



17443 - Establishing the Geometry of Lyman Continuum Escape

Cycle: 31, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Cody Andrew Carr (PI) (Contact)	Zhejiang University (ZJU)
Prof. Stephan Robert McCandliss (CoI) (CoPI) (Contact)	The Johns Hopkins University
Ms. Sophia R Flury (CoI)	University of Massachusetts - Amherst
Prof. Anne Jaskot (CoI)	Williams College
Dr. Alberto Saldana-Lopez (CoI) (ESA Member)	Stockholm University
Prof. Claudia Scarlata (CoI)	University of Minnesota - Twin Cities

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) J105331+523753	COS/FUV COS/NUV	2	25-Jun-2024 16:00:17.0	yes
02	(2) J115855+312559	COS/FUV COS/NUV	3	25-Jun-2024 16:00:18.0	yes
03	(3) J154050+572442	COS/FUV COS/NUV	4	25-Jun-2024 16:00:18.0	yes
04	(4) J144010+461937	COS/FUV COS/NUV	4	25-Jun-2024 16:00:19.0	yes
05	(5) J103344+635317	COS/FUV COS/NUV	5	25-Jun-2024 16:00:20.0	yes

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06	(6) J091703+315221	COS/FUV COS/NUV	5	25-Jun-2024 16:00:21.0	yes

23 Total Orbits Used

ABSTRACT

The past decade has seen remarkable success in the direct detection of the fraction of ionizing radiation escaping from compact star-forming galaxies ($r_{50} < 500$ pc) with high star formation rates ($10 - 100 \text{ Msol yr}^{-1}$) in the rest frame Lyman continuum using the G140L, CENWAV800 mode of COS. We can now use confirmed LyC leakers to test how geometry and kinematics influence ionizing radiation escape in starbursting galaxies. We propose a pilot program to probe the nature of the outflows in a carefully chosen set of bright leakers and non-leakers, spanning a narrow range of metallicity to control on abundance uncertainties. We will use high resolution spectroscopy from COS G130M and archival G160M, to analyze absorption line profiles of HI and the host of low and high ionization species. We will employ the Semi-Analytical Line Transfer (SALT) code to determine the geometry, terminal velocities, and mass outflow rates as a function of ionization for each atomic species. We will address the long standing problem of whether ionizing radiation, at these select metallicities, escapes through holes in a patchy ISM/CGM or through a relatively smooth and tenuous density bounded optically thin medium. These analyses will inform the potential yield of a future program to examine objects at lower metallicities where the range in observed escape fraction is more extreme but the objects are fainter.

OBSERVING DESCRIPTION

For this pilot project our 6 targets were picked from the set of LzLCS objects within a narrow range of metallicity ($8.2 < 12 + \log(O/H) < 8.5$) and light weighted age (Saldana-Lopez et al. 2022) ($3.1 < \text{age}(\text{Myr}) < 5.9$), having the highest rest frame F1100. We selected three of these with the highest fLyC, and three with no fLyC. These 6 bright objects offer an exposure efficient program for meaningful tests of the SALT parameter determination, while controlling for metallicity and age to minimize potential variations in those parameters. This proof of concept for the SALT determination of geometry can then be proposed for a broader sample of stellar ages, metallicities, and escape fraction where the variation in escape fraction is more extreme.

We will acquire data with a velocity resolution of 80 km s^{-1} at a continuum signal-to-noise of 10 using G130M. We will use these new data along with archival G160M of our objects to assess the kinematics of absorption and emission line structures.

Proposal 17443 (STScI Edit Number: 4, Created: Tuesday, June 25, 2024 at 3:00:22 PM Eastern Standard Time) - Overview

These observations of high and low escape fraction objects will allow high fidelity determination, using the diagnostic power of SALT, of the line core optical depth, column density as a function of velocity, covering fraction, terminal velocity, and geometry. These data, when used in conjunction with Cloudy models to determine the nebular ionization parameter and degree of ionization stratification between the high- and non-leakers, will allow us to address whether there is a trend in outflow strength as a function of fLyC that warrants further investigation with an expanded data set.

We will also take advantage of recently acquired imaging data from ACS/SBC (F150LP, F165LP) and WFC3/UVIS (F438W, F547M, F850LP) from the LACOS program (Hayes - HST 17069), along with the NUV acquisition images obtained here, to assess the broadband spectral energy distributions, account for dust attenuation, and assess the geometry of extended emission beyond the aberrated COS aperture.

The six target Visits (J1053, J1158, J1540, J1440, J1033, J0917) are ordered by orbit allocations (2, 3, 4, 4, 5, 5) determined from ETC analysis of previously acquired G140 CENWAV=800 observations. All targets are point like with FWHM ranging from 0.18 to 0.44 arcsec.

Initial acquisitions will use the Mirror A NUV ACQ/Image mode with exposure times conservatively calculated from the ETC by adding 1 magnitude to the GALEX NUV magnitude and then doubling the given exposure time. This is similar to the algorithm used in the Low z LyC ACQ/Images to set up the G140L observations from which these targets were derived (Jaskot - HST 15626).

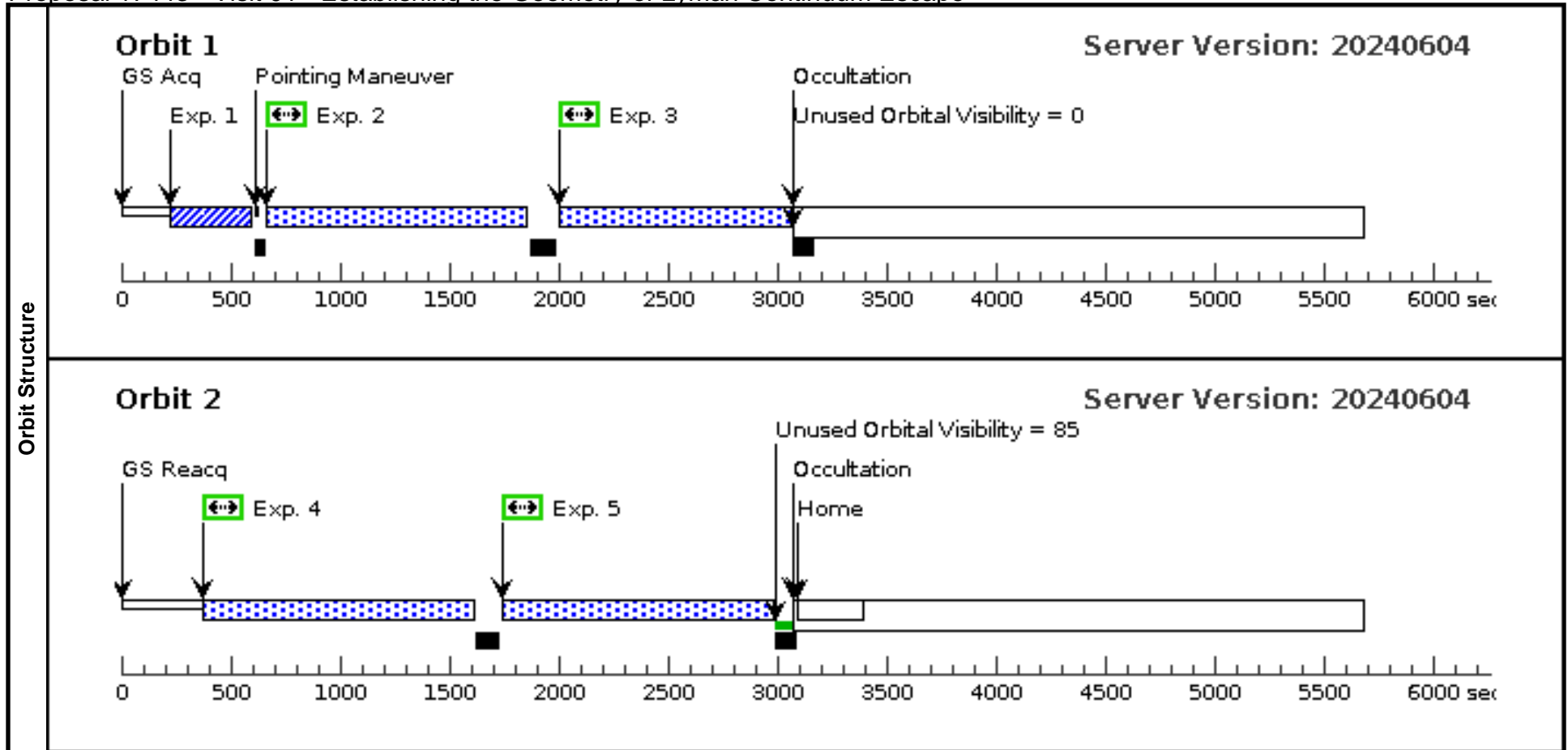
Five of target will be observed at CENWAV 1222 in FP-POS 1-4 in both A and B Segments. One of them (J103344+635317, Visit 05) will be observed in CENWAV 1291, using only in FP-POS 3-4 to allow spectral acquisition in both A and B Segments.

It is expected that each visit will fully use the orbital allocation for each target.

Proposal 17443 - Visit 01 - Establishing the Geometry of Lyman Continuum Escape

Tue Jun 25 20:00:22 GMT 2024

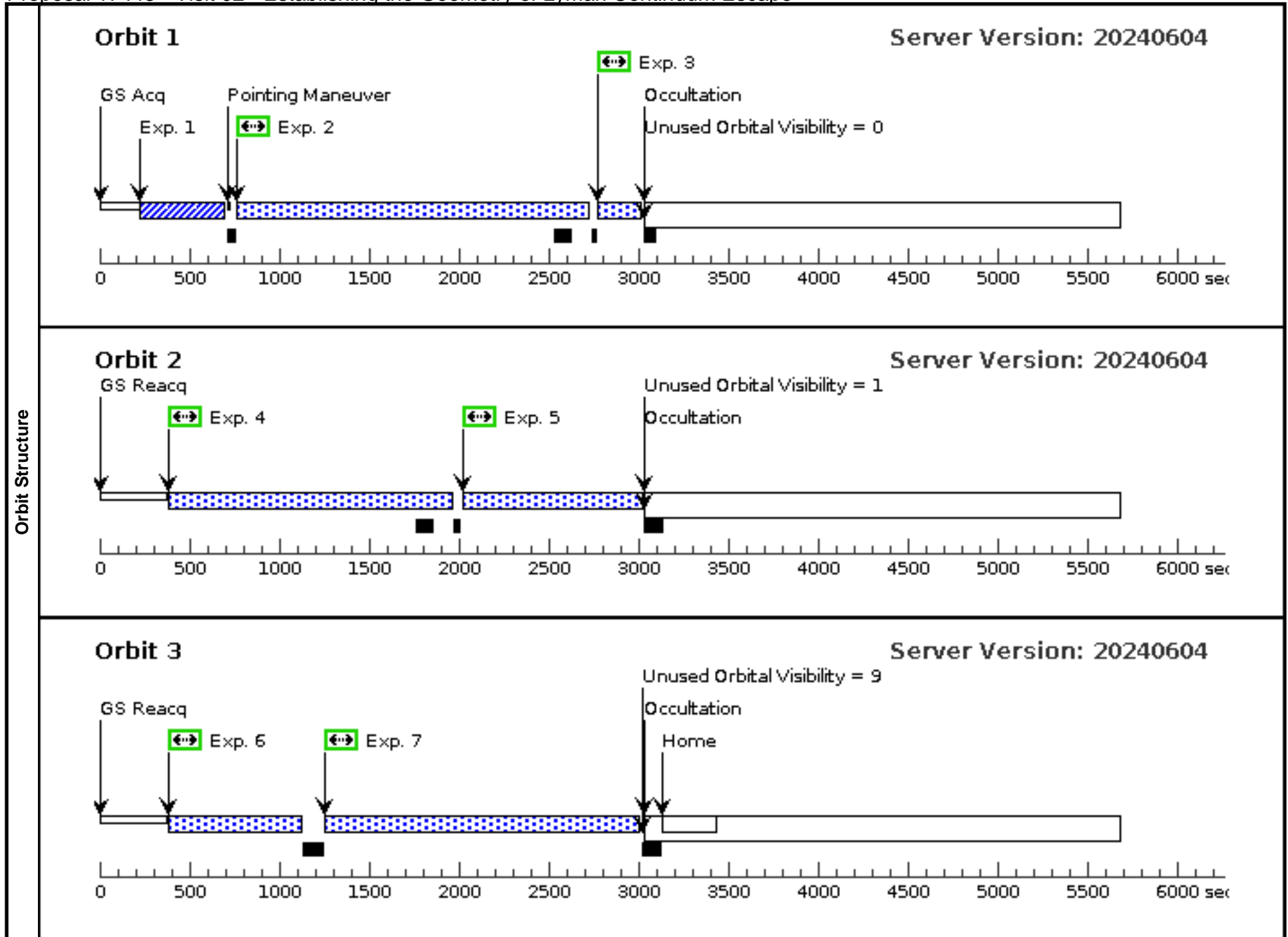
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Proposal 17443 - Visit 02 - Establishing the Geometry of Lyman Continuum Escape

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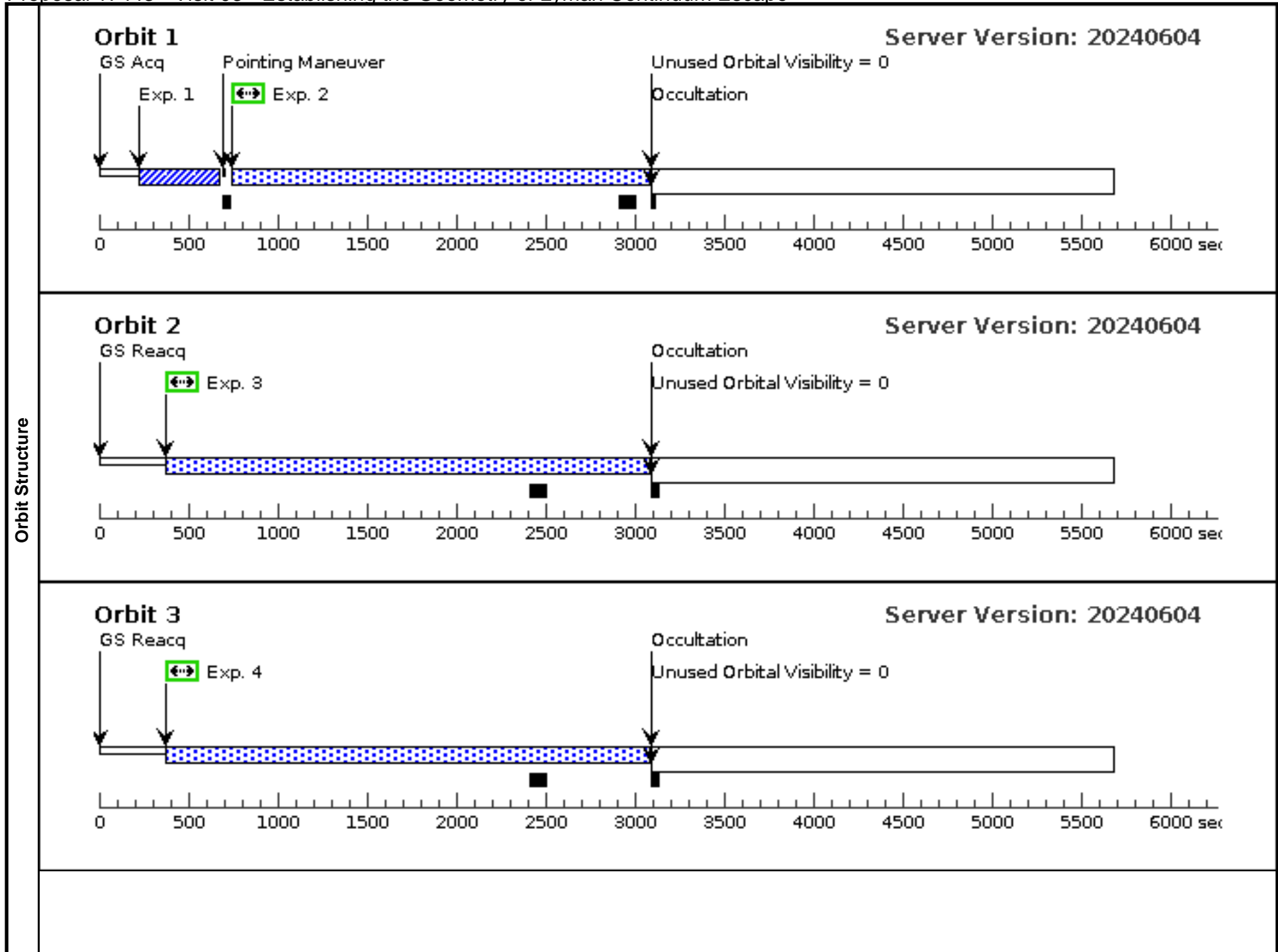
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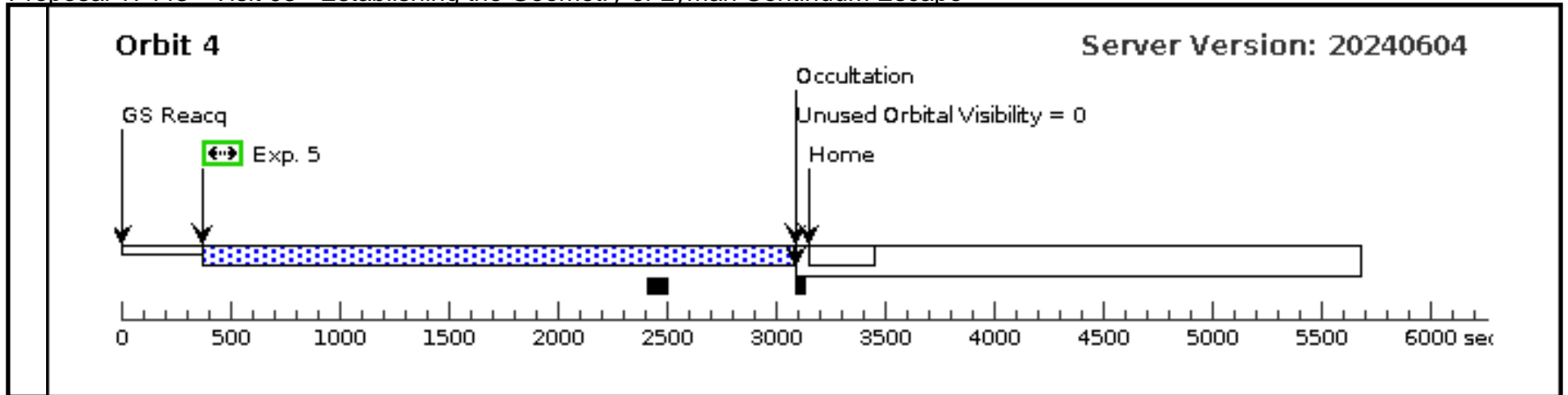


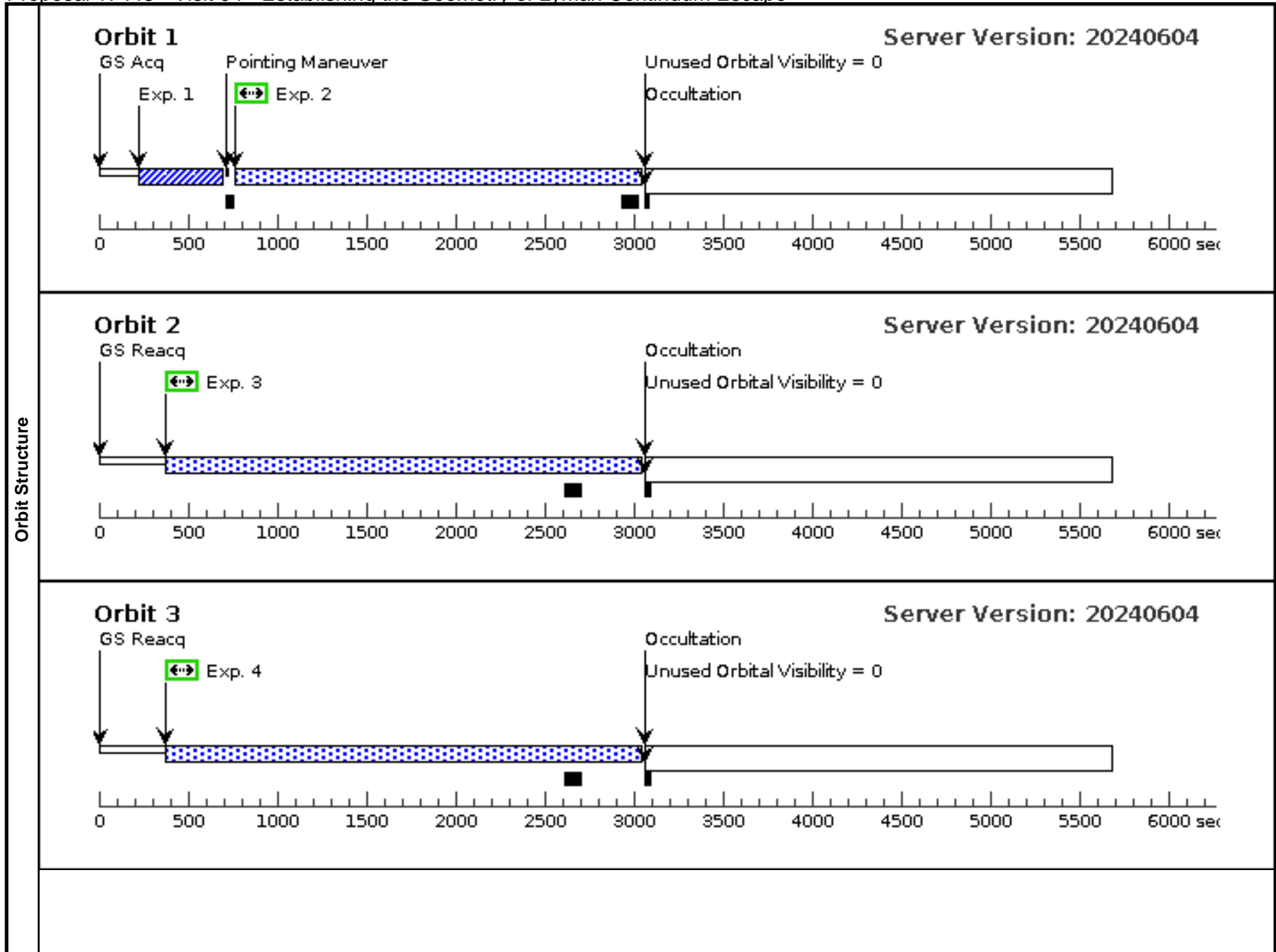
Proposal 17443 - Visit 03 - Establishing the Geometry of Lyman Continuum Escape

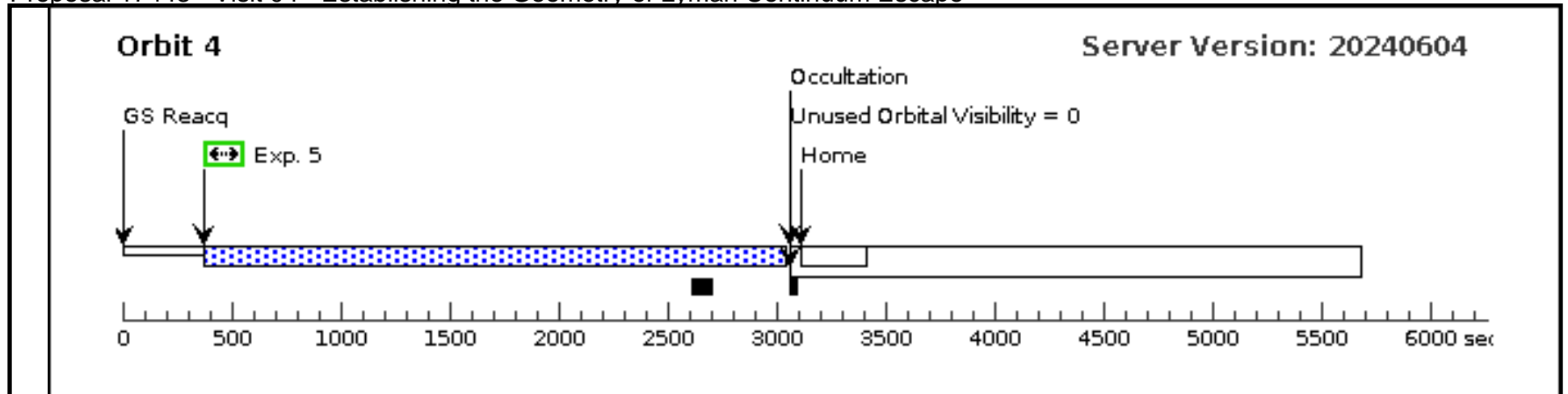
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	3	(cos.sp.1864 127)	(3) J154050+572442	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=20 00; FLASH=YES; FP-POS=2			2922 Secs (2655 Secs) [==>2655.0 Secs]	[2]																																																			
	4	(cos.sp.1864 127)	(3) J154050+572442	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=20 00; FLASH=YES; FP-POS=3			2922 Secs (2655 Secs) [==>2655.0 Secs]	[3]																																																			
5	(cos.sp.1864 127)	(3) J154050+572442	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=20 00; FLASH=YES; FP-POS=4			2922 Secs (2655 Secs) [==>2655.0 Secs]	[4]																																																				





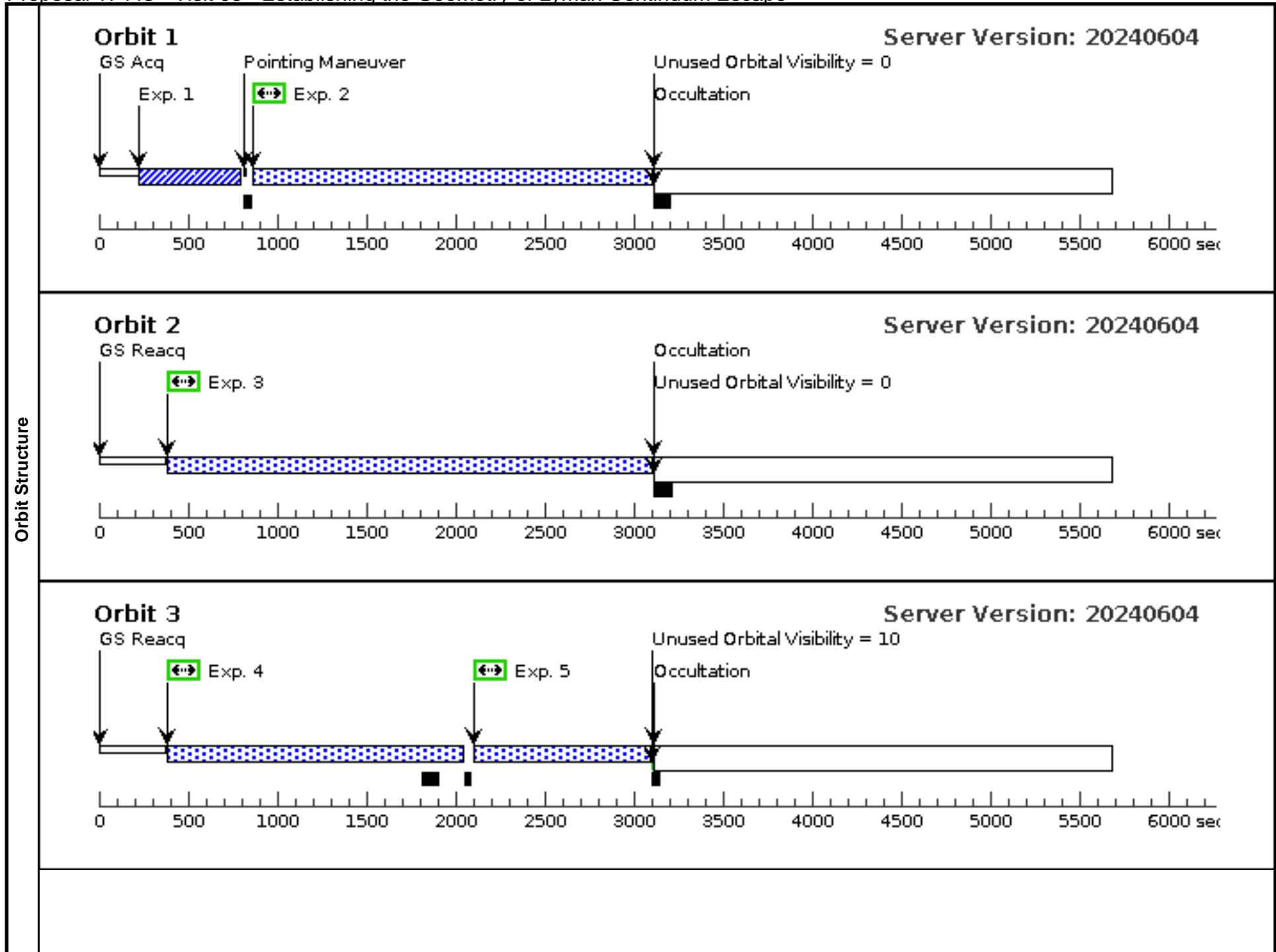


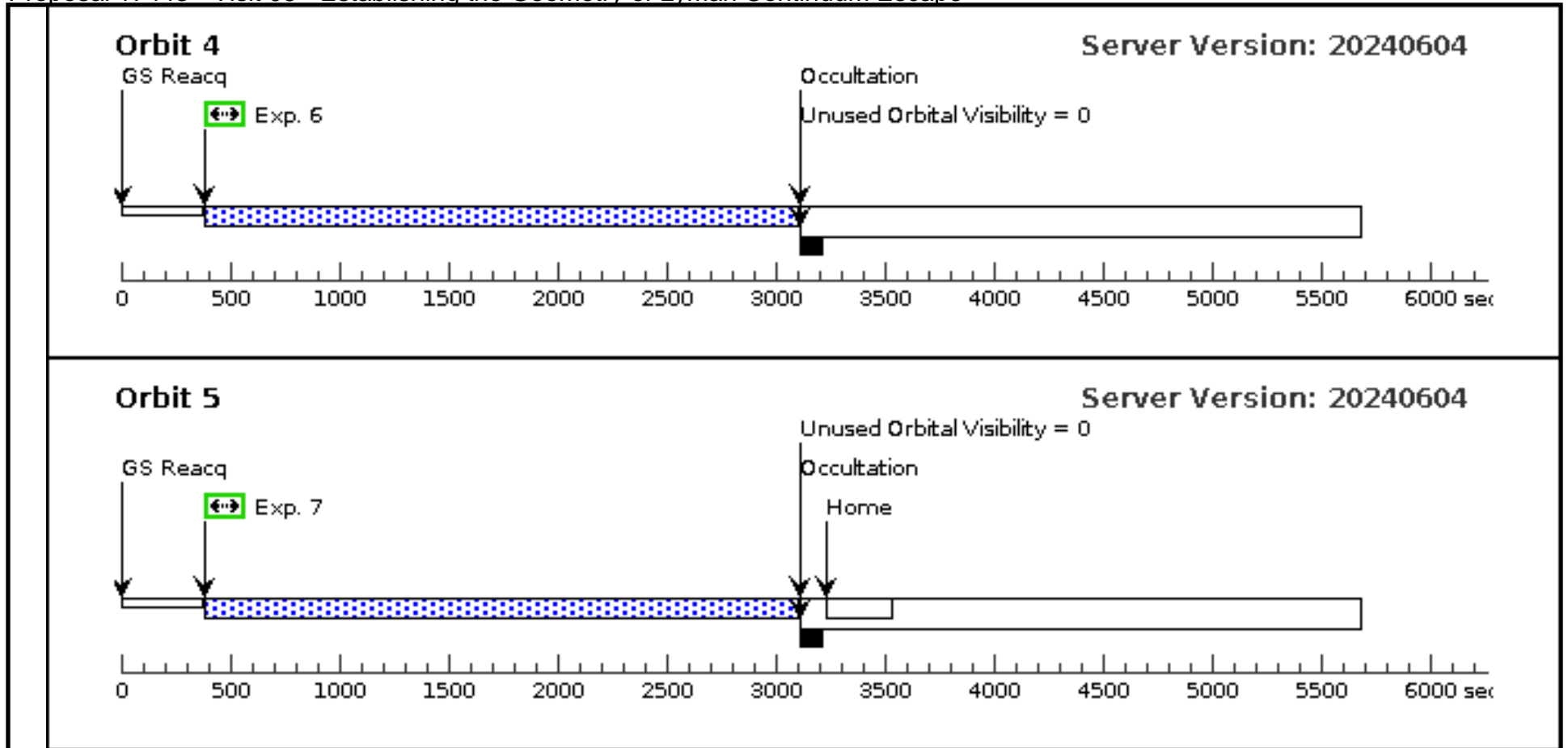


Proposal 17443 - Visit 05 - Establishing the Geometry of Lyman Continuum Escape

Tue Jun 25 20:00:22 GMT 2024

Visit	Proposal 17443, Visit 05, implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(5)	J103344+635317	RA: 10 33 44.0520 (158.4335500d) Dec: +63 53 17.20 (63.88811d) Equinox: J2000	Redshift: 0.347	V=19.5+/-0.1 f1481=50e-17 (rest 1100), FUV=19.89, NUV=19.88	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(COS.ta.189 1813)	(5) J103344+635317	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				180 Secs (180 Secs) [==>]	[1]
	2	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=25 80; FLASH=YES; FP-POS=3			2290 Secs (2066 Secs) [==>2066.0 Secs]	[1]
	3	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=29 50; FLASH=YES; FP-POS=3			2950 Secs (2675 Secs) [==>2675.0 Secs]	[2]
	4	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=14 00; FLASH=YES; FP-POS=3			1748 Secs (1610 Secs) [==>1610.0 Secs]	[3]
	5	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=29 50; FLASH=YES; FP-POS=4			1078 Secs (940 Secs) [==>940.0 Secs]	[3]
	6	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=29 50; FLASH=YES; FP-POS=4			2950 Secs (2675 Secs) [==>2675.0 Secs]	[4]
	7	(cos.sp.1864 059)	(5) J103344+635317	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=29 50; FLASH=YES; FP-POS=4			2950 Secs (2675 Secs) [==>2675.0 Secs]	[5]





Proposal 17443 - Visit 06 - Establishing the Geometry of Lyman Continuum Escape

Tue Jun 25 20:00:22 GMT 2024

Visit	Proposal 17443, Visit 06, implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																		
	Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(6)</td> <td>J091703+315221</td> <td>RA: 09 17 2.5248 (139.2605200d) Dec: +31 52 20.56 (31.87238d) Equinox: J2000</td> <td>Redshift: 0.300</td> <td>V=19.5+/-0.1 f1430=43e-17 (rest 1100), FUV=20.13, NUV=19.78</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td colspan="6"> <i>Comments:</i> Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO </td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(6)	J091703+315221	RA: 09 17 2.5248 (139.2605200d) Dec: +31 52 20.56 (31.87238d) Equinox: J2000	Redshift: 0.300	V=19.5+/-0.1 f1430=43e-17 (rest 1100), FUV=20.13, NUV=19.78	Reference Frame: ICRS	<i>Comments:</i> Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO				
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous														
(6)	J091703+315221	RA: 09 17 2.5248 (139.2605200d) Dec: +31 52 20.56 (31.87238d) Equinox: J2000	Redshift: 0.300	V=19.5+/-0.1 f1430=43e-17 (rest 1100), FUV=20.13, NUV=19.78	Reference Frame: ICRS														
<i>Comments:</i> Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO																			
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit									
	1	(COS.ta.189 1814)	(6) J091703+315221	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				160 Secs (160 Secs) [==>]	[1]									
	2	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=23 18; FLASH=YES; FP-POS=1			2069 Secs (2007 Secs) [==>2007.0 Secs]	[1]									
	3	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=80 0; FLASH=YES; FP-POS=1			1063 Secs (1006 Secs) [==>1006.0 Secs]	[2]									
	4	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=17 00; FLASH=YES; FP-POS=2			1516 Secs (1459 Secs) [==>1459.0 Secs]	[2]									
	5	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=14 50; FLASH=YES; FP-POS=2			1616 Secs (1564 Secs) [==>1564.0 Secs]	[3]									
	6	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=13 00; FLASH=YES; FP-POS=3			972 Secs (920 Secs) [==>920.0 Secs]	[3]									
	7	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=18 00; FLASH=YES; FP-POS=3			2160 Secs (2103 Secs) [==>2103.0 Secs]	[4]									
	8	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=48 8; FLASH=YES; FP-POS=4			428 Secs (371 Secs) [==>371.0 Secs]	[4]									
	9	(cos.sp.1864 050)	(6) J091703+315221	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=27 00; FLASH=YES; FP-POS=4			2703 Secs (2590 Secs) [==>2590.0 Secs]	[5]									

