

JWST Post-Pipeline Data Analysis

JWST post-pipeline data analysis tools will be used for viewing and analyzing JWST data. While its development is still ongoing, overviews, software installation, and training materials are currently available for interested users.

Introduction

JWST post-pipeline data analysis tools are distributed as part of [AstroConda](#) to assist observers in viewing and analyzing their JWST data. The tools are generally written in Python and work with [Astropy](#). Development is ongoing¹.

The suite of post-pipeline data analysis tools is intended to help astronomers with the often iterative and interactive workflow involved in converting these pipeline data products into meaningful scientific results. This involves tasks such as:

- inspecting data and data quality information;
- masking or flagging data and using those annotations to guide later steps in the analysis;
- using the results of interactive analysis to guide a custom run of the pipeline (e.g., tweaking spectral extraction parameters or background estimates);
- combining data sets in various ways, with careful attention to astrometry, PSF matching, and other issues;
- source detection and photometry using different choices or algorithms than those used in the pipeline;
- measuring lines and continuum in spectral data;
- fitting models to data or otherwise testing hypotheses.

A typical workflow involves highly interactive exploratory analysis on small portions of the data, followed by the development of custom scripts to automate the analysis on larger data sets.

¹ All software is open source and community contributions are welcome in the form of suggestions, bug reports, or actual code. Further details on how to contribute can be found at the [Data Analysis Tools Development Forum](#).

Software installation

The recommended way to install stable versions of the JWST data analysis tools is to use [AstroConda](#).

There are development versions of many of the tools linked in the "Repository" column in Table 1 that link to the open-source development locations on Github. Contributions to these developments are welcomed via bug reports (most effectively filed as [github issues](#), but the [JWST help desk](#) is fine as well), or by code contributions through [github pull requests](#). Use of the development versions of the code straight from github comes with the following caveats: at any given time, the code may not actually run or return correct results, and the documentation may be inconsistent with the code. Users who are not interested in contributing to the development software should use the versions in [AstroConda](#).

Software packages

Table 1 provides links to further information about the tools. [User training workshops](#) are being offered to help new users familiarize themselves with these tools.

Table 1. Software tools information

Package	Purpose	Repository	Maturity
Astropy	A community python library for astronomy (documentation & tutorials)	Astropy	
glue	A Python library to explore relationships within and among related datasets.	glue	
ginga	A toolkit designed for building viewers for scientific image data in Python.	ginga	
Photutils	Tools for detecting and performing photometry of astronomical sources.	Photutils	
astroimtools	Convenience tools for working with astronomical images.	astroimtools	
imexam	Tool for simple image examination, and plotting, with similar functionality to IRAF's imexamine.	imexam	
specviz	An interactive astronomical 1D spectra analysis tool with similar functionality to IRAF's splot.	specviz	
mosviz	A quick-look analysis and visualization tool for multi-object spectroscopy.	mosviz	
cubeviz	Interactive analysis tool for 3D spectroscopy (coming soon)	cubeviz	
asdf	Advanced Scientific Data Format is a next generation interchange format for scientific data (docs)	asdf	
gwcs	Generalized World Coordinate System tools for dealing with image and spectral geometries (docs)	gwcs	
synphot	Synthetic photometry toolkit for building model spectra and estimating count-rates. (docs)	synphot	

Levels of maturity run from prototypes with little or no documentation, symbolized by buds,



, progressing through various levels:



to



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The exact meanings of these icons are a bit hard to quantify, but the flowers will tend to be still lacking in documentation and important features. The cherries are generally quite robust and well documented. The cherry pies are ready to be baked into your day-to-day workflow.

Be aware that *all of the packages* above are in very active stages of development, including Astropy and glue. For the ones at the cherry pie level, there is significant attention given to backwards compatibility as the APIs of the different modules evolve.

Training resources

There are many resources available for learning Python and for using Python for astronomical data analysis. This section provides pointers to astronomy-focused materials and to more JWST-specific training materials.

General python astronomical data analysis training

Table 2. List of training resources for python astronomical data analysis

Resource	Written materials	Videos	Comments
Using Python for Astronomical Data Analysis	Notebooks		January 2017 American Astronomical Society Special Session
Astropy	Tutorials		
Scientific Python Course at STScI	Notebooks	Videos	Notebooks are from 2015 version of course; videos from 2012-13
Practical Python for Astronomers	Web documents		2011, 2012, 2013 Smithsonian Astrophysical Observatory

JWST focused training materials

Training materials for JWST data analysis will eventually include worked examples of common workflows, using outputs from the JWST pipeline. Currently the materials are more general than that, and make use example data sets from other observatories. Table 3 provides links to these materials.

Table 3. List of JWST focused training materials

Resource	Written materials	Videos	Comments
JWST User Training in Data Analysis	Notebooks	Webcast	2016 Workshop at STScI

Table 4 shows a more topic-oriented map of the materials from the 2016 Workshop.

Table 4. Introductory material

Introductory lectures		
Python	Notebooks	Webcast
Numpy	Notebooks	Webcast
Plotting	Notebooks	Webcast
Units	Notebooks	Webcast
Tables, I/O and FITS	Notebooks	Webcast
Coordinates	Notebooks	Webcast
Modeling	Notebooks	Webcast

Table 5. More specialized material

JWST user training		
JWST pipeline overview		Webcast starts at 50:00
Astropy & JWST tools overview		Webcast
Image examination (imexam)	Notebooks	Webcast
Image display toolkit (ginga)	Ginga embedded in a Jupiter Notebook	Webcast starts at 26:00 Glue-Ginga Interoperability Webcast 1:03:00
Photometry (photutils)	Intro Notebooks PSF-photometry Notebook	Webcast starts at 55:30 PSF-fitting Webcast 46:00
Data exploration (glue)		Webcast Customizing Glue Webcast 28:10
Interactive spectral analysis (SpecViz, MosViz, CubeViz)		Webcast starts at 1:01:30
NIRCam Data Reduction		Webcast
Advanced Astropy Tables	Notebook	Webcast
Generalized World Coordinate System (gwcs)	Notebook	Webcast