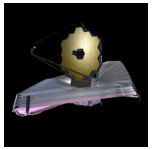

4903 - Early Quiescent Galaxies Under the Magnifying Glass

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	S1522 IFU	NIRSpec IFU Spectroscopy	(3) MRGS1522
	2	S1522 Imaging	NIRCam Imaging	(3) MRGS1522
	3	M2129 IFU	NIRSpec IFU Spectroscopy	(9) MRGM2129-IFU
	4	M2129 Imaging	NIRCam Imaging	(4) MRGM2129
	5	P0918 IFU	NIRSpec IFU Spectroscopy	(2) MRGP0918
	6	P0918 Imaging	NIRCam Imaging	(2) MRGP0918
	7	M0150 IFU	NIRSpec IFU Spectroscopy	(1) MRGM0150
	8	M0150 Imaging	NIRCam Imaging	(1) MRGM0150

ABSTRACT

Star formation had shut down in a significant fraction of massive galaxies by z ~ 2. We still lack a firm understanding of the processes that ended star formation and prevent future activity, as well as their relationship to morphological change and black hole growth. A significant advance requires detailed, spatially resolved information that can be gleaned only through IFU spectroscopy. Yet this is a challenge, even with JWST, due to these galaxies' compact sizes. We propose to overcome this limitation via deep NIRSpec IFU spectroscopy and brief NIRCam imaging of 4 gravitationally lensed and exceptionally bright quiescent galaxies at z=2.1-2.6, all seen within ~1 Gyr after quenching. We will (1) spatially resolve detailed star formation histories and multi-element stellar abundances, testing proposed quenching models by constraining when, where, and how quickly quenching proceeded; (2) resolve the stellar kinematics of recently quenched galaxies to determine how much morphological transformation into ellipticals accompanied quenching; (3) test the exciting suggestion that early quiescent galaxies, like local "relic" galaxies proposed to be their analogs, host overmassive black holes by searching for their dynamical signature; and (4) map the ubiquitous ionized gas that appears to be shock heated, along with any neutral ISM or outflows, thereby shedding light on the suppression of star formation at high redshifts. These rich and detailed insights into early quiescent galaxies' formation history, chemistry, structure, kinematics, ISM, outflows, and black holes are possible only by coupling lensing with the resolution, sensitivity, and wavelength coverage of JWST.

OBSERVING DESCRIPTION

We propose NIRSpec IFU observations of 4 lensed quiescent galaxies using the G140M and G235M gratings for each target. The total IFU science exposure time ranges from ~7-10 hr per target. We use the NRSIRS2 readout pattern and an 8- or 9-point small cycling dither pattern to improve sampling of the PSF, and to provide redundancy to mitigate contamination from stuck-open MSA shutters and other sources. We will use blank sky within the field of view for background subtraction. In some cases, small OFFSET requirements are intended to increase the available blank sky. V3PA requirements are imposed on some targets to maximize the area of the target contained within the FOV. We also restricted the V3PA for MRG-P0918 to avoid placing particularly bright (H < 9) stars on the MSA.

We will use WATA acquisition to accurately place the extended sources within the FOV. APT raises warnings about the separation of the offset star and target in several cases, but we always found that the guide star availability was not a limiting factor on the schedulable time in the Visit Planner, and so were advised to ignore these warnings.

We also propose relatively short NIRCam images of each target using four filters. We will use the INTRAMODULEBOX 3-point primary dither pattern to mitigate any detector artifacts that could fall near the target of interest. We added small offsets (-10" in X and Y) to ensure that the targets (typical extent ~3 arcsec) fall well within the fully exposed region regardless of the V3PA.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MRGM0150	RA: 01 50 20.1090 (27.5837875d) Dec: -10 05 32.80 (-10.09244d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[High-redshift galaxies]* *Extended=YES*				
(2)	MRGP0918	RA: 09 18 34.0760 (139.6419833d) Dec: -81 03 8.43 (-81.05234d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[High-redshift galaxies]* *Extended=YES*				
(3)	MRGS1522	RA: 15 22 53.5940 (230.7233083d) Dec: +25 35 48.60 (25.59683d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[High-redshift galaxies]* *Extended=YES*				
(4)	MRGM2129	RA: 21 29 22.3510 (322.3431292d) Dec: -07 41 31.17 (-7.69199d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[High-redshift galaxies]* *Extended=YES*				
(5)	MRGM0150STAR	RA: 01 50 19.3860 (27.5807750d) Dec: -10 05 2.13 (-10.08393d) Equinox: J2000	Proper Motion RA: 5.4 mas/yr Proper Motion Dec: -14.9 mas/yr Epoch of Position: 2019.76	
Comments: *Category=Star* *Description=[Disk stars]* *Extended=NO*				
(6)	MRGP0918STAR	RA: 09 18 36.1940 (139.6508083d) Dec: -81 03 9.65 (-81.05268d) Equinox: J2000	Proper Motion RA: 12.0 mas/yr Proper Motion Dec: 10.9 mas/yr Parallax: 0.0004" Epoch of Position: 2015.93	
Comments: *Category=Star* *Description=[Disk stars]* *Extended=NO*				
(7)	MRGS1522STAR	RA: 15 22 53.7890 (230.7241208d) Dec: +25 35 37.58 (25.59377d) Equinox: J2000	Proper Motion RA: -1.85 mas/yr Proper Motion Dec: -3.33 mas/yr Parallax: 0.0004" Epoch of Position: 2019.62	
Comments: *Category=Star* *Description=[Disk stars]* *Extended=NO*				

	(8)	MRGM2129STAR	RA: 21 29 23.5759 (322.3482329d) Dec: -07 41 43.67 (-7.69546d) Equinox: J2000	Proper Motion RA: 6.6 mas/yr Proper Motion Dec: -0.006 mas/yr Parallax: 0.0006" Epoch of Position: 2024.76
	Comments: *Category=Star* *Description=[Disk stars]* *Extended=NO*			
	(9)	MRGM2129-IFU	RA: 21 29 22.3427 (322.3430946d) Dec: -07 41 30.91 (-7.69192d) Equinox: J2000	
	Comments: *Category=Galaxy* *Description=[High-redshift galaxies]* *Extended=YES*			

Observation

Proposal 4903, Observation 1: S1522 IFU

Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(S1522 IFU (Obs 1)) Warning (Form): The slew between the acquisition exposure and the farthest science exposure is 44.058 Arcsec (larger than the recommended limit of 40.000 Arcsec) and may result in reduced or no schedulability. See more information in the diagnostic browser.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	MRGS1522	RA: 15 22 53.5940 (230.7233083d) Dec: +25 35 48.60 (25.59683d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	7 MRGS1522STAR	WATA	SUB2048	F110W	NRSRAPID	3	1	1	3.628	177539

Template

HFF Readout Mode
false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	8	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	25	1	false	true	NONE	8	8	14705.601	171757
2	G235M/F170LP	NRSIRS2	17	1	false	true	NONE	8	8	10037.156	

Special Requirements	Offset -0.3 arcsec, -0.3 arcsec

Observation

Proposal 4903, Observation 2: S1522 Imaging Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam 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
(3)	MRGS1522	RA: 15 22 53.5940 (230.7233083d) Dec: +25 35 48.60 (25.59683d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	3	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	F444W	SHALLOW4	6	1	3	3	934.099	177541
2	F115W	F277W	MEDIUM8	6	1	3	3	1868.198	

Special Requirements

Offset -10.0 arcsec, -10.0 arcsec

Observation

Proposal 4903, Observation 3: M2129 IFU Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(M2129 IFU (Obs 3)) Warning (Form): The slew between the acquisition exposure and the farthest science exposure is 54.790 Arcsec (larger than the recommended limit of 50.000 Arcsec) and may result in reduced or no schedulability. See more information in the diagnostic browser.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(9)	MRGM2129-IFU	RA: 21 29 22.3427 (322.3430946d) Dec: -07 41 30.91 (-7.69192d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	8 MRGM2129STAR	WATA	SUB32	F110W	NRSRAPIDD6	3	1	1	0.26	177539

Template

HFF Readout Mode
false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	8	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	21	2	false	true	NONE	8	16	24742.757	171757
2	G235M/F170LP	NRSIRS2	21	1	false	true	NONE	8	8	12371.379	

Observation

Proposal 4903, Observation 4: M2129 Imaging Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam 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
(4)	MRGM2129	RA: 21 29 22.3510 (322.3431292d) Dec: -07 41 31.17 (-7.69199d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	3	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	F444W	SHALLOW4	7	1	3	3	1095.151	177541
2	F115W	F277W	MEDIUM8	6	1	3	3	1868.198	

Special Requirements

Offset -10.0 arcsec, -10.0 arcsec

Observation

Proposal 4903, Observation 5: P0918 IFU

Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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
(2)	MRGP0918	RA: 09 18 34.0760 (139.6419833d) Dec: -81 03 8.43 (-81.05234d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	6 MRGP0918STAR	WATA	SUB32	F110W	NRSRAPIDD6	3	1	1	0.26	177539

Template

HFF Readout Mode
false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	8	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	24	1	false	true	NONE	8	8	14122.046	171757
2	G235M/F170LP	NRSIRS2	23	1	false	true	NONE	8	8	13538.49	

Special Requirements	
	Aperture PA Range 13.97164917 to 22.97164917 Degrees (V3 235.0 to 244.0) Aperture PA Range 142.97164917 to 163.97164917 Degrees (V3 4.0 to 25.0) Aperture PA Range 244.97164917 to 295.97164917 Degrees (V3 106.0 to 157.0) Aperture PA Range 315.97164917 to 337.97164917 Degrees (V3 177.0 to 199.0) Offset -0.4 arcsec, 0.1 arcsec

Observation

Proposal 4903, Observation 6: P0918 Imaging Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MRGP0918	RA: 09 18 34.0760 (139.6419833d) Dec: -81 03 8.43 (-81.05234d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	3	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	F444W	SHALLOW4	6	1	3	3	934.099	177541
2	F115W	F277W	MEDIUM8	6	1	3	3	1868.198	

Special Requirements

Offset -10.0 arcsec, -10.0 arcsec

Observation

Proposal 4903, Observation 7: M0150 IFU Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(M0150 IFU (Obs 7)) Warning (Form): The slew between the acquisition exposure and the farthest science exposure is 60.034 Arcsec (larger than the recommended limit of 40.000 Arcsec) and may result in reduced or no schedulability. See more information in the diagnostic browser.

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 7:1) 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)	MRGM0150	RA: 01 50 20.1090 (27.5837875d) Dec: -10 05 32.80 (-10.09244d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	5 MRGM0150STAR	WATA	SUB2048	F110W	NRSRAPID	3	1	1	3.628	177539

Template

HFF Readout Mode
false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	9	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	24	1	false	true	NONE	9	9	15887.301	171757
2	G235M/F170LP	NRSIRS2	24	1	false	true	NONE	9	9	15887.301	

Special Requirements	Aperture PA Range 18.97164917 to 58.97164917 Degrees (V3 240.0 to 280.0) Aperture PA Range 205.97164917 to 213.97164917 Degrees (V3 67.0 to 75.0)

Observation

Proposal 4903, Observation 8: M0150 Imaging Mon Mar 03 14:00:24 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MRGM0150	RA: 01 50 20.1090 (27.5837875d) Dec: -10 05 32.80 (-10.09244d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[High-redshift galaxies]
Extended=YES

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	3	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	F444W	SHALLOW4	8	1	3	3	1256.202	177541
2	F115W	F277W	MEDIUM8	6	1	3	3	1868.198	

Special Requirements

Offset -10.0 arcsec, -10.0 arcsec