16462 - Atmospheric characterization of the innermost gas giants in the infant multiplanet system V1298 Tau

Cycle: 28, 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	(1) V-V1298-TAU	WFC3/IR	8	11-Oct-2021 11:01:00.0	yes

8 Total Orbits Used

ABSTRACT

The newborn planetary system comprising of four gas giants transiting the bright 23 Myr old star V1298 Tau presents an exciting opportunity to probe the atmospheric properties of planetary systems immediately post-formation, and to do so within one system. We propose to observe a transit of the hottest gas giant in the system, V1298 Tau c, using the HST/WFC3/G141 grism, to measure the strength of water absorption features. The NIR transmission spectrum of this hot Neptune planet will be used to constrain its metallicity and cloud or haze coverage, which in turns will inform planet formation and evolution models. In conjunction with the previous WFC3/G141 observations of the warm gas giant V1298 Tau b in the system, our observations will enable comparative exoplanetology of planets within a multiplanet system fresh after formation. When put in the context of directly imaged planets at wider orbital separations but similar age as the V1298 Tau system, the inferences from our comparative study of a close-in multiplanet system will put constraints on the effect of insolation and location in the planet-forming disks on the bulk planetary composition and properties.

OBSERVING DESCRIPTION

We will observe V1298 Tau c during a transit of the planet using time series spectroscopy with WFC3/G141 in drift scan mode.

The planet b exhibit 30 mins TTV, and 12 mins uncertainty on mid-transit times by the end of 2022.

We currently have a restrictive phase constraint (+/-30mins) starting 3 HST orbits before primary transit and ending 1-2 orbits after transit. The observing start window is relaxed (60 minutes) to ensure we cover properly the transit. This observing window could be relaxed more to enable as many observing opportunities as possible. We plan to get updated ephemeris by the end of the year which will help constraining the TTVs.

We will collect data with the WFC3/IR camera configuration in the spectroscopic scanning mode with the G141 grism. This will provide us with a high quality transit spectrum of our target in the 1.1-1.65 micron region. In order to achieve our science goals, we require high sensitivity. Since the target star is bright (H = 8.19), we will employ the bi-directional spatial scanning mode for WFC3 in order to maximize the photon-collecting efficiency and the duty cycle of the telescope. In order to maximize the duty cycle of the telescope and estimate the signal-to-noise of our observations, we use the PandExo HST open source tool. This approach allows us to maximize the duty cycle (not including occultation by Earth) to

65%, while avoiding mid-orbit buffer dumps. We will use NSAMP = 5 and SAMP_SEQ = SPARS25. We use GRISM256 aperture to limit interference from nearby bright stars. The exposure time calculations result in optimal scan rate of 0.230 "/s, resulting in scan heights of 170 pixels (21"). This observation is time critical - it will only work if the target star is observed for the duration of the entire transit, plus out-of-transit baselines before and after transit. To ensure adequate coverage of the unusually long transit, we will observe the light curve for 10 HST orbits. The transit duration is 4.66 hours, and will allow 4 hours for pre-ingress and post-egress baselines.

Visit

Proposal 16462, V1298 Tau c transit (01), implementation Mon Oct 11 15:01:04 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: SCHED 100%; Period 8.249141 D AND ZERO-PHASE HJD2457064.281606

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-V1298-TAU	RA: 04 05 19.5970 (61.3316542d) Dec: +20 09 25.31 (20.15703d) Equinox: J2000	Proper Motion RA: 3.712731804600008E-4 sec of time/yr Proper Motion Dec: -0.016077000032055366 arcsec/yr Epoch of Position: 2015.5	V=10.12 H=8.191	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.This object was generated by the targetselector and retrieved from the SIMBAD database.
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Description=[EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, K V-IV, T TAURI STAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0; PHASE 0.9630 TO 0.9681	Sequence 1-3 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[1]***
2		(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 1-3 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[1]***
3		(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Round trip	Sequence 1-3 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	 ***[1]***
4		(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 4-6 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[2]***

	5	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Round trip	Sequence 4-6 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	***[2]***
	6	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Forward	Sequence 4-6 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	***[2]***
	7	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 7-9 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	***[3]***
	8	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Round trip	Sequence 7-9 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	***[3]***

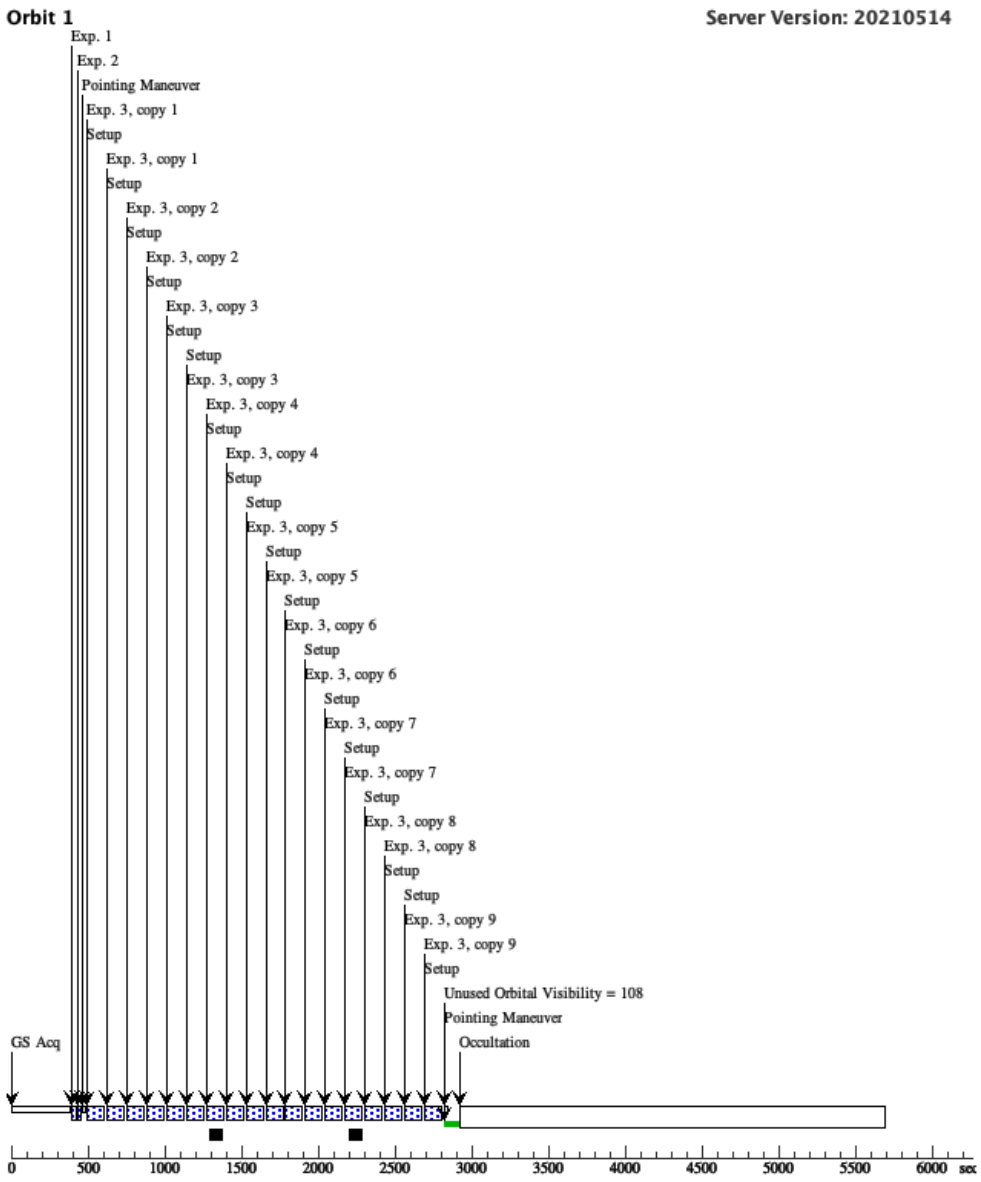
9	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Forward	Sequence 7-9 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	 ***[3]***
10	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 10-12 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[4]***
11	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Round trip	Sequence 10-12 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	 ***[4]***
12	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Forward	Sequence 10-12 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	 ***[4]***
13	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 13-15 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[5]***

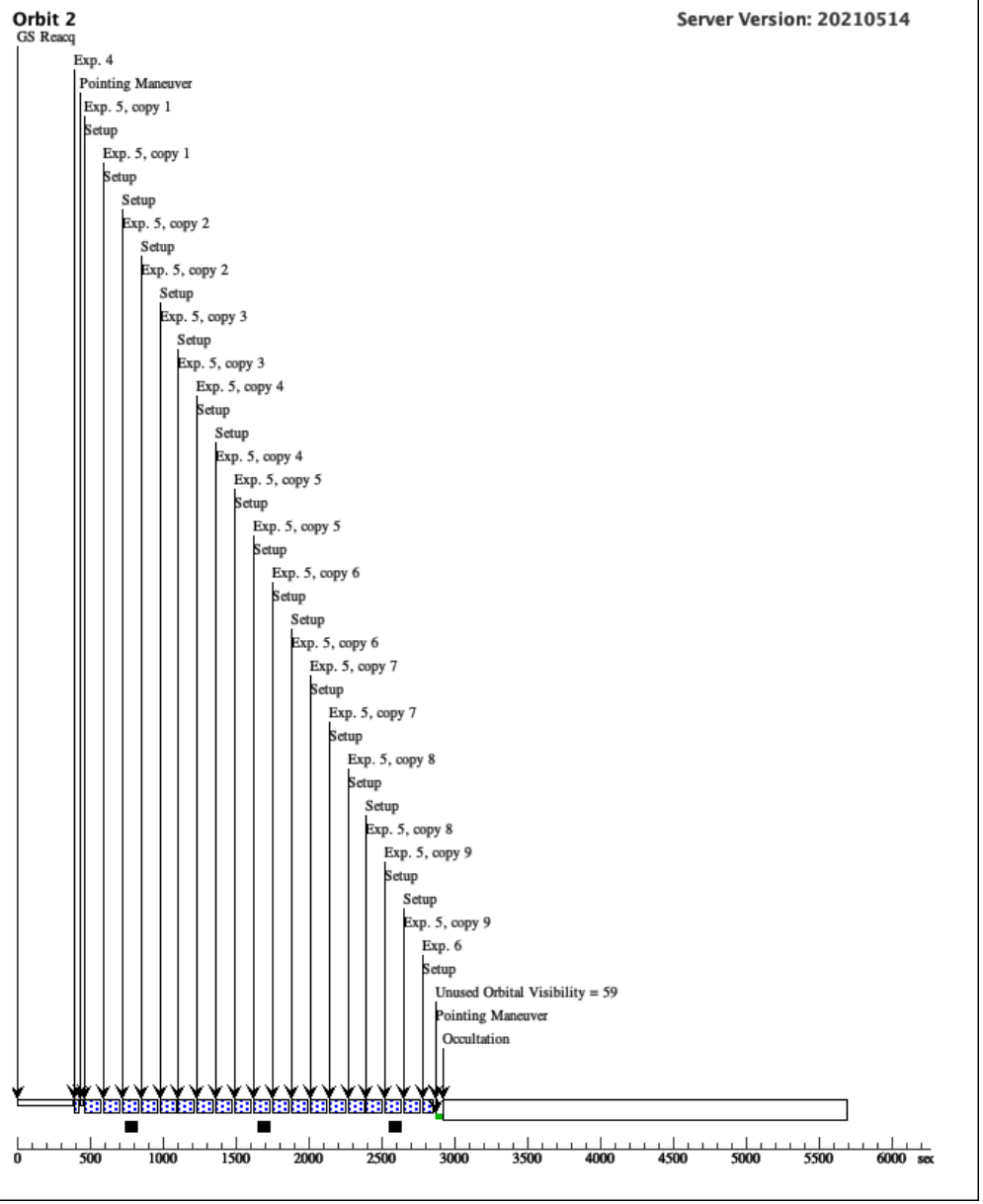
	14	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Round trip	Sequence 13-15 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	***[5]***
	15	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Forward	Sequence 13-15 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	***[5]***
	16	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 16-18 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	***[6]***
	17	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Round trip	Sequence 16-18 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	***[6]***

18	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Forward	Sequence 16-18 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	 ***[6]***
19	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 19-21 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[7]***
20	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Round trip	Sequence 19-21 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	 ***[7]***
21	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.23,90.0 Degrees,Forward	Sequence 19-21 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	 ***[7]***
22	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	F126N	NSAMP=2; SAMP-SEQ=RAPID	POS TARG 0,0	Sequence 22-24 Non-Int in V1298 Tau c transit (01)	0.55563 Secs (0.556 Secs) *[==>]*	 ***[8]***

	23	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=5	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Round trip	Sequence 22-24 Non-Int in V1298 Tau c transit (01)	89.661971 Secs X 9 (1613.915 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	***[8]***
	24	(1) V-V1298-TAU	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 25; NSAMP=3	POS TARG 0,-12; SPATIAL SCAN 0.2 3,90.0 Degrees,Forward	Sequence 22-24 Non-Int in V1298 Tau c transit (01)	44.969893 Secs (44.97 Secs) *[==>]*	***[8]***

Orbit Structure

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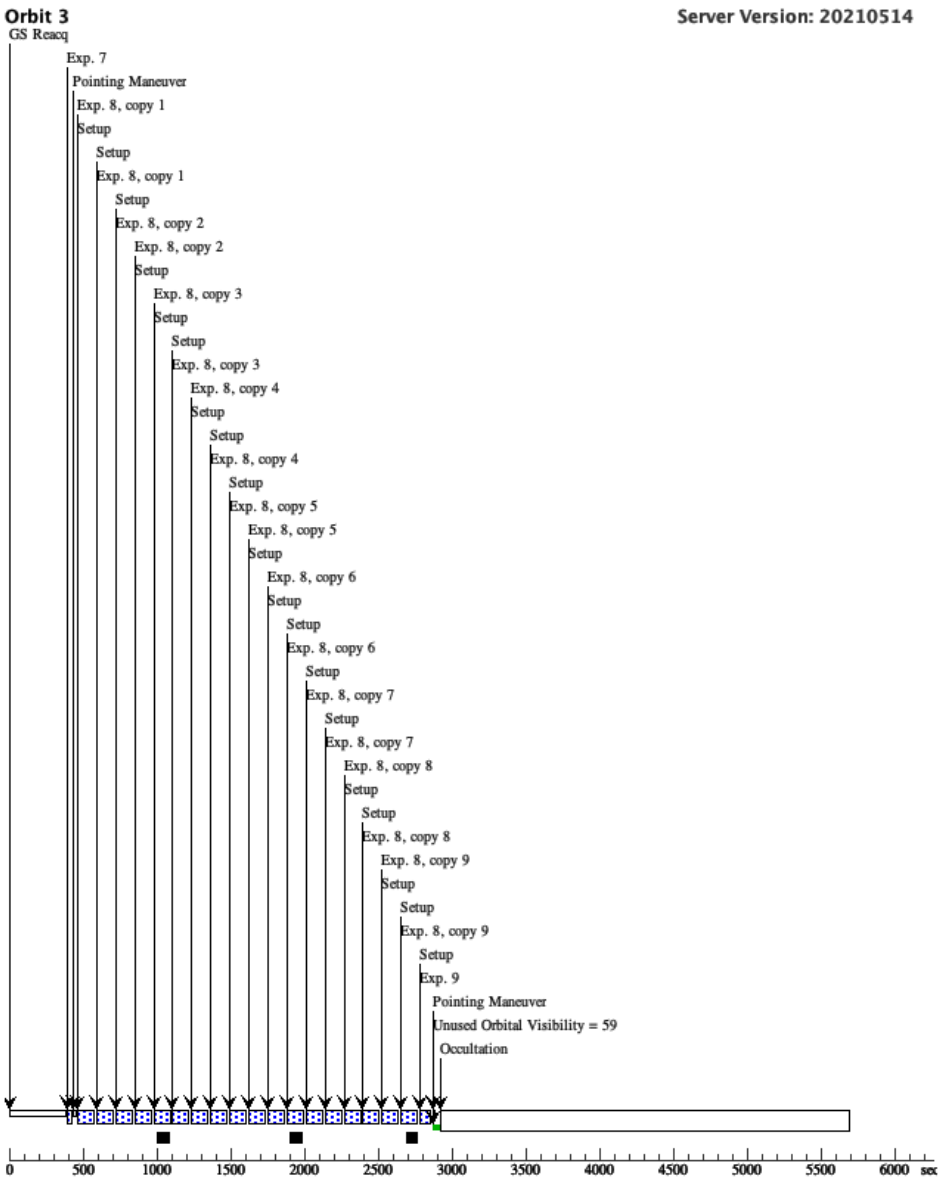
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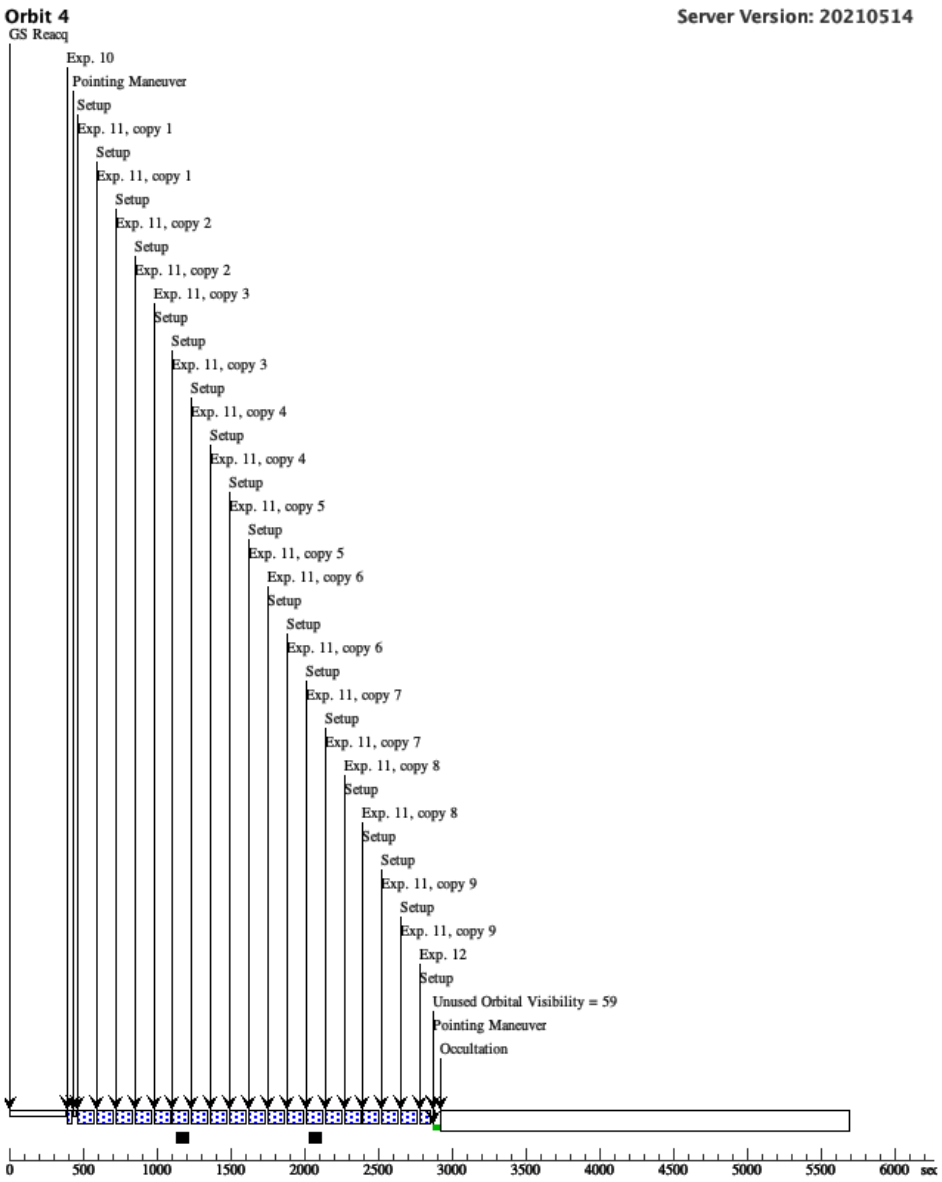
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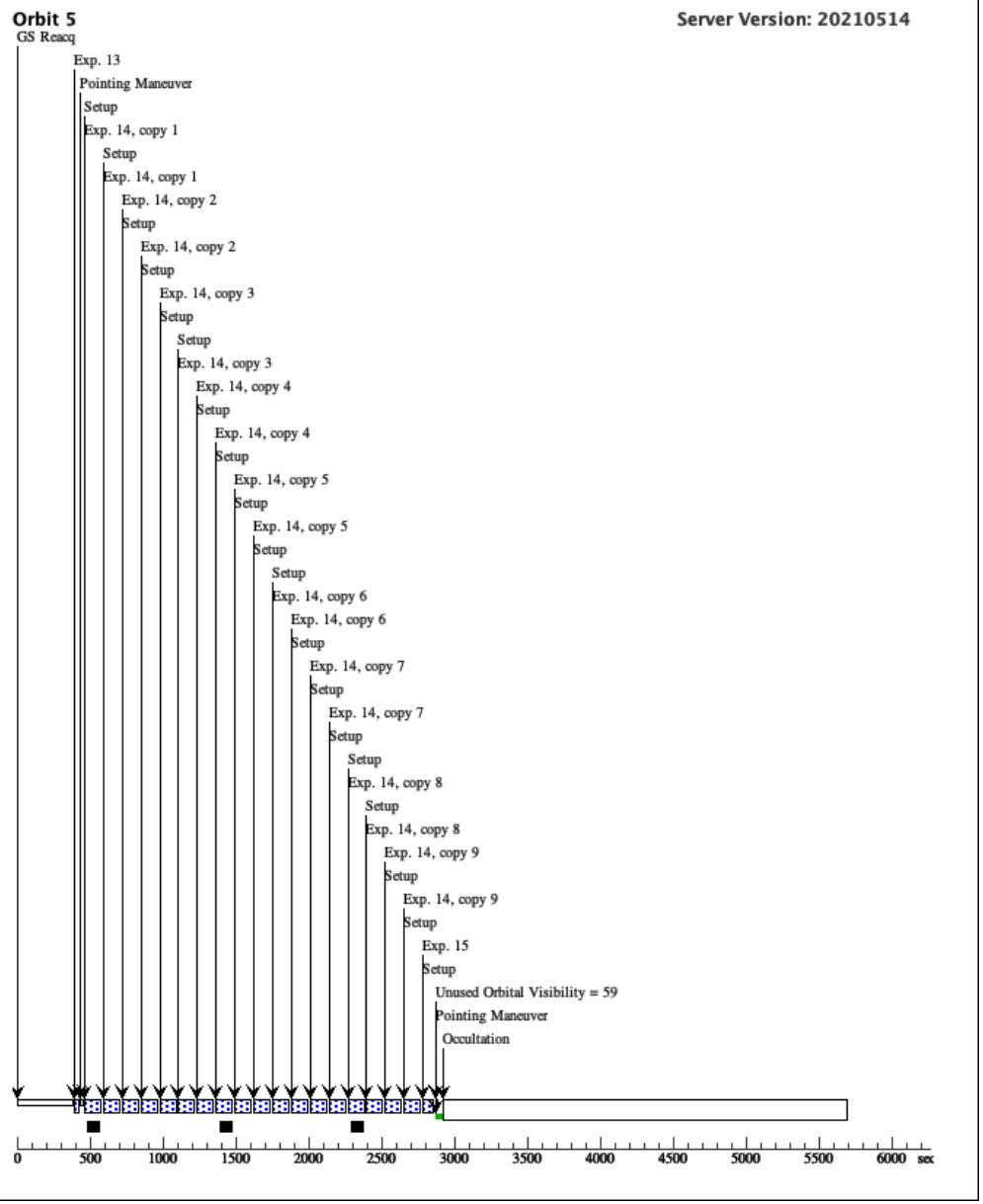
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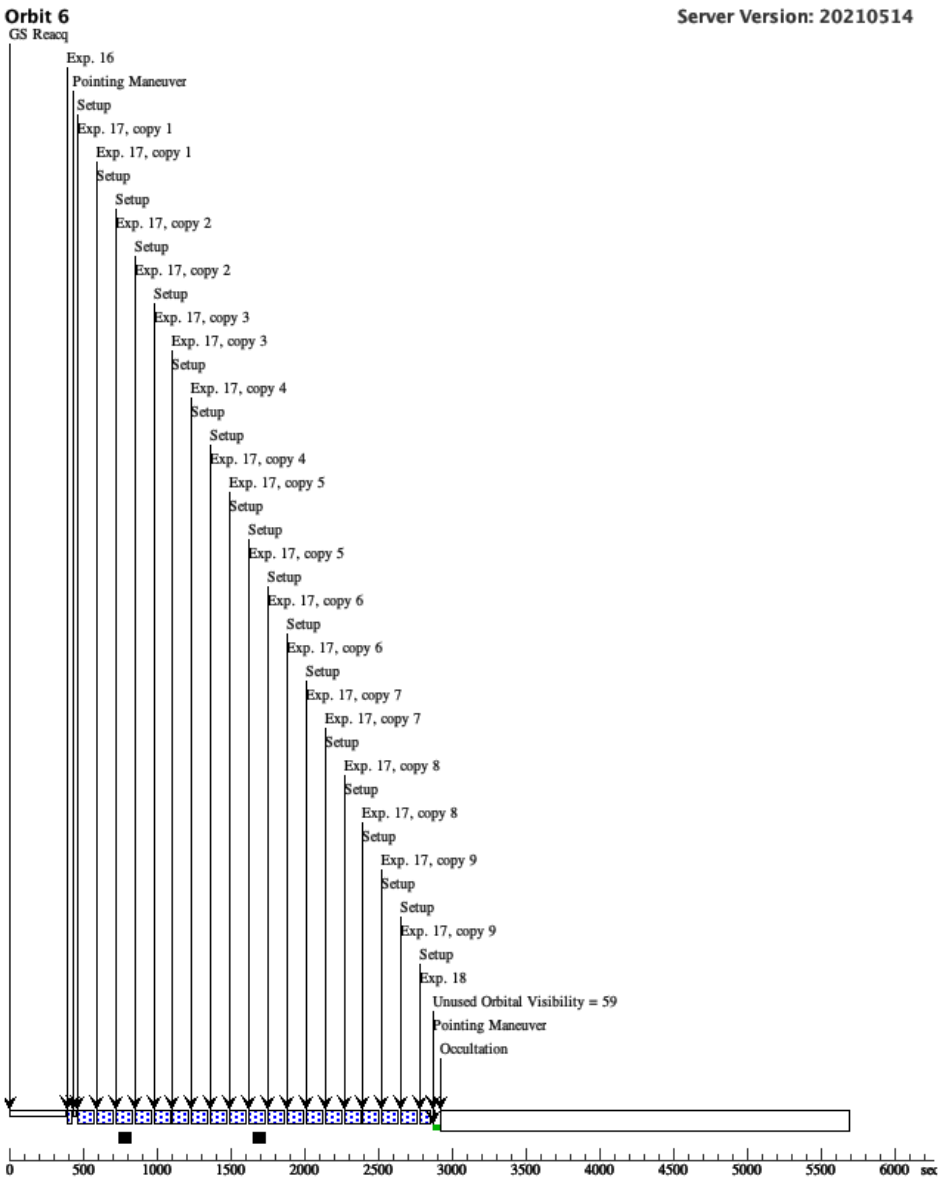
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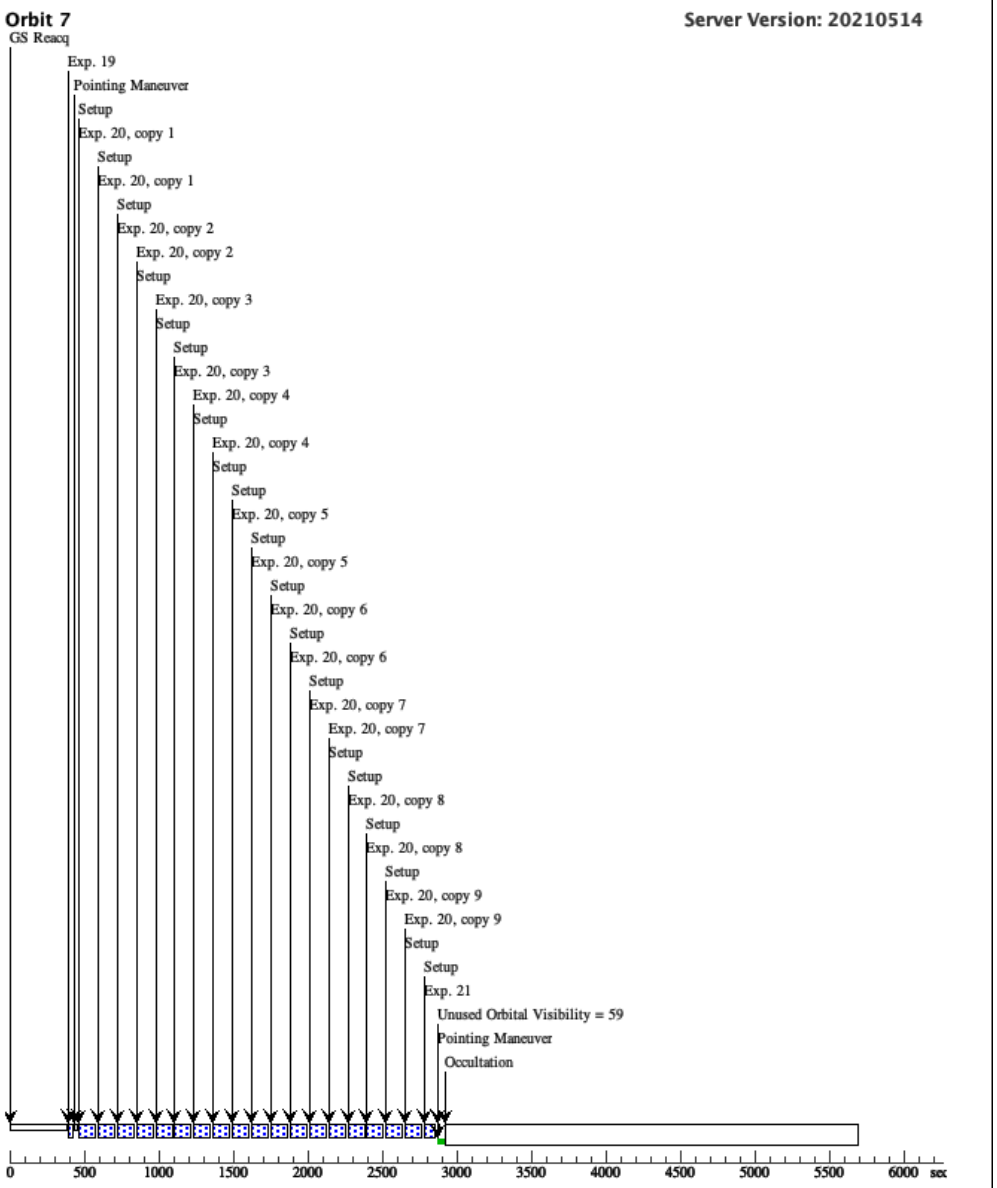
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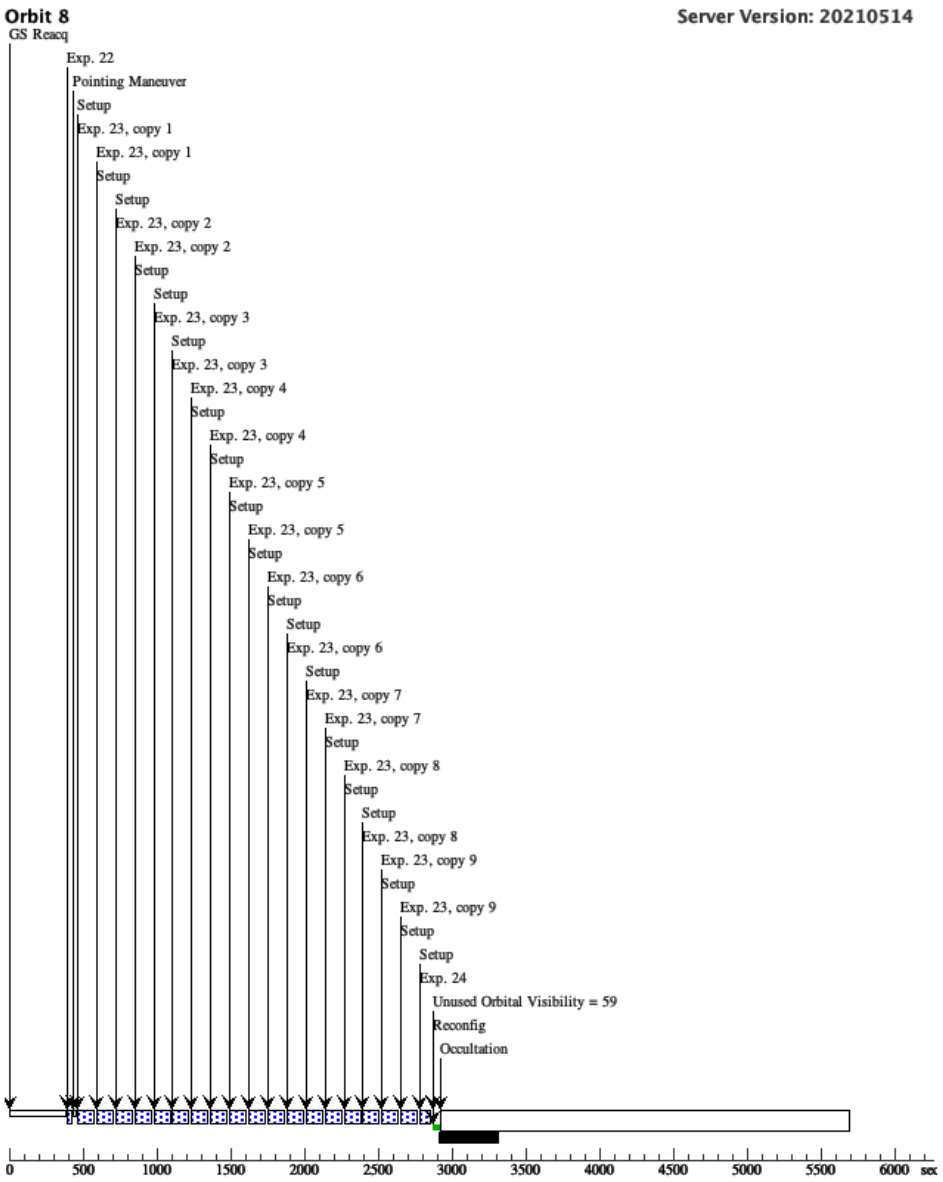
Setup
Setup
Exp. 20, copy 8
Setup
Exp. 20, copy 8
Setup
Exp. 20, copy 9
Exp. 20, copy 9
Setup
Setup
Exp. 21
Unused Orbital Visibility = 59
Pointing Maneuver
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 8
Server Version: 20210514
GS Reacq
Exp. 22
Pointing Maneuver
Setup
Exp. 23, copy 1
Exp. 23, copy 1
Setup
Setup
Exp. 23, copy 2
Exp. 23, copy 2
Setup
Setup
Exp. 23, copy 3
Setup
Exp. 23, copy 3
Exp. 23, copy 4
Setup
Exp. 23, copy 4
Setup
Exp. 23, copy 5
Setup
Exp. 23, copy 5
Setup
Exp. 23, copy 6
Setup
Setup
Exp. 23, copy 6
Setup
Exp. 23, copy 7
Exp. 23, copy 7
Setup
Exp. 23, copy 8
Setup
Setup
Exp. 23, copy 8
Exp. 23, copy 9
Setup
Exp. 23, copy 9
Setup
Setup
Exp. 24
Unused Orbital Visibility = 59
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec