MIRI LRS Slitless Target Acquisition

The JWST MIRI low resolution spectrometer (LRS) mode requires target acquisition (TA) when operated in slitless mode for time-series spectroscopy. A dedicated TA procedure has been defined for the mode.

Introduction

Parent pages: MIRI Operations → MIRI Target Acquisitions

The MIRI LRS is used in slitless mode exclusively for time-series observations (TSOs). Such high precision spectro-photometric observations place specific demands on the instruments to achieve the highest precision; precise placement of the target to its nominal pointing position and precise repeatability of this placement are critical to account for any inter- or intra-pixel response variations. As for LRS in slit mode, the wavelength calibration also requires accurate knowledge of the source position.

Target acquisition (TA) is mandatory for slitless LRS observations.

⚠ The Exposure Time Calculator should always be used to determine the optimal filter choice and exposure settings for target acquisition. Dedicated documentation pages are available describing how to perform TA calculations in the ETC for MIRI.

TA target

Typically the science target is used for TA. However, the procedure can also be carried out with a nearby bright star, which should be within 60" from the science target. Use of an offset target may be desirable if the science target is not a point source, or if the TA exposure would add an unacceptably long overhead to the observation.

TA filters

Main article: MIRI Filters and Dispersers

As in other MIRI modes, LRS slitless has four filters available for TA:

- F560W
- F1000W
- F1500W

- FND (a neutral density filter)

TA exposures

TA exposure settings should be calculated using the ETC. The exposure should be carried out in a single integration, with a limit of approximately 1,000 s to avoid too many cosmic ray hits. The maximum number of groups in a TA integration is 99. If sufficient SNR cannot be reached on the science target in this time (SNR > 20 is recommended), use of an offset target should be considered. The minimum number of groups in an integration for TA is three.

TA will typically be performed with the ***FAST*** [1] readout mode. However, the ***FASTGRPAVG*** readout mode is also available to achieve longer integration times within the 99 group limit. In ***FASTGRPAVG***, each group represents the average of four reads.

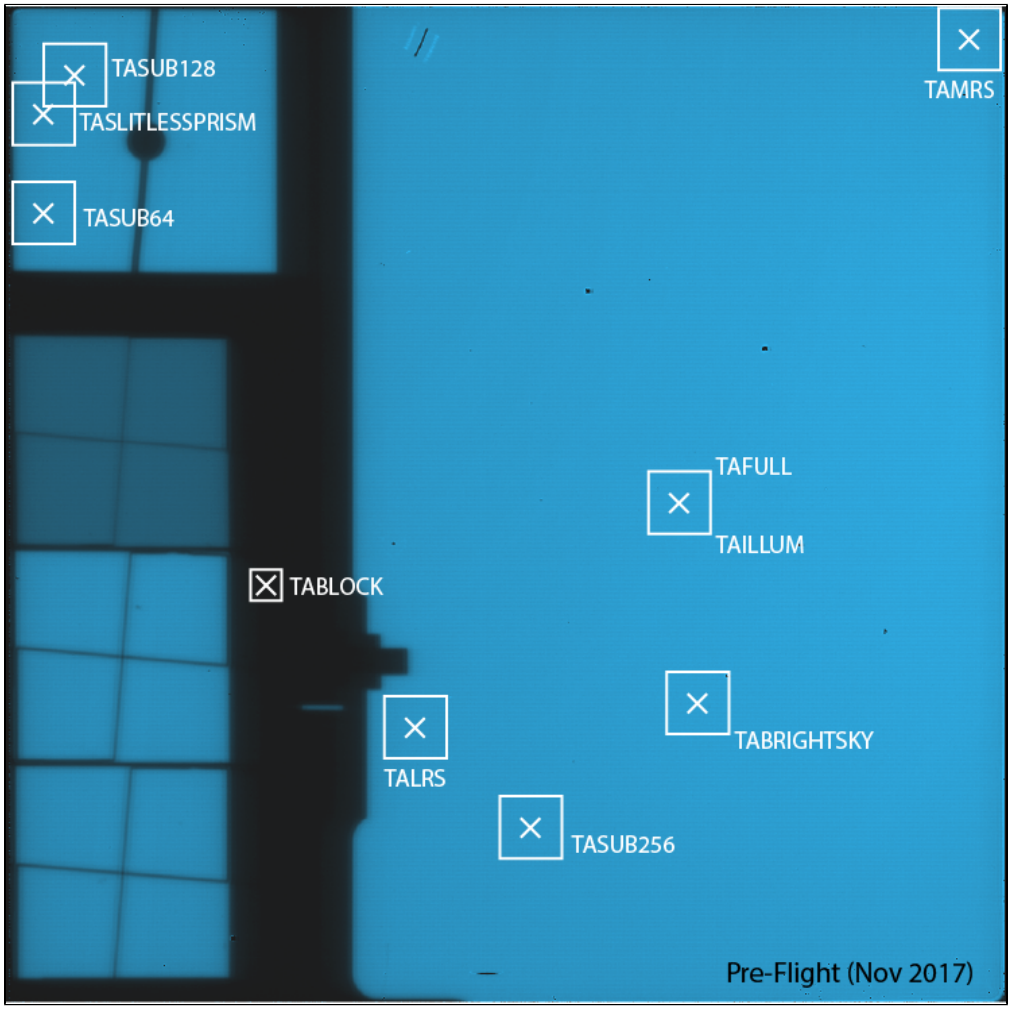
[1] ***Bold italics*** font style is used to indicate parameters, parameter values, and/or special requirements that are set in the APT GUI.

LRS slitless subarray and region of interest (ROI)

See also: MIRI Detector Readout Fast, MIRI Optics and Focal Plane

The MIRI LRS uses the ***SLITLESSPRISM*** subarray for its slitless time-series observations, to increase the dynamic range of the mode and allow observations of brighter targets. The frame read time in ***FAST*** mode is 0.16 s, compared to 2.77 s for a ***FULL*** frame read. To avoid switching between ***FULL*** and ***SLITLESSPRISM*** array configurations on short timescales, which can cause undesirable detector artifacts, the TA region of interest (ROI) defined for LRS slitless TA is part of the ***SLITLESSPRISM*** subarray itself, occupying 64 × 64 pixels of the subarray (~7 × 7") and positioned such that overlap with the science spectrum is minimal. The location of the TA ROI is shown in Figure 1.

Figure 1. MIRI field of view showing LRS slitless target acquisition region of interest



The box labeled "TASLITLESSPRISM" in the imager region is where the LRS slitless target acquisition 64 × 64 pixel region of interest (ROI) is located. The reference point is taken to be the midpoint of this ROI.

TA sequence

See also: MIRI Filters and Dispersers

Before the TA sequence is begun, the target is placed behind the focal plane metering structure, to avoid saturation. The filter wheel then moves to the TA filter, specified by the user in the APT proposal template. Once the filter has been acquired, the target is moved into the ***SLITLESSPRISM*** subarray, and placed in the ROI defined for target acquisition. An exposure is taken with the user-specified exposure setup, the centroiding algorithm calculates the precise location of the target, and the offset to the pointing location for the science exposure is computed.

The telescope then performs a small angle maneuver (SAM) to place the target at the nominal pointing position, ready for science. Before performing the filter wheel move to acquire the double prism disperser, a second exposure is taken with the same setup parameters as the TA exposure, to allow the user to verify the target positioning during data analysis. Following this exposure, the filter wheel will be moved to the double prism location, and the science exposure will begin.

Both the TA image and the verification image will be available to the observer.