JWST Proposal planning tools

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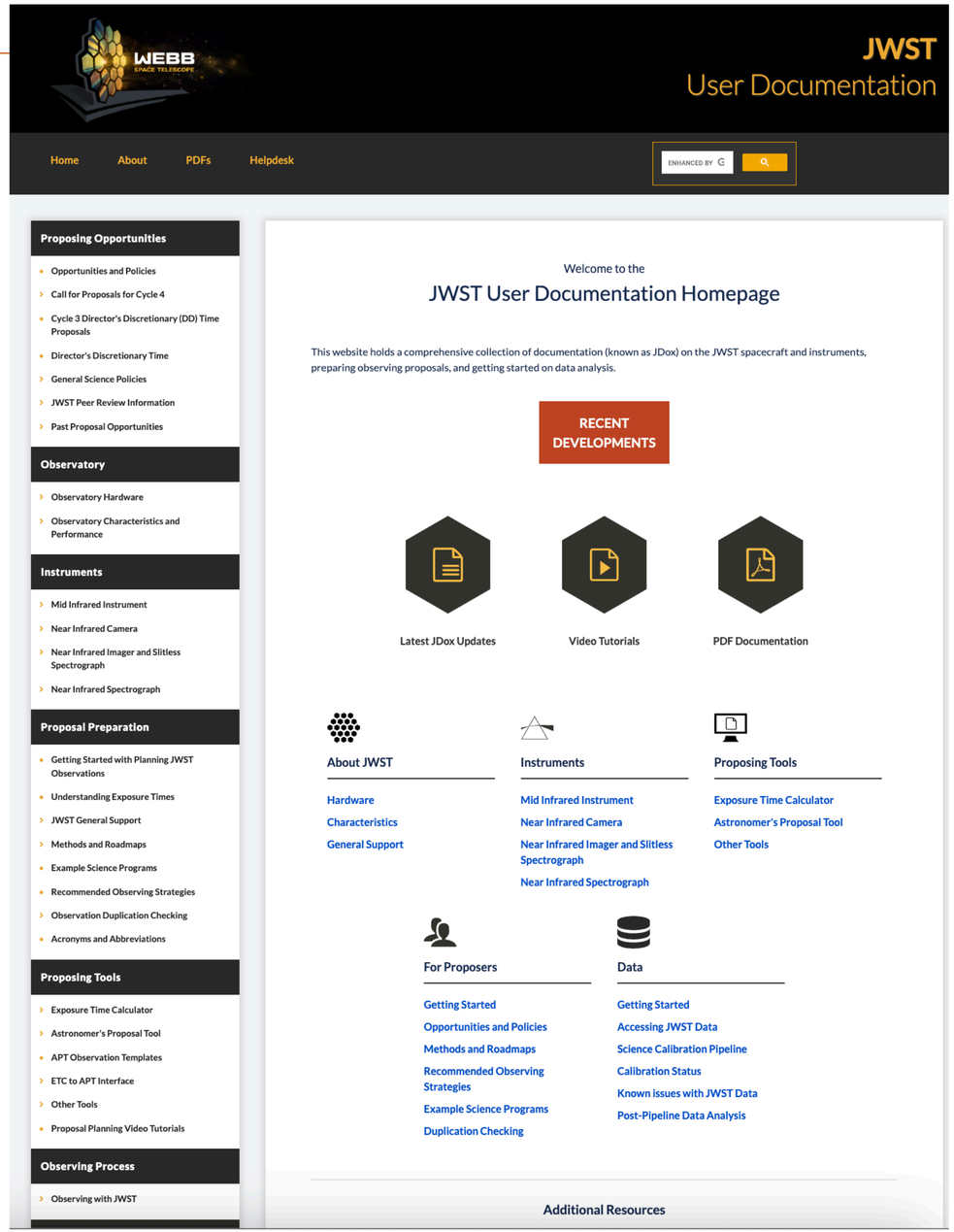
Materials adapted from ESA Masterclass & STScI/JHU JWST proposal writing workshops.

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

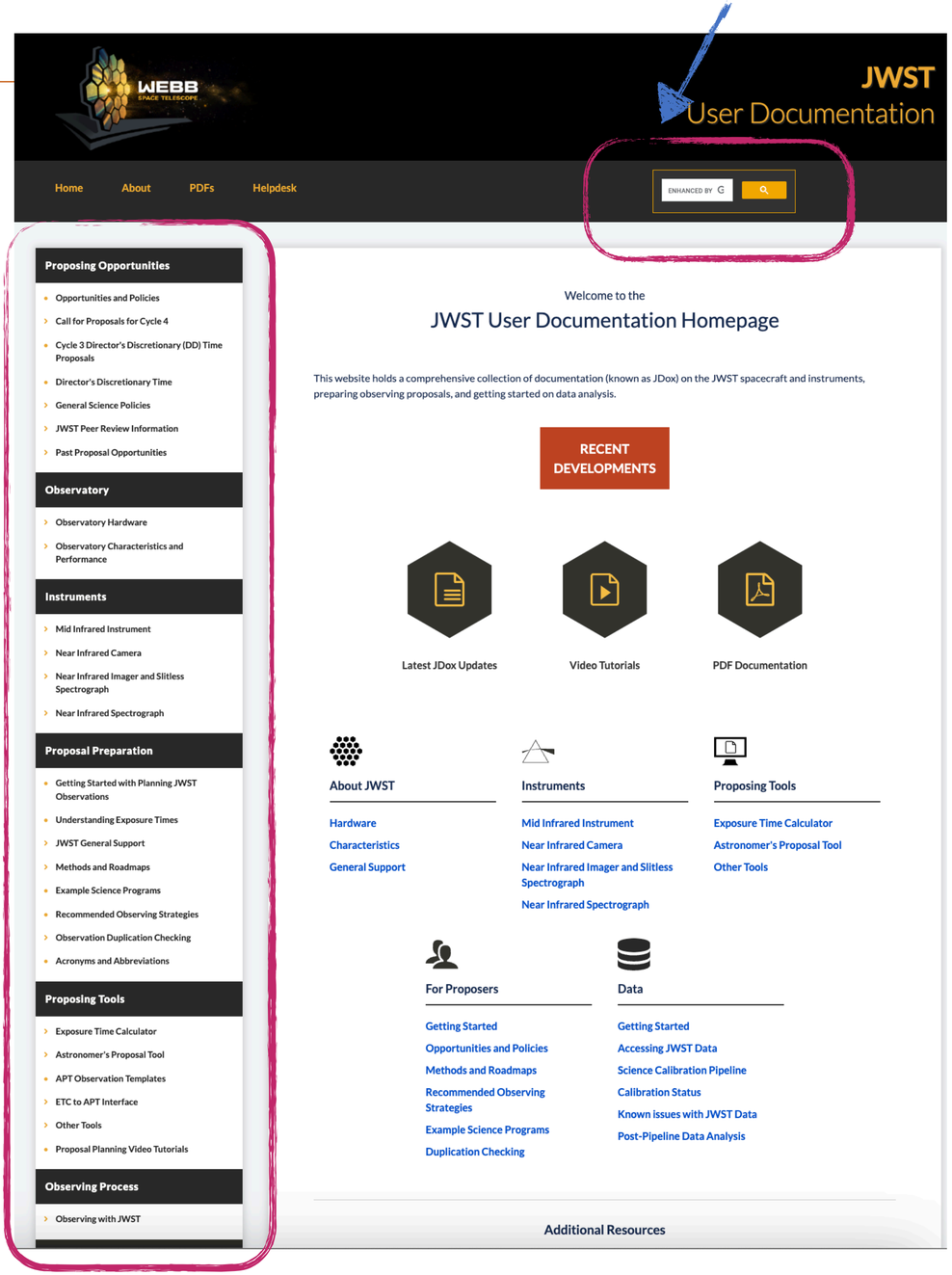


JDox: JWST Documentation

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



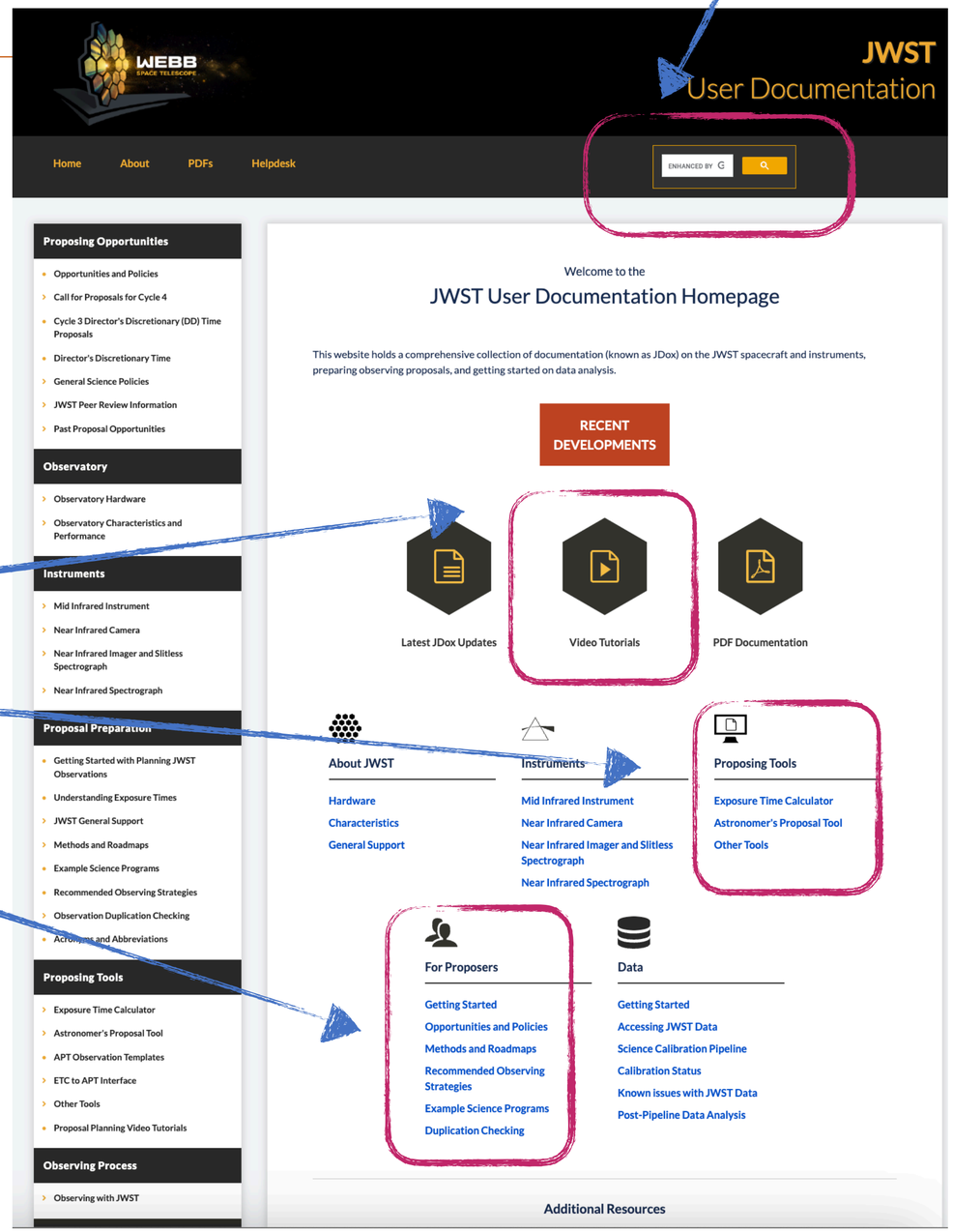
JDox: JWST Documentation

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

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!

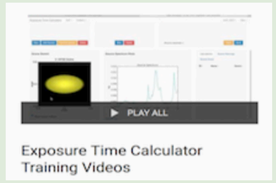
This release features support for single-group ramps, the addition of aperture visualizations in images, a new NIRCam short-wavelength grism time series mode, and updates to the thermal background and MIRI throughputs: see the Release Notes for details, and be sure to review the Known Issues for this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



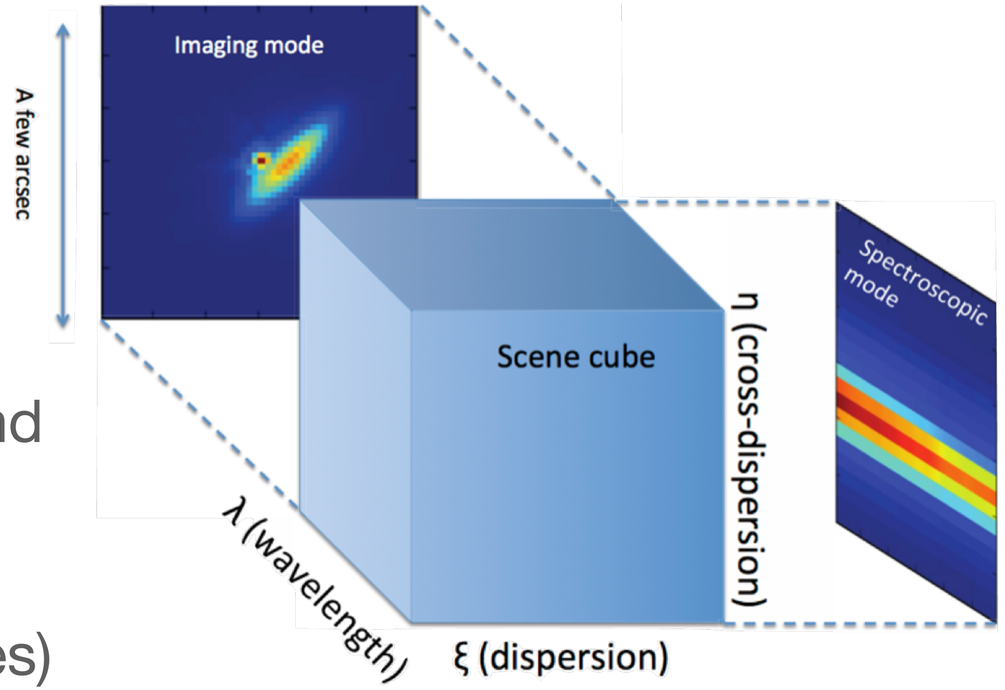
Watch the Videos

Read the Docs

JWST ETC Concept

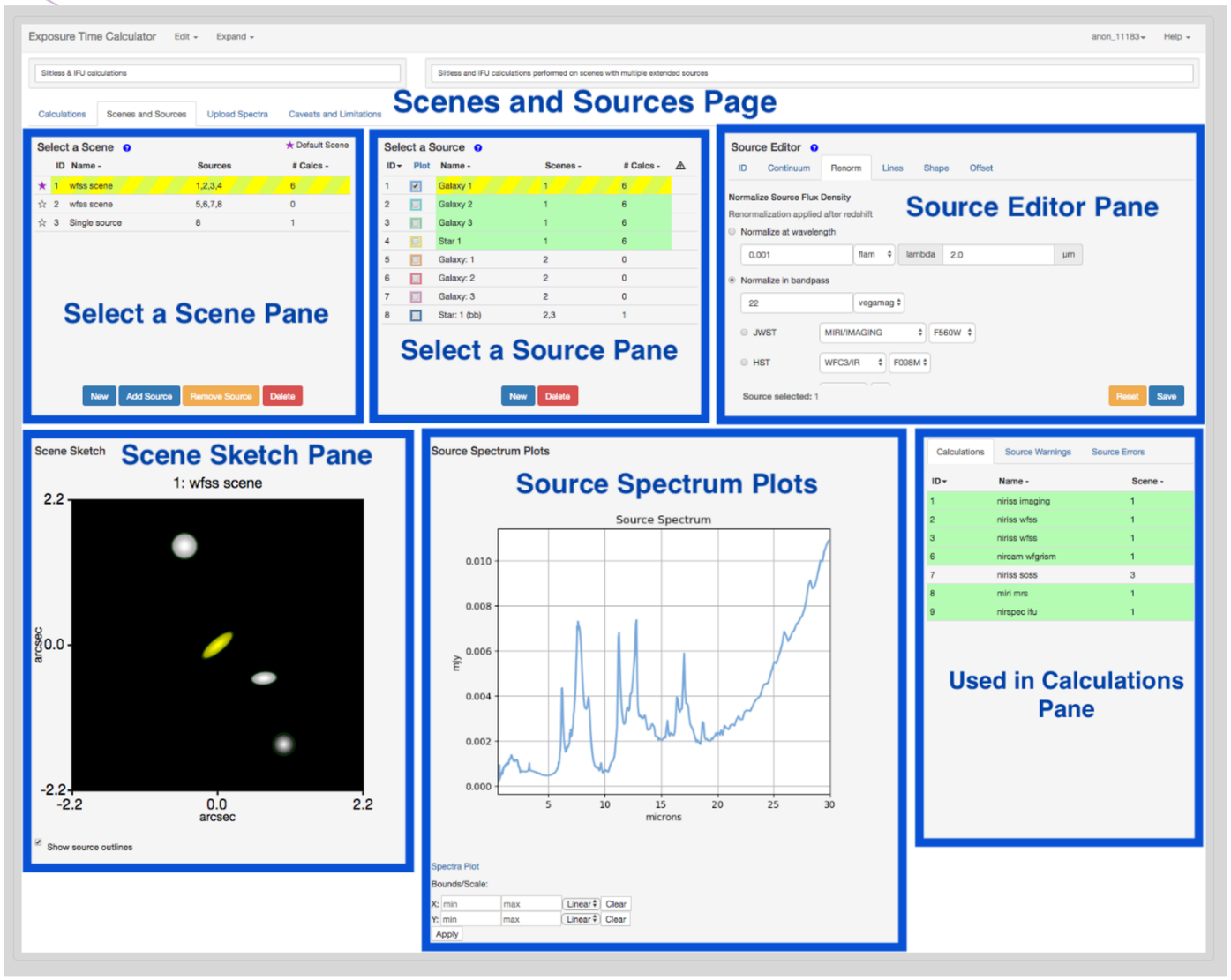
Modern design

- 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

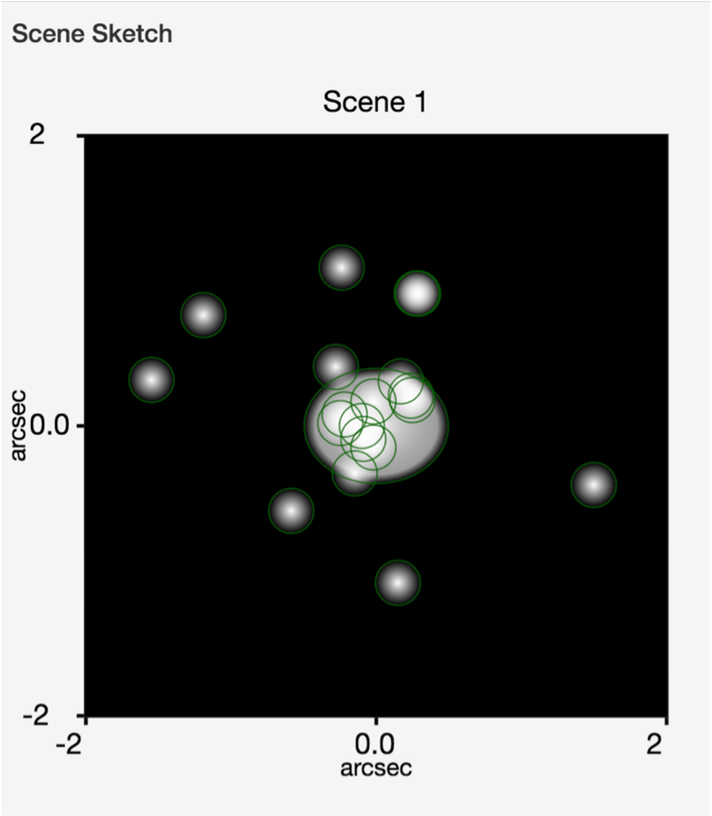
ETC Web Application Features



- 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

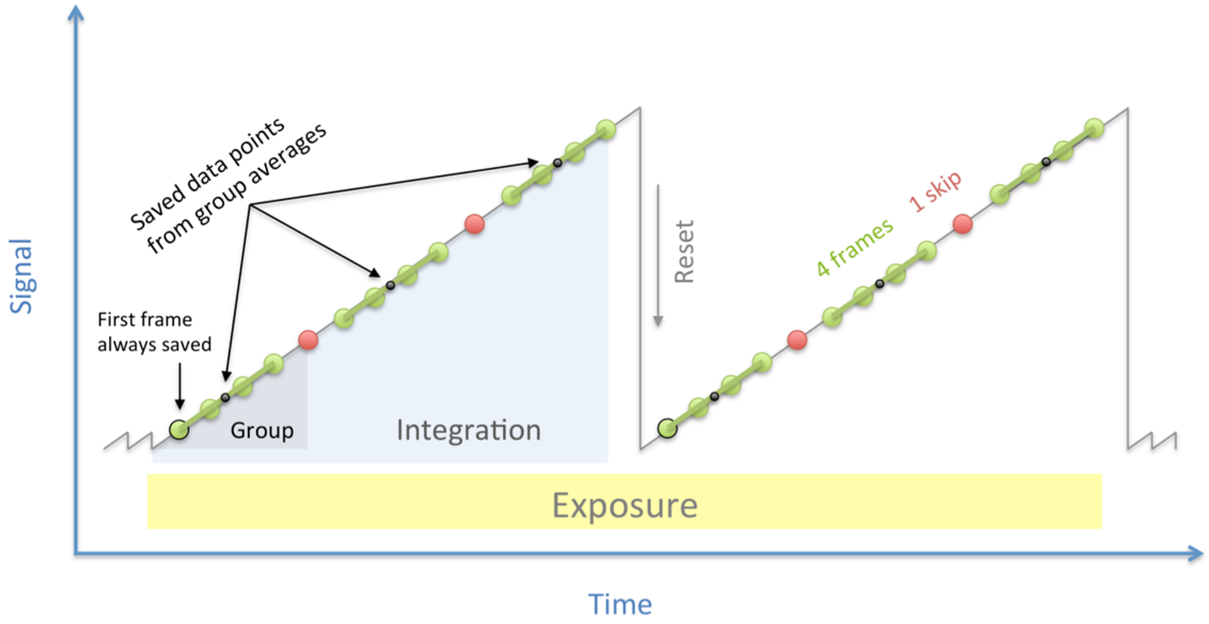
ETC Scenes & Sources

- 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, nexps 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.

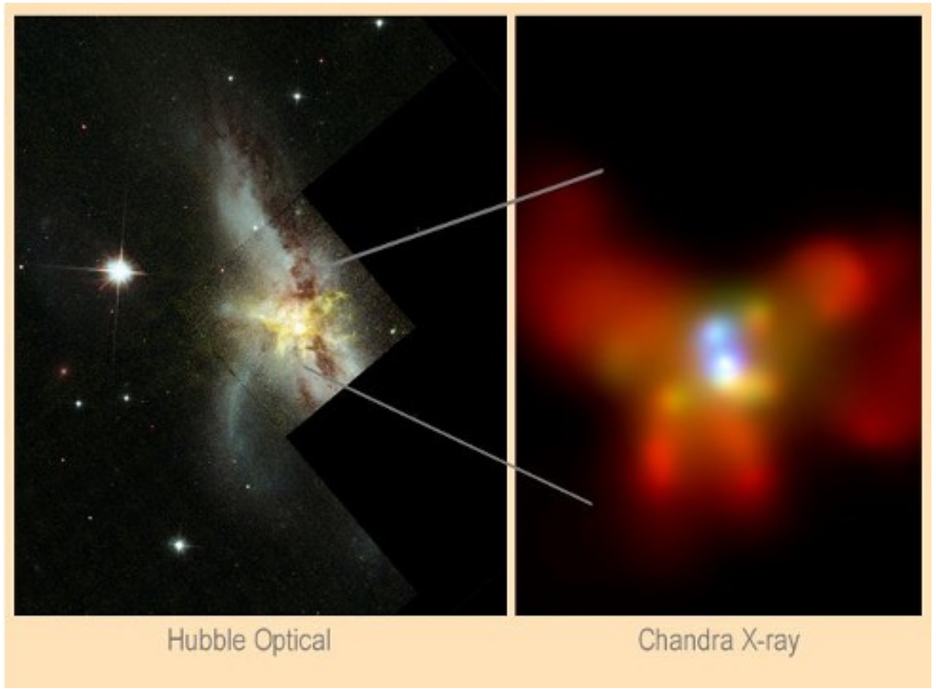
ETC hands-on exercise

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:

- H_2 1-0 S(1) 2.12 micron line:
  - ➢ Obs lambda = 2.1738 micron
  - ➢ Line Flux= 2E-13 erg/cm^2/s
  - ➢ FWHM= 400 km/s
- Integrated continuum: 33.7 mJy at 3.6 micron



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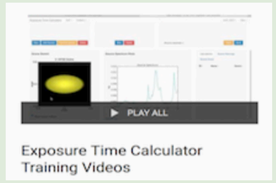

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ETC Exercise: scence/source set up & calculations

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 arcsec (unused)

