15865 - Mg II Emission: A new Tracer for Lyman Alpha and Lyman Continuum

Cycle: 27, Proposal Category: GO

(UV Initiative, JWST Initative)

(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) J124619+444902	COS/FUV COS/NUV	1	03-Oct-2019 16:00:19.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(2) J110359+483456	COS/FUV COS/NUV	2	03-Oct-2019 16:00:21.0	yes
03	(3) J121948+481411	COS/FUV COS/NUV	2	03-Oct-2019 16:00:22.0	yes
04	(4) J110506+594741	COS/FUV COS/NUV	2	03-Oct-2019 16:00:24.0	yes
05	(5) J015208-043117	COS/FUV COS/NUV	2	03-Oct-2019 16:00:25.0	yes
06	(6) J020819-040136	COS/FUV COS/NUV	4	03-Oct-2019 16:00:27.0	yes
07	(7) J010534+234960	COS/FUV COS/NUV	3	03-Oct-2019 16:00:29.0	yes
08	(8) J142535+524902	COS/FUV COS/NUV	3	03-Oct-2019 16:00:30.0	yes

19 Total Orbits Used

ABSTRACT

In studies of the intergalactic medium (IGM) reionization, the Lyman Alpha (LyA) emission from galaxies is a heavily used diagnostic. This spectral feature is frequently used to infer the IGM neutral hydrogen fraction, and is also thought to predict the emission of hydrogen-ionizing Lyman Continuum (LyC) photons. Nevertheless, LyA is difficult to observe in a neutral IGM, and its evolution in the reionization epoch may be partly due to galaxy evolution. Therefore, we propose a new way forward: emission from the Mg II 2796, 2803 doublet. Recently, Henry et al. (2018) showed that Mg II appears in emission, rather than absorption, in nearby analogs to reionization-epoch galaxies. Since the strength of Mg II correlates tightly with that of LyA in these galaxies, it is plausible that observations of Mg II from z>6 galaxies could provide valuable constraints on reionization. Still, only seven reionization-epoch analogs have observations in LyA, LyC, and Mg II, and this existing sample misses most of the strongest Mg II emitters. Therefore, we propose new COS observations for eight star-forming galaxies with the highest Mg II equivalent widths. These objects may reveal some of the highest LyC escape fractions seen nearby. These observations will quantify how LyC in this sample relates to the intensity of Mg II and LyA emission, as well as the velocity structure of the emission line profiles. Finally, we will carry out new multi-ion radiation transport modeling, in order to obtain stringent constraints on the scattering gas that regulates the escape of LyC, LyA, and Mg II.

OBSERVING DESCRIPTION

Sample Selection

We have identified a sample of 8 Mg II emitters from SDSS-I/eBOSS spectra. In order to select these galaxies, we made the following cuts: (a) we require GALEX NUV detections, with NUV <22 AB. (b) we choose galaxies with H-beta equivalent width > 5 Angstroms to remove passive galaxies, (c) AGN were removed using a cut in the [NII]/Halpha vs [OIII]/Hbeta plot. (d) We require z=0.3 - 0.45, so that the Mg II is covered by the BOSS spectra, while Lyman Alpha falls in the COS G160M bandpass. These cuts defined a sample which we then fit with custom software to measure the Mg II emission lines. (e) Then, we require Mg II emission at SNR > 7, in order to ensure that we are not proposing followup of spurious detections. (f) Finally, we selected 9 galaxies observable in 4 orbits or less (see below) where the Mg II (summed) equivalent width is greater than 10 Angstroms. Among these 9 galaxies, one has COS Lyman Alpha and LyC observations (G140L and G160M) planned in Cycle 26, and another has LyC observations in G140L. Therefore, we will acquire Lyman Alpha observations for 8 galaxies, and LyC for 7.

Observations

We aim to observe Lyman Alpha at high resolution in the G160M gating, and LyC and the non-ionizing UV continuum at lower resolution in the G140L grating. Our exposure time calculations assume a point source. In order to quantify the Lyman Alpha line wings, we aim for a signal-to-noise of 0.3 per six (spectral) pixel resolution element in G160M. For the LyC, we aim to measure escape fractions of 5% at 5 sigma signifcance by binning over 20 Angstroms. We assume an intrinsic Lyman Break corresponding to 0.75 magnitudes. Fortuitously, the redshifts of our sources place the LyC near the peak of the G140L throughput, resulting in efficient observations. The depths in this program are comparable to the Low Redshift LyC Survey (GO 15626). The sources are observed for 1-4 orbits each, with G140L:G160M exposure time ratios dictated by our exposure time calculations and efficient usage of each orbit. We use all four FP-POS settings. Since our targets are faint, we use the primary science aperture.

Target Acquisition:

We acquire the sources using NUV imaging. We use ACQ/IMAGE mode with MIRRORA and the Primary Science Aperture. We assume an

extended source with half the light falling within a 0.2" radius. NUV magnitudes used in this calculation are taken from GALEX. The target acquisition exposure times range between 65 and 224 seconds.

Bright Object Checks

We ran the bright object tool on each visit. Visits 1-7 showed no GALEX-detected objects in the COS field-of-regard (the PSA and the annulus where the BOA could fall.) Visit 8 does not contain GALEX data in Aladin or the BOT, even though the field is covered by GALEX. We used Aladin with SDSS, and also the BOT with GSC II, to identify one potential object in the COS field-of-regard. This object is undetected in the GALEX images found on GalexView/MAST.

Visit

Proposal 15865, J124619+444902 (01), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

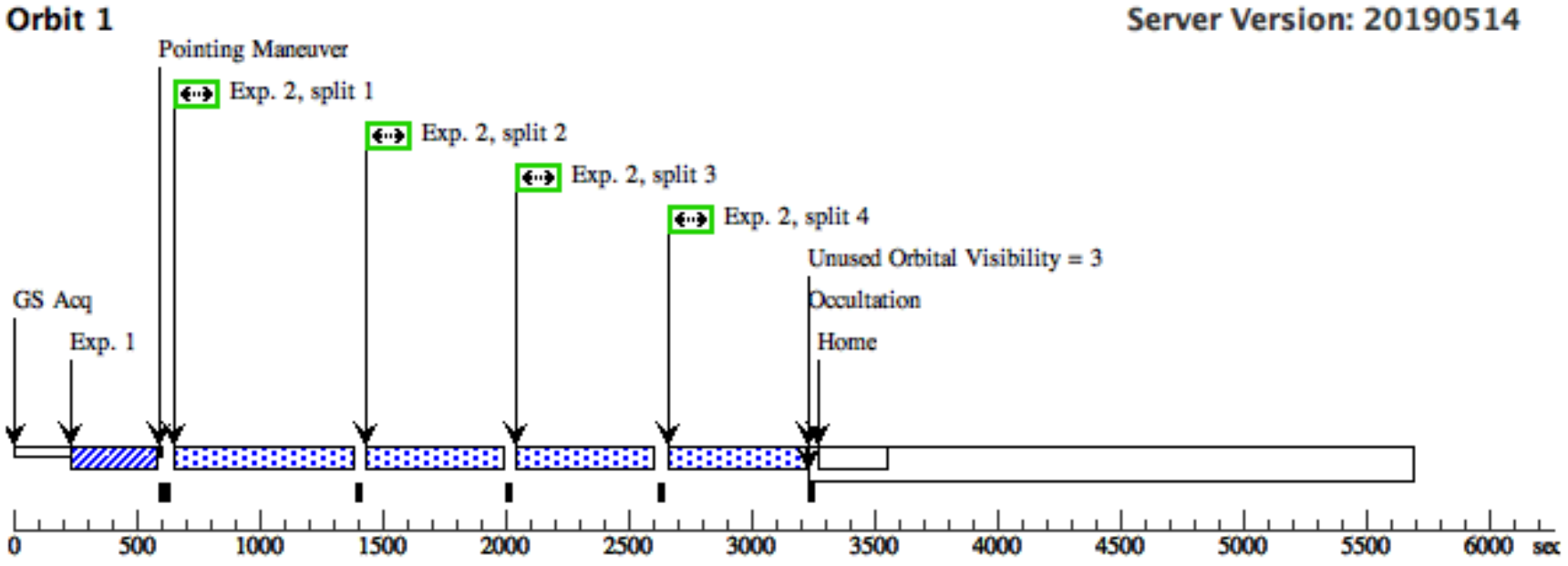
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J124619+444902	RA: 12 46 19.4840 (191.5811833d) Dec: +44 49 2.29 (44.81730d) Equinox: J2000	Redshift: 0.32224	V=20.2 FUV = 20.6, NUV = 20.2	Reference Frame: ICRS

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	ACQ/IM (COS.ta.1366702)	(1) J124619+444902	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				65 Secs (65 Secs) *[==>]*	*[1]*
2	G160M/1533 (COS.sp.1366708)	(1) J124619+444902	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=18847; FP-POS=ALL			480 Secs (2032 Secs) *[==>508.0 Secs (Split 1)]* *[==>508.0 Secs (Split 2)]* *[==>508.0 Secs (Split 3)]* *[==>508.0 Secs (Split 4)]*	*[1]*

Orbit Structure



Visit

Proposal 15865, J110359+483456 (02), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

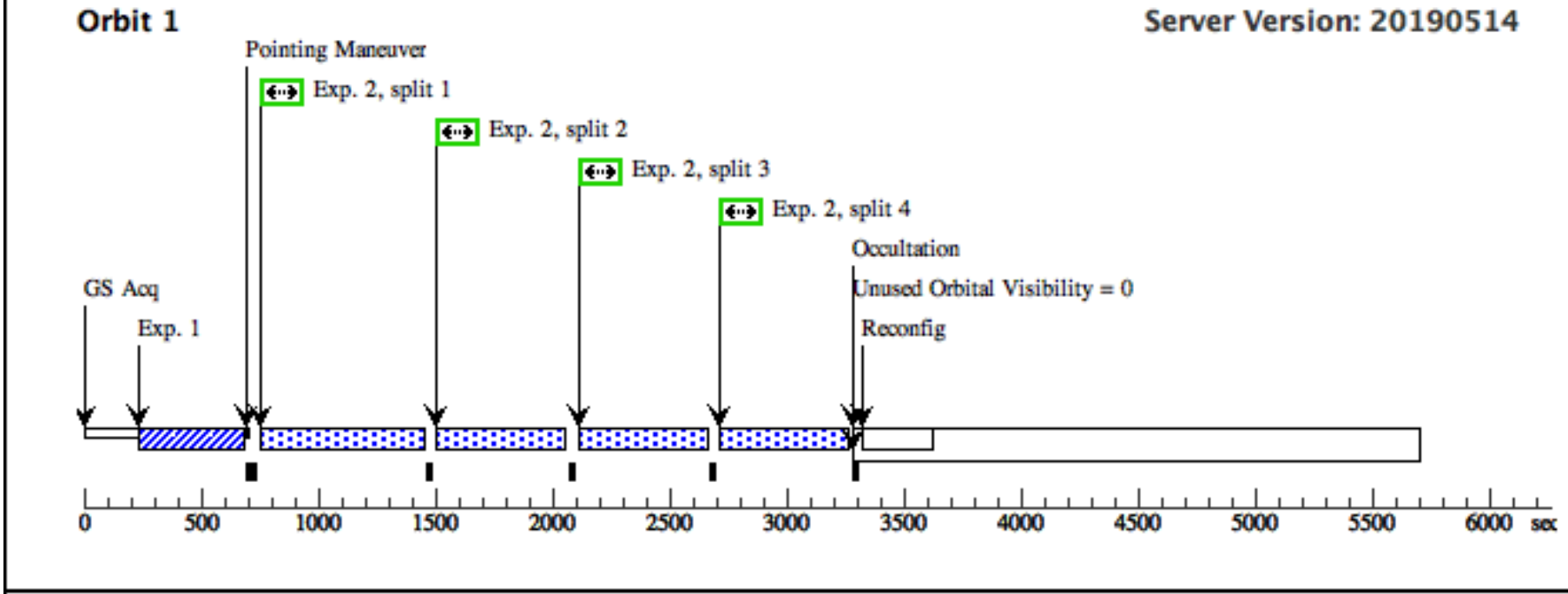
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	J110359+483456	RA: 11 03 58.9987 (165.9958279d) Dec: +48 34 55.87 (48.58219d) Equinox: J2000	Redshift: 0.417971	V=21.1 NUV = 20.8	Reference Frame: ICRS

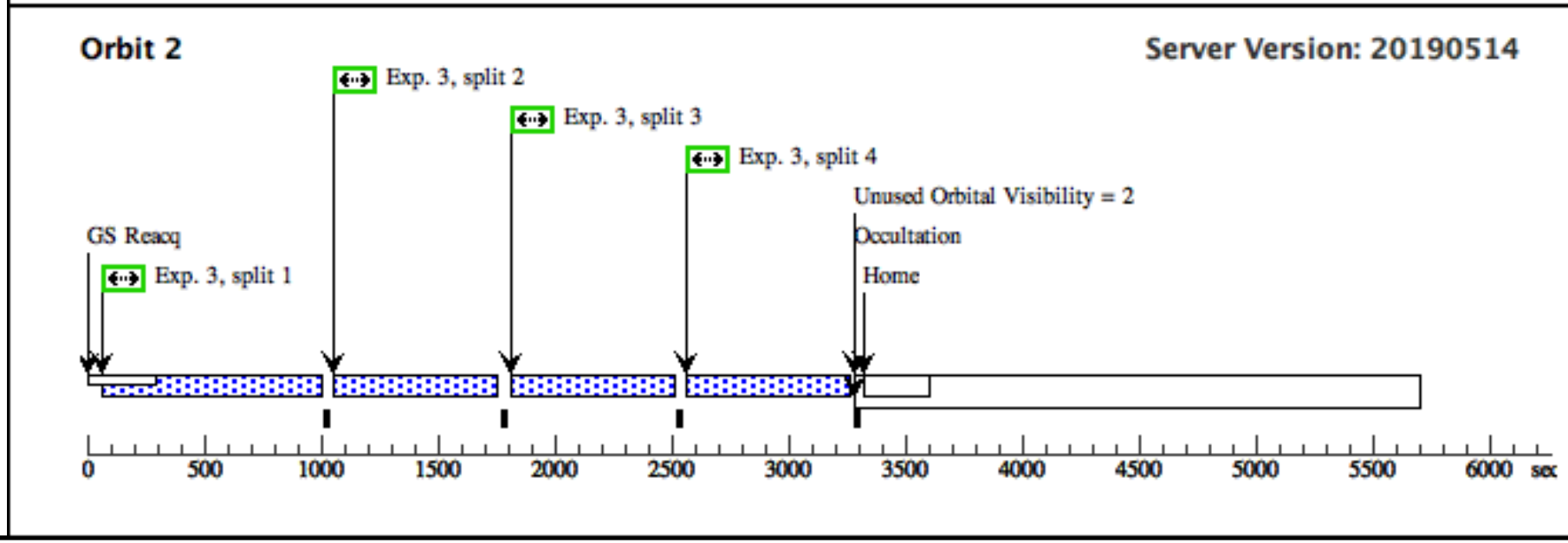
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366703)	(2) J110359+483456	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				115 Secs (115 Secs) *[==>]*	*[1]*
2	G140L/800 (COS.sp.1366716)	(2) J110359+483456	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9170			472 Secs (2004 Secs) *[==>501.0 Secs (Split 1)]* *[==>501.0 Secs (Split 2)]* *[==>501.0 Secs (Split 3)]* *[==>501.0 Secs (Split 4)]*	*[1]*
3	G160M/1623 (COS.sp.1366709)	(2) J110359+483456	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=20625; FP-POS=ALL			628 Secs (2600 Secs) *[==>650.0 Secs (Split 1)]* *[==>650.0 Secs (Split 2)]* *[==>650.0 Secs (Split 3)]* *[==>650.0 Secs (Split 4)]*	*[2]*

Orbit Structure





Visit

Proposal 15865, J121948+481411 (03), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

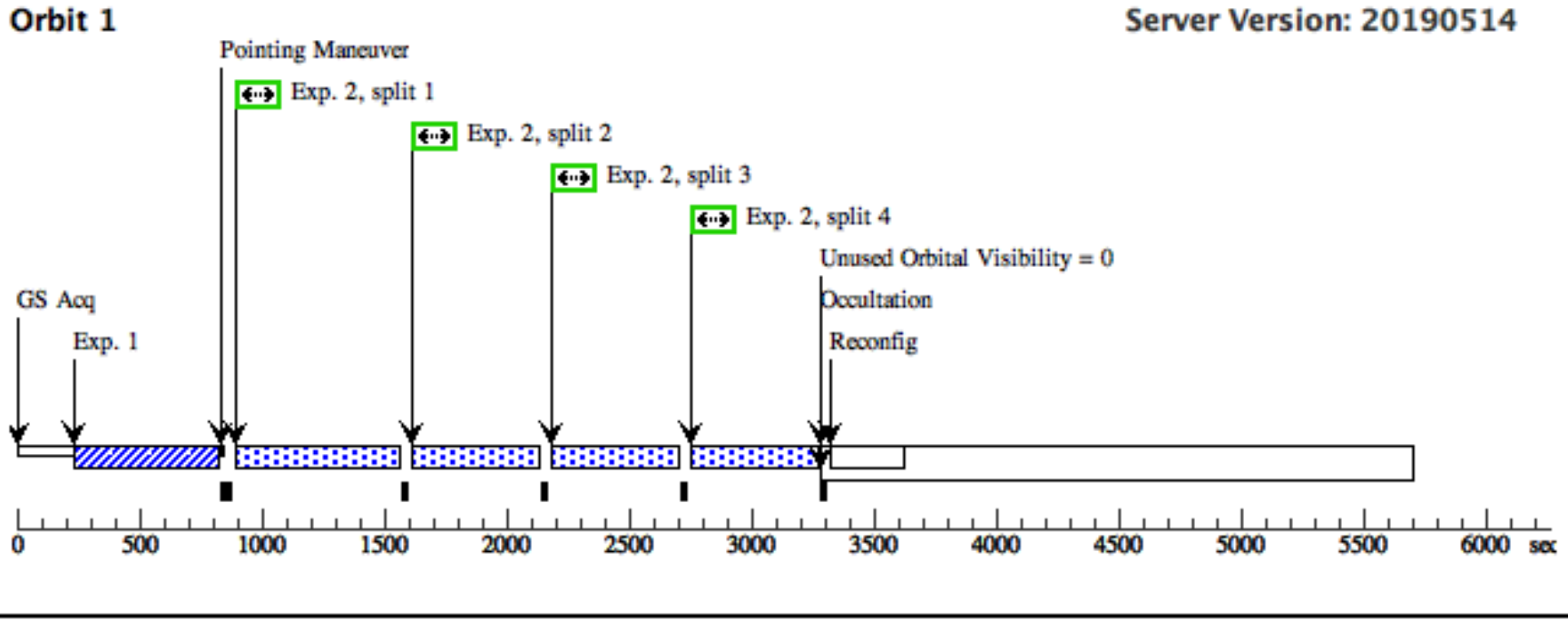
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	J121948+481411	RA: 12 19 47.8641 (184.9494337d) Dec: +48 14 10.50 (48.23625d) Equinox: J2000	Redshift: 0.420143	V=21.3 FUV = 21.6, NUV = 21.3	Reference Frame: ICRS

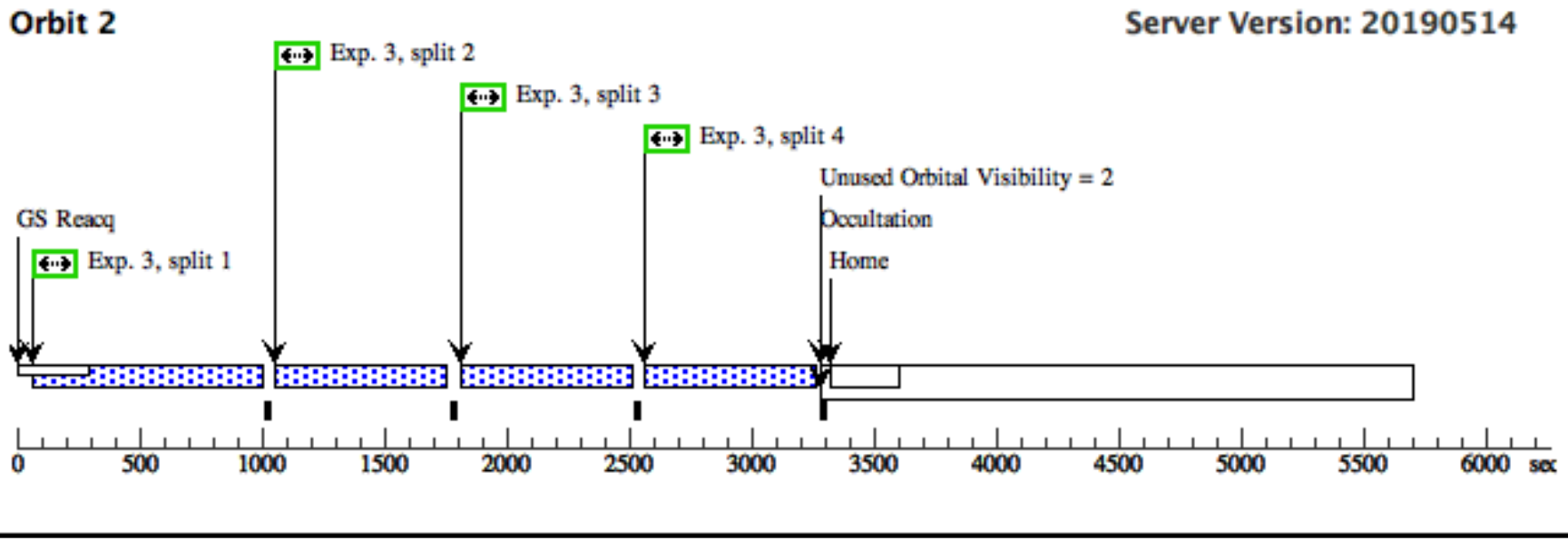
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366704)	(3) J121948+481411	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				185 Secs (185 Secs) *[==>]*	*[1]*
2	G140L/800 (COS.sp.1366718)	(3) J121948+481411	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9173			430 Secs (1864 Secs) *[==>466.0 Secs (Split 1)]* *[==>466.0 Secs (Split 2)]* *[==>466.0 Secs (Split 3)]* *[==>466.0 Secs (Split 4)]*	*[1]*
3	G160M/1623 (COS.sp.1366710)	(3) J121948+481411	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=20910; FP-POS=ALL			628 Secs (2600 Secs) *[==>650.0 Secs (Split 1)]* *[==>650.0 Secs (Split 2)]* *[==>650.0 Secs (Split 3)]* *[==>650.0 Secs (Split 4)]*	*[2]*

Orbit Structure





Visit

Proposal 15865, J110506+594741 (04), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

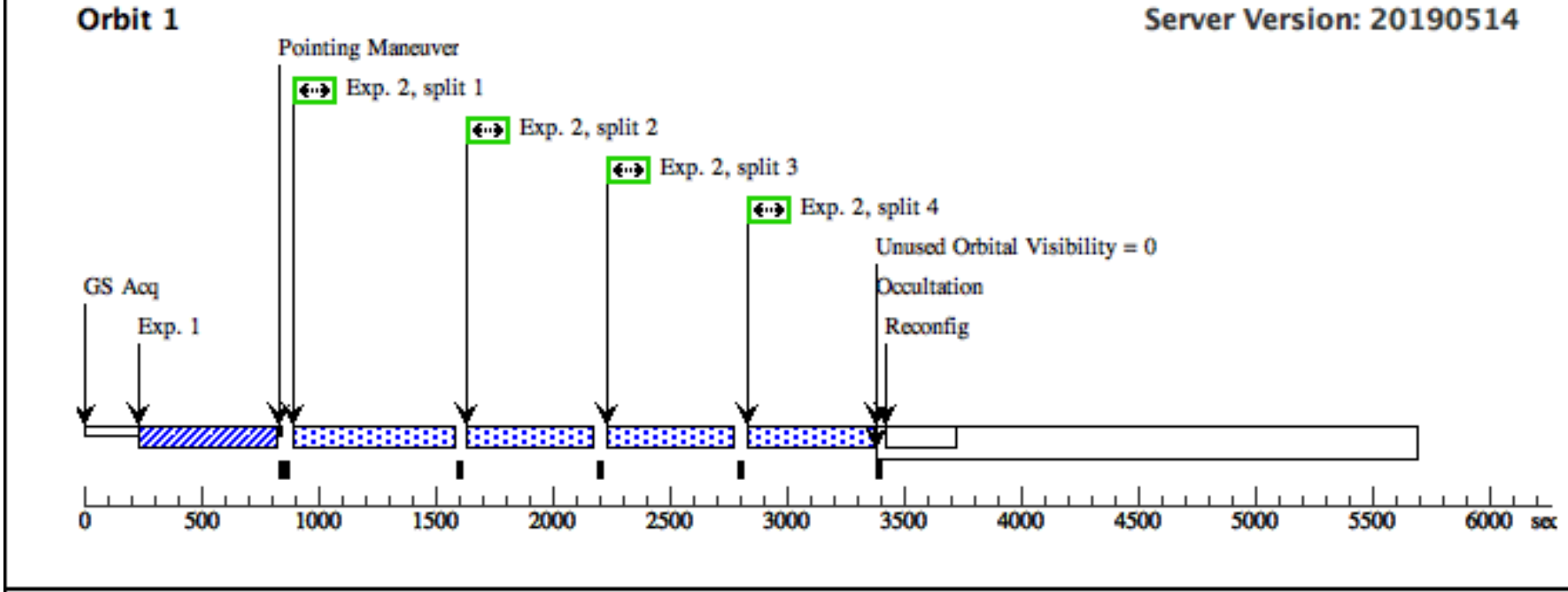
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	J110506+594741	RA: 11 05 6.3278 (166.2763658d) Dec: +59 47 41.41 (59.79484d) Equinox: J2000	Redshift: 0.405444	V=21.3 FUV = 22.3, NUV = 21.3	Reference Frame: ICRS

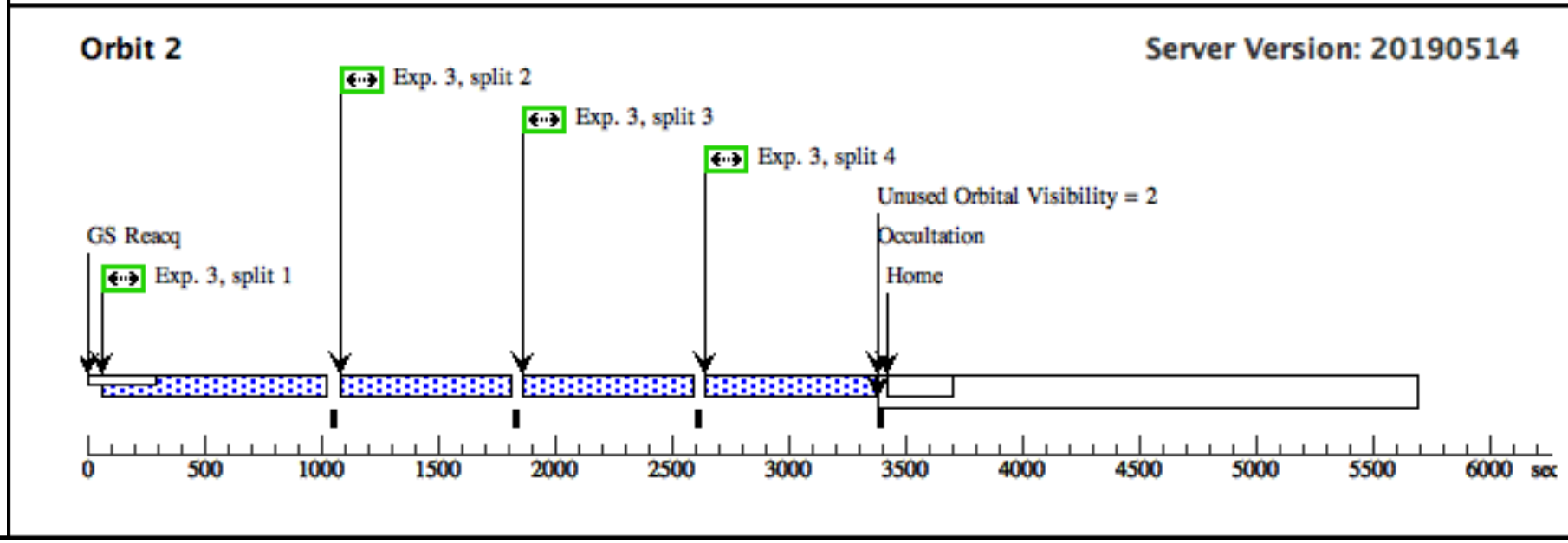
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366704)	(4) J110506+594741	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				185 Secs (185 Secs) *[==>]*	*[1]*
2	G140L/800 (COS.sp.1366719)	(4) J110506+594741	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9177			456 Secs (1968 Secs) *[==>492.0 Secs (Split 1)]* *[==>492.0 Secs (Split 2)]* *[==>492.0 Secs (Split 3)]* *[==>492.0 Secs (Split 4)]*	*[1]*
3	G160M/1623 (COS.sp.1366711)	(4) J110506+594741	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=20909; FP-POS=ALL			654 Secs (2704 Secs) *[==>676.0 Secs (Split 1)]* *[==>676.0 Secs (Split 2)]* *[==>676.0 Secs (Split 3)]* *[==>676.0 Secs (Split 4)]*	*[2]*

Orbit Structure





Visit

Proposal 15865, J015208-043117 (05), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

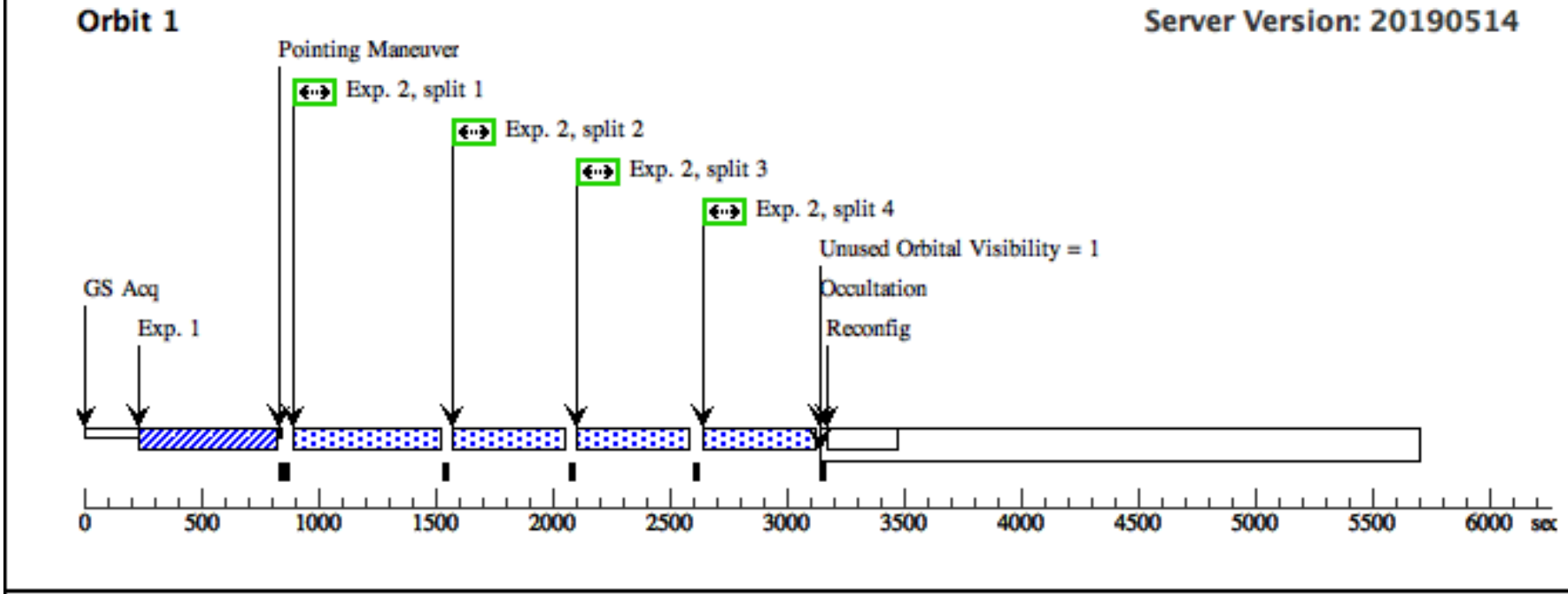
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	J015208-043117	RA: 01 52 7.9944 (28.0333100d) Dec: -04 31 17.22 (-4.52145d) Equinox: J2000	Redshift: 0.38358	V=21.3 FUV = 21.5, NUV = 21.3	Reference Frame: ICRS

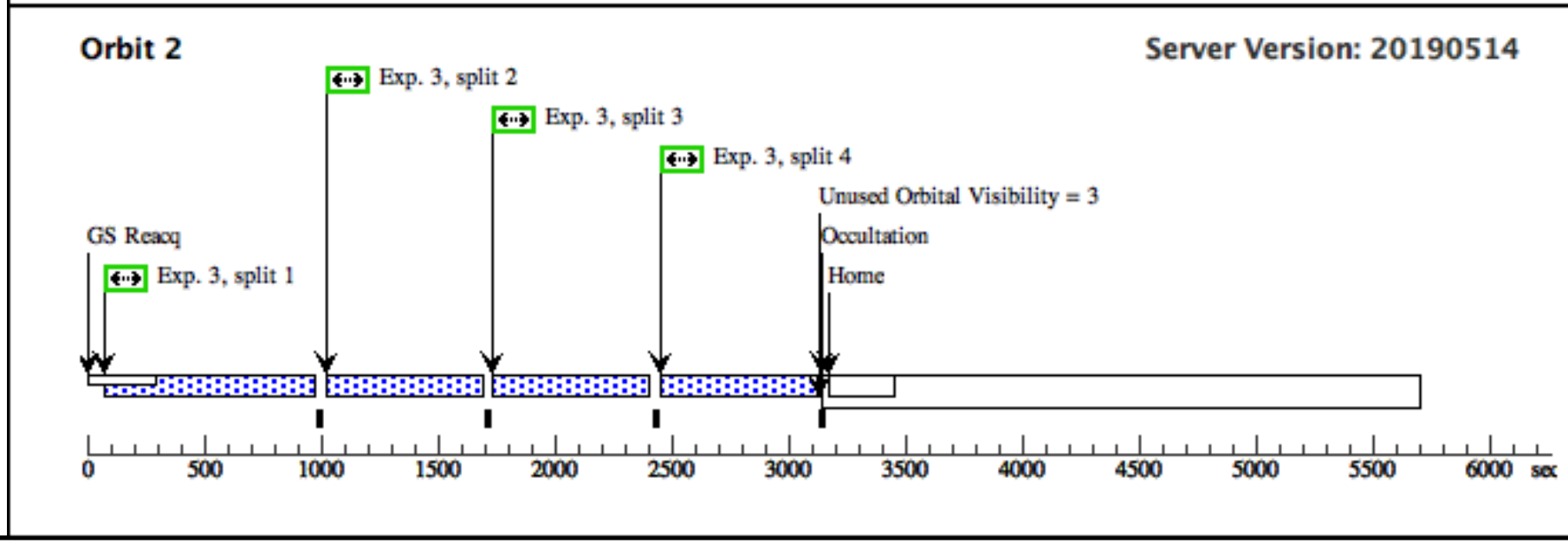
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366704)	(5) J015208-043117	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				185 Secs (185 Secs) *[==>]*	*[1]*
2	G140L/800 (COS.sp.1366720)	(5) J015208-043117	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9154			387 Secs (1720 Secs) *[==>430.0 Secs (Split 1)]* *[==>430.0 Secs (Split 2)]* *[==>430.0 Secs (Split 3)]* *[==>430.0 Secs (Split 4)]*	*[1]*
3	G160M/1600 (COS.sp.1366712)	(5) J015208-043117	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20842; FP-POS=ALL			593 Secs (2456 Secs) *[==>614.0 Secs (Split 1)]* *[==>614.0 Secs (Split 2)]* *[==>614.0 Secs (Split 3)]* *[==>614.0 Secs (Split 4)]*	*[2]*

Orbit Structure





Visit

Proposal 15865, J020819-040136 (06), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

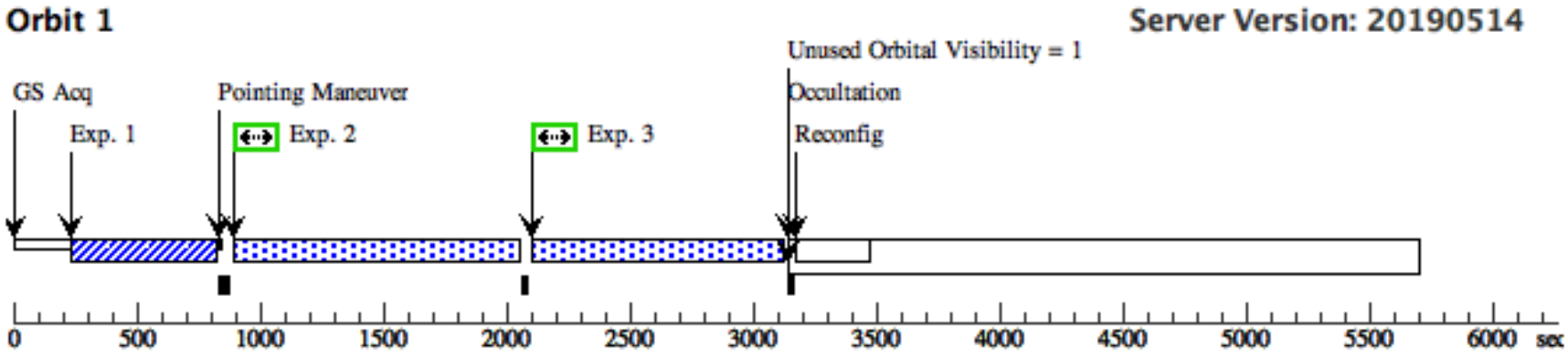
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(6)	J020819-040136	RA: 02 08 18.9045 (32.0787688d) Dec: -04 01 36.45 (-4.02679d) Equinox: J2000	Redshift: 0.384452	V=21.3 NUV = 21.2, FUV = 21.3	Reference Frame: ICRS

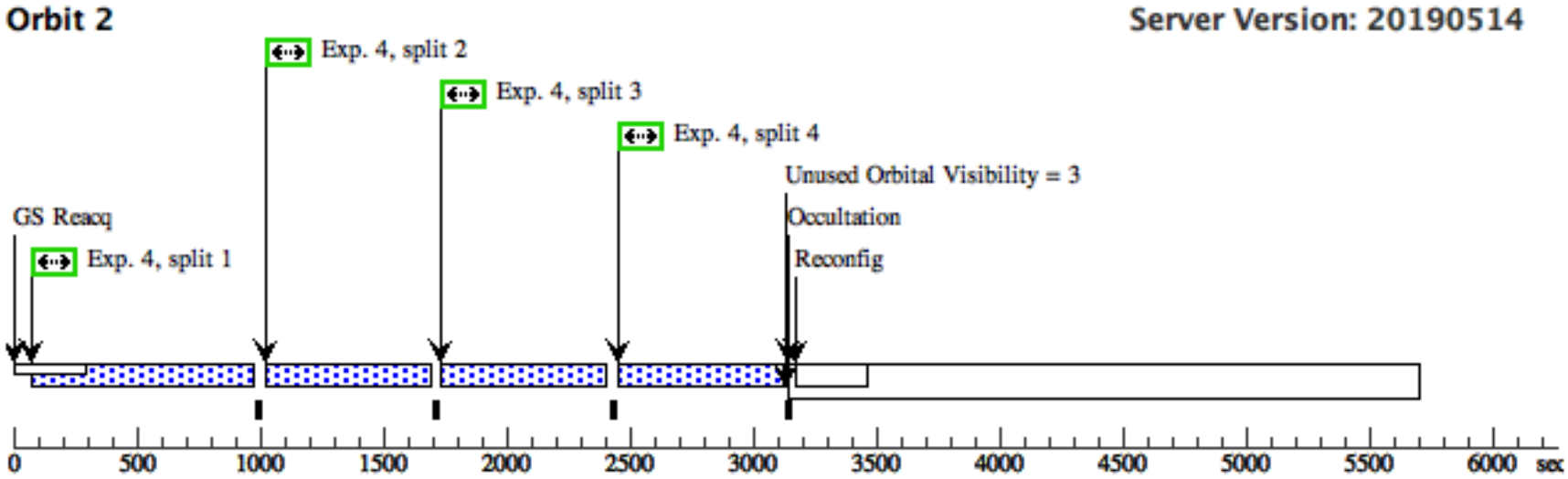
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

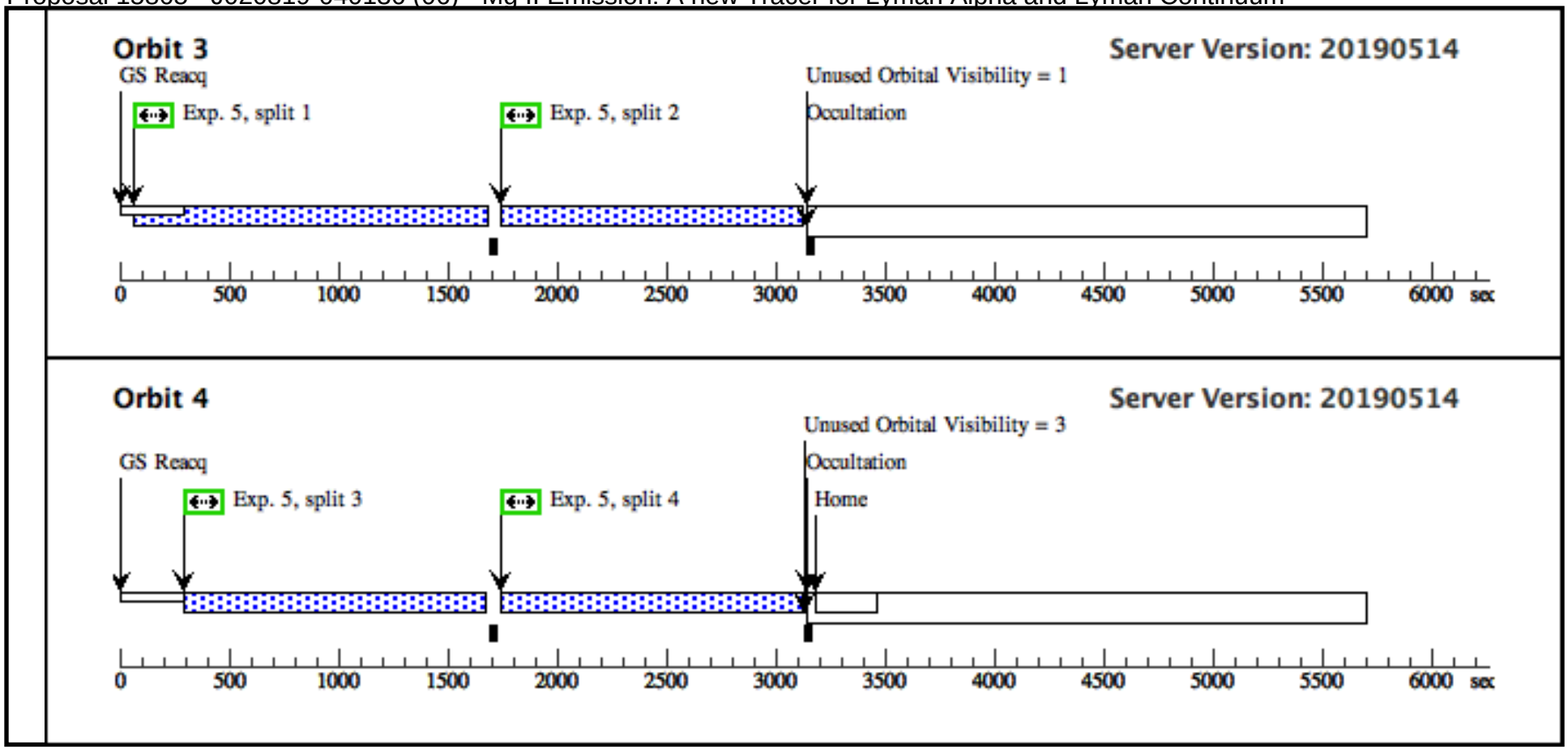
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366704)	(6) J020819-040136	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				185 Secs (185 Secs) *[==>]*	*[1]*
2	G140L/800/1 (COS.sp.1366721)	(6) J020819-040136	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=1; BUFFER-TIME=9187			954 Secs (963 Secs) *[==>963.0 Secs]*	*[1]*
3	G140L/800/2 (COS.sp.1366721)	(6) J020819-040136	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=2; BUFFER-TIME=9187			958 Secs (967 Secs) *[==>967.0 Secs]*	*[1]*
4	G160M/1600 (COS.sp.1366707)	(6) J020819-040136	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20742; FP-POS=ALL			593 Secs (2456 Secs) *[==>614.0 Secs (Split 1)]* *[==>614.0 Secs (Split 2)]* *[==>614.0 Secs (Split 3)]* *[==>614.0 Secs (Split 4)]*	*[2]*
5	G140L/800 (COS.sp.1366721)	(6) J020819-040136	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9187			1329 Secs (5316 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[3]* *[4]*

Orbit Structure






Orbit 3
Server Version: 20190514
GS Reacq
Exp. 5, split 1
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Occultation
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3500
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4500
5000
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sec
Orbit 4
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GS Reacq
Occultation
Exp. 5, split 3
Exp. 5, split 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15865, J010534+234960 (07), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

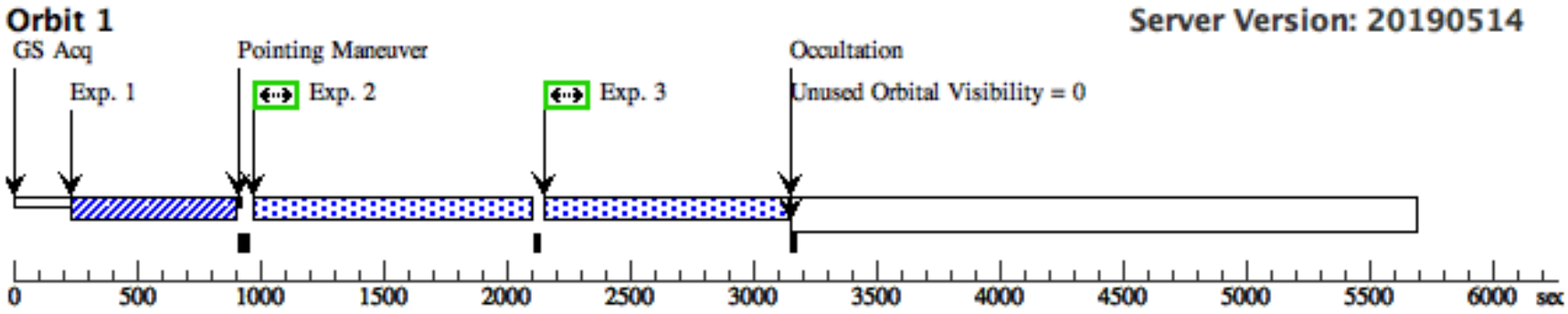
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	J010534+234960	RA: 01 05 33.7361 (16.3905671d) Dec: +23 49 59.71 (23.83325d) Equinox: J2000	Redshift: 0.338207	V=21.0 FUV 21.9, NUV = 21.5	Reference Frame: ICRS

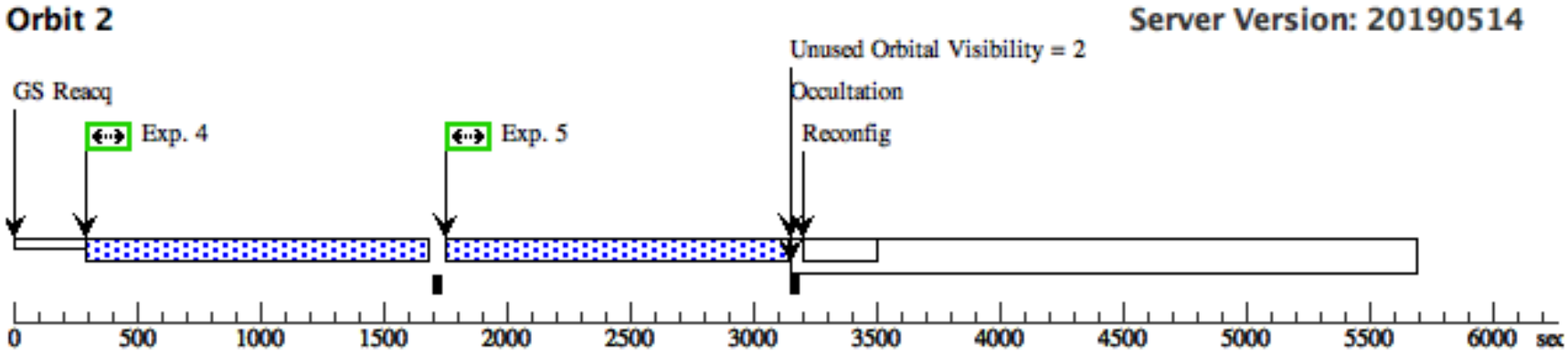
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

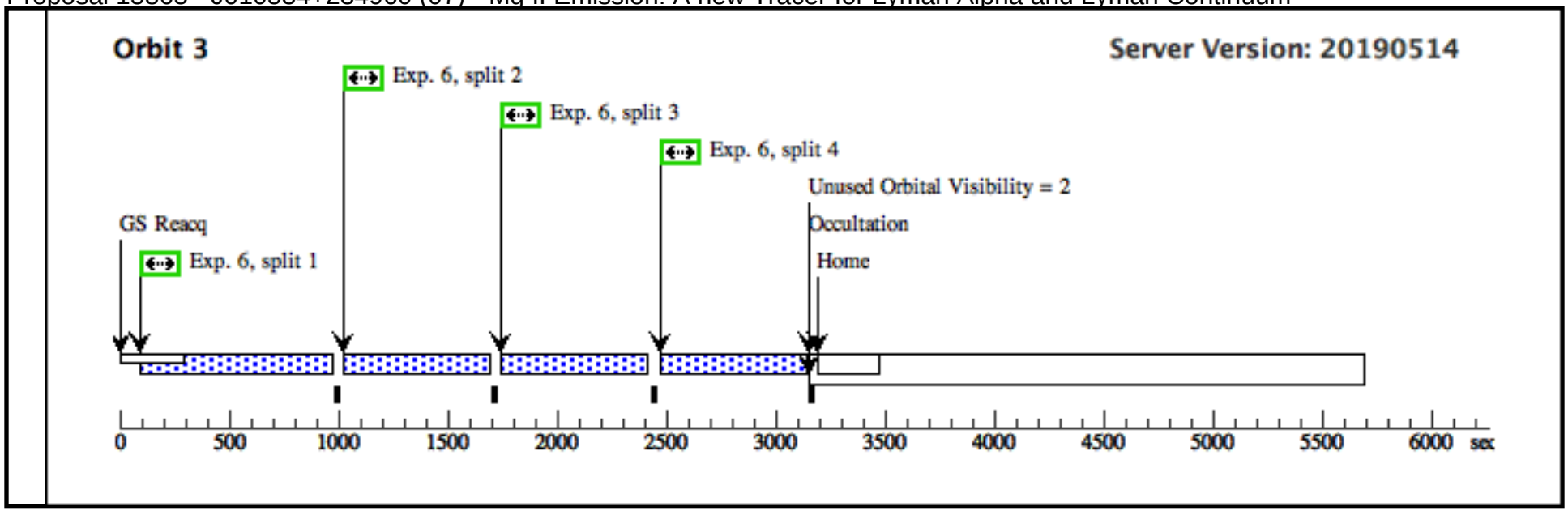
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366705)	(7) J010534+234960	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				224 Secs (224 Secs) *[==>]*	*[1]*
2	G140L/800/1 (COS.sp.1366722)	(7) J010534+234960	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=1; BUFFER-TIME=9173			924 Secs (934 Secs) *[==>934.0 Secs]*	*[1]*
3	G140L/800/2 (COS.sp.1366722)	(7) J010534+234960	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=2; BUFFER-TIME=9173			924 Secs (934 Secs) *[==>934.0 Secs]*	*[1]*
4	G140L/800/3 (COS.sp.1366722)	(7) J010534+234960	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=3; BUFFER-TIME=9173			1337 Secs (1337 Secs) *[==>]*	*[2]*
5	G140L/800/4 (COS.sp.1366722)	(7) J010534+234960	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=4; BUFFER-TIME=9173			1337 Secs (1337 Secs) *[==>]*	*[2]*
6	G160M/1533 (COS.sp.1366713)	(7) J010534+234960	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=20701; FP-POS=ALL			596 Secs (2472 Secs) *[==>618.0 Secs (Split 1)]* *[==>618.0 Secs (Split 2)]* *[==>618.0 Secs (Split 3)]* *[==>618.0 Secs (Split 4)]*	*[3]*

Orbit Structure






Orbit 3
Server Version: 20190514
Exp. 6, split 2
Exp. 6, split 3
Exp. 6, split 4
Unused Orbital Visibility = 2
GS Reacq
Occultation
Exp. 6, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15865, J142535+524902 (08), implementation Thu Oct 03 20:00:31 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

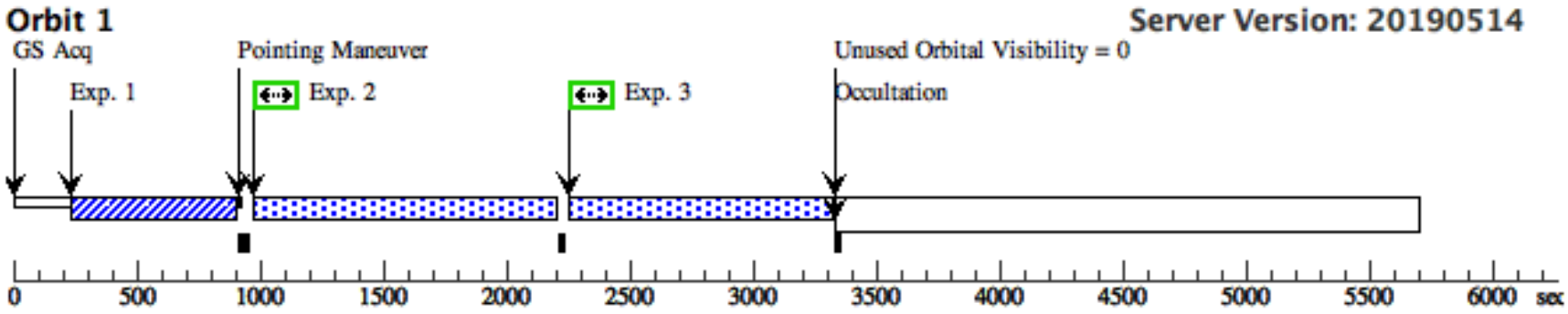
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(8)	J142535+524902	RA: 14 25 35.1090 (216.3962875d) Dec: +52 49 2.21 (52.81728d) Equinox: J2000	Redshift: 0.387000	V=21.6 FUV = 21.9, NUV = 21.5	Reference Frame: ICRS

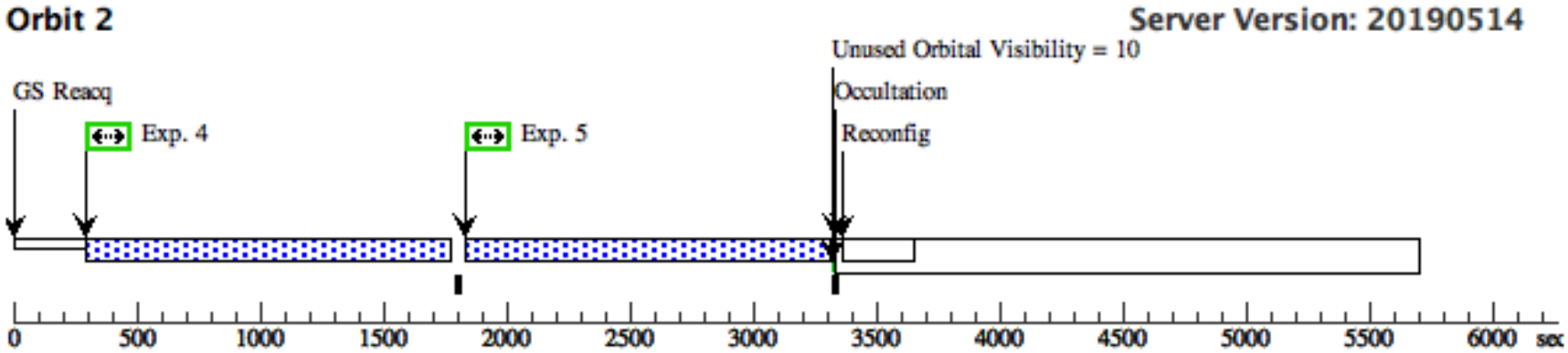
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STARBURST]
Extended=NO

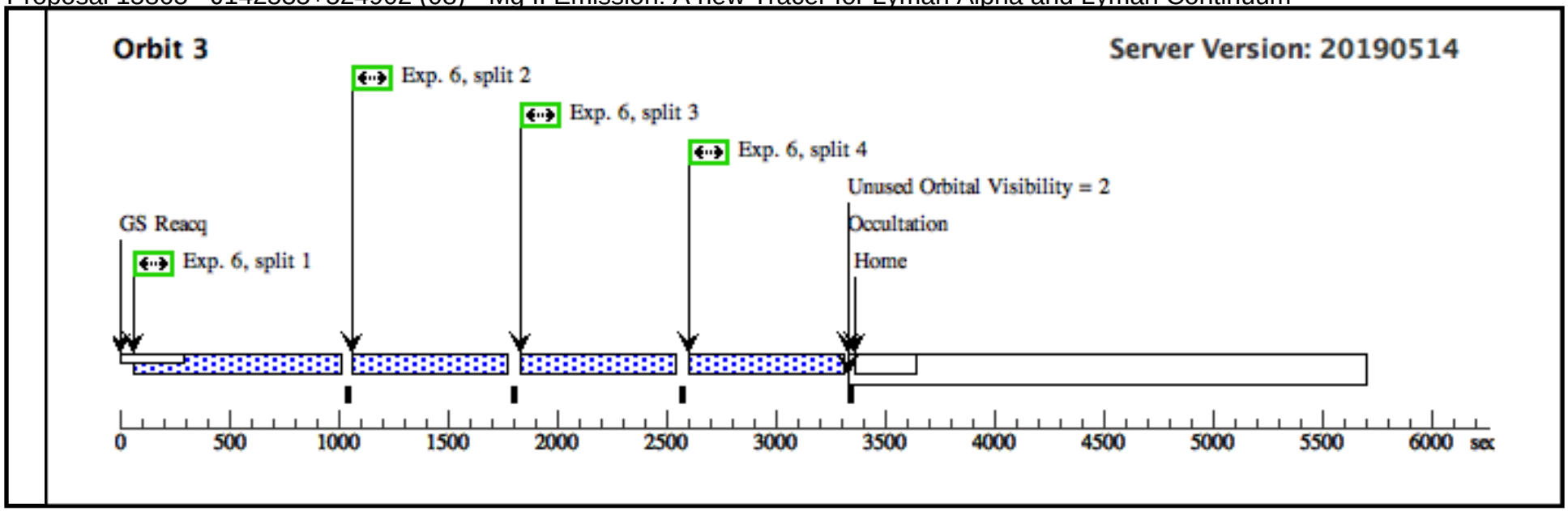
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/IM (COS.ta.1366705)	(8) J142535+524902	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				224 Secs (224 Secs) *[==>]*	*[1]*
2	G160M/1600/1 (COS.sp.1366714)	(8) J142535+524902	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20910; FP-POS=1			1008 Secs (1014 Secs) *[==>1014.0 Secs]*	*[1]*
3	G160M/1600/2 (COS.sp.1366714)	(8) J142535+524902	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20910; FP-POS=2			1008 Secs (1014 Secs) *[==>1014.0 Secs]*	*[1]*
4	G160M/1600/3 (COS.sp.1366714)	(8) J142535+524902	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20910; FP-POS=3			1426 Secs (1426 Secs) *[==>]*	*[2]*
5	G160M/1600/4 (COS.sp.1366714)	(8) J142535+524902	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20910; FP-POS=4			1426 Secs (1426 Secs) *[==>]*	*[2]*
6	G140L/800 (COS.sp.1366723)	(8) J142535+524902	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=9179			640 Secs (2648 Secs) *[==>662.0 Secs (Split 1)]* *[==>662.0 Secs (Split 2)]* *[==>662.0 Secs (Split 3)]* *[==>662.0 Secs (Split 4)]*	*[3]*

Orbit Structure






Orbit 3
Server Version: 20190514
Exp. 6, split 2
Exp. 6, split 3
Exp. 6, split 4
Unused Orbital Visibility = 2
GS Reacq
Occultation
Exp. 6, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec