

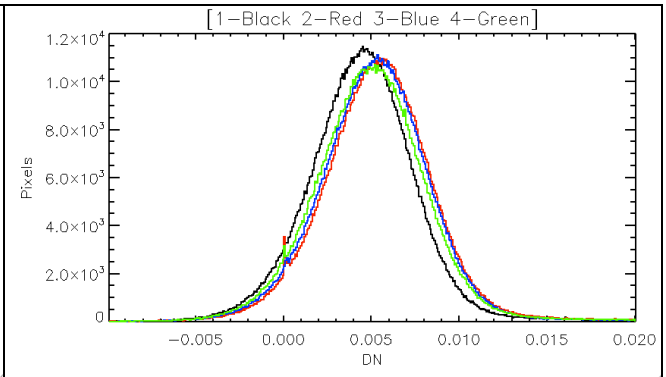


Figure 28 SCA 492 Histogram of Dark Current output by output from FM1 data

2.4 Hot Pixels

2.4.1 SCA491

- Compare **491_hot_pixel_map.png** with the figures below.

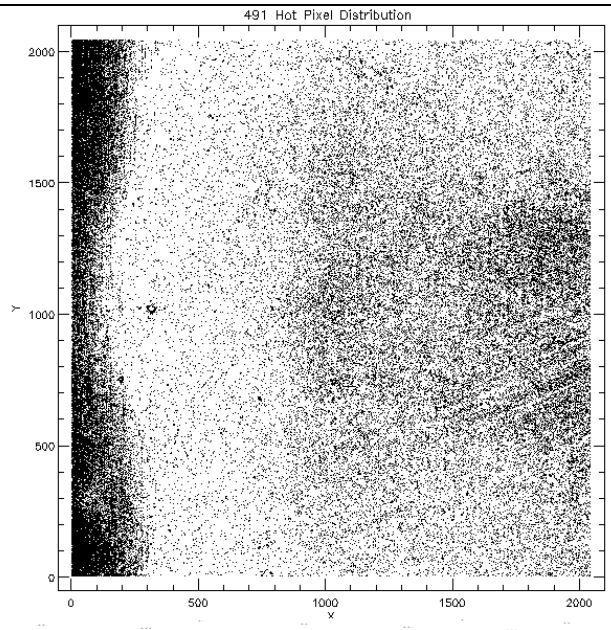


Figure 29 SCA 491 Hot Pixels Map during DCL testing.

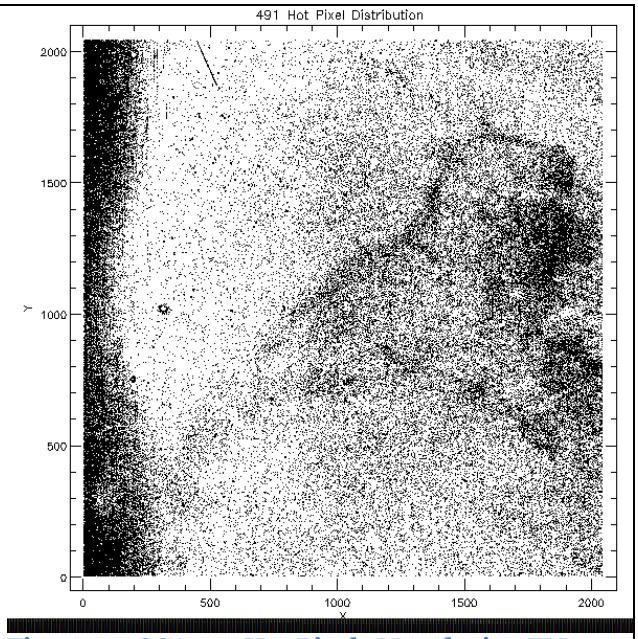


Figure 30 SCA 491 Hot Pixels Map during FM1

- Compare **491_hot_pixels_stat.txt** with the table below.
  The files *_hot_pixesl_stat.txt have two numbers, the one on the top is the total number of hot pixels, the one on the bottom is the percentage.

