12277 - HD 62542: Probing the Bare, Dense Core of an Interstellar Cloud

Cycle: 18, 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) HD62542	STIS/CCD STIS/FUV-MAMA	5	09-Jul-2010 00:47:59.0	yes
02	(1) HD62542	STIS/CCD STIS/FUV-MAMA	5	09-Jul-2010 00:48:11.0	yes
03	(1) HD62542	STIS/CCD STIS/NUV-MAMA	3	09-Jul-2010 00:48:19.0	yes
04	(1) HD62542	STIS/CCD STIS/NUV-MAMA	5	09-Jul-2010 00:48:27.0	yes

18 Total Orbits Used

ABSTRACT

The line of sight to HD 62542 is remarkable for its unusual UV extinction, high column densities of various molecules (for A_v~1), and apparent dearth of diffuse atomic gas. Most of the interstellar material resides in a single cold cloud -- a small, relatively dense (n_H ~ 500--1000 cm^-3), molecular knot whose more diffuse outer layers appear to have been stripped away by stellar winds and shocks. As such, it provides an ideal venue for investigating the properties of moderately dense molecular gas -- including the production of molecules and growth of grains in such gas -- with minimal confusion from any associated diffuse atomic gas. We propose to obtain high resolution, moderately high S/N STIS spectra of C I, CO and its isotopomers, C_2, CS, C II, O I, and many other atomic species (characterized by a wide range in depletion behavior). Those data will be used to compare various diagnostics of the physical conditions (e.g., C I and O I fine-structure excitation, CO and C_2 rotational excitation), to determine the relative abundances of the various CO isotopomers (fractionation), and to determine the depletions of various elements in moderately dense gas (the predicted severe depletions have likely been masked by associated diffuse gas in other cases). Understanding the fractionation and excitation of CO in this relatively simple case will aid in understanding its behavior in other more complex regions (important because CO and its isotopomers are often used to trace and characterize molecular gas where H_2 cannot be directly measured).

OBSERVING DESCRIPTION

Our goal is to obtain high resolution (FWHM ~ 2.7 km/s), moderately high S/N (~ 40--100) STIS echelle observations of interstellar absorption lines toward HD 62542. The line of sight to HD 62542 offers the rare opportunity to probe the moderately dense molecular core of an interstellar cloud, with little associated diffuse atomic gas.

Wavelength settings:
The four wavelength settings are chosen to cover
1) multiplets of C~I (range in strength);
2) permitted and intersystem bands of CO and isotopomers (range in strength);
3) (relatively) strong C2 bands (1314, 1341, 2313);
4) a newly identified line of CS (1400) (Destree et al. 2009);
5) strong and weak lines of C~II (1334, 2325) and Si~II (1808, 2335);
6) lines of various dominant ions (both depleted and undepleted); and
7) lines from a number of trace neutral species.

Only HST/STIS can cover these UV lines at the high spectral resolution required to resolve the CO rotational structure and determine the properties of the main component in the various atomic lines. (We will use simultaneous multi-component fits to the profiles of similarly distributed species, using information from the higher-resolution optical spectra, to determine column densities.) The two E140H settings largely overlap, in order to obtain higher S/N for weak lines in the region of overlap. Because the permitted 12CO A-X bands will likely be quite strong toward HD 62542, we will obtain CO column densities from the much weaker intersystem lines (e.g., at 1323, 1366, 1402, 1419, 1422, and 1442A), for which accurate f-values are now available (Sheffer et al. 2002a). Many of the atomic species will have relatively weak (but measurable) lines within our spectral coverage; stronger lines will include contributions from additional velocity components. We will use the 0.2x0.09 slit for all settings.

Grating	Setting	Range	Species
E140H	1307	1206-1408	12CO, 13CO, C17O, C18O, C2, CS, C~I, C~II,
&	&	&	O~I, Cl~I, P~II, Cu~II, Ni~II, S~II, Mg~II, Si~II,
&	&	&	S~I, B~II, Ge~II, Kr~I, Sn~II, As~II, Cu~II
E140H	1343	1242-1444	most lines from 1307, plus Ga~II, Pb~II, more CO
E230H	1913	1774-2051	Mg~I, Si~I, S~I, Zn~II, Si~II, Ti~II, Al~III
E230H	2263	2124-2401	Si~I, Fe~I, Zn~I, C2, Fe~II, C~II], Si~II]

Exposure times:

For the E140H settings, we require S/N ~ 50 in the overlap region (1242--1408 A), in order to obtain 2sigma uncertainties < 1 mA for narrow, unresolved lines (e.g., for reliable measurement of the various weak CO intersystem and isotopomeric lines that are needed for accurate column densities). Given the high N(C3) and N(CN), we expect N(CO) in the range 2--6 x 10^{16} cm^{-2} (higher than toward X Per), so a number of those weaker lines should be accurately measurable. Somewhat lower S/Ns are acceptable for the stronger lines sought in the non-overlap E140H regions and in the E230H/1913 exposure. For the E230H/2263 setting, we require S/N ~ 100, to obtain 2sigma uncertainties (or limits) of about 1 mA for the very weak C~II] 2325 and Si~II] 2335 lines. For the Si~II] line, such a limit will enable either a detection or a significant limit (when coupled with the 1808 line); the 2335 line has been detected at W ~ 0.5--2.5 mA in other translucent sight lines (Miller et al. 2007). The high S/N should also enable the detection of individual C2 D-X (0-0) rotational lines to at least J=14 -- enabling more precise estimates for the temperature and density in the cloud. We have used the on-line (web-based) STIS exposure calculator to estimate exposure times; the fluxes (at 1500 and 2000 A) are from IUE low-dispersion spectra. No STIS count rate limits are violated.

At dec ~ -42, each orbit will have about 57 min visibility, and each multi-orbit visit will have the following overheads:
6 min for initial guide star acquisition (5 min for re-acquisition in subsequent orbits);
6 min for target acquisition;
6 min for initial peakup;
6 min for second peakup (after 3rd orbit);
8 min for each new MAMA spectroscopic exposure (1 min for subsequent identical exposures).
The following table shows the plan for the four visits.

Grating&Setting& Range&Resolution& Flux &Exposure&S/N&Orbits
& & & (\kms) & & (min) & &

E140H& 1307& 1206-1408& 2.7&2.0e-12& 229& 35& 5
E140H& 1343& 1242-1444& 2.7&2.0e-12& 229& 36& 5
E230H& 1913& 1774-2051& 2.7&3.0e-12& 133& 43& 3
E230H& 2263& 2124-2401& 2.7&3.0e-12& 229& 96& 5

Acquisition:
HD 62542 is bright enough and isolated enough that a standard CCD point source acquisition should be sufficient, with the time dominated by overhead.

Visit

Proposal 12277, Visit 01 Fri Jul 09 04:48:32 GMT 2010

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD62542	RA: 07 42 37.2200 (115.6550833d) Dec: -42 13 47.80 (-42.22994d) Equinox: J2000	Proper Motion RA: -6.815643540032627E-4s/yr Proper Motion Dec: 0.00439"/yr Parallax: 0.00406" Epoch of Position: 2000.0	V=8.03+/-0.03 F(1350)=2.0e-12; F(1900)=3.0e-12; F(2250)=3.0e-12	Reference Frame: ICRS

Comments: UV fluxes are from IUE spectra (low dispersion, large aperture)
GSC2ID = S132331157
coordinates from Hipparcos catalog

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	HD62542_acq	(1) HD62542	STIS/CCD, ACQ, F28X50OII	MIRROR				2 Secs *[==>]*	 ***[1]***
Comments: see STIS target acq ETC STIS.A330371-- S/N~254 for t_exp=2 sec (t_sat~7.8 sec) *assumes B3 V star, with E(B-V)=0.35, LMC extinction (steeper than MW), V=8.0*									
2	HD62542_peak	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	 ***[1]***
Comments: see STIS target acq ETC STIS.A330376 -- S/N~323 for t_exp=2 sec (t_sat~7.3 sec) *assumes B3 V star, with E(B-V)=0.35, LMC extinction (steeper than MW), V=8.0*									
3	HD62542_spec1	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A				1941 Secs *[==>1941.0 Secs]*	 ***[1]***
4	HD62542_spec2	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A				3089 Secs *[==>3089.0 Secs]*	 ***[2]***
5	HD62542_spec3	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A				3089 Secs *[==>3089.0 Secs]*	 ***[3]***
6	HD62542_peak2	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	 ***[4]***
7	HD62542_spec4	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A				2090 Secs *[==>2090.0 Secs]*	 ***[4]***
8	HD62542_spec5	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A				3089 Secs *[==>3089.0 Secs]*	 ***[5]***

Orbit Structure

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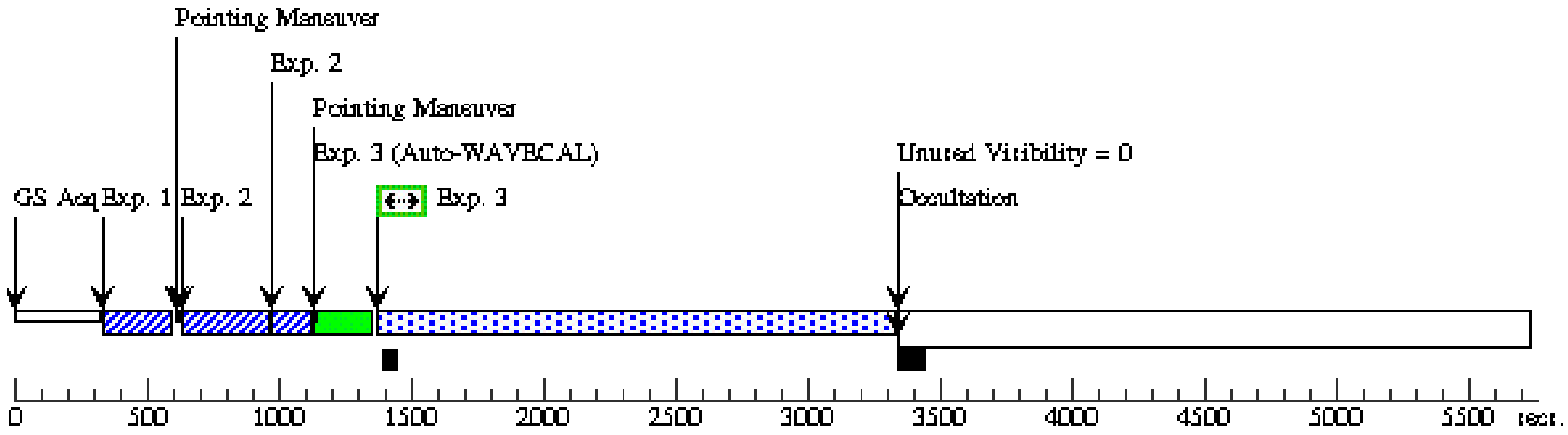

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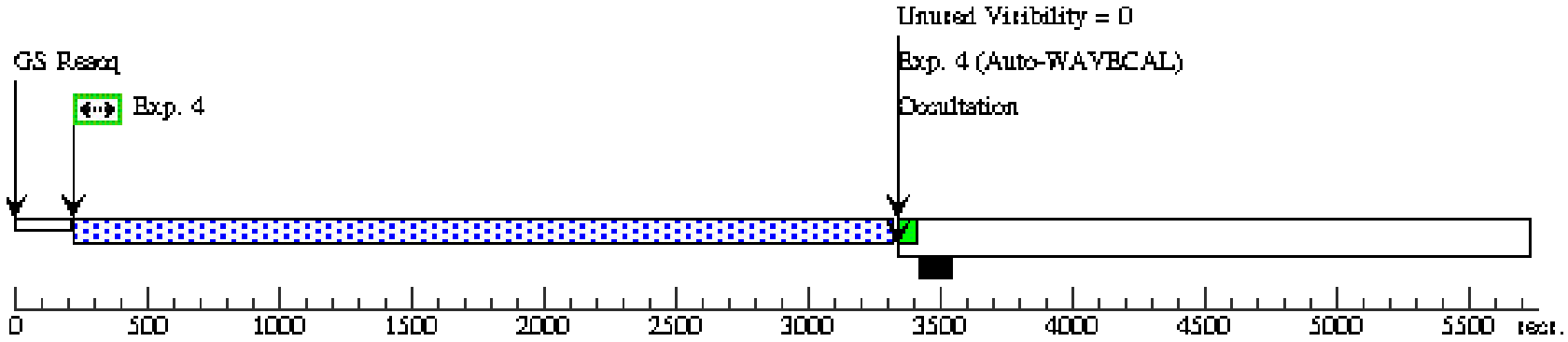

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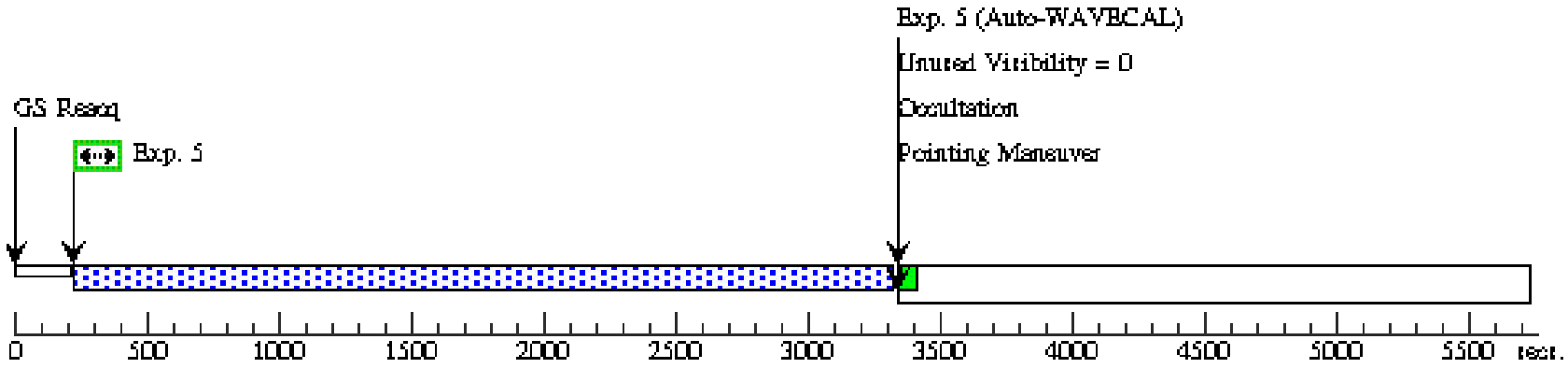

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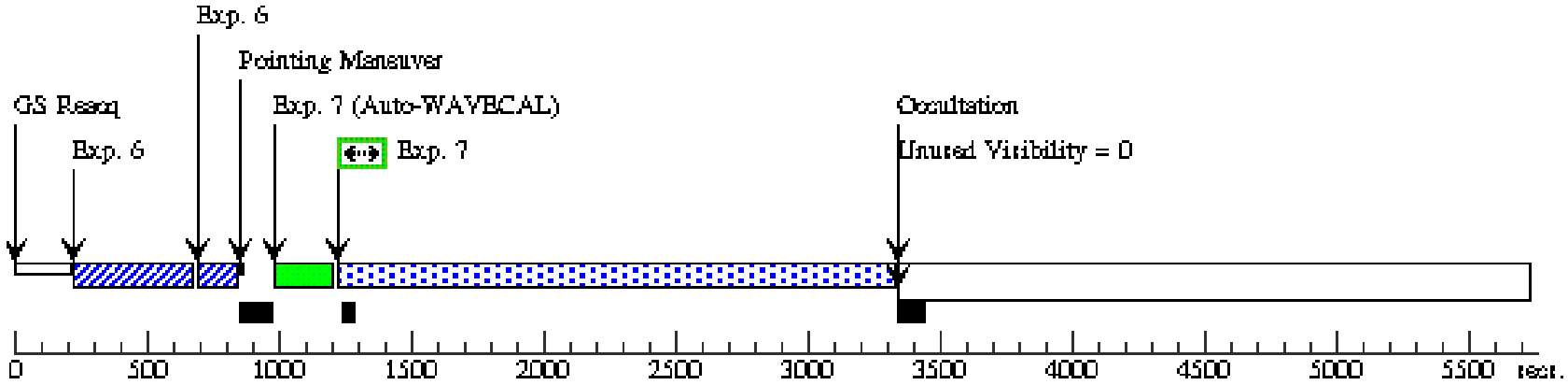

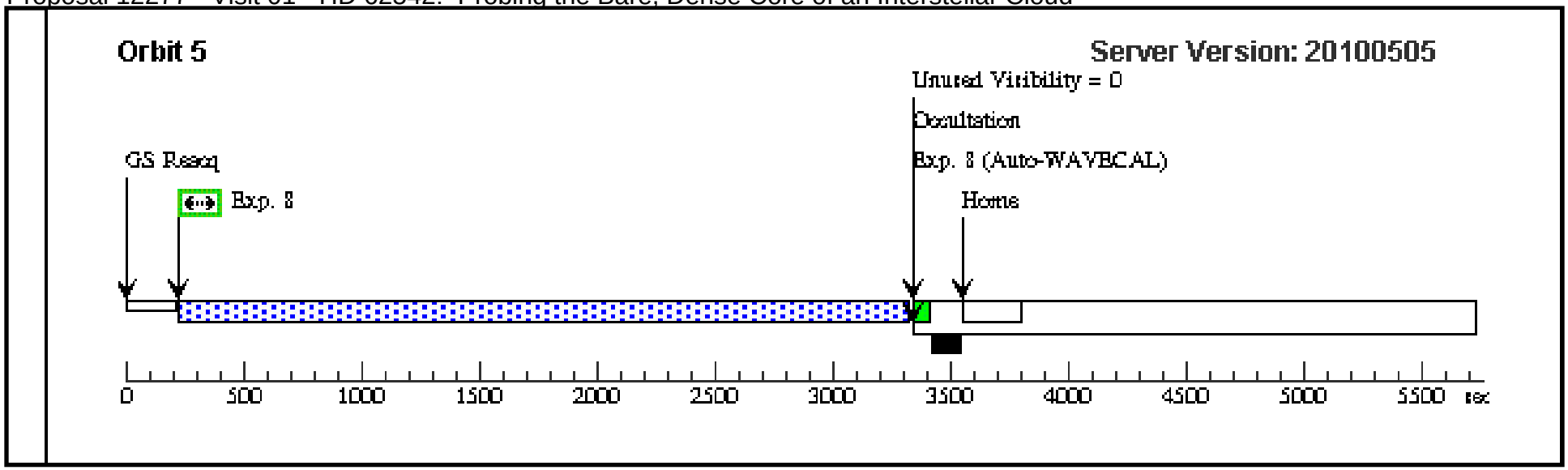
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Visit

Proposal 12277, Visit 02

Fri Jul 09 04:48:34 GMT 2010

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

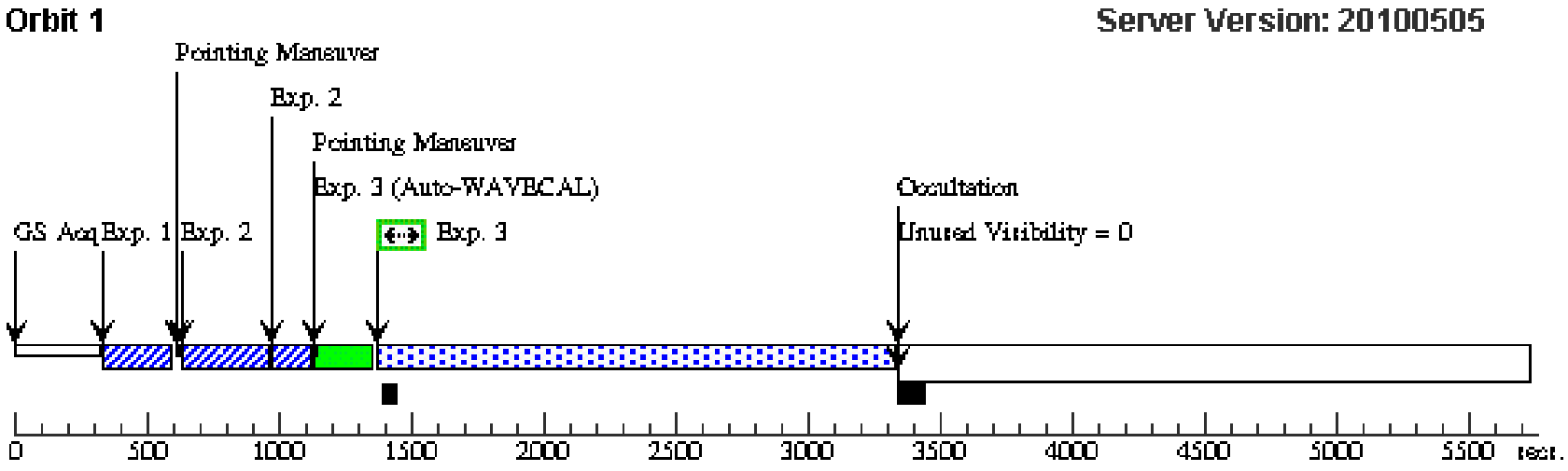
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD62542	RA: 07 42 37.2200 (115.6550833d) Dec: -42 13 47.80 (-42.22994d) Equinox: J2000	Proper Motion RA: -6.815643540032627E-4s/yr Proper Motion Dec: 0.00439"/yr Parallax: 0.00406" Epoch of Position: 2000.0	V=8.03+/-0.03 F(1350)=2.0e-12; F(1900)=3.0e-12; F(2250)=3.0e-12	Reference Frame: ICRS

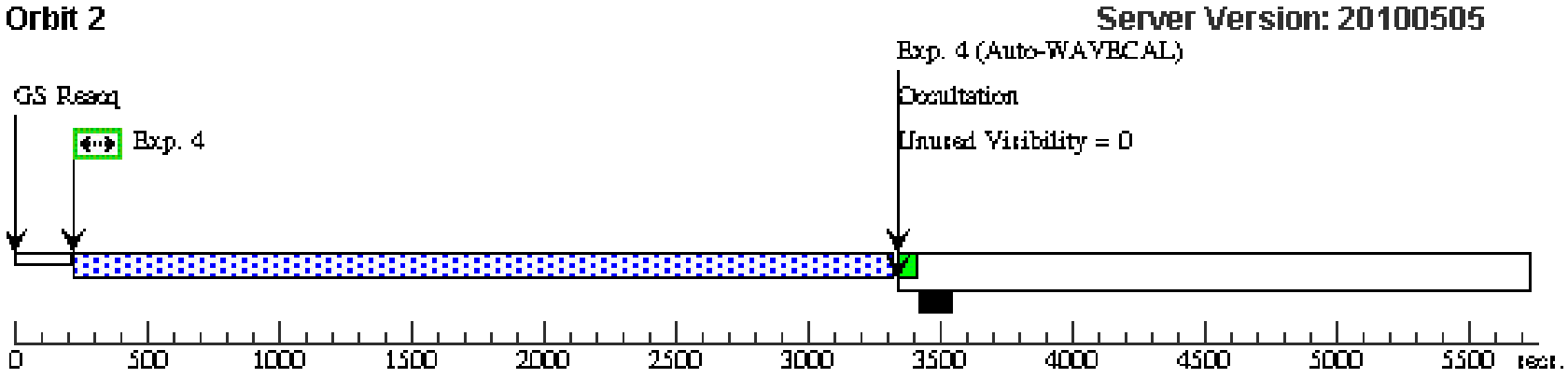
Comments: UV fluxes are from IUE spectra (low dispersion, large aperture)
GSC2ID = S132331157
coordinates from Hipparcos catalog

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	HD62542_acq	(1) HD62542	STIS/CCD, ACQ, F28X50OII	MIRROR				2 Secs *[==>]*	***[1]***
2	HD62542_peak	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	***[1]***
3	HD62542_spec1	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1343 A				1941 Secs *[==>]*	***[1]***
4	HD62542_spec2	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1343 A				3089 Secs *[==>]*	***[2]***
5	HD62542_spec3	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1343 A				3089 Secs *[==>]*	***[3]***
6	HD62542_peak2	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	***[4]***
7	HD62542_spec4	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1343 A				2090 Secs *[==>]*	***[4]***
8	HD62542_spec5	(1) HD62542	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1343 A				3089 Secs *[==>]*	***[5]***

Orbit Structure





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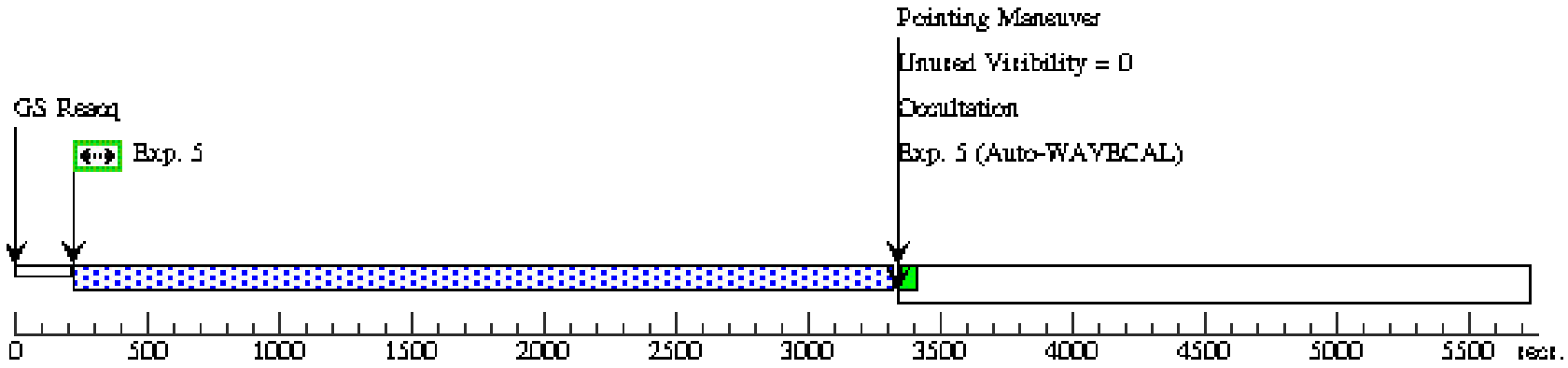

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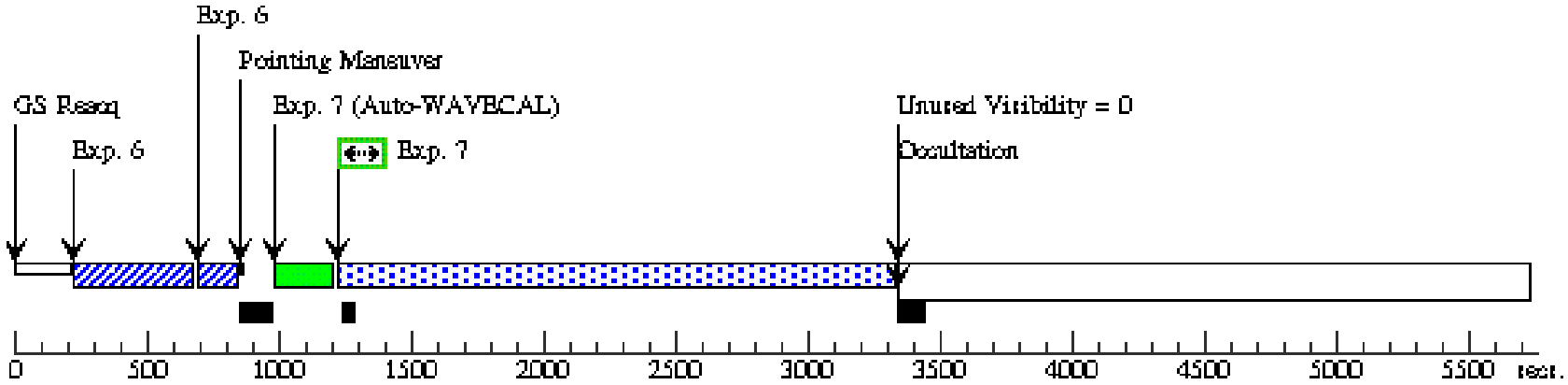

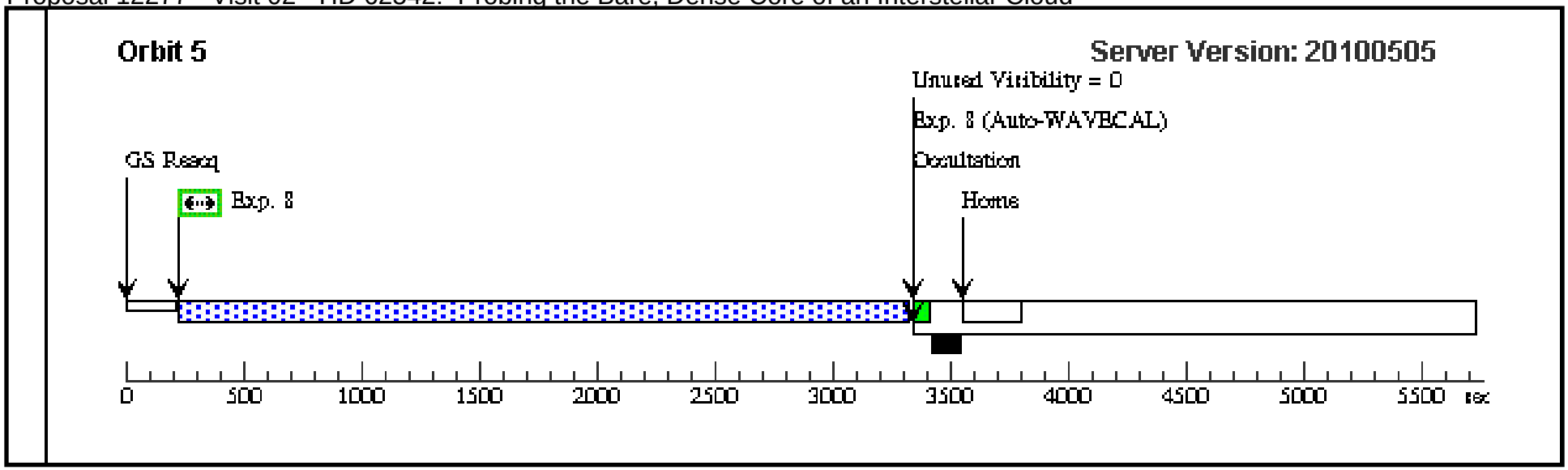
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sec

Visit

Proposal 12277, Visit 03

Fri Jul 09 04:48:35 GMT 2010

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

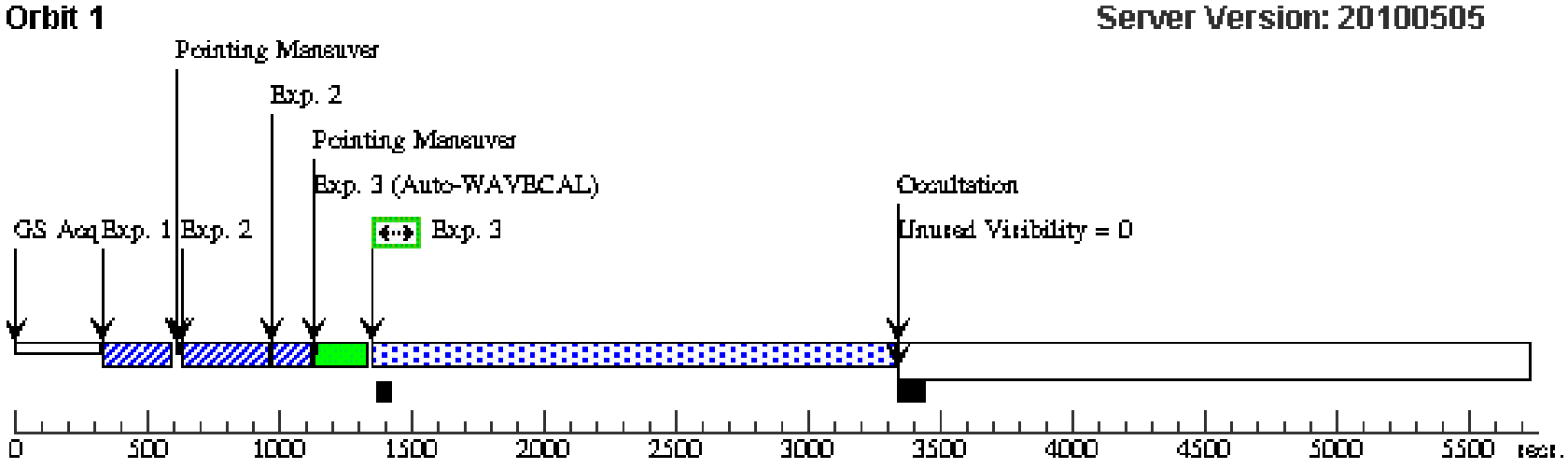
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD62542	RA: 07 42 37.2200 (115.6550833d) Dec: -42 13 47.80 (-42.22994d) Equinox: J2000	Proper Motion RA: -6.815643540032627E-4s/yr Proper Motion Dec: 0.00439"/yr Parallax: 0.00406" Epoch of Position: 2000.0	V=8.03+/-0.03 F(1350)=2.0e-12; F(1900)=3.0e-12; F(2250)=3.0e-12	Reference Frame: ICRS

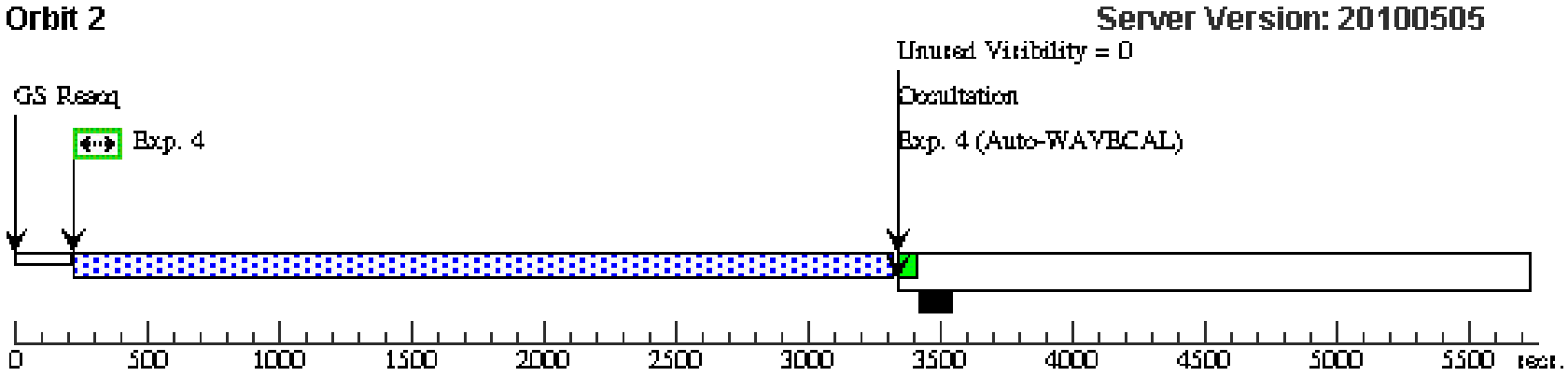
Comments: UV fluxes are from IUE spectra (low dispersion, large aperture)
GSC2ID = S132331157
coordinates from Hipparcos catalog

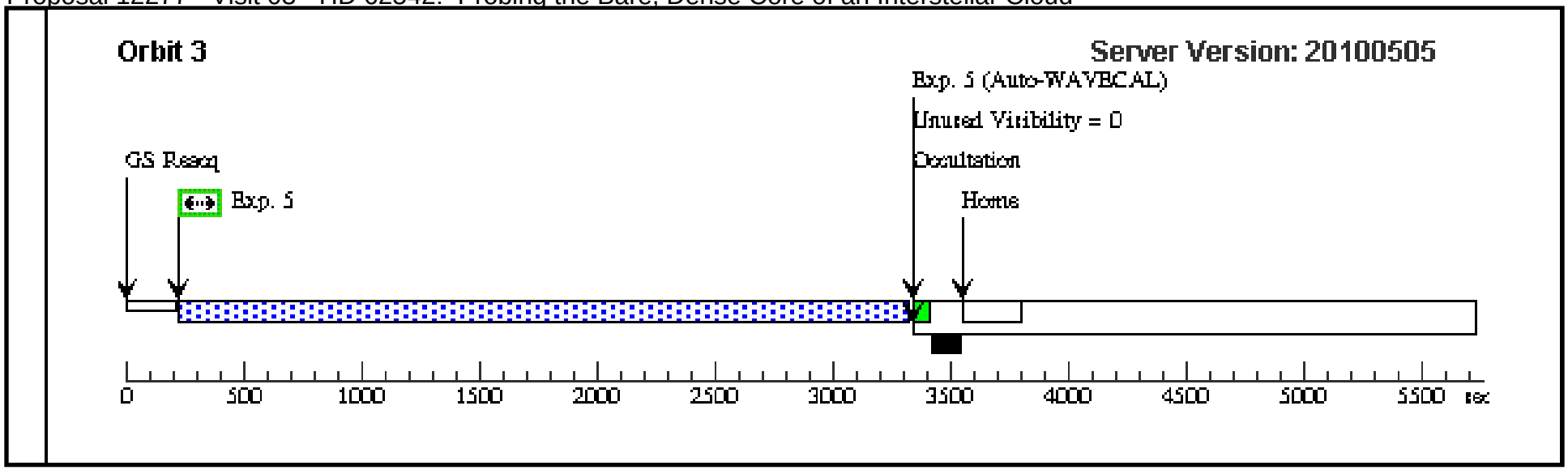
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	HD62542_acq	(1) HD62542	STIS/CCD, ACQ, F28X50OII	MIRROR				2 Secs *[==>]*	 ***[1]***
2	HD62542_peak	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	 ***[1]***
3	HD62542_spec1	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1913 A				1961 Secs *[==>]*	 ***[1]***
4	HD62542_spec2	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1913 A				3089 Secs *[==>]*	 ***[2]***
5	HD62542_spec3	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1913 A				3089 Secs *[==>]*	 ***[3]***

Orbit Structure



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Exp. 5
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Visit

Proposal 12277, Visit 04 Fri Jul 09 04:48:35 GMT 2010

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

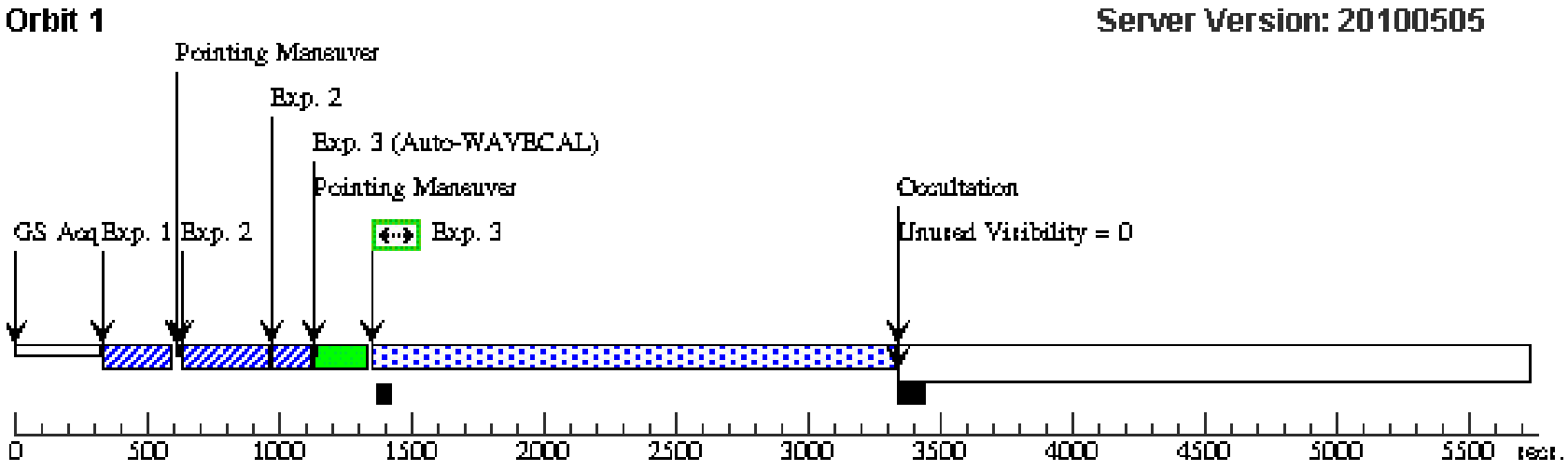
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD62542	RA: 07 42 37.2200 (115.6550833d) Dec: -42 13 47.80 (-42.22994d) Equinox: J2000	Proper Motion RA: -6.815643540032627E-4s/yr Proper Motion Dec: 0.00439"/yr Parallax: 0.00406" Epoch of Position: 2000.0	V=8.03+/-0.03 F(1350)=2.0e-12; F(1900)=3.0e-12; F(2250)=3.0e-12	Reference Frame: ICRS

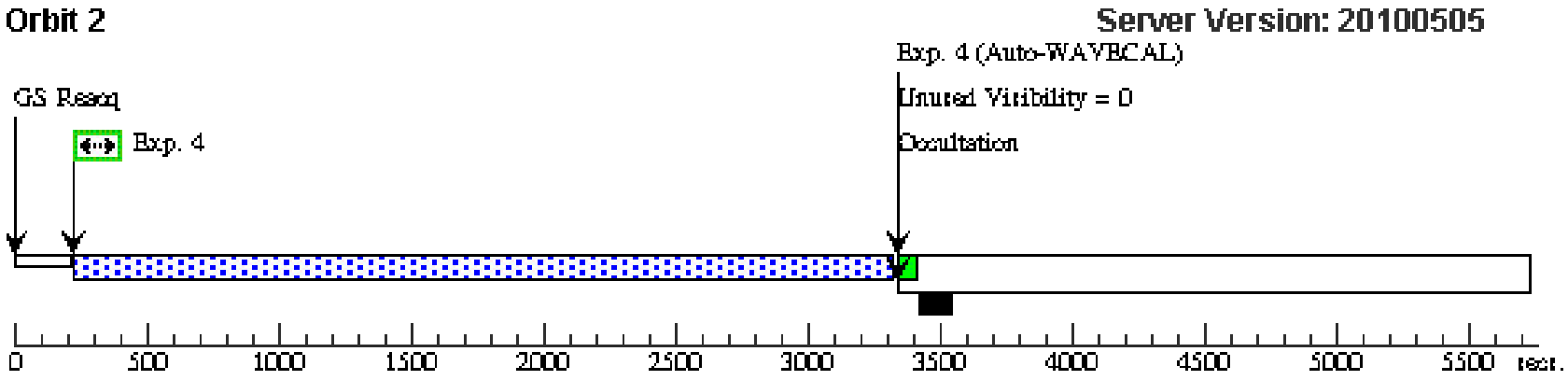
Comments: UV fluxes are from IUE spectra (low dispersion, large aperture)
GSC2ID = S132331157
coordinates from Hipparcos catalog

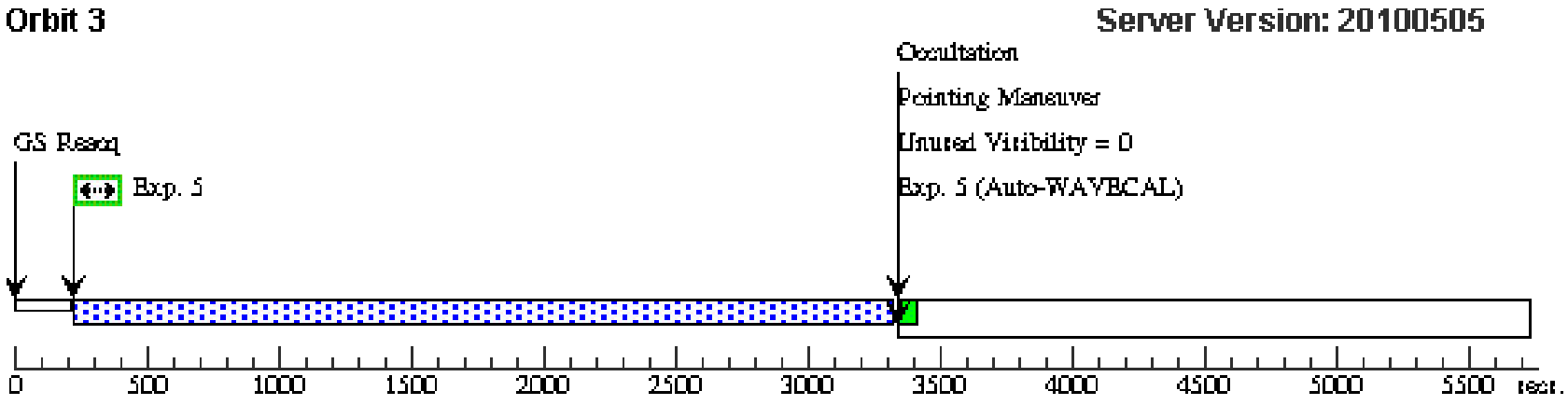
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	HD62542_acq	(1) HD62542	STIS/CCD, ACQ, F28X50OII	MIRROR				2 Secs *[==>]*	*[1]*
2	HD62542_peak	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	*[1]*
3	HD62542_spec1	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2263 A				1961 Secs *[==>]*	*[1]*
4	HD62542_spec2	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2263 A				3089 Secs *[==>]*	*[2]*
5	HD62542_spec3	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2263 A				3089 Secs *[==>]*	*[3]*
6	HD62542_peak2	(1) HD62542	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR				2 Secs *[==>]*	*[4]*
7	HD62542_spec4	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2263 A				2150 Secs *[==>]*	*[4]*
8	HD62542_spec5	(1) HD62542	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2263 A				3089 Secs *[==>]*	*[5]*

Orbit Structure



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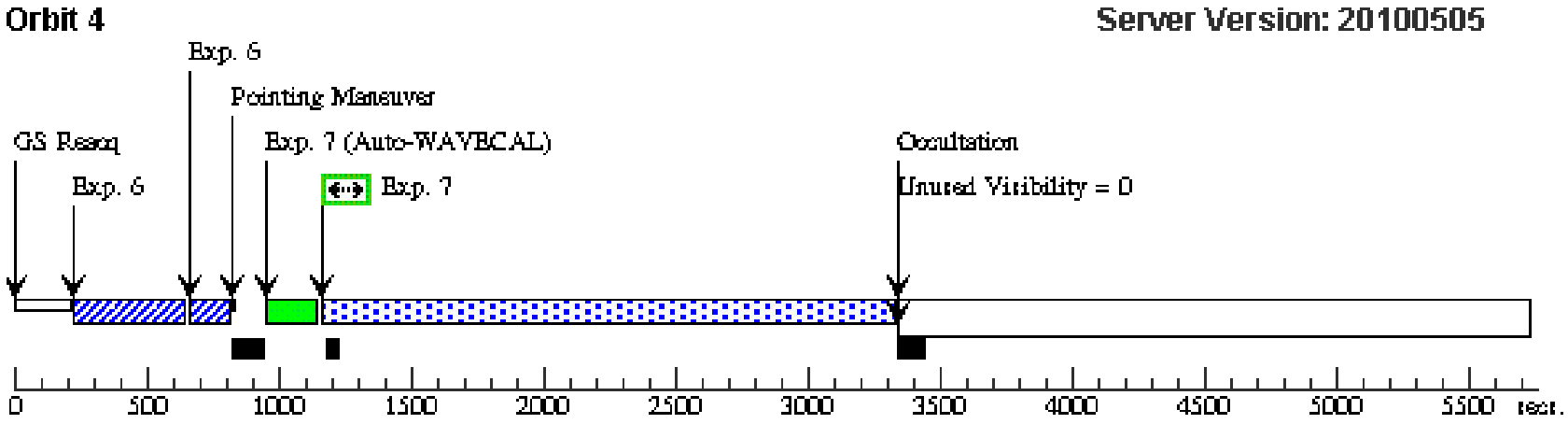
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Exp. 7 (Auto-WAVECAL)
Occultation
GS Reacq
Exp. 6
Exp. 7
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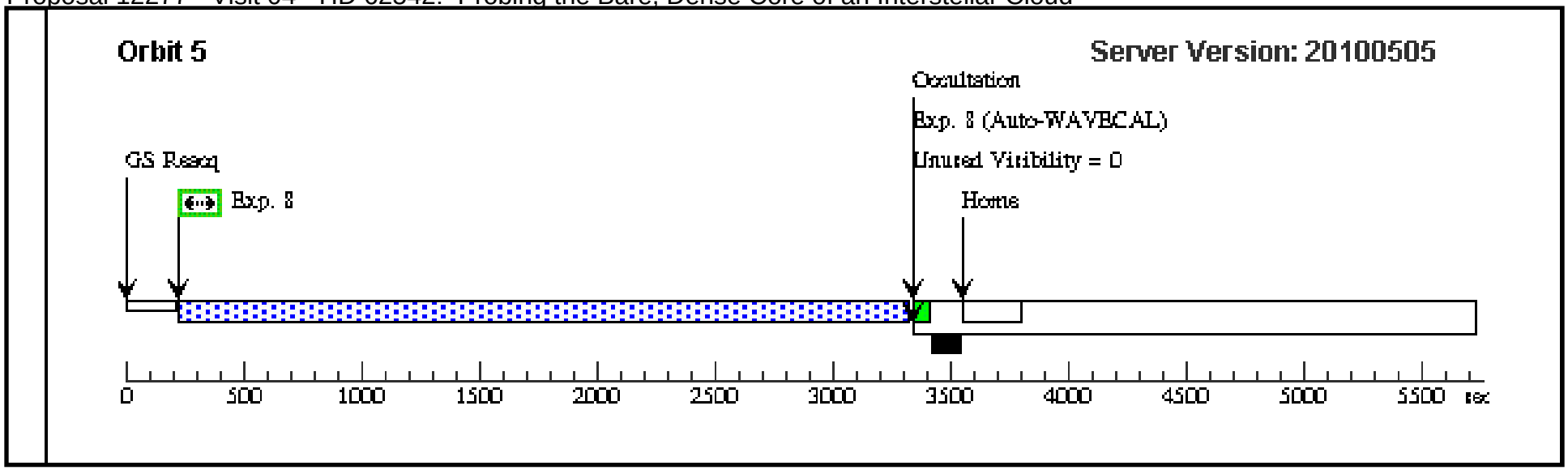
5500
sec.


Orbit 5
Server Version: 20100505
Occultation
Exp. 8 (Auto-WAVECAL)
Unused Visibility = 0
GS Reacq
Exp. 8
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec