



18432 - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

Cycle: 34, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Guangwei Fu (PI) (Contact)	The Johns Hopkins University
Prof. David K. Sing (CoI)	The Johns Hopkins University
Dr. Joshua D. Lothringer (CoI)	Space Telescope Science Institute

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) V-V1298-TAU WAVE	STIS/CCD	10	30-Jul-2026 16:01:53.0	yes
02	(1) V-V1298-TAU WAVE	STIS/CCD	10	30-Jul-2026 16:02:08.0	yes

20 Total Orbits Used

ABSTRACT

What shapes the exoplanet radius valley between super-Earths and sub-Neptunes: XUV-driven photoevaporation or core-powered mass loss? Direct mass-loss measurements during the first ~ 100 Myr when escape peaks are the key test. Current He I 1083 nm fits suffer an order-of-magnitude (T , $\dot{M}$) degeneracy; a multi-line hydrogen diagnostic breaks it. We propose 20 HST orbits (2 transits) of STIS G750M to detect H-alpha atmospheric escape from V1298 Tau c, a 23 Myr sub-Neptune ($P=8.25$ d, $R_p \sim 5.6 R_{\text{Earth}}$, $M_p \sim 4.7 M_{\text{Earth}}$) at the upper edge of the radius valley. The JWST NIRISS/SOSS transit already reveals a strong He I 1083 nm excess (~ 3400 ppm) and the first Paschen-alpha 1875 nm escape detection on any exoplanet (~ 2300 ppm), both with trailing tails >2 hr past egress. HST H-alpha completes the first simultaneous H-alpha + Pa-alpha + He I escape measurement on any exoplanet. The H-alpha/Pa-alpha depth ratio probes the $n=2$ and $n=3$ excited-hydrogen populations, providing a Balmer-

Paschen thermometer that breaks the (T, $\dot{M}$) degeneracy. Combined with the JWST He I depth and non-LTE modeling framework, we will constrain the outflow temperature to ~ 5 -10% and the mass-loss rate to better than 0.1 dex, an order-of-magnitude improvement over single-line analyses. Only HST/STIS delivers the ~ 15 hr continuous stare and few-hundred-ppm stability needed to resolve the post-egress tail; ground-based H-alpha and He I campaigns on V1298 Tau c have failed due to limited phase coverage. This measurement provides a critical calibration anchor for photoevaporation vs. core-powered mass-loss models and establishes a multi-line diagnostic framework for the growing sample of young transiting planets.

OBSERVING DESCRIPTION

We will observe two transits of the 23 Myr sub-Neptune V1298 Tau c with STIS/CCD G750M centered at 6581 Å (covering H-alpha at 6563 Å) through the 52X2 slit, to measure H-alpha absorption from the escaping atmosphere. Each visit is a single uninterrupted block of 10 orbits (~ 15 hr). Because the JWST NIRISS He I and Pa-alpha light curves show an asymmetric escape signature with a trailing tail extending more than 2 hr past egress, the transit is deliberately not centered in the visit: the phase constraint starts each visit 5.0-4.5 hr before mid-transit, giving ~ 2 orbits of pre-ingress baseline, the full 4.8 hr transit, the post-egress tail, and ~ 3 orbits of post-tail baseline to anchor the out-of-transit flux and recover the true transit depth. The phase constraint uses a JWST-anchored ephemeris ($T_0 = 2460924.7690$ BJD_TDB from the 2025 Sep 6 NIRISS transit; $P = 8.24924$ d from the 2021 CHEOPS to 2025 JWST transit baseline).

Each visit begins with a CCD target acquisition (F28X50LP), followed by time-series spectroscopy: 8 exposures of 238 s in orbit 1 and 10 per orbit thereafter (98 total per visit, ~ 260 s cadence). We acknowledge that these 10-orbit visits exceed 6 orbits and will execute under shared-risk long-stare scheduling in reduced gyro mode.

Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

Visit	Proposal 18432, V1298 Tau c H-alpha transit 1 of 2 (01)	Thu Jul 30 20:02:10 GMT 2026
	Diagnostic Status: Warning	
	Scientific Instruments: STIS/CCD	
	Special Requirements: Period 8.24924 D AND ZERO-PHASE HJD2460924.7690	
	<i>Comments: V1298 Tau c transit 1 of 2. 10 continuous orbits in a single visit (unbroken block). Phase constraint places visit start ~5.0-4.5 hr before predicted mid-transit: ~2 orbits pre-ingress baseline, full T14=4.67 hr transit, and post-eqress coverage of the trailing tail plus ~2 orbits post-tail baseline. Shared-risk long-stare scheduling (>6 orbits) acknowledged in Phase I special requirements.</i>	

Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

[illegible]

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[illegible]

Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	V-V1298-TAU	RA: 04 05 19.5910 (61.3316292d)	Proper Motion RA: 5.413 mas/yr	V=10.12	Reference Frame: ICRS
			Dec: +20 09 25.56 (20.15710d)	Proper Motion Dec: -16.052000023591972 mas/yr		
			Equinox: J2000	Parallax: 0.0092577"		
				Epoch of Position: 2000		
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.						
SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.						
Category=STAR						
Description=[K III-I]						

Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

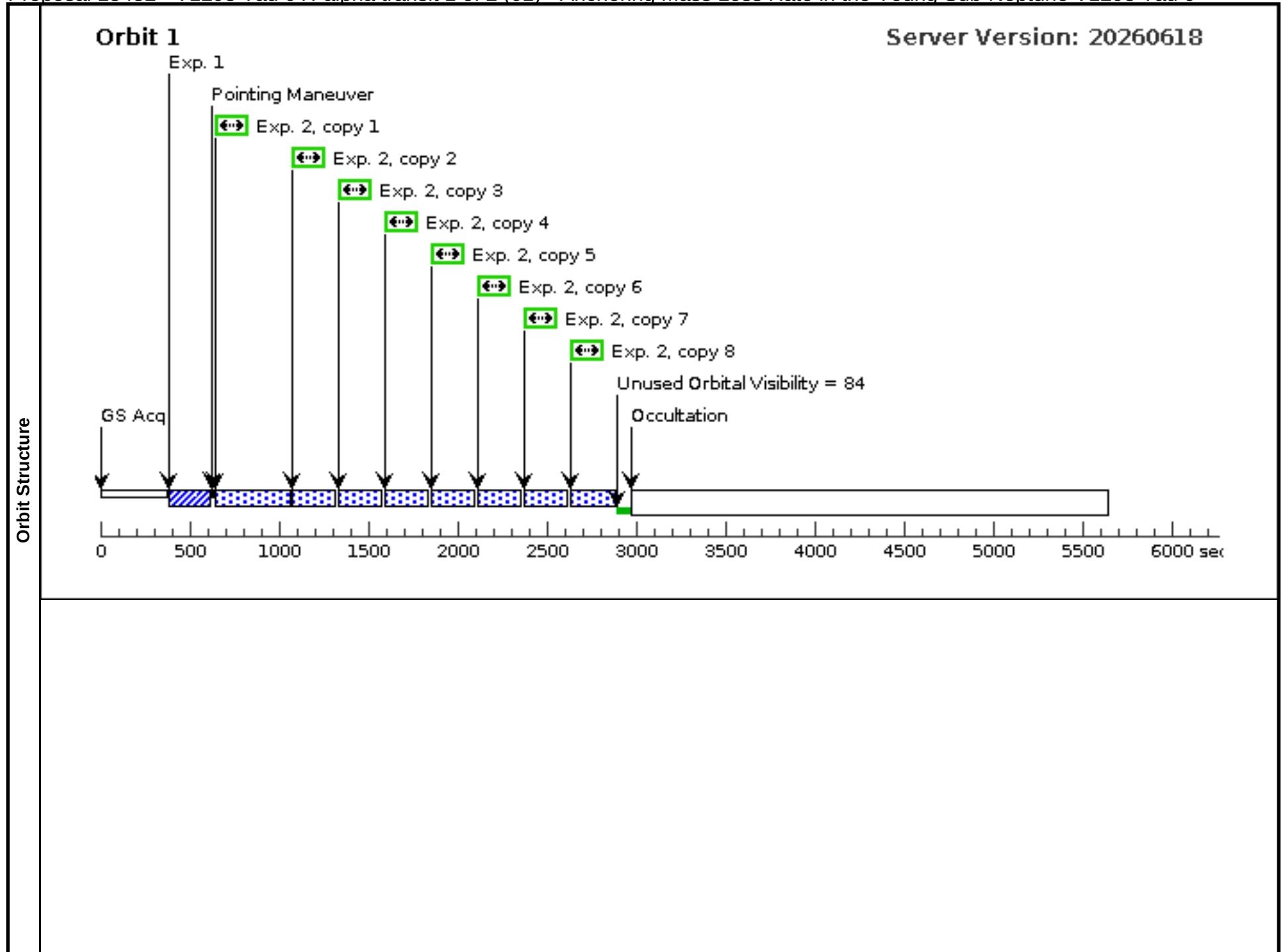
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACQ phase constrained	(1) V-V1298-TAU	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.97474514 8 TO 0.977270633		0.2 Secs (0.2 Secs)	
									[==>]	[1]
	Comments: CCD target acquisition. Verify exposure time with STIS ETC for V=10.12 K1.5 star (scaled from heritage programs).									
	2	G750M orbit 1	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 8 (1904 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[1]
	3	G750M orbit 2	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 10 (2380 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[2]
	4	G750M orbit 3	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 10 (2380 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[3]

Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

5	G750M orbi t 4	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[4]
6	G750M orbi t 5	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[5]
7	G750M orbi t 6	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[6]
8	G750M orbi t 7	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[7]

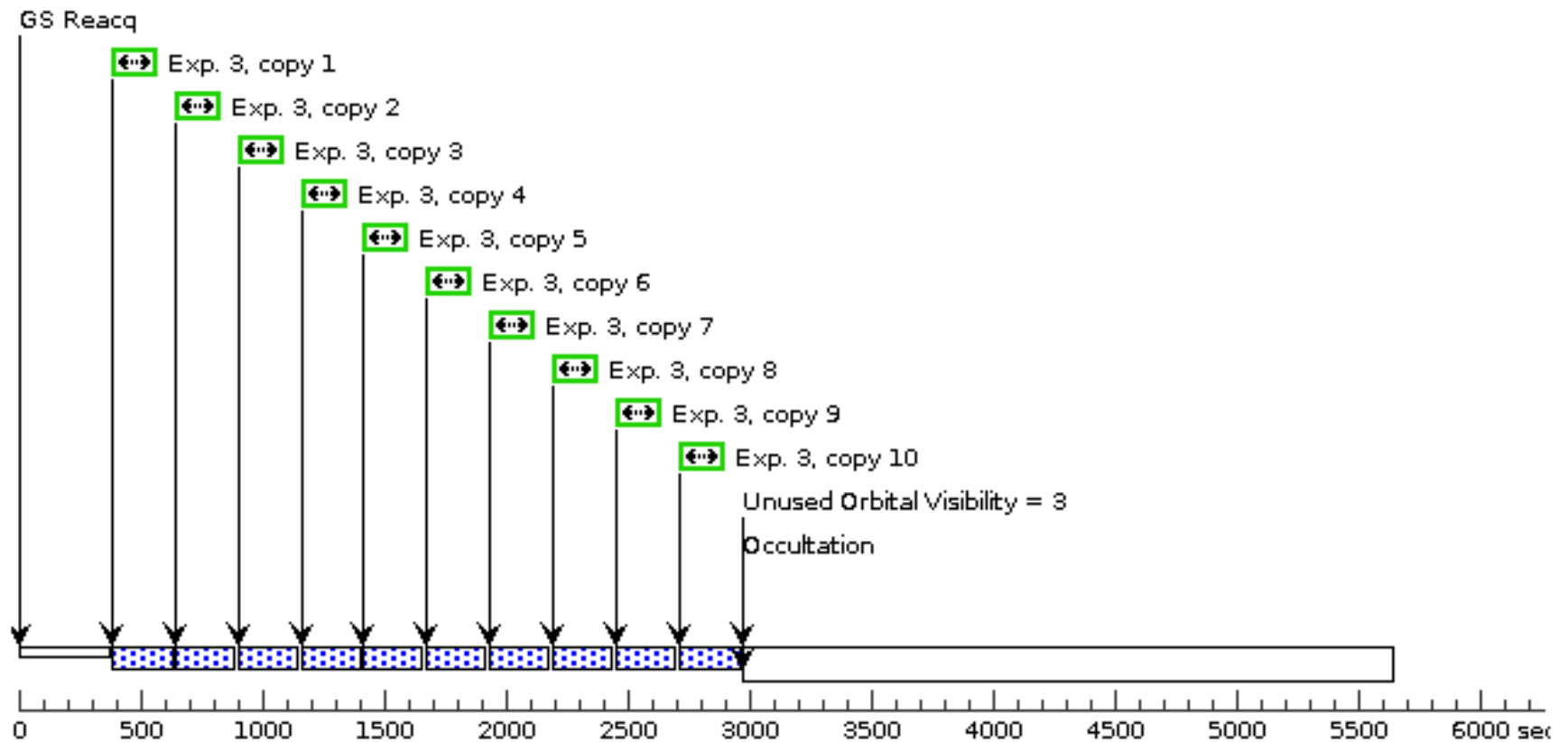
Proposal 18432 - V1298 Tau c H-alpha transit 1 of 2 (01) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

9	G750M orbi t 8	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[8]
10	G750M orbi t 9	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[9]
11	G750M orbi t 10	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[10]
12	WAVE	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6581 A		[==>]	[10]
Comments: Explicit WAVECAL; auto-wavecal disabled on science exposures.							



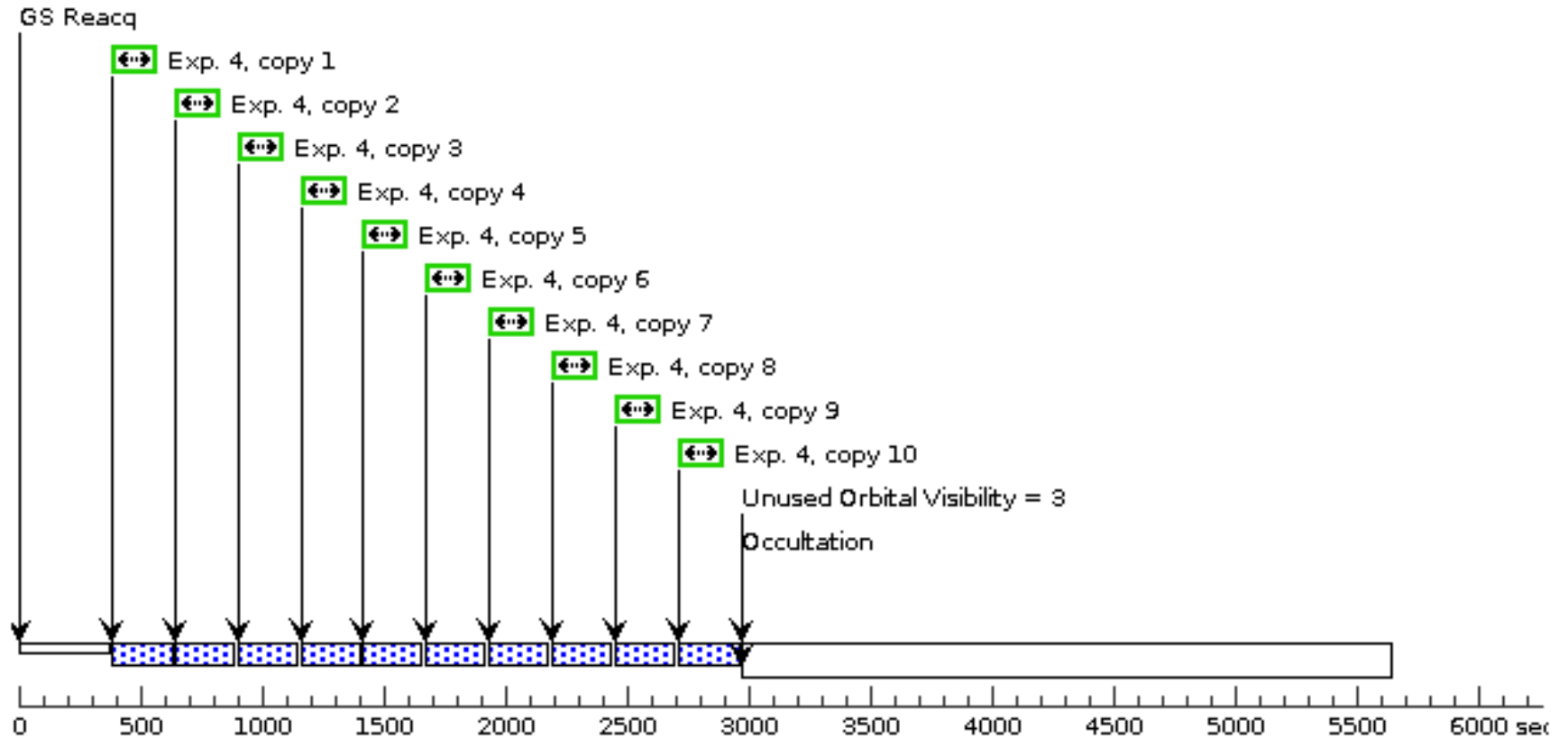
Orbit 2

Server Version: 20260618



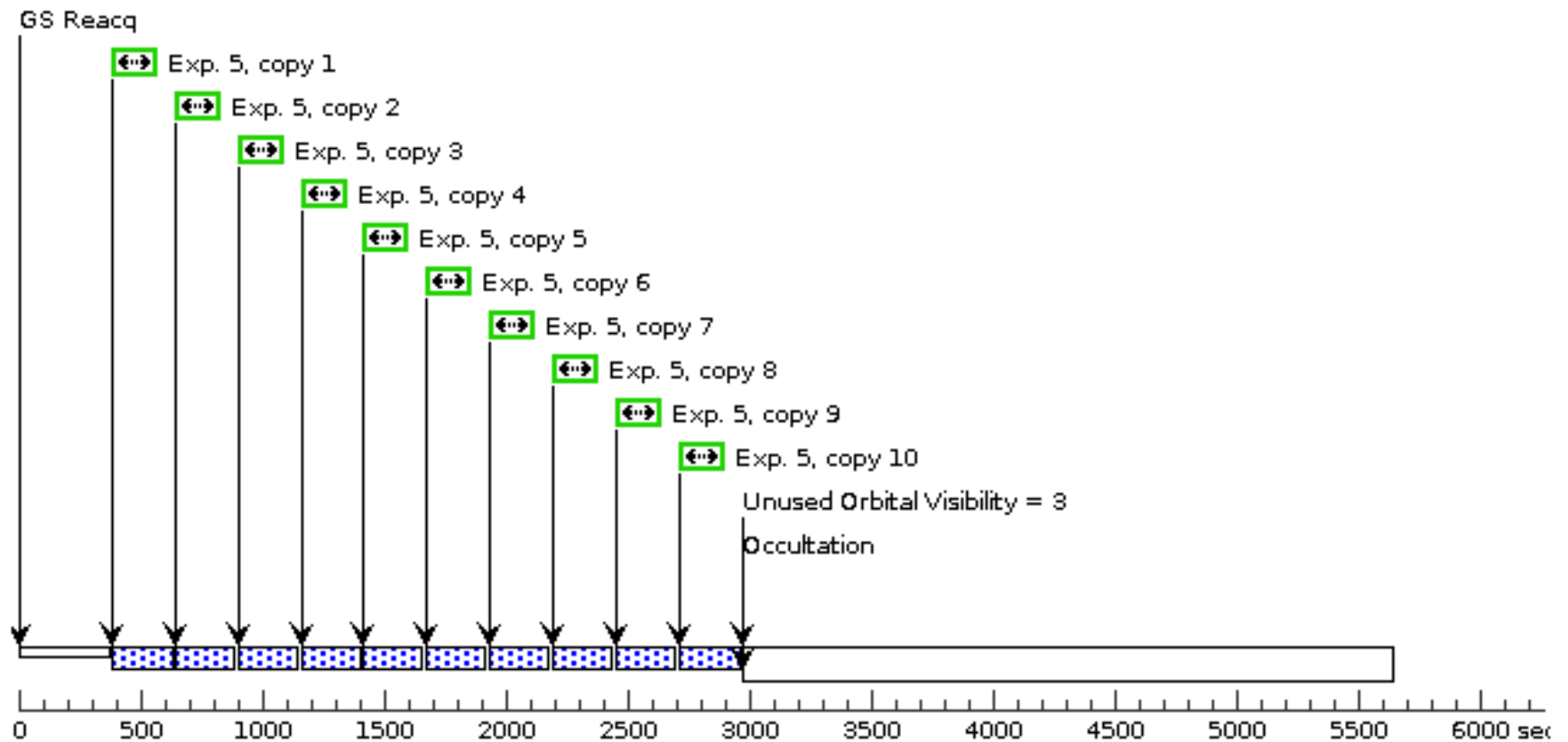
Orbit 3

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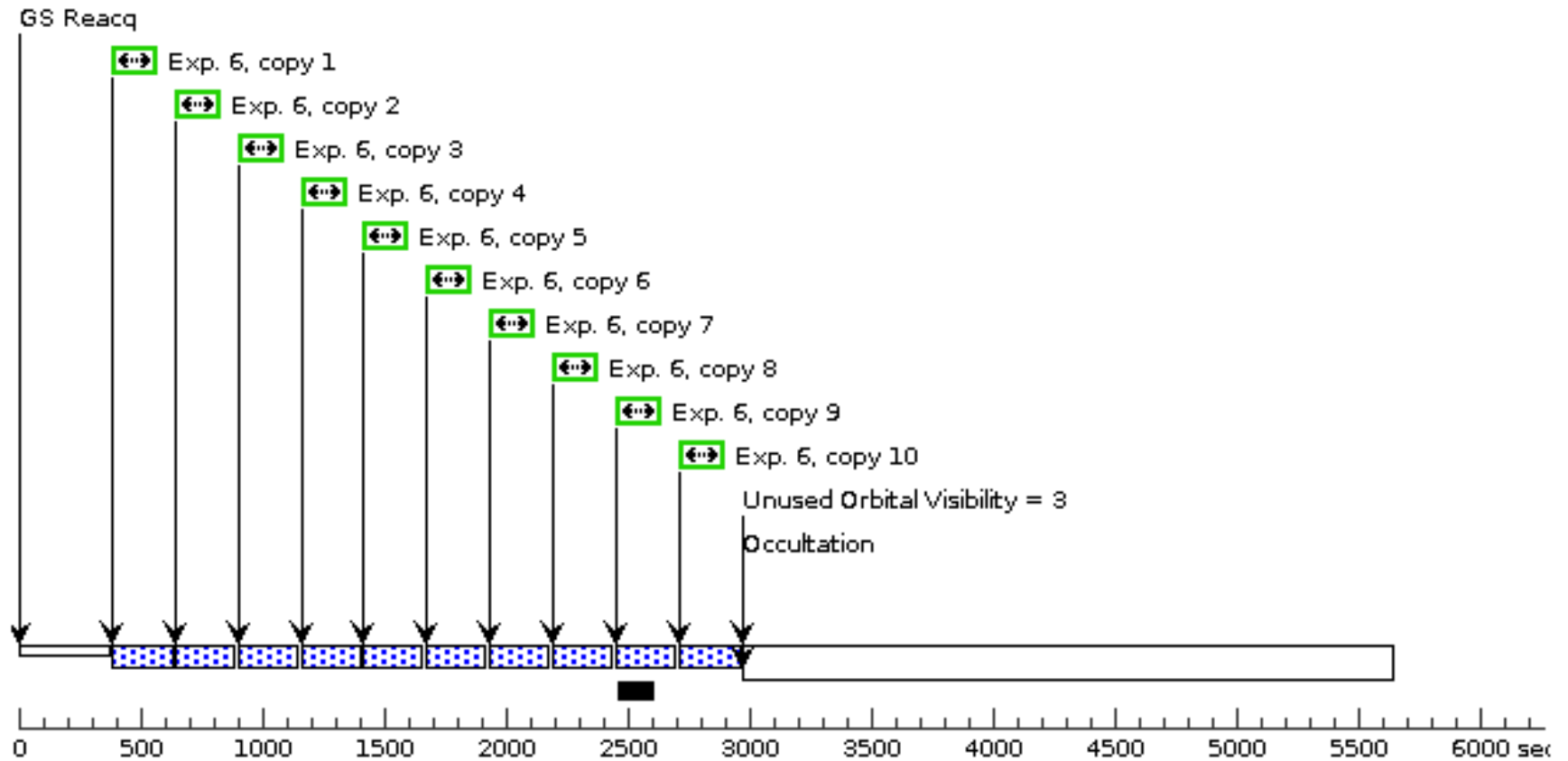
Orbit 4

Server Version: 20260618



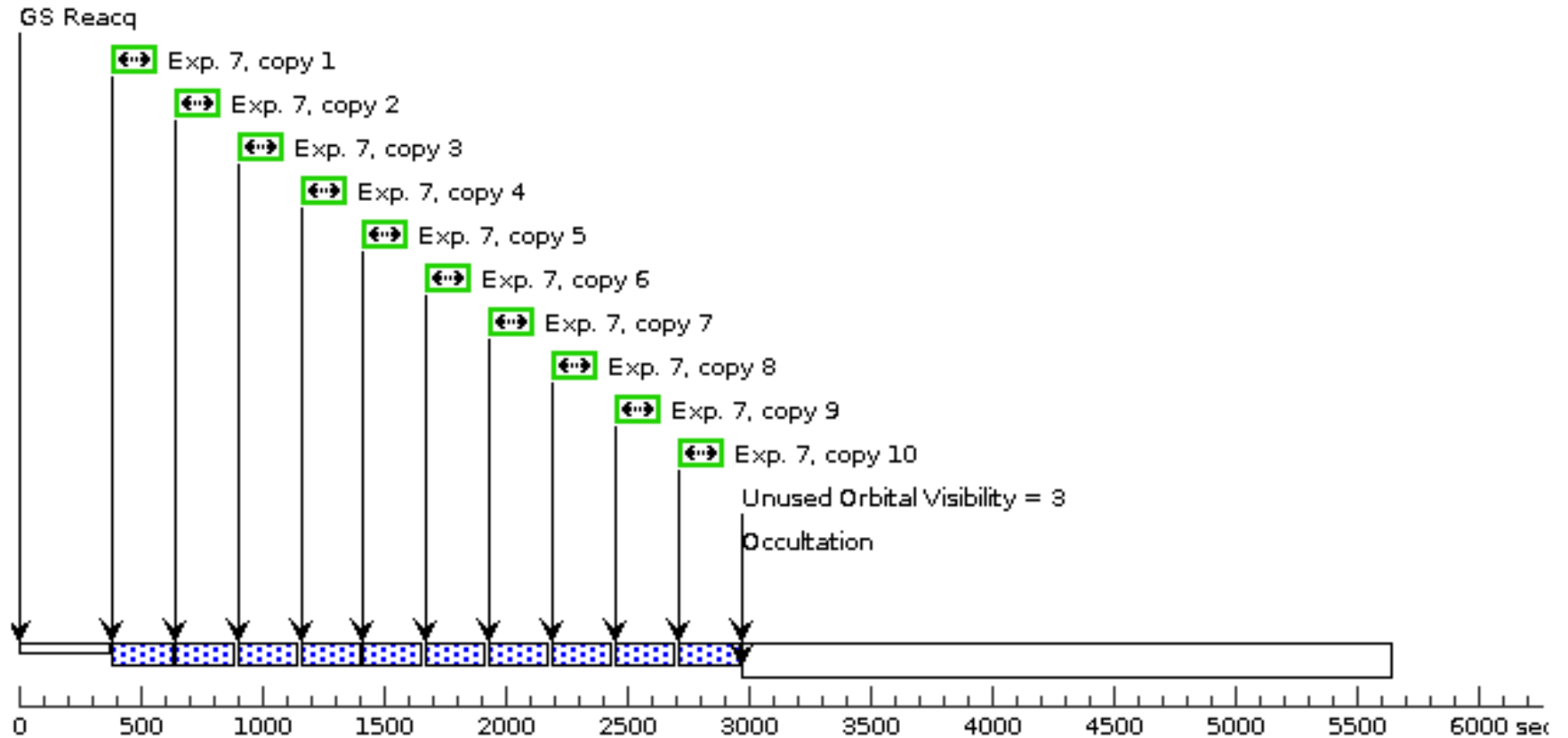
Orbit 5

Server Version: 20260618



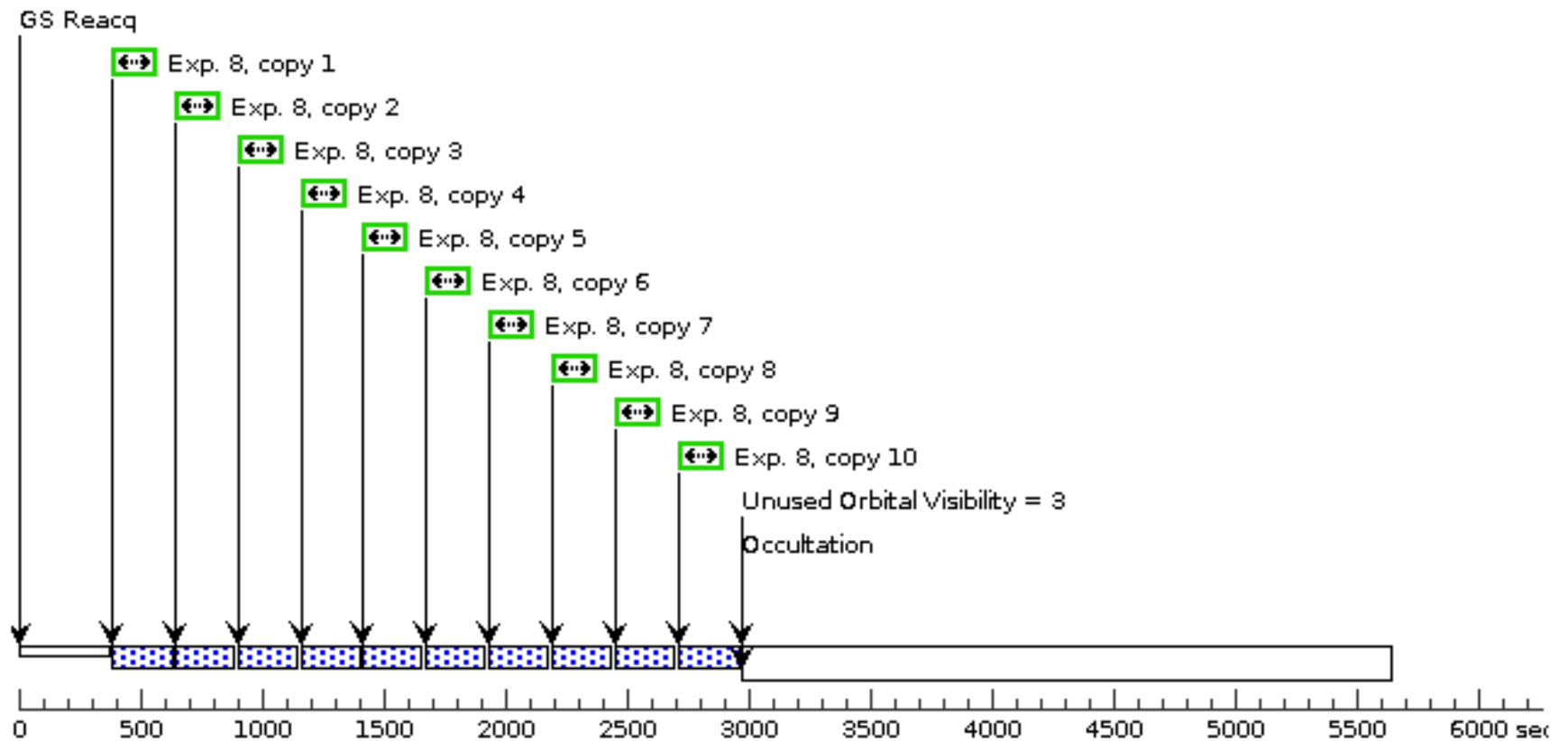
Orbit 6

Server Version: 20260618



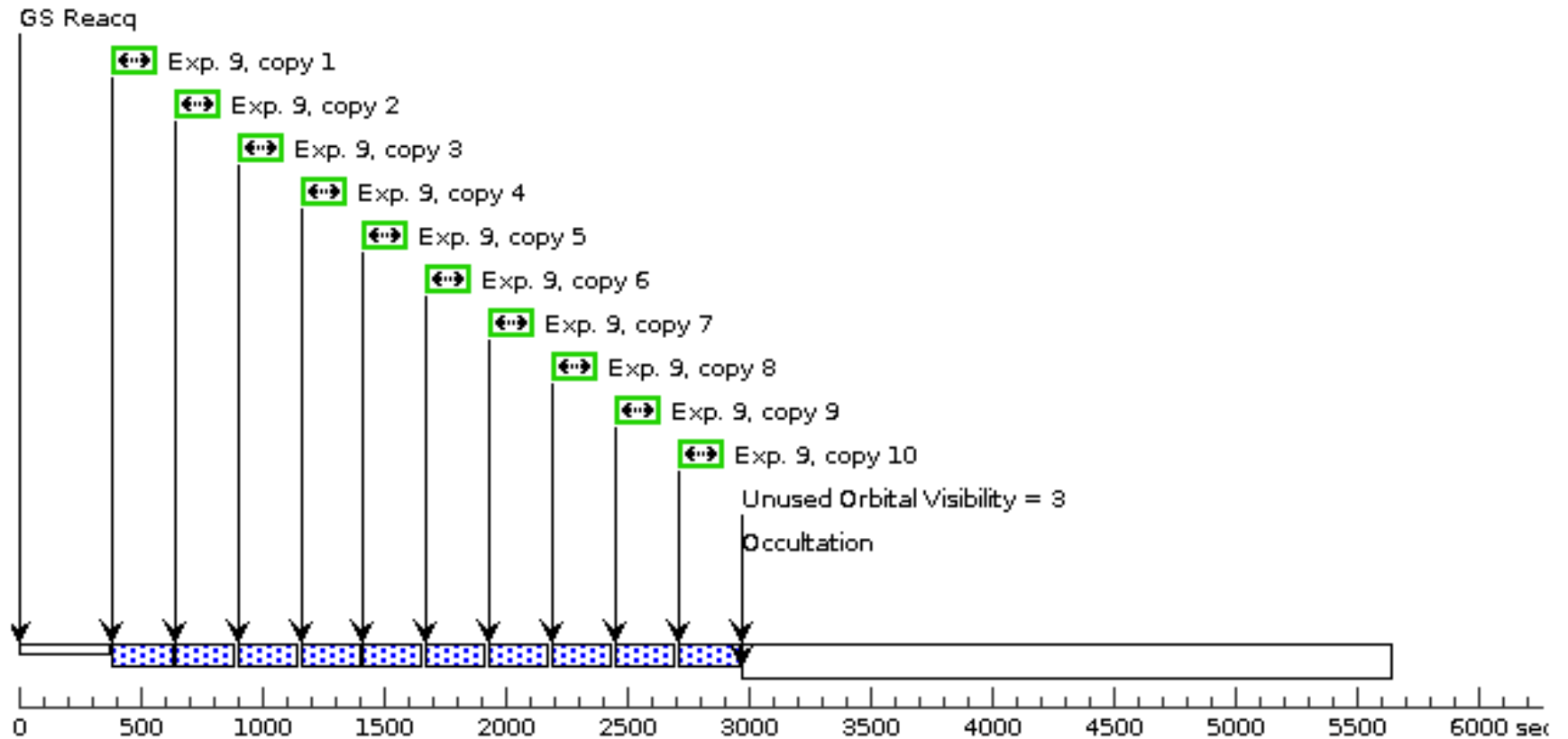
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Server Version: 20260618



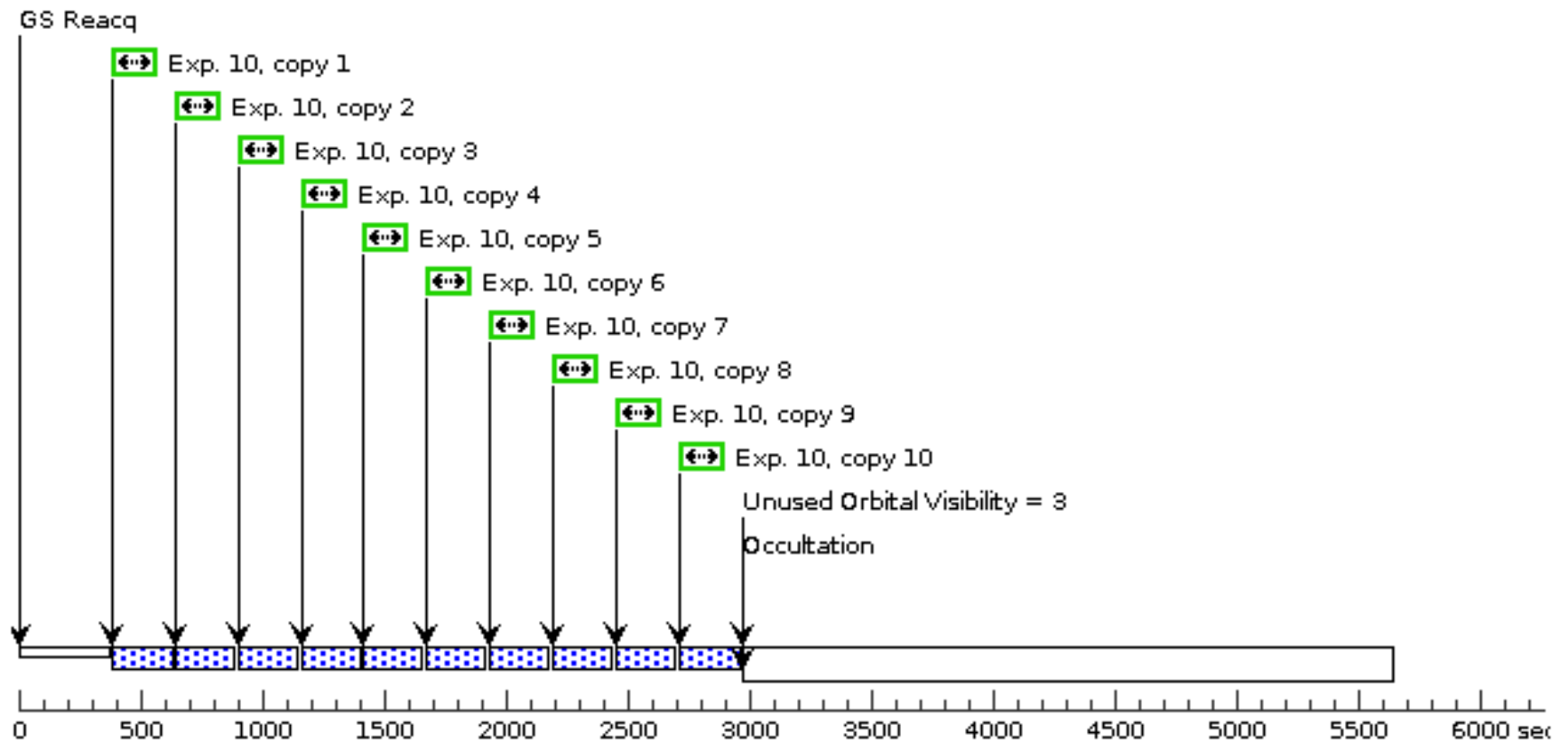
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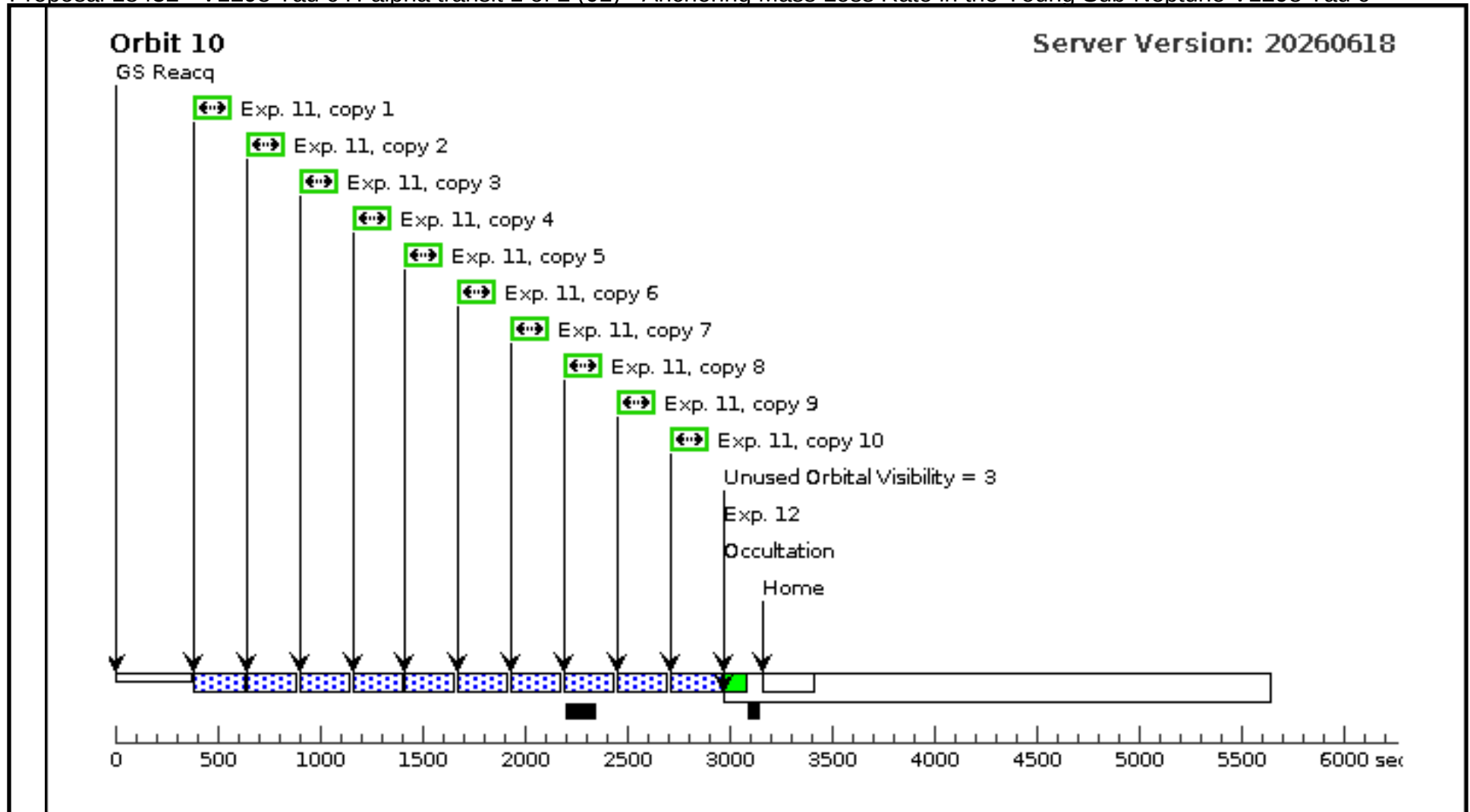
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Orbit 9

Server Version: 20260618





Proposal 18432 - V1298 Tau c H-alpha transit 2 of 2 (02) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

Visit	Proposal 18432, V1298 Tau c H-alpha transit 2 of 2 (02) Thu Jul 30 20:02:11 GMT 2026 Diagnostic Status: Warning Scientific Instruments: STIS/CCD Special Requirements: Period 8.24924 D AND ZERO-PHASE HJD2460924.7690 <i>Comments: V1298 Tau c transit 2 of 2. 10 continuous orbits in a single visit (unbroken block). Phase constraint places visit start ~5.0-4.5 hr before predicted mid-transit: ~2 orbits pre-ingress baseline, full T14=4.67 hr transit, and post-eqress coverage of the trailing tail plus ~2 orbits post-tail baseline. Shared-risk long-stare scheduling (>6 orbits) acknowledged in Phase I special requirements.</i>
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[illegible]

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[illegible]

Proposal 18432 - V1298 Tau c H-alpha transit 2 of 2 (02) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	V-V1298-TAU	RA: 04 05 19.5910 (61.3316292d)	Proper Motion RA: 5.413 mas/yr	V=10.12	Reference Frame: ICRS
			Dec: +20 09 25.56 (20.15710d)	Proper Motion Dec: -16.052000023591972 mas/yr		
			Equinox: J2000	Parallax: 0.0092577"		
				Epoch of Position: 2000		
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.</i> Category=STAR Description=[K III-I]						

Proposal 18432 - V1298 Tau c H-alpha transit 2 of 2 (02) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

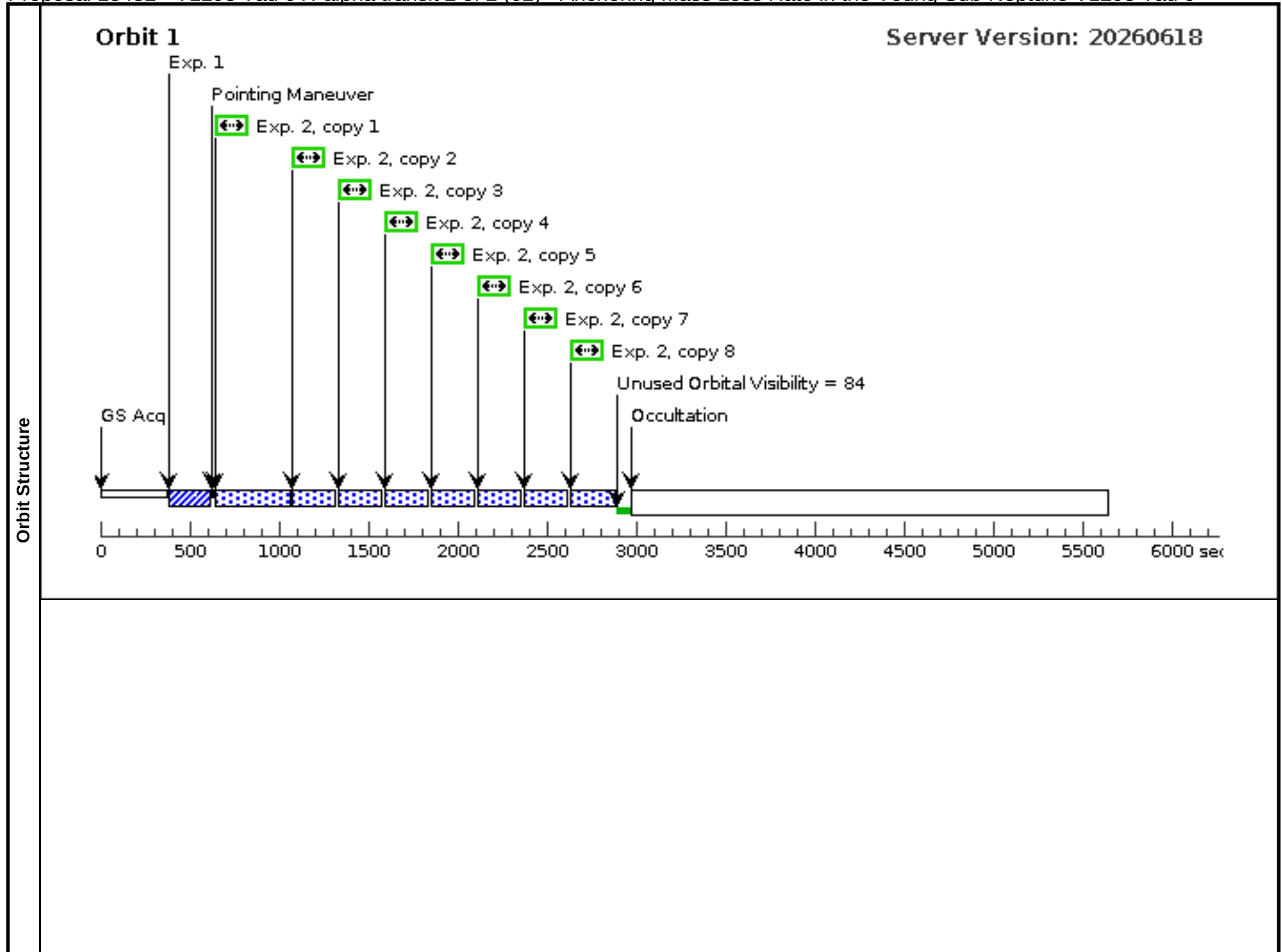
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACQ phase constrained	(1) V-V1298-TAU	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.97474514 8 TO 0.977270633		0.2 Secs (0.2 Secs)	
									[==>]	[1]
	Comments: CCD target acquisition. Verify exposure time with STIS ETC for V=10.12 K1.5 star (scaled from heritage programs).									
	2	G750M orbit 1	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 8 (1904 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[1]
	3	G750M orbit 2	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 10 (2380 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[2]
	4	G750M orbit 3	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO			238 Secs X 10 (2380 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[3]

Proposal 18432 - V1298 Tau c H-alpha transit 2 of 2 (02) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

5	G750M orbi t 4	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[4]
6	G750M orbi t 5	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[5]
7	G750M orbi t 6	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[6]
8	G750M orbi t 7	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[7]

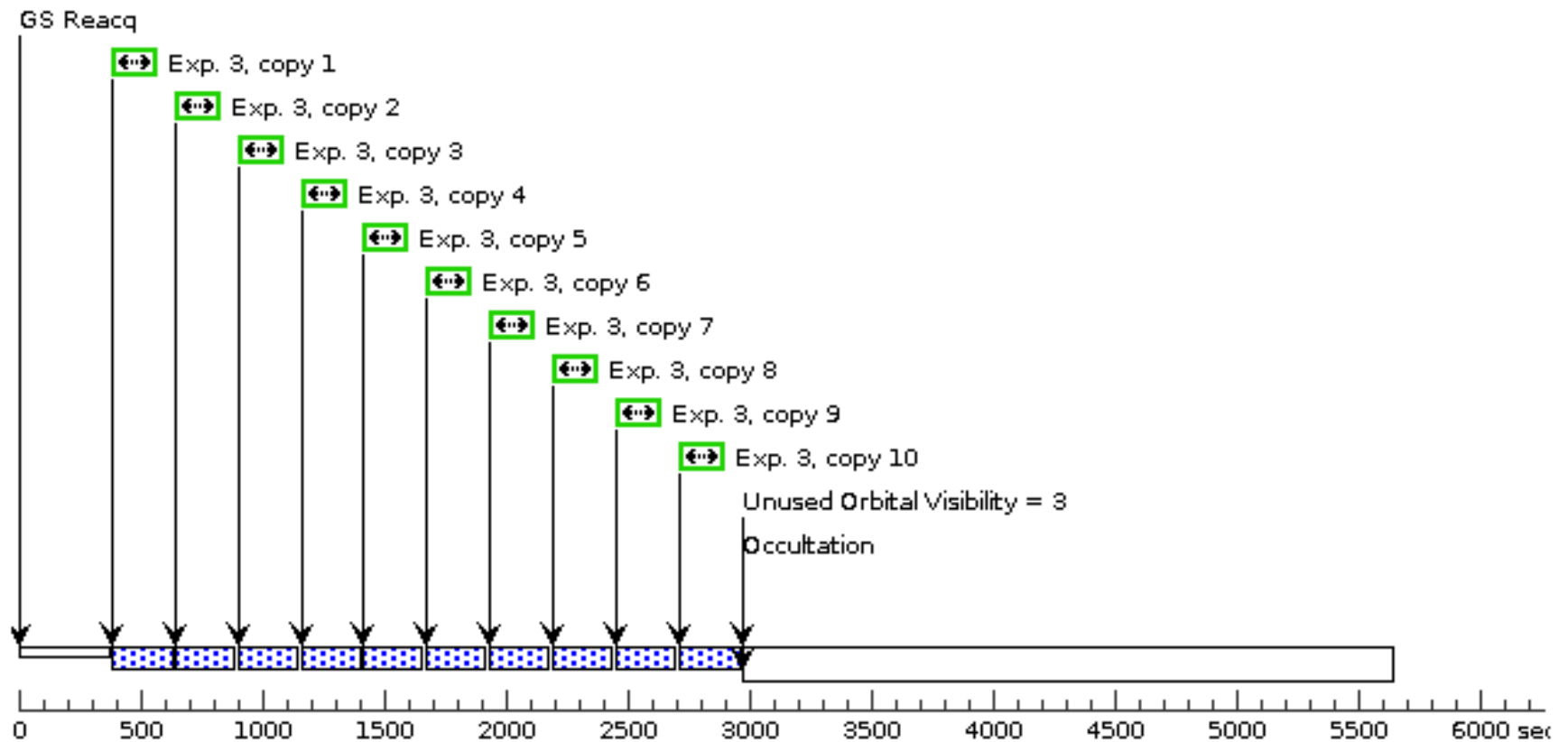
Proposal 18432 - V1298 Tau c H-alpha transit 2 of 2 (02) - Anchoring Mass Loss Rate in the Young Sub-Neptune V1298 Tau c

9	G750M orbi t 8	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[8]
10	G750M orbi t 9	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[9]
11	G750M orbi t 10	(1) V-V1298-TAU	STIS/CCD, ACCUM, 52X2	G750M 6581 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0; WAVECAL=NO	238 Secs X 10 (2380 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)]	[10]
12	WAVE	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6581 A		[==>]	[10]
Comments: Explicit WAVECAL; auto-wavecal disabled on science exposures.							



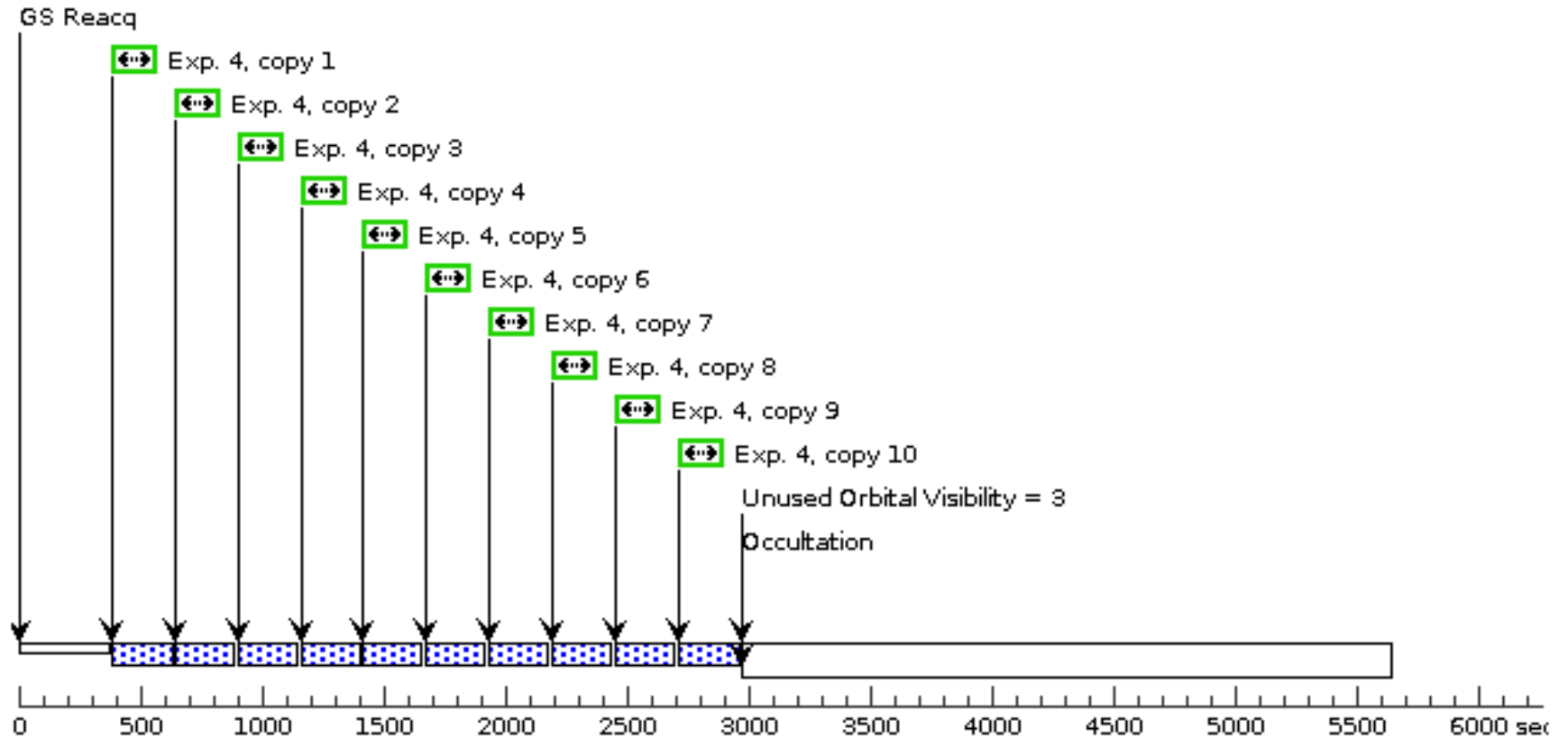
Orbit 2

Server Version: 20260618



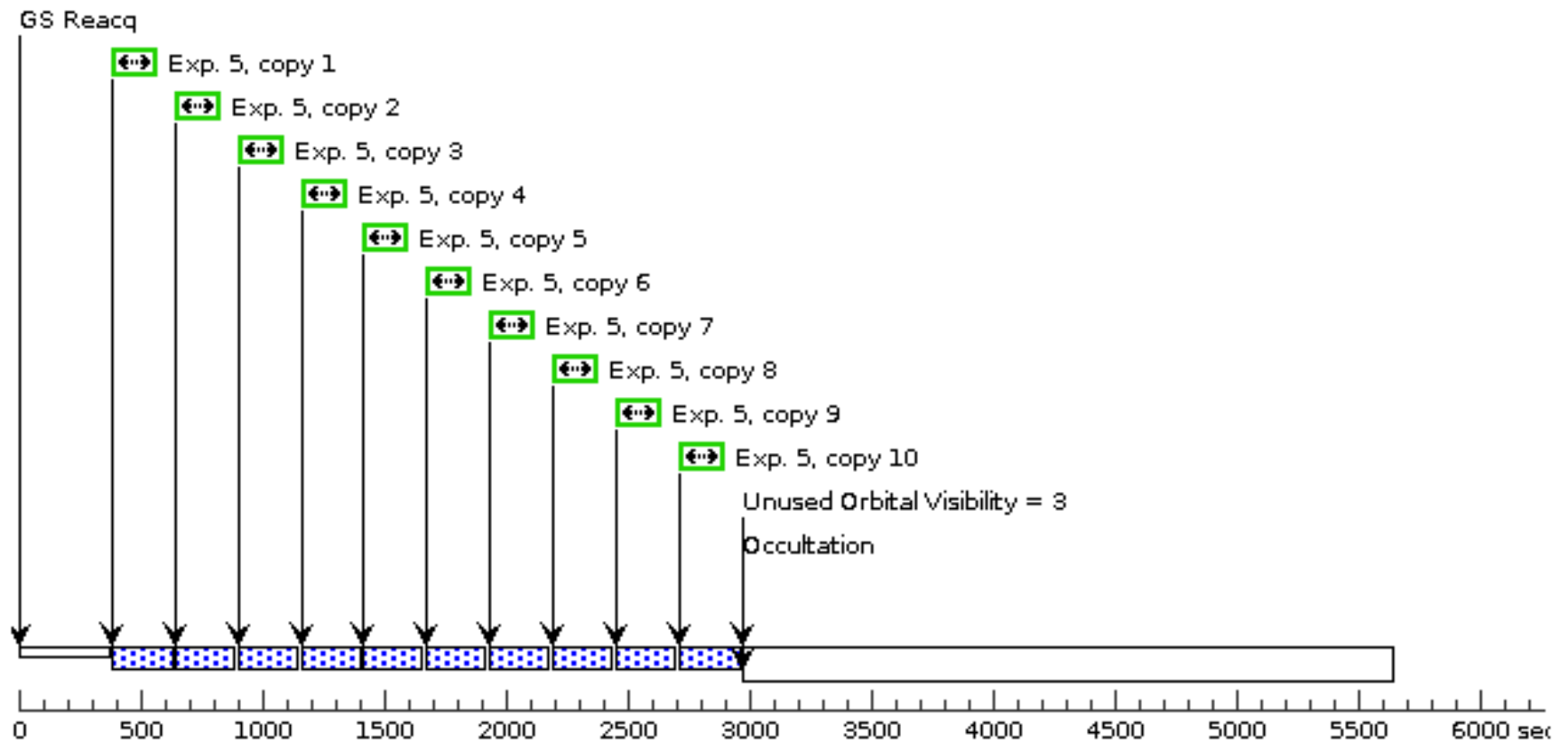
Orbit 3

Server Version: 20260618



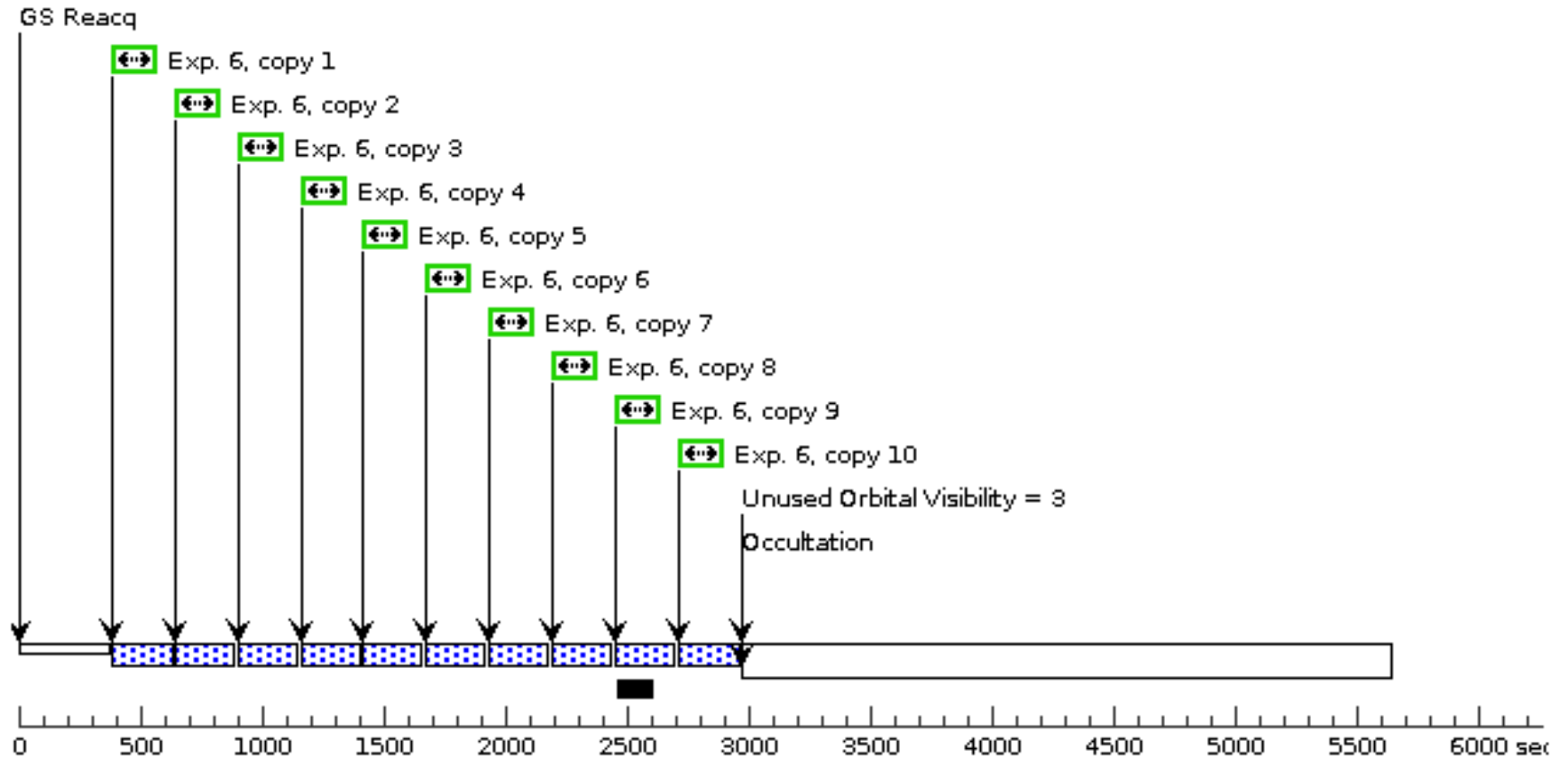
Orbit 4

Server Version: 20260618



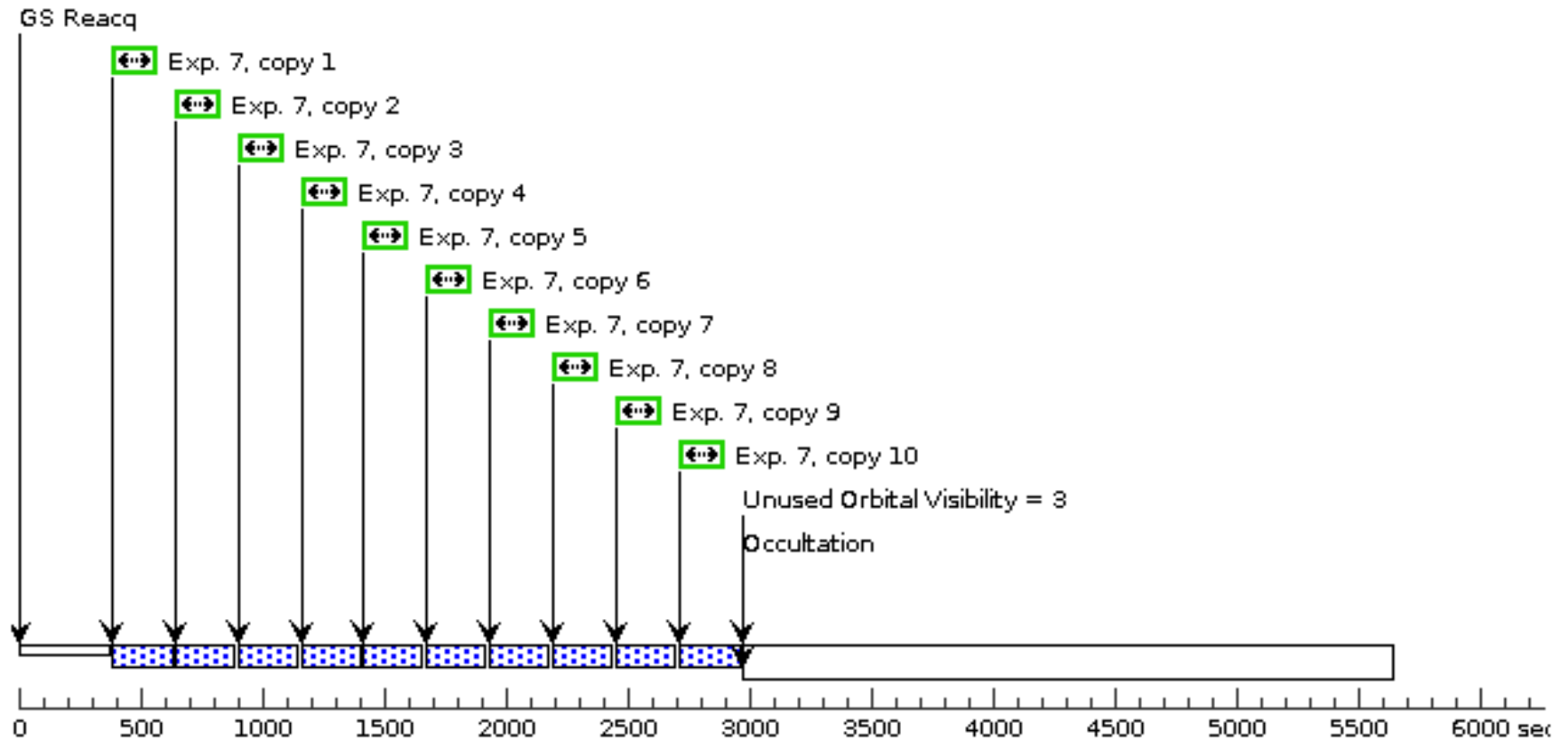
Orbit 5

Server Version: 20260618



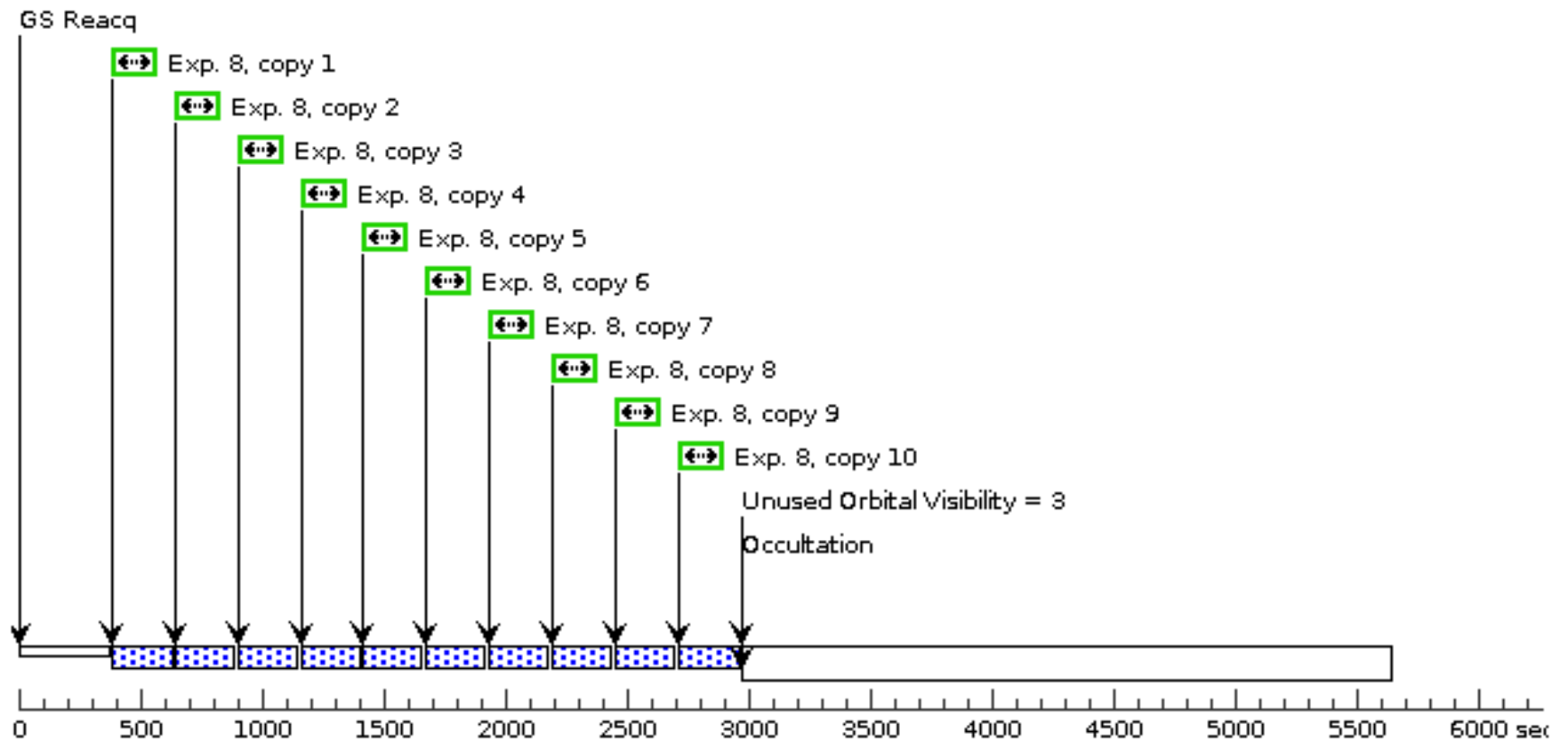
Orbit 6

Server Version: 20260618



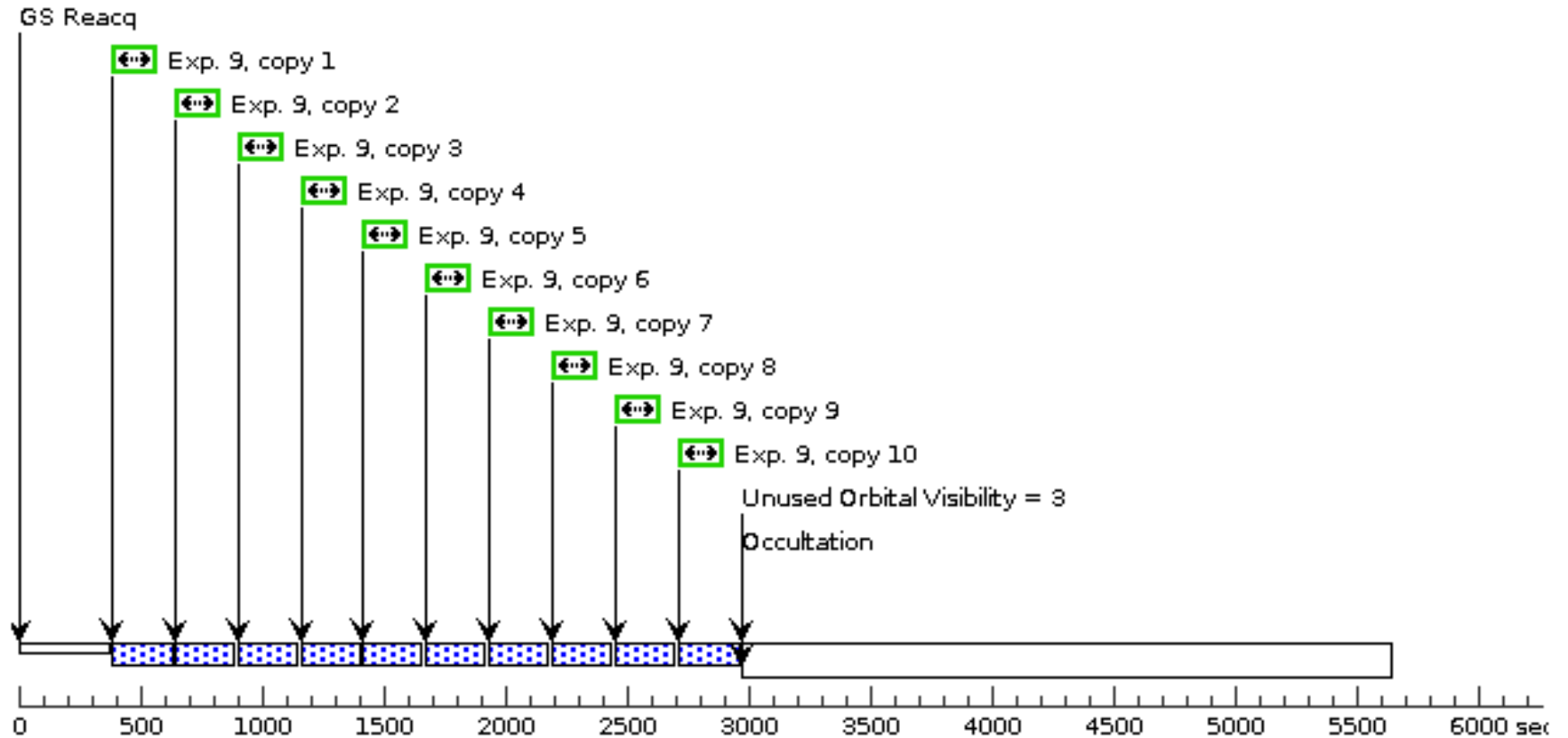
Orbit 7

Server Version: 20260618



Orbit 8

Server Version: 20260618



Orbit 9

Server Version: 20260618

