



9947 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Cycle: 5, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
NIRSpec				
	1	j0314_p1_prism	NIRSpec MultiObject Spectroscopy	(1) PANO_j031404m1759_apr_v3
	2	j0314_p2_prism	NIRSpec MultiObject Spectroscopy	(1) PANO_j031404m1759_apr_v3
	3	j0144-pt1-29-full-v1	NIRSpec MultiObject Spectroscopy	(5) PANO_j014428p1715_hzmask

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
	4	j0218-pt1-36-full-v1	NIRSpec MultiObject Spectroscopy	(6) PANO_j021824m0517_hzmask
	5	j0332-pt1-79-full-v1	NIRSpec MultiObject Spectroscopy	(8) PANO_j033224m2756_hzmask

ABSTRACT

One of the biggest surprises in the first years of JWST has been the discovery of an unexpectedly large number of luminous ($M_{UV} \lesssim -20$), and potentially massive ($\log M > 9$) candidates very early in the Universe's history. These findings show a more than 10-fold excess of bright galaxies compared to pre-JWST models, suggesting more efficient star formation, different stellar populations, or other changing physics in the early Universe. However, while photometric redshifts have identified many $z > 9$ candidates, most sources exhibit secondary peaks in their redshift likelihoods. Spectroscopic follow-up is crucial to ruling out low-redshift contaminants such as obscured galaxies or faint AGN -- and to build a library of such spectra. Deep NIRSpec observations have proven very successful to confirm galaxies at $z > 9$, including the luminous GSz14 at $z = 14.18$. Its implied past star-formation history shows that progenitor galaxies as bright as $M_{UV} \sim -19.5$ existed out to $z \sim 18$. Here, we propose to confirm such sources. In particular, we exploit NIRCам pure parallel imaging data, which has the unique power to identify overdense lines-of-sight containing several luminous $z > 9$ candidates at the same time. These fields make NIRSpec multi-object spectroscopy particularly efficient, allowing us to target up to 50 luminous galaxies with $M_{UV} < -19.5$ at $z > 9$, including several promising candidates up to $z \sim 15-17$. Our program has the promise of characterizing the most overdense regions in the early Universe and to reveal the physical properties of a statistical sample of luminous $z > 9$ sources.

OBSERVING DESCRIPTION

The primary goal of this program is to obtain spectroscopic redshift confirmations of bright high-redshift galaxy candidates. We will achieve this with 3.5hr deep NIRSpec/prism observations. No pre-imaging is required, as these sources all have been identified in the NIRCам images of key legacy fields, which were aligned to Gaia DR3.

NIRSpec exposures:

The observing strategy for the MSA consists of 3 nods in 3 slitlet slits, which we repeat 3 times. We are taking a series of 19 groups of integrations and 1 integration per exposure with the NRSIRS2 readout mode, resulting in a total science time of 12605s, or 3.5hrs per mask. This same strategy will be repeated for each of our five masks in the four PANORAMIC fields. Our tests show that we can target up to ~ 50 $z > 9$ galaxies. The MSA mask design will be finalized once the VPA3 angle of JWST is assigned. We have no particular constraints and can safely avoid the micro meteorites.

Background Limited Special Requirement:

One of the requirements of our program is to measure faint continuum spectra, at $\sim 2.0\text{-}4.5\mu\text{m}$. The peak S/N at this wavelength changes by $>16\%$ between the lowest and highest background conditions for one of our pointings, and $>8\%$ for two others. We thus set the Background-Limited Special requirement. This still ensures large enough scheduling windows.

Proposal 9947 - Targets - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	PANO_j031404m1759_apv3	RA: 03 14 2.4145 (48.5100604d) Dec: -17 58 39.07 (-17.97752d) Equinox: J2000		
	Comments: Description=[]				
	(5)	PANO_j014428p1715_hzmask	RA: 01 44 26.0795 (26.1086646d) Dec: +17 14 31.55 (17.24210d) Equinox: J2000		
	Comments: Description=[]				
	(6)	PANO_j021824m0517_hzmas k	RA: 02 18 24.0025 (34.6000104d) Dec: -05 17 21.75 (-5.28938d) Equinox: J2000		
	Comments: Description=[]				
	(8)	PANO_j033224m2756_hzmas k	RA: 03 32 17.4972 (53.0729050d) Dec: -27 58 37.91 (-27.97720d) Equinox: J2000		
	Comments: Description=[]				

Proposal 9947 - Observation 1 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Observation	Proposal 9947, Observation 1: j0314_p1_prism										Fri Aug 07 15:00:39 GMT 2026										
	Diagnostic Status: Warning																				
	Observing Template: NIRSpec MultiObject Spectroscopy																				
Diagnostics	(j0314_p1_prism (Obs 1)) Warning (Form): Config c1 (#1) has 6 primary slit traces affected by failed open shutters.																				
	(j0314_p1_prism (Obs 1)) Warning (Form): Config c1 (#2) has 6 primary slit traces affected by failed open shutters.																				
	(j0314_p1_prism (Obs 1)) Warning (Form): Config c1 (#3) has 6 primary slit traces affected by failed open shutters.																				
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.																				
	(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.																				
Fixed Targets	<table><tr><th>#</th><th>Name</th><th>Target Coordinates</th><th>Targ. Coord. Corrections</th><th>Miscellaneous</th></tr><tr><td>(1)</td><td>PANO_j031404m1759_apr_v3</td><td>RA: 03 14 2.4145 (48.5100604d) Dec: -17 58 39.07 (-17.97752d) Equinox: J2000</td><td></td><td></td></tr></table>											#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous	(1)	PANO_j031404m1759_apr_v3	RA: 03 14 2.4145 (48.5100604d) Dec: -17 58 39.07 (-17.97752d) Equinox: J2000		
	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous																
	(1)	PANO_j031404m1759_apr_v3	RA: 03 14 2.4145 (48.5100604d) Dec: -17 58 39.07 (-17.97752d) Equinox: J2000																		
Comments: Description=[]																					
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID										
	1	Filter: CLEAR; Readout: NRSRAPIDD1; 8 sources in 4 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD1	3	1	4	257.682											
Template	TA Method		HFF Readout Mode		Obtain Confirmation Images	Science Aperture	Primary Candidate List		Filler Candidate List		Spectral Overlap Map	Spectral Overlap Threshold									
	MSATA		false		After Target ACQ	MSA Center	PANO_j031404m1759_apr_v3 (4501 sources)				jwst-nirspec-prism	1.5									
Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude											
	1	2865	48.511408	-17.955705	22.31911800133712	1	5959	48.489289	-17.986608	22.332156581260932											
	1	3564	48.520991	-17.962775	23.01971766391789	1	6736	48.527155	-17.993509	23.846032889627175											
	1	4186	48.519953	-17.968284	23.76596122049221	1	7014	48.496430	-17.996509	23.831210262940797											
	1	5009	48.519766	-17.976031	22.4167157290876	1	9001	48.517728	-18.013263	23.28924763571052											
Confirmation	#	Confirmation Type		Conf. Readout Pattern		Conf. Groups/Int		Conf. Integrations/Exp		Conf. Total Integrations		Conf. Total Exposure Time									
	1	After Target Acq		NRSIRS2RAPID		5		1		1		87.533									

Proposal 9947 - Observation 1 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

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 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.511208541666 67 Degrees - 17.991440000000 01 Degrees	54.088006935876 855			3	3	4201.6
	2	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.511208541666 67 Degrees - 17.991440000000 01 Degrees	54.088006935876 855			3	3	4201.6
	3	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.511208541666 67 Degrees - 17.991440000000 01 Degrees	54.088006935876 855			3	3	4201.6
Special Requirements	Background Limited. Background no more than 30th percentile above minimum MSA Scheduled Aperture PA 54.0884 to 54.0884 Degrees (V3 275.51382 to 275.51382)										

Proposal 9947 - Observation 2 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Observation	Proposal 9947, Observation 2: j0314_p2_prism										Fri Aug 07 15:00:39 GMT 2026
	Diagnostic Status: Warning										
	Observing Template: NIRSpec MultiObject Spectroscopy										
Diagnostics	(j0314_p2_prism (Obs 2)) Warning (Form): Config c1 (#1) has 6 primary slit traces affected by failed open shutters.										
	(j0314_p2_prism (Obs 2)) Warning (Form): Config c1 (#2) has 6 primary slit traces affected by failed open shutters.										
	(j0314_p2_prism (Obs 2)) Warning (Form): Config c1 (#3) has 6 primary slit traces affected by failed open shutters.										
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
	(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(1)	PANO_j031404m1759_apr_v3	RA: 03 14 2.4145 (48.5100604d) Dec: -17 58 39.07 (-17.97752d) Equinox: J2000								
	Comments: Description=[]										
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
	1	Filter: CLEAR; Readout: NRSRAPIDD6; 8 sources in 4 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	
Template	TA Method	HFF Readout Mode		Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List		Spectral Overlap Map		Spectral Overlap Threshold
	MSATA	false		After Target ACQ	MSA Center	PANO_j031404m1759_apr_v3 (4501 sources)		jwst-nirspec-prism		1.5	
Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude	
	1	783	48.529514	-17.934631	24.652344536845415	1	2833	48.528782	-17.955114	24.808991826463945	
	1	1520	48.534300	-17.943928	23.305671503929695	1	4544	48.498611	-17.971731	24.541701298416736	
	1	2504	48.500083	-17.952266	23.75367479252123	1	4782	48.495516	-17.973755	24.778417896012954	
	1	2761	48.526143	-17.954355	23.913078252473333	1	5119	48.517011	-17.977271	24.064450228898487	
Confirmation	#	Confirmation Type		Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp		Conf. Total Integrations		Conf. Total Exposure Time	
	1	After Target Acq		NRSIRS2RAPID	4	1		1		72.944	

Proposal 9947 - Observation 2 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

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 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.5134215 Degrees - 17.950735555555 525 Degrees	54.066888933272 15			3	3	4201.6
	2	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.5134215 Degrees - 17.950735555555 525 Degrees	54.066888933272 15			3	3	4201.6
	3	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	48.5134215 Degrees - 17.950735555555 525 Degrees	54.066888933272 15			3	3	4201.6
Special Requirements	Background Limited. Background no more than 30th percentile above minimum MSA Scheduled Aperture PA 54.0679 to 54.0679 Degrees (V3 275.4933 to 275.4933)										

Proposal 9947 - Observation 3 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Observation	Proposal 9947, Observation 3: j0144-pt1-29-full-v1										Fri Aug 07 15:00:39 GMT 2026	
	Diagnostic Status: Error											
Observing Template: NIRSpec MultiObject Spectroscopy												
Diagnostics	(j0144-pt1-29-full-v1 (Obs 3)) Error (Form): This observation was created with an Aperture PA of 29.0000 but it has been assigned an Aperture PA of 24.0402											
	(Aperture PA) Error (Form): This observation was created with an Aperture PA of 29.0000 but it has been assigned an Aperture PA of 24.0402											
	(Visit 3:1) Error (Form): Reference stars are required but none were found for this visit											
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(Visit 3:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.											
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous			
	(5)	PANO_j014428p1715_hzmask	RA: 01 44 26.0795 (26.1086646d) Dec: +17 14 31.55 (17.24210d) Equinox: J2000									
Comments: Description=[]												
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	
	1		SAME	F140X	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788		
Template	TA Method		HFF Readout Mode		Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List		Spectral Overlap Map	Spectral Overlap Threshold	
	MSATA		false		After Target ACQ	MSA Center	primary (73 sources)		jwst-nirspec-prism		1.5	
Reference Stars												
Confirmation	#	Confirmation Type		Conf. Readout Pattern		Conf. Groups/Int		Conf. Integrations/Exp		Conf. Total Integrations		Conf. Total Exposure Time
	1	After Target Acq		NRSIRS2RAPID		5		1		1		87.533

Proposal 9947 - Observation 3 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

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 (PRISM/CLEAR)	c1	3 Shutter Slitlet	26.111264541666 667 Degrees 17.227278055555 555 Degrees	24.040909420333 705			3	3	4201.6
	2	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	26.111264541666 667 Degrees 17.227278055555 555 Degrees	24.040909420333 705			3	3	4201.6
	3	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	26.111264541666 667 Degrees 17.227278055555 555 Degrees	24.040909420333 705			3	3	4201.6
Special Requirements	Background Limited. Background no more than 30th percentile above minimum MSA Scheduled Aperture PA 24.0402 to 24.0402 Degrees (V3 245.4656 to 245.4656)										

Proposal 9947 - Observation 4 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Observation	Proposal 9947, Observation 4: j0218-pt1-36-full-v1										Fri Aug 07 15:00:39 GMT 2026
	Diagnostic Status: Error										
Observing Template: NIRSpec MultiObject Spectroscopy											
Diagnostics	(j0218-pt1-36-full-v1 (Obs 4)) Error (Form): This observation was created with an Aperture PA of 36.0000 but it has been assigned an Aperture PA of 39.1339										
	(Aperture PA) Error (Form): This observation was created with an Aperture PA of 36.0000 but it has been assigned an Aperture PA of 39.1339										
	(Visit 4:1) Error (Form): Reference stars are required but none were found for this visit										
	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
	(Visit 4:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(6)	PANO_j021824m0517_hzmas k	RA: 02 18 24.0025 (34.6000104d) Dec: -05 17 21.75 (-5.28938d) Equinox: J2000								
Comments: Description=[]											
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
	1		SAME	F140X	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	
Template	TA Method	HFF Readout Mode		Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List		Spectral Overlap Map		Spectral Overlap Threshold
	MSATA	false		After Target ACQ	MSA Center	primary (31 sources)				jwst-nirspec-prism	1.5
Reference Stars											
Confirmation	#	Confirmation Type		Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp		Conf. Total Integrations		Conf. Total Exposure Time	
	1	After Target Acq		NRSIRS2RAPID	5	1		1		87.533	

Proposal 9947 - Observation 4 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

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 (PRISM/CLEAR)	c1	3 Shutter Slitlet	34.604951791666 664 Degrees - 5.268547222221 96 Degrees	39.133454639694 01			3	3	4201.6
	2	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	34.604951791666 664 Degrees - 5.268547222221 96 Degrees	39.133454639694 01			3	3	4201.6
	3	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	34.604951791666 664 Degrees - 5.268547222221 96 Degrees	39.133454639694 01			3	3	4201.6
Special Requirements	Background Limited. Background no more than 30th percentile above minimum MSA Scheduled Aperture PA 39.1339 to 39.1339 Degrees (V3 260.5593 to 260.5593)										

Proposal 9947 - Observation 5 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

Observation	Proposal 9947, Observation 5: j0332-pt1-79-full-v1										Fri Aug 07 15:00:39 GMT 2026
	Diagnostic Status: Error										
Observing Template: NIRSpec MultiObject Spectroscopy											
Diagnostics	(j0332-pt1-79-full-v1 (Obs 5)) Error (Form): This observation was created with an Aperture PA of 79.0000 but it has been assigned an Aperture PA of 158.0261										
	(Aperture PA) Error (Form): This observation was created with an Aperture PA of 79.0000 but it has been assigned an Aperture PA of 158.0261										
	(Visit 5:1) Error (Form): Reference stars are required but none were found for this visit										
	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(8)	PANO_j033224m2756_hzmas k	RA: 03 32 17.4972 (53.0729050d) Dec: -27 58 37.91 (-27.97720d) Equinox: J2000								
Comments: Description=[]											
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
	1		SAME	F140X	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	
Template	TA Method	HFF Readout Mode		Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List		Spectral Overlap Map		Spectral Overlap Threshold
	MSATA	false		After Target ACQ	MSA Center	primary (73 sources)		jwst-nirspec-prism		1.5	
Reference Stars											
Confirmation	#	Confirmation Type		Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp		Conf. Total Integrations		Conf. Total Exposure Time	
	1	After Target Acq		NRSIRS2RAPID	5	1		1		87.533	

Proposal 9947 - Observation 5 - Spectroscopic Exploration of Luminous $z > 9$ Galaxies: Revealing Early Overdensity Peaks with JWST

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 (PRISM/CLEAR)	c1	3 Shutter Slitlet	53.056301666666 66 Degrees - 27.991920833333 324 Degrees	158.03388538083 416			3	3	4201.6
	2	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	53.056301666666 66 Degrees - 27.991920833333 324 Degrees	158.03388538083 416			3	3	4201.6
	3	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	53.056301666666 66 Degrees - 27.991920833333 324 Degrees	158.03388538083 416			3	3	4201.6
Special Requirements	MSA Scheduled Aperture PA 158.0261 to 158.0261 Degrees (V3 19.451542 to 19.451542)										