◉ Specify position in scene

X 0 arcsec

Y 0 arcsec

Wavelength of Slice 1.66 - 3.17 µm

2.1738 microns

Aperture radius

0.3 arcsec

Shape ◉ circular

Angular units arcsec

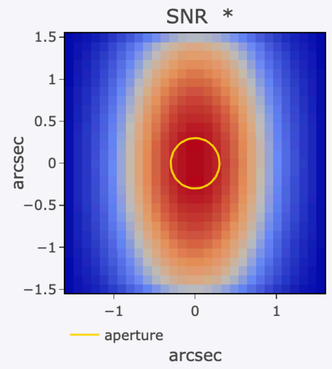
Calculation: 1, **Mode:** nirspec ifu

Reset | Calculate

Images

Calculation: 1, **Mode:** nirspec ifu

2D SNR | Detector | Saturation | Groups Before Saturation

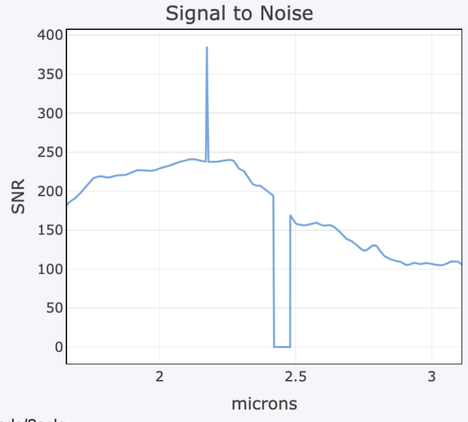


Click the legend to display or remove items.

** The 2D SNR image does not include contributions from correlated read noise for NIRSpec, while the 1D SNR plots do.*

Plots

ApFlux | ApBackground | SNR (λ) | SNR (time) | Contrast



Bounds/Scale:

X:	1.66	3.11	Linear	Clear
Y:	-21.41	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.

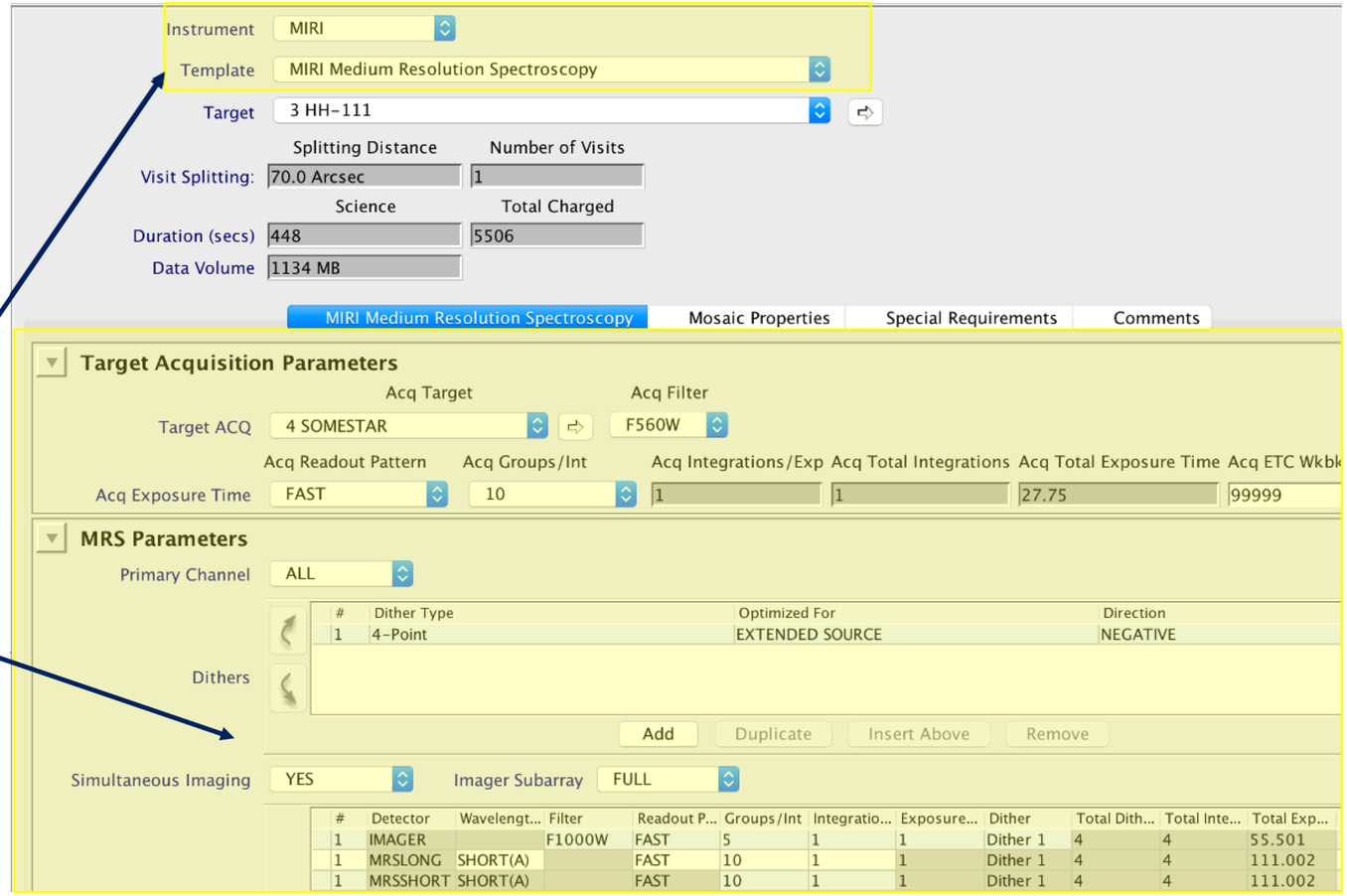
- Need a resource estimate for the TAC.
- APT uses a system of overhead charges to make this resource estimate possible.

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

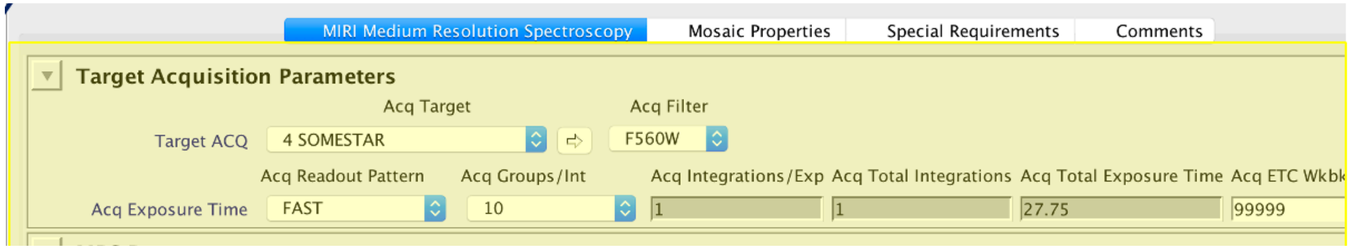


Target Acquisition

- 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.



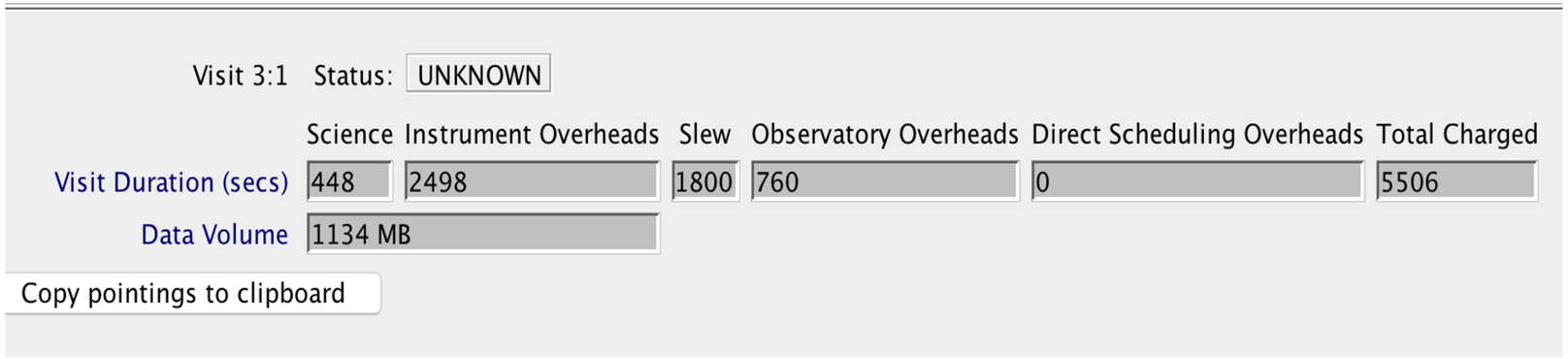
NOTE: If the target acquisition fails, the observation fails!

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



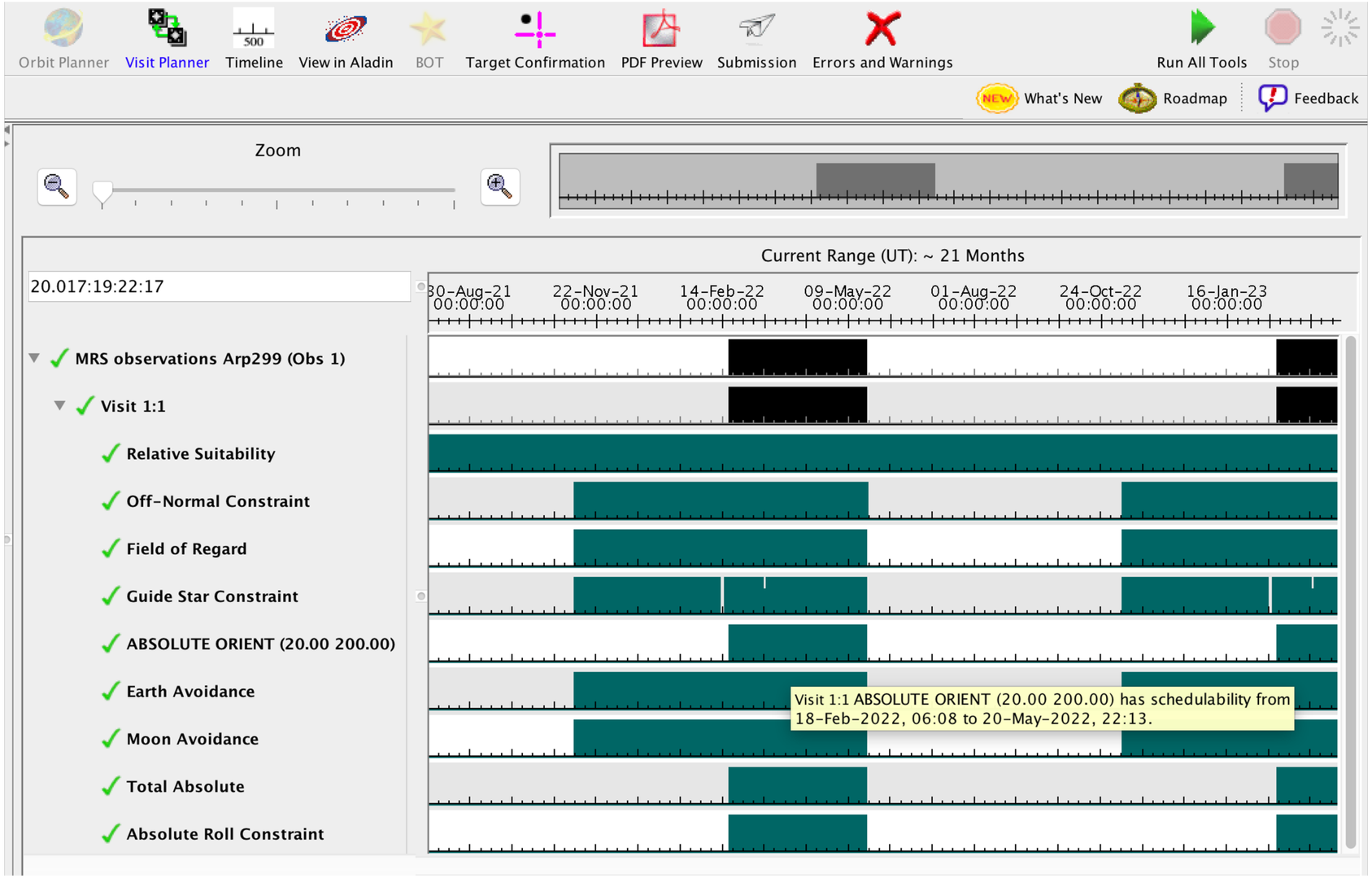
The duration of a Visit also includes:

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

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

APT Visit Planner

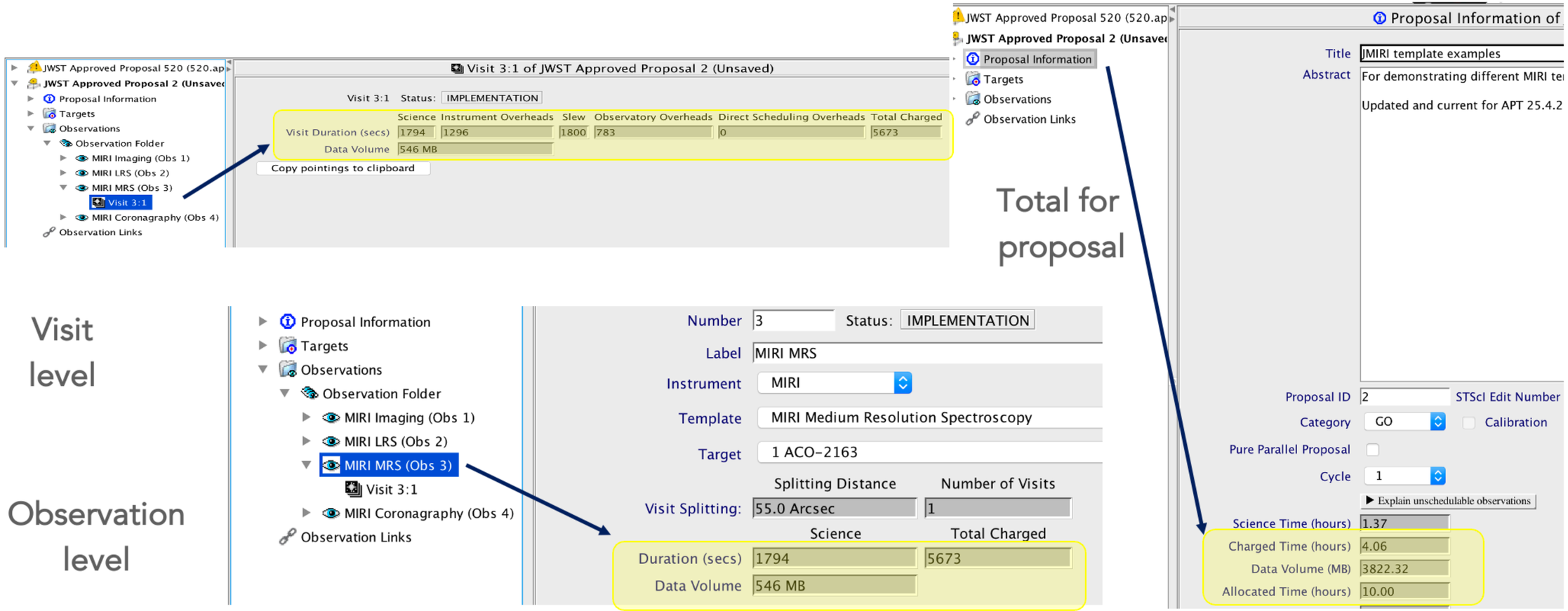
Performs a detailed check of the schedulability of the visits in observations.



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

APT Charged Time vs Science Time

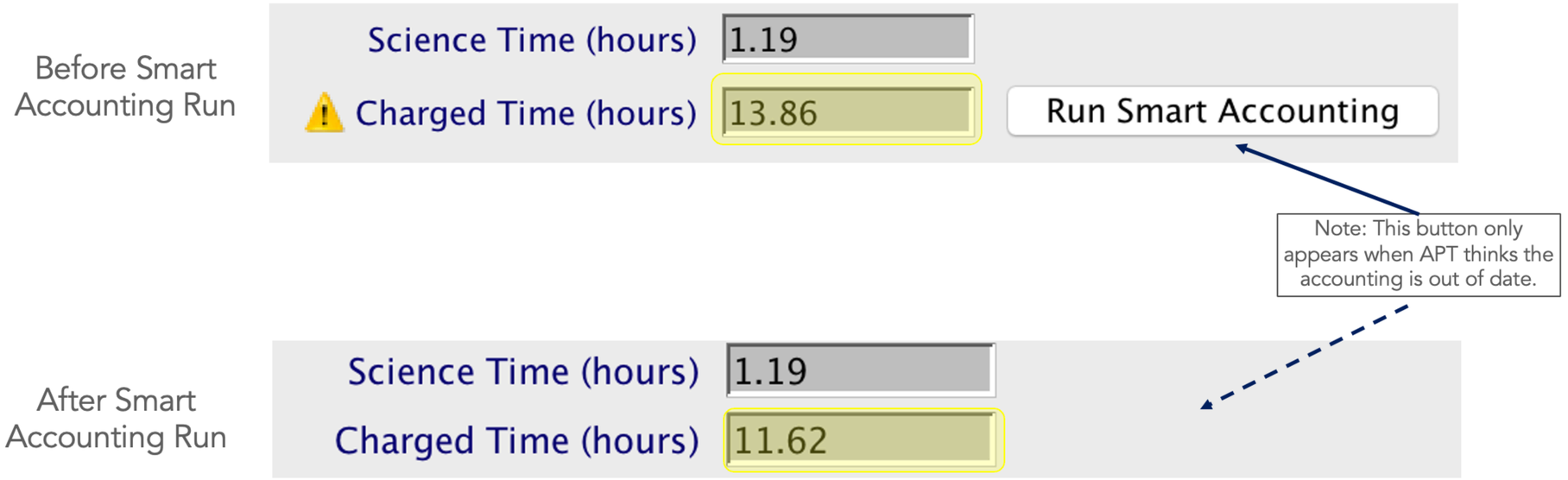
Science time and total charged time (including overheads) can be viewed in APT at the proposal level, the observation level, and visit level.



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.



Always run Smart Accounting before submitting your proposal!

Proposal Submission

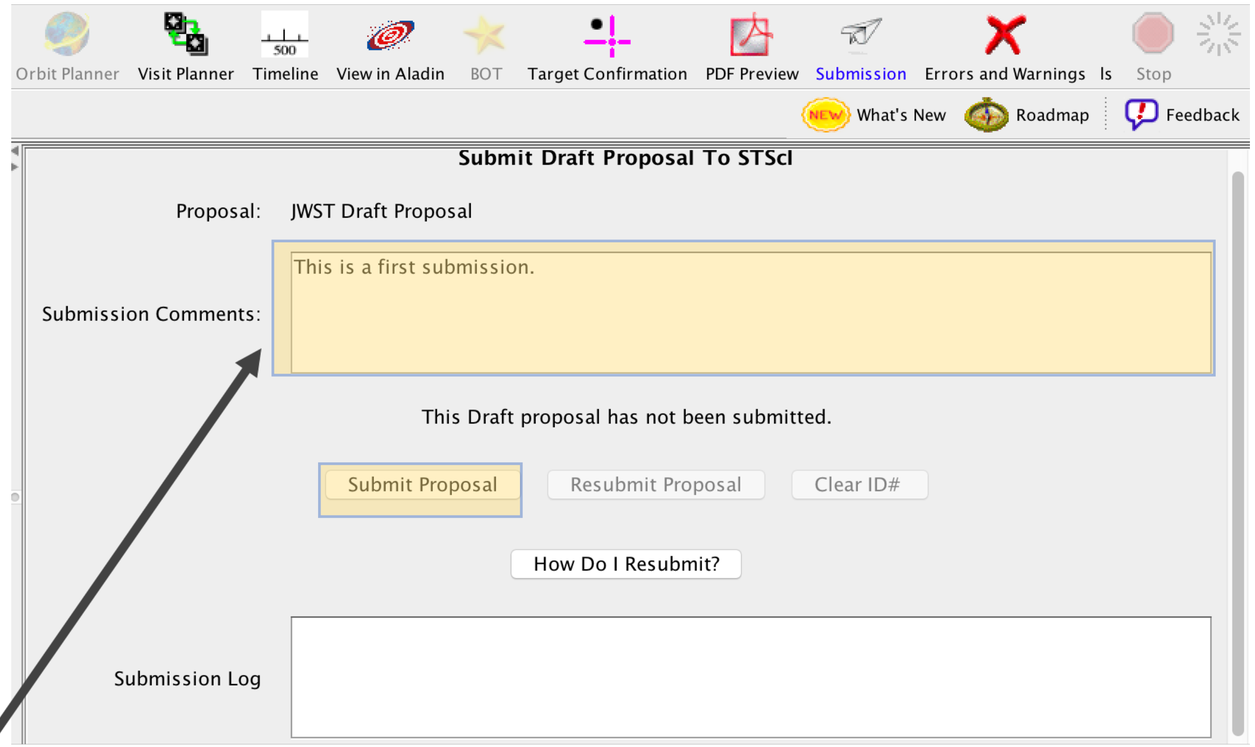
- Prior to submitting a proposal, the following should be completed:

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

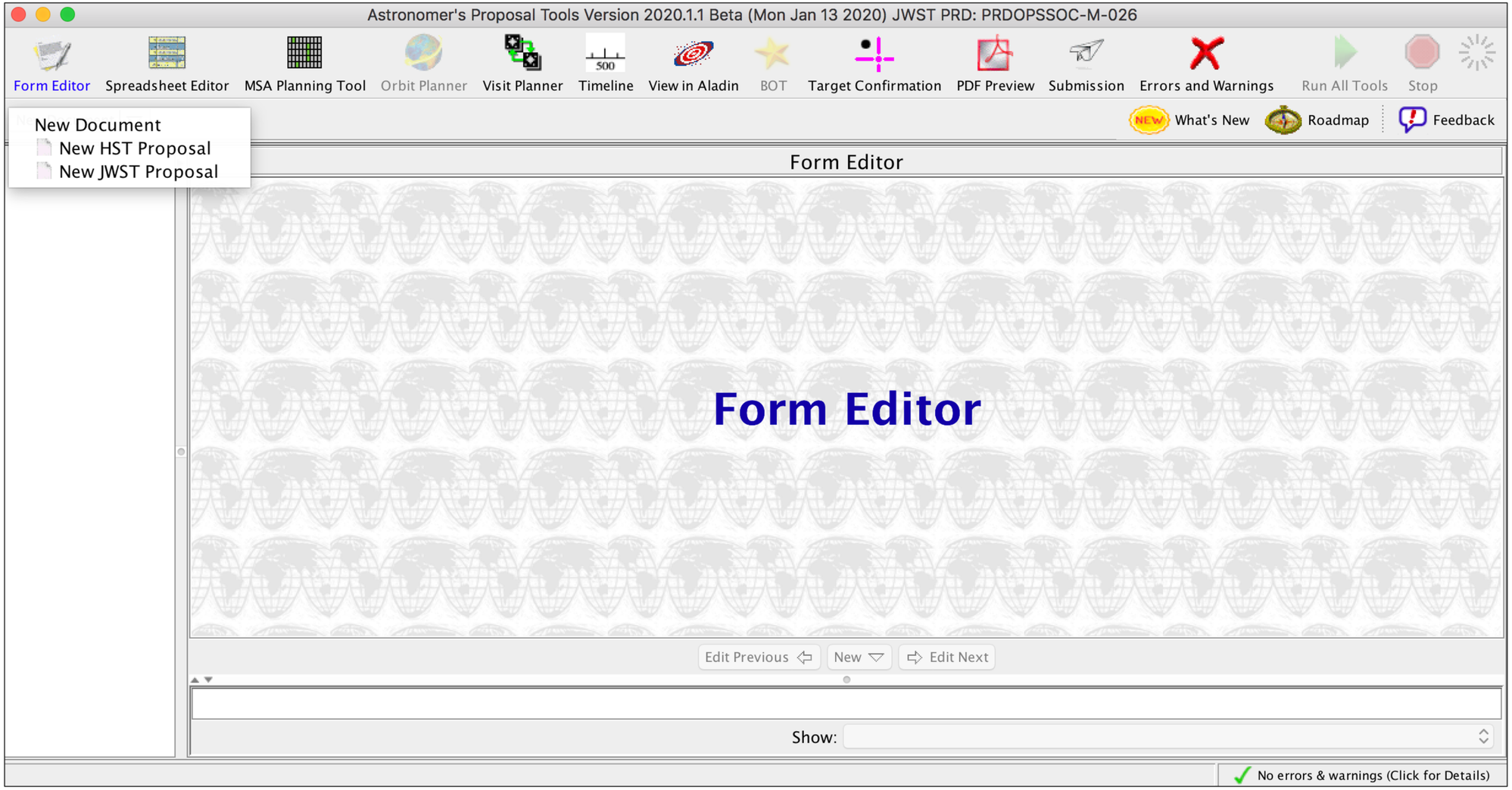
-You can hover over Errors or Warnings to see a description of the issue
-Errors: appear when required information is missing or if unsupported values have been selected or entered into a field
-Warnings: may or may not be a real problem, depending on the context, so you need to check.

- Submit!

-You cannot submit with Errors, but can submit with Warnings. Any diagnostics should be commented on.



APT Exercise



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 coI -> Name Search: your coI 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

Thanks to several experts from ESA, NASA, CSA (& Marco Sirianni) for JWST and all related resources!