15127 - Search for an evaporating ocean on the super-Earth HIP 116454b

Cycle: 25, Proposal Category: GO

(UV Initiative)

(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) HIP-116454 WAVE	STIS/CCD STIS/FUV-MAMA	5	05-Dec-2018 13:00:42.0	yes
02	(1) HIP-116454 WAVE	STIS/CCD STIS/FUV-MAMA	5	05-Dec-2018 13:00:44.0	yes
03	(1) HIP-116454 WAVE	STIS/CCD STIS/FUV-MAMA	5	05-Dec-2018 13:00:47.0	yes

15 Total Orbits Used

ABSTRACT

The super-Earth HIP116454b was the first exoplanet detected by the K2 mission, in transit across a bright and nearby K1 dwarf (V=10.2, d=55 pc). The low density of the planet suggests it must have at least 30% water or a 0.5% H-He envelope. Given the strong XUV irradiation from the young (2 Gyr) host star, this H-He envelope should have been lost through evaporation in a few hundred millions year, suggesting that HIP 116454b likely contains a large mass fraction of water. The shallow transit depth makes difficult the search for water vapor in the lower atmosphere with HST/WFC3. The moderate orbital distance of this warm (~700 K) planet favors the formation of a super-critical steam envelope, which should be promptly dissociated at high altitude by the XUV irradiation and become observable as hydrogen flowing within and beyond the Roche lobe. The host star is similar to HD 189733, host to an evaporating hot Jupiter, and numerical simulations of HIP116454b show that the hydrogen exosphere resulting from the dissociation of water is observable with HST/STIS at Ly-alpha. The detection of this exosphere would be the first signature of an evolved evaporating ocean on an extrasolar planet, as well as the first validation of internal structure models of exoplanets in this mass regime. It would also determine how to best search for water in the lower atmosphere of HIP116454b with the JWST. A non-detection of escaping hydrogen, as with 55 Cnc e and HD 97658b, would bring useful constraints on the nature of the planetary atmosphere, the evolutionary path of close-in super-Earths, and the progenitors of the rocky evaporation remnants detected by Kepler.

OBSERVING DESCRIPTION

This program consists in 3 visits of 5 HST orbits each. In each visit, we will observe the transit of an exoplanet (HIP116454b) in front of its host star. Transits occur every 9.12 days (the orbital period of the planet) and last for 2.25 hours. The goal is to search for a hydrogen exosphere surrounding the planet and occulting the star at Lyman-alpha. The timing requirements are set as phase constraints on the first ACQ exposure of the first orbit in a visit, with allowed start phase range between 19-26 min depending on the visit.

We schedule the three visits so that there are always two HST orbits falling within the planet transit. Phase constraints are shifted from visit #1 to #3 so that visit #1 also covers the phase range before the transit, visit #2 before and after the transit, and visit #3 after the transit. This is because the transit of the putative exosphere can begin earlier, and end later, than the planet transit.
We set a BETWEEN constraint for all visits between April, 1st 2018 and October, 1st 2018 to optimize airglow contamination in intensity and radial velocity. It would be best for our science goals if the three visits could be scheduled as close as possible to the end of this window.

We moved the AUTO-WAVECAL to GO-WAVECAL done during Earth occultation.

Visit

Proposal 15127, Visit 01, implementation Wed Dec 05 18:00:48 GMT 2018

Diagnostic Status: Warning

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

Special Requirements: SCHED 100%; BETWEEN 01-APR-2019:00:00:00 AND 01-OCT-2019:00:00:00; Period 9.1205 D AND ZERO-PHASE HJD2456907.89

Comments: We set a BETWEEN constraint to optimize airglow contamination in intensity and radial velocity

Diagnostics

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

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

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

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

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

Fixed Targets

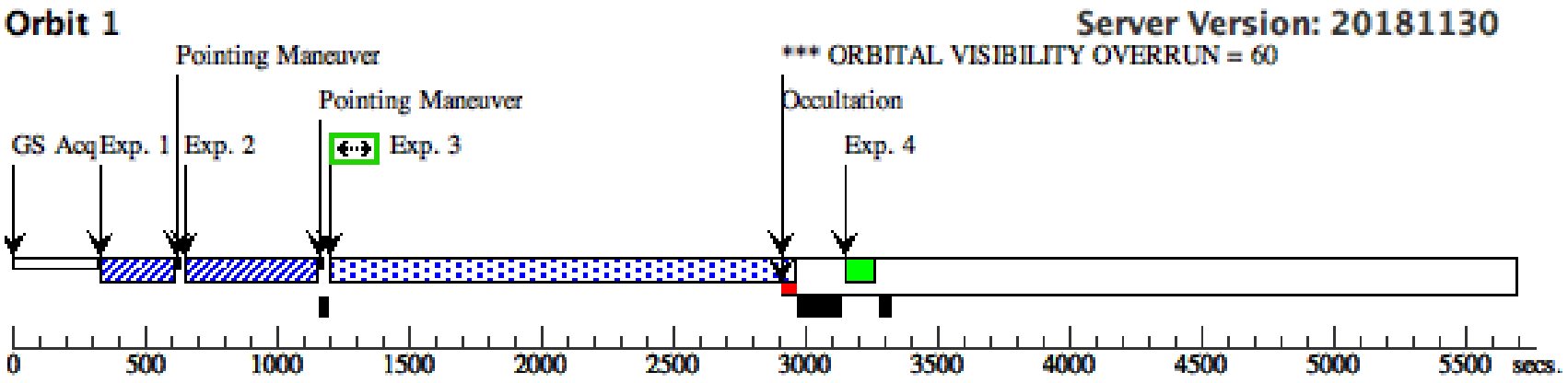
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HIP-116454	RA: 23 35 49.2814 (353.9553392d) Dec: +00 26 43.86 (.44552d) Equinox: J2000	Proper Motion RA: -238.0 mas/yr Proper Motion Dec: -185.9 mas/yr Parallax: 0.01777 " Epoch of Position: 2000 Radial Velocity: -3.26 km/sec	V=10.19 B 11.08; R 9.71; I 9.25; J 8.604 ; H 8.140 ; K 8.029	Reference Frame: ICRS

