GMOS-S imaging and longslit with bad amp#5

GMOS CCDs have been in a bad state (abnormally high counts on amp #5, plus noise structures on the rest of CCD2) after the uncontrolled warmup caused by the general power failure at CPO on January 28th. Since then a series of controlled thermal cycles (plus dewar vacuum pumping) have been attempted, with no success, unfortunately. This procedure had worked in the past most of the time; which had enabled us to resume normal operation within a couple of days at most. But now has been failing consistently over the last two weeks, which might indicate something more severe affecting this time. An intervention is being planned, in order to to permanently solve the issue. In the meantime, we looked into the possibility of resuming observations in a "limited" mode - for some use cases, data taken in this status would still be usable for science.

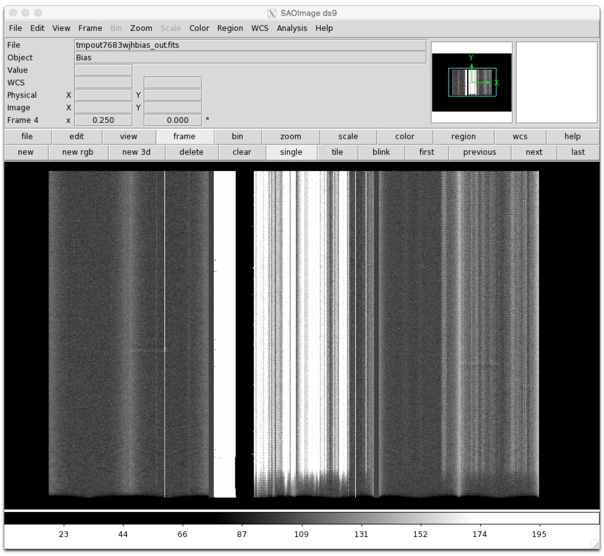
Imaging mode

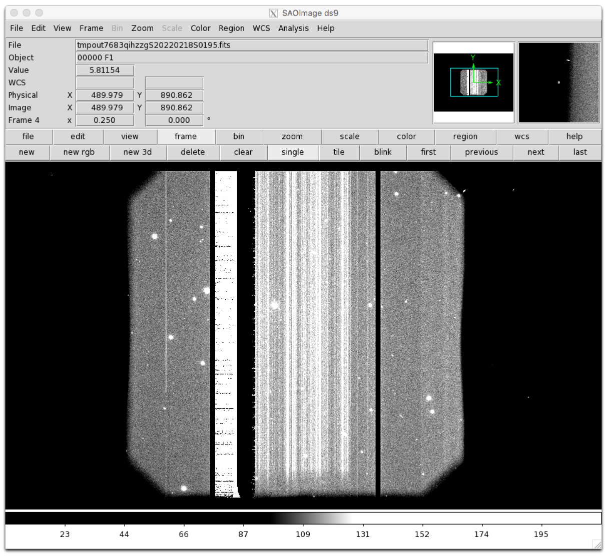
The options are:

1. do without the information on amp#5, if this is acceptable for the science case, or:

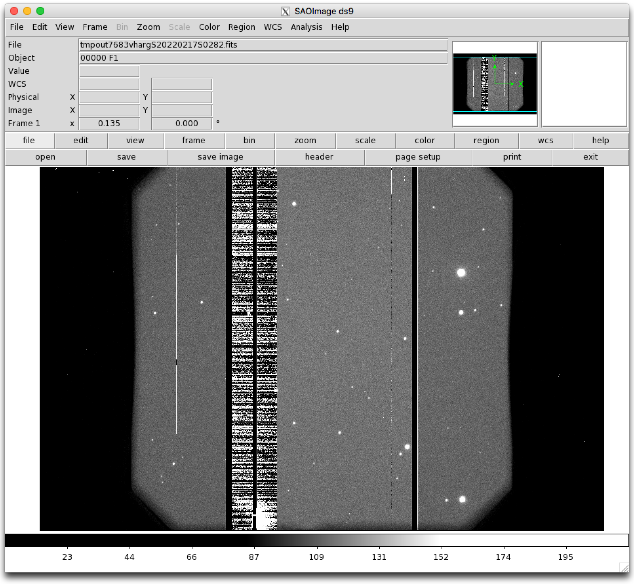
2. modify the observing strategy: dither in P in order not to lose information and mask amp#5 as if it was a broad ‘gap’.

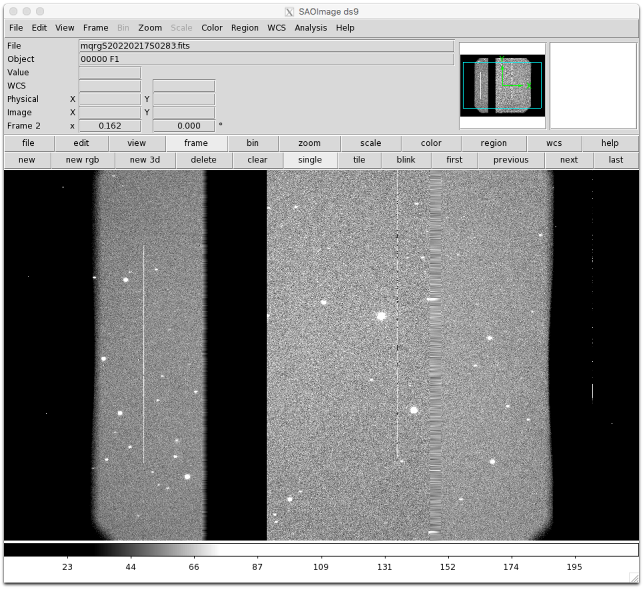
Biases taken *after* Feb18 are needed for reduction. Examples of a bias and an on-sky image are shown below:



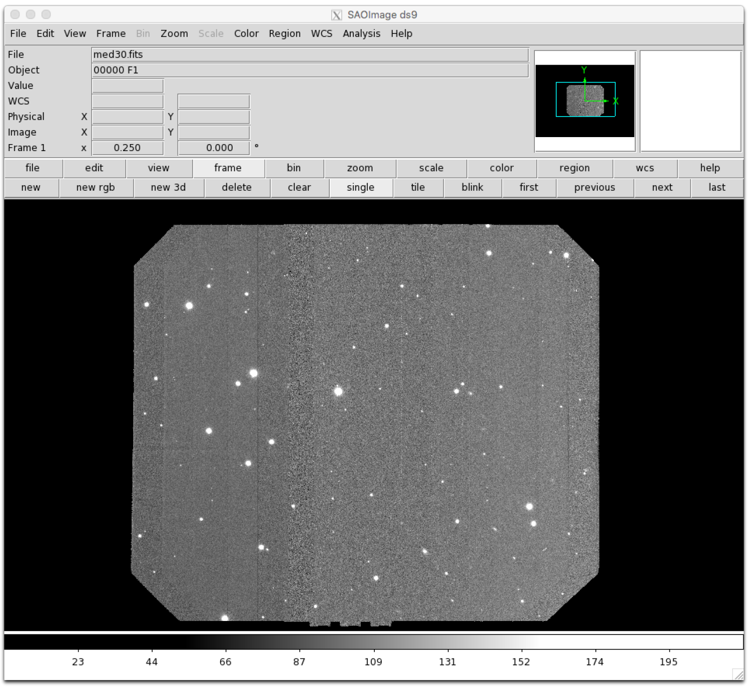


The noise structures are present in both CCD2 and CCD3, and counts on amp#5 (on the left left of CCD2) are close to saturation. By subtraction the bias from the image, the noise structures subtract very well, but amp#5 is completely unusable (figure below, left). One can simply mask amp#5 (in iraf: imreplace image.fits[5] 0.). This can work for e.g. imaging of a single point source (image below, right), and corresponds to option 1 above.



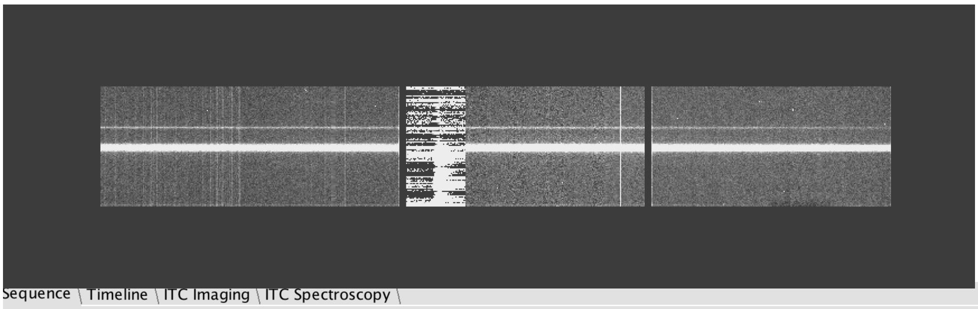


Option 2 is to use use an observing sequence consisting of a dithered imaging sequence with offsets P = 0, +30 , - 30 arcseconds. (Note: this will -in general- restrict the availability of guide stars to some extent). Therefore we end up with three images; when combined, we make up for the missing amp5 data of the original P=0 image, and all the FOV is recovered (note that the data will be slightly noisier at the loci of the fringes)



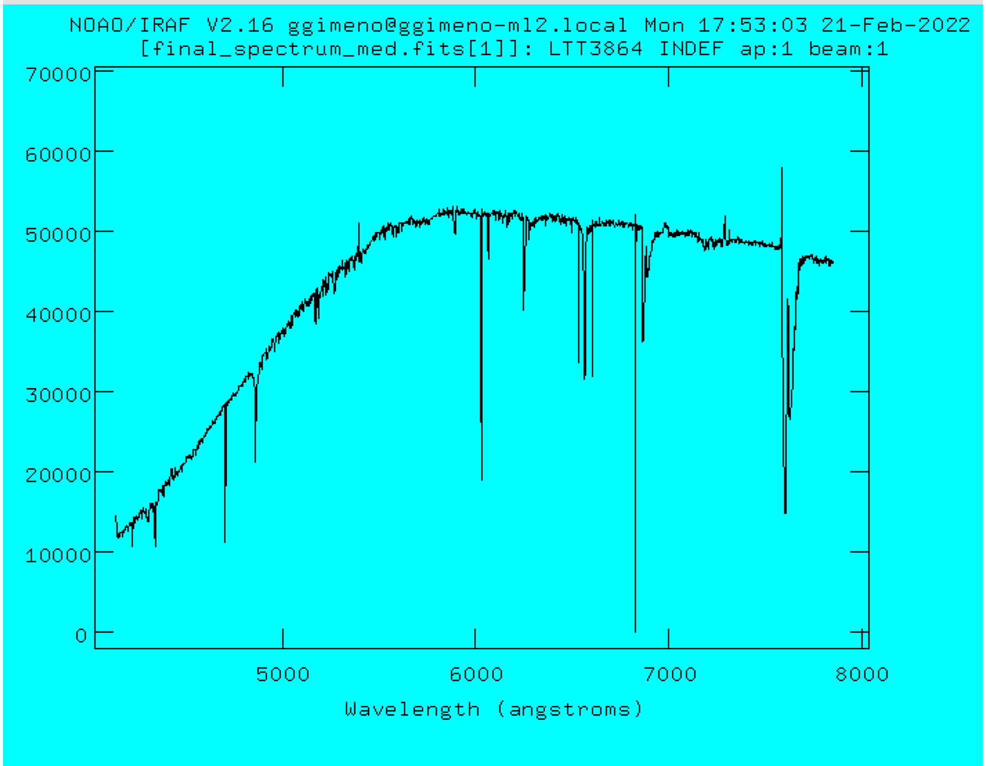
Longslit mode

The idea is the same, only that instead of offsets in P, we need offset in wavelength in order to compensate for amp#5 gap. The minimum amount of offset will depend on the grating used and the central wavelength. The image below shows an example of a spectrum of a standard star, observed with B600, at (600nm +/- 30nm) central wavelengths. This was enough for this particular setting. The figure below shows the single 600nm spectrum, the snapshot of the OT sequence and the final reduced, combine spectrum.



Sequence | Timeline | ITC Imaging | ITC Spectroscopy

Data Label	Class	Exposure Time	Disperser Lambda	Observing Wavelength	Object	Observe Type
GS-ENG20220219-16-001	Nighttime Partner Calibration	3.0	570.0	0.570	GCALflat	FLAT
GS-ENG20220219-16-002	Science	60.0	570.0	0.570	LTT3864	OBJECT
GS-ENG20220219-16-003	Science	60.0	600.0	0.600	LTT3864	OBJECT
GS-ENG20220219-16-004	Nighttime Partner Calibration	3.0	600.0	0.600	GCALflat	FLAT
GS-ENG20220219-16-005	Science	60.0	630.0	0.630	LTT3864	OBJECT
GS-ENG20220219-16-006	Nighttime Partner Calibration	3.0	630.0	0.630	GCALflat	FLAT



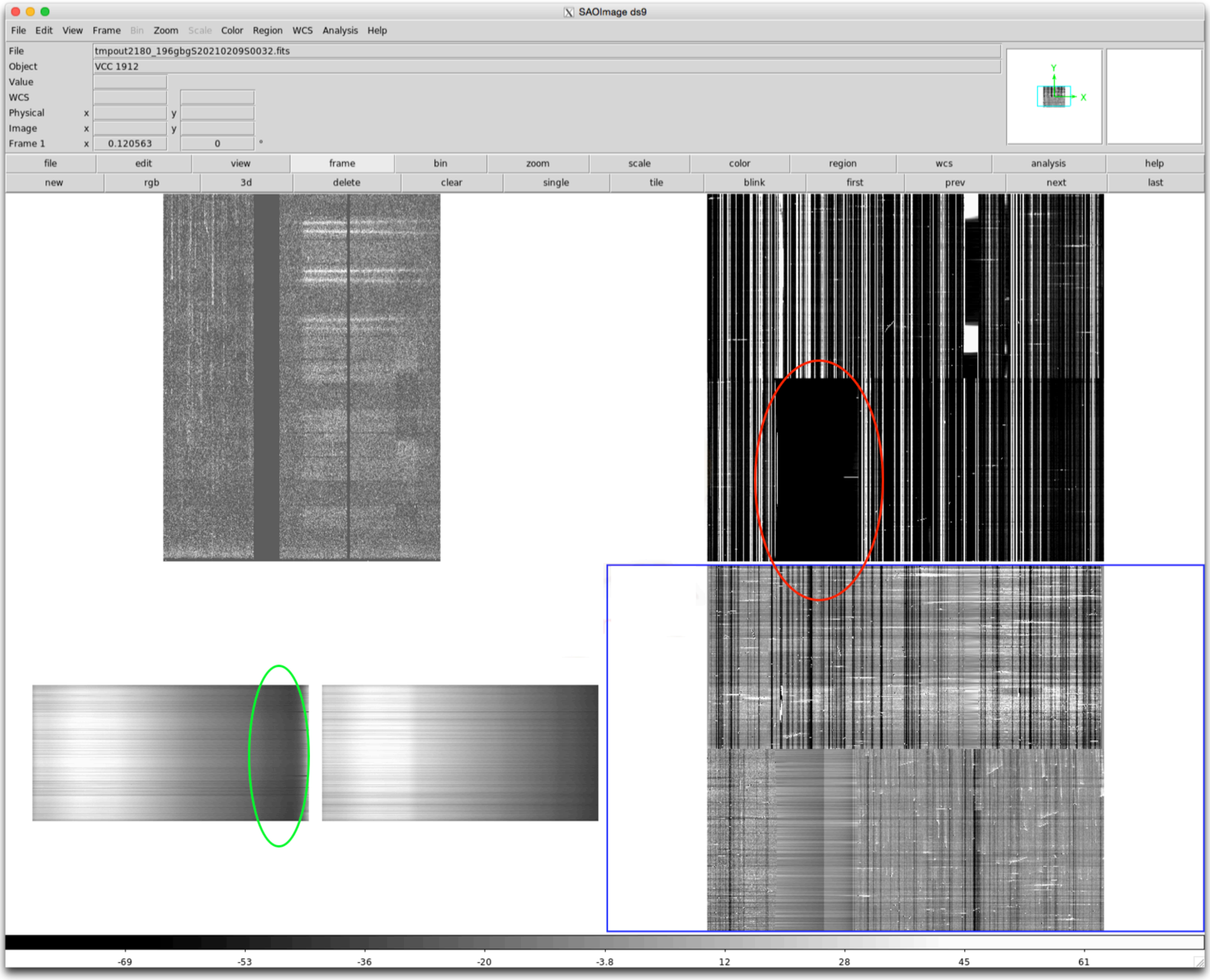
IFU mode

The dithering strategy works also in IFU-R (in all tests done so far) and in some IFU-2 as well. With IFU-2, the situation is more severe since the lost spectral interval is a bigger portion, therefore the wavelength calibration is more likely to fail for the red slit.

The figure below shows an example of a successful IFU-2 data reduction (B600 grating, central wavelength 478nm). Note the missing spectral interval corresponding to the amp#5 in the raw data (top left), and the extracted, calibrated arcs (top right, red ellipse).

The extracted GCALflat are shown on the bottom left, the green ellipse shows the location of the amp5 on the red slit fibers, after interpolation across the gap (*)

The extracted science data is shown at the bottom right. Where the amp5 has been interpolated also.



(*) This is achieved by modifying the "chipgaps.dat" file called by the task 'gmosaic'. The easiest way is to build a local copy of this file (call it e.g. 'chipgaps_amp5.dat') with the contents:

```
# GMOS-N old ccd chip gaps, unbinned after gmosaic
2046 2086 1 4608
4133 4176 1 4608
# GMOS-S new ccd chip gaps (Hamamatsu), unbinned after gmosaic #hcode
2025 2622 1 4176
4140 4240 1 4176
# GMOS-N Hamamatsu, unbinned after gmosaic
2032 2130 1 4176
4147 4245 1 4176
```

where all we did is to specify a broader 'gap' between CCD1 and CCD2 (2025 2622). Then we tell gmosaic to use this file by specifying

```
bpmfile = "./chipgaps_amp5.dat'
```

and make sure you specify

```
fl_fixipix = "yes"
```

in this way we activate the interpolation across the whole amp5.