



## 11673 - Dynamics in the atmosphere of the evaporating planet HD189733b

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Dr. Alain Lecavelier des Etangs (PI) (ESA Member)</b>	<b>CNRS, Institut d'Astrophysique de Paris</b>	<b>lecaveli@iap.fr</b>
Dr. Alfred Vidal-Madjar (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	vidalmdjar@iap.fr
Dr. Gilda E. Ballester (CoI) (AdminUSPI)	University of Arizona	gilda@vega.lpl.arizona.edu
Mr. Jean-Michel Desert (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	desert@iap.fr
Mr. David Ehrenreich (CoI) (ESA Member)	Universite de Grenoble I	david.ehrenreich@obs.ujf-grenoble.fr
Dr. Roger D. Ferlet (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	ferlet@iap.fr
Dr. Guillaume Hebrard (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	hebrard@iap.fr
Dr. David Kent Sing (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	sing@iap.fr

### 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-189733	COS/FUV COS/NUV	4	23-Nov-2009 21:22:09.0	yes
02	(1) HD-189733	STIS/CCD STIS/FUV-MAMA	4	23-Nov-2009 21:22:25.0	yes

<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>
03	(1) HD-189733	STIS/CCD STIS/FUV-MAMA	4	23-Nov-2009 21:22:35.0	yes

12 Total Orbits Used

### **ABSTRACT**

With HST/STIS, we detected and characterized the upper atmosphere of the extrasolar planet HD209458b, showing that the planet must be evaporating at a rate of  $\sim 10^{10}$  g/s in a "blow-off" mechanism.

More recently, using ACS we concluded that HD189733b is also evaporating. However, because of the low resolution of the ACS prism spectroscopy, the escape rate and mechanism are still to be determined. This is one of the prime objectives of the present proposal.

COS observations of the absorption line profile with 15 km/s resolution will allow us to probe the dynamics of the escaping gas, and therefore to determine the escape rate. Simultaneous observations of the transit depth and spectral shape in several important lines (not only HI, but also OI, CII and possibly NI) will constrain the escape mechanism and allow us to distinguish between several scenarios. The results will enlighten the physical phenomena at work in the exosphere of these extrasolar planets, and provide new constraints for the modeling of the evaporation of hot-Jupiters.

Note: After execution of the first orbit with COS. A Change Request has been accepted to the STIS instrument to secure the scientific return of the Lyman-alpha observations.

### **OBSERVING DESCRIPTION**

We plan to observe 3 transits of HD189733b, using 3 visits of 4 HST orbits each.

In visit #1, COS was used to obtain 3 exposures with the G130M and in time-tag mode.

For visits #2 and #3, STIS will be used with the G140M and in time-tag mode.

For each HST visit for STIS observation, we will first execute an ACQ at the beginning of the first orbit with the F28X500II aperture. With an exposure time of 2s (per search point) the S/N ratio is about 160. For each orbit we request an ACQ/PEAK with G430L, the 52x0.05 slit and exposure time of 1s providing a total count of about  $5e6$ .

To observe the planetary transit, the time constraint is given by a phase requirement calculated to allow 2 full HST orbits observation to be executed before and one full HST orbit after the planetary transit. The first exposure of the first orbit must be taken at a phase in the range 0.927 - 0.934

#### **ADDITIONAL COMMENTS**

This program should be scheduled for observations with the lowest airglow possible.

The keyword SHADOW has not been selected so that the observations are schedulable, but these observations should be scheduled close to SHADOW if possible. (Selection of SHADOW keyword results in strange results from the 'orbit planner', and almost zero visibility from the 'visit planner').

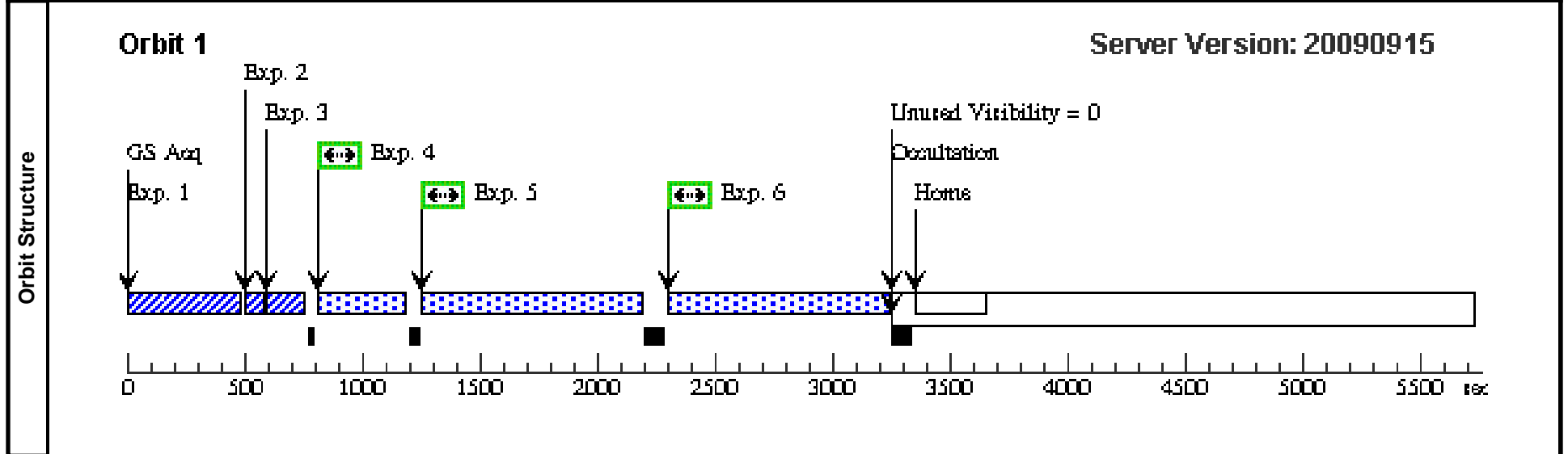
Proposal 11673 - Visit 01 - Dynamics in the atmosphere of the evaporating planet HD189733b

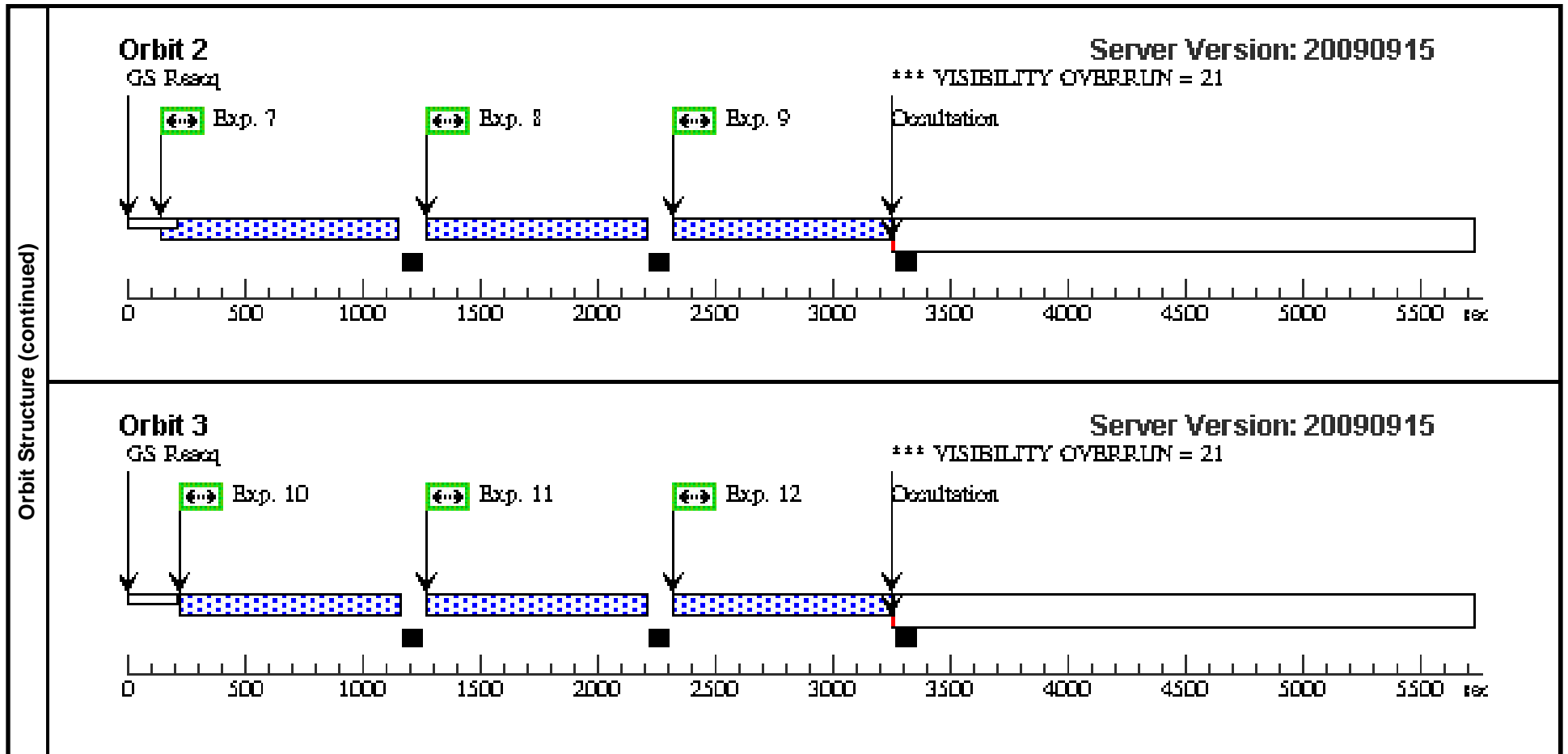
Tue Nov 24 02:22:40 GMT 2009

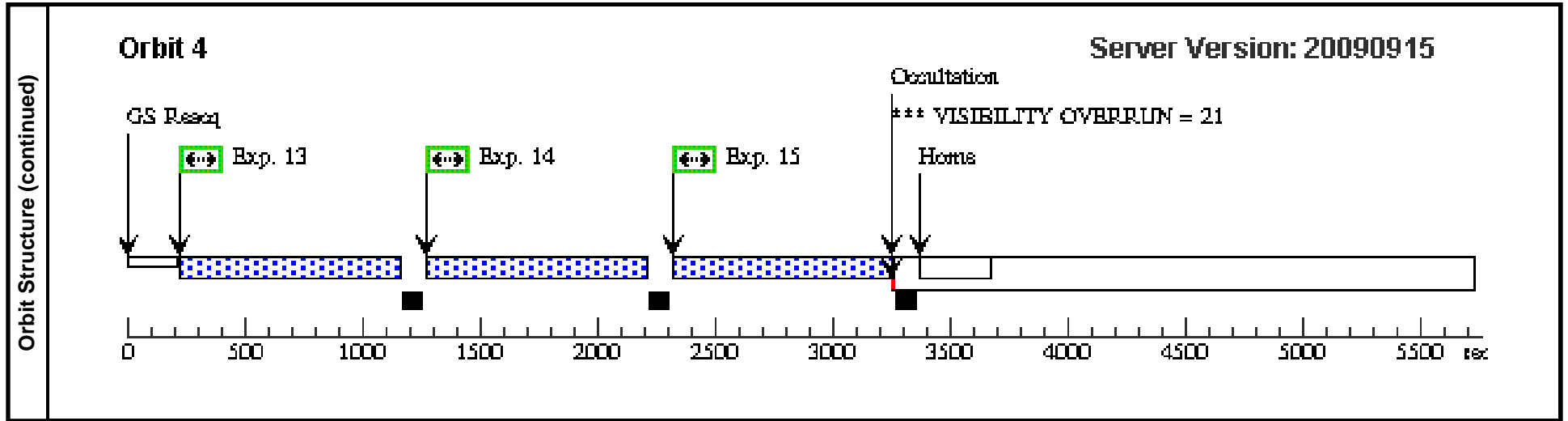
<b>Visit</b>	<b>Proposal 11673, Visit 01, completed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/NUV, COS/FUV Special Requirements: Period 2.218584 D AND ZERO-PHASE HJD2453629.3942 <i>Comments: This program should be scheduled for observations with the lowest airglow possible. The keyword SHADOW has not been selected so that the observations are schedulable, but these observations should be scheduled close to SHADOW if possible. (Selection of SHADOW keyword results in strange results from the 'orbit planner', and almost zero visibility from the 'visit planner').</i>									
	(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>				
	(1)	HD-189733	RA: 20 00 43.7133 (300.1821388d) Dec: +22 42 39.07 (22.71085d) Equinox: J2000	Proper Motion RA: -0.00017s/yr Proper Motion Dec: -0.251"/yr Parallax: 0.052" Epoch of Position: 2000.0	V=7.67	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>	<b>Orbit</b>
	1	(1) HD-189733	(1) HD-189733	COS/NUV, ACQ/SEARCH, PSA	G230L 3000 A	SCAN-SIZE=2			3 Secs [==>]	[1]
	<i>Comments: Exposure time to reach S/N of 100</i>									
	2	(1) HD-189733	(1) HD-189733	COS/NUV, ACQ/PEAKXD, PSA	G230L 3000 A				2 Secs [==>]	[1]
	<i>Comments: Exposure time of 2s for S/N of 100 on Stripe B</i>									
	3	(1) HD-189733	(1) HD-189733	COS/NUV, ACQ/PEAKD, PSA	G230L 3000 A	STEP-SIZE=1.2			2 Secs [==>]	[1]
	<i>Comments: Exposure time of 2s for S/N of 100</i>									
	4	(1) HD-189733	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			120 Secs [==>209.0 Secs ]	[1]
	5	(1) HD-189733	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [==>889.0 Secs ]	[1]
6	(1) HD-189733	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [==>889.0 Secs ]	[1]	
7	(1) HD-189733	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00	PHASE 0.962 TO 0. 976		800 Secs [==>889.0 Secs ]	[2]	
8	(1) HD-189733	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [==>889.0 Secs ]	[2]	

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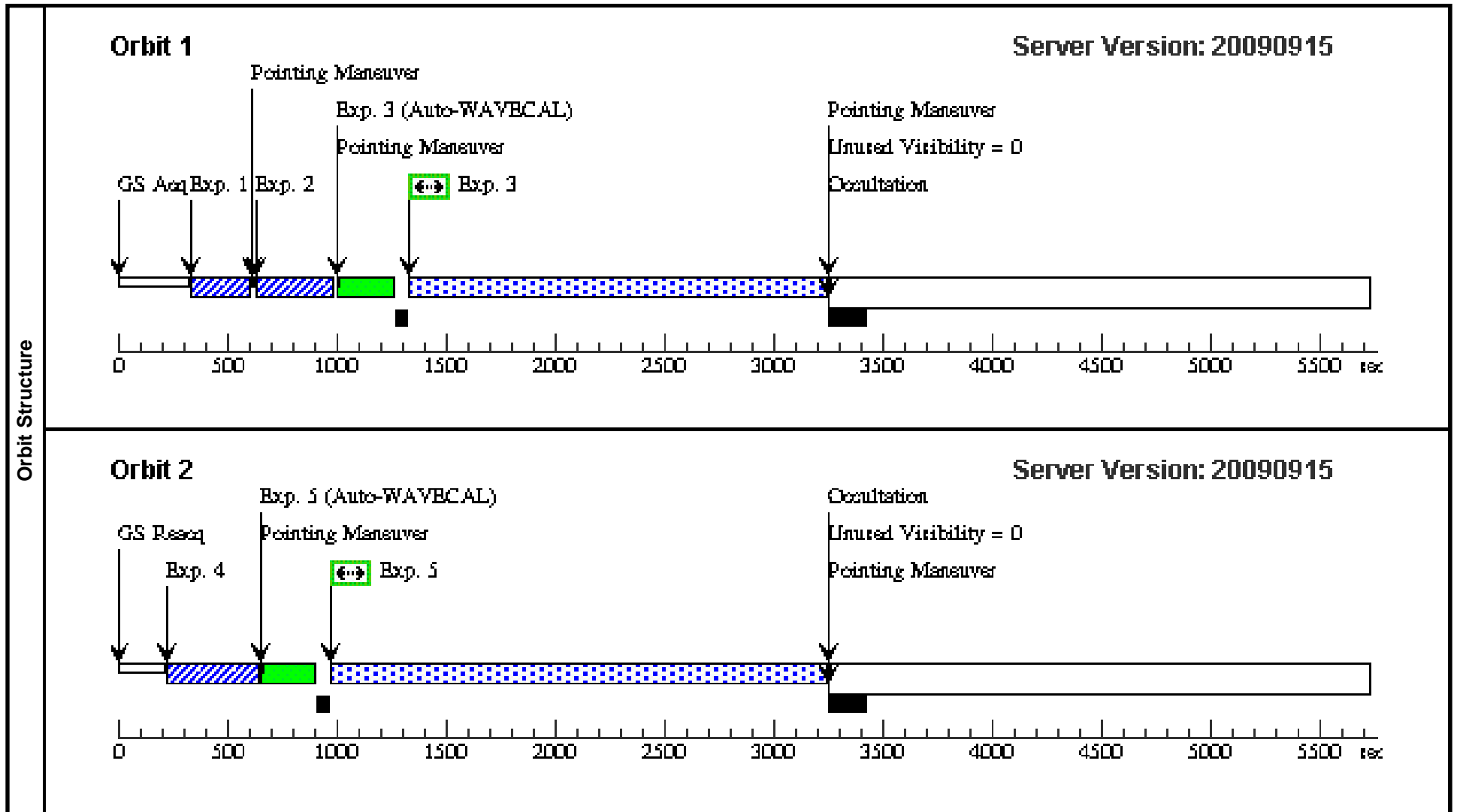
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	9	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[2]
	10	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[3]
	11	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[3]
	12	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[3]
	13	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[4]
	14	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[4]
	15	(1) HD-189733	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=12 00			800 Secs [=>889.0 Secs ]	[4]

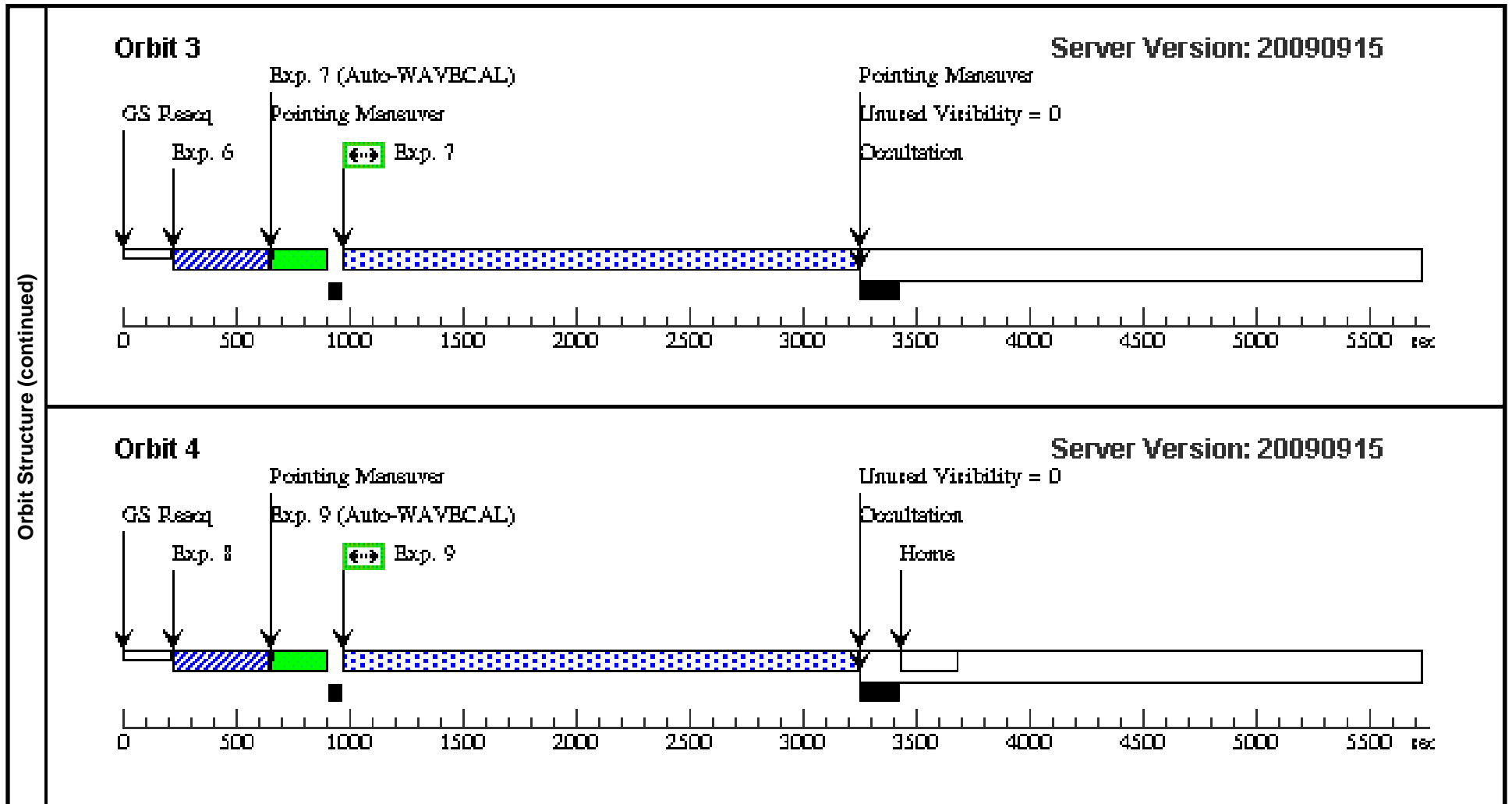






Visit		<b>Proposal 11673, Visit 02, pi</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/FUV-MAMA, STIS/CCD Special Requirements: Period 2.218576 D AND ZERO-PHASE HJD2454399.2399								
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
		(1)	HD-189733	RA: 20 00 43.7133 (300.1821388d) Dec: +22 42 39.07 (22.71085d) Equinox: J2000	Proper Motion RA: -0.00017s/yr Proper Motion Dec: -0.251"/yr Parallax: 0.052" Epoch of Position: 2000.0	V=7.67	Reference Frame: ICRS			
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(1)	HD-189733	STIS/CCD, ACQ, F28X500II	MIRROR		PHASE 0.927 TO 0.934	Sequence 1-3 Non-Int	2 Secs [==>]	[1]
	<i>Comments: SNR = 163.00, Brightest (binned) pixel = 15400 e- (ETC 18.0.2).</i>									
	2	(1)	HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A			Sequence 1-3 Non-Int	1 Secs [==>]	[1]
	<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>									
	3	(1)	HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=2000		Sequence 1-3 Non-Int	1880 Secs [==>1894.0 Secs ]	[1]
	<i>Comments: For the Buffer time, we assumed a total rate conservative upper limit of about 250 count/s (K0 star V=7.5+ high airglow + Ly-alpha line of 5e-13 erg/s/cm2), providing a maximum buffer-time of 8000s. 2000 s buffer-time will secure the accum of all scientific photons (p228 and Fig. 11.6 p229 of STIS Handbook).</i>									
	4	(1)	HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A			Sequence 4-5 Non-Int	1 Secs [==>]	[2]
	<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>									
	5	(1)	HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=2000		Sequence 4-5 Non-Int	2240 Secs [==>2253.0 Secs ]	[2]
6	(1)	HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A			Sequence 6-7 Non-Int	1 Secs [==>]	[3]	
<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>										
7	(1)	HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=2000		Sequence 6-7 Non-Int	2240 Secs [==>2253.0 Secs ]	[3]	
8	(1)	HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A			Sequence 8-9 Non-Int	1 Secs [==>]	[4]	
<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>										
9	(1)	HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=2000		Sequence 8-9 Non-Int	2240 Secs [==>2253.0 Secs ]	[4]	





Visit		Proposal 11673, Visit 03, pi								
Visit		Diagnostic Status: No Diagnostics								
Visit		Scientific Instruments: STIS/FUV-MAMA, STIS/CCD								
Visit		Special Requirements: Period 2.218576 D AND ZERO-PHASE HJD2454399.2399								
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	HD-189733	RA: 20 00 43.7133 (300.1821388d) Dec: +22 42 39.07 (22.71085d) Equinox: J2000	Proper Motion RA: -0.00017s/yr Proper Motion Dec: -0.251"/yr Parallax: 0.052" Epoch of Position: 2000.0	V=7.67	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(1) HD-189733	STIS/CCD, ACQ, F28X500II	MIRROR			PHASE 0.927 TO 0.934	Sequence 1-3 Non-Int	2 Secs [==>]	[1]
	<i>Comments: SNR = 163.00, Brightest (binned) pixel = 15400 e- (ETC 18.0.2).</i>									
	2	(1) HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A				Sequence 1-3 Non-Int	1 Secs [==>]	[1]
	<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>									
	3	(1) HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		BUFFER-TIME=2000		Sequence 1-3 Non-Int	1880 Secs [==>1894.0 Secs ]	[1]
	<i>Comments: For the Buffer time, we assumed a total rate conservative upper limit of about 250 count/s (K0 star V=7.5+ high airglow + Ly-alpha line of 5e-13 erg/s/cm2), providing a maximum buffer-time of 8000s. 2000 s buffer-time will secure the accum of all scientific photons (p228 and Fig. 11.6 p229 of STIS Handbook).</i>									
	4	(1) HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A				Sequence 4-5 Non-Int	1 Secs [==>]	[2]
	<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>									
	5	(1) HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		BUFFER-TIME=2000		Sequence 4-5 Non-Int	2240 Secs [==>2253.0 Secs ]	[2]
6	(1) HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A				Sequence 6-7 Non-Int	1 Secs [==>]	[3]	
<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>										
7	(1) HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		BUFFER-TIME=2000		Sequence 6-7 Non-Int	2240 Secs [==>2253.0 Secs ]	[3]	
8	(1) HD-189733	STIS/CCD, ACQ/PEAK, 52X0.05	G430L 4300 A				Sequence 8-9 Non-Int	1 Secs [==>]	[4]	
<i>Comments: Total count = 5e6 in 1 sec (Gain=4, CR Split=1), exposure time well below saturation at ~40 s.</i>										
9	(1) HD-189733	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		BUFFER-TIME=2000		Sequence 8-9 Non-Int	2240 Secs [==>2253.0 Secs ]	[4]	

