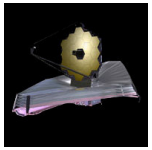

1871 - The First Observations of the Ionizing Luminosity of Galaxies within the Epoch of Reionization

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Final Setting	NIRSpec MultiObject Spectroscopy	(3) SUPER-SAMPLE-W-STANDARDS

ABSTRACT

The first galaxies changed cosmic history by emitting sufficient ionizing photons to ionize all the gas between galaxies. This cosmic reionization changed the thermal history of intergalactic gas, quenched early star formation, and set the seeds of the large-scale structure in the present universe.

While theory underscores the importance of reionization, observations have yet to determine how reionization occurred. Hubble Space Telescope observations suggest that star-forming galaxies may have supplied the ionizing photons, but it is not clear whether they originated in rare massive galaxies or more common low-mass galaxies. Observations must constrain the sources of cosmic reionization. For the first time, the James Webb Space Telescope can open the window onto empirical constraints of the sources of reionization. Here, we propose 22.2 hours of charged time for a NIRSpec MOS configuration focused on the GOODS-North footprint. HST, Spitzer, and Keck have revealed compelling candidates for sources of ionizing photons within this field. We propose deep G235H and G395H observations to observe Mg II, [O II], [Ne III], [O III], and Balmer emission lines in up to 15 galaxies within the epoch of reionization. We will use well-tested methods to estimate the escape fraction of ionizing photons from these galaxies using the Mg II doublet and Balmer decrement. Additionally, the extinction-corrected Balmer emission will estimate the production of ionizing photons. Combined, this will be the first measurement of the ionizing luminosity during the epoch of reionization, and stringently test whether bright and/or faint galaxies emitted enough ionizing photons to reionize the universe.

OBSERVING DESCRIPTION

Here we propose one NIRSpec MOS configuration of a well-studied field of high-redshift galaxies within GOODS-N. We use a catalog of spectroscopic and photometric redshifts to prepare the MSA configuration. We center the proposed pointing on a single bright galaxy and weight the catalog based off of the presence of spectroscopic redshifts. We utilize the 3-shutter setup and will nod between each shutter to subtract the background. We will observe in both the G235H grating, to observe Mg II, and the G395H grating to observe the [O II], H-gamma, H-beta, and [O III] emission lines. The H-gratings will test optical depth effects of the resonant Mg II transition by determining the Mg II velocity offset from the other Balmer emisison lines.

We determine the coordinates of all objects using GAIA matched HST photometry measured on the same astrometric frame. We find reference stars by using the Skelton et al. 2014 catalog and predicting the JWST magnitudes using SED fitting of the HST photometry. 2 reference stars are included on the MSA design to aid in flux calibration of the data. We find an MSA pointing with more than 5 reference stars that includes the Mg II and [O III] emission line flux from our highest priority sources. We then do a fine sampling (0.01"x0.01") of the area around this coordinate to find the optimal number of spectroscopically confirmed and photometric candidates.

We determine the required exposure times from SED fits to the HST and Spitzer data and make conservative lower estimates for the minimum equivalent widths of our brightest sources. We estimate that we will have to detect Mg II with flux levels of 3 x 10^-19 erg/s/cm^-2 integrated across the line at the 5 sigma significance in the G235H grating and H-gamma for our faintest sources with fluxes of 3 x 10^-19 erg/s/cm^-2 at the 3 sigma significance in the G395H grating. We assume line widths of 100 km/s.

We use the JWST ETC to determine the required exposure times using the NRSIR2 readout patterns, which is recommend for long observations to reduce data volumes. We assume that we will nod between each exposure and use the maximum number of 20 groups per integration to determine that we require 12 integrations per exposure with the G235H grating and 2 integrations per exposure with the G395H grating. After running smart accounting, APT suggests that this will take 22.2 total hours of charged time. We will require one confirmation image after the target acquisition and MSA configuration. We use the JWST ETC to determine that the 26 magnitude sources will be detected in 450 s of total integration time at the 10 sigma significance using the NRSIR2RAPID readout. This requires 1 integration of 30 groups.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CATALOG-BY-HAND-MODELS	RA: 12 36 53.3568 (189.2223200d) Dec: +62 14 12.40 (62.23678d) Equinox: J2000		
Comments: *Description=[]*				
(2)	SUPERSAMPLE	RA: 12 36 48.9164 (189.2038183d) Dec: +62 14 41.42 (62.24484d) Equinox: J2000		
Comments: *Description=[]*				
(3)	SUPER-SAMPLE-W-STANDARDS	RA: 12 36 48.9164 (189.2038183d) Dec: +62 14 41.42 (62.24484d) Equinox: J2000		
Comments: *Description=[]*				

Observation

Proposal 1871, Observation 1: Final Setting

Thu Jan 05 22:00:41 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Diagnostics

(Final Setting (Obs 1)) Warning (Form): This Aperture PA requirement is overridden by the assigned Aperture PA selected by the scheduling system.

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

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	SUPER-SAMPLE-W-STANDARDS	RA: 12 36 48.9164 (189.2038183d) Dec: +62 14 41.42 (62.24484d) Equinox: J2000		

Comments:
Description=[]

Acquisition

#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	Filter: F140X; Readout: NRSRAPIDD6; 5 sources in 3 quads; [IFU Level Accuracy]	SAME	F140X	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	

Template

TA Method	Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold
MSATA	After Target ACQ and New MSA Config	MSA Center	Specz Set (19 sources)	photoz Set (1036 sources)	jwst-nirspec-hr	1.5

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	1190	189.219799	62.265099	24.474531	1	1196	189.148332	62.275850	24.995224
1	1191	189.230850	62.266323	22.463215	1	1205	189.201347	62.302591	23.918346
1	1193	189.207381	62.273472	24.333267					

Confirmation

#	Confirmation Type	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time
1	c1	NRSIRS2RAPID	30	1	1	452.256

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 (G235H/F170LP)	c1	3 Shutter Slitlet	189.17799841666667 Degrees 62.295409444444445 Degrees	9.089642753506709			3	18	26522.602
2	1 (G235H/F170LP)	c1	3 Shutter Slitlet	189.17799841666667 Degrees 62.295409444444445 Degrees	9.089642753506709			3	18	26522.602
3	2 (G395H/F290LP)	c1	3 Shutter Slitlet	189.17799841666667 Degrees 62.295409444444445 Degrees	9.089642753506709			3	6	9716.201

Special Requirements

Aperture PA Range 305 to 35 Degrees (V3 166.4254303 to 256.4254303)
MSA Scheduled Aperture PA 9.1124097 to 9.1124097 Degrees (V3 230.53784 to 230.53784)