



JWST Proposal planning tools

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Materials adapted from ESA Masterclass & STScI/JHU JWST proposal writing workshops.





Overview

- JDox: JWST Documentation
- ETC: Exposure Time Calculator
overview + hands-on exercise
- APT: Astronomers Proposal Tool
overview + hands-on exercise



JDox: JWST Documentation

Link: <https://jwst-docs.stsci.edu>

WEBB SPACE TELESCOPE

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- Opportunities and Policies
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- Cycle 3 Director's Discretionary (DD) Time Proposals
- Director's Discretionary Time
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- JWST Peer Review Information
- Past Proposal Opportunities

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- Observatory Characteristics and Performance

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Welcome to the **JWST User Documentation Homepage**

This website holds a comprehensive collection of documentation (known as JDox) on the JWST spacecraft and instruments, preparing observing proposals, and getting started on data analysis.

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Latest JDox Updates

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JDox: JWST Documentation

Link: <https://jwst-docs.stsci.edu>

Info about:

- Proposing Opportunities
(including policies,
e.g., anonymous review process)

- Observatory
- Instruments
- Proposal Preparation
- Proposing Tools
- Observing Process

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About JWST	Instruments	Proposing Tools
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Characteristics	Near Infrared Camera	Astronomer's Proposal Tool
General Support	Near Infrared Imager and Slitless Spectrograph	Other Tools
	Near Infrared Spectrograph	
For Proposers	Data	
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Additional Resources



JDox: JWST Documentation

Link: <https://jwst-docs.stsci.edu>

Search tab

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About JWST

- Hardware Characteristics General Support

Instruments

- Mid Infrared Instrument Near Infrared Camera Near Infrared Imager and Slitless Spectrograph Near Infrared Spectrograph

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- Getting Started with Planning JWST Observations Understanding Exposure Times JWST General Support Methods and Roadmaps Example Science Programs Recommended Observing Strategies Observation Duplication Checking Acronyms and Abbreviations

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- Observing with JWST

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- For Proposers Getting Started Opportunities and Policies Methods and Roadmaps Recommended Observing Strategies Example Science Programs Duplication Checking
- Data Getting Started Accessing JWST Data Science Calibration Pipeline Calibration Status Known Issues with JWST Data Post-Pipeline Data Analysis

Most useful for this group:

- Video Tutorials
- Proposing Tools
- For Proposers

Demo:

- Find Cycle 4 Timeline
- Find JWST proposal workflow
- Use search tab



JWST ETC: Exposure Time Calculator

ETC link: <https://jwst.etc.stsci.edu/>

Welcome to the JWST Exposure Time Calculator

[Quick Start](#)[Create User](#)[Login](#)[Work Anonymously](#)

News

Welcome to version 4.0 of the JWST ETC!

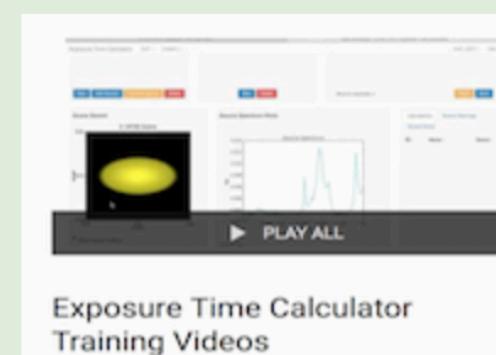
This release features support for single-group ramps, the addition of aperture visualizations in images, a new NIRCam short-wavelength grism time series mode, and updates to the thermal background and MIRI throughputs: see the [Release Notes](#) for details, and be sure to review the [Known Issues](#) for this release.

When you log in, workbooks from ETC 3.2 and earlier will be marked with a previous version number in the "Ver" column:

- When you load them, they will open in Read-Only mode: this ensures that your previous results are not overwritten and remain available to you for reference.
- If you copy an out-of-date workbook, and load the copy, all its calculations will be automatically updated for you with the current version of the software.
- For more information, see [ETC Releases and Out-of-Date Workbooks](#).

Be sure to review the [Known Issues](#) with this release.

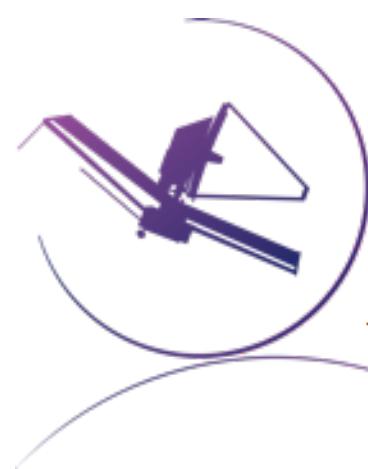
Help



Exposure Time Calculator
Training Videos

[Watch the Videos](#)

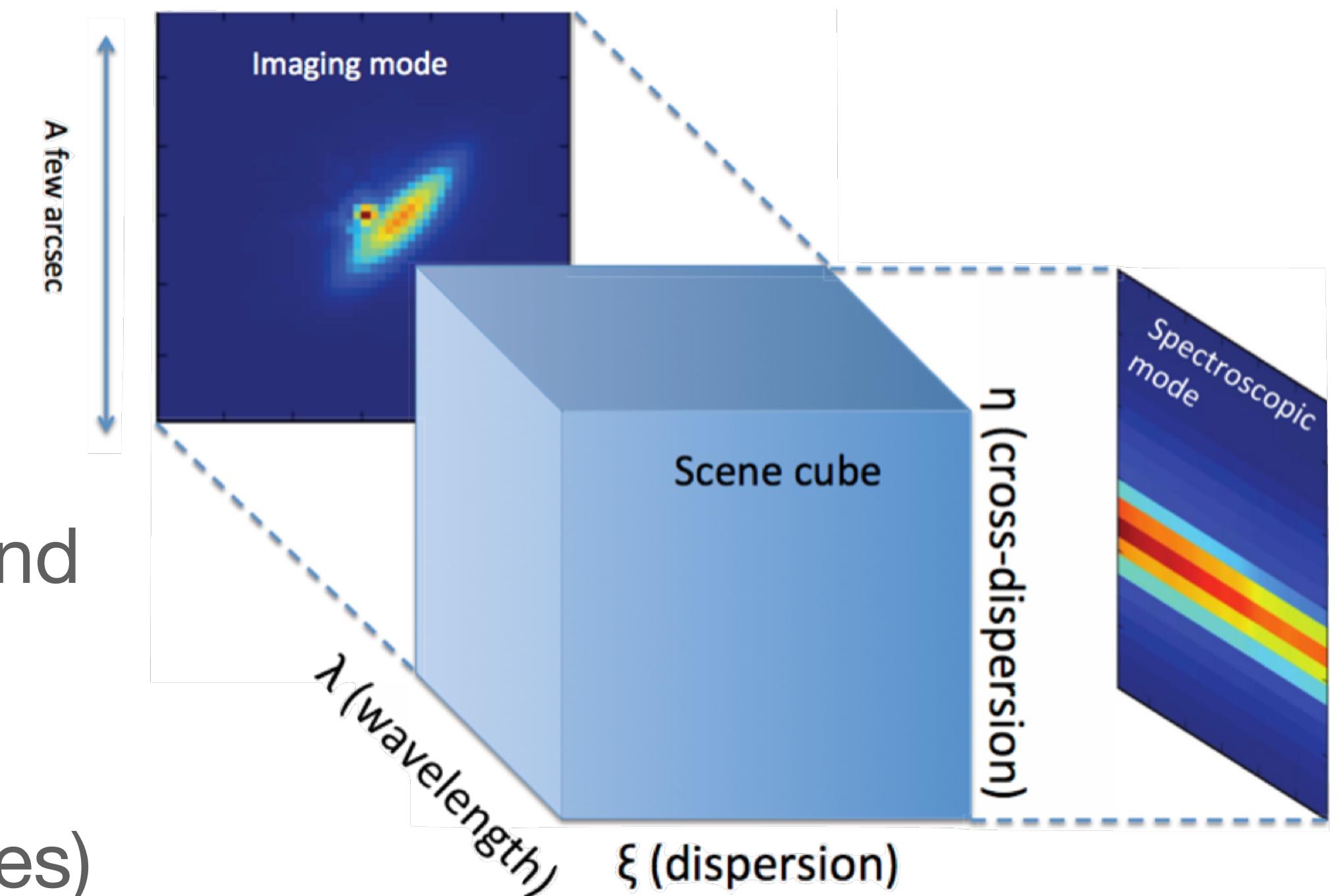
Read the Docs



JWST ETC Concept

Modern design

- ▶ Signal (source + background) modelled in 3D
- conserves flux
- resolve lines
- ▶ Pixel based:
- Models the detector (e.g. correlated noise)
- Final S/N calculation includes data analysis and post-processing steps (“strategy”)
- Allows the modelling of complex scenes (e.g. estimate contamination from bright sources)



Supports all JWST modes



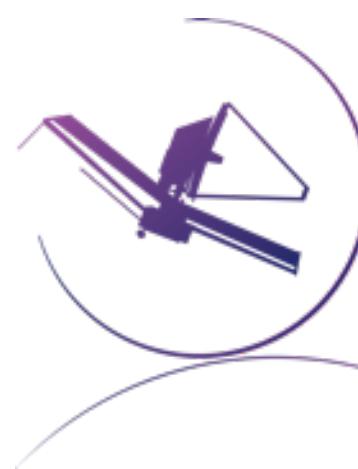
ETC Web Application Features

Scenes and Sources Page

This page allows users to manage scenes and sources. It includes tabs for Calculations, Scenes and Sources, Upload Spectra, and Caveats and Limitations.

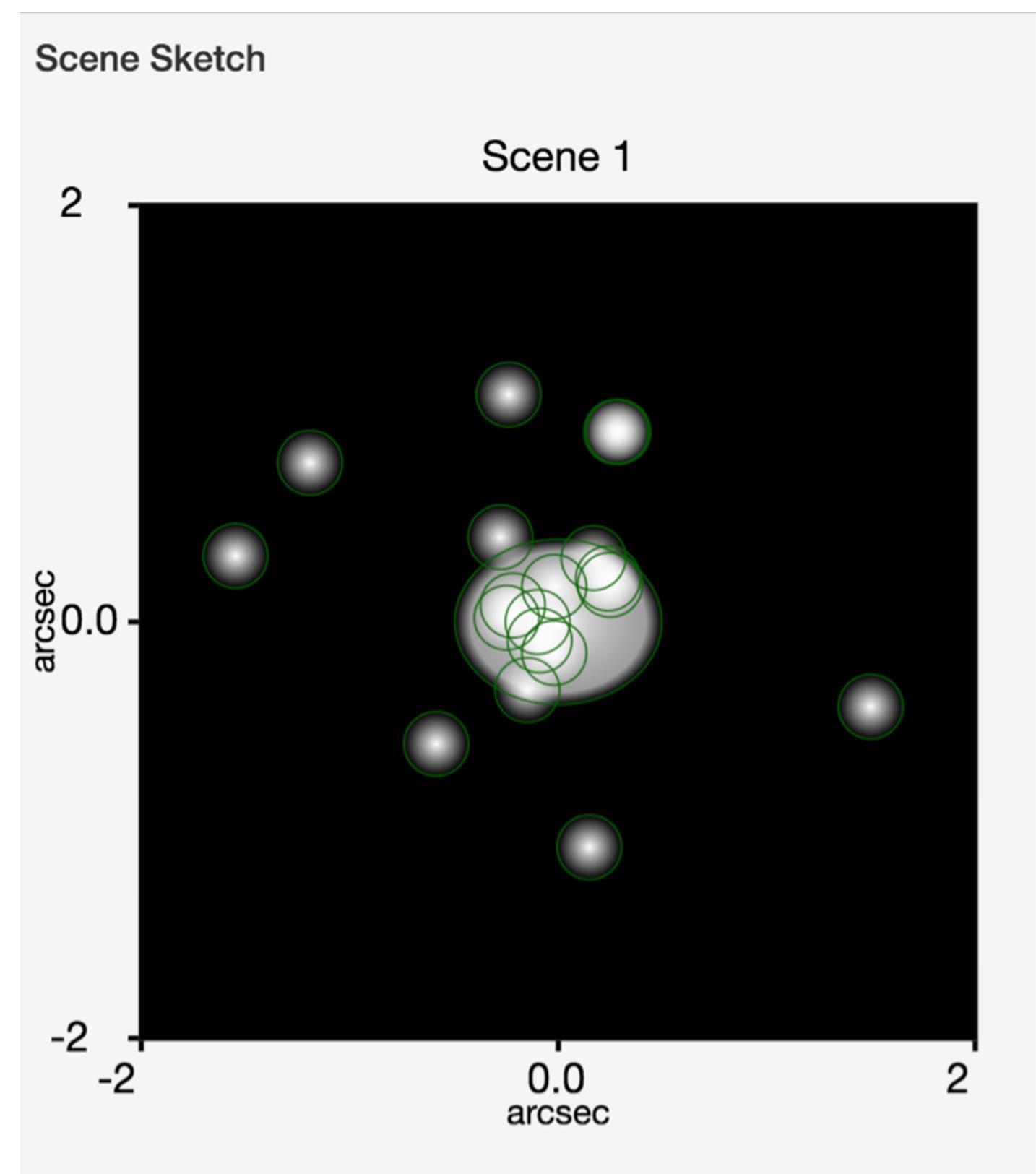
- Select a Scene Pane:** Lists scenes with columns for ID, Name, Sources, and # Calcs. The first scene is selected (wfss scene).
- Select a Source Pane:** Lists sources with columns for ID, Plot, Name, Scenes, and # Calcs. Sources include Galaxy 1 through Galaxy 8, Star 1, and Star 1 (bb).
- Source Editor Pane:** Provides tools for normalizing source flux density, selecting instruments (JWST or HST), and defining continua.
- Scene Sketch Pane:** Displays a 2D coordinate system (arcsec) showing source outlines for the wfss scene.
- Source Spectrum Plots:** Shows two plots: a Source Spectrum plot (flux vs. wavelength in microns) and a Spectra Plot (flux vs. wavelength in microns).
- Used in Calculations Pane:** Lists instruments and modes used in calculations, such as niriss imaging, niriss wfss, niriss wfsss, nircam wfgrism, niriss soss, miri mrs, and nirspect ifu.

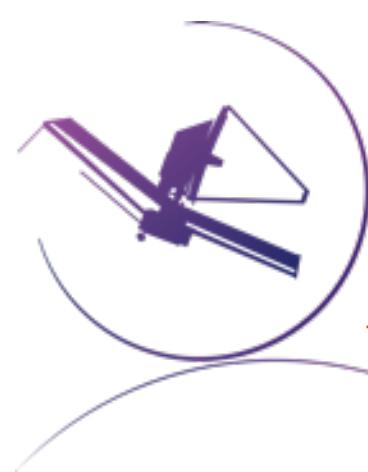
- Workbooks: Organize and save your ETC calculations
- Build your own sources and scenes library
- Analyze and compare different instruments and modes
- Share your work with your team



ETC Scenes & Sources

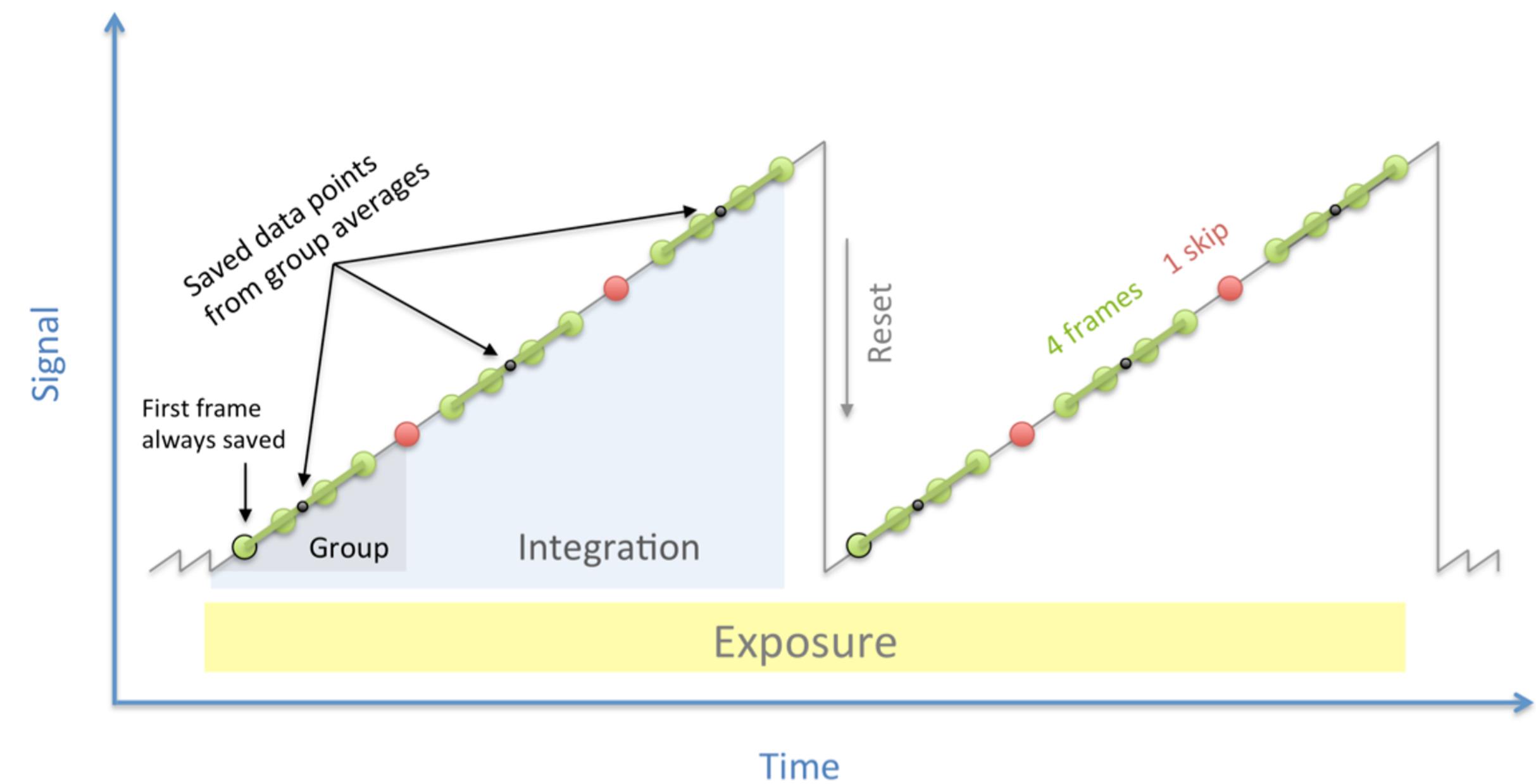
- Scene: small postage-stamp of the sky (a few arcsec on a side)
 - A scene can have no source (just background) or multiple sources
 - Scenes can be reused in multiple calculations
- Source: specify SED, normalisation, extinction, emission lines and shape
 - Each source can be reused in multiple scenes
 - Location: x,y offset (with orientation) within the postage stamp scene
 - Shape: point source or extended (flat, Gaussian, Sersic, power law...)
 - Spectrum:
 - Continuum: flat, black body, power law, templates
 - Lines: centre, width, flux
 - Normalise to magnitude/flux in JWST or HST bandpass, or at a λ
 - Upload a spectrum (ASCII or FITS format)





JWST Detector Readout terminology

- Reading out of data JWST's instruments is done using a non destructive readout method called “MULTIACCUM.”
- Subarray: the window on the detector being read out
- Frame: one complete read of the detector or subarray
- Group: a set of consecutive frames averaged onboard (some frames may be skipped)
- Integration: one non-destructive ramp
- Exposure: a set of consecutive integrations at the same pointing
- Dither: an exposure at a new pointing
- The combination of readout pattern, groups, ints, nexp is called “Detector Setup.”





Tips for optimizing Detector Setup

- More frames per integration decreases read noise.
- Longer groups decreases data volume.
- Shorter groups decreases chance of cosmic ray hit per group.
- More groups per integration make the cosmic ray correction better.
- Longer integrations may make ramp fitting more certain.
- More dithered exposures decreases flat-field errors and the impact of bad pixels.
Note: in ETC, all exposures are assumed to be dithers, except for time-series observations
- Readout patterns that skip lots of frames have higher read noise, but slightly better duty cycle
- Each SI has a dedicated JDox page discussing trade-offs.



