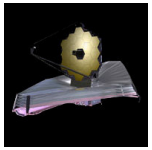

2073 - Towards Tomographic Mapping of Reionization Epoch Quasar Light-Echoes with JWST

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
J0252-0503				
	1	J0252 Pre-imaging	NIRCam Imaging	(2) DESJ0252-0503
	2	J0252_p0_v2	NIRSpec MultiObject Spectroscopy	(13) J0252-eMPT-target-pointing0
	7	J0252_p1_v2	NIRSpec MultiObject Spectroscopy	(14) J0252-eMPT-target-pointing1
J1007+2115				
	3	J1007 Pre-imaging	NIRCam Imaging	(1) J1007+2115
	6	J1007_pointing0	NIRSpec MultiObject Spectroscopy	(10) J1007-eMPT-target-pointing0

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	8	J1007_pointing1_upd	NIRSpec MultiObject Spectroscopy	(12) J1007-eMPT-target-pointing1-upd

ABSTRACT

The existence of luminous quasars at z>7, just 800 Myr after the Big Bang challenges our understanding of supermassive black hole (SMBH) growth. In the standard picture, there is not enough time to grow their > 10^9 M_sun SMBHs unless one invokes initial seeds >1000 M_sun formed via exotic processes. During the epoch of reionization, the quasar radiation sources a cosmological-scale HII region encoding its radiative history. Careful analysis of these proximity zones along the quasar sightline reveals a puzzling discrepancy. The quasar lifetimes are far too short to grow their SMBHs, implying at z >

7 either: 1) SMBHs grow faster than allowed by general relativity and the Eddington limit, obviating the need for massive seeds, or 2) the bulk of SMBH growth is enshrouded by dust. This degeneracy, inherent to 1D measurements along the quasar line-of-sight, can be broken using background (b/g) galaxies as Ly-alpha absorption probes to tomographically map the 'light-echo' produced by the foreground (f/g) quasar in 3D. We propose to combine NIRCam imaging with a powerful NIRSpec/MSA redshift survey to confirm 60 galaxies around two z > 7 quasars. This will set the stage for future deep integrations to definitively detect their light-echoes providing fundamentally new insights about SMBH growth possible only with JWST. The requested data will also: 1) enable the first measurement of quasar clustering at z > 7, providing a totally independent constraint on the quasar lifetime, 2) characterize the Ly-alpha fraction for a sample of 20 galaxies in the overdense quasar environment, 3) confirm 20 f/g galaxies to be correlated with absorption lines in the b/g quasar spectra.ansa

OBSERVING DESCRIPTION

We target two of the highest redshift quasars known, J0252-0503 at z =7.00 and J1007+2115 at z = 7.51. Both quasars will be observed with NIRCam to obtain imaging to photometrically select galaxies. Galaxies selected from these NIRCam images will be targeted for spectroscopy with the NIRSpec/MSA with the PRISM/CLEAR disperser-filter combination. At fixed depth, the number of galaxies expected for the higher z=7.51 J1007+2115 are slightly lower than for J0252-0503 at z=7.00, so so we have increased the NIRCam imaging and NIRSpec/MSA exposure times by factors of 1.5 and 1.6, respectively. Below we summarize the observing plan for each observing mode.

1. NIRCam imaging: Two quasars observed with a total of 16 visits, 7.0hr science, 13hr total charged.

We will observe with two SW-LW setups, F090W-F277W and F115W-444W, with equal exposure time in each. As these images will be used to target galaxies with the NIRSpec/MSA, we adopt the 8NIRSPEC 8-point dither pattern, which results in 8 visits per quasar. Our detector setup is MEDIUM8 readout, with 6 (9) groups per integration, amounting to 623s (945s) per exposure, yielding a total science time 9968s or 2.8 hr (15120 or

4.2hr) and total NIRCAM charged time 20484s or 5.7hr (26331s or 7.3hr), for J0252-0503 (J1007+2115).

2. NIRSpec/MSA Spectroscopy: Two quasars observed with a total of 2 visits, 6.3hr science, 11.3hr total charged.

For the NIRSpec/MSA PRISM spectra of both quasar targets we adopt two MSA configuratinos, and the 3 Shutter Slitlet Nod pattern. For J0252-0503 (J1007+2115), we will perform 1 (2) 100 (80) group integrations at each of the 3 nod positions for each of 2 MSA configurations, giving a total of 6 (12) exposures. This resulting exposure time per MSA configuration is 4420s (7090s) per MSA configuration, or a total science time of 8754s or 2.4hr (14010s or 3.9hr). The total NIRSpec charged time is 17308 or 4.8hr (23514s or 6.5hr).

3. Parallel Observations with NIRCam during primary NIRSpec/MSA spetroscopy: Two quasars observed for a total science time of 5.9hr

We will observe with two SW-LW setups, F090W-F277W and F115W-444W, with equal exposure time in each, which is the same strategy used for our primary NIRCam science observations. For J0252-0503 (J1007+2115) our detector setup is DEEP8 (MEDIUM8) with 7 (7) groups per integration, 1 (3) integrations per NIRSpec nod position, amounting to 1374s (737s) per exposure, and a total science time of 8250s or 2.3hr (13146s or 3.7hr).

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	J1007+2115	RA: 10 07 58.2640 (151.9927667d) Dec: +21 15 29.21 (21.25811d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Quasars]* *Extended=NO*				
(2)	DESJ0252-0503	RA: 02 52 16.6400 (43.0693333d) Dec: -05 03 31.80 (-5.05883d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Quasars]* *Extended=NO*				
(10)	J1007-eMPT-target-pointing0	RA: 10 07 58.5530 (151.9939708d) Dec: +21 15 19.95 (21.25554d) Equinox: J2000		
Comments: *Description=[]*				
(12)	J1007-eMPT-target-pointing1-upd	RA: 10 07 59.3895 (151.9974563d) Dec: +21 15 57.51 (21.26598d) Equinox: J2000		
Comments: *Description=[]*				
(13)	J0252-eMPT-target-pointing0	RA: 02 52 16.2532 (43.0677217d) Dec: -05 03 21.02 (-5.05584d) Equinox: J2000		
Comments: *Description=[]*				
(14)	J0252-eMPT-target-pointing1	RA: 02 52 16.4909 (43.0687121d) Dec: -05 02 57.24 (-5.04923d) Equinox: J2000		
Comments: *Description=[]*				

Observation

Proposal 2073, Observation 1: J0252 Pre-imaging

Wed Jul 12 23:00:51 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.
(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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	DESJ0252-0503	RA: 02 52 16.6400 (43.0693333d) Dec: -05 03 31.80 (-5.05883d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Quasars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
2	1	-5.0	0.0	-1.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	6	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	F090W	F277W	SHALLOW4	8	1	6	6	2512.404	
2	F115W	F444W	SHALLOW4	8	1	6	6	2512.404	

Special Requirements	
	Group Visits within 53.0 Days Visits Same PA No Parallel Attachments Background Limited. Background no more than 40th percentile above minimum

Observation

Proposal 2073, Observation 2: J0252_p0_v2 Wed Jul 12 23:00:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): NIRCam Imaging

Diagnostics

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

(Visit 2:1) Warning (Form): The recommended value is 8 Reference Stars for this template.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(13)	J0252-eMPT-target-pointing0	RA: 02 52 16.2532 (43.0677217d) Dec: -05 03 21.02 (-5.05584d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	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: NRSRAPIDD6; 5 sources in 3 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
Obtain Confirmation Images: No	Subarray: FULL
Science Aperture: MSA Center	Target Placement: Module Gap
Primary Candidate List: targets-p0 (161 sources)	
Filler Candidate List: null	
Spectral Overlap Map: jwst-nirspec-prism	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	5852	43.088695	-5.041873	25.28329590723638	1	14338	43.084153	-5.087149	25.415336436335703
1	9420	43.059994	-5.062675	25.62261652023286	1	14931	43.084703	-5.089944	24.79600785120441
1	10663	43.052137	-5.069094	24.23733990345862					

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	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)	shutter_mask	3 Shutter Slitlet	43.069407916666 66 Degrees - 5.0567861111111 37 Degrees	207.57442449889 325			3	3	2450.934

Spectral Elements

NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F090W	F277W	MEDIUM8	7	1	3	3	2190.301	

Special Requirements

No Parallel Attachments
MSA Scheduled Aperture PA 207.5746 to 207.5746 Degrees (V3 69.0 to 69.0)

Observation

Proposal 2073, Observation 7: J0252_p1_v2 Wed Jul 12 23:00:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): NIRCam Imaging

Diagnostics

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

(Visit 7:1) Warning (Form): The recommended value is 8 Reference Stars for this template.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(14)	J0252-eMPT-target-pointing1	RA: 02 52 16.4909 (43.0687121d) Dec: -05 02 57.24 (-5.04923d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	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: NRSRAPIDD6; 7 sources in 4 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
Obtain Confirmation Images: No	Subarray: FULL
Science Aperture: MSA Center	Target Placement: Module Gap
Primary Candidate List: targets-p1 (159 sources)	
Filler Candidate List: null	
Spectral Overlap Map: jwst-nirspec-prism	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	2240	43.067283	-5.023228	25.67630592080578	1	8389	43.074589	-5.056814	23.87048743897908
1	4101	43.087727	-5.032579	25.4861264284759	1	9268	43.079633	-5.061738	25.65828160291772
1	7253	43.056922	-5.050264	25.454337123478624	1	10051	43.071652	-5.065981	23.41215170972294
1	8163	43.049901	-5.055403	25.576683884455285					

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	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)	shutter_mask	3 Shutter Slitlet	43.06924166666666 Degrees -5.043405555555 8 Degrees	33.33419372757354			3	3	2450.934

Spectral Elements

NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	MEDIUM8	7	1	3	3	2190.301	

Special Requirements

No Parallel Attachments
MSA Scheduled Aperture PA 33.3342 to 33.3342 Degrees (V3 254.75966 to 254.75966)

Observation

Proposal 2073, Observation 3: J1007 Pre-imaging Wed Jul 12 23:00:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 3:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	J1007+2115	RA: 10 07 58.2640 (151.9927667d) Dec: +21 15 29.21 (21.25811d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Quasars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
2	1	-5.0	10.0	1.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	6	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	F090W	F277W	MEDIUM8	6	1	6	6	3736.396	
2	F115W	F444W	MEDIUM8	6	1	6	6	3736.396	

Special Requirements	
	Sequence Visits within 53.0 Days Visits Same PA Background Limited. Background no more than 40th percentile above minimum 6 After 3 by 60.0 Days to <None specified>

Observation

Proposal 2073, Observation 6: J1007_pointing0 Wed Jul 12 23:00:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): 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
(10)	J1007-eMPT-target-pointing0	RA: 10 07 58.5530 (151.9939708d) Dec: +21 15 19.95 (21.25554d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	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: NRSRAPIDD6; 8 sources in 4 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
Obtain Confirmation Images: No	Subarray: FULL
Science Aperture: MSA Center	Target Placement: Module Gap
Primary Candidate List: primary_pointing0 (123 sources)	
Filler Candidate List: null	
Spectral Overlap Map: jwst-nirspec-prism	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	6604	151.993001	21.274104	24.97240347931823	1	8438	152.008050	21.265549	25.05032142289249
1	7364	151.967820	21.270504	24.57672846874432 4	1	12028	152.016881	21.248056	23.47572272606864
1	8023	152.006820	21.267340	24.24653829438698 7	1	14957	151.981576	21.233146	24.96191951622798
1	8220	151.966578	21.266409	24.34300912517617 7	1	15364	151.978152	21.230975	25.12119865638780 4

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	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)	shutter_mask**	3 Shutter Slitlet	151.99014708333334 Degrees 21.2473 Degrees	253.0381526823095			3	6	4901.867

Spectral Elements

NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F090W	F277W	MEDIUM8	7	2	6	3	4412.812	

Special Requirements

No Parallel Attachments
MSA Scheduled Aperture PA 253.0395 to 253.0395 Degrees (V3 114.46495 to 114.46495)

6 After 3 by 60.0 Days to <None specified>

Observation

Proposal 2073, Observation 8: J1007_pointing1_upd Wed Jul 12 23:00:51 GMT 2023

Diagnostic Status: Error

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): NIRCam Imaging

Diagnostics

(J1007_pointing1_upd (Obs 8)) Error (Form): This observation was created with an Aperture PA of 253.0395 but it has been assigned an Aperture PA of 253.0392

(Aperture PA) Error (Form): This observation was created with an Aperture PA of 253.0395 but it has been assigned an Aperture PA of 253.0392

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(12)	J1007-eMPT-target-pointing1-upd	RA: 10 07 59.3895 (151.9974563d) Dec: +21 15 57.51 (21.26598d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	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: NRSRAPIDD1; 8 sources in 4 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD1	3	1	4	257.682	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
Obtain Confirmation Images: No	Subarray: FULL
Science Aperture: MSA Center	Target Placement: Module Gap
Primary Candidate List: primary_pointing1_upd (114 sources)	
Filler Candidate List: null	
Spectral Overlap Map: jwst-nirspec-prism	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	5017	152.018239	21.281744	23.853108169479746	1	11854	151.982291	21.248955	23.84020387798716
1	8808	151.969245	21.263560	24.249533405104398	1	12028	152.016881	21.248056	23.47572272606864
1	9439	152.022745	21.260122	22.57482885074911	1	12757	151.981452	21.243943	22.82775979731914
1	10674	152.030000	21.254540	24.193603267823026	1	14650	151.993938	21.234798	23.820988066224857

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	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)	shutter_mask**	3 Shutter Slitlet	151.99965 Degrees 21.267111111111 11 Degrees	253.04031169020973			3	6	4901.867

Spectral Elements

NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	MEDIUM8	7	2	6	3	4412.812	

Special Requirements

Aperture PA Range 253.0392 to 253.0392 Degrees (V3 114.4646303 to 114.4646303) [MSA Selected]
No Parallel Attachments
MSA Scheduled Aperture PA 253.0392 to 253.0392 Degrees (V3 114.4646303 to 114.4646303)