



3526 - Probing Reionization and Early Cosmic Enrichment with the MgII Forest

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>
Observation Folder				
	1	J0038-0653	NIRSpec Fixed Slit Spectroscopy	(1) QSO-J0038-0653
	2	J0313-1806	NIRSpec Fixed Slit Spectroscopy	(2) QSO-J0313-1806
	5	J1007+2115	NIRSpec Fixed Slit Spectroscopy	(4) QSO-J1007+2115
	7	J0038-1527	NIRSpec Fixed Slit Spectroscopy	(5) QSO-J003836.10-152723.6
	8	J0252-0503	NIRSpec Fixed Slit Spectroscopy	(6) QSO-J0252-0503
	12	J0410-0139	NIRSpec Fixed Slit Spectroscopy	(3) QSO-J0410-0139

ABSTRACT

Understanding how reionization occurred and the nature of the early sources that drove it are among the most important open questions in cosmology. In the process of producing the roughly three ionizing photons per hydrogen atom required to reionize the IGM, the same massive stars

explode and eject metals into their surroundings, enriching the Universe to a metallicity of $Z \sim 10^{-3}$. While the overly sensitive Ly-alpha transition makes Gunn-Peterson absorption an ineffective probe of reionization at $z > 6$, strong low-ionization transitions like the MgII 2796,2804 doublet will give rise to a detectable 'metal-line forest', if the metals produced during reionization pollute the neutral IGM. A novel statistical approach leveraging techniques from precision cosmology has recently been developed to detect this signal, thereby allowing one to constrain early IGM enrichment and trace the history and topology of reionization with cosmic time. We request deep NIRSpec observations of six $z > 7$ quasars to realize this qualitatively new absorption spectroscopy experiment. These new data will be combined with comparable quality spectra of two $z > 7$ quasars from approved programs to yield a statistical sample of eight absorption spectra with unprecedented sensitivity (S/N ~ 80). With this combined sample, we expect to make a 10sigma detection of the MgII forest, and jointly constrain the metallicity [Mg/H] and the neutral fraction to a 1sigma precision of 0.04 dex and 8%, respectively. If the IGM is pristine, we will constrain $[Mg/H] < -3.94$ at 95% confidence, close to the critical metallicity of -4 that defines the transition from the PopIII to PopII star-formation mode.

OBSERVING DESCRIPTION

We are targeting 6 bright quasars at $7 < z < 7.6$ with NIRSpec in fixed slit mode through the G235H/F170LP filter in order to observe the redshifted MgII forest along the lines-of-sight of these quasars.

Below is the summary of the observing plan:

NIRSpec FS OBSERVATION

2 quasars (J0313-1806 and J1007+2115) will be placed in slit S200A1 while the rest of the targets will be placed in slit S200A2.

All targets will be observed through G235H/F170LP to do spectroscopy from 1.66 - 3.05 micron. We will use the NRSIRS2RAPID readout and FULL subarray for all targets. We will use 3 dither positions for 2 quasars (J0038-0653 and J0038-1527) and 5 dither positions for the rest.

We will use WATA for target acquisition.

Visit 1: J0038-0653 (1.2 hrs science, 2.5 hrs total)

JWST Proposal 3526 (Created: Thursday, July 11, 2024 at 4:00:19 PM Eastern Standard Time) - Overview

Visit 2: J0313-1806 (2.1 hrs science, 3.6 hrs total)

Visit 3: J0410-0139 (2.9 hrs science, 4.7 hrs total)

Visit 4: J1007-2115 (2.1 hrs science, 3.6 hrs total)

Visit 5: J0038-1527 (1.2 hrs science, 2.1 hrs total)

Visit 6: J0252-0503 (1.8 hrs science, 3.3 hrs total)

Proposal 3526 - Targets - Probing Reionization and Early Cosmic Enrichment with the MqII Forest

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	QSO-J0038-0653	RA: 00 38 3.7820 (9.5157583d) Dec: -06 53 22.87 (-6.88969d) Equinox: J2000		
<p><i>Comments: Coordinates double checked via program 2249</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i> <i>Extended=NO</i></p>				
(2)	QSO-J0313-1806	RA: 03 13 43.8390 (48.4326625d) Dec: -18 06 36.40 (-18.11011d) Equinox: J2000	Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates checked by comparing to program 1764.</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i></p>				
(3)	QSO-J0410-0139	RA: 04 10 9.0500 (62.5377083d) Dec: -01 39 19.88 (-1.65552d) Equinox: J2000		
<p><i>Comments: Coordinates double checked against Banados draft publication.</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i> <i>Extended=NO</i></p>				
(4)	QSO-J1007+2115	RA: 10 07 58.2640 (151.9927667d) Dec: +21 15 29.21 (21.25811d) Equinox: J2000	Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against proposal 1764.</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i></p>				
(5)	QSO-J003836.10-152723.6	RA: 00 38 36.1000 (9.6504167d) Dec: -15 27 23.60 (-15.45656d) Equinox: J2000	Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against Wang et al. publication.</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i></p>				
(6)	QSO-J0252-0503	RA: 02 52 16.6400 (43.0693333d) Dec: -05 03 31.80 (-5.05883d) Equinox: J2000	Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against Wang et al. 2020 and Yang et al. 2019.</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i></p>				

Fixed Targets

Proposal 3526 - Observation 1 - Probing Reionization and Early Cosmic Enrichment with the Mqll Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	Proposal 3526, Observation 1: J0038-0653 Diagnostic Status: Warning Observing Template: NIRSpec Fixed Slit Spectroscopy										
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(1)	QSO-J0038-0653	RA: 00 38 3.7820 (9.5157583d) Dec: -06 53 22.87 (-6.88969d) Equinox: J2000								
<i>Comments: Coordinates double checked via program 2249</i> <i>Category=Unidentified</i> <i>Description=[Infrared sources]</i> <i>Extended=NO</i>											
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A2					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					NONE				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A2	NRSIRS2RAPID	64	1	1	NONE	5	5	4741.389

Proposal 3526 - Observation 2 - Probing Reionization and Early Cosmic Enrichment with the Mqll Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	<p>Proposal 3526, Observation 2: J0313-1806</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>										
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		
	(2)	QSO-J0313-1806	RA: 03 13 43.8390 (48.4326625d) Dec: -18 06 36.40 (-18.11011d) Equinox: J2000			Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates checked by comparing to program 1764.</i></p> <p><i>Category=Unidentified</i></p> <p><i>Description=[Infrared sources]</i></p>										
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A1					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					NONE				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A1	NRSIRS2RAPID	102	1	1	NONE	5	5	7513.278

Proposal 3526 - Observation 5 - Probing Reionization and Early Cosmic Enrichment with the Mqll Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	<p>Proposal 3526, Observation 5: J1007+2115</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>										
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		
	(4)	QSO-J1007+2115	RA: 10 07 58.2640 (151.9927667d) Dec: +21 15 29.21 (21.25811d) Equinox: J2000			Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against proposal 1764.</i></p> <p><i>Category=Unidentified</i></p> <p><i>Description=[Infrared sources]</i></p>										
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A1					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					NONE				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A1	NRSIRS2RAPID	102	1	1	NONE	5	5	7513.278

Proposal 3526 - Observation 7 - Probing Reionization and Early Cosmic Enrichment with the Mqll Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	<p>Proposal 3526, Observation 7: J0038-1527</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>										
Diagnostics	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(5)	QSO-J003836.10-152723.6	RA: 00 38 36.1000 (9.6504167d) Dec: -15 27 23.60 (-15.45656d) Equinox: J2000			Epoch of Position: 2015.5					
	<p>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against Wang et al. publication. Category=Unidentified Description=[Infrared sources]</p>										
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A2					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	3					NONE				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A2	NRSIRS2RAPID	102	1 1	NONE	3	3	4507.967	

Proposal 3526 - Observation 8 - Probing Reionization and Early Cosmic Enrichment with the Mqll Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	<p>Proposal 3526, Observation 8: J0252-0503</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>										
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		
	(6)	QSO-J0252-0503	RA: 02 52 16.6400 (43.0693333d) Dec: -05 03 31.80 (-5.05883d) Equinox: J2000			Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates double checked against Wang et al. 2020 and Yang et al. 2019.</i></p> <p><i>Category=Unidentified</i></p> <p><i>Description=[Infrared sources]</i></p>										
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A2					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					NONE				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A2	NRSIRS2RAPIDD	90	1	1	NONE	5	5	6637.945

Proposal 3526 - Observation 12 - Probing Reionization and Early Cosmic Enrichment with the MqII Forest

Thu Jul 11 21:00:19 GMT 2024

Observation	<p>Proposal 3526, Observation 12: J0410-0139</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>										
Diagnostics	<p>(Visit 12:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(3)	QSO-J0410-0139	RA: 04 10 9.0500 (62.5377083d) Dec: -01 39 19.88 (-1.65552d) Equinox: J2000								
	<p><i>Comments: Coordinates double checked against Banados draft publication.</i></p> <p><i>Category=Unidentified</i></p> <p><i>Description=[Infrared sources]</i></p> <p><i>Extended=NO</i></p>										
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136945
Template	Slit					Subarray					
	S200A2					FULL					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					SPATIAL				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	S200A2	NRSIRS2RAPID	72	1	1	NONE	10	10	10649.89