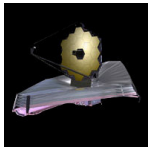

4092 - How Does Reionization End? A Search for [O III] Emitters in the Most Transparent Regions of the IGM Near Redshift Six

Cycle: 2, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Prof. George D Becker (PI)	**University of California - Riverside**
Dr. Ryan Endsley (CoI)	University of Texas at Austin
Dr. Anson D'Aloisio (CoI)	University of California - Riverside
Holly Christenson (CoI)	University of California - Riverside
Dr. Yongda Zhu (CoI)	University of Arizona
Prof. Charlotte Mason (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Prof. John Chisholm (CoI)	University of Texas at Austin

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
J359				
	1	J359_grism	NIRCam Wide Field Slitless Spectroscopy	(1) PSOJ359-06
J1306				
	2	J1306_grism	NIRCam Wide Field Slitless Spectroscopy	(2) SDSSJ1306+0356

ABSTRACT

Multiple observations now indicate that reionization ended well below z=6, opening the door to new and more detailed tests of reionization models. One such test concerns the relationship between IGM opacity and density near the end of reionization. Late-reionization models predict that quasar Lyman-alpha forest opacities near z=6 should anti-correlate with line-of-sight density due to UV background fluctuations and/or absorption by the last islands of neutral gas. This picture has been supported by Lyman-alpha emitter (LAE) surveys along high-opacity lines of sight, which have

found that giant Lyman-alpha troughs are associated with galaxy under-densities. Recently, however, LAE surveys have indicated that the lowest-opacity sightlines at these redshifts also trace under-densities, contrary to expectations. This tension suggests that either the LAEs are missing some high-density regions or important aspects of the reionization process are missing from the models. To address this, we will use NIRCam WFSS to search for [O III] emitters along two quasar lines of sight with the lowest-known Lyman-alpha forest opacities near z=6, regions that have previously been surveyed for LAEs. The [O III] emitters will provide a sensitive and independent tracer of the large-scale densities in these volumes. Conclusively showing that these low-opacity sight lines correspond to cosmic under-densities would have important implications for our understanding of how reionization ends.

OBSERVING DESCRIPTION

We will target two of the lowest-opacity Lyman-alpha forest QSO sightlines at z~5.7 to directly test models of cosmic hydrogen reionization. This will be achieved by detecting [OIII] doublet emission from z=5.50-5.85 galaxies along these sightlines to quantify the galaxy space densities relative to the mean at this epoch.

Our science goals are most efficiently achieved by performing NIRCam WFSS grism observations in F335M, boosting line sensitivity and mitigating source confusion relative to wide filter observations. Simultaneous F115W imaging at short wavelengths will allow us to measure the far-UV luminosities of each z~5.7 galaxy detected in the grism data.

Given the physical scales associated with model predictions we aim to test, we will mosaic our NIRCam pointings into a 4 row by 2 column grid (~10x7.5 arcmin^2) with partial overlap between pointings. In each pointing, we adopt the INTRAMODULEBOX4 primary dither pattern to achieve the largest fraction of overlapping area, full coverage of gaps between the short-wavelength detectors, as well as a sufficient number of overlapping exposures to flag artifacts (e.g. snowballs).

Using the ETC, we determine that all sensitivites necessary for our science goals are most efficiently met by adopting a SHALLOW4 readout pattern with 10 groups /integration for the F115W imgaging + F335M grism exposures, followed by a SHALLOW4 readout pattern with 5 groups/integration for the direct imaging, with one integration for every exposure.

As demonstrated in Cycle 1 studies, the well-defined wavelength separation and flux ratio of the target [OIII]4959,5007 doublet makes it easy to distinguish from emission features of low-redshift galaxies, even in single-orientation grism observations. We will apply the proven median-filtering deconfusion technique developed by these studie to efficiently conduct our observations with the Grism R orientation. This setting has been most

commonly utilized thus far and hence has the best understood spectral tracing and wavelength calibration.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PSOJ359-06	RA: 23 56 32.4520 (359.1352167d) Dec: -06 22 59.31 (-6.38314d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Quasars]*				
(2)	SDSSJ1306+0356	RA: 13 06 8.2590 (196.5344125d) Dec: +03 56 26.19 (3.94061d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Quasars]*				

Observation

Proposal 4092, Observation 1: J359_grism Tue Jan 27 05:00:11 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRCam Wide Field Slitless Spectroscopy

Diagnostics

(J359_grism (Obs 1)) Warning (Form): This observation is split across multiple visits using multiple filters. Not selecting the sequence option may result in execution of the visits in a non-numerical order and is not recommended.

(J359_grism (Obs 1)) Warning (Form): Use of only one of GRISMR or GRISMC may result in spectral overlap from multiple sources that can't be corrected. Users should address this issue in their proposal text.

(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.

(J359_grism (Obs 1)) Informational (Form): Target Placement is a required field.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PSOJ359-06	RA: 23 56 32.4520 (359.1352167d) Dec: -06 22 59.31 (-6.38314d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Quasars]

Template

Module	Subarray	Grism (Long Wavelength)	Target Placement
ALL	FULL	GRISMR	

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
4	2	15.0	15.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Positions
1	INTRAMODULEBOX	4	NONE

Direct Image

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F115W	F335M	SHALLOW4	5	1	1	257.682		GRISMR	Direct Image	1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F115W	F335M	SHALLOW4	10	1	4	2104.407		GRISMR	Grism (Long Wavelength)	4
2	F115W	F335M	SHALLOW4	5	1	2	515.365			Out of Field	2

Special Requirements

Group Visits within 53.0 Days
Visits Same PA

Observation

Proposal 4092, Observation 2: J1306_grism Tue Jan 27 05:00:11 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRCam Wide Field Slitless Spectroscopy

Diagnostics

(J1306_grism (Obs 2)) Warning (Form): This observation is split across multiple visits using multiple filters. Not selecting the sequence option may result in execution of the visits in a non-numerical order and is not recommended.

(J1306_grism (Obs 2)) Warning (Form): Use of only one of GRISMR or GRISMC may result in spectral overlap from multiple sources that can't be corrected. Users should address this issue in their proposal text.

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

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

(Visit 2:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(J1306_grism (Obs 2)) Informational (Form): Target Placement is a required field.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	SDSSJ1306+0356	RA: 13 06 8.2590 (196.5344125d) Dec: +03 56 26.19 (3.94061d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Quasars]

Template

Module	Subarray	Grism (Long Wavelength)	Target Placement
ALL	FULL	GRISMR	

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
4	2	15.0	15.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Positions
1	INTRAMODULEBOX	4	NONE

Direct Image

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F115W	F335M	SHALLOW4	5	1	1	257.682		GRISMR	Direct Image	1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F115W	F335M	SHALLOW4	10	1	4	2104.407		GRISMR	Grism (Long Wavelength)	4
2	F115W	F335M	SHALLOW4	5	1	2	515.365			Out of Field	2

Special Requirements

Group Visits within 53.0 Days
Visits Same PA