17094 - Constraining the mass loss in evaporating planets by catching the second tail

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) HD-209458B WAVE	STIS/CCD STIS/FUV-MAMA	5	15-Jul-2022 16:01:59.0	yes
02	(1) HD-209458B WAVE	STIS/CCD STIS/FUV-MAMA	5	15-Jul-2022 16:02:02.0	yes
03	(1) HD-209458B WAVE	STIS/CCD STIS/FUV-MAMA	5	15-Jul-2022 16:02:04.0	yes

15 Total Orbits Used

ABSTRACT

Highly irradiated gas-giant exoplanets vigorously lose their atmospheres. This makes them excellent laboratories for extreme atmospheric physics - where we can study the effect of high levels of irradiation and stellar wind. Despite decades of observations with HST, the scientific value of the Lyman-alpha detections remains surprisingly under-exploited. In particular, the observations have not yet been able to precisely quantify planetary mass-loss rates. To address the gap between Lyman-alpha models and observations, a new observational pathway has been proposed to untangle the web of parameter interdependency. Originally identified in the 3D radiative-hydrodynamic simulations, this method requires measuring the second Lyman-alpha transits that are predicted to occur for hot Jupiters after the main transit. Second Lyman-alpha transits have never yet been probed or observed, despite this theoretical prediction. By measuring the time-delay of the secondary transit, the strength of the acceleration mechanism and the inertia of the outflowing gas can be measured, which is set by the mass loss rate. Thus, a measurement of a hot Jupiter's secondary transit will allow us to break the degeneracies that have plagued interpretation of Lyman-alpha transits, bringing firm physical constraints which will finally allow us to observationally, qualitatively constrain the mass-loss rate of an exoplanet.

OBSERVING DESCRIPTION

Our program will observe the HD209458 system three times, covering the nominal exoplanet transit in one visit, and then covering ten hours of post-transit time at subsequent transit events. Each observation will consist of 5 HST orbits which overlap in planet orbital phase by approximately 1.5 orbits. Combined, they will cover the entire planet transit plus any post-transit tail, caused by material escaping from the atmosphere and trailing behind the planet. The aim of the proposal is to measure the length of this post-transit tail.

The transit duration of HD209458b is 3.05 hours, corresponding to 2 and 2.5 orbits. Visit 1, a 5-orbit sequence, will therefore capture the entire nominal transit, if there is no post-transit tail. We require observations before the transit to establish a pre-transit baseline. Visits 2 and 3 are also 5 orbits long, and will measure any extended egress (as is the case for many other exoplanets). Because we can accomodate ~ 30 mins of timing uncertainty, we set the phase requirements to +- 0.25 hours.

We planned our observations so that the first orbit of each visit has an ACQ and ACQ-PEAKUP exposure, followed by a science exposure and wavelength calibration. Subsequent orbits only have a science exposure and a wavelength calibration exposure, with no ACQ or ACQ-PEAKUP. Because the few minutes' difference in orbital visibility due to precession has minimal impact on our science, we change the schedulability parameter from 30 to 90 to make scheduling easier. If possible, we kindly ask the Program Coordinator to expand our science observations to fill up the entire

orbital visibility for the orbits that are actually scheduled.

We do not forsee major impacts from reduced gyro mode.

Visit

Proposal 17094, Visit 1 (01) Fri Jul 15 20:02:05 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: SCHED 90%; Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521

Fixed Targets

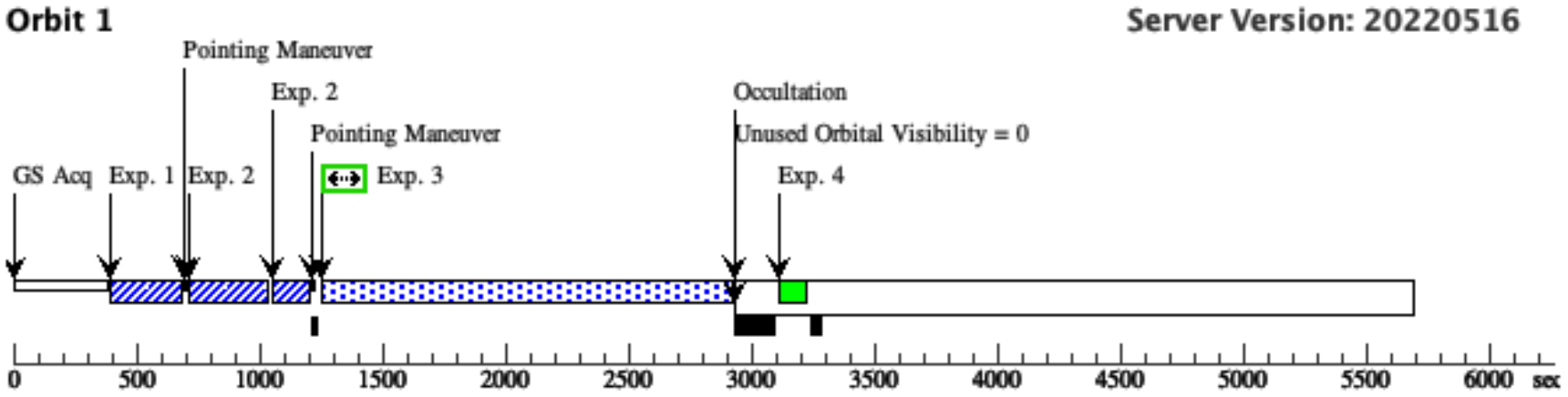
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-209458B	RA: 22 03 10.8053 (330.7950221d) Dec: +18 53 3.27 (18.88424d) Equinox: J2000	Proper Motion RA: 0.0020841118849359345 sec of time/yr Proper Motion Dec: -0.017889999958242697 arcsec/yr Epoch of Position: 2015.5	V=7.63	Reference Frame: ICRS

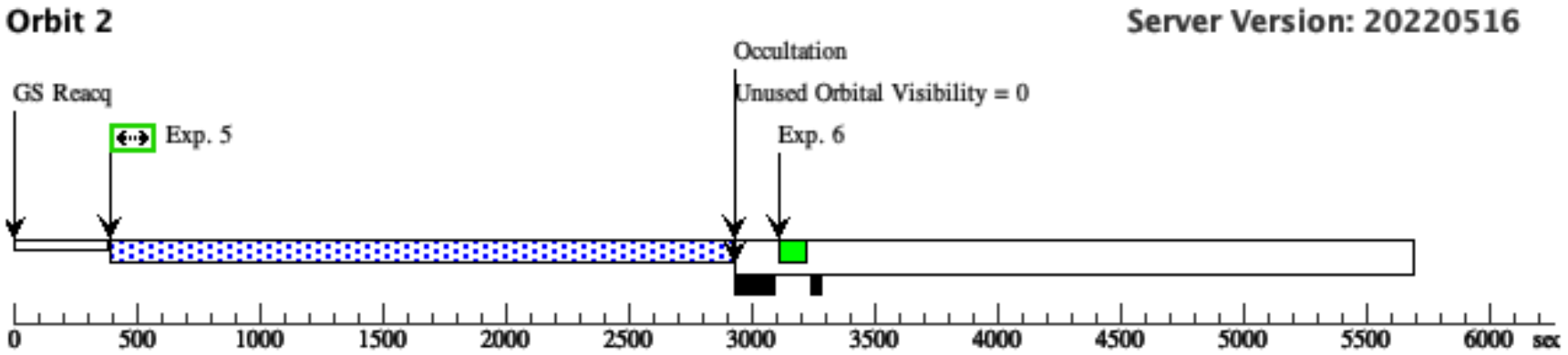
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=EXT-STAR
Description=[EXTRA-SOLAR PLANETARY SYSTEM, G V-IV]

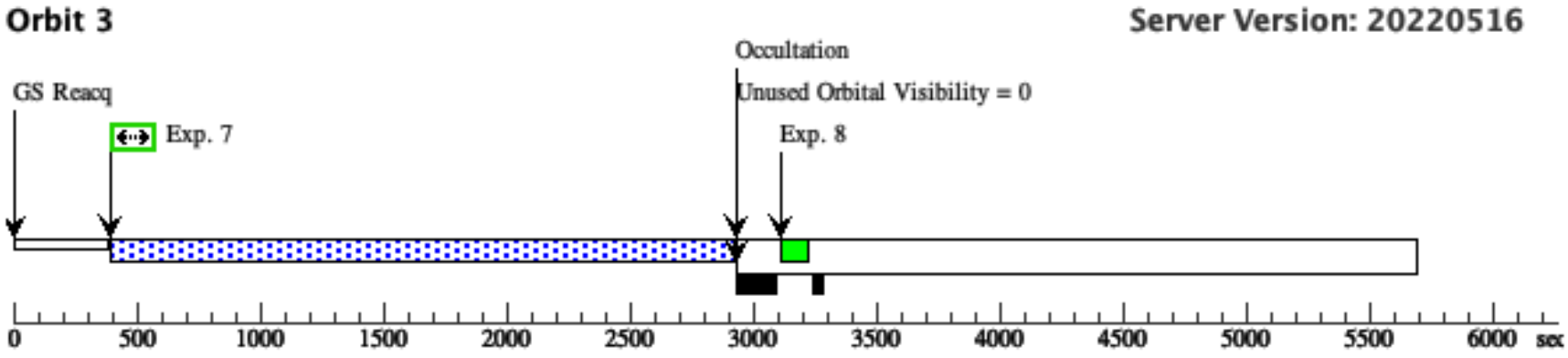
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.1813148)	(1) HD-209458B	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0.9433 TO 0.9492	Sequence 1-4 Non-Int in Visit 1 (01)	5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ/PEAK (STIS.ta.1813149)	(1) HD-209458B	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR			Sequence 1-4 Non-Int in Visit 1 (01)	1.5 Secs (1.5 Secs) *[==>]*	*[1]*
3	Science (STIS.sp.1813151)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 1 (01)	1509 Secs (1509 Secs) *[==>]*	*[1]*
4	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 1 (01)	*[==>]*	*[1]*
5	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 1 (01)	2517 Secs (2517 Secs) *[==>]*	*[2]*
6	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 1 (01)	*[==>]*	*[2]*
7	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 1 (01)	2517 Secs (2517 Secs) *[==>]*	*[3]*
8	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 1 (01)	*[==>]*	*[3]*
9	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 1 (01)	2517 Secs (2517 Secs) *[==>]*	*[4]*
10	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 1 (01)	*[==>]*	*[4]*
11	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 1 (01)	2517 Secs (2517 Secs) *[==>]*	*[5]*
12	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 1 (01)	*[==>]*	*[5]*

Orbit Structure



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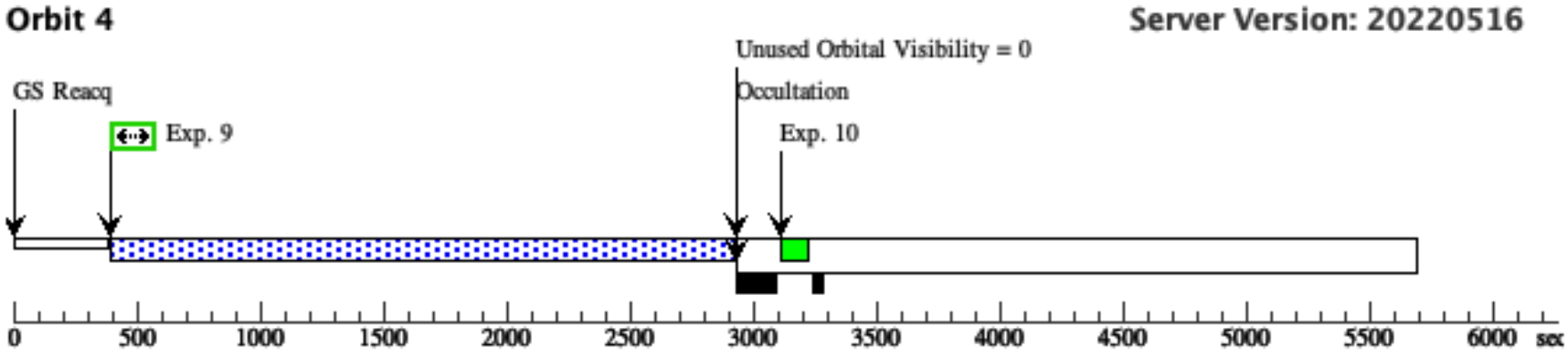
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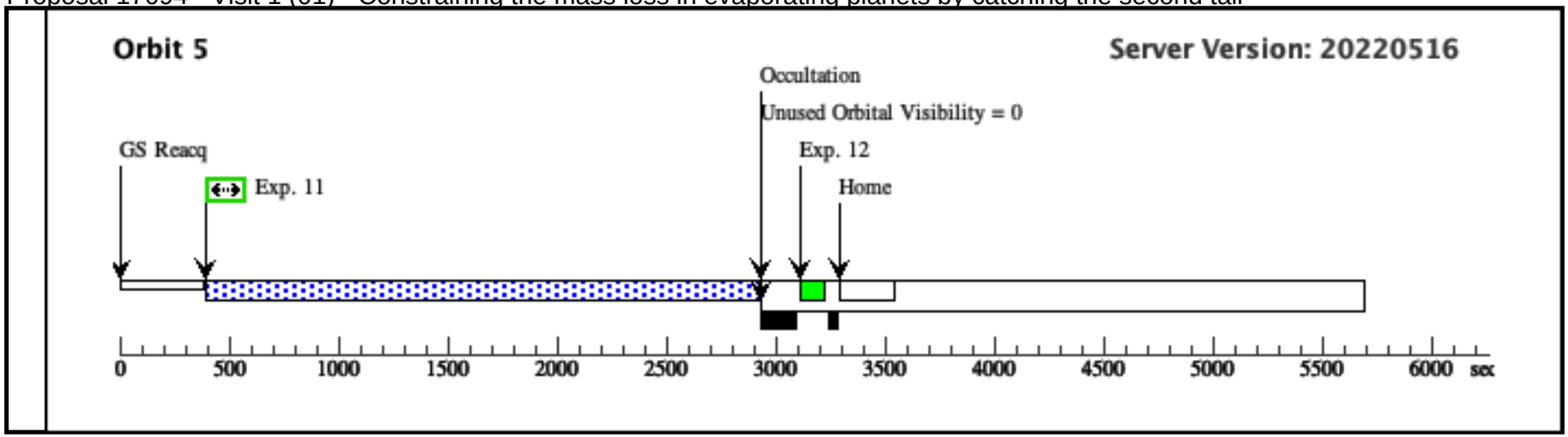
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Visit

