13797 - Early-Time UV Spectroscopy of Stripped-Envelope Supernovae: A New Window

Cycle: 22, 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	(2) PSN2037+6607 CCDFLAT	STIS/CCD STIS/NUV-MAMA	6	03-Apr-2015 21:03:42.0	yes
02	(2) PSN2037+6607 CCDFLAT	STIS/CCD STIS/NUV-MAMA	5	03-Apr-2015 21:03:47.0	yes
03	(2) PSN2037+6607 CCDFLAT	STIS/CCD STIS/NUV-MAMA	5	03-Apr-2015 21:03:51.0	yes

16 Total Orbits Used

ABSTRACT

We propose to continue our Cycle 19 and 20 Target-of-Opportunity (ToO) programs to obtain three early-time UV spectra of a stripped-envelope core-collapse supernova (SN Ib or SN Ic), starting well before maximum brightness. The underlying nature of these objects, from the mass-loss process stripping the envelope to the details of the explosion mechanism, remain mysterious. Connections to gamma-ray bursts and X-ray flashes further motivate this study. Many high-redshift SNe are being found in deep transient surveys, but the ability to distinguish between thermonuclear Type Ia SNe and stripped-envelope core-collapse SNe requires thorough knowledge of the latter at UV wavelengths. By comparing the evolution of the spectra as the photosphere recedes to deeper layers of the ejecta with our time series of spectral models, we will gain a better understanding of the explosion, and possibly of the progenitor star. Specifically, we may be able to determine the metal content of the progenitor through comparisons with our spectral models, and we should be able to probe the degree of mixing during the explosion. The heterogeneity seen in stripped-envelope SNe will allow us to choose objects with different characteristics than the ones observed in Cycles 19-20, gaining further insights into this unique class of cosmic explosion. We need to seize this opportunity now, while we still have access to the space UV, and indeed the UV is the Cycle 22 priority of HST.

OBSERVING DESCRIPTION

Obtain STIS UV spectra of one bright (Vmax < 15.5 mag), nearby, stripped-envelope SN as soon as possible after discovery (preferably at t < -6 d, relative to maximum brightness), with subsequent spectra just before and just after maximum, for a total of 3 epochs (16 orbits). The cadence of the spectral observations has been determined from the timescale over which significant changes are observed in ground-based optical/near-UV spectra.

-------- Realtime Justification --------

This is a disruptive ToO observation of a single bright SN. However, it is not an ultra-rapid (< 2 day turnaround) ToO. We will work with STScI staff to expedite the observations, and we will try to choose an object that minimizes the time between ToO activation and observations. If our object is found 14 days before maximum brightness, and we have a turnaround time of 8 days (i.e., significantly longer than the 2-5 day minimum), the first observation will commence about 6 days before maximum light.

We will use both the STIS/CCD and MAMA detectors to provide full wavelength coverage. The CCD observations can be done during the final

MAMA orbit of each epoch. The requirement that such observations be split into separate visits presents a substantial problem for our program. The spectra of SNe change rapidly (on a time scale of 1-2 days) at these early phases; temporally separating pieces of the spectrum might seriously compromise our ability to model it. Our program would greatly benefit if the whole spectrum were obtained in a single visit, as was the case in our Cycle 19 and 20 programs. Therefore, we once again request an exception to this rule, a possibility explicitly mentioned in Section 2.6 of the STIS Instrument Handbook.

We hope to split our 16 allocated orbits between 3 total visits, which means that we will require a visit of 6 orbits using STIS/MAMA. This is discouraged, due to the interfering effects of the SAA, but in consultation with our Contact Scientist and Program Coordinator (Dr. Hugues Sana, Tony Roman), we were told this is likely to be possible, contingent on the exact position of our chosen target.

------ Calibration Justification -------

Our SN, which is optically bright, will have ground-based astrometry with respect to HST guide stars accurate to better than 0.2". Using the STIS Acquisition ETC we find acquisition times of less than 1 min for all epochs, for the 0.2" slit. Previously, we have successfully acquired SNe with STIS in this manner.

--------- Additional Comments ----------

This is a ToO proposal. We will update our phase 2 with the supernova coordinates as they become available. In order to make sure there are no bright objects in the target vicinity and to estimate the target UV flux, we will obtain rapid-response Swift/UVOT observations, as we have done in the past for this program.

Visit

Proposal 13797, Visit 01, scheduled Sat Apr 04 01:03:53 GMT 2015

Diagnostic Status: Warning

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

Special Requirements: BEFORE 08-APR-2015; ON HOLD ; TOO RESPONSE TIME 8.0D; VISIBILITY INTERVAL 53.5 M

On Hold Comments: Initial ToO visit

Diagnostics

(Visit 01) Warning (Orbit Planner): LONG STIS MAMA SU LIKELY TO INTERSECT THE SAA

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.275	Center Pattern=false		
	Line Spacing=			

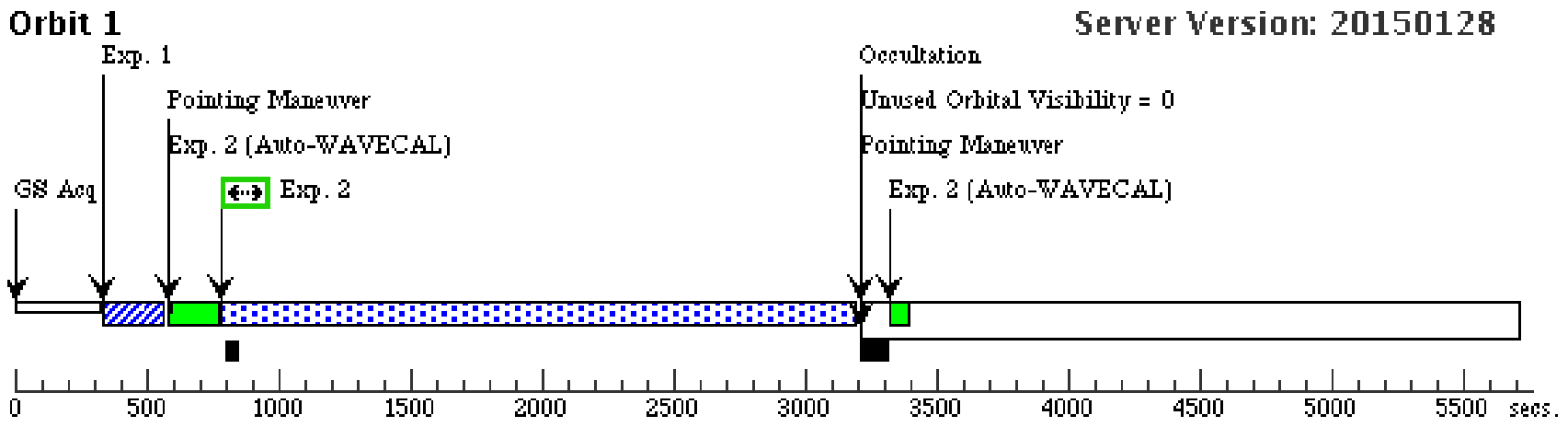
Fixed Targets

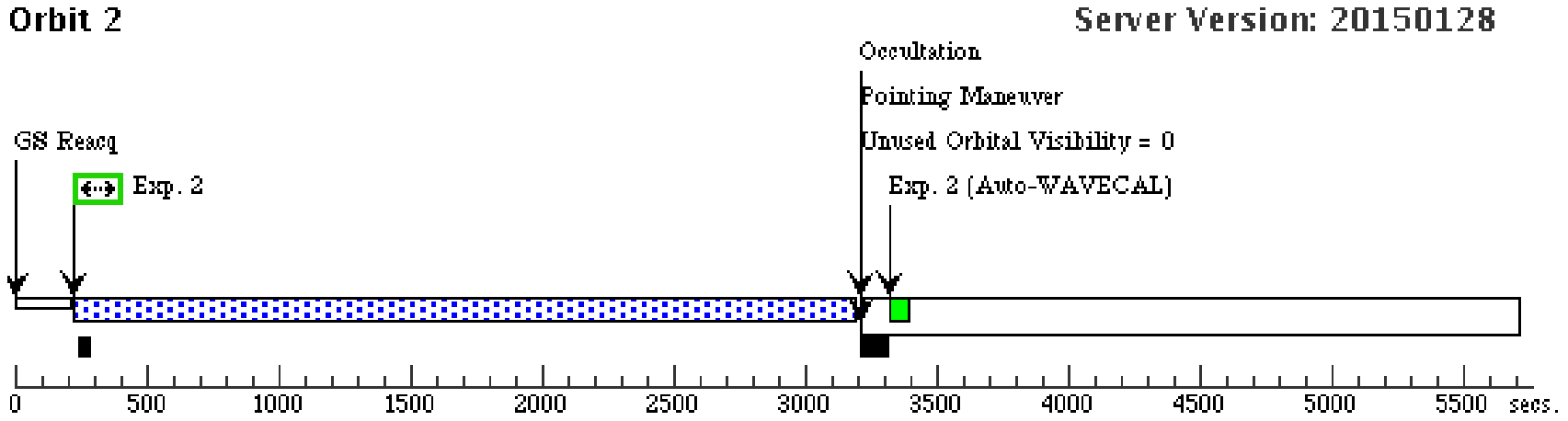
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PSN2037+6607	RA: 20 37 25.5600 (309.3565000d)		V=16.7	Reference Frame: ICRS
		Dec: +66 07 11.68 (66.11991d)			
		Equinox: J2000			

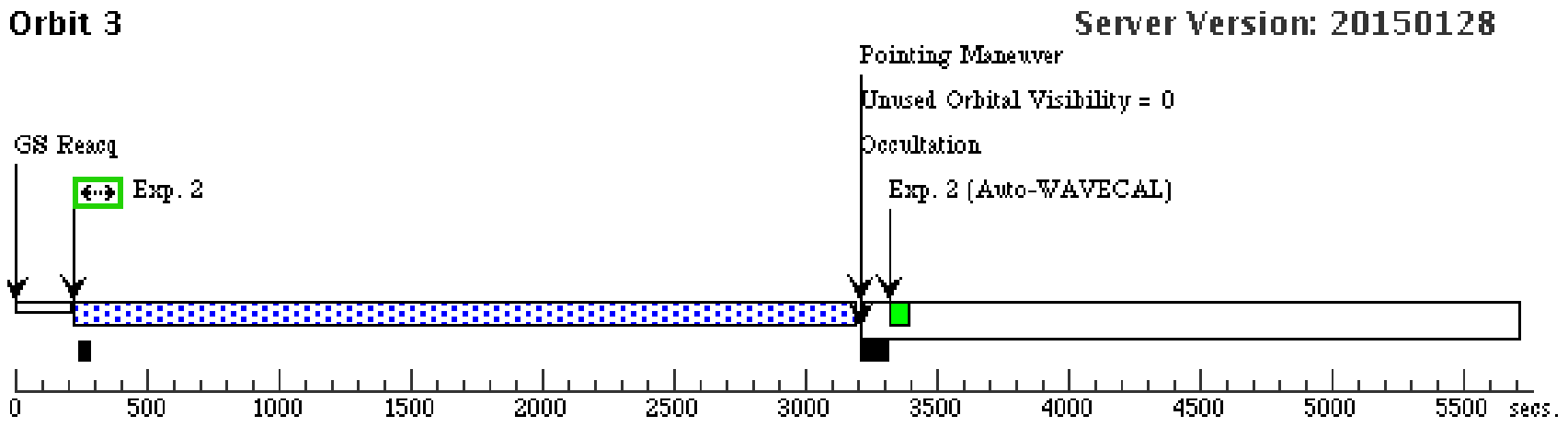
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (STIS.ta.623545)	(2) PSN2037+6607	STIS/CCD, ACQ, F28X50LP	MIRROR				2 Secs (2 Secs) *[==>]*	***[1]***
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
2	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 01 (1)	3000 Secs (8320 Secs) *[==>2400.0 Secs (Pattern 1)]* *[==>2960.0 Secs (Pattern 2)]* *[==>2960.0 Secs (Pattern 3)]*	***[1]*** ***[2]*** ***[3]***
3	Peak Up	(2) PSN2037+6607	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR				8 Secs (8 Secs) *[==>]*	***[4]***
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
4	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A		POS TARG 0,0.825	Pattern 1, Exps 4-4 in Visit 01 (1)	3000 Secs (7269 Secs) *[==>2345.0 Secs (Pattern 1)]* *[==>2960.0 Secs (Pattern 2)]* *[==>1964.0 Secs (Pattern 3)]*	***[4]*** ***[5]*** ***[6]***
5	SpectroscopyG430L (STIS.sp.621403)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A				200 Secs (200 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[6]***
6	SpectroscopyG750L (STIS.sp.621405)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A				100 Secs (100 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[6]***
7	Fringe Flat G750L	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[6]***

Orbit Structure



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Occultation
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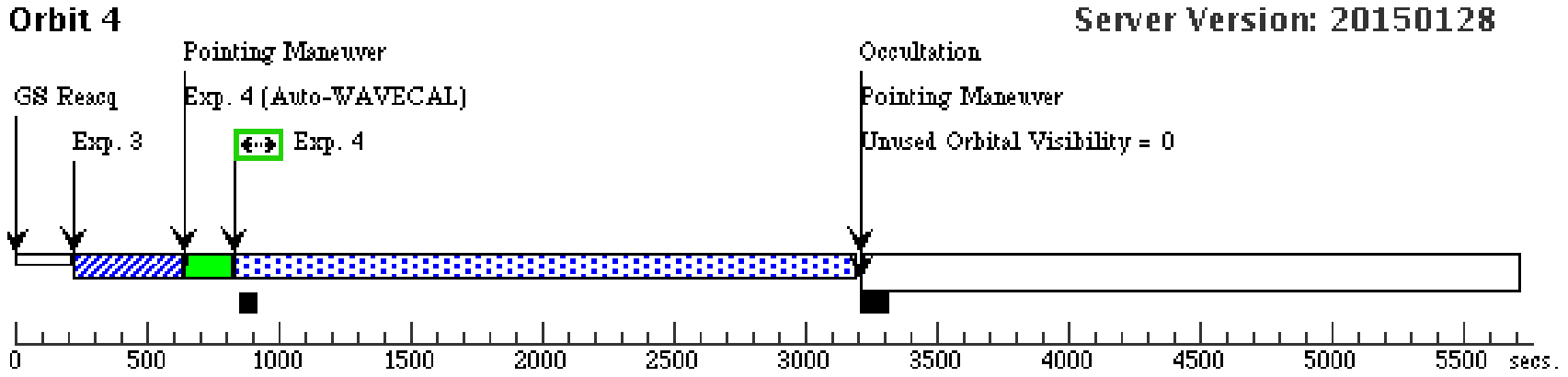
secs.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Occultation
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Pointing Maneuver
Exp. 3
Exp. 4
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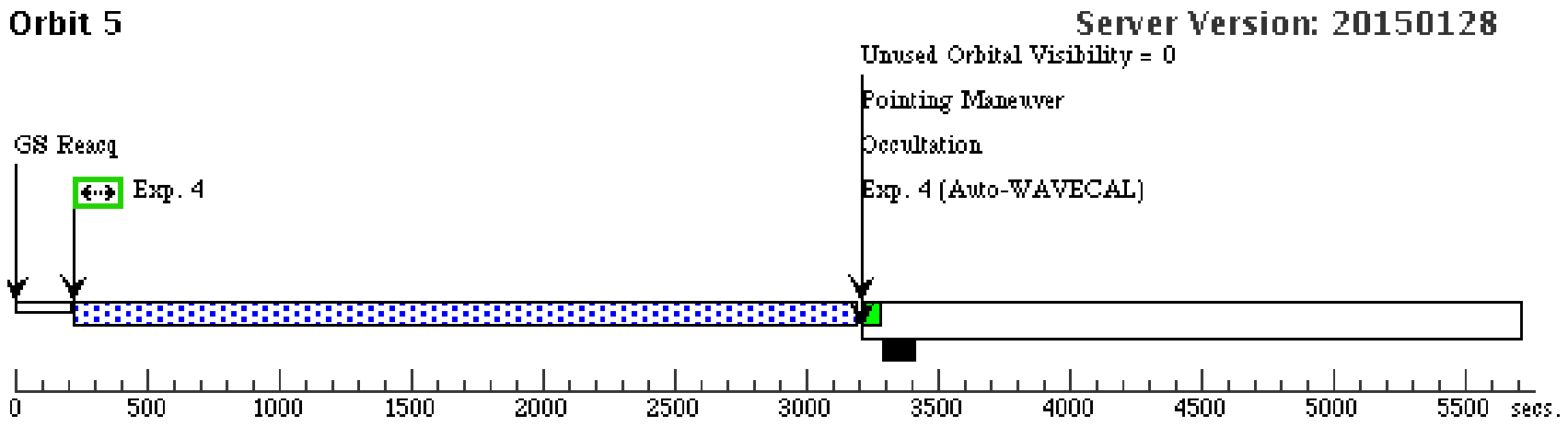
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Pointing Maneuver
Occultation
GS Reacq
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Exp. 4 (Auto-WAVECAL)
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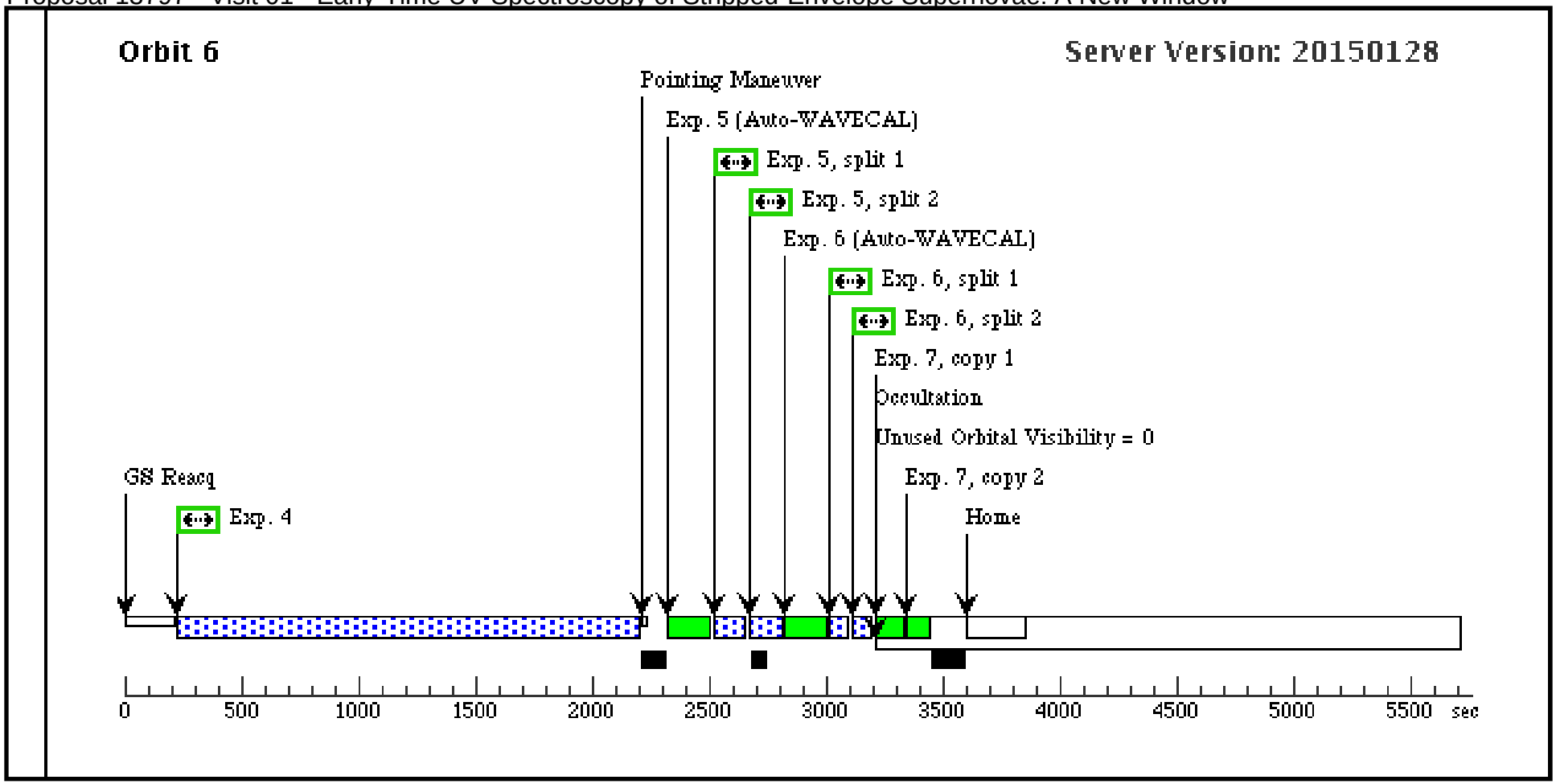
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Exp. 5, split 2
Exp. 6 (Auto-WAVECAL)
Exp. 6, split 1
Exp. 6, split 2
Exp. 7, copy 1
Occultation
Unused Orbital Visibility = 0
Exp. 7, copy 2
GS Reacq
Exp. 4
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4500
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sec

Visit

Proposal 13797, Visit 02, scheduled Sat Apr 04 01:03:53 GMT 2015

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 01 BY 6 D TO 8 D; ON HOLD ; TOO RESPONSE TIME 8.0D; VISIBILITY INTERVAL 53.5 M

On Hold Comments: 2nd ToO visit

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
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	Point Spacing=0.275	Center Pattern=false		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.275	Center Pattern=false		
	Line Spacing=			

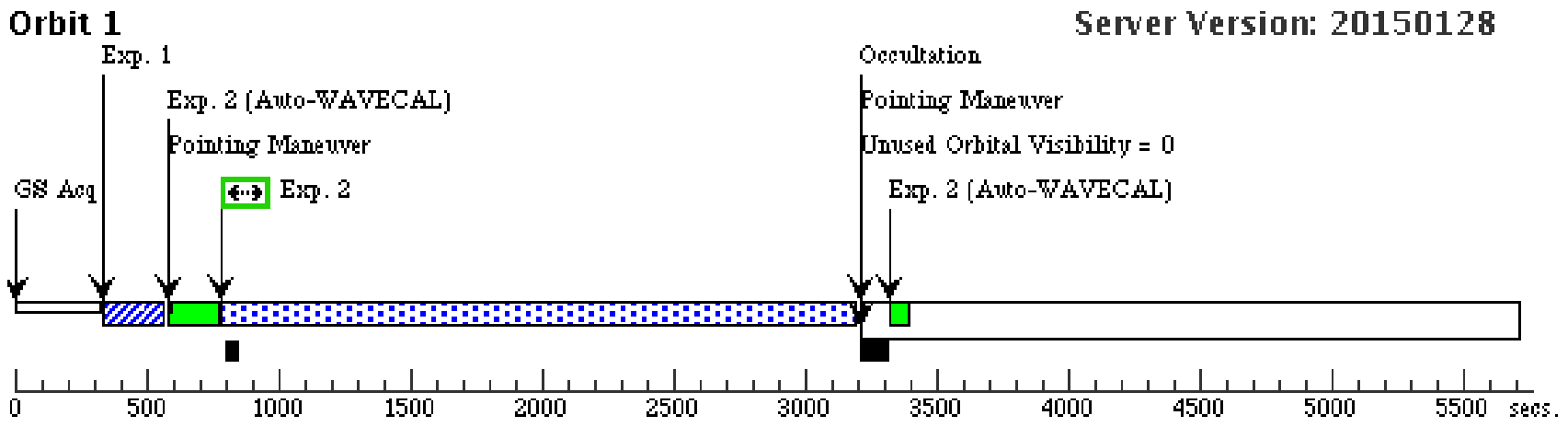
Fixed Targets

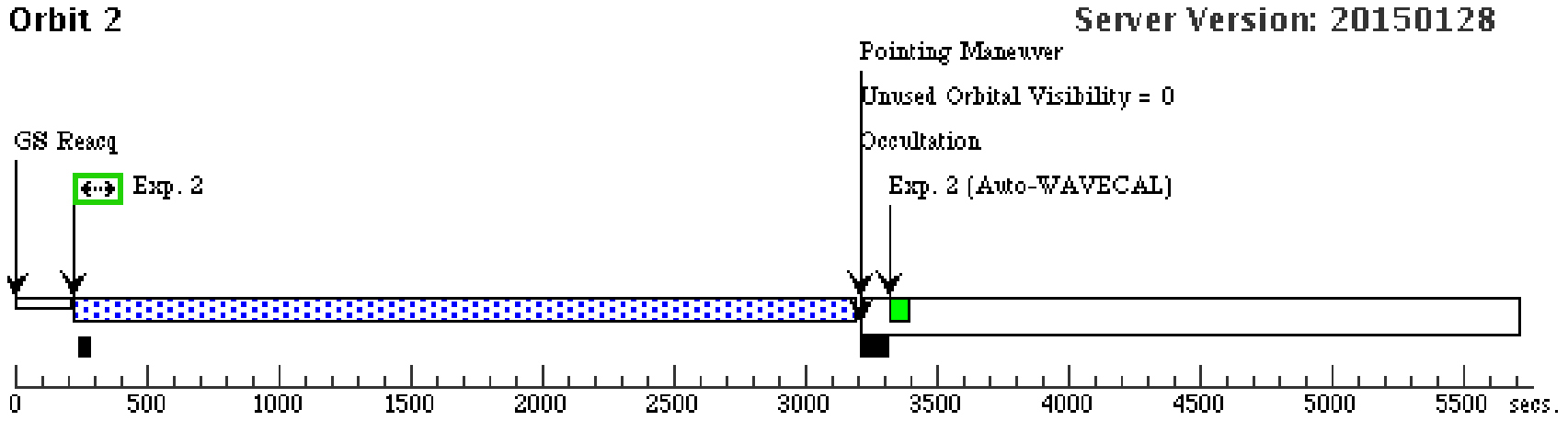
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PSN2037+6607	RA: 20 37 25.5600 (309.3565000d)		V=16.7	Reference Frame: ICRS
		Dec: +66 07 11.68 (66.11991d)			
		Equinox: J2000			

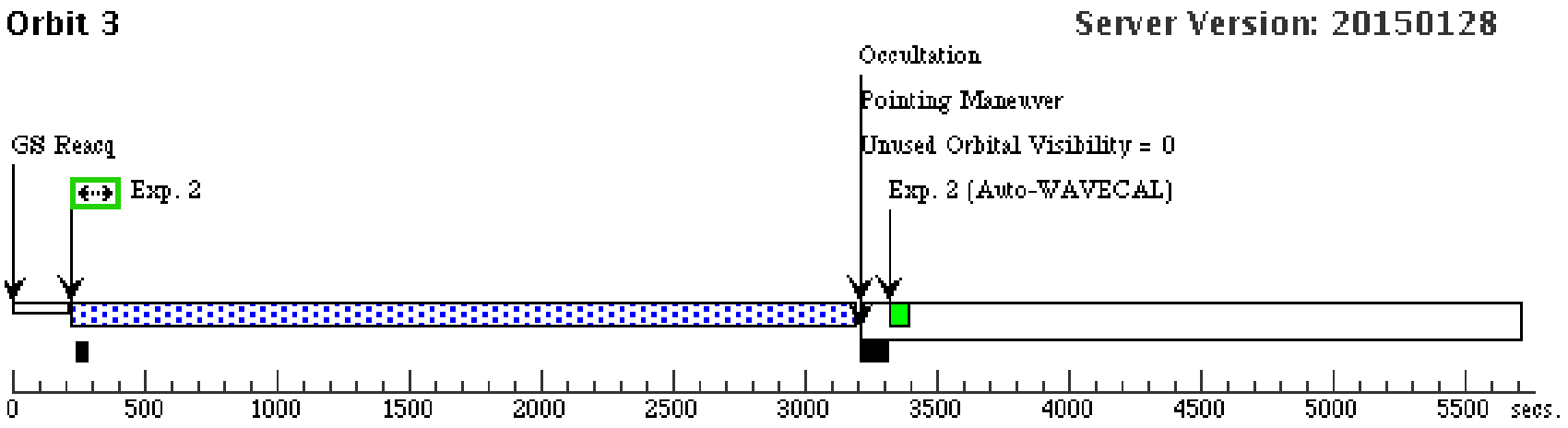
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (STIS.ta.623545)	(2) PSN2037+6607	STIS/CCD, ACQ, F28X50LP	MIRROR				2 Secs (2 Secs) *[==>]*	***[1]***
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
2	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 02 (1)	3000 Secs (8320 Secs) *[==>2400.0 Secs (Pattern 1)]* *[==>2960.0 Secs (Pattern 2)]* *[==>2960.0 Secs (Pattern 3)]*	***[1]*** ***[2]*** ***[3]***
3	Peak Up	(2) PSN2037+6607	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR				8 Secs (8 Secs) *[==>]*	***[4]***
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
4	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A		POS TARG 0,0.825	Pattern 2, Exps 4-4 in Visit 02 (2)	3000 Secs (4205 Secs) *[==>2345.0 Secs (Pattern 1)]* *[==>1860.0 Secs (Pattern 2)]*	***[4]*** ***[5]***
5	SpectroscopyG430L (STIS.sp.621403)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A				200 Secs (200 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[5]***
6	SpectroscopyG750L (STIS.sp.621405)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A				100 Secs (100 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[5]***
7	Fringe Flat G750L	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[5]***

Orbit Structure



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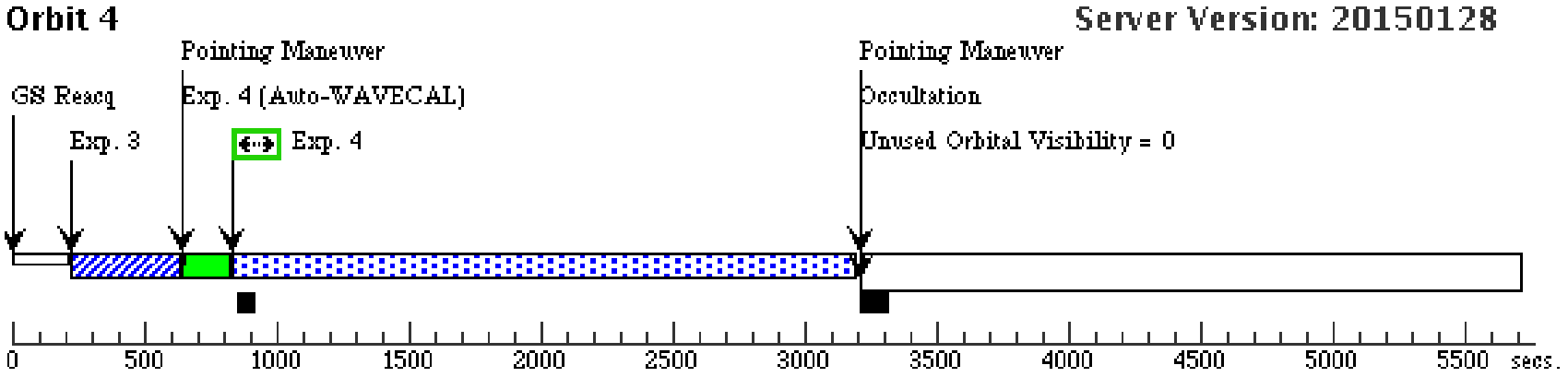
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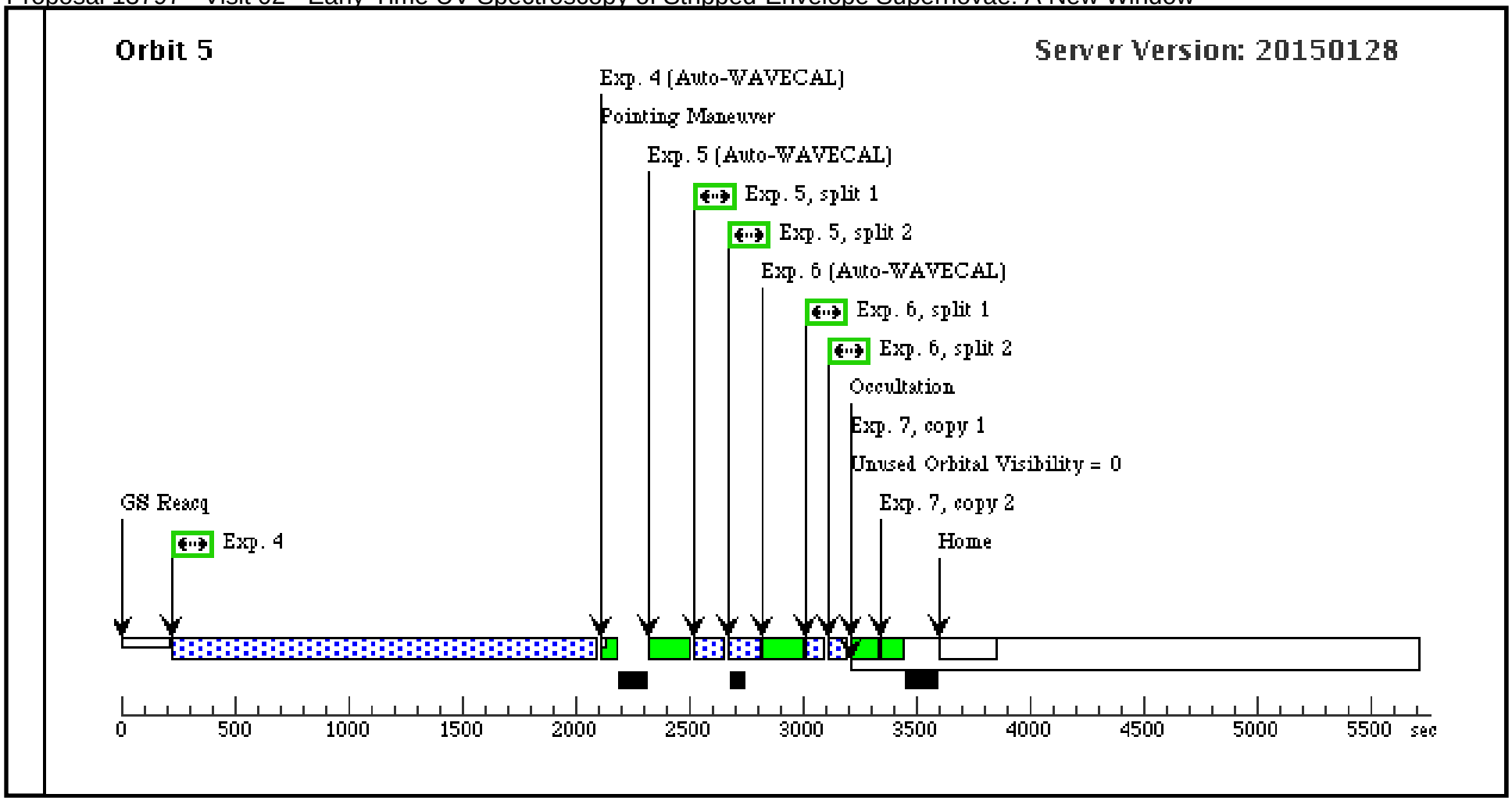
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Exp. 5, split 2
Exp. 6 (Auto-WAVECAL)
Exp. 6, split 1
Exp. 6, split 2
Occultation
Exp. 7, copy 1
Unused Orbital Visibility = 0
Exp. 7, copy 2
Home
GS Reacq
Exp. 4
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sec

Visit

Proposal 13797, Visit 03, scheduling Sat Apr 04 01:03:54 GMT 2015

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 02 BY 6 D TO 9 D; ON HOLD ; TOO RESPONSE TIME 8.0D; VISIBILITY INTERVAL 53.5 M

On Hold Comments: 3rd ToO visit

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.275	Center Pattern=false		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.275	Center Pattern=false		
	Line Spacing=			

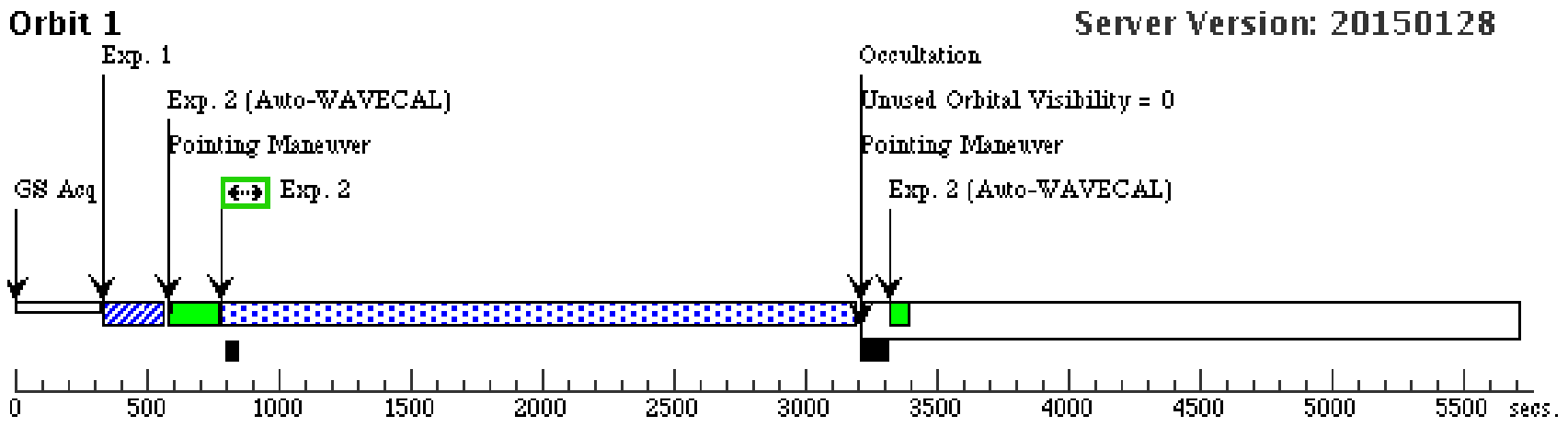
Fixed Targets

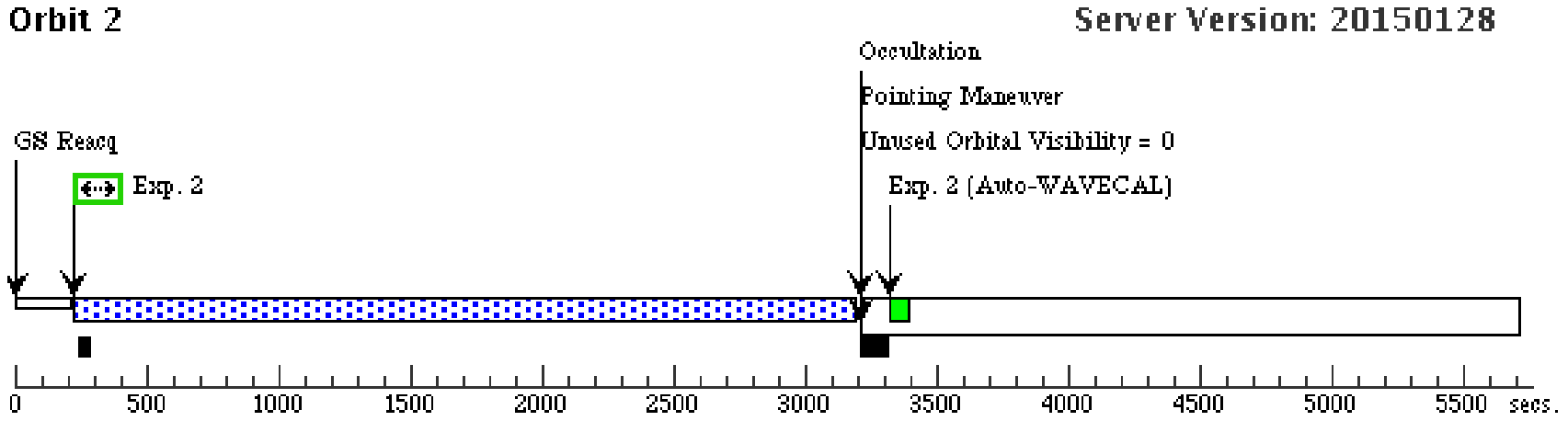
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PSN2037+6607	RA: 20 37 25.5600 (309.3565000d)		V=16.7	Reference Frame: ICRS
		Dec: +66 07 11.68 (66.11991d)			
		Equinox: J2000			

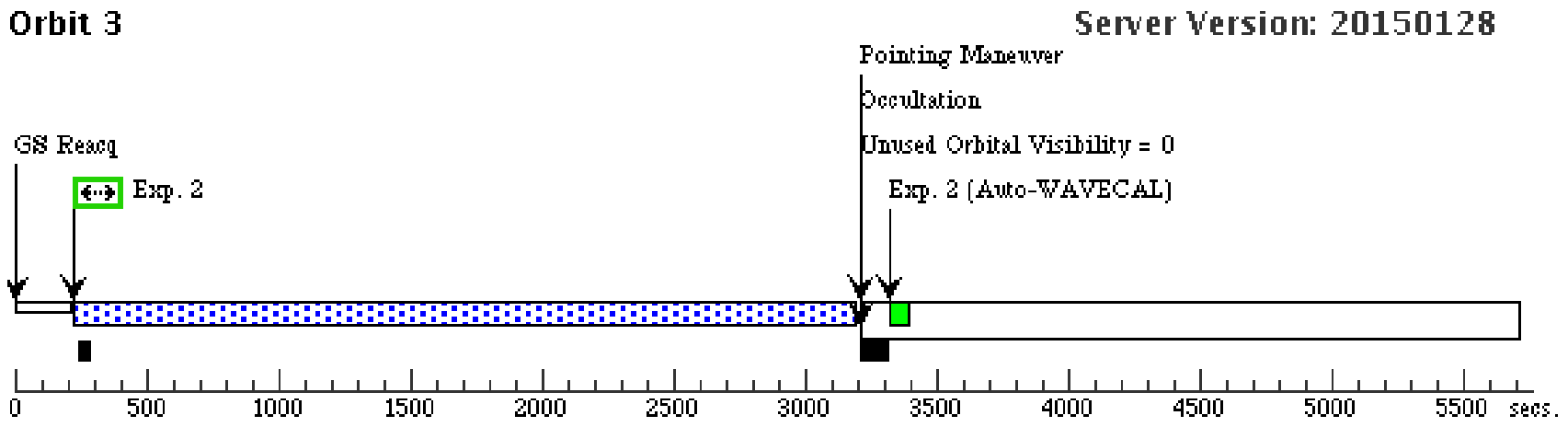
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (STIS.ta.623545)	(2) PSN2037+6607	STIS/CCD, ACQ, F28X50LP	MIRROR				2 Secs (2 Secs) *[==>]*	*[1]*
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
2	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 03 (1)	3000 Secs (8320 Secs) *[==>2400.0 Secs (Pattern 1)]* *[==>2960.0 Secs (Pattern 2)]* *[==>2960.0 Secs (Pattern 3)]*	*[1]* *[2]* *[3]*
3	Peak Up	(2) PSN2037+6607	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR				8 Secs (8 Secs) *[==>]*	*[4]*
Comments: Our SN. though UV-faint, will be optically bright. Using the STIS Acquisition ETC and the spectrum of PTF12gzk obtained in Cycle 20, we find that a 2s exposure yields a S/N > 100.									
4	SpectroscopyNUV (STIS.sp.624498)	(2) PSN2037+6607	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A		POS TARG 0,0.825	Pattern 2, Exps 4-4 in Visit 03 (2)	3000 Secs (4005 Secs) *[==>2345 Secs (Pattern 1)]* *[==>1660.0 Secs (Pattern 2)]*	*[4]* *[5]*
5	SpectroscopyG430L (STIS.sp.621403)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A				200 Secs (200 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	*[5]*
6	SpectroscopyG750L (STIS.sp.621405)	(2) PSN2037+6607	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A				100 Secs (300 Secs) *[==>150.0 Secs (Split 1)]* *[==>150.0 Secs (Split 2)]*	*[5]*
7	Fringe Flat G750L	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	*[5]*

Orbit Structure



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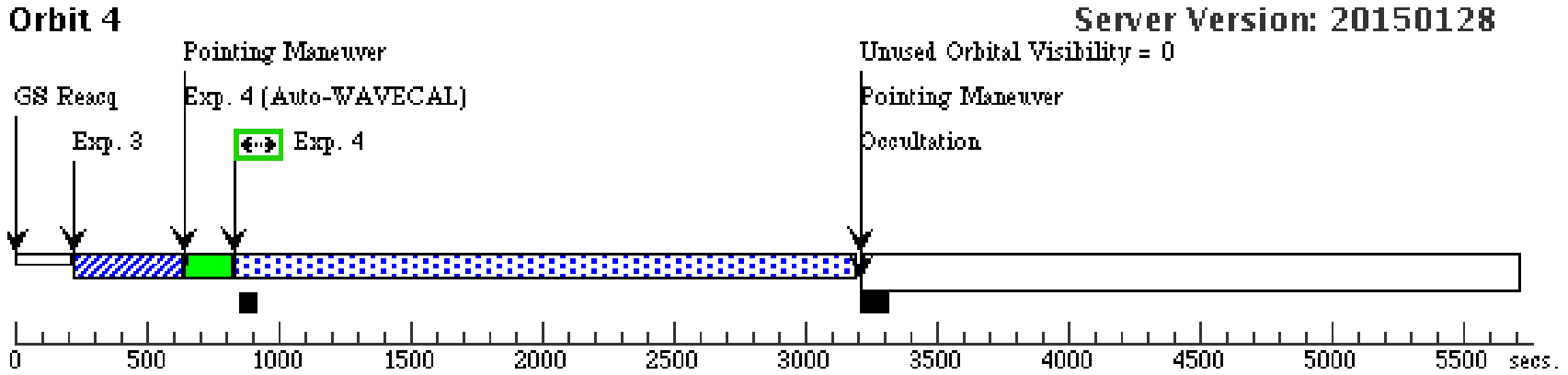
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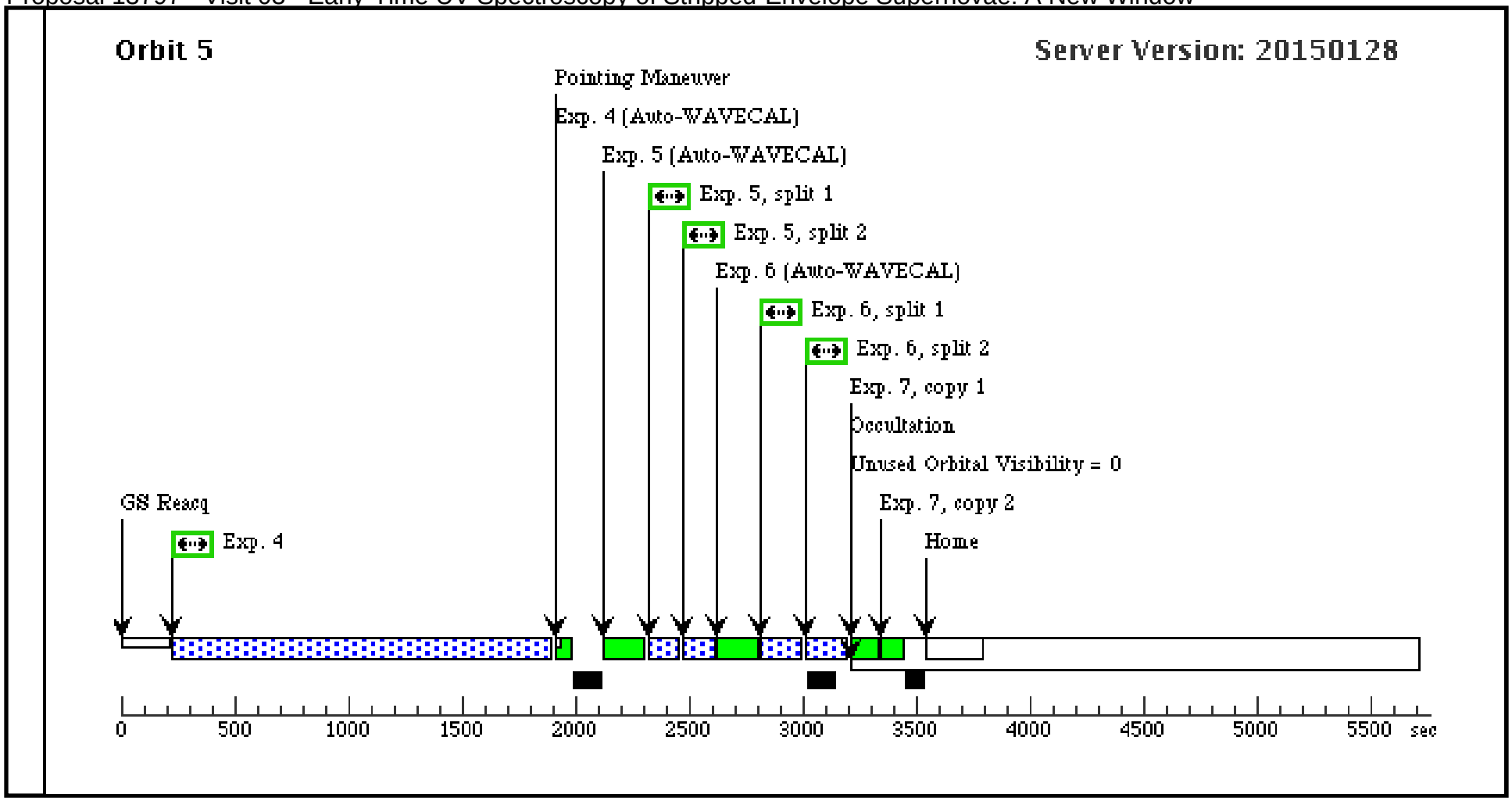
Pointing Maneuver
Exp. 3
Exp. 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 5
Server Version: 20150128
Pointing Maneuver
Exp. 4 (Auto-WAVECAL)
Exp. 5 (Auto-WAVECAL)
Exp. 5, split 1
Exp. 5, split 2
Exp. 6 (Auto-WAVECAL)
Exp. 6, split 1
Exp. 6, split 2
Exp. 7, copy 1
Occultation
Unused Orbital Visibility = 0
Exp. 7, copy 2
Home
GS Reacq
Exp. 4
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec