



14625 - Connecting the lower and upper atmospheres of a warm-Neptune.

Implications for planetary evolution.

Cycle: 24, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

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	(1) BD+47-2936	COS/FUV COS/NUV	5	09-Nov-2016 11:27:18.0	yes
02	(1) BD+47-2936 WAVE	STIS/CCD STIS/FUV-MAMA	5	09-Nov-2016 11:27:21.0	yes

10 Total Orbits Used

ABSTRACT

The FUV transit technique specific to HST is unique at characterizing the upper atmospheres of exoplanets. Indeed, the uppermost layers of a planet orbiting close to an EUV-bright star undergo great heating, inflation and mass escape. FUV transit observations of the warm-Neptune GJ 436b have revealed an immense H I cloud with an escaping cometary tail, evidencing substantial mass loss that can significantly affect the atmospheric composition and evolution of the planet. As known to take place on hot Jupiters, the outflow of the light hydrogen-dominated escaping material can drag along heavier species. All three key atoms of H I, O I, and C II that reside in the uppermost layers have strong resonant FUV lines. Here we propose FUV transit observations of the warm-Neptune HAT-P-11b, which is the only low-mass exoplanet to have positively revealed water absorption in a relatively clear lower atmosphere, thus showing that oxygen is available in measurable amounts in its bulk atmosphere. One transit will be made with STIS/G140M and another with COS/G130M, which will measure the spatial extent as well as global velocity/energy properties in all three H I, O I, and C II atoms. With such data we can study the processes involved in the escape and space physics environment. Together with comprehensive, iterative modeling of the lower and upper atmospheres, and of the magnetosphere expected for these planets, we can gain insight into the composition and escape in the uppermost planetary regions, and into how they relate to the lower atmosphere and thus the planetary properties.

OBSERVING DESCRIPTION

We will observe two transits of HAT-P-11b, 5 HST orbits each: one with COS/G130M (1291) to sample O I and C II lines, and the other with STIS/G140M (1222) for H I Ly-alpha. For both instruments, a single time-tagged exposure will be taken during each orbit. Both visits should start with the planet around orbital phase 0.961-0.964 to observe before, during and after nominal transit. If possible, the COS visit should be the one scheduled the closest possible to opposition (near SHADOW) for minimum geocoronal O I 1304 A.

COS: COS/G130M (1291) must be used with a single FP-POS (and single CENWAVE) over the full visit. The need was stated in the Phase 1 proposal to obtain consistent zero wavelengths and line shapes of the planetary line absorption profiles. The stellar lines will not be bright enough to adequately correlate and co-add spectra of different FP-POSs (as found for archival HD 209458 COS spectra with multiple FP-POSs; Ballester & Ben-Jaffel, ApJ 2015). Single FP-POSs per visit of 2, 3, and 4 were used in our Cycle 23 GO 14090 program on HD 209458b. Here we chose FP-POS=1 to compensate for the detector health between programs (Cycle 24 COS IHB, Sec. 5.8), but the value can be changed.

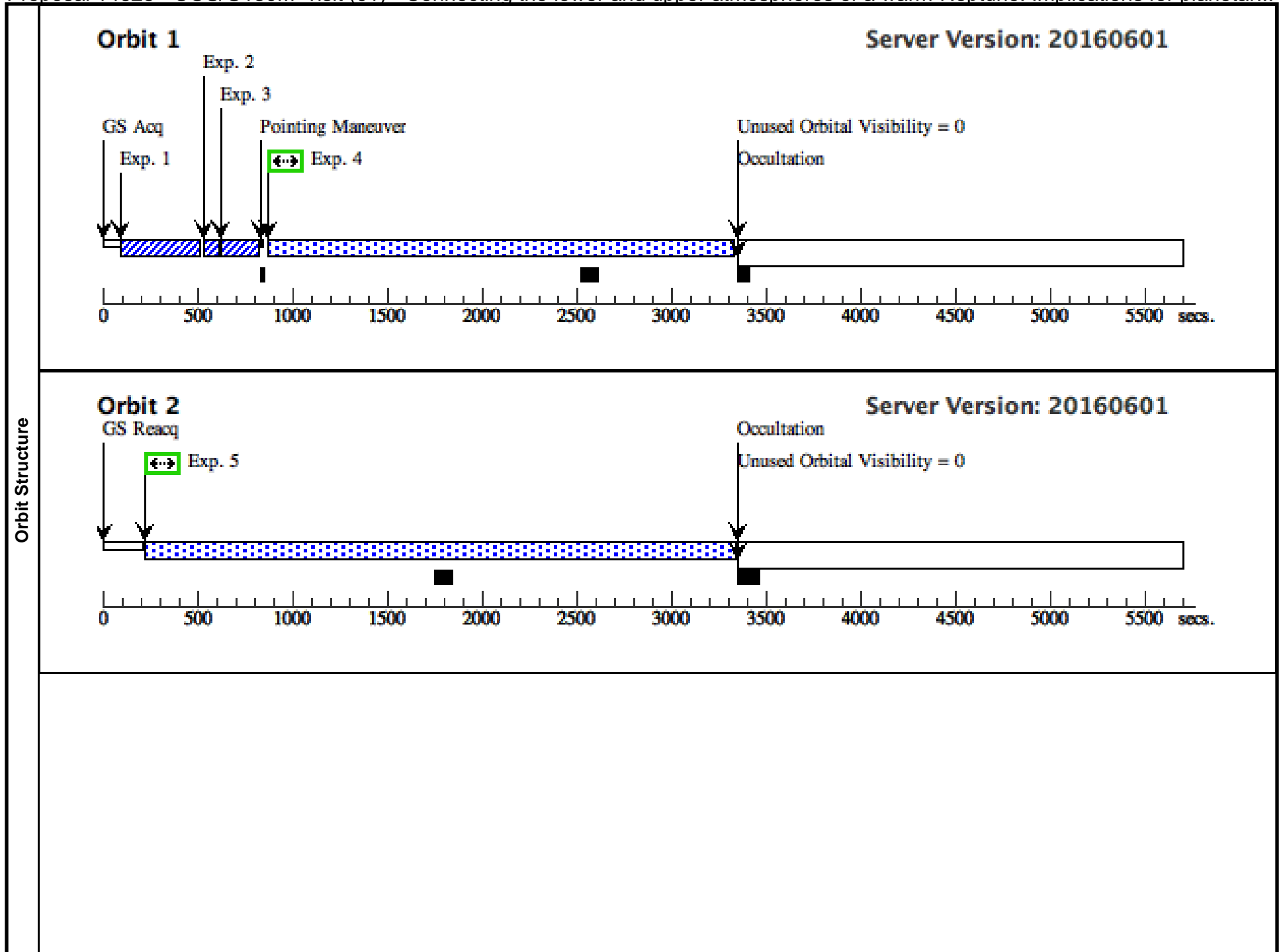
STIS: WAVECAL=NO was approved and we will execute a WAVE calibration exposure after each orbit's visibility.

Proposal 14625 - COS/G130M visit (01) - Connecting the lower and upper atmospheres of a warm-Neptune. Implications for planetar...

Visit	Proposal 14625, COS/G130M visit (01), scheduled Wed Nov 09 16:27:22 GMT 2016 Diagnostic Status: Warning Scientific Instruments: COS/FUV, COS/NUV Special Requirements: Period 4.887804 D AND ZERO-PHASE HJD2454605.89132																
	(COS/G130M visit (01)) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.																
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>BD+47-2936</td> <td>RA: 19 50 50.2477 (297.7093654d) Dec: +48 04 51.09 (48.08086d) Equinox: J2000</td> <td>Proper Motion RA: 127.20 mas/yr Proper Motion Dec: 231.23 mas/yr Epoch of Position: 2000</td> <td>V=9.59</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>					#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	BD+47-2936	RA: 19 50 50.2477 (297.7093654d) Dec: +48 04 51.09 (48.08086d) Equinox: J2000	Proper Motion RA: 127.20 mas/yr Proper Motion Dec: 231.23 mas/yr Epoch of Position: 2000	V=9.59	Reference Frame: ICRS
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Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. 4780 K2V-K4V star. Extended=NO																	

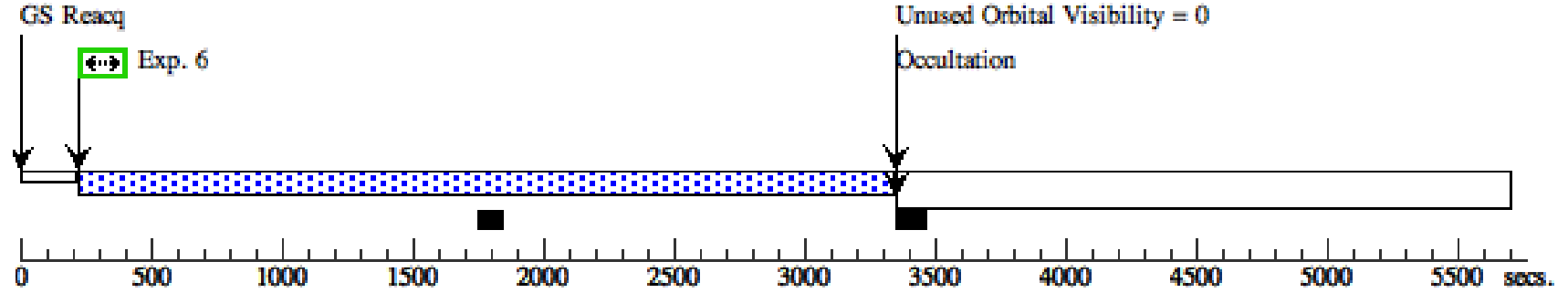
Proposal 14625 - COS/G130M visit (01) - Connecting the lower and upper atmospheres of a warm-Neptune. Implications for planetar...

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	ACQ-SEAR CH (COS.ta.840 729)	(1) BD+47-2936	COS/NUV, ACQ/SEARCH, PSA	G230L 3000 A	SCAN-SIZE=2; STEP-SIZE=1.767; CENTER=DEF	PHASE 0.961 TO 0. 964	Sequence 1-4 Non-Int in COS/G130M visit (01)	10 Secs (10 Secs) [==>]	[1]	
	2	ACQ-PEAK XD (COS.ta.840 728)	(1) BD+47-2936	COS/NUV, ACQ/PEAKXD, PSA	G230L 3000 A	STRIPE=MEDIUM		Sequence 1-4 Non-Int in COS/G130M visit (01)	10 Secs (10 Secs) [==>]	[1]	
	3	ACQ-PEAK D (COS.ta.840 729)	(1) BD+47-2936	COS/NUV, ACQ/PEAKD, PSA	G230L 3000 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-W T-FLR		Sequence 1-4 Non-Int in COS/G130M visit (01)	10 Secs (10 Secs) [==>]	[1]	
	4	COS-orbit 1 (COS.sp.827 195)	(1) BD+47-2936	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=15 00; SEGMENT=BOTH; FP-POS=1		Sequence 1-4 Non-Int in COS/G130M visit (01)	2610 Secs (2297 Secs) [==>2297.0 Secs]	[1]	
	<i>Comments: The ETC was run with a COS/G130M spectrum of HD 189733, which of similar type and activity level, and closer in at 19 vs 37 pc.</i>										
	5	COS-orbit 2 (COS.sp.827 195)	(1) BD+47-2936	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=15 00; SEGMENT=BOTH; FP-POS=1			3030 Secs (3066 Secs) [==>3066.0 Secs]	[2]	
	6	COS-orbit 3 (COS.sp.827 195)	(1) BD+47-2936	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=15 00; SEGMENT=BOTH; FP-POS=1			3030 Secs (3066 Secs) [==>3066.0 Secs]	[3]	
	7	COS-orbit 4 (COS.sp.827 195)	(1) BD+47-2936	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 00; SEGMENT=BOTH; FP-POS=1			3030 Secs (3066 Secs) [==>3066.0 Secs]	[4]	
8	COS-orbit 5 (COS.sp.827 195)	(1) BD+47-2936	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 00; SEGMENT=BOTH; FP-POS=1			3030 Secs (3066 Secs) [==>3066.0 Secs]	[5]		



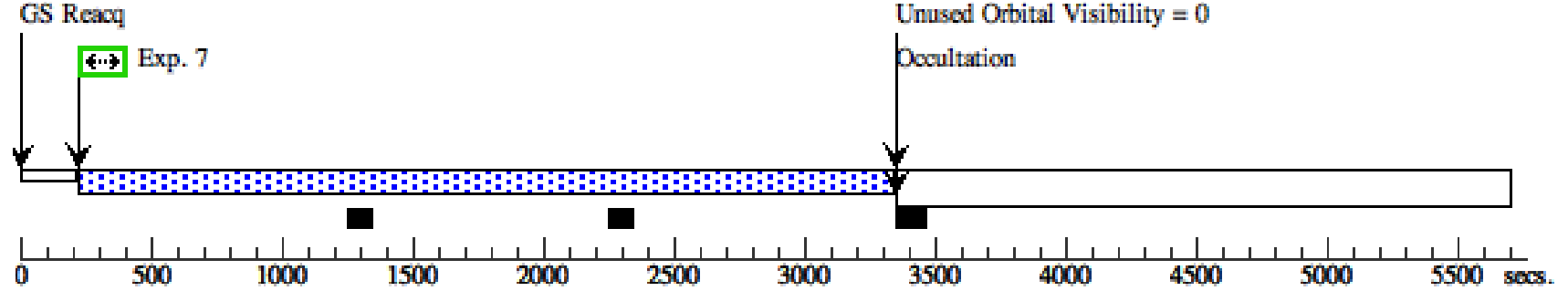
Orbit 3

Server Version: 20160601



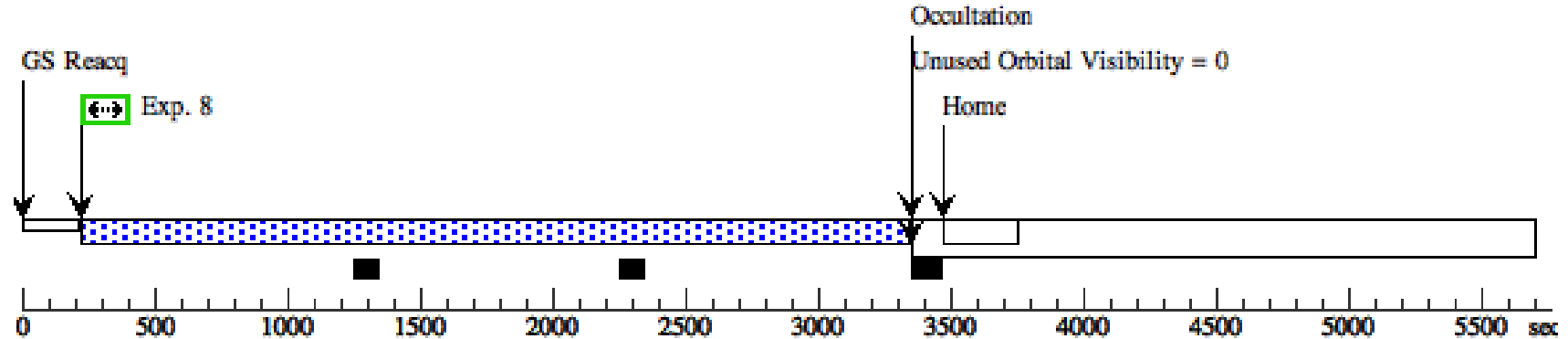
Orbit 4

Server Version: 20160601



Orbit 5

Server Version: 20160601

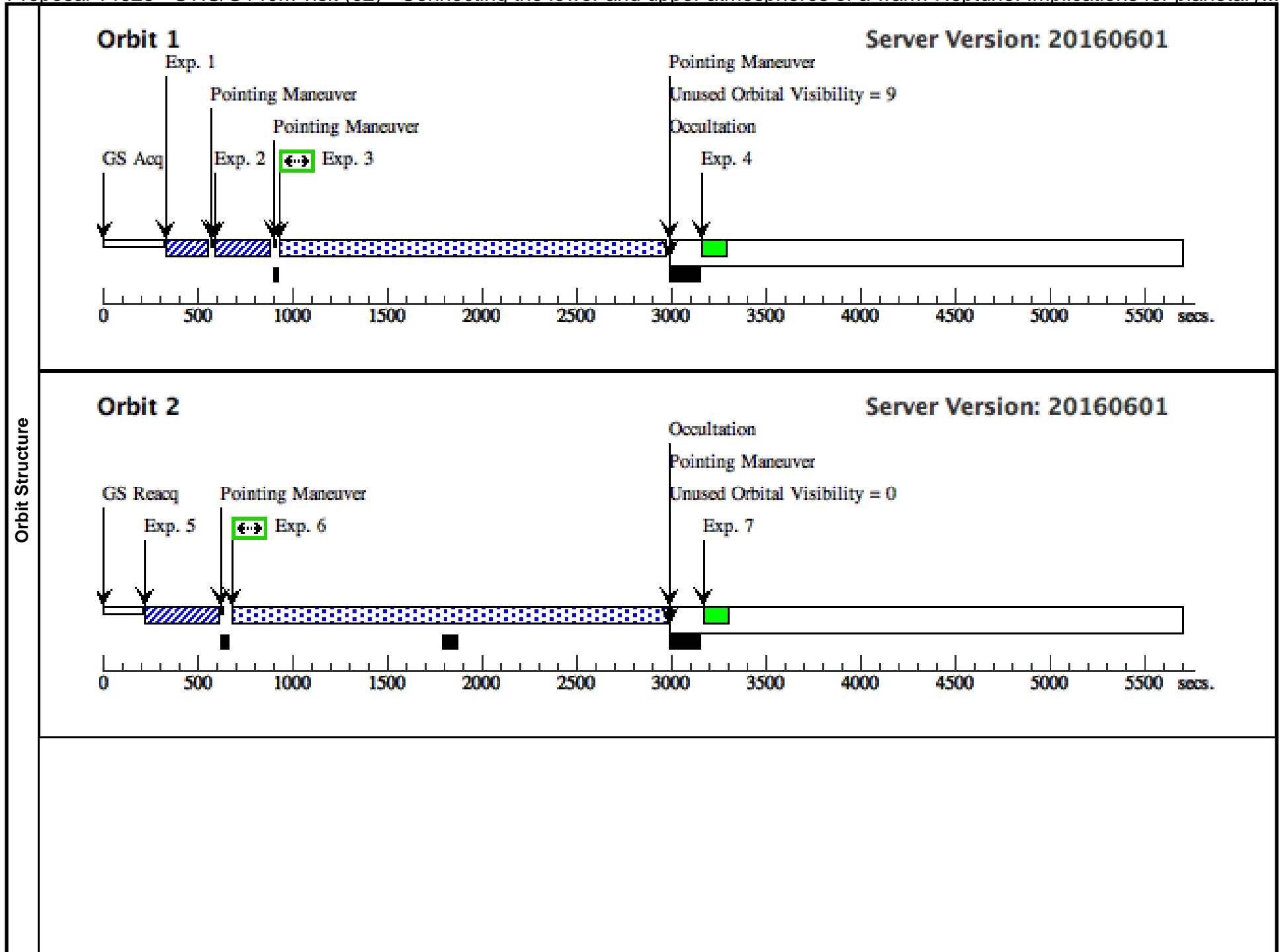


Proposal 14625 - STIS/G140M visit (02) - Connecting the lower and upper atmospheres of a warm-Neptune. Implications for planetary...

Visit	Proposal 14625, STIS/G140M visit (02), implementation Wed Nov 09 16:27:23 GMT 2016																	
	Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; Period 4.887804 D AND ZERO-PHASE HJD2454605.89132																	
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	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous												
(1)	BD+47-2936	RA: 19 50 50.2477 (297.7093654d) Dec: +48 04 51.09 (48.08086d) Equinox: J2000	Proper Motion RA: 127.20 mas/yr Proper Motion Dec: 231.23 mas/yr Epoch of Position: 2000	V=9.59	Reference Frame: ICRS													

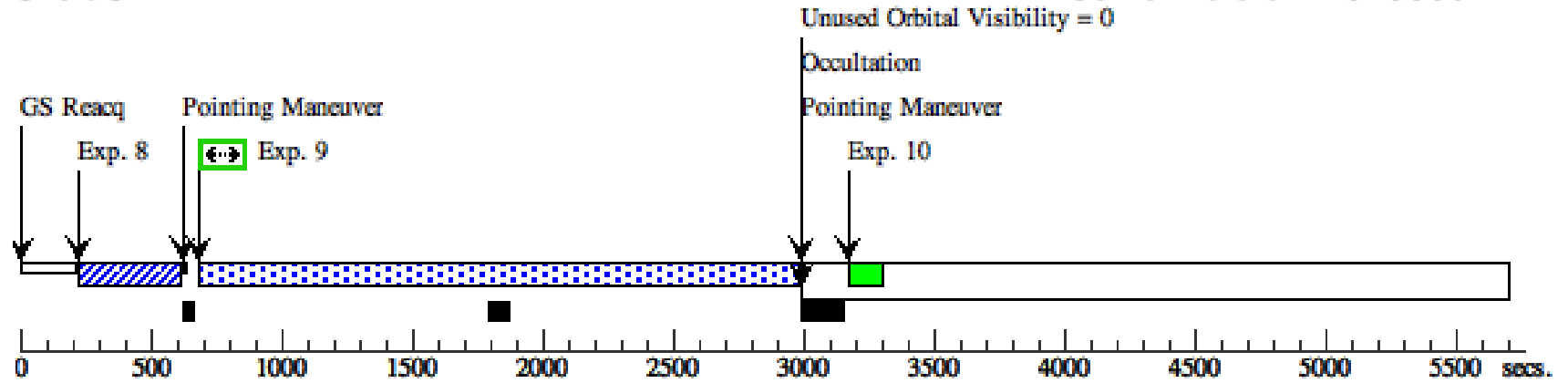
Proposal 14625 - STIS/G140M visit (02) - Connecting the lower and upper atmospheres of a warm-Neptune. Implications for planetary...

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	ACQ (STIS.ta.825 271)	(1) BD+47-2936	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.961 TO 0.964	Sequence 1-4 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[1]
	<i>Comments: Saturation is calculated at 0.19 seconds. Minimum exposure time (0.1 seconds) used here, target has Vmag=9.47, which is within limiting magnitude of 8.4 with F28X50LP (Table 8.3 STIS handbook).</i>									
	2	ACQ/PEAK (STIS.ta.828 014)	(1) BD+47-2936	STIS/CCD, ACQ/PEAK, 52X0.05D1	MIRROR			Sequence 1-4 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[1]
	3	STIS orbit 1 (STIS.sp.82 7199)	(1) BD+47-2936	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=1000; WAVECAL=NO	Sequence 1-4 Non-Int in STIS/G140M visit (02)	1900 Secs (1900 Secs) [==>]	[1]
	<i>Comments: ETC for STIS/G140M spectrum of FUV-brighter star HD-189733.</i>									
	4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 1-4 Non-Int in STIS/G140M visit (02)	[==>]	[1]
	5	ACQ/PEAK (STIS.ta.828 014)	(1) BD+47-2936	STIS/CCD, ACQ/PEAK, 52X0.05D1	MIRROR			Sequence 5-7 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[2]
	6	STIS orbit 2 (STIS.sp.82 7199)	(1) BD+47-2936	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=1000; WAVECAL=NO	Sequence 5-7 Non-Int in STIS/G140M visit (02)	2160 Secs (2178 Secs) [==>2178.0 Secs]	[2]
	7	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 5-7 Non-Int in STIS/G140M visit (02)	[==>]	[2]
	8	ACQ/PEAK (STIS.ta.828 014)	(1) BD+47-2936	STIS/CCD, ACQ/PEAK, 52X0.05D1	MIRROR			Sequence 8-10 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[3]
	9	STIS orbit 3 (STIS.sp.82 7199)	(1) BD+47-2936	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=1000; WAVECAL=NO	Sequence 8-10 Non-Int in STIS/G140M visit (02)	2160 Secs (2178 Secs) [==>2178.0 Secs]	[3]
	10	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 8-10 Non-Int in STIS/G140M visit (02)	[==>]	[3]
	11	ACQ/PEAK (STIS.ta.828 014)	(1) BD+47-2936	STIS/CCD, ACQ/PEAK, 52X0.05D1	MIRROR			Sequence 11-13 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[4]
	12	STIS orbit 4 (STIS.sp.82 7199)	(1) BD+47-2936	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=1000; WAVECAL=NO	Sequence 11-13 Non-Int in STIS/G140M visit (02)	2160 Secs (2178 Secs) [==>2178.0 Secs]	[4]
	13	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 11-13 Non-Int in STIS/G140M visit (02)	[==>]	[4]
	14	ACQ/PEAK (STIS.ta.828 014)	(1) BD+47-2936	STIS/CCD, ACQ/PEAK, 52X0.05D1	MIRROR			Sequence 14-16 Non-Int in STIS/G140M visit (02)	0.1 Secs (0.1 Secs) [==>]	[5]
15	STIS orbit 5 (STIS.sp.82 7199)	(1) BD+47-2936	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=1000; WAVECAL=NO	Sequence 14-16 Non-Int in STIS/G140M visit (02)	2160 Secs (2178 Secs) [==>2178.0 Secs]	[5]	
16	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 14-16 Non-Int in STIS/G140M visit (02)	[==>]	[5]	



Orbit 3

Server Version: 20160601



Orbit 4

Server Version: 20160601