Proposal 17094, Visit 2 (02) Fri Jul 15 20:02:05 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: SCHED 90%; Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521

Fixed Targets

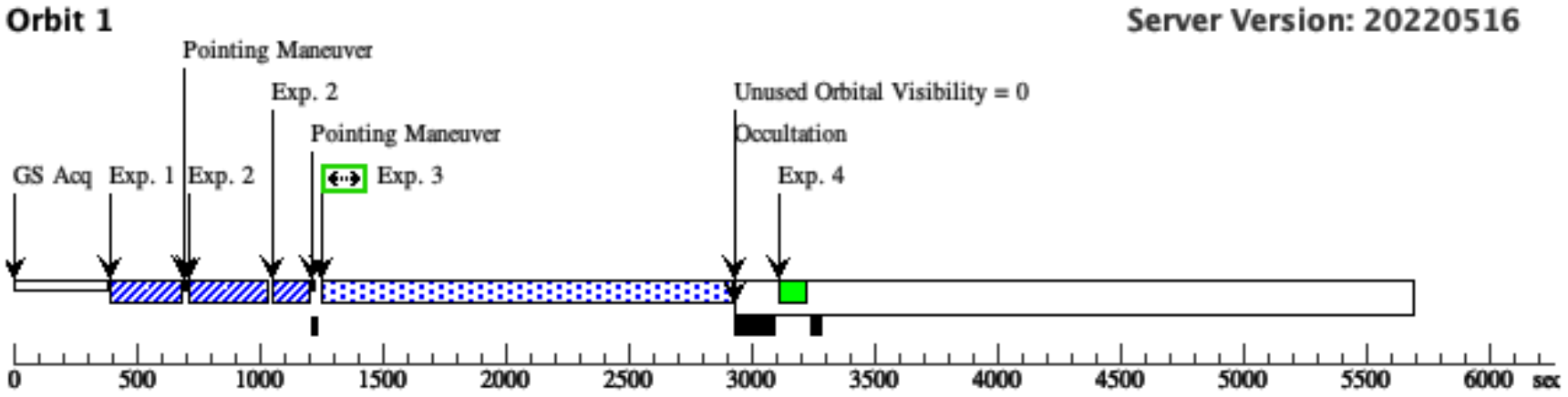
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-209458B	RA: 22 03 10.8053 (330.7950221d) Dec: +18 53 3.27 (18.88424d) Equinox: J2000	Proper Motion RA: 0.0020841118849359345 sec of time/yr Proper Motion Dec: -0.017889999958242697 arcsec/yr Epoch of Position: 2015.5	V=7.63	Reference Frame: ICRS

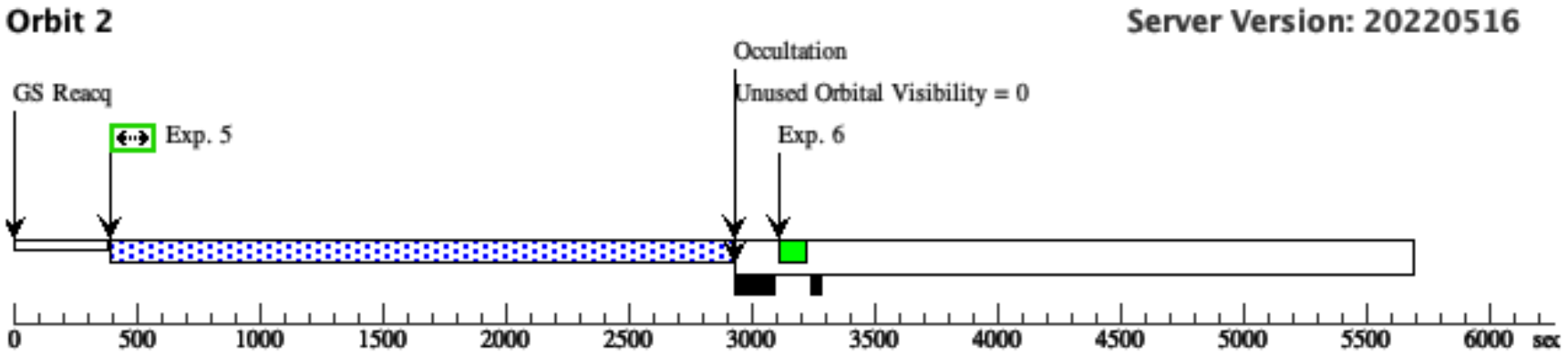
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=EXT-STAR
Description=[EXTRA-SOLAR PLANETARY SYSTEM, G V-IV]

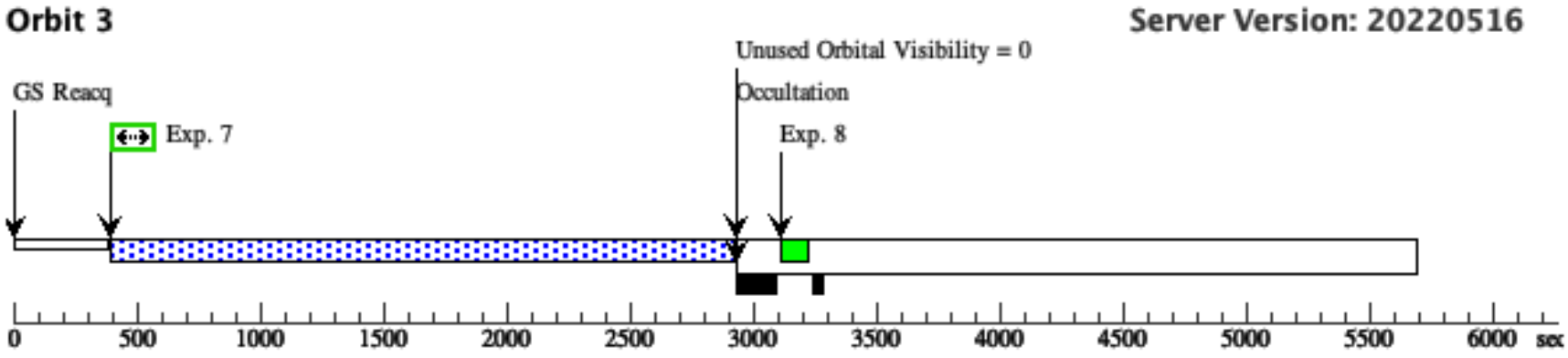
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.1813148)	(1) HD-209458B	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0 TO 0.0059	Sequence 1-4 Non-Int in Visit 2 (02)	5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ/PEAK (STIS.ta.1813149)	(1) HD-209458B	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR			Sequence 1-4 Non-Int in Visit 2 (02)	1.5 Secs (1.5 Secs) *[==>]*	*[1]*
3	Science (STIS.sp.1813151)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 2 (02)	1509 Secs (1509 Secs) *[==>]*	*[1]*
4	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 2 (02)	*[==>]*	*[1]*
5	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 2 (02)	2517 Secs (2517 Secs) *[==>]*	*[2]*
6	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 2 (02)	*[==>]*	*[2]*
7	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 2 (02)	2517 Secs (2517 Secs) *[==>]*	*[3]*
8	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 2 (02)	*[==>]*	*[3]*
9	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 2 (02)	2517 Secs (2517 Secs) *[==>]*	*[4]*
10	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 2 (02)	*[==>]*	*[4]*
11	Science (STIS.sp.1447662)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 2 (02)	2517 Secs (2517 Secs) *[==>]*	*[5]*
12	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 2 (02)	*[==>]*	*[5]*

Orbit Structure



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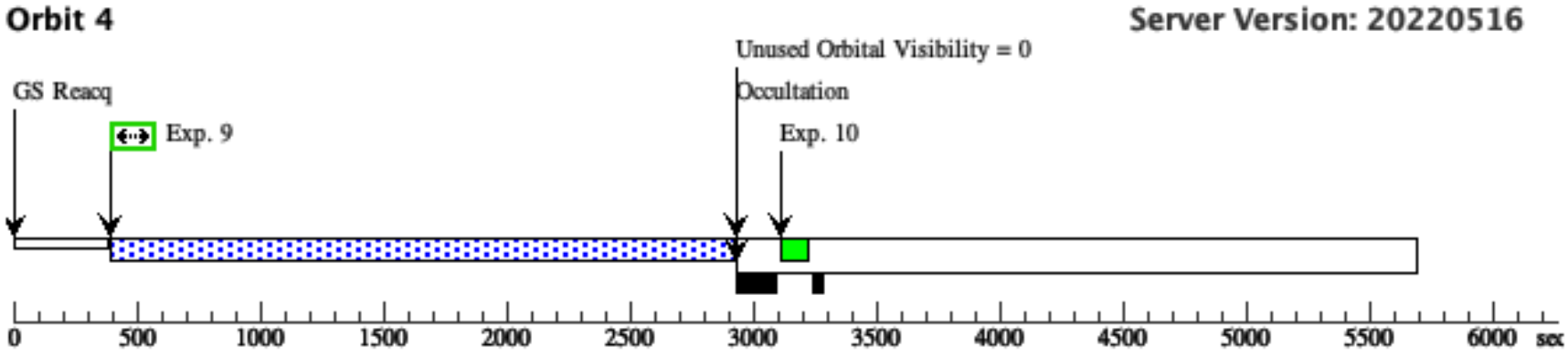
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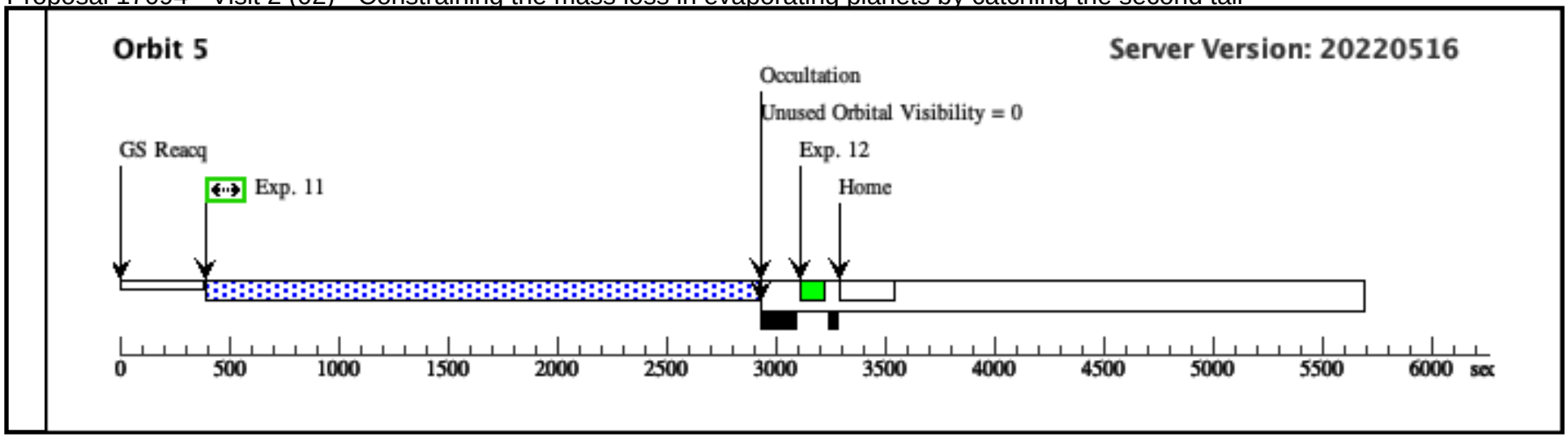
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sec

Visit

Proposal 17094, Visit 3 (03) Fri Jul 15 20:02:06 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: SCHED 90%; Period 3.52474859 D AND ZERO-PHASE HJD2452826.628521

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-209458B	RA: 22 03 10.8053 (330.7950221d) Dec: +18 53 3.27 (18.88424d) Equinox: J2000	Proper Motion RA: 0.0020841118849359345 sec of time/yr Proper Motion Dec: -0.017889999958242697 arcsec/yr Epoch of Position: 2015.5	V=7.63	Reference Frame: ICRS

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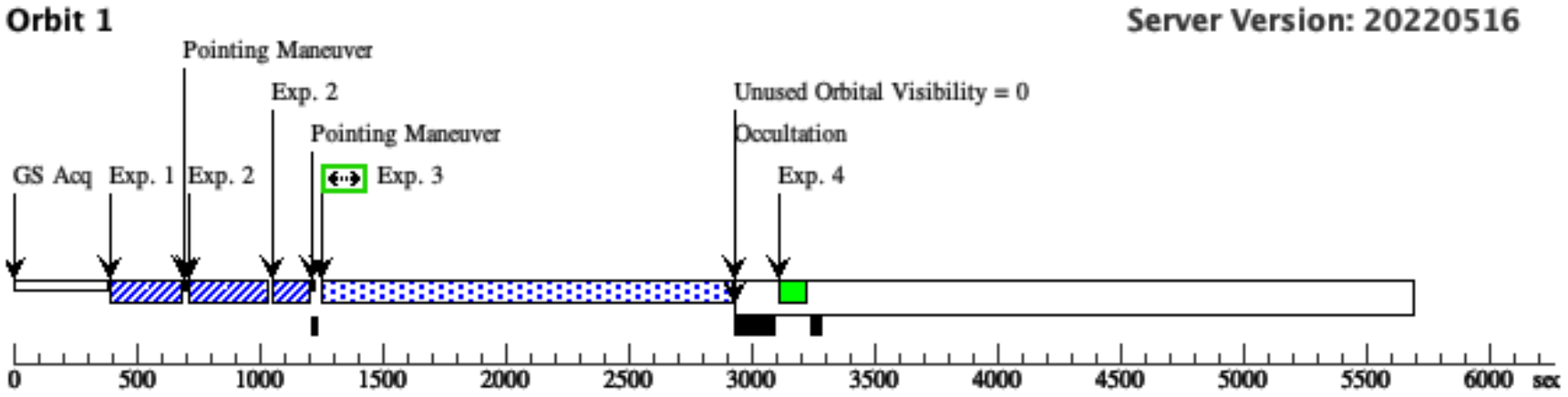
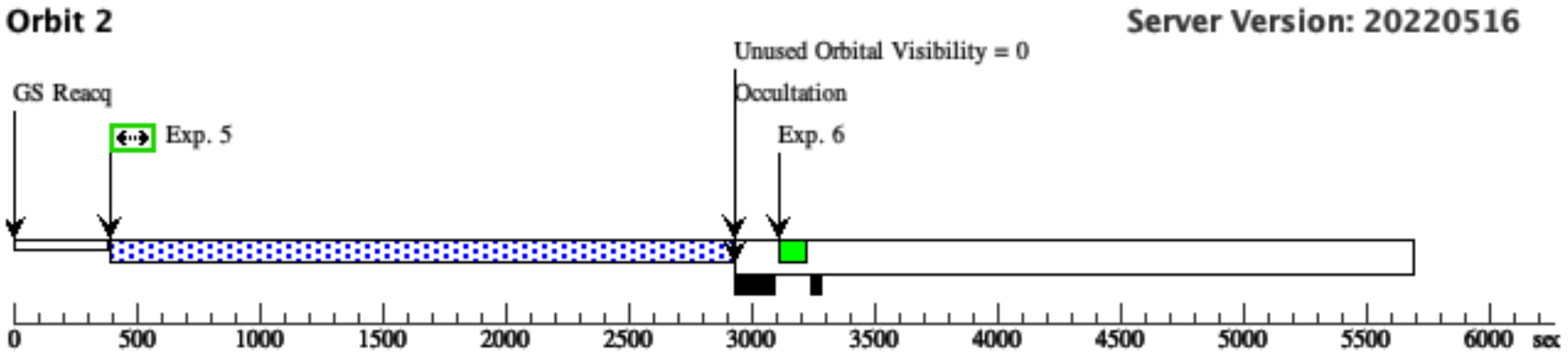
Category=EXT-STAR
Description=[EXTRA-SOLAR PLANETARY SYSTEM, G V-IV]

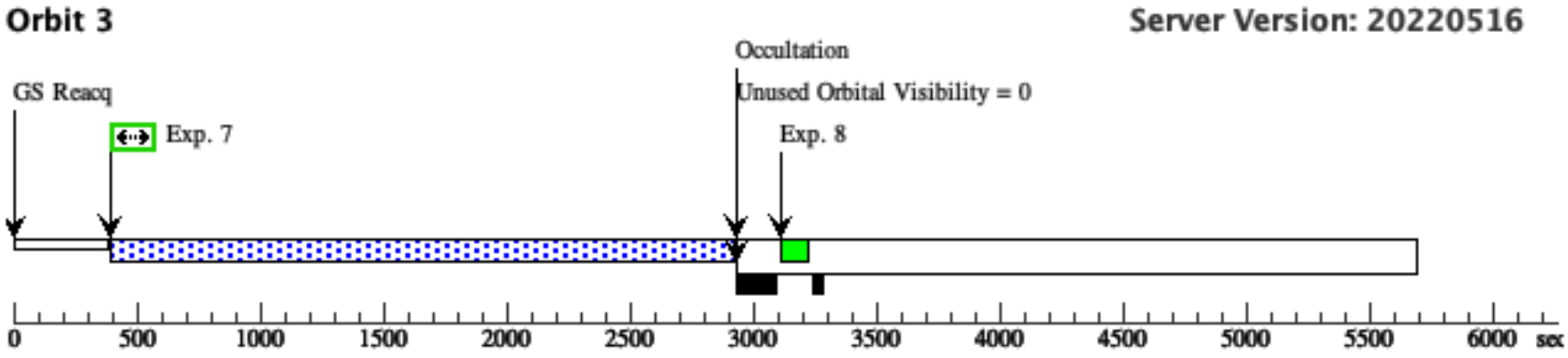
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.1813148)	(1) HD-209458B	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0.0426 TO 0.0485	Sequence 1-4 Non-Int in Visit 3 (03)	5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ/PEAK (STIS.ta.1813149)	(1) HD-209458B	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	MIRROR			Sequence 1-4 Non-Int in Visit 3 (03)	1.5 Secs (1.5 Secs) *[==>]*	*[1]*
3	Science (STIS.sp.1813151)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 3 (03)	1509 Secs (1509 Secs) *[==>]*	*[1]*
4	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 3 (03)	*[==>]*	*[1]*
5	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 3 (03)	2517 Secs (2517 Secs) *[==>]*	*[2]*
6	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 3 (03)	*[==>]*	*[2]*
7	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 3 (03)	2517 Secs (2517 Secs) *[==>]*	*[3]*
8	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 3 (03)	*[==>]*	*[3]*
9	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 3 (03)	2517 Secs (2517 Secs) *[==>]*	*[4]*
10	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 3 (03)	*[==>]*	*[4]*
11	Science (STIS.sp.1813153)	(1) HD-209458B	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	BUFFER-TIME=1500; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 3 (03)	2517 Secs (2517 Secs) *[==>]*	*[5]*
12	WAVECAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 3 (03)	*[==>]*	*[5]*

Orbit Structure



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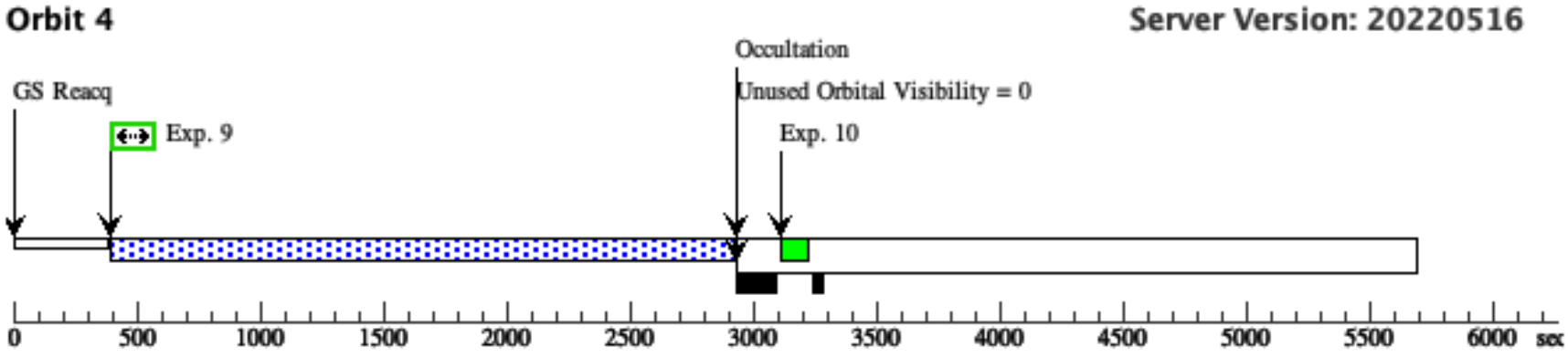
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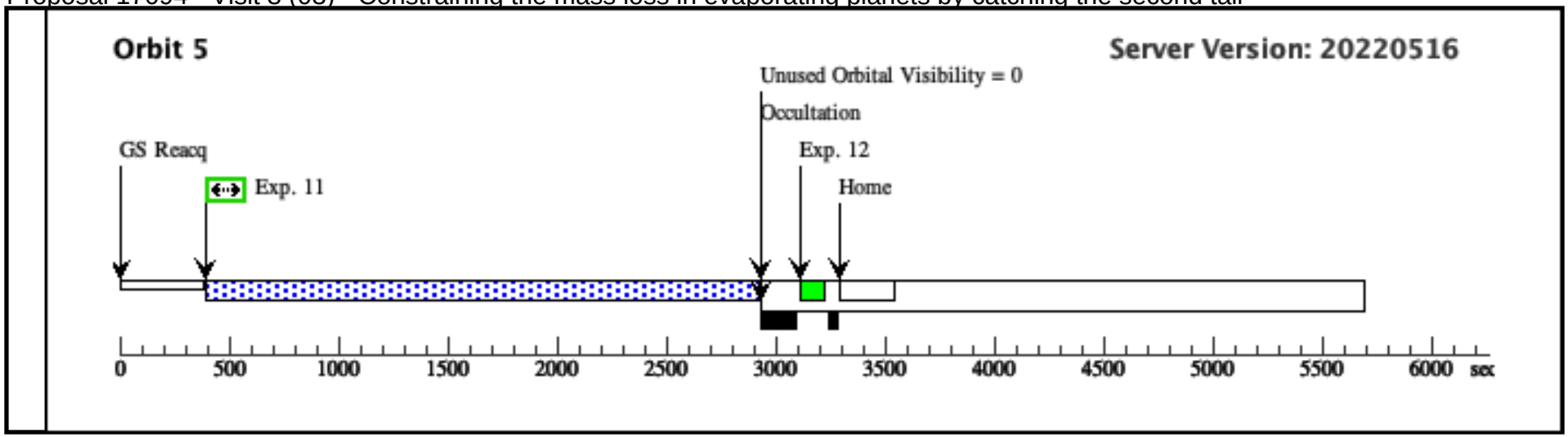
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