

# Step-by-Step APT Guide for NIRISS WFSS and NIRCам Parallel Imaging of Galaxies in Lensing Clusters

## Example Science Program #33 APT Guide

Instructions are provided for filling out the JWST APT observing template for the [Galaxies in Lensing Clusters Example Science Program](#), where NIRISS WFSS is a prime observing mode and NIRCам Imaging is executed as a coordinated parallel observation.

## Introduction

*Main articles: [NIRISS Wide Field Slitless Spectroscopy](#), [NIRISS WFSS Template APT Guide](#), [JWST APT Coordinated Parallel Observations](#)*

*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 "Using NIRISS WFSS and NIRCам Imaging to Observe Galaxies Within Lensing Clusters" [Example Science Program](#).



A filled out APT file can be [downloaded here](#) for reference. The APT file was created with version 27.1. There may be inconsistencies or additional warnings or errors with other versions of APT.

## Fill Out Proposal information

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

After opening APT, we selected "New JWST Proposal" under the "New Document" pull-down menu. On the Proposal Information page, we entered **Title**, **Abstract**, and **Category** of the proposal and kept **Cycle** number at its default value. We updated **Scientific Category** to **Cosmology** and added the following **Science Keywords**: **Clusters of Galaxies**, **Cosmological Parameters and Distance Scale**, **Extragalactic Legacy and Deep Fields**, **Gravitational Lensing**, and **Reionization**. In **Alternate Category**, we entered **Galaxies and the IGM**.

Note that APT issues errors in the Proposal Information page since **Category** is set to GTO (which is reserved for GTO proposers whose programs should already be marked as approved in the proposal database) and a PDF

science justification is not uploaded. For the purposes of this tutorial, it is fine to ignore these warnings. However, for proposals submitted in response to the Call for Proposals, ensure the **Category** field is correctly set and that you upload a PDF of your science justification prior to submission.

## Enter Proposed Targets

*Main article: [APT Targets](#)*

**Target information** is entered by selecting **Targets** in the Tree Editor, which provides options in the Active GUI window. In our case, we chose the **New Fixed Target** button, entered **MACSJ0416.1-2403** in the field for **Name in the Proposal**, and selected **Clusters of Galaxies** for **Category**. We entered the coordinates for this source: **RA = 04 16 9.40, Dec = -24 04 04.00**. Near the **Description** field, we clicked the "+/-" button which opens a list of approved keywords and selected **Rich Clusters**.

## Observations

*Main articles: [APT Observations](#), [JWST APT Coordinated Parallel Observations](#)*

Selecting **Observations** in the Tree editor, we clicked on the **New Observation Folder**. In the **Label** field, we entered **MACSJ01416.1-2403 NIRISS WFSS Prime NIRCcam Imaging Parallel**. Note that while this label is not required, setting it is useful for visually organizing your observation folders when potentially many targets and/or instrument setups are used.

We clicked "Observation 1" in the Tree Editor to open the **observation template** to be filled out. In the **Prime Instrument** pull-down menu, we selected **NIRISS**, and then selected the **NIRISS Wide Field Slitless Spectroscopy template** in the **Template** pull-down menu. We checked the **Coordinated Parallel** checkbox and selected **NIRISS WFSS-NIRCcam Imaging** in the pull-down menu. In the **Target** pull-down menu, we selected the target we defined above, **MACSJ01416.1-2403**.

## Complete APT Observation Template for NIRISS WFSS

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

*See also: [NIRISS WFSS Dithers](#), [NIRISS WFSS Recommended Strategies](#)*

As discussed in the parent article and the [Step-by-Step ETC Guide](#), a set of observations will be taken through three filters: **F115W**, **F150W**, and **F200W**. Both the **GR150C and GR150R** grisms are used, with an 8-step dither pattern. In the NIRISS WFSS template, a direct image is automatically taken before and after each set of dithered grism exposures. An exposure sequence through a NIRISS filter is thus:

Direct Image → 8 × GR150C → Direct Image

Direct Image → 8 × GR150R → Direct Image

In the "Science Observation" window, we updated the number of **Dithers** in the pull-down menu to **8**, and kept **Pattern Size** at the default value of **Medium** (see [NIRISS WFSS Recommended Strategies](#) for a discussion about the trade-offs of different dither sizes and number of dither steps). We clicked the "Add" button to add an entry to the "Sequences" window. We selected **GR150C** in the **Grism** field and **F115W** in the **Filter** field and keep the default **Readout Pattern** of **NIS**. We entered **23** in the **Groups/Int** field and **1** in the **Integrations/Exp** field ("Sequence" #1). As discussed in the [Step-by-Step ETC Guide](#), these exposure specifications will provide the desired signal to noise ratio (SNR) for the WFSS observation.

Though an option exists in APT to select **BOTH** grisms when specifying parameters in the Science Observation window, this would result in a single sequence in which we would have to specify the NIRCcam setup in parallel. As the CANUCS program wishes to observe in two separate short-wavelength/long-wavelength pairs of NIRCcam filters for each NIRISS blocking filter, we must specify separate **GR150C** and **GR150R** exposure sequences.

Note that entering a grism exposure in the "Science Observation" window automatically adds a blank entry in the "Direct Image Exposure Parameters" window, where the filter will automatically match that of the WFSS exposure. In the "All Exposures Display" field, the order of exposures is listed. The entries of these fields cannot be edited directly. Instead, any updates made in the "Science Observation" field and "Direct Imaging Exposure Parameters" field are propagated to "All Exposures Display."

In the "Direct Image Exposure Parameters" field, we entered **13** in the **Groups/Int** field and **1** in the **Integrations/Exp** field ("Direct Images" #1). As shown in the [Step-by-Step ETC Guide](#), four coadded exposures from one NIRISS filter will produce the desired SNR for the imaging observation. The "All Exposures Display" shows the first exposure sequence in "Exposures" #1: Direct Image → 8 × GR150C → Direct Image.

To enter the exposure parameters for the **GR150R Grism** for the **F115W** filter, we highlighted "Sequences" 1 in the "Science Observation" window, clicked "Duplicate", and updated the **Grism** pull-down of this new entry to **GR150R**. The "Direct Images" window was automatically updated to have the same exposure specifications of the direct image of the duplicated exposure ("Direct Images" #2), requiring no additional edits. Exposure 2 in the "All Exposures Display" window shows the exposure sequence for this set of direct image and WFSS exposures.

We repeated this procedure for the **F150W** filter (Exposures #3 - 4) and **F200W** filter (Exposures #5 - 6), using the same exposure specifications for these filters (23 **Groups/Int** and 1 **Integrations/Exp**).

# Complete APT Template for Parallel NIRCcam Imaging Observation

*Main article: [NIRCcam Imaging](#), [NIRCcam Imaging APT Template](#)*

*See also: [JWST Parallel Observations](#), [NIRCcam Detector Readout Patterns](#)*

NIRCcam Imaging exposures will be observed in parallel with the WFSS observations as part of the CANUCS program. Since each WFSS observation consists of three exposure specifications (Direct Image → 8 × GR150 → Direct Image), the associated NIRCcam Imaging observation has to also be specified as three exposures. Since the primary instrument determines the total integration time per exposure, the exposure time for the NIRCcam observations (specified by [readout pattern](#), the number of groups and number of integrations) must not exceed that of the NIRISS exposure. APT will issue an error if the exposure time exceeds that of the prime exposure. For each WFSS observation, NIRCcam imaging observations are taken in the short wavelength channel and long wavelength channel.

To specify the exposure parameters for these parallel observations, we clicked on the "NIRCcam Imaging" tab. In the **Module** pull-down menu, we selected **ALL** and ensured that **FULL** is selected in the **Subarray** pull-down menu.

In this program, NIRCcam images are obtained for 12 filters, six in the short wavelength channel (**F090W**, **F115W**, **F150W**, **F182M**, **F210M**, **F140M**) and six in the long wavelength channel (**F277W**, **F250M**, **F300M**, **F335M**, **F360M**, **F410M**). The NIRCcam images taken in parallel with the NIRISS direct images are shorter exposures and use the **MEDIUM8 Readout Pattern**. The NIRCcam images taken in parallel with the NIRISS grism exposures are longer and use the **DEEP8 Readout Pattern** and follow the same dither pattern as the NIRISS grism exposures.

We clicked "Add" to add an entry to the observing template. We then selected **F090W** for the **Short Filter** and **F277W** for the **Long Filter**. Since this exposure will be observed simultaneously with the NIRISS direct image, we selected **MEDIUM8** for **Readout Pattern**, **5 Groups/Int**, and **1 Integrations/Exp** (Exposure #1).

We clicked "Duplicate" to add an entry that will be observed simultaneously as the set of WFSS dithered exposures. Since this exposure is longer, we selected **DEEP8** for **Readout Pattern**. Notice that the number of dithers is set to 8 by default, matching the dithering of the prime observing mode. This field can not be updated. We kept the number of groups set to 5 and number of integrations set to 1 (Exposure #2).

We clicked "Duplicate" to add an entry that corresponds to the direct image after the first set of dithered WFSS exposures. We updated the **Readout Pattern** to **MEDIUM8**, so that this entry matches the first entry in the NIRCcam sequence (Exposure #3). The set of three NIRCcam Imaging exposures that are to be observed in parallel to the first set of the NIRISS WFSS exposure sequence in the **F115W** filter (Direct Image → 8 × GR150C → Direct Image) are now fully specified in Exposures #1 - 3.

We repeated the procedures above to create a set of NIRCcam Imaging observations for the remaining sets of NIRISS WFSS observations, using the following NIRCcam filter combination in the short/long filters: **F115W/F250M** (Exposures #4-6), **F150W/F300M** (Exposures #7-9), **F182M/F335M** (Exposures #10-12), **F210M/F360M** (Exposures #13-15), and **F140M/F410M** (Exposures #16-18).

## Define Special Requirements

We defined an [APT Special Requirement](#) to restrict the position angle of the observation to avoid observing nearby bright stars which would adversely affect data quality.

## Run Visit Planner

To determine the visibility window of our proposed observation and ensure that guide stars can be found, we ran the [Visit Planner Tool](#), by clicking the **Visit Planner** icon in the Top Tool Bar. We then selected **Update Display** in the resulting Active GUI Window. The **Visit Planner** returned with a confirmation that the observation is schedulable (green check on the selected observation) and shows us the observing window(s) for this target over the next ~19 months.

## Run Smart Accounting

To minimize excessive overheads, we ran [Smart Accounting](#) from the Visit Planner page by selecting the **Run Smart Accounting** option. The charged time for the observing program, including exposure time and [overheads](#), is now accurately calculated.

## APT Warning

In addition to the APT issued errors about proposal category and science justification PDF [discussed above](#), APT issues a warning that the [data volume](#) for the JWST visit exceeds more than half of the maximum allowance. Since this program uses NIRISS WFSS and NIRCam Imaging in parallel, it is expected that the data volume for the program will be large. However, the visit does not exceed the data volume limit, and the observation can be scheduled as is.