12596 - In Search of a Young Solar Wind

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) HD30652	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	13-Aug-2012 21:27:55.0	yes
02	(2) HD72905	STIS/CCD STIS/FUV-MAMA	2	13-Aug-2012 21:28:07.0	yes
03	(3) HD35296	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	13-Aug-2012 21:28:17.0	yes
04	(4) HD206860	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	13-Aug-2012 21:28:28.0	yes

8 Total Orbits Used

ABSTRACT

There are three main reasons why we would very much like to know how the coronal winds emanating from the Sun and other solar-like stars evolve with time. 1. Stellar winds have important effects on planetary atmospheres, with Mars being a particularly important example in our own solar system. 2. Stellar winds may contribute to the dissipation of debris disks. 3. Stellar winds play a central role in the angular momentum and activity evolution of cool main sequence stars. The best way to investigate stellar wind evolution is to detect and measure the winds of solar-like stars of various ages to see how they change with time. Unfortunately, detecting coronal winds is extremely difficult. The only detections to date come from high resolution HST Lyman-alpha spectra of nearby stars, which sometimes show absorption from the stellar "astrospheres" (i.e., interaction regions between stellar winds and the ISM). The amount of absorption can be used as a diagnostic of the stellar wind strength. There are 13 astrospheric detections so far, but unfortunately there are still no unambiguous detections for any true young, solar analogs. We here propose to try to rectify this situation by observing four young, very active solar-like stars with HST/STIS, in the hopes that at least one or two will yield an astrospheric detection that can finally tell us what coronal winds are like for young F and G stars. Success would mean a major step forward in being able to address the question of how winds evolve for solar-like stars, and how that affects the planets and disks that surround them.

OBSERVING DESCRIPTION

We will observe our 4 stars with STIS for 2 orbits each. We acquire each of our rather bright stars with a 0.1 second exposure onto the STIS/CCD with the F28X50OII filter. An accurate wavelength scale is important for our purposes so we will perform a peakup into the narrow 0.2"x0.09" aperture. A dispersed light peakup is required for our bright targets and we use a 0.1 s exposure with the G430M grating for the peakups. After acquisition, the first orbit will generally consist of an E230H spectrum of the 2574-2851 Angstrom wavelength range, through the 0.2"x0.09" aperture. We require this spectrum to study the velocity structure of the ISM towards our targets using the narrow interstellar Mg II h & k lines near 2800 Angstrom and Fe II at 2600 Angstroms. This information is needed to maximize our ability to accurately model the interstellar H I Lyman-alpha absorption and search for the presence of an astrospheric absorption signature for which the ISM cannot account (Wood et al. 2005b).

The second orbit of each target visit will be used for an E140M spectrum of the 1150-1700 Angstrom wavelength range through the 0.2"x0.2" aperture, which will contain the primary line of interest: H I Lyman-alpha at 1216 Angstroms. All but one of our targets are comfortably in compliance with STIS/MAMA bright object limits, as verified using both Table 13.44 in the STIS Instrument Handbook and the online STIS exposure time calculator. The exception is HD 30652. The E230H exposure for this star exceeds the total image count rate limit unless we replace the 0.2"x0.09" aperture with the tiny 0.1"x0.03" slit. An extra peakup is required to center the star in this tiny aperture. Note also that the E230H exposure will not be necessary for HD 72905, as one already exists in the HST archive. Thus, both orbits will be used for the E140M exposure in this case. The E230H observation will provide the highest resolution spectrum of the Mg II and Fe II absorption lines. The E140M grating does not

have quite the resolution of E230H, but its resolution is good enough to study the H I Lyman-alpha line profile in the detail that we require.

Estimating expected S/N for our planned spectra requires first estimating Lyman-alpha and Mg II fluxes, which we can do by extrapolating from previously observed stars. Chromospheric line fluxes (such as Mg II and Lyman-alpha) are related to X-ray fluxes through the relation $f_{\rm chrom}\propto f_{\rm X}^{0.34}$ from Ayres et al. (1995). Thus, Lyman-alpha or Mg II fluxes for our stars can be estimated from the equation

\begin{equation}
f_{2}=f_{1} \left(\frac{d_{1}}{d_{2}} \right)^{2}
\left(\frac{L_{X2}}{L_{X1}} \right)^{0.34},
\end{equation}

where d_{2} and L_{X2} are the distances and X-ray luminosities listed in Table 1 for our target stars, and d_{1}, L_{X1}, and f_{1} are the distance, X-ray luminosity, and Lyman-alpha (or Mg II) flux observed from some reference star, respectively. Wood et al. (2005b) provide Lyman-alpha spectra for many stars. We use Chi1 Ori as the comparison star for our purposes here.

After acquisition, peakup, and observational overhead are considered, we expect about 28 minutes to be available in the first orbit for the E230H exposure. We expect this to be enough time to attain a more than sufficient S/N >50 at line center for the strong Mg II lines. After acquisition and overheads are considered, we expect our 1 orbit E140M exposure to be about 46 minutes in length, sufficient to achieve a S/N>15 within the H I Lyman-alpha line profile for all of our stars, which should be good enough for our purposes considering the broad width of the line.

Visit

Proposal 12596, Visit 01, completed Tue Aug 14 01:28:35 GMT 2012

Diagnostic Status: Warning

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

Special Requirements: BETWEEN 14-MAY-2011 AND 20-DEC-2011; BETWEEN 14-MAY-2012 AND 20-DEC-2012; BETWEEN 14-MAY-2013 AND 20-DEC-2013

Diagnostics

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD30652	RA: 04 49 50.1380 (72.4589083d)	Proper Motion RA: 464.06 mas/yr	V=3.19+/-0.01	Reference Frame: ICRS
	Alt Name1: PI3-ORI	Dec: +06 57 40.49 (6.96125d)	Proper Motion Dec: 11.21 mas/yr	TYPE=F6V,	
		Equinox: J2000	Parallax: 0.12394"	F-LINE(2796)=2.7+/-0.7E-11,	
			Epoch of Position: 2000.0	W-LINE(2796)=0.6,	
			Radial Velocity: +24.1 km/sec	F-LINE(1216)=1.2+/-0.4E-11,	
				W-LINE(1216)=0.8	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

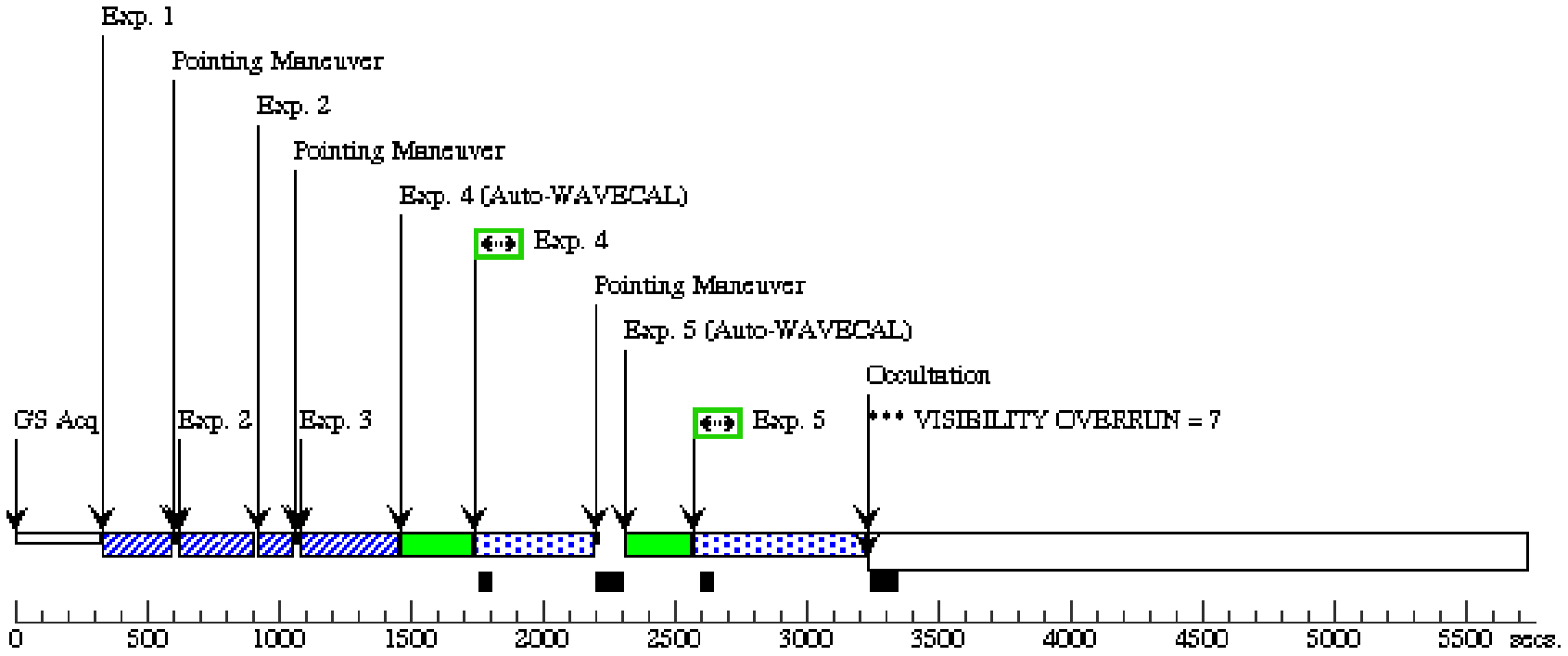
Exposures

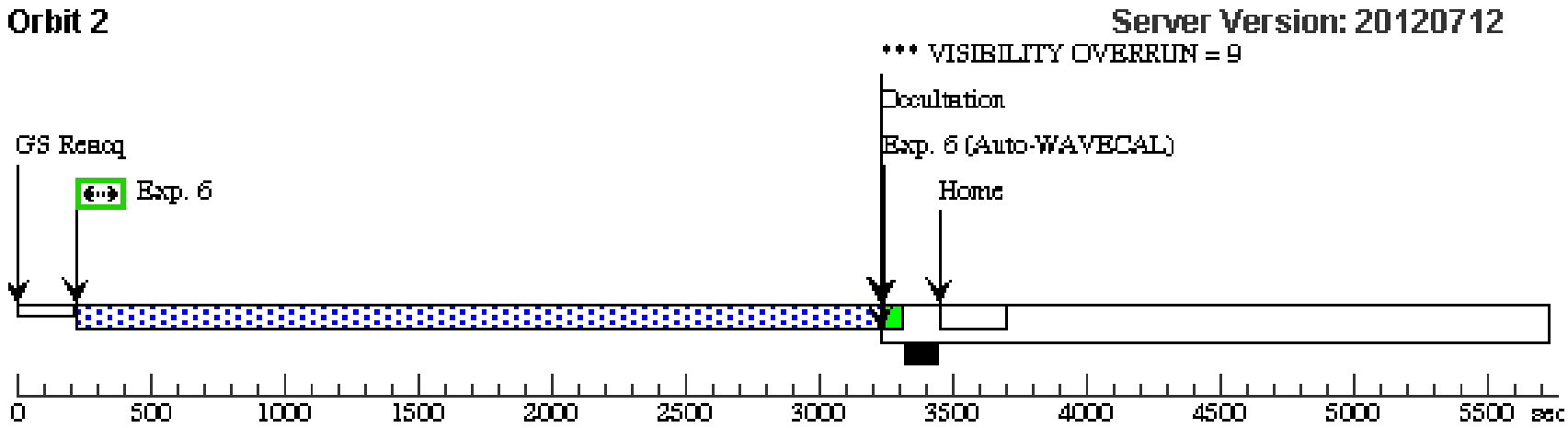
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(178378)	(1) HD30652	STIS/CCD, ACQ, F28X50OII	MIRROR				0.1 Secs	
								[==>]	***[1]***
2	(178389)	(1) HD30652	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M				0.1 Secs	
				4451 A				*[==>]*	***[1]***
3	(178389)	(1) HD30652	STIS/CCD, ACQ/PEAK, 0.1X0.03	G430M				0.1 Secs	
				4451 A				*[==>]*	***[1]***
4	(178400)	(1) HD30652	STIS/NUV-MAMA, ACCUM, 0.1X0.03	E230H				300.0 Secs	
				2713 A				*[==>431.0 Secs]*	***[1]***

Comments: The total expected count rate is 161128/s, which is within 40% of the Bright Object Limit, so there is a warning. But this NUV continuum flux should not be variable. So as long as the count rate estimate i s good, it should be OK. And I tried different models for this F6 V star in the exposure time calculator, and they are all very consistent.

5	(178406)	(1) HD30652	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				500 Secs	
				1425 A				*[==>631.0 Secs]*	***[1]***
6	(178406)	(1) HD30652	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				3000 Secs	
				1425 A				*[==>2990.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 12596, Visit 02, implementation Tue Aug 14 01:28:38 GMT 2012

Diagnostic Status: Warning

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

Special Requirements: (none)

Diagnostics

(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

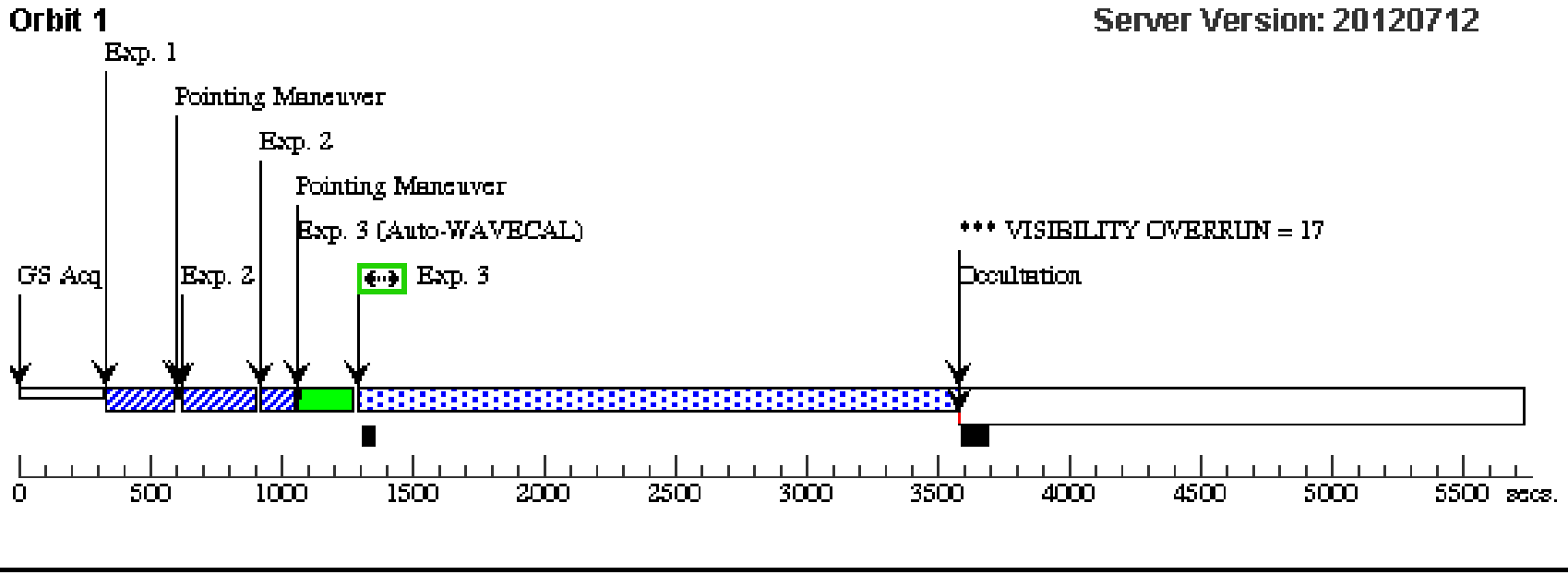
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HD72905 Alt Name1: PI1-UMA	RA: 08 39 11.7040 (129.7987667d) Dec: +65 01 15.27 (65.02091d) Equinox: J2000	Proper Motion RA: -27.44 mas/yr Proper Motion Dec: 88.13 mas/yr Parallax: 0.06966" Epoch of Position: 2000.0 Radial Velocity: -12.0 km/sec	V=5.645+/-0.010 TYPE=G1.5V, F-LINE(2796)=8.2+/-2.0E-12, W-LINE(2796)=0.6, F-LINE(1216)=3.6+/-1.2E-12, W-LINE(1216)=0.8	Reference Frame: ICRS

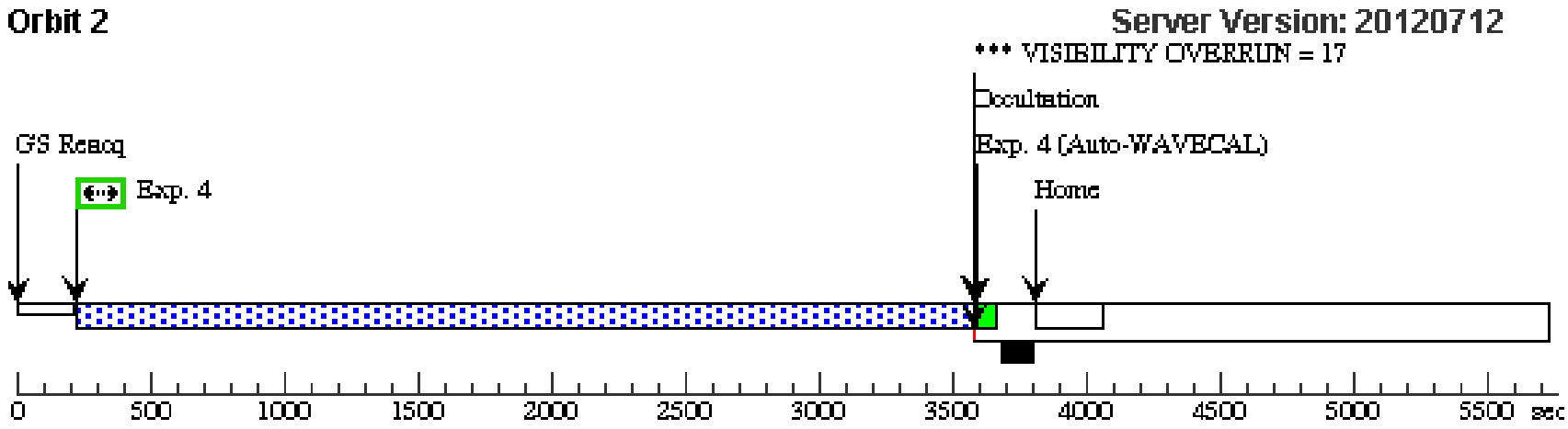
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(178383)	(2) HD72905	STIS/CCD, ACQ, F28X50OII	MIRROR				0.1 Secs *[==>]*	 ***[1]***
2	(178390)	(2) HD72905	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 4451 A				0.1 Secs *[==>]*	 ***[1]***
3	(178407)	(2) HD72905	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				1500 Secs *[==>2279.0 Secs]*	 ***[1]***
4	(178407)	(2) HD72905	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				3000 Secs *[==>3347.0 Secs]*	 ***[2]***

Orbit Structure





Visit

Proposal 12596, Visit 03, implementation Tue Aug 14 01:28:42 GMT 2012

Diagnostic Status: Warning

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

Special Requirements: BETWEEN 25-MAY-2010 AND 29-DEC-2010; BETWEEN 25-MAY-2011 AND 29-DEC-2011; BETWEEN 25-MAY-2012 AND 29-DEC-2012; BETWEEN 25-MAY-2013:00:00:00 AND 29-DEC-2013:00:00:00

Diagnostics

(Visit 03) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 03) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

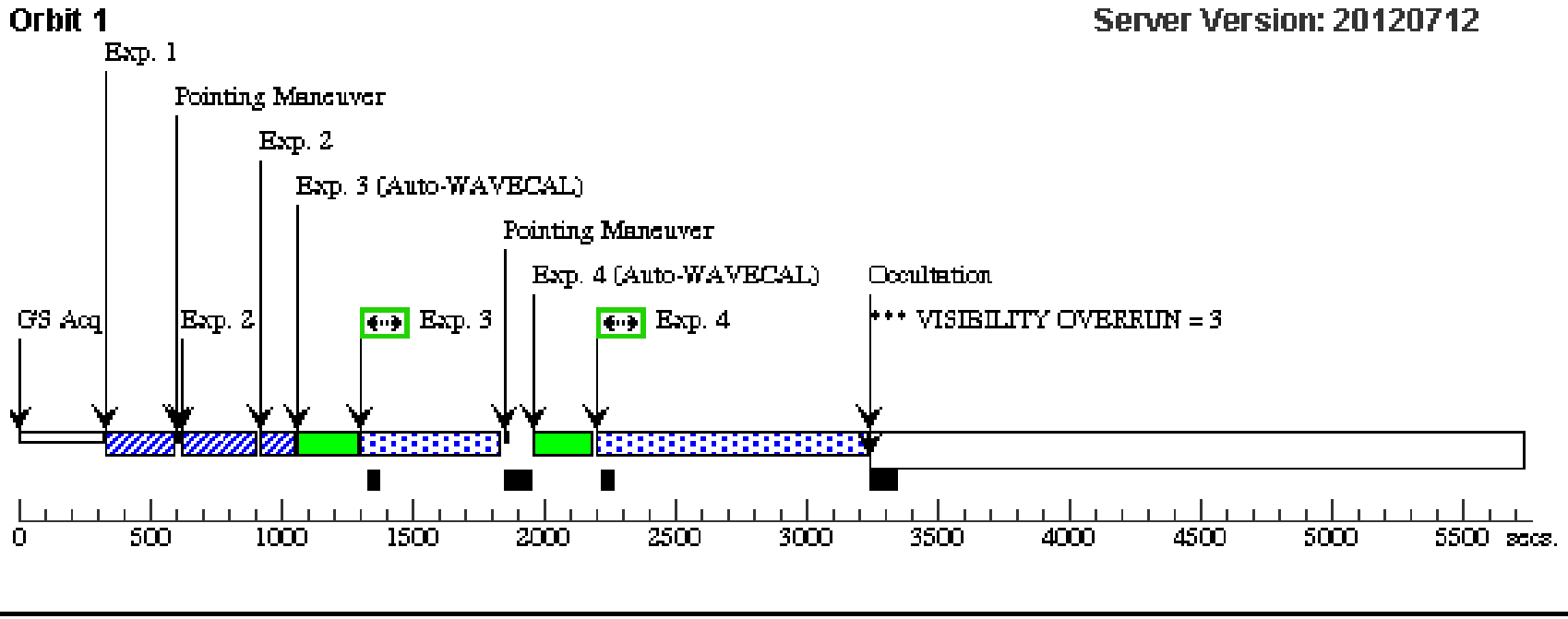
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD35296	RA: 05 24 25.4640 (81.1061000d)	Proper Motion RA: 251.05 mas/yr	V=5.00+/-0.01	Reference Frame: ICRS
	Alt Name1: V1119-TAU	Dec: +17 23 0.72 (17.38353d)	Proper Motion Dec: -7.99 mas/yr	TYPE=F8V,	
		Equinox: J2000	Parallax: 0.06951"	F-LINE(2796)=1.0+/-0.3E-11,	
			Epoch of Position: 2000.0	W-LINE(2796)=0.6,	
			Radial Velocity: +36.5 km/sec	F-LINE(1216)=4.6+/-1.5E-12,	
				W-LINE(1216)=0.8	

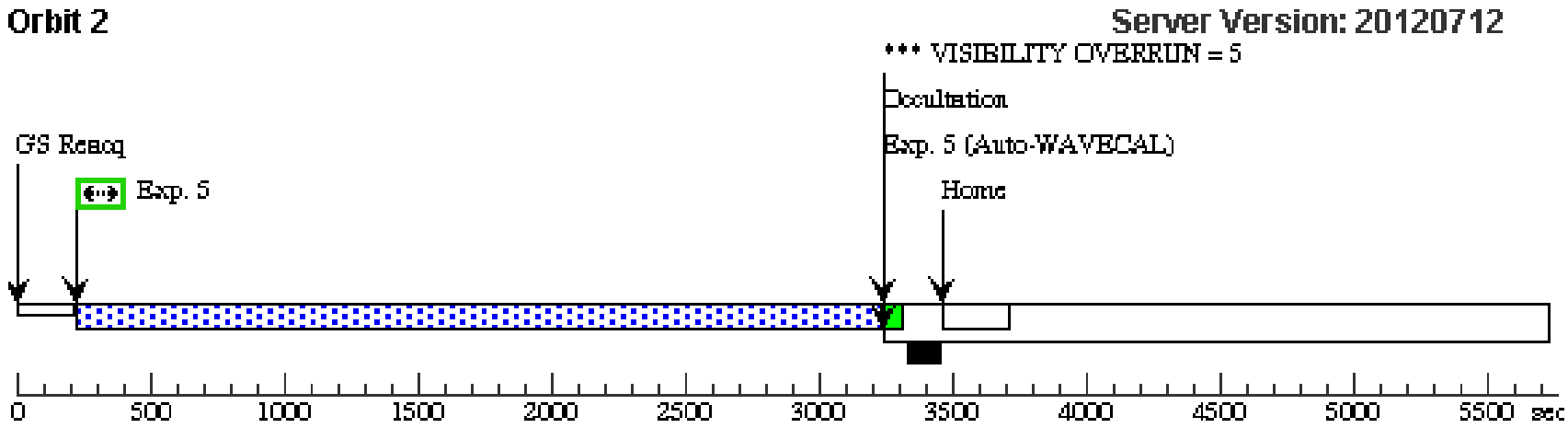
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(178384)	(3) HD35296	STIS/CCD, ACQ, F28X50OII	MIRROR				0.1 Secs	
								[==>]	***[1]***
2	(178391)	(3) HD35296	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M				0.1 Secs	
				4451 A				*[==>]*	***[1]***
3	(178405)	(3) HD35296	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H				500.0 Secs	
				2713 A				*[==>516.0 Secs]*	***[1]***
4	(178408)	(3) HD35296	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				1000 Secs	
				1425 A				*[==>1016.0 Secs]*	***[1]***
5	(178408)	(3) HD35296	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				2900 Secs	
				1425 A				*[==>2997.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 12596, Visit 04, implementation Tue Aug 14 01:28:44 GMT 2012

Diagnostic Status: Warning

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

Special Requirements: (none)

Diagnostics

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	HD206860	RA: 21 44 31.3290 (326.1305375d)	Proper Motion RA: 229.93 mas/yr	V=5.95+/-0.01	Reference Frame: ICRS
	Alt Name1: HN-PEG	Dec: +14 46 18.98 (14.77194d)	Proper Motion Dec: -113.46 mas/yr	TYPE=G0V,	
		Equinox: J2000	Parallax: 0.05591"	F-LINE(2796)=5.9+/-1.5E-12,	
			Epoch of Position: 2000.0	W-LINE(2796)=0.6,	
			Radial Velocity: -18.9 km/sec	F-LINE(1216)=2.6+/-0.9E-12,	
				W-LINE(1216)=0.8	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(178385)	(4) HD206860	STIS/CCD, ACQ, F28X50OII	MIRROR				0.1 Secs	
								[==>]	***[1]***
2	(178392)	(4) HD206860	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M				0.1 Secs	
				4451 A				*[==>]*	***[1]***
3	(178404)	(4) HD206860	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H				900.0 Secs	
				2713 A				*[==>964.0 Secs]*	***[1]***
4	(178409)	(4) HD206860	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				500 Secs	
				1425 A				*[==>564.0 Secs]*	***[1]***
5	(178409)	(4) HD206860	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M				2900 Secs	
				1425 A				*[==>2993.0 Secs]*	***[2]***

Orbit Structure