JWST IAC Workshop-GO1 Proposal Planning

IFU example

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NIRSpec and MIRI IFS of a star-forming galaxy at z~4

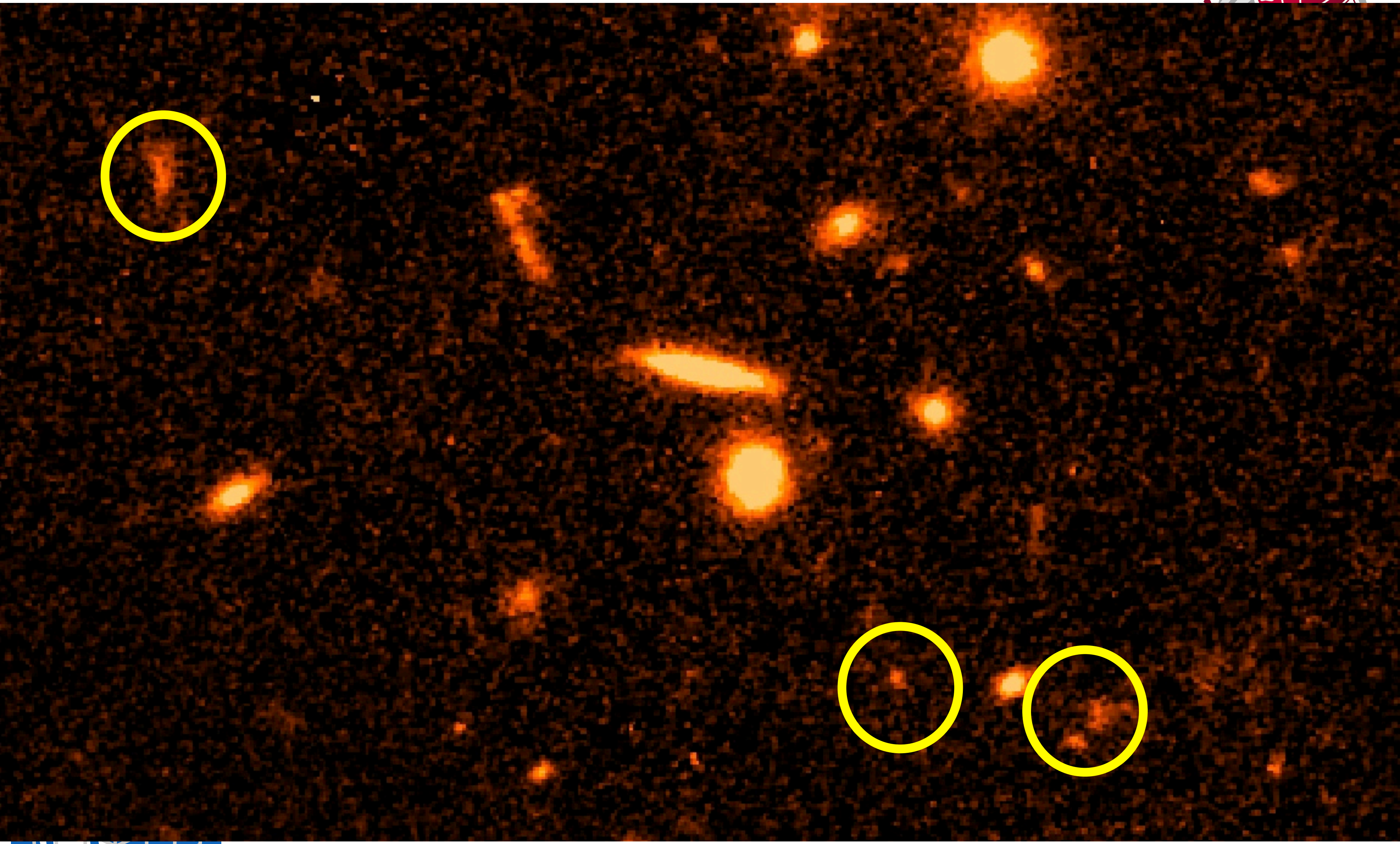
Overview

MIRI:

- MRS+imaging: mosaic targeting the main near-infrared emission lines (Hydrogen Paschen, [FeII], H2, ..) in the SF galaxy and the surrounding fields.

NIRSpec:

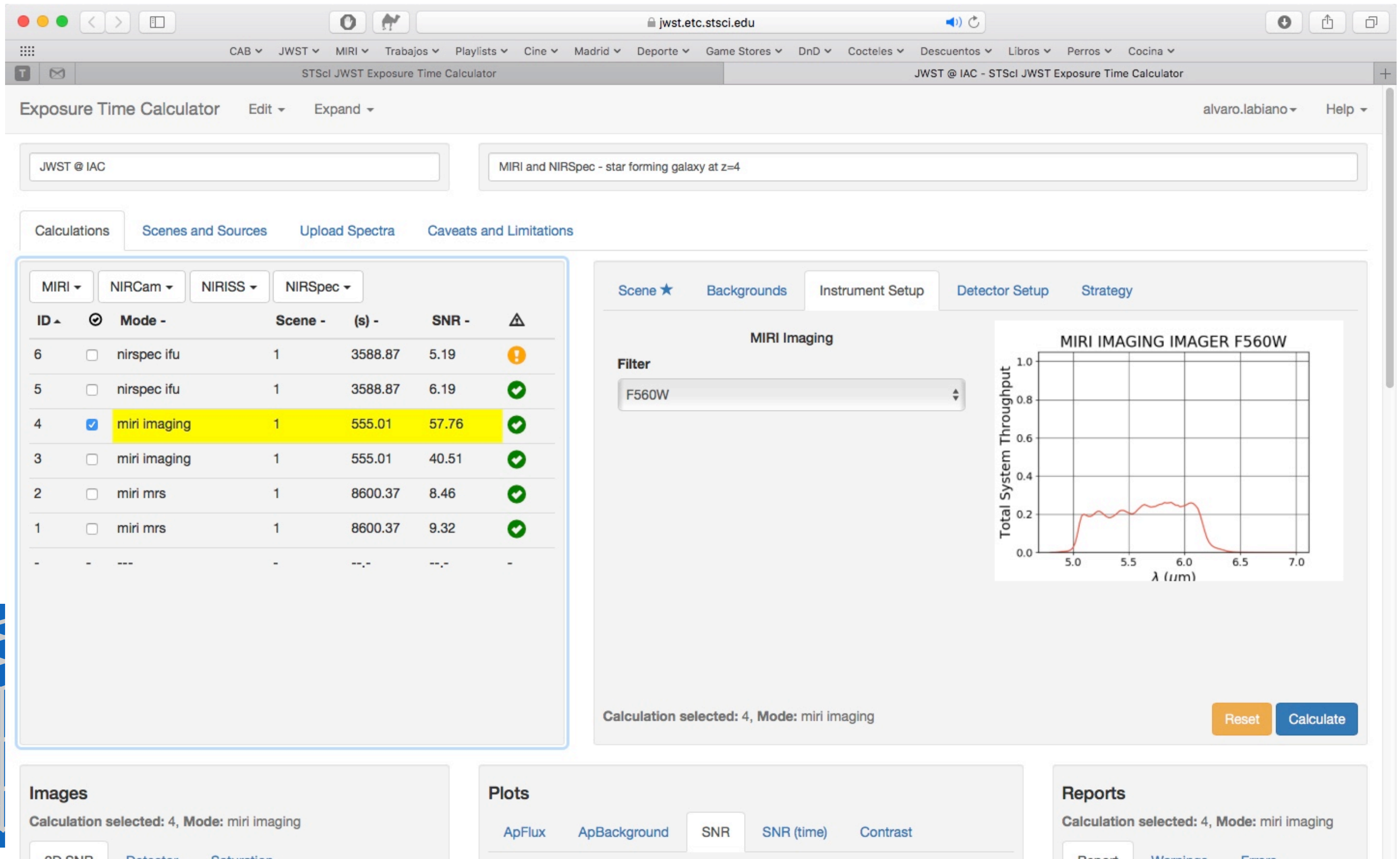
- IFS at R100 covering the whole spectral range from 0.6 to 5.3 microns.
- IFS at R2700 including the emission lines around Hα.



Exposure Time Calculator (ETC)

It can be used only through web interface: https://jwst.etc.stsci.edu/

Latest version 1.2



Astronomer's Proposal Tool (APT)

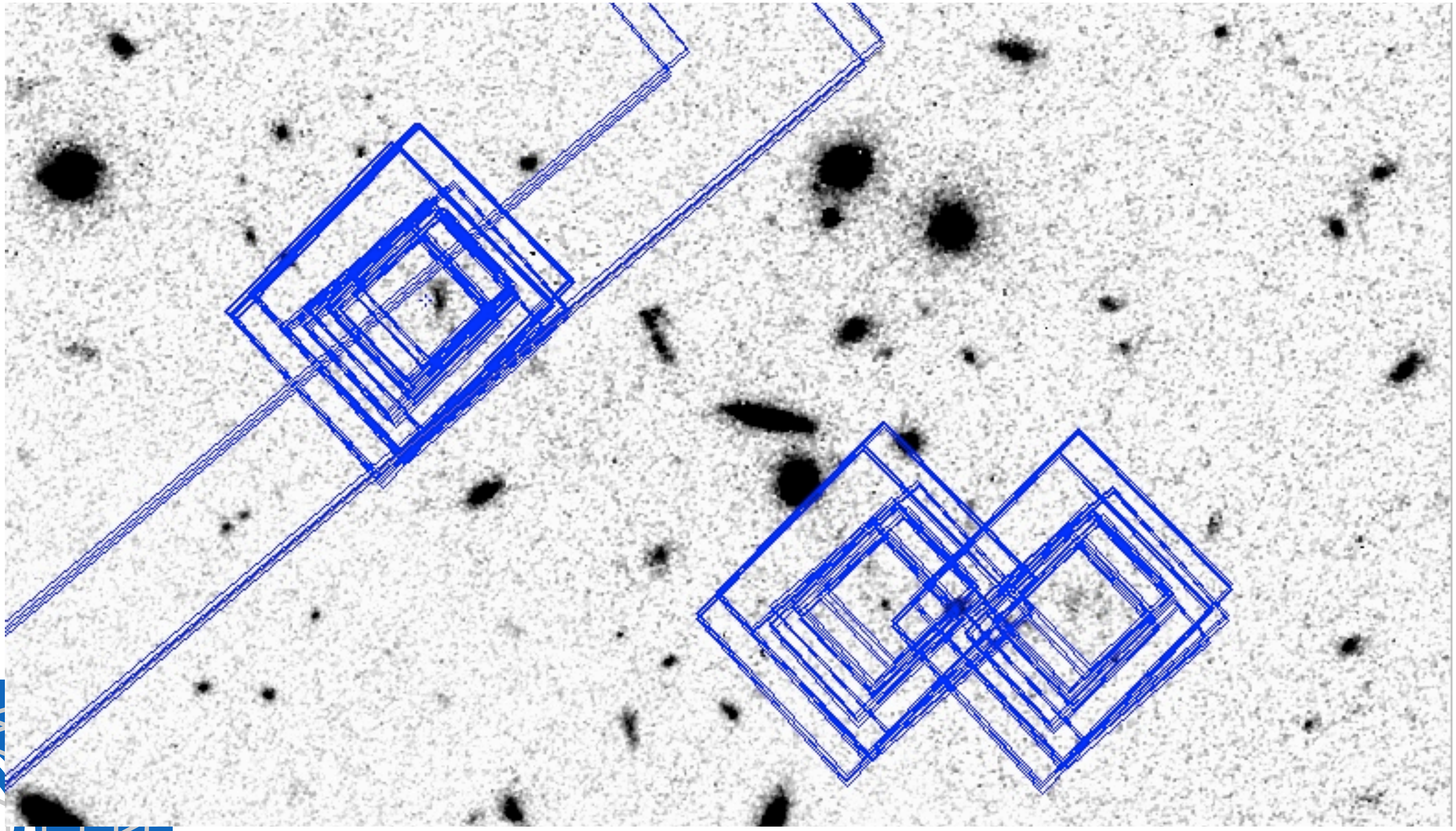
Latest version: 25.4.3 (February)

http://www.stsci.edu/hst/proposing/apt

Example:

NIRSpec IFU, MIRI IFU + Simult Imager, MIRI Imager for GN 20
+ background + mosaic

APT - Mosaic



MSA leakage (NIRSpec IFU obs)

In IFU mode, the NIRSpec MSA shutters are configured "all closed," and the IFU aperture is opened. Light from the NIRSpec IFU is dispersed onto the detector across the same pixel region as spectra obtained in the NIRSpec MSA mode. There are, however, two MSA instrument characteristics that affect IFU data and sensitivity.

- Failed open MSA shutters: The MSA has a population of shutters that are permanently or intermittently stuck in an open configuration (for an example of how this affects the data, see Figure 4). These failed open shutters always produce spectra of the sky, no matter the state of the MSA. For an IFU mode observation in a low density region of the sky, these shutters might only contain sky background flux from a blank field. However, in very crowded fields, the IFU spectra will likely be contaminated by the spectra of field objects through these failed open MSA shutters. If this characteristic is considered problematic for science data quality, the IFU aperture can be closed and a MSA leakage correction "leakcal" exposure or set of exposures can be acquired. Such observations can be used in post-processing to subtract the spectral contamination from failed open MSA shutters.
- MSA contrast: The MSA shutters have finite contrast and are not completely opaque. Flux contamination in IFU observations from finite contrast MSA shutters is referred to as "print-through." MSA shutter contrast is defined as the flux through an open MSA shutter divided by

Target Acquisition Best Practices

An overview of the MIRI Target Acquisition process is given elsewhere in the documentation, and discussed in the mode-dedicated Best Practices pages (Imaging, MRS, LRS and TSO). The aim of this section is to give details on choosing the TA source and its environment in a way that ensures the centroid algorithm is carried out on the source requested by the user.The on-board centroid algorithm for MIRI works as follows:

- The raw image is pre-treated (background-subtacted and flat-fielded).
- It then finds the brightest 3 × 3 pixel region of the detector region of interest (ROI, see Table 1). The checkbox size (3 × 3) has been defined to encompass the imager PSF.
- After that it performs a fine location by calculating the centroid in the previously located brightest area.

The success of this procedure depends on several aspects:

- The TA target should be a point source.
- The TA source should be the brightest source in the ROI. If there is a source brighter (by any factor) than the one selected by the observer, TA will be carried out on that. If there is a source with the same brightness the algorithm will perform TA in the first one encountered following the direction in which the detector is read out.
- Users should be aware that regions with bright diffuse emission may also result in false identification of the TA target. To reduce the possibility of this happening the checkbox area is a very small one.

Table 1: Sizes of detector regions regions of interest used to perform target acquisition.

TA Region of Interest	Size
MRS (TA performed in imager detector)	64 × 64 $pixel^2$
LRS (slit and slitless)	64 × 64 $pixel^2$
Coronagraphs	64 × 64 $pixel^2$ (16 × 16 $pixel^2$ secondary TA)

Note that the MIRI detector plate scale is 0.11 arcsec/pix.

Thanks!

… and good luck ☺

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Extras

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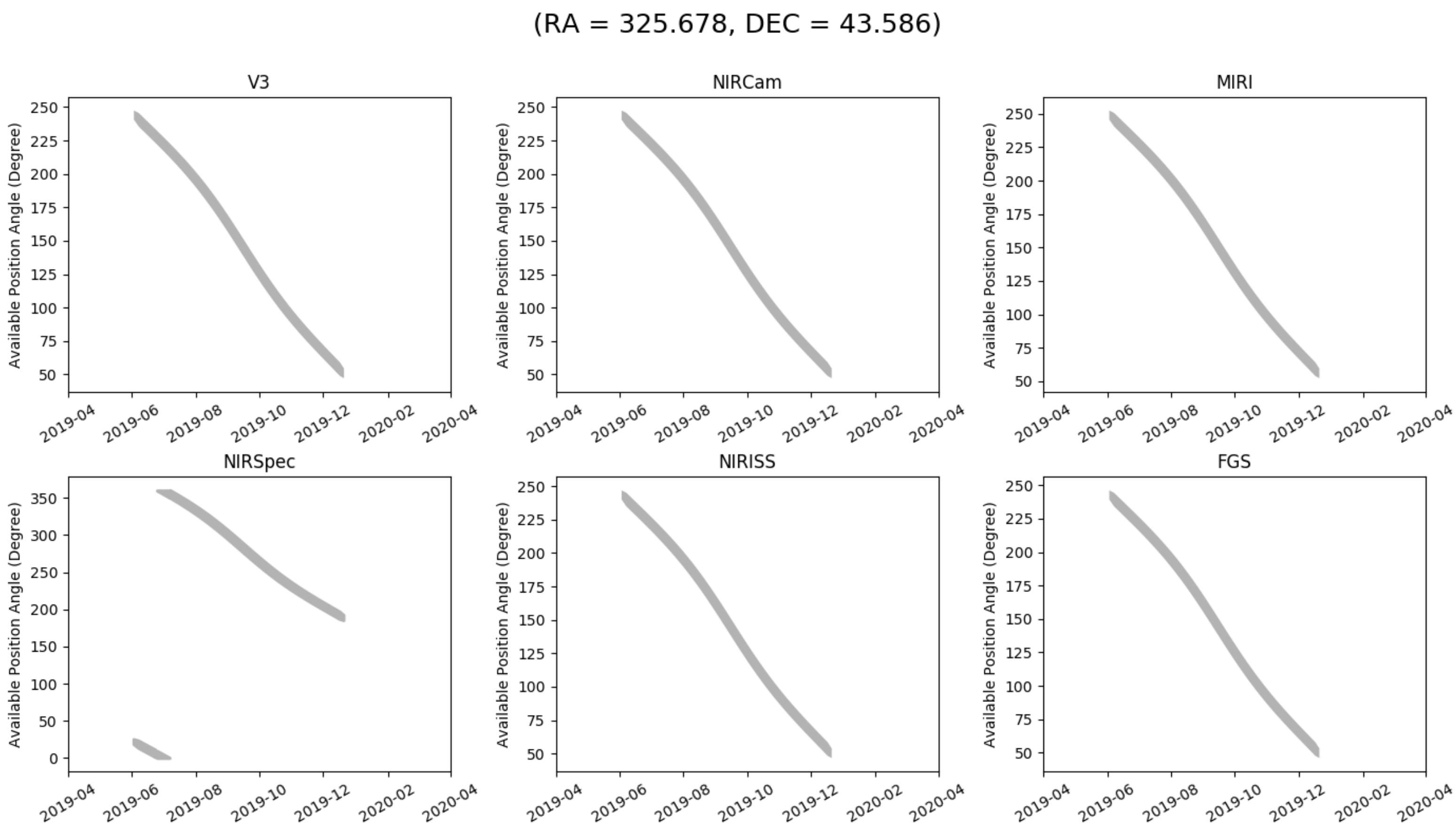
Target visibility tool (GTVT)

Included in AstroConda

Example: (astroconda)$ jwst_gtvt RA Dec &



JWST Background tool

What does the JBT do?

For a given target (RA, DEC in decimal degrees), and wavelength (in microns), the JBT can do the following:

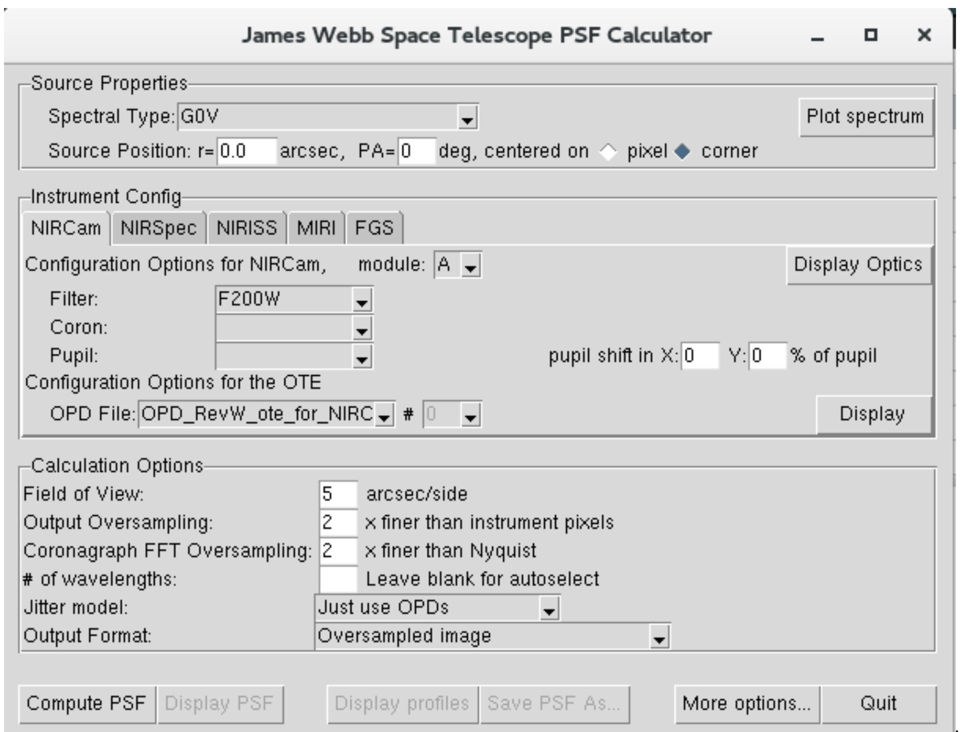
- Plot the spectrum of the background for that target on a given calendar day.
- Plot the total background for that target versus calendar day.
- Compute and plot the number of days per year that the target is observable at low background, for a given wavelength and a selectable threshold. (We refer to this plot as a "bathtub curve" or "bathtub plot.")
- Write the ASCII data for the background spectrum and bathtub curves to output files for use by other programs you may have or develop.

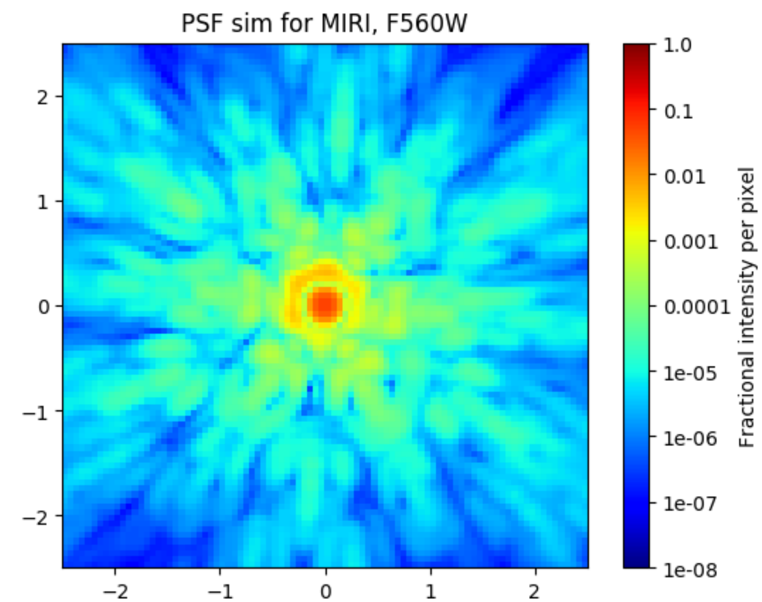
ⓘ **Bathtub curves**

A bathtub curve is the total background intensity (in MJy/sr) at a single wavelength of interest as a function of day of the year. These curves often have steep sides with a central trough, reminiscent of a bathtub shape.

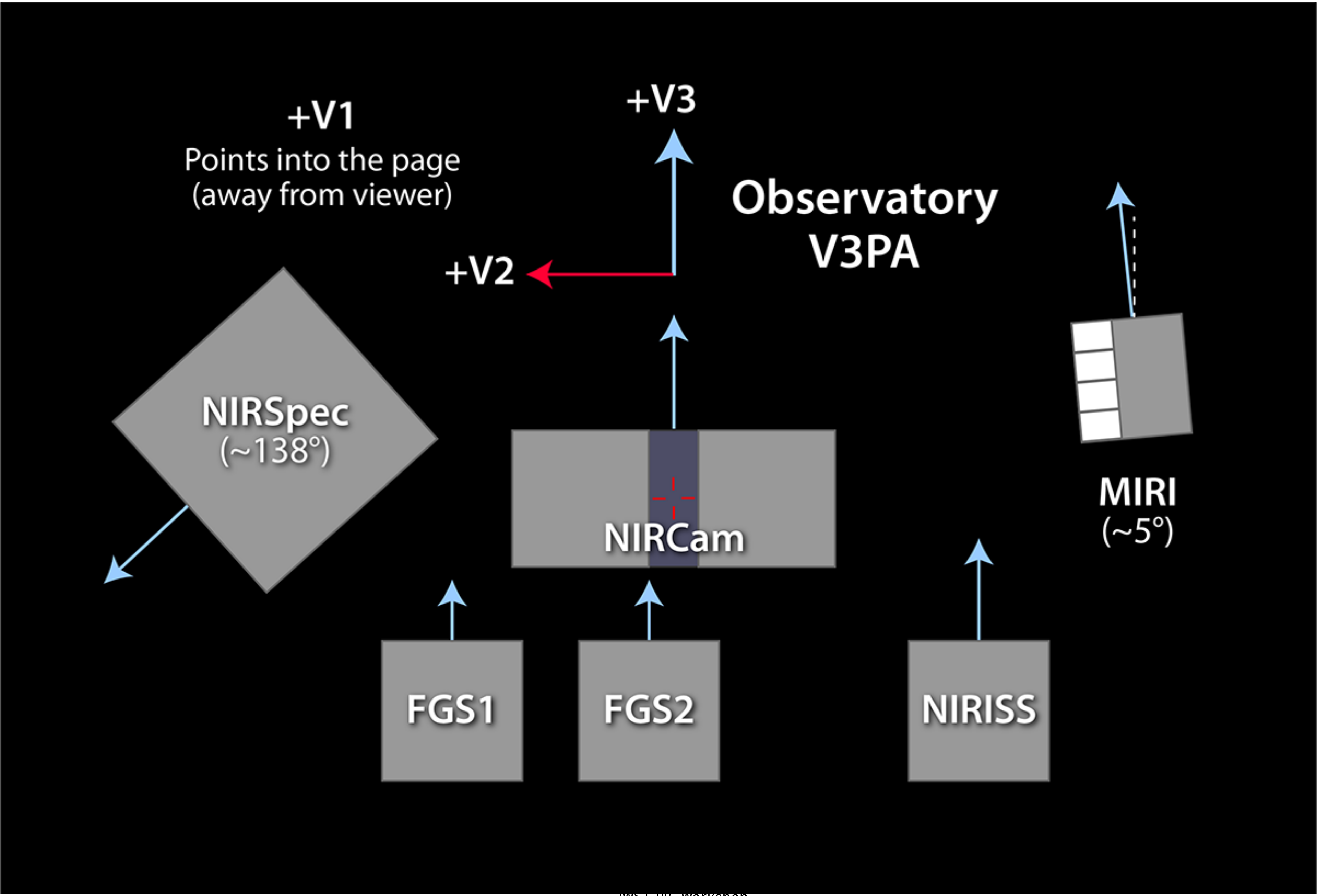
PSF Simulation Tool: WebbPSF

- PSF for imaging and coronagraphic modes, and for non-redundant aperture masking mode on NIRISS.
- The spectroscopy modes of NIRSpec and MIRI are not yet supported. Detector imperfections are not included.
- Included in AstroConda



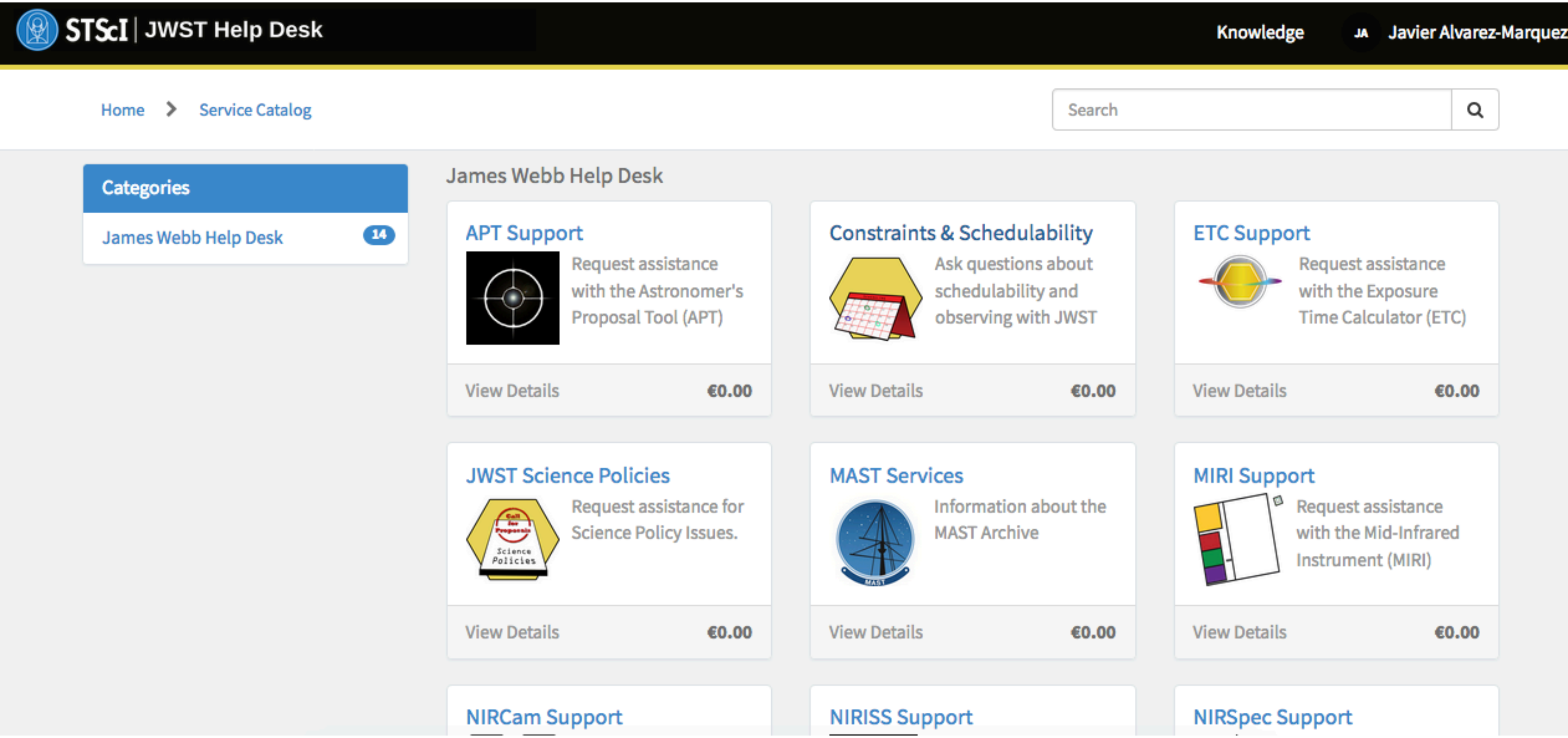


http://nbviewer.jupyter.org/github/mperrin/webbpsf/blob/master/notebooks/WebbPSF_tutorial.ipynb


+V1
Points into the page
(away from viewer)
+V3
Observatory
V3PA
+V2
NIRSpec
(~138°)
NIRCam
MIRI
(~5°)
FGS1
FGS2
NIRISS

JWST Help Desk

- Link: https://stsci.service-now.com/jwst



ESAC meeting on JWST tools

https://www.cosmos.esa.int/web/jwst-2017-esac/hands-on-material

MIRI Simulator (MIRISim)

- It simulates MIRI instrument observations (MRS, IMAGER, and LRS).
- Python code included in the software package MIRICLE: http://www.miricle.org/
- Will be public soon, it is in the last test phase.
- It provides Level 1B detector images, that have the same format as real MIRI data.

MRS-Imager Simultaneous Observations (SIMO)

[≠ parallel]

Imager has better PSF and larger FoV -> We can refine the MRS astrometry!

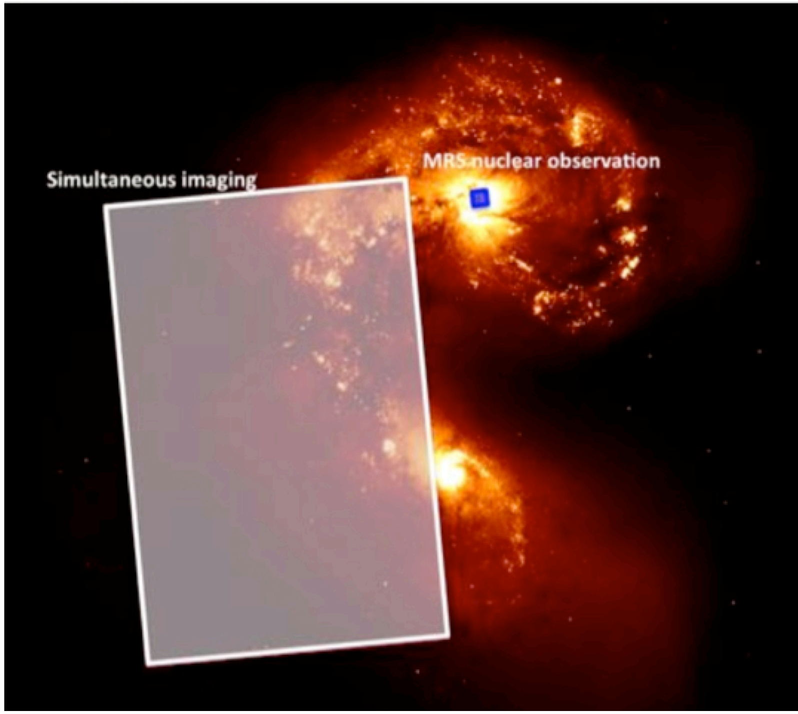
Very useful for dithers, mosaics, and deep observations:

Combine cubes of faint or undetected sources from different visits

Mosaics of diffuse emission

Serendipitous discovery of asteroids.

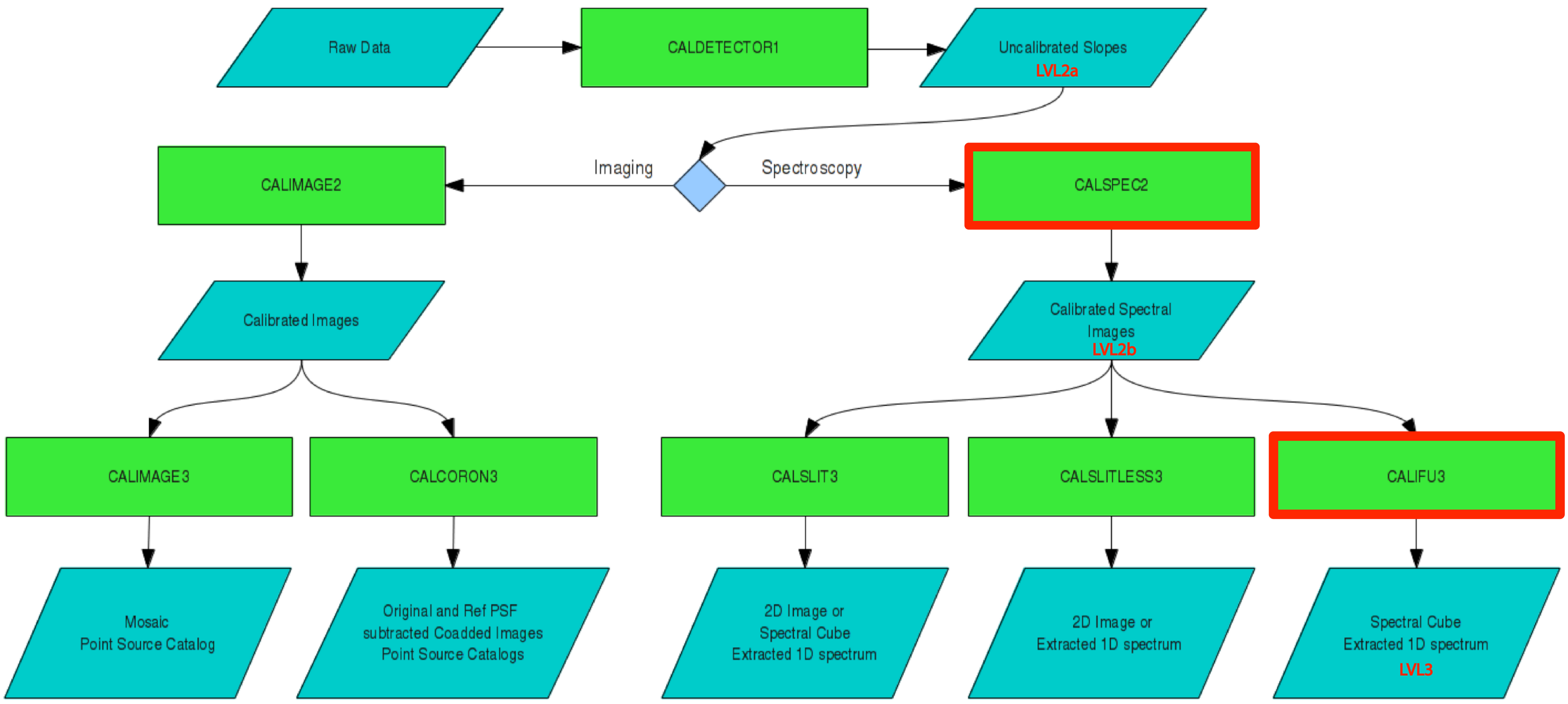
Extra data for only 30 seconds per filter!

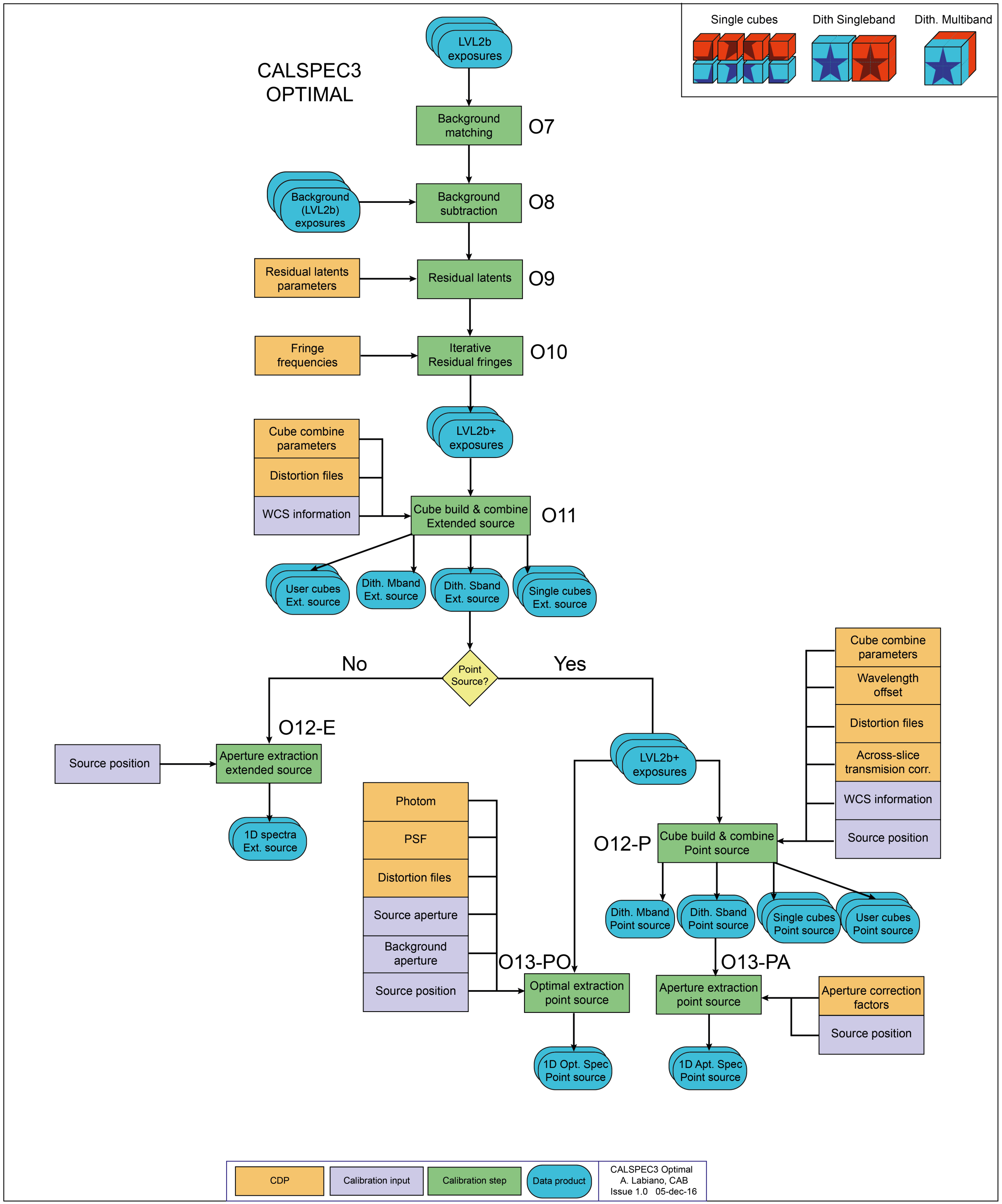


JWST Pipeline

- Python – Open source
- Modular design
- https://github.com/STScI-JWST/jwst
- JDOX: https://jwst-docs.stsci.edu/display/JDAT/JWST+Data+Reduction+Pipeline
- Two flavors: Baseline & Optimal

JWST Pipeline




CALSPEC3
OPTIMAL
Single cubes
Dith Singleband
Dith. Multiband
LVL2b exposures
Background matching
O7
Background (LVL2b) exposures
Background subtraction
O8
Residual latents parameters
Residual latents
O9
Fringe frequencies
Iterative Residual fringes
O10
LVL2b+ exposures
Cube combine parameters
Distortion files
WCS information
Cube build & combine Extended source
O11
User cubes Ext. source
Dith. Mband Ext. source
Dith. Sband Ext. source
Single cubes Ext. source
No
Point Source?
Yes
O12-E
Source position
Aperture extraction extended source
1D spectra Ext. source
LVL2b+ exposures
Cube combine parameters
Wavelength offset
Distortion files
Across-slice transmision corr.
WCS information
Source position
O12-P
Cube build & combine Point source
Photom
PSF
Distortion files
Source aperture
Background aperture
Source position
Dith. Mband Point source
Dith. Sband Point source
Single cubes Point source
User cubes Point source
O13-PO
Optimal extraction point source
O13-PA
Aperture extraction point source
Aperture correction factors
Source position
1D Opt. Spec Point source
1D Apt. Spec Point source
CDP
Calibration input
Calibration step
Data product
CALSPEC3 Optimal
A. Labiano, CAB
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