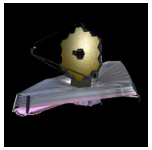

5069 - Weighting the odd: dynamics, assembly history and quenching of the oldest galaxy in the young Universe

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRSpec IFU Spectroscopy	(1) ZF-UDS-7329-3.19
	2		NIRSpec IFU Spectroscopy	(1) ZF-UDS-7329-3.19

ABSTRACT

ZF-UDS-7329 is one of the most remarkable objects to have been discovered by JWST in its first year of operations (Glazebrook et al., 2023). This galaxy stands out as by far the oldest high-redshift galaxy, with a formation redshift of z = 11 and a stellar mass M*>10^11 MSun. At the time of formation, the volume density of this type of galaxy is much higher than that of dark-matter haloes sufficiently massive to host it; its stellar mass and age would have required a baryon-to-dark-matter fraction higher than the cosmic value, which is impossible. In addition, the old age and lack of star formation in ZF-UDS-7329 require quenching to have happened extremely quickly.

Existing JWST data may support this scenario, with spectral features hinting at non-solar chemical abundances and neutral gas outflows. Unfortunately, our understanding of this unique object is currently severely limited by the low resolution of the existing prism spectrum. However, this is easy to fix: we propose to observe ZF-UDS-7329 in high spectral resolution with the NIRSpec IFU, to measure its dynamical mass, chemical abundances, gas properties, and spatially resolved star-formation history. Its dynamical mass will provide the true mass of this galaxy, and and a test of IMF assumptions. Its chemical abundance pattern will allow us to see if this galaxy really did form extremely quickly at z>10. This analysis will be able to confirm or rule out the tension between previous observations and theory. Its impact extends to many fields: stellar kinematics and galaxy assembly, initial mass functions, chemical abundances, SMBH feedback and quenching, and, possibly, even the theory itself of galaxy formation.

OBSERVING DESCRIPTION

We propose ultra-deep NIRSpec IFS spectroscopy of a massive quiescent galaxy at z=3.2 (ZF-UDS-7329).
We aim to detect spatially resolved stellar absorption and to measure spatially resolved star-formation histories.
There are two configurations:
NIRSpec/IFS G235H/F170LP 15:20 h on source
NIRSpec/IFS PRISM/CLEAR 2:45 h on source
The grating has significantly longer integration, because of differences in efficiency and science goals.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	ZF-UDS-7329-3.19	RA: 02 17 1.4140 (34.2558917d)	Proper Motion RA: 0 mas/yr	
		Dec: -05 14 1.92 (-5.23387d)	Proper Motion Dec: 0 mas/yr	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	
Comments: HST (2010) 02:17:01.412 -05:14:01.936 *Primer (Glazebrook) 02:17:01.414 -05:14:01.923* *DJA (Francesco) 2:17:01.415 -05:14:01.913* *Category=Galaxy* *Description=[Elliptical galaxies]* *Extended=YES*				
(2)	UDS-7698-TA_Star	RA: 02 17 1.8820 (34.2578417d)	Proper Motion RA: 0. mas/yr	
		Dec: -05 13 58.21 (-5.23284d)	Proper Motion Dec: 0. mas/yr	
		Equinox: J2000	Epoch of Position: 2023	
Comments: Target Acquisition Star. PM between 2011 (HST/ACS and WFC3) and 2023 (JWST/NIRCam) is 17 mas/year *TA Star is CANDELS UDS 7698* *I measure F150W to be 1,740 nJy, giving 23.3 AB mag.* *Category=Calibration* *Description=[Target acquisition test]* *Extended=NO*				

Observation

Proposal 5069, Observation 1 Mon Nov 10 20:00:21 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: We restricted the PA range due to two bright 'spoiler' stars in the MSA field of view.

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)	ZF-UDS-7329-3.19	RA: 02 17 1.4140 (34.2558917d) Dec: -05 14 1.92 (-5.23387d) Equinox: J2000	Proper Motion RA: 0 mas/yr Proper Motion Dec: 0 mas/yr Parallax: 0" Epoch of Position: 2000	

Comments: HST (2010) 02:17:01.412 -05:14:01.936
Primer (Glazebrook) 02:17:01.414 -05:14:01.923
DJA (Francesco) 2:17:01.415 -05:14:01.913
Category=Galaxy
Description=[Elliptical galaxies]
Extended=YES

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 UDS-7698-TA_Star	WATA	FULL	F140X	NRSRAPID	3	1	1	42.947	204854.1

Template

HFF Readout Mode
false

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	1	30	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	G235H/F170LP	NRSIRS2	24	1	false	true	NONE	30	30	52957.671	36764.1

Special Requirements	
	Aperture PA Range 138.97164917 to 198.97164917 Degrees (V3 0.0 to 60.0) Offset 0.7 arcsec, 0.0 arcsec Group Observations 1, 2, Non-interruptible

Observation

Proposal 5069, Observation 2 Mon Nov 10 20:00:21 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: We restricted the PA range due to two bright 'spoiler' stars in the MSA field of view.

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)	ZF-UDS-7329-3.19	RA: 02 17 1.4140 (34.2558917d) Dec: -05 14 1.92 (-5.23387d) Equinox: J2000	Proper Motion RA: 0 mas/yr Proper Motion Dec: 0 mas/yr Parallax: 0" Epoch of Position: 2000	

Comments: HST (2010) 02:17:01.412 -05:14:01.936
Primer (Glazebrook) 02:17:01.414 -05:14:01.923
DJA (Francesco) 2:17:01.415 -05:14:01.913
Category=Galaxy
Description=[Elliptical 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	Optional ETC ID
1	PRISM/CLEAR	NRSIRS2	20	1	false	true	NONE	8	8	11787.823	36764.1

Special Requirements

Aperture PA Range 138.97164917 to 198.97164917 Degrees (V3 0.0 to 60.0)
Offset 0.7 arcsec, 0.0 arcsec

Group Observations 1, 2, Non-interruptible