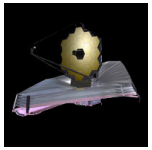

1207 - MIRI in the Hubble Ultra-Deep Field

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
HUDF MIRI Imaging Survey				
	1	Mosaic	MIRI Imaging	(1) XDF-OFFCENTER
Observation Folder				
	2	HUDF-NIRSPEC1	NIRSpec MultiObject Spectroscopy	(5) TARGET-OBSERVATION-3
	3	HUDF-NIRSPEC2	NIRSpec MultiObject Spectroscopy	(6) TARGET-OBSERVATION-4
	4	HUDF-NIRSPEC3	NIRSpec MultiObject Spectroscopy	(7) TARGET-OBSERVATION-5

ABSTRACT

We plan a MIRI multi-band survey in the GOODS-S/HUDF region, covering about 30 square arcmin and using all the MIRI imaging bands. Selected galaxies from this survey will be observed with NIRSpec at R = 1000 and from 1 to 5.2 microns. We will model the photometry to separate AGNs from star forming galaxies. We expect to find 30 - 40 AGN of known types and detected at 10:1 signal to noise or higher at 21 microns. We should be able to identify any previously unknown obscured AGNs, and with the deep X-ray, optical and radio data in the same field should obtain a complete sample of these objects. This same survey will provide high quality measurements of some 2000 star forming galaxies. We will compare star formation rates determined from X-rays, hydrogen recombination lines, UV, and mid-infrared to calibrate these indicators at z = 2. We will also

use the spectra to estimate metallicities and study the dependence of the aromatic bands and other properties of the galaxies on this parameter. Together these measurements will let us determine accurate SFR densities, luminosity functions, and other parameters relevant to galaxy evolution.

GRIEKE_4001-4011

OBSERVING DESCRIPTION

This program will be executed in two parts. First, MIRI imaging in 8 bands will be obtained in a 3x5 mosaic of the HUDF/GOODS-S region. The mosaic position was chosen to optimize overlap with the NIRCam GTO HUDF/GOODS-S program. AGN can be identified by their SEDs filling in the minimum in star forming galaxy SEDs near rest 4.5 microns. We are developing techniques based on the relative flux densities in the MIRI and some of the NIRCam bands for rapid separation of AGN from star forming galaxies, whose spectra not only have the aforementioned minimum but also are characterized by strong aromatic emission features. Deriving robust star formation rates from 21 micron photometry of highly luminous galaxies (i.e. ULIRGs) will require: 1.) distinguishing nuclear- concentrated star formation from galaxies where the SF is distributed over the disk, an issue for $z < 1$ (Rujopakarn et et al. 2013; Shipley et al. 2016); and 2.) determining in which cases the 21 microns output is contaminated by AGN. The mid-IR spectral energy distribution can be used as a proxy for the central concentration of star forming galaxies. JWST photometry can help select the appropriate spectral template through comparing the behavior of the output of the aromatic bands, which are dominant for 6 - 13 microns, with that of the dust grains that dominate the emission at 13 - 30 microns. For example, the MIRI photometric bands at 12.8 microns and 21 microns sample these two spectral components separately for $0 < z < 0.6$. Their relative behavior can be expressed by the ratio of the flux densities in the two bands. Using the templates suggested by Rujopakarn et al. (2013), the ratio f(12.8)/f(21) for (low central concentration) over (high central concentration) is a factor of 1.5 or more over this redshift range. This approach can be extended to $z = 1$ by using the 15 micron and 25.5 micron bands. A relatively short integration in the latter band suffices for this application. AGN contamination can be identified with moderately deep observations in the additional MIRI bands, and the results can be tested with the ancillary datasets (e.g., deep X-ray and radio). Finally, the most luminous and embedded star forming galaxies can be identified from previous ultradeep surveys with Spitzer and Herschel, plus the high resolution (0.35 arcsec) and deep radio observations in this region.

This MIRI imaging, together with the NIRCam GTO imaging, will then be used to select targets for NIRSpec MOS follow-up. Three pointings with NIRSpec will obtain R=1000, 1-5um spectra for selected targets. The target selection will prioritize conditional targets identified with MIRI (color-selected AGN, etc) and other interesting sources relevant to this program (radio sources, proto-cluster members, etc). Accurate positions will be determined through NIRCam imaging. As NIRSpec MOS follow-up in this proposal requires both MIRI and NIRCam pre-imaging, it is equired that the NIRSpec follow-up not be scheduled for at least 60 days following the MIRI or NIRCam imaging, whichever is observed last.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	XDF-OFFCENTER	RA: 03 32 37.3890 (53.1557875d) Dec: -27 48 0.01 (-27.80000d) Equinox: J2000		
Comments: This pointing is roughly centered on the XDF and the proposed location of NIRCam GTO imaging (MRIEKE_0001-0068). Exact positioning will rely on the launch date and final PA of the NIRCam GTO program. When this information is available, this pointing center and PA will be re-assessed. *Category=Unidentified* *Description=[Blank field]*				
(2)	NIRSPEC1	RA: 03 32 40.3000 (53.1679167d) Dec: -27 46 17.10 (-27.77142d) Equinox: J2000		
Comments: This pointing center is a placeholder for a NIRSpec follow-up observations that will primarily target sources selected via NIRCam and MIRI pre-imaging. When this data is available, this pointing center and the corresponding observation/MSA setup will be re-assessed. *Category=Unidentified* *Description=[Infrared sources, Radio sources, X-ray sources]*				
(3)	NIRSPEC2	RA: 03 32 33.6001 (53.1400004d) Dec: -27 47 23.00 (-27.78972d) Equinox: J2000		
Comments: This pointing center is a placeholder for a NIRSpec follow-up observations that will primarily target sources selected via NIRCam and MIRI pre-imaging. When this data is available, this pointing center and the corresponding observation/MSA setup will be re-assessed. *Category=Unidentified* *Description=[Infrared sources, Radio sources, X-ray sources]*				
(4)	NIRSPEC3	RA: 03 32 39.1000 (53.1629167d) Dec: -27 48 58.40 (-27.81622d) Equinox: J2000		
Comments: This pointing center is a placeholder for a NIRSpec follow-up observations that will primarily target sources selected via NIRCam and MIRI pre-imaging. When this data is available, this pointing center and the corresponding observation/MSA setup will be re-assessed. *Category=Unidentified* *Description=[Infrared sources, Radio sources, X-ray sources]*				
(5)	TARGET-OBSERVATION-3	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		
Comments: This target was generated automatically for MSA Observation 3 *Category=Unidentified* *Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]*				
(6)	TARGET-OBSERVATION-4	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		
Comments: This target was generated automatically for MSA Observation 4 *Category=Unidentified* *Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]*				
(7)	TARGET-OBSERVATION-5	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		
Comments: This target was generated automatically for MSA Observation 5 *Category=Unidentified* *Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]*				

Observation

Proposal 1207, Observation 1: Mosaic Tue Jun 25 13:00:34 GMT 2019

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Comments: This mosaic is roughly centered on the XDF and the proposed location of NIRCam GTO imaging (MRIEKE_0001-0068). Exact positioning will rely on the launch date and final PA of the NIRCam GTO program. When this information is available, this pointing center and PA will be re-assessed.

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:9) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:10) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:11) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:12) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:13) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:14) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:15) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	XDF-OFFCENTER	RA: 03 32 37.3890 (53.1557875d) Dec: -27 48 0.01 (-27.80000d) Equinox: J2000		

Comments: This pointing is roughly centered on the XDF and the proposed location of NIRCam GTO imaging (MRIEKE_0001-0068). Exact positioning will rely on the launch date and final PA of the NIRCam GTO program. When this information is available, this pointing center and PA will be re-assessed.
Category=Unidentified
Description=[Blank field]

Template

Subarray
FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
3	5	5.0	5.0	0.0	0.0	HILBERT_CURVE

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets	1	4		5	1	POINT SOURCE	POSITIVE	SMALL
2	4-Point-Sets	1	8		5	2	POINT SOURCE	POSITIVE	MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F560W	FAST	59	1	1	Dither 1	4	4	654.909	
2	F770W	FAST	78	1	1	Dither 1	4	4	865.812	
3	F1000W	FAST	58	1	1	Dither 1	4	4	643.809	
4	F1280W	FAST	68	1	1	Dither 1	4	4	754.811	
5	F1500W	FAST	101	1	1	Dither 1	4	4	1121.116	
6	F1800W	FAST	68	1	1	Dither 1	4	4	754.811	
7	F2100W	FAST	32	3	1	Dither 2	8	24	2131.231	
8	F2550W	FAST	18	4	1	Dither 1	4	16	799.212	

Special Requirements

Sequence Visits within 53.0 Days
Aperture PA Range 41 to 41 Degrees (V3 36.550295 to 36.550295)
Visits Same PA

2 After 1 by 60 Days to <None specified>
3 After 1 by 60 Days to <None specified>
4 After 1 by 60 Days to <None specified>

Observation

Proposal 1207, Observation 2: HUDF-NIRSPEC1 Tue Jun 25 13:00:34 GMT 2019

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Comments: This observation is a place holder for a NIRSPec pointing with this exposure set-up. The final NIRSpec pointing and MSA slit configuration is dependent on conditional targets identified through MIRI and NIRCam pre-imaging.

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	TARGET-OBSERVATION-3	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		

Comments: This target was generated automatically for MSA Observation 3
Category=Unidentified
Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]

Acquisition

#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		SAME	F140X	Auto Acq MSA Config	NRS	3	1	4	558.312	

Template

TA Method	Obtain Confirmation Images	Science Aperture
MSATA	No	MSA Center

Reference Stars

Spectral Elements

#	Grating/Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
2	G235M/F170LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
3	G395M/F290LP	Configuration: c0	NRSIRS2	16	1	NONE	3	3	3545.1	

Special Requirements	
	On Hold contingent on NIRCam imaging (MRIEKE_0001-0068) and MIRI imaging (this proposal). MSA Planned Aperture PA 180.0 to 180.0 Degrees (V3 41.50766 to 41.50766) 2 After 1 by 60 Days to <None specified> Sequence Observations 2, 3, 4, Non-interruptible

Observation

Proposal 1207, Observation 3: HUDF-NIRSPEC2 Tue Jun 25 13:00:34 GMT 2019

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Comments: This observation is a place holder for a NIRSPec pointing with this exposure set-up. The final NIRSpec pointing and MSA slit configuration is dependent on conditional targets identified through MIRI and NIRCam pre-imaging.

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(6)	TARGET-OBSERVATION-4	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		

Comments: This target was generated automatically for MSA Observation 4
Category=Unidentified
Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]

Acquisition

#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		SAME	F140X	Auto Acq MSA Config	NRS	3	1	4	558.312	

Template

TA Method	Obtain Confirmation Images	Science Aperture
MSATA	No	MSA Center

Reference Stars

Spectral Elements

#	Grating/Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
2	G235M/F170LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
3	G395M/F290LP	Configuration: c0	NRSIRS2	16	1	NONE	3	3	3545.1	

Special Requirements	
	On Hold contingent on NIRCam imaging (MRIEKE_0001-0068) and MIRI imaging (this proposal). MSA Planned Aperture PA 180.0 to 180.0 Degrees (V3 41.50766 to 41.50766) 3 After 1 by 60 Days to <None specified> Sequence Observations 2, 3, 4, Non-interruptible

Observation

Proposal 1207, Observation 4: HUDF-NIRSPEC3 Tue Jun 25 13:00:34 GMT 2019

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Comments: This observation is a place holder for a NIRSPec pointing with this exposure set-up. The final NIRSpec pointing and MSA slit configuration is dependent on conditional targets identified through MIRI and NIRCam pre-imaging.

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(7)	TARGET-OBSERVATION-5	RA: 03 32 36.3463 (53.1514429d) Dec: -27 46 39.39 (-27.77761d) Equinox: J2000		

Comments: This target was generated automatically for MSA Observation 5
Category=Unidentified
Description=[Infrared sources, Radio sources, Visible sources, X-ray sources]

Acquisition

#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		SAME	F140X	Auto Acq MSA Config	NRS	3	1	4	558.312	

Template

TA Method	Obtain Confirmation Images	Science Aperture
MSATA	No	MSA Center

Reference Stars

Spectral Elements

#	Grating/Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
2	G235M/F170LP	Configuration: c0	NRSIRS2	32	1	NONE	3	3	7046.434	
3	G395M/F290LP	Configuration: c0	NRSIRS2	16	1	NONE	3	3	3545.1	

Special Requirements	
	On Hold contingent on NIRCam imaging (MRIEKE_0001-0068) and MIRI imaging (this proposal). MSA Planned Aperture PA 180.0 to 180.0 Degrees (V3 41.50766 to 41.50766) 4 After 1 by 60 Days to <None specified> Sequence Observations 2, 3, 4, Non-interruptible