15433 - The first UV emission line spectrum of a strong low-z Lyman continuum leaker - a key to studying the sources of cosmic reionization

Cycle: 25, Proposal Category: GO

(UV Initiative)

(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) J1154+2443	STIS/CCD STIS/NUV-MAMA	4	19-Jun-2018 12:10:33.0	yes
02	(1) J1154+2443	STIS/CCD STIS/NUV-MAMA	4	19-Jun-2018 12:10:36.0	yes
52	(1) J1154+2443	STIS/CCD STIS/NUV-MAMA	4	19-Jun-2018 12:10:38.0	yes

12 Total Orbits Used

ABSTRACT

Few UV templates of low-z star-forming galaxies covering all major UV emission lines between 1200 and 2000 Ang (i.e. Lyman-alpha, HeII, CIV, CIII], OIII], and others) exist and most importantly none for galaxies with known Lyman continuum (LyC) leakage. Selecting for high [OIII]/[OII]>4 optical line ratios and compactness, our team has recently achieved a breakthrough in the identification of Lyman continuum leaking galaxies with high escape fraction (fesc=6-13%), which currently represent the best analogs of the sources of cosmic reionization.

In recent (20-21 july 2017) COS/HST observations we discovered a new LyC leaker showing very strong Lyman continuum flux, with an escape fraction fesc=46+-3%, the highest LyC escape fractions observed so far in low-z galaxies. We here request STIS spectroscopy of this unique source to measure the complete UV spectrum, including all of the above UV lines.

The proposed observations will provide for the first time an empirical UV emission line spectrum of Lyman continuum leakers, which are rare at low redshift but whose properties are very similar to those of common high-z star-forming galaxies. Obtaining rest-UV spectra of Lyman continuum leakers, currently the best analogs of the sources of cosmic reionization, is both crucial and urgent for upcoming studies with the JWST and the largest ground-based facilities.

OBSERVING DESCRIPTION

So far, we have observed the Lyman continuum and the Ly-alpha line with COS, using the G140L and G160M grisms in the FUV channel, which is in practice limited to wavelengths shorter than 2000 A. At z > 0.3 the UV lines of interest here (primarily C iv 1550, He ii 1640, O iii] 1661,1666, C iii] 1907,1909) are at 2000-2600 A, a range which is in principle observable with the NUV channel of COS or with STIS. STIS observations are preferred for this spectral range, since the NUV channel of COS is not well calibrated, STIS is more sensitive in the 1700-3200 A domain, and has no spectral gaps. Our goal is to obtain spatially integrated flux measurements for the emission lines. A low spectral resolution is thus sufficient. The G230L (MAMA) has a higher throughput than the G230LB (CCD) at < 2250. Since most lines (C iv 1550, He ii 1640, O iii]1661,1666) are at observed wavelengths 2000-2160 A and C iii] 1907,1909 is likely the strongest, we prefer G230L (MAMA). Our objects are very compact (by selection), both from ground-based imaging (SDSS) and from the COS FUV acquisition images, where the objects show UV surface brightness profiles with exponential scale heights of 0.6-1.4 kpc, corresponding to 0.13-0.32 arcsec. Observations with the 0.5 arcsec slit will thus capture most of the emission line flux, even if it was somewhat more extended than the UV continuum. The wider slit (2 arcsec) is not optimal because it would degrade the spectral resolution and reduce the contrast of narrow nebular lines against the continuum, making them harder to detect. The exposure time was determined to reach a S/N=3 for weak lines of EWrest=1 A to place also strong constraints on the emission lines in case of non-detection. C

iii] 1908 equivalent widths of 5-15 A are not uncommon in normal star-forming galaxies with low metallicities. The other targetted lines (C iv 1550, He ii 1640, and O iii] 1666) are normally considerably weaker. We used the STIS ETC using the known continuum flux (from COS spectra and/or GALEX photometry) at 2000 A rest-frame. We adopted the extended object option with 0.5 arcsec in diameter. The required time corresponds to 8 orbits. The observations will be split into two visits, 4 orbits each. Our object is sufficiently bright and compact for standard target acquisition with short overheads.

Visit

Proposal 15433, J1154+2443visit1 (01), completed Tue Jun 19 16:10:39 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: (none)

Fixed Targets

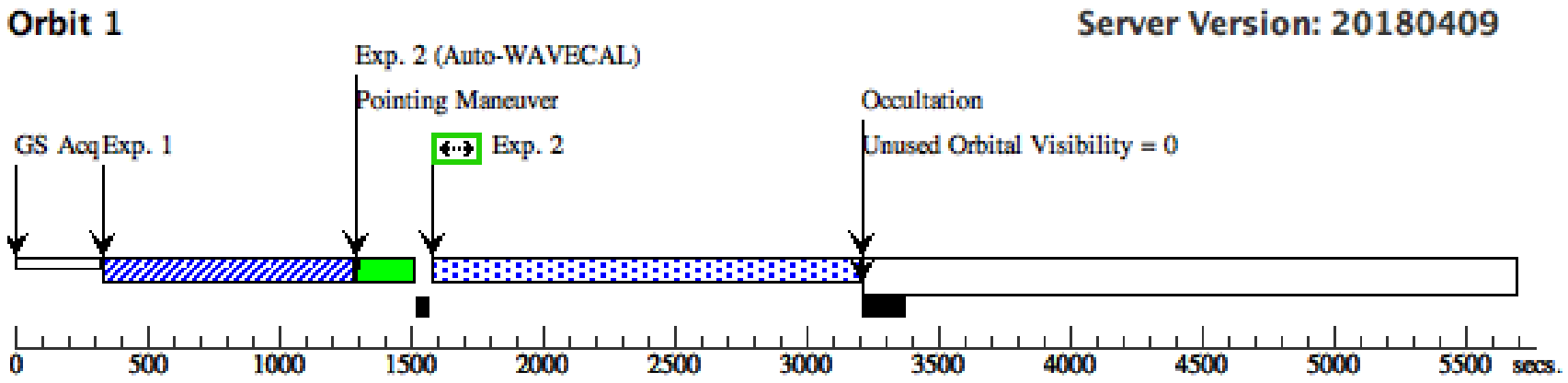
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J1154+2443	RA: 11 54 48.8500 (178.7035417d) Dec: +24 43 33.02 (24.72584d) Equinox: J2000	Proper Motion RA: 0.0 Proper Motion Dec: 0.0 Epoch of Position: 2000 Redshift: 0.369	V=21.77+/-0.05 FUV=22.10+/-0.26, NUV=21.57+/-0.24, acq=870s, spectrum=23000s, http://etc.stsci.edu/etc/results/STIS.sp.1026387	Reference Frame: ICRS

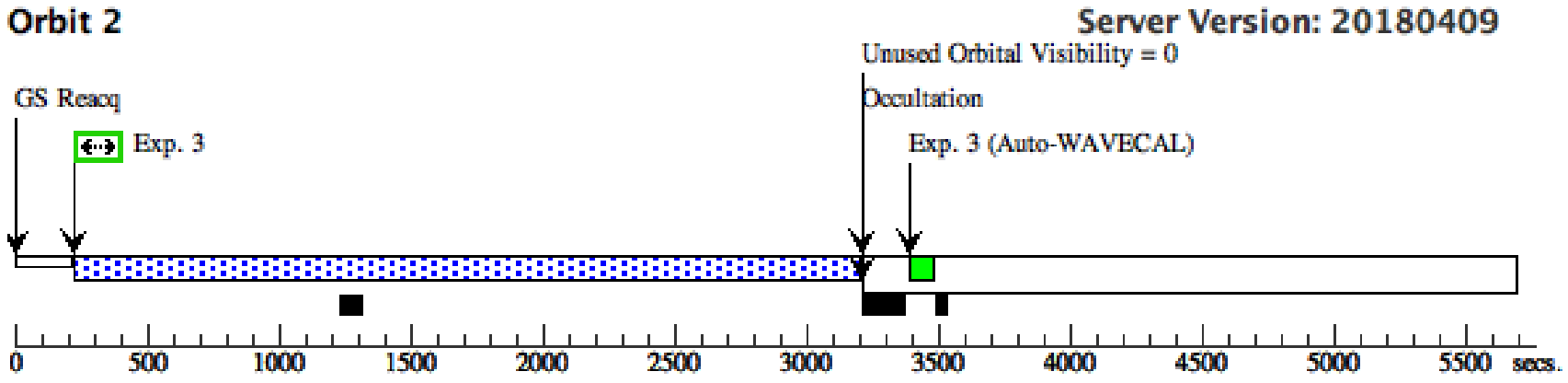
Comments:
Category=GALAXY
Description=[DWARF COMPACT, EMISSION LINE NEBULA, STARBURST]
Extended=NO

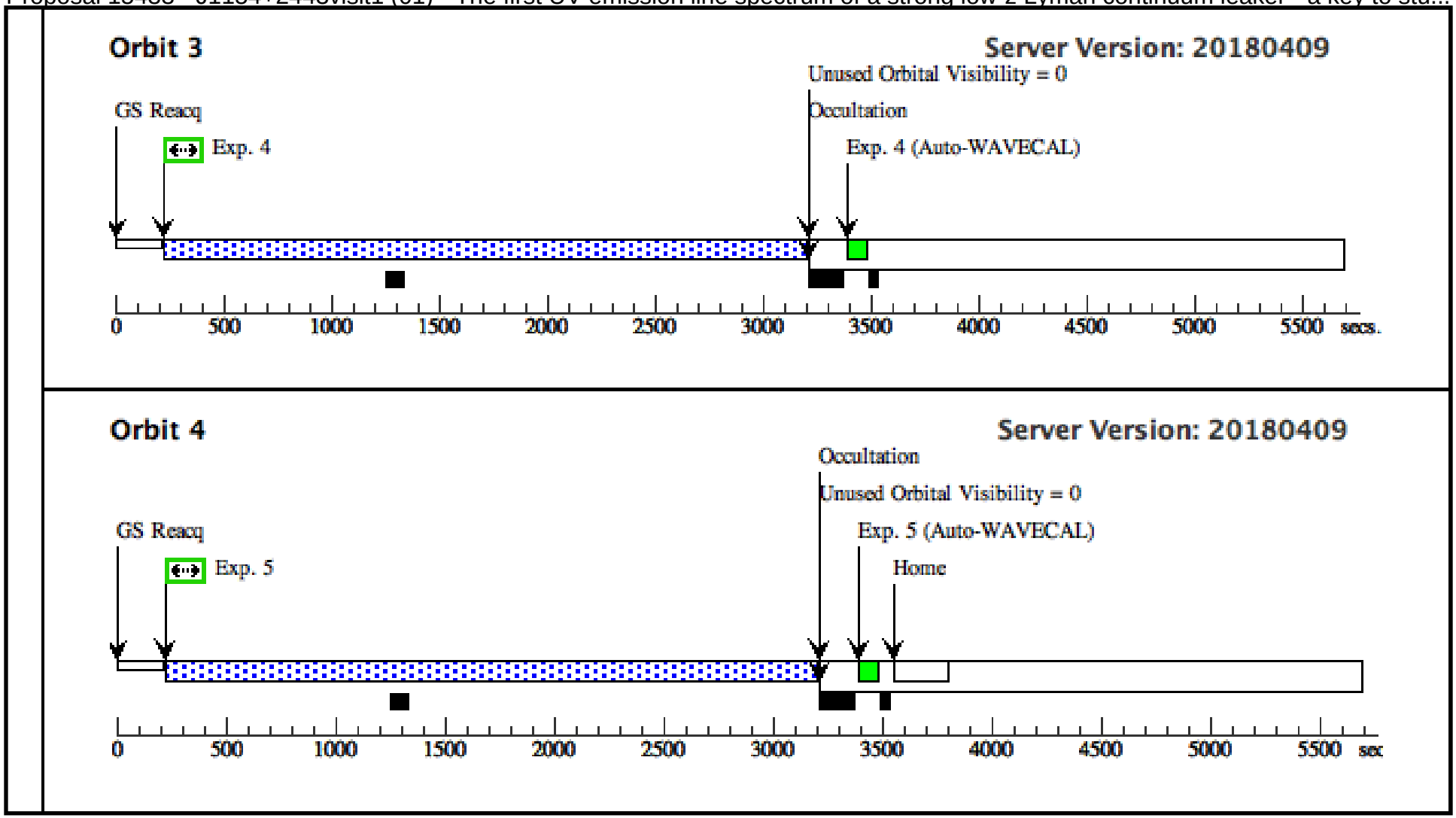
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J1154+2443 acq1 (STIS.ta.1036172)	(1) J1154+2443	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			180 Secs (180 Secs) *[==>]*	*[1]*
2	J1154+2443 NUV1 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (1579 Secs) *[==>1579.0 Secs]*	*[1]*
3	J1154+2443 NUV2 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2967 Secs) *[==>2967.0 Secs]*	*[2]*
4	J1154+2443 NUV3 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[3]*
5	J1154+2443 NUV4 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[4]*

Orbit Structure



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Visit

Proposal 15433, J1154+2443visit2 (02), failed Tue Jun 19 16:10:39 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: SAME ORIENT AS 01

Comments: Same orientation as in visit J1154+2443visit1.

Fixed Targets

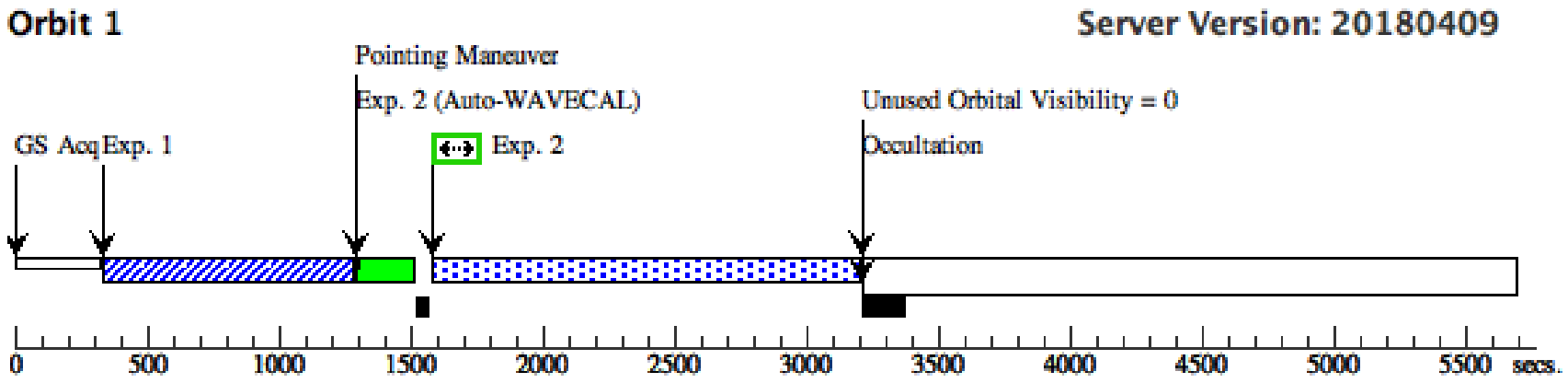
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J1154+2443	RA: 11 54 48.8500 (178.7035417d) Dec: +24 43 33.02 (24.72584d) Equinox: J2000	Proper Motion RA: 0.0 Proper Motion Dec: 0.0 Epoch of Position: 2000 Redshift: 0.369	V=21.77+/-0.05 FUV=22.10+/-0.26, NUV=21.57+/-0.24, acq=870s, spectrum=23000s, http://etc.stsci.edu/etc/results/STIS.sp.1026387	Reference Frame: ICRS

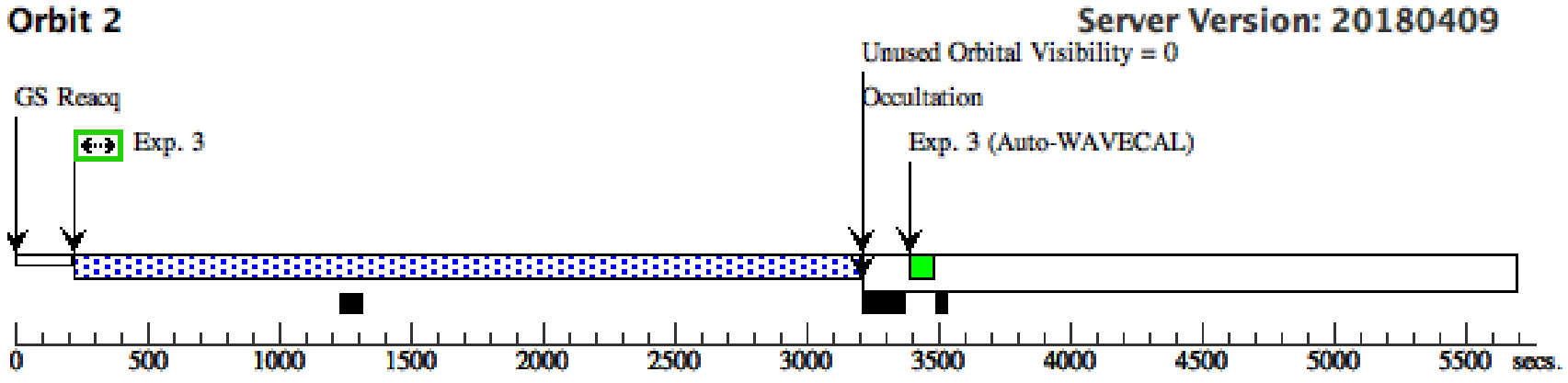
Comments:
Category=GALAXY
Description=[DWARF COMPACT, EMISSION LINE NEBULA, STARBURST]
Extended=NO

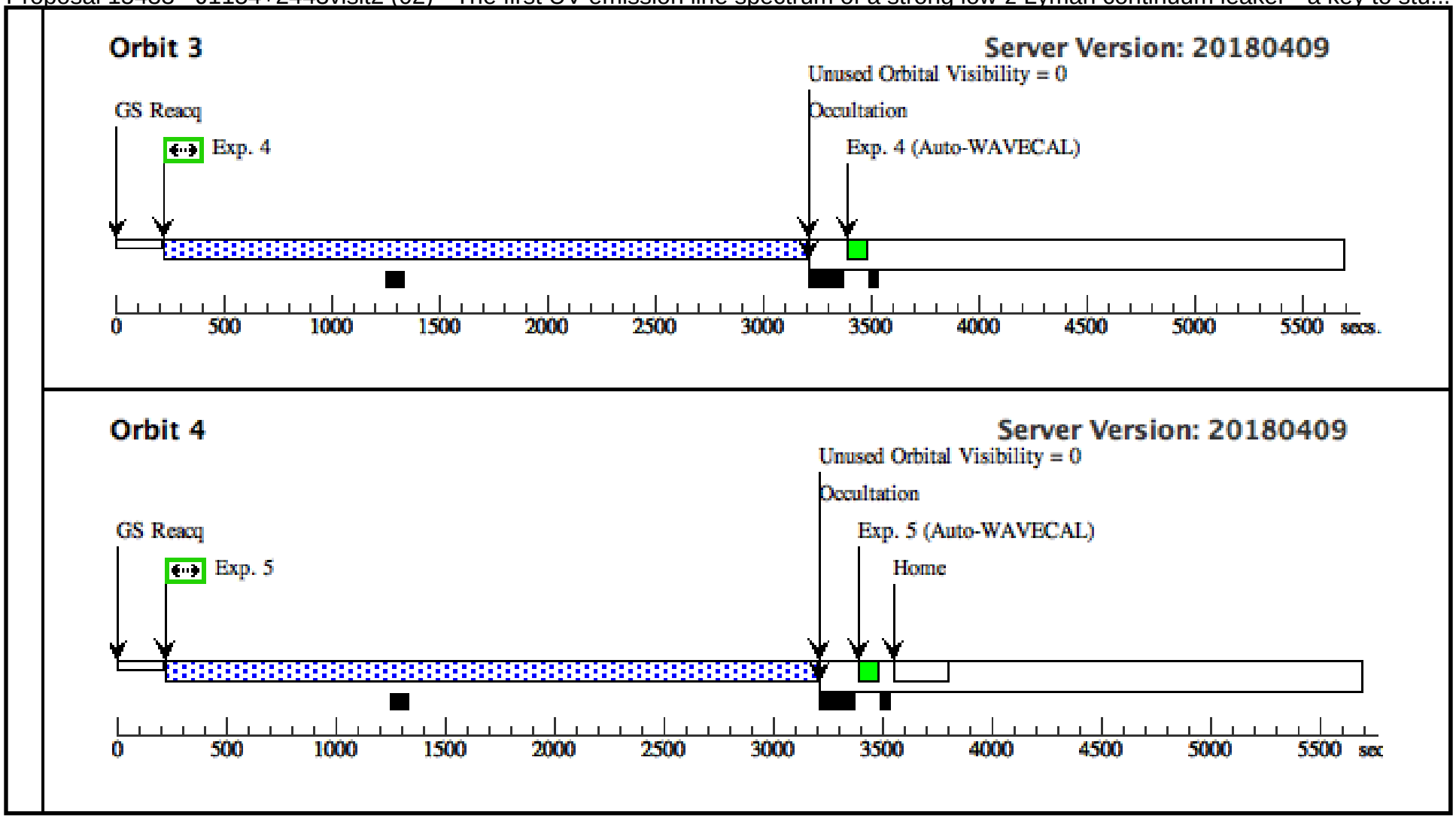
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J1154+2443 acq2 (STIS.ta.1036172)	(1) J1154+2443	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			180 Secs (180 Secs) *[==>]*	*[1]*
2	J1154+2443 NUV1 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (1579 Secs) *[==>1579.0 Secs]*	*[1]*
3	J1154+2443 NUV2 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2967 Secs) *[==>2967.0 Secs]*	*[2]*
4	J1154+2443 NUV3 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[3]*
5	J1154+2443 NUV4 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[4]*

Orbit Structure



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Occultation
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Exp. 5
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Visit

Proposal 15433, J1154+2443visit2 (52) Tue Jun 19 16:10:39 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: (none)

Comments: Duplicate of failed visit 02

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J1154+2443	RA: 11 54 48.8500 (178.7035417d) Dec: +24 43 33.02 (24.72584d) Equinox: J2000	Proper Motion RA: 0.0 Proper Motion Dec: 0.0 Epoch of Position: 2000 Redshift: 0.369	V=21.77+/-0.05 FUV=22.10+/-0.26, NUV=21.57+/-0.24, acq=870s, spectrum=23000s, http://etc.stsci.edu/etc/results/STIS.sp.1026387	Reference Frame: ICRS

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
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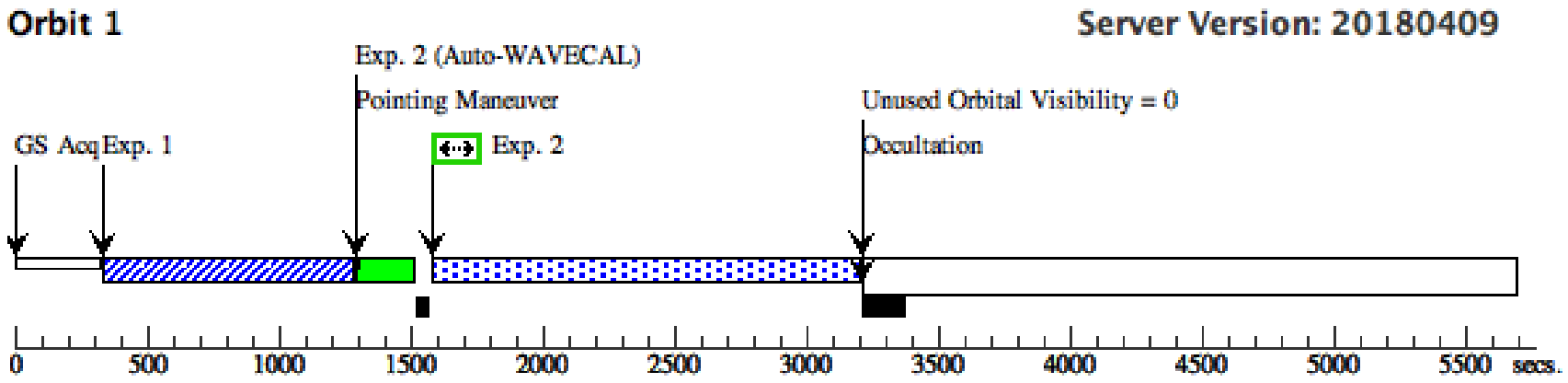
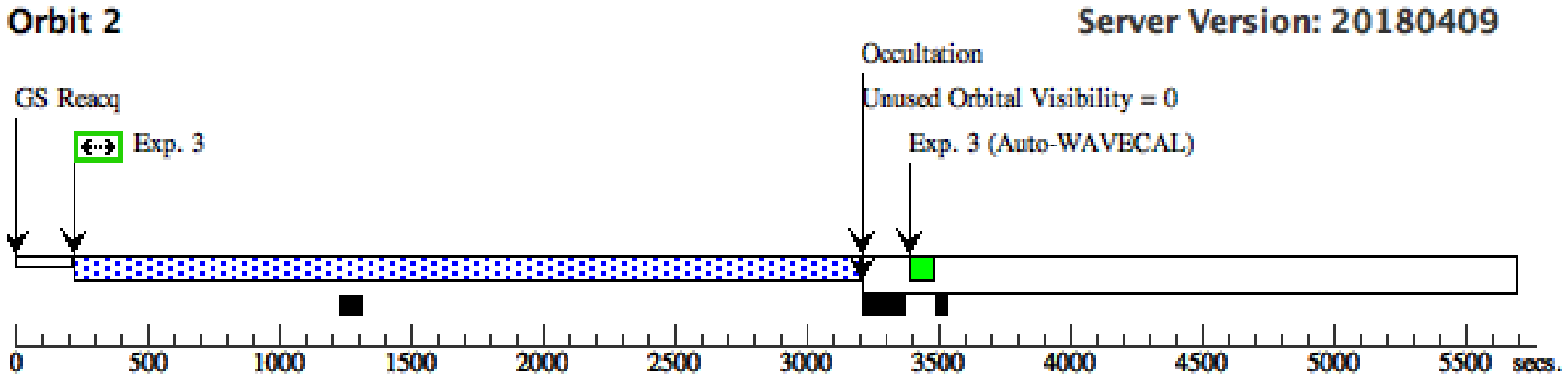
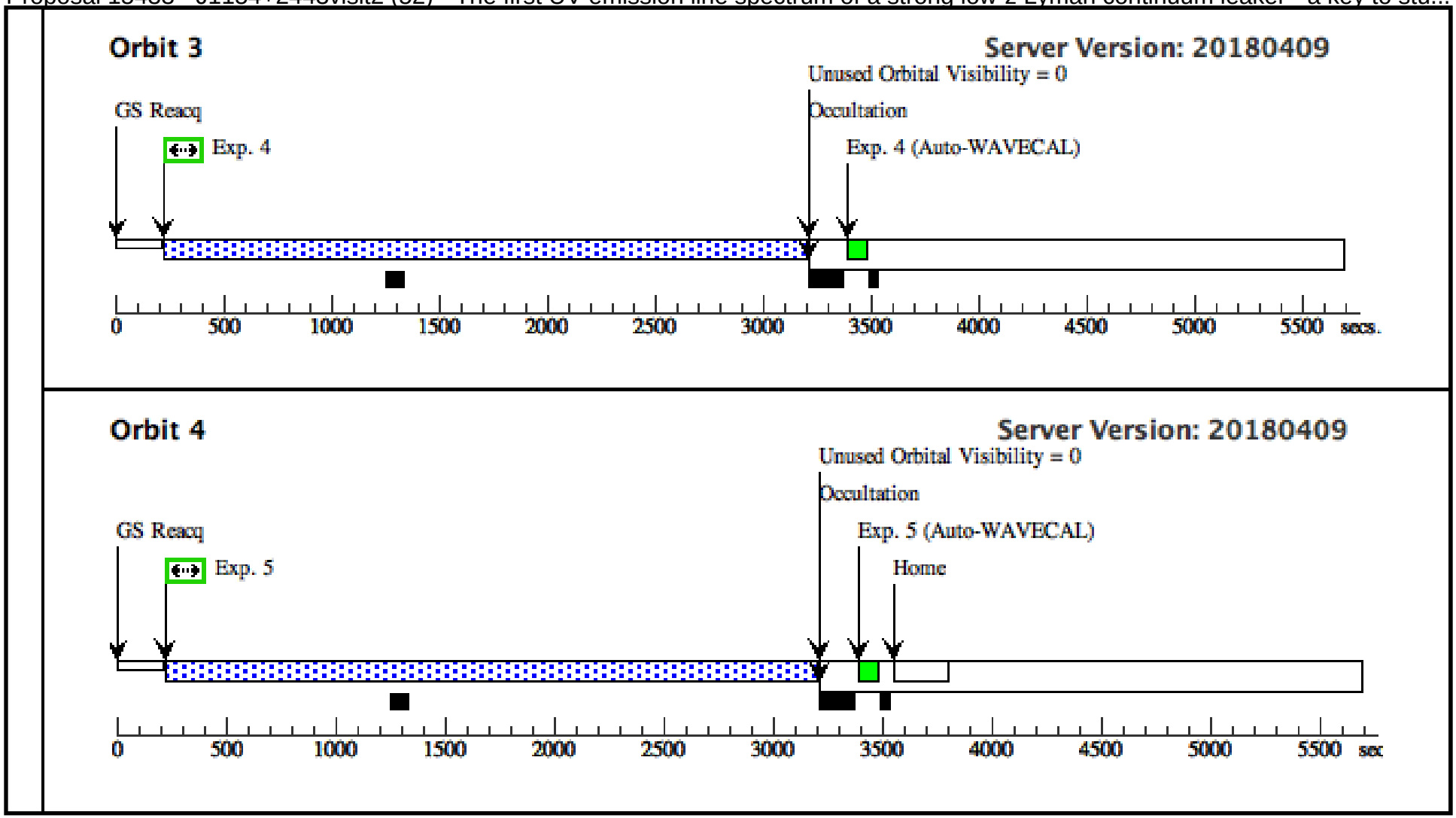
2	J1154+2443 NUV1 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (1579 Secs) *[==>1579.0 Secs]*	*[1]*
3	J1154+2443 NUV2 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2967 Secs) *[==>2967.0 Secs]*	*[2]*
4	J1154+2443 NUV3 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[3]*
5	J1154+2443 NUV4 (STIS.sp.1026387)	(1) J1154+2443	STIS/NUV-MAMA, TIME-TAG, 52X0.5	G230L 2376 A	BUFFER-TIME=1014.0			2300.0 Secs (2944 Secs) *[==>2944.0 Secs]*	*[4]*

Orbit Structure



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