



15100 - Mapping the escaping ionizing flux of Lyman continuum galaxies

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Prof. Jeff Cooke (PI) (Contact)	Swinburne University of Technology	jcooke@astro.swin.edu.au
Dr. John M. O'Meara (CoI)	Saint Michaels College	jomeara@smcvt.edu
Dr. Marc Rafelski (CoI) (AdminUSPI)	Space Telescope Science Institute	mrafelski@stsci.edu
Dr. Emma Ryan-Weber (CoI)	Swinburne University of Technology	eryan@astro.swin.edu.au
Dr. Lee Spitler (CoI)	Macquarie University	lee.spitler@mq.edu.au
Dr. Ikuru Iwata (CoI)	National Astronomical Obs of Japan (NAOJ), Subaru Telescope	iwata@naoj.org
Dr. Ivo Labbe (CoI) (ESA Member)	Universiteit Leiden	ivolabbe@gmail.com
Mr. Uros Mestric (CoI)	Swinburne University of Technology	umestric@astro.swin.edu.au

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) ZF-LCG-F1 ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:20.0	yes
02	(6) ZF-LCG-F1B ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:23.0	yes
03	(6) ZF-LCG-F1B ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:25.0	yes
04	(2) ZF-LCG-F2 ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:27.0	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>
05	(2) ZF-LCG-F2 ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:30.0	yes
06	(2) ZF-LCG-F2 ANY	ACS/WFC WFC3/UVIS	5	28-Feb-2018 18:00:32.0	yes

30 Total Orbits Used

ABSTRACT

We propose WFC3 imaging to map the origin and extent of escaping ionizing ($< 912 \text{ \AA}$) flux for ~ 50 $z \sim 3-4$ Lyman continuum galaxies (LCGs) in the COSMOS field. LCGs are a recently identified population of galaxies selected via 30-band photometry and deep spectroscopy that exhibit excess Lyman continuum (LyC; $< 912 \text{ \AA}$) flux. In this program, we will observe 2 WFC3 pointings to gather a statistical sample of the the full population. The data will (1) map the full LyC flux extent and origin, (2) measure the LyC flux as a function of galaxy luminosity, morphology, UV continuum slope, and Ly α emission for the spectroscopic subset, and (3) secure the number density of this newly identified population of galaxies. This is the first systematic investigation of a $z = 3-4$ galaxy population analog to $z > 6$ galaxies responsible for cosmic reionization. LCG ionizing flux measurements will be used with our Keck/MOSFIRE restframe optical spectroscopic program to calibrate models that predict the escaping ionizing photon fraction based on nebular emission line strength ratios. The method will be used to infer galaxy ionizing photon escape fractions near, and beyond, the epoch of reionization using JWST, as direct measurements of $< 912 \text{ \AA}$ photons at $z > 5$ are impossible as a result of IGM absorption. Complete LyC flux measurements, including the full extent and physical origin of the ionizing flux for proper calibration of the models at $z \sim 3-4$ can only be done with HST imaging.

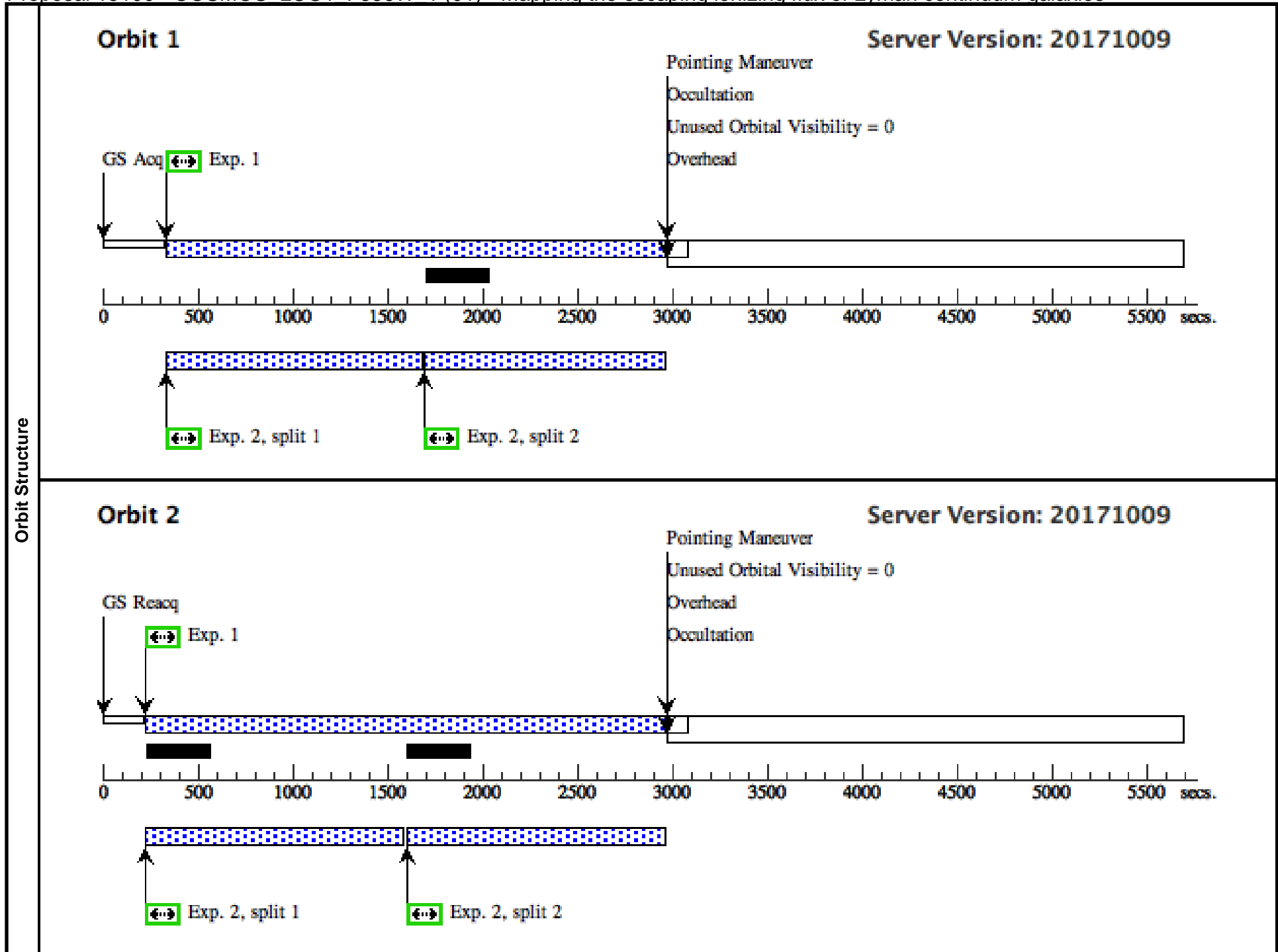
OBSERVING DESCRIPTION

This program consists of two primary and parallel fields in the COSMOS footprint. Each field has 15 orbits split into three 5-orbit visits. The prime observations image with WFC3/UVIS and the F336W filter and the parallel observations image with ACS/WFC and the F435W filter. The orbits are constrained in order to accommodate the targets in the primary WFC3 fields. As described in the Phase I, the WFC3/UVIS charge transfer efficiency (CTE) is degrading with time, and therefore observations need to be acquired as soon as possible. There is a relatively bright star (U ~ 15.5 and V ~ 14.1) just off detector chip 2 (quadrant C). However, previous observations with bright stars at that location did not result in significant "dragon's breath" flux.

Proposal 15100 (STScI Edit Number: 4, Created: Wednesday, February 28, 2018 6:00:34 PM EST) - Overview

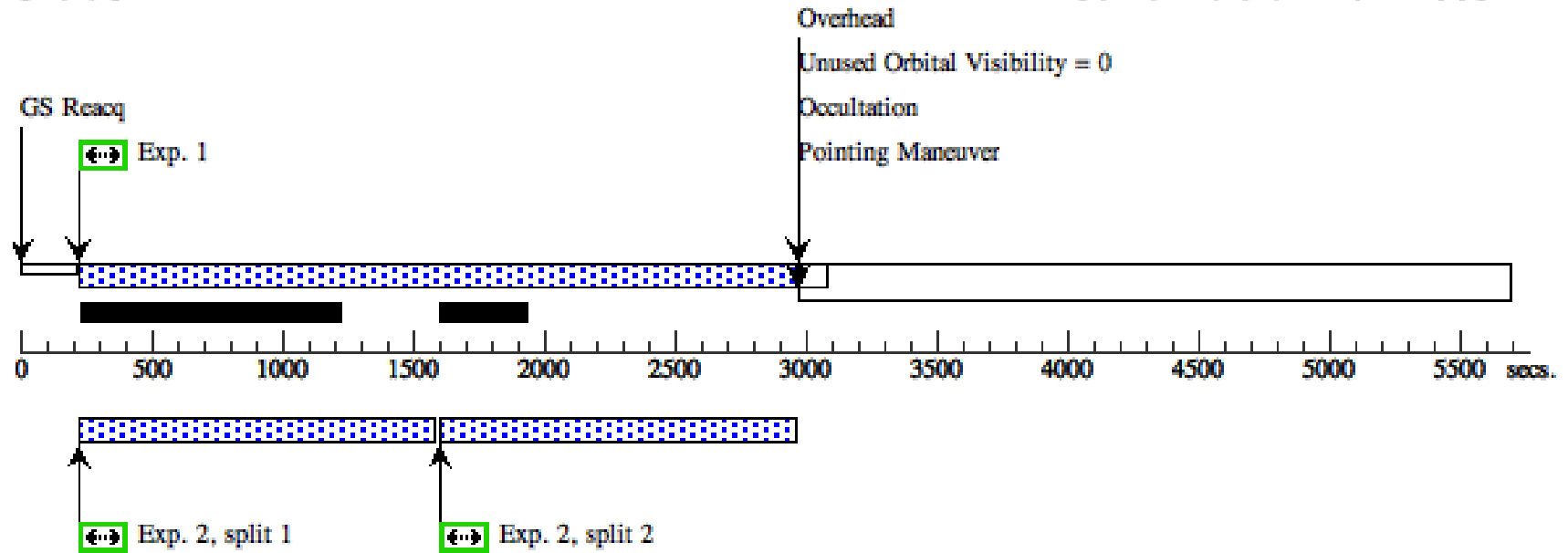
Prime imaging - WFC3 F336W: Exposures are post-flashed by $4e^-$ to help mitigate the CTE observed with WFC3/UVIS. Such long exposures achieve $>12e^-$ per pixel. The 15 orbits for F336W imaging are broken into three visits of five orbits. One exposure per orbit increases the background flux to reduce the required post-flash and to maximize the total depth, as compared to half-orbit exposures (by ~ 0.5 mag). A minimum of eight exposures (8 orbits) is necessary to properly clean the full orbit exposures of cosmic rays. In addition, five orbits per visit result in much better alignment of objects in the UV images and cosmic ray rejection. The dither pattern per visit is set 5 times larger than the default box pattern to help minimize the blotchy pattern observed in F336W imaging (i.e., similar to that seen in Rafelski et al. 2015, AJ, 150 31, Figure 15). Reducing CTE effects and blotchy patterns are important for our science targeting extremely faint, potentially diffuse flux from high redshift galaxies. Each visit adopts a 3pt dither line pointing using pos-targs to fill in chip gaps for WFC3 and the parallel ACS observations.

Parallel imaging - ACS F435W: The parallel imaging complements the F336W observations by targeting $z \sim 4$ galaxies. The 15 orbits will have three visits per target, with two exposures per orbit. The F435W background is sufficient that no post-flash is necessary. The dither patterns chosen will accommodate the ACS chip gap as described above.



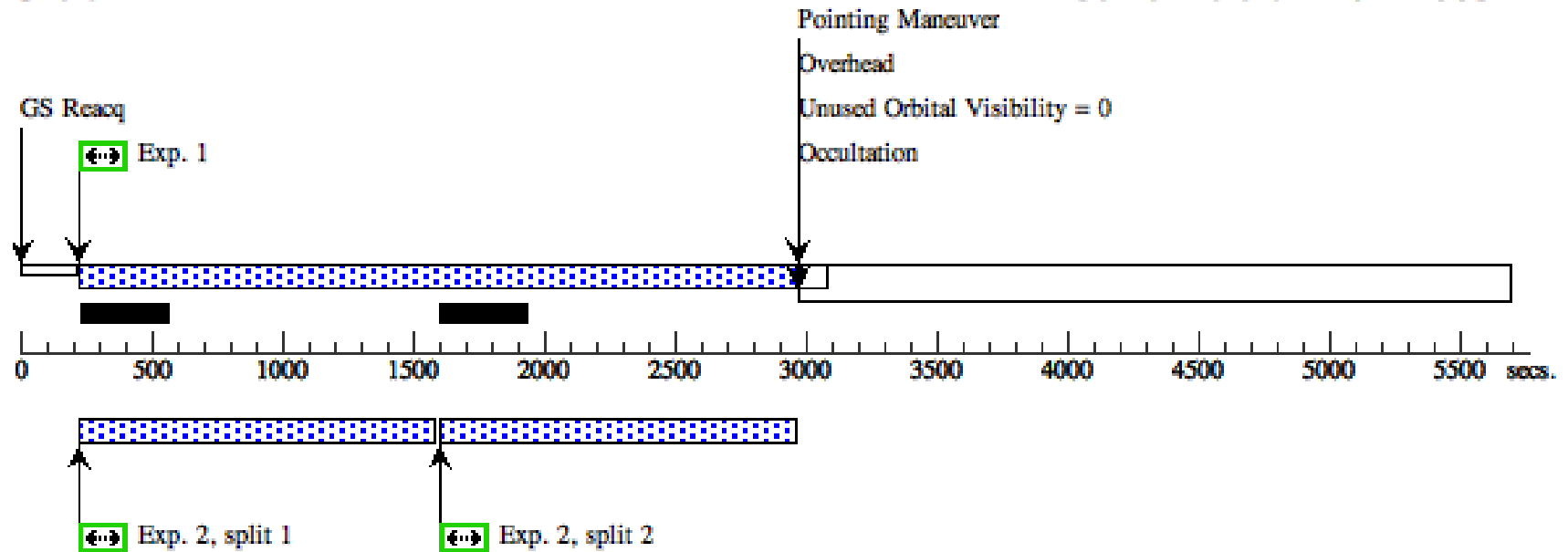
Orbit 3

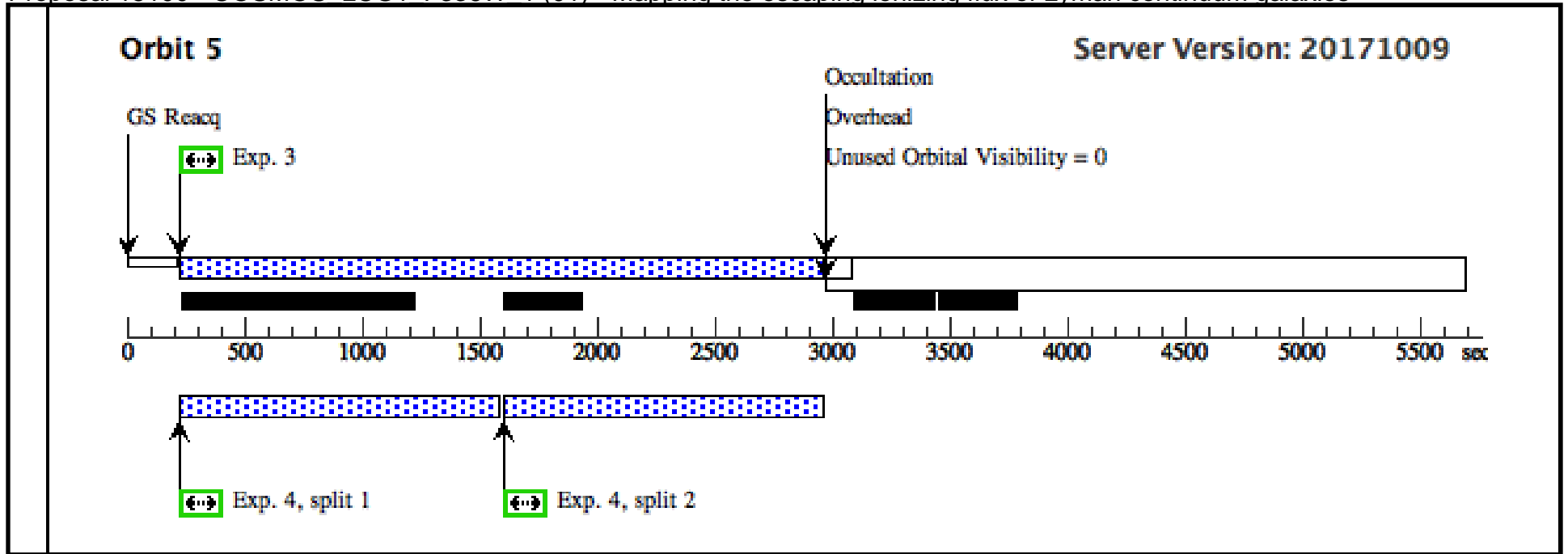
Server Version: 20171009



Orbit 4

Server Version: 20171009

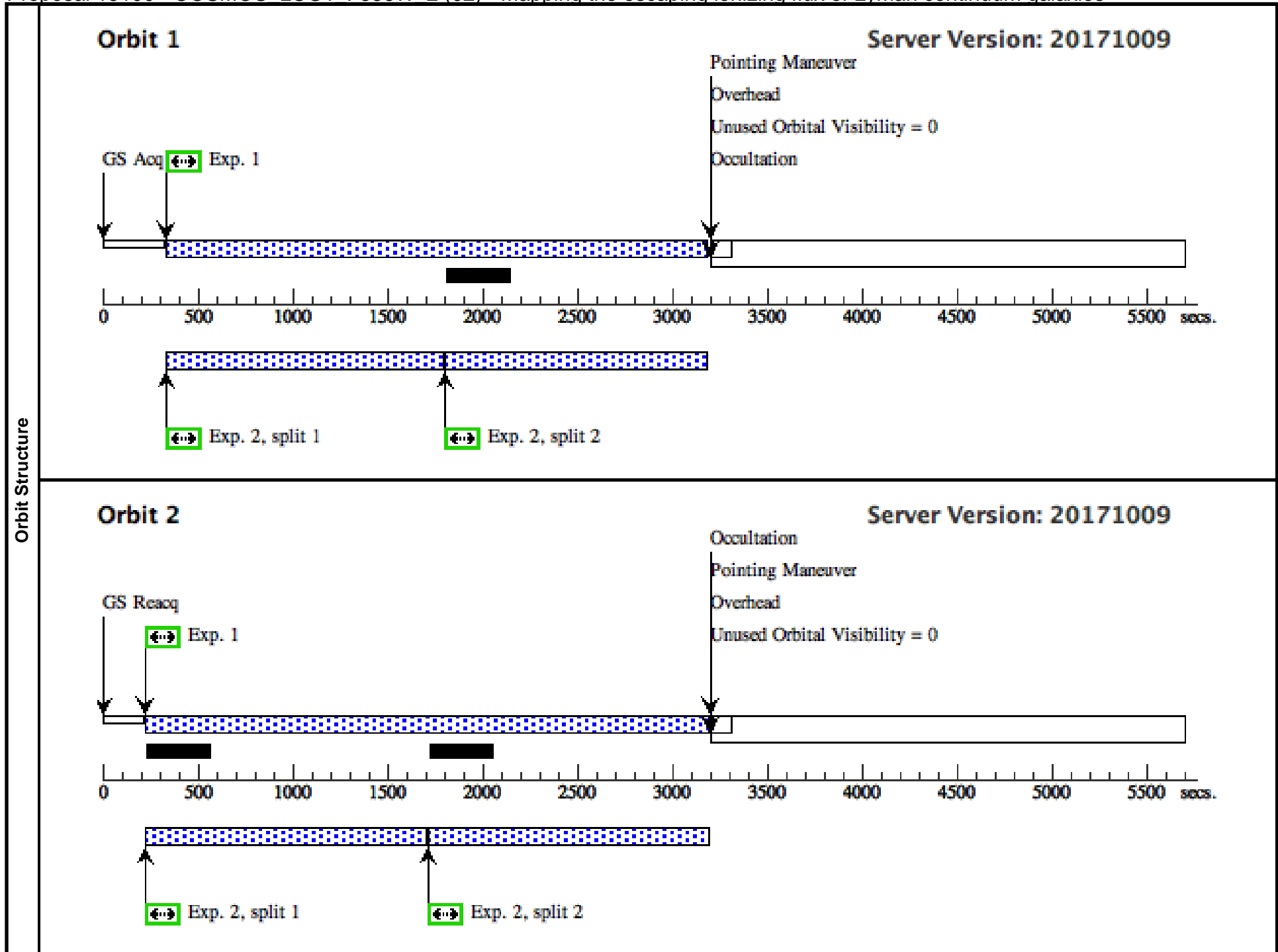




Proposal 15100 - COSMOS LCG1 F336W 2 (02) - Mapping the escaping ionizing flux of Lyman continuum galaxies

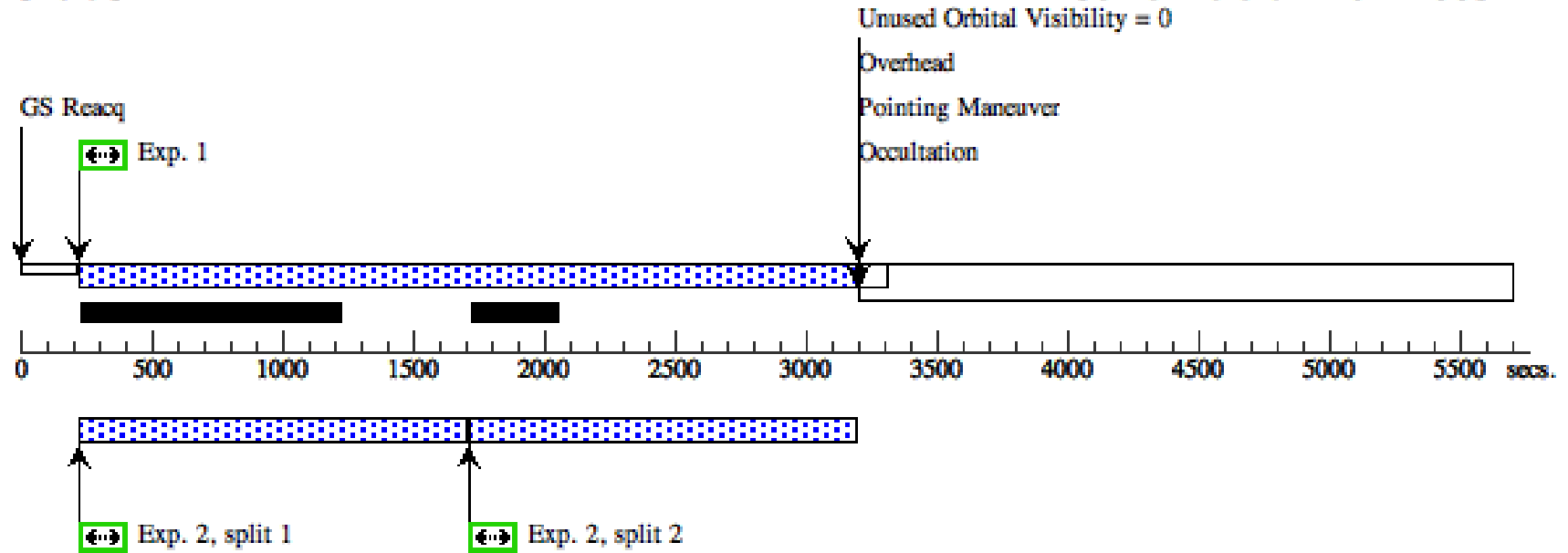
Wed Feb 28 23:00:35 GMT 2018

Visit	Proposal 15100, COSMOS_LCG1_F336W_2 (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS, ACS/WFC Special Requirements: ORIENT 85.5D TO 87.3 D; BEFORE 31-DEC-2018:00:00:00									
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	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(6)	ZF-LCG-F1B	RA: 10 00 48.5800 (150.2024167d) Dec: +02 18 40.13 (2.31115d) Equinox: J2000		V=25.0+/-1.0	Reference Frame: ICRS				
	<i>Comments:</i> <i>Category=GALAXY</i> <i>Description=[HIGH REDSHIFT GALAXY]</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1012769)	(6) ZF-LCG-F1B	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_2 (02) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_2 (02)	2825 Secs (11729 Secs) [==>(Pattern 1)] [==>2968.0 Secs (Pattern 2)] [==>2968.0 Secs (Pattern 3)] [==>2968.0 Secs (Pattern 4)]	[1] [2] [3] [4]
2	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_2 (02) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_2 (02)	2510 Secs (10622 Secs) [==>(Pattern 1, Split 1)] [==>(Pattern 1, Split 2)] [==>1352.0 Secs (Pattern 2, Split 1)] [==>1352.0 Secs (Pattern 2, Split 2)] [==>1352.0 Secs (Pattern 3, Split 1)] [==>1352.0 Secs (Pattern 3, Split 2)] [==>1352.0 Secs (Pattern 4, Split 1)] [==>1352.0 Secs (Pattern 4, Split 2)]	[1] [2] [3] [4]	
3	(1012769)	(6) ZF-LCG-F1B	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG 0.2883,1 .23	Prime + Parallel Group 3-4 in COSMOS_LCG1_F336W_2 (02)	2825 Secs (2968 Secs) [==>2968.0 Secs]	[5]	
4	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Prime + Parallel Group 3-4 in COSMOS_LCG1_F336W_2 (02)	2510 Secs (2704 Secs) [==>1352.0 Secs (Split 1)] [==>1352.0 Secs (Split 2)]	[5]	



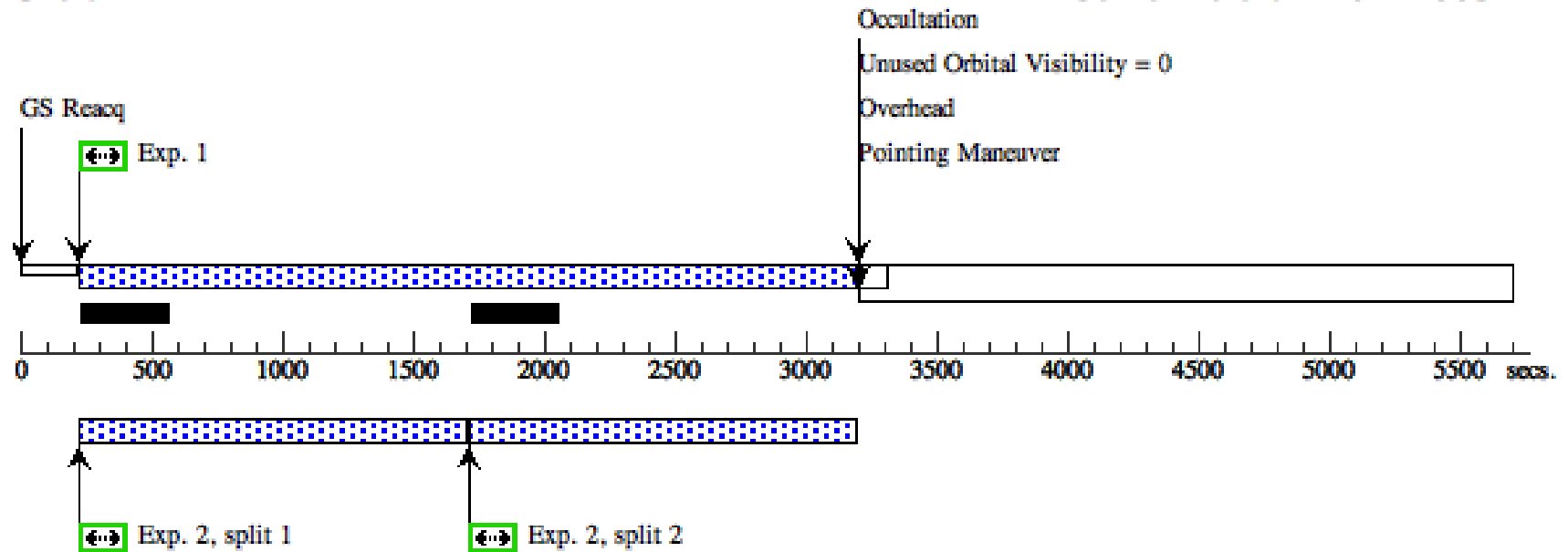
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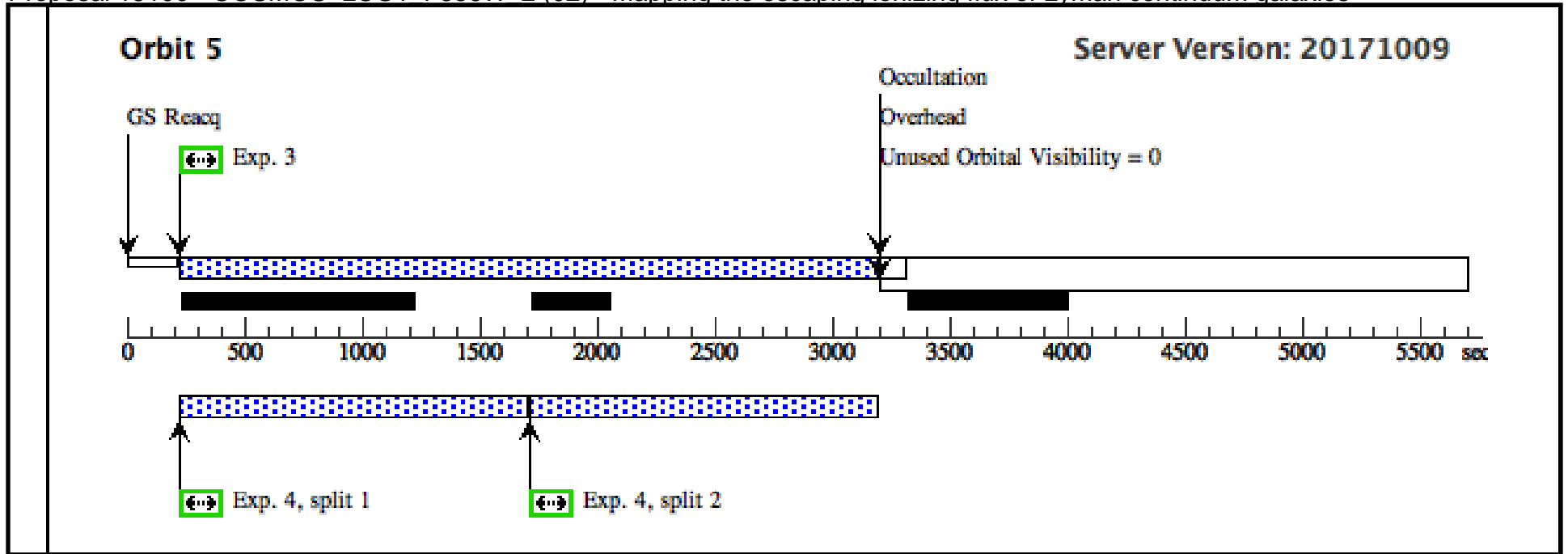
Server Version: 20171009



Orbit 4

Server Version: 20171009

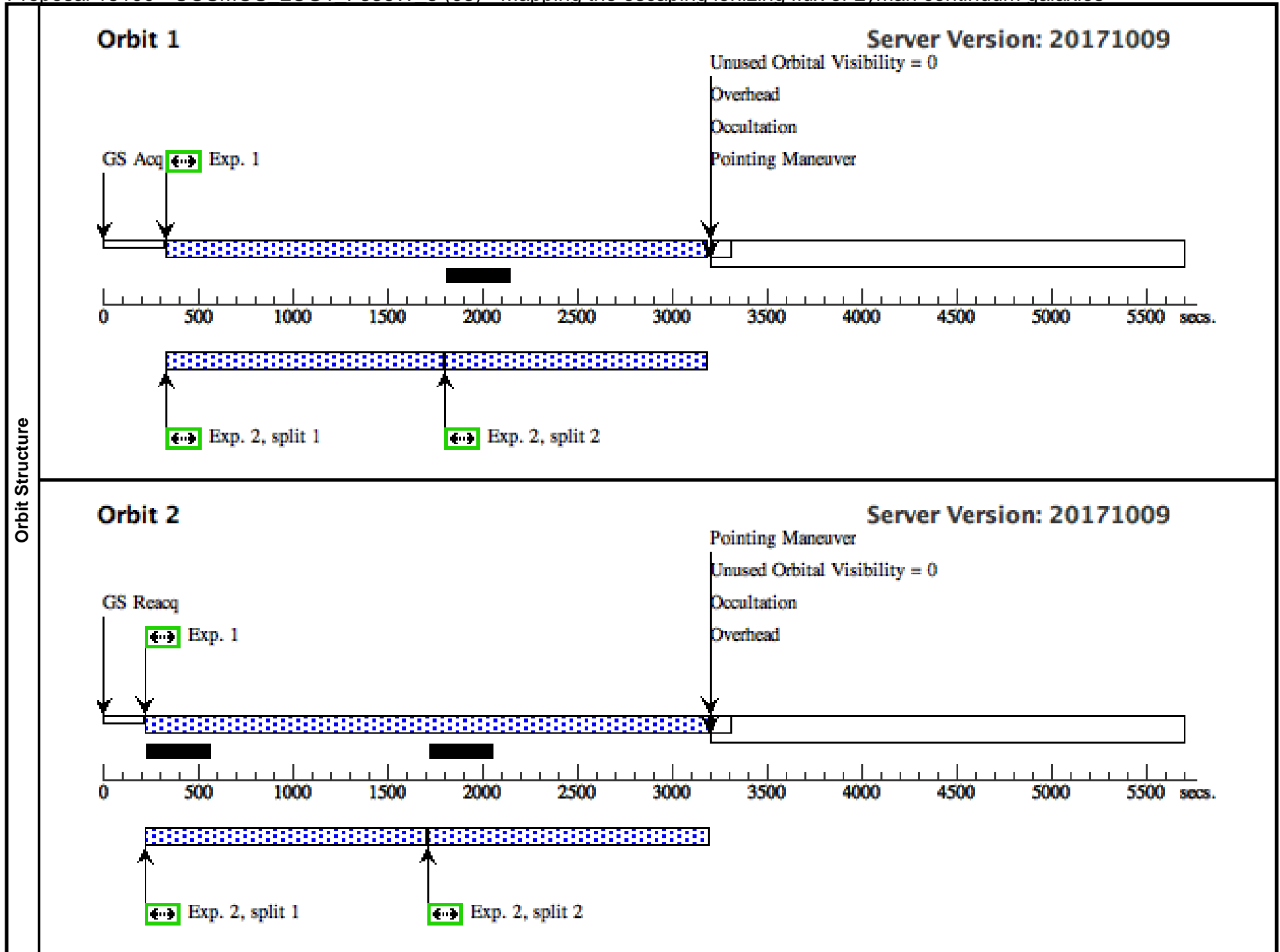




Proposal 15100 - COSMOS LCG1 F336W 3 (03) - Mapping the escaping ionizing flux of Lyman continuum galaxies

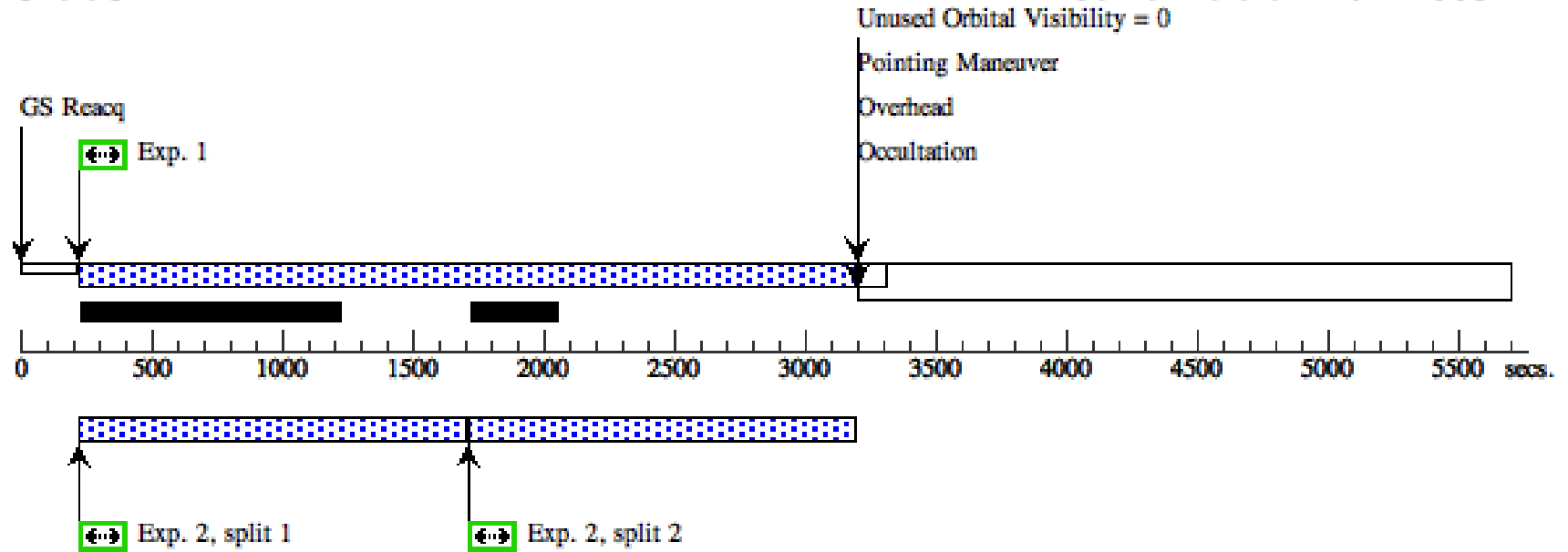
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Visit	Proposal 15100, COSMOS_LCG1_F336W_3 (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS, ACS/WFC Special Requirements: SAME ORIENT AS 02; BEFORE 31-DEC-2018:00:00:00									
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	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(6)	ZF-LCG-F1B	RA: 10 00 48.5800 (150.2024167d) Dec: +02 18 40.13 (2.31115d) Equinox: J2000		V=25.0+/-1.0	Reference Frame: ICRS				
	<i>Comments:</i> <i>Category=GALAXY</i> <i>Description=[HIGH REDSHIFT GALAXY]</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1012769)	(6) ZF-LCG-F1B	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG 0.723,1.463; GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_3 (03) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_3 (03)	2825 Secs (11729 Secs) [==>(Pattern 1)] [==>2968.0 Secs (Pattern 2)] [==>2968.0 Secs (Pattern 3)] [==>2968.0 Secs (Pattern 4)]	[1] [2] [3] [4]
2	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_3 (03) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG1_F336W_3 (03)	2510 Secs (10622 Secs) [==>(Pattern 1, Split 1)] [==>(Pattern 1, Split 2)] [==>1352.0 Secs (Pattern 2, Split 1)] [==>1352.0 Secs (Pattern 2, Split 2)] [==>1352.0 Secs (Pattern 3, Split 1)] [==>1352.0 Secs (Pattern 3, Split 2)] [==>1352.0 Secs (Pattern 4, Split 1)] [==>1352.0 Secs (Pattern 4, Split 2)]	[1] [2] [3] [4]	
3	(1012769)	(6) ZF-LCG-F1B	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG 1.0113,2.693	Prime + Parallel Group 3-4 in COSMOS_LCG1_F336W_3 (03)	2825 Secs (2968 Secs) [==>2968.0 Secs]	[5]	
4	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Prime + Parallel Group 3-4 in COSMOS_LCG1_F336W_3 (03)	2510 Secs (2704 Secs) [==>1352.0 Secs (Split 1)] [==>1352.0 Secs (Split 2)]	[5]	



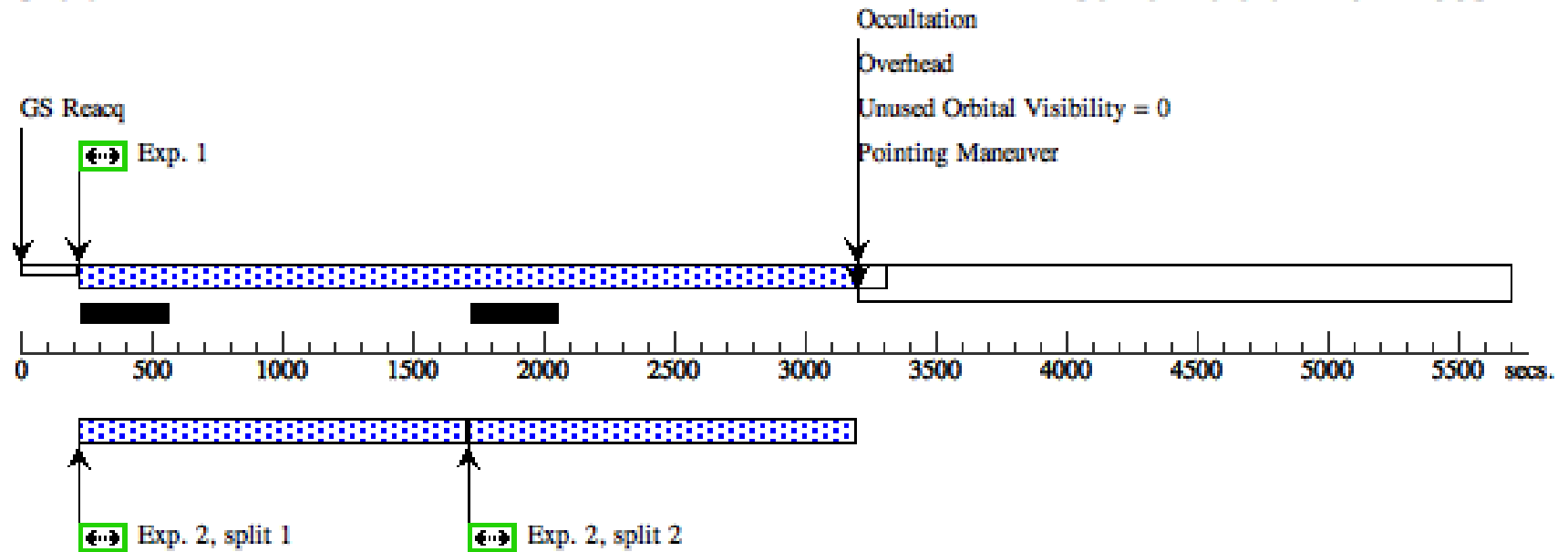
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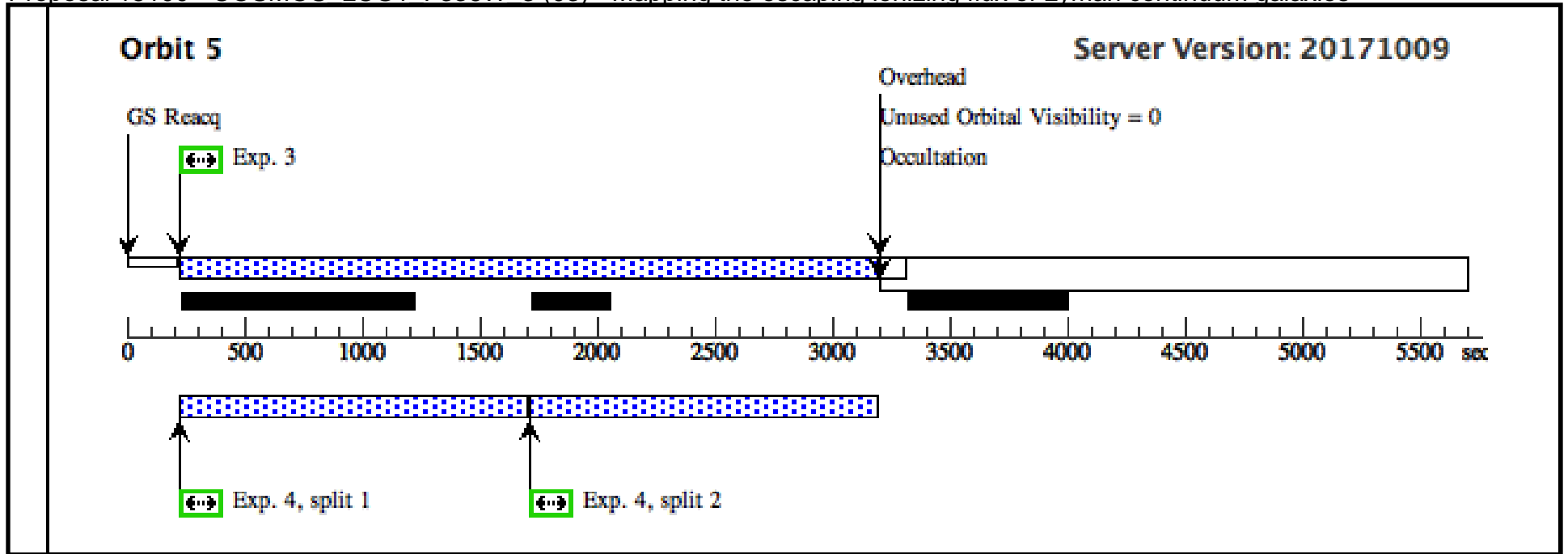
Server Version: 20171009



Orbit 4

Server Version: 20171009

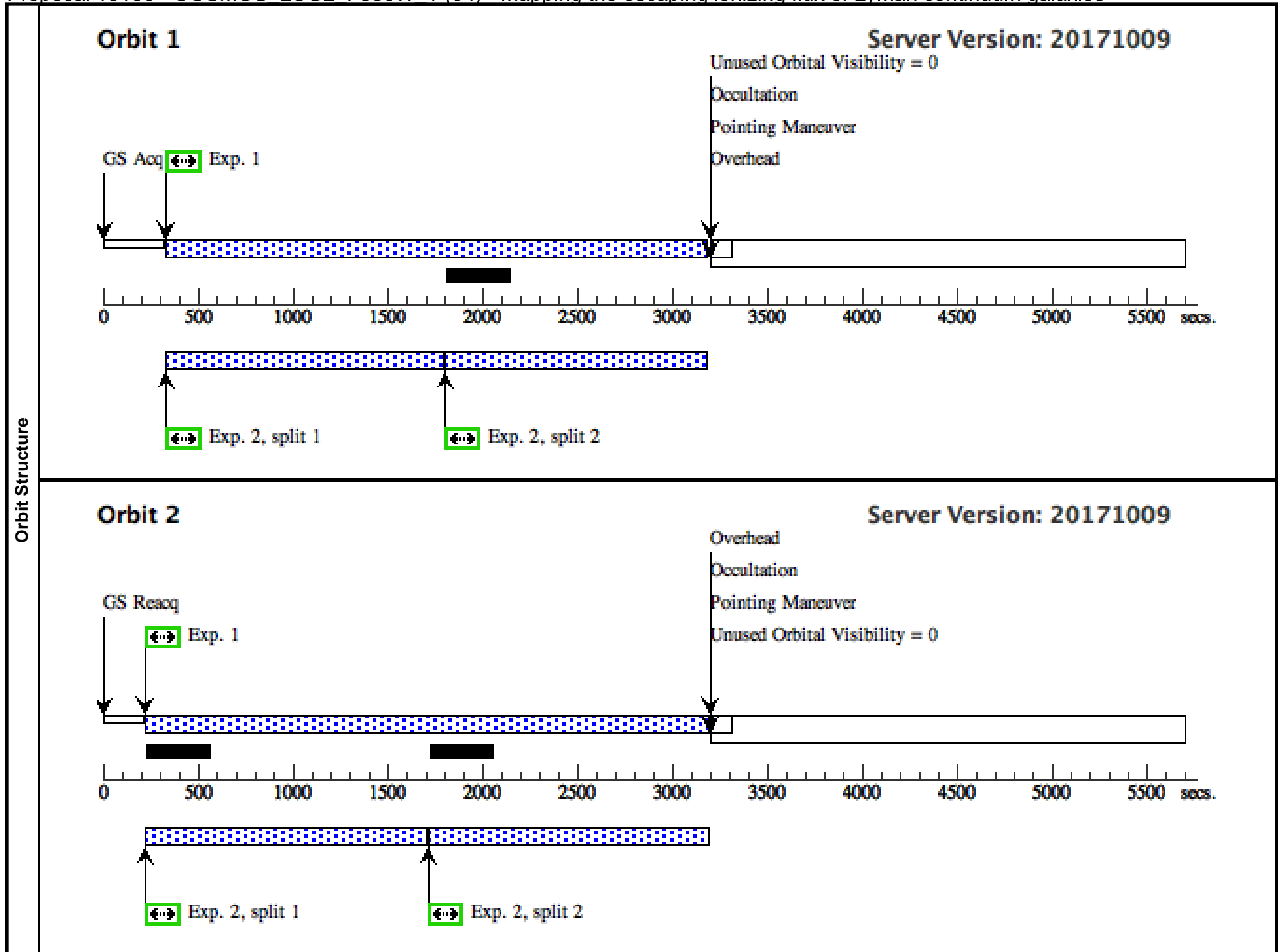




Proposal 15100 - COSMOS LCG2 F336W 1 (04) - Mapping the escaping ionizing flux of Lyman continuum galaxies

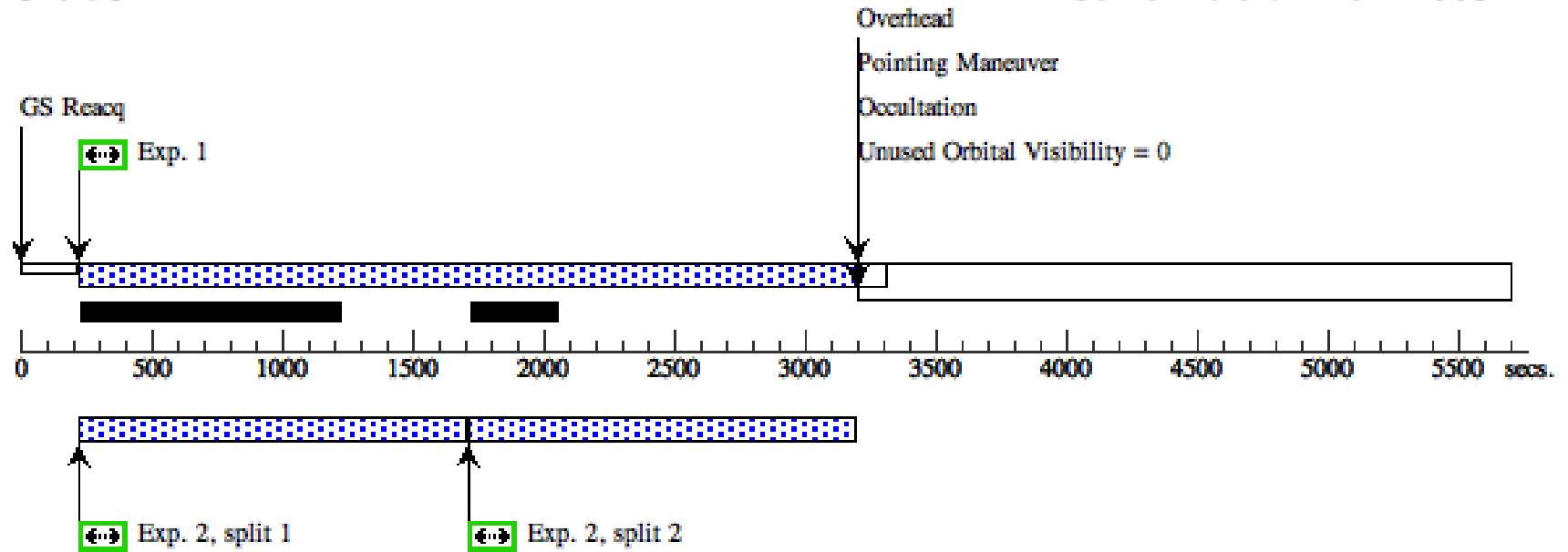
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Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	ZF-LCG-F2	RA: 10 00 25.6000 (150.1066667d) Dec: +02 15 45.00 (2.26250d) Equinox: J2000		V=25.0+/-1.0	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[HIGH REDSHIFT GALAXY]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4			Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_1 (04) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_1 (04)	2825 Secs (11729 Secs) [==>(Pattern 1)] [==>2968.0 Secs (Pattern 2)] [==>2968.0 Secs (Pattern 3)] [==>2968.0 Secs (Pattern 4)]
2	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2			Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_1 (04) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_1 (04)	2510 Secs (10622 Secs) [==>(Pattern 1, Split 1)] [==>(Pattern 1, Split 2)] [==>1352.0 Secs (Pattern 2, Split 1)] [==>1352.0 Secs (Pattern 2, Split 2)] [==>1352.0 Secs (Pattern 3, Split 1)] [==>1352.0 Secs (Pattern 3, Split 2)] [==>1352.0 Secs (Pattern 4, Split 1)] [==>1352.0 Secs (Pattern 4, Split 2)]	[1] [2] [3] [4]
3	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG	0.2883,1.23	Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_1 (04)	2825 Secs (2968 Secs) [==>2968.0 Secs]	[5]
4	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2			Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_1 (04)	2510 Secs (2704 Secs) [==>1352.0 Secs (Split 1)] [==>1352.0 Secs (Split 2)]	[5]



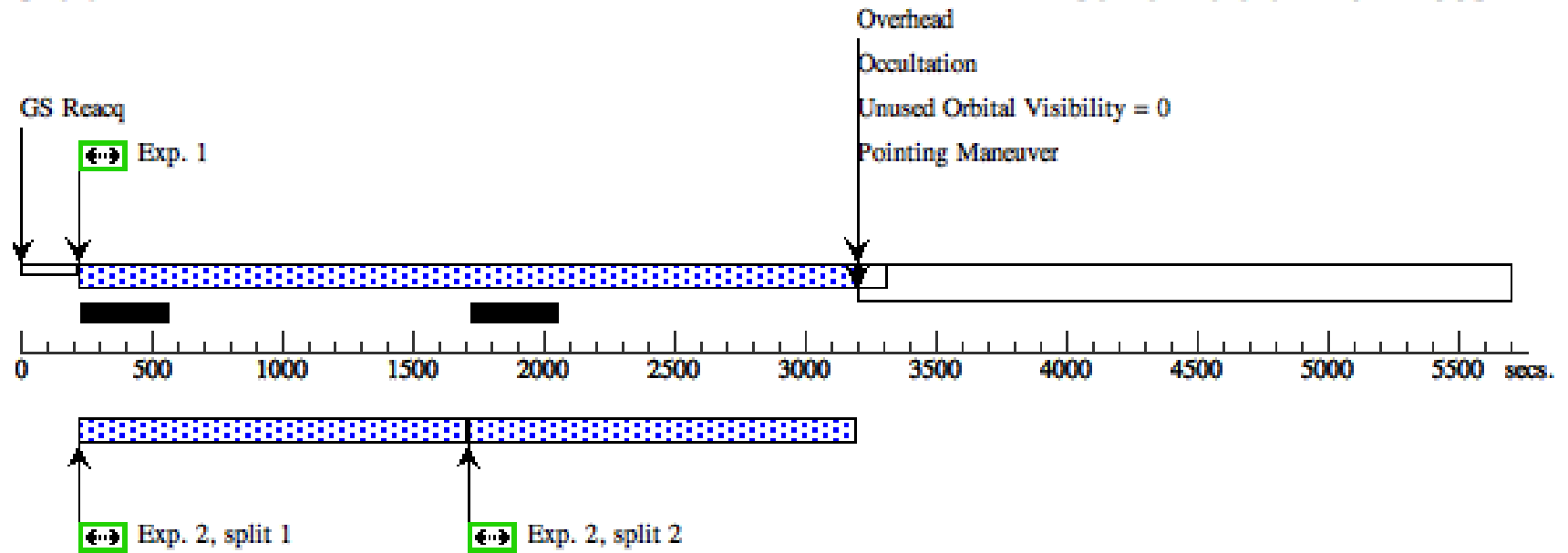
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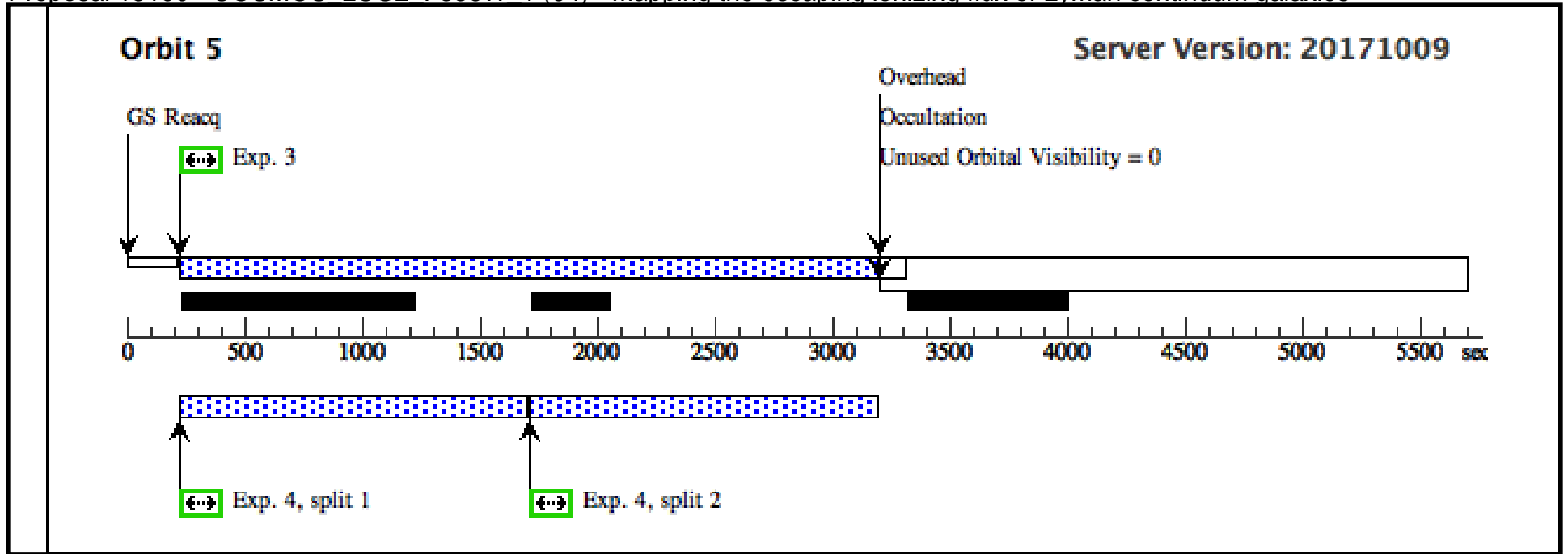
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Orbit 4

Server Version: 20171009





Proposal 15100 - COSMOS LCG2 F336W 2 (05) - Mapping the escaping ionizing flux of Lyman continuum galaxies

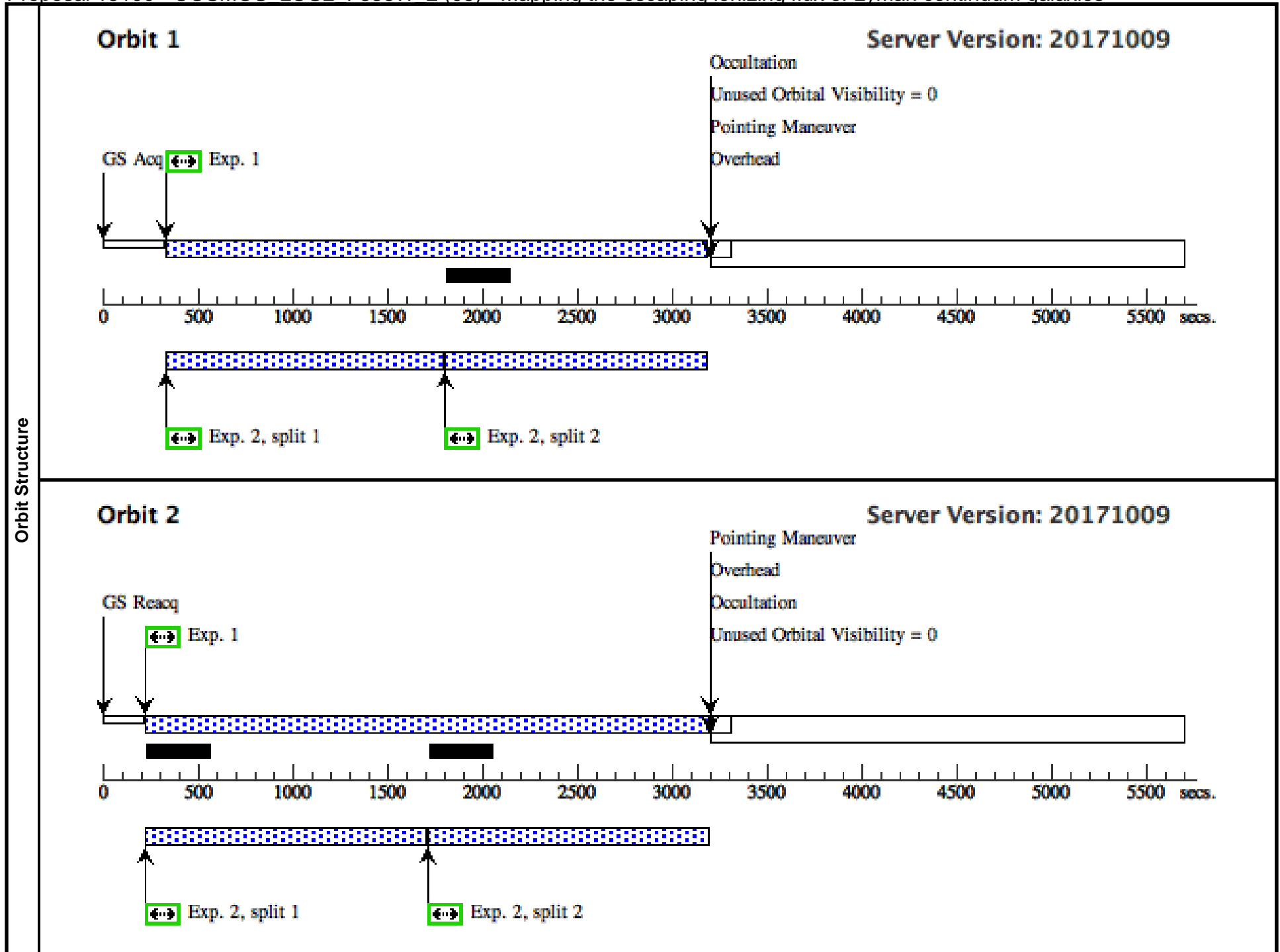
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Visit	Proposal 15100, COSMOS_LCG2_F336W_2 (05), scheduled		
	Diagnostic Status: No Diagnostics		
	Scientific Instruments: WFC3/UVIS, ACS/WFC		
	Special Requirements: SAME ORIENT AS 04; BEFORE 31-DEC-2018:00:00:00		

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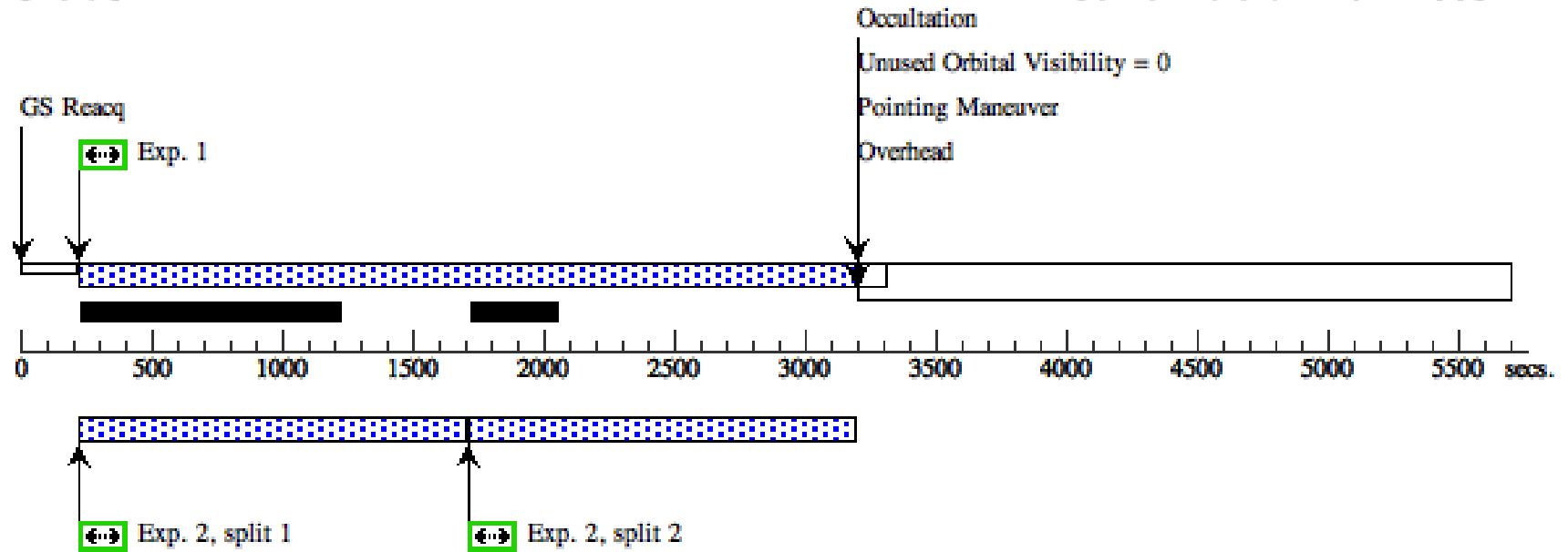
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	ZF-LCG-F2	RA: 10 00 25.6000 (150.1066667d) Dec: +02 15 45.00 (2.26250d) Equinox: J2000		V=25.0+/-1.0	Reference Frame: ICRS
<i>Comments:</i> Category=GALAXY Description=[HIGH REDSHIFT GALAXY]						

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
		1	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG 1.446,2.926	Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_2 (05) (1)	2825 Secs (11729 Secs)
									[==>(Pattern 1)]	[1]
Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_2 (05)									[==>2968.0 Secs (Pattern 2)]	[2]
									[==>2968.0 Secs (Pattern 3)]	[3]
	2	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2	Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_2 (05) (1)	Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_2 (05)	2510 Secs (10622 Secs)	
									[==>(Pattern 1, Split 1)]	[1]
									[==>(Pattern 1, Split 2)]	
									[==>1352.0 Secs (Pattern 2, Split 1)]	[2]
	3	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG 1.7,4.2	Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_2 (05)	2825 Secs (2968 Secs)	
									[==>2968.0 Secs]	[5]
								Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_2 (05)	[==>1352.0 Secs (Pattern 3, Split 1)]	[3]
									[==>1352.0 Secs (Pattern 3, Split 2)]	
	4	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2	Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_2 (05)	Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_2 (05)	2510 Secs (2704 Secs)	
									[==>1352.0 Secs (Split 1)]	[5]
									[==>1352.0 Secs (Split 2)]	



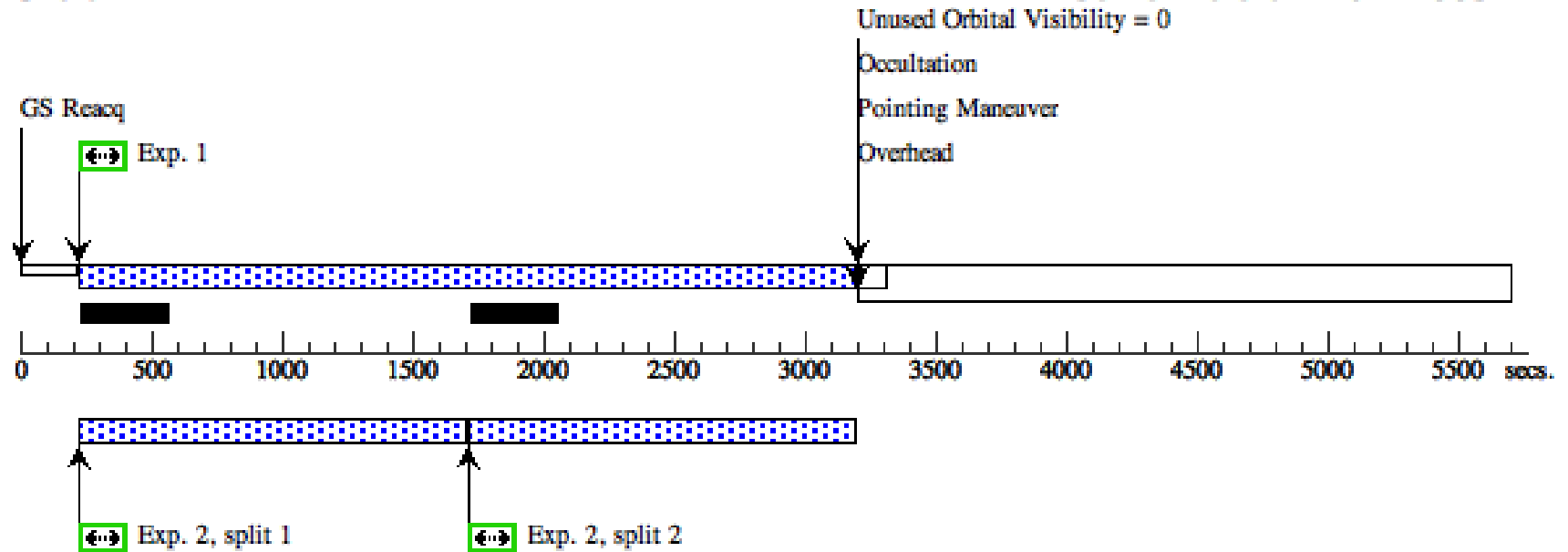
Orbit 3

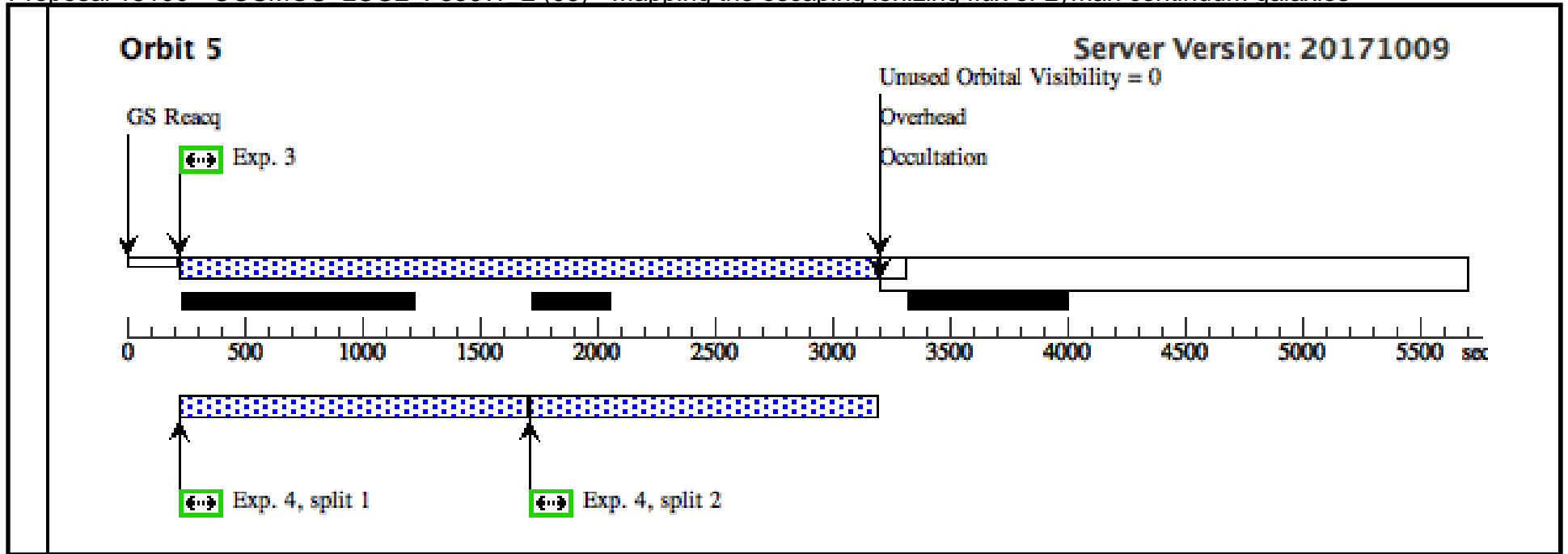
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Orbit 4

Server Version: 20171009

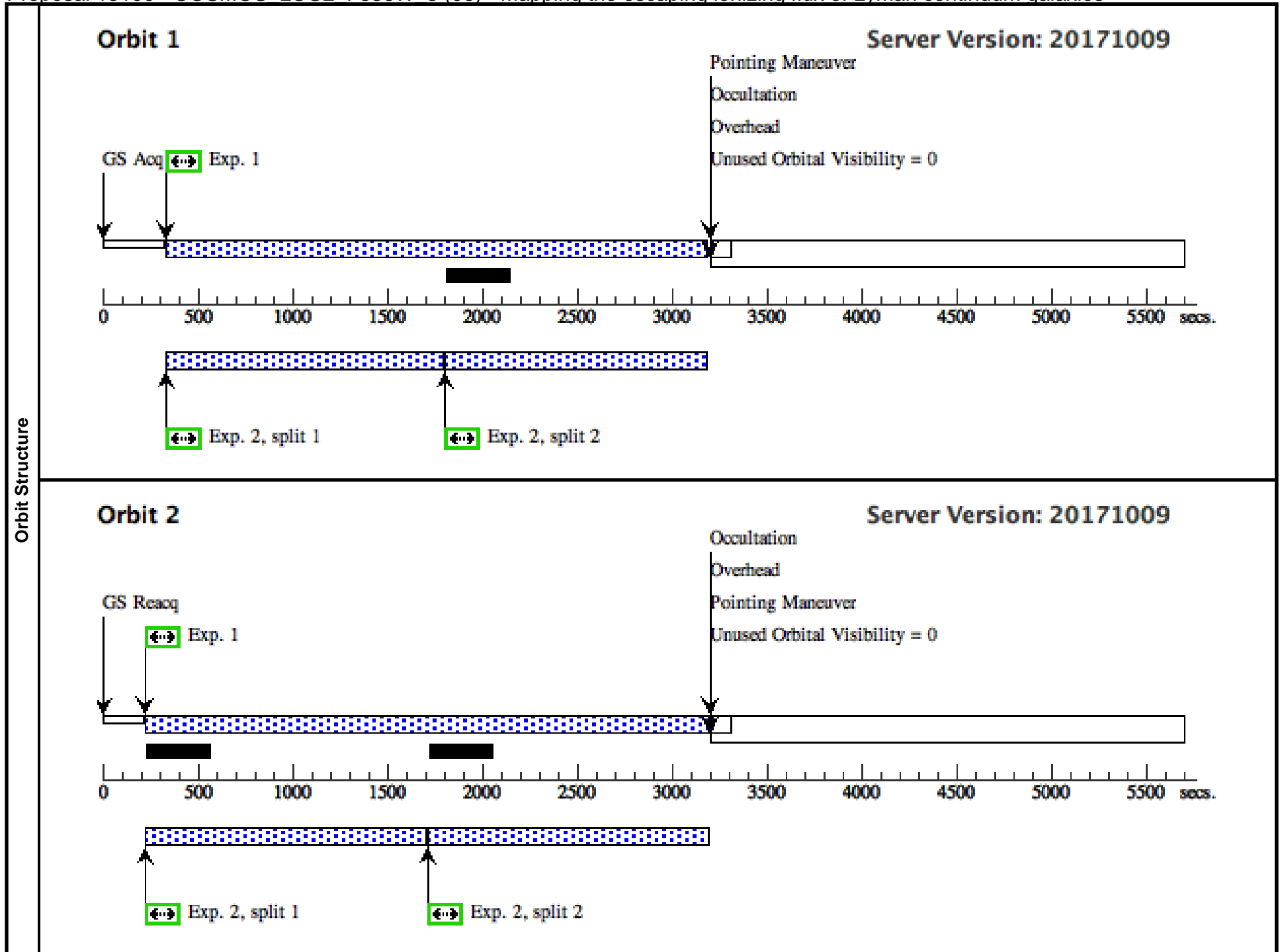




Proposal 15100 - COSMOS LCG2 F336W 3 (06) - Mapping the escaping ionizing flux of Lyman continuum galaxies

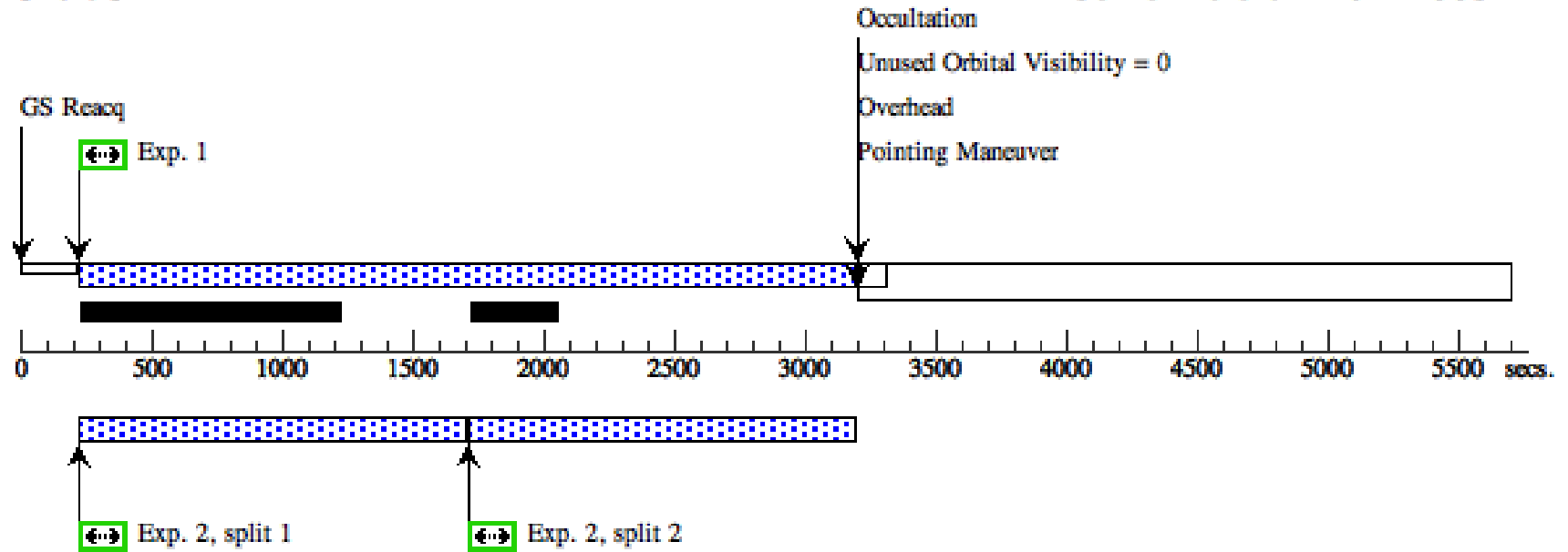
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Visit	Proposal 15100, COSMOS_LCG2_F336W_3 (06), scheduled Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS, ACS/WFC Special Requirements: SAME ORIENT AS 04; BEFORE 31-DEC-2018:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	ZF-LCG-F2	RA: 10 00 25.6000 (150.1066667d) Dec: +02 15 45.00 (2.26250d) Equinox: J2000		V=25.0+/-1.0	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[HIGH REDSHIFT GALAXY]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG -1.446,-2.926	Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_3 (06) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_3 (06)	2825 Secs (11729 Secs) [==>(Pattern 1)] [==>2968.0 Secs (Pattern 2)] [==>2968.0 Secs (Pattern 3)] [==>2968.0 Secs (Pattern 4)]	[1] [2] [3] [4]
2	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_3 (06) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in COSMOS_LCG2_F336W_3 (06)	2510 Secs (10622 Secs) [==>(Pattern 1, Split 1)] [==>(Pattern 1, Split 2)] [==>1352.0 Secs (Pattern 2, Split 1)] [==>1352.0 Secs (Pattern 2, Split 2)] [==>1352.0 Secs (Pattern 3, Split 1)] [==>1352.0 Secs (Pattern 3, Split 2)] [==>1352.0 Secs (Pattern 4, Split 1)] [==>1352.0 Secs (Pattern 4, Split 2)]	[1] [2] [3] [4]	
3	(1012769)	(2) ZF-LCG-F2	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=4	POS TARG -1.2,-1.7	Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_3 (06)	2825 Secs (2968 Secs) [==>2968.0 Secs]	[5]	
4	(1012775)	ANY	ACS/WFC, ACCUM, WFCENTER	F435W	CR-SPLIT=2		Prime + Parallel Group 3-4 in COSMOS_LCG2_F336W_3 (06)	2510 Secs (2704 Secs) [==>1352.0 Secs (Split 1)] [==>1352.0 Secs (Split 2)]	[5]	



Orbit 3

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Orbit 4

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