Gemini Task Turnaround Notes

Kevin Cooke

August 17, 2021

The data for our fast turnaround program GN-2021B-FT-201 [1] uses the Gemini Observatory Archive (GOA) and the data can be downloaded once you've set up a profile and attached this program to your profile. To do so, go into My Programs on the Archive, and use the following to link your profile to our proprietary data: program ID is GN-2021B-FT-201, and key=DCTRX. Once the program has been linked you can download the observations whenever you want.

As of Aug 17, 2021, only CQ 507 and some of its calibrations have been observed. CQ 4472 and the standard star for our program have not been observed. To understand what each data type shown in the archive mean, check `http://www.gemini.edu/observing/phase-iii/understanding-and-processing-data`.

As the python data reduction suite for Gemini, DRAGONS, does not have a public release for spectroscopic reduction, we'll have to use the Gemini GMOS IRAF package `http://www.gemini.edu/observing/phase-iii/understanding-and-processing-data/Data-Processing-Software`. This requires a Python 2.7 environment and the capacity to run 32-bit libraries (a.k.a. Mac OS X 10.10 to 10.14.0). I used an old astroconda environment to do this. If your Mac is too new, you'll have to use a virtual machine hosted by Gemini (`https://gemini-iraf-vm-tutorial.readthedocs.io`). Or you can always ask your friendly neighborhood collaborator to do it for you.

There are several example scripts that I used to base my own (gmos_ls_proc_Cooke.cl). My script is located in the raw data folder, while the original template supplied by Gemini (`http://ast.noao.edu/sites/default/files/GMOS_Cookbook/Processing/IrafProcLS.html`) is kept as a backup at the top of the tar'ed directory structure. For more details on the steps performed by the example script, see the previous link for a description of how the script uses header search terms to build lists of files to act on. For example, there are search commands for finding science exposures, biases, and arcs. Then the list of these files are taken as input for the Gemini reduction pipeline. 2 issues have cropped up during this process. First, is that we lack the standard star so that commands are commented out. Second, there appears to be a glitch in the bias construction task gbias due to how to handles fits extensions (from what I can tell by the bug's link to the task gemextn). Therefore I used the prepared *_bias.fits provided by the Gemini science archive. If you want to push the data this will have to be remedied.

The overall data reduction process is:

1. Make lists of science, bias, and arc exposures using hselect to find files and gemextn to trim the names to shortened versions.
2. Create the bias residual using gbias, or just download the prepared one from GOA
3. For each central wavelength setting, create flats using gsflat
4. For each central wavelength setting, perform basic bias and flat subtraction from the science exposures using gsreduce
5. For each central wavelength setting, perform basic bias subtraction from arcs using gsreduce
6. For each central wavelength setting, find the wavelength solution using gswavelenth. While originally set to non-interactive (fl_inter-), for best results this should be done manually (fl_inter+)

[1] `https://archive.gemini.edu/searchform/GN-2021B-FT-201/not_site_monitoring/cols=CTOWEQ/NotFail/notengineering#`

7. For each central wavelength setting, apply the wavelength solution to the bias-subtracted science exposures using gstransform

8. For each central wavelength setting, apply sky subtraction using gsskysub. This can be customized to select specific detector regions for sky, see gsskysub documentation and look at your 2D spectra in DS9

9. For each central wavelength setting, extract the 1D spectrum from the 2D image using gsextract. You should super super always do this manually (fl_inter+).

10. Combine the different central wavelength spectra into a single stacked spectrum using gemscombine. The combination setting of 'median' gave me weird results when only using 2 spectra, so you may need to experiment

At various points in this process, you may want to actually look at what you've done. For 2D spectra, the IRAF task imexam will display the image in your display engine of choice. I tended to have DS9 open so it was routed to that window for example. For 1D spectra, the IRAF task splot will display a plot of electrons or flux versus wavelength.

Finally, a table of how to understand the file naming structure:

- N***.fits – raw data
- gsN**.fits – data that has been run through gprepare as part of other tasks. In this case it's been bias and flat corrected
- tgsN**.fits – data that has had its wavelength solution applied
- stgsN**.fits – data that has been sky subtracted
- estgsN**.fits – extracted 1D spectra