

Step-by-Step APT Guide for NIRCcam Grism Time-Series Science Use Case

Instructions are provided for filling out the APT observing template for the JWST NIRCcam Grism Time Series Observations of GJ 436 Science Use Case.

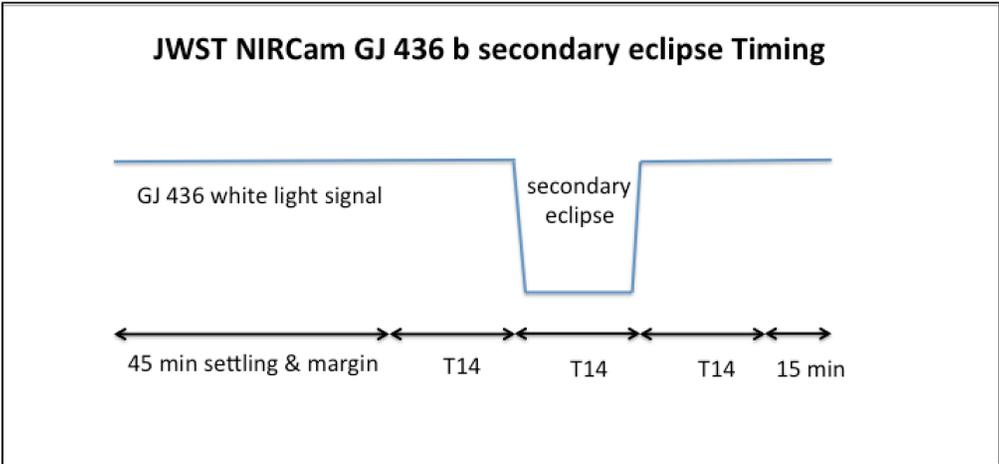
Astronomer's Proposal Tool

Main article: [JWST Astronomers Proposal Tool Overview](#)
See also: [NIRCcam Grism Time-Series APT Template](#)

Defining grism time-series observations in APT

We plan to observe GJ 436 for a total time of $3 T_{14} + 1 \text{ hr} = 3.27 \text{ hours}$, real time, in each filter. This allows for sufficient detector settling time (currently estimated to be ~ 30 minutes), the secondary eclipse, and twice the eclipse duration before and after the secondary eclipse to reduce photon noise. This also allows some margin if the observations do not start exactly when expected or if the secondary eclipse occurs at a slightly different time than predicted. This timing is shown in Figure 1.

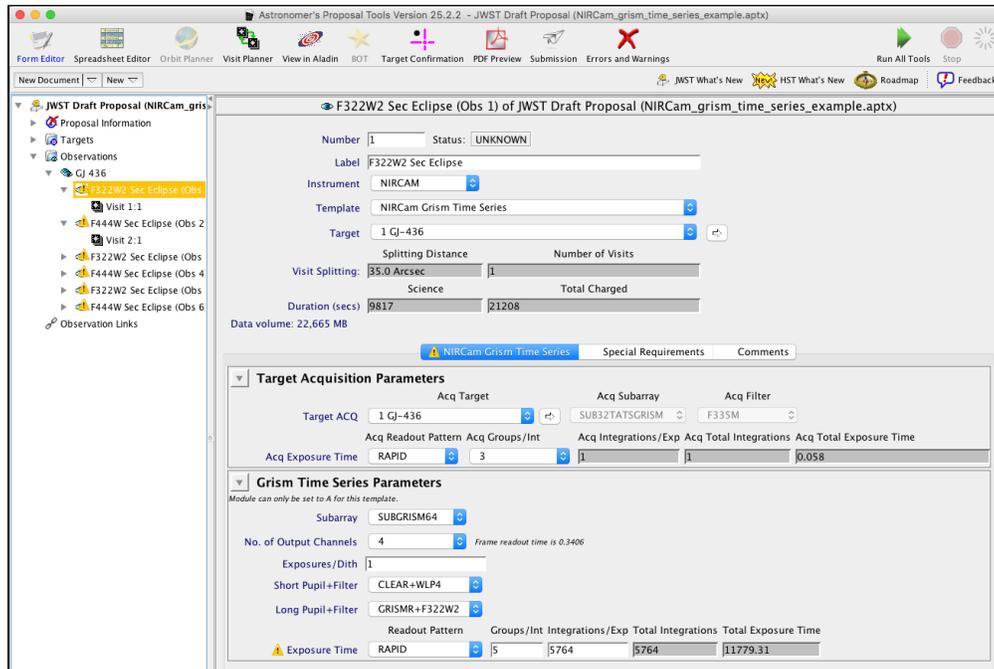
Figure 1. Timing of GJ 436 b secondary eclipse observations



We now construct an APT file that describes our desired observations. We will use the [NIRCcam grism time series template](#) to specify a single-exposure observation with a real-time duration of 3.27 hours as explained above. We enter the following values in APT:

- Create a new **fixed target** in the Targets portion of the tree editor. Enter the name GJ 436, and resolve with SIMBAD. Be sure that the coordinates, proper motion, and parallax values are correct; APT does not yet enter all of these automatically.
- Create a new **NIRCam observation**, and select the NIRCam grism time-series template. For the Target Acquisition, select the **Same Target as Observation**, with the **RAPID** readout pattern and $N_{Group} = 3$ (see the ETC section for notes on saturation).
- Set up the observation parameters for the F322W2 observation next. Choose the **SUBARAYS = SUBGRISM64** subarray with **NUMBER OF DETECTOR OUTPUT CHANNELS = 4**, **NUMBER OF EXPOSURES /DITHER = 1**, **SHORT PUPIL-FILTER = CLEAR+WLP4** for simultaneous short-wavelength imaging, **LONG PUPIL-FILTER = GRISMR+F322W2** for the 2.4–4.0 μm spectroscopy, and a **READOUT PATTERN = RAPID** with **NUMBER OF GROUPS/INTEGRATIONS = 5** and **NUMBER OF INTEGRATIONS/EXPOSURE = 5764**. This results in a total exposure time of 11,779 s or 3.27 hours. The long exposure is allowed, but APT gives a warning (yellow triangle) that the high gain antenna may be moved during the exposure. The APT setup is shown in Figure 2.

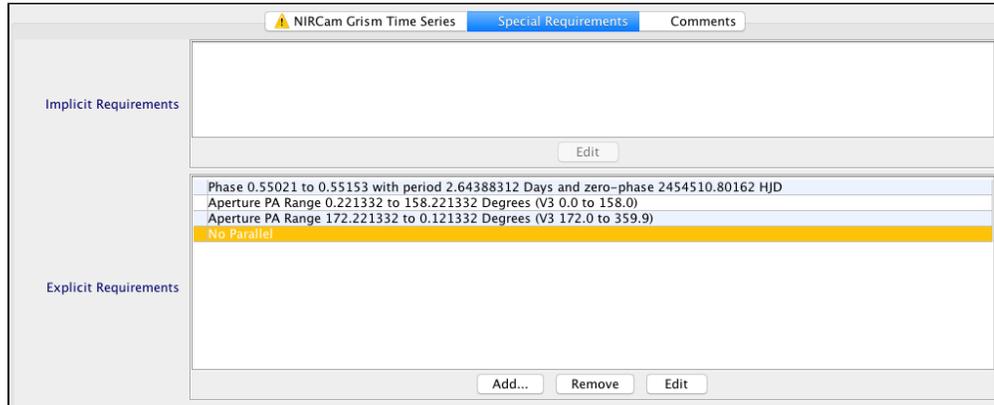
Figure 2. F322W2 + grism APT observation parameters for GJ 436 b secondary eclipse



The yellow triangles indicate a warning from APT that high gain antenna may be moved during the exposure. Warnings do not prevent submission of the proposal, though errors (red X's) do. The error marking Proposal Information in the Tree editor is indicating that not all information has been filled out yet. The proposal cannot be submitted until that section is complete.

- Select **Special Requirements** in the observation window to add phase and position angle (PA) restrictions. Choose **PHASE = 0.54955 to 0.55219**, with **PERIOD = 2.64388312 days** and **ZERO-PHASE = 2454510.80162**. This starts the spectroscopic observation within +/- 5 minutes of the ideal phase shown in Figure 2. GJ 436 has only 1 nearby bright star ($\Delta K < 7$ mag), but it will not contaminate the F322W2 grism spectrum if the modest **APERTURE PA RANGE** constraints of $V3 = 0$ to 158 degrees and $V3 = 172$ to 359.9 degrees are assigned. These entries are shown in Figure 3.

Figure 3. APT Special Requirements for GJ 436 b secondary eclipse F322W2 + grism observation



Create a new NIRCам grism time-series observation using the F444W filter. The setup is similar to the above F322W2 observation. Choose the **SUBARAY = SUBGRISM64** with **NUMBER OF DETECTOR OUTPUT CHANNELS = 4**, **NUMBER OF EXPOSURES/DITHER = 1**, **SHORT PUPIL-FILTER = CLEAR+WLP4** for simultaneous short-wavelength imaging, **LONG PUPIL-FILTER = GRISMR+F444W** for the 3.9–5 μm spectroscopy, and a **READOUT PATTERN = RAPID** with **NUMBER OF GROUPS/INTEGRATIONS = 10** and **NUMBER OF INTEGRATIONS/EXPOSURE = 3164**. This results in total exposure time of 11,779 s or 3.27 hours.

- Select Special Requirements in the Observation window to add phase and PA restrictions for the GRISMR + F444W observation. Use the same phase constraints as for F322W2, and **APERTURE PA RANGE** constraints of V3 = 0 to 158 degrees and V3 = 170 to 335 degrees will prevent spectral contamination from nearby stars.
- Each of the above observations should be duplicated twice to create a total of 3 secondary eclipse observations in each filter to achieve the desired SNR on the final spectrum. Expand the observations in the tree editor to see that each observation requires 21,208 s (5.89 h) of real time. This also shows that the F322W2 observations have science/total efficiency of 0.46 and the F444W observations are 0.50 efficient.

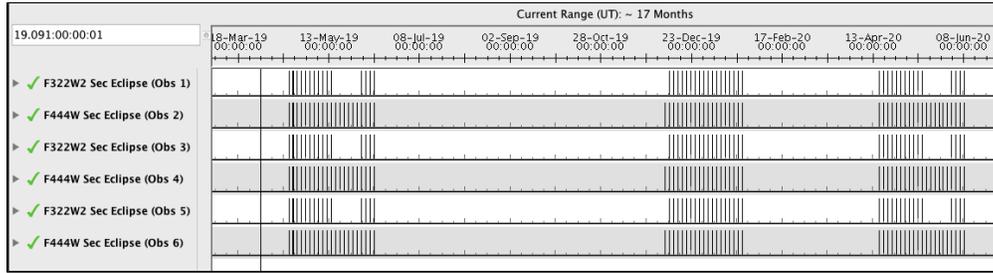
Data volume and schedulability

Main article: JWST Solid State Recorder

APT (v 25.4.2) shows that each F322W2 observation has a data volume of 22,665 MB and each F444W observation has a data volume of 24,725 MB. This is found at the visit level under the observations in the APT tree editor (see Figure 4 above). These data volumes do not violate any limits for these 3.3 hour observations.

Observation visibilities are shown in the [Visit Planner](#). Select that tab in the APT toolbar, then select at least one F322W2 and one F444W observation in the left panel. Click Update Display (at the bottom) to see the visibility plot, shown in Figure 6.

Figure 6. Visibilities of GJ 436 b secondary eclipse F322W2 and F444W grism time series observations



Visibility of GJ 436 b NIRCcam grism time series observations. Note that the F444W observations have more scheduling opportunities than the F322W2 observations. This is because the star is located at *different detector locations for each mode*, leading to different availability of guide stars.