



3073 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
NIRSpec PRISM on cosmic dawn				
	5	PA 30 - V4 obs5 1	NIRSpec MultiObject Spectroscopy	(14) A2744 NIRSpec_v4_MSA2_obs5
	9	PA 31.4966 - V4 obs9 1	NIRSpec MultiObject Spectroscopy	(16) A2744_NIRSpec_v4_MSA2_obs9
	8	PA 30 - V4 obs8 1	NIRSpec MultiObject Spectroscopy	(15) A2744_NIRSpec_v4_MSA2_obs8
	10	PA 175 - V21 obs10 3	NIRSpec MultiObject Spectroscopy	(8) A2744 NIRSpec_v21_obs10
	11	PA 175 - V21 obs11 6	NIRSpec MultiObject Spectroscopy	(9) A2744_NIRSpec_v21_obs11
	12	PA 175 - V21 obs12 1	NIRSpec MultiObject Spectroscopy	(10) A2744_NIRSpec_v21_obs12

ABSTRACT

The discovery of a large number of bright galaxies at $z > 10$ in the first JWST NIRCам fields is questioning our understanding of galaxy evolution at cosmic dawn. The surprisingly high number density compared to theoretical models may imply that the evolution of early star formation is decoupled from the evolution of dark matter halos. Spectroscopic validation of the photometric selections and an assessment of the role of cosmic variance on early UV LF estimates are needed to confirm these findings. The present proposal will clarify these issues by targeting the field behind the cluster Abell-2744 where the most remarkable examples of this unexpected population have been reported. We will observe with NIRSpec PRISM six robust candidates at $z \sim 9-12$. The sample includes GHZ1/GLASS- z_{10} at $z \sim 10-11$ and GHZ2/GLASS- z_{12} at $z \sim 12-12.5$, that stand out for their brightness and robustness assessed by several independent investigations, and four robust candidates that possibly form an overdensity at $z \sim 10$ together with GHZ1/GLASS- z_{11} . The proposed observations will secure the redshift and SFR of the targets with $\text{SNR} > 5-10$ measurements of both their Lyman break and [OII]3727 line, while obtaining deep limits on Ly-alpha and on UV emission lines. JWST spectra will confirm this new population, assess the presence of an overdensity at $z \sim 10$ and of early ionized bubbles in the field and detect whether the objects host an AGN or extreme stellar populations. Coordinated six-band NIRCам parallel observations on two flanking fields will extend the selection of $z > 9$ galaxies in the region and the mapping of the potential overdensity at $z \sim 10$.

OBSERVING DESCRIPTION

We request JWST NIRSpec CLEAR/PRISM observations covering the entire UV rest frame range of the six targets. The NIRSpec spectra will measure at high significance the region of the Ly-alpha enabling a robust ($\text{SNR} > 5-10$) measurement of the Lyman break and of the line, if present. The [OII]3727 line, whose flux has been estimated under conservative assumptions, will be detected at $\text{SNR} > 5$. Similarly, any UV emission line with $\text{EW} > 5 \text{ \AA}$ will be detected at $\text{SNR} > 5$. The detection of a break will be sufficient as a spectroscopic confirmation of their redshift, while the [OII]3727 line will also enable measurement of the SFR of the sources. The potential detection of the Ly-alpha line, whose intrinsic emission is expected to be prominent in these bright objects, would point to the presence of a reionized region around them and would be an extremely important probe of the status of IGM at still unexplored redshifts. The Ly-alpha region is always within the wavelength range probed by NIRSpec prism for all sources. Detection of the UV rest-frame lines CIV, HeII, OIII] and CIII], will constrain the presence of AGN or hard-ionizing populations. We define our strategy on the basis of the continuum flux and slope measured from NIRCам photometry exploiting the most up-to-date calibrations. We adopt the readout pattern NRSIRS2, standard 3-shutter "slits" and a 3-point nodding. We require two NIRSpec MOS pointings whose overlap ensures that all sources will reach the SNR requested for our science goals. We divide the observation of each pointing in three visits to enable the six-band coordinated parallel NIRCам observations on flanking fields as described below. Assuming medium background at the position of the field, we reach our science goals with three visits of 1 integrations per exposure, with 3 exposures (one per nod positions) of 30 groups each. The total exposure time is of 6567 s per visit, corresponding to a total charged time of 19.3 hours including overheads.

The first pointing will observe candidates GHZ1, GHZ2, GHZ4 and GHZ9, while the second pointing will observe the close pair GHZ7-GHZ8 which lies in the northernmost part of the field, while re-observing GHZ4 and GHZ9. The inclusion of GHZ4 and GHZ9 in both pointings ensures the requested SNR on the two faintest targets in the sample.

The Aperture PA range needs to be slightly restricted in order to cover all the six candidates with two pointings while including the faintest ones (GHZ4 and GHZ9) in both. In particular, pointing one must have $20 < \text{PA} < 55$ or $162 < \text{PA} < 170$, while pointing two must have $50 < \text{PA} < 55$ or $165 < \text{PA} < 185$.

The NIRCам coordinated parallel observations will cover two flanking fields outside the area currently covered by JWST. The three NIRSpec visits per pointing will observe the F115W+F277W, F150W+F356W and F200W+F444W filter pairs, with 6055.538 sec. science time each. The final depth in 0.2 arcsec apertures on point sources will be of $\text{mag} = 29.8$ at $\text{SNR} = 2$ in the F115W band, and $\text{mag} \sim 28.0-28.5$ at $\text{SNR} = 10$ for the other bands.

Proposal 3073 - Targets - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(8)	A2744_NIRSpec_v21_obs10	RA: 00 14 0.9665 (3.5040271d) Dec: -30 20 49.25 (-30.34701d) Equinox: J2000		
<i>Comments: The catalog has been extracted from NIRCcam multi-band observations of the region</i> <i>Description=[]</i>				
(9)	A2744_NIRSpec_v21_obs11	RA: 00 14 0.9665 (3.5040271d) Dec: -30 20 49.25 (-30.34701d) Equinox: J2000		
<i>Comments: The catalog has been extracted from NIRCcam multi-band observations of the region</i> <i>Description=[]</i>				
(10)	A2744_NIRSpec_v21_obs12	RA: 00 14 0.9665 (3.5040271d) Dec: -30 20 49.25 (-30.34701d) Equinox: J2000		
<i>Comments: The catalog has been extracted from NIRCcam multi-band observations of the region</i> <i>Description=[]</i>				
(14)	A2744_NIRSpec_v4_MSA2_o bs5	RA: 00 14 0.9618 (3.5040075d) Dec: -30 20 43.19 (-30.34533d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				
(15)	A2744_NIRSpec_v4_MSA2_o bs8	RA: 00 14 0.9618 (3.5040075d) Dec: -30 20 43.19 (-30.34533d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				
(16)	A2744_NIRSpec_v4_MSA2_o bs9	RA: 00 14 0.9618 (3.5040075d) Dec: -30 20 43.19 (-30.34533d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				

Fixed Targets

Proposal 3073 - Observation 5 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 5: PA 30 - V4 obs5 1 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCам Imaging																																																												
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Proposal 3073 - Observation 5 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Spectral Elements	NIRSpec	Exposure	MSA	Nod Pattern	Pointing	Aperture PA	Dispersion Offset	Cross-Dispersion	Total Dithers	Total	Total Exposure
	MultiObject Spectroscopy	Specification	Configuration				(Shutters)	Offset (Shutters)		Integrations	Time
1		1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.5072672083333 334 Degrees - 30.341993611111 093 Degrees	29.998357774879 697			3	6	6652.534
Spectral Elements	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure	ETC Wkbk.Calc	
									Time	ID	
1		F115W	F277W	DEEP8	10	1	3	3	6055.538		
Special Requirements	Aperture PA Range 20 to 55 Degrees (V3 241.42543030000002 to 276.4254303)										
	Aperture PA Range 162 to 170 Degrees (V3 23.4254303 to 31.4254303)										
No Parallel Attachments											
MSA Scheduled Aperture PA 30.0000 to 30.0000 Degrees (V3 251.42543 to 251.42543)											

Proposal 3073 - Observation 9 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 9: PA 31.4966 - V4 obs9 1 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCam Imaging																																																												
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	1	18677	3.546552	-30.340810	25.229700088500977	1	23158	3.505905	-30.315856	25.170499801635742																																																			
	1	18687	3.518607	-30.340626	23.730100631713867	1	23459	3.501222	-30.328363	25.689599990844727																																																			
	1	21278	3.502895	-30.311148	24.697599411010742	1	24340	3.484746	-30.315404	24.71139907836914																																																			
1	22284	3.482605	-30.318163	23.47450065612793																																																									
Dithers	<table border="1"> <thead> <tr> <th>#</th> <th>Dither Type</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>NONE</td> </tr> </tbody> </table>											#	Dither Type	1	NONE																																														
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1	NONE																																																												

Proposal 3073 - Observation 9 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Spectral Elements	NIRSpec	Exposure	MSA	Nod Pattern	Pointing	Aperture PA	Dispersion Offset	Cross-Dispersion	Total Dithers	Total	Total Exposure
	MultiObject Spectroscopy	Specification	Configuration				(Shutters)	Offset (Shutters)		Integrations	Time
1		1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.5062292916666 666 Degrees - 30.341275555555 57 Degrees	31.495484286325 44			3	6	6652.534
Spectral Elements	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure	ETC Wkbk.Calc	
									Time	ID	
1		F150W	F356W	DEEP8	10	1	3	3	6055.538		
Special Requirements	Aperture PA Range 20 to 55 Degrees (V3 241.42543030000002 to 276.4254303)										
	Aperture PA Range 162 to 170 Degrees (V3 23.4254303 to 31.4254303)										
No Parallel Attachments											
MSA Scheduled Aperture PA 31.4966 to 31.4966 Degrees (V3 252.92203 to 252.92203)											

Proposal 3073 - Observation 8 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 8: PA 30 - V4 obs8 1 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCam Imaging																																																												
	(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.																																																												
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Proposal 3073 - Observation 8 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Spectral Elements	NIRSpec	Exposure	MSA	Nod Pattern	Pointing	Aperture PA	Dispersion Offset	Cross-Dispersion	Total Dithers	Total	Total Exposure
	MultiObject Spectroscopy	Specification	Configuration				(Shutters)	Offset (Shutters)		Integrations	Time
1		1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.5072672083333 334 Degrees - 30.341993611111 093 Degrees	29.998357774879 697			3	6	6652.534
Spectral Elements	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure	ETC Wkbk.Calc	
									Time	ID	
1		F200W	F444W	DEEP8	10	1	3	3	6055.538		
Special Requirements	Aperture PA Range 20 to 55 Degrees (V3 241.42543030000002 to 276.4254303)										
	Aperture PA Range 162 to 170 Degrees (V3 23.4254303 to 31.4254303)										
No Parallel Attachments											
MSA Scheduled Aperture PA 30.0000 to 30.0000 Degrees (V3 251.42543 to 251.42543)											

Proposal 3073 - Observation 10 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 10: PA 175 - V21 obs10 3 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCам Imaging																																																												
	(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Visit 10:1) Warning (Form): The recommended value is 8 Reference Stars for this template.																																																												
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Proposal 3073 - Observation 10 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Spectral Elements	NIRSpec	Exposure	MSA	Nod Pattern	Pointing	Aperture PA	Dispersion Offset	Cross-Dispersion	Total Dithers	Total	Total Exposure
	MultiObject Spectroscopy	Specification	Configuration				(Shutters)	Offset (Shutters)		Integrations	Time
1		1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.4833062083333 335 Degrees - 30.332620555555 536 Degrees	175.01041891271 052			3	6	6652.534
Spectral Elements	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure	ETC Wkbk.Calc	
									Time	ID	
1		F115W	F277W	DEEP8	10	1	3	3	6055.538		
Special Requirements	Aperture PA Range 165 to 175 Degrees (V3 26.4254303 to 36.4254303)										
	No Parallel Attachments MSA Scheduled Aperture PA 175.0000 to 175.0000 Degrees (V3 36.42543 to 36.42543)										

Proposal 3073 - Observation 11 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 11: PA 175 - V21 obs11 6 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCам Imaging																																																												
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Proposal 3073 - Observation 11 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Spectral Elements	NIRSpec	Exposure	MSA	Nod Pattern	Pointing	Aperture PA	Dispersion Offset	Cross-Dispersion	Total Dithers	Total	Total Exposure
	MultiObject Spectroscopy	Specification	Configuration				(Shutters)	Offset (Shutters)		Integrations	Time
1		1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.4833062083333 335 Degrees - 30.332620555555 536 Degrees	175.01041891271 052			3	6	6652.534
Spectral Elements	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure	ETC Wkbk.Calc	
									Time	ID	
1		F150W	F356W	DEEP8	10	1	3	3	6055.538		
Special Requirements	Aperture PA Range 165 to 175 Degrees (V3 26.4254303 to 36.4254303)										
	No Parallel Attachments										
MSA Scheduled Aperture PA 175.0000 to 175.0000 Degrees (V3 36.42543 to 36.42543)											

Proposal 3073 - Observation 12 - Spectroscopic confirmation of an unexpected population of bright galaxies at cosmic dawn

Wed Apr 24 16:01:30 GMT 2024

Observation	Proposal 3073, Observation 12: PA 175 - V21 obs12 1 Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCам Imaging																																																												
	(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Visit 12:1) Warning (Form): The recommended value is 8 Reference Stars for this template.																																																												
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