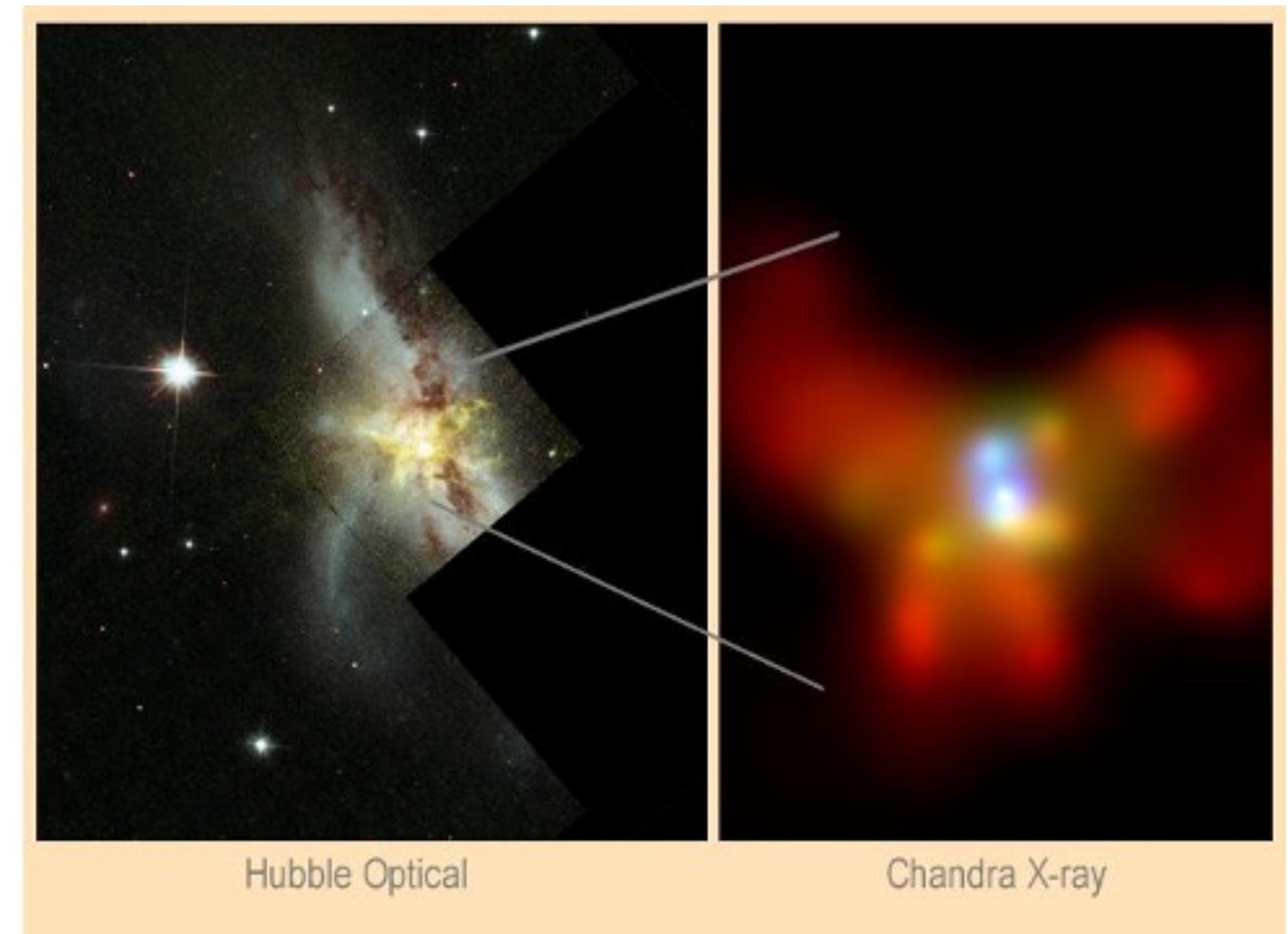
ETC hands-on exercise

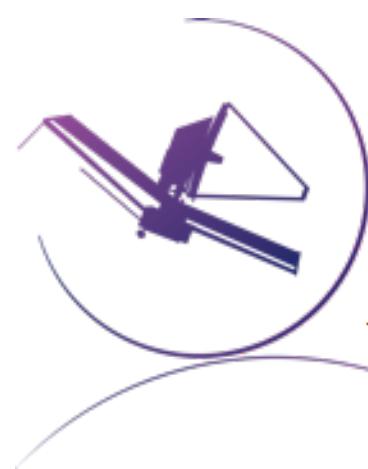
Exercise goal: Determine ETC parameters for NIRSpec IFU observation for NGC 6240

Science goal: Study kinematics of the shock-excited extended H₂ 1-0 S(1)2.12 micron emission

NGC 6240 Observational parameters:

- H₂ 1-0 S(1) 2.12 micron line:
 - Obs lambda = 2.1738 micron
 - Line Flux= 2E-13 erg/cm²/s
 - FWHM= 400 km/s
- Integrated continuum: 33.7 mJy at 3.6 micron





ETC: Hands-on Exercise

ETC link: <https://jwst.etc.stsci.edu/>

Welcome to the JWST Exposure Time Calculator

[Quick Start](#) [Create User](#) [Login](#) [Work Anonymously](#)

News

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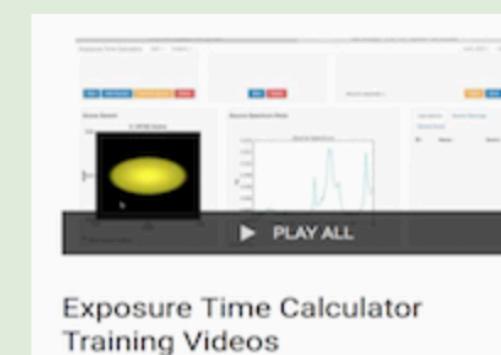
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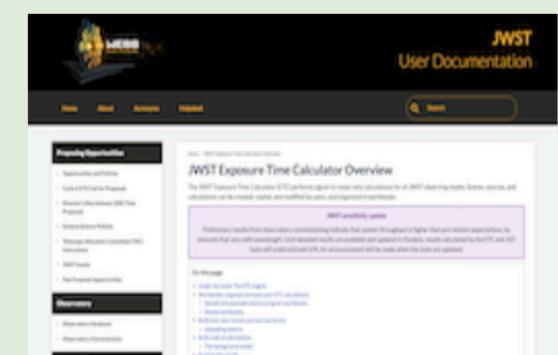
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Help



Exposure Time Calculator
Training Videos

[Watch the Videos](#)



[Read the Docs](#)



ETC Exercise: scence/source set up & calculations

- 1) Login to ETC
- 2) Click on “Create New Workbook”
- 3) Click on “Scenes and Sources”
- 4) Click on “ID” under “Source Editor”
- 5) Fill in “Scene Identity Information” as “NIRSpec IFU Scene 1”
- 6) Fill in “Source Identity Information” as “NGC6240”
- 7) “Save”
- 8) Click on “Continuum” under “Source Editor”
- 9) Choose “Select” under “Spectral Energy Distribution”
- 10) Choose “Galaxy Spectra from Brown et al (2014)” from the dropdown menu showing “flat continuum”
- 11) Choose “NGC6240 (Pec, AGN)” from the dropdown menu showing “fun”
- 12) “Save”
- 13) Choose “Normalize at Wavelength”, and fill up the parameters “33.7” mJy at lambda “3.6” micron.
- 14) “Save”
- 15) Click on “Lines” under “Source Editor”
- 16) Add “Line name” as “H2”, “Line Center” as “2.1738”, “Line width” as “400” km/s, “Line Strength” as “2e-13” erg/cm²/s
- 17) Click on “Add” and then “Save”
- 18) Click on “Extended” and model it as “2D Gaussian” under “Flux Distribution” and define “parameters” of the Gaussian as “ σ_x ” = “0.5” & “ σ_y ” = “1.0”
- 19) Select “Normalization Choice” as “Integrated Flux” and then “Save”
- 20) Click on “Calculation” and then “NIRSpec IFU”
- 21) Click on “Instrument Setup” and Choose the appropriate Grating/Filter pair, i.e., “G235H/F170LP” to cover H2 line.
- 22) Click on “Detector Setup” and choose “FULL” subarray and “NRSIRS2RAPID” readout pattern and “4” dithers for optimal dataset.
- 23) Click on “Strategy panel”, choose “IFU on-target + off-target pointing” from the dropdown menu, choose “Specify position in Scene”, and modify “wavelength slice” to 2.1738
- 24) Click on “Calculate” and inspect the results.



