



14090 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

Cycle: 23, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Gilda E. Ballester (PI) (Contact)	University of Arizona	gilda@lpl.arizona.edu
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Dr. Gregory W. Henry (CoI)	Tennessee State University	gregory.w.henry@gmail.com

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) HD-209458	COS/FUV COS/NUV	4	05-Dec-2015 21:01:08.0	yes
02	(1) HD-209458	COS/FUV COS/NUV	4	05-Dec-2015 21:01:11.0	yes
03	(1) HD-209458	COS/FUV COS/NUV	4	05-Dec-2015 21:01:14.0	yes

12 Total Orbits Used

ABSTRACT

As the first known transiting exoplanet, HD 209458b has set various precedents in the study of the lower and upper atmospheres of worlds beyond our solar system. The discovery with HST STIS/G140L FUV transit observations of this hot Jupiter of an extended upper atmosphere of H I and heavy O I and C II species has driven much theoretical work to explain the heating and inflation at high altitudes caused by the large XUV input from the nearby star. Our recent work shows however that the stellar activity and XUV input have been significantly overestimated in all previous studies. With up-to-date upper-atmosphere models combined with magnetospheric simulations, we find that for the STIS results of line-integrated absorptions of about 10%, the extended distributions of O I and C II should be accompanied by broad line-absorption profiles from non-thermal processes together with supersolar abundances in O and C, and the planet may also possess an extended magnetosphere. The picture is degenerate, but can be significantly improved if detections better than the 2-3 sigma measurements from STIS are obtained. The unique FUV capabilities of HST COS/G130M will be exploited for this key target. Line-integrated absorptions in both O I and C II will be measured at ~ 5 -10 sigma. For the first time, absorption line profiles will be adequately resolved, with information on Doppler shifts and equivalent widths to help distinguish between atmospheric scenarios and potential magnetospheric phenomena.

OBSERVING DESCRIPTION

Will observe HD 209458 during three transits of its hot Jupiter, spanning 4 HST orbits per transit. Each visit will start with the planet around orbital phase 0.957-0.970 to observe before transit (orbit 1), during transit (orbits 2 and 3) and after transit (orbit 4) and properly sample the baseline stellar fluxes.

We will use COS G130M in time-tagged mode with the 1291 grating setting and a single FP-POS per visit, in order to sample all O I 1304, C II 1335, and Si III 1206 Ang simultaneously, and to keep a consistent zero wavelength and dispersion. This is key for the program's goal of measuring the planetary absorption line profiles. The repeatability provided by a single setup together with the time-tagging of the data will also allow for selection of part of the exposures with respect to the sampling of the transit light curve as needed per visit.

Ideally there should be the lowest possible geocoronal (O I 1304 Ang) background as is possible when observing near opposition (near SHADOW conditions). However, the timing of the transits is a stronger time scheduling constraint, and we need to observe 3 transits to build up the S/N, hopefully all in this cycle.

Proposal 14090 - Visit 01 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

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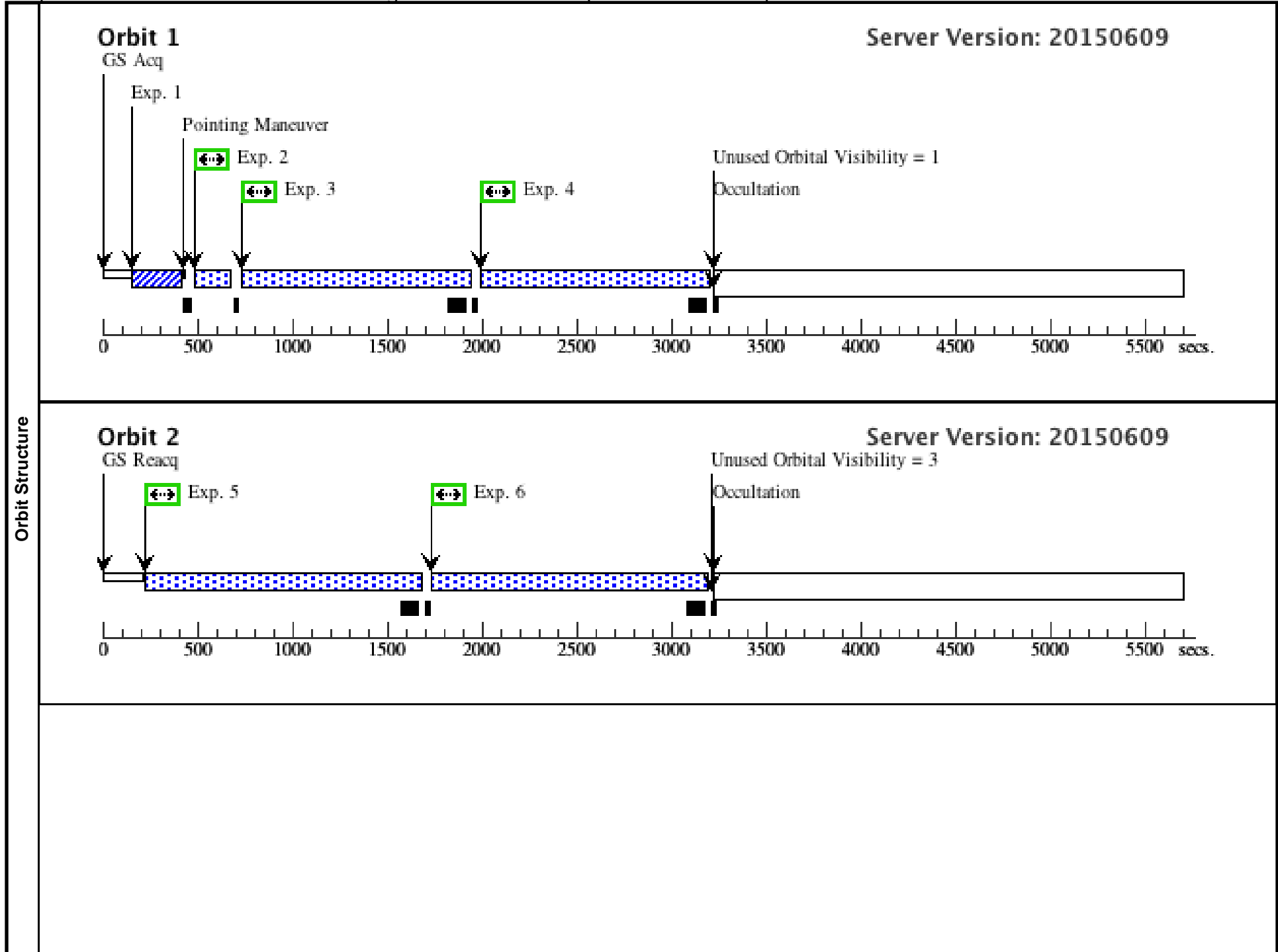
Visit	<p>Proposal 14090, Visit 01, implementation</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV, COS/NUV</p> <p>Special Requirements: Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521</p>												
	Diagnostics	<p>(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.</p> <p>(Exposure 2 (Sequence 1-4 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 3 (Sequence 1-4 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 4 (Sequence 1-4 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 5 (Sequence 5-6 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 6 (Sequence 5-6 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 7 (Sequence 7-8 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 8 (Sequence 7-8 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 9 (Sequence 9-10 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 10 (Sequence 9-10 Non-Int in Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p>											
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Proposal 14090 - Visit 01 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(733361)	(1) HD-209458	COS/NUV, ACQ/IMAGE, BOA	MIRRORA	PHASE 0.957 TO 0.970	Sequence 1-4 Non-Int in Visit 01	12 Secs (12 Secs) [==>]	[1]
	2		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=20 0; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 1-4 Non-Int in Visit 01	20 Secs (20 Secs) [==>]	[1]
	3		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 65; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 1-4 Non-Int in Visit 01	1162 Secs (1162 Secs) [==>]	[1]
	4		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 65; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 1-4 Non-Int in Visit 01	1162 Secs (1162 Secs) [==>]	[1]
	5		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 5-6 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[2]
	6		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 5-6 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[2]
	7		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 7-8 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[3]
	8		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 7-8 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[3]
	9		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 9-10 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[4]

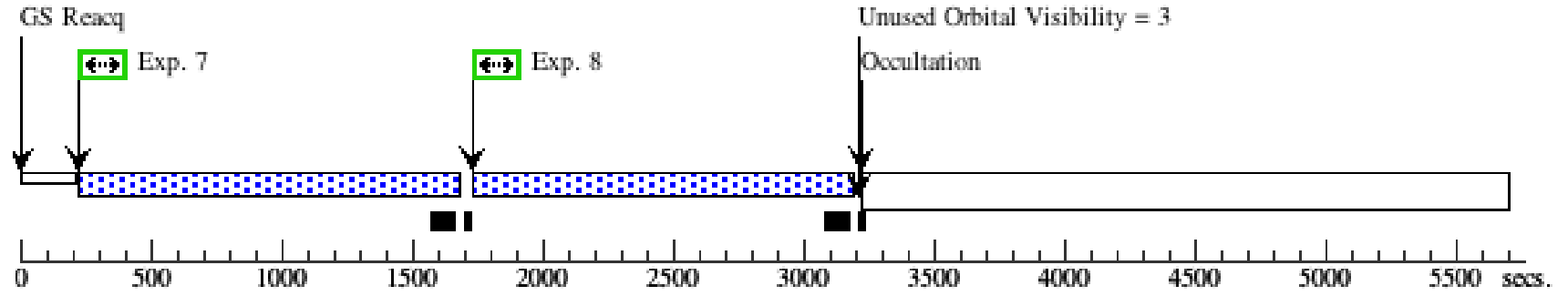
Proposal 14090 - Visit 01 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

10	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=4; FLASH=YES	Sequence 9-10 Non-Int in Visit 01	1415 Secs (1415 Secs) [==>]	[4]
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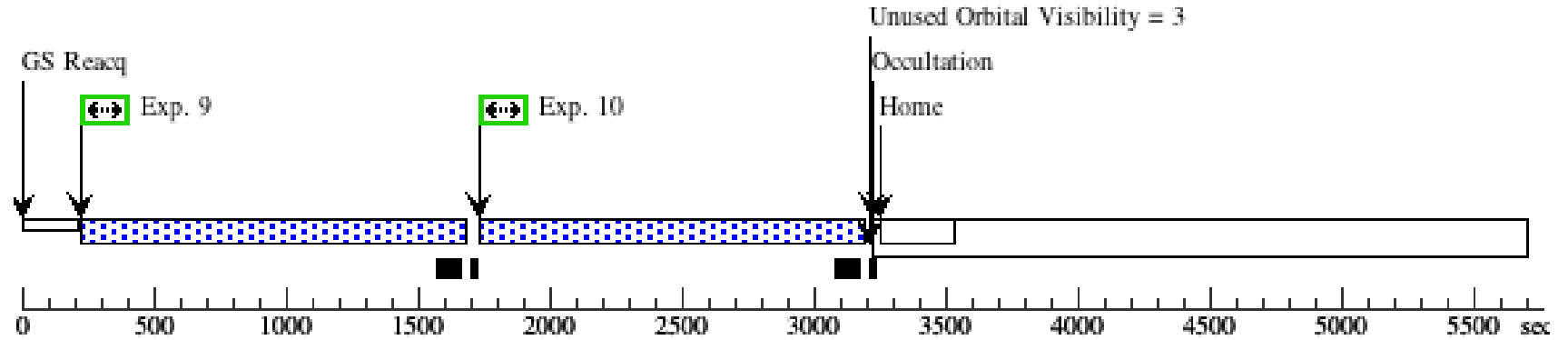
Orbit 3

Server Version: 20150609



Orbit 4

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Proposal 14090 - Visit 02 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

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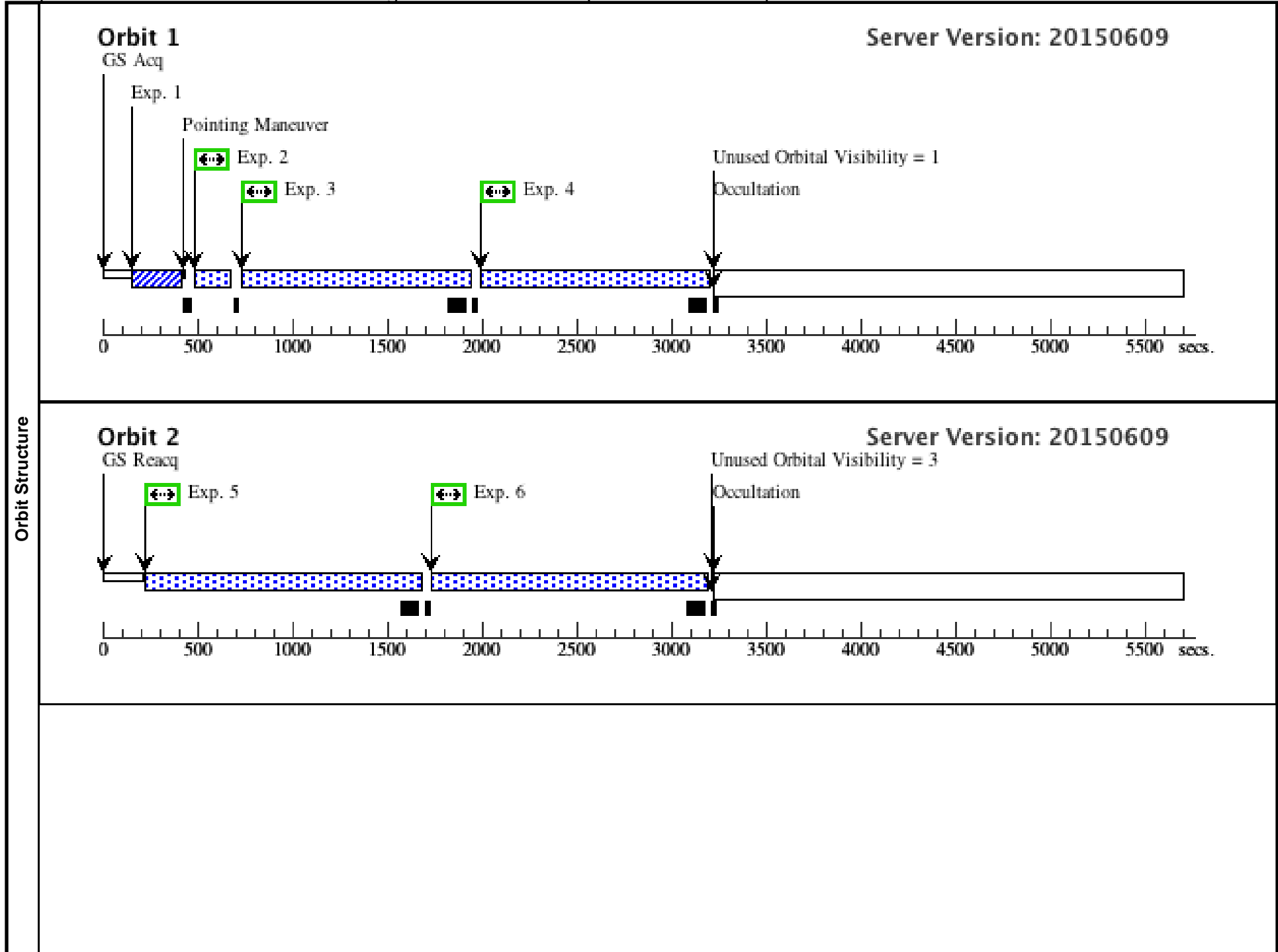
Visit	<p>Proposal 14090, Visit 02, implementation</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV, COS/NUV</p> <p>Special Requirements: Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521</p>												
	Diagnostics	<p>(Visit 02) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.</p> <p>(Exposure 2 (Sequence 1-4 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 3 (Sequence 1-4 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 4 (Sequence 1-4 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 5 (Sequence 5-6 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 6 (Sequence 5-6 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 7 (Sequence 7-8 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 8 (Sequence 7-8 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 9 (Sequence 9-10 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p> <p>(Exposure 10 (Sequence 9-10 Non-Int in Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.</p>											
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Proposal 14090 - Visit 02 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(733361) (1) HD-209458	COS/NUV, ACQ/IMAGE, BOA	MIRRORA		PHASE 0.957 TO 0.970	Sequence 1-4 Non-Int in Visit 02	12 Secs (12 Secs) [==>]	[1]
	2	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=20 0; SEGMENT=BOTH; FP-POS=2; FLASH=YES		Sequence 1-4 Non-Int in Visit 02	20 Secs (20 Secs) [==>]	[1]
	3	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 65; SEGMENT=BOTH; FP-POS=2; FLASH=YES		Sequence 1-4 Non-Int in Visit 02	1162 Secs (1162 Secs) [==>]	[1]
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	5	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=2; FLASH=YES		Sequence 5-6 Non-Int in Visit 02	1415 Secs (1415 Secs) [==>]	[2]
	6	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=2; FLASH=YES		Sequence 5-6 Non-Int in Visit 02	1415 Secs (1415 Secs) [==>]	[2]
	7	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=13 15; SEGMENT=BOTH; FP-POS=2; FLASH=YES		Sequence 7-8 Non-Int in Visit 02	1415 Secs (1415 Secs) [==>]	[3]
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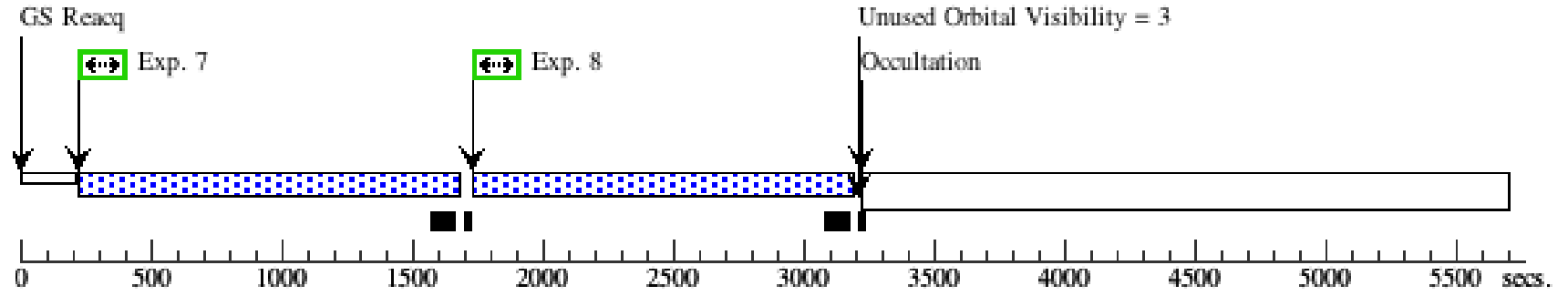
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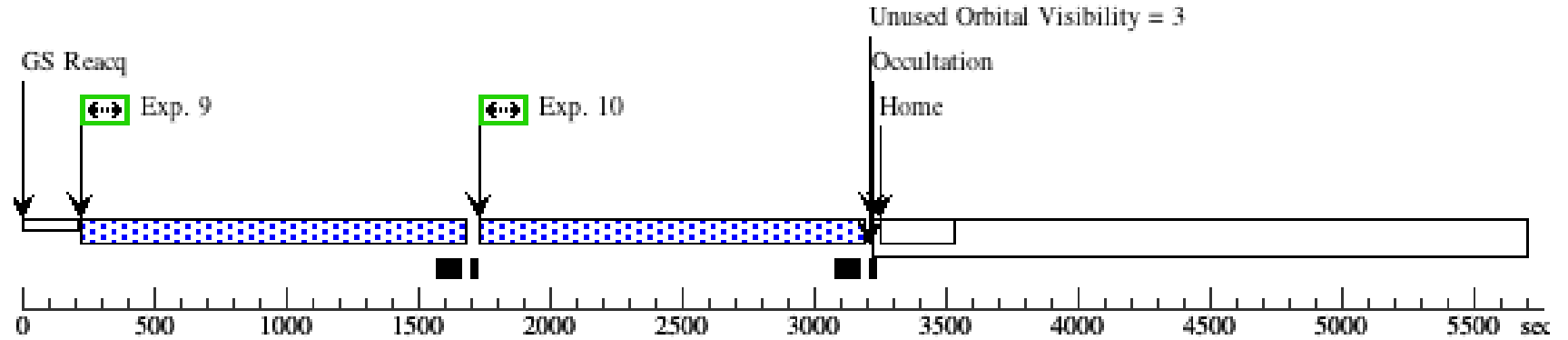
Orbit 3

Server Version: 20150609



Orbit 4

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Proposal 14090 - Visit 03 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

Sun Dec 06 02:01:16 GMT 2015

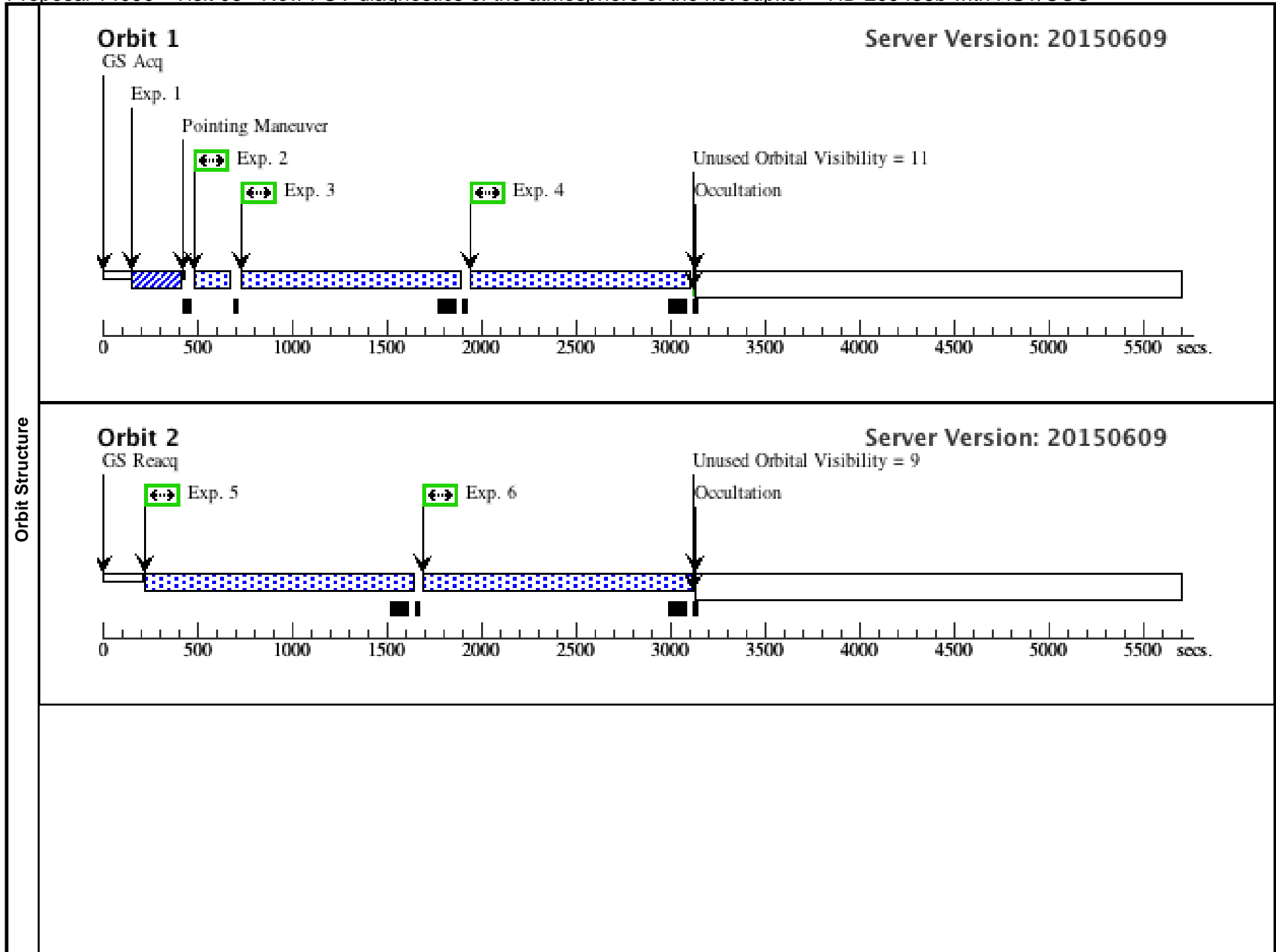
Visit	<p>Proposal 14090, Visit 03, implementation</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV, COS/NUV</p> <p>Special Requirements: SCHED 50%; Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521</p>																																								
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Proposal 14090 - Visit 03 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

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	2		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=20 0; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 1-4 Non-Int in Visit 03	20 Secs (20 Secs) [==>]	[1]
	3		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 15; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 1-4 Non-Int in Visit 03	1115 Secs (1115 Secs) [==>]	[1]
	4		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=10 15; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 1-4 Non-Int in Visit 03	1115 Secs (1115 Secs) [==>]	[1]
	5		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 5-6 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[2]
	6		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 5-6 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[2]
	7		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 7-8 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[3]
	8		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 7-8 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[3]
	9		(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 9-10 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[4]

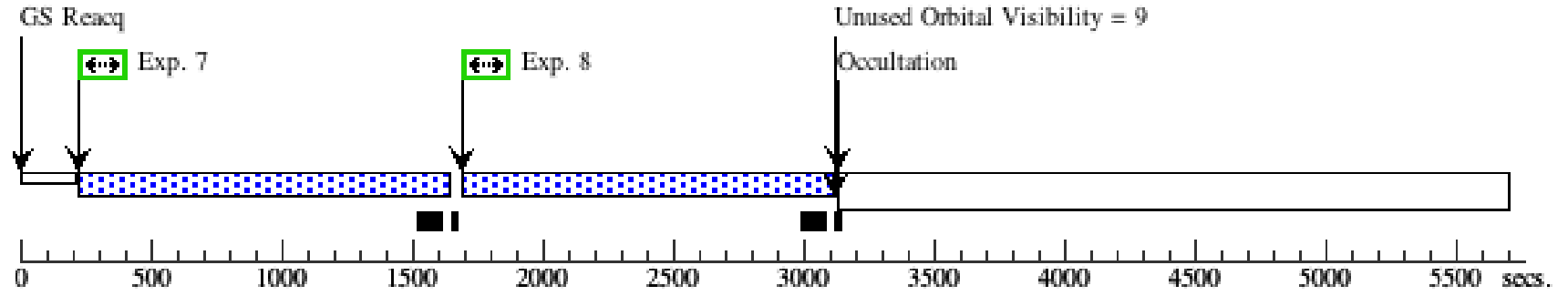
Proposal 14090 - Visit 03 - New FUV diagnostics of the atmosphere of the hot-Jupiter HD 209458b with HST/COS

	10	(1) HD-209458	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 70; SEGMENT=BOTH; FP-POS=3; FLASH=YES	Sequence 9-10 Non-Int in Visit 03	1370 Secs (1370 Secs) [==>]	[4]
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Orbit 3

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