



STScI



# Preparing for JWST

Nikole K. Lewis  
Space Telescope Science Institute

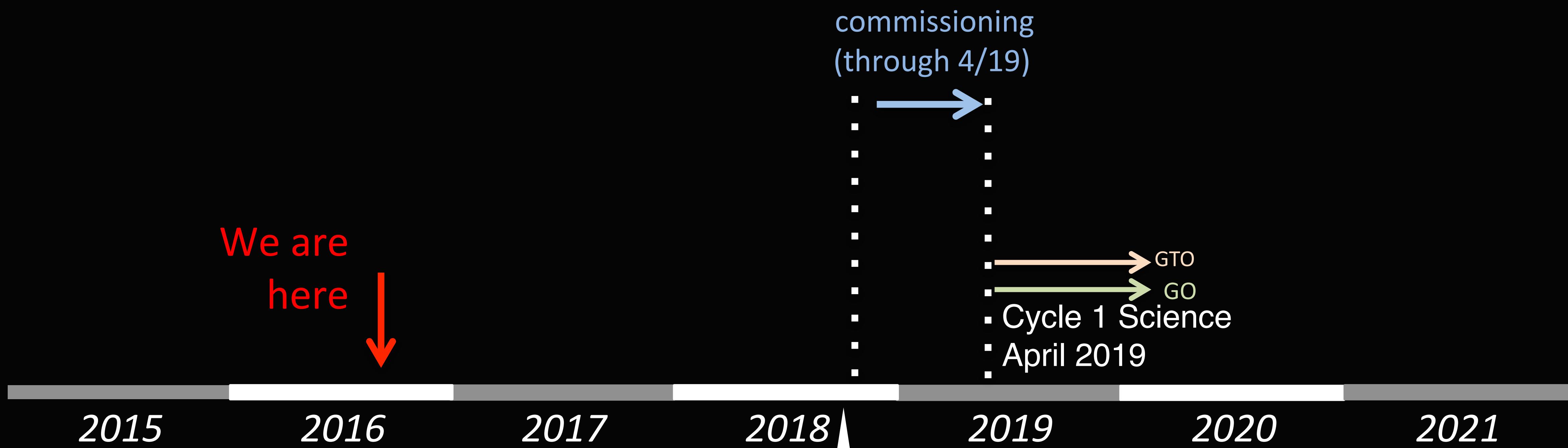
We are  
here



launch  
2018Oct

JWST Science Timeline  
*Current as of October 2016*

We are  
here ↓



### Commissioning (2018 Oct - 2019 Apr)

- full schedule of deployments & checkout activities
- limited set of science calibration observations possible

launch  
2018Oct

JWST Science Timeline  
*Current as of October 2016*

We are  
here



commissioning  
(through 4/19)

- →
- 
- 
- 
- 
- 
- 
- →
- →
- Cycle 1 Science
- April 2019

2015 2016 2017 2018 2019 2020 2021

GTO CP  
2017Jan06

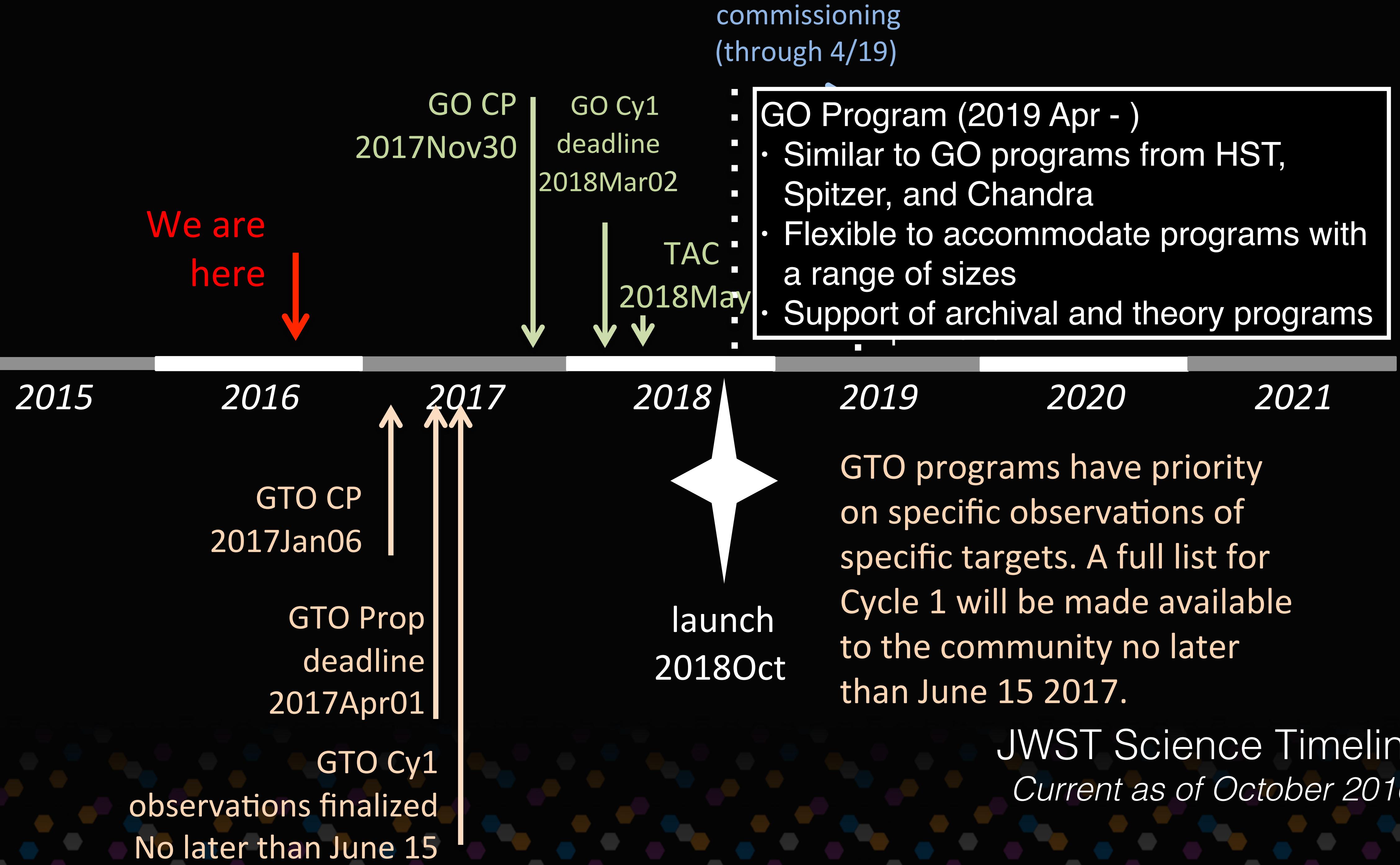
GTO Prop  
deadline  
2017Apr01

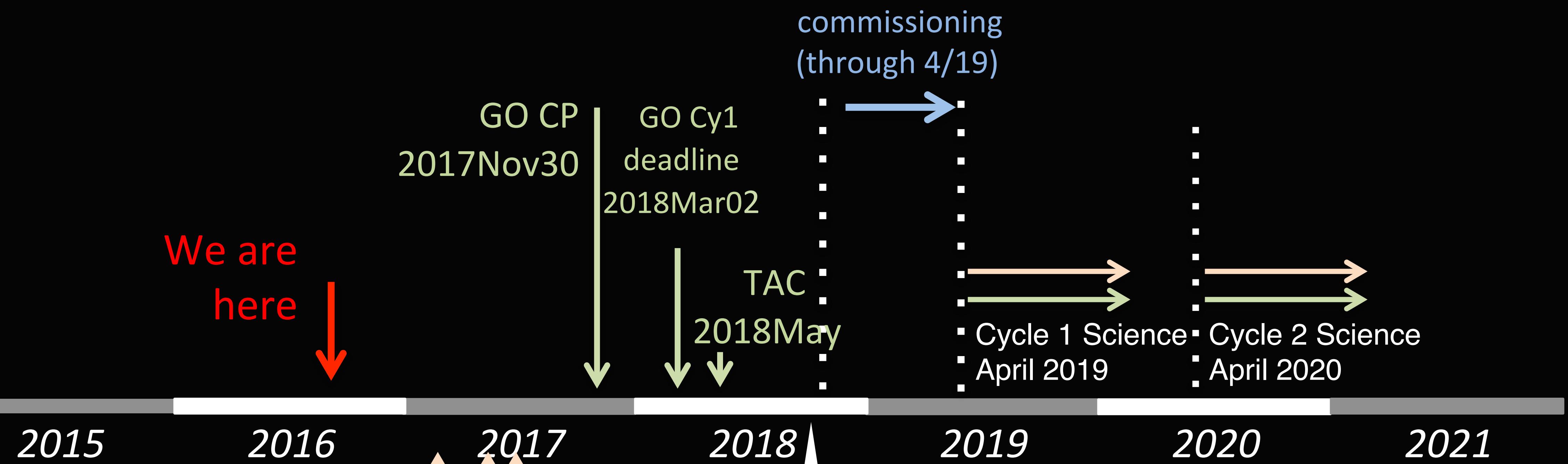
GTO Cy1  
observations finalized  
No later than June 15

### GTO Program (2019 Apr - 2021)

- 4020 hr total allocation in the first 30 months after commissioning
- >1970 hours must be used in Cycle 1
- ~10% of time available in nominal 5 year lifetime

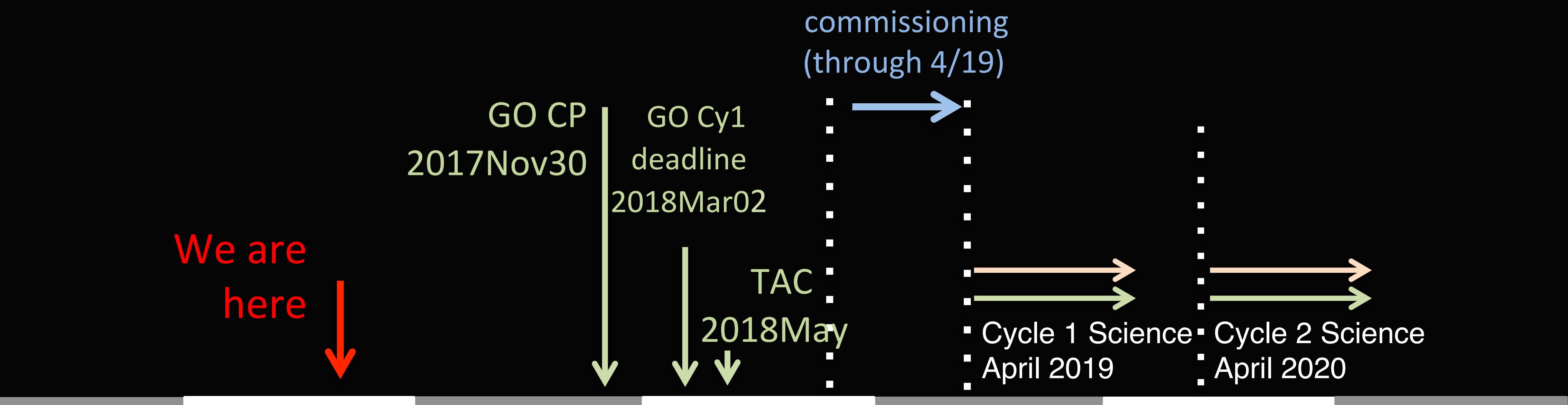
JWST Science Timeline  
*Current as of October 2016*





2015      2016      2017      2018      2019      2020      2021

JWST Science Timeline  
*Current as of October 2016*



JWST Science Timeline  
*Current as of October 2016*

# Science Timeline Realities

## addressed by JSTAC in 2010

The JSTAC recommends an Early Release Science Program:

“..to obtain images and spectra... to demonstrate key modes...  
to enable the community to understand the performance of  
JWST prior to the submission of the first post-launch Cycle 2  
proposals that will be submitted just months after the end of  
commissioning.”

“The JSTAC recommends that... data be released both in raw  
form and with any initial calibrations as soon as possible; the  
key aspect is speed.”

UNIVERSITY OF CALIFORNIA, SANTA CRUZ



SANTA BARBARA • SANTA CRUZ

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

UNIVERSITY OF CALIFORNIA OBSERVATORIES/LICK OBSERVATORY  
DEPARTMENT OF ASTRONOMY AND ASTROPHYSICS

SANTA CRUZ, CALIFORNIA 95064

June 21, 2010

Dr. Matt Mountain, Director  
Space Telescope Science Institute  
3700 San Martin Drive  
Baltimore, MD 21218

Dear Dr. Mountain:

At its recent meeting the James Webb Space Telescope Advisory Committee (JSTAC) continued to discuss ways in which the science return from JWST could be optimized and maximized. Meeting this goal requires that the GO and GTO science user community has access to early data demonstrating instrument and telescope performance, and is informed, involved and well-prepared to “hit the ground running” as soon as science observations begin. In particular, the JSTAC began to appreciate the need for the community to be well-informed about JWST’s capabilities soon after the 6-month commissioning period ends, since the deadline for Cycle 2 Proposals occurs just a few months later.

Such community involvement and access must continue over the subsequent years. As the JSTAC noted in a previous letter (*JSTAC\_Science-Operations\_Capabilities.pdf*), the interplay between the short, five-year required lifetime of JWST, the TAC cycles, and a one-year proprietary period for data has a dramatic impact on the ability of the science community to implement follow-up observations. The greatest benefit from observations made by JWST will occur when the delay between initial observations and follow-up observations is minimized. However, Figure 1 in that letter (reproduced below) showed that for data with a one-year proprietary period, the Call for Proposals for Cycle 4 is the

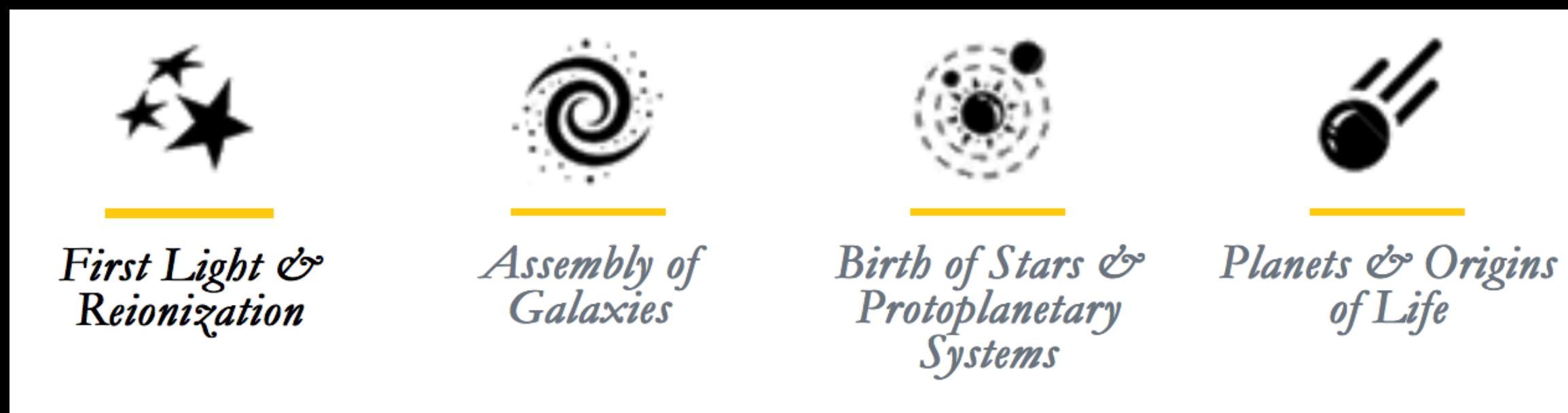
first where no full Cycle 4 datasets public and can be used as the basis for follow-up proposals by all members of the science community. Such a long delay before the community has full access to key observations and datasets, and can carry out follow-up programs, will have a dramatic impact on the overall scientific productivity of JWST.

In addition, the JSTAC’s focus on maximizing the science return from JWST, and the desire to make the most of the mission, leads to recommendations that will help develop a sophisticated science program that is as quick as possible, and provide data and results that can be rapidly used for subsequent proposals and observations. The three recommendations build on experience with the current three Great Observatories and are a natural extrapolation from TAC procedures and processes that have developed over the lifetime of these missions. In particular, they arose from discussions at our last

*STScI Director Ken Sembach will allocate ~500 hours of Director's Discretionary time for Early Release Science (DD-ERS) to*

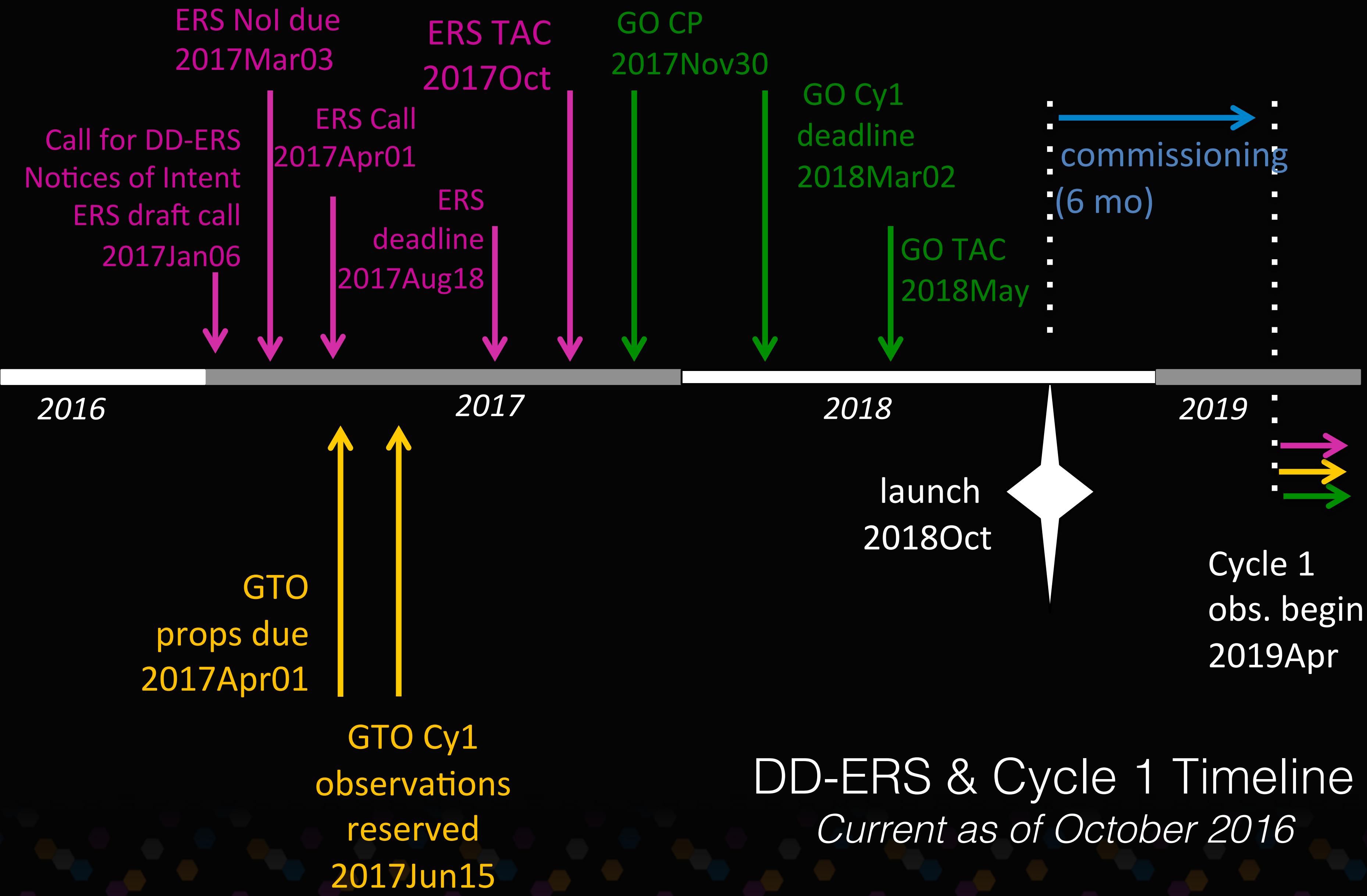
- accelerate the diffusion of JWST know-how, and*
- expand early opportunities for the community to gain experience with JWST data and scientific analysis.*

*Early resources are allocated to support up to 15 teams. Proposals will be selected in research areas spanning the science themes of JWST :*



*A multi-disciplinary committee of experts will recommend a suite of proposals that both fulfills the goals of the DD-ERS and makes optimal use of the available time for observation and funding.*

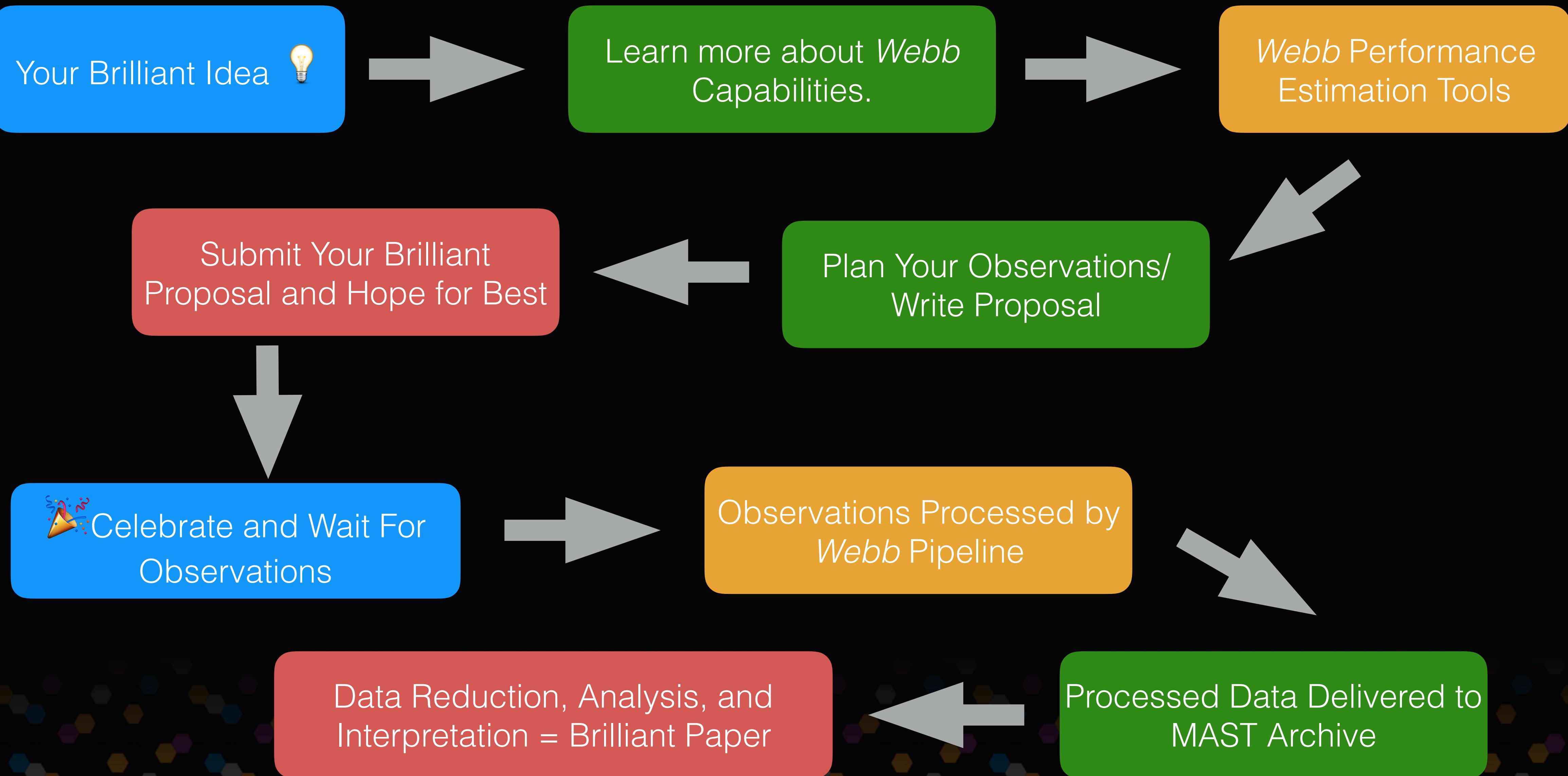


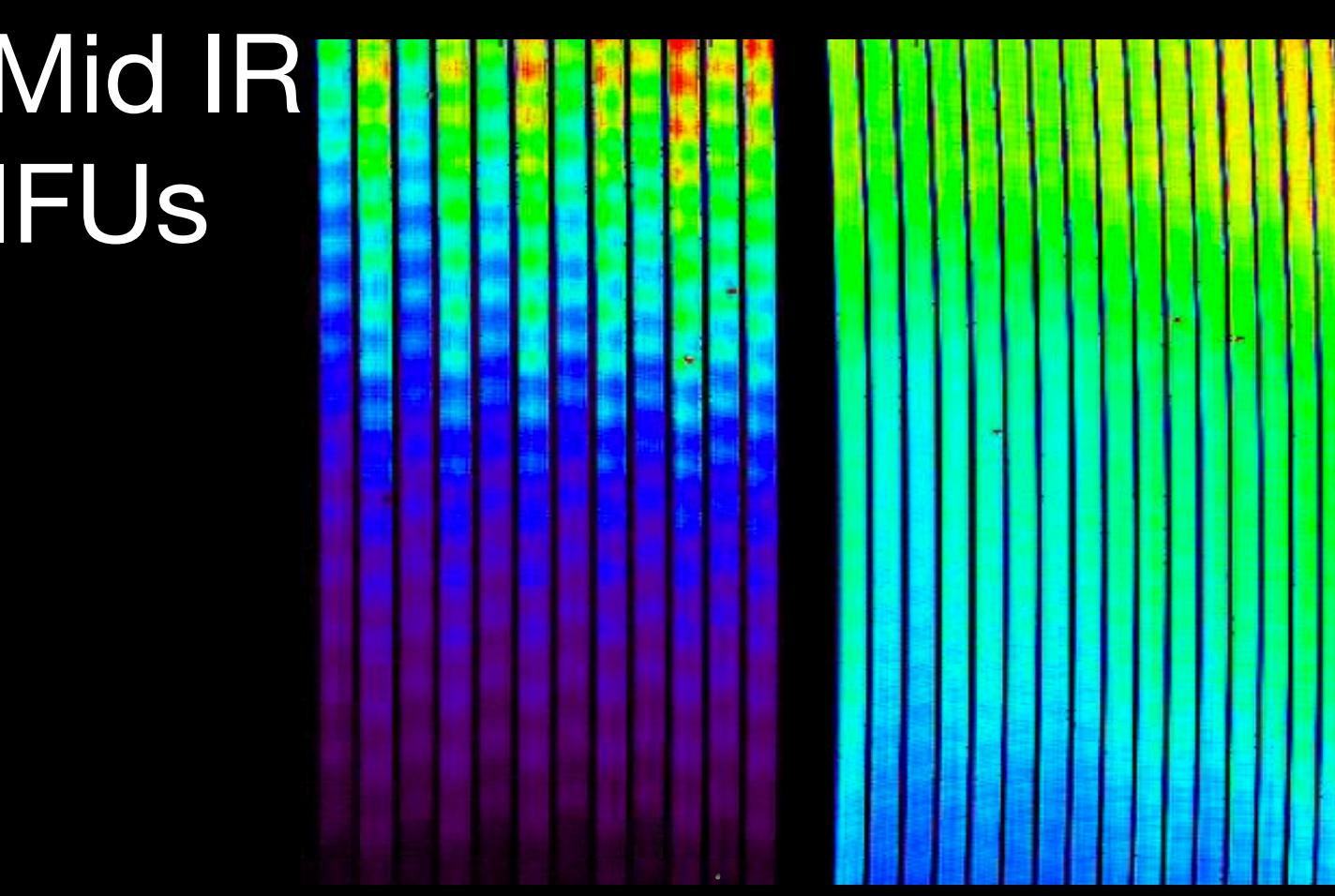
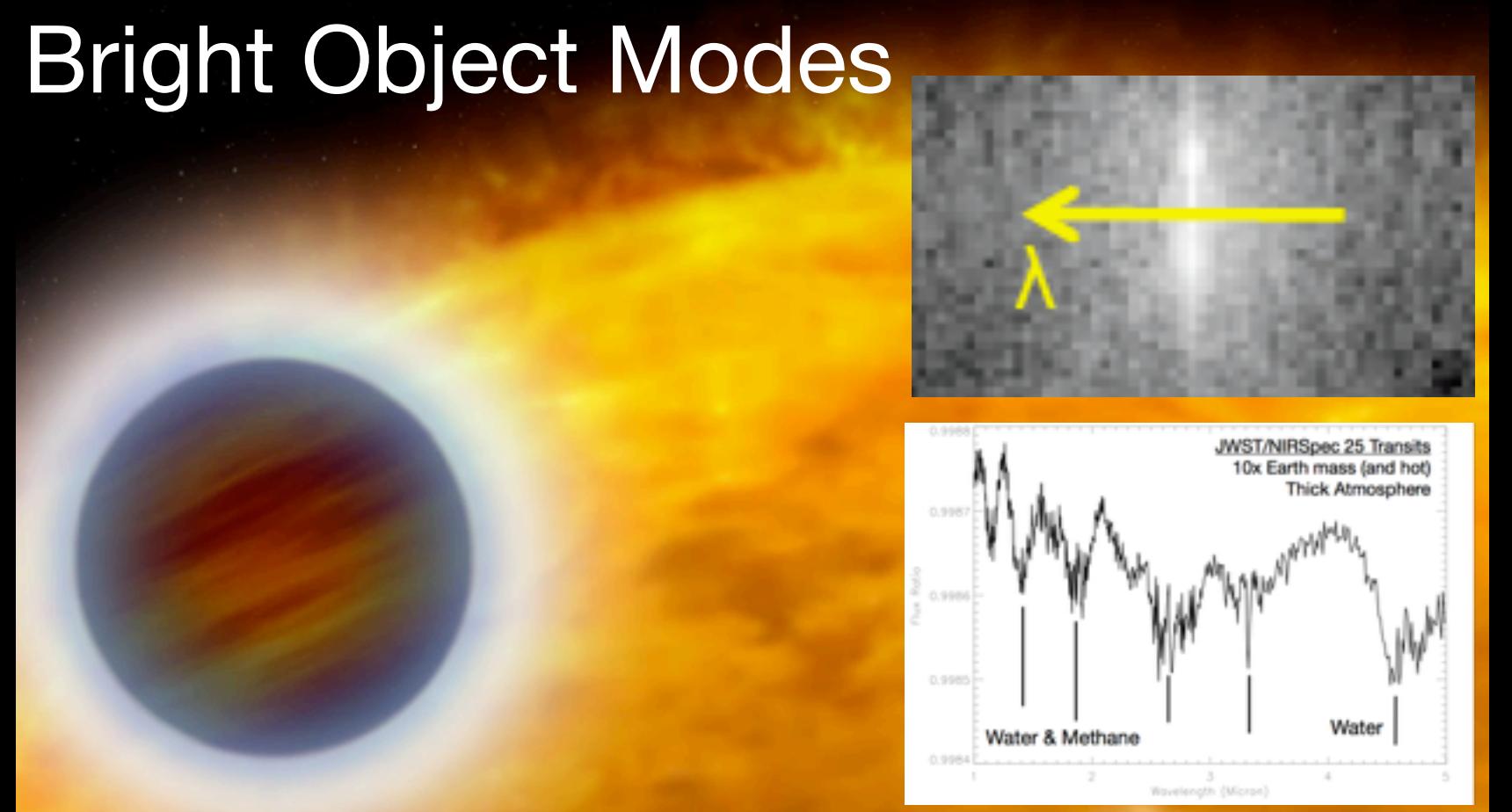
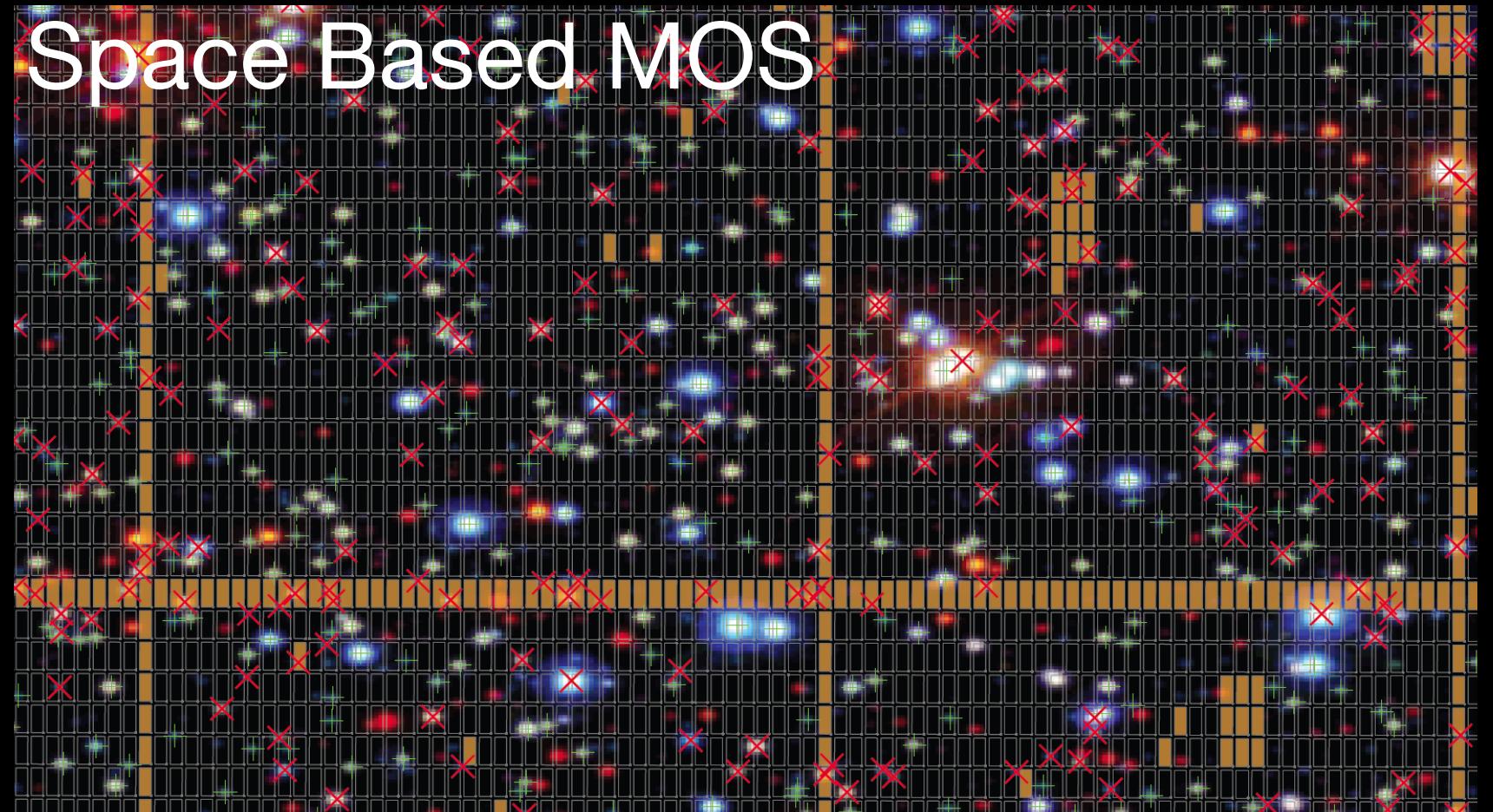


JWST Cycle 1 Calls for  
Proposals are Coming....

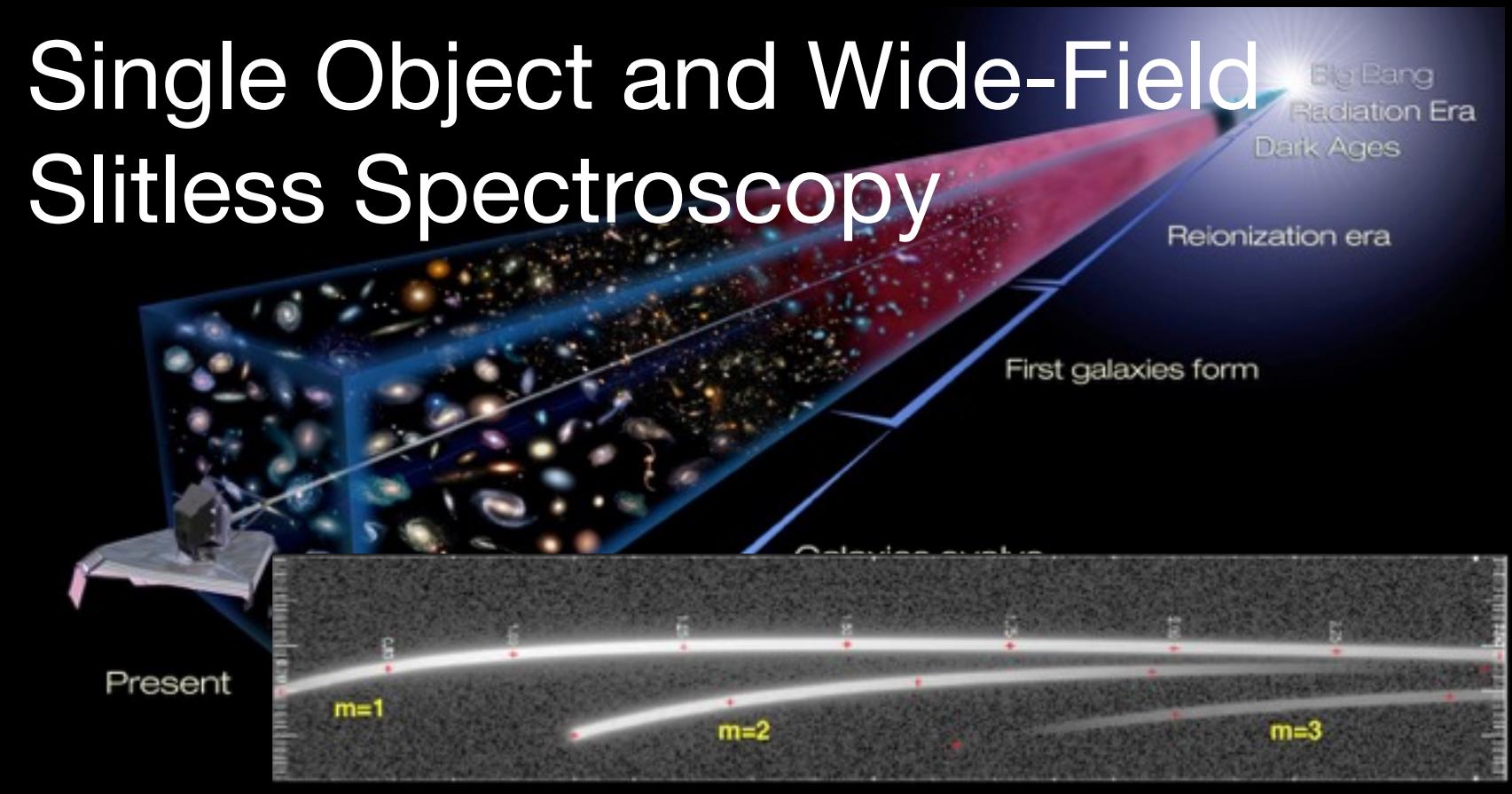


# Life-cycle of your observations with Webb

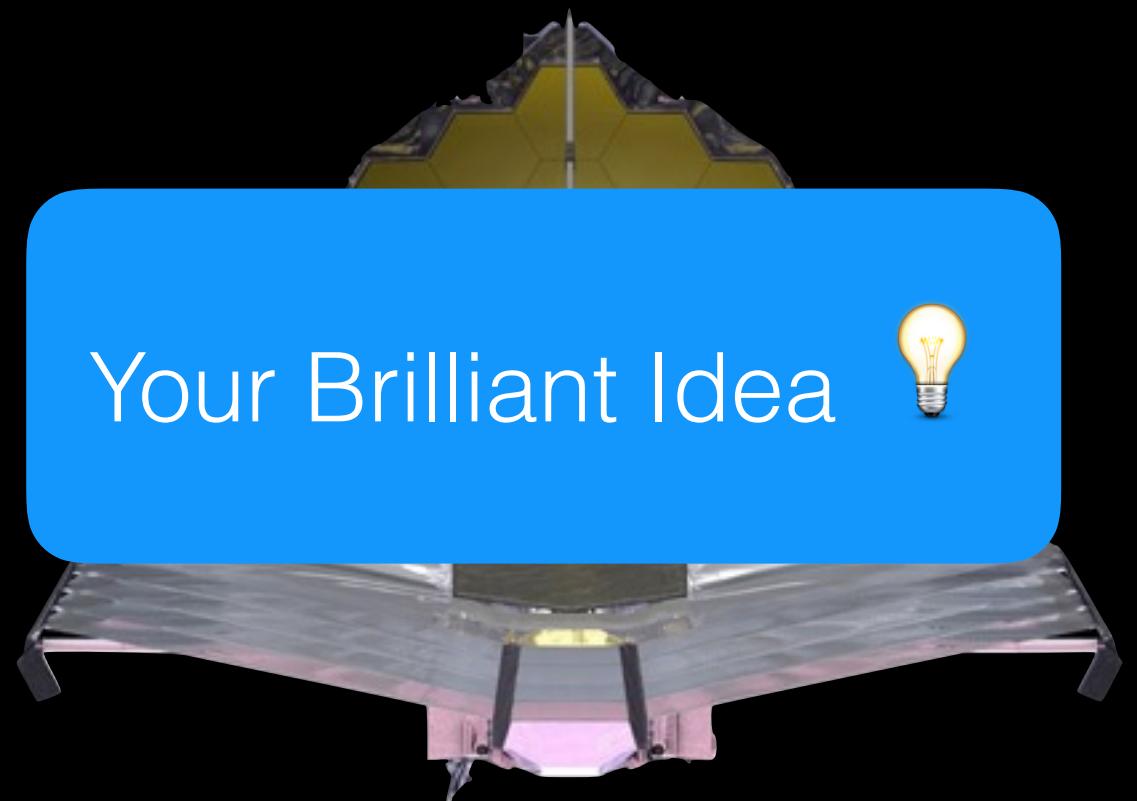




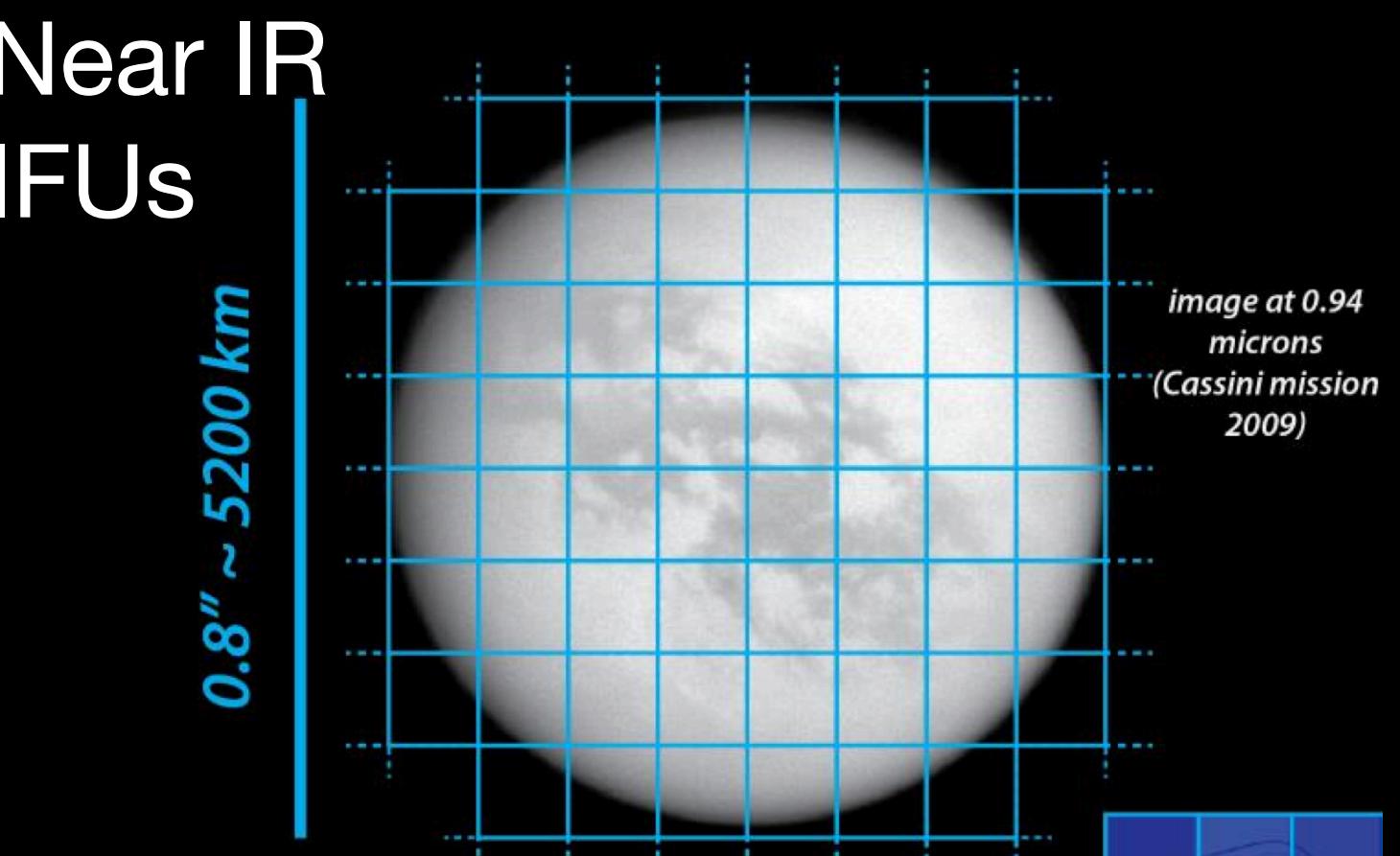
Mid IR  
IFUs



Single Object and Wide-Field  
Slitless Spectroscopy



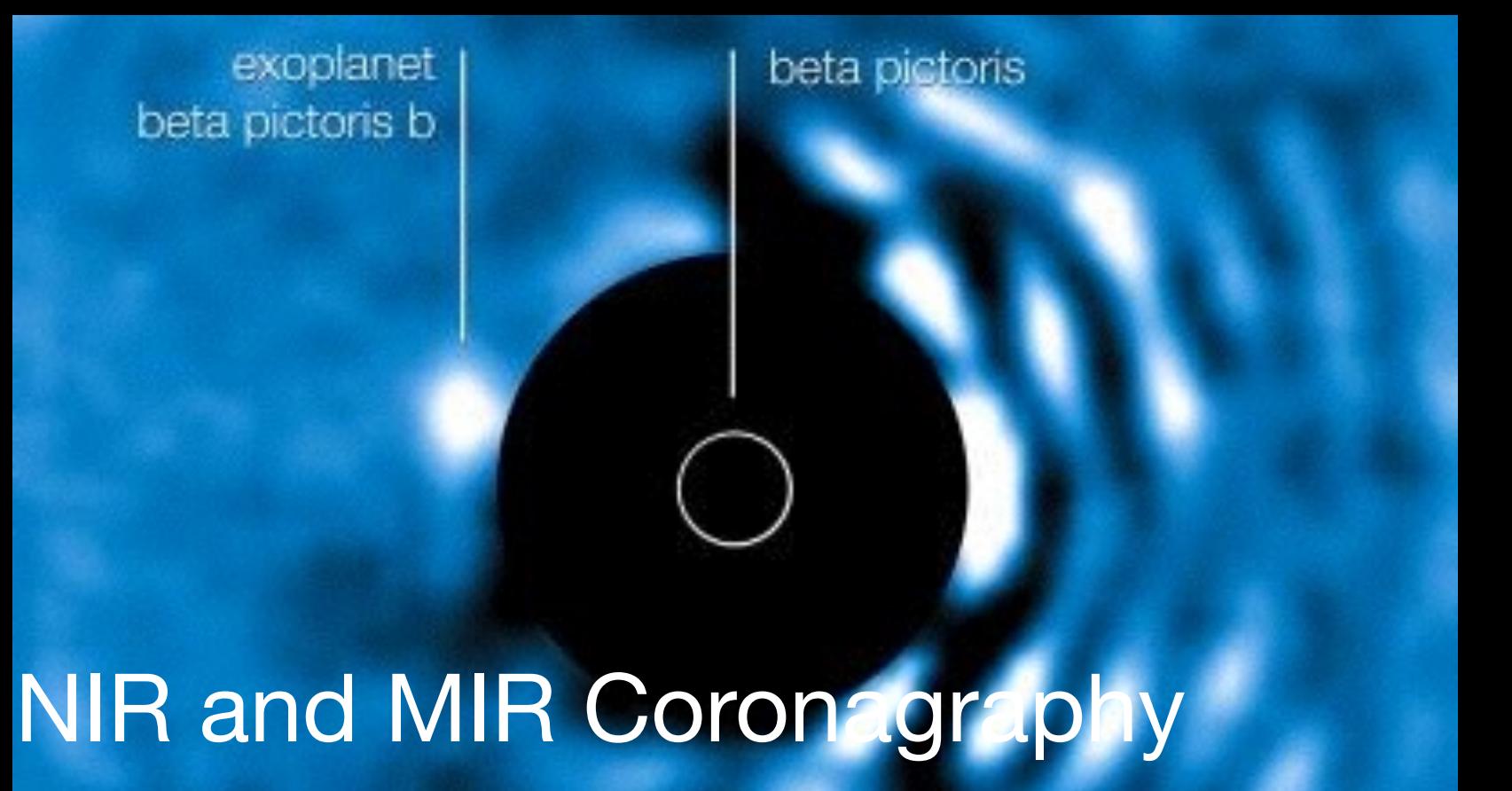
Science Capabilities



Near IR  
IFUs



Moving Target Support



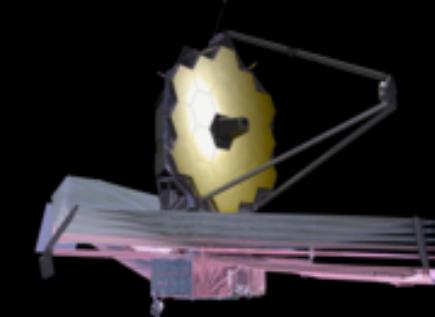
NIR and MIR Coronagraphy

Learn more about Webb  
Capabilities.

The collage displays four different web pages related to the James Webb Space Telescope (JWST), each featuring a large image of the telescope's mirrors and instruments:

- Left Top:** NASA's James Webb Space Telescope website ([jwst.stsci.edu](http://jwst.stsci.edu)). The page includes a banner for the "5 meter Flight Mirror", a navigation bar with links like About, News, Events, Multimedia, Science Planning, Instrumentation, and a search bar. The URL [www.jwst.nasa.gov](http://www.jwst.nasa.gov) is overlaid in a white box.
- Top Right:** Explore James Webb Space Telescope website. It features a prominent "Explore" logo and tabs for Intro, Amazing Facts, and FAQ Lite. The URL [www.jwst.nasa.gov](http://www.jwst.nasa.gov) is overlaid in a white box.
- Bottom Left:** Canadian Space Agency website ([www.asc-csa.gc.ca/eng/satellites/jwst/](http://www.asc-csa.gc.ca/eng/satellites/jwst/)). The page has a Canadian flag and a search bar. The URL [www.asc-csa.gc.ca/eng/satellites/jwst/](http://www.asc-csa.gc.ca/eng/satellites/jwst/) is overlaid in a white box.
- Bottom Right:** European Space Agency (ESA) website ([sci.esa.int/jwst/](http://sci.esa.int/jwst/)). The page features the ESA logo and a red background image of a galaxy. The URL [sci.esa.int/jwst/](http://sci.esa.int/jwst/) is overlaid in a white box.

Learn more about Webb Capabilities.



## JAMES WEBB SPACE TELESCOPE USER DOCUMENTATION

About Instruments ▾ Proposing ▾ Data ▾ Reference ▾

# A New Paradigm for JWST User Documentation

New documentation system: “Every page is page one”

- Short articles
- Self-contained, one-level information
- Hyperlinked network rather than monolithic handbook

Think Wikipedia (but it's not a wiki)

Multiple conceptual spaces: Background articles, planning cookbooks, science policy, engineering specs

Incremental releases (as articles are written and reviewed), beginning with instruments, APT, ETC articles

JWST Telescope and Instrumentation Home / MIRI

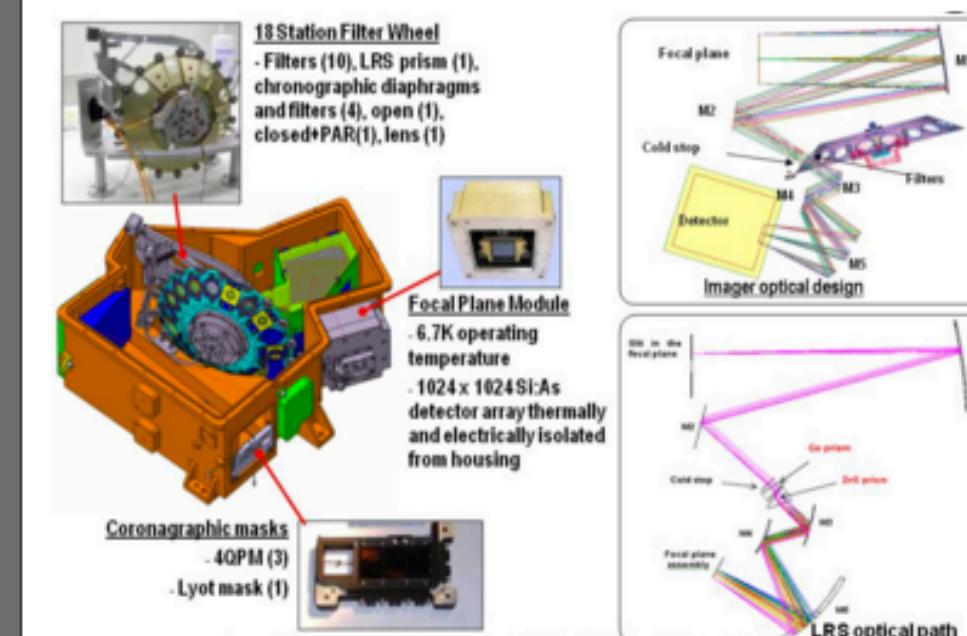
## MIRI Imaging

Created by Shireen Gonzaga, last modified by Klaus Pontoppidan on Nov 22, 2015

MIRI is the only JWST instrument that offers imaging at wavelengths longer than 5.2 micron. MIRI offers science-mode imaging in 9 broad-band filters covering wavelengths between 5.6 and 25.5 micron over a free field of view of up to 74x113". The MIRI imaging mode supports the use of detector subarrays for bright targets, as well as a variety of dither patterns, which may act to improve sampling at the shortest wavelengths, remove detector artifacts and cosmic ray hits, facilitate self-calibration by removing diffuse background contributions from both the telescope and celestial sources. MIRI imaging can also be used in conjunction with the APT mosaicking tool to image larger fields.

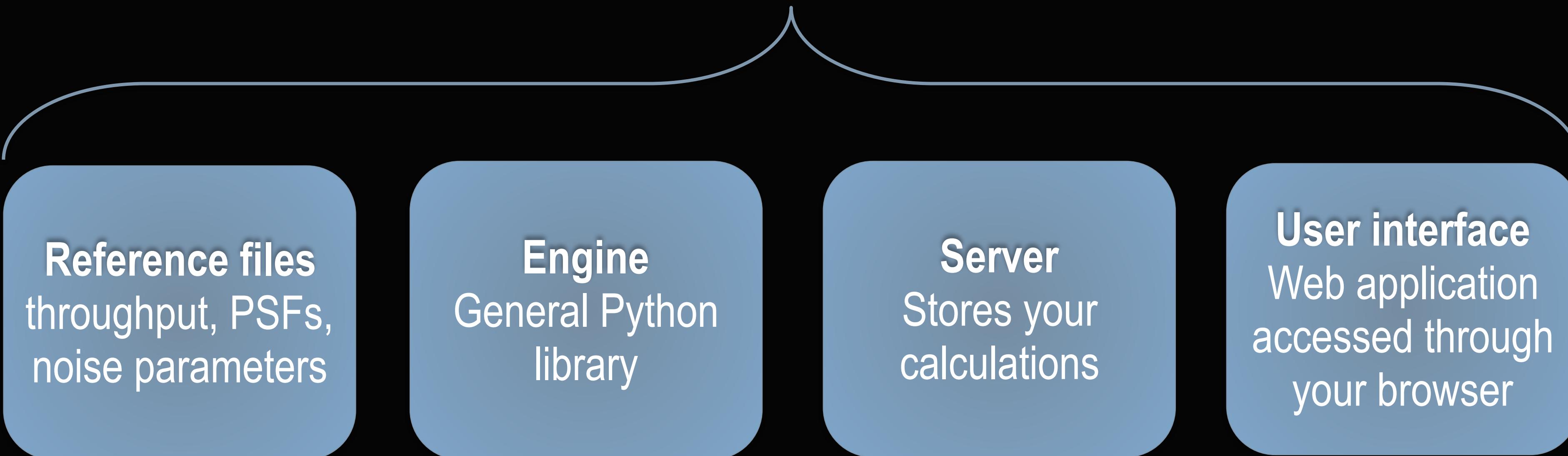
### Basic Properties

Imaging with MIRI is generally diffraction-limited in all filters, with Strehl ratios in excess of 80%, although the detector plate scale of 0.11" slightly undersamples the PSF at the shortest wavelengths <6.25 micron. At the shortest wavelengths, the sensitivity of the MIRI imager is limited by detector noise, while it becomes dominated by background noise, in particular from the JWST primary, at wavelengths longer than ~15 micron.



James Webb Space Telescope User Documentation

# JWST Exposure Time Calculator (Pandeia)



## RELEASE SCHEDULE

ETC beta released  
ETC flight release: January

# Webb Performance Estimation Tools

# JWST Exposure Time Calculator (Pandeia)

Exposure Time Calculator Edit ▾ Expand ▾ Klaus Pontoppidan ▾ Help ▾

Calculation	Instrument	Mode	Filter	Exposure Time (s)	SNR
11	niriss wfss	1	425.20	152.46	✓
10	niriss wfss	1	425.20	162.05	⚠
9	niriss wfss	1	425.20	123.13	⚠
8	miri mrs	3	2497.50	240.46	✓
7	nirspec fixed_slit	1	1528.00	46.00	✓
4	nircam wfgrism	1	1934.66	97.75	✓
3	niriss wfss	1	425.20	116.46	✓
2	miri lrsltless	1	6.55	2.96	✓
1	miri mrs	2	3330.00	28.15	⚠
-	-	-	--	--	-

2: Normalize at wavelength  
10 mJy at 20 μm

Normalize in bandpass  
0.00001 flam at

JWST MIRI/IMAGING F560W

HST WFC3/IR F098M

Other Bessel H

Calculation selected: 1, Mode: miri mrs

Reset Calculate

**Images**  
Calculation selected: 1, Mode: miri mrs

2D SNR Detector Saturation

Cube Slice at Display Wavelength

**Plots**

ApFlux ApBackground SNR SNR (time) Contrast

Signal to Noise

**Reports**  
Calculation selected: 1, Mode: miri mrs

Report Warnings Errors Downloads

Instrument Filter/Disperser: null/long

Extraction Aperture Position (arcsec): [0.00, 0.00]

Wavelength of Interest used to Calculate Scalar Values (microns): 26.00

Size of Extraction Aperture (arcsec): 1

Total Time Required for Observation (seconds): 6660.00

Total On-Source Time (seconds): 3330.00

Extracted Flux (e-/sec): 15.14

Variance in Extracted Flux (e-/sec): 0.54

Extracted Signal-to-Noise ratio: 28.15

Input Background Surface Brightness (MJy/sr): 1737.12

Total Background Flux in Extraction Aperture (e-/sec): 262.47

Sky Background Flux in Extraction Aperture (e-/sec): 262.47

Fraction of Total Background due to Signal From Scene: 0.00

Average Number of Cosmic Rays per Ramp: 0.04

Webb Performance  
Estimation Tools

Data Reduction, Analysis, and  
Interpretation = Brilliant Paper

The screenshot shows the official website for NASA's James Webb Space Telescope. The header features the telescope's name in large white letters against a dark background with a starry field. Below the name, it says "Developed in partnership with ESA and CSA. Operated by AURA's Space Telescope Science Institute". The navigation bar includes links for PUBLIC, EDUCATORS, and RESEARCHERS, as well as ABOUT, NEWS, EVENTS, MULTIMEDIA, SCIENCE PLANNING, INSTRUMENTATION, and a search icon. The current page is under SCIENCE PLANNING > Performance & Simulation Tools. The main content title is "Performance and Simulation Tools". A text block states: "STScI is currently building a wide range of new tools to help the community prepare for JWST science. These tools, including a modern exposure time calculator and a JWST image simulator, will be released prior to the Cycle 1 Call for Proposals." Below this are five tool cards with hexagonal backgrounds: "SENSITIVITY OVERVIEW" (Continue), "EXPOSURE TIME CALCULATOR" (Continue), "IMAGE AND SPECTROSCOPY SIMULATOR" (Continue), "PSF SIMULATOR" (Continue), and "DATA ANALYSIS TOOLS" (Continue). The URL at the bottom is [jwst.stsci.edu/science-planning/performance-and-simulation-tools](http://jwst.stsci.edu/science-planning/performance-and-simulation-tools).

# NASA's James Webb Space Telescope

Developed in partnership with ESA and CSA. Operated by AURA's Space Telescope Science Institute

PUBLIC EDUCATORS RESEARCHERS

ABOUT NEWS EVENTS MULTIMEDIA SCIENCE PLANNING INSTRUMENTATION Q

SCIENCE PLANNING > Performance & Simulation Tools

## Performance and Simulation Tools

STScI is currently building a wide range of new tools to help the community prepare for JWST science. These tools, including a modern exposure time calculator and a JWST image simulator, will be released prior to the Cycle 1 Call for Proposals.

**SENSITIVITY OVERVIEW**  
Continue

**EXPOSURE TIME CALCULATOR**  
Continue

**IMAGE AND SPECTROSCOPY SIMULATOR**  
Continue

**PSF SIMULATOR**  
Continue

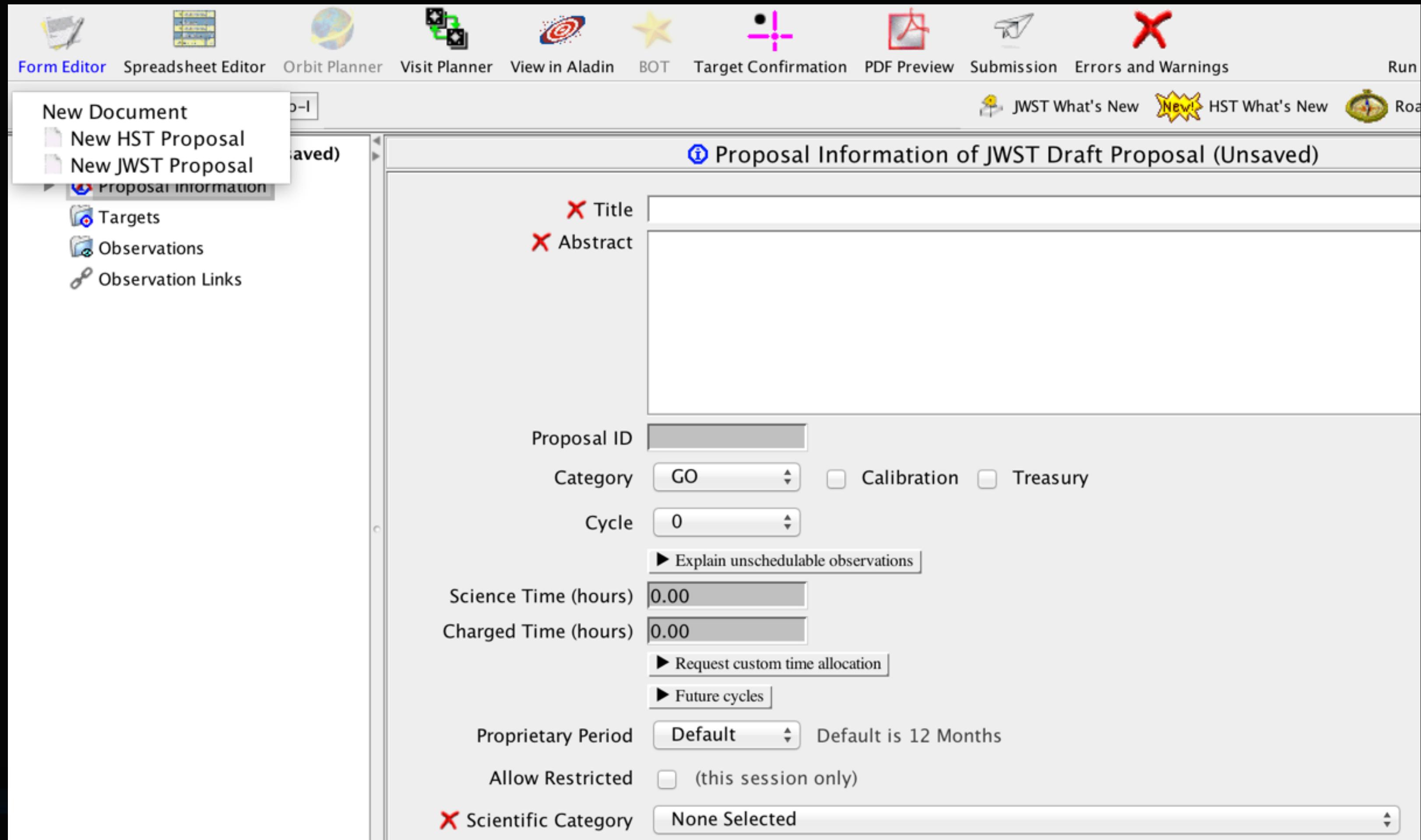
**DATA ANALYSIS TOOLS**  
Continue

jwst.stsci.edu/science-planning/performance-and-simulation-tools

Plan Your Observations/  
Write Proposal

# The Astronomer's Proposal Tool (APT)

- Familiar to HST users
- To be used to define JWST observing programs and submit JWST proposals.
- Development releases of JWST APT available together with HST APT
- <http://www.stsci.edu/hst/proposing/apt>



# The Astronomer's Proposal Tool (APT)

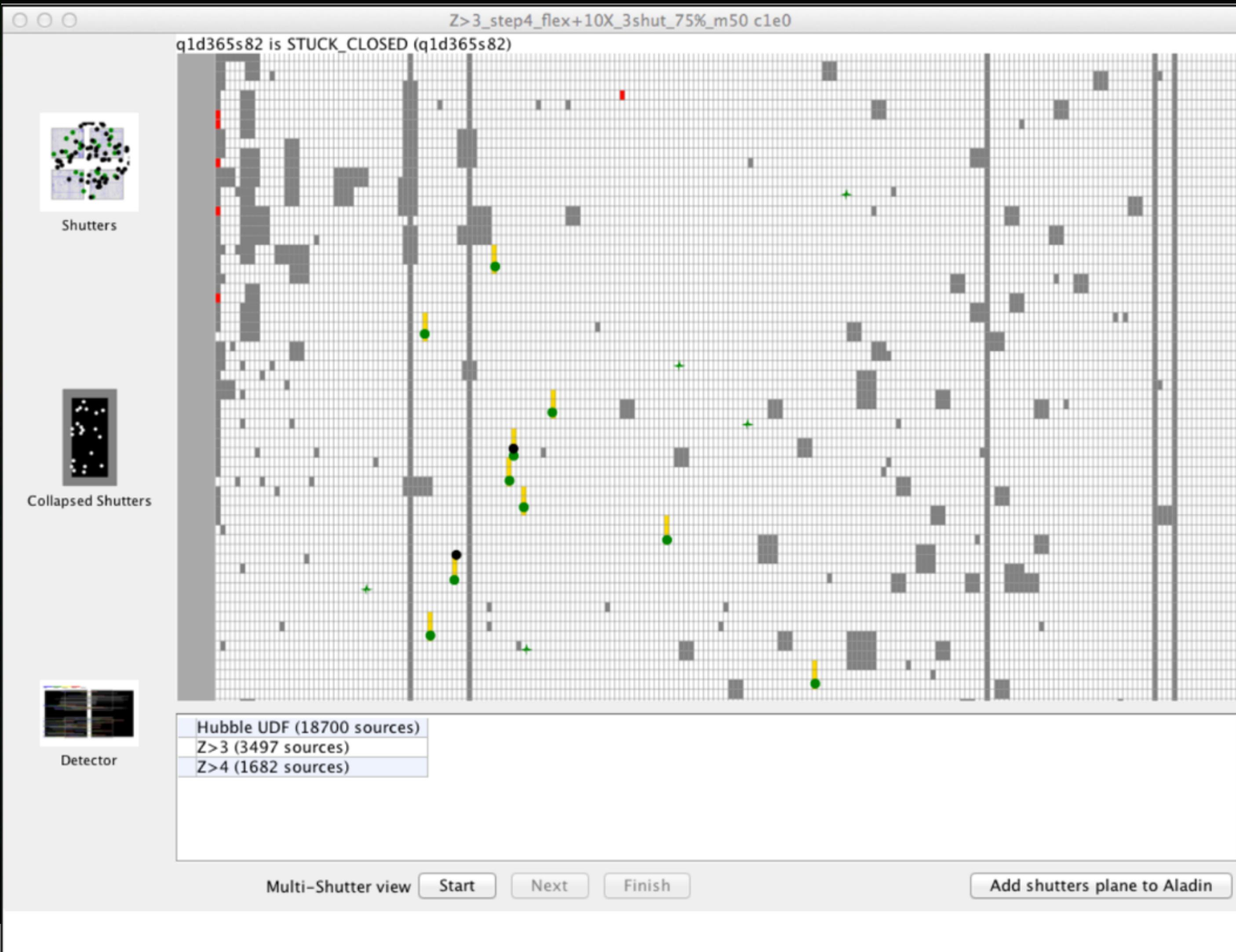
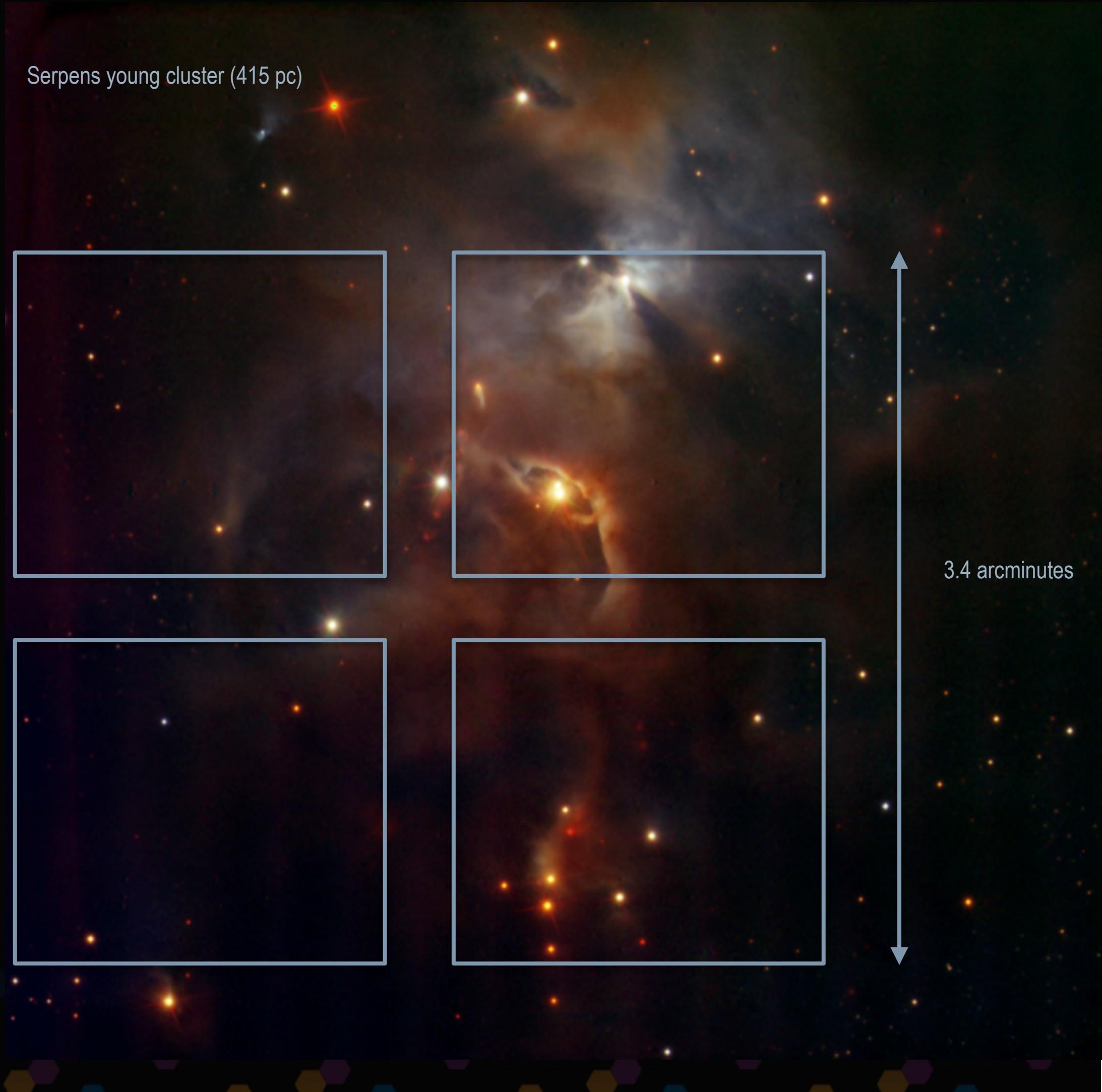
- Similar to Spitzer, Herschel and Chandra (but unlike HST) JWST observations are defined by **templates**.
- Observing modes/strategies define the templates
  - e.g., MIRI imaging, NIRSpec IFU, NIRCam coronagraphy,...
- Requires only necessary information
- Automatically splits **observations** into **visits** (sequences using a single guide star) and **exposures**.

The screenshot shows the APT interface with various configuration panels:

- Top Panel:** Basic observation parameters. The "Number" field is set to 1. The "Instrument" dropdown is set to NIRCAM. The "Template" dropdown is set to "NIRCam Coronagraphic Imaging". The "Target" field is set to "None Selected".
- Middle Panel:** Visit splitting and duration. "Visit Splitting" is set to "20.0 Arcsec" and "Number of Visits" is 1. "Duration (secs)" is 126, resulting in a "Total Charged" time of 3325 seconds. The "Data volume" is listed as 3 MB.
- Bottom Panel:** Acquisition settings for the NIRCam Coronagraphic Imaging template. It includes fields for "Coronagraphic Mask" (set to MASK210R), "Acq Target" (set to "Same Target as Observation"), "Acq Filter" (set to F182M), and "Acq Flux".
- Table View:** A table showing acquisition parameters. It includes columns for "Acq Exposure Time" (set to RAPID), "Acq Readout Pattern" (set to RAPID), "Acq No. of Groups" (set to 3), "Acq No. of Integrations" (set to 1), "Acq Photon Collect Duration" (set to 12.538), and "Filters". The "Filters" table has one row: #1, F210M, RAPID, 10, 3, 125.38, 125.38.
- Buttons:** At the bottom are buttons for "Add", "Duplicate", "Insert Above", and "Remove".

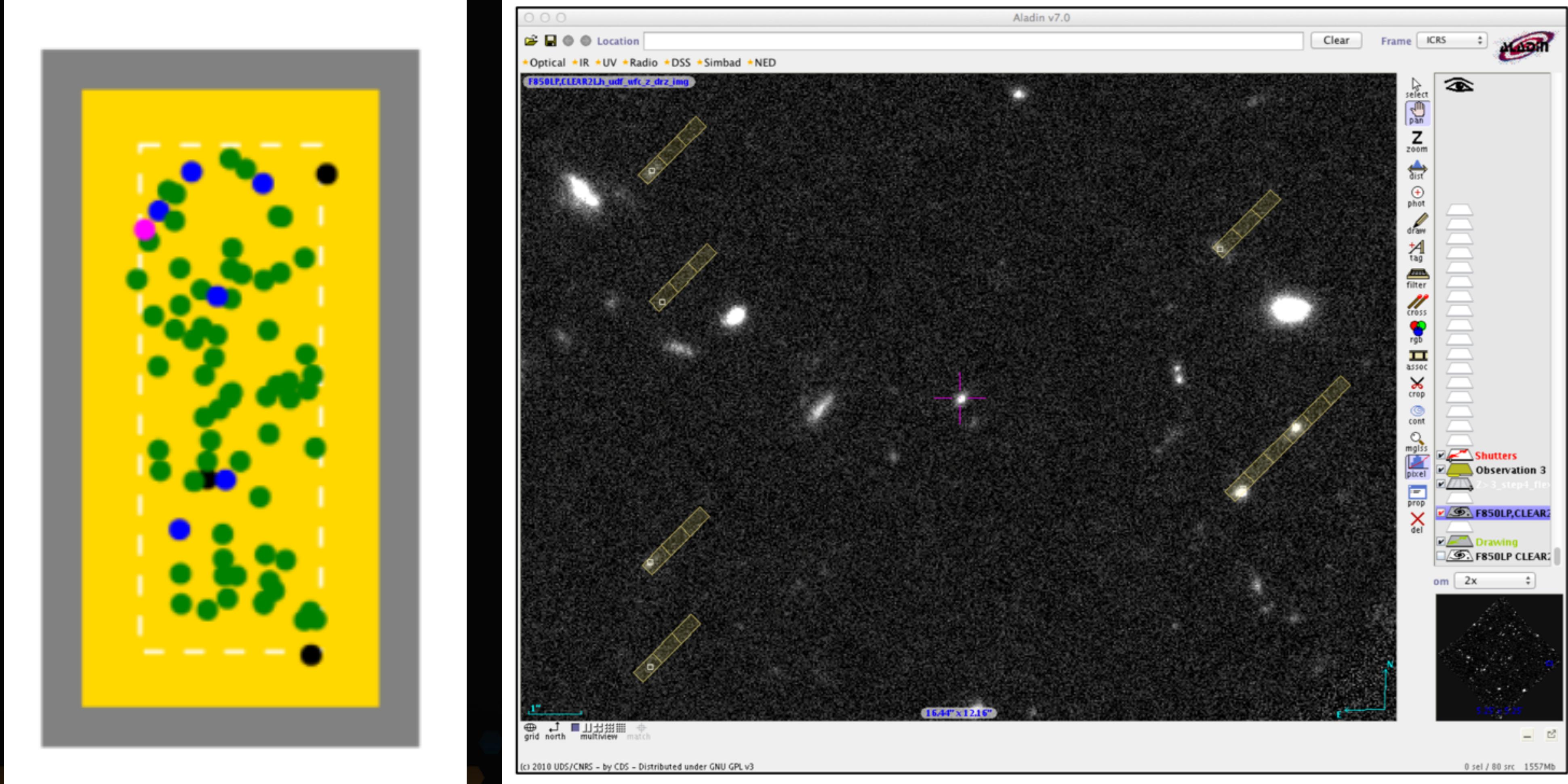
Plan Your Observations/  
Write Proposal

# The Micro-shutter Arrays Planning Tool (MPT)



Plan Your Observations/  
Write Proposal

# The Micro-shutter Arrays Planning Tool (MPT)

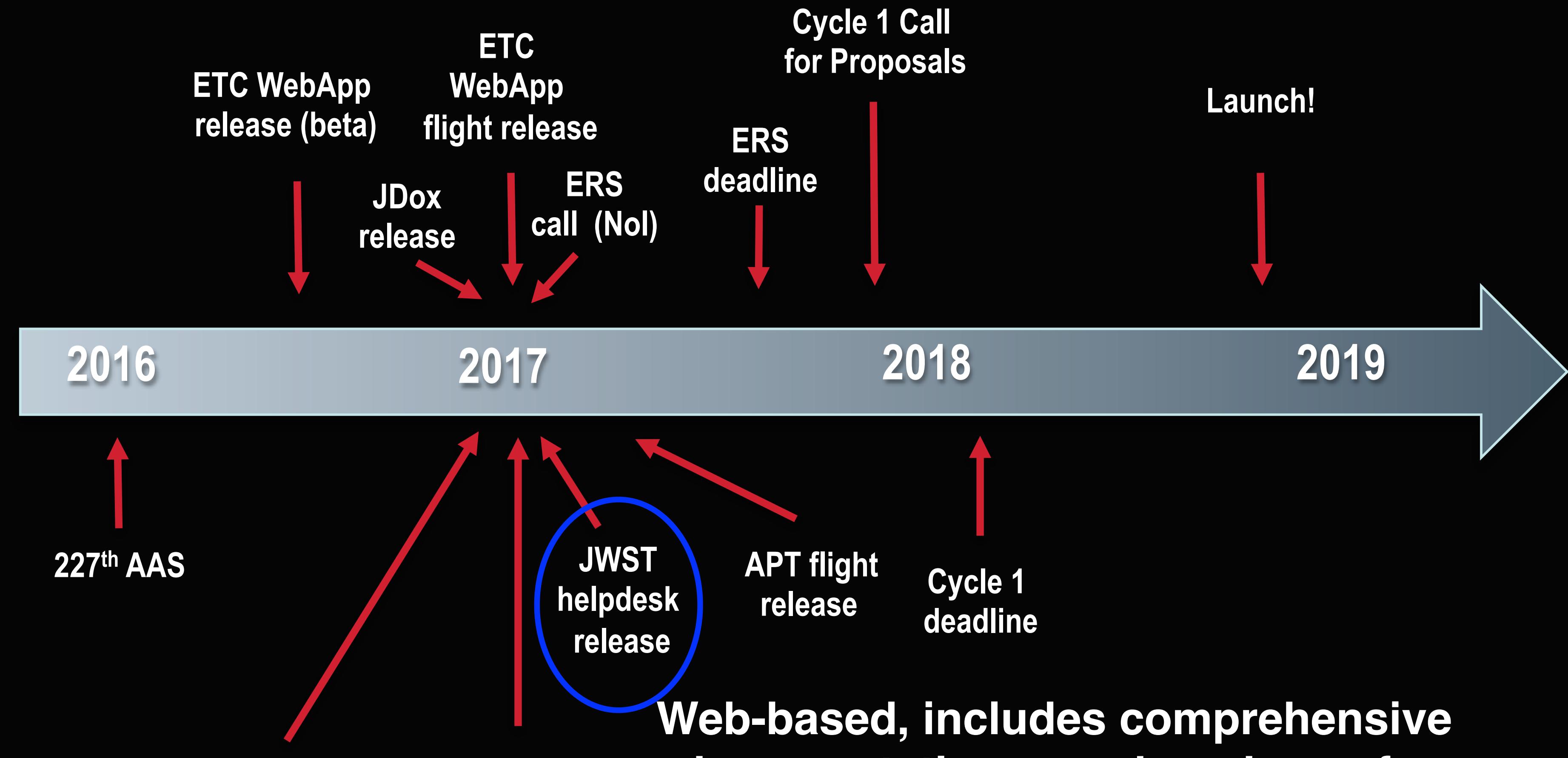


Learn more about Webb Capabilities.

Webb Performance Estimation Tools

Plan Your Observations/  
Write Proposal

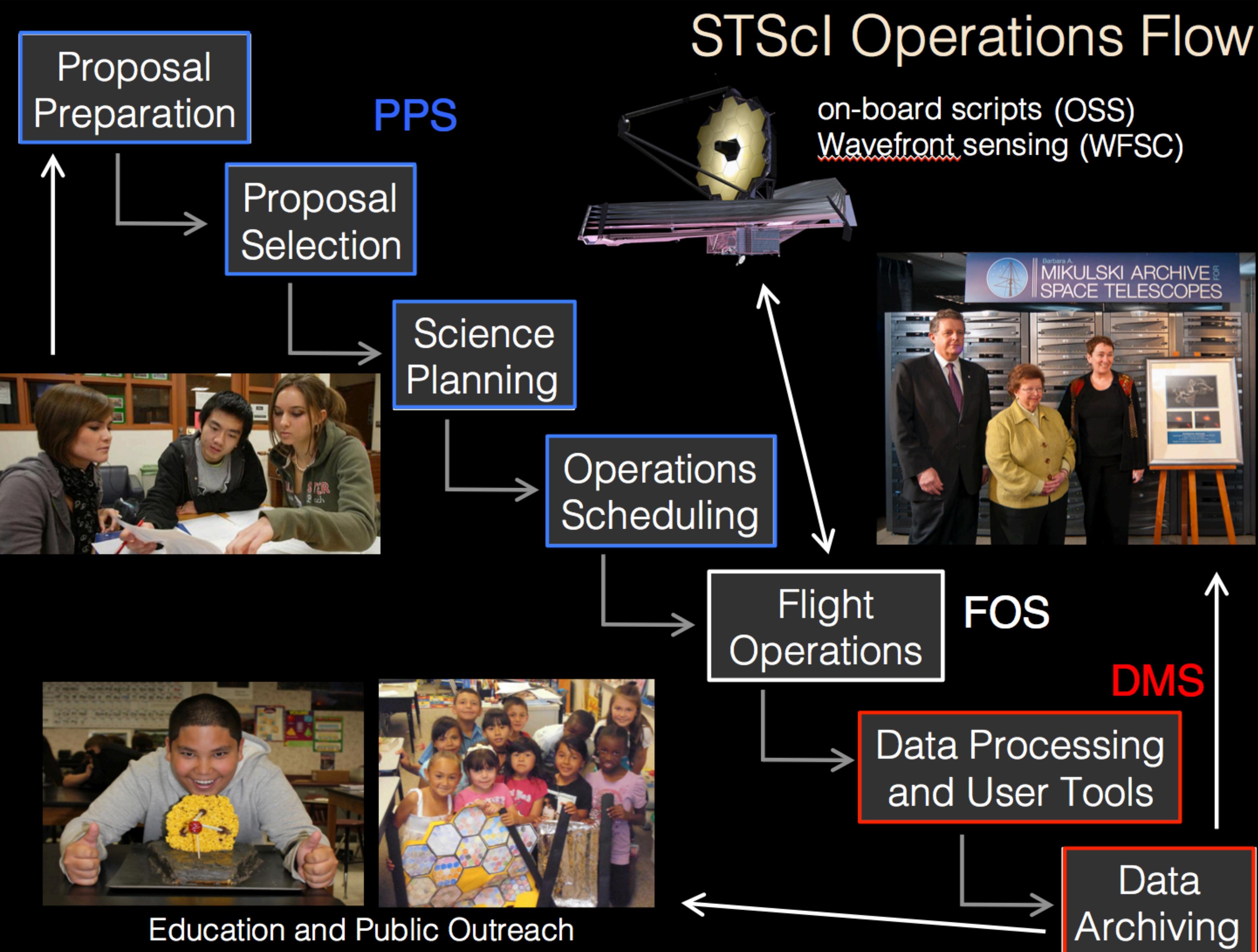
# Timeline For JWST Tools Releases



**Web-based, includes comprehensive documentation search and user forum.**

Submit Your Brilliant  
Proposal and Hope for Best

Celebrate and Wait For  
Observations



# The *Webb* Pipeline Architecture

## Pipeline Availability

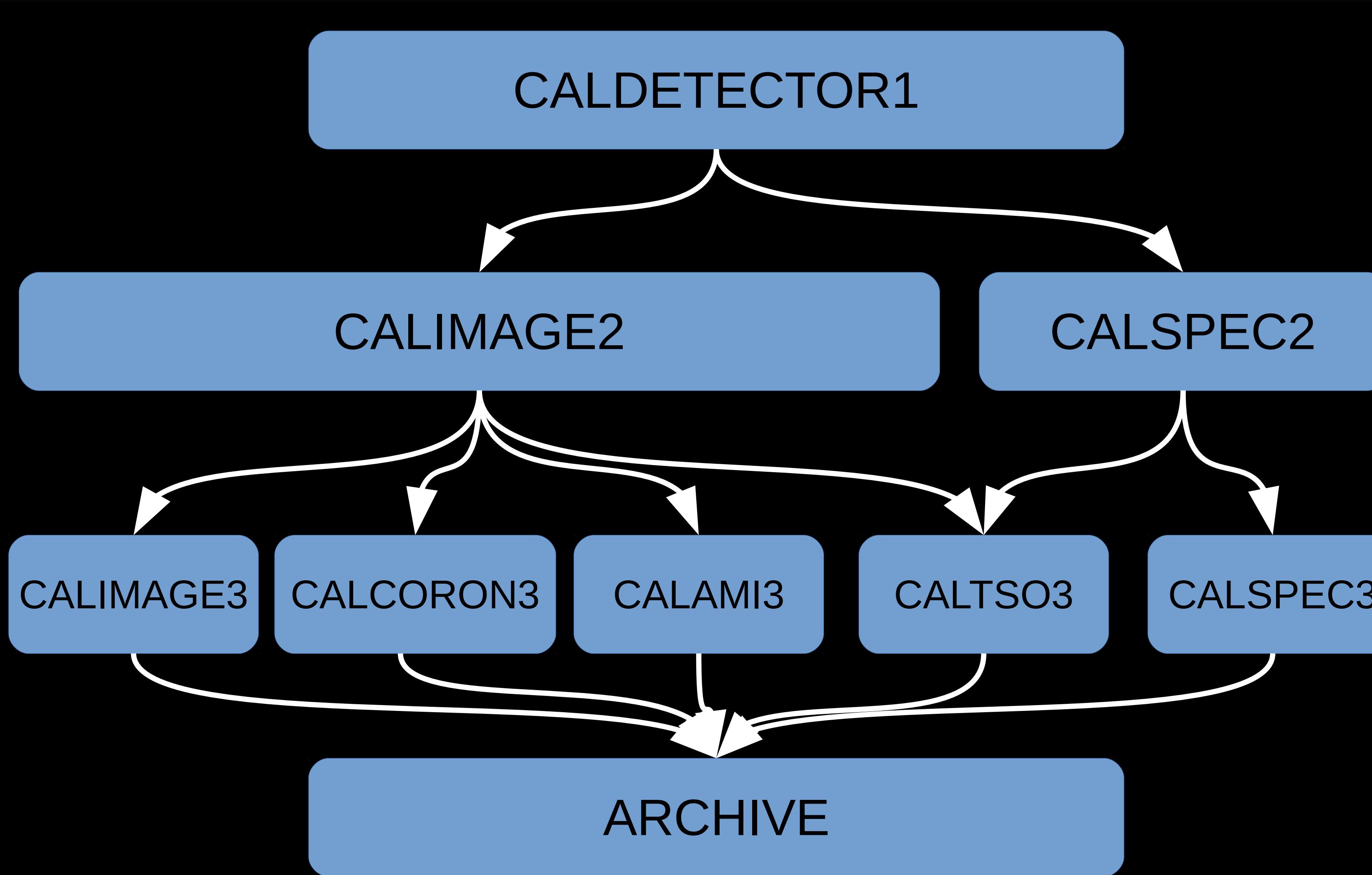
- Written in python
- Freely available
- Easily configurable
- Users can rerun all or part of the pipeline
- Users can replace specific modules
- Hosted on github
- Based on astropy

## Data Products

- Raw data
- Intermediate stage data
- Final data
  - Best quality from an automated pipeline
  - “browse-quality” data in Spitzer-speak
  - Flux, wavelength, and position calibrated
- Any user can rerun the pipeline offline
  - Changed parameters to specific steps
  - Replace a step with a user written version

Observations Processed by  
*Webb* Pipeline

# The *Webb* Pipeline Architecture



Ramps-to-Slopes

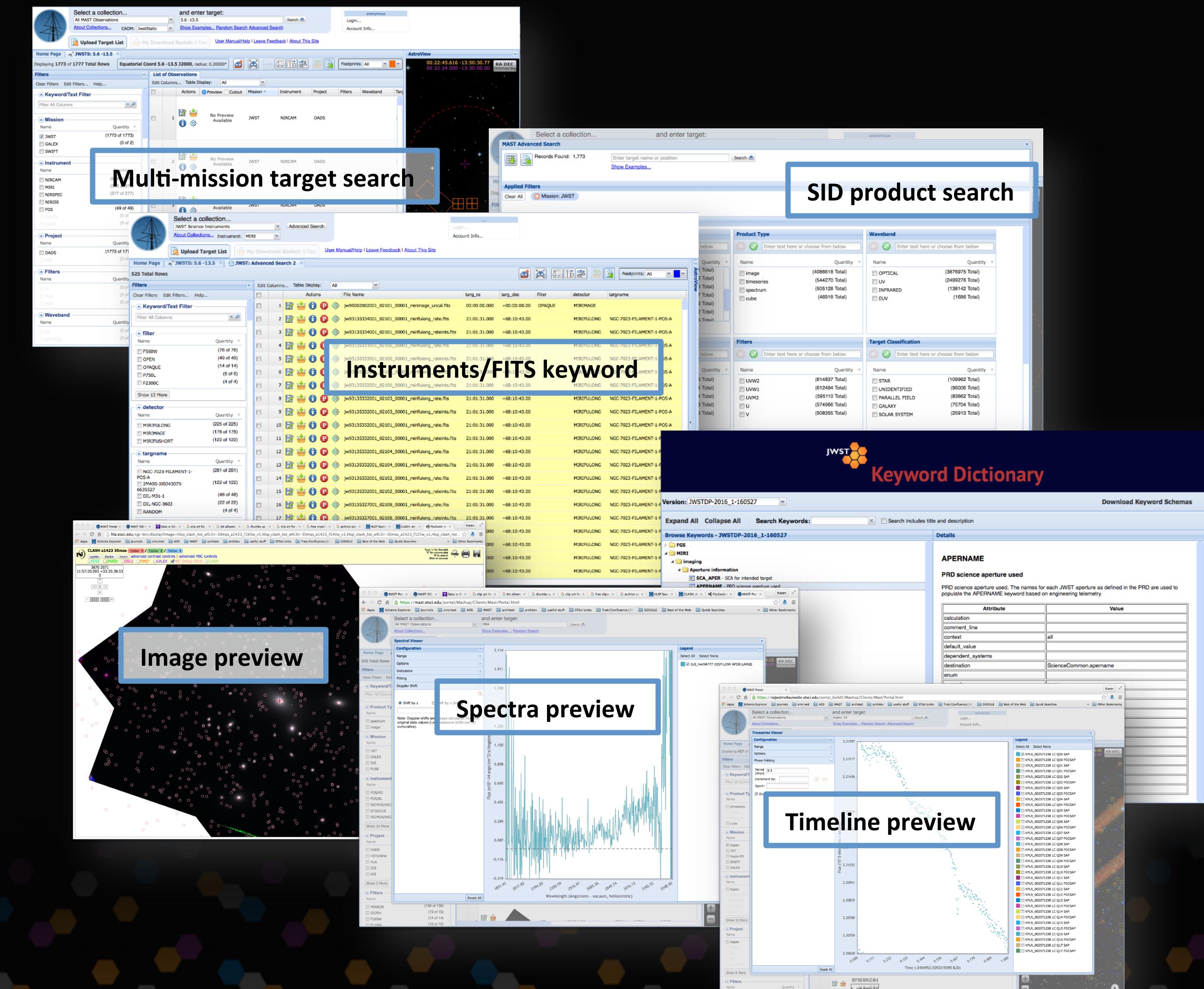
Calibrated Slopes

Ensemble Processing

# Processed Data Delivered to MAST Archive

- Common Archive Observation Model (CAOM)
- JWST-specific views
- Distribution (URL & Curl-scripts)
- Subscription Service
- High Level Science Products (HLSP)
- Digital Object Identifier (DOI): Linking Data to Papers
  - Starting with AAS journals

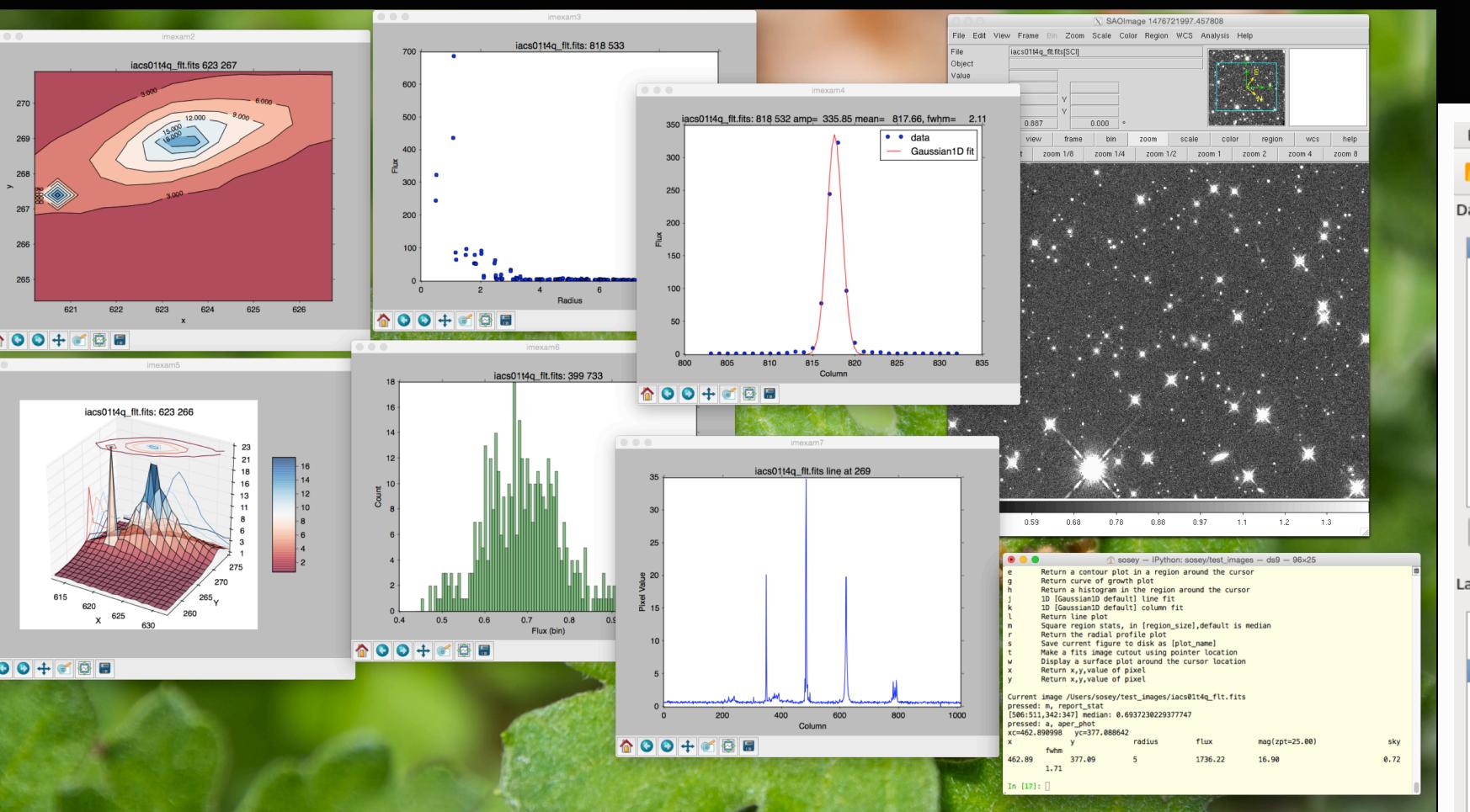
# The MAST Archive in the Era of JWST



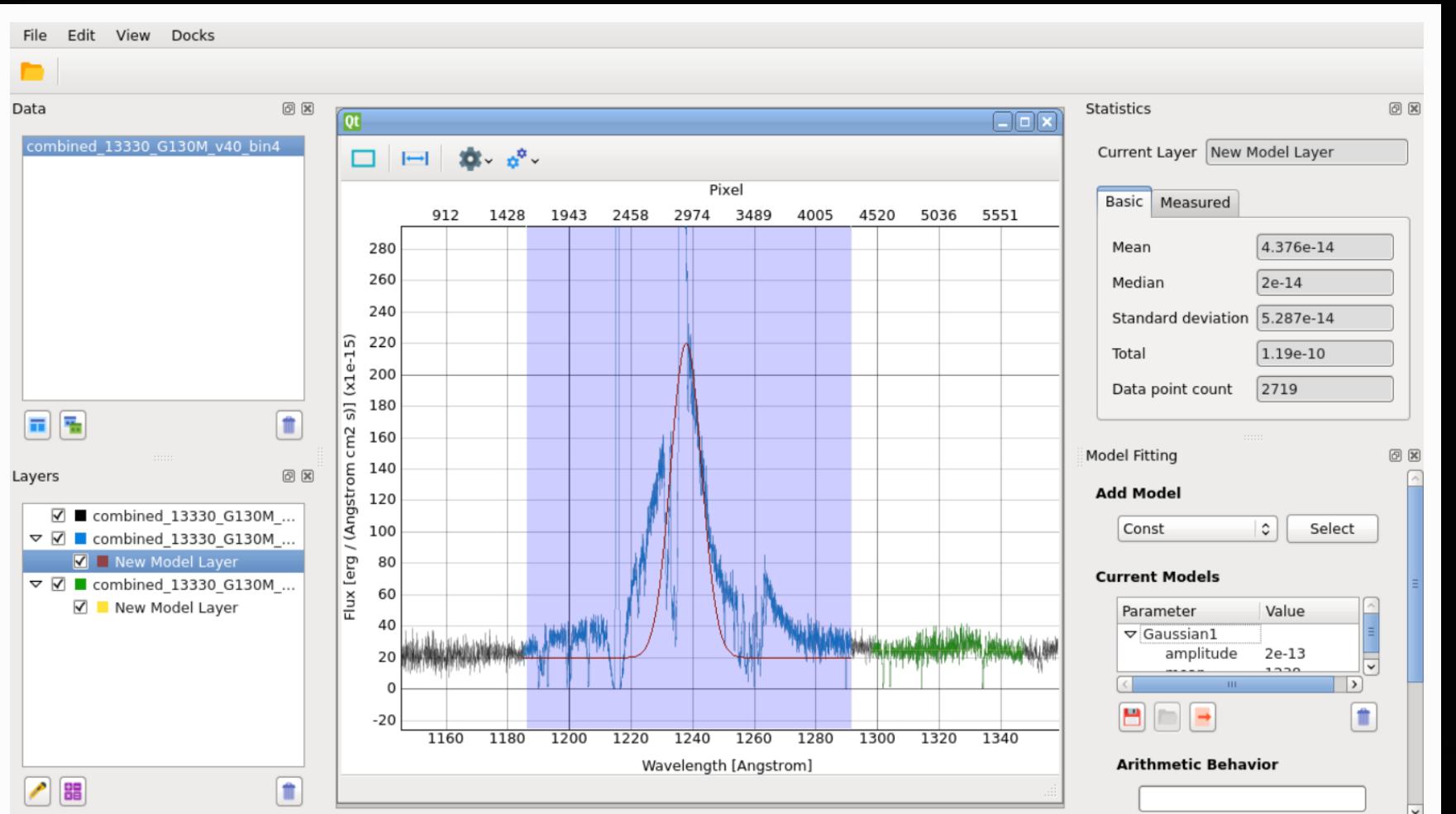
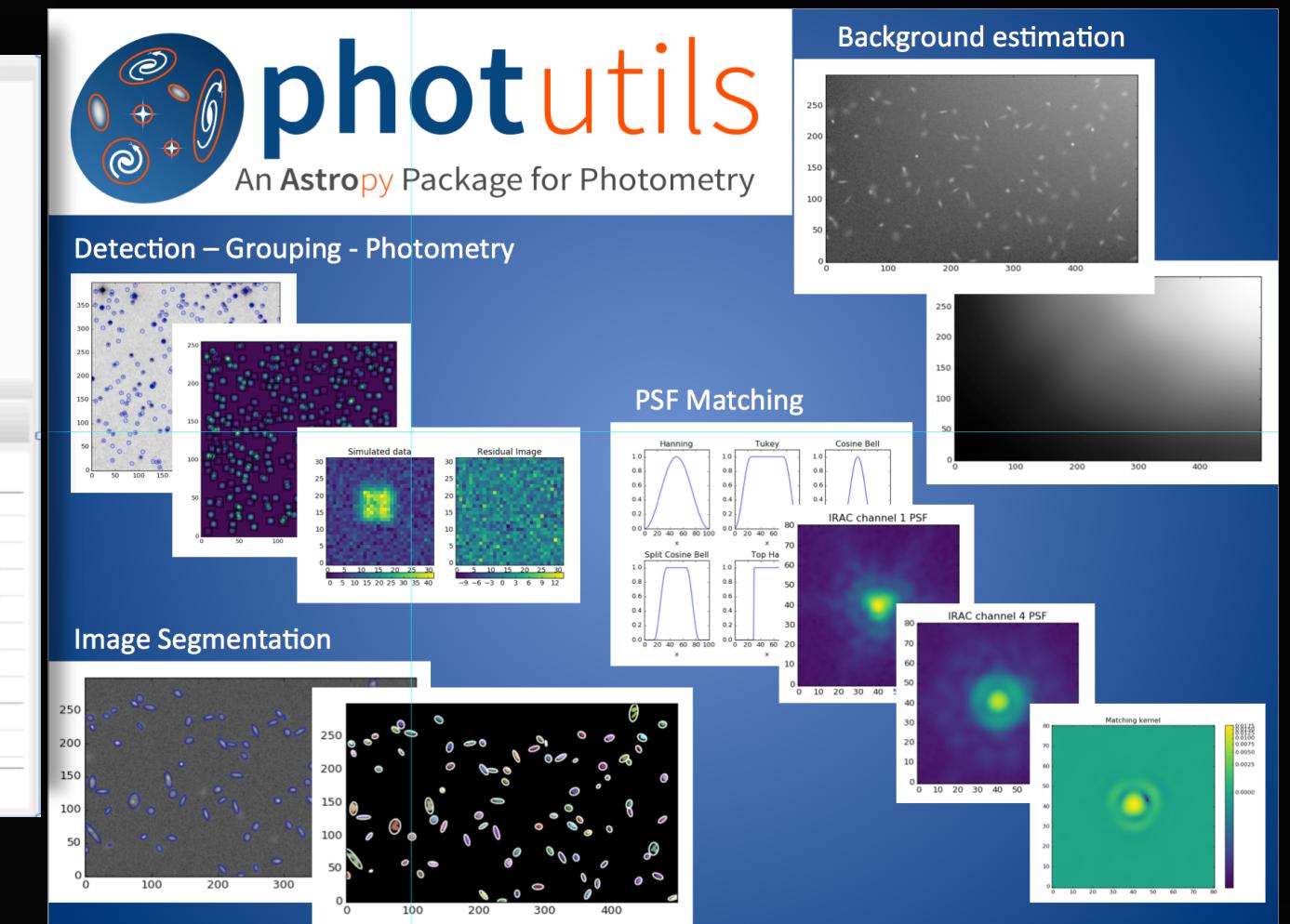
Data Reduction, Analysis, and Interpretation = Brilliant Paper

# JWST Data Analysis Tools

- Flexible, Modular tools
- In Python
- Supporting JWST data structures
- Simple installation



Please take a short survey:  
<http://bit.do/jwstDA>



Data Reduction, Analysis, and Interpretation = Brilliant Paper

# JWST Data Analysis Tools

- Training workshops
  - STScI
  - AAS
- Easy installation with AstroConda
- Extensive online documentation

[webcast.stsci.edu](http://webcast.stsci.edu)

## User Training in JWST Data Analysis II

Training Workshop • November 8th



The second "User Training in JWST Data Analysis" workshop will be held on November 8-11, 2016 at the Space Telescope Science Institute (STScI). The purpose of this three-day meeting is to provide training in the open-source data analysis tools being developed at STScI for use with the James Webb Space Telescope (JWST), as well as for many other optical/IR observatories.

## Welcome to AstroConda's documentation!

AstroConda is a free software repository maintained by the [Space Telescope Science Institute \(STScI\)](#) in Baltimore, Maryland. This repository provides tools and utilities commonly used by the community.

# How do I get ready for JWST? Participate in our training events!



Today!! -> [jwst.stsci.edu/news](http://jwst.stsci.edu/news)

# JWST Community Engagement: Navigating and Preparing for Cycle 1 DD-ERS and GO Proposals

Proposal Planning  
Workshops

Topical Science  
Workshops

Condensed 0.5-1 Day  
Add-on Workshops

Webinars & Video  
Libraries

Proposal Planning Workshops

Topical Science Workshops

Condensed 0.5-1 Day  
Add-on Workshops

- More than a dozen in-person workshops and events occurring between now and January 2018!
- All events to be webcast and/or recorded to enable remote participation.
- Some events will support ‘Ask-an-Expert’ help desk
- Opportunities at events for discussion of DD-ERS programs among community members

Full Schedule:

<https://jwst.stsci.edu/science-planning>

[Issue 3: newsletter.stsci.edu](http://newsletter.stsci.edu)



Space Telescope Science Institute  
**NEWSLETTER**

October 2016 Special Issue  
**JWST Proposal Planning**

## Proposal Planning Workshops

## Topical Science Workshops

## Condensed 0.5-1 Day Add-on Workshops

Just a Sample of  
Upcoming Events!



18-20 Jan 2017	<a href="#"><u>JWST Nearby Galaxies Workshop (Pasadena, CA)</u></a>	Capabilities; Proposal and Planning
20-24 Mar 2017	<a href="#"><u>Science with Hubble and JWST V (Venice, Italy)</u></a>	Capabilities; Proposal and Planning; Data Analysis
15-17 May 2017	<a href="#"><u>JWST Proposal and Planning Workshop (Baltimore, MD)</u></a>	Capabilities; Proposal and Planning; On-site help desk
4-8 Jun 2017	<a href="#"><u>American Astronomical Society 230th Meeting (Austin, TX)</u></a>	Proposal and Planning; Ask-an-expert
10-12 Jul 2017	<a href="#"><u>Planning Transiting Exoplanet Science with JWST (Baltimore, MD)</u></a>	Capabilities; Proposal and Planning
10-12 Jul 2017	<a href="#"><u>Galaxies Throughout Cosmic Time with JWST (Baltimore, MD)</u></a>	Capabilities; Proposal and Planning
4-6 Oct 2017	<a href="#"><u>Mastering the Science Instruments and the Observing Modes of JWST: Get Set (location TBD)</u></a>	Proposal and Planning; Ask-an-expert
15-20 Oct 2017	<a href="#"><u>Division of Planetary Science 49th Meeting (Provo, UT)</u></a>	Capabilities; Proposal and Planning; Ask-an-expert

## Webinars & Video Libraries

Webinars (~1 hour) with both topical and tool specific focus are on going with many planned for Fall 2016 and beyond

[https://confluence.stsci.edu/display/JWSTLC/  
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James Webb Space Telescope User Documentation

## Webinars & Video Libraries



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10/18/16	Laurent Pueyo (STScI)	Preparing a JWST Coronagraph Proposal	<a href="#">Video</a> <a href="#">Abstract</a> <a href="#">Slides</a>
11/1/16 11 am ET	David Law (STScI)	The NIRSpec and MIRI IFUs	<a href="#">Video</a> <a href="#">Abstract</a> <a href="#">Slides</a>
11/15/16	Karl Gordon (STScI)	Absolute Flux Calibration	<a href="#">Video</a> <a href="#">Abstract</a> <a href="#">Slides</a>
11/29/16	Jay Anderson (STScI)	Astrometric Calibration	<a href="#">Video</a> <a href="#">Abstract</a> <a href="#">Slides</a>
12/13/16	James Muzerolle (STScI)	The NIRSpec MSA	<a href="#">Video</a> <a href="#">Abstract</a> <a href="#">Slides</a>

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