15864 - Is the Type Ic supernova progenitor WS35 a white dwarf merger product?

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Tomer Shenar (CoI) (ESA Member)	Katholieke Universiteit Leuven	tomer.shenar@kuleuven.be
Prof. Hugues Sana (CoI) (ESA Member)	Katholieke Universiteit Leuven	hugues.sana@kuleuven.be
Dr. Josiah Schwab (CoI)	University of California - Santa Cruz	jwschwab@ucsc.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) WS35	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	13-Feb-2020 13:00:17.0	yes
02	(1) WS35	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	13-Feb-2020 13:00:20.0	yes

10 Total Orbits Used

ABSTRACT

We propose to obtain UV spectroscopy of the newly discovered emission-line star WS35 with HST/STIS, which was found in the center of a hydrogen-free infrared nebula. Its pure C-O-Ne surface composition, high surface temperature of 200,000 K, and luminosity of 40,000 Lsun imply it is an immediate progenitor of a Type Ic supernova. Optical spectra show an unprecedented, supernova-like velocity of its wind, 16,000 km/s, whose kinetic energy exceeds the photon energy implied by WS35's luminosity. This argues for the wind acceleration being aided by a strong magnetic field and rapid rotation. It has thus been suggested that WS35 is the result of a recent white dwarf merger exceeding the Chandrasekhar mass, caught during its brief evolution from merging to collapse. We aim to test this scenario using FUV/NUV spectra of WS35, which allow to assess the velocity profile of its wind, and thereby provide a clear diagnostic of the wind acceleration mechanism. The proposed STIS UV spectroscopy will further provide unprecedented information on the surface chemical composition that is not accessible from optical spectra, in particular on the so far unconstrained neon abundance. Our results will shed new light on the formation of Type Ic supernovae, constrain the origin of Type Ia supernovae in the double-degenerate scenario, and trial the idea of generating strong magnetic fields in stellar mergers.

OBSERVING DESCRIPTION

We obtained 10 HST orbits to observe WS35 with STIS long-slit spectroscopy in low spectral resolution with gratings G140L in the FUV and G230L in the NUV. We wish to obtain data for two epochs to constrain a possible binary nature of the object. We further use time-tag mode to get information on short-term variability, which could be of the order of 5min.

We split our observing time in two visits with 5 orbits each. With an integration time of 7051s per visit in the NUV and 7645s per visit in the FUV we obtain a minimum S/N of 20 per visit in the relevant wavelength ranges (~1600-3000A in the NUV, and ~1250-1600A in the FUV, cf. ETC runs STIS.sp.1368104 and STIS.sp.1368105). For time-tag mode we chose buffer times that are roughly a factor three lower than the ETC recommendations to be safe against uncertainties in the source flux and the interstellar extinction (which is included in our uploaded model spectrum). We adopt the standard 52"x0.2" slit.

For target acquisition we use a standard point source acquisition.

Visit

Proposal 15864, Visit 01, implementation Thu Feb 13 18:00:21 GMT 2020

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 06-SEP-2020:00:00:00

Fixed Targets

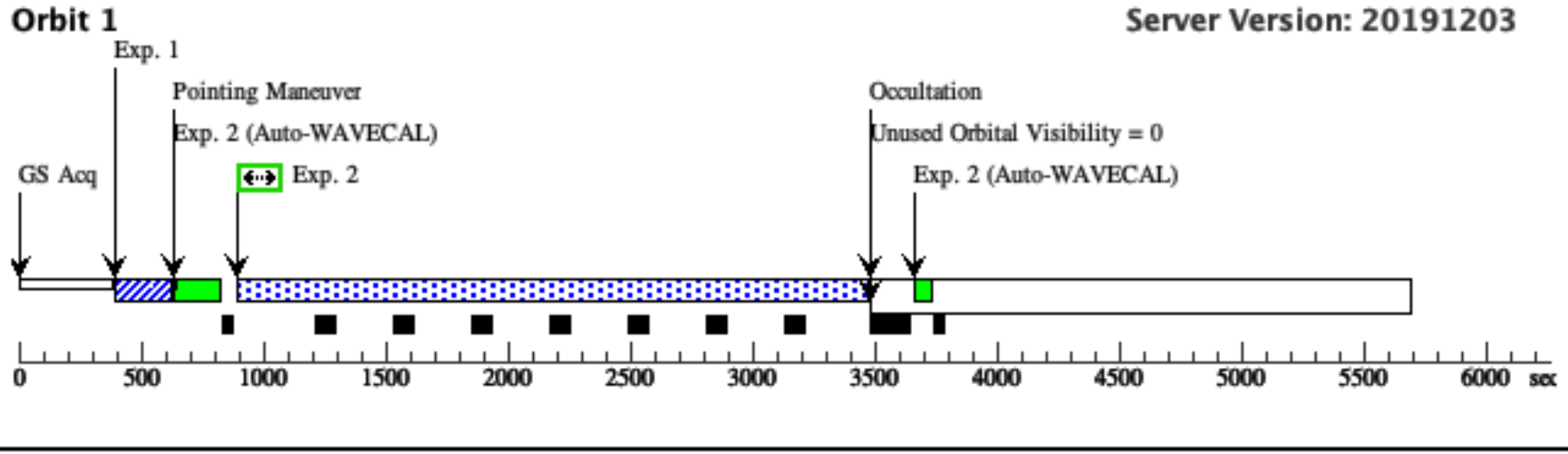
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WS35	RA: 00 53 11.2100 (13.2967083d) Dec: +67 30 2.10 (67.50058d) Equinox: J2000		V=15.23	Reference Frame: ICRS

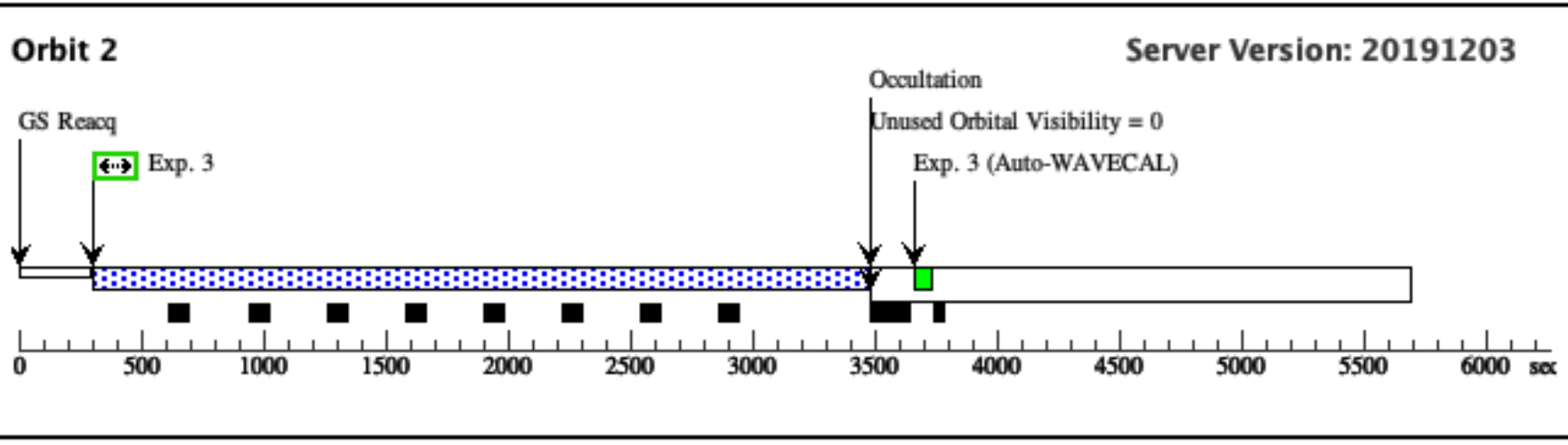
Comments: This object was generated by the targetselector and retrieved from the 2MASS database.
Category=STAR
Description=[WOLF RAYET]

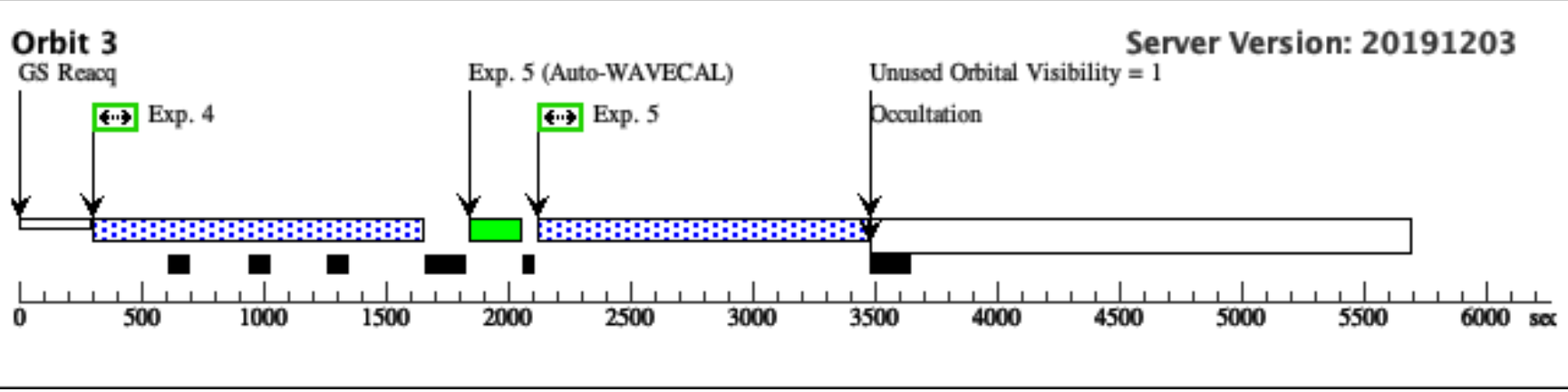
Exposures

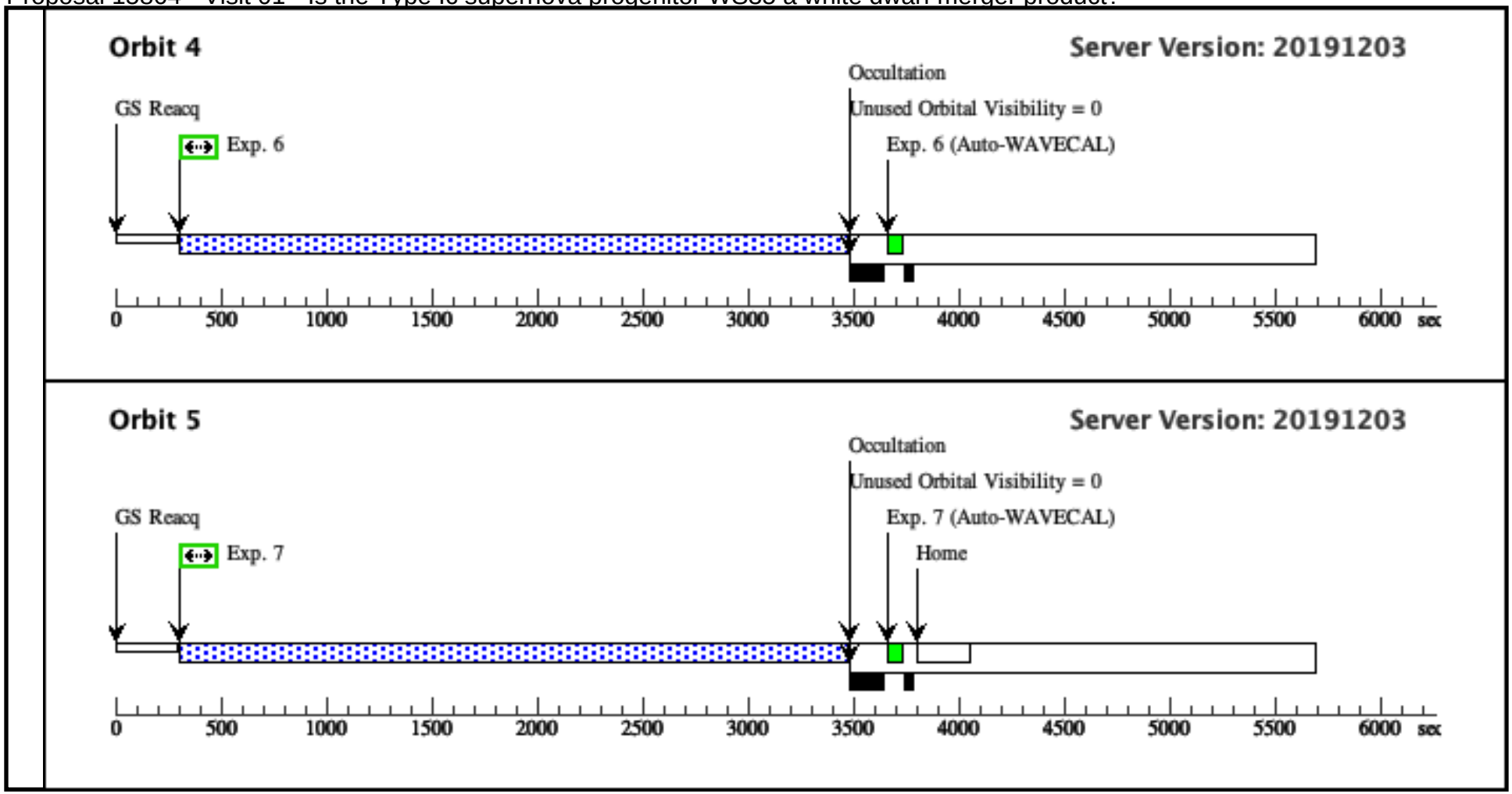
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.1365087)	(1) WS35	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			1 Secs (1 Secs) *[==>]*	*[1]*
2	STIS/NUV (STIS.sp.1368104)	(1) WS35	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=320			1000 Secs (2562 Secs) *[==>2562.0 Secs]*	*[1]*
3	STIS/NUV (STIS.sp.1368104)	(1) WS35	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=320			1000 Secs (3156 Secs) *[==>3156.0 Secs]*	*[2]*
4	STIS/NUV (STIS.sp.1368104)	(1) WS35	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=320			1000 Secs (1333 Secs) *[==>1333.0 Secs]*	*[3]*
5	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (1333 Secs) *[==>1333.0 Secs]*	*[3]*
6	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (3156 Secs) *[==>3156.0 Secs]*	*[4]*
7	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (3156 Secs) *[==>3156.0 Secs]*	*[5]*

Orbit Structure





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Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 6
Exp. 6 (Auto-WAVECAL)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec
Orbit 5
Server Version: 20191203
Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 7
Exp. 7 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15864, Visit 02, implementation Thu Feb 13 18:00:22 GMT 2020

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 06-SEP-2020:00:00:00

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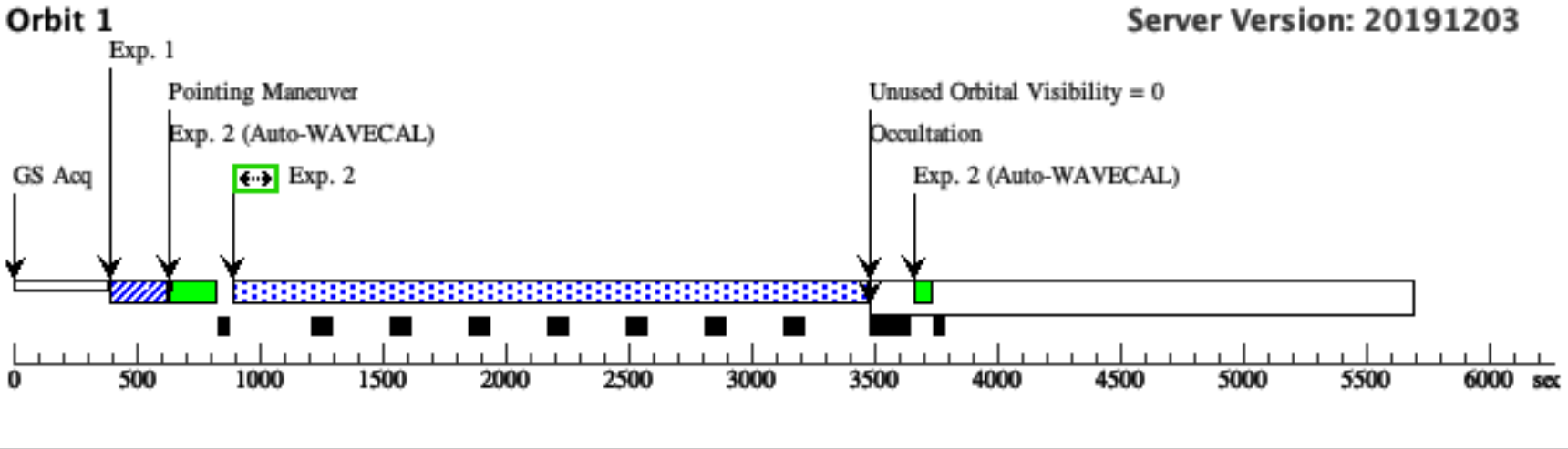
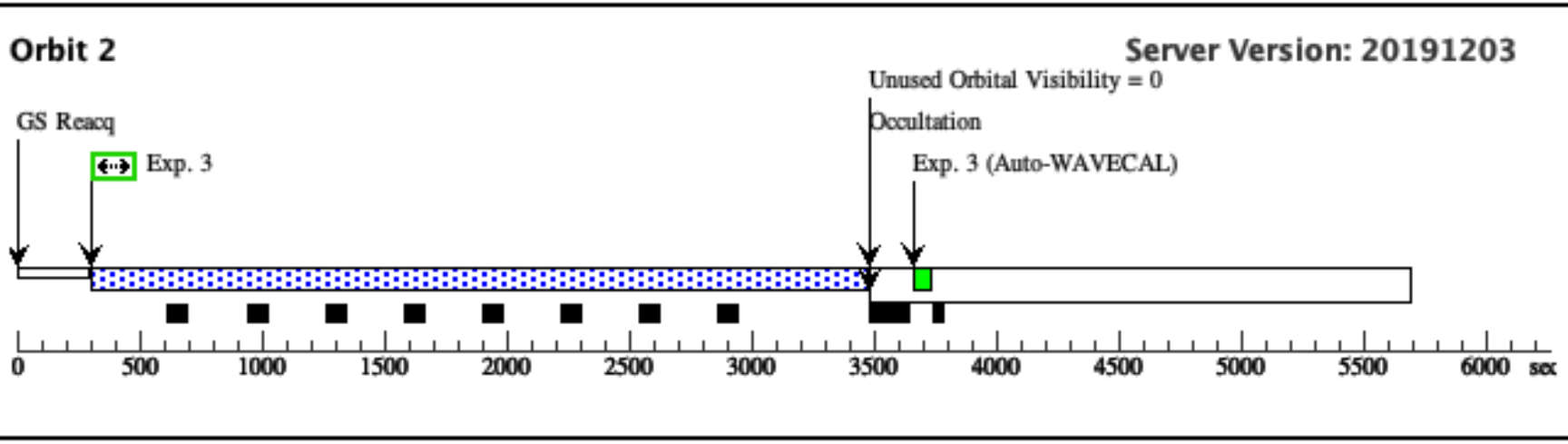
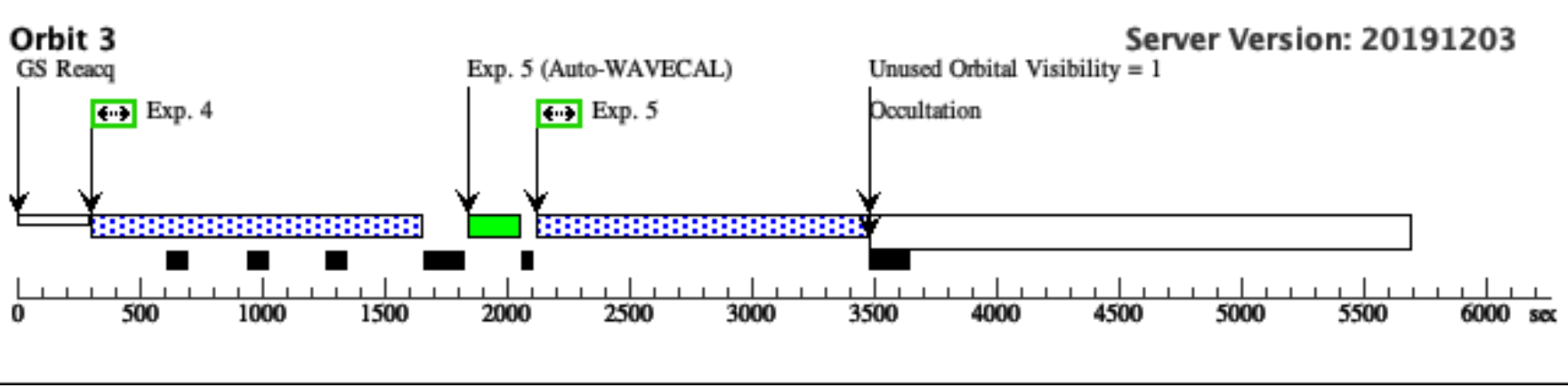
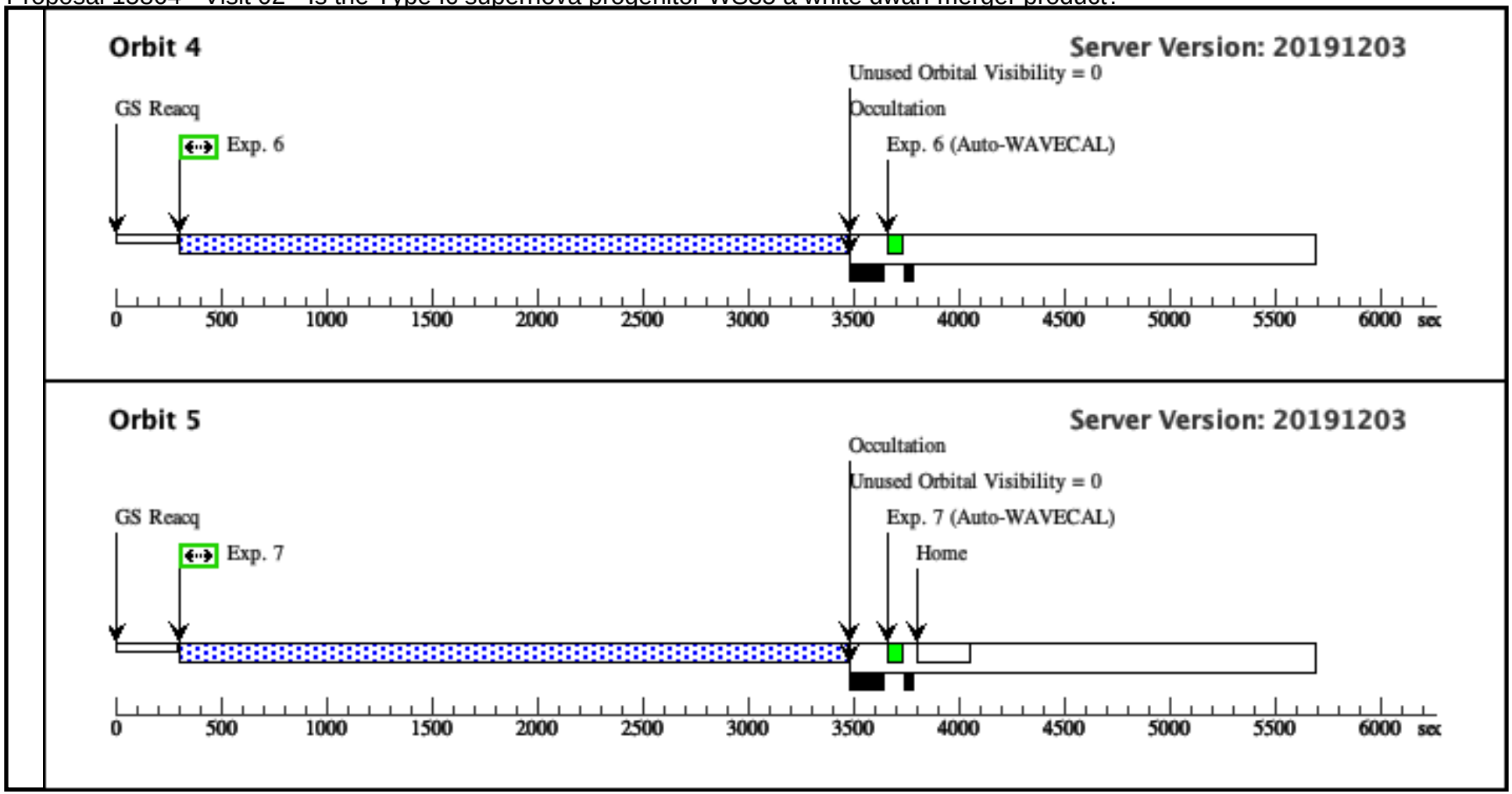
5	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (1333 Secs) *[==>1333.0 Secs]*	*[3]*
6	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (3156 Secs) *[==>3156.0 Secs]*	*[4]*
7	STIS/FUV (STIS.sp.1368105)	(1) WS35	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=2000			1000 Secs (3156 Secs) *[==>3156.0 Secs]*	*[5]*

Orbit Structure








Orbit 4
Server Version: 20191203
Unused Orbital Visibility = 0
GS Reacq
Occultation
Exp. 6
Exp. 6 (Auto-WAVECAL)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec
Orbit 5
Server Version: 20191203
Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 7 (Auto-WAVECAL)
Exp. 7
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec