



7722 - To catch an AGN: Ionizing Emission and AGN Activity of COLA1 in the Epoch of Reionization

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Main				
	1	cola1_7722_p1_g140m_g235m	NIRSpec MultiObject Spectroscopy	(2) COLA1_photcat_C20_v8_2026.01.15

ABSTRACT

One of the main open questions about the Epoch of Reionization (EoR) is identifying the primary sources of ionizing photons. Direct detection of ionizing continuum (LyC) during the EoR is impossible due to total IGM absorption, so we rely on indirect methods, calibrated with lower-redshift observations or simulations. Rest-frame UV spectroscopy of EoR objects is key to identifying the main ionizers. COLA1, a highly luminous galaxy at $z=6.6$, stands out with its unusual double-peaked Ly-alpha profile. This feature is rare in the EoR, where the neutral IGM should absorb the blue

peak, suggesting that COLA1 resides inside a highly ionized region. Previous NIRCам WFSS and photometric studies indicates that it is a strong LyC leaker, with a moderate overdensity around it. However, if star formation is the main source of UV emission, its compact UV size (<260 pc) would imply extreme star formation rate surface density. Moreover, COLA1's abnormal UV SED measured by NIRCам is poorly reproduced by models. These factors raise the question: does COLA1 host an AGN?

We propose deep rest-frame UV spectroscopy of COLA1 and four neighboring galaxies using NIRSpec MOS to achieve two goals: 1) determine if COLA1 hosts an AGN and assess its contribution to the UV luminosity, and 2) map the ionized region around COLA1 through the Ly-alpha emission of nearby galaxies. This will provide a detailed dissection of the UV emission mechanisms of a strong LyC leaker in the EoR, and a precise tomography of the ionized region around it. If confirmed, it would be the first case of a bright AGN significantly contributing to reionization, providing insights into the role of luminous sources in the EoR.

OBSERVING DESCRIPTION

We propose to obtain deep NIRSpec MOS spectroscopy of COLA1, a very luminous ($F115W = 25.88$) object at $z=6.6$, along with four galaxies in its environment selected based on their [OIII] doublet emission in NIRCам WFSS data (GO #1933). Additionally, we will include ~ 25 filler [OIII] emitters at $z=5.5-6.9$, detected in the same way, and $\sim 5-10$ sources with photometric redshifts from the COSMOS2020 catalog located outside the NIRCам program's field-of-view. We will use medium resolution (R1000) grating spectroscopy for all targets, utilizing the G140M/F070LP and G235M/F170LP grating/filter pairs, with a total exposure of 7 hours for each.

Our main goal is to measure rest-frame UV emission lines in COLA1, and to cover the Lyman-alpha and [OII] (372.8 nm) emission lines for COLA1's neighbors and all filler targets. Deep NIRCам imaging in F115W, F150W, F200W, and F356W, as well as WFSS/F356W data, are available for all targets except those from COSMOS2020. We have defined wavelength masks in the input catalog to ensure that: 1) COLA1 is fully covered from Lyman-alpha to the red end in G140M and coverage of at least MgII, [NeV] and [OII] in G235M; and 2) all targets have Lyman-alpha coverage in G140M and [OII] coverage in G235M (± 1000 km/s from the systemic wavelength based on their measured redshifts).

All targets will be observed in a single configuration per grating, within a single visit. For each grating, we will use the NRSIRS2 readout mode, offering a good balance between data rates and quality, with 19 groups per integration and 2 integrations per exposure. We will apply a three-shutter nodding pattern, repeating each configuration 3 times to mitigate random shutter failures, resulting in total exposure times of 25,209.6 seconds per grating (7 hours). The requested exposure times are motivated by the goal of measuring moderately low EW UV lines in COLA1 (down to $EW=3$ Angstrom), while being able to detect Ly-alpha lines (down to $EW \sim 25$ Angstroms) from fainter companions (median $F115W \sim 27.5$). We also

request short (160 s) confirmation image for quality assessment and data reduction.

Proposal 7722 - Targets - To catch an AGN: Ionizing Emission and AGN Activity of COLA1 in the Epoch of Reionization

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(2)	COLA1_photcat_C20_v8_202 6.01.15	RA: 10 02 35.1646 (150.6465192d) Dec: +02 12 18.04 (2.20501d) Equinox: J2000		
	<i>Comments:</i> Description=[]				

Proposal 7722 - Observation 1 - To catch an AGN: Ionizing Emission and AGN Activity of COLA1 in the Epoch of Reionization

Wed Mar 11 22:00:27 GMT 2026

Observation	Proposal 7722, Observation 1: cola1_7722_p1_g140m_g235m Diagnostic Status: Warning Observing Template: NIRSspec MultiObject 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		
	(2)	COLA1_photcat_C20_v8_202 6.01.15	RA: 10 02 35.1646 (150.6465192d) Dec: +02 12 18.04 (2.20501d) Equinox: J2000								
<i>Comments: Description=[]</i>											
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
	1	Filter: F110W; Readout: NRSRAPIDD6; 8 sources in 4 quads; [Optimal TA Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	
Template	TA Method	HFF Readout Mode	Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold			
	MSATA	false	After Target ACQ and New MSA Config	MSA Center	P123 (11 sources)	COLA1_photcat_C20_v8 _2026.01.15 (20170 sources)	juwst-nirspec-mr	1.5			
Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude	
	1	1639	150.668015	2.199975	22.795677	1	7628	150.633294	2.160286	21.842056	
	1	5371	150.636353	2.153347	22.201298	1	16566	150.631361	2.193511	22.673332	
	1	5821	150.659173	2.205869	22.534601	1	500001	150.674071	2.182743	21.3131008148193	
	1	6882	150.635176	2.160309	23.219685	1	500020	150.674517	2.175822	22.4223003387451	
Confirmation	#	Confirmation Type	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time				
	1	c1	NRSIRS2RAPID	10	1	1	160.478				

Proposal 7722 - Observation 1 - To catch an AGN: Ionizing Emission and AGN Activity of COLA1 in the Epoch of Reionization

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 (G140M/F070LP)	c1	3 Shutter Slitlet	150.64999799999 998 Degrees 2.1793377777777 776 Degrees	247.00018175377 474			3	18
	2	2 (G235M/F170LP)	c1	3 Shutter Slitlet	150.64999799999 998 Degrees 2.1793377777777 776 Degrees	247.00018175377 474			3	18	25209.602
Special Requirements	Aperture PA Range 237 to 255 Degrees (V3 98.4254303 to 116.4254303) MSA Scheduled Aperture PA 247.0000 to 247.0000 Degrees (V3 108.42543 to 108.42543)										