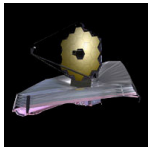

5086 - Confirming Population III or a Direct Collapse Black Hole in the halo of GN-z11 at z=10.6

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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Name	***Institution***
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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Observation Folder				
	1	IFS	NIRSpec IFU Spectroscopy	(1) GNz11

ABSTRACT

Previous observations have revealed HeII emission in the halo of the lumionous galaxy GN-z11 at z=10.6, which could be tracing either Population III stars (formed in a pocket of pristine gas, as expected by some models) or an accreting Direct Collapse Black Hole (DCBH), in the earliest (pristine) phases of its formation. However, the detection is still tenative (5 sigma). We propose to obtain a deep NIRSpec-IFS observation (40 hours on-source), with the high resolution grating, with the primary goal of confirming the HeII detection in the halo of GN-z11 and discriminate between the PopIII and DCBH scenarios. The confirmation of the detection of either of these long-sought objects would be a groundbreaking discovery. In addition, the observation will tackle a wealth of additional science cases, such as: trace the ionization cone and outflow in GN-z11, which is key for understanding the onset of AGN feedback in early galaxies; determine the C/O abundance in the host galaxy of GN-z11 and in its circumgalacting medium, possibly confirming signatures of PopIII enrichment; accurately measure the black hole mass of GN-z11; disentangle the nitrogen emission from the Broad Line Region in GN-z11 from the emission coming from of the host galaxy, hence constraining the N/O abundance in the nuclear region of GN-z11 and its host galaxy; confirm the presence of WR stars and their spatial distribution, hence providing tight constraints on the age of the stellar population in GN-z11.

OBSERVING DESCRIPTION

We propose observations for GN-z11 using the NIRSpec/IFS mode to explore the 2D spatially resolved properties of its ISM and the PopIII cluster 0.5 arcseconds away.. To this goal we plan to use the medium resolution (R~2700) G235H/F170LP spectral configurations to target the following lines: CIII]1907,09, NIII], NIV] and HeII1640 in GN-z11 and its surrounding.

These lines have measured fluxes in the range of 5-22 x 10^-19 erg/s/cm2 from NIRSPEC/MSA observations using PRISM and R1000 gratings in previous IFS and MSA observtions (Bunker et al 2023, Maiolino et al 2023, Scholtz et al 2023). Considering these values and assuming a linewidth

of ~120 km/s, with 40 hours of exposure time for G235H/F170LP the ETC gives an integrated S/N >10 (depending on the line) at the central ~0.6 arcsec region, then allowing us to explore its 2D properties beyond that zone.

No target acquisition is included, as the accuracy of the direct JWST pointing is enough to guarantee that the target is well centered in the NIRSpec IFU FoV.

To minimize the redout noise we use NRSIRS2 readout pattern with 25 groups per integration. To each a total exposure time of ~40 hr, we use 38 dither positions with 2 integrations per exposure. We select a cycling medium dither pattern, which provides a good compromise between an amplitude (~0.5 ") large enough to "jump" the failed open microshutters, and to deal with other sources of background. This dither pattern also provides a good sub-pixel sampling, and allows to reconstruct the datacube with spaxels of 50 mas.

No extra background exposures are included. At high resolution we expect the background to be low and, in addition, there will plenty of spaxels free from galaxy emission suitable to derive the background.

We do not ask for MSA lekeage exposures, as we have verified that there are not very bright targets on the MSA FoV that could contaminate the IFU spectra. In addition, the presence of possible leakage would mainly affect the continuum, but our main goal is the analysis of the emission lines. We restricted PA to avoid bright stars in the FoV of the MSA masks.

Proposal 5086 - Targets - Confirming Population III or a Direct Collapse Black Hole in the halo of GN-z11 at z=10.6

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GNz11	RA: 12 36 25.4501 (189.1060421d) Dec: +62 14 31.35 (62.24204d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Lyman-alpha galaxies, Protogalaxies]

Observation

Proposal 5086, Observation 1: IFS

Wed Mar 06 18:01:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec IFU 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)	GNz11	RA: 12 36 25.4501 (189.1060421d) Dec: +62 14 31.35 (62.24204d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Lyman-alpha galaxies, Protogalaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	1	39	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G235H/F170LP	NRSIRS2	25	2	false	true	NONE	39	78	143379.611	169782

Special Requirements

Group Visits within 53.0 Days
Aperture PA Range 48 to 58 Degrees (V3 269.02835083 to 279.02835083)
Aperture PA Range 144 to 159 Degrees (V3 5.02835083 to 20.02835083)
Aperture PA Range 235 to 283 Degrees (V3 96.02835083 to 144.02835083)
Aperture PA Range 296 to 305 Degrees (V3 157.02835083 to 166.02835083)
Visits Same PA