JWST Master Class Workshop

Available Proposal Tools: APT

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The JWST 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.

What is an APT Observation?

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

Additional Resource: JDox Article: APT Observations

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

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 following when clicking on a Visit, which cannot be directly edited, and is for user information only.

- The duration of a Visit also includes:
  - Observatory overheads
    - Station keeping
    - Momentum management
  - Direct scheduling overheads
    - Very tight timing constraints
    - Rapid turnaround of target of opportunities

APT Visit Splitting Distance

- Users specify observation, then APT splits an observation into one or more Visits depending on the Visit Splitting Distance.

- This allowed distance for offsets (or dithers) within a Visit is based on the expected guide star availability, which drop off towards higher galactic latitudes.

- The Visit Splitting Distance used by APT is between 35"–80" depending on the Galactic latitude of the target. Exceptions:
    - 30" for moving targets
    - 38" for WATA Target Acq for NIRSpec

- The Visits of a multi-visit observation are not guaranteed to execute in a continuous manner unless a special requirement (to be discussed in more detail later) is specified.

Additional Resource: JDox Article: APT Visit Splitting

Galactic Latitude	Pointing Change	Galactic Latitude	Pointing Change
0° ≤ |b| < 10°	80"	45° ≤ |b| < 50°	45"
10° ≤ |b| < 15°	70"	50° ≤ |b| < 60°	40"
15° ≤ |b| < 20°	65"	60° ≤ |b| < 65°	30"
20° ≤ |b| < 25°	60"	65° ≤ |b| < 70°	40"
25° ≤ |b| < 35°	55"	70° ≤ |b| < 80°	35"
35° ≤ |b| < 45°	50"	|b| ≥ 80°	45"

Target	10 M–82

	Splitting Distance	Number of Visits
Visit Splitting:	50.0 Arcsec	1

	Science	Total Charged
Duration (secs)	43	2841
Data Volume	217 MB	

Ex: At the Observation-level, the target is M-82, which has a visit splitting distance of 50.0"

APT Observation Templates

APT Observation Templates

- Template Form changes based on selection of instrument and observing mode.
- APT templates give users access to all supported JWST observing modes.
- Examples:
  ‣ Coronagraphy
  ‣ Mosaiking
  ‣ Coordinated Parallels

Additional Resource: JDox Article: APT Observation Templates

APT 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
  - Or the 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.

Useful: annotation box, useful for documenting your calculation ID!

Additional Resources:
- JDox Article: APT Target Acquisition
- JDox Article: APT to ETC Connectivity

APT Observation Templates - TA

APT Special Requirements

Special Requirements

- Additional constraints placed on specific observations.
  - ‣ Applied at the observation level.
  - ‣ Affects all visits within an observation
  - ‣ **Must be justified by the science goals**
- Can decrease scheduling availability
- Explicit requirements: set by user
- Implicit requirements: set by APT and reported for your information.
- Examples: Timing, Position Angle, Target of Opportunity, Background Limited, Offset, No Parallel
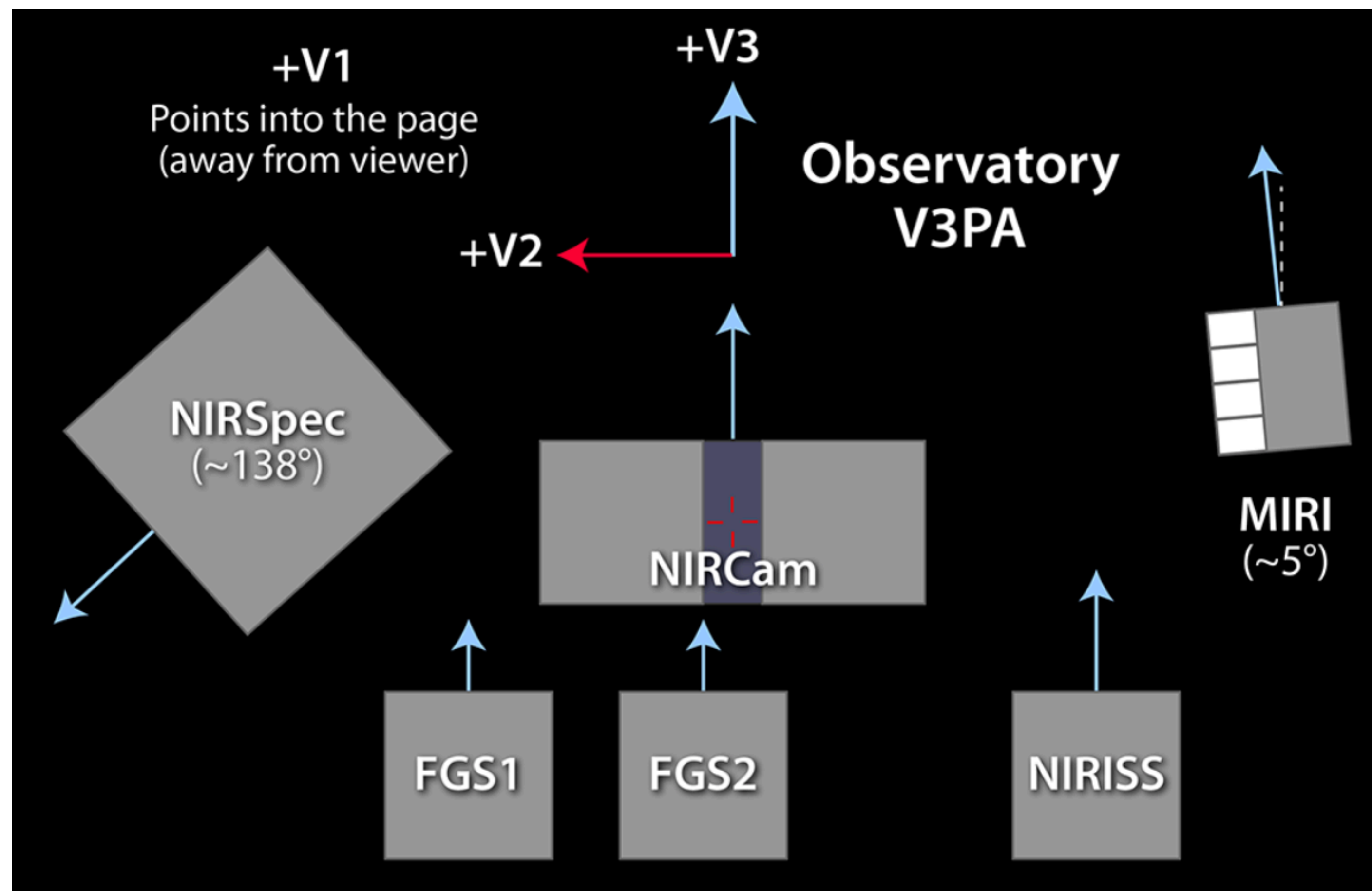

Additional Resources:
- JDox Article: APT Special Requirements
- YouTube Video Tutorial: APT Special Requirements

V3 Position Angle (V3PA) vs Aperture Position Angle (APA)

- V3PA is the observatory reference angle used by APT diagnostics and the scheduling system.
- APA is specific to each instrument, and is the PA (degrees east of north as projected onto the sky) of the reference axes shown as light blue arrows at left.

Instrument	Offset Angle from V3
NIRCam	0.0°
MIRI	4.45°
NIRISS	0.57°
NIRSpec	138.5°

Additional Resource: JDox Article: Position Angles, Ranges and Offsets

APT Visit Planner

APT Visit Planner

- The APT visit planner performs a detailed check of the *schedulability* of the visits in observations, including target visibility, constraint checking, and whether guide stars are available.

- Diagnostic information is provided when scheduling checks fail. But interpreting this information can be tricky.

Additional Resources:

- JDox Article: APT Visit Planner
- YouTube Video Tutorial: APT Visit Planner

# APT Visit Planner Diagnostics – Position Angle Problems
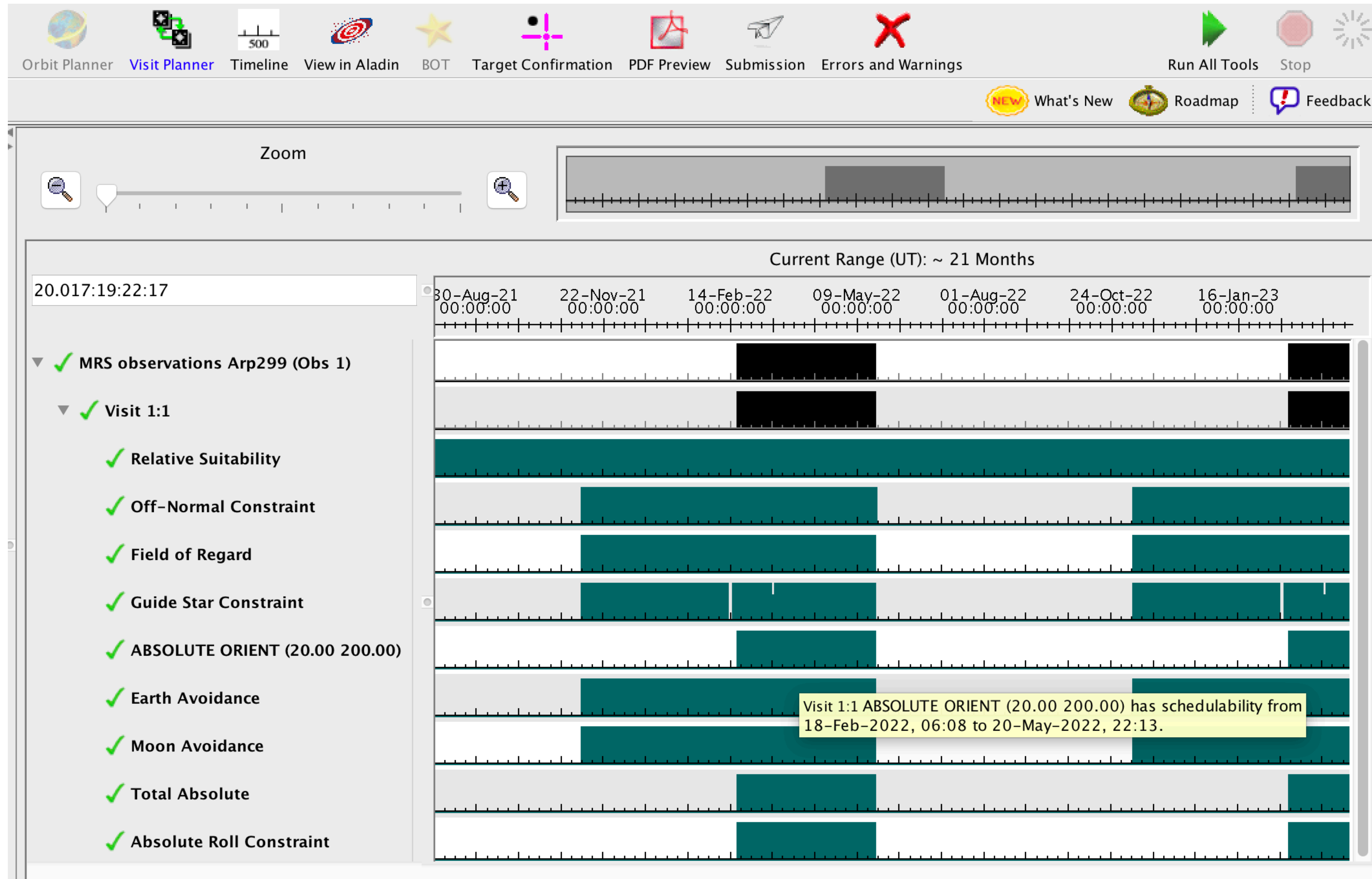
Other Useful APT Capabilities

Other Useful APT Capabilities

- **Find** – can search on any part of the APT file (proposal info, target, observation, etc.)

- **Duplicate/Multiple Duplicate** a target, observation folder or observation

- **Copy/Paste** a target, observation folder, or observation within your proposal or into a separate proposal.

- **Differences** – can difference two separate proposals, or on any part of the APT file (two parts of proposal info, two targets, two observations, etc.)

Important: to revise a label to provide clear tracking within your proposal.
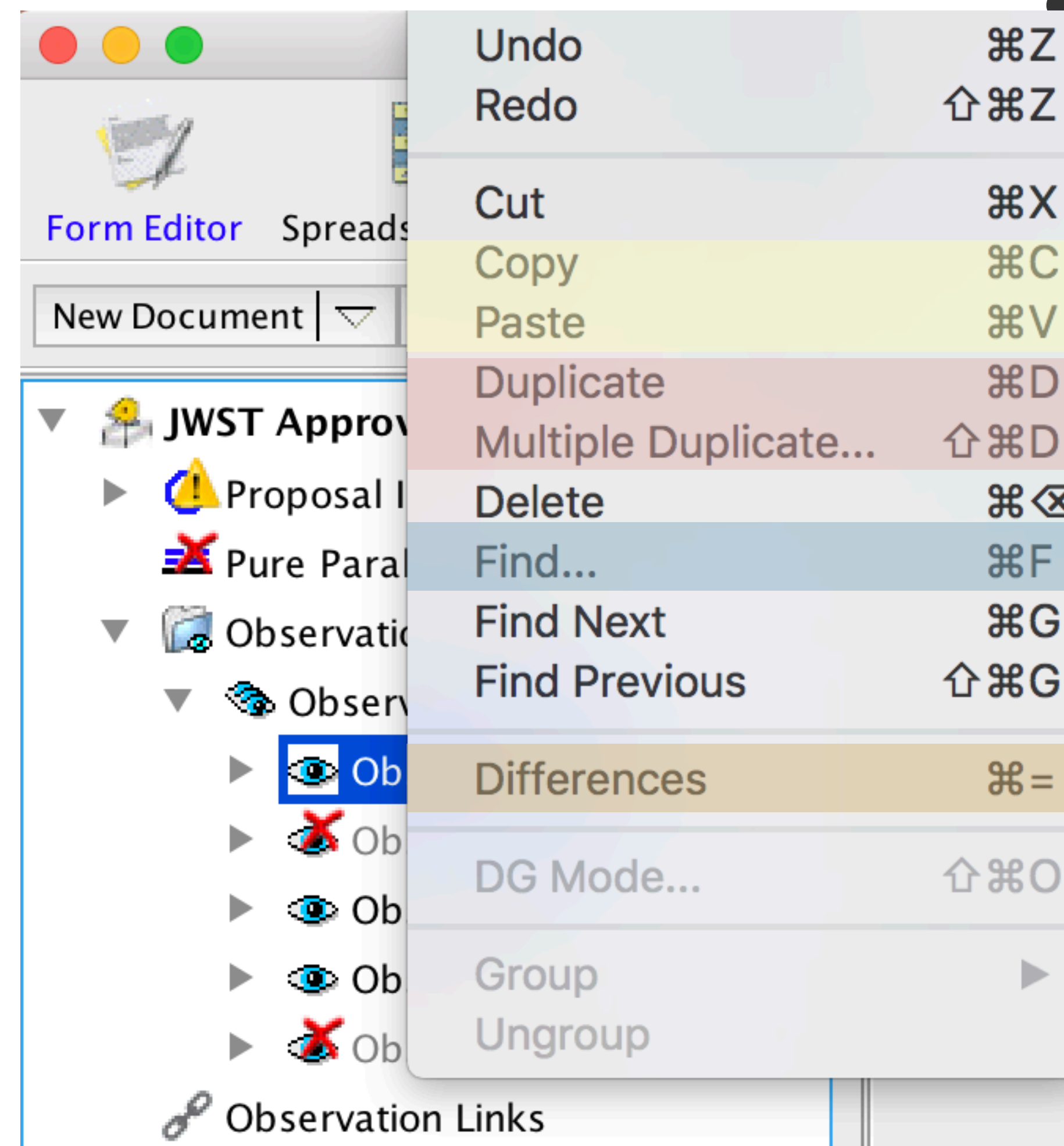
APT Overheads and Smart Accounting

APT Overheads

- JWST autonomous operations are complex.
  - There are many activities that need to occur to set up each observation. While most are fairly short, in the ensemble, the time can add up.
  - Slewing and settling take time, even for small motions.
- By policy, JWST amortizes the estimated time for calibrations and observatory and charges to each program.
  - Pre-launch estimate for this is 16%, which is included by APT.
- But to first order, overheads are what they are.
  - There is not too much you can do to lower your overhead charges by changing details in APT.
  - The Smart Accounting step in APT makes a reasonable attempt to lower artificially high overheads.

Our best advice to you is to concentrate on the science you want to do and don't be overly concerned about overheads!

APT Overheads, continued

- Direct overheads – activities directly associated with an observing program
  - major slews
  - mechanism motion times
  - guide star acquisition times
  - small angle maneuvers
  - target acquisitions
- Indirect overheads – activities performed for the general support of science observations (16%)
  - calibrations
  - momentum management
  - wavefront sensing and control
  - other observatory maintenance activities
- Instrument overheads – activities directly associated with each instrument
  - Filter/grating changes
  - detector readout
  - Instrument operations script compilation time

Additional Resource:
- JDox Article: JWST Overheads and TIme Accounting Overview

APT Overheads, continued

- Many overheads are known from ground testing, and can be applied deterministically (those occurring within a visit)

  - mechanism motions (filter or grating wheel rotations, other setup activities).

  - Small Angle Maneuvers (SAMs) (e.g., motions between dither steps or mosaic tiles).

  - target acquisition time (when needed).

- Statistical time estimates – assumed average time of activities that depend on the exact sequence of events when scheduled.

  - Ex: Initial slew time from previous observation to the first visit of your observation cannot be known by APT.

  - Scheduling studies indicate an average initial slew time of 1800 s.

  - This is charged once per observation, but see below (Smart Accounting)

- Some overheads are combinations!

  - Guide star acquisition time assumed includes a statistical estimate of how often initial failures and retries will need to be executed.

  - But then this fixed time is charged to each visit.

APT Graphical Timeline

- Shows a summary of various overheads affecting the proposed observations.
- Provides you with insight into the major steps that occur and the times accounted to each.
- Is not meant to represent the actual detailed set of events that occur in the onboard execution of the observation.


Olive: Visit Slew

Lt blue: Visit Overhead

Red: GS Acq

Gray: Target Locate

Orange: OSS compile (scripts)

Blue: Mechanism motion

Pink: Small Angle Maneuvers

Green: Exposure Overhead

Crosshash: Science Exposing Time
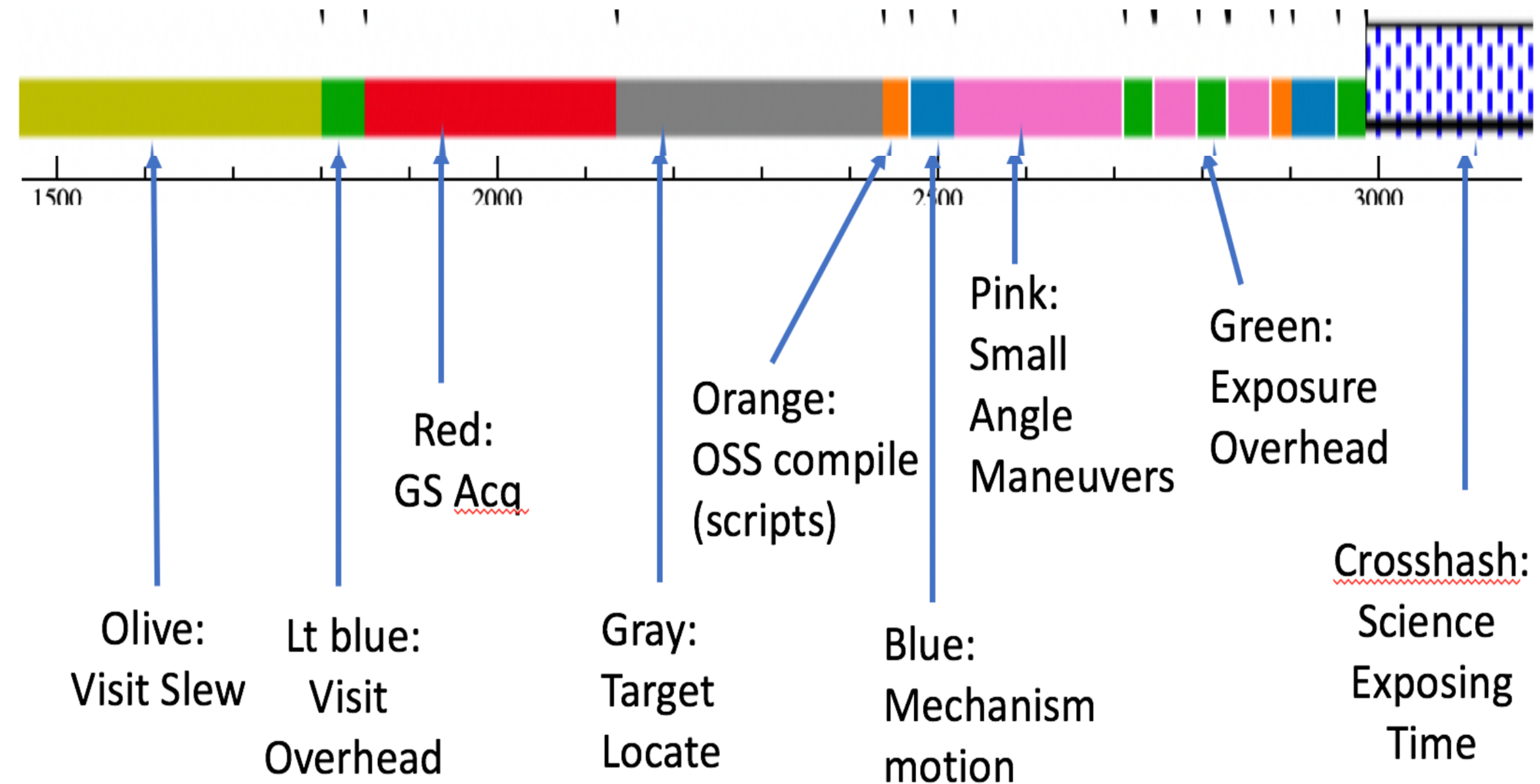
Additional Resources:
- JDox Article: APT Graphical Timeline
- YouTube Video Tutorial: APT Graphical Timeline

APT Graphical Timeline Examples

Initial visit, relatively short science exposure; overheads dominate
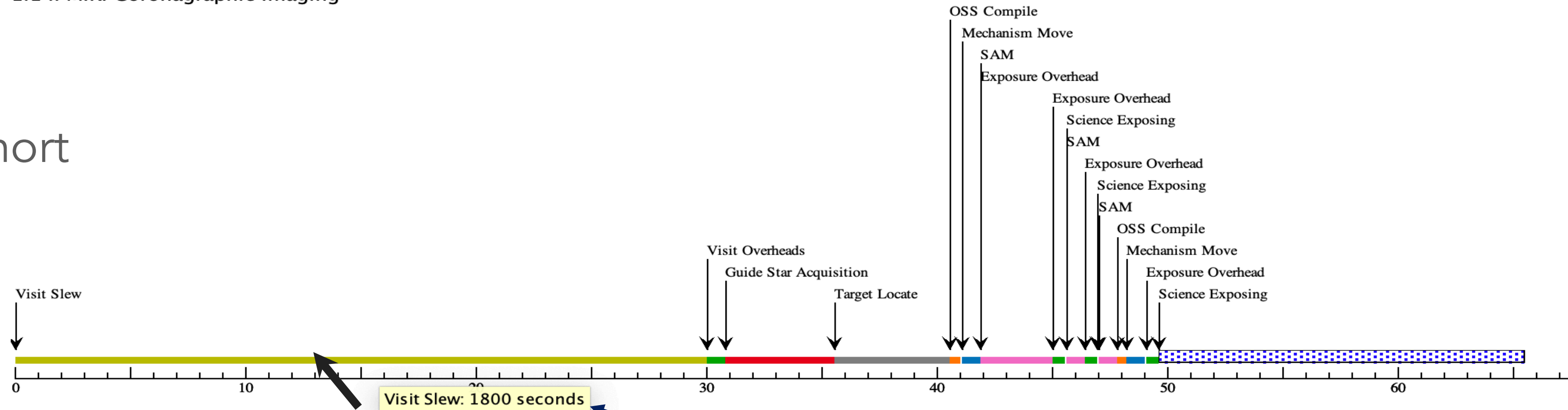
A second visit, relatively fewer overheads, long science exposure
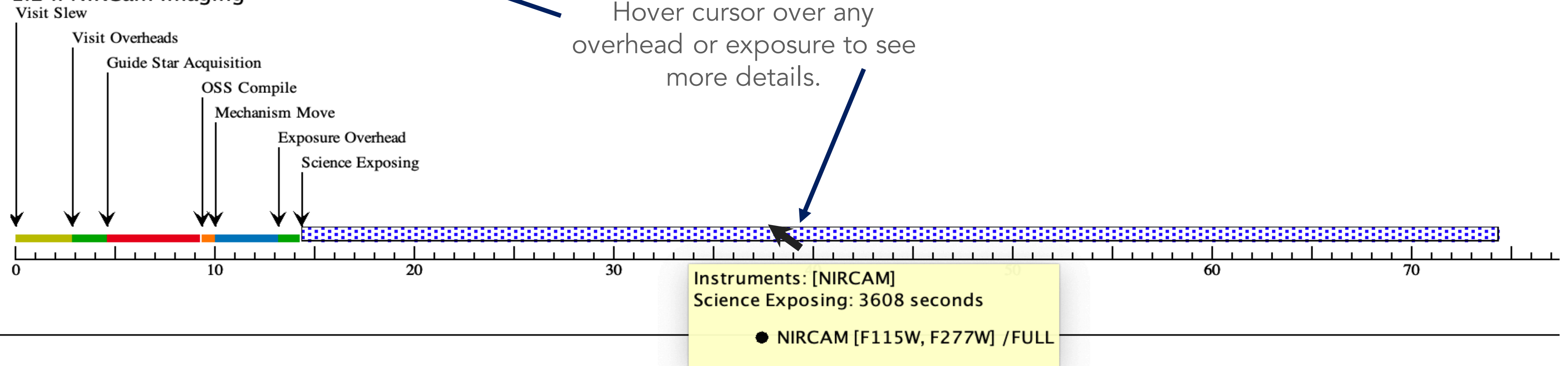
APT Science Time and Total Charged Time

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

Total for proposal

Visit level

Observation level

APT Overhead Charge Corrections (Smart Accounting)

- While designing and building an observing program, overheads can become overestimated as observations are added individually.
  - Ex: NIRCam and MIRI imaging requested on the same source, will likely be scheduled back-to-back.
  - Ex: Many targets closely spaced on the sky, will likely be scheduled in close succession.
  - In both cases, initial assumptions of a large 1800 s slew to start each observation are likely a significant overestimate.
- Running *Smart Accounting* on your finished observations searches for and removes extra initial slews and other smaller inefficiencies that may have crept in.
  - Some programs will see a significant correction while others will not.

Note: While Smart Accounting may reduce your proposal's total time request (which is good for you!), this adjustment is important in a larger sense, to provide the best estimate of overall observatory resource usage expected. So…

Always run Smart Accounting before submitting your proposal!

Where to find and run Smart Accounting in APT

- Because of the importance of running *Smart Accounting*, APT provides several places where it can be invoked.

  - A button right on the Proposal Information page.

  - From within the Visit Planner

    - By clicking the "Run Smart Accounting" button at lower right.

    - Or simply by selecting your entire observation folder in the tree editor and running the "Update Display" button in the Visit Planner.

APT Smart Accounting Hint

To see the impact of Smart Accounting, note the total charged time on the Proposal Information page prior to executing the task. Then compare to the result when the task completes.

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`

Additional Resource: JDox Article: APT Smart Accounting

APT Science Time and Total Charged Time -- Summary

- *Science time vs. Total Charged Time is just informational for the proposer.*
  - Proposals with short exposures will be dominated by overheads.
  - Proposals with relatively long exposures will have more balance.
  - That's just the way it is for JWST observations.   BUT…
  - The Time Allocation Committee (TAC) only sees the total resource request.

*So don't obsess over the "efficiency" of your proposal. Just concentrate on proposing the best science you can!*

**This is an important point to communicate in your own workshops.**

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.
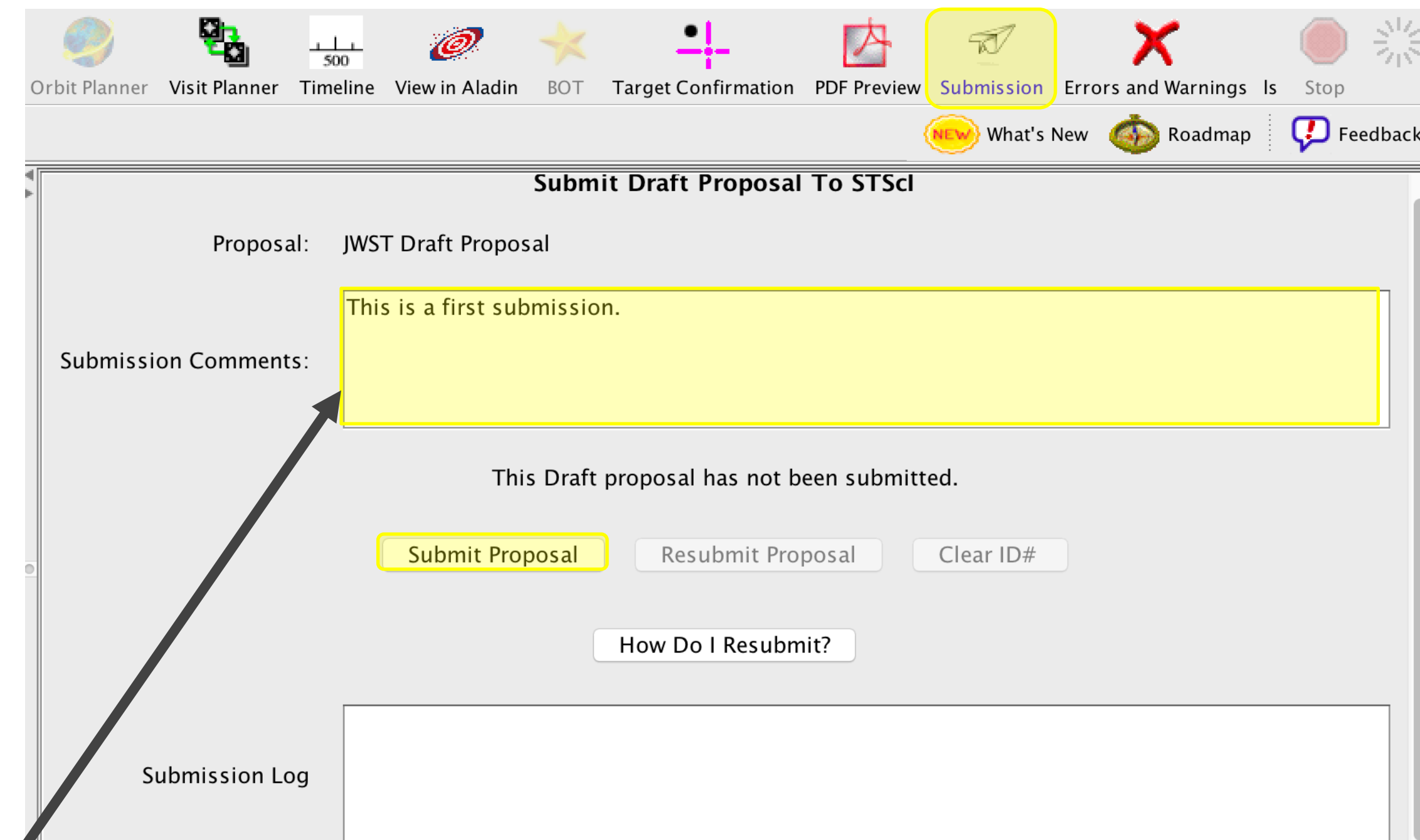
Additional Resources for Help with APT

- JWST User Documentation Website https://jwst-docs.stsci.edu/, including
  - The JWST Astronomer's Proposal Tool Overview (and links therein)
  - Help with Individual APT Templates
  - Example Science Programs, each of which has a specific APT step-by-step guide.

- YouTube Tutorial Videos https://www.youtube.com/jwstobserver, and in particular, the Playlist of APT-specific Videos

- Context Sensitive Help within APT
  - Clicking on Blue headings within APT opens a browser and points to relevant JDox support information.
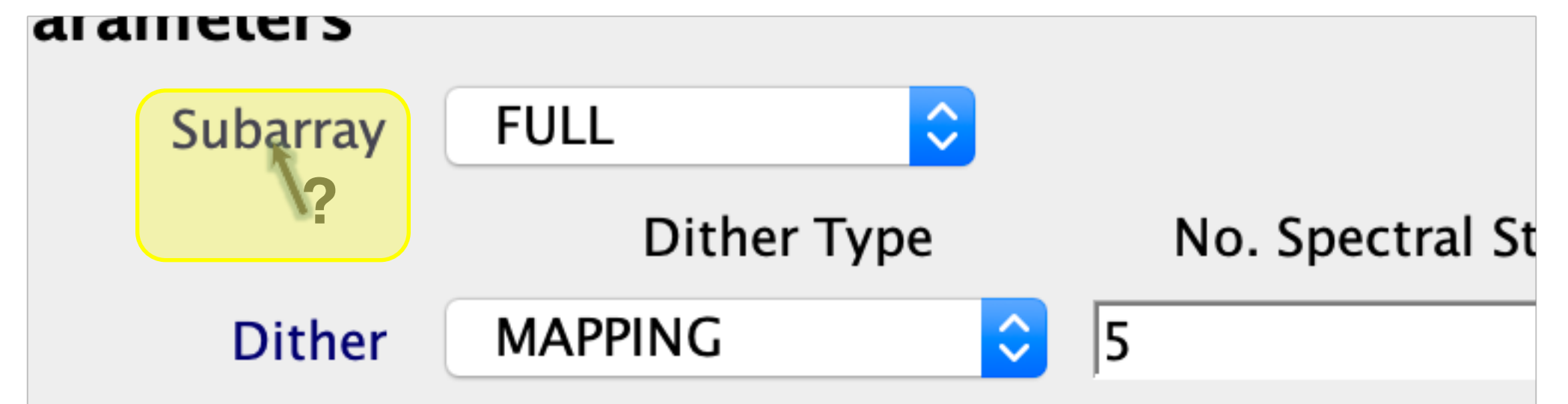
Thanks for Listening – Questions?