14782 - Is the atmosphere of the extremely irradiated exoplanet WASP-43b in a blow-off state?

Cycle: 24, Proposal Category: GO

(Availability Mode: AVAILABLE)

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) GSC-05490-00141 WAVE	STIS/CCD	4	12-Dec-2016 21:00:45.0	yes

4 Total Orbits Used

ABSTRACT

In the past months we have obtained evidence that an unusual phenomenon is happening in the atmosphere of one of the Hot Jupiters with shortest period. High-resolution spectroscopy from the ground reveals a transit spectrum where the sodium absorption signal from the planet peaks at 2-3%, which is larger than the planet transit depth in white light and 100 times larger than the well HST-established detection of sodium in HD 209458b

(Charbonneau et al. 2002). Only in the UV have such large signatures been observed, for lighter hydrogen, carbon and oxygen atoms being blown-off by hydrodynamical atmospheric escape. So far, sodium atoms have never been observed higher than the thermosphere, where they should get promptly ionized.

Analysis of ground-based data is challenging because the spectroscopic signatures can be mimicked by the Earth atmosphere, and a sophisticated removal of telluric contamination is necessary. Our observations show that an efficient telluric correction for this target, particularly faint in the sodium region, is impossible, making a space-based confirmation necessary. In a single transit, HST/STIS could obtain a 5-sigma confirmation of the signal. This detection would unambiguously show that the planetary atmosphere is in a state of extreme blow-off, with large exospheric densities allowing for a high recombination rate able to maintain sodium in a neutral state even high up in the atmosphere. This would represent the first constraint on atmospheric evaporation obtained in the optical, and would thus open a new, UV-independent path to the characterization of evaporating atmospheres, crucial in the post-HST era.

OBSERVING DESCRIPTION

We are going to collect STIS spectra during one transit of WASP-43b. In order to have enough out-of-transit and in-transit data 4 orbits are required. Two orbits will be collected before the transit of the planet to establish the baseline flux, one during and one after the transit. This strategy allows to measure the drop in stellar flux due to the transit of the planet. Key to the success of the program is extremely precise photometry, of which HST/STIS has already demonstrated to be capable.

We are going to use the STIS CCD G750M observing mode centred at 6094 A to observe sodium at R ~ 5000, and with the 52" x 2" slit to minimize flux losses.

The duration of the transit is of 2200 s excluding ingress and egress, thus it is possible to completely cover it with the third orbit. Each orbit is split in ~ 270 s exposures with sub-array reading (efficiency > 90 %), to sample the transit of the planet finely enough while keeping a high duty cycle.

Additional comments:

Experience gained from past proposals by several groups (14461, 14410, 12473, 11572 among others) has shown that maximized photometric precision and efficient thermal breathing trends removal is key to the success of HST transit observations. This is achieved with three main precