Observation Specifications

Observation Specifications are part of all JWST observation templates. The Astronomer's Proposal Tool (APT) is used to fill out the template and schedule Observations.

Introduction

The *Observation Specifications* are used to define the proposed sequence of events that will execute on JWST to obtain the desired data. Before proceeding further, it is useful to define more carefully what is meant by a **template**, a **group**, a **readout pattern**, an **integration**, an **exposure**, a **visit**, and an **observation**.

Template   - Unlike HST proposals, where individual exposures are defined, JWST proposals are similar to Spitzer proposals, where individual observations are defined. An Observation Template is completed which provides the necessary information for the internal scheduling software to generate the observing sequence (integrations, exposures, and visits) to execute on the telescope. The templates are selected based on an observing strategy (e.g. MIRI imaging, MIRI low resolution spectroscopy) required for your observations (note that there are a limited number of coordinated parallel template pairings available).

Group – This is a set of non-destructive read samples (also often called "frames") that is grouped together for co-adding by the detector readout electronics. A group is the smallest collection of data within an exposure that is saved as an entity onto the data recorder.

Readout Pattern – This defines the way individual read samples (or frames) are co-added into a group (see above). It sets the number of samples to be co-added and the number of samples to be skipped (or ignored) within a group.

Integration – This is a single set of groups. An integration (sometimes called a ramp) is bounded by destructive readouts of the detector.

Exposure – This is a set of one or more integrations. The proposer will specify a set of parameters (readout pattern, number of groups, and number of integrations) which will result in the total exposure duration.

Visit – This is a set of exposures (with overheads) obtained on the same Guide Star without scheduled interruption. A Visit consists of the following parts:

- Slew to the guide star acquisition attitude
- Guide star acquisition (to point JWST at the target)
- Target acquisition (to place the target in an instrument aperture, if necessary)
- Science exposure(s) (to obtain the data)
- Instrument overheads (to set up the instrument and read out the data)
- Instrument calibrations (if more than the standard calibration is required)

There are several situations that limit the amount of science that can be done in a single Visit:

- When the total pointing change is large enough that it is no longer feasible to use a single guide star for all exposures. For moving targets, this distance is 38". For fixed targets, see Table 1. When *PCS MODE COARSE* is used, the distance for all objects will be 180". If a visit is forced to contain a position that is greater than the splitting distance, such as a Target Acquisition position, then an error will be generated. This visit can not be executed as it is.

- When the total duration of the Visit exceeds a maximum of 24 hours; but Time Series Observations can be longer. This limit is imposed for efficiency (because very long visits are hard to schedule efficiently) and to preserve flexibility to insert engineering Visits where needed.

- If different instrument templates are used, separate Visits and Observations will be necessary (see below).

Table 1. Pointing Change Requiring a New Visit for Fixed Targets

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"

Observation – This is a set of one or more visits to be obtained of one astronomical field that can in principle be made at the same time. However, since a visit is the scheduling unit, there is no guarantee that all visits will execute together. For long observations, it may be necessary to break for observatory maintenance or other reasons imposed by the scheduling system. Observations are independent of each other unless specifically linked by the observer. Any special requirements (e.g. *APERTURE PA*) placed on an Observation will apply to all Visits in that Observation.

Note that not all of the fields described below are available for all instrument templates.

The following policies and constraints apply to Observations:

- The estimated spacecraft time for an Observation will include a statistical estimate based on the **average** time to slew to the attitude of the first Visit from an unknown attitude (30 minutes; this number is documented in the Project Reference Database). This is referred to as a *major slew.*   If the Observation contains multiple Visits, each Visit after the first will incur additional slew time. The time for these *minor slews* – from the pointing of the previous Visit to the current Visit – is a function of the distance between the visits.

    Note that observations which are determined to be candidates to be scheduled back to back, will

generally incur the minor slew rather than the major slew. This analysis is part of what is included in " Smart Accounting".

- Observations are designed for a single astronomical field that allows back-to-back Visit scheduling. There is no hard limit on the total pointing change within an Observation, but there are practical limits imposed to limit the complexity of managing Observations and to preserve flexibility in planning and scheduling.

  All Visits within an Observation are implicitly *SAME APERTURE PA*. Executing each Visit at the same position angle ensures they can be scheduled at the same time, consistent with the assumptions used for slew time estimates. *SAME APERTURE PA* also facilitates creation of a uniform mosaic.

  Visits within a multi-visit Observation are implicitly *GROUP VISITS WITHIN 53 DAYS*. This is interpreted in the same manner as *GROUP OBSERVATIONS WITHIN* across observations : the last Visit to be scheduled will *start* within 53 days of the start of the first. This restriction forces the Visits into the same target visibility window. Except near the ecliptic, the span of the observation is limited by the *SAME APERTURE PA* constraint (to a minimum of ~10 days at the ecliptic poles).

  If it is necessary to further restrict the total duration of an observation, a *GROUP VISITS WITHIN <duration>* Special Requirement may be placed on the Observation. The specified *<duration>* may not exceed 53 days.

- The total duration of an Observation is subject to limitations in order to preserve scheduling flexibility .

  By default, STScI may interrupt an (multi-visit) Observation to insert other science or engineering Visits. If it is important for an Observation to be executed without interruption, a *GROUP or SEQUENCE NON-INTERRUPTIBLE* Special Requirement should be placed on the Observation. Because long non-interruptible observations create the same scheduling problems as long Visits, the total duration of a non-interruptible observation may not exceed 24 hours .

Observation Folder - Observation Folders allow you to keep related Observations in one place. You can organize and even label your multi-observation science program in ways that are helpful to you and your Co-Is, such as by target, instrument, or science mode (e.g. coronagraphy sequence). For more on Folders, see APT Observations.

These folders are for convenience, and in general do not imply any scheduling constraints or data reduction implications. Note that the structure and folder labels are not passed to TAC's view of the proposal, nor to the archive after execution. However, in the case of a mosaic that must be split into separate Observations, APT will create an Observation Folder to keep the primary mosaic associated with an individual tile or tiles that have been split off. In this case the Observation Folder does imply an association to the data reduction pipeline.

There are 2 option fields associated with Observation Folders:

Observation Folder Label

You can assign a label to each Observation Folder. This allows you to call each Observation Folder by a name that has some scientific meaning. For example, if an Observation Folder is to perform coronagraphy of Beta Pic, you could label the Observation Folder "Beta Pic Coron".

Observation Folder Comments

The comments field should be used to record observing notes to yourself and your Co-Is. It should generally not be used to specify scheduling requirements because comments are not interpreted by the software. An example of an *Observation Folder Comments* is:

- Epoch 2 observations of Target X

Observation Number

You must assign each Observation a unique observation number ranging from 1-999.

Duplication

This keyword should be selected when the observation duplicates, or might be perceived to duplicate, previous or upcoming GO and/or GTO exposures; see JWST Duplication Checking for more details.

Observation Label

You can assign a label to each Observation. This allows you to call each Observation by a name that has more meaning than just the observation number.

For example, if an Observation is to mosaic M57, you could label the Observation "Ring Nebula".

Science Instrument

Select the desired science instrument (MIRI, NIRCam, NIRSpec, or NIRISS).

Instrument Mode Templates

Each instrument has several different modes each of which requires different parameters organized into templates. Select the Instrument Mode Template for MIRI , NIRCam , NIRSpec, or NIRISS. There are Engineering (Limited Access Parameter) Mode templates for MIRI , NIRCam , NIRSpec, NIRISS, FGS, Wavefront Sensing and Control, Realtime Commanding, and ISIM Engineering.

Target Name

Choose a target from the Target List you previously entered. In the case of certain internal and external calibration sources, a special code must be used (see Special Target Names).

Coordinated Parallel

If the observation is to have a coordinated parallel observation , select this option.

Astronomical Targets

The target name should be selected from the Target List (see Fixed Targets, Solar System Targets, or Generic Targets). The **Name in the Proposal** is used only in the proposal, while the **Name for the Archive** is used for the archive.

Special Targets

If a calibration observation is requested, one of the specific "target" names in Table 2 must be chosen. The calibration source should **not** be inserted in the Target List; these sources will be available by default.

 Table 2. Special Target Names

Name	Purpose
PARALLEL (External)	for pure parallel observations. The target will be wherever the parallel aperture happens to point.
SK-TARGET (Internal)	for station keeping observations.
NONE (Internal)	for spacecraft mode observations

Specific astronomical objects used as external calibrators (e.g., standard stars) should be inserted in the Target List as normal targets.

ETC Wkbk. Calc ID

You can include the name of the ETC Workbook Calculation ID for each target acquisition and science exposure. This field is optional for science exposures, but you will get a warning if you do not populate it for target acquisition exposures. The format is: Your ETC workbook number followed by a decimal point, then the Calculation ID. Example: 1234.9.

Special Requirements for Scheduling JWST Observations

A variety of Observation-level Special Requirements may be chosen; these requirements apply to all Visits in the Observation. These requirements will be interpreted by the software that is used to schedule the observations. If none of the allowed Special Requirements appears to be sufficient, you can describe the requirements with a text explanation in *Observation Comments* . **You should contact the JWST Help Desk at jwsthelp.stsci.edu prior to entering such a comment in your proposal.**

Several of these Special Requirements require the use of limited resources or may impose serious constraints on the scheduling system (e.g., *APERTURE POSITION ANGLE* , *AFTER OBS BY* , *BETWEEN*). Use these Special Requirements with care.

The observation-level Special Requirements are of 4 types:

- General Special Requirements
- Timing Special Requirements
- Aperture Position Angle Special Requirements
- Solar System Special Requirements

On Hold Comments

If you have requested, via the Special Requirement *ON HOLD* , that a given Observation be placed "on hold" (which means that the Observation will not be scheduled until **you** have cleared the hold), then indicate why the Observation is on hold, and how the hold is to be released. Examples of *On Hold Comments* are:

- Waiting for Early Acquisition data from Observation <number>
- Waiting for non-JWST data [to be obtained <date>]
- Waiting for Position Angle assignment for NIRSpec MSA observations
- Conditional if <text>
- Conditional on <observation-list> if <text>
- Select <number> of <observation-list>

Mosaics

Some observations with JWST will be obtained as mosaics of large objects; see Table 3 and Table 4 to determine if a science or engineering template supports mosaicking.   Choose the mosaic pattern to be used.

Table 3. Mosaic Support for Science Templates

Science Template	Mosaic supported
MIRI Imaging	Yes
MIRI Low Resolution Spectroscopy	Yes
MIRI Medium Resolution Spectroscopy	Yes
MIRI Coronagraphic Imaging	No
NIRCam Imaging	Yes
NIRCam Coronagraphic Imaging	No
NIRCam Time Series	No
NIRCam GRISM Time Series	No
NIRCam GRISM Spectroscopy	Yes
NIRSpec Multi-Object Spectroscopy	No
NIRSpec Fixed Slit Spectroscopy	Yes
NIRSpec Integral Field Unit Spectroscopy	Yes
NIRSpec Bright Object Time Series	No
NIRISS Imaging	Yes
NIRISS Wide Field Slitless Spectroscopy	Yes
NIRISS Single Object Slitless Spectroscopy	No
NIRISS Aperture Masking Interferometry	No

Table 4. Engineering Templates that Support Mosaics

Engineering Template	Mosaic Supported
MIRI Imager Flat	Yes
MIRI MRS Flat	Yes
MIRI MIMF	Yes
MIRI Coronagraphic Photometric Calibration	Yes
MIRI MRS Cross-Grating Engineering	Yes
NIRCam External Flat	Yes
NIRCam Engineering	Yes
NIRSpec Imaging	Yes
NIRISS Internal Flat	Yes
NIRISS External Calibration	Yes
FGS External Calibration	Yes (Imaging only)

Observation Comments

The comments field should be used only to record observing notes; it should generally not be used to specify scheduling requirements. Comments are not interpreted by the software, but are maintained in the database and do appear on printouts of the proposals. An example of an *Observation Comments* is:

- Mid-IR observation of Target X

Maximum Exposure/Visit Duration

In most cases, the exposure parameters (such as **NUMBER OF GROUPS/INTEGRATION** and **NUMBER OF INTEGRATIONS/EXPOSURE**) do not have their own individual limits; see the individual template articles for details when there are restrictions. However, APT will enforce the total duration of each exposure (photon collecting time plus exposure readout overheads) against the maximum time allowed between required High Gain Antenna (HGA) repositioning. Since an HGA move may induce jitter that can affect science quality, an error is generated in most cases. There is also a maximum duration for the visit which is also enforced by APT.

There is an exception for the time series templates (those with the TIME SERIES OBSERVATION special requirement). Instead of an error APT will generate a warning about the possibility of a High Gain Antenna move which the user can ignore if they feel there observations will not be impacted by such a move.

Maximum Number of Dithers

Although it is quite high, there is a maximum number of dither points allowed per visit which APT will enforce.

Change log

Version 10 (April 16, 2019)

1. Editorial change (moved change log to main article)

Version 9 (October 2, 2018)

1. PR 89731 - Added explanation of parameter format to ETC Wkbk.CalcID section.

Version 8 (February 8, 2018)

1. Added Coordinated Parallel parameter.

Version 7 (November 24, 2017)

1. PR 87895 - updated Exposure field labels to Groups/Integration and Integrations/Exposure
2. PR 86461, PR 87906 - noted limit on time series observations
3. PR 88984 - noted limit on number of dither points
4. PR 86725 - added Duplication flag
5. PR 89343 - updated moving target visit splitting distance
6. PR 85692 - added ETC ID field for science exposures

Version 6 (March 30, 2017)

1. Removed/updated several TBD/TBR notes per meeting with Matt Lewis.
2. Revised description of integrations, groups, etc. based on feedback from Paul Goudfrooij.
3. Added On Hold example for NIRSpec MSA observations.

Version 5 (September 12, 2016)

PR 85563 - added definition of Observation Folder to the Introduction

Version 4 (August 23, 2016)

PR 85188 - updated restriction on pointing change (Visit definition, first bullet under amount of science time in a visit)

Version 3 (June 29, 2016)

Editorial - removed SEQ VISITS notes from Observation bullet 5

Editorial - revised special requirement name for NON-INTERRUPTIBLE in Observation bullet 7

Version 2 (May 30, 2016)

PR 81679 - replaced "program" with "proposal"

Version 1 (March 21, 2016)

This is the converted Word File from Chapter 5.

Related links

None.

Keywords

JWST Observation Specifications

JWST Template

JWST Integration

JWST Exposure

JWST Visit

JWST Observation

JWST Observation Number

JWST Observation Label

JWST Observation Comments

JWST Maximum Exposure Duration

Format definitions

Boldface italics type indicates the name of an APT parameter or a value for a parameter.

Purple text indicates the parameter is Limited Access .

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