

NIRCam Time Series Template APT Guide

Instructions for designing JWST [NIRCam Time Series](#) imaging observations using the Astronomer's Proposal Tool (APT).

Introduction

[Time-series](#) imaging is one of the five [NIRCam observing modes](#) and one of two [NIRCam time-series observing modes](#). Each mode has a corresponding template in [APT](#) for users to design their observing programs.

No telescope moves (dithering nor mosaics) are allowed during NIRCam time series observations.

Lists of allowed values for each input parameter are documented and maintained in the [NIRCam Time Series Imaging Template Parameters](#) article.

Step-by-step APT instructions

Generic

The following parameters are generic to all templates, and are not discussed in this article: [Observation Number](#), [Observation Label](#), [Observations Comments](#), [Target Name](#), [ETC Workbook Calculation ID](#), [Mosaic Properties](#), and [Special Requirements](#).

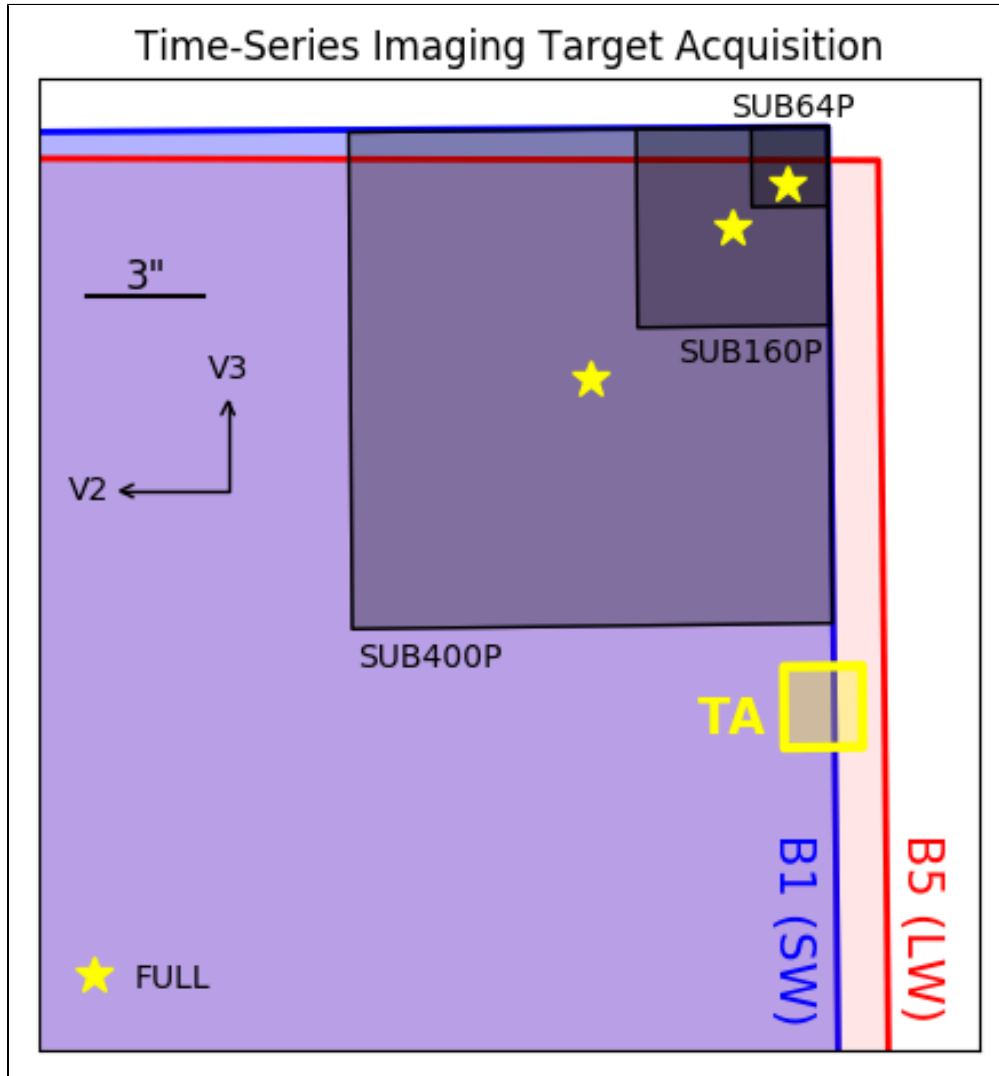
Note: mosaics are not available for NIRCam time-series imaging.

Target acquisition parameters

Target ACQ

Target acquisition may be performed either on the science target (SAME TARGET AS OBSERVATION) or any other target nearby (within 55"). Target acquisition occurs with a 32×32 pixel subarray on the long-wavelength channel of Module B located near the point source subarrays and uses the F335M filter.

Figure 1. Target acquisition location



Target acquisition is performed with a 32×32 pixel subarray (yellow square) on the long-wavelength detector B5. The target acquisition pointing is centered in the TA subarray, followed by a telescope slew to one of the yellow stars for the science exposures, collecting data within the subarrays shown or the FULL array. For simplicity, only the SW subarrays are shown here. Locations of the LW subarrays are shown below in Figure 2.

Acq exposure time

i Please consult the [Exposure Time Calculator \(ETC\)](#). We recommend a signal-to-noise ratio of 30 or higher to obtain a centroid accuracy of 0.1 pixel for the TA source. We also recommend not saturating any pixels.

ACQ READOUT PATTERN: The [NIRCam detectors](#) are read out continuously using [readout patterns](#). Patterns with longer exposure times typically average more frames to reduce data volume (less of a concern for subarrays).

ACQ GROUPS/INT: The number of groups to include during an integration. Each group results in a saved image, perhaps averaged from multiple frames (reads).

Only one integration per exposure is permitted. Thus the exposure time and integration time are equal.

Time series parameters

Module

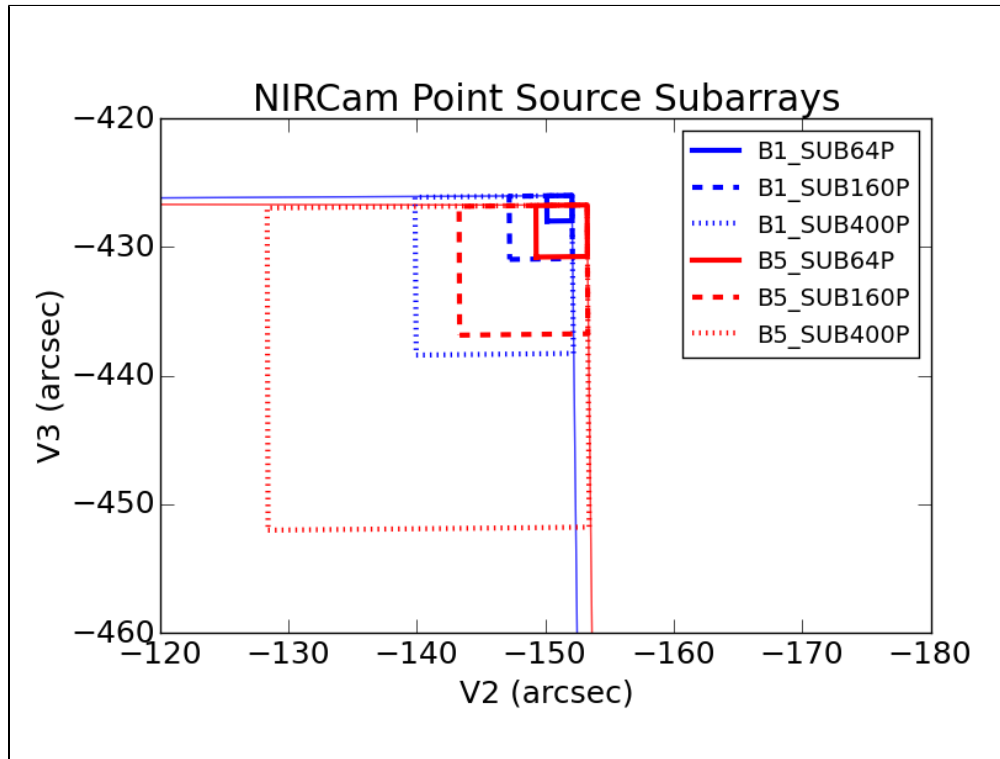
[Module B](#) is used for this observing mode.

Subarray

Users may opt to either [read out](#) two detectors completely or more quickly read out two [detector subarrays](#), one in each wavelength channel. Smaller subarrays allow for brighter saturation limits in each integration. NIRCam's point source subarrays are available in this observing mode. The subarrays are read out through a single detector output; the full detector is read out through four outputs simultaneously.

| Time series subarray | Size in pixels $N_{\text{rows}} \times N_{\text{columns}}$ | Short wavelength FOV (each side) | Long wavelength FOV (each side) | Frame time (s) | Number of outputs |
|----------------------|---|----------------------------------|---------------------------------|----------------|-------------------|
| <i>FULL</i> | 2048 × 2048 | 132" (with 4"-5" gaps) | 129" | 10.73677 | 4 |
| <i>SUB400P</i> | 400 × 400 | 12.7" | 25.9" | 1.65624 | 1 |
| <i>SUB160P</i> | 160 × 160 | 5.1" | 10.4" | 0.27864 | 1 |
| <i>SUB64P</i> | 64 × 64 | 2.0" | 4.1" | 0.05016 | 1 |

Figure 2. NIRCam point source subarrays



Subarrays available for NIRCam time series imaging, plotted in the NIRCam field of view, zooming in on the corners of detectors B1 and B5. Blue and red correspond to the short and long wavelength channels, respectively. By selecting a subarray size, the user is choosing two subarrays, one in each wavelength channel. The science target is always centered within the short wavelength subarray.

Number of exposures

Multiple exposures may be performed in sequence to increase the total exposure time. Each exposure is executed as defined in the remaining sections below.

i In APT, this section is named "Exposures/Dith" (Exposures per Dither) for consistency with other observing modes, even though no dithering is allowed in this mode.

Short wavelength

In this APT template, users select both [pupil and filter wheel](#) elements. Light passes through both elements in series in each wavelength channel. Only certain combinations of these elements are allowed in APT.

In addition to broad, medium, and narrowband [filters](#), the [NIRCam weak lens WLP8](#) is available in this observing mode in the short wavelength channel. The weak lens defocuses incoming light, mitigating uncertainties (jitter and flat fields) and allowing for observations of brighter objects before saturation in a given integration time.

Long wavelength

The [pupil and filter wheel](#) elements allowed in the long-wavelength channel are restricted based on those selected in the short-wavelength channel. For example, if the weak lens is selected in the short wavelength channel, then the long-wavelength observations must include a **narrowband** filter as well. These restrictions guide users to select elements with similar saturation limits in both wavelength channels, since exposures are obtained simultaneously in both.

Exposure time

Each exposure is defined as a [readout pattern](#), number of groups per integration, and number of integrations per exposure. The resulting Total Exposure Time is reported. This readout configuration applies to both wavelength channels (short and long).

Users should consult the [Exposure Time Calculator, ETC](#), to achieve sufficient signal-to-noise for their science without saturating during each integration. Approximate saturation limits may be found at [NIRCam Time-Series Imaging](#).

Each group yields saved data. Each integration accumulates charge for its duration, preceded and followed by detector resets. Shorter integrations may prevent saturation. Saturated sources may be recovered (unsaturated) in earlier groups during the integration.

Each exposure is performed without moving the telescope nor any mechanisms, with one exception. Exposures of more than 10,000 s are permitted in this observing mode, but users are warned that the High Gain Antenna may need to move during a longer exposure. That movement may introduce jitter and affect data quality.