14088 - Unveiling the Lyman continuum morphology with HST

Cycle: 23, 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) ION1	WFC3/UVIS	4	23-Jul-2015 21:25:31.0	yes
02	(1) ION1	WFC3/UVIS	4	23-Jul-2015 21:25:32.0	yes
03	(1) ION1	WFC3/UVIS	4	23-Jul-2015 21:25:33.0	yes
04	(2) ION2	WFC3/UVIS	5	23-Jul-2015 21:25:34.0	yes
05	(2) ION2	WFC3/UVIS	4	23-Jul-2015 21:25:35.0	yes
06	(2) ION2	WFC3/UVIS	4	23-Jul-2015 21:25:36.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
07	(2) ION2	WFC3/UVIS	4	23-Jul-2015 21:25:37.0	yes

29 Total Orbits Used

ABSTRACT

One of the key questions in observational cosmology is the identification of the sources responsible for cosmic reionization and for keeping the IGM ionized at all times. The general consensus is that a population of faint low-mass galaxies must be responsible for the bulk of the ionizing photons. However, attempts at identifying the ionizing Lyman continuum radiation (LyC) leaking from the individual galaxies have so far been largely unsuccessful at any redshift. What controls the escape of ionizing radiation from star-forming galaxies? And at which level? We propose here to observe the LyC domain of the only two known galaxies, one at z=3.213 and the other at z=3.795, for which a leakage of ionizing radiation has already been detected, while other observed properties (UV and near-infrared spectra) are also consistent with a high LyC escape fraction. Goal of the observations is to determine where the ionizing radiation is escaping from the galaxies, i.e. the central regions or the periphery, and whether the emission is diffuse, patchy or unresolved. This will help identify the conditions that allow ionizing photons to leave the galaxies and to identify possible links with other properties of these galaxies. Only HST has the angular resolution to allow imaging of the LyC emission at the sub-kpc scales and characterize its spatial distribution relative to the non-ionizing UV emission (from existing GOODS+CANDELS images), as well as other wavelengths. This project is currently the unique concrete possibility to conduct a direct empirical investigation of the physical conditions regulating the escaping ionizing radiation.

OBSERVING DESCRIPTION

The program goal is to directly detect escaping LyC from galaxies that have been selected via ground-based (U-band) observations. The targets are at z=3.795 (Ion1, Vanzella et al. 2012, 2015) and z=3.213 (Ion2, Vanzella et al. 2015). The targets are very faint (~28 AB), and the backrounds will be very low. Our observations will therefore be strongly affected by charge transfer efficiency (CTE), or lack thereof, and much of our observing strategy is dictated by this. In particular, we are both taking long (whole-orbit) exposures and using the FLASH LED to guarantee ~12 e-/pixel in each exposure. According to the MacKenty & Smith (2012) CTE white paper, this is the approximate critical threshold for efficient charge transfer.

Filter Choice: We aim to use filters where the red cutoff in transmission is closest to the Lyman limit of the targets, as that is the location in the Lyman continuum where the transmission through the intergalactic medium is highest. We therefore choose to use the F410M filter for Ion1 (12 orbits) and the F336W filter for Ion2 (17 orbits).

Exposure times: Because the background must be >= 12 e-/pix/exposure, we will have to use the post-flash LED to add background on each exposure. We are therefore using whole orbit exposures to minimize the number of exposures (and therefore maximizing the S/N).

Visit length: Because whole orbit exposures with UVIS will have a large number of cosmic rays (CRs), we require at least 4 exposures per visit to guarantee that we can reasonably clean CRs from the images in each visit, and ensure good alignment of images between visits. All visits are either 4 or 5 orbits in length.

Orientation: The orientation is constrained modestly to ensure that the entirety of the image lies within the footprint of the GOODS fields, so that these data can be used for ancillary investigations. This is particularly important for the F336W exposure which will add area to the deep F336W being obtained by PID 13872 (PI: P. Oesch).

Expected Background and Post-flash Levels: Assuming an exposure time of 2750s, we expect ~4-5 e-/pix in dark current and a sky background of ~6 e-/pix in F336W and a ~7 e-/pix in F410M. However, the sky background can vary considerably, and we prefer to be conservative in our sky estimation so that we can add post-flash and guarantee that we obtain the required 12 e-/pix. Therefore, we use the low sky background estimates of 4 e-/pix (F336W) and 5 e-/pix (F410M) and *total* background (incl. 4 e-/pix dark current) of 8 e-/pix (F336W) and 9 e-/pix (F410M). This requires post-flash of 4 e-/pix (F336W) and 3 e-/pix (F410M).

Dither pattern and offsets: We choose to use standard dither patterns (WFC3-UVIS-DITHER-BOX for 4 orbit visits and WFC3-UVIS-DITHER-LINE for 5 orbit visits) to do small dithers in n+1/2 pixel intervals to better sample the PSF. This is particularly important for this program, as the LyC-emitting regions appear to be very compact and the underlying morphology will help us better understand the LyC escape. Between visits, we will do large offsets (3" in x, 1" in y) to smooth out any residual "blotchy" structure in the darks (see Rafelski et al. 2015).

Target position on chip: We choose to put the target on the UVIS 2 CCD (which has slightly higher QE at bluer wavelengths), amplifier C (slightly lower read noise). We use the UVIS2 aperture and do a large POSTARG offset to put the object near the edge of the detector (in the readout detection) so that the target is only ~10-12" away from the edge (and in the center of the amplifier (in the x-direction). This will greatly reduce losses due to charge transfer inefficiency.

Visit

Proposal 14088, ION1 Visit 1 (01) Fri Jul 24 01:25:38 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 290D TO 50 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

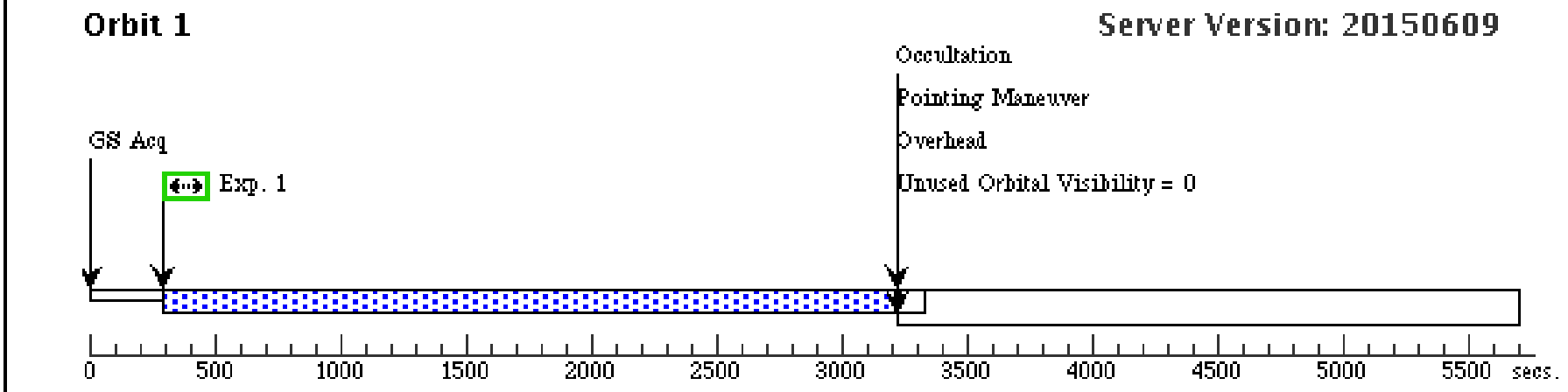
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ION1	RA: 03 32 16.6370 (53.0693208d) Dec: -27 42 53.35 (-27.71482d) Equinox: J2000		V=25.27+/-0.035 i775 = 24.89+/- 0.05	Reference Frame: ICRS

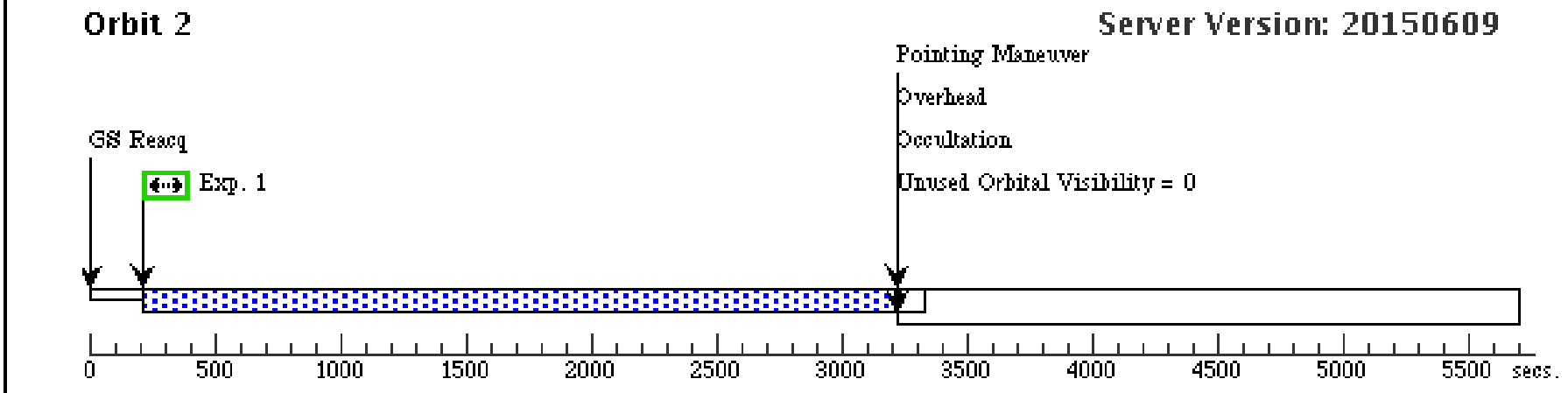
Comments: Extended=NO

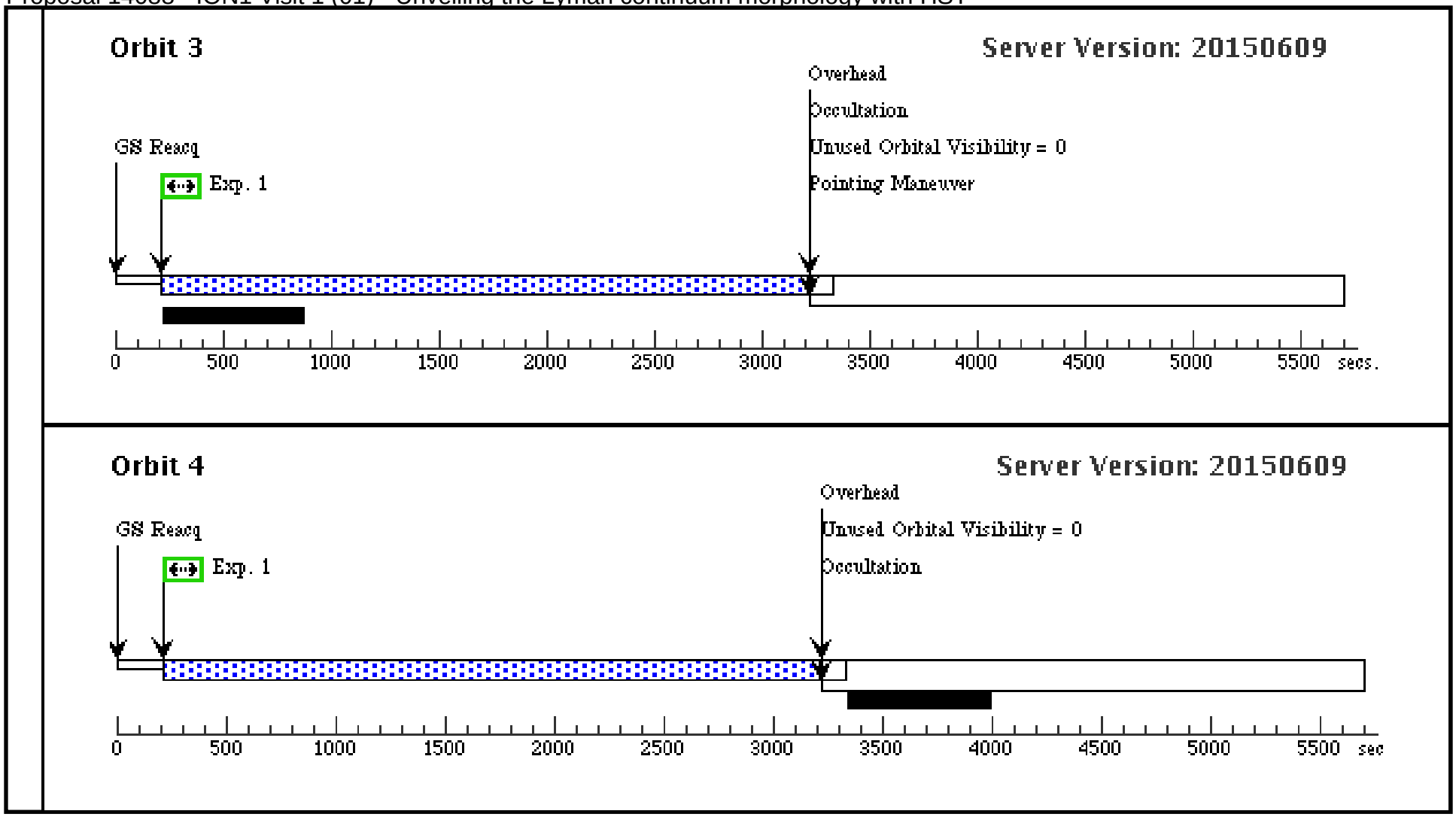
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) ION1	WFC3/UVIS, ACCUM, UVIS2	F410M	FLASH=3	POS TARG -41,-31	Pattern 2, Exps 1-1 in ION1 Visit 1 (01) (2)	2800 Secs (11885 Secs)	
								[==>2888.0 Secs (Pattern 1)]	***[1]***
								[==>2999.0 Secs (Pattern 2)]	***[2]***
								[==>2999.0 Secs (Pattern 3)]	***[3]***
								[==>2999.0 Secs (Pattern 4)]	***[4]***

Orbit Structure



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Overhead
Occultation
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Pointing Maneuver
GS Reacq
Exp. 1
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5500
secs.
Orbit 4
Server Version: 20150609
Overhead
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 1
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sec

Visit

Proposal 14088, ION1 Visit 2 (02) Fri Jul 24 01:25:39 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

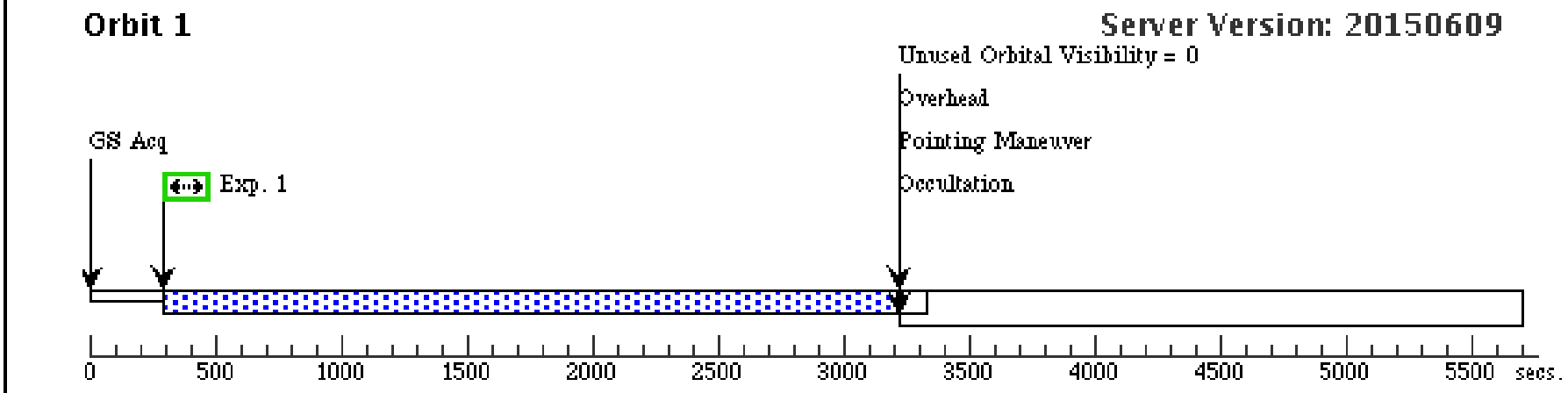
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ION1	RA: 03 32 16.6370 (53.0693208d) Dec: -27 42 53.35 (-27.71482d) Equinox: J2000		V=25.27+/-0.035 i775 = 24.89+/- 0.05	Reference Frame: ICRS

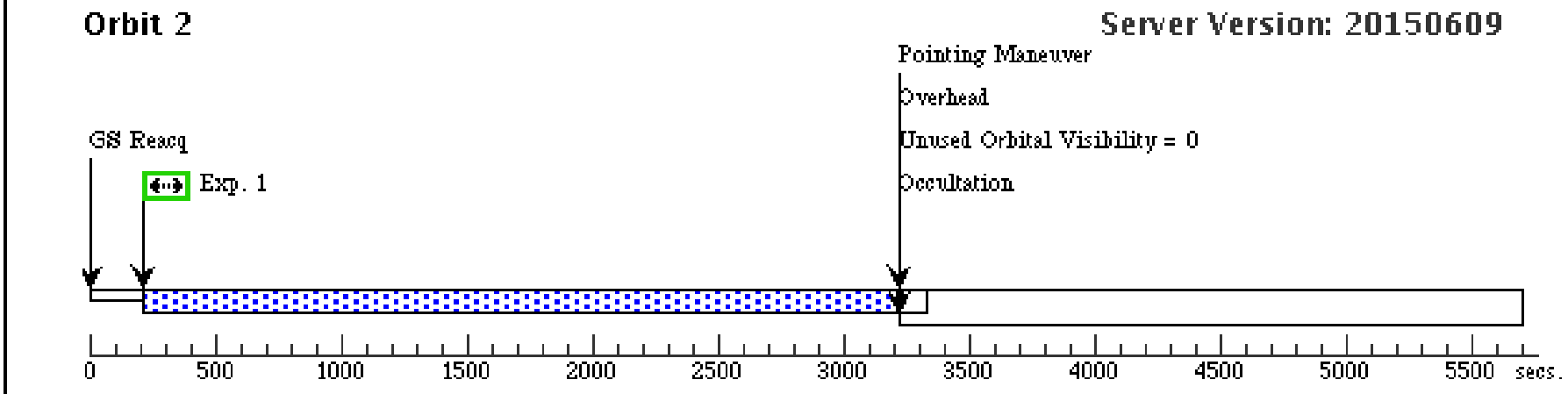
Comments: Extended=NO

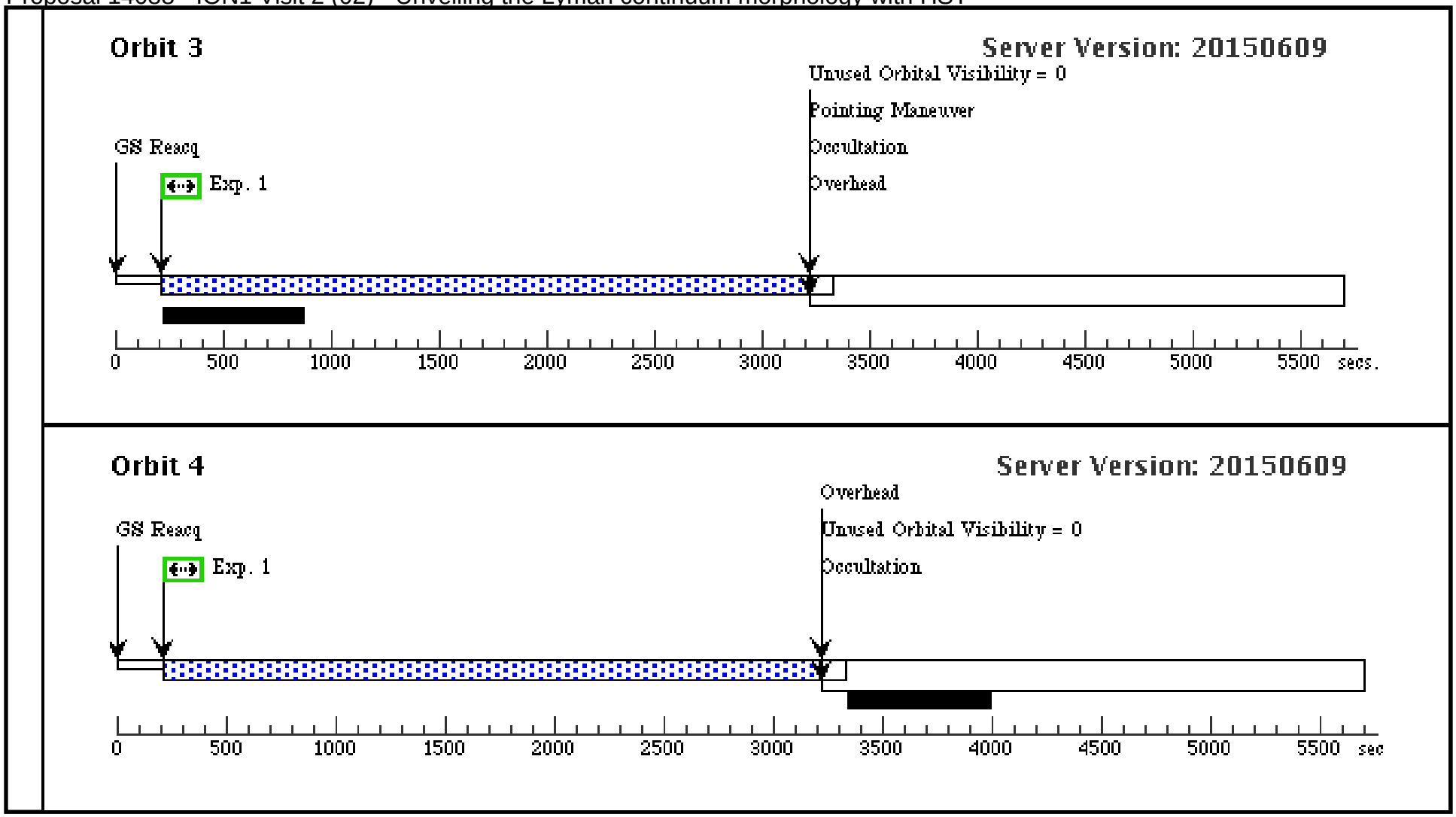
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) ION1	WFC3/UVIS, ACCUM, UVIS2	F410M	FLASH=3	POS TARG -38,-30	Pattern 2, Exps 1-1 in ION1 Visit 2 (02) (2)	2800 Secs (11885 Secs)	
								[==>2888.0 Secs (Pattern 1)]	***[1]***
								[==>2999.0 Secs (Pattern 2)]	***[2]***
								[==>2999.0 Secs (Pattern 3)]	***[3]***
								[==>2999.0 Secs (Pattern 4)]	***[4]***

Orbit Structure



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Pointing Maneuver
Occultation
Overhead
GS Reacq
Exp. 1
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secs.
Orbit 4
Server Version: 20150609
Overhead
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 1
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sec

Visit

Proposal 14088, ION1 Visit 3 (03) Fri Jul 24 01:25:39 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

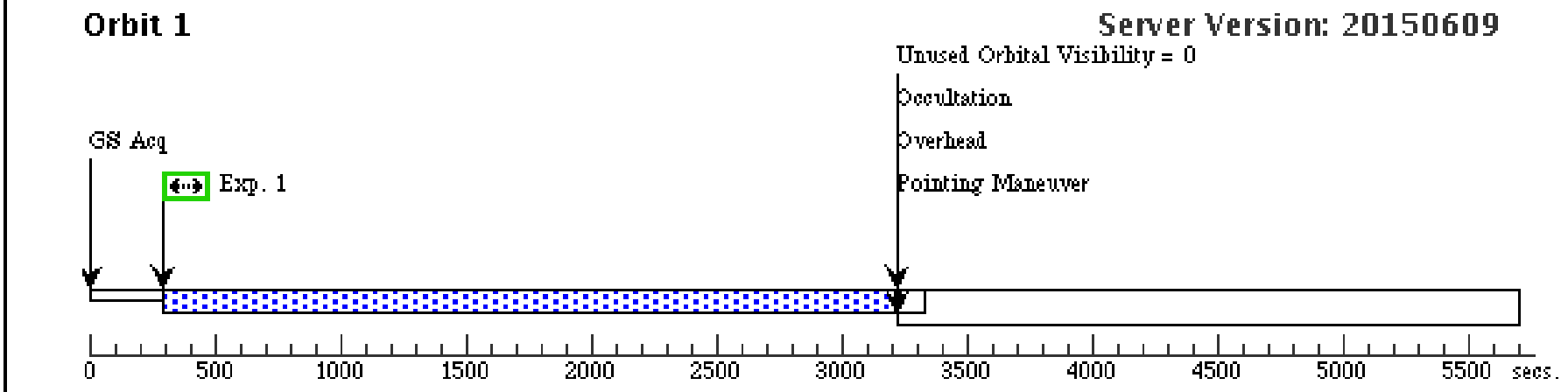
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ION1	RA: 03 32 16.6370 (53.0693208d) Dec: -27 42 53.35 (-27.71482d) Equinox: J2000		V=25.27+/-0.035 i775 = 24.89+/- 0.05	Reference Frame: ICRS

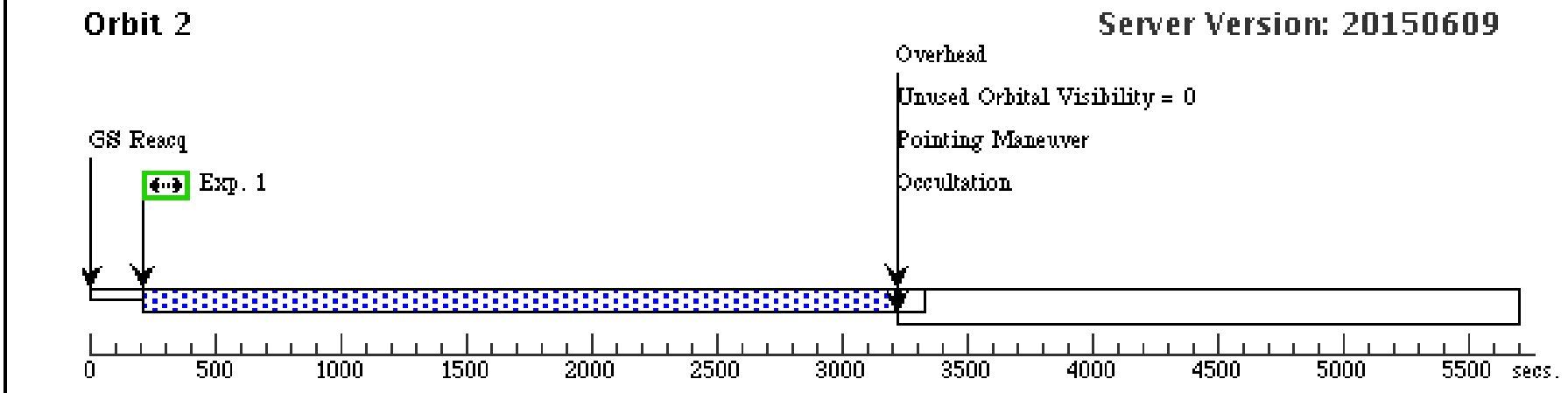
Comments: Extended=NO

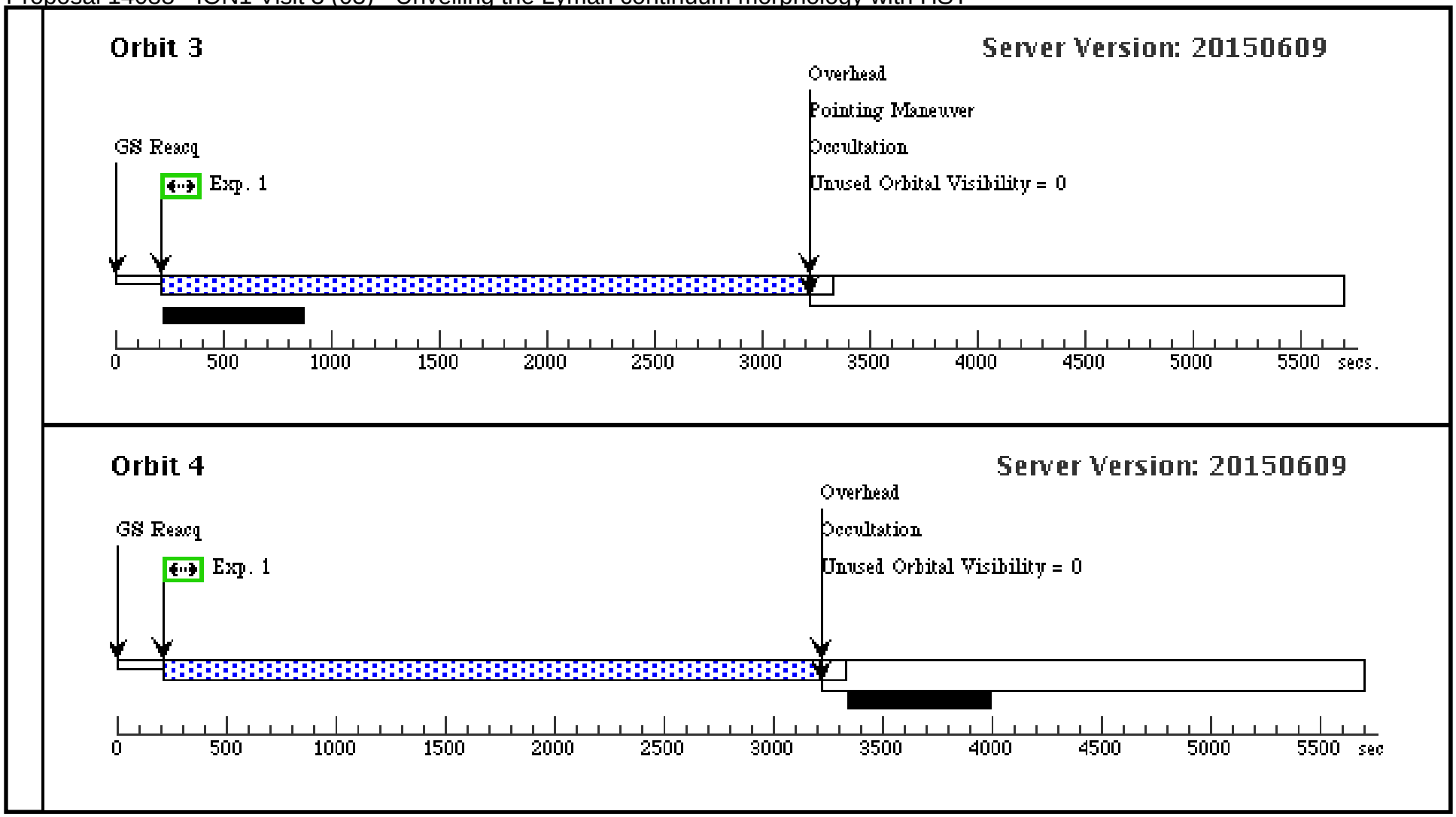
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) ION1	WFC3/UVIS, ACCUM, UVIS2	F410M	FLASH=3	POS TARG -35,-29	Pattern 2, Exps 1-1 in ION1 Visit 3 (03) (2)	2800 Secs (11885 Secs)	
								[==>2888.0 Secs (Pattern 1)]	***[1]***
								[==>2999.0 Secs (Pattern 2)]	***[2]***
								[==>2999.0 Secs (Pattern 3)]	***[3]***
								[==>2999.0 Secs (Pattern 4)]	***[4]***

Orbit Structure



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Pointing Maneuver
Occultation
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secs.
Orbit 4
Server Version: 20150609
Overhead
Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 1
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Visit

Proposal 14088, ION2 Visit 1 (04) Fri Jul 24 01:25:39 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 220D TO 325 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=5 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

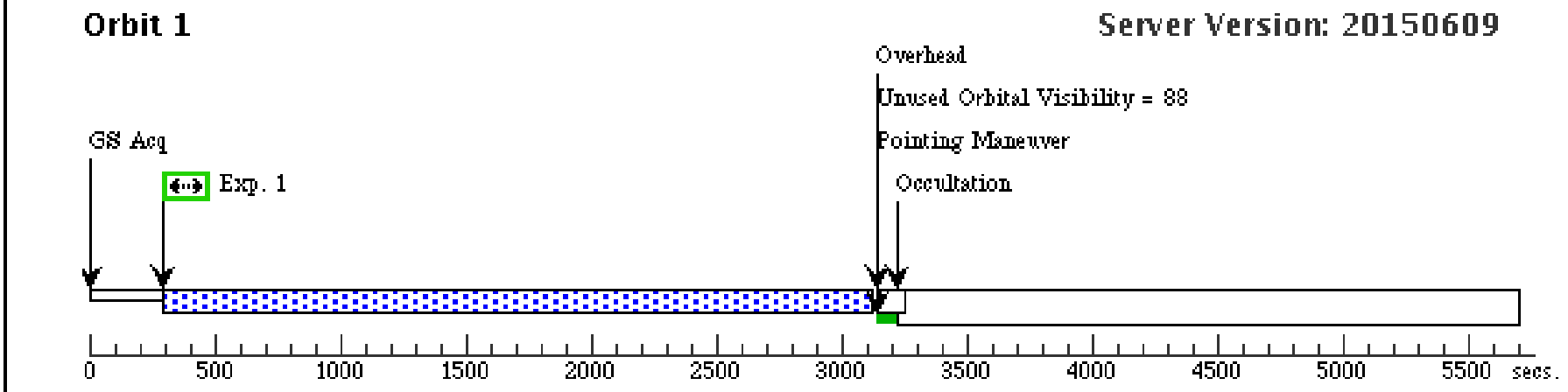
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ION2	RA: 03 32 3.2437 (53.0135154d) Dec: -27 45 18.84 (-27.75523d) Equinox: J2000		V=24.44+/-0.017 24.47 +/- 0.029	Reference Frame: ICRS

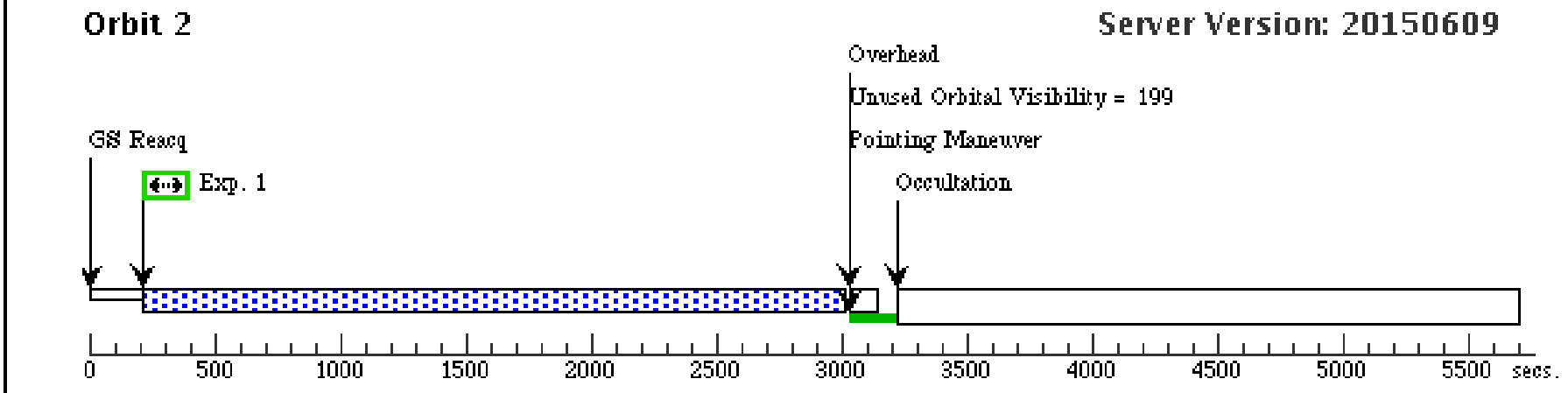
Comments: Extended=NO

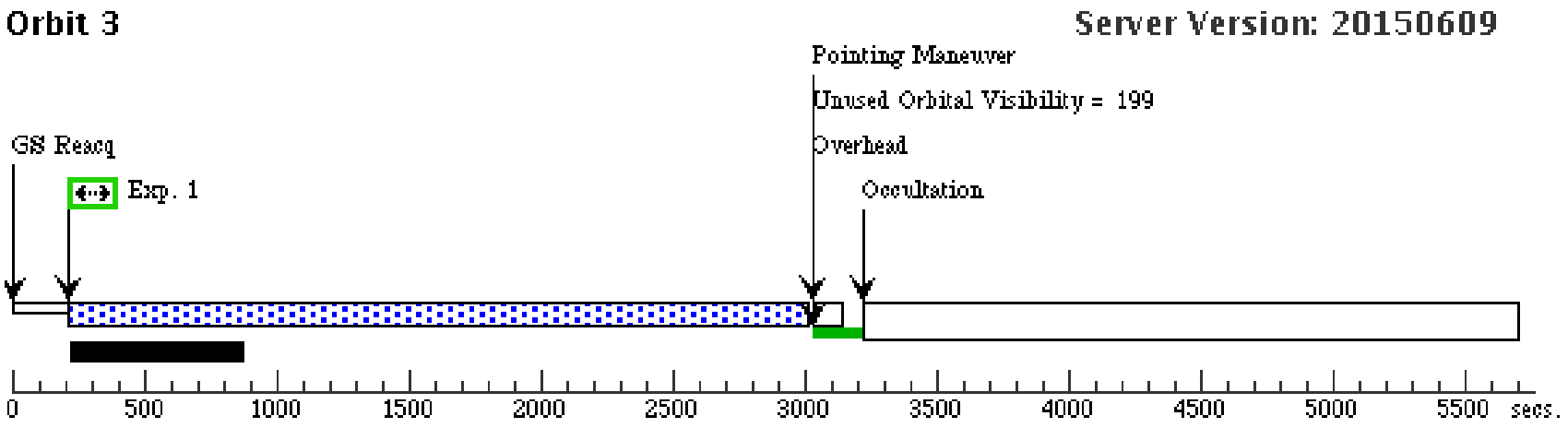
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) ION2	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=4	POS TARG -41,-30	Pattern 1, Exps 1-1 in ION2 Visit 1 (04) (1)	2800 Secs (14000 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
								[==>(Pattern 5)]	***[5]***

Orbit Structure






Orbit 3
Server Version: 20150609
Pointing Maneuver
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GS Reacq
Exp. 1
Overhead
Occultation
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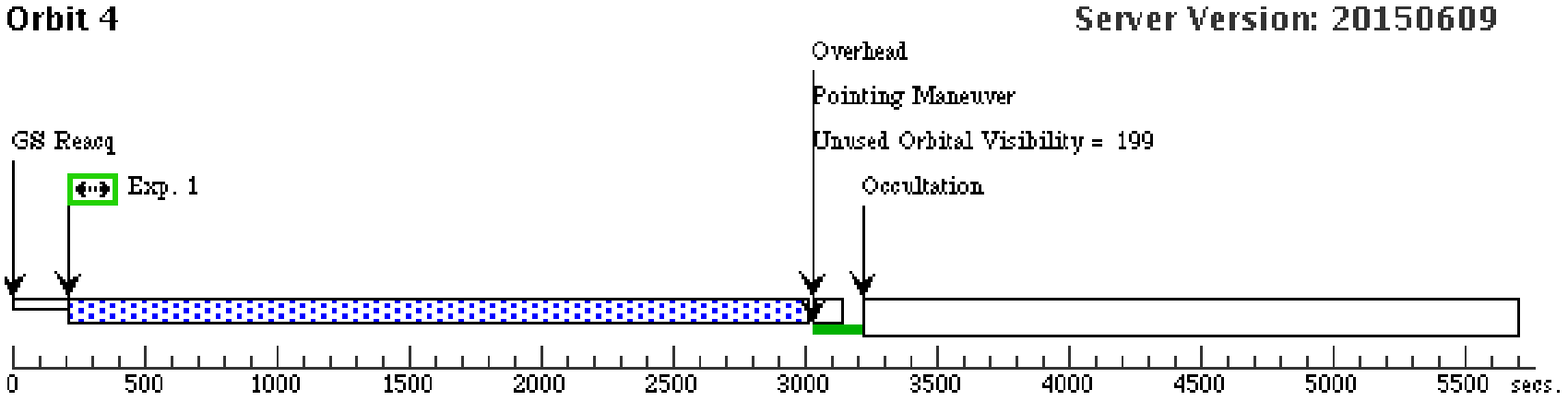
secs.


Orbit 4
Server Version: 20150609
Overhead
Pointing Maneuver
Unused Orbital Visibility = 199
GS Reacq
Exp. 1
Occultation
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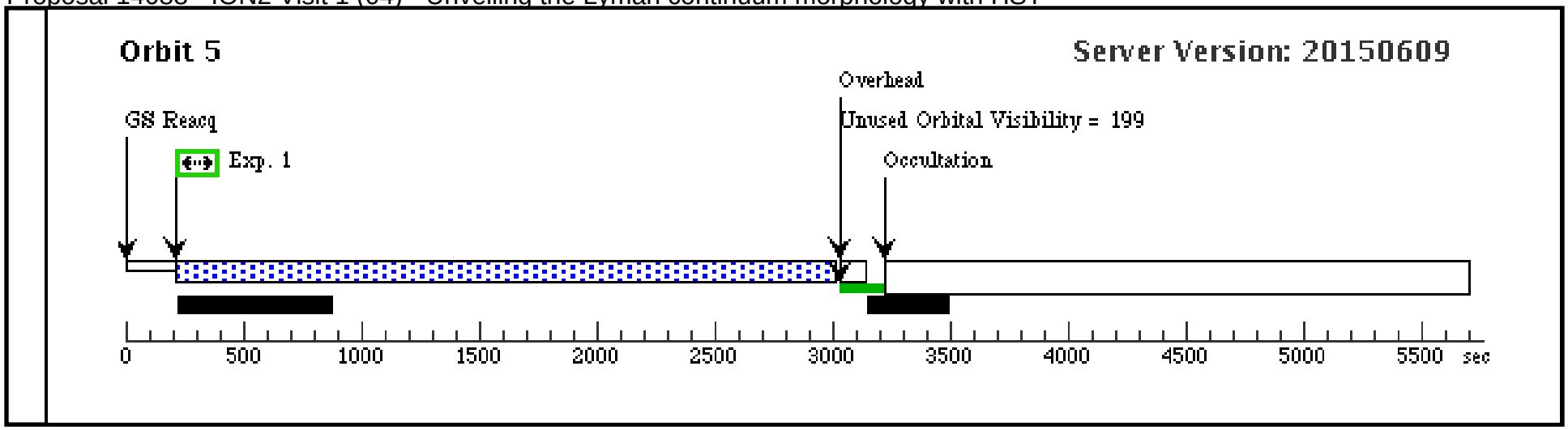
secs.


Orbit 5
Server Version: 20150609
Overhead
GS Reacq
Unused Orbital Visibility = 199
Exp. 1
Occultation
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sec

Visit

Proposal 14088, ION2 Visit 2 (05) Fri Jul 24 01:25:39 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 04

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

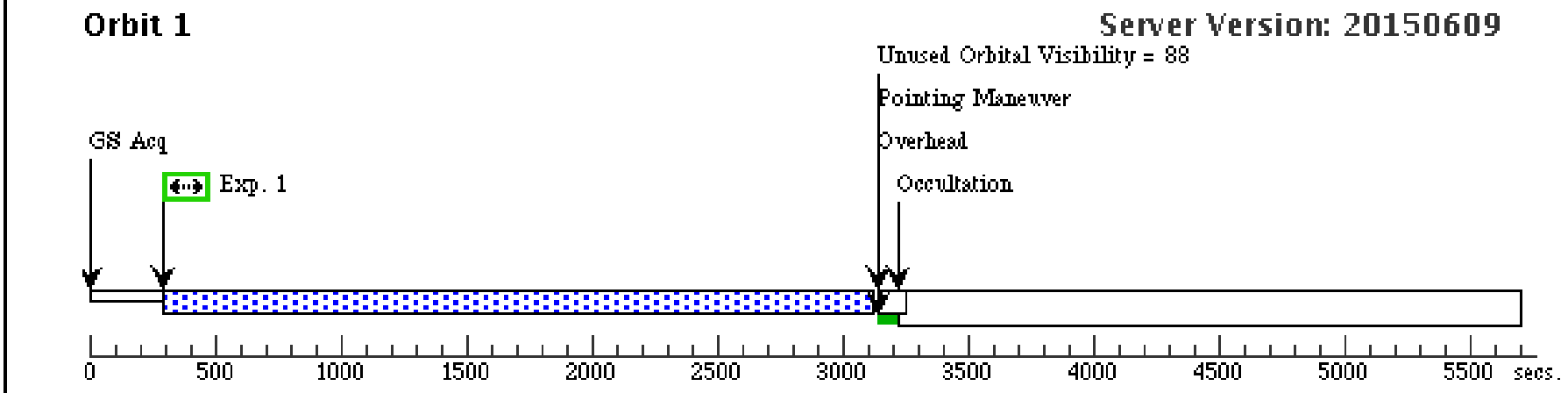
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ION2	RA: 03 32 3.2437 (53.0135154d) Dec: -27 45 18.84 (-27.75523d) Equinox: J2000		V=24.44+/-0.017 24.47 +/- 0.029	Reference Frame: ICRS

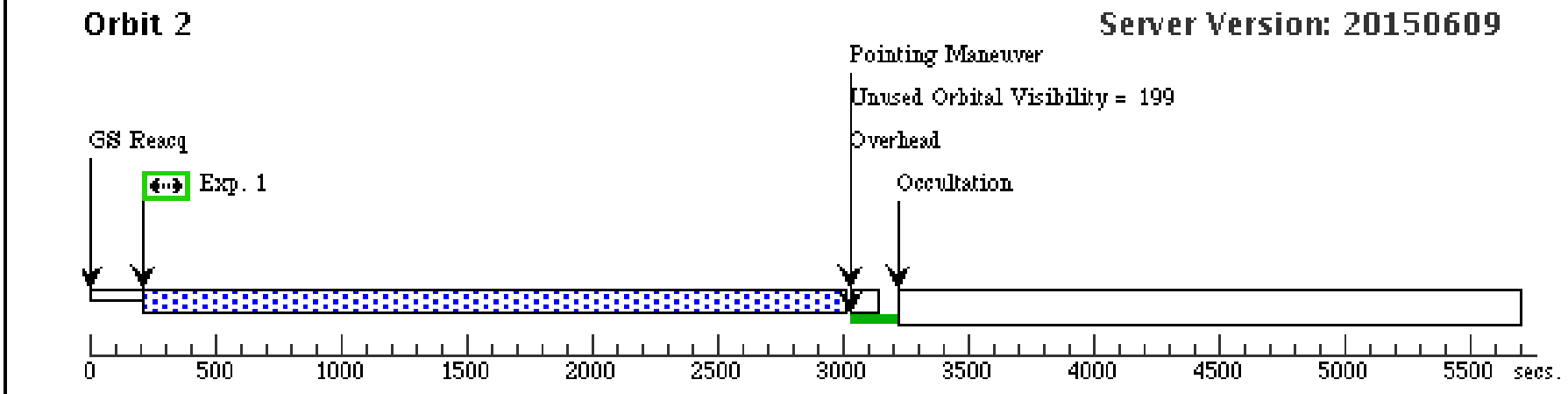
Comments: Extended=NO

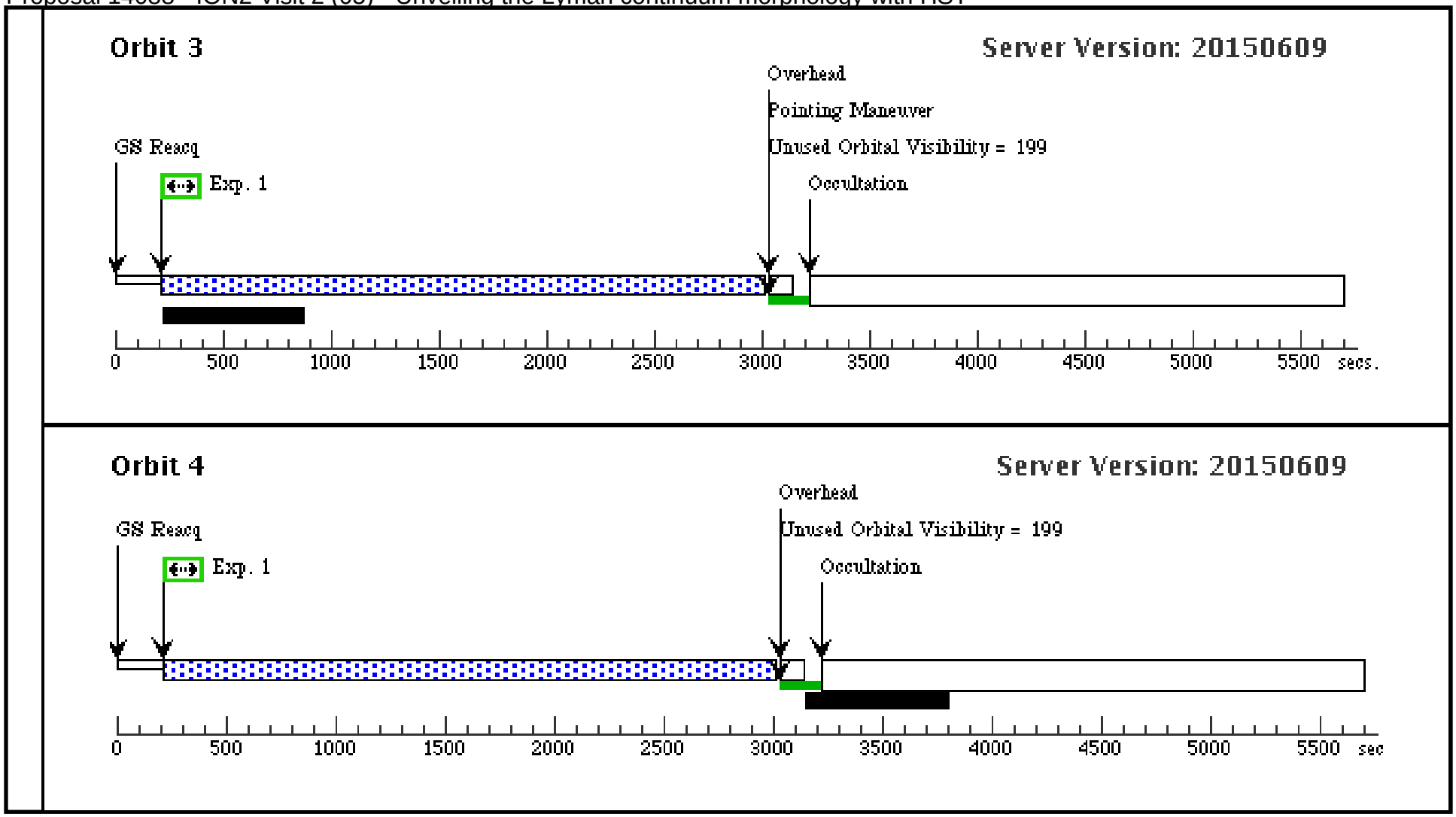
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) ION2	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=4	POS TARG -38,-29	Pattern 2, Exps 1-1 in ION2 Visit 2 (05) (2)	2800 Secs (11200 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure






Orbit 3
Server Version: 20150609
Overhead
Pointing Maneuver
Unused Orbital Visibility = 199
GS Reacq
Exp. 1
Occultation
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secs.
Orbit 4
Server Version: 20150609
Overhead
Unused Orbital Visibility = 199
GS Reacq
Exp. 1
Occultation
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sec

Visit

Proposal 14088, ION2 Visit 3 (06) Fri Jul 24 01:25:39 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 04

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

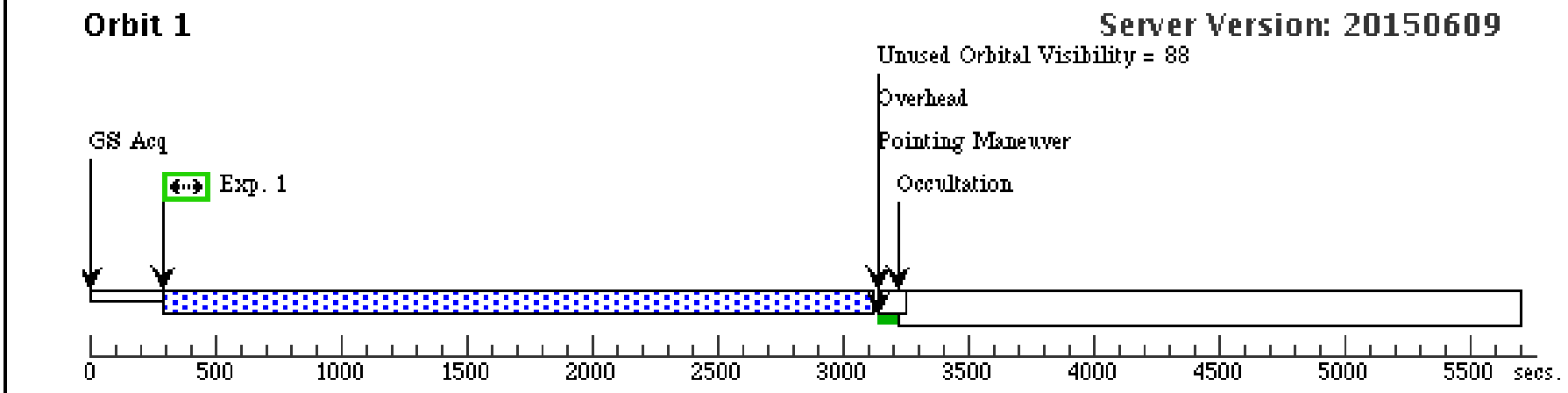
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ION2	RA: 03 32 3.2437 (53.0135154d) Dec: -27 45 18.84 (-27.75523d) Equinox: J2000		V=24.44+/-0.017 24.47 +/- 0.029	Reference Frame: ICRS

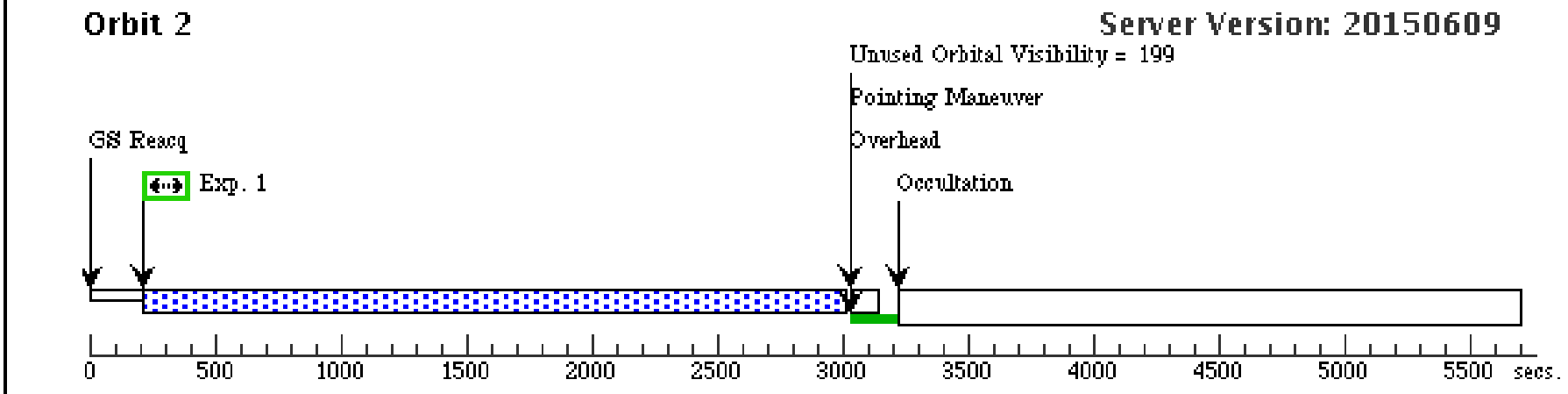
Comments: Extended=NO

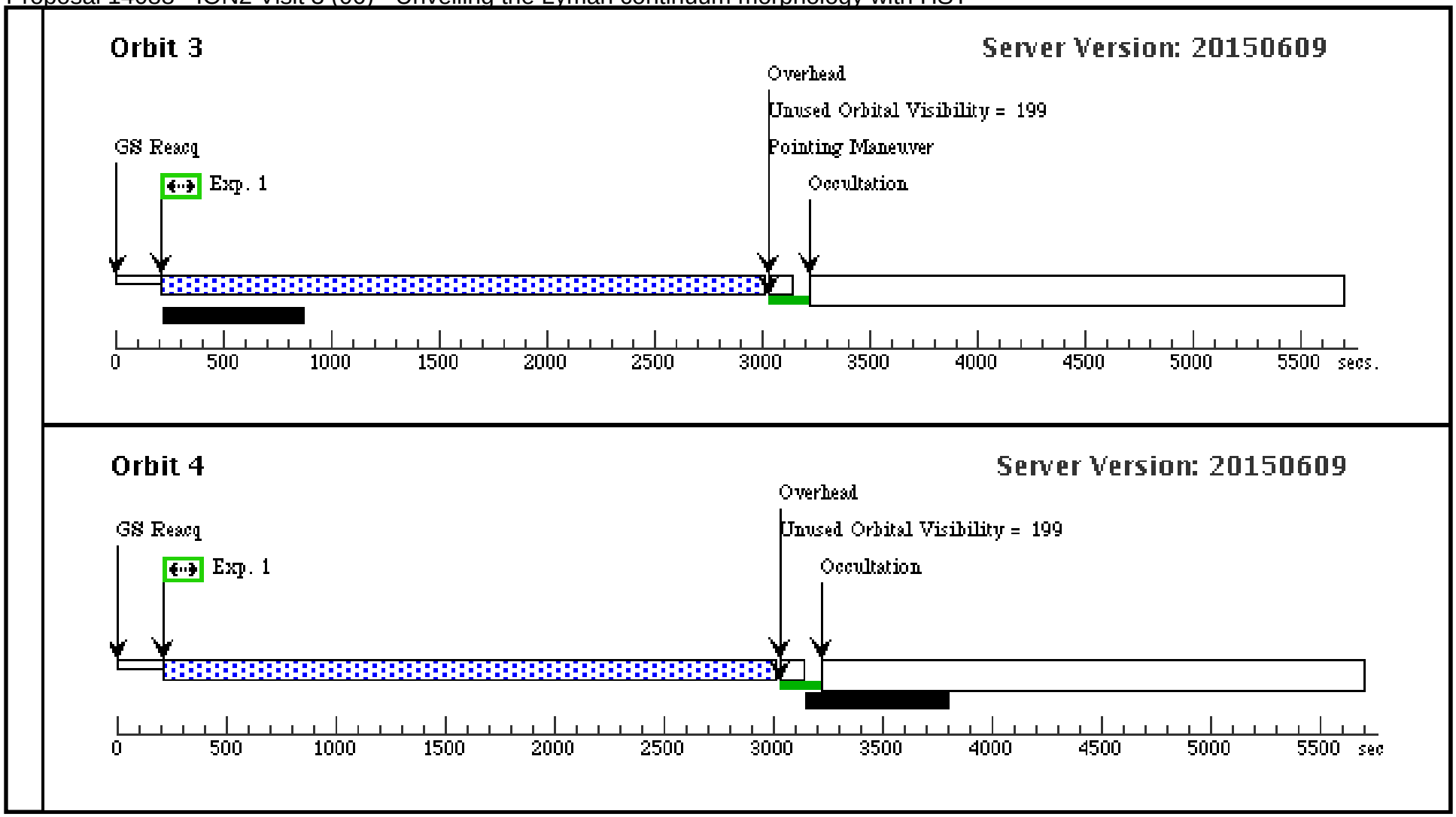
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) ION2	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=4	POS TARG -35,-28	Pattern 2, Exps 1-1 in ION2 Visit 3 (06) (2)	2800 Secs (11200 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure






Orbit 3
Server Version: 20150609
Overhead
Unused Orbital Visibility = 199
GS Reacq
Pointing Maneuver
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.
Orbit 4
Server Version: 20150609
Overhead
GS Reacq
Unused Orbital Visibility = 199
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14088, ION2 Visit 4 (07) Fri Jul 24 01:25:40 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 04

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

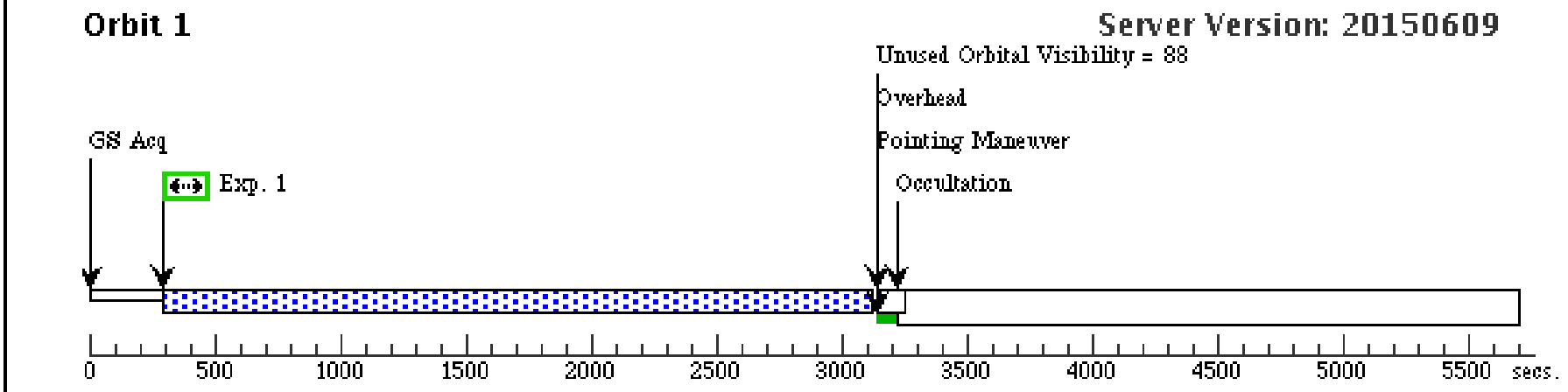
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ION2	RA: 03 32 3.2437 (53.0135154d) Dec: -27 45 18.84 (-27.75523d) Equinox: J2000		V=24.44+/-0.017 24.47 +/- 0.029	Reference Frame: ICRS

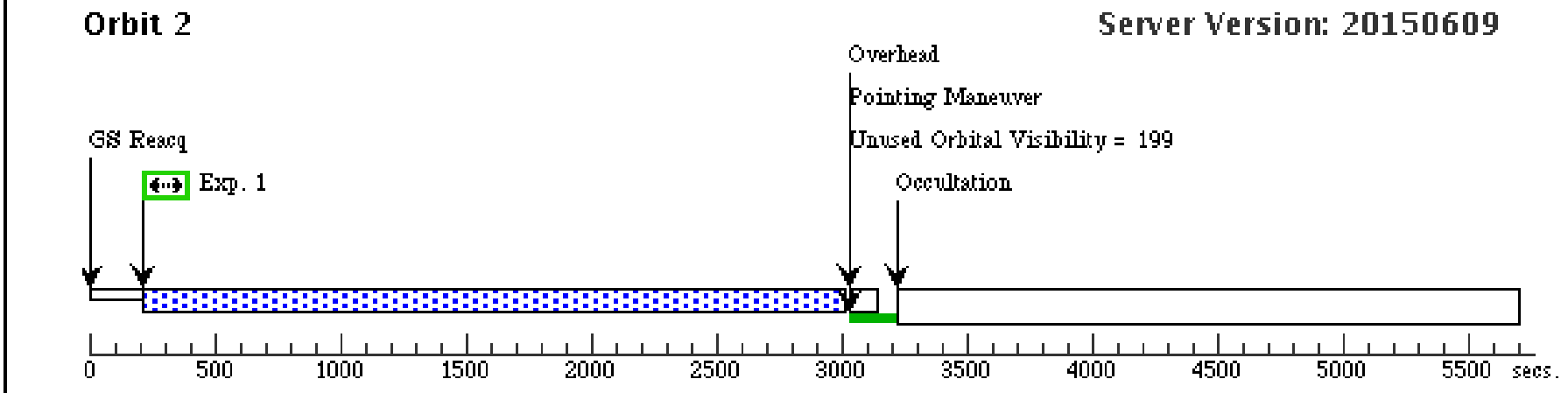
Comments: Extended=NO

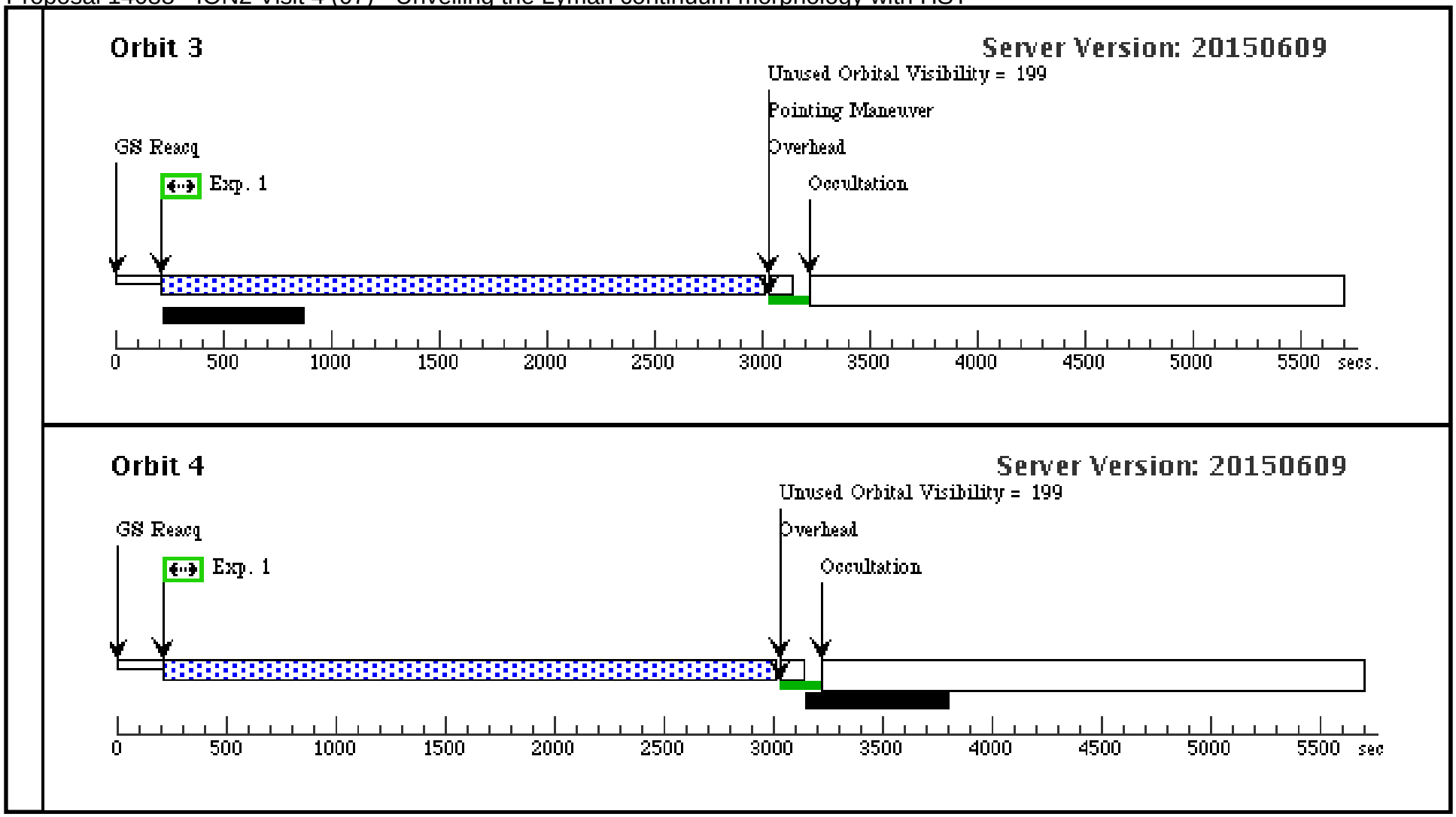
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) ION2	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=4	POS TARG -32,-27	Pattern 2, Exps 1-1 in ION2 Visit 4 (07) (2)	2800 Secs (11200 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure






Orbit 3
Server Version: 20150609
Unused Orbital Visibility = 199
Pointing Maneuver
Overhead
GS Reacq
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.
Orbit 4
Server Version: 20150609
Unused Orbital Visibility = 199
Overhead
GS Reacq
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec