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NIRSpec Technical Note
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Features and Anomalies in cycle-1 Data

Abstract:

We describe some of the anomalies and features encountered so far in cycle-1 data.

1 INTRODUCTION

In the spring 2010 the NIRSpec Flight Module went through the first TV characterization in IABG-Germany. Some anomalies and features have been detected in data acquired during this cycle-1. In most cases the root cause has been indentified and a fix or mitigation has been set in place for cycle-2. This document only briefly describes the manifestation of the anomaly in the data. More detailed analysis and characterization will be presented in follow-up reports.
At the time of writing this report the analysis of cycle 1 data is still ongoing and new features or anomalies will likely be discovered. Should the reader encounter anomalies on cycle-1 data that are not described in this document, he/she is strongly encouraged to check the content of the log file created during the calibration campaign [IDL command, **log_to_nid**, *NID*] and to contact the ESA JWST Science Operation Team (SOT) @ jwst@rssd.esa.int.

1.1 Instrument configuration during cycle-1

1.1.1 Detectors system

Channel	SCA	ASIC
491	FPA#104- SCA055	S/N 202
492	FPA#104-SCA054	S/N 215

1.1.2 MSA

During this first cycle [cycle-1] the MSA was not operative due to the infamous fiber contamination. It was however possible to move the MSA magnet arm back and forth between its PARK (default park position with the IFU aperture blocked) and LAUNCH (default launch position with the IFU aperture unblocked) positions.

2 BIAS ANOMALY

During the first phases of the cycle-1 calibration campaign the output #1 of both SCA491 and SCA492 showed an anomalous bias drift when compared with exposures taken at GSFC/DCL or later during the cycle-1 campaign (see Figure 1 and 2). Exposures with NID < 4185 show this anomaly. While the cause is still unknown, a space wire crash occurred on Feb 03 2011 marked the disappearance of this anomaly. The bias frame created using exposures with NID > 4585 after the recovery from the crash resembles very closely the one derived from data taken at DCL and has been used to create the reference files for the pipeline.
Exposures with NID < 4185 should therefore either discarded or used with cautions. Due to the differences in the bias drift the exposures with NID < 4185 are not properly bias subtracted by the pipeline and the resulting count rate image will show an imprint of the subtracted super-bias.

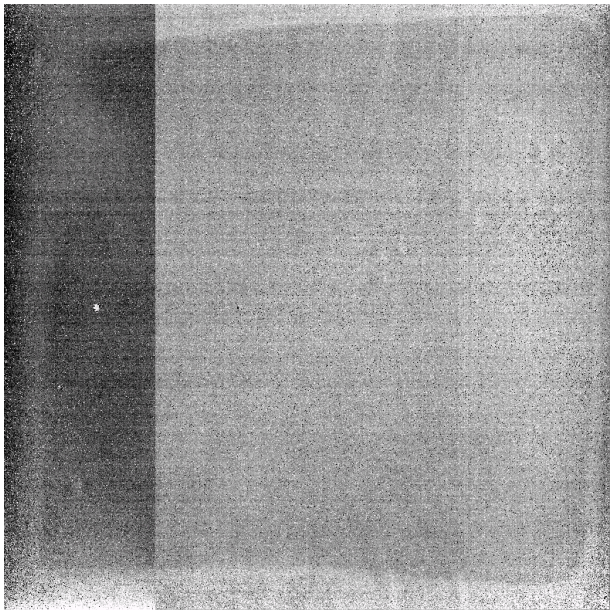

Figure 1 - Difference between bias frame during the first and second phase of cycle-1 for SCA491

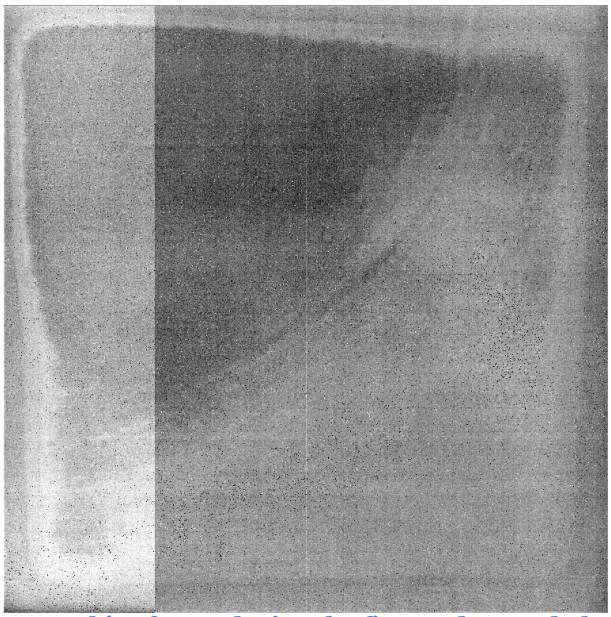

Figure 2 - Difference between bias frame during the first and second phase of cycle-1 for SCA492

3 PERSISTENCE IN DARK FRAMES

Due to their proximity in time to illuminated exposures, most of the dark exposures part of the routine monitoring procedure MON-DET-DARK-SHORT are affected by persistence. Figure 3 shows the count rate measured at the location of one fixed slit after subtraction of the local background. Each point in the figure marks the NID of the exposure. All five runs of the procedure [NID 4276-4280, 5202-52011, 5228-5232, and 6025-6029] have been affected by persistence at some degree. Additional dark exposures taken as part of the procedure FILL_DET_DARK-SHORT starting from NID=6263, also shown in the plot, are not affected by persistence.

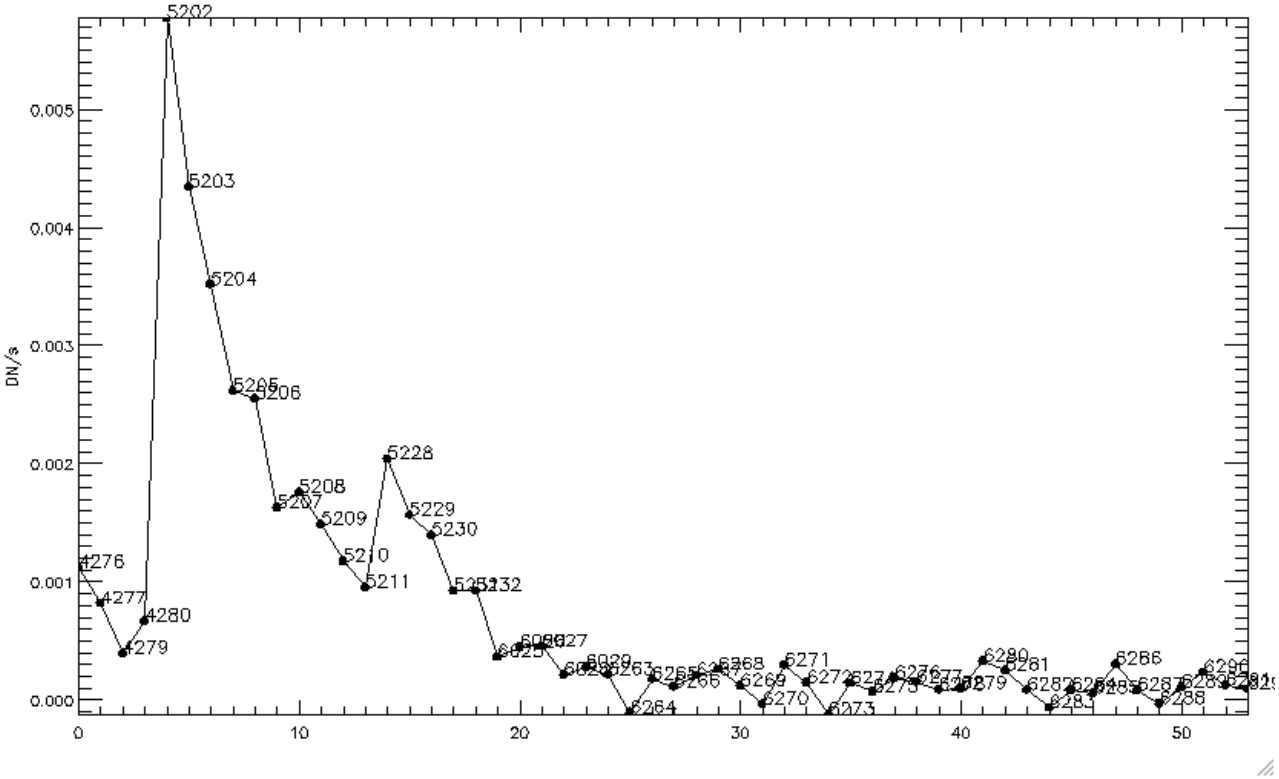

Figure 3 - Countrate in dark exposures contaminated by persistence

4 GHOST

A diffused and stretched optical ghost due to reflection of zero order light at the edge of one of the CAM mirrors appears in band I and partially in band II high spectral resolution exposures. In MOS mode this ghost impacts the band I (Figure 4) and Band II (Figure 5) configuration at a ~4% and < 1% level respectively. In IFU mode the same grating configurations are affected but the impact is higher when compared to the MOS mode (up to ~10% level) because of the relative faintness of the IFU spectra. The ghost is not visible in band III.

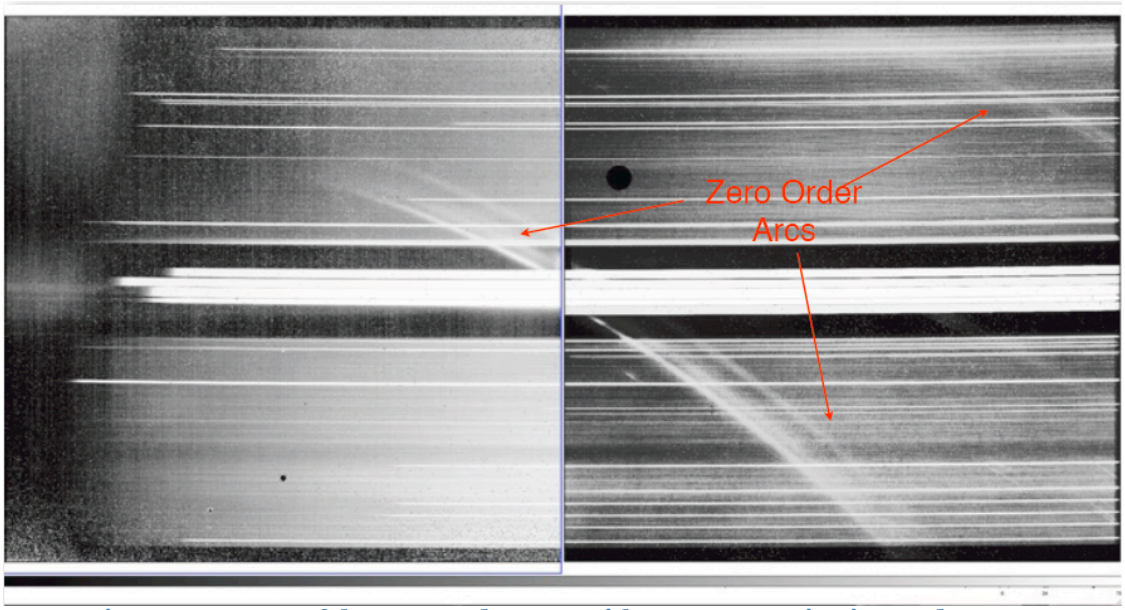

Figure 4 - Image of the Zero Order Arcs with R=2700 Grating in Band I- MOS

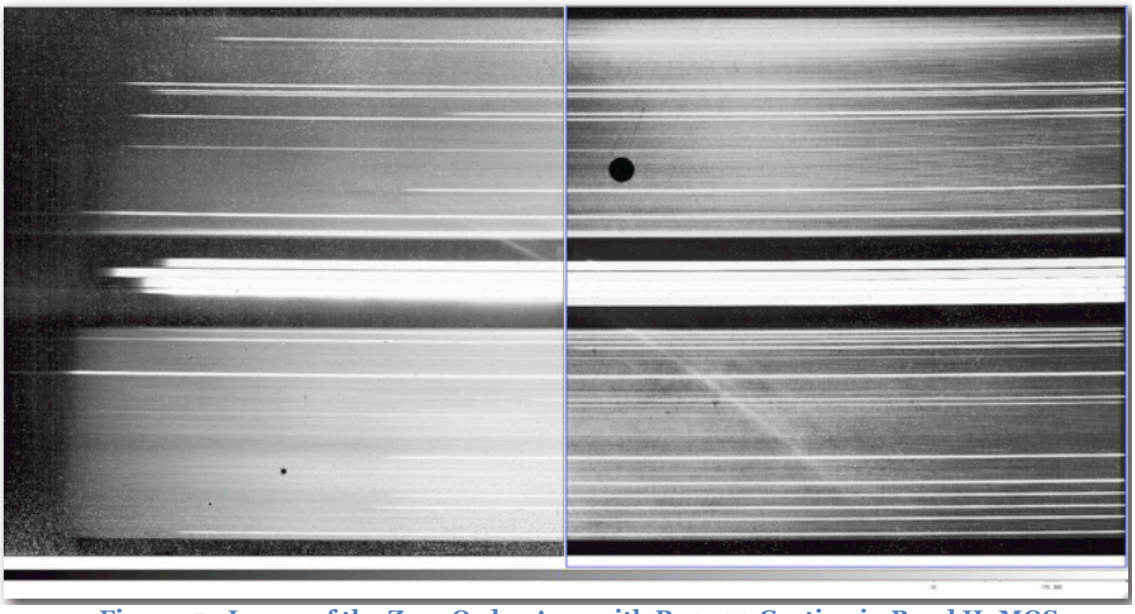

Figure 5 - Image of the Zero Order Arcs with R=2700 Grating in Band II- MOS

5 CHARGE DIFFUSION

The analysis of the spectra taken at different illumination intensity has revealed significant charge diffusion at high signal intensities (Figure 6). This effect was not observed or characterized at DCL level because data acquired at GSFC had quite homogeneous illumination. Charge diffusion results in significant blurring of sharp edges and produces an anomalous linearity behaviour (Figure 7) which is not properly corrected by the current linearity correction procedures of the pre-processing pipeline.

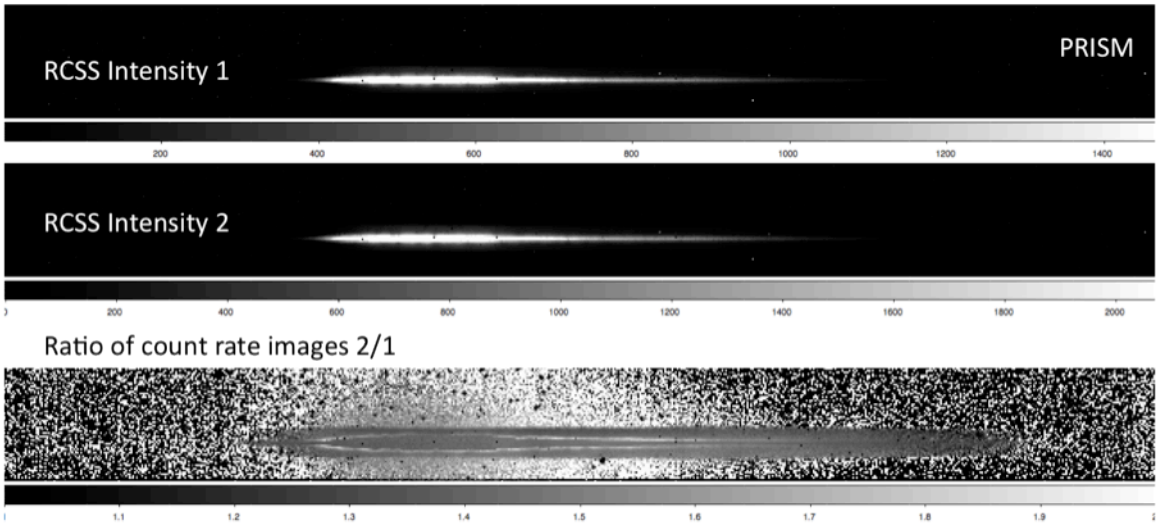

Figure 6 - Effect of charge diffusion on prism observation with the RCSS lamp at two different intensities. The panel at the bottom shows the excess of counts in regions close to the center of the PSF of the spectrum with Intensity 2 .

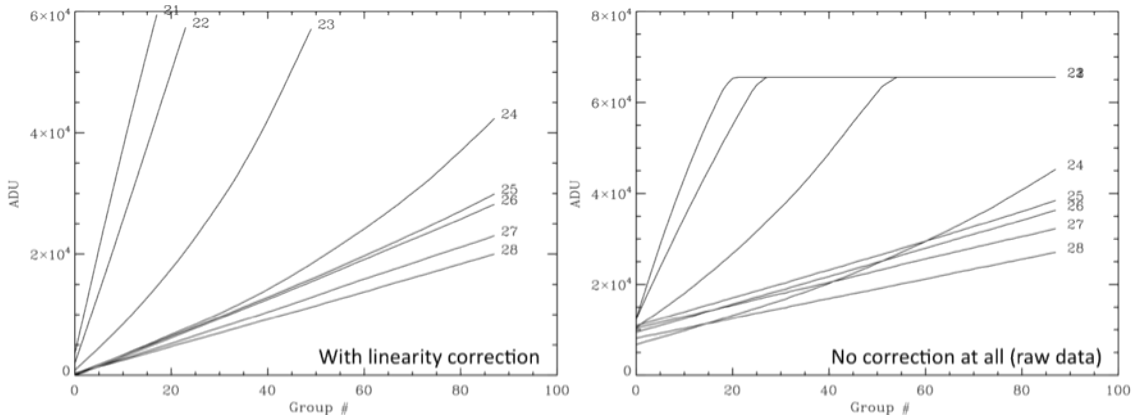

Figure 7 - Signal accumulated during the UTR exposure at the center of the PSF (pixel 21) moving toward the edges of the PSF. The accumulation of extra counts in pixels closed to the peak of the PSF is evident in both raw data (right) and after the pre-processing (left).

6 MSA SUBSTRATE LEAK

The lack of metal coating in some regions of the silicon boards of the MSA quadrants Q1 & Q2 is the main cause of the feature shown in Figure 8. These regions are transparent above 1.5 microns and allow incoming light scattered back by the MSA to be reflected back by the MSA cover and to reach the detector. This feature can appear in imaging mode (Figure 9) or as zero order in dispersed mode (Figure 10).

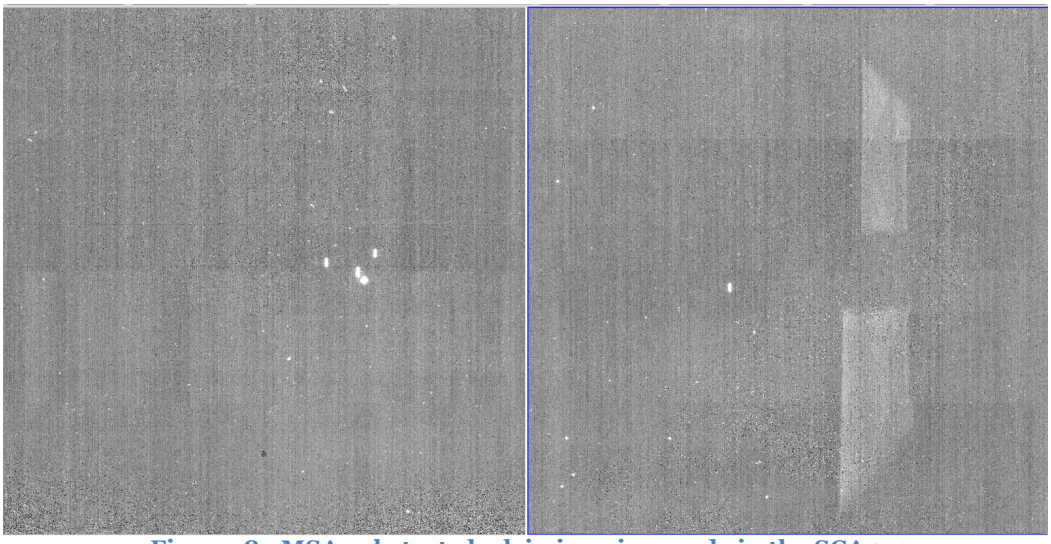

Figure 8 - MSA substrate leak in imaging mode in the SCA492

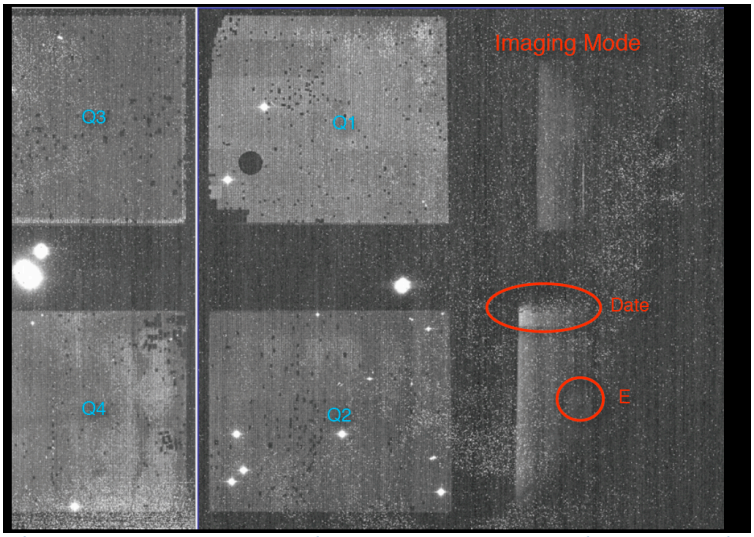

Figure 9 - Portion of the full FPA showing the substrate leak in SCA 492 in imaging mode

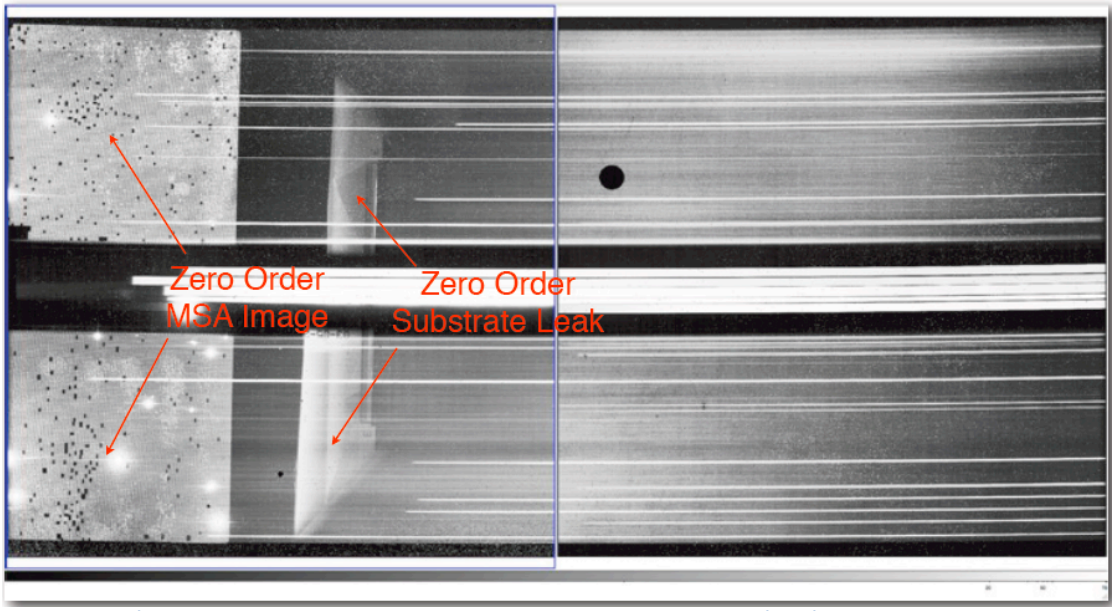

Figure 10 - Substrate leak appearance as zero order in dispersed model.

7 IFU GHOST

In imaging mode under high illumination levels the IFU pseudo slits show a ghost image to their left side (Figure 11). Cause is currently unknown.

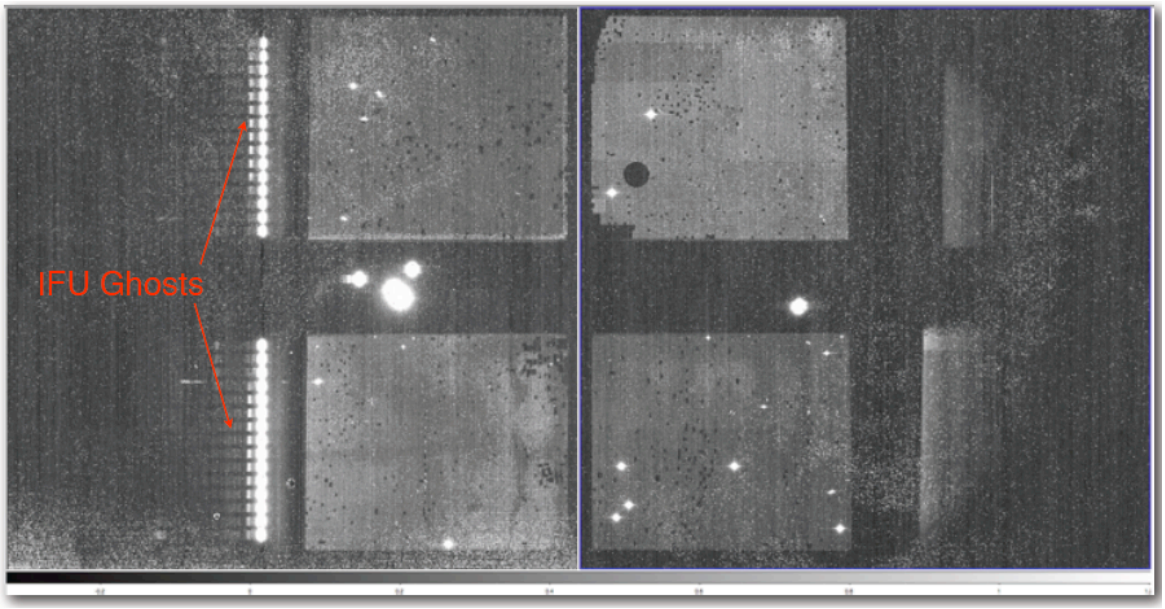

Figure 11 – IFU Ghost in imaging mode

8 INCORRECT EXPOSURE TIME FOR SOME WINDOW MODES

Version 3.5 of the FITSWriter, the one used during the cycle-1 calibration campaign, contains a bug impacting exposures taken in window mode with NROWS=NCOLS=2048. For this type of data the following keywords in the header of the RAW FITS files are populated with an incorrect value:
TGROUP
TFRAME
INTIME
EXPTIME.

There are only six exposures impacted by this bug: NID= 6224,6293,6294,6295,6341,6344.

The pipeline calculates the correct value for these keywords and re-populate the header of the processed count-rate images *.CTS.FITS. The header is also updated in the HISTORY section with the following message:

```
HISTORY Engineering table added with FITSWriter 3.5 on 2011-03-01
HISTORY The exposure times (TSAMPLE, TFRAME, TGROUP, INTTIME, EXPTIME) have been
HISTORY updated by the processing pipeline and might differ from the original
HISTORY raw data header
```

No modification is done to the header of the original raw fits file.

In previous versions of the FITSwriter this bug applied to all exposures in window and stripe mode. As a consequence, in order to ensure backward compatibility, by default the pipeline re-calculate the value of the above listed keywords for all exposures in window and stripe mode.

9 SNOWBALLS

As in the case of data acquired at GSFC/DCL few exposures feature snowballs in the image. Snowballs have been so far detected in exposures: 4543, 5229, 5410, 6518.

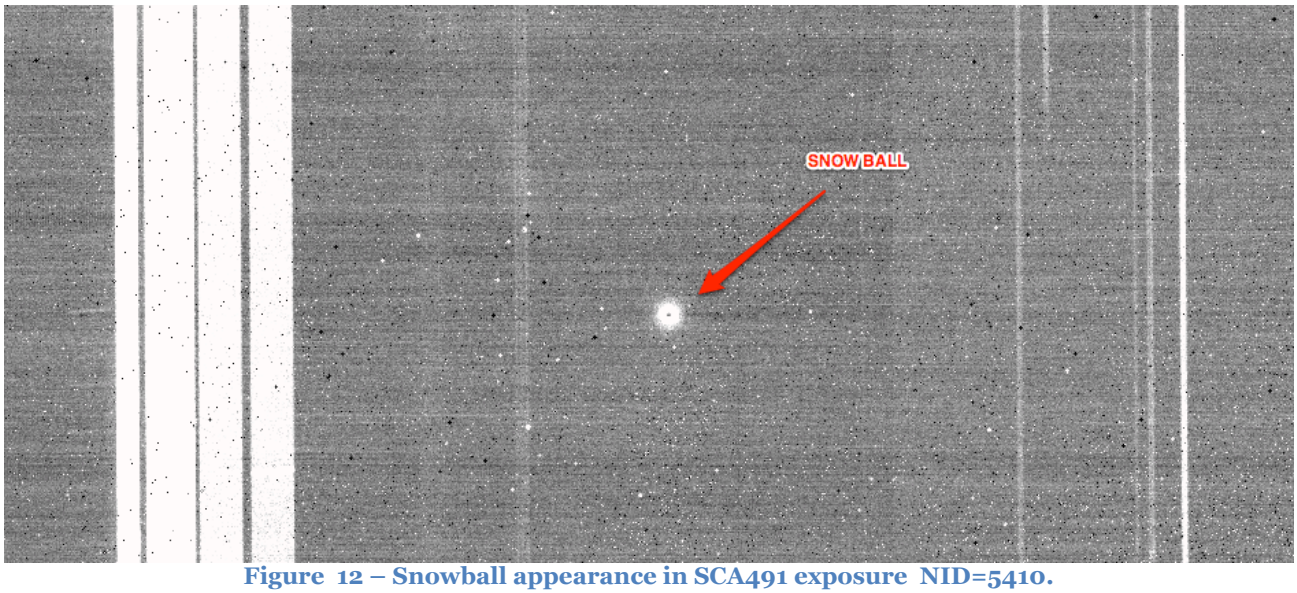

Figure 12 – Snowball appearance in SCA491 exposure NID=5410.

10 OTHER COSMETIC DEFECTS

The exposure NID=4627 shows an anomalous halo around an open pixel.

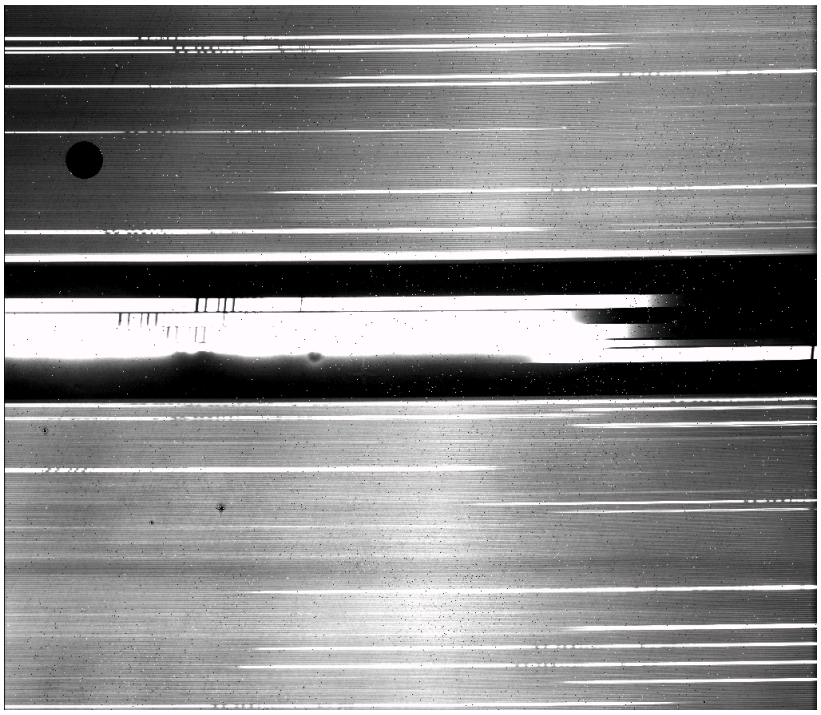

Figure 13 - SCA 492 of NID=4627 showing the cosmetic defects in the center of the frame.

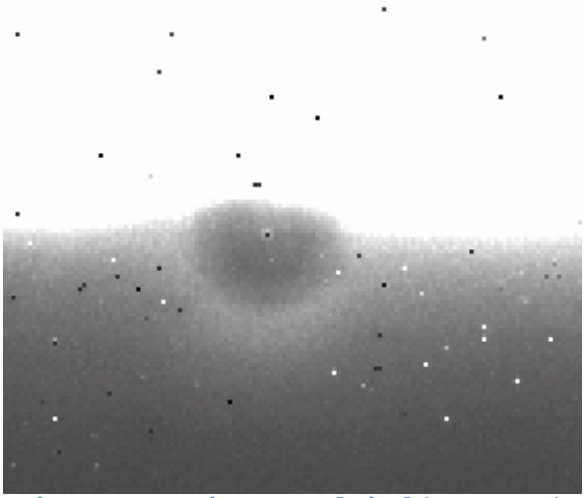

Figure 14 - Region around pixel (1096,1268)

11 MISSING EXPOSURES

At the time of writing the following exposures are missing. In some instances the exposures are missing from the ESTEC archive but are present in the ESA Archive in EADS and will be retrieved at the first opportunity.

DAY	NID	Notes
2011034	4185	SITS crashed
2011035	4278	Failed Exposure
2011041	5054	Missing - unknown cause, log reports absence
2011042	5135	Missing - unknown cause, log reports absence
2011054	5948	Missing – unknown cause, log reports absence and notes that 5947 is missing the exposure from one SCA/ASIC
2011055	6157-6159	Missing from ESTEC archive, present in log- warm up exposures
2011055	6160-6162	Missing – unknown cause, not in log
2011056	6163-6165	Missing from ESTEC archive, present in log- warm up exposures
2011056	6177	Missing – unknown cause, not in log
2011061	6496-6522	Missing from ESTEC archive, present in log
2011061	6745	Missing from ESTEC archive, present in log