Table 1 Percentage of hot pixels in 492 data

Environment	% of hot pixels
DCL Data 38.50 K	2.4
FM Data 38.50 K	3.0

2.4.2 SCA492

- Compare **492_hot_pixel_map.png** with the figures below.

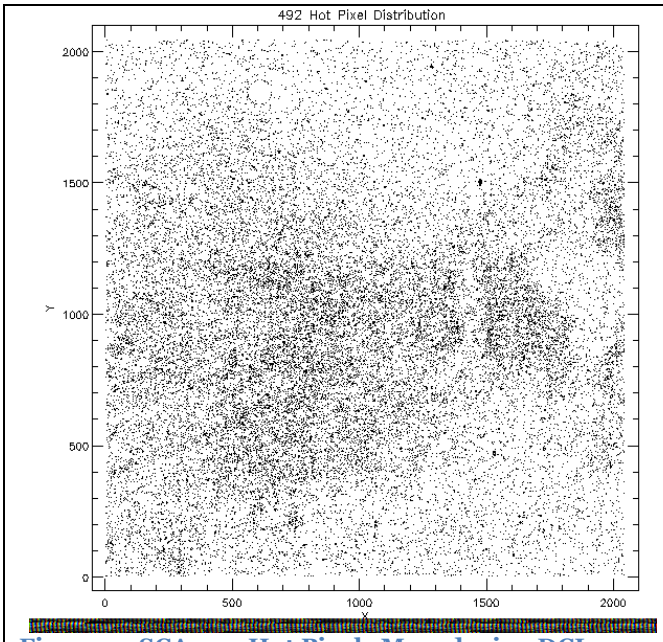


Figure 31 SCA 492 Hot Pixels Map during DCL testing.

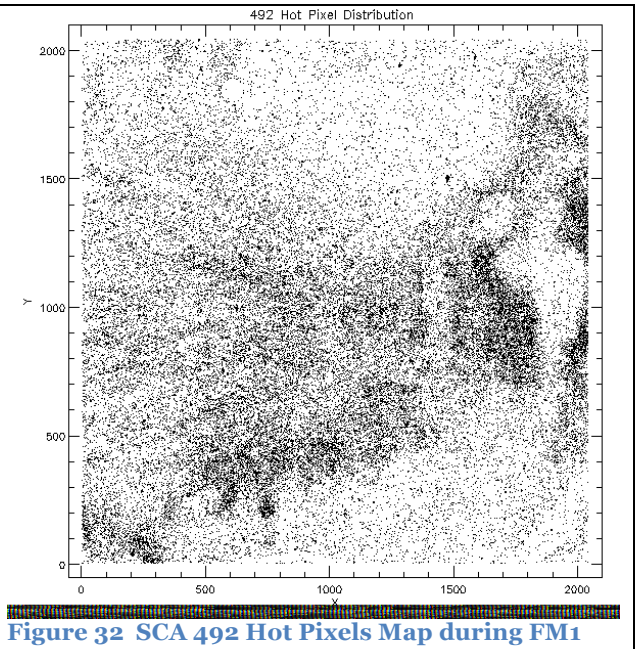


Figure 32 SCA 492 Hot Pixels Map during FM1

- Compare **492_hot_pixels_stat.txt** with the table below.
  The files *_hot_pixesl_stat.txt have two numbers, the one on the top is the total number of hot pixels, the one on the bottom is the percentage.

Table 2 Percentage of hot pixels in 492 data

Environment	% of hot pixels
DCL Data 38.50 K	0.99
FM Data 38.50 K	1.58

3 PREP-DET GAIN MEASUREMENT -

The present section will guide you through the measurement of the detector system gain with data acquired as part of the PREP-DET-CHECK (part 2) procedure.

STEP-1 –create a working directory

```
mkdir TEST_GAIN
cd TEST_GAIN
```

STEP-2- start IDL in NIRSpec mode

```
start_nirspec
```

STEP-3- check if the REF_DATA is defined and point to the proper location

```
print,getenv('REF_DATA')
```

the result should look something like:
/Users/msiriann/Library/Software/JWST_C/var/FPA104_T3850/

If REF_DATA define it as in the following example:

```
setenv,'REF_DATA=/Users/msiriann/Library/Software/JWST_C/var/FPA104
_T3850/'
```

If you are not 100% sure to have the proper set of reference files, move to the proper location and download the most recent set of reference files for the proper FPA and TEMP

```
cd,getenv('REF_DATA'),current=here
copy_reference_files, 104, 38.5
```

be sure to return to the working directory by typing:

```
cd,here
```

STEP-4- if you do not know already the range of exposure to use , start `nar_find` to identify the range of NIDs needed

"TOOL DAY" example: OBS_ID=PREP-DET-CHECK-3 and be sure to select 3 identical exposures, for example NID:4555-4557

```
prep_det_gain_part1,4555,4557,/verbose
```

the program will:

- create a subdirectory DATA and a subdirectory RESULTS

- copy the raw files from the archive to the directory DATA
- run the pipeline and save the process data cube in the directory DATA

STEP-5- once the selected exposures have been processed (note, both SCA 491 and SCA 492 are copied and processed) you can execute the second part of the script.

```
prep_det_gain_part2,sca=sca[,region=region,ngroup=ngroup,,/manu,/verbose]
```

- SCA must be either =1 for 491 or =2 for 492

- If region is not specified and the /manu(al) keyword is not set the full frame will be used for the photon-transfer test. This is applicable only to uniform illuminated exposures, and this is not generally the case for NIRSpec level data.

  Therefore a region should be selected. Either providing it at the command line (CASE A), or inspecting the image end then entering the coordinate of the region at the prompt (CASE B)

CASE A) selecting a known good region (shown here, fixed slit that worked well for FM1)

```
prep_det_gain_part2, sca=491,region=[960,970,1285,1918],/verbose
prep_det_gain_part2, sca=492,region=[1029,1060,1200,1700],/verbose
```

CASE B) inspecting the image with DS9 and entering region's coordinate at the prompt

```
prep_det_gain_part2, sca=491,/manu,/verbose
prep_det_gain_part2, sca=491,/manu,/verbose
```

in this case DS9 will be opened and the countrate image of one of the input exposures will be displayed for inspection. Select a region fairly clear from many cosmetic defects and insert the coordinates of the corners of the region as prompted.

- NGROUP=
  The script will use by default all the group in the exposures. If however saturation is reached a smaller number of groups should be used. The keyword ngroup should be used to specify the maximum number of groups to be used.

3.1 OUTPUTS:

The gain will be displayed on the terminal output:

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Wed Oct 10 09:56:51 2012 *** PREP_DET_GAIN_PART2.PRO - RESULTS
 - SCA 492
 REGION:     1029    1060    1200    1700
 measured GAIN (e-/DN): 1.51405
 GAIN Corrected for IPC (e-/DN) :1.38853

 results saved in :/Users/msiriann/Desktop/PREP_DET_SCRIPTS/GAIN/RESULTS/ :
Gain_SCA_492_20121010095651.txt
Gain_SCA_492_20121010095651.png
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

Figure 33 – screen output of PREP_DET_GAIN_PART2.pro

and the linear fit will be displayed in a graphical window:

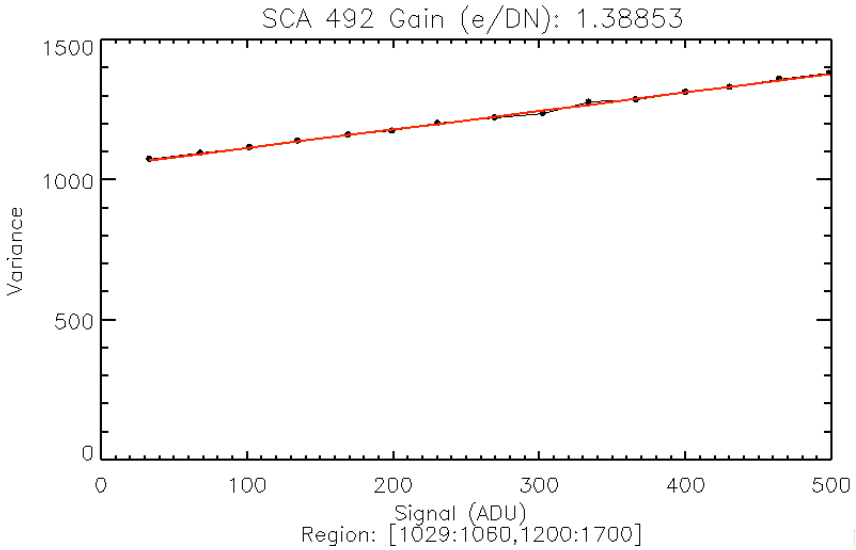


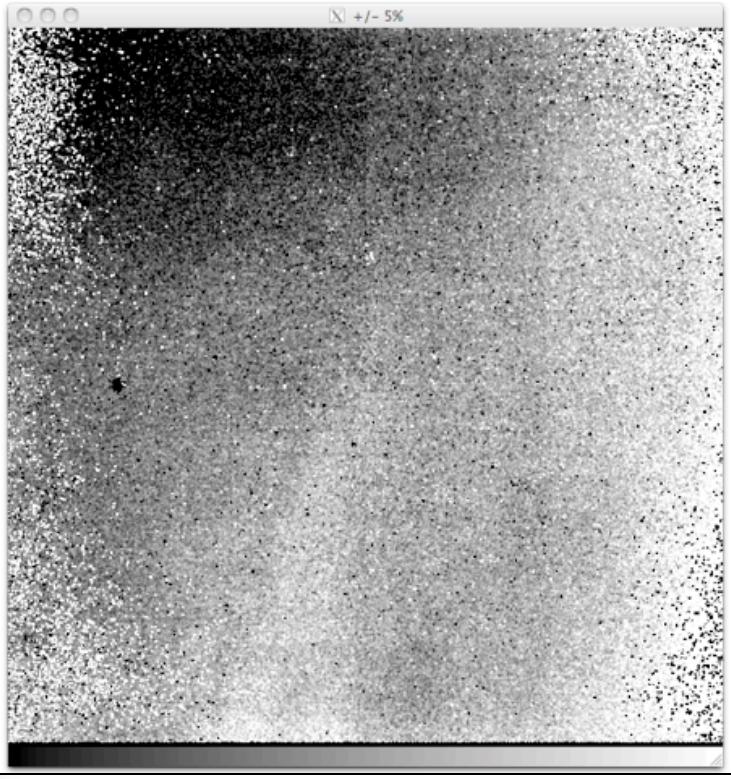
Figure 34. Photon Transfer plot and fit, output of PREP_DET_GAIN_PART2.pro

The results are saved in two files as indicated in the text on the termina. They are located in the ./RESULTS subdirectory of the working directory and their name have a time stamp:
Gain_SCA_492_20121010095651.txt
Gain_SCA_492_20121010095651.png

What to expect:

DATA from DCL have been used to determine the GAIN with the photon transfer test both temporally (pixel-to-pixel) gain or spatially (standard gain). The results are in good agreement. There is however indication of spatial variation in the gain (see figures 3 and 4) and therefore you may have different results depending on where you select your region.

For the propose of this test, you should expect agreement with DCL results at levels of 15-20% .



FPA 104

SCA 491

Temp 38.50K

Average Gain 1.45 e-/DN

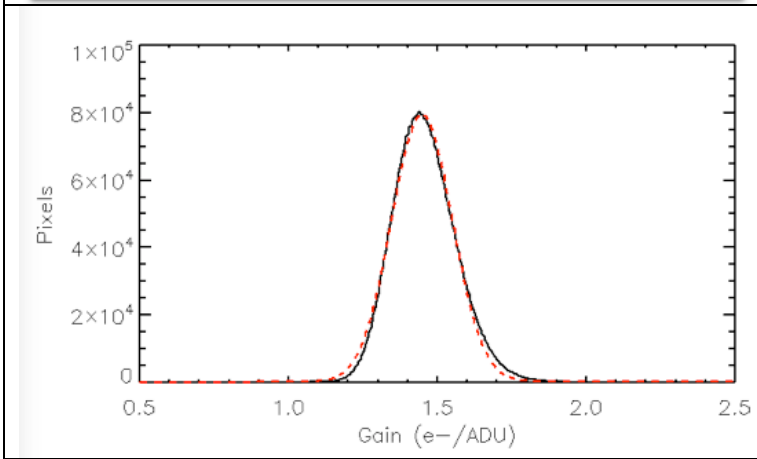


Figure 35. Gain Measurements for SCA 491 from DCL data.

<table>
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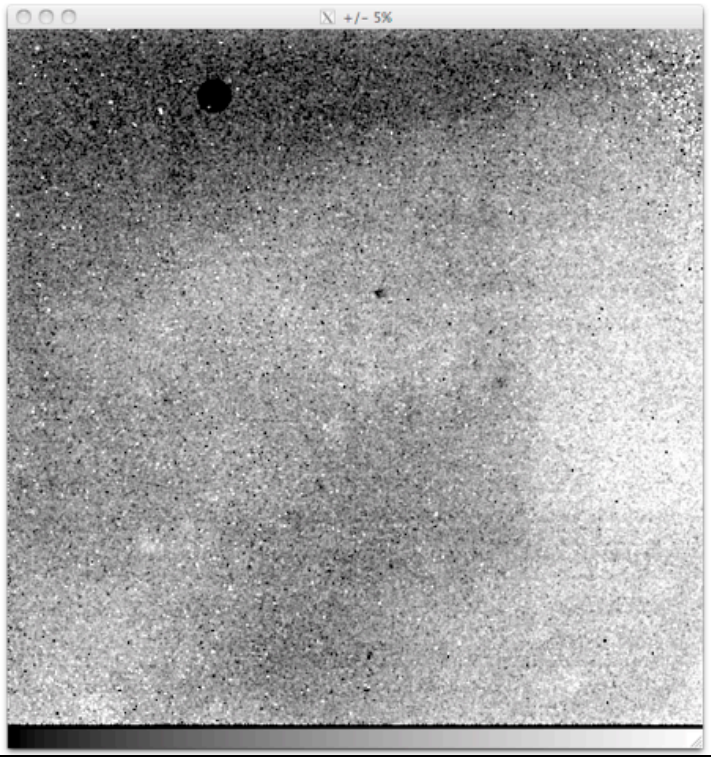
<td> 
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<td>FPA 104
SCA 492
Temp 38.50K
Average Gain 1.34 e-/DN</td>
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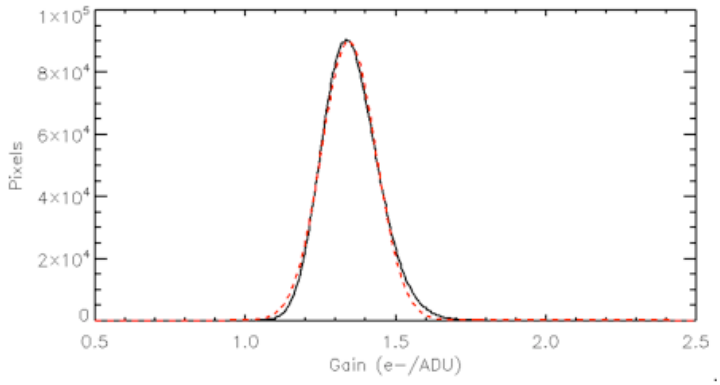
<td> 
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Figure 36. Gain Measurements for SCA 491 from DCL data.