ESAC 2017 JWST Workshop

Spectroscopic-Imaging of PDRs: *JWST* observations of the Pillars of Creation.

Javier R. Goicoechea, Macarena Garcia Marin, Nora Luetzgendorf, Sarah Kendrew

Science Case 1.4

Overview

Goal: To spatially resolve the structure of a HII/PDR/Cloud interface in many atomic, molecular, PAH and dust features.

Methodology: Integral Field Spectroscopy of an extended and bright Photo Dissociation Region. The rich MIR spectra will uncover a wealth of emission lines, dust features and warm dust continuum that will be used to diagnose UV flux and physical conditions. MIR imaging in a few selected PAH and warm dust emission filters will provide information to understand the environment.

Planned observations: MIRI MRS in all spectral bands and MIRI imaging in three filters

Source type: Extended

Analysis technique: Spectral analysis and modeling, photometry of extended sources.

ESASky

Use ESA Sky to find the source of interest, and display the JWST instruments footprint on it. Here are the target coordinates:

Coords: 18:18:52.425, -13:49:17.93

Identify the science aperture for the MIRI Imager and MRS. Note that if they are used simultaneously the imager cover the field next to the MRS.

ESA Sky can be also used to download already reduced files of the target of from all ESA missions.

Target Visibility Tool

Targets:

MIRI imager center:

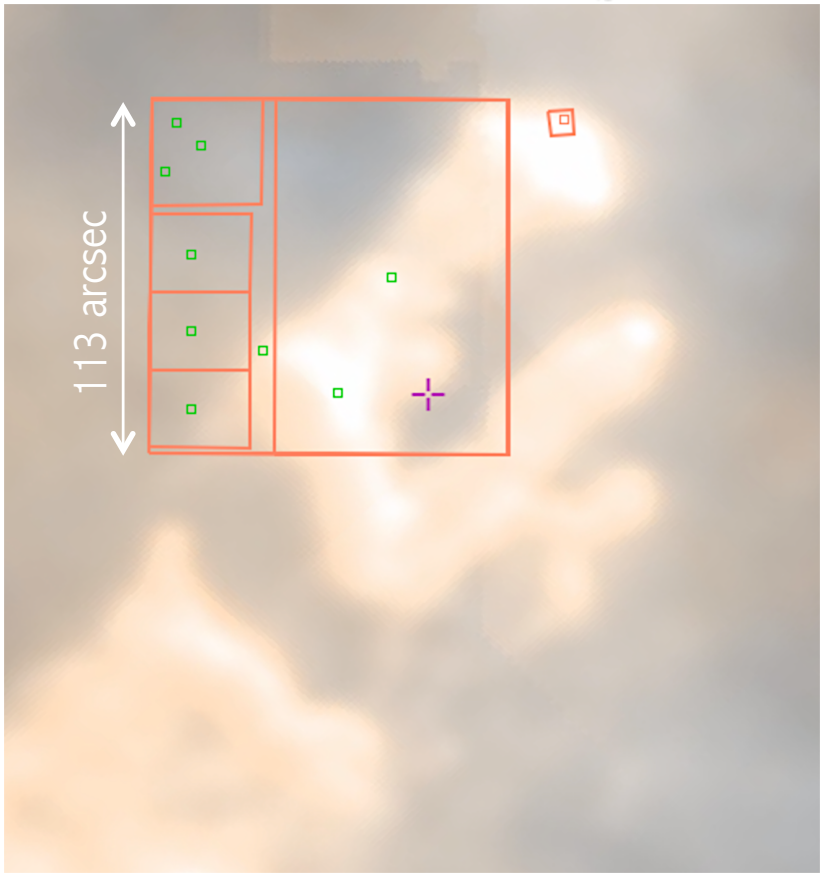
EQ.J2000 (18:18:52.425, -13:49:17.93)

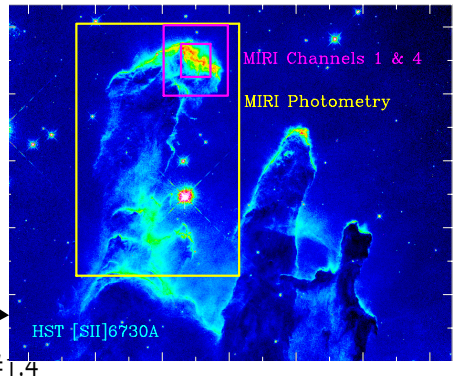
MIRI IFU center:

EQ.J2000 (18:18:49.885, -13:48:54.89)

Run the target visibility tool to find out when this target is visible and which orients will be available.

Use that information to check in ESA sky, or later in Aladdin/APT, how the MIRI footprints map the cloud **for the allowed orients.** Is that consistent with the approximate ideal orientation displayed in this insert? →





Instrument Configuration

MIRI MRS

Use ALL spectral bands. Allow simultaneous use of the imager; choose a detector array that will not saturate using the F560W filter.

MIRI Imager:

Use filters F770W, F1130W and F2550W with an adequate detector array so there is not saturation.

Exposure Time Calculator

Sources and scenes:

Create a new source and load the provided spectrum (file pillars_etc_kendrew.txt, taken from Urquhart et al. 2003, A&A, 409, 193) on the ETC. Original spectra is from ISO using a 6”x6” pixel FOV. The file has two columns: (1)microns (2)mJy.

Choose “do not renormalize”. Shape is a flat extended source, with semi-minor and – major axis of 3.38” (to preserve the defined pixel size).

Create a scene with that source, place in the center of the FOV.

Exposure Time Calculator

Calculations:

MRS: Set up different calculations for channels 1, 2 and 3. Estimate the detector readout mode, number of groups, integrations and exposures to detect emission lines in the range with a SNR of more than 50 (and SNR ~10 in Channel 1-Short). Adapt the aperture radius to the approximate size of the size MRS slicers. Channel 4 wavelength is not covered by the provided file, so we will assume same exptime.

Choose IFU Nod scene (i.e. we will define a background target). Nexp can be assumed to be number of dithers. In this case extrapolate the calculation to the entire wavelength range.

Imager: Create calculations for F560W, F770W and F1130W, assuming the background is subtracted using a background region (define sky annulus). The F2550W filter is not covered by the provided file, so we will assume half the exposure time to avoid saturation. Considering the information about the telescope thermal emission in JDox, do you think this is a reasonable assumption?

This is a bright source. If needed use subarrays to avoid saturation.

Exposure Time Calculator

Calculations:

MRS: Set up different calculations for channels 1, 2 and 3. Estimate the detector readout mode, number of groups, integrations and exposures to detect emission lines in the range with a SNR of more than 50. Adapt the aperture radius to the approximate size of the size MRS slicers. Channel 4 wavelength is not covered by the provided file, so we will assume same exptime.

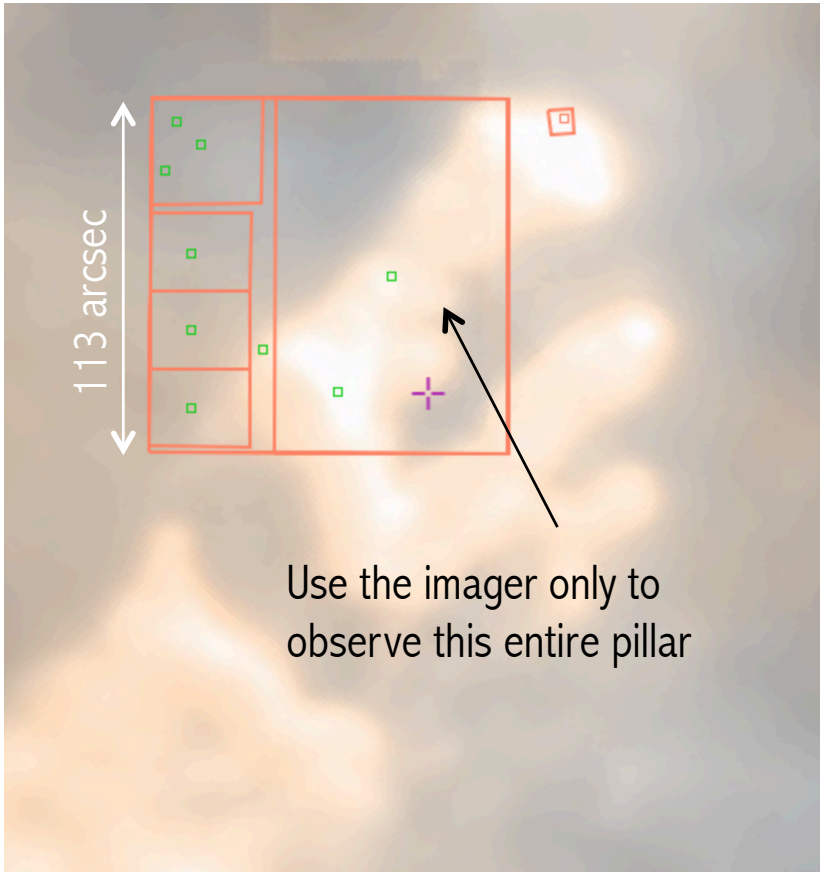
Choose IFU Nod scene (i.e. we will define a background target). Nexp can be assumed to be number of dithers. In this case extrapolate the calculation to the entire wavelength range.

Imager: Create calculations for F560W, F770W and F1130W, and assuming the background is subtracted using a background region (define sky annulus). This is a bright source. Consider using subarrays to avoid saturation.

Astronomer's proposal tool

Define three different targets:

1. MIRI imager center: EQ.J2000
   (18:18:52.425, -13:49:17.93)
2. MIRI IFU center: EQ.J2000
   (18:18:49.885, -13:48:54.89)
3. Define an MRS background target
   (check in Aladdin or ESASky).



You will need three different observations:

- Imaging in three filters. If needed mosaic to cover the area/pillar of interest.

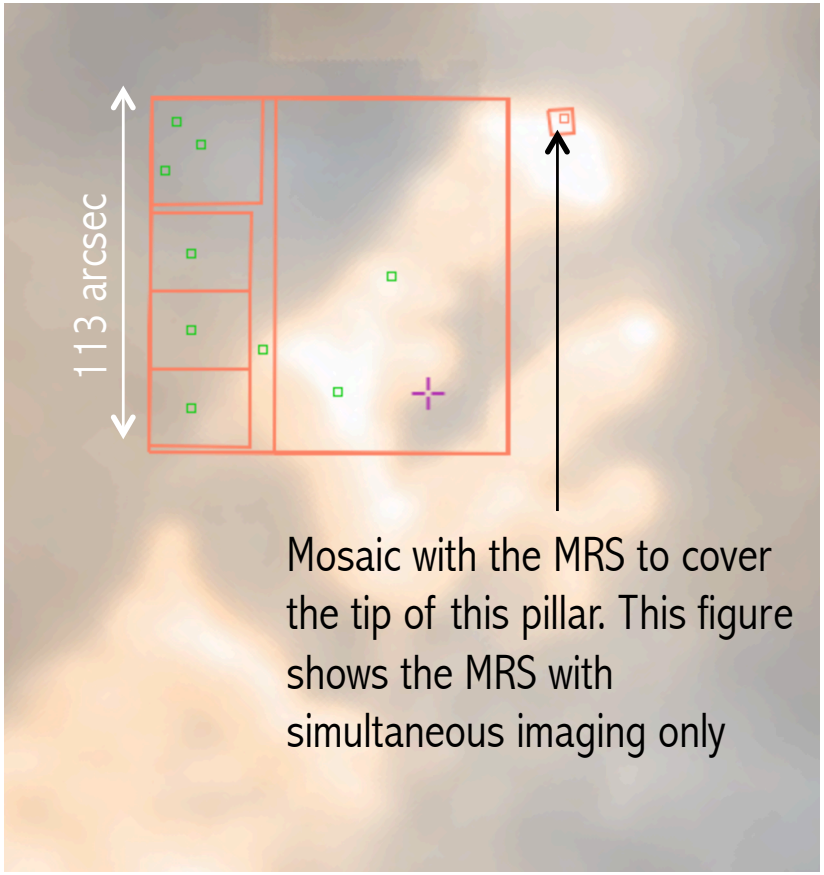
Remeber: you may be using subarrays

Astronomer's proposal tool

- An MRS mosaic (10% overlap) with simultaneous imaging (all MRS bands and F560W filter).
The mosaic should cover the tip of the pillar.

- MRS background (must be linked with the MRS science observation. Sequence non interruptible).
Consider you may not need to mimic the MRS dithers /mosaic Strategy.

- Use the ETC wokbook results to define the Ngroups, integratons and exposures (i.e. dither positions).



Mosaic with the MRS to cover the tip of this pillar. This figure shows the MRS with simultaneous imaging only

Astronomer's proposal tool

Target Acquisition considerations:

Do you think you need TA for the MRS observations? Pick a suitable star, estimate the exposure time with the ETC and add a new target to be used in the TA section. Currently TA is mandatory but that may change in the near future.

To make such decision you should consider the telescope pointing accuracy (check in JDocs).

Special Requirements:

Do you need to impose some (scientifically justified) time constraints? In other words, does timing matter when scheduling the observations? Do you need to impose certain orientation? Do you need to link visits (e.g. different exposures of a mosaic?)

Visit planner: Run the visit planner. Can the observations be scheduled? If so, when? How do you check?

Warnings or Errors: Are there any warnings or errors in APT? Are these expected/acceptable?