ETC scene/source set up & calculations: Results

[Calculations](#) [Scenes and Sources](#) [Upload Spectra](#) [Caveats and Limitations](#)

[MIRI](#) [NIRCam](#) [NIRISS](#) [NIRSpec](#) [?](#)

ID	Mode	λ	Scn	(s)	SNR	!
1	nirspec ifu	2.17	1	641.91	385.41	✓

Scene ★ Backgrounds Instrument Setup Detector Setup Strategy

IFU On-Target + Off-Target Pointing [?](#)

Aperture location
 Centered on source
 1: NGC6240
 $X, Y: 0, 0 \text{ arcsec (unused)}$

Specify position in scene
 X: 0 arcsec
 Y: 0 arcsec

Aperture radius
 0.3 arcsec

Shape circular

Angular units arcsec

Wavelength of Slice [?](#) 1.66 - 3.17 μm
 2.1738 microns

Calculation: 1, Mode: nirspec ifu [Reset](#) [Calculate](#)

Images [?](#)
 Calculation: 1, Mode: nirspec ifu

2D SNR [Detector](#) [Saturation](#) [Groups Before Saturation](#)

Click the legend to display or remove items.
 * The 2D SNR image does not include contributions from correlated read noise for NIRSpec, while the 1D SNR plots do.

Plots [?](#)
[ApFlux](#) [ApBackground](#) [SNR \(\$\lambda\$ \)](#) [SNR \(time\)](#) [Contrast](#)

Signal to Noise

Bounds/Scale:
 X: 1.66 to 3.11 [Linear](#) [Clear](#)
 Y: -21.41 to 406.83 [Linear](#) [Clear](#)

Reports [?](#)
 Calculation: 1, Mode: nirspec ifu

Results Warnings Errors Downloads

Results

Extracted Signal-to-Noise Ratio	385.41
Extracted Flux	315.77 e-/s
Standard Deviation of Extracted Flux	0.82 e-/s
Brightest Pixel Rate	12.46 e-/s
Maximum Fraction of Saturation	4.04e-02
Maximum Number of Groups Before Saturation	247.00 groups

Instrument and Detector

Instrument Filter/Disperser	f170lp, g235h
Total Time Required for Strategy	1283.82 s
Total Exposure Time	641.91 s
Single Exposure Time	160.48 s
Fraction of Time Spent Collecting Flux	0.91
Time Between First and Last Measurement, per exposure	131.30 s
Time Between First Reset and Last Measurement, per integration	145.89 s



APT: Astronomer's Proposal Tool

- The Astronomer's Proposal Tool (APT) is used to specify proposed observations for JWST and submit them for consideration, by the Time Allocation Committee (TAC).
- The scientific justification PDF must be attached, at the bottom of the Proposal Information page, prior to submission.

APT is also a resource estimator.

- Need a resource estimate for the TAC.
- APT uses a system of overhead charges to make this resource estimate possible.



APT Basics

- Observation – basic proposal design element specified by the user. Observations are divided into one or more visits by APT.
- Visit – set of exposures (included overheads) obtained on a single guide star without scheduling interruptions. (This is the scheduling unit.)
- Observation Template – GUI form filled out by the user.
- Overhead – charged time for operations activities performed by the observatory.
- Graphical Timeline – provides a visual display of overheads for each visit.
- Visit Planner – checks the schedulability of an observation (including guide star availability).
- Smart Accounting – updates the full proposal's resource estimates and remove excess overheads prior to submission.



APT Observation & Template

- User specified
- Single observing mode (template)
- All parameters for exposures and scheduling requests

Instrument: MIRI Template: MIRI Medium Resolution Spectroscopy

Target: 3 HH-111

Visit Splitting: 70.0 Arcsec Number of Visits: 1

Science Duration (secs): 448 Total Charged: 5506

Data Volume: 1134 MB

MIRI Medium Resolution Spectroscopy Mosaic Properties Special Requirements Comments

Target Acquisition Parameters

Acq Target: 4 SOMESTAR Acq Filter: F560W

Acq Readout Pattern: FAST Acq Groups/Int: 10 Acq Integrations/Exp: 1

Acq Total Integrations: 1 Acq Total Exposure Time: 27.75 Acq ETC Wkbk: 99999

MRS Parameters

Primary Channel: ALL

#	Dither Type	Optimized For	Direction
1	4-Point	EXTENDED SOURCE	NEGATIVE

Add Duplicate Insert Above Remove

Simultaneous Imaging

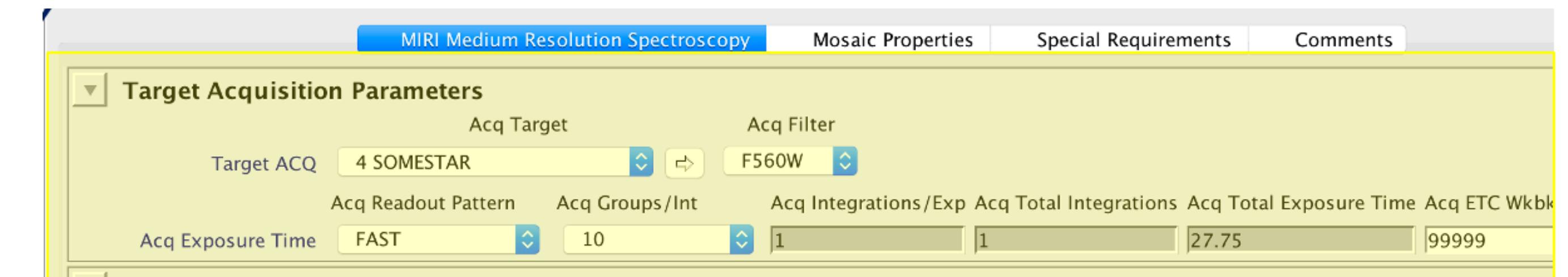
YES Imager Subarray: FULL

#	Detector	Wavelength	Filter	Readout P...	Groups/Int	Integratio...	Exposure...	Dither	Total Dith...	Total Inte...	Total Exp...
1	IMAGER		F1000W	FAST	5	1	1	Dither 1	4	4	55.501
1	MRSLONG	SHORT(A)		FAST	10	1	1	Dither 1	4	4	111.002
1	MRSSHORT	SHORT(A)		FAST	10	1	1	Dither 1	4	4	111.002



Target Acquisition

- The target acquisition target should be the brightest source in the Region Of Interest (ROI).
- Some APT templates:
 - Have no target acquisition
 - Require a target acquisition
 - Target acquisition is optional
- Consider your science case and expected pointing performance to decide whether a TA is necessary.



NOTE: If the target acquisition fails, the observation fails!

Users should obtain accurate target acquisition exposure information using the [JWST Exposure Time Calculator](#) and transfer to APT.



APT Visit

A Visit is set of exposures and associated overheads that can be executed, without interruption, using a single guide star. This is what makes Visits the “scheduling unit” used by the scheduling system.

A typical Visit includes

- o Slew to guide star position
- o Guide star acquisition
- o Target acquisition (if needed)
- o Small Angle Maneuvers (SAMs)
- o Science exposures
- o Instrument overheads

The duration of a Visit also includes:

- o Observatory overheads
 - Station keeping
 - Momentum management
- o Direct scheduling overheads
 - Very tight timing constraints
 - Rapid turnaround of target of opportunities

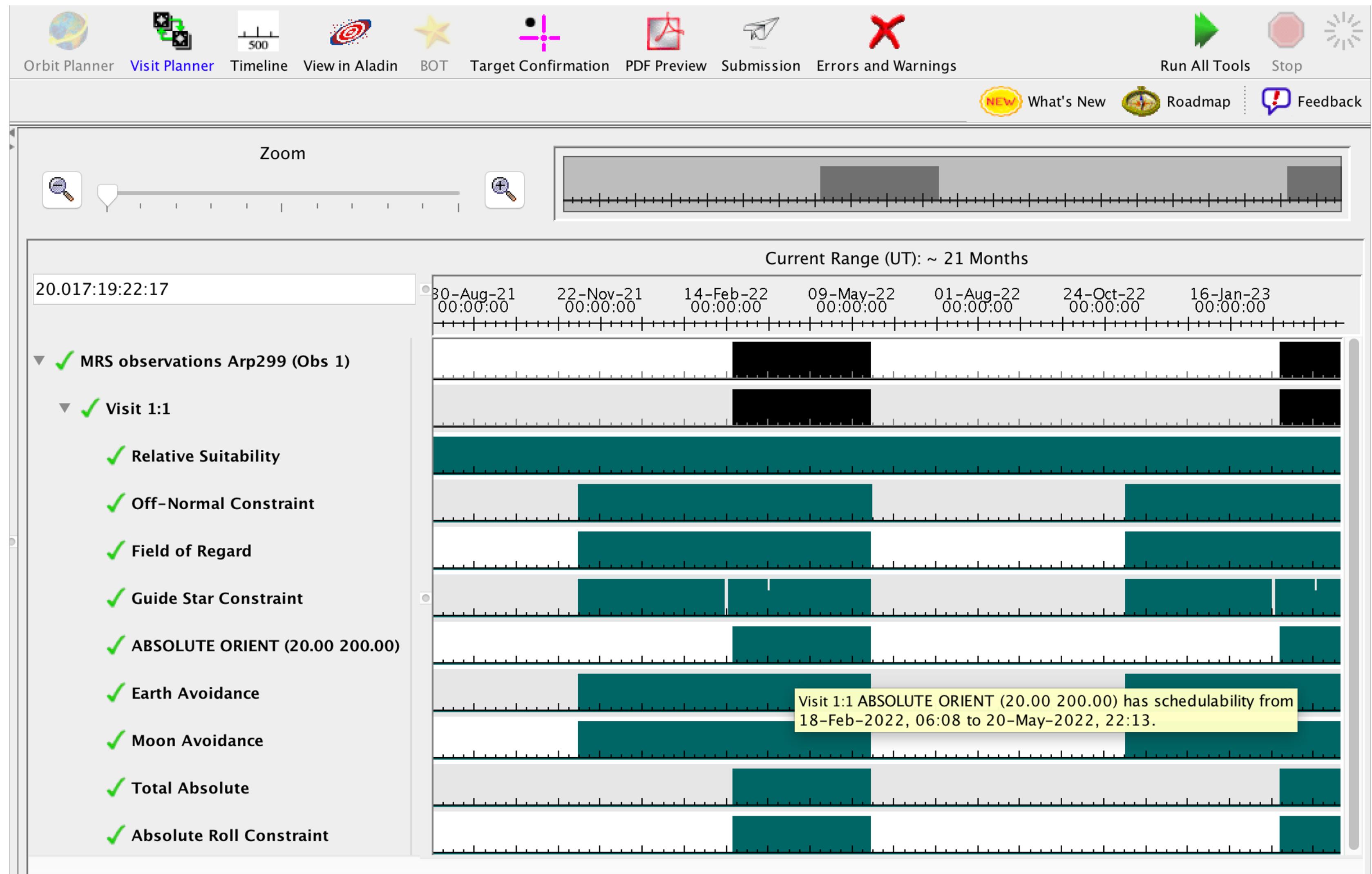
Visit 3:1 Status: UNKNOWN											
	Science	Instrument	Overheads	Slew	Observatory	Overheads	Direct	Scheduling	Overheads	Total	Charged
Visit Duration (secs)	448	2498		1800	760		0			5506	
Data Volume	1134 MB										
Copy pointings to clipboard											

APT shows the above when clicking on a Visit, which cannot be directly edited, and is for user information only.



APT Visit Planner

Performs a detailed check of the schedulability of the visits in observations.



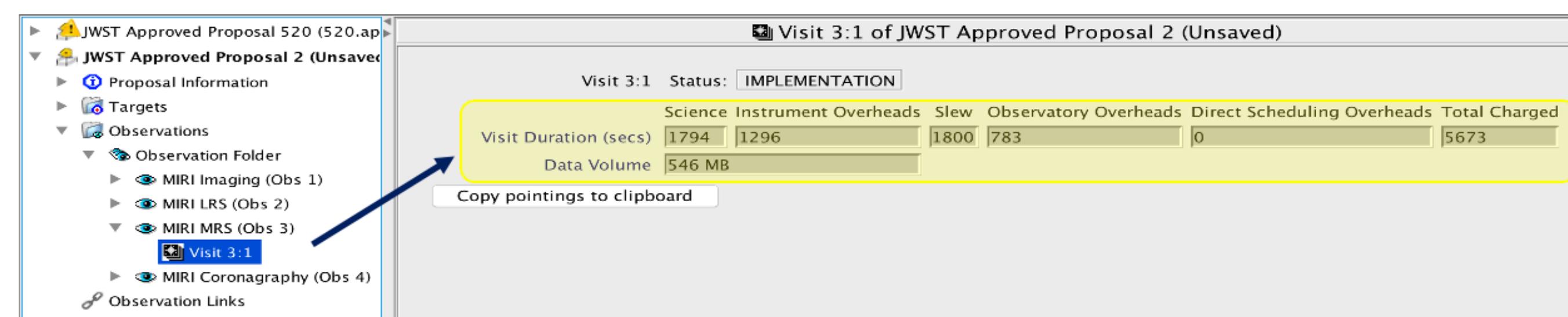
Note: all constraints windows need to have a window of schedulability at the same time.



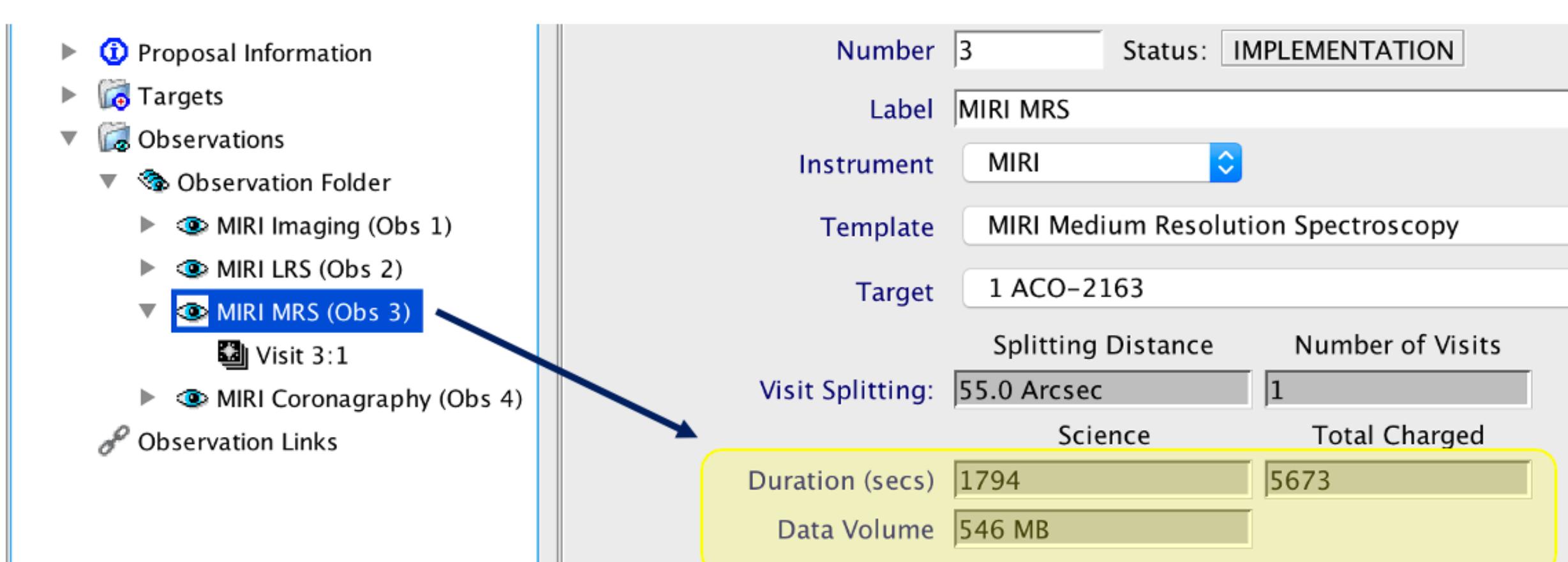
APT Charged Time vs Science Time

Science time and total charged time (including overheads) can be viewed in APT at the proposal level, the observation level, and visit level.

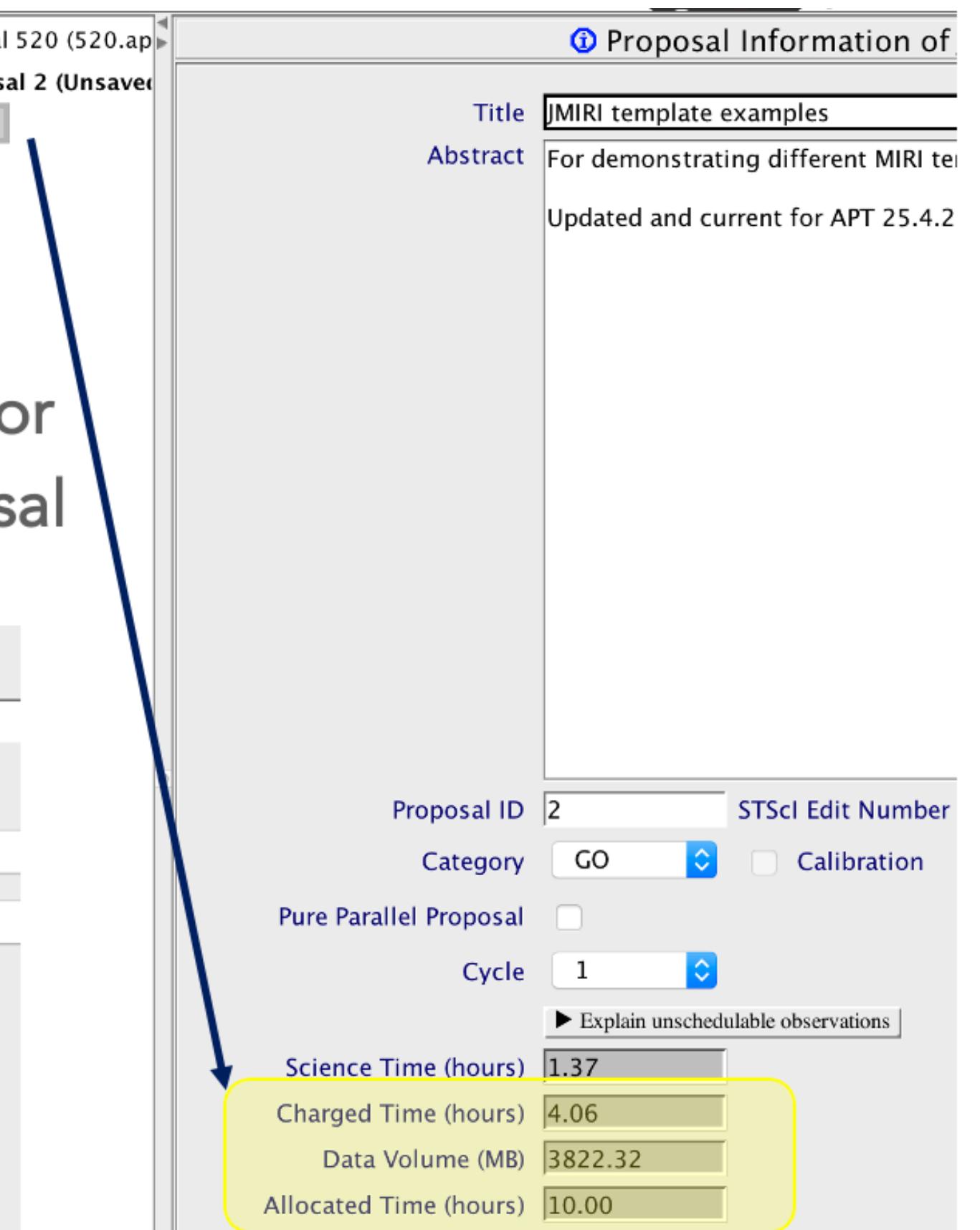
Visit level



Observation level



Total for proposal





APT Smart Accounting: Overhead charge correction

While designing and building an observing program, overheads can become overestimated as observations are added individually.

Running Smart Accounting on your finished observations searches for and removes extra initial slews and other smaller inefficiencies that may have crept in.

Before Smart Accounting Run

Science Time (hours)	1.19
⚠ Charged Time (hours)	13.86

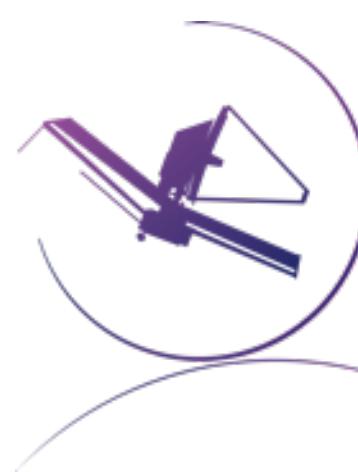
Run Smart Accounting

Note: This button only appears when APT thinks the accounting is out of date.

After Smart Accounting Run

Science Time (hours)	1.19
Charged Time (hours)	11.62

Always run Smart Accounting before submitting your proposal!

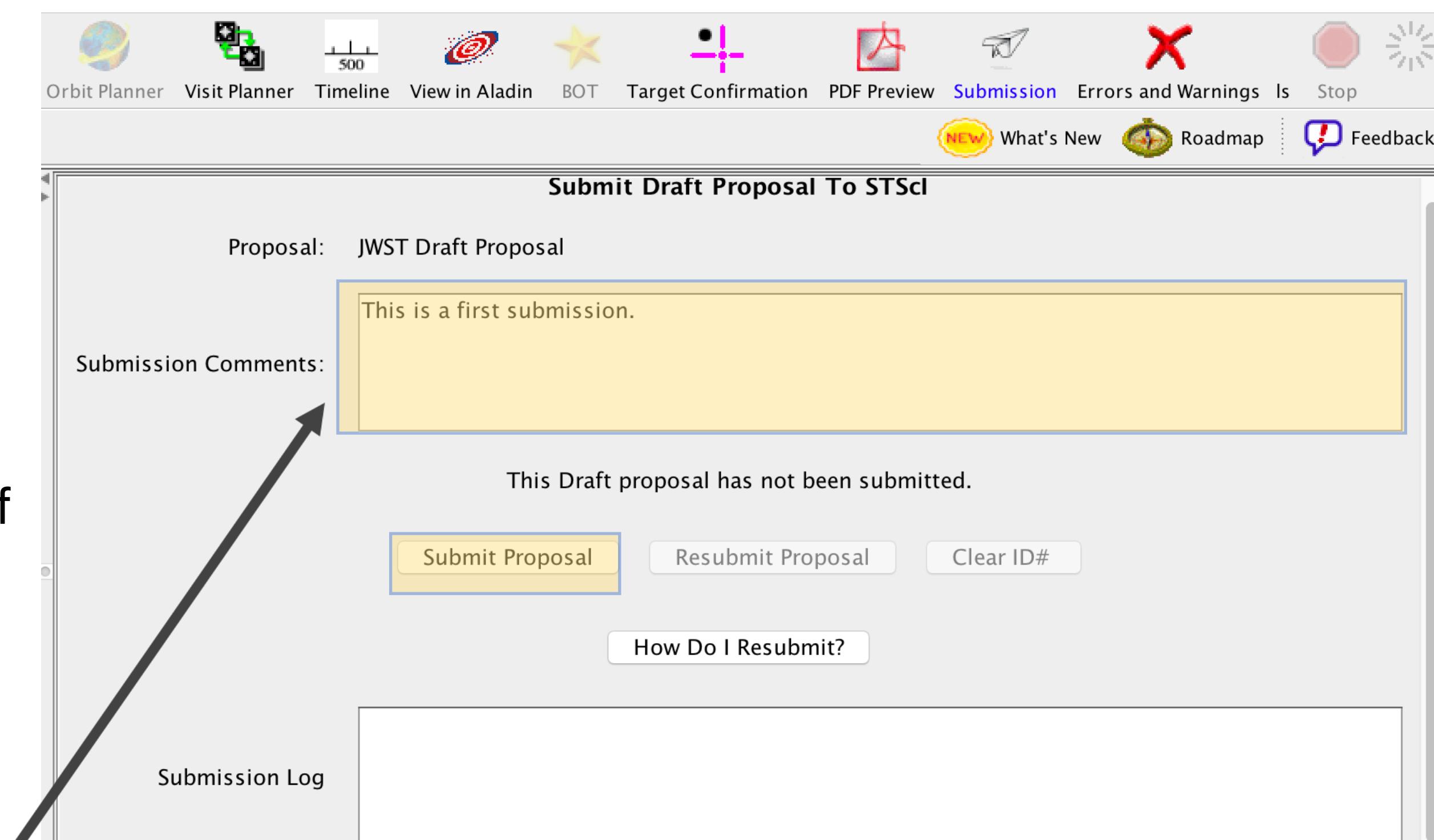


Proposal Submission

- Prior to submitting a proposal, the following should be completed:

- Run *Smart Accounting*
- Run *Visit Planner*
- Run *Target Confirmation*
- Verify the Science Justification PDF is attached.
- Review *Errors and Warnings*

- You can hover over **Errors** or **Warnings** to see a description of the issue
- Errors: appear when required information is missing or if unsupported values have been selected or entered into a field
- Warnings: may or may not be a real problem, depending on the context, so you need to check.
- Submit!
- You cannot submit with Errors, but can submit with Warnings. Any diagnostics should be commented on.





APT Exercise

The screenshot shows the Astronomer's Proposal Tools (APT) Version 2020.1.1 Beta interface. The title bar displays the version information and the JWST PRD: PRDOPSSOC-M-026. The menu bar includes options like Form Editor, Spreadsheet Editor, MSA Planning Tool, Orbit Planner, Visit Planner, Timeline, View in Aladin, BOT, Target Confirmation, PDF Preview, Submission, Errors and Warnings, Run All Tools, and Stop. A toolbar below the menu bar contains icons for each of these tools. On the left, a sidebar menu titled "New Document" offers options to "New HST Proposal" or "New JWST Proposal". The main workspace is labeled "Form Editor" and features a repeating pattern of world maps. At the bottom, there are buttons for "Edit Previous", "New", and "Edit Next", along with a "Show:" dropdown and a status message indicating "No errors & warnings (Click for Details)".



APT Exercise Set up

- 1) New Document -> New JWST proposal
- 2) Title: IAUS Demo
- 3) Abstract: NIRSpec IFU for NGC 6420
- 4) Scientific Category: Galaxies
- 5) Scientific Category: Nearby Galaxies, Starburst Galaxies
- 6) PDF Attachment - need to include.
- 7) Proposal Information-> Proposal Description ->
Observing Description: Provide some technical information here which guided the choice of observation parameters (just fill NIRSpec IFU for now)
- 8) Edit Team Expertise: The PI “your name” is an expert in galaxies, similarly for your co-Is.
- 9) Edit Unnamed PI -> Name Search: your name -> hit search light -> “Select” name for database, if not add yourself via “Add a New Investigator”
- 10) Edit Unnamed col -> Name Search: your col name
- 11) Targets: Fixed Target Resolver -> Object Name: NGC6240 -> Search -> Select Object as Target
- 12) Fixed Targets -> Edit Target -> Category: Galaxy -> Description: Starburst galaxies -> Extended: Yes
- 13) Edit Observations -> New Observation Folder -> Label: NIRSpec IFU
- 14) Observation 1 -> Instrument: NIRSpec -> Template: NIRSpec IFU Spectroscopy -> Target: 1 NGC6240
- 15) TA Method: None
- 16) Science Parameters -> Dither Parameters: 4-point dither
- 17) Gratings/Filters -> Add -> Grating: G235H/170LP -> Readout: NRSIRS2RAPID -> Groups: 10 -> Integrations:1 -> ETC Wkb: your ETC Workbook ID
- 18) Click on “Visit Planner” at the top -> Update Display -> Click on downward pointing triangles before “Observation 1:!1”, and “Visit 1:1”
- 19) Click on “PDF Review”
- 20) Click on “Submission” - > “Submit Proposal”



Other Resources & tools

- Several videos on APT & ETC on JdoX:
- Pandeia for Exposure time:
<https://jwst-docs.stsci.edu/jwst-exposure-time-calculator-overview/jwst-etc-pandeia-engine-tutorial>
- JWST Interactive Sensitivity Tools (JIST):
<https://jist.stsci.edu/jist>
- Background tools:
<https://jwst-docs.stsci.edu/jwst-other-tools/jwst-backgrounds-tool>
- Visibility tools:
GTVT: <https://jwst-docs.stsci.edu/jwst-other-tools/jwst-target-visibility-tools/jwst-general-target-visibility-tool-help>
CTV: <https://jwst-docs.stsci.edu/jwst-other-tools/jwst-target-visibility-tools/jwst-coronagraphic-visibility-tool-help>
- JWST Helpdesk:
<https://stsci.service-now.com/jwst>

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