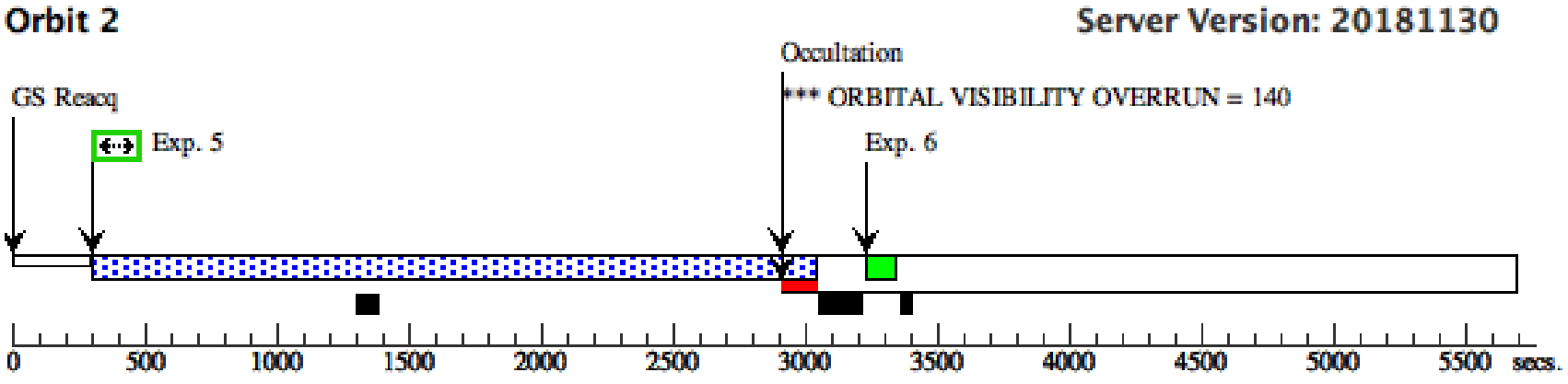
Comments: All target properties come from the SIMBAD database. The star has Hipparcos astrometric coordinates (HIP 116454). We used the confirmation charts to check that the coordinates and proper motion were correct.
Category=STAR
Description=[EXTRA-SOLAR PLANET, K III-I]
Extended=NO

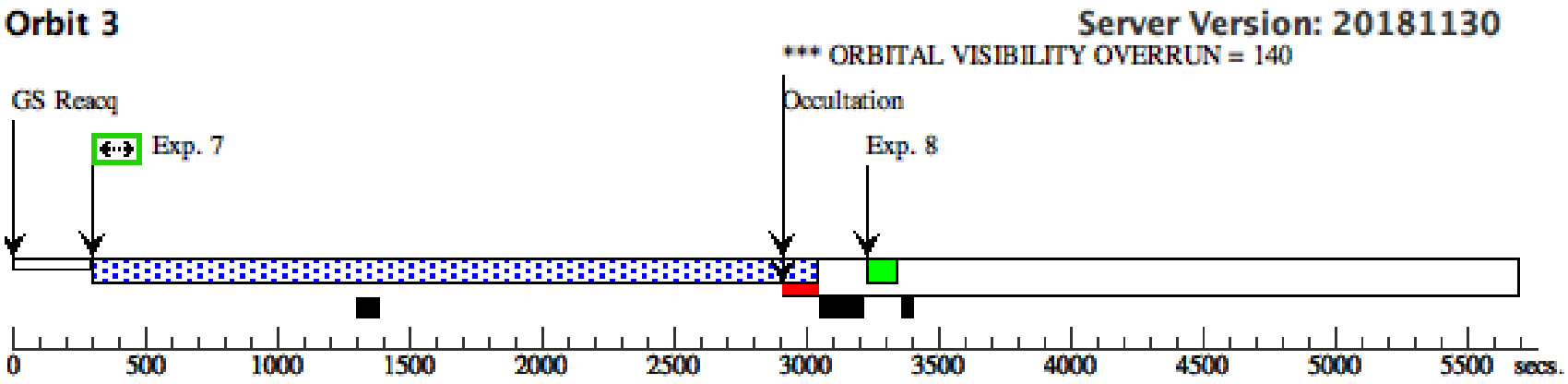
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.10004020)	(1) HIP-116454	STIS/CCD, ACQ, F28X50OII	MIRROR		PHASE 0.972 TO 0.9735	Sequence 1-4 Non-Int in Visit 01	5 Secs (5 Secs) *[==>]*	***[1]***
	Comments: The target is too bright for the longpass filter, and the F28X50OII was selected instead. Time to reach signal to noise ratio of 40 is estimated at 1.8s, with time to saturation 187s. We set exposure time to 5s.								
2	ACQ/PEAK (STIS.sp.1004044)	(1) HIP-116454	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Visit 01	10 Secs (10 Secs) *[==>]*	***[1]***
	Comments: 10s allows to reach over S/N=70 with STIS/CCD/G430L at 4300 Angstroms, and is well below the time to saturation (200s). The Spectroscopic ETC yields a warning about the issue with charge transfer efficiency for low background, but we are just using the CCD for the target acquisition, after which we switch to the MAMA.								
3	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 01	1796 Secs (1595 Secs) *[==>1595.0 Secs]*	***[1]***
	Comments: We are basically photon-starved and set the exposure time to the maximum possible value. The star is a near twin of HD189733 (see above ETC run) and HD97658, observed with the same settings in previous programs, except that it is farther away and fainter. We thus expect lower count rates, and can define the buffer-time as Texp/2 for the orbits of all visits.								
4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 01	*[==>]*	***[1]***
5	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 01	3000 Secs (2726 Secs) *[==>2726.0 Secs]*	***[2]***
6	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 01	*[==>]*	***[2]***
7	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 01	3000 Secs (2726 Secs) *[==>2726.0 Secs]*	***[3]***
8	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 01	*[==>]*	***[3]***
9	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 01	3000 Secs (2726 Secs) *[==>2726.0 Secs]*	***[4]***
10	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 01	*[==>]*	***[4]***
11	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 01	3000 Secs (2726 Secs) *[==>2726.0 Secs]*	***[5]***
12	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 01	*[==>]*	***[5]***

Orbit Structure



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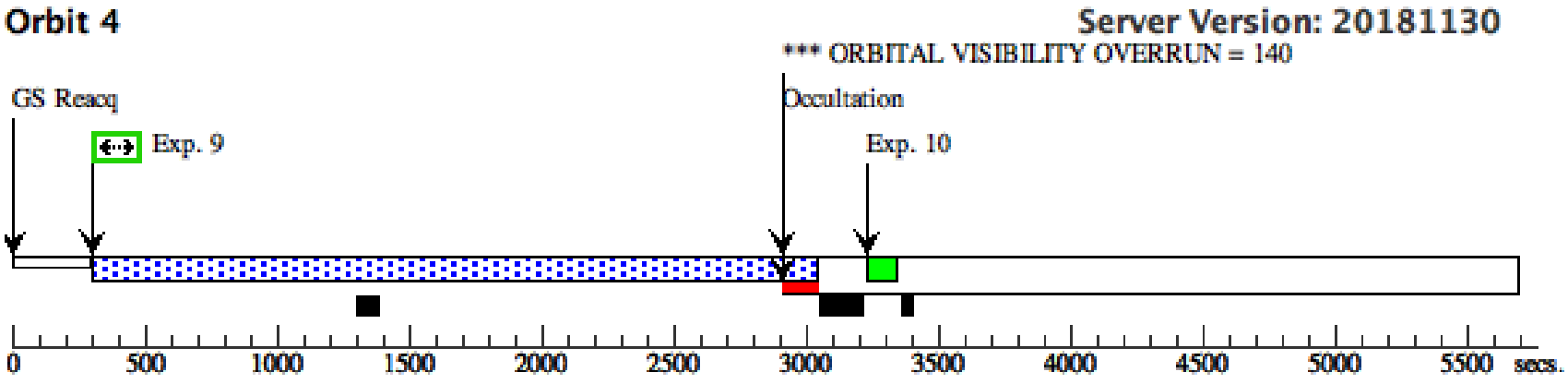
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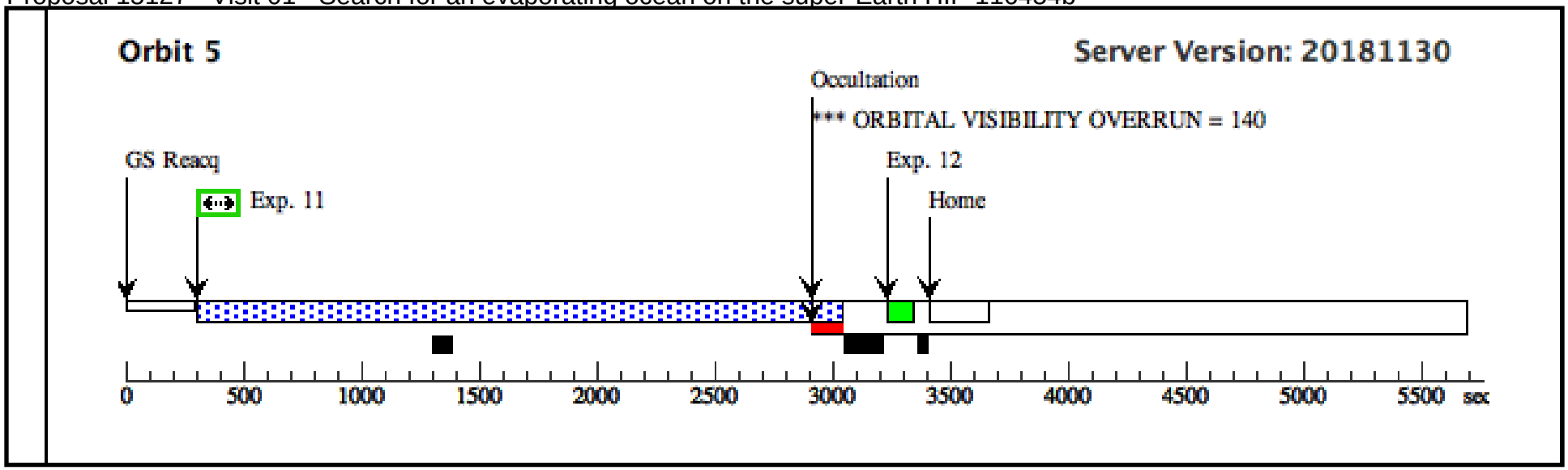
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3500
4000
4500
5000
5500
sec

Visit

Proposal 15127, Visit 02, completed Wed Dec 05 18:00:48 GMT 2018

Diagnostic Status: Warning

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

Special Requirements: SCHED 100%; BETWEEN 01-APR-2018:00:00:00 AND 01-OCT-2018:00:00:00; Period 9.1205 D AND ZERO-PHASE HJD2456907.89

Comments: We set a BETWEEN constraint to optimize airglow contamination in intensity and radial velocity

Diagnostics

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

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

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

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

Fixed Targets

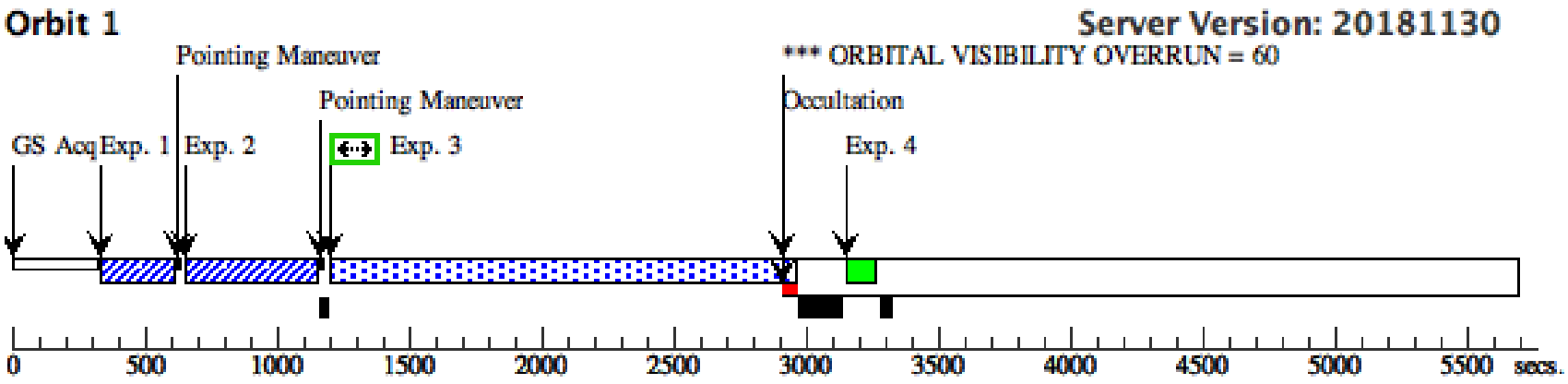
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HIP-116454	RA: 23 35 49.2814 (353.9553392d) Dec: +00 26 43.86 (.44552d) Equinox: J2000	Proper Motion RA: -238.0 mas/yr Proper Motion Dec: -185.9 mas/yr Parallax: 0.01777 " Epoch of Position: 2000 Radial Velocity: -3.26 km/sec	V=10.19 B 11.08; R 9.71; I 9.25; J 8.604 ; H 8.140 ; K 8.029	Reference Frame: ICRS

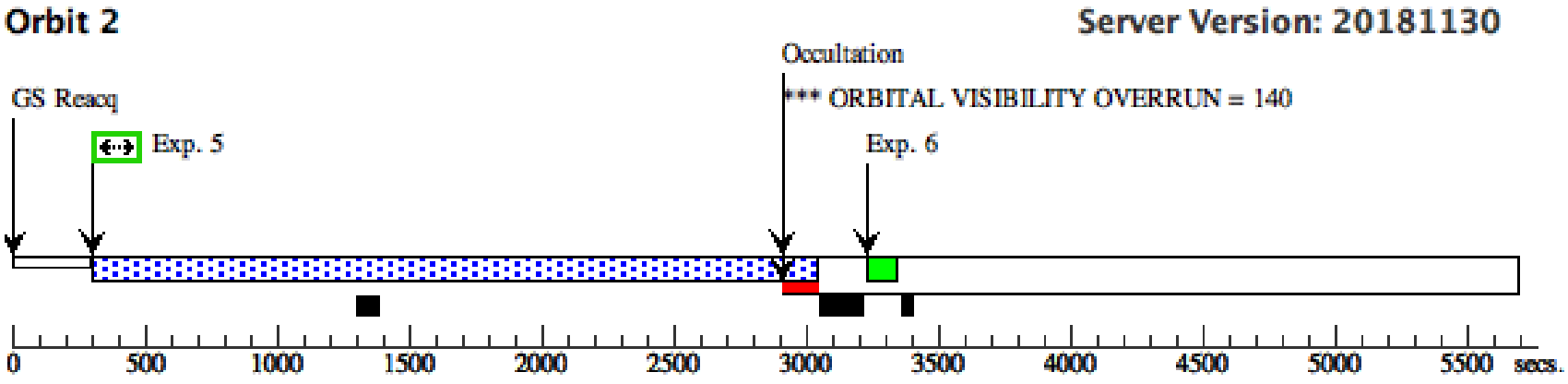
Comments: All target properties come from the SIMBAD database. The star has Hipparcos astrometric coordinates (HIP 116454). We used the confirmation charts to check that the coordinates and proper motion were correct.
Category=STAR
Description=[EXTRA-SOLAR PLANET, K III-I]
Extended=NO

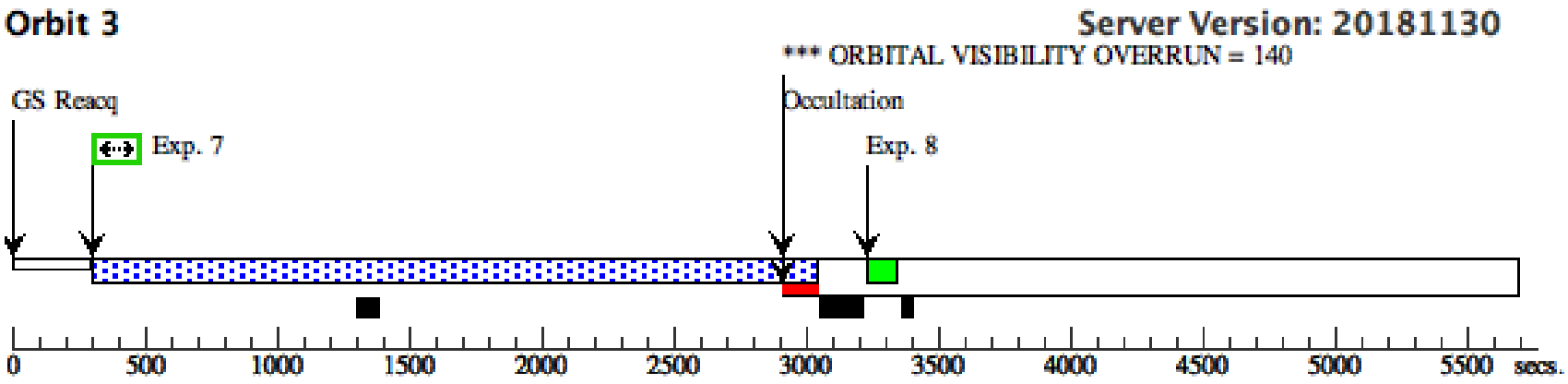
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.10004020)	(1) HIP-116454	STIS/CCD, ACQ, F28X50OII	MIRROR		PHASE 0.982 TO 0.984	Sequence 1-4 Non-Int in Visit 02	5 Secs (5 Secs) *[==>]*	***[1]***
	Comments: The target is too bright for the longpass filter, and the F28X50OII was selected instead. Time to reach signal to noise ratio of 40 is estimated at 1.8s, with time to saturation 187s. We set exposure time to 5s .								
2	ACQ/PEAK (STIS.sp.1004044)	(1) HIP-116454	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Visit 02	10 Secs (10 Secs) *[==>]*	***[1]***
	Comments: 10s allows to reach over S/N=70 with STIS/CCD/G430L at 4300 Angstroms, and is well below the time to saturation (200s). The Spectroscopic ETC yields a warning about the issue with charge transfer efficiency for low background, but we are just using the CCD for the target acquisition, after which we switch to the MAMA.								
3	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 02	1796 Secs (1595 Secs) *[==>1595.0 Secs]*	***[1]***
	Comments: We are basically photon-starved and set the exposure time to the maximum possible value. The star is a near twin of HD189733 (see above ETC run) and HD97658, observed with the same settings in previous programs, except that it is farther away and fainter. We thus expect lower count rates, and can define the buffer-time as Texp/2 for the orbits of all visits.								
4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 02	*[==>]*	***[1]***
5	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 02	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[2]***
6	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 02	*[==>]*	***[2]***
7	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 02	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[3]***
8	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 02	*[==>]*	***[3]***
9	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 02	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[4]***
10	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 02	*[==>]*	***[4]***
11	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 02	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[5]***
12	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 02	*[==>]*	***[5]***

Orbit Structure



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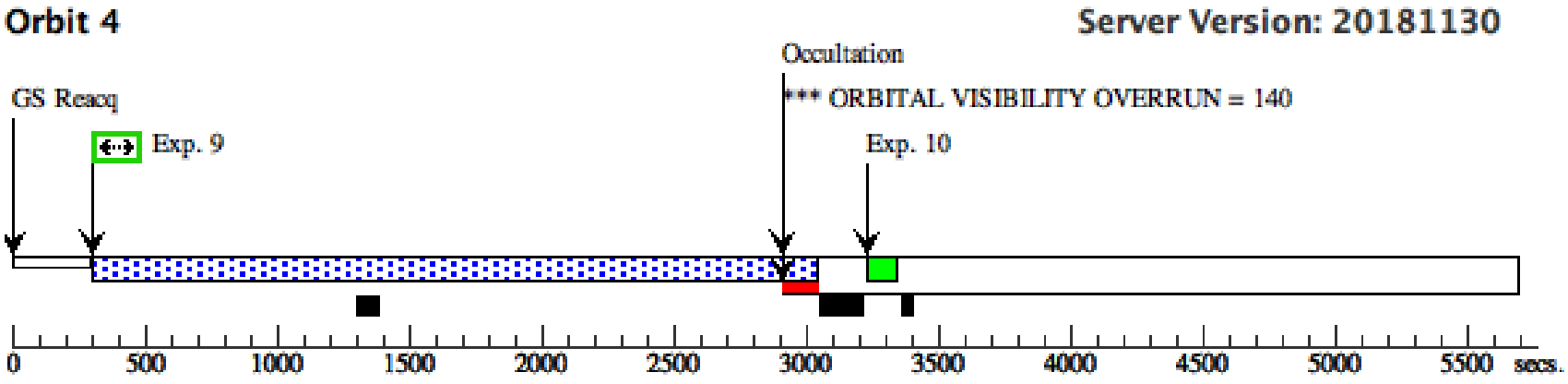
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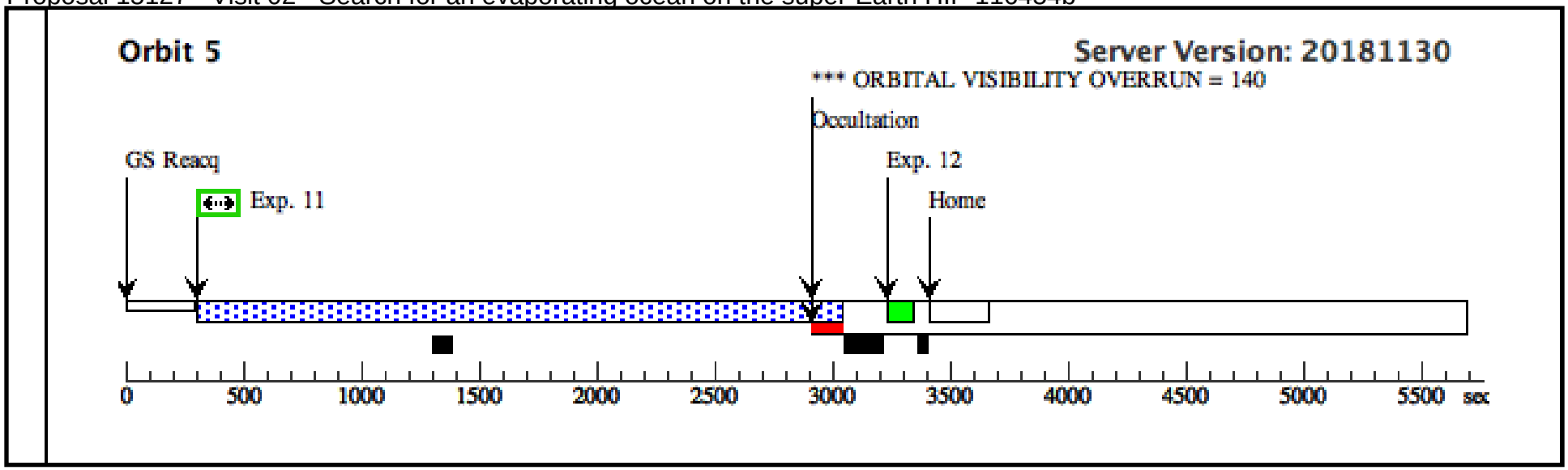
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Visit

Proposal 15127, Visit 03, implementation Wed Dec 05 18:00:48 GMT 2018

Diagnostic Status: Warning

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

Special Requirements: SCHED 100%; BETWEEN 01-APR-2019:00:00:00 AND 01-OCT-2019:00:00:00; Period 9.1205 D AND ZERO-PHASE HJD2456907.89

Comments: We set a BETWEEN constraint to optimize airglow contamination in intensity and radial velocity

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

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

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

Fixed Targets

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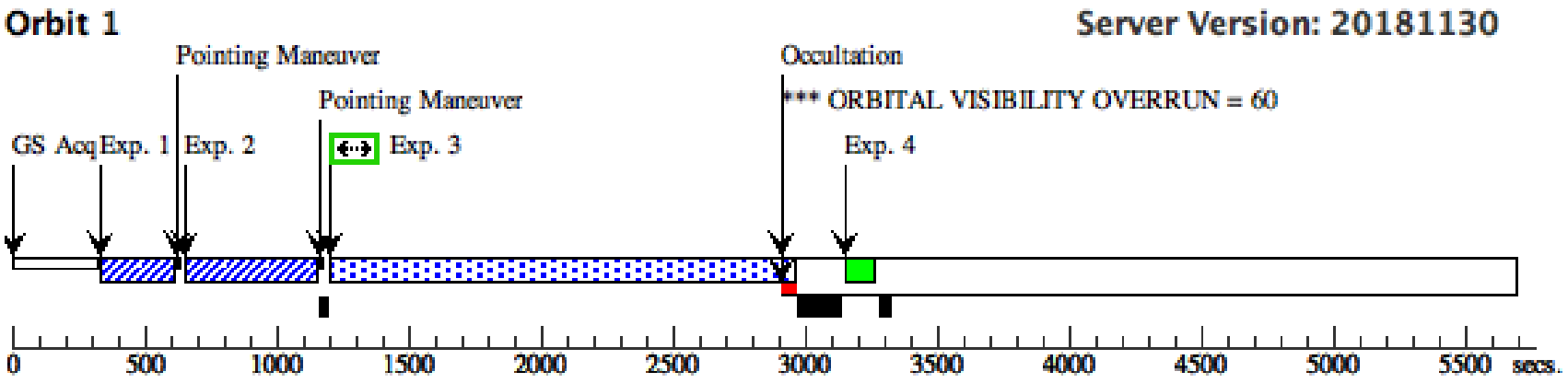
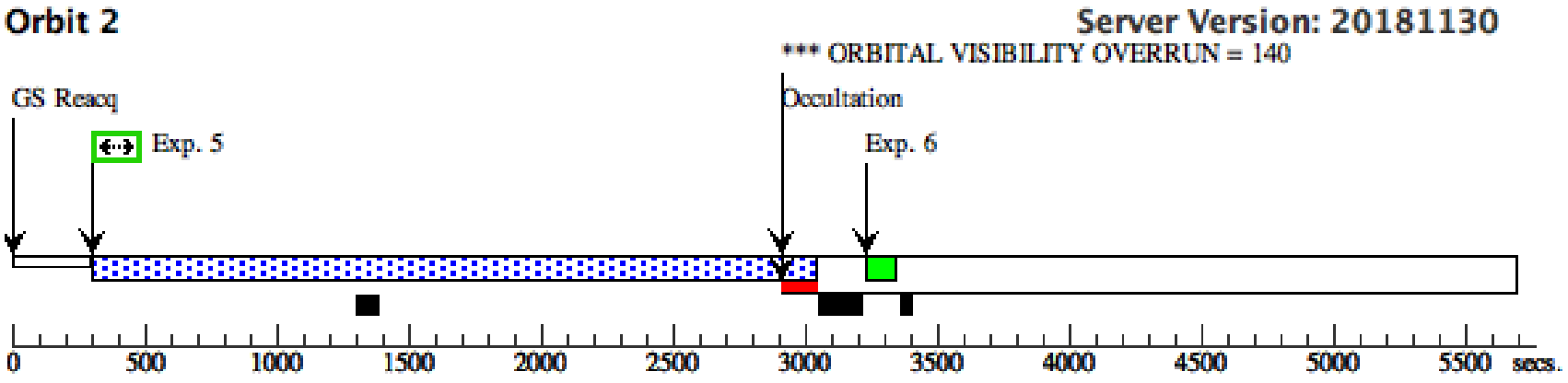
Comments: All target properties come from the SIMBAD database. The star has Hipparcos astrometric coordinates (HIP 116454). We used the confirmation charts to check that the coordinates and proper motion were correct.
Category=STAR
Description=[EXTRA-SOLAR PLANET, K III-I]
Extended=NO

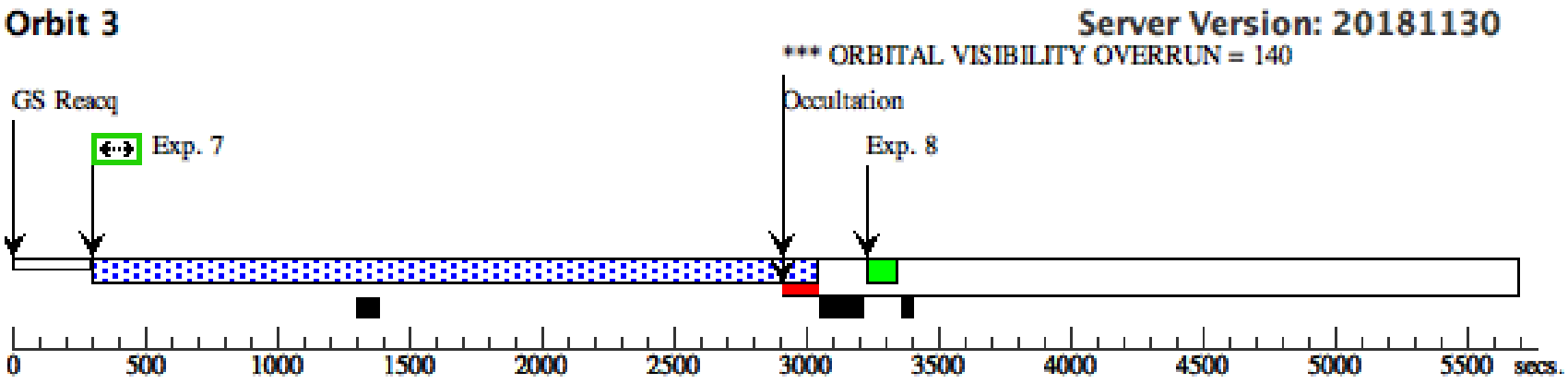
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.10004020)	(1) HIP-116454	STIS/CCD, ACQ, F28X50OII	MIRROR		PHASE 0.992 TO 0.994	Sequence 1-4 Non-Int in Visit 03	5 Secs (5 Secs) *[==>]*	***[1]***
	Comments: The target is too bright for the longpass filter, and the F28X50OII was selected instead. Time to reach signal to noise ratio of 40 is estimated at 1.8s, with time to saturation 187s. We set exposure time to 5s .								
2	ACQ/PEAK (STIS.sp.1004044)	(1) HIP-116454	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Visit 03	10 Secs (10 Secs) *[==>]*	***[1]***
	Comments: 10s allows to reach over S/N=70 with STIS/CCD/G430L at 4300 Angstroms, and is well below the time to saturation (200s). The Spectroscopic ETC yields a warning about the issue with charge transfer efficiency for low background, but we are just using the CCD for the target acquisition, after which we switch to the MAMA.								
3	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 03	1796 Secs (1595 Secs) *[==>1595.0 Secs]*	***[1]***
	Comments: We are basically photon-starved and set the exposure time to the maximum possible value. The star is a near twin of HD189733 (see above ETC run) and HD97658, observed with the same settings in previous programs, except that it is farther away and fainter. We thus expect lower count rates, and can define the buffer-time as Texp/2 for the orbits of all visits.								
4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 03	*[==>]*	***[1]***
5	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 03	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[2]***
6	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 03	*[==>]*	***[2]***
7	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 03	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[3]***
8	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 03	*[==>]*	***[3]***
9	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 03	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[4]***
10	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 03	*[==>]*	***[4]***
11	SCI (STIS.sp.415446)	(1) HIP-116454	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 03	2153 Secs (2726 Secs) *[==>2726.0 Secs]*	***[5]***
12	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 03	*[==>]*	***[5]***

Orbit Structure






Orbit 3
Server Version: 20181130
*** ORBITAL VISIBILITY OVERRUN = 140
GS Reacq
Exp. 7
Occultation
Exp. 8
0
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1000
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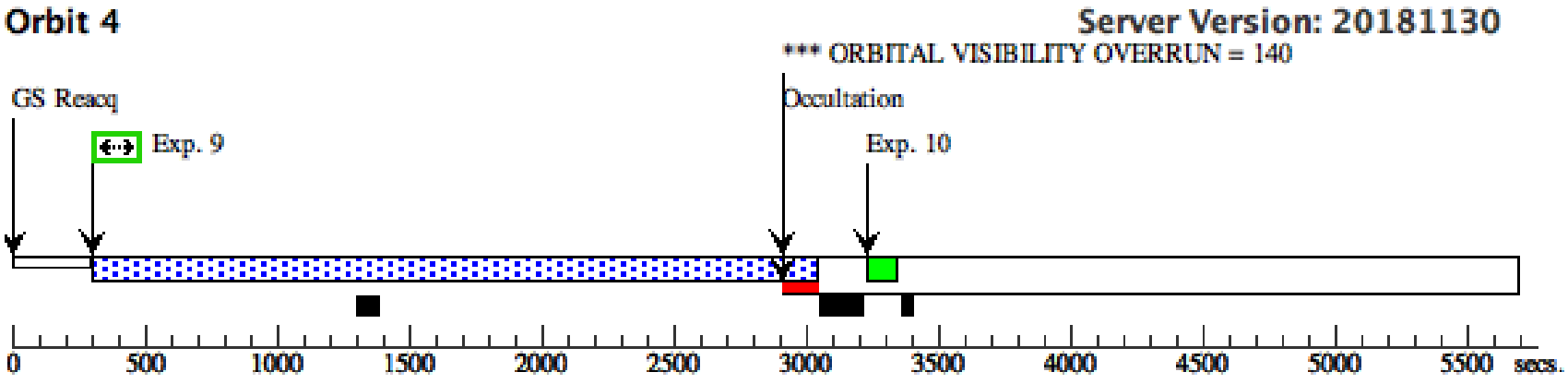
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 4
Server Version: 20181130
*** ORBITAL VISIBILITY OVERRUN = 140
GS Reacq
Exp. 9
Occultation
Exp. 10
0
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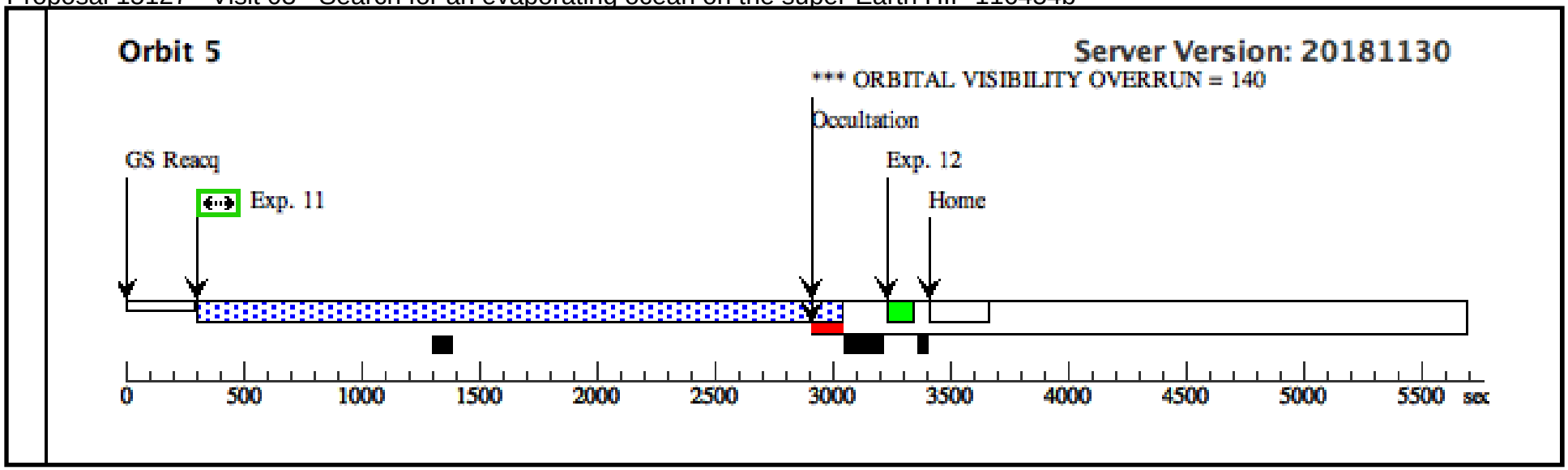
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 5
Server Version: 20181130
*** ORBITAL VISIBILITY OVERRUN = 140
Occultation
GS Reacq
Exp. 11
Exp. 12
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec