



# 1283 - The MIRI HUDF Deep Imaging Survey

Cycle: 1, Proposal Category: GTO

## INVESTIGATORS

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|--|--|--------------------------|
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## OBSERVATIONS

| <i>Folder</i>      | <i>Observation</i> | <i>Label</i>                       | <i>Observing Template</i> | <i>Science Target</i>    |
|--------------------|--------------------|------------------------------------|---------------------------|--------------------------|
| Observation Folder |                    |                                    |                           |                          |
|                    | 1                  | MIRI XDF NIRCам F1 15W+F277W       | MIRI Imaging              | (1) MDS.MIRI-DEEP-SURVEY |
|                    | 2                  | MIRI XDF NIRCам F1 15W+F277W/F356W | MIRI Imaging              | (2) MDS-MIRI-SURVEY-2    |
|                    | 3                  | MIRI XDF NIRCам F1 15W+F356W       | MIRI Imaging              | (3) MDS-MIRI-SURVEY-3    |
|                    | 4                  | MIRI XDF NIRISS JH-bands           | MIRI Imaging              | (4) MSD-MIRI-SURVEY-4    |
|                    | 5                  | MIRI XDF NIRISS K-band             | MIRI Imaging              | (5) MDS-MIRI-SURVEY-5    |

## ABSTRACT

A key theme of JWST is to provide unique information about the formation and evolution of galaxies in the early universe. A lot of effort will be performed to examine the details of how the reionization of the Universe was evolving from the recombination phase at  $z \sim 1100$  to  $z \sim 6$  (Epoch of Reionization, EoR). One of the fundamental unknowns in this transition is the source of the ionizing photons during EoR.

EC-MIRI is participating in the multi-instrument NIRCам – NIRSpec - MIRI coordinated imaging and spectroscopic study of the HUDF and surrounding field. Following on the spirit of this setup, and with the goal of strengthening the primary objectives of MIRI GTO high- $z$  science, the

EC-MIRI team proposes coordinated parallel observations with NIRISS and NIRCам of a well selected field around HUDF, while executing the MIRI deep HUDF imaging survey for a total of 60 hours. The proposed coordinated parallels split the time into about 20 hours of NIRISS observations and about 40 hours of NIRCам imaging. The selected strategies complement those of NIRCам and NIRSpec in the same area of the sky in two very important aspects:

- 1) The proposed NIRCам coordinated parallels will supplement the NIRCам Survey by providing deeper images in an additional pointing with three filters selected to optimize the detection of  $z > 10$  candidates
- 2) The proposed NIRISS coordinated parallels will provide deep wide field slitless low resolution spectroscopy of all high- $z$  sources in a field of  $2.2 \times 2.2$  arcmin<sup>2</sup> within the NIRSpec WIDE MOS survey

## OBSERVING DESCRIPTION

### The MIRI HUDF Deep Imaging Survey

#### Scientific Justification

The whole Universe exploded about 13.8 billion years ago in the Big Bang. The detailed physics of the evolution of the Universe from a tiny fraction of a second after Big Bang to the recombination of hydrogen, when the Universe was 380.000 years old, are well understood, mainly because of very detailed temperature and polarization maps of the Cosmic Microwave Background (CMB) radiation (the latest provided by the Planck Mission). Our understanding of the next period from the recombination to the epoch when the Universe has been fully ionized again is much more uncertain. The end of this transition is established by observations of significant fluxes short ward of Ly in QSOs with  $z \sim 6$ , when the Universe was about 1 billion years old (Fan et al. 2001, Fan et al. 2006).

The fundamental question for the reionization epoch is that the sources responsible for emitting the ionizing photons have not been identified. AGN's are known to emit a lot of UV photons, but their number density is peaking around  $z = 2 - 3$  and is decreasing dramatically up  $z \sim 6$ . This means that they cannot provide a significant contribution to the reionization of the Universes. The most likely source is intrinsically faint star forming galaxies, so faint that they have been below the detection limits of the available instruments.

An important constrain on the reionization scenario is the optical depth of Thomson scattering of the electrons by the CMB photons. The Planck Mission (Planck Collaboration XX 2015) finds  $\tau = 0.066 \pm 0.012$ , somewhat smaller than the value found by WMAP 9yr (Bennett et al. 2013),  $0.089 \pm 0.014$ . Robertson et al. (2013, 2015) show that it is much easier to explain this lower value from the known UV luminosity function ( $MUV > -17$ ) but it is still necessary to extrapolate the luminosity functions below  $MUV < -13$  (Robertson et al. 2015).

Recently, three investigations of the total number of high redshifts sources detected by HST and UltraVISTA have been published (Bouwens et al. 2015, Finkelstein 2015, Bowler et al. 2015). For  $z \sim 7$  and  $z \sim 8$  they discuss many hundreds of sources. For  $z \sim 10$ , only 6 sources have been identified. HST is covering wavelengths  $1.6 \mu\text{m}$ . This means that at these redshifts HST is observing rest – frame wavelengths in the UV,  $2100\text{\AA}$ ,

1900Å and 1500Å, for these 3 redshift intervals. This implies that from HST photometry of high redshift objects, mainly information about the content, ages etc. of young stars can be extracted.

With the unique sensitivity above 5 μm, MIRI will play an important role in studying the different phases of EoR. With MIRI photometry, it will be possible for the first time to get:

- 1) an unbiased estimate of the total stellar masses in objects with  $z > 4$ ,
  - 2) determine masses and ages of the young and old stellar populations in objects with  $z > 8.5$ , exploiting clean measurements of the Balmer Break.
- From these masses and ages, information about the star formation rate can be derived, and thereby estimate how these populations have contributed with ionizing photons during the EoR.

Furthermore, with the 5.6 μm filter, MIRI will be the only instrument onboard JWST which will be able to study the H emission line for sources with  $z \sim 7.5$  and the H + [OIII] lines for sources with  $z \sim 10$ .

Other high priority scientific areas, where this program will provide new insight, are ‘Mass assembly evolution’, ‘Morphology evolution ‘ and ‘Obscured AGN’.

The MIRI Deep Imaging Survey will be performed with the 5.6 μm filter on the HST UDF area covering both the ALMA and the MUSE Deep Surveys, spending about 60 h GTO time. With the estimated sensitivity of this filter given in ETC, the detection limit is 28.3 AB, S/N = 4.0. With this detection limit a small, but significant, number of sources will be detected with  $z > 9$ .

EC-MIRI is participating in the multi-instrument NIRCcam – NIRSpec - MIRI coordinated imaging and spectroscopic study of the HUDF and surrounding field. Following on the spirit of this effort, and with the goal of strengthening the primary objectives of MIRI GTO high- $z$  science, the EC-MIRI team proposes coordinated parallel observations with NIRISS and NIRCcam of a well selected field around HUDF, while executing the MIRI deep HUDF imaging survey for a total of 60 hours. The proposed coordinated parallels split the time into about 20 hours of NIRISS observations and about 40 hours of NIRCcam imaging. The selected strategies complement those of NIRCcam and NIRSpec in the same area of the sky in two very important aspects:

- 1) As part of their cosmological survey, NIRCcam will be getting a deep pointing on the HUDF to a (almost) uniform depth of AB ~30 mag over the full wavelength coverage of NIRCcam. The proposed NIRCcam coordinated parallels will built upon this set of data by providing deeper images in an additional pointing with three filters selected to optimize the detection of  $z > 10$  candidates using a Lyman break technique.
- 2) The proposed NIRISS coordinated parallels will provide deep wide field slitless low resolution spectroscopy of all high- $z$  sources in a field of  $2.2 \times 2.2$  arcmin<sup>2</sup> around the HUDF with some of the deepest ancillary HST data. This set of data will be taken in a subsection of the planned NIRSpec WIDE MOS survey, and therefore complement the NIRSpec survey by providing deeper spectroscopy without pre-selection of targets.

The MIRI EC Team is collaborating with the MIRI US, the NIRCcam and the NIRSpec Teams on all the observations collected in HUDF within the



## Proposal 1283 - Targets - The MIRI HUDF Deep Imaging Survey

| Fixed Targets   | #   | Name  | Target Coordinates  | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|--------------------------|---------------|
|   | (1)   | MDS-MIRI-DEEP-SURVEY  | RA: 03 32 38.1090 (53.1587875d)<br>Dec: -27 46 41.86 (-27.77829d)<br>Equinox: J2000 |                          |               |
|   | Comments:<br>Category=Unidentified<br>Description=[Blank field] |   |   |                          |               |
|   | (2)   | MDS-MIRI-SURVEY-2   | RA: 03 32 38.3160 (53.1596500d)<br>Dec: -27 46 41.86 (-27.77829d)<br>Equinox: J2000 |                          |               |
|   | Comments:<br>Category=Unidentified<br>Description=[Blank field] |   |   |                          |               |
|   | (3)   | MDS-MIRI-SURVEY-3   | RA: 03 32 38.1090 (53.1587875d)<br>Dec: -27 46 39.11 (-27.77753d)<br>Equinox: J2000 |                          |               |
|   | Comments:<br>Category=Unidentified<br>Description=[Blank field] |   |   |                          |               |
| (4)   | MSD-MIRI-SURVEY-4   | RA: 03 32 37.9018 (53.1579242d)<br>Dec: -27 46 41.86 (-27.77829d)<br>Equinox: J2000 |   |                          |               |
| Comments:<br>Category=Unidentified<br>Description=[Blank field] |   |   |   |                          |               |
| (5)   | MDS-MIRI-SURVEY-5   | RA: 03 32 38.1090 (53.1587875d)<br>Dec: -27 46 44.61 (-27.77906d)<br>Equinox: J2000 |   |                          |               |
| Comments:<br>Category=Unidentified<br>Description=[Blank field] |   |   |   |                          |               |

# Proposal 1283 - Observation 1 - The MIRI HUDF Deep Imaging Survey

|                   |  |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
|-------------------|--|---------------------------------|---|------------------|------------------|------------------|-------------------------------|---------------|---------------------|---------------------|------------------------------|
| Observation       | Proposal 1283, Observation 1: MIRI XDF NIRCam F115W+F277W  |                                 |   |                  |                  |                  |                               |               |                     |                     | Fri Jun 21 17:00:48 GMT 2019 |
|                   | Diagnostic Status: Warning   |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
|                   | Observing Template: MIRI Imaging   |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
|                   | Coordinated Parallel Template(s): NIRCam Imaging   |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
|                   | Comments: Due to the uncertainty on the date of the launch of JWST , we expect, once a reliable launch date has been establish, to update the specifications on the ranges of PA angles, to assure an optimal overlab with other JWST observations of HUDF<br>We expect to update the APT once the overheads for parellel observations have been implemented in the APT software |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
| Diagnostics       | (Visit 1:1) Warning (Form): Data volume for this visit 56705.73 MB exceeds half the maximum allowed of 58000.0 MB.   |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
|                   | (Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.  |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
| Fixed Targets     | #  | Name                            | Target Coordinates  |                  |                  |                  | Targ. Coord. Corrections      |               | Miscellaneous       |                     |                              |
|                   | (1)  | MDS.MIRI-DEEP-SURVEY            | RA: 03 32 38.1090 (53.1587875d)<br>Dec: -27 46 41.86 (-27.77829d)<br>Equinox: J2000 |                  |                  |                  |                               |               |                     |                     |                              |
|                   | Comments:<br>Category=Unidentified<br>Description=[Blank field]  |                                 |   |                  |                  |                  |                               |               |                     |                     |                              |
| Template          | MIRI Imaging   |                                 |   |                  |                  |                  | NIRCam Imaging                |               |                     |                     |                              |
|                   | Subarray: FULL   |                                 |   |                  |                  |                  | Module: ALL<br>Subarray: FULL |               |                     |                     |                              |
| Dithers           | #  | Dither Type                     | Starting Point  | Number of Points | Points           | Starting Set     | Number of Sets                | Optimized For | Direction           | Pattern Size        |                              |
|                   | 1  | 4-POINT-MIRI-F1000W-WITH-NIRCam | 1   | 5                |                  | 1                | 1                             |               |                     | DEFAULT             |                              |
| Spectral Elements | MIRI Imaging   | Filter                          | Readout Pattern   | Groups/Int       | Integrations/Exp | Exposures/Dith   | Dither                        | Total Dithers | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID             |
|                   | 1  | F560W                           | FAST  | 95               | 36               | 1                | Dither 1                      | 4             | 144                 | 37962.547           |                              |
| Spectral Elements | NIRCam Imaging   | Short Filter                    | Long Filter   | Readout Pattern  | Groups/Int       | Integrations/Exp | Total Integrations            | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID    |                              |
|                   | 1  | F115W                           | F277W   | DEEP8            | 6                | 8                | 32                            | 4             | 37406.907           |                     |                              |

## Proposal 1283 - Observation 1 - The MIRI HUDF Deep Imaging Survey

### Special Requirements

Aperture PA Range 294.38 to 334.59 Degrees (V3 289.930295 to 330.140295)  
Aperture PA Range 355.81 to 42.89 Degrees (V3 351.360295 to 38.440295)  
No Parallel  
Background Limited. Background no more than 10% above minimum

# Proposal 1283 - Observation 2 - The MIRI HUDF Deep Imaging Survey

|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|-------------------|--|---------------------------------|---------------------------------|------------------|------------------|------------------|--------------------------|---------------|---------------------|---------------------|------------------------------|
| Observation       | Proposal 1283, Observation 2: MIRI XDF NIRCam F115W+F277W/F356W  |                                 |                                 |                  |                  |                  |                          |               |                     |                     | Fri Jun 21 17:00:48 GMT 2019 |
|                   | Diagnostic Status: Warning   |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | Observing Template: MIRI Imaging   |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | Coordinated Parallel Template(s): NIRCam Imaging   |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Diagnostics       | Comments: Due to the uncertainty on the date of the launch of JWST, we expect, once a reliable launch date has been established to update the specifications on the ranges of PA angles, to assure an optimal overlap with other JWST observations of HUDF |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | we expect to update the APT once the overheads for parallel observations have been implemented in the APT software   |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | (Visit 2:1) Warning (Form): Data volume for this visit 56714.33 MB exceeds half the maximum allowed of 58000.0 MB.   |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | (Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Fixed Targets     | #  | Name                            | Target Coordinates              |                  |                  |                  | Targ. Coord. Corrections |               |                     | Miscellaneous       |                              |
|                   | (2)  | MDS-MIRI-SURVEY-2               | RA: 03 32 38.3160 (53.1596500d) |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 | Dec: -27 46 41.86 (-27.77829d)  |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 | Equinox: J2000                  |                  |                  |                  |                          |               |                     |                     |                              |
| Template          | Comments:  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | Category=Unidentified  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   | Description=[Blank field]  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Dithers           | MIRI Imaging   |                                 | NIRCam Imaging                  |                  |                  |                  |                          |               |                     |                     |                              |
|                   | Subarray: FULL   |                                 | Module: ALL                     |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 | Subarray: FULL                  |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Spectral Elements | #  | Dither Type                     | Starting Point                  | Number of Points | Points           | Starting Set     | Number of Sets           | Optimized For | Direction           | Pattern Size        |                              |
|                   | 1  | 4-POINT-MIRI-F1000W-WITH-NIRCam | 1                               | 5                |                  |                  |                          |               |                     | DEFAULT             |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Spectral Elements | MIRI Imaging   | Filter                          | Readout Pattern                 | Groups/Int       | Integrations/Exp | Exposures/Dith   | Dither                   | Total Dithers | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID             |
|                   | 1  | F560W                           | FAST                            | 95               | 18               | 1                | Dither 1                 | 4             | 72                  | 18981.274           |                              |
|                   | 2  | F560W                           | FAST                            | 95               | 18               | 1                | Dither 1                 | 4             | 72                  | 18981.274           |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |
| Spectral Elements | NIRCam Imaging   | Short Filter                    | Long Filter                     | Readout Pattern  | Groups/Int       | Integrations/Exp | Total Integrations       | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID    |                              |
|                   | 1  | F115W                           | F277W                           | DEEP8            | 6                | 4                | 16                       | 4             | 18681.98            |                     |                              |
|                   | 2  | F115W                           | F356W                           | DEEP8            | 6                | 4                | 16                       | 4             | 18681.98            |                     |                              |
|                   |  |                                 |                                 |                  |                  |                  |                          |               |                     |                     |                              |



Proposal 1283 - Observation 2 - The MIRI HUDF Deep Imaging Survey

|                      |  |
|----------------------|--|
| Special Requirements | Aperture PA Range 294.38 to 334.59 Degrees (V3 289.930295 to 330.140295)<br>Aperture PA Range 355.81 to 42.89 Degrees (V3 351.360295 to 38.440295)<br>No Parallel<br>Background Limited. Background no more than 10% above minimum |
|----------------------|--|

# Proposal 1283 - Observation 3 - The MIRI HUDF Deep Imaging Survey

|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|-------------------|---|---------------------------------|---------------------------------|------------------|------------------|--------------------------|--------------------|---------------|---------------------|---------------------|------------------------------|
| Observation       | Proposal 1283, Observation 3: MIRI XDF NIRCam F115W+F356W   |                                 |                                 |                  |                  |                          |                    |               |                     |                     | Fri Jun 21 17:00:48 GMT 2019 |
|                   | Diagnostic Status: Warning  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Observing Template: MIRI Imaging  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Coordinated Parallel Template(s): NIRCam Imaging  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Diagnostics       | Comments: Due to the uncertainty on the date of the launch of JWST, we expect, once a reliable launch date has been established, to update the specifications on the ranges of the PA angles, to assure an optimal overlap with other JWST observations of HUDF |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | we expect to update the APT, once the overheads for the parallel observations are implemented in the APT software   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | (Visit 3:1) Warning (Form): Data volume for this visit 56705.73 MB exceeds half the maximum allowed of 58000.0 MB.  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Fixed Targets     | #   | Name                            | Target Coordinates              |                  |                  | Targ. Coord. Corrections |                    |               | Miscellaneous       |                     |                              |
|                   | (3)   | MDS-MIRI-SURVEY-3               | RA: 03 32 38.1090 (53.1587875d) |                  |                  |                          |                    |               |                     |                     |                              |
|                   |   |                                 | Dec: -27 46 39.11 (-27.77753d)  |                  |                  |                          |                    |               |                     |                     |                              |
|                   |   |                                 | Equinox: J2000                  |                  |                  |                          |                    |               |                     |                     |                              |
| Template          | Comments:   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Category=Unidentified   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Description=[Blank field]   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Dithers           | MIRI Imaging  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | NIRCam Imaging  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Subarray: FULL  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | Module: ALL   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Spectral Elements | Subarray: FULL  |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   | #   | Dither Type                     | Starting Point                  | Number of Points | Points           | Starting Set             | Number of Sets     | Optimized For | Direction           | Pattern Size        |                              |
|                   | 1   | 4-POINT-MIRI-F1000W-WITH-NIRCam | 1                               | 5                |                  |                          |                    |               |                     | DEFAULT             |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Spectral Elements | MIRI Imaging  | Filter                          | Readout Pattern                 | Groups/Int       | Integrations/Exp | Exposures/Dith           | Dither             | Total Dithers | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID             |
|                   | 1   | F560W                           | FAST                            | 95               | 36               | 1                        | Dither 1           | 4             | 144                 | 37962.547           |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
| Spectral Elements | NIRCam Imaging  | Short Filter                    | Long Filter                     | Readout Pattern  | Groups/Int       | Integrations/Exp         | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID    |                              |
|                   | 1   | F115W                           | F356W                           | DEEP8            | 6                | 8                        | 32                 | 4             | 37406.907           |                     |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |
|                   |   |                                 |                                 |                  |                  |                          |                    |               |                     |                     |                              |

Proposal 1283 - Observation 3 - The MIRI HUDF Deep Imaging Survey

|                      |  |
|----------------------|--|
| Special Requirements | Aperture PA Range 294.38 to 334.59 Degrees (V3 289.930295 to 330.140295)<br>Aperture PA Range 355.81 to 42.89 Degrees (V3 351.360295 to 38.440295)<br>No Parallel<br>Background Limited. Background no more than 10% above minimum |
|----------------------|--|

# Proposal 1283 - Observation 4 - The MIRI HUDF Deep Imaging Survey

|                   |   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|-------------------|---|---------------------------------|---|------------------|------------------|----------------|--------------------------|---------------|--------------------|---------------------|------------------|------------------------------|---|
| Observation       | Proposal 1283, Observation 4: MIRI XDF NIRISS JH-bands  |                                 |   |                  |                  |                |                          |               |                    |                     |                  | Fri Jun 21 17:00:48 GMT 2019 |   |
|                   | Diagnostic Status: Warning  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | Observing Template: MIRI Imaging  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | Coordinated Parallel Template(s): NIRISS Wide Field Slitless Spectroscopy   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | <i>Comments: Due to the uncertainty in the date of the launch of JWST, we expect, once a reliable launch date has been established, to update the specifications on the ranges of the PA angles, to assure an optimal overlap with other JWST observations of HUDF</i><br><i>We expect to update the APT, once the overheads on parallel observations have been implemented in the APT software</i> |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
| Diagnostics       | (Visit 4:1) Warning (Form): Data volume for this visit 48183.79 MB exceeds half the maximum allowed of 58000.0 MB.  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | (Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
| Fixed Targets     | #   | Name                            | Target Coordinates  |                  |                  |                | Targ. Coord. Corrections |               |                    | Miscellaneous       |                  |                              |   |
|                   | (4)   | MSD-MIRI-SURVEY-4               | RA: 03 32 37.9018 (53.1579242d)<br>Dec: -27 46 41.86 (-27.77829d)<br>Equinox: J2000 |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | <i>Comments:</i><br><i>Category=Unidentified</i><br><i>Description=[Blank field]</i>  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
| Template          | MIRI Imaging  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              | NIRISS Wide Field Slitless Spectroscopy |
|                   | Subarray: FULL  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
|                   | Dither Direct Images Primes: NO_DITHERING   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |                              |   |
| Dithers           | #   | Dither Type                     | Starting Point  | Number of Points | Points           | Starting Set   | Number of Sets           | Optimized For | Direction          | Pattern Size        |                  |                              |   |
|                   | 1   | 4-POINT-MIRI-F1000W-WITH-NIRISS |   |                  |                  | 1              | 1                        |               |                    | SMALL               |                  |                              |   |
| Spectral Elements | MIRI Imaging  | Filter                          | Readout Pattern   | Groups/Int       | Integrations/Exp | Exposures/Dith | Dither                   | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |                              |   |
|                   | 1   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 2   | F560W                           | FAST  | 97               | 9                | 1              | Dither 1                 | 4             | 36                 | 9690.44             |                  |                              |   |
|                   | 3   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 4   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 5   | F560W                           | FAST  | 97               | 9                | 1              | Dither 1                 | 4             | 36                 | 9690.44             |                  |                              |   |
|                   | 6   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 7   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 8   | F560W                           | FAST  | 97               | 9                | 1              | Dither 1                 | 4             | 36                 | 9690.44             |                  |                              |   |
|                   | 9   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 10  | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |
|                   | 11  | F560W                           | FAST  | 97               | 9                | 1              | Dither 1                 | 4             | 36                 | 9690.44             |                  |                              |   |
|                   | 12  | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |                              |   |

# Proposal 1283 - Observation 4 - The MIRI HUDF Deep Imaging Survey

|                      | NIRISS Wide Field Slitless Spectroscopy  | Exposure Type | Filter | Grism  | Readout Pattern | Groups/Int | Integrations/Exp | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|----------------------|--|---------------|--------|--------|-----------------|------------|------------------|---------------|--------------------|---------------------|------------------|
| Spectral Elements    | 1  | DIRECT        | F115W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 2  | GRISM         | F115W  | GR150C | NIS             | 6          | 9                | 4             | 36                 | 9663.093            |                  |
|                      | 3  | DIRECT        | F115W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 4  | DIRECT        | F115W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 5  | GRISM         | F115W  | GR150R | NIS             | 6          | 9                | 4             | 36                 | 9663.093            |                  |
|                      | 6  | DIRECT        | F115W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 7  | DIRECT        | F150W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 8  | GRISM         | F150W  | GR150R | NIS             | 6          | 9                | 4             | 36                 | 9663.093            |                  |
|                      | 9  | DIRECT        | F150W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 10   | DIRECT        | F150W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
|                      | 11   | GRISM         | F150W  | GR150C | NIS             | 6          | 9                | 4             | 36                 | 9663.093            |                  |
|                      | 12   | DIRECT        | F150W  |        | NIS             | 6          | 1                | 1             | 1                  | 268.419             |                  |
| Special Requirements | Aperture PA Range 294.38 to 334.59 Degrees (V3 289.930295 to 330.140295)<br>Aperture PA Range 355.81 to 42.89 Degrees (V3 351.360295 to 38.440295)<br>No Parallel<br>Background Limited. Background no more than 10% above minimum |               |        |        |                 |            |                  |               |                    |                     |                  |

# Proposal 1283 - Observation 5 - The MIRI HUDF Deep Imaging Survey

|                   |   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
|-------------------|---|---------------------------------|---|------------------|------------------|----------------|--------------------------|---------------|--------------------|---------------------|------------------|---|
| Observation       | Proposal 1283, Observation 5: MIRI XDF NIRISS K-band  |                                 |   |                  |                  |                |                          |               |                    |                     |                  | Fri Jun 21 17:00:48 GMT 2019            |
|                   | Diagnostic Status: Warning  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
|                   | Observing Template: MIRI Imaging  |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
|                   | Coordinated Parallel Template(s): NIRISS Wide Field Slitless Spectroscopy   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
|                   | Comments: Due to the uncertainty on the date of the launch of JWST, we expect, once a reliable launch date has been established, to update the specifications on the ranges of PA angles, to assure an optimal overlap with other JWST observations<br>We expect to update the APT once the overheads for parallel observations have been implemented in the APT software |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
| Diagnostics       | (Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
| Fixed Targets     | #   | Name                            | Target Coordinates  |                  |                  |                | Targ. Coord. Corrections |               |                    | Miscellaneous       |                  |   |
|                   | (5)   | MDS-MIRI-SURVEY-5               | RA: 03 32 38.1090 (53.1587875d)<br>Dec: -27 46 44.61 (-27.77906d)<br>Equinox: J2000 |                  |                  |                |                          |               |                    |                     |                  |   |
|                   | Comments:<br>Category=Unidentified<br>Description=[Blank field]   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
|                   |   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
| Template          | MIRI Imaging  |                                 |   |                  |                  |                |                          |               |                    |                     |                  | NIRISS Wide Field Slitless Spectroscopy |
|                   | Subarray: FULL<br>Dither Direct Images Primes: NO_DITHERING   |                                 |   |                  |                  |                |                          |               |                    |                     |                  |   |
| Dithers           | #   | Dither Type                     | Starting Point  | Number of Points | Points           | Starting Set   | Number of Sets           | Optimized For | Direction          | Pattern Size        |                  |   |
|                   | 1   | 4-POINT-MIRI-F1000W-WITH-NIRISS |   |                  |                  | 1              | 2                        |               |                    | SMALL               |                  |   |
| Spectral Elements | MIRI Imaging  | Filter                          | Readout Pattern   | Groups/Int       | Integrations/Exp | Exposures/Dith | Dither                   | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |   |
|                   | 1   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |   |
|                   | 2   | F560W                           | FAST  | 90               | 9                | 1              | Dither 1                 | 4             | 36                 | 8991.13             |                  |   |
|                   | 3   | F560W                           | FAST  | 92               | 1                | 1              | None                     | 1             | 1                  | 255.304             |                  |   |
|                   | 4   | F560W                           | FAST  | 77               | 1                | 1              | None                     | 1             | 1                  | 213.678             |                  |   |
|                   | 5   | F560W                           | FAST  | 90               | 9                | 1              | Dither 1                 | 4             | 36                 | 8991.13             |                  |   |
|                   | 6   | F560W                           | FAST  | 77               | 1                | 1              | None                     | 1             | 1                  | 213.678             |                  |   |
| Spectral Elements | NIRISS Wide Field Slitless Spectroscopy   | Exposure Type                   | Filter  | Grism            | Readout Pattern  | Groups/Int     | Integrations/Exp         | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |   |
|                   | 1   | DIRECT                          | F200W   |                  | NIS              | 6              | 1                        | 1             | 1                  | 268.419             |                  |   |
|                   | 2   | GRISM                           | F200W   | GR150R           | NIS              | 5              | 10                       | 4             | 40                 | 9018.887            |                  |   |
|                   | 3   | DIRECT                          | F200W   |                  | NIS              | 6              | 1                        | 1             | 1                  | 268.419             |                  |   |
|                   | 4   | DIRECT                          | F200W   |                  | NIS              | 5              | 1                        | 1             | 1                  | 225.472             |                  |   |
|                   | 5   | GRISM                           | F200W   | GR150C           | NIS              | 5              | 10                       | 4             | 40                 | 9018.887            |                  |   |
|                   | 6   | DIRECT                          | F200W   |                  | NIS              | 5              | 1                        | 1             | 1                  | 225.472             |                  |   |

## Proposal 1283 - Observation 5 - The MIRI HUDF Deep Imaging Survey

### Special Requirements

Aperture PA Range 294.38 to 334.59 Degrees (V3 289.930295 to 330.140295)  
Aperture PA Range 355.81 to 42.89 Degrees (V3 351.360295 to 38.440295)  
No Parallel  
Background Limited. Background no more than 10% above minimum