16753 - The radius and magnetic field structure of the smallest white dwarf

Cycle: 29, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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Prof. Shrinivas R. Kulkarni (CoI)	California Institute of Technology
Prof. Jim Fuller (CoI)	California Institute of Technology
Dr. Adela Kawka (CoI)	Curtin University
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Prof. dayal tissa wickramasinghe (CoI)	Australian National University
Prof. Lilia Ferrario (CoI)	Australian National University

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) ZTFJ1901+1458	COS/FUV	2	10-Jun-2024 15:00:18.0	yes
04	(1) ZTFJ1901+1458	COS/FUV	2	10-Jun-2024 15:00:19.0	yes
R4	(1) ZTFJ1901+1458	COS/FUV	2	10-Jun-2024 15:00:20.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(1) ZTFJ1901+1458	STIS/CCD STIS/NUV-MAMA	3	10-Jun-2024 15:00:21.0	yes
03	(1) ZTFJ1901+1458	STIS/CCD STIS/NUV-MAMA	3	10-Jun-2024 15:00:23.0	yes
R5	(1) ZTFJ1901+1458	STIS/CCD STIS/NUV-MAMA	1	10-Jun-2024 15:00:23.0	yes

13 Total Orbits Used

ABSTRACT

The white dwarf ZTF J1901+1458 is extreme in almost every regard: it rotates every 6.94 minutes, one of the shortest periods measured for an isolated white dwarf, it is threaded by a magnetic field of almost a billion Gauss, and is the smallest white dwarf for which a radius has been measured, with a size comparable to that of the Moon. The white dwarf is so compact, that it might be gravitationally unstable and headed toward collapse. The radius's measurement, however, hinges on assumptions on the white dwarf's spectral distribution that can only be verified by ultraviolet spectroscopy. Moreover, a UV spectrum will allow a detailed modeling of the white dwarf's magnetic field strength and morphology.

OBSERVING DESCRIPTION

The purpose of this program is to study the SED and lightcurve of the white dwarf ZTF J1901+1458, as well as detect hydrogen absorption features in the far UV. ZTF J1901+1458 is the smallest white dwarf known (with a radius of about 2100 km), which shows signs of a very strong magnetic fields (almost a billion Gauss) and a variation in optical luminosity of about 3% over a period of 6.94 minutes. The proposed observations will allow us to constrain the surface temperature and radius of the white dwarf, as well as its magnetic field strength and structure.

We ask for 4 orbits of COS spectroscopy and 6 orbits of STIS spectroscopy in the time-tag mode, so that we will obtain high signal-to-noise phase resolved spectra and UV lightcurves. For the COS observations, we ask for a different FP-POS in each orbit, for a total of 4. There are no time constraints on the observations, and the 4 visits can be scheduled separately.

The Swift UVOT data for this white dwarf in the UV shows a flattening of the SED, in contrast to what we expect from a non magnetized white dwarf. For this reason, we cannot predict with high confidence the luminosity in the far UV. Thus, we employ two different models in the ETC: a flat

spectrum normalized to the bluest UVOT filter, which correspond to the faintest hypothesis for the far UV, and the white dwarf spectrum that best fits both the optical and UV data, which predicts a higher number of counts. To be the most conservative, we use the flat spectrum to estimate the exposure times in the targeting mode of COS, while we employ the white dwarf spectrum to estimate the correct buffer times and the exposure times in the targeting mode of STIS.

Visit

Proposal 16753, Visit 01, completed Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave.

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

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

Fixed Targets

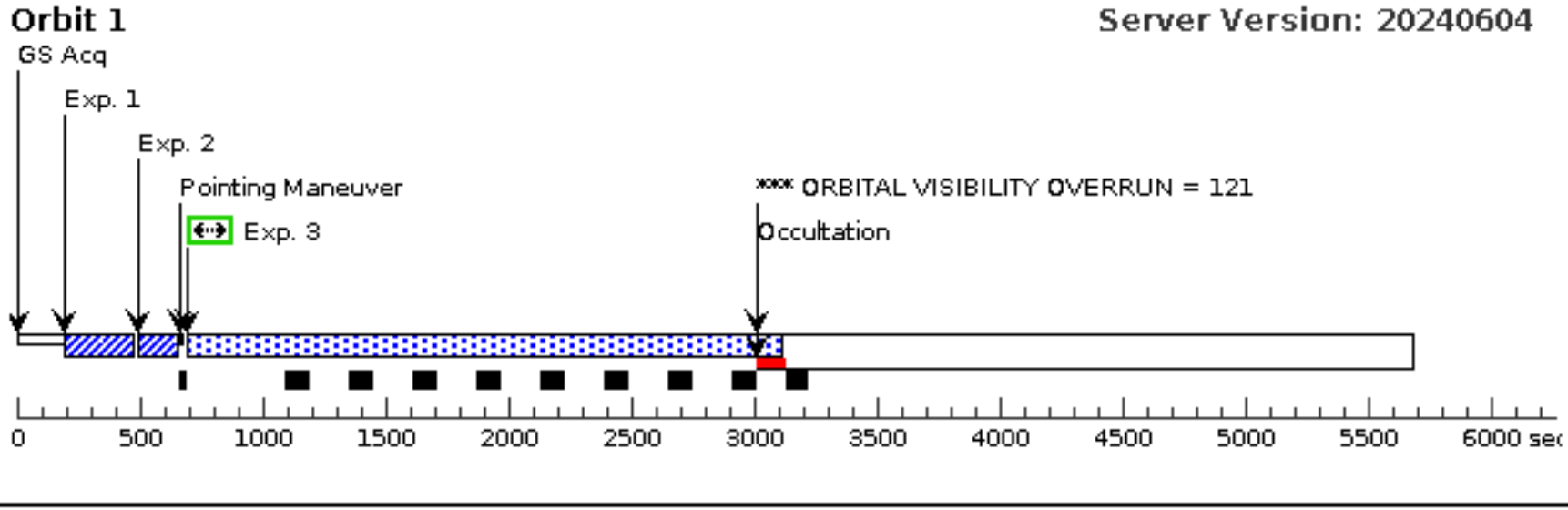
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

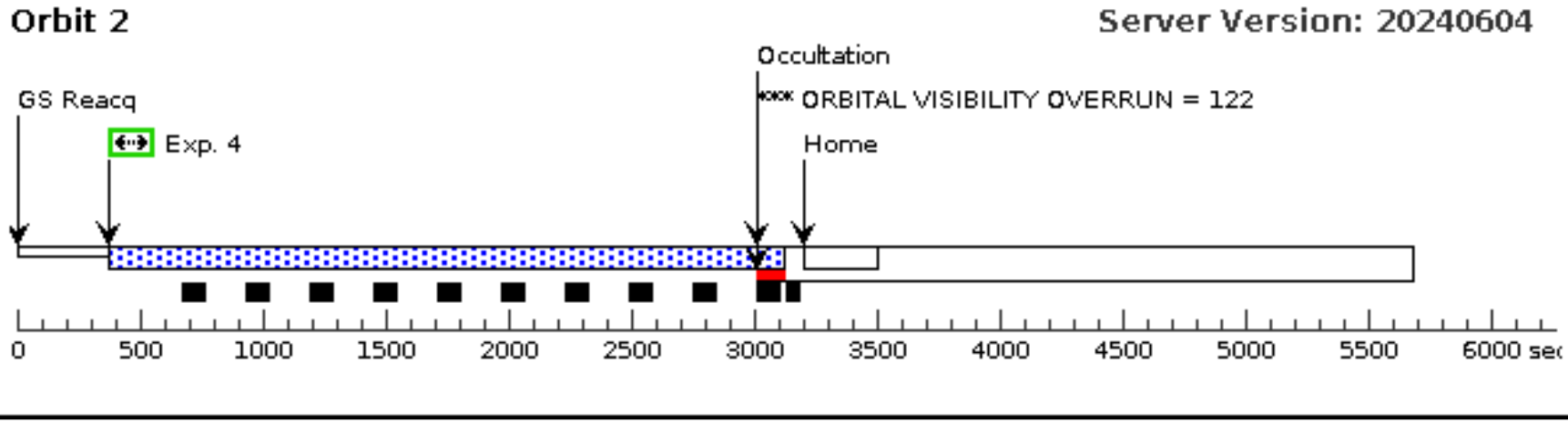
Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A				1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
2	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-WT-FLR			1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
3	(1529744)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=1			2273 Secs (2268 Secs) *[==>2268.0 Secs]*	 ***[1]***
4	(1529745)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=2			2693 Secs (2693 Secs) *[==>]*	 ***[2]***

Orbit Structure





Visit

Proposal 16753, Visit 04, failed Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 04) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave.

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

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

Fixed Targets

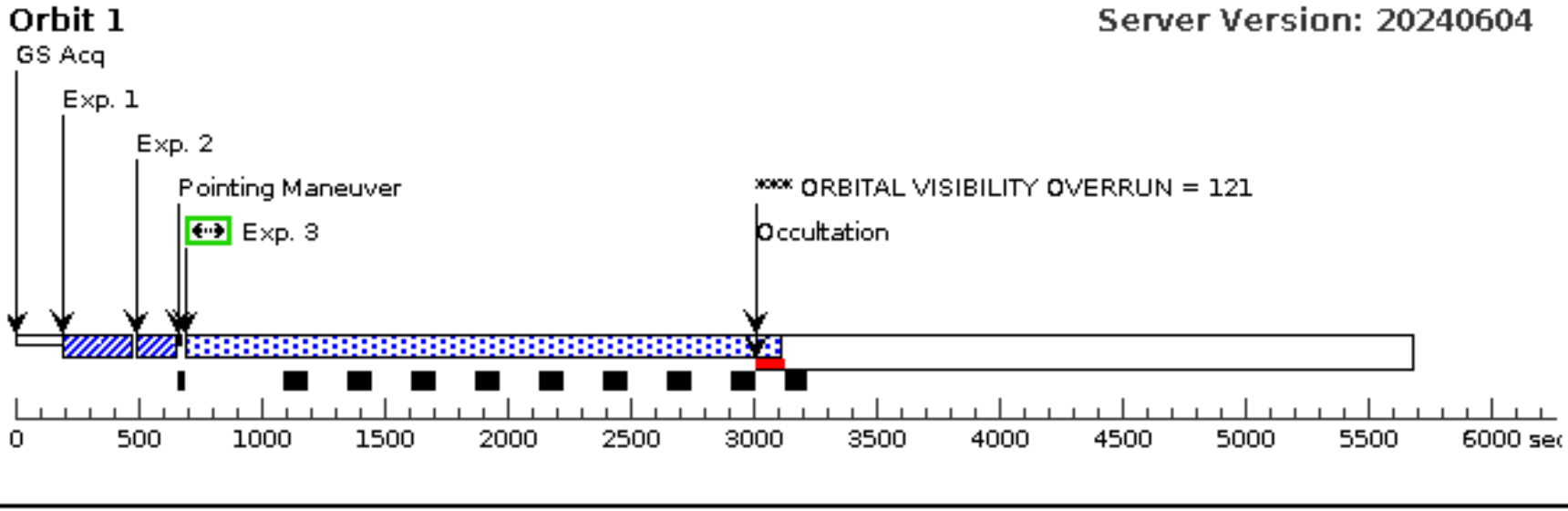
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

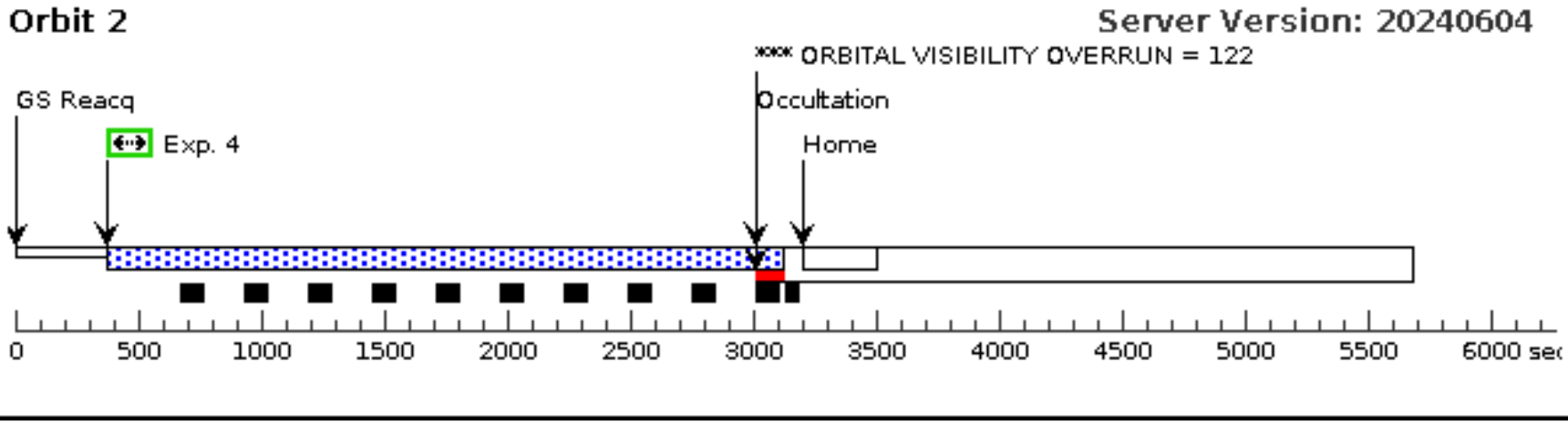
Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A				1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
2	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-WT-FLR			1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
3	(1529744)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=3			2273 Secs (2268 Secs) *[==>2268.0 Secs]*	 ***[1]***
4	(1529745)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=4			2693 Secs (2693 Secs) *[==>]*	 ***[2]***

Orbit Structure





Visit

Proposal 16753, Visit R4, completed Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Diagnostics

(Visit R4) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave.

(Visit R4) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit R4) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

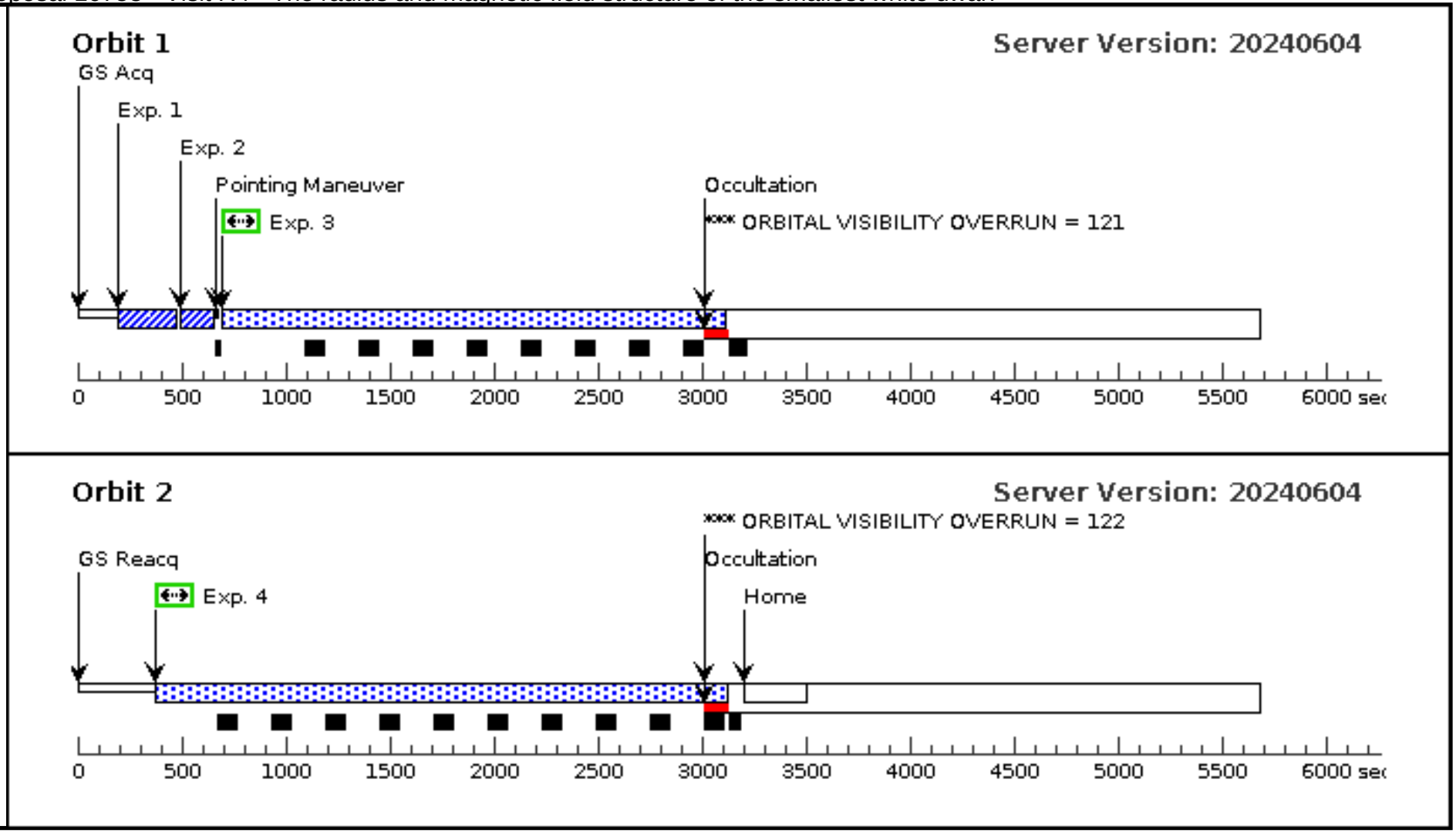
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A				1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
2	(1529740)	(1) ZTFJ1901+1458	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-WT-FLR			1.5 Secs (1.5 Secs) *[==>]*	 ***[1]***
3	(1529744)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=3			2273 Secs (2268 Secs) *[==>2268.0 Secs]*	 ***[1]***
4	(1529745)	(1) ZTFJ1901+1458	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=260; FP-POS=4			2693 Secs (2693 Secs) *[==>]*	 ***[2]***

Orbit Structure



Visit

Proposal 16753, Visit 02, completed Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: Warning

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

Special Requirements: (none)

Diagnostics

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

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

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

Fixed Targets

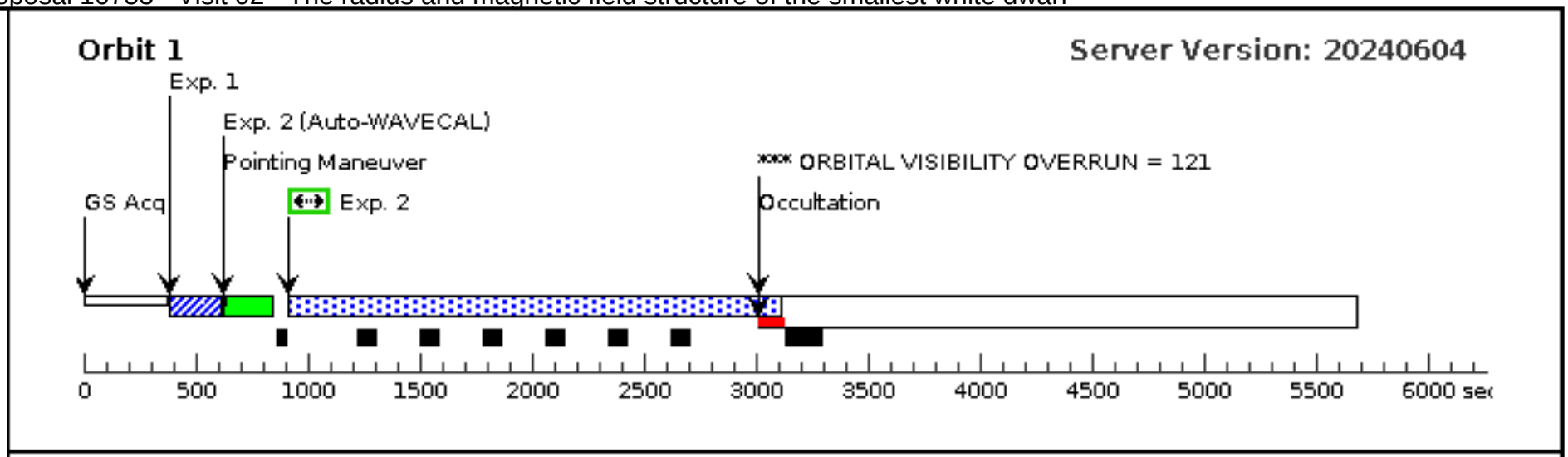
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

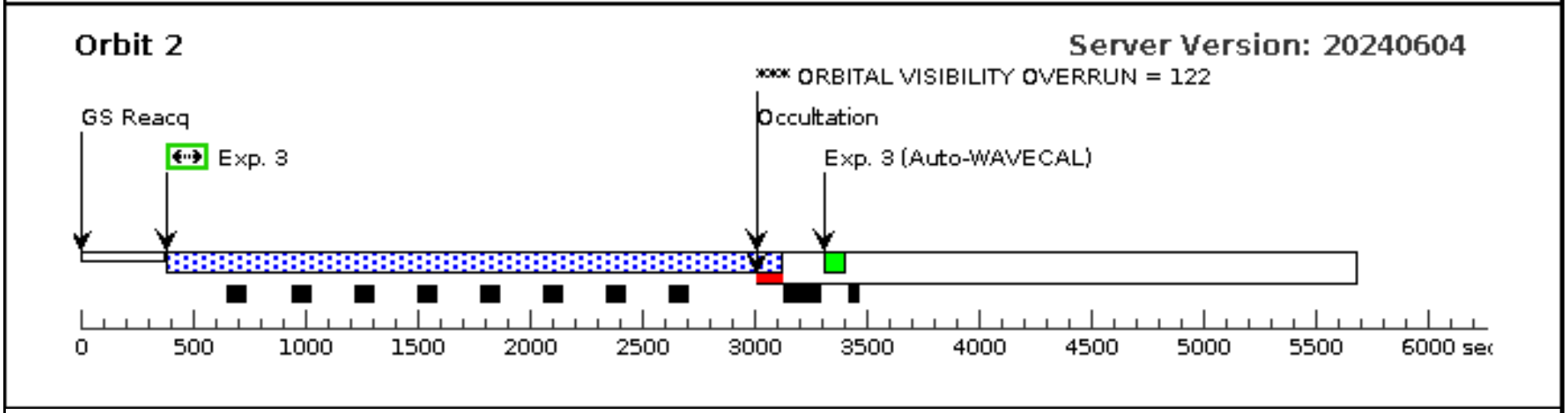
Comments:
Category=STAR
Description=[DA]
Extended=NO

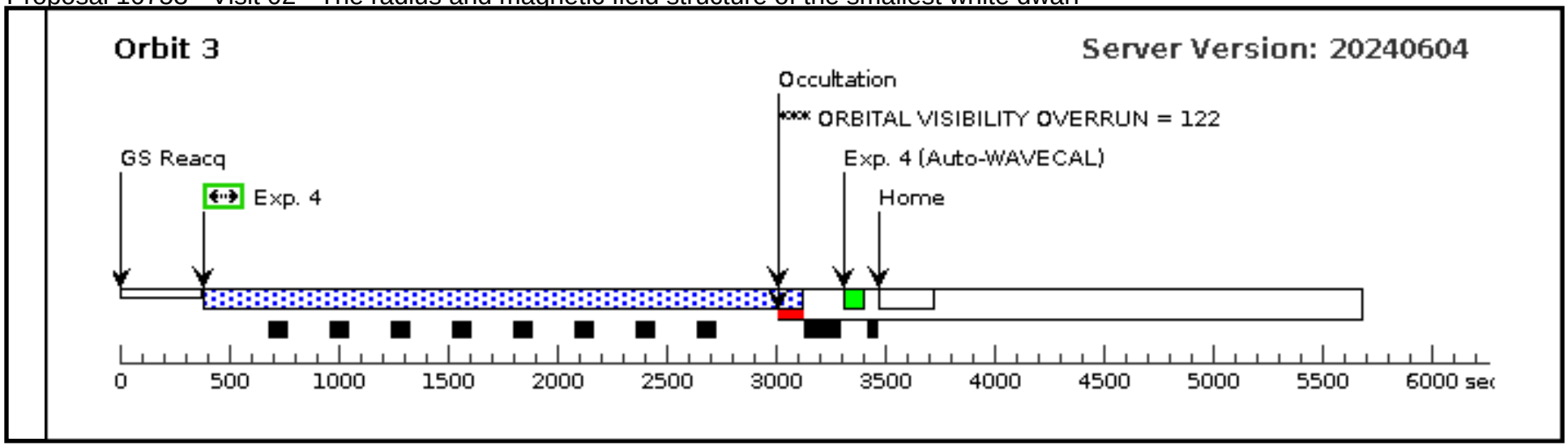
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529746)	(1) ZTFJ1901+1458	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			1.1 Secs (1.1 Secs)	
								[==>]	***[1]***
2	(1529747)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2165 Secs (2165 Secs)	
								[==>]	***[1]***
3	(1529748)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2729 Secs (2729 Secs)	
								[==>]	***[2]***
4	(1528629)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2729 Secs (2704 Secs)	
								[==>2704.0 Secs]	***[3]***

Orbit Structure



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6000 sec

Visit

Proposal 16753, Visit 03, failed Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: Warning

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

Special Requirements: (none)

Diagnostics

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

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

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

Fixed Targets

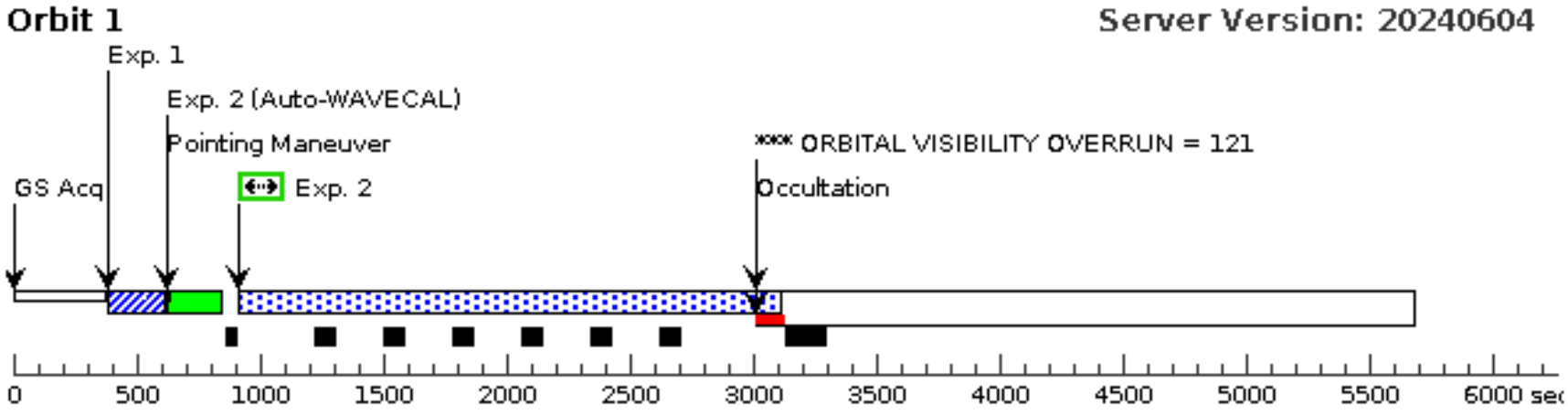
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

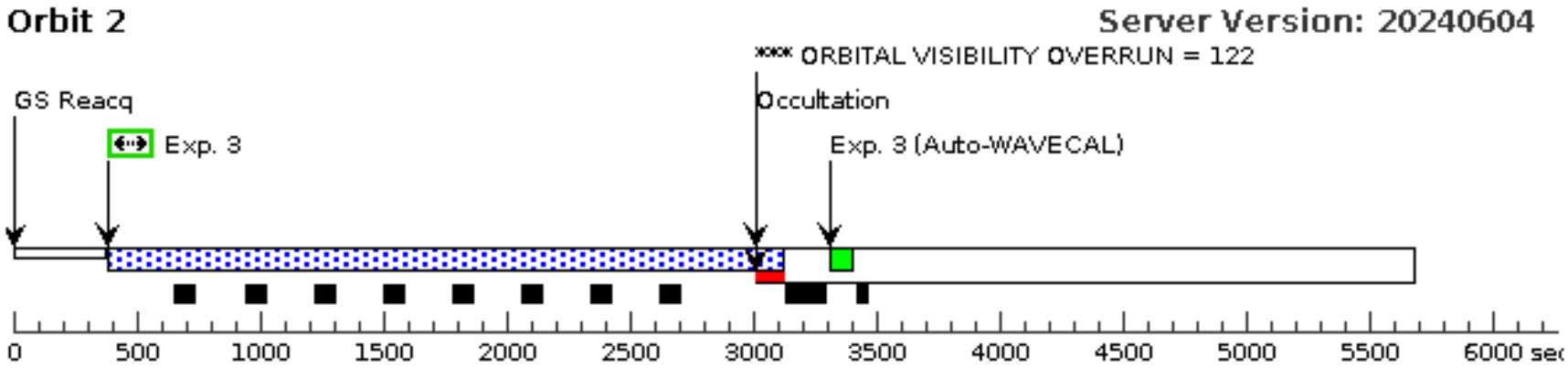
Comments:
Category=STAR
Description=[DA]
Extended=NO

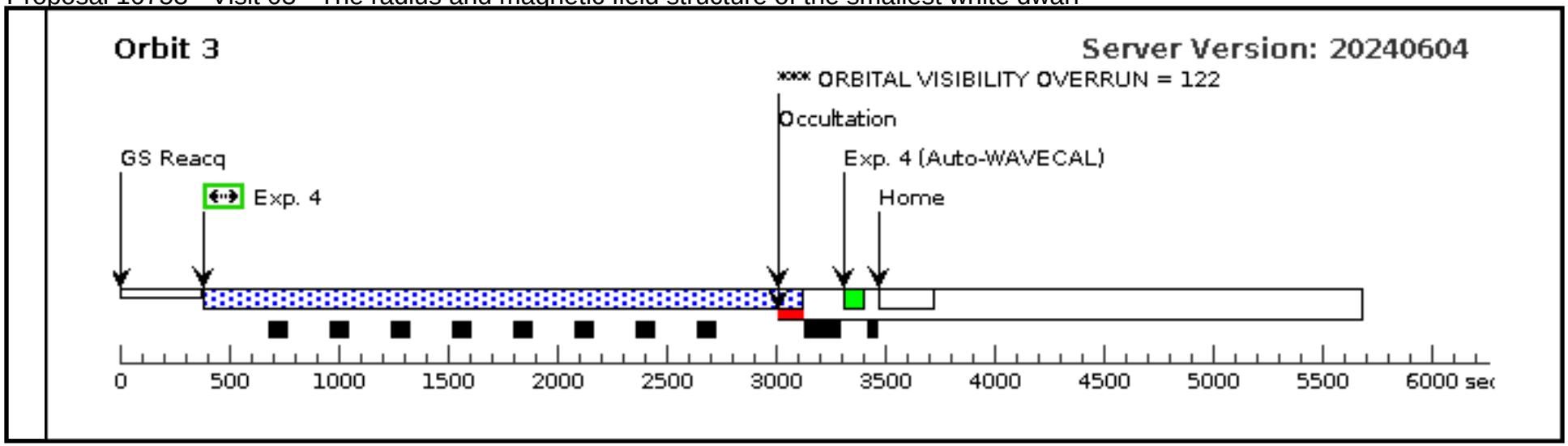
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529746)	(1) ZTFJ1901+1458	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			1.1 Secs (1.1 Secs)	
								[==>]	***[1]***
2	(1529747)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2165 Secs (2165 Secs)	
								[==>]	***[1]***
3	(1529748)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2729 Secs (2729 Secs)	
								[==>]	***[2]***
4	(1529748)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2729 Secs (2704 Secs)	
								[==>2704.0 Secs]	***[3]***

Orbit Structure



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Exp. 4 (Auto-WAVECAL)
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Visit

Proposal 16753, Visit R5, implementation Mon Jun 10 19:00:24 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZTFJ1901+1458 Alt Name1: IPHAS-J190132.77+145807.6 Alt Name2: GAIA-DR2-4506869128279648512	RA: 19 01 32.8452 (285.3868550d) Dec: +14 58 8.34 (14.96898d) Equinox: J2000	Proper Motion RA: 95.366 mas/yr Proper Motion Dec: 72.558 mas/yr Parallax: 0.0241538" Epoch of Position: 2016.0	V=15.72+/-0.02 PS1 g 15.51, Swift U 14.94, Swift UVW1 14.42, Swift UVM2 14.40	Reference Frame: ICRS

Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1529746)	(1) ZTFJ1901+1458	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			1.1 Secs (1.1 Secs)	
								[==>]	***[1]***
2	(1529747)	(1) ZTFJ1901+1458	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=280			2165 Secs (2044 Secs)	
								[==>2044.0 Secs]	***[1]***

Orbit Structure