12475 - Cool Star Winds and the Evolution of Exoplanetary Atmospheres

Cycle: 19, Proposal Category: GO

(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) HD192310	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	04-Jun-2012 21:06:59.0	yes
02	(2) HD147513	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	4	04-Jun-2012 21:07:15.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(3) HD1237	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	04-Jun-2012 21:07:30.0	yes
53	(3) HD1237	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	04-Jun-2012 21:07:41.0	yes
04	(4) HD9826	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	04-Jun-2012 21:07:52.0	yes

16 Total Orbits Used

ABSTRACT

Stellar mass loss is a ubiquitous property of stars, and most stars may host planetary companions. While we are just in the initial stages of assessing how common exoplanets may be, there already exists a rich body of work that seeks to understand the profound connection between a star and its planets, particularly their atmospheres. The unique properties of a star's electromagnetic radiation and particle wind can dictate a planet's thermal and chemical atmospheric structure. Indeed, the solar wind likely eroded a warm and wet ancient Martian atmosphere. As our capability to discover and characterize exoplanets and their atmospheres continues to improve, the habitability of these planets will become a central and potentially radical scientific research question. At the heart of this question will be the relationship of the planet with its host star. The detection of the relatively weak winds of cool, solar-like stars can only be made with high resolution UV spectra. The interaction of a stellar wind with its surrounding interstellar medium produces detectable HI Lyman-alpha absorption, where the amount of absorption is proportional to the mass loss rate. We propose observations of a sample of 4 nearby exoplanetary host stars in order to measure their winds and enable an evaluation, not only of the current stellar conditions, but to reconstruct its evolution over the course of its lifetime. These measurements by HST will provide exclusive insight into how stellar winds influence planetary atmospheres that the community will draw upon long after HST has ended its mission, as the detection and characterization of planets like our own is just beginning.

OBSERVING DESCRIPTION

We plan to obtain observations of four late-type (F-K) stars that host exoplanetary systems, in order to inventory the mass-loss rates impacting these specific exoplanets, while simultaneously improving the general relationship between mass-loss, activity, and age.

Desired Spectral Coverage and Resolution: We plan to use the high resolution E230H grating to observe MgII and FeII. Because the hydrogen at the astrospheric interface is hot (T ~ 100,000 K), it has a broad absorption profile, and does not necessarily require high spectral resolution, and therefore, to maximize S/N, we plan to use the E140M setting.

Desired Aperture Size and Geocoronal Emission: The narrow aperture sizes of STIS are critical in order to minimize the contamination by the geocoronal Lyman-alpha emission. Depending on the time of year, the Earth's motion can Doppler shift the geocoronal line into the region of astrospheric absorption and contaminate our measurement. For 3 of our targets, we require a minimal timing constraint to ensure that the geocoronal line is in the core of the ISM absorption (still allowing >6 months to perform observations).

Desired Signal-to-Noise and Exposure Times: Because cool star spectra are emission line sources in the UV, estimating expected S/N for our planned spectra requires first estimating Lyman-alpha and MgII fluxes, which we can do by extrapolating from previously observed stars. Chromospheric line fluxes (such as MgII and Lyman-alpha) are related to X-ray fluxes (Ayres et al. 1995). Wood et al. (2005a) provide Lyman-alpha spectra for many stars, which serve as the comparison stars for our purposes here. After acquisition, peakup, and observational overhead are considered, we expect at least 28 minutes to be available in the first orbit for the E230H exposure. This provides time to attain very high S/N of >50 at the half-maximum (that is, one half FWHM from the line center, because it is unlikely that the ISM absorption will be centered at the same velocity as the star) of the strong MgII lines. After acquisition and overheads are considered, we expect at least 41 minutes of exposure time to be available in the second orbit for the E140M exposure, and 48 minutes in subsequent orbits.

Brightness Limits: All of our targets are late-type stars which have UV spectra characterized by minimal continua, but strong emission lines. For this reason, all of our targets fall far short of the global brightness limit. IUE spectra for our stars confirm this. For example, in the E230H setting, using IUE data, our earliest spectral type target (GJ61; F8V) only results in 5.8 counts/s. The emission lines also fall far short of the local brightness limit. The two emission lines of interest in this proposal (Lyman-alpha and MgII) are also the brightest, and therefore, the procedure given above for estimating the S/N near their peaks is also utilized to test for brightness limit violations. Again, GJ61 is among the strongest MgII emission line sources in our sample, and in the brightest pixel, only generates 3.0 counts/s.

REAL TIME JUSTIFICATION

For 3 of our 4 targets, it will be necessary to restrict the time of observation to ensure that geocoronal emission centered on the Earth's rest frame is well within the saturated core of the broad ISM Lyman-alpha absorption, and therefore does not contaminate the region where astrospheric absorption is expected. Indeed, the geocoronal emission actually becomes a very useful wavelength calibrator. This is not a major time constraint, and there are windows of at least 6 months where the observations can be performed.

Visit

Proposal 12475, Visit 01, completed Tue Jun 05 01:08:00 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 15-JUN-2011:00:00:00 AND 24-FEB-2012:00:00:00; BETWEEN 15-JUN-2012:00:00:00 AND 24-FEB-2013:00:00:00

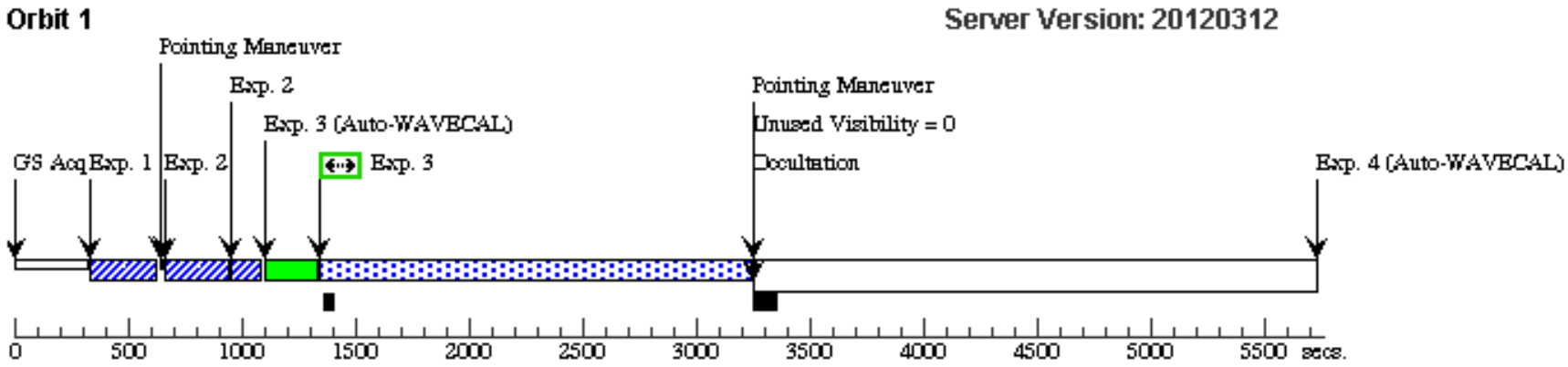
Fixed Targets

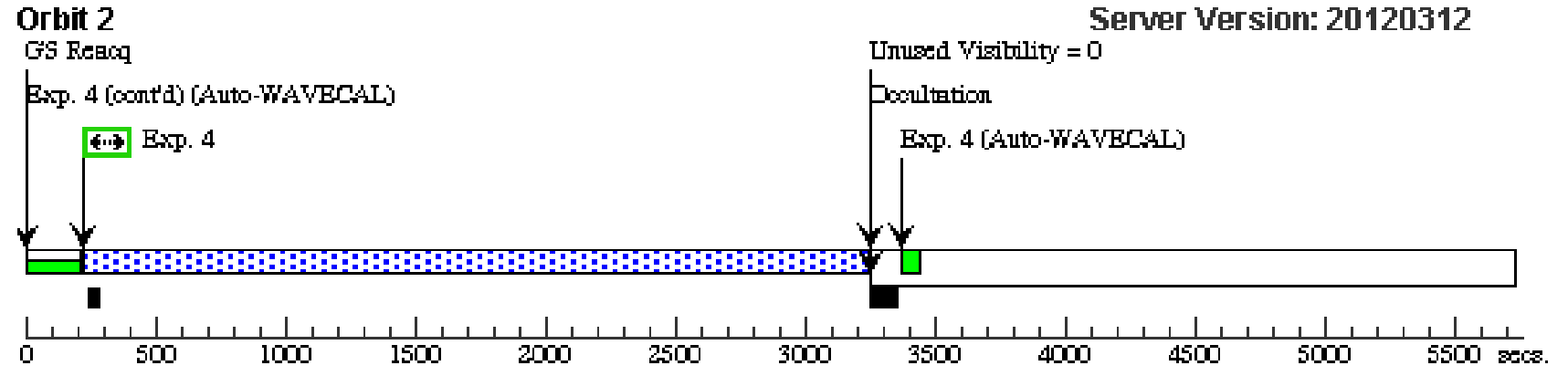
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD192310 Alt Name1: GJ785 Alt Name2: GSC2S333002246410	RA: 20 15 16.5800 (303.8190833d) Dec: -27 01 57.13 (-27.03254d) Equinox: J2000	Proper Motion RA: +0.08276 sec of time/yr Proper Motion Dec: -0.18146 arcsec/yr Parallax: 0.11333" Epoch of Position: 1991.25 Radial Velocity: -54.2 km/sec	V=5.723+/-0.04 TYPE=K1V, B-V=0.908, E(B-V)=0, F-LINE(2796)=4.20E-12, W-LINE(2796)=0.6, F-LINE(1216)=2.90E-12, W-LINE(1216)=0.7	Reference Frame: ICRS

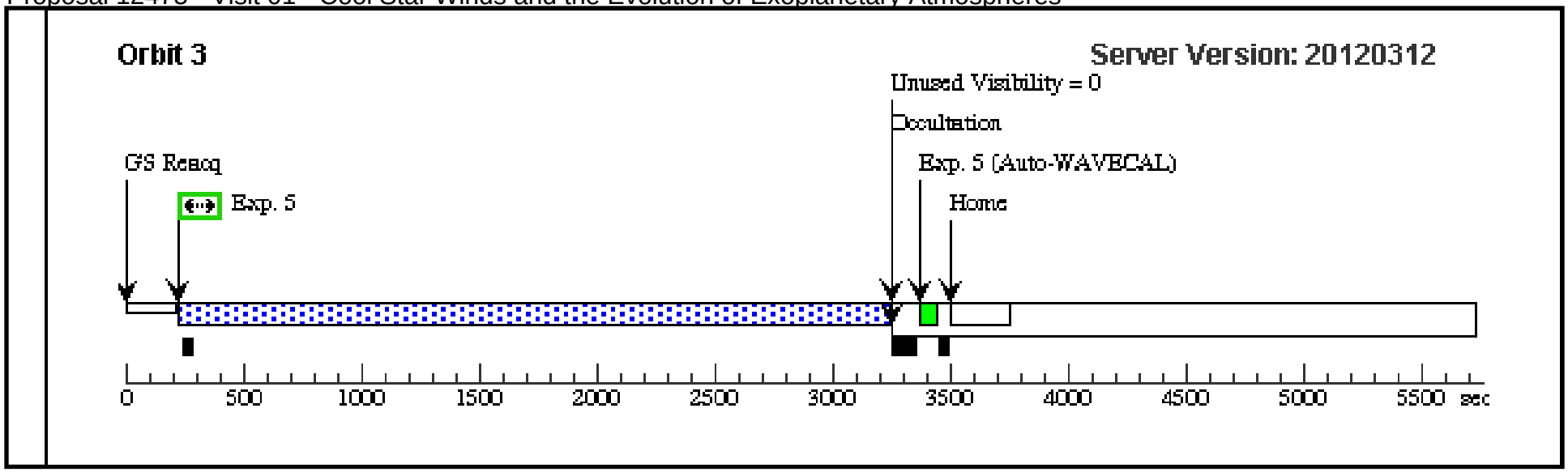
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) HD192310	STIS/CCD, ACQ, F25ND3	MIRROR				0.2 Secs	
								[==>]	***[1]***
2		(1) HD192310	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				.1 Secs	
								[==>]	***[1]***
3	(STIS.sp.18 6073)	(1) HD192310	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1885 Secs	
								[==>]	***[1]***
	Comments: Exposure time (seconds) = 1,885.0000 at wavelength 2796.00 Å gives: SNR = 54.0639 (per resolution element)								
4	(STIS.sp.18 6100)	(1) HD192310	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3005 Secs	
								[==>]	***[2]***
	Comments: Exposure time (seconds) = 6,010.0000 at wavelength 1216.00 Å gives: SNR = 31.0419 (per resolution element)								
5	(STIS.sp.18 6100)	(1) HD192310	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3005 Secs	
								[==>]	***[3]***
	Comments: Exposure time (seconds) = 6,010.0000 at wavelength 1216.00 Å gives: SNR = 31.0419 (per resolution element)								

Orbit Structure



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Exp. 5 (Auto-WAVECAL)
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Visit

Proposal 12475, Visit 02, scheduling Tue Jun 05 01:08:02 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 08-MAY-2011:00:00:00 AND 24-DEC-2011:00:00:00; BETWEEN 08-MAY-2012:00:00:00 AND 24-DEC-2012:00:00:00

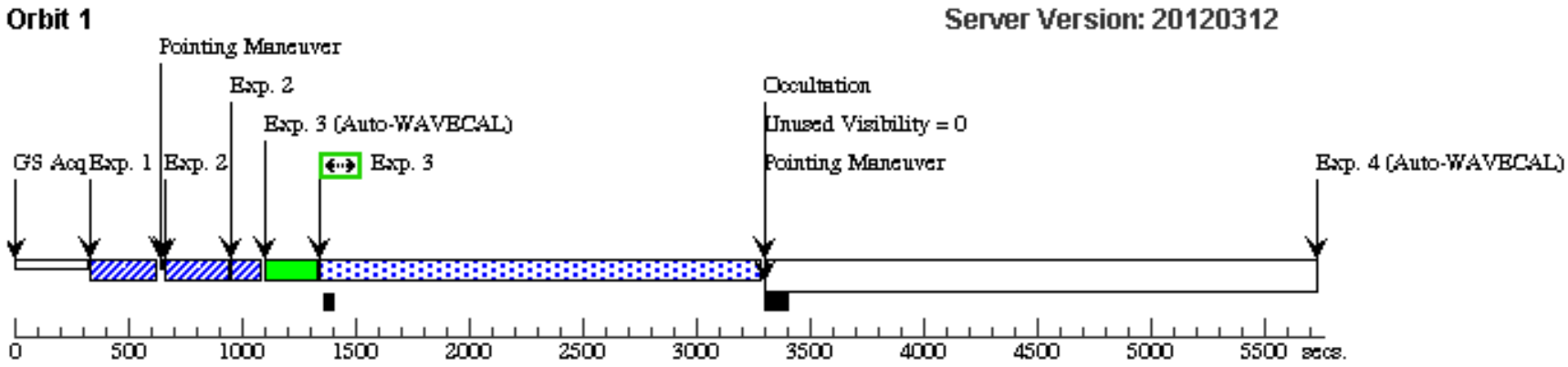
Fixed Targets

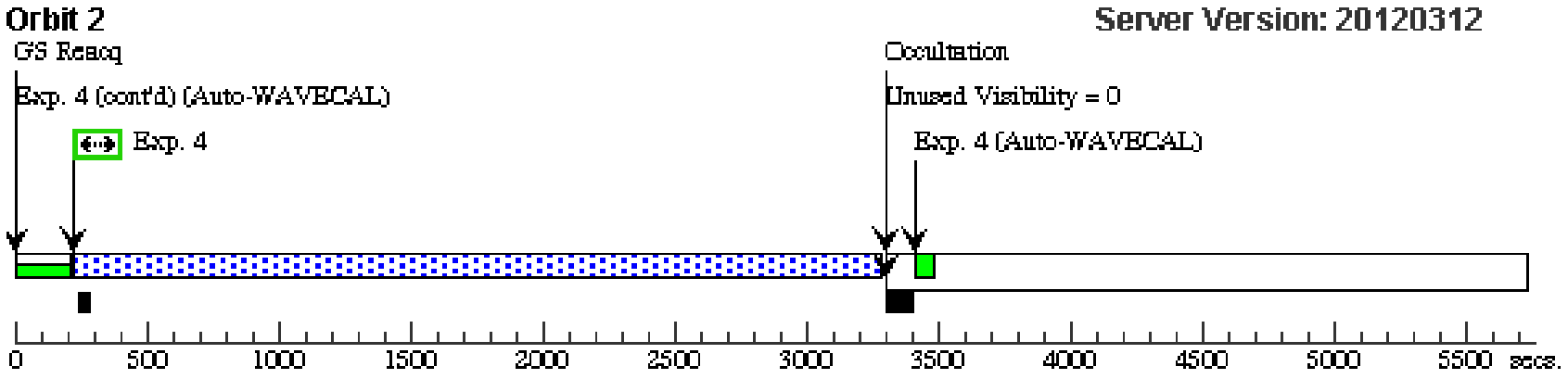
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HD147513 Alt Name1: GJ9559 Alt Name2: GSC2S2303310248	RA: 16 24 1.2400 (246.0051667d) Dec: -39 11 34.76 (-39.19299d) Equinox: J2000	Proper Motion RA: +00.484 sec of time/yr Proper Motion Dec: +0.00341 arcsec/yr Parallax: 0.07769" Epoch of Position: 1991.25 Radial Velocity: +10.1 km/sec	V=5.38+/-0.02 TYPE=G5V, B-V=0.597, E(B-V)=0, F-LINE(2796)=8.58E-12, W-LINE(2796)=0.6, F-LINE(1216)=5.70E-12, W-LINE(1216)=0.7	Reference Frame: ICRS

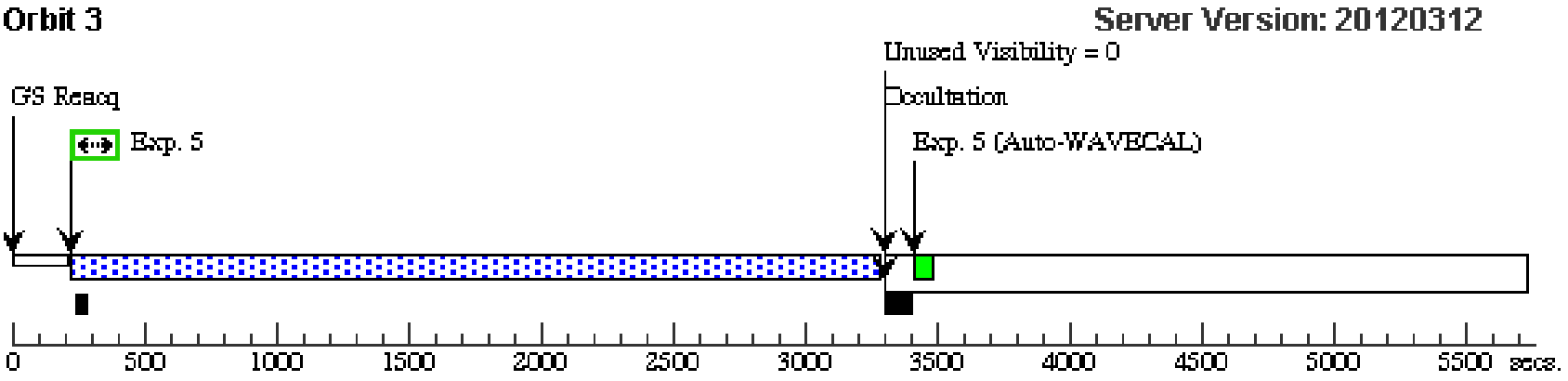
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) HD147513	STIS/CCD, ACQ, F25ND3	MIRROR				0.2 Secs *[==>]*	 ***[1]***
2		(2) HD147513	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				.1 Secs *[==>]*	 ***[1]***
3	(STIS.sp.18 6134)	(2) HD147513	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1929 Secs *[==>]*	 ***[1]***
Comments: Exposure time (seconds) = 1,929.0000 at wavelength 2796.00 Å gives: SNR = 78.3816 (per resolution element)									
4	(STIS.sp.18 6136)	(2) HD147513	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3049 Secs *[==>]*	 ***[2]***
Comments: Exposure time (seconds) = 9,147.0000 at wavelength 1216.00 Å gives: SNR = 61.8090 (per resolution element)									
5	(STIS.sp.18 6136)	(2) HD147513	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3049 Secs *[==>]*	 ***[3]***
Comments: Exposure time (seconds) = 9,147.0000 at wavelength 1216.00 Å gives: SNR = 61.8090 (per resolution element)									
6	(STIS.sp.18 6136)	(2) HD147513	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3049 Secs *[==>]*	 ***[4]***
Comments: Exposure time (seconds) = 9,147.0000 at wavelength 1216.00 Å gives: SNR = 61.8090 (per resolution element)									

Orbit Structure



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Occultation
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Exp. 5 (Auto-WAVECAL)
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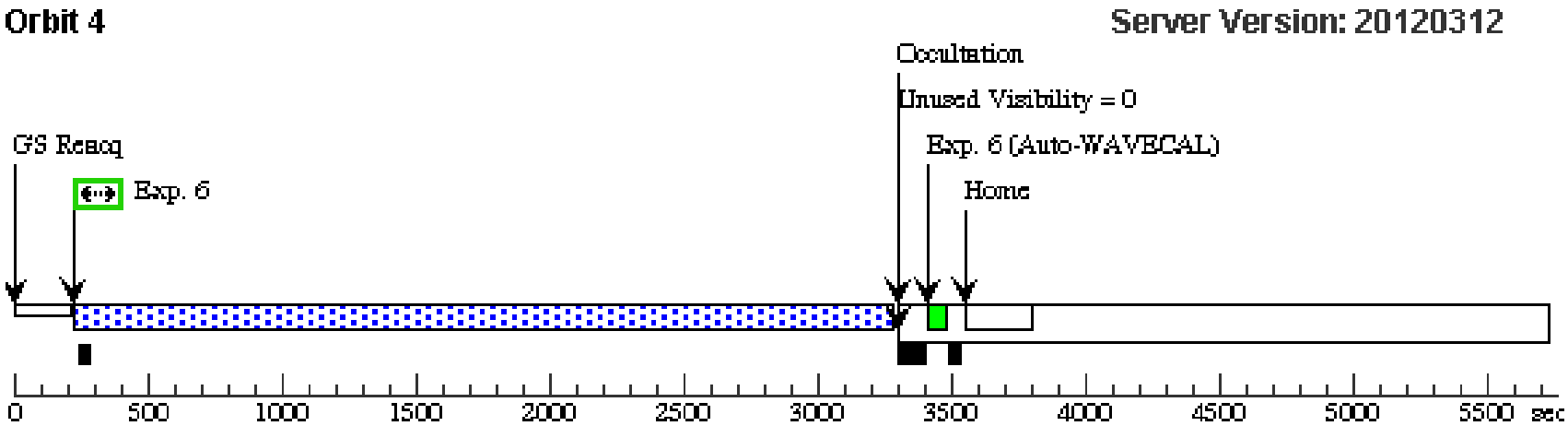
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Exp. 6
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Visit

Proposal 12475, Visit 03, scheduled Tue Jun 05 01:08:03 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

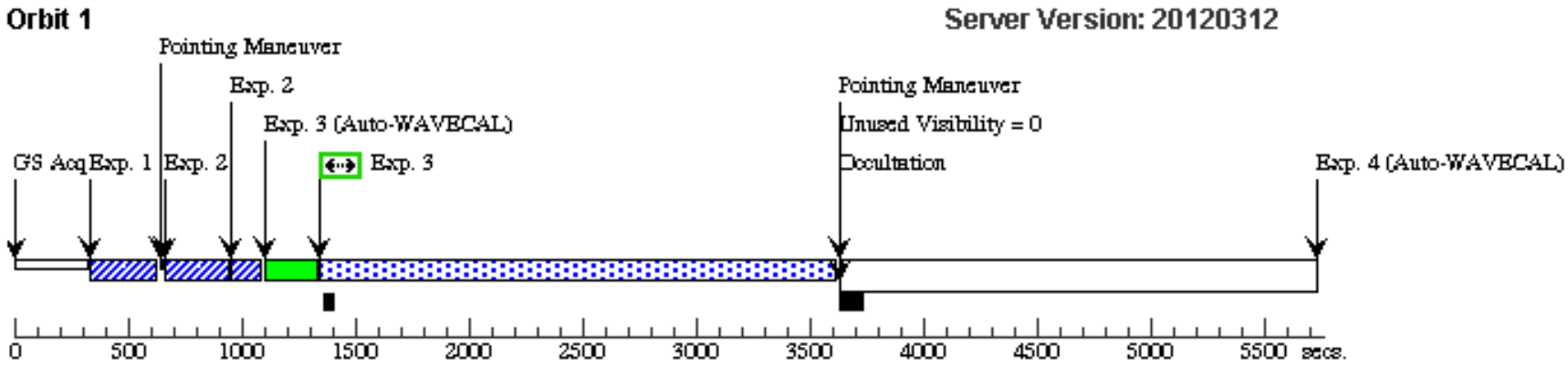
Fixed Targets

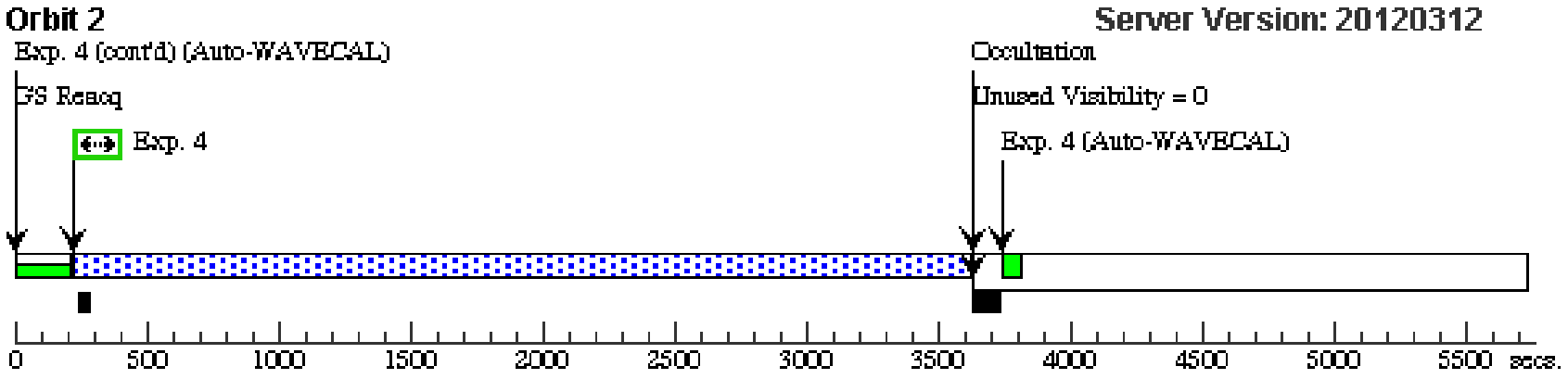
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD1237 Alt Name1: GJ3021 Alt Name2: GSC2S0100200192	RA: 00 16 11.2400 (4.0468333d) Dec: -79 51 3.75 (-79.85104d) Equinox: J2000	Proper Motion RA: +0.02892 sec of time/yr Proper Motion Dec: -0.05795 arcsec/yr Parallax: 0.05676" Epoch of Position: 1991.25 Radial Velocity: -5.9 km/sec	V=6.59+/-0.01 TYPE=G8V, B-V=0.757, E(B-V)=0, F-LINE(2796)=4.82E-12, W-LINE(2796)=0.6, F-LINE(1216)=3.44E-12, W-LINE(1216)=0.7	Reference Frame: ICRS

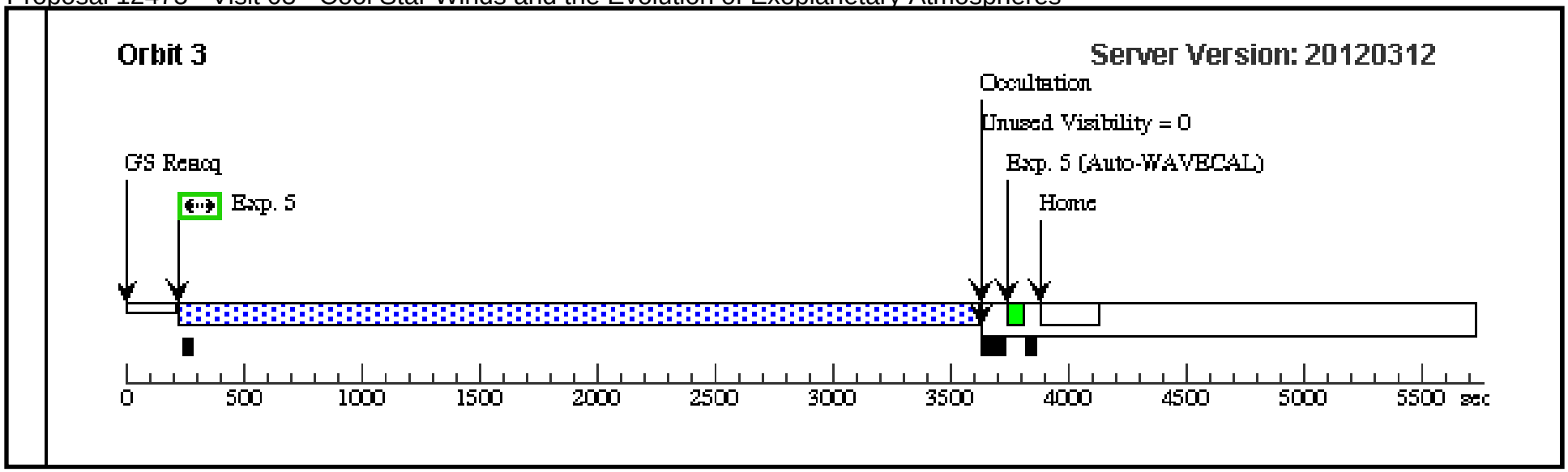
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(3) HD1237	STIS/CCD, ACQ, F25ND3	MIRROR				0.4 Secs	
								[==>]	***[1]***
2		(3) HD1237	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				.2 Secs	
								[==>]	***[1]***
3	(STIS.sp.18 6154)	(3) HD1237	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				2259 Secs	
								[==>]	***[1]***
Comments: Exposure time (seconds) = 2,259.0000 at wavelength 2796.00 Å gives: SNR = 62.0043 (per resolution element)									
4	(STIS.sp.18 6155)	(3) HD1237	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3381 Secs	
								[==>]	***[2]***
Comments: Exposure time (seconds) = 6,762.0000 at wavelength 1216.00 Å gives: SNR = 35.8792 (per resolution element)									
5	(STIS.sp.18 6155)	(3) HD1237	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3381 Secs	
								[==>]	***[3]***
Comments: Exposure time (seconds) = 6,762.0000 at wavelength 1216.00 Å gives: SNR = 35.8792 (per resolution element)									

Orbit Structure



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Exp. 5
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Visit

Proposal 12475, Visit 53 Tue Jun 05 01:08:04 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

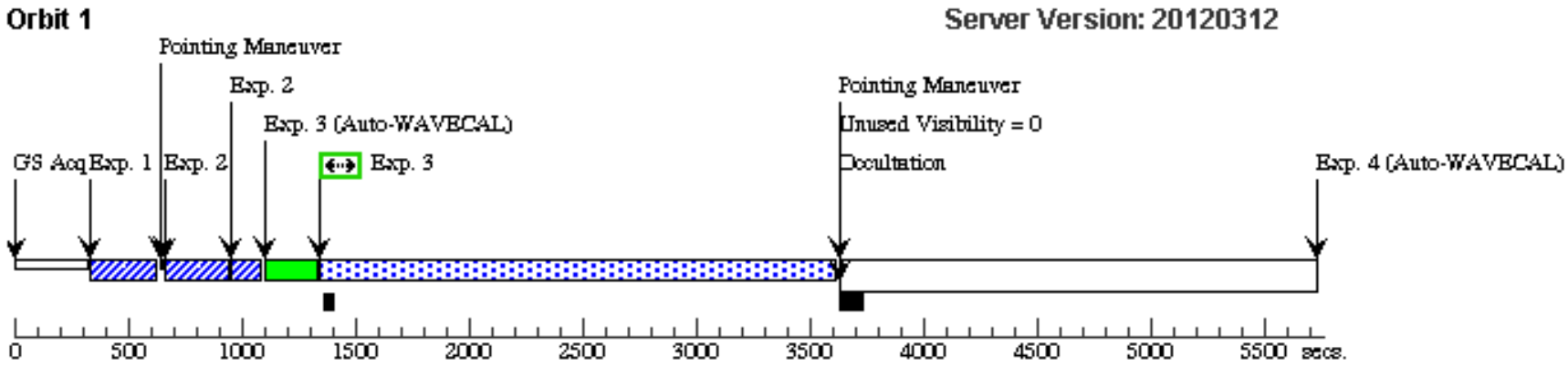
Fixed Targets

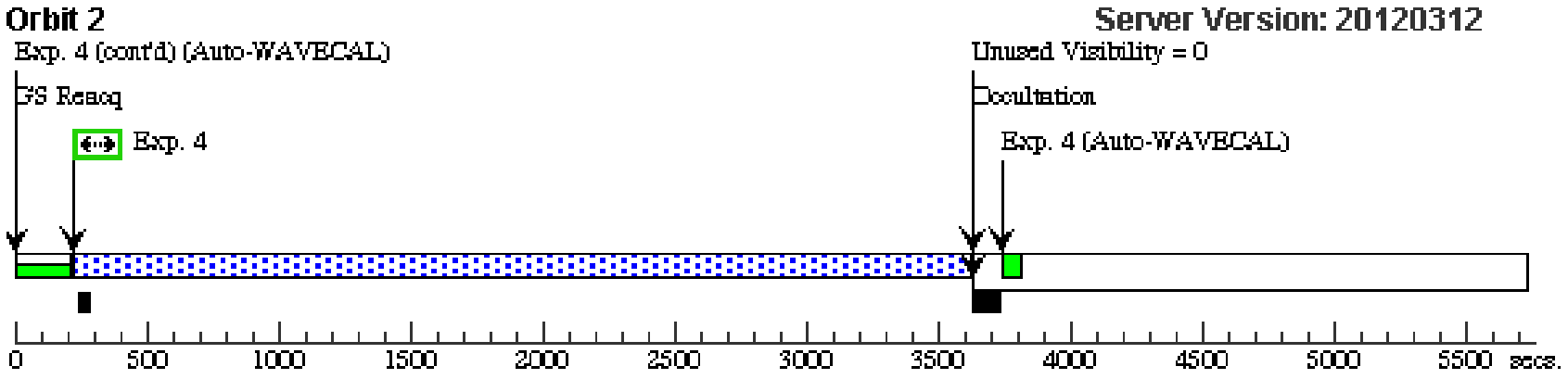
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD1237 Alt Name1: GJ3021 Alt Name2: GSC2S0100200192	RA: 00 16 11.2400 (4.0468333d) Dec: -79 51 3.75 (-79.85104d) Equinox: J2000	Proper Motion RA: +0.02892 sec of time/yr Proper Motion Dec: -0.05795 arcsec/yr Parallax: 0.05676" Epoch of Position: 1991.25 Radial Velocity: -5.9 km/sec	V=6.59+/-0.01 TYPE=G8V, B-V=0.757, E(B-V)=0, F-LINE(2796)=4.82E-12, W-LINE(2796)=0.6, F-LINE(1216)=3.44E-12, W-LINE(1216)=0.7	Reference Frame: ICRS

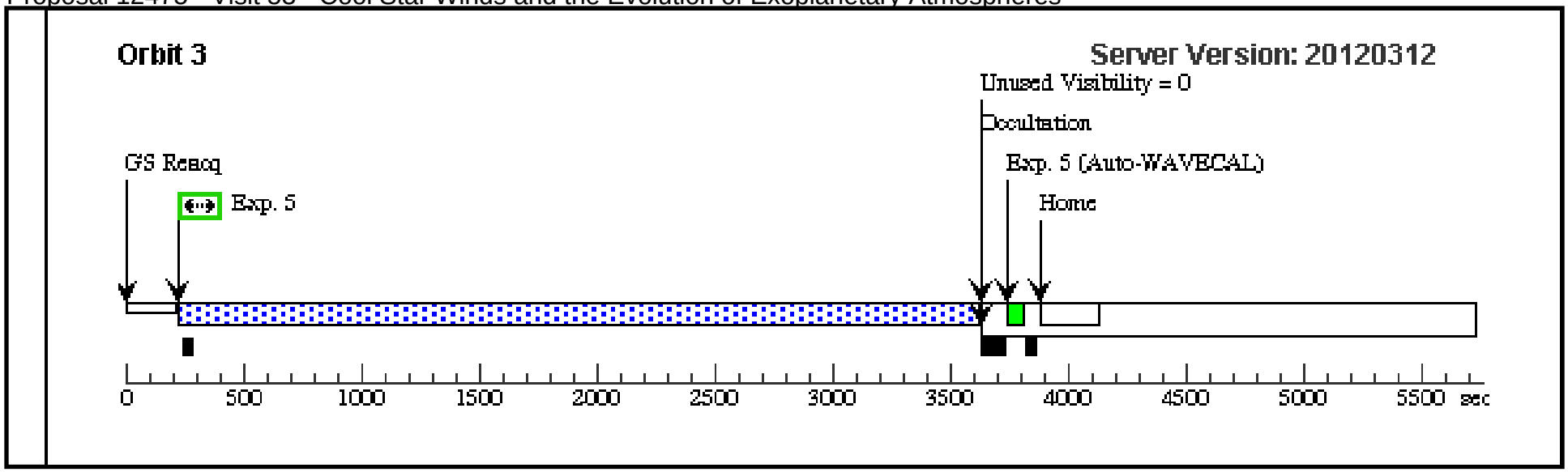
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(3) HD1237	STIS/CCD, ACQ, F25ND3	MIRROR				0.4 Secs	
								[==>]	***[1]***
2		(3) HD1237	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				.2 Secs	
								[==>]	***[1]***
3	(STIS.sp.18 6154)	(3) HD1237	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				2259 Secs	
								[==>]	***[1]***
	Comments: Exposure time (seconds) = 2,259.0000 at wavelength 2796.00 Å gives: SNR = 62.0043 (per resolution element)								
4	(STIS.sp.18 6155)	(3) HD1237	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3381 Secs	
								[==>]	***[2]***
	Comments: Exposure time (seconds) = 6,762.0000 at wavelength 1216.00 Å gives: SNR = 35.8792 (per resolution element)								
5	(STIS.sp.18 6155)	(3) HD1237	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3381 Secs	
								[==>]	***[3]***
	Comments: Exposure time (seconds) = 6,762.0000 at wavelength 1216.00 Å gives: SNR = 35.8792 (per resolution element)								

Orbit Structure



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Exp. 5 (Auto-WAVECAL)
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Visit

Proposal 12475, Visit 04, completed Tue Jun 05 01:08:05 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 14-MAR-2011:00:00:00 AND 13-DEC-2011:00:00:00; BETWEEN 14-MAR-2012:00:00:00 AND 13-DEC-2012:00:00:00; BETWEEN 14-MAR-2013:00:00:00 AND 13-DEC-2013:00:00:00

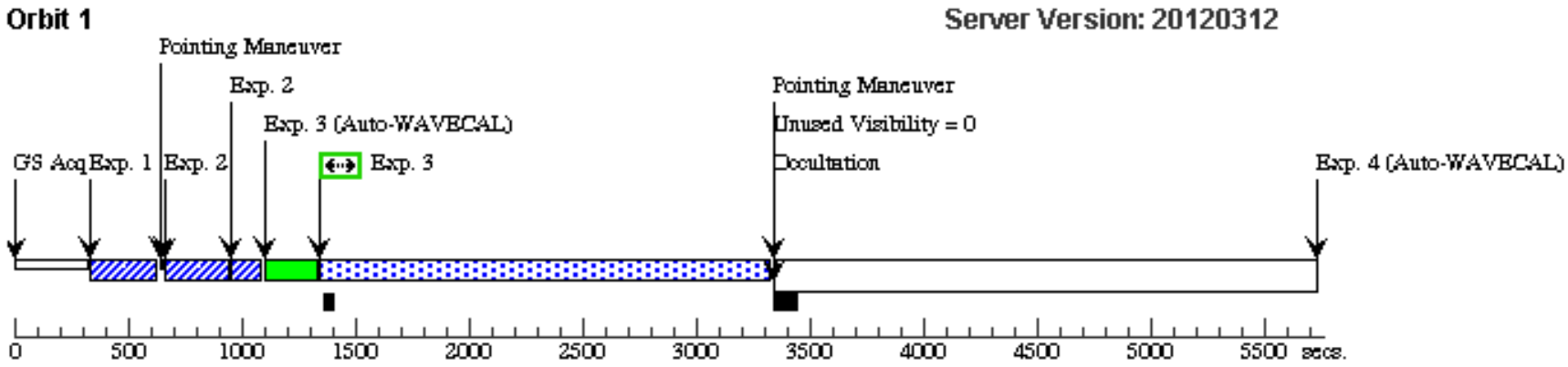
Fixed Targets

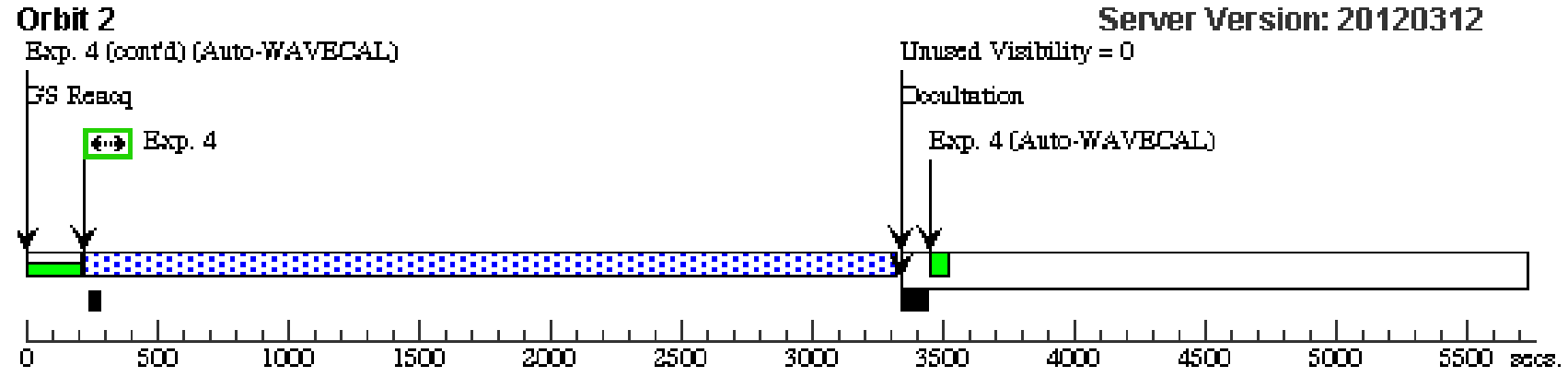
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	HD9826 Alt Name1: GJ61 Alt Name2: GSC2N3303311819	RA: 01 36 47.9800 (24.1999167d) Dec: +41 24 22.99 (41.40639d) Equinox: J2000	Proper Motion RA: -0.01150 sec of time/yr Proper Motion Dec: -0.38101 arcsec/yr Parallax: 0.07425" Epoch of Position: 1991.25 Radial Velocity: -28.3 km/sec	V=4.09+/-0.02 TYPE=F8V, B-V=0.54, E(B-V)=0, F-LINE(2796)=1.61E-11, W-LINE(2796)=0.75, F-LINE(1216)=7.83E-12, W-LINE(1216)=1.0	Reference Frame: ICRS

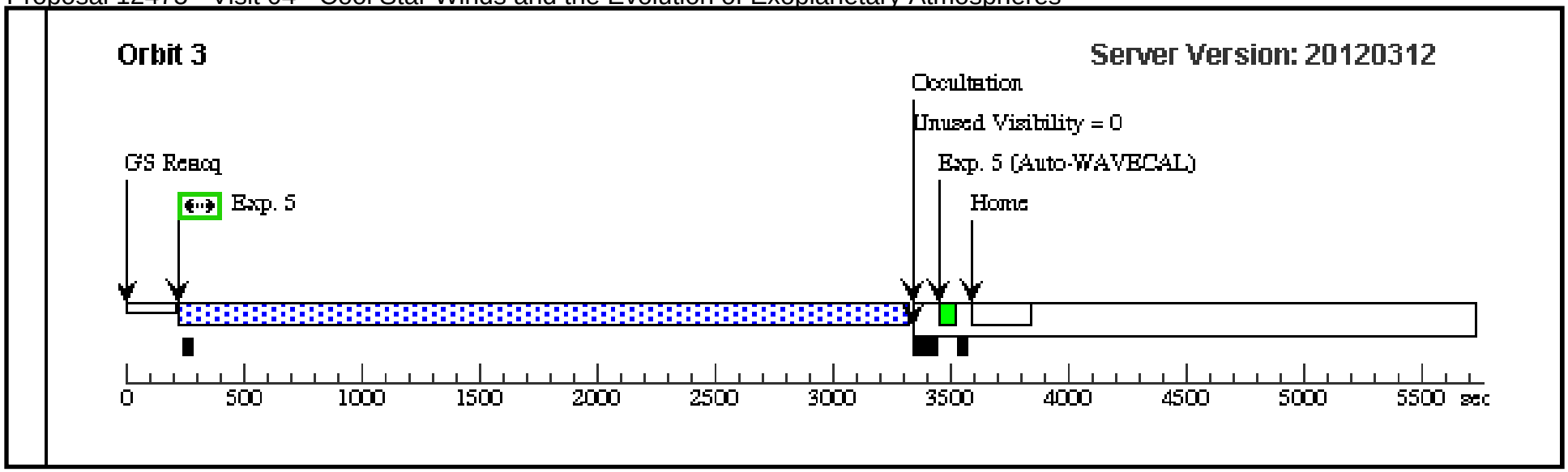
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(4) HD9826	STIS/CCD, ACQ, F25ND3	MIRROR				0.1 Secs	
								[==>]	***[1]***
2		(4) HD9826	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				.1 Secs	
								[==>]	***[1]***
3	(STIS.sp.18 6169)	(4) HD9826	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1969 Secs	
								[==>]	***[1]***
	Comments: Exposure time (seconds) = 1,969.0000 at wavelength 2796.00 Å gives: SNR = 115.4967 (per resolution element)								
4	(STIS.sp.18 6171)	(4) HD9826	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3089 Secs	
								[==>]	***[2]***
	Comments: Exposure time (seconds) = 6,178.0000 at wavelength 1216.00 Å gives: SNR = 47.0706 (per resolution element)								
5	(STIS.sp.18 6171)	(4) HD9826	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3089 Secs	
								[==>]	***[3]***
	Comments: Exposure time (seconds) = 6,178.0000 at wavelength 1216.00 Å gives: SNR = 47.0706 (per resolution element)								

Orbit Structure






Orbit 3
Server Version: 20120312
Occultation
Unused Visibility = 0
GS Reacq
Exp. 5
Exp. 5 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec