12978 - Properties of Diffuse Molecular Gas in the Magellanic Clouds

Cycle: 20, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) SK18	STIS/CCD STIS/FUV-MAMA	5	06-Jul-2012 21:59:57.0	yes
02	(1) SK18	STIS/CCD STIS/NUV-MAMA	5	06-Jul-2012 22:00:13.0	yes
03	(2) SK-68D73	STIS/CCD STIS/FUV-MAMA	4	06-Jul-2012 22:00:24.0	yes
04	(2) SK-68D73	STIS/CCD STIS/NUV-MAMA	5	06-Jul-2012 22:00:37.0	yes

19 Total Orbits Used

ABSTRACT

Studies of the interstellar medium in the lower-metallicity Magellanic Clouds explore somewhat different environmental conditions from those typically probed in our own Galactic ISM. Recent studies based on optical/UV spectra of SMC and LMC targets, for example, have revealed

unexpected differences in gas-phase abundance patterns (for various atomic and molecular species) and have begun to explore the effects of differences in metallicity on the atomic-to-molecular transition and resulting molecular fraction f(H_2) -- a key aspect in the formation of molecular clouds. We propose a more detailed study of the abundances, depletions, and local physical conditions characterizing diffuse molecular material in the Magellanic Clouds, using STIS E140H and E230M spectra of two sight lines with N(H_2) > 10^20 cm^-2 (both probing the outskirts of molecular clouds seen in CO emission). The two STIS settings will include lines from various neutral and ionized species (with a range in depletion behavior), several C I multiplets, and several bands of CO and C_2. By probing and characterizing the atomic-to-molecular transition in the Magellanic Clouds, we will address key issues regarding the effects of differences in metallicity on the relationship between the atomic and molecular gas in galaxies; on cloud structure, physical conditions, and diffuse cloud chemistry; and on the composition and properties of interstellar dust. The results of this project should thus aid in the interpretation of observations of atomic and molecular material in more distant low-metallicity systems.

OBSERVING DESCRIPTION

We propose to obtain high-to-moderate resolution (~2.7-10 km/s), moderate-to-high S/N (~25-70) STIS spectra of interstellar absorption lines from a variety of atomic and molecular species toward 2 moderately reddened LMC and SMC stars with appreciable N(H_2).

Targets:

The targets are the UV-brightest stars with measured N(H_2) > 10^{20} cm^{-2} in each of the SMC and LMC; both lie near molecular material seen in CO emission.

Sk18 lies near the prominent molecular and star-forming regions (strong radiation field?) in the SW part of the main SMC bar.

Sk-68d73 lies within the edge of a CO complex, north of the center of the LMC, and shows CO absorption in FUSE spectra.

Both have been observed with VLT/UVES (4.5-5.0 km/s; very high S/N) and FUSE; both have high resolution (1.2-2.0 km/s) Na~I spectra.

Star	Flux (1500/2050)	MC E(B-V)	MC N(H2)	Location	Other Data
Sk18	6.0e-13/5.0e-13	0.14	20.6	SMC - SW bar	FUSE, opt
Sk-68d73	4.0e-13/3.0e-13	0.34	20.1	LMC - central	FUSE, HST, opt

Wavelength settings:
We will observe both stars with STIS using the E140H/1307 and E230M/1978 settings, which include numerous lines from both neutral and singly ionized species of both depleted and undepleted elements, as well as several bands of CO and C_2. Several C I multiplets (important for estimating local thermal pressures and densities) will be included. The high resolution of the E140H spectra is needed to discern the complex component structure known from the existing optical spectra and to resolve the CO rotational structure (though the optical data for CH suggest that only a single component for CO will be detectable in each sight line). While higher resolution would be desirable as well for the near-UV spectra, the NUV-MAMA dark current makes observations with E230H difficult for these faint targets. We have elected to use STIS/E230M instead of COS, to enable somewhat higher resolution and broad wavelength coverage in a single setting. Many of the lines will be detectable, but not saturated -- so that reliable column densities can be derived via simultaneous, multi-component fits to the line profiles. We will use the profiles in the higher resolution E140H spectra -- together with higher-resolution, higher-S/N optical spectra -- to define the component structures for the lines in the lower resolution (but higher S/N) E230M spectra. While the Si II 1808 line may be strong, use of component information from weaker lines (e.g., Mg II 1240) should still enable us to discern deviations from Galactic depletion patterns. Only HST can cover these UV lines.

Grating & Setting & Range & Species

E140H & 1307 & 1206-1408 & CO, C_2, C~I, C~II, O~I, Mg~II, S~II, P~II,
& & & Cl~I, S~I, Cu~II, Ni~II, Si~II, Ge~II
E230M & 1978 & 1574-2382 & C~I, C_2, Mg~I, Si~I, S~I, Zn~II, Al~II, Al~III,
& & & Si~II, Ti~II, Cr~II, Fe~II, Ni~II

Exposure times:
For both stars, we aim to achieve a S/N of 25-30 per resolution element in the extracted E140H spectra near 1300\AA\ (comparable to the values obtained for our previous STIS echelle spectra of MC stars), and S/N of 60-70 for the E230M spectra near 2000 A. These S/N should enable detections (or interesting limits) for several of the stronger CO A-X bands, as well as adequate definition of the line profiles for the simultaneous fits. We will use the 0.2x0.2 arcsec slit for all exposures, in order to maximize S/N.

We will take advantage of the one CVZ opportunity for Sk$-$68~73 to minimize the total orbits needed.

We have used the on-line STIS exposure calculator, with IUE low-dispersion spectra, for these estimates; none of the targets violates any STIS count rate limits.

Each visit (<=5 orbits) will have the following overheads:
6 min for initial guide star acquisition (4 min for re-acquisition in subsequent non-CVZ orbits);
6 min for target acquisition (no peakup, with the 0.2x0.2 slit);
8 min for each new MAMA spectroscopic exposure (1 min for subsequent identical exposures).
For Sk18, each orbit will have about 51 min visibility (reduced for scheduling

flexibility); for Sk-68d73 the CVZ orbits will have 96 min visibility, and the regular orbits will have 60 min visibility.

The following table gives the plan for the 4 visits (19 orbits):

Star	Grating	Setting	Range (\kms)	Resolution	Flux	Orbits	Exposure (min)	S/N
Sk18	E140H	1307	1206-1408	2.7	6.0e-13	5	226	30
	E230M	1978	1574-2382	10.0	5.0e-13	5	226	68
Sk-68d73	E140H	1307	1206-1408	2.7	4.0e-13	4CVZ	346	26
	E230M	1978	1574-2382	10.0	3.0e-13	5	269	60

Acquisition:

The stars have accurate coordinates, and are bright enough and isolated enough that a standard STIS CCD point source acquisition should be sufficient, with the time dominated by overhead.

Visit

Proposal 12978, SK18-FUV (01) Sat Jul 07 02:00:47 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: SCHED 100%

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SK18 Alt Name1: GSC09141-07581 Alt Name2: AZV26	RA: 00 47 50.0500 (11.9585417d) Dec: -73 08 21.10 (-73.13919d) Equinox: J2000		V=12.46+/-0.03 F(1500)=6.0e-13	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	SK18-acq (407199)	(1) SK18	STIS/CCD, ACQ, F28X50LP	MIRROR				1.0 Secs *[==>]*	***[1]***
2	SK18-FUV1 (414009)	(1) SK18	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				2263 Secs *[==>]*	***[1]***
3	SK18-FUV2 (414009)	(1) SK18	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				2821 Secs *[==>]*	***[2]***
4	SK18-FUV3 (414009)	(1) SK18	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				2821 Secs *[==>]*	***[3]***
5	SK18-FUV4 (414009)	(1) SK18	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				2821 Secs *[==>]*	***[4]***
6	SK18-FUV5 (414009)	(1) SK18	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				2821 Secs *[==>]*	***[5]***

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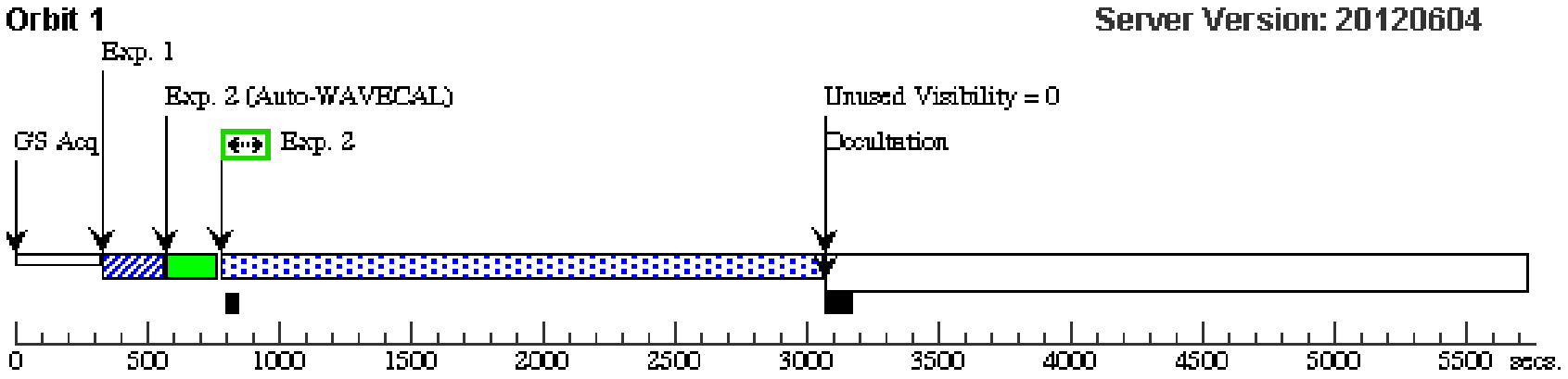

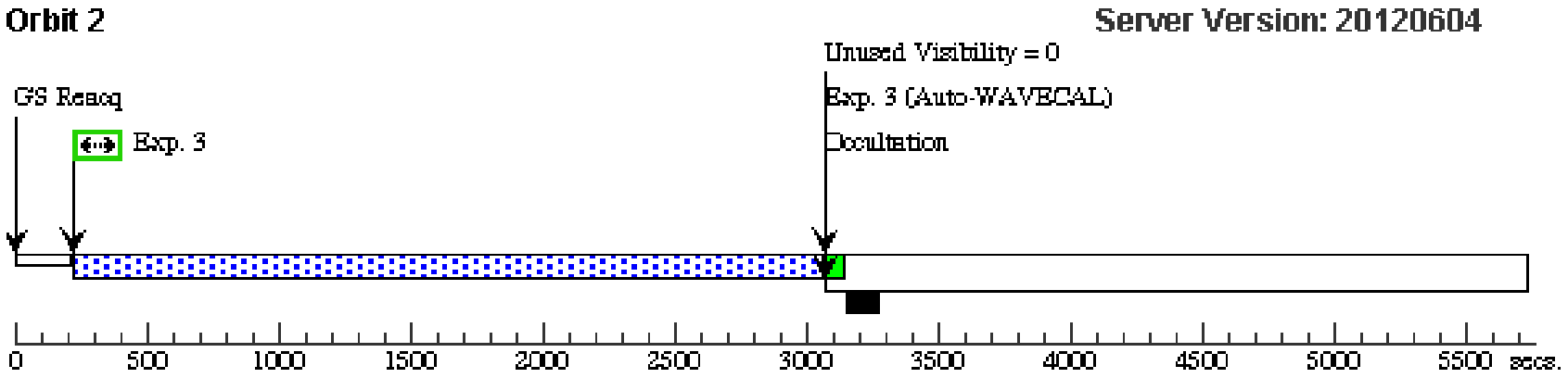

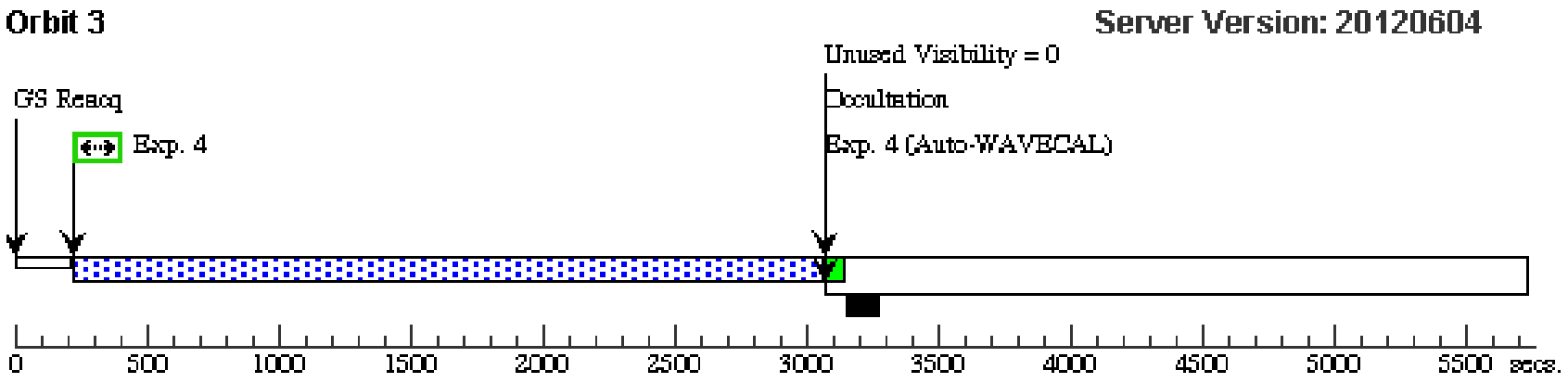
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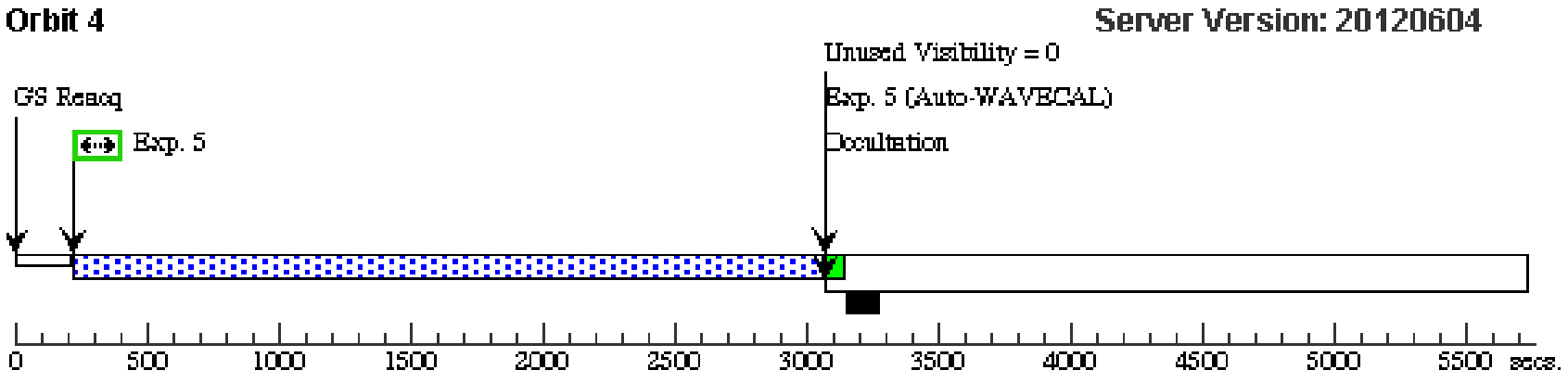
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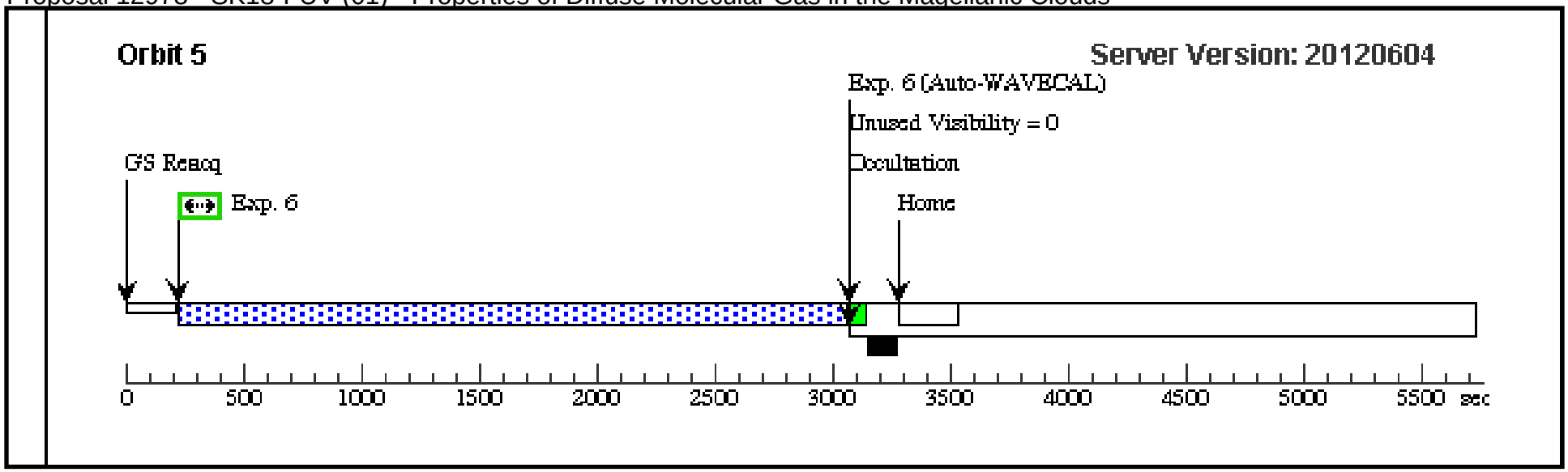
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Visit

Proposal 12978, SK18-NUV (02) Sat Jul 07 02:00:53 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: SCHED 100%

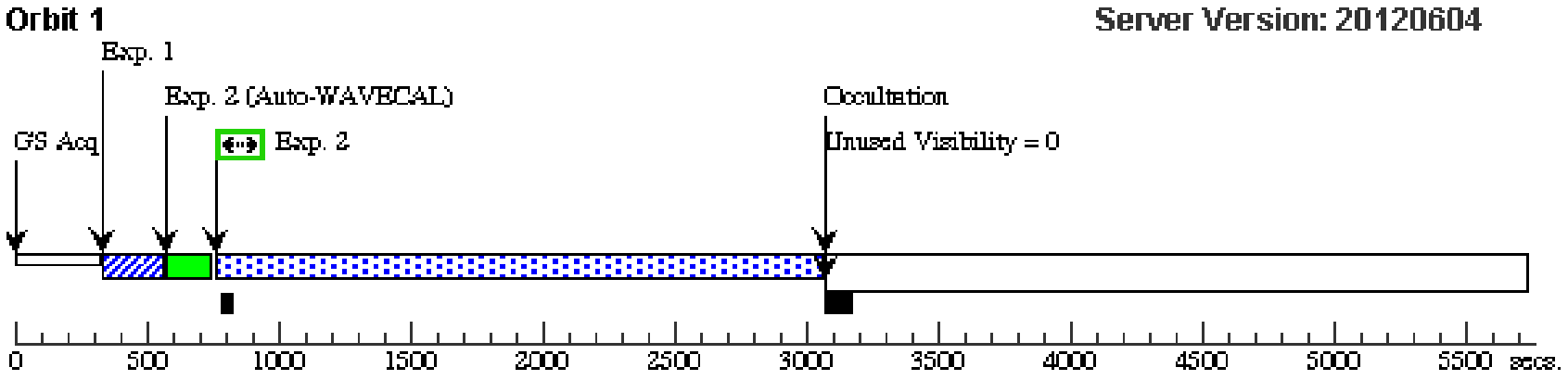
Fixed Targets

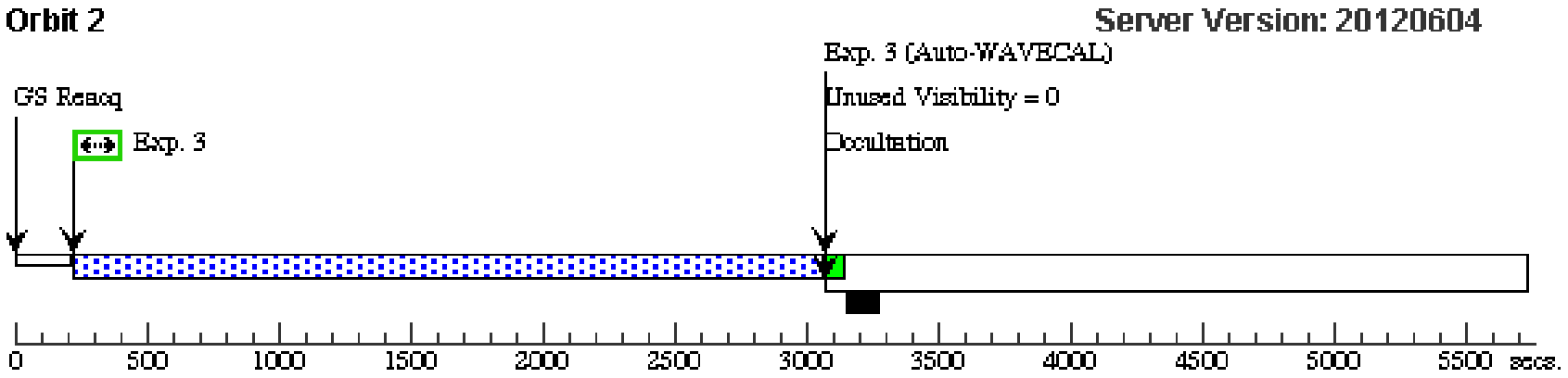
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SK18 Alt Name1: GSC09141-07581 Alt Name2: AZV26	RA: 00 47 50.0500 (11.9585417d) Dec: -73 08 21.10 (-73.13919d) Equinox: J2000		V=12.46+/-0.03 F(1500)=6.0e-13	Reference Frame: ICRS

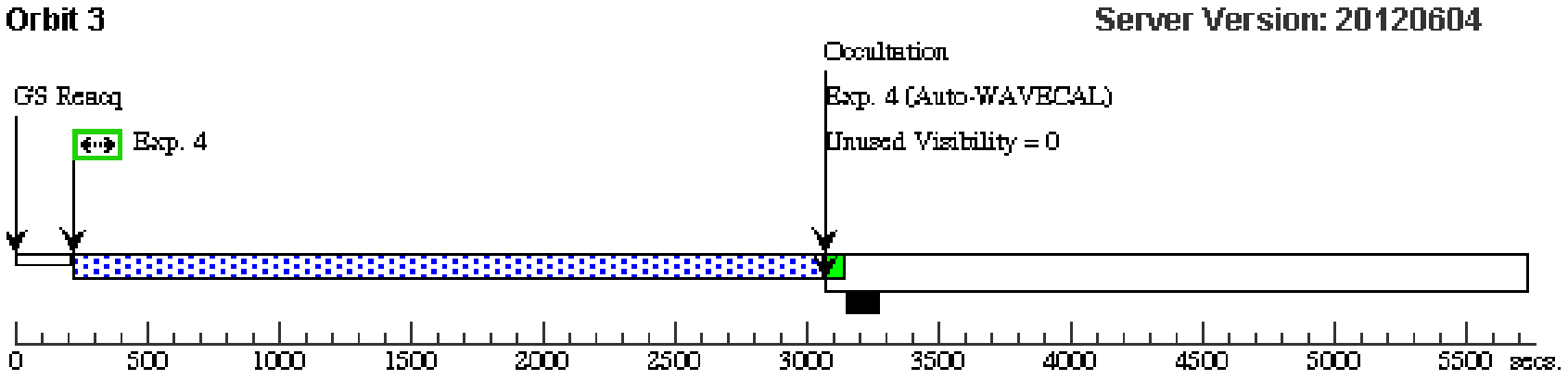
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	SK18-acq (407199)	(1) SK18	STIS/CCD, ACQ, F28X50LP	MIRROR				1.0 Secs *[==>]*	***[1]***
2	SK18-NUV 1 (414010)	(1) SK18	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2283 Secs *[==>]*	***[1]***
3	SK18-NUV 2 (414010)	(1) SK18	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2821 Secs *[==>]*	***[2]***
4	SK18-NUV 3 (414010)	(1) SK18	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2821 Secs *[==>]*	***[3]***
5	SK18-NUV 4 (414010)	(1) SK18	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2821 Secs *[==>]*	***[4]***
6	SK18-NUV 5 (414010)	(1) SK18	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2821 Secs *[==>]*	***[5]***

Orbit Structure



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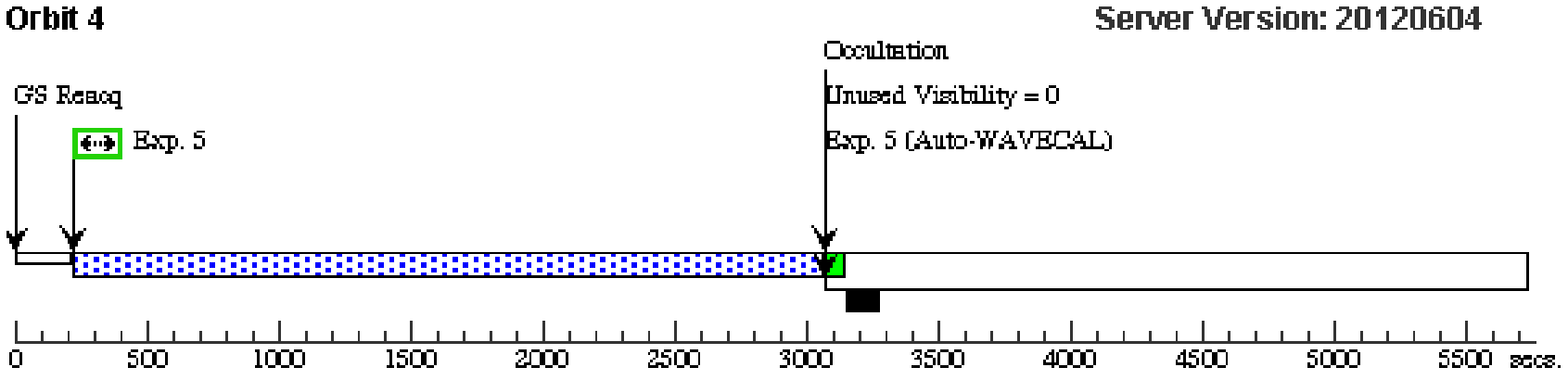
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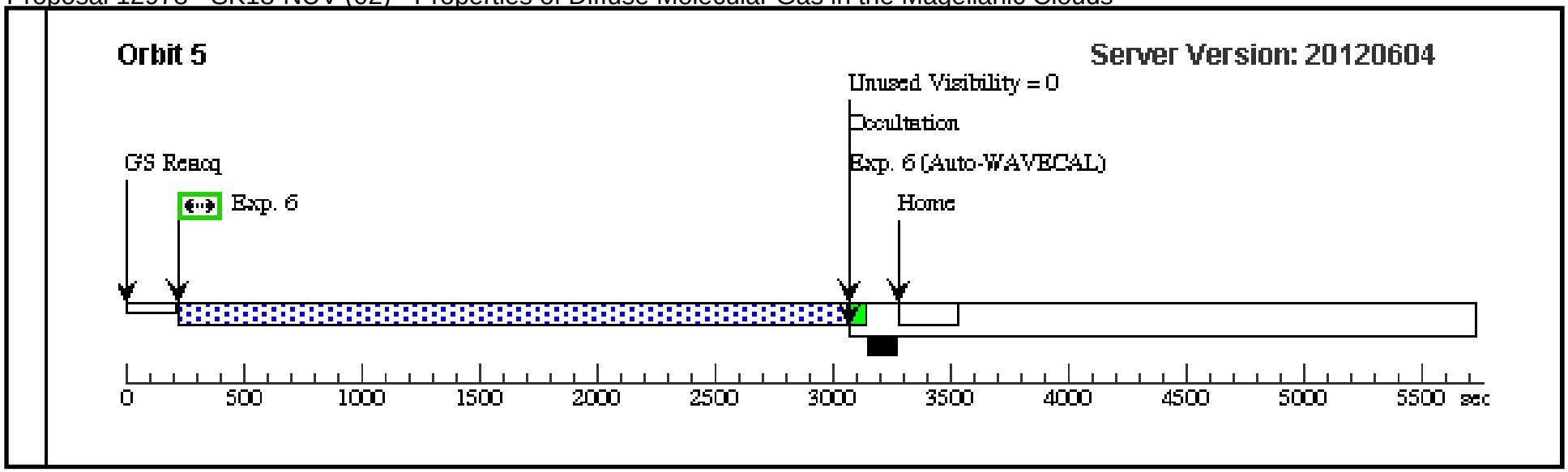
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Visit

Proposal 12978, SK-68D73-FUV (03) Sat Jul 07 02:00:58 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: CVZ

Comments: If necessary for scheduling, this 4-orbit CVZ visit could be split into two 2-orbit CVZ visits -- each of which would contain three 3240-sec exposures.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SK-68D73 Alt Name1: GSC09162-00453 Alt Name2: HD269445	RA: 05 22 59.8000 (80.7491667d) Dec: -68 01 46.60 (-68.02961d) Equinox: J2000		V=11.45+/-0.03 F(1500)=4.0e-13	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	SK-68D73-acq (407201)	(2) SK-68D73	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs	
								[==>]	***[1]***
2	SK-68D73-FUV1 (414014)	(2) SK-68D73	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A				4150 Secs X 5	
								[==>(Copy 1)] *[==>(Copy 2)]*	***[1]***
								[==>(Copy 3)]	***[2]***
								[==>(Copy 4)]	***[3]***
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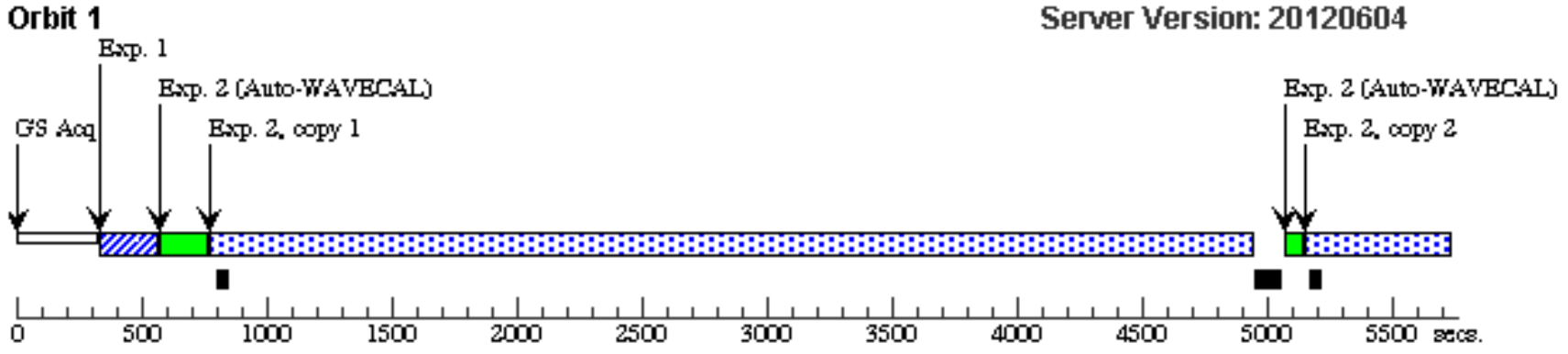
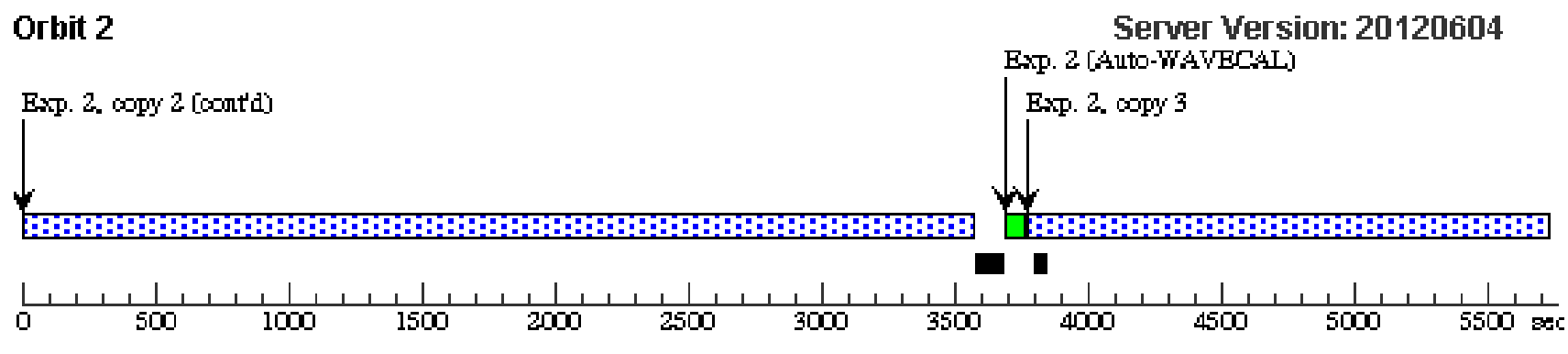
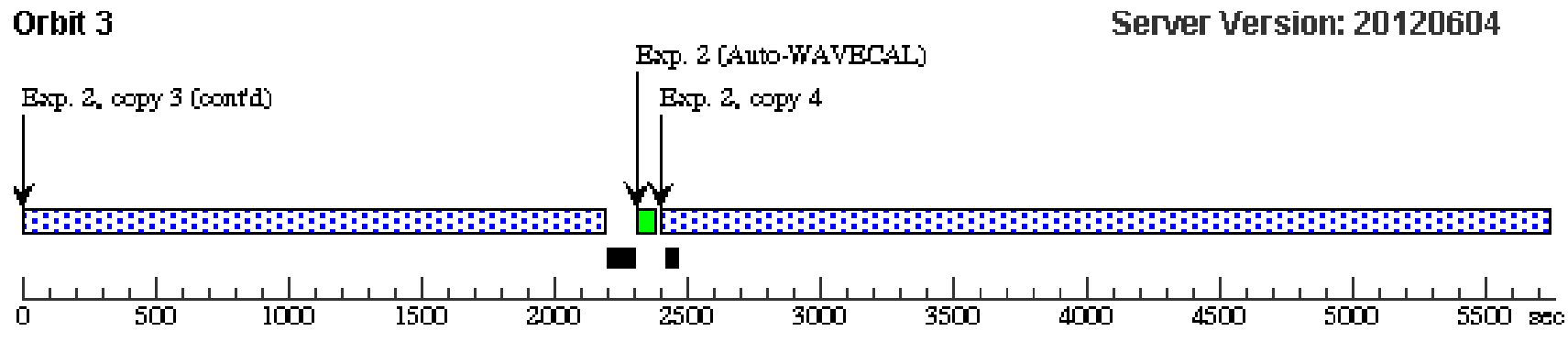
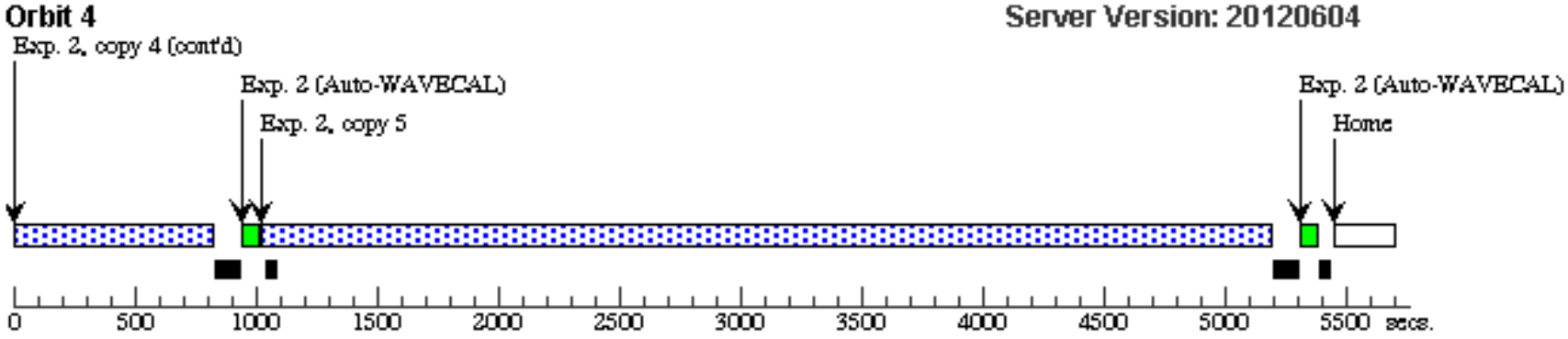
Orbit Structure





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Visit

Proposal 12978, SK-68D73-NUV (04) Sat Jul 07 02:01:01 GMT 2012

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

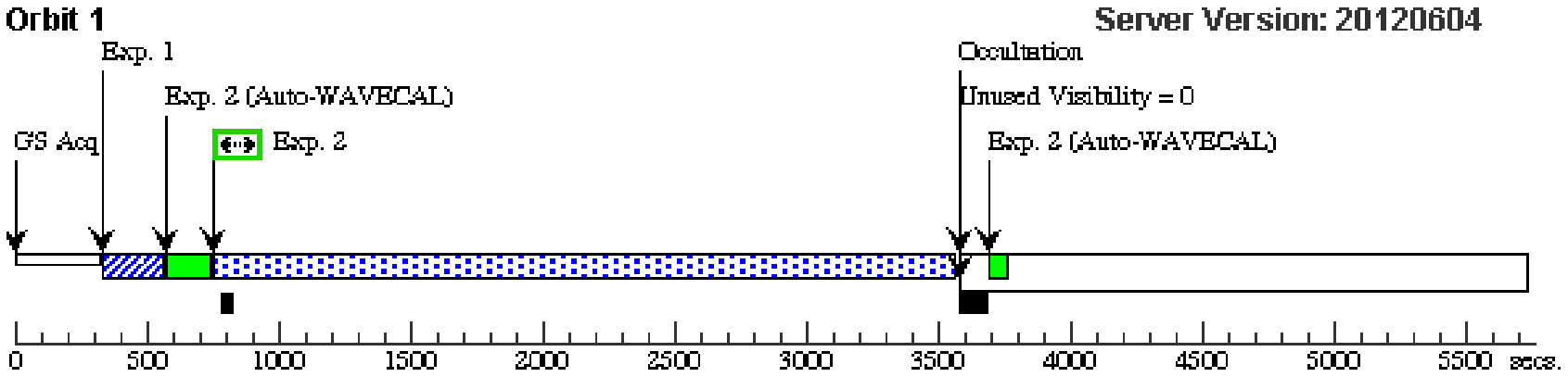
Fixed Targets

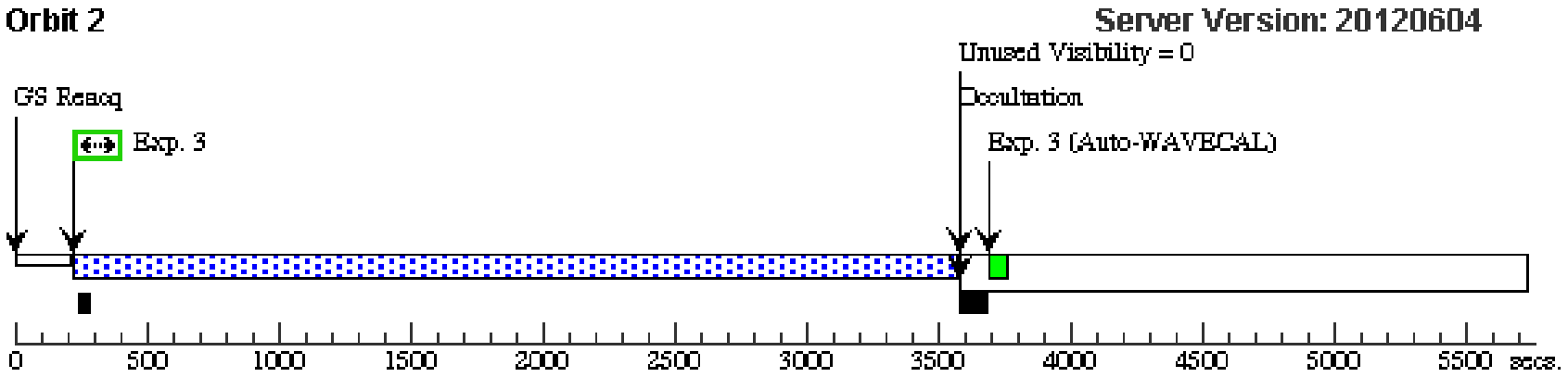
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SK-68D73 Alt Name1: GSC09162-00453 Alt Name2: HD269445	RA: 05 22 59.8000 (80.7491667d) Dec: -68 01 46.60 (-68.02961d) Equinox: J2000		V=11.45+/-0.03 F(1500)=4.0e-13	Reference Frame: ICRS

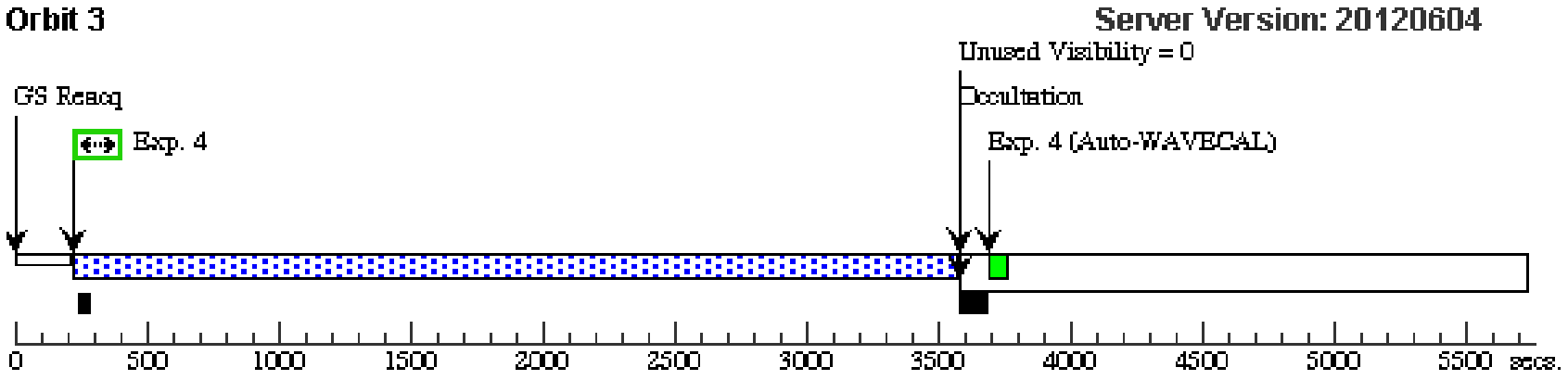
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	SK-68D73-acq (407201)	(2) SK-68D73	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs *[==>]*	***[1]***
2	SK-68D73-NUV1 (414013)	(2) SK-68D73	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				2794 Secs *[==>]*	***[1]***
3	SK-68D73-NUV2 (414013)	(2) SK-68D73	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				3330 Secs *[==>]*	***[2]***
4	SK-68D73-NUV3 (414013)	(2) SK-68D73	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				3330 Secs *[==>]*	***[3]***
5	SK-68D73-NUV4 (414013)	(2) SK-68D73	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				3330 Secs *[==>]*	***[4]***
6	SK-68D73-NUV5 (414013)	(2) SK-68D73	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 1978 A				3330 Secs *[==>]*	***[5]***

Orbit Structure



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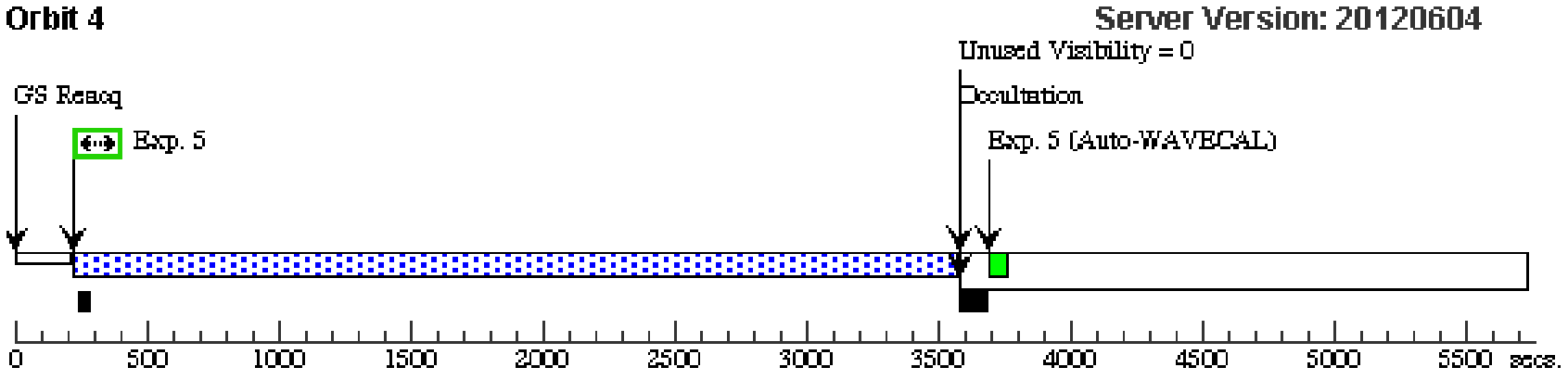
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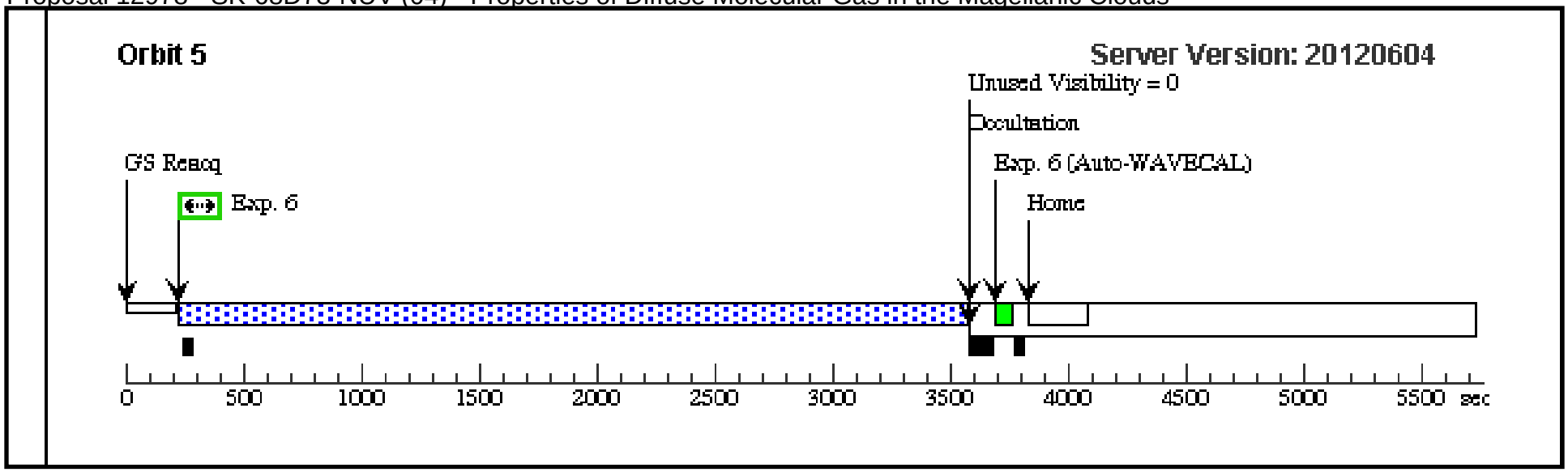
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