

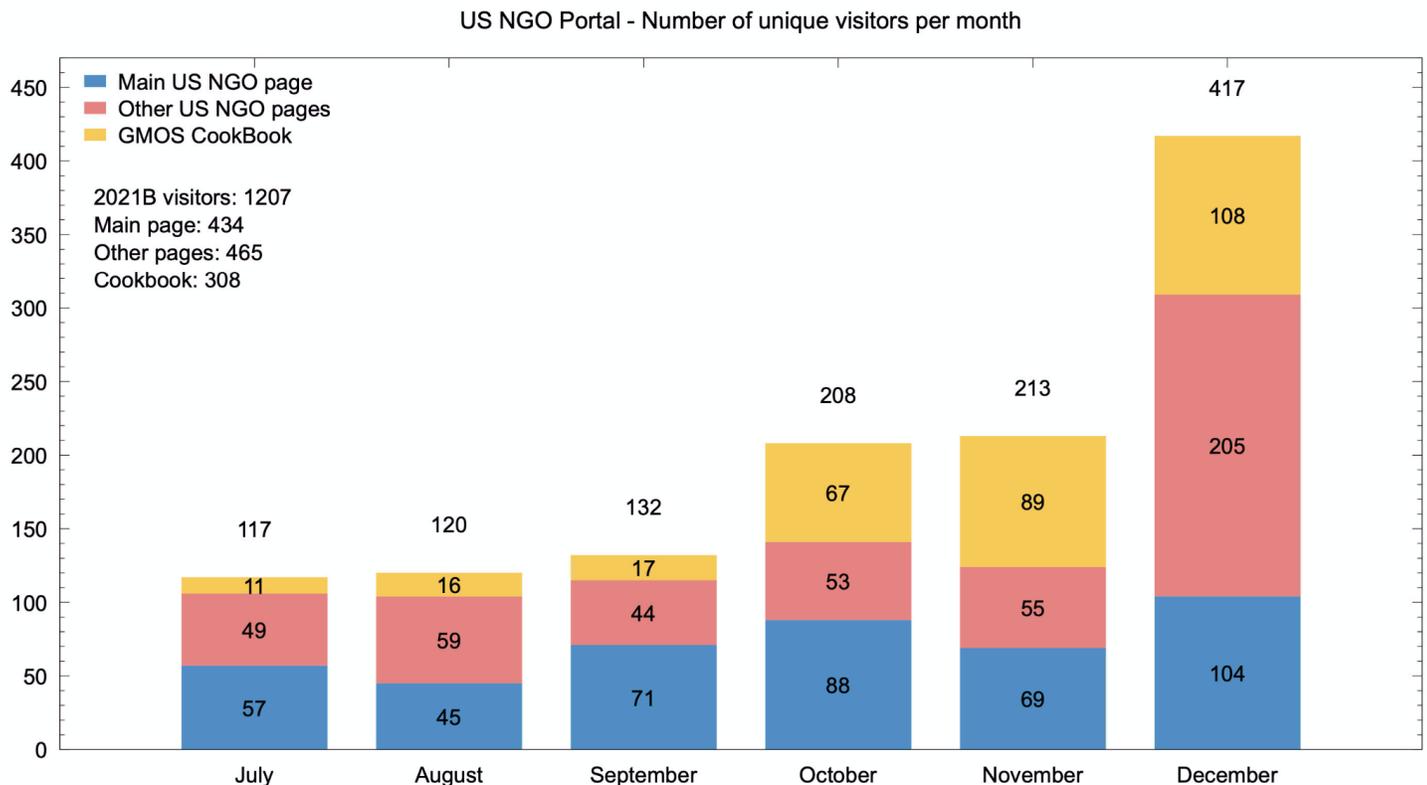
# The US NGO GMOS Data Reduction Cookbook: Version 2.0

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The [US National Gemini Office](#) (US NGO) has released Version 2.0 of the [GMOS Data Reduction Cookbook](#) and posted it on our [website](#). This revision includes 1) updating the five existing Pyraf processing cookbooks for the GMOS modes, in compliance with the latest software provided by Gemini Observatory; 2) placing the cookbook on a GitLab repository; and 3) editing the text to improve clarity.

The twin Gemini Multi-Object Spectrographs ([GMOS](#)) are among the top-subscribed capabilities at Gemini Observatory. In 2016, the NGO released the first version of the GMOS data reduction cookbook to guide users in data reduction with the Gemini IRAF routines. The cookbook included an introduction to the instrument and its observing modes, a description of specific data structure, and specific instructions for data reduction for the individual GMOS modes, with examples and tutorials.

In the future, the majority of Gemini GMOS data will likely be reduced with the Python-based DRAGONS routines that are already available for Imaging mode and are under development for all GMOS modes. In the interim, users rely on IRAF/PyRAF to reduce their GMOS data.



**Figure 1.** The number of visits to the [US NGO Portal](#) during Semester 2021B. The colors refer to specific sections of the Portal. The GMOS Cookbook has seen a great deal of traffic. The Portal is accessed by the entire Gemini community.

We analyzed the needs of the users and realized that there was a great deal of interest in a guide for GMOS data reduction with IRAF/PyRAF, as seen in the volume of traffic directed to the GMOS Data Reduction Cookbook web page through the US NGO Portal (Figure 1). The US NGO thus made it a priority to revise and maintain user access to GMOS data reduction with IRAF/PyRAF by updating the cookbook.

The new version (v2.0) of the cookbook is now available online. The document has been updated in all its parts and for all of the GMOS modes – Imaging, Long Slit Spectra, Long Slit Nod and Shuffle, Multi-Object Spectra, and IFU Spectral Images.

The GMOS cookbook improvement and modernization process have been multipronged. The cookbook has a new look, new address, and updated processing tutorials. We have completed the following revision steps:

1. *We revised the five existing Pyraf processing cookbooks (i.e., the cookbooks for the individual GMOS modes) by verifying that the code is compliant with the latest software provided by the Observatory (including native astroconda installation and version 6.1.28 of the [virtual machine](#) with the Gemini IRAF packages).*

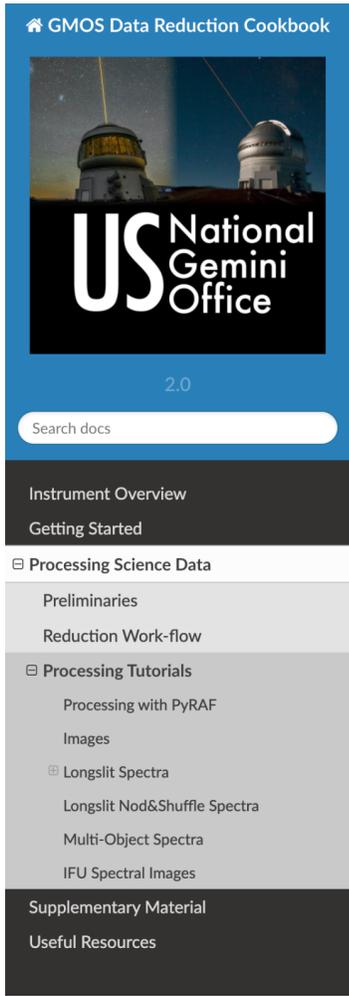
The GMOS cookbook consists of a general section describing the instrument (including its observing modes, the data properties, and general reduction issues) and five individual Pyraf cookbooks, one for each observing mode, giving specifications of data reduction through tutorials.

The tutorial modernization portion of the project involved analyzing the existing documentation for the five PyRAF processing tutorials to correct errors and determine areas that could benefit from further explanation. For example, code was added to help users reproduce the outputs featured in the tutorials (Figure 2).

The improvement portion of the project involved verifying that every line of code listed in the individual mode cookbooks would run without crashing, solving any line order issues in the code, and correcting punctuation to avoid errors. We added informative and warning boxes as appropriate throughout the tutorials. We also corrected grammatical errors and punctuation. Broken links that resulted from the retirement of the noao.edu domain were updated.

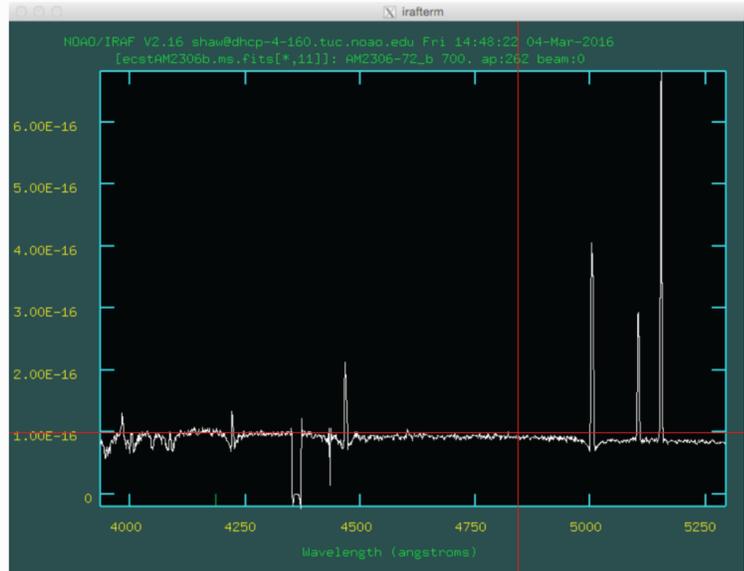
2. *We moved the cookbook to GitLab, allowing for version control and real-time collaboration.*

The cookbook code and HTML pages are now hosted in a GitLab repository, allowing real-time collaboration and version control. Any updates to the pages and changes to the code are automatically published on the new website.



An extracted spectrum of one of the brighter apertrues (#11) is shown below. To display the spectrum, enter the following command into an active PyRAF session.

```
iraf.splot('ecstAM2306b.ms.fits[*],11', xmin=3925, xmax=5275, ymin=-0.25e-16, ymax=6.5e-16)
```



Screen shot of a portion of a 1-D spectrum for AM2306b, which is the sum of 4 spatial pixels. [Click image to enlarge.](#)

Possible improvements to the above process, which are left as an exercise, include the construction and use of a **Static Bad-Pixel Mask MasterCal** and a rejection of cosmic rays.

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**Figure 2.** An example of code added to the Reduction of Long-Slit Spectras with PyRAF that users can use to verify that they have successfully reduced their data

### 3. We improved the overall clarity.

We revised the cookbook’s text to improve the overall clarity of the instructions and added informative notes. We inserted a box on the [main cookbook web page](#) with information on the 2.0 release and a link to the “Getting Started” section, which in turn has been updated with the latest software instructions. We added a prominent box in this section, with software installation procedure links for all available products (astroconda/PyRAF and the Gemini Virtual Machine). We corrected the broken links and updated the instructions and references to make the cookbook up-to-date. We also revised the supplemental materials and resources.

We plan to keep abreast of any software issues and changes and revise the cookbook periodically so users can have a seamless experience in reducing their GMOS data.

The US NGO welcomes suggestions from the GMOS user community! Please contact us at [usngo@noirlab.edu](mailto:usngo@noirlab.edu) or via our [Twitter account](#). Visit our [Users Support Portal](#) for information on the US NGO and links to important information on our activities.