16295 - A Spectroscopic Redshift for the Most Luminous Galaxy Candidate at z~11

Cycle: 28, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) XMM3-3085	WFC3/IR	1	30-Aug-2021 14:00:15.0	yes
02	(1) XMM3-3085	WFC3/IR	1	30-Aug-2021 14:00:16.0	yes
03	(1) XMM3-3085	WFC3/IR	1	30-Aug-2021 14:00:16.0	yes
04	(1) XMM3-3085	WFC3/IR	1	30-Aug-2021 14:00:17.0	yes

4 Total Orbits Used

ABSTRACT

Detailed studies of the ages and star formation histories of the most distant known galaxies promise to provide new insight into the epoch when the first sources emerged from the cosmic dark ages as well as the practicality of using JWST to search for their progenitors. Recent progress analysing the spectral energy distributions of two spectroscopically-confirmed z>9 galaxies, MACS1149_JD1and GNz-11, has been particularly informative.

One surprise is the remarkable brightness of GNz-11 at z=11 which suggests that luminous sources may somehow emerge very promptly. Until now, GNz-11 has been regarded as an anomaly. Here we propose to obtain WFC3/G141 grism spectroscopy for a second luminous candidate thought to be at z~10.9, XMM3-3085 with MUV=-23.7 mag. Both sources are consistent with being drawn from the bright end of UV luminosity function at z=5-10. However, as was the case for GNz-11, without a spectroscopic redshift a low redshift interloper or a faint dwarf star cannot be excluded. A suitable spectrum for XMM3-3085 cannot be secured with ground-based instruments because of the low atmospheric transparency at the expected wavelength of its Lyman break. Confirmation of the redshift of XMM3-3085 can be economically secured with HST and would strengthen the evidence supporting the emergence of luminous galaxies at z=11, only 400 Myrs after the Big Bang. This would provide a major impetus for surveys for earlier galaxies with JWST.

OBSERVING DESCRIPTION

The goal of this program is to spectroscopically confirm a Lyman break at z~11 for XMM3-3085 (02:26:59.08 -05:12:17.49). We will observe this source for a total of 4 orbits at different orientations.

Orientations:

In the grism observations, the 4 orbit exposures will be split into two sets of 2 orbit exposures with distinct orientations >30 deg apart. We choose orientation ranges of ORIENT=58-59 and 304-309 degrees (x-axis (direction of the spectral dispersion) is aligned to PAs=13-14 and 259-264 degrees, respectively) to avoid neighboring sources within 20 arcsec. This minimizes contaminating flux from neighboring sources.

Choice of instruments and filters:

We will use the WFC/G141 grism and a JH_140 filter for direct imaging. According to the photometric redshift uncertainty, the Lyman break should lie within the wavelength range 1.3-1.6 um (at z=10.9+/-1.0), and can be captured with the instrument throughput of >~40% in this configuration. JH_140 imaging is necessary to establish a wavelength calibration for the grism observations.

Visit and dither pattern:

Our observation strategy is to obtain two visits of 1 orbit at two different orientations. Each visit contains two short pre-images of F140W each followed by a long G141 grism exposure. The two sets of exposures are dithered following the standard two-point dither (WFC3-IR-DITHER-BLOB), i.e., we set POS-TARG: (-1.930, -1.729) (1.930, 1.729).

Depth:

We have conducted simulations to evaluable the feasibility of the grism observations. Because the photometric redshift is estimated to be z=10.9+/-1.0, we constructed 1000 model galaxy spectra at z=9.9, 10.9, and 11.9 with H=23.9 mag, adding different levels of noise for a range of exposure times based on the HST ETC. We then estimated the signal to noise ratio of the UV continuum in each case. We expect to detect a z=10.9+/-1.0 Lyman break with >10sigma significance with a ~9000 sec exposure. Each grism exposure is accompanied by a 150 seconds direct image exposure in JH_140 in the same manner as undertaken by Oesch et al. (2016). With this exposure time, we can also clearly distinguish the Lyman break from spectra of interlopers. Assuming a science exposure time of 42 minutes per orbit, we require a total of 4 orbits.

Visit

Proposal 16295, Ori_67-69_1 (01), implementation Mon Aug 30 18:00:17 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 67D TO 69 D

Fixed Targets

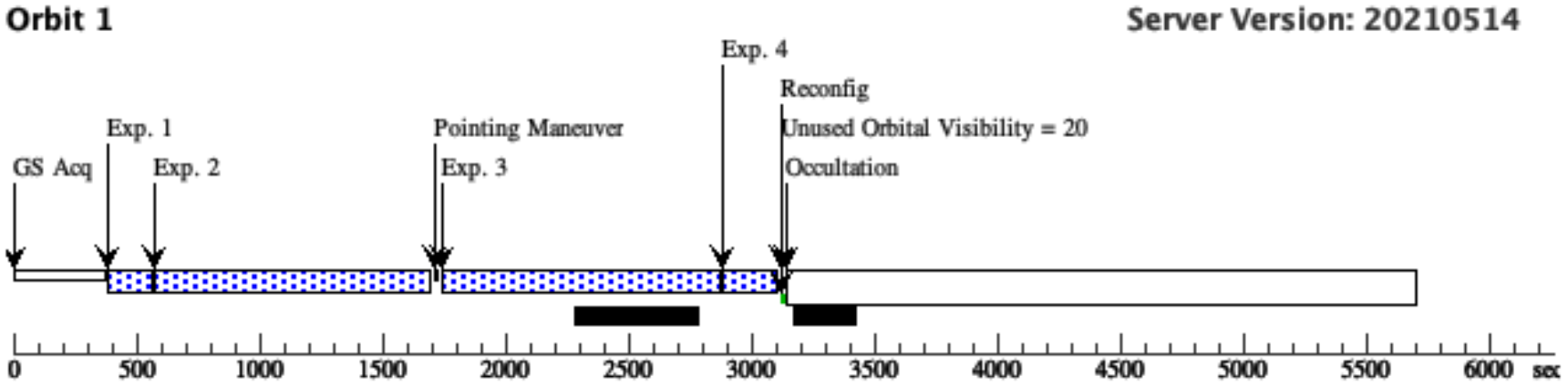
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	XMM3-3085	RA: 02 26 59.0800 (36.7461667d) Dec: -05 12 17.49 (-5.20486d) Equinox: J2000		V=30+/-1 H=23.9 ABmag	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Direct_Imaging_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=4; SAMP-SEQ=SPARS50	POS TARG -1.930,-1.729		152.933644 Secs (152.934 Secs) *[==>]*	*[1]*
2	Spec_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG -1.930,-1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
3	Spec_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG 1.930,1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
4	Direct_Imaging_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=5; SAMP-SEQ=SPARS50	POS TARG 1.930,1.729		202.934095 Secs (202.934 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 16295, Ori_67-69_2 (02), implementation Mon Aug 30 18:00:17 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 67D TO 69 D

Fixed Targets

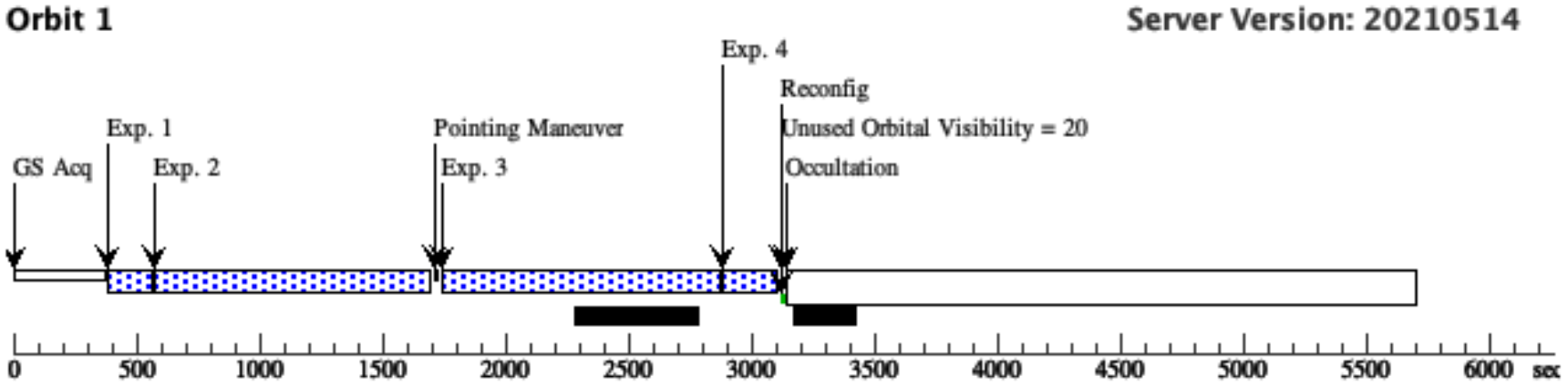
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	XMM3-3085	RA: 02 26 59.0800 (36.7461667d) Dec: -05 12 17.49 (-5.20486d) Equinox: J2000		V=30+/-1 H=23.9 ABmag	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Direct_Imaging_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=4; SAMP-SEQ=SPARS50	POS TARG -1.930,-1.729		152.933644 Secs (152.934 Secs) *[==>]*	*[1]*
2	Spec_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG -1.930,-1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
3	Spec_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG 1.930,1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
4	Direct_Imaging_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=5; SAMP-SEQ=SPARS50	POS TARG 1.930,1.729		202.934095 Secs (202.934 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 16295, Ori_304-309_1 (03), scheduling Mon Aug 30 18:00:18 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 304D TO 309 D; ORIENT 31D TO 32 D

