MIRI Low Resolution Spectroscopy Template APT Guide

This page contains instructions for filling out the APT MIRI LRS template, including both slit and slitless (time series observations; TSO) spectroscopy.

Introduction

Low-Resolution Spectroscopy is one of four observing templates available with the the Mid-Infrared Instrument (MIRI). MIRI's low-resolution spectrometer (LRS) offers both slit and slitless spectroscopy from 5 to 12 µm using a double prism mounted in the MIRI filter wheel, designed to provide a spectral resolving power of R = 40 at 5 µm, and R = 160 at 10 µm for compact sources (<2"). The slitless LRS mode is dedicated to time series observations of time variable systems, such as eclipsing binaries or transiting exoplanets. The APT parameters for slitless LRS are optimised for this type of observation.

The APT template requires information on the following aspects of the observation:

1. Target Acquisition
2. Subarray (which controls whether the observation will be slitless or with slit)
3. Dither or mapping pattern
4. Detector read mode and exposure settings
5. Mosaic settings

Allowed values are documented and maintained in the MIRI LRS Template parameters, but described below.

Step-by-step APT instructions

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Target acquisition parameters

Target acquisition is required for LRS slit and slitless observations. This field specifies the ***ACQ TARGET***, ***ACQ FILTER***, and ***ACQ EXPOSURE TIME***.

Target ACQ

The target to be used for TA should be selected ***ACQ TARGET*** from the pull down menu, which contains a list of targets defined in the proposal. The filter to be used to TA can be selected from the ***ACQ FILTER*** drop-down list include: ***F560W***, ***F1000W***, ***F1500W***, and ***FND***.

ACQ exposure time

A Target ACQ must be completed by selecting a MULTIACCUM exposure configuration. Each exposure is configured by setting the readout pattern and characteristics parameters: ***ACQ READOUT PATTERN*** and ***ACQ GROUPS/INT***.

> **Users should use the Exposure Time Calculator (ETC) to *determine the best exposure configuration to optimize the signal-to-noise.***

ACQ READOUT PATTERN

1. ***FAST*** (default)
2. ***FASTGRPAVG***

NUMBER OF GROUPS AND INTEGRATIONS

The MIRI readout timing pattern in the ACQ exposure is defined by only one of the MULTIACCUM parameters:

1. ***ACQ GROUPS/INT*****:** the number of groups per integration.

ACQ INTEGRATIONS/EXP, ACQ TOTAL INTEGRATIONS and ***ACQ TOTAL EXPOSURE TIME*** are not user changeable; MIRI TA is always carried out in a single integration and exposure.

The TA saturation limit for each filter depends on the choice of subarray, which also determines which subarray will be used for TA. The user should always refer to the ETC for signal-to-noise calculations.

LRS parameters

Subarray

The MIRI LRS supports both slit and slitless mode, each of which presents its own scientific merit. The slitless LRS mode uses a dedicated detector subarray called SLITLESSPRISM. The ***SUBARRAY*** choice therefore implicitly controls whether the observation will use the slit, or be slitless. Note that slitless observations are by default time-series observations (TSO). Low-resolution spectroscopy using the slit use FULL frame readout, for slitless spectroscopy, the user should select SLITLESSPRISM.

Dither

If you have chosen the SLITLESSPRISM subarray for slitless spectroscopy (a time series observation), dithers are not permitted.

If you have chosen slit spectroscopy, the ***DITHER TYPE*** drop-down menu specifies what dither pattern should be used. The ***ALONG SLIT NOD***, particularly suitable for point or point-like sources, moves the targets between two positions along the slit. It allows for mitigation of bad pixels and provides a measurement of the background.

The ***MAPPING*** option can be used to define a small pointing grid, which is more suitable for extended targets. For LRS slit observations, the user must select one of these 2 options. When choosing the MAPPING options, the user should enter the number of steps required in the spatial and spectral directions, and the respective sizes of the offsets in each (in units of arcseconds). The number of steps must be greater than 0.

Exposure time

Users should use the Exposure Time Calculator (ETC) to determine the best exposure configuration to optimize the signal-to-noise.

A LRS sequence must be completed by selecting a MULTIACCUM exposure configuration in the ***LRS PARAMETERS*** dialog box. Each exposure is configured by setting the readout pattern and characteristics parameters: ***READOUT PATTERN***, ***GROUPS/INT***, ***INTEGRATIONS/EXP*** and ***EXPOSURES/DITH***. Note: For the ***POINT SOURCE*** dither, ***NO. OF EXPOSURES*** refers to the number of repeats for the two point nod. Three greyed-out boxes will show calculated parameters based on the exposure dither setting entered; these fields are not editable by the user.

READOUT PATTERN

For LRS slitless, only the FAST mode readout pattern is available. For LRS slit operation, the following options can be selected:

1. FAST (default)
2. SLOW

NUMBER OF GROUPS AND INTEGRATIONS

The MIRI timing pattern per exposure is defined by three MULTIACCUM parameters:

1. ***GROUPS/INT***: the number of groups during an integration ;
2. ***INTEGRATIONS/EXP***: the number of integrations during an exposure, where integration is defined as the time between resets;
3. ***EXPOSURES/DITH***: the number of exposures per dither position.

TOTAL DITHERS (not user-editable)

This field returns the total number of dither steps for the observations. For ***ALONG SLIT NOD*** dithering, the box will show a value of 2. For ***MAPPING*** observations, the total number of dithers will be the product of ***NO. OF SPATIAL STEPS*** and ***NO. OF SPECTRAL STEPS***.

TOTAL INTEGRATIONS (not user-editable)

This field shows the total number of integrations for the observation, taking into account the dither and exposure settings. The formula used is: ***TOTAL INTEGRATIONS*** = ***TOTAL DITHERS*** x ***INTEGRATIONS/EXP*** x ***EXPOSURES/DITH.***

TOTAL EXPOSURE TIME (not user-editable)

This field returns the total exposure time calculated from the dither and exposure settings. The formula used is: ***TOTAL EXPOSURE TIME*** = ***GROUPS/INT*** x ***TOTAL INTEGRATIONS*** x group read time. The group read times for FULL and SLITLESSPRISM array configurations is documented in the MIRI Detector Subarrays article for each subarray. The time is given in seconds.

Other Tabs

Mosaic properties

The MIRI LRS may be used to obtain data for a region larger than their size by creating a MIRI LRS mosaic pattern . Use of the mosaic pattern is not recommended when using the LRS in slitless mode.

Special requirements

A variety of observatory level special requirements may be chosen. When using the LRS in slitless mode, i.e. the user selects the SLITLESSPRISM subarray configuration, the Time Series Observation and No-Parallels special requirements will be selected by default. The Time Series Observation special requirement cannot be selected for LRS slit observations.

Comments

The comments field should be used only to record observing notes.