

Step-by-Step APT Guide for NIRISS SOSS Science Use Case

Instructions are provided for filling out the APT observing template for the JWST NIRISS SOSS Time-Series Observations of HAT-P-1 Science Use Case.

Introduction

*Main article: [NIRISS Single Object Slitless Spectroscopy, NIRISS SOSS Template APT Guide](#)
See also: [JWST APT Training Examples and Video Tutorials](#)*

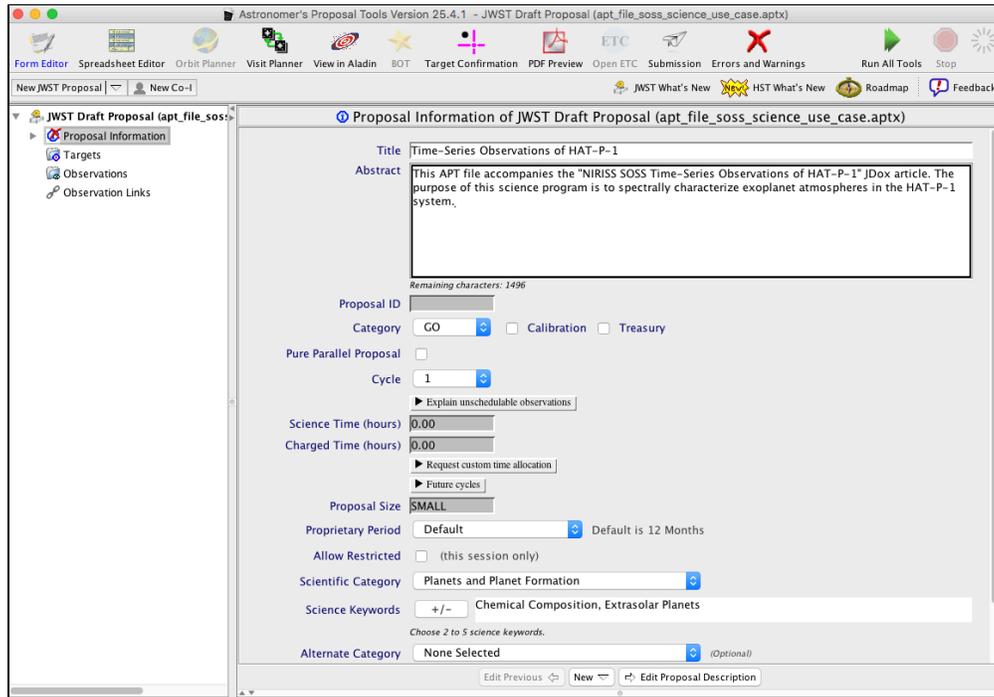
The [Astronomer's Proposal Tool \(APT\)](#) is used for submitting JWST proposals. There are multiple components to an APT submission: generic proposal information, target information, and exposure specifications for the proposed program. This guide discusses how to fill out the APT observing template for the "NIRISS SOSS Time-Series Observations of HAT-P-1" [Science Use Case](#). A filled out APT file can be [downloaded here for reference](#).

Proposal Information

Main article: [JWST Astronomers Proposal Tool Overview](#)

After opening APT, select "New JWST Proposal" under the "New Document" pull-down menu. On the Proposal Information page, enter **Title**, **Abstract**, and **Category** of proposal. Keep **Cycle** number at its default value. Update **Scientific Category** to **Planets and Planet Formation** and add the following **Science Keywords**: **Chemical Composition** and **Extrasolar Planets** (see Figure 1).

Figure 1. Generic proposal information filled out for the JWST Observing Template in APT



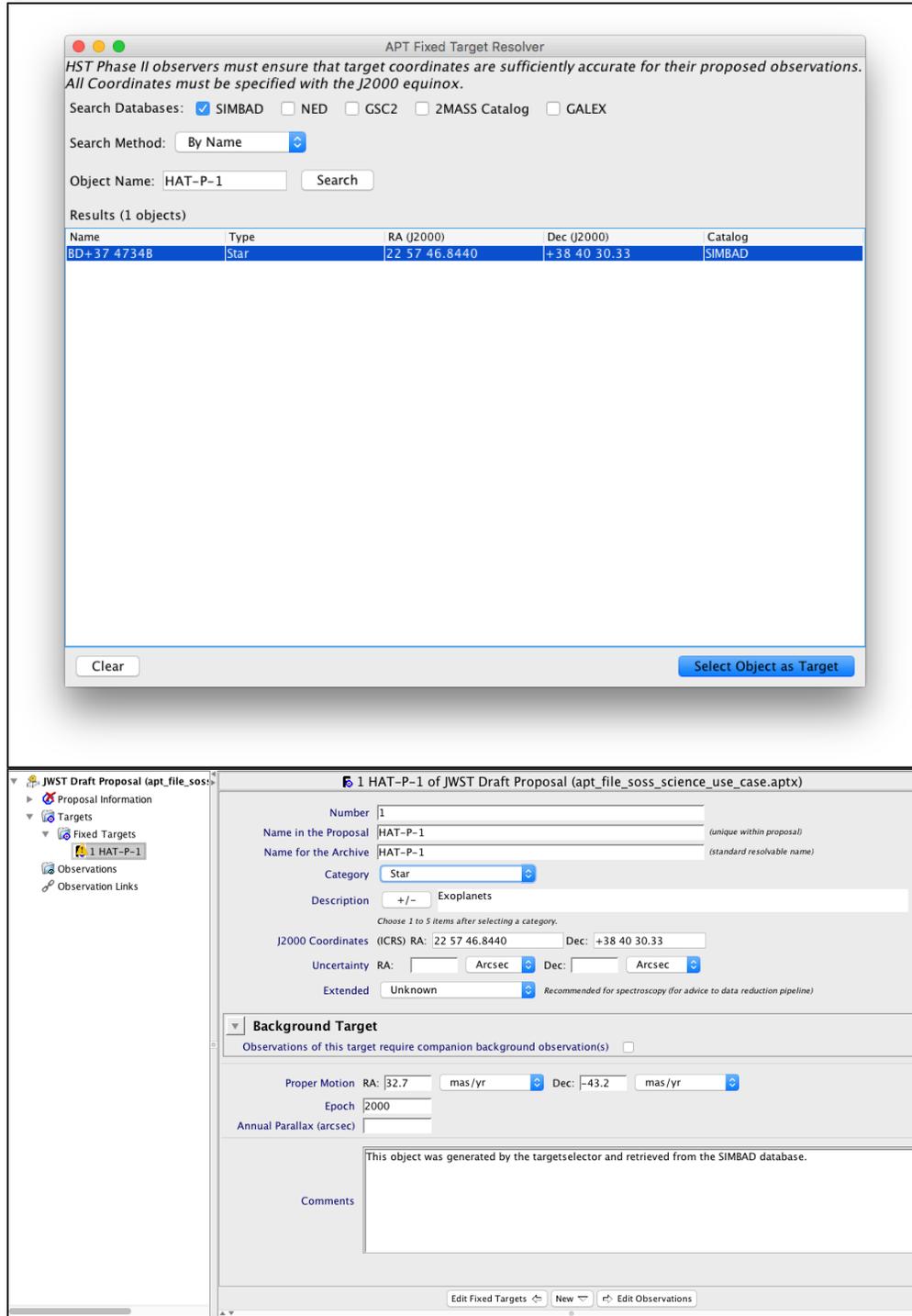
Targets

Main article: [APT Targets](#)

Target information is entered on the "[Targets](#)" page. When clicking on the "Targets" page, click on the "Fixed Target Resolver" button. In the pop-up window, enter "HAT-P-1" in the "Object Name" search box. The result is returned from querying the SIMBAD database is "BD+37 4734B", which is an alternate name for HAT-P-1. By clicking "Select Object as Target", the target name and coordinates are imported to the APT observation template. (Figure 2, top).

Select this target in the left-hand page tree to provide additional information in the Targets template. In both the **Name in the Proposal** and **Name for the Archive** fields, update the name of the object to the more familiar **HAT-P-1**. In the **Category** drop-down menu, select **Star**. In the **Description** menu, select **Exoplanets**. Enter the proper motion of the source in the template. From looking up HAT-P-1 in Simbad, we see that the proper motion in RA is 32.7 mas/year and the proper motion in Dec is -43.2 mas/year. In the **Epoch** box, enter **2000** (Figure 2, bottom).

Figure 2. Enter target information into APT



Top: Using "Fixed Target Resolver", look up the coordinates of the source by querying the SIMBAD database. The returned object is our target. By clicking "Select Object as Target," the name and coordinates of the targets are transferred into the APT observing template. Bottom: Additional information about the target needs to be added to the Target template: Category, Description, Proper Motion, and Epoch. The name can also be updated from the default name returned from SIMBAD to the more familiar "HAT-P-1."

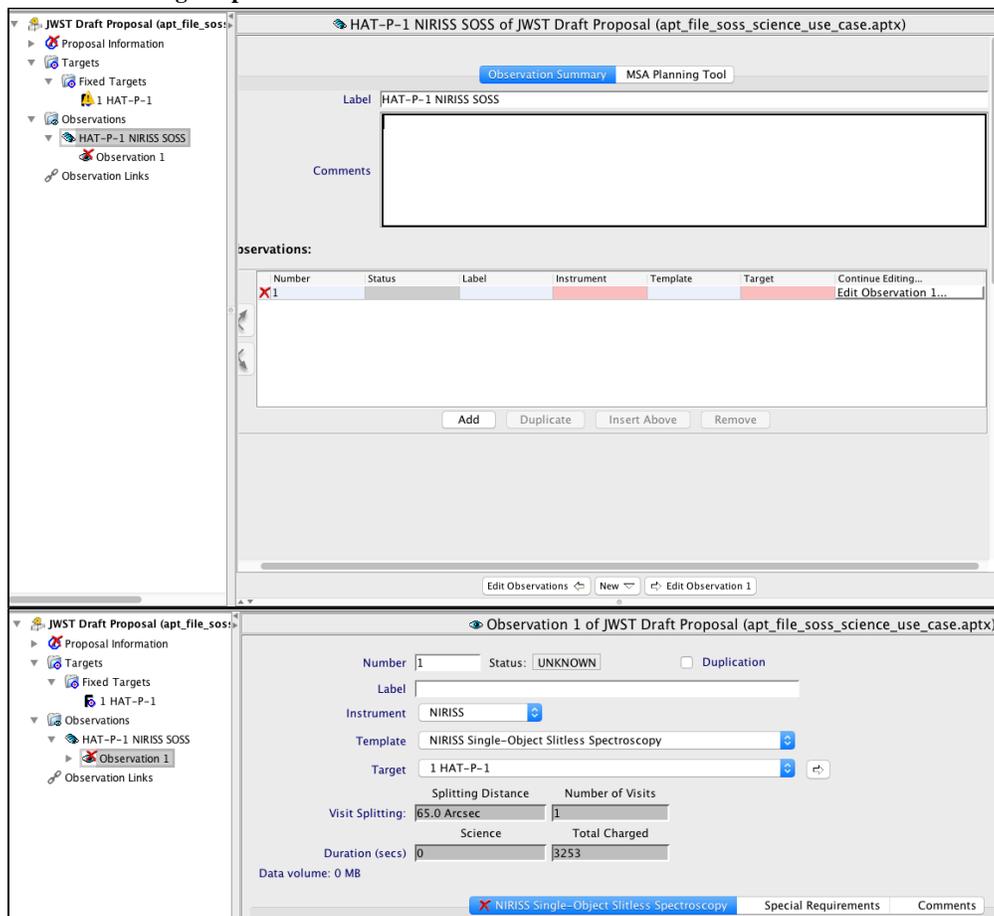
Observations

Main article: [APT Observations](#)

On the "Observations" page, click on the "New Observation Folder" button. In the **Label** field, enter **HAT-P-1 NIRISS SOSS** (Figure 3, top).

Click "Observation 1" in the left hand page tree to open the [observation template](#) to be filled out. In the **Instrument** pull-down menu, select **NIRISS**, and then select **NIRISS Single-Object Slitless Spectroscopy** template in the **Template** pull-down menu. In the **Target** pull-down menu, select **HAT-P-1** (Figure 3, bottom).

Figure 3. Select the SOSS observing template



Top: Clicking on the "New Observations" folder will open a summary screen for the first observation. Update the Label field with information to identify this observation, in this case HAT-P-1 NIRISS SOSS. **Bottom:** Clicking on "Observation 1" in the page tree will open a JWST observing template. Selecting the options as described in the main text (shown here) will bring up an observing template that can be filled out with exposure parameters derived from the ETC Step-by-Step guide (see Figure 4).

NIRISS SOSS Observation Template

Main article: [NIRISS SOSS Template APT Guide](#)

See also: [NIRISS APT Target Acquisition](#)

Target Acquisition

A [target acquisition \(TA\)](#) is required when using a subarray with SOSS to ensure the target is placed on the "sweet spot" on the detector. As described in the [Step-by-Step ETC guide](#), a $SNR \geq 30$ is required to ensure the TA will succeed, otherwise the observation fails.

For this science use case, we perform the TA on the target, so keep the acquisition target in the **Target ACQ** pull-down menu at its default value of **SAME TARGET AS OBSERVATION**. Using the results from the ETC calculations, select **SOSSFAIN**t for **Acq Mode**, **NISRAPID** for **Acq Readout Pattern**, and **3 Acq Groups/Int** (Figure 4). It is recommended to include the ETC workbook ID number in the **Acq ETC Wkbk Calc ID** field so the TA SNR calculations can be verified by Instrument Scientists during technical reviews.

Figure 4. Populate target acquisition parameters in the SOSS observation template

The screenshot shows a form titled "Target Acquisition Parameters" with several fields and dropdown menus. The fields are arranged in a grid-like structure:

Acq Target		Acq Mode		AcqFilter							
Target ACQ	SAME TARGET AS OBSERVATION		SOSSFAIN		F480M						
Acq Readout Pattern		Acq Groups/Int		Acq Integrations/Exp		Acq Total Integrations		Acq Total Exposure Time		Acq ETC Wkbk.Calc ID	
Acq Exposure Time	NISRAPID	3		1		1		0.201		11703	

Using the results from the ETC calculation, fill out the target acquisition parameters. Here, we perform TA on the target of the observation to ensure the source is precisely positioned on the detector. Including the ETC workbook ID in the template is highly recommended to ensure the TA specifications input by the user passes a technical review.

SOSS Parameters

Populate the SOSS Parameters portion of the SOSS observation template with the exposure parameters determined from the Step-by-Step ETC guide (Figure 5). Ensure that **SUBSTRIP256** is selected in the **Subarray** pull-down menu. The only permitted **Readout Pattern** when using a subarray in the SOSS observing mode is **NISRAPID**, and is the only option thus available in the APT template.

For **Groups/Int**, enter **2**, and enter **2042** for **Integrations/Exp**. The **ETC Wkbk. Calc ID** can also be entered in the template. The yellow exclamation point indicates a warning for this exposure, which alerts the user that due to the long exposure ($> 10,000$ seconds), a High Gain Antenna move may be performed during the exposure which can induce jitter that affects the science observation.

Figure 5. Populate SOSS parameters in the SOSS observation template

SOSS Parameters							
Subarray	SUBSTRIP256						
Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
⚠ Exposure Time	NISRAPID	2	2042	1	2042	33656.244	11703

Using the results from the ETC calculation, fill out the SOSS exposure parameters: SUBSTRIP256 subarray, 2 groups per integration, and 2042 integrations per exposure. The only permitted Readout Pattern is NISRAPID since a subarray is being used, so APT does not offer an option other than NISRAPID for the readout pattern. The ETC workbook ID can also be entered.

Special requirements

Main article: [APT Special Requirements](#)

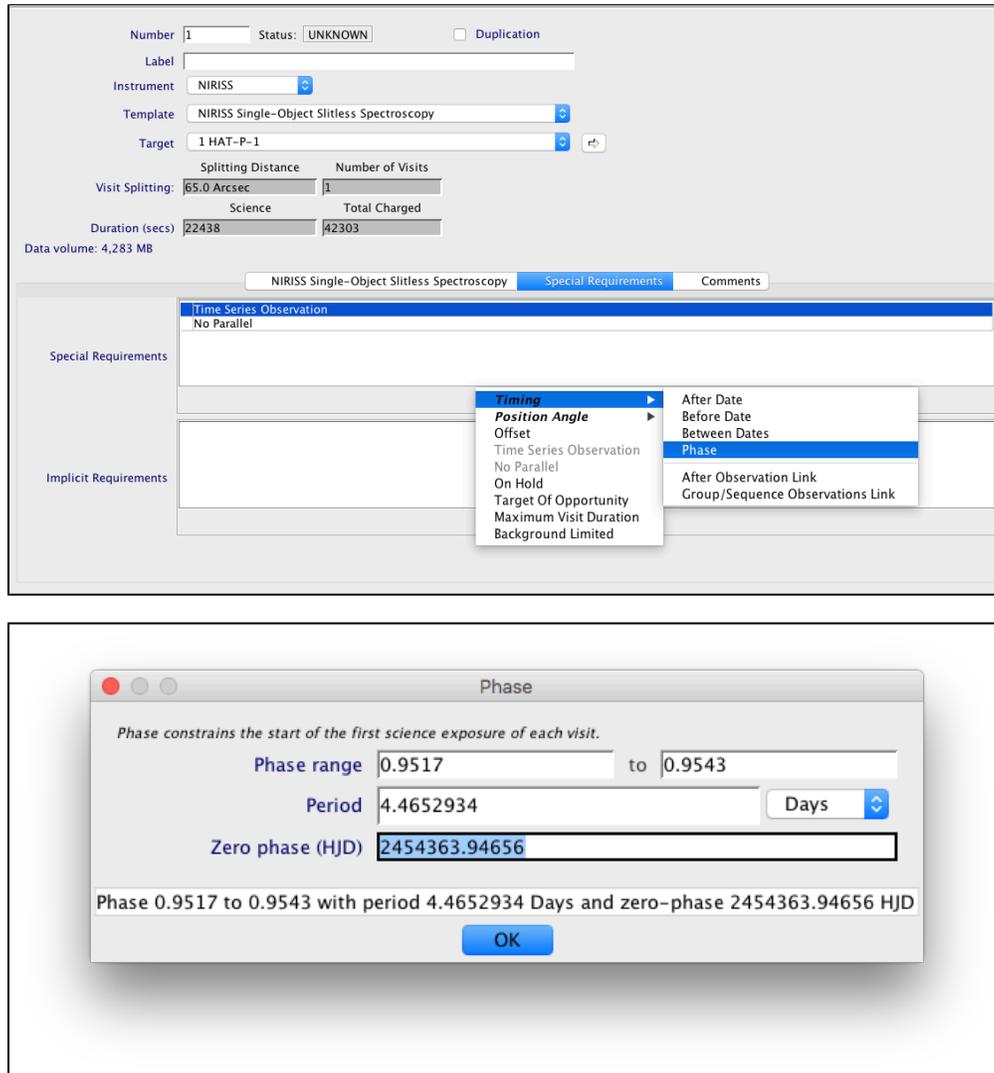
To observe the transit of the exoplanet, phase constraints need to be applied to the proposal, which are specified in the [Special Requirements](#) tab. Two special requirements were already added by APT: Time Series Observation, which signals the pipeline how to process the data and causes APT to give a warning rather than an error about the exposure duration exceeding 10,000s, and No Parallel, which prohibits a [parallel observation](#) from being scheduled simultaneously with this program.

It is recommended to add 1 hour of "timing window" to the observation, which will allow the observatory scheduling enough leeway to place this transit observation in the normal event driven scheduling. Timing windows of 1 hour or more of margin plus settling time will avoid an extra timing overhead on tight observation execution windows (< 1 hr). A factor of $2 T_{14} + 1.5$ hr allows for both detector settling and some margin in case the observation execution initiation window is defined to be large or if the primary transit occurs at a slightly different time than predicted. Click "Add" to specify the phase special requirement for this observation (Figure 6, top). The phase range of the transit needs to be specified, where APT accepts values from 0 to 1. By convention, the transit occurs at phase = 0.0. The phase is specified relative to the period of HAT-P-1, which is 4.4652934 days.

To minimize loss of coverage, we want the observation to start no later than $1.5 \times T_{14} + 1.5$ hours, where T_{14} is the exoplanet transit duration of 2.784 hours. The phase, in units of the period of HAT-P-1 in days, is thus $1 - (1.5 \times T_{14} + 1.5 \text{ [hrs]}) / P_{\text{HATP1}} = 1 - (1.5 \times 2.784 / (24 \times 4.4652934) + 90 / (60 \times 24 \times 4.4652934)) = 0.94704$.

In the "Phase" window that pops up after adding a phase special requirement in APT, enter 0.94704 and 0.95637 in phase range and 4.4652934 as the period. According to the discovery paper, the transit center is 2454363.94656 (HJD), so enter this value for zero phase (Figure 6, bottom). Click "OK" to add the phase special requirements to the program.

Figure 6. Specify phase special requirement



Top: To specify a phase window in which HAT-P-1 can be observed, enter the "Special Requirements" template, click "Add", open the "Timing" menu, and select "Phase." Bottom: In the "Phase" window that pops up, enter the phase specifications as derived in the main text.

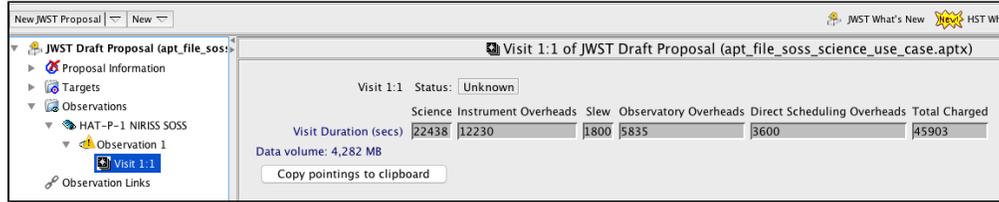
Data Volume

Main article: [JWST Data Rate and Data Volume Limits](#)

The [data volume limit for JWST observations](#) is 28.6 GBytes per 12 hour interval, to prevent solid state recorder from running out of space before data are downlinked to Earth. Since NIRISS has only one [Hawaii 2RG detector](#), it is rare for this data volume limit to be reached. Nevertheless, it is prudent to check the data volume for this observation.

In the left-hand page tree, click the triangle next to "Observation 1" to open the Visit pane (Figure 7). Here we see that the data volume for the observation is 4,282 MB, and thus does not violate the data volume limit.

Figure 7. Visit pane for NIRISS SOSS observation of HAT-P-1



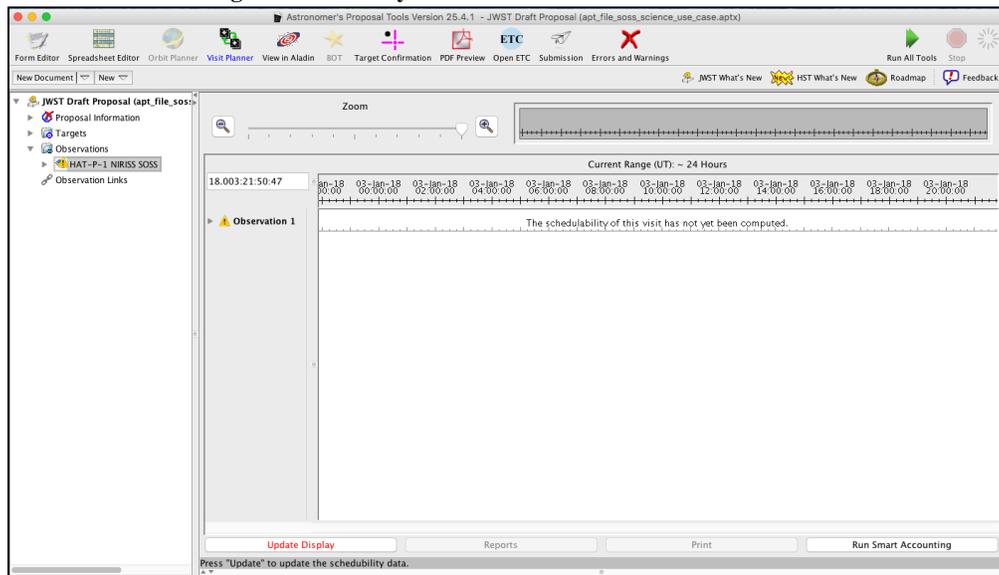
The visit pane shows that for the NIRISS SOSS observation of HAT-P-1, the data volume will be 4,282 MB, which is under the data volume limit of 28.6 GBytes per 12 hour interval.

Schedulability

Main article: [APT Visit Planner](#)

The [APT Visit Planner](#) tool checks the schedulability of an observation and whether guide stars can be found to support the observation. To check the schedulability of this observation as specified, click on the "Visit Planner" icon in the top tool bar and click "Update Display" (Figure 8).

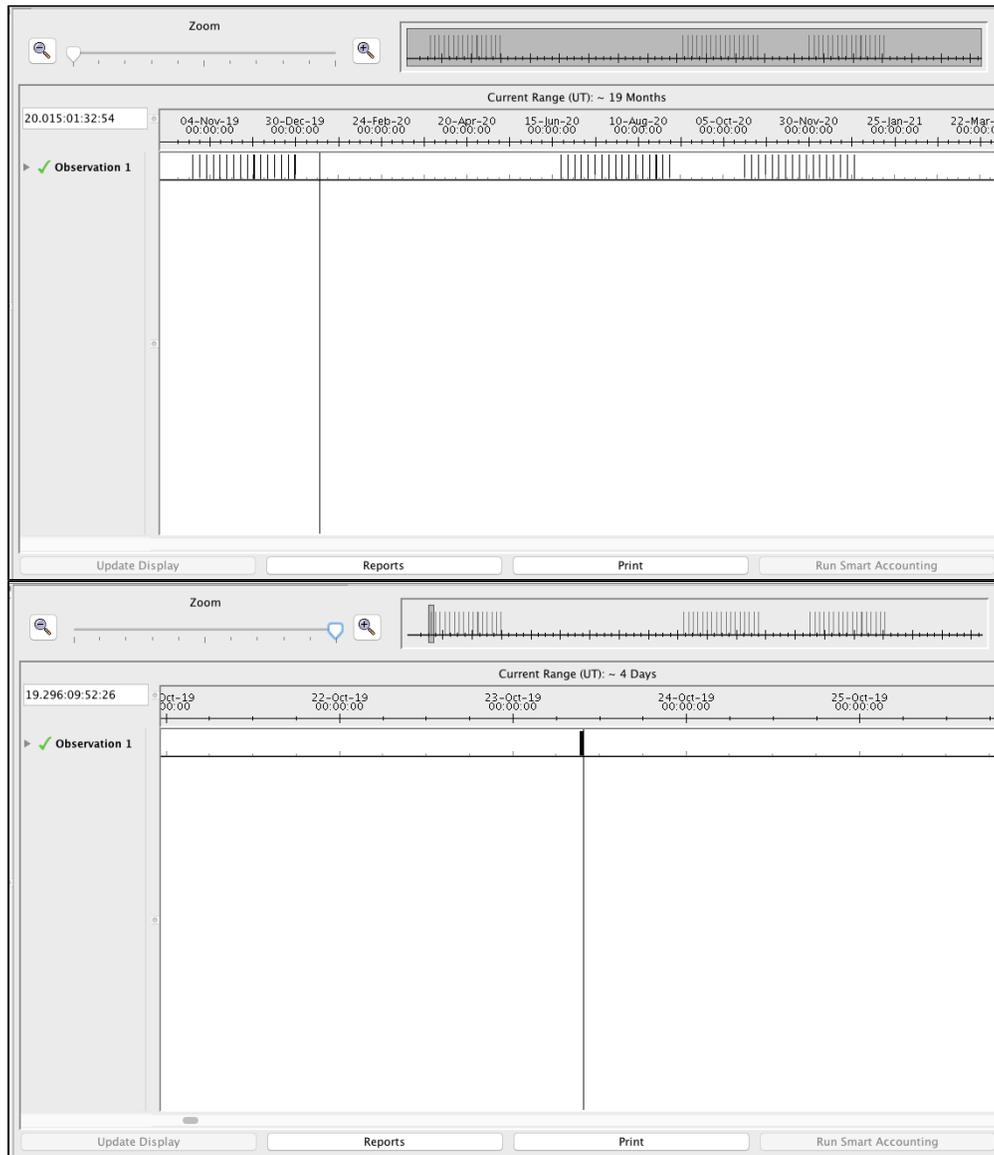
Figure 8. Run Visit Planner to check target schedulability



Because JWST has very special observational constraints - related to the [position of the sun relative to the observatory's orbit](#)-each target's RA and Dec has a specific set of "patches" of days that targets can be observed (Figure 9, top). We can "zoom in" on one of those patches: using the zoom slider bar above the figure and

manually adjusting the grey box to the right of that slider bar, we can isolate a the leftmost "patch" of observing windows (Figure 9, bottom). By zooming in on specific windows, we can see the specific calendar dates when this target can be observed by JWST, given the phase constraint. It is good practice to confirm future dates of an estimated transit opportunity.

Figure 9. Inspect results from visit planner



Top: The windows where the the observation of HAT-P-1 can be scheduled over a 19 month period, given the specified phase constraint, is returned from the Visit Planner. **Bottom:** Using the zoom slide-bar and gray box to the right of the zoom slide-bar to isolate the left-most visibility "patch," the specific UT window can be found.