Fixed Targets

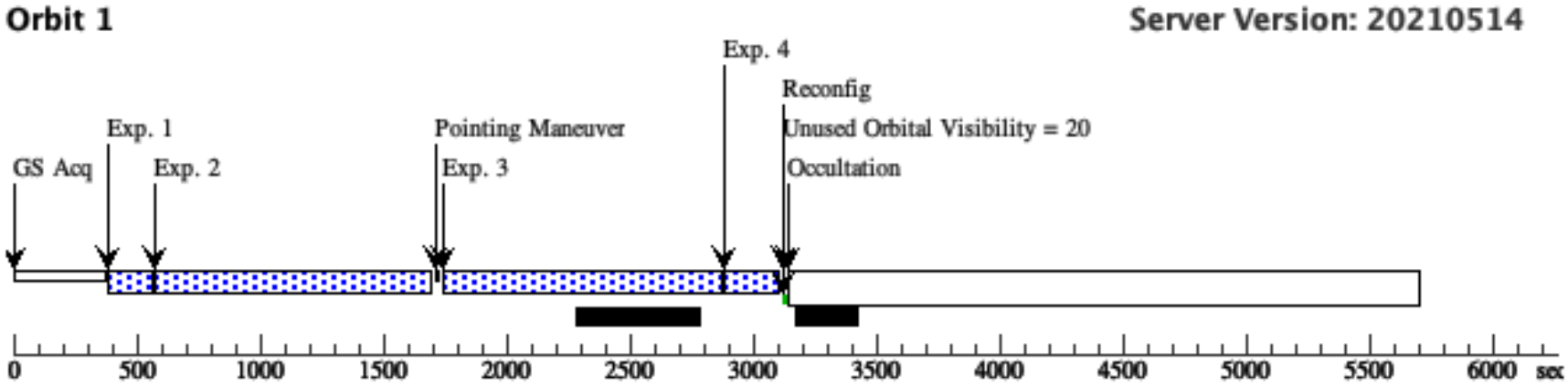
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	XMM3-3085	RA: 02 26 59.0800 (36.7461667d) Dec: -05 12 17.49 (-5.20486d) Equinox: J2000		V=30+/-1 H=23.9 ABmag	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Direct_Imaging_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=4; SAMP-SEQ=SPARS50	POS TARG -1.930,-1.729		152.933644 Secs (152.934 Secs) *[==>]*	*[1]*
2	Spec_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG -1.930,-1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
3	Spec_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG 1.930,1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
4	Direct_Imaging_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=5; SAMP-SEQ=SPARS50	POS TARG 1.930,1.729		202.934095 Secs (202.934 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 16295, Ori_304-309_2 (04), scheduling Mon Aug 30 18:00:18 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 304D TO 309 D; ORIENT 31D TO 32 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	XMM3-3085	RA: 02 26 59.0800 (36.7461667d) Dec: -05 12 17.49 (-5.20486d) Equinox: J2000		V=30+/-1 H=23.9 ABmag	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

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2	Spec_1	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG -1.930,-1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
3	Spec_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100	POS TARG 1.930,1.729		1102.935844 Secs (1102.936 Secs) *[==>]*	*[1]*
4	Direct_Imaging_2	(1) XMM3-3085	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=5; SAMP-SEQ=SPARS50	POS TARG 1.930,1.729		202.934095 Secs (202.934 Secs) *[==>]*	*[1]*

Orbit Structure