4246 - Physical Properties of a Possible Galaxy Merger at z=10.2

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRCam Imaging	NIRCam Imaging	(4) CLG-J0647+7015
	20	MIRI MRS IFU background	MIRI Medium Resolution Spectroscopy	(20) MACS0647-MRS-background
	21	MIRI MRS IFU	MIRI Medium Resolution Spectroscopy	(111) MACS0647-JD1ABC
	3	NIRSpec MSA	NIRSpec MultiObject Spectroscopy	(11) MACS0647_weight1_MSA11v

ABSTRACT

JWST was designed to discover and study the first galaxies. And JWST has delivered: more detailed studies of z <= 9 galaxies than most of us dreamed, and more discoveries of z >= 10 galaxies than most expected. But detailed studies of z >= 10 galaxies in the first 500 Myr have remained elusive due to the bright [OIII] emission line redshifting beyond NIRSpec's wavelength range.

Emission lines have recently been detected for the first time at z > 10. MACS0647-JD lensed to AB mag 25.1 was discovered in Hubble imaging, revealed to be merging galaxies in JWST NIRCam imaging, and is now confirmed spectroscopically at z = 10.17 with 5 emission lines observed in NIRSpec PRISM data.

Here we propose higher resolution spectroscopy spanning 3000Å – 7000Å rest-frame in the first detailed study of a galaxy at z = 10:

1. NIRSpec G395H high-resolution spectroscopy (R ~ 3000) to resolve the [OII] doublet delivering gas density, and measure line widths and thus outflow strengths. Outflows may clear ionized channels allowing Lyman continuum photons to escape and reionize the universe. Other lines will include [OIII] 4363Å, delivering a confident direct metallicity measurement, based on the line flux ratio with [OIII] 5007Å.

2. MIRI MRS spectroscopy to detect H and [OIII] 5007Å. In addition to metallicity, [OIII] will help constrain the galaxy's ionizing strength. H will deliver the star formation rate as well as the dust extinction when combined with H from NIRSpec (with H likely too faint for detection).

Simultaneous MIRI imaging of the other bright lensed image of MACS0647-JD will yield rest-frame optical photometry securing measurements of the stellar mass and age.

OBSERVING DESCRIPTION

We proposed the following observations on the MACS0647+70 cluster field and primary target lensed galaxy images JD1 and JD2:

* 4.2 hours MIRI MRS SHORT (A) spectroscopy on JD1 + F560W imaging on JD2
* 4.2 hours MIRI MRS LONG (C) spectroscopy on JD1 + F770W imaging on JD2
* 2.5 hours NIRSpec spectroscopy G395H/F290LP high resolution
* 0.6 hour NIRCam imaging F200W + F410M

MIRI requires specific roll angles to obtain MRS observations of one target JD1 and imaging of the other JD2.

NIRSpec MSA observations are now specified at the assigned roll angle. We split our observations into two pointings in order to cover the wavelength gap and observe more targets:

– Pointing 1: standard 3-shutter slitlets and nods
– Pointing 2: single shutter slitlets with 2 dithers + master background slitlets added by manually editing the configuration

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MACS0647-JD1	RA: 06 47 55.7310 (101.9822125d) Dec: +70 14 35.76 (70.24327d) Equinox: J2000		
Comments: Category=Galaxy Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]				
(2)	MACS0647-JD2	RA: 06 47 53.1120 (101.9713000d) Dec: +70 14 22.94 (70.23971d) Equinox: J2000		
Comments: Category=Galaxy Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]				
(3)	MACS0647-JD3	RA: 06 47 55.4520 (101.9810500d) Dec: +70 15 38.09 (70.26058d) Equinox: J2000		
Comments: Category=Galaxy Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]				
(4)	CLG-J0647+7015	RA: 06 47 50.0000 (101.9583333d) Dec: +70 14 55.00 (70.24861d) Equinox: J2000		
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=Clusters of Galaxies Description=[Rich clusters]				
(11)	MACS0647_weight1_MSA11v	RA: 06 47 50.7677 (101.9615321d) Dec: +70 14 55.78 (70.24883d) Equinox: J2000		
Comments: Description=[]				
(16)	MACS0647_weight1_MSA16b	RA: 06 47 50.7677 (101.9615321d) Dec: +70 14 55.78 (70.24883d) Equinox: J2000		
Comments: Description=[]				
(20)	MACS0647-MRS-background	RA: 06 47 58.8633 (101.9952638d) Dec: +70 14 38.27 (70.24396d) Equinox: J2000		
Comments: Category=Galaxy Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]				
(111)	MACS0647-JD1ABC	RA: 06 47 55.8493 (101.9827054d) Dec: +70 14 36.54 (70.24348d) Equinox: J2000		
Comments: Category=Galaxy Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]				

Proposal 4246 - Observation 1 - Physical Properties of a Possible Galaxy Merger at z=10.2

Observation

Proposal 4246, Observation 1: NIRCam Imaging

Mon Dec 18 23:01:50 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	CLG-J0647+7015	RA: 06 47 50.0000 (101.9583333d) Dec: +70 14 55.00 (70.24861d) Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Clusters of Galaxies
Description=[Rich clusters]

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	STANDARD		1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F200W	F410M	SHALLOW4	10	1	4	4	2104.407	

Special Requirements

Aperture PA Range 80 to 285 Degrees (V3 80.0713531 to 285.0713531)
Offset -86.0 arcsec, 0.0 arcsec

Observation

Proposal 4246, Observation 20: MIRI MRS IFU background Mon Dec 18 23:01:50 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: []

Diagnostics

(Visit 20:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(20)	MACS0647-MRS-background	RA: 06 47 58.8633 (101.9952638d) Dec: +70 14 38.27 (70.24396d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	Channel 1	YES	FULL	NEUTRAL

Dithers

#	Dither Type	Optimized For	Direction
1	2-Point	EXTENDED SOURCE	NEGATIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F560W	SLOWR1	19	1	1	Dither 1	2	2	907.817	
1	SHORT(A)	MRSLONG		SLOWR1	19	1	1	Dither 1	2	2	907.817	
1	SHORT(A)	MRSSHORT		SLOWR1	19	1	1	Dither 1	2	2	907.817	
2		IMAGER	F770W	SLOWR1	19	1	1	Dither 1	2	2	907.817	
2	LONG(C)	MRSLONG		SLOWR1	19	1	1	Dither 1	2	2	907.817	
2	LONG(C)	MRSSHORT		SLOWR1	19	1	1	Dither 1	2	2	907.817	

Special Requirements	
	Aperture PA Range 125 to 140 Degrees (V3 125.0 to 140.0) Sequence Observations 20, 21, Non-interruptible

Observation

Proposal 4246, Observation 21: MIRI MRS IFU

Mon Dec 18 23:01:50 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 21:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(111)	MACS0647-JD1ABC	RA: 06 47 55.8493 (101.9827054d) Dec: +70 14 36.54 (70.24348d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies, Lyman-break galaxies, Primordial galaxies]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	Channel 1	YES	FULL	NEUTRAL

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	EXTENDED SOURCE	NEGATIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F560W	SLOWR1	19	8	1	Dither 1	4	32	15193.989	
1	SHORT(A)	MRSLONG		SLOWR1	19	8	1	Dither 1	4	32	15193.989	
1	SHORT(A)	MRSSHORT		SLOWR1	19	8	1	Dither 1	4	32	15193.989	
2		IMAGER	F770W	SLOWR1	19	8	1	Dither 1	4	32	15193.989	
2	LONG(C)	MRSLONG		SLOWR1	19	8	1	Dither 1	4	32	15193.989	
2	LONG(C)	MRSSHORT		SLOWR1	19	8	1	Dither 1	4	32	15193.989	

Special Requirements	
	Aperture PA Range 125 to 140 Degrees (V3 125.0 to 140.0) Sequence Observations 20, 21, Non-interruptible

Observation

Proposal 4246, Observation 3: NIRSpec MSA

Mon Dec 18 23:01:50 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

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
(11)	MACS0647_weight1_MSA11v	RA: 06 47 50.7677 (101.9615321d) Dec: +70 14 55.78 (70.24883d) Equinox: J2000		

Comments:
Description=[]

Acquisition

#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	Filter: CLEAR; Readout: NRSRAPID; 8 sources in 3 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	

Template

TA Method	Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold
MSATA	No	MSA Center	Primary11v (8 sources)	MACS0647_weight1_MSA11v (1172 sources)	jwst-nirspec-hr-no-g235h	1.5

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	61172	101.931471	70.200253	23.695	1	63282	101.900716	70.238741	23.575
1	61668	101.894866	70.208654	21.871	1	63851	101.929915	70.245431	22.905
1	61761	101.959513	70.210398	23.006	1	64382	101.931409	70.254081	23.008
1	63248	101.956596	70.238030	22.051	1	64566	101.933160	70.256463	22.244

Spectral Elements

#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
1	1 (G395H/F290LP)	c1	3 Shutter Slitlet	101.91074833333333 Degrees 70.22690833333334 Degrees	306.57974462579676			3	3	4420.434
2	2 (G395H/F290LP)	16b_dither-2_fixed2_exposure1		101.91353958333333 Degrees 70.23555555555555 Degrees	306.58236284240337			1	2	2217.511
3	2 (G395H/F290LP)	16b_dither-2_fixed2_exposure2		101.91310383333334 Degrees 70.23585 Degrees	306.58195283019967			1	2	2217.511

Special Requirements	
	MSA Scheduled Aperture PA 306.6275 to 306.6275 Degrees (V3 168.05292 to 168.05292)