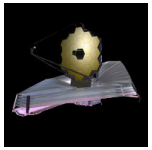

7335 - Forever Blowing Bubbles: What Powers a 24-kpc Ionized Gas Nebula Around a Normal Galaxy at z=6?

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRSpec IFU Spectroscopy	(1) GS-53.00804-27.85477
	2		NIRSpec IFU Spectroscopy	(1) GS-53.00804-27.85477

ABSTRACT

It is thought that powerful galactic outflows may be responsible for disrupting and quenching star formation in massive galaxies at high redshift. This proposal will explore outflows in ID518794, a quenching galaxy hosting a 24 kpc extended [OIII] emission nebula at z = 6. This shell-like nebula, the most extended observed across the GOODS extragalactic fields, is extraordinary in size and luminosity (2 10^10 LSun), but is even more notable since it is centered not around a massive quasar, but rather a more typical (10^10 Msun) galaxy with evidence of a recent drop in star-formation rate. This unique system is at least 5-10 times more rare than quiescent galaxies at z = 4-5, and we may be observing a short-lived phase of a powerful gas outflow just before the onset of long-term quenching. To test this hypothesis, we seek to understand whether the giant nebula is an outflow, an AGN ionization echo (a "voorwerp""), or tidally stripped material, and then to confirm the quenching nature of the central galaxy. To achieve these goals, we propose NIRSpec/IFS observations with

the prism and g395h dispersers to
1) investigate the star-formation history and stellar-population properties of the central galaxy
2) search for evidence of an active galactic nucleus in ID518794 and
3) measure the kinematics, chemistry and physical conditions of the gas, in both the host galaxy and the giant nebula.
If confirmed to host a massive, 24-kpc outflow, this system may help to explain how AGNs are able to quench massive galaxies in the first 1-2 billion years after the Big Bang.

OBSERVING DESCRIPTION

This proposal aims to obtain NIRSpec/IFS spatially resolved spectroscopy in clear/prism (3 hours) and f290lp/g395h (7.5 hours).
The targets are a massive z=6 galaxy (10.2 dex Msun) and its extended, surrounding nebula (4 arcsec).
To ensure observing the nebula in a single (dithered) NIRSpec/IFS pointing, we further require target acquisition.

To optimize telescope usage, we designed the two observations to be consecutive, i.e. sharing the same target acquisition. This further constrains the two observing setups to have the same aperture angle, which greatly simplifies the analysis, due to the NIRSpec/IFS PSF being elliptical and aligned with the aperture angle.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GS-53.00804-27.85477	RA: 03 32 1.9405 (53.0080854d) Dec: -27 51 17.31 (-27.85481d) Equinox: J2000	Epoch of Position: 2024	
Comments: *Category=Galaxy* *Description=[Active galactic nuclei, Galaxy halos, High-redshift galaxies]* *Extended=YES*				
(2)	GAIA5057502833478542336	RA: 03 32 3.4165 (53.0142354d) Dec: -27 50 58.83 (-27.84967d) Equinox: J2000	Proper Motion RA: -4.3214 mas/yr Proper Motion Dec: 13.76 mas/yr Epoch of Position: 2023	
Comments: F115W = 18.9 AB mag *F150W = 18.8 AB mag* *F410M and F335M Centroid [2023] from own measurement in ICRSd:* *53.0142356 -27.8496760* *By comparing with F814W [2018?] I get a pm of 25 mas/year; but not sure the epoch is really 2018?* *GAIA DR1 03 32 3.4185 -27 50 58.74* *GAIA Entry (Epoch 2015--2016). Note: no PM available in GAIA!* *# ID RA[J2000 deg] eRA[mas] Dec[J2000 deg] eDec[mas] Gmag* *5057502833478542336 053.0142439078 0.681 -27.8496492533 1.159 19.332* *Category=Calibration* *Description=[Target acquisition test]* *Extended=NO*				

Observation

Proposal 7335, Observation 1 Mon Jul 28 19:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: PA Restrictions arise from avoiding spoiler stars in the NIRSpec/MSA footprint.
The range 194.4-208.4 was excluded because of a bright spoiler in the NIRCam parallel. We deemed this PA range fairly small, so it does not greatly reduce the schedulability of the proposed programme. At the same time, a deep pure-parallel observation may benefit from avoiding bright galaxies.
The range V3 PA 282.263 to 89.163 is required by WATA target acquisition (TA), to achieve a slew distance <40 arcsec between the the slit S1600A1 at the location of the TA target and the IFS aperture at the location of the science target; this range is more permissive than our spoiler-star constraints, so it has not been added to the Special Requirements.

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GS-53.00804-27.85477	RA: 03 32 1.9405 (53.0080854d) Dec: -27 51 17.31 (-27.85481d) Equinox: J2000	Epoch of Position: 2024	

Comments:
Category=Galaxy
Description=[Active galactic nuclei, Galaxy halos, High-redshift galaxies]
Extended=YES

Template

TA Method	HFF Readout Mode
NONE	false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	1	8	

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	PRISM/CLEAR	NRSIRS2	20	1	false	true	NONE	8	8	11787.823	

Special Requirements

Aperture PA Range 71.67164917 to 82.97164917 Degrees (V3 292.7 to 304.0)
Aperture PA Range 100.97164917 to 114.97164917 Degrees (V3 322.0 to 336.0)
Aperture PA Range 137.57164917 to 138.96164917 Degrees (V3 358.6 to 359.99)
Aperture PA Range 138.97164917 to 217.87164917 Degrees (V3 0.0 to 78.9)
Aperture PA Range 323.87164917 to 333.37164917 Degrees (V3 184.9 to 194.4)

Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 7335, Observation 2

Mon Jul 28 19:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: PA Restrictions arise from avoiding spoiler stars in the NIRSpec/MSA footprint.
The range 194.4-208.4 was excluded because of a bright spoiler in the NIRCam parallel. We deemed this PA range fairly small, so it does not greatly reduce the schedulability of the proposed programme. At the same time, a deep pure-parallel observation may benefit from avoiding bright galaxies.
The range V3 PA 282.263 to 89.163 is required by WATA target acquisition (TA), to achieve a slew distance <40 arcsec between the the slit S1600A1 at the location of the TA target and the IFS aperture at the location of the science target; this range is more permissive than our spoiler-star constraints, so it has not been added to the Special Requirements.

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)	GS-53.00804-27.85477	RA: 03 32 1.9405 (53.0080854d) Dec: -27 51 17.31 (-27.85481d) Equinox: J2000	Epoch of Position: 2024	

Comments:
Category=Galaxy
Description=[Active galactic nuclei, Galaxy halos, High-redshift galaxies]
Extended=YES

Template

TA Method	HFF Readout Mode
NONE	false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	1	19	

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	G395H/F290LP	NRSIRS2	19	1	false	true	NONE	19	19	26610.135	

Special Requirements

Aperture PA Range 71.67164917 to 82.97164917 Degrees (V3 292.7 to 304.0)
Aperture PA Range 100.97164917 to 114.97164917 Degrees (V3 322.0 to 336.0)
Aperture PA Range 137.57164917 to 138.96164917 Degrees (V3 358.6 to 359.99)
Aperture PA Range 138.97164917 to 217.87164917 Degrees (V3 0.0 to 78.9)
Aperture PA Range 323.87164917 to 333.37164917 Degrees (V3 184.9 to 194.4)

Sequence Observations 1, 2, Non-interruptible