



13800 - Heavy-metal, extreme chemistry and puzzling pulsation: ultraviolet clues to the formation of hot subdwarfs

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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	(3) TYC-5331-1560-1	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	1	20-Jan-2015 15:53:12.0	yes
02	(2) TYC-1954-398-1	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	20-Jan-2015 15:53:14.0	yes
03	(1) ALS-11634	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	4	20-Jan-2015 15:53:19.0	yes

7 Total Orbits Used

ABSTRACT

Subdwarf B stars are low-mass core-helium burning stars with a very thin hydrogen envelope; in most cases, surface helium and light elements are depleted, heavy elements are enhanced by a factor ten. It is argued that normal He-poor sdB stars evolve from giants which have been stripped almost to the core to reveal helium-enriched material. As the star ignites helium and contracts to the extreme horizontal branch, radiative processes re-stratify the internal chemistry of the atmosphere and the helium sinks. When does this happen, how long does it take, and what does it look like? A small number of sdB stars have intermediate helium abundances (He-sdB) and a few have extraordinary surface compositions. The pulsating "zirconium" star LS IV-14 116 shows a four dex overabundance of zirconium, yttrium and strontium. Two other He-sdBs show a four dex overabundance of lead. Such stars are almost completely unexplored in the space ultraviolet.

We will observe the ultraviolet spectrum of LS IV-14 116 and two other chemically peculiar hot subdwarfs in order to determine:

- (a) the impact of extraordinary composition on their overall flux distribution and hence on measurements of their effective temperatures,
- (b) the degree of stratification in the atmosphere (how thick is the enhanced layer?), and
- (c) the abundances of species not observable in the visible.
- (d) the ultraviolet lightcurve due to the principle pulsation modes of LS IV-14 116.

The observations will allow us to explore the processes that lead to heavily stratified atmospheres and to the transformation of red giants with helium-enriched surface into horizontal-branch stars with helium-poor surfaces.

OBSERVING DESCRIPTION

1. Description of Observations.

We require wide spectral coverage observations of ALS-11634 (LS IV-14 116), PG 0909+276 and [CW83] 0512-08, in the NUV and FUV at a spectral resolution sufficient to resolve narrow lines in crowded spectral regions. A S/N ratio better than 30 at a spectral resolution 30000 is normally required to establish chemical abundances with confidence.

The required data are provided by the medium-resolution echelle E230M and E140M gratings centered at 1978 Å and 1425 Å to cover the wavelength ranges 1700-2370 Å and 1160-1730 Å respectively.

We also require time-resolved FUV spectroscopy of ALS-11634 (LS IV-14 116) in order to measure the flux variation due to the principal pulsation

Proposal 13800 (STScI Edit Number: 1, Created: Tuesday, January 20, 2015 3:53:22 PM EST) - Overview

mode ($P = 1957$ s). The pulsation amplitude is 0.27% in white light (22), and is expected to be more than this in the FUV by a factor of a few, so we require $< 0.1\%$ photometric precision with a time resolution better than $10/P$, i.e. $t_{exp} \sim 180$ s. Photometric precision can be achieved by a combination of binning over wavelength and/or phase.

FUV times-series spectroscopy will also be obtained with the medium-resolution echelle and E140M grism centered at 1425 Å, using repeated 180 s exposures.

The observations will be obtained on 3 visits comprising a total of 7 orbits as allocated.

Visit 1: 1 Orbit: TYC-5331-1560-1 = CW 0512-08 to acquire both NUV and FUV spectra in the same orbit.

Visit 2: 2 Orbits: TYC-1954-398-1 = PG 0909+276 to acquire both NUV and FUV spectra, one in each orbit.

Visit 3: 4 Orbits: ALS-11364 = LS IV -14 116 to acquire the mean NUV spectrum (one orbit) and time-resolved exposures of the FUV spectrum (three orbits).

2, Justification of Real-time Observations and Special Scheduling

We have no real-time or special scheduling requirements. We will endeavour to obtain simultaneous, or near-simultaneous ground-based observations for Visit 3 if the likely schedule is known sufficiently well in advance.

3. Justification of Special Calibration Requirements

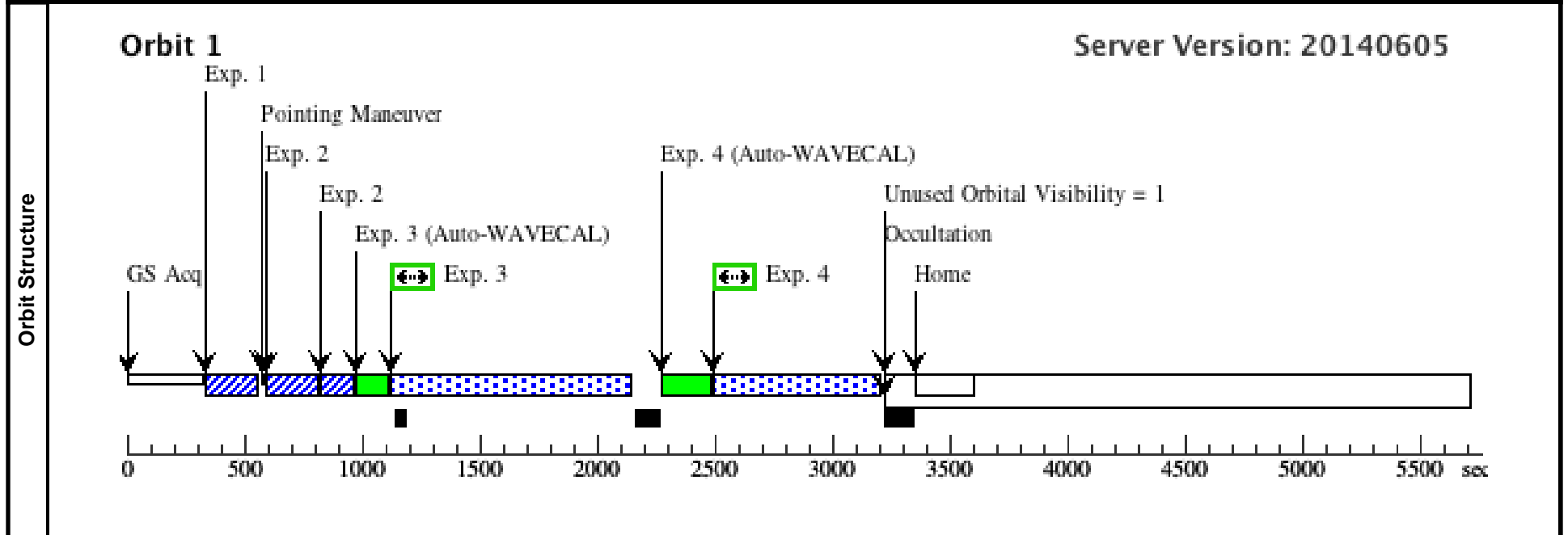
No special calibrations are required, except that for the repeated FUV spectra of LS IV -14 116 we ask that WAVECAL exposures are carried out during the Earth Occultation periods in order to maximise on-target exposure times.

4. Additional Comments

Visit	Proposal 13800, TYC-5331-1560-1 = CW 0512-08 (01), implementation				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA, STIS/NUV-MAMA				
	Special Requirements: (none)				

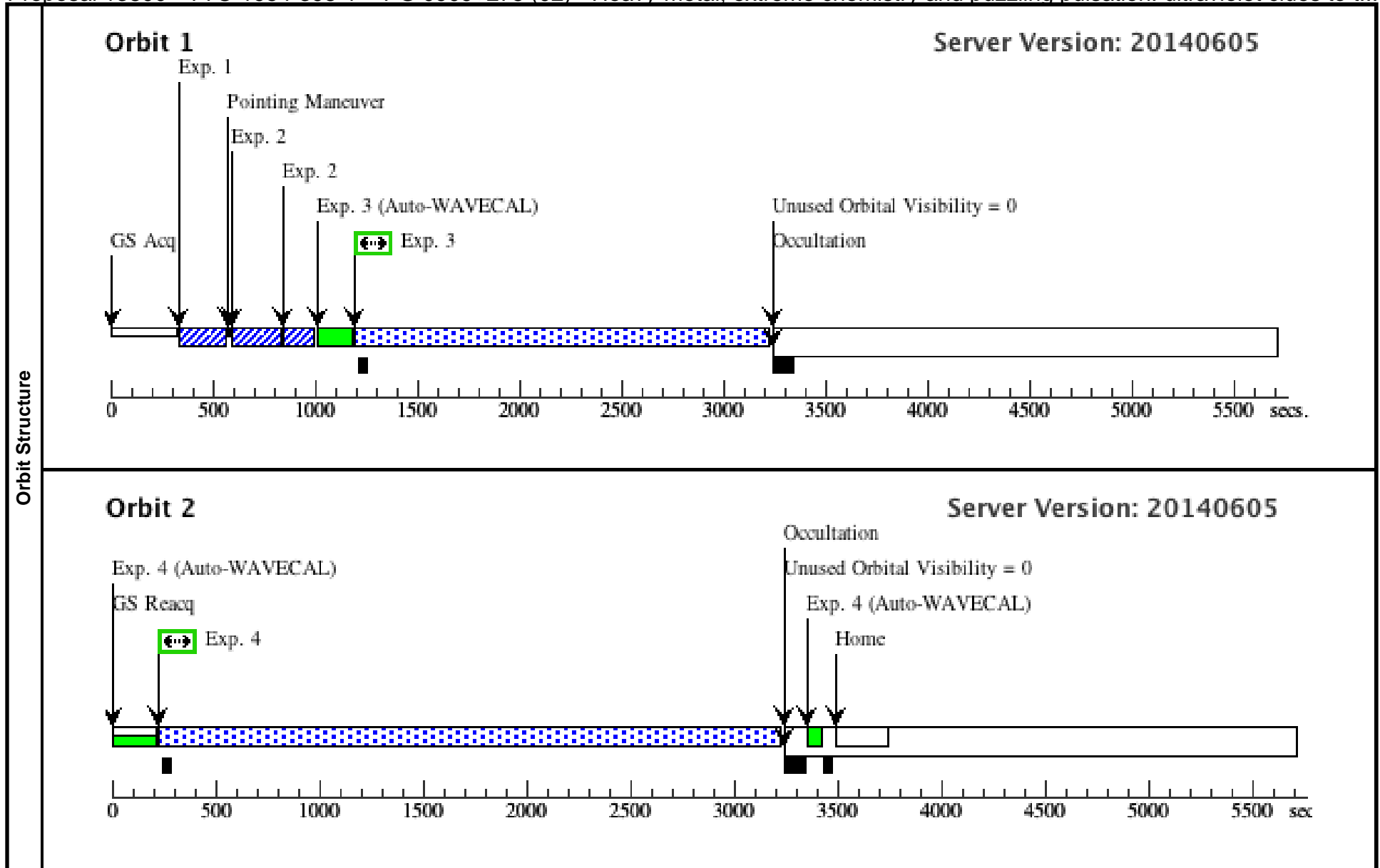
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(3)	TYC-5331-1560-1	RA: 05 14 43.9700 (78.6832083d) Dec: -08 48 6.00 (-8.80167d) Equinox: J2000		V=11.34	Reference Frame: ICRS
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	TYC-5331: ACQ (STIS.ta.621 800)	(3) TYC-5331-1560-1	STIS/CCD, ACQ, F28X50LP	MIRROR					0.1 Secs (0.1 Secs) [==>]	[1]
	2	TYC-5331: ACQ/PEAK (STIS.ta.621 799)	(3) TYC-5331-1560-1	STIS/CCD, ACQ/PEAK, 0.2X0.06	MIRROR					0.1 Secs (0.1 Secs) [==>]	[1]
	3	TYC-5331: FUV (STIS.sp.62 1851)	(3) TYC-5331-1560-1	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A					1000 Secs (1006 Secs) [==>1006.0 Secs]	[1]
	4	TYC-5331: NUV (STIS.sp.62 1853)	(3) TYC-5331-1560-1	STIS/NUV-MAMA, ACCUM, 0.2X0.06	E230M 2124 A					690 Secs (696 Secs) [==>696.0 Secs]	[1]



Proposal 13800 - TYC-1954-398-1 = PG 0909+275 (02) - Heavy-metal, extreme chemistry and puzzling pulsation: ultraviolet clues to t...

Visit	Proposal 13800, TYC-1954-398-1 = PG 0909+275 (02), implementation Tue Jan 20 20:53:22 GMT 2015 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: (none)									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	TYC-1954-398-1	RA: 09 12 51.6620 (138.2152583d) Dec: +27 20 31.43 (27.34206d) Equinox: J2000		V=12.1	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	TYC-1954: ACQ (STIS.ta.621 825)	(2) TYC-1954-398-1	STIS/CCD, ACQ, F28X50LP	MIRROR				1 Secs (1 Secs) [==>]	[1]
	2	TYC-1954: ACQ/PEAK (STIS.ta.621 829)	(2) TYC-1954-398-1	STIS/CCD, ACQ/PEAK, 0.2X0.06	MIRROR				1.8 Secs (1.8 Secs) [==>]	[1]
	3	TYC-1954: NUV (STIS.sp.62 1837)	(2) TYC-1954-398-1	STIS/NUV-MAMA, ACCUM, 0.2X0.06	E230M 2124 A				2100 Secs (2019 Secs) [==>2019.0 Secs]	[1]
	4	TYC-1954: FUV (STIS.sp.62 1836)	(2) TYC-1954-398-1	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				3000 Secs (2989 Secs) [==>2989.0 Secs]	[2]

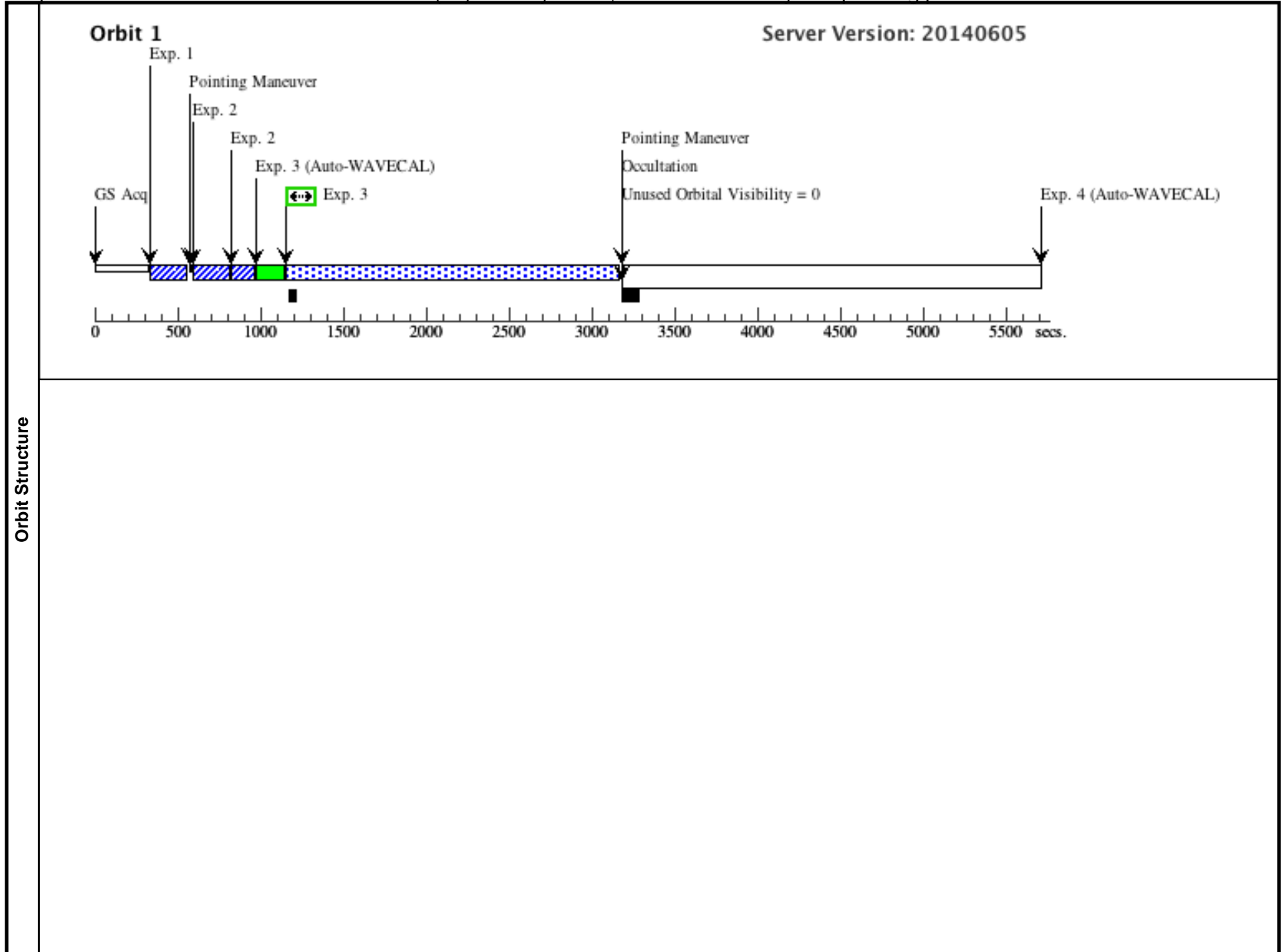


Proposal 13800 - ALS-11364 = LS IV-14 116 (03) - Heavy-metal, extreme chemistry and puzzling pulsation: ultraviolet clues to the for...

Visit	Proposal 13800, ALS-11364 = LS IV-14 116 (03), implementation Tue Jan 20 20:53:23 GMT 2015					
	Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: BETWEEN 23-AUG-2015:00:00:00 AND 28-AUG-2015:00:00:00; VISIBILITY INTERVAL 53 M					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	ALS-11634	RA: 20 57 38.8400 (314.4118333d) Dec: -14 25 41.60 (-14.42822d) Equinox: J2000		V=13.029	Reference Frame: ICRS
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

Proposal 13800 - ALS-11364 = LS IV-14 116 (03) - Heavy-metal, extreme chemistry and puzzling pulsation: ultraviolet clues to the for...

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	LS IV-14 11 6: ACQ (STIS.ta.621 858)	(1) ALS-11634	STIS/CCD, ACQ, F28X50LP	MIRROR			0.1 Secs (0.1 Secs) [==>]	[1]
	2	LS IV-14 11 6 ACQ/PEA K (STIS.ta.621 864)	(1) ALS-11634	STIS/CCD, ACQ/PEAK, 0.2X0.06	MIRROR			0.1 Secs (0.1 Secs) [==>]	[1]
	3	LS IV-14 11 6: NUV (STIS.sp.62 4208)	(1) ALS-11634	STIS/NUV-MAMA, ACCUM, 0.2X0.06	E230M 2124 A			2300 Secs (1996 Secs) [==>1996.0 Secs]	[1]



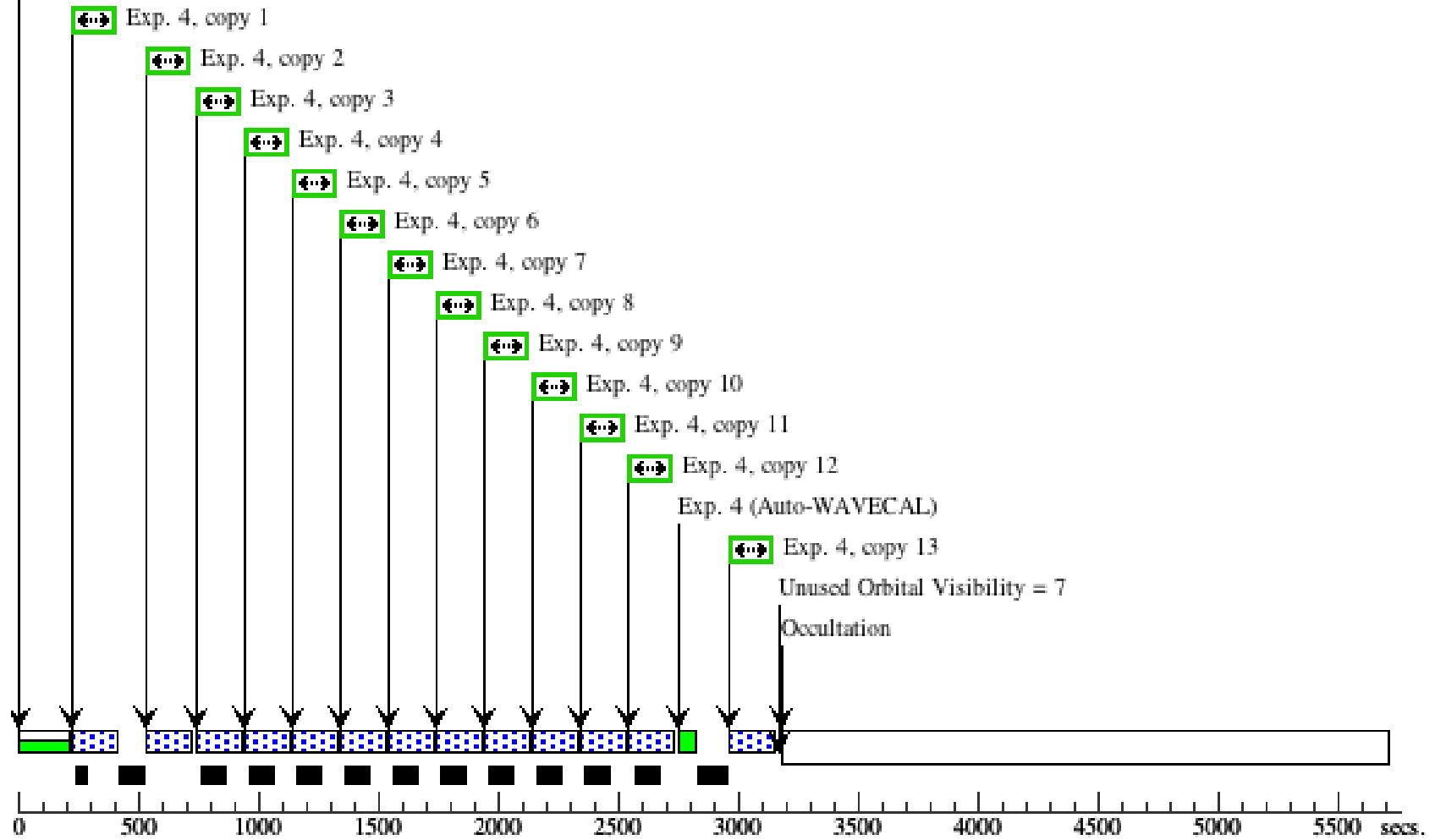
Orbit Structure

Orbit 2

Server Version: 20140605

Exp. 4 (cont'd) (Auto-WAVECAL)

GS Reacq



Orbit 3

Server Version: 20140605

GS Reacq

