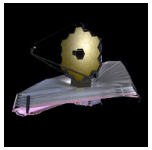

7078 - On the search for a primeval black hole in a spectroscopically-confirmed galaxy at z=12.3

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Observation Folder				
	1	Halpha	MIRI Medium Resolution Spectroscopy	(1) GHZ2
	2	Background_Ha	MIRI Medium Resolution Spectroscopy	(1) GHZ2

ABSTRACT

JWST has discovered a surprisingly large number of bright galaxies at z>10, which challenges theoretical expectations. To account for their existence, we must consider different physical properties compared to lower-z systems, or the potential influence of early AGN activity. Recent observations on the bright galaxy GN-z11 at z=10.60 suggest the presence of an active black hole with a super-Eddington accretion rate, which accounts for its high luminosity. It is now imperative to study other bright galaxies at similar or even higher redshifts to test whether this early onset of AGN is a common feature among these unique systems.

Here, we propose to conduct MIRI/MRS spectroscopy of GHZ2 at z=12.35, the highest redshift AGN candidate. Recent NIRSpec/PRISM and MIRI/LRS spectroscopy detected several emission lines that revealed extremely high ionization conditions, potentially due to AGN. Additionally, compact morphology and SED fitting results imply a significant AGN contribution. Nevertheless, their low spectral resolution hampers the identification of unique AGN signatures, such as broad emission lines. The proposed MRS spectroscopy, with R~3000, will allow us to measure the Ha line width and investigate whether GHZ2 has an AGN through one of the robust and well-calibrated methodologies. This is crucial to understand the physical origins responsible for the overabundance of bright galaxies at z>11. If the existence of an AGN is confirmed, this would be the most distant massive black hole to date, providing unparalleled information about the black hole seeding mechanisms and early black hole growth scenarios.

OBSERVING DESCRIPTION

This program will perform MIRI/MRS spectroscopy of GHZ2/GLASS-z12, the highest redshift AGN candidate.
The target of this program, GHZ2, is the best target to explore a seed of the SMBH given its compact morphologies, strong UV emission lines (EW(CIV)>20A), and MRS coverage of the Halpha, Hbeta, and [OIII] simultaneously.
We will use the Medium (B) gratings in Channels 2, which cover wavelengths of ~6um and ~8 um, where the [OIII] and Halpha lines are redshifted.
We aim to demonstrate the AGN signature through the identification of a broad permitted Halpha emission line and narrow forbidden [OIII] line by detecting the whole Halpha and [OIII]4959 line at ~15 sigma and ~12 sigma levels, respectively.
Halpha broad line is one of the robust ways to identify AGN, as alternative ways of UV line diagnostics, electron density measurements, and broad line signatures in bright UV line can be affected by several other contaminants such as high-ionizing ISM conditions in star-forming galaxies and outflows.
ETC simulation suggests that the broad line will be detected in >6sigma if GHZ2 has a similar AGN activity with typical JWST-identified AGN.

Proposal 7078 - Targets - On the search for a primeval black hole in a spectroscopically-confirmed galaxy at z=12.3

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GHZ2	RA: 00 13 59.7556 (3.4989817d) Dec: -30 19 29.14 (-30.32476d) Equinox: J2000		
Comments: JWST/NIRCam-selected LBG at z_phot=12.3, m277W=26.9 (Castellano et al. 2022; Naidu et al. 2022; Harikane et al. 2022) and spectroscopically confirmed to be z=12.35 with NIRSpec and MIRI/LRS (Castellano et al. 2024, Zavala et al. 2024) *Category=Galaxy* *Description=[Active galactic nuclei, High-redshift galaxies, Primordial galaxies]* *Extended=NO*				
(2)	TARGET-ACQ-STAR	RA: 00 13 58.3218 (3.4930075d) Dec: -30 20 14.10 (-30.33725d) Equinox: J2000	Epoch of Position: 2016	
Comments: Acquisition star for target GHZ2. Coordinates, PM, and epoch from Gaia DR3. *Category=Star* *Description=[G stars]* *Extended=NO*				

Observation

Proposal 7078, Observation 1: Halpha

Thu Jul 03 18:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GHZ2	RA: 00 13 59.7556 (3.4989817d) Dec: -30 19 29.14 (-30.32476d) Equinox: J2000		

Comments: JWST/NIRCam-selected LBG at z_phot=12.3, m277W=26.9 (Castellano et al. 2022; Naidu et al. 2022; Harikane et al. 2022) and spectroscopically confirmed to be z=12.35 with NIRSpec and MIRI/LRS (Castellano et al. 2024, Zavala et al. 2024)
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Primordial galaxies]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 TARGET-ACQ-STAR	F560W	FAST	6	1	1	16.65	248869.2

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	Allow Auto Reorder

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	POINT SOURCE	NEGATIVE
2	4-Point	POINT SOURCE	POSITIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F560W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
1	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
1	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
2		IMAGER	F560W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
2	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
2	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
3		IMAGER	F770W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
3	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
3	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
4		IMAGER	F770W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
4	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
4	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
5		IMAGER	F770W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
5	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
5	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
6		IMAGER	F770W	SLOWR1	20	12	1	Dither 1	4	48	23985.48	
6	MEDIUM(B)	MRSLONG		SLOWR1	20	12	1	Dither 1	4	48	23985.48	
6	MEDIUM(B)	MRSSHORT		SLOWR1	20	12	1	Dither 1	4	48	23985.48	

Special Requirements

Group Visits within 53.0 Days
Aperture PA Range 50.0 to 65.0 Degrees (V3 50.0 to 65.0)
Visits Same PA
Background Limited. Background no more than 40th percentile above minimum

Group Observations 1, 2, Non-interruptible

Observation

Proposal 7078, Observation 2: Background_Ha

Thu Jul 03 18:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

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
(1)	GHZ2	RA: 00 13 59.7556 (3.4989817d) Dec: -30 19 29.14 (-30.32476d) Equinox: J2000		

Comments: JWST/NIRCam-selected LBG at z_phot=12.3, m277W=26.9 (Castellano et al. 2022; Naidu et al. 2022; Harikane et al. 2022) and spectroscopically confirmed to be z=12.35 with NIRSpec and MIRI/LRS (Castellano et al. 2024, Zavala et al. 2024)
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Primordial galaxies]
Extended=NO

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	Imager	YES	FULL	Allow Auto Reorder

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	BACKGROUND	NEGATIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F1000W	SLOWR1	9	4	1	Dither 1	4	16	3726.828	
1	MEDIUM(B)	MRSLONG		SLOWR1	20	2	1	Dither 1	4	8	3917.947	
1	MEDIUM(B)	MRSSHORT		SLOWR1	20	2	1	Dither 1	4	8	3917.947	

Special Requirements	
	Aperture PA Range 54.83544897 to 69.83544897 Degrees (V3 50.0 to 65.0) Group Observations 1, 2, Non-interruptible