



12886 - Direct Detection of Escaping Lyman Continuum Emission from Local Lyman-Break Analog Galaxy

Cycle: 20, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) 2MASS-J09215939+4509126	COS/FUV COS/NUV	5	26-Nov-2012 21:28:29.0	yes
02	(1) 2MASS-J09215939+4509126	COS/FUV COS/NUV	4	26-Nov-2012 21:28:41.0	yes

9 Total Orbits Used

ABSTRACT

Lyman continuum photons leaking out of massive star forming systems are believed to be the source of ionizing photons that led to reionization of the universe at $z > 6$. However, our understanding of how these photons leaked from their parent galaxies is limited at best. Part of the problem is that the high-redshift galaxies are hard to study. Therefore, we have compiled a sample of local galaxies that mimic star-forming Lyman-Break galaxies in every measurable way. We found

that a class of these galaxies with Dominant Central Object (DCO) has much higher star-formation rates per unit volume and much faster outflows that can blow away and ionize interstellar medium, thus allowing a significant fraction of their Lyman continuum to escape. We request 9 orbits of HST to observe one such extremely rare galaxy with estimated escape fraction as high as 0.3. This value was estimated from three independent but indirect lines of evidence. These observations will provide the first direct evidence of leaking Lyman continuum emission in these systems. This will be a major step forward in understanding massive star forming systems and how ionizing radiation might have escaped at the epoch of reionization.

OBSERVING DESCRIPTION

J092159 is a unique Lyman Break Analog (LBA) galaxy that has a compact massive star forming region (~ 100 pc with $10^9 M_{\odot}$) known as a Dominant Compact Object (DCO). In our recent study of eight LBAs including this target with COS (Heckman et al. 2011), we found that galaxies with a DCO drive outflows with velocities much higher than the LBAs without a DCO. These powerful (~ 1000 km/s) outflows can blow holes through the interstellar medium (ISM) that may allow ionizing photon to escape.

We also found indirect evidence of holes in the ISM of this galaxy. The COS spectrum show strong saturated metal absorption-lines (e.g. C II and Si II) in the neutral ISM that are not black suggesting optically thick could partially covering the starburst. They also show blue shifted Lyman alpha in emission further suggesting holes in the ISM of this galaxy. Furthermore, the star formation rate implied by the far-IR plus far-UV continuum luminosity is over three times higher than that implied by the extinction-corrected H alpha emission-line luminosity.

Our primary goals of this project is to understand if ionizing radiation is escaping from Lyman Break Galaxy Analogs (LBAs) and if so the physical conditions responsible for it.

The project uses COS FUV grating G140L for 9 orbits in order to achieve the above-mentioned goals. The 25500 s observations for the target galaxy with FUV of 19.41 ± 0.15 mags at 1126 A (Lyman continuum edge of the target galaxy) will result in a $S/N > 19.2$ per resolution element (COS.sp.413287). As a safety check, a magnitude higher source (i.e FUV = 18.4 mag) when observed for 25500 s will yield 213 cts/s for the entire detector (COS.sp.413288).

For the target acquisition we use NUV MIRROR A imaging setting for 45 secs (COS.ta.413264). The target galaxy has a NUV magnitude = 18.98 ± 0.07 mags or 18.9 mags in the worst-case scenario based on error estimate. This exposure will have a count rate for the entire detector of 1042

Proposal 12886 (STScI Edit Number: 0, Created: Monday, November 26, 2012 9:28:49 PM EST) - Overview

cts/s and for the brightest pixel 15 cts/s. To check the safety of the acquisition exposures, we estimate the counts for an exposure of 45 s for a source 1 mag brighter, i.e. NUV=17.98 mags including the error margin, to 38 cts/s for the brightest pixel (i.e. less than 50 cts/s) and 1205 cts/s for the entire detector (COS.ta.413263). We will observe for another 600 s with MIRRORA after target acquisition for a deeper image. (COS.im.413289)

Hence, we conclude that both the exposures are within safe limits for the detectors.

As including this target with COS (Heckman et al. 2011), we found that galaxies with a DCO drive outflows with velocities much higher than the LBAs without a DCO. These powerful (~1000 km/s) outflows can blow holes through the interstellar medium (ISM) that may allow ionizing photon to escape.

We also found indirect evidence of holes in the ISM of this galaxy. The COS spectrum show strong saturated metal absorption-lines (e.g. C II and Si II) in the neutral ISM that are not black suggesting optically thick could partially covering the starburst. They also show blue shifted Lyman alpha in emission further suggesting holes in the ISM of this galaxy. Furthermore, the star formation rate implied by the far-IR plus far-UV continuum luminosity is over three times higher than that implied by the extinction-corrected H alpha emission-line luminosity.

Our primary goals of this project is to understand if ionizing radiation is escaping from Lyman Break Galaxy Analogs (LBAs) and if so the physical conditions responsible for it.

The project uses COS FUV grating G140L for 9 orbits in order to achieve the above-mentioned goals. The 25500 s observations for the target galaxy with FUV of 19.41 +/- 0.15 mags at 1126 A (Lyman continuum edge of the target galaxy) will result in a S/N >19.2 per resolution element (COS.sp.413287). As a safety check, a magnitude higher source (i.e FUV = 18.4 mag) when observed for 25500 s will yield 213 cts/s for the entire detector (COS.sp.413288).

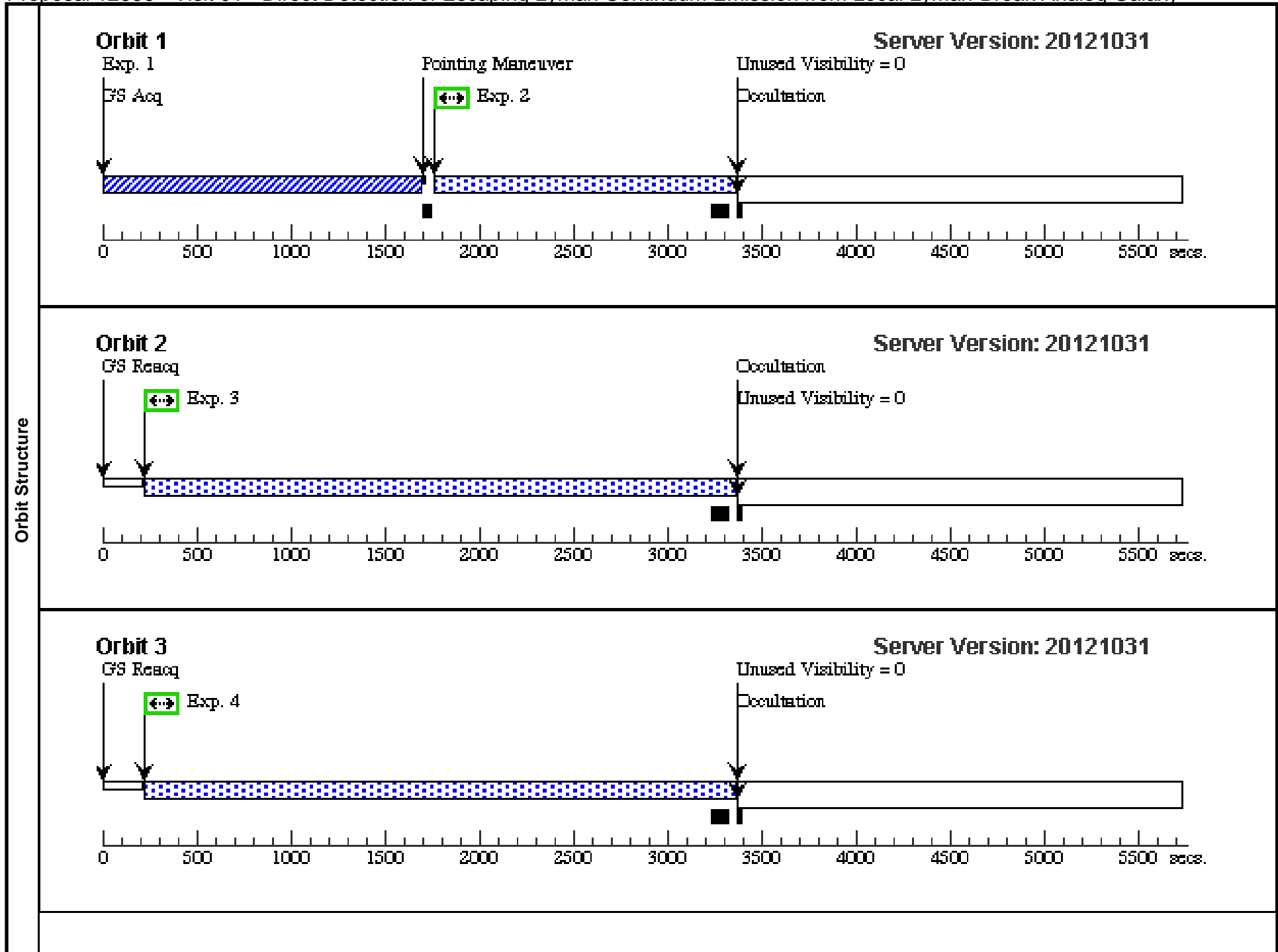
For the target acquisition we use NUV MIRROR A imaging setting for 45 secs (COS.ta.413264). The target galaxy has a NUV magnitude =18.98 +/- 0.07 mags or 18.9 mags in the worst-case scenario based on error estimate. This exposure will have a count rate for the entire detector of 1042 cts/s and for the brightest pixel 15 cts/s. To check the safety of the acquisition exposures, we estimate the counts for an exposure of 45 s for a source 1 mag brighter, i.e. NUV=17.98 mags including the error margin, to 38 cts/s for the brightest pixel (i.e. less than 50 cts/s) and 1205 cts/s for the entire detector (COS.ta.413263). We will observe for another 600 s with MIRRORA after target acquisition for a deeper image. (COS.im.413289)

Hence, we conclude that both the exposures are within safe limits for the detectors.

Proposal 12886 - Visit 01 - Direct Detection of Escaping Lyman Continuum Emission from Local Lyman-Break Analog Galaxy

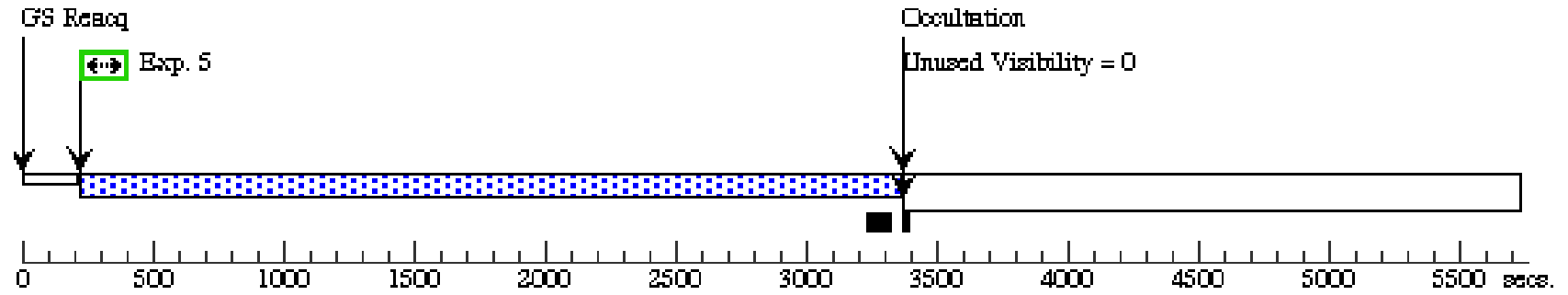
Tue Nov 27 02:28:49 GMT 2012

Visit	Proposal 12886, Visit 01, pi Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none) <i>Comments: 5/9 orbits of G140L at the rest frame Lyman limit of the target at wave_obs=1126 corresponding to z=0.2 to detect escaping Lyman continuum photons from this galaxy.</i>									
	Diagnostics	(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.								
Fixed Targets		#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	2MASS-J09215939+4509126	RA: 09 21 59.3900 (140.4974583d) Dec: +45 09 12.40 (45.15344d) Equinox: J2000	Redshift: 0.23499	V=18.441 GALEX FUV= 19.41 +/- 0.15 ; NUV = 18.91 +/- 0.07	Reference Frame: ICRS			
	<i>Comments: This object is a LBA galaxy from the sample presented by Heckman et al. 2011 (ApJ, 730, 5)</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Target Acq + deeper imaging (COS.ta.413 264)	(1) 2MASS-J09215939+4509126	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				645 Secs [==>]	[1]
	2	(COS.sp.413 287)	(1) 2MASS-J09215939+4509126	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; SEGMENT=BOTH; BUFFER-TIME=13 11			1421 Secs [==>]	[1]
	3	(COS.sp.413 287)	(1) 2MASS-J09215939+4509126	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; SEGMENT=BOTH; BUFFER-TIME=29 81			3091 Secs [==>]	[2]
	4	(COS.sp.413 287)	(1) 2MASS-J09215939+4509126	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; SEGMENT=BOTH; BUFFER-TIME=29 81			3091 Secs [==>]	[3]
	5	(COS.sp.413 287)	(1) 2MASS-J09215939+4509126	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; SEGMENT=BOTH; BUFFER-TIME=29 81			3091 Secs [==>]	[4]
	6	(COS.sp.413 287)	(1) 2MASS-J09215939+4509126	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; SEGMENT=BOTH; BUFFER-TIME=29 81			3091 Secs [==>]	[5]



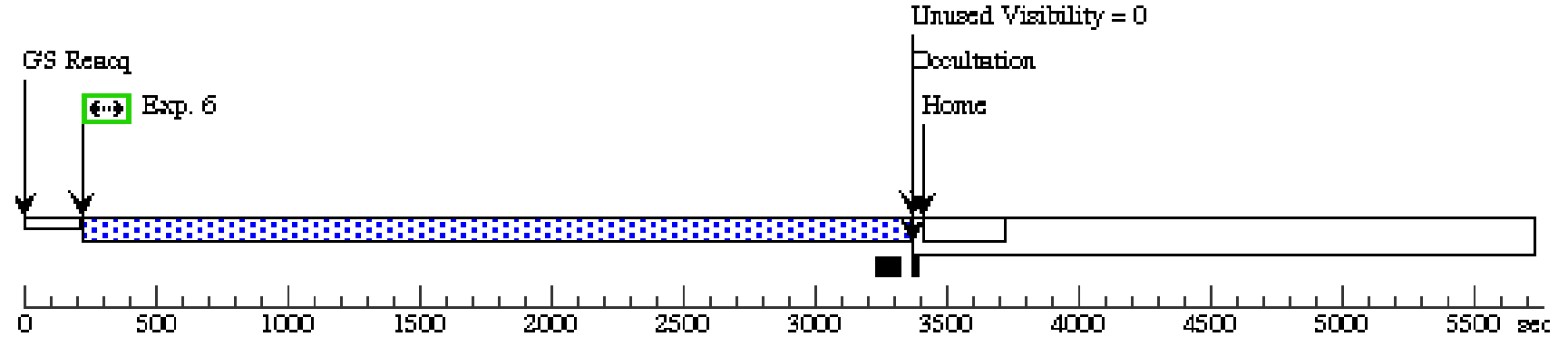
Orbit 4

Server Version: 20121031



Orbit 5

Server Version: 20121031



Proposal 12886 - Visit 02 - Direct Detection of Escaping Lyman Continuum Emission from Local Lyman-Break Analog Galaxy

Tue Nov 27 02:28:55 GMT 2012

Visit	Proposal 12886, Visit 02, pi Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none) <i>Comments: 4/9 orbits of G140L at the rest frame Lyman limit of the target at wave_obs=1126 corresponding to z=0.2 to detect escaping Lyman continuum photons from this galaxy.</i>																																																																				
	Diagnosics (Visit 02) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.																																																																				
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