



# 17171 - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstrom

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Prof. Daniel Schaerer (PI) (ESA Member) (Contact)</b>	<b>University of Geneva, Department of Astronomy</b>
Dr. Yuri I. Izotov (CoI)	Ukrainian National Academy of Sciences, BITP
Dr. Natalia G. Guseva (CoI)	Ukrainian National Academy of Sciences, BITP
Prof. Anne Verhamme (CoI) (ESA Member)	University of Geneva, Department of Astronomy
Dr. Gabor Worseck (CoI) (ESA Member)	Private Company
Prof. John Chisholm (CoI) (CoPI) (AdminUSPI)	University of Texas at Austin
Dr. Charlotte Simmonds (CoI) (ESA Member)	University of Cambridge

## 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) J0256+0122	COS/FUV COS/NUV	5	11-Jun-2024 19:00:16.0	yes
02	(2) J0815+2942	COS/FUV COS/NUV	5	11-Jun-2024 19:00:17.0	yes
03	(3) J0908+4626	COS/FUV COS/NUV	5	11-Jun-2024 19:00:17.0	yes

<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>
04	(4) J0955+3935	COS/FUV COS/NUV	5	11-Jun-2024 19:00:18.0	yes
05	(5) J1021+0436	COS/FUV COS/NUV	5	11-Jun-2024 19:00:19.0	yes
55	(55) J1021+0436-REPEAT	COS/FUV COS/NUV	4	11-Jun-2024 19:00:20.0	yes

29 Total Orbits Used

## **ABSTRACT**

The Lyman continuum (LyC = hydrogen-ionizing radiation at wavelengths  $< 912$  Ang) of galaxies plays a fundamental role in determining the physical and observational properties of the ISM and IGM, including cosmic reionization. Yet it is basically inaccessible to direct observations, and one therefore heavily relies on theoretical, yet untested predictions from synthesis models. Furthermore the ionizing spectra differ significantly between different models, with important implications on widely used emission line diagnostics and other observables.

We here propose to observe for the first time the shape of the ionizing continuum of star-forming galaxies over a wide spectral range, from  $\sim 550$  to  $912$  Angstrom. This can be achieved with COS by targeting LyC emitters at  $z \sim 0.8-1$ . The observations will measure stellar and nebular features in the LyC, and thus provide direct constraints for stellar population models in this generally inaccessible part of the spectrum.

The proposed observations will provide unique insight on the hardness of the ionizing spectra of star-forming galaxies, with numerous possible implications on our understanding of the emission line properties of distant galaxies, sources of cosmic reionization, emission line diagnostics, and related topics.

## **OBSERVING DESCRIPTION**

We have verified that our targets are sufficiently faint to satisfy safety conditions for observing with the COS and that there are no sources brighter than the COS safety limits in proximity (within circle of  $43''$  diameter) of our targets. We will obtain NUV acquisition images of the targets with the standard Mirror A and the ACQ/IMAGE mode, with exposures of  $\sim 300$  seconds to reach a  $S/N \sim 20$  within a  $9 \times 9$  pixel box centered on the brightest part of the galaxy. We have used the GALEX NUV magnitudes to estimate the S/N. The angular galaxy radius is chosen to be  $0.2''$ , inside which

## Proposal 17171 (STScI Edit Number: 2, Created: Tuesday, June 11, 2024 at 6:00:20 PM Eastern Standard Time) - Overview

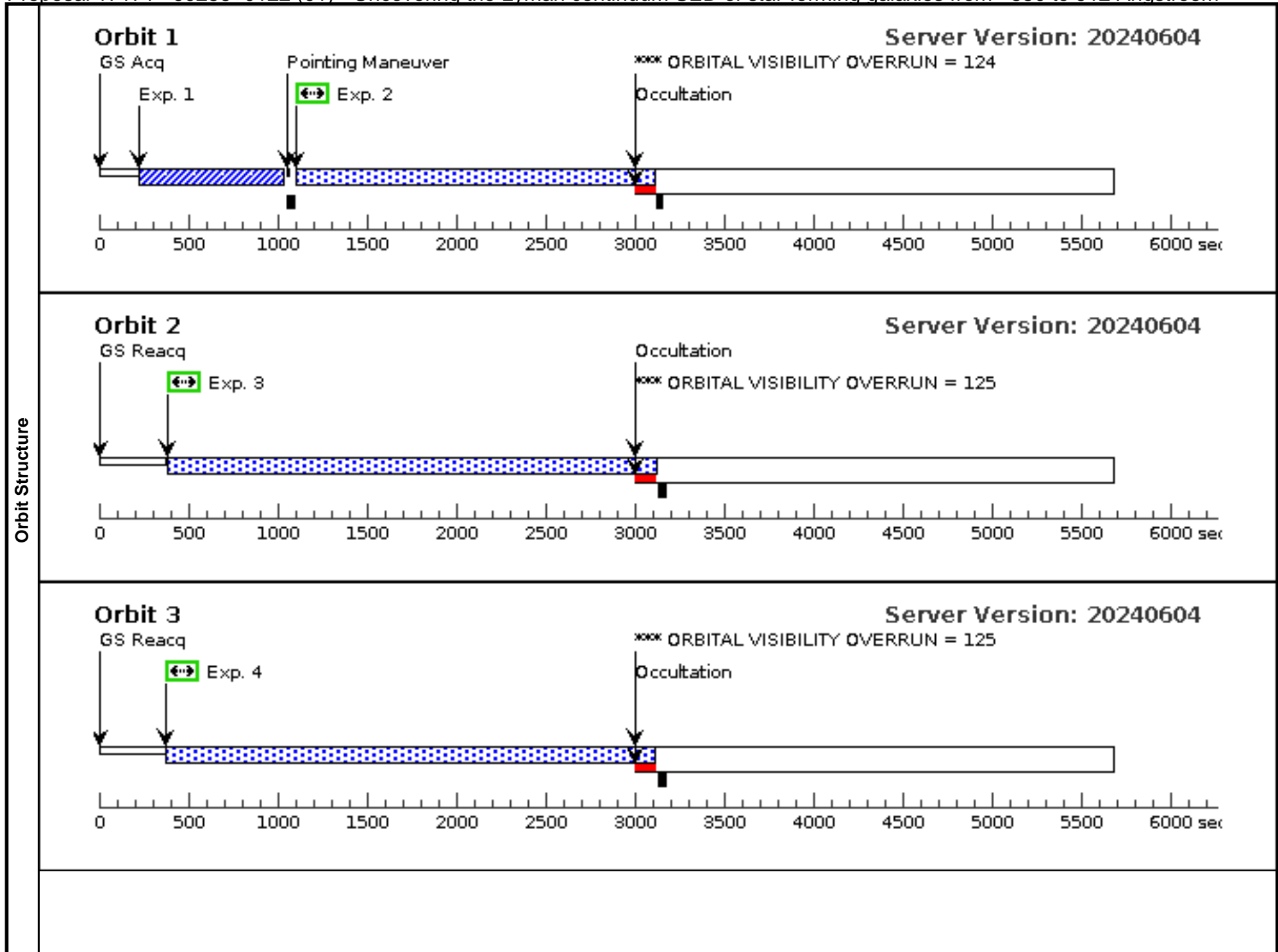
most of the galaxy light is concentrated. The total time for acquisition is 0.3 orbit. The acquisition image will allow us to analyse the UV morphology of the sources. The COS will be used in combination with the low-resolution G140L grating centered at 800Å to measure the LyC. The required number of orbits for each object is calculated so as to detect the LyC at the level above 1sigma with a 100-pixel binning of the data at the observed wavelength  $\sim 900 \times (1+z) \text{Å}$ . For the LyC flux we have assumed the minimum value corresponding to an escape fraction of 5 %, and the intrinsic LyC flux density that is obtained from the relation  $I(\text{H}\beta)/I(912) \sim 9A$ , where  $I(\text{H}\beta)$  is the extinction-corrected flux of the Hbeta emission line. For intrinsic fluxes at shorter wavelengths we have taken a range of predictions from Starburst99 and BPASS models. We have also done simulations of the expected observations using synthetic spectra obtained from SED fits to the available photometry and SDSS spectra and using Starburst99 and BPASS models. These confirm that a sufficient S/N can be obtained over the wavelength range of interest. The extinction of the targets, measured from the Balmer decrement is very low ( $E(B-V) \sim 0 - 0.07$ ). All the available data (including combination of COS + SDSS spectra, GALEX photometry and SED) will be used to model and correct for selective extinction. It is difficult to foresee the selective extinction in this spectral range. For each target 0.3 orbit is needed for acquisition, and 4.7 orbits for the spectrum with the low-resolution G140L grating, i.e. 5 orbits in total. All four FP-POS are used in consecutive orbits of a visit. We therefore request a total of 25 orbits for 5 objects.

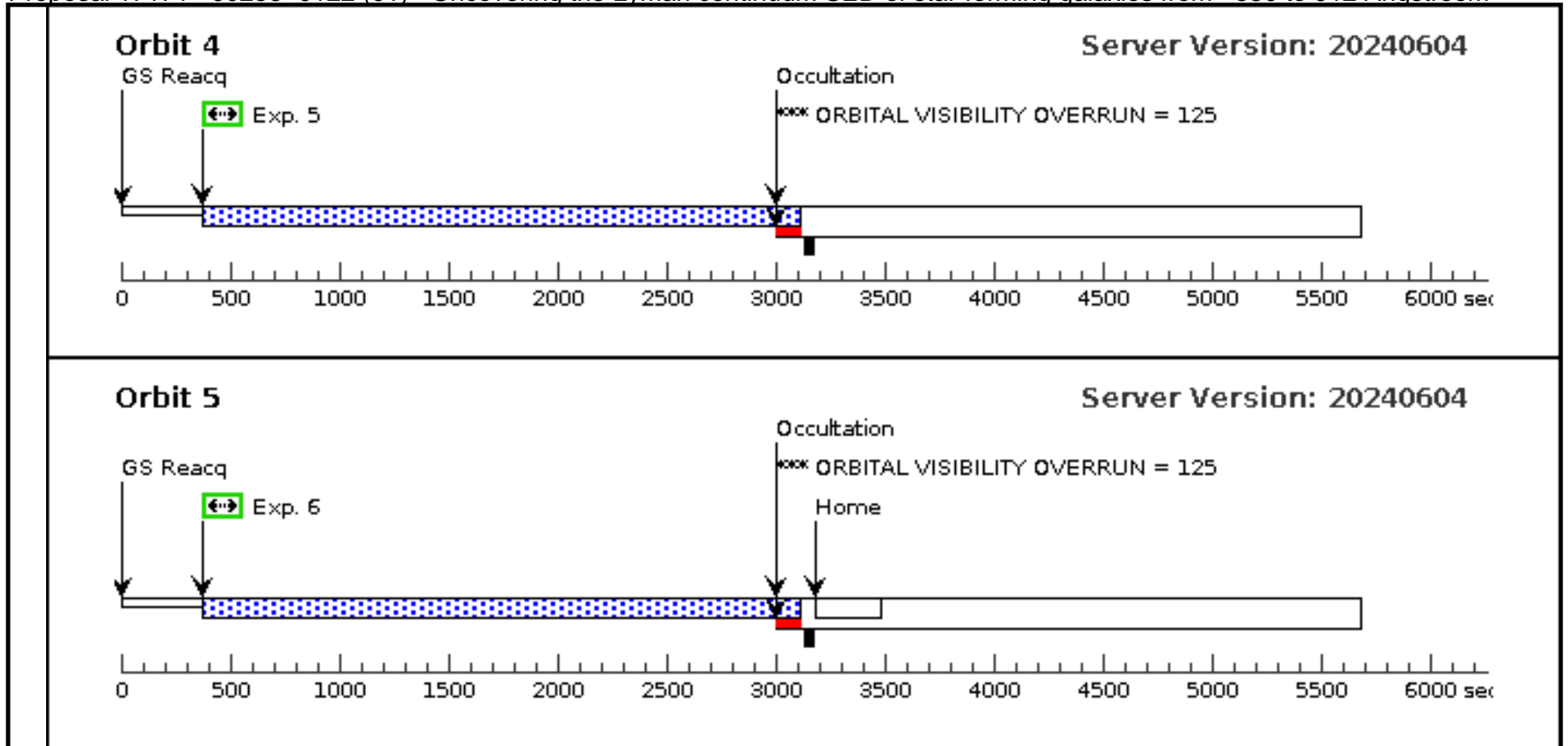
Proposal 17171 - J0256+0122 (01) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstroem

<b>Visit</b>	<b>Proposal 17171, J0256+0122 (01), completed</b> <span style="float: right;">Tue Jun 11 23:00:20 GMT 2024</span> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																
	<b>Diagnosics</b> (J0256+0122 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0256+0122 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0256+0122 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0256+0122 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0256+0122 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																
<b>Fixed Targets</b>	<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>(1)</td> <td>J0256+0122</td> <td>RA: 02 56 58.2600 (44.2427500d) Dec: +01 22 45.80 (1.37939d) Equinox: J2000</td> <td>Redshift: 0.88662</td> <td>V=20.98+/-0.10 NUV=21.57+/-0.07, f(912*1.81474=1717A)=3.70e-1 8 erg s-1 cm-2 A-1 - 5% of the i ntrinsic LyC flux</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>					#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	J0256+0122	RA: 02 56 58.2600 (44.2427500d) Dec: +01 22 45.80 (1.37939d) Equinox: J2000	Redshift: 0.88662	V=20.98+/-0.10 NUV=21.57+/-0.07, f(912*1.81474=1717A)=3.70e-1 8 erg s-1 cm-2 A-1 - 5% of the i ntrinsic LyC flux	Reference Frame: ICRS
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Comments: Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO																	

Proposal 17171 - J0256+0122 (01) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstrom

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	2	J0256+0122 G140L1 (COS.sp.180 8666)	(1) J0256+0122	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			1799. Secs (1799 Secs) [==>]	[1]
	3	J0256+0122 G140L2 (COS.sp.180 8666)	(1) J0256+0122	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			2686. Secs (2686 Secs) [==>]	[2]
	4	J0256+0122 G140L3 (COS.sp.180 8666)	(1) J0256+0122	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=2; SEGMENT=A			1286. Secs (2686 Secs) [==>2686.0 Secs ]	[3]
	5	J0256+0122 G140L4 (COS.sp.180 8666)	(1) J0256+0122	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=3; SEGMENT=A			1285 Secs (2686 Secs) [==>2686.0 Secs ]	[4]
	6	J0256+0122 G140L5 (COS.sp.180 8666)	(1) J0256+0122	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=4; SEGMENT=A			1285. Secs (2686 Secs) [==>2686.0 Secs ]	[5]



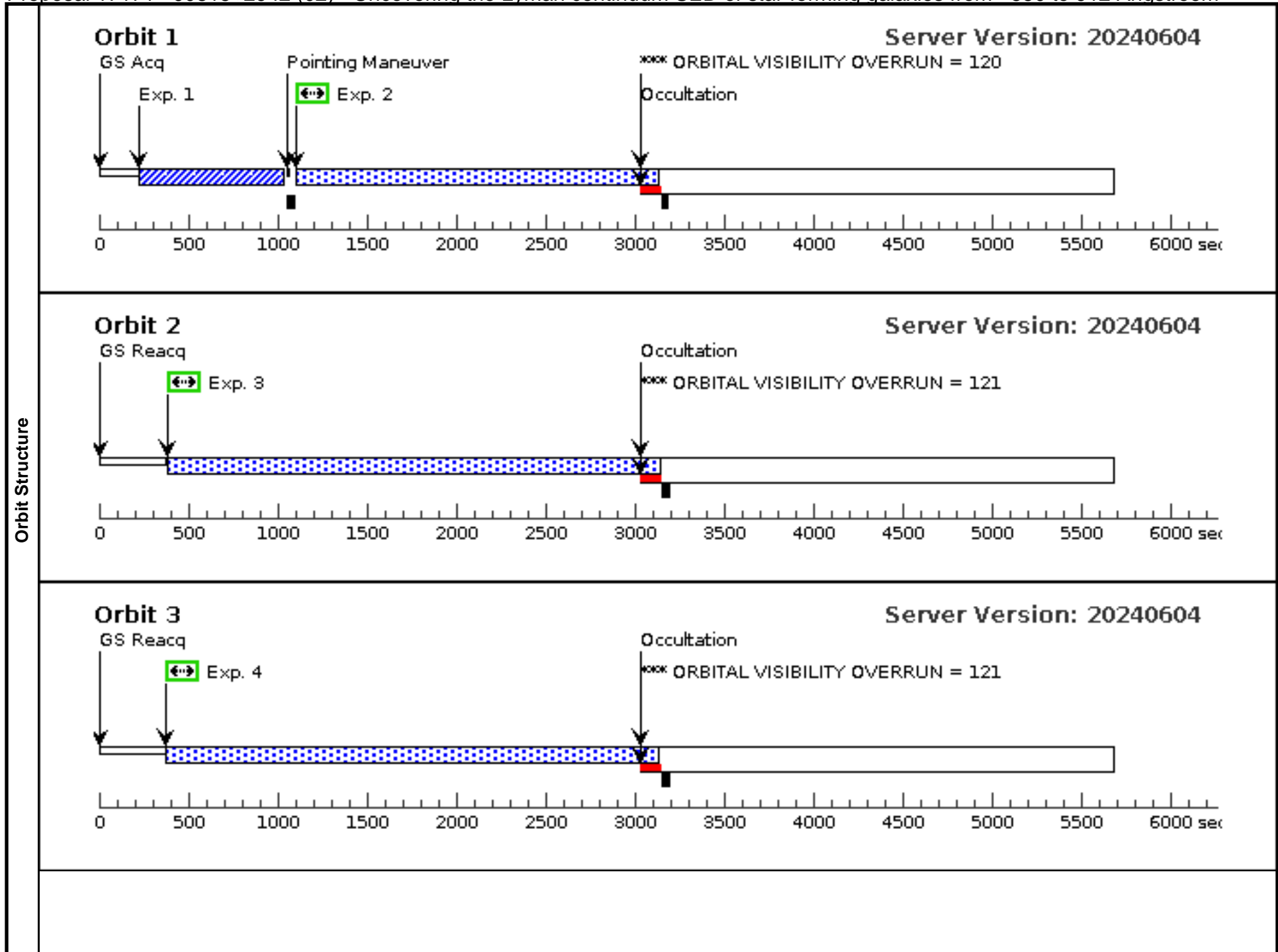


Proposal 17171 - J0815+2942 (02) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstroem

<b>Visit</b>	<b>Proposal 17171, J0815+2942 (02), completed</b> <span style="float: right;">Tue Jun 11 23:00:20 GMT 2024</span> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																
	<b>Diagnosics</b> (J0815+2942 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0815+2942 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0815+2942 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0815+2942 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0815+2942 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																
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(2)	J0815+2942	RA: 08 15 53.7200 (123.9738333d) Dec: +29 42 29.70 (29.70825d) Equinox: J2000	Redshift: 0.91414	V=21.33+/-0.10 NUV=21.33+/-0.12, f(912*1.91414=1746A)=3.2e-18 erg s-1 cm-2 A-1- 5% of the intrinsic LyC flux	Reference Frame: ICRS												
Comments: Category=GALAXY Description=[DWARF COMPACT, STARBURST] Extended=NO																	

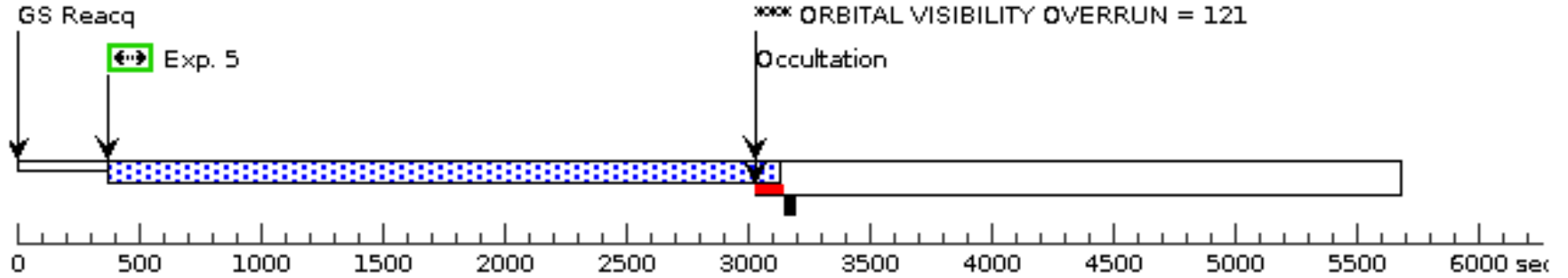
Proposal 17171 - J0815+2942 (02) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstrom

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	J0815+2942 ACQ (COS.ta.180 8589)	(2) J0815+2942	COS/NUV, ACQ/IMAGE, PSA	MIRRORA					300. Secs (300 Secs) [==>]	[1]
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	3	J0815+2942 G140L2 (COS.sp.180 8665)	(2) J0815+2942	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			2709. Secs (2709 Secs) [==>]	[2]
	4	J0815+2942 G140L3 (COS.sp.180 8665)	(2) J0815+2942	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=2; SEGMENT=A			1297. Secs (2709 Secs) [==>2709.0 Secs ]	[3]
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	6	J0815+2942 G140L5 (COS.sp.180 8665)	(2) J0815+2942	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=4; SEGMENT=A			1297. Secs (2709 Secs) [==>2709.0 Secs ]	[5]



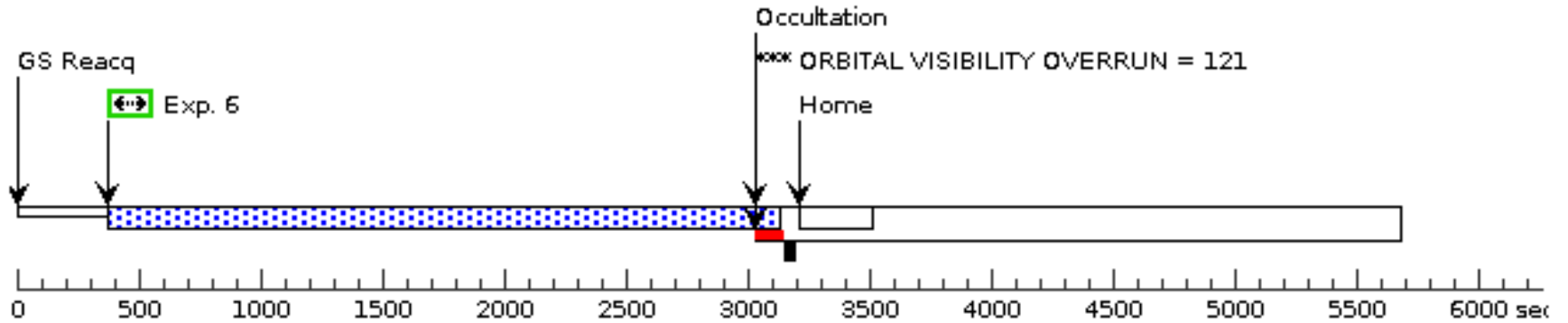
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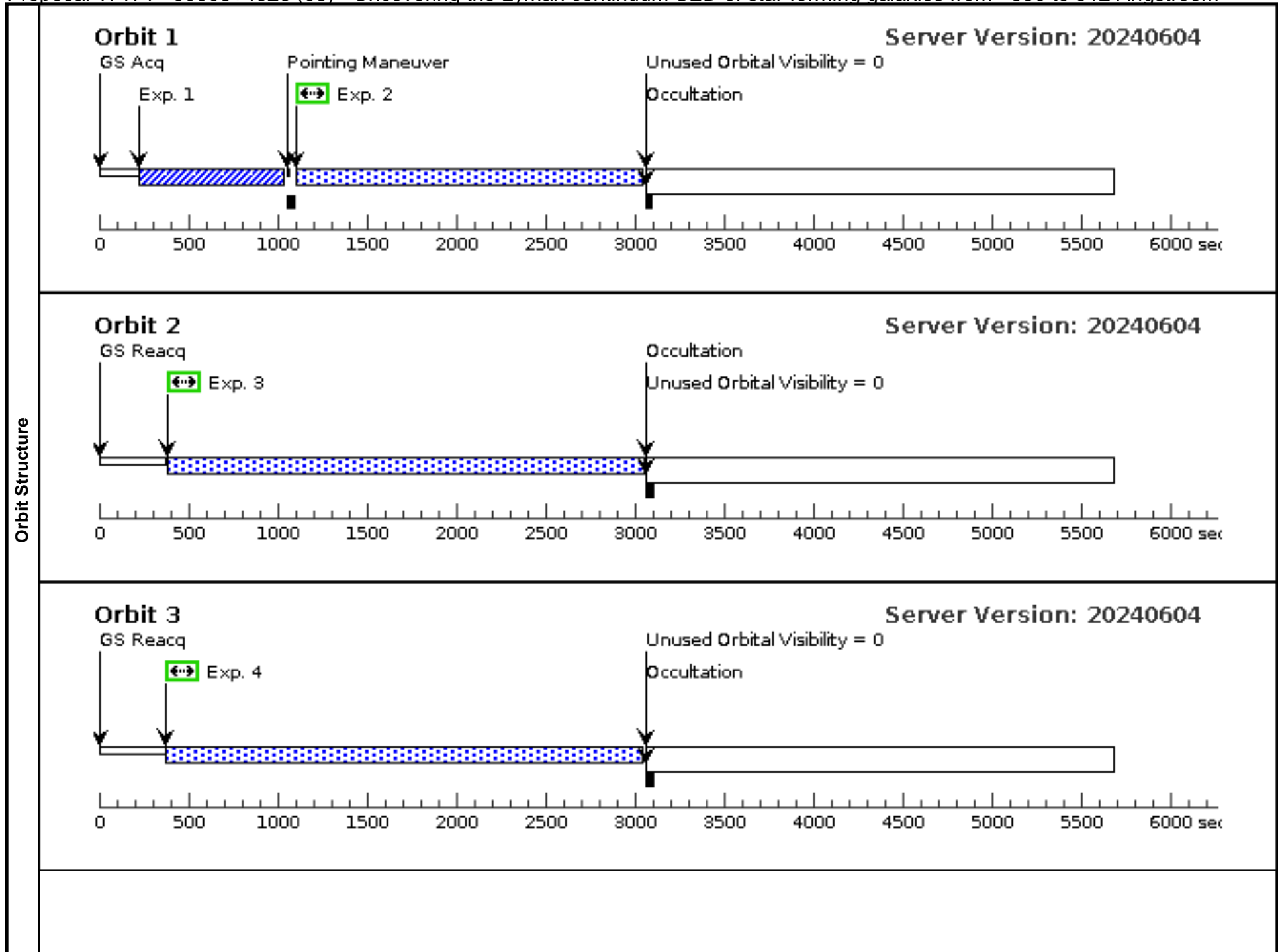


### Orbit 5

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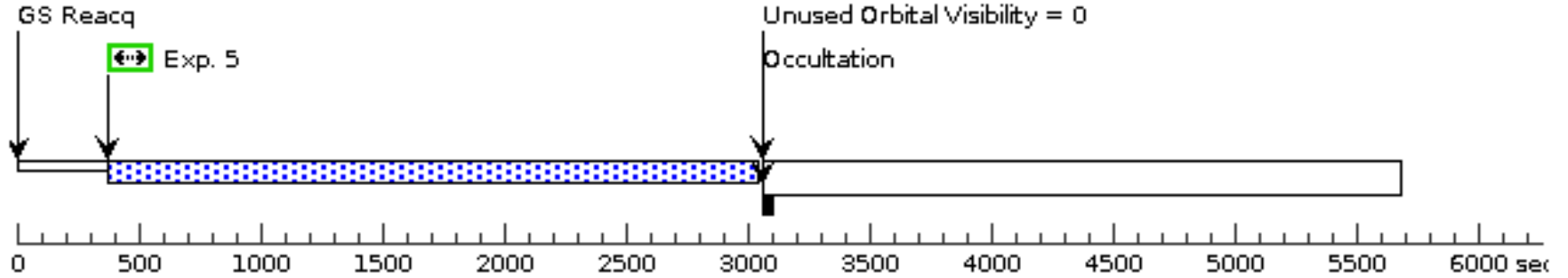






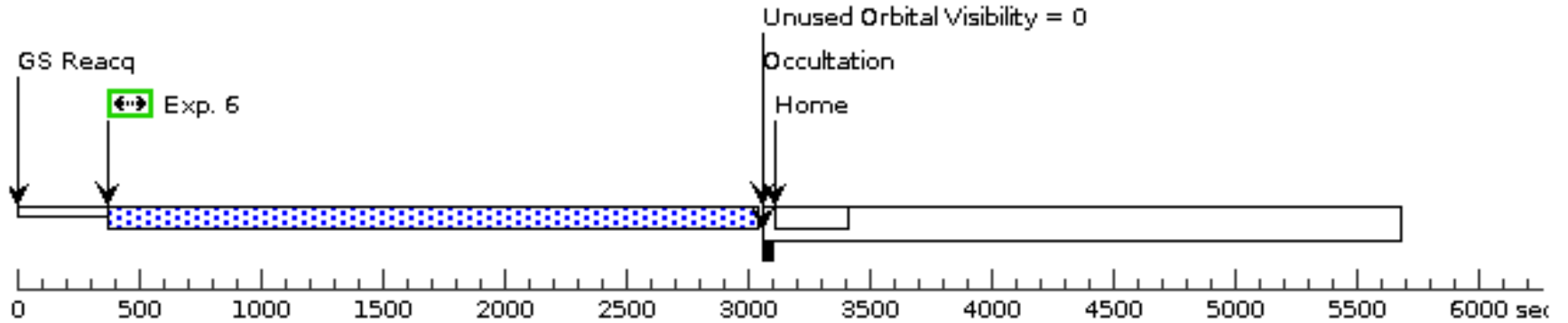
### Orbit 4

Server Version: 20240604



### Orbit 5

Server Version: 20240604

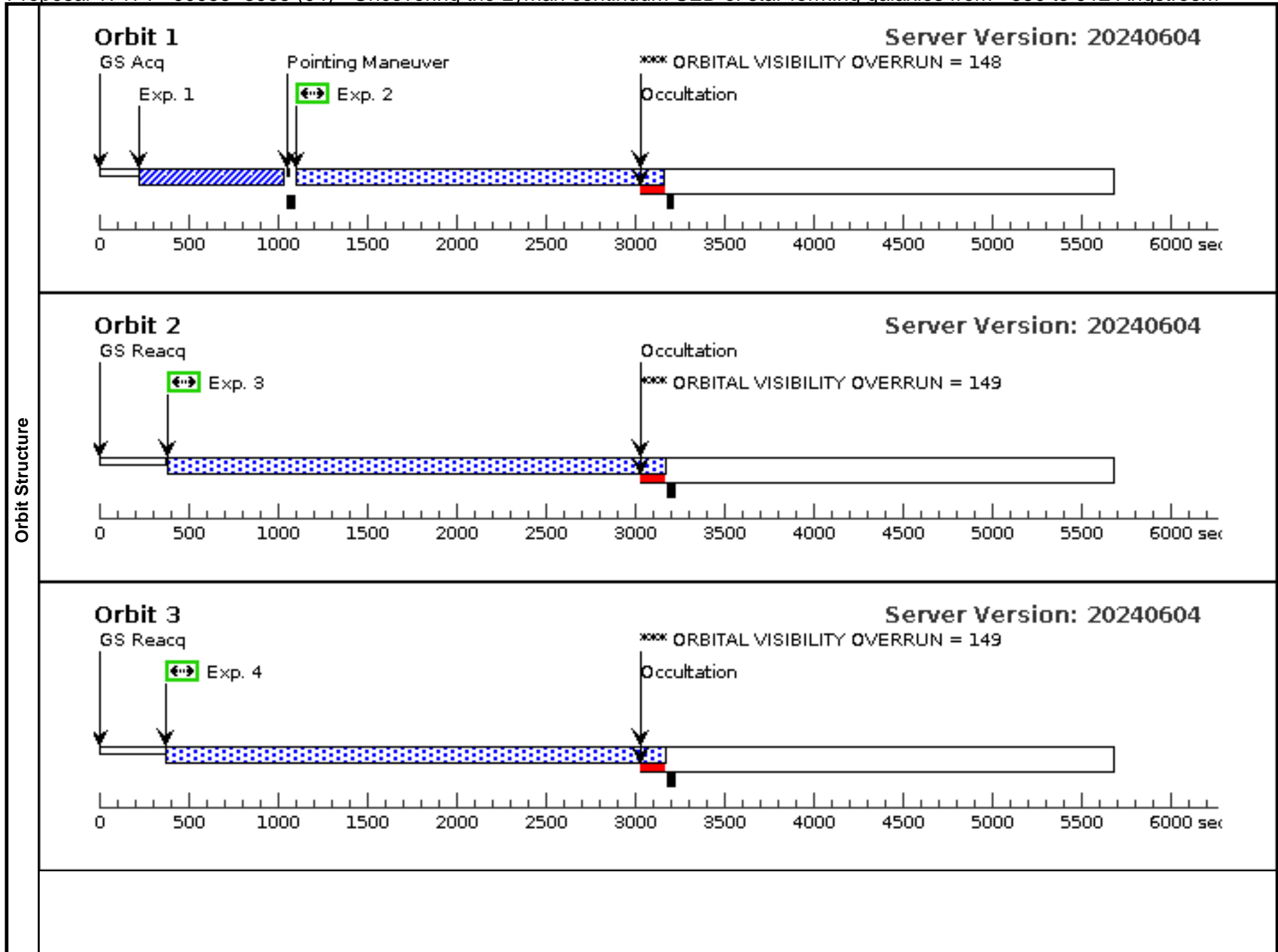


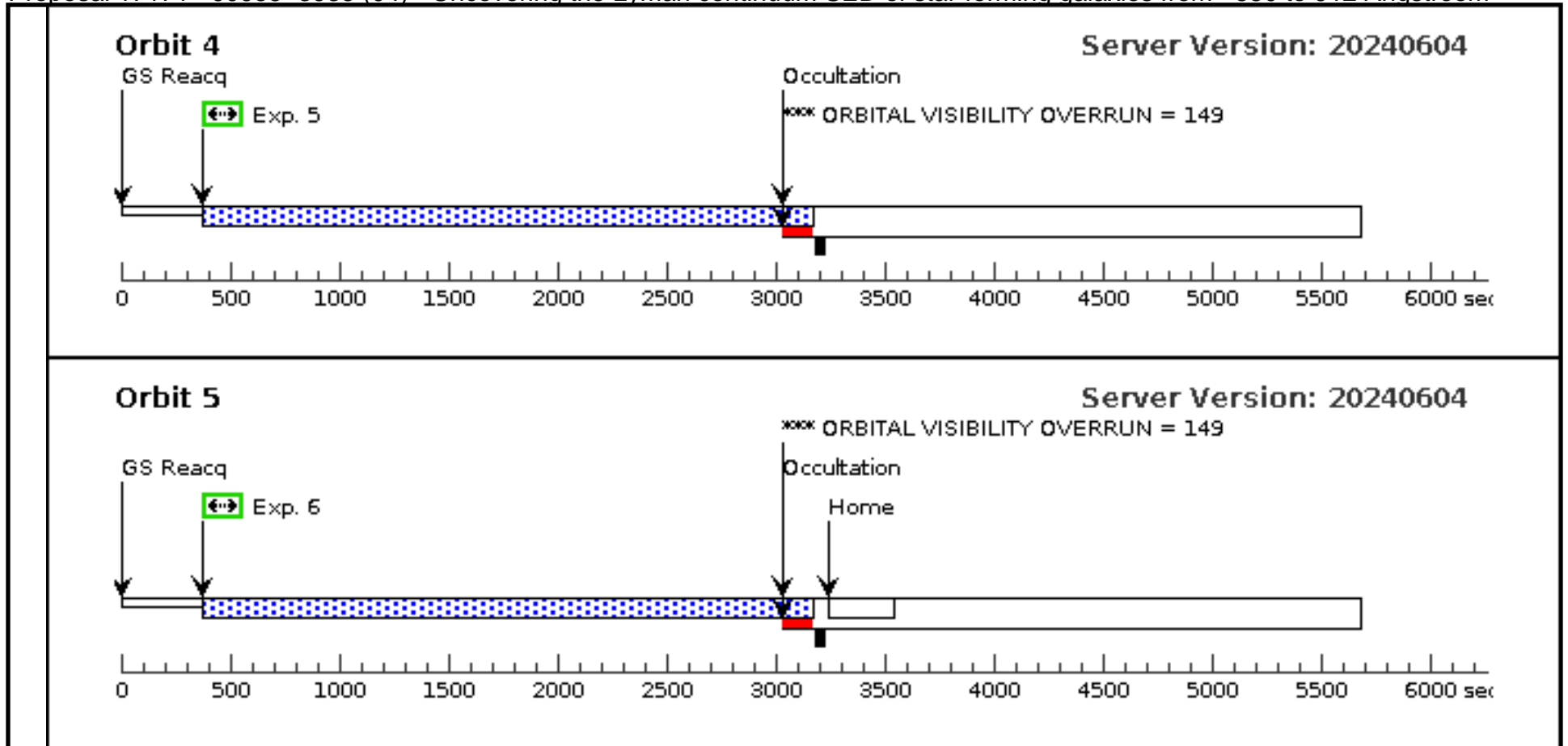
Proposal 17171 - J0955+3935 (04) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstroem

<b>Visit</b>	<b>Proposal 17171, J0955+3935 (04), completed</b> <span style="float: right;">Tue Jun 11 23:00:21 GMT 2024</span> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																
	<b>Diagnosics</b> (J0955+3935 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0955+3935 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0955+3935 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0955+3935 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J0955+3935 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																
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Proposal 17171 - J0955+3935 (04) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstrom

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	1	J0955+3935 ACQ (COS.ta.180 8591)	(4) J0955+3935	COS/NUV, ACQ/IMAGE, PSA	MIRRORA					300. Secs (300 Secs) [==>]	[1]
	2	J0955+3935 G140L1 (COS.sp.180 8669)	(4) J0955+3935	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			1857. Secs (1857 Secs) [==>]	[1]
	3	J0955+3935 G140L2 (COS.sp.180 8669)	(4) J0955+3935	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			2800. Secs (2744 Secs) [==>2744.0 Secs ]	[2]
	4	J0955+3935 G140L3 (COS.sp.180 8669)	(4) J0955+3935	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=2; SEGMENT=A			1270. Secs (2744 Secs) [==>2744.0 Secs ]	[3]
	5	J0955+3935 G140L4 (COS.sp.180 8669)	(4) J0955+3935	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=3; SEGMENT=A			1270. Secs (2744 Secs) [==>2744.0 Secs ]	[4]
	6	J0955+3935 G140L5 (COS.sp.180 8669)	(4) J0955+3935	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=4; SEGMENT=A			1315. Secs (2744 Secs) [==>2744.0 Secs ]	[5]



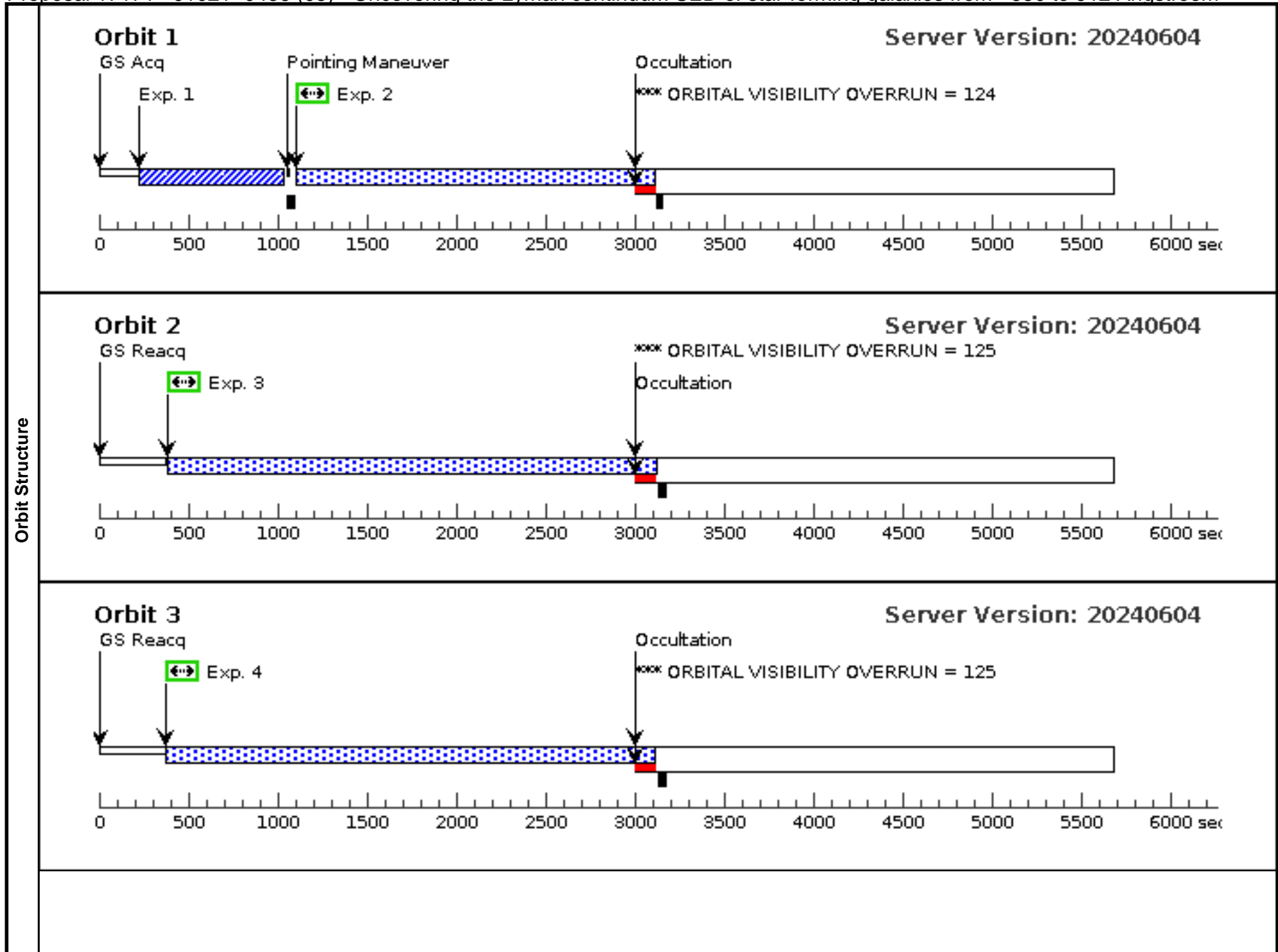


Proposal 17171 - J1021+0436 (05) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstroem

<b>Visit</b>	<b>Proposal 17171, J1021+0436 (05), failed</b> <span style="float: right;">Tue Jun 11 23:00:21 GMT 2024</span> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																
	<b>Diagnosics</b> (J1021+0436 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J1021+0436 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J1021+0436 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J1021+0436 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (J1021+0436 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																
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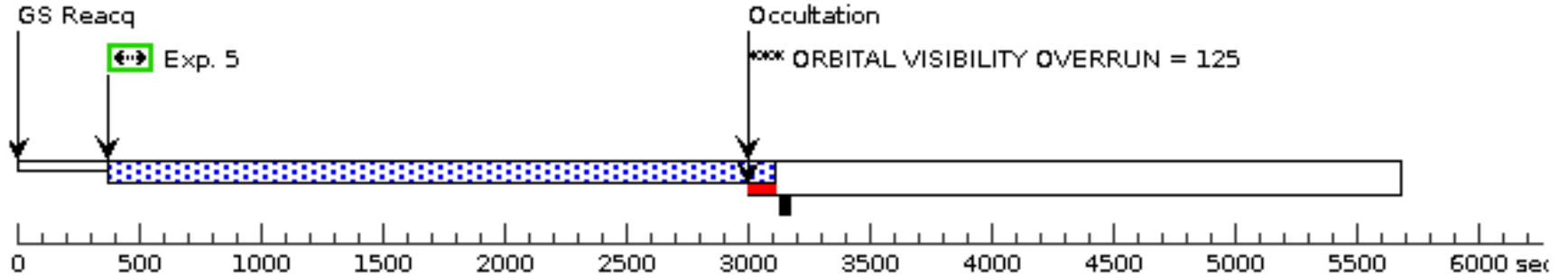
Proposal 17171 - J1021+0436 (05) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angstrom

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	J1021+0436 ACQ (COS.ta.180 8592)	(5) J1021+0436	COS/NUV, ACQ/IMAGE, PSA	MIRRORA					300. Secs (300 Secs) [==>]	[1]
	2	J1021+0436 G140L1 (COS.sp.180 8670)	(5) J1021+0436	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			1799. Secs (1799 Secs) [==>]	[1]
	3	J1021+0436 G140L2 (COS.sp.180 8670)	(5) J1021+0436	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A			2686. Secs (2686 Secs) [==>]	[2]
	4	J1021+0436 G140L3 (COS.sp.180 8670)	(5) J1021+0436	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=2; SEGMENT=A			1285. Secs (2686 Secs) [==>2686.0 Secs ]	[3]
	5	J1021+0436 G140L4 (COS.sp.180 8670)	(5) J1021+0436	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=3; SEGMENT=A			1286. Secs (2686 Secs) [==>2686.0 Secs ]	[4]
	6	J1021+0436 G140L5 (COS.sp.180 8670)	(5) J1021+0436	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=4; SEGMENT=A			1285. Secs (2686 Secs) [==>2686.0 Secs ]	[5]



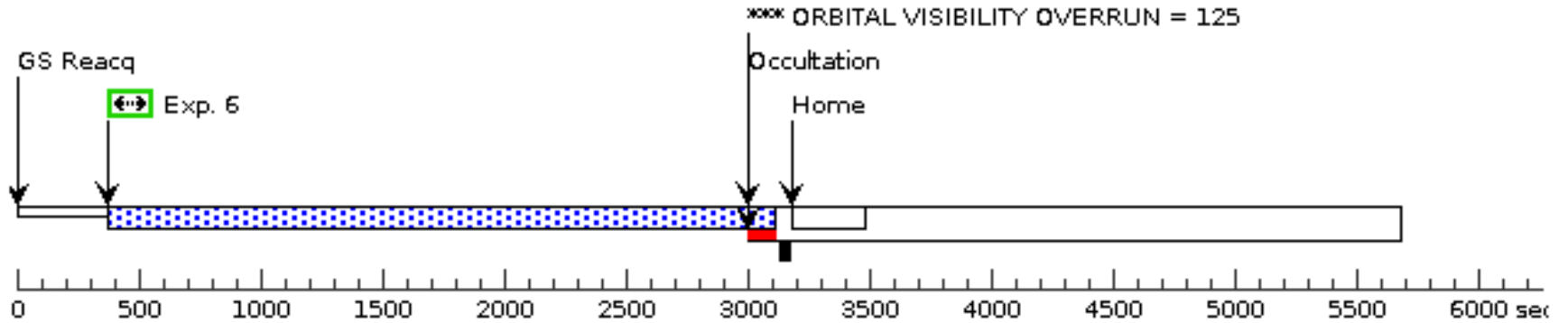
### Orbit 4

Server Version: 20240604



### Orbit 5

Server Version: 20240604



Proposal 17171 - J1021+0436-REPEAT (55) - Uncovering the Lyman continuum SED of star-forming galaxies from ~550 to 912 Angst...

Tue Jun 11 23:00:21 GMT 2024

Visit	<b>Proposal 17171, J1021+0436-REPEAT (55), implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none) Comments: Repeat of failed visit 05									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(55)	J1021+0436-REPEAT	RA: 10 21 40.5500 (155.4189583d) Dec: +04 36 47.90 (4.61331d) Equinox: J2000	Redshift: 1.00509	V=20.63+/-0.10 NUV=20.75+/-0.05, f(912*2.00509=1828A)=6.6e-18 erg s-1 cm-2 A-1 - 5% of the intr insic LyC flux	Reference Frame: ICRS			
	Comments: 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	J1021+0436 ACQ (COS.ta.180 8592)	(55) J1021+0436-REPEAT	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				150. Secs (150 Secs) [==>]	[1]
	2	J1021+0436 G140L1 (COS.sp.180 8670)	(55) J1021+0436-REPEAT	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=1; SEGMENT=A		1975 Secs (1975 Secs) [==>]	[1]
	3	J1021+0436 G140L2 (COS.sp.180 8670)	(55) J1021+0436-REPEAT	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=2; SEGMENT=A		2561. Secs (2561 Secs) [==>]	[2]
	4	J1021+0436 G140L3 (COS.sp.180 8670)	(55) J1021+0436-REPEAT	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=3; SEGMENT=A		2561. Secs (2561 Secs) [==>]	[3]
	5	J1021+0436 G140L4 (COS.sp.180 8670)	(55) J1021+0436-REPEAT	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000.;	FLASH=YES; FP-POS=4; SEGMENT=A		2561 Secs (2561 Secs) [==>]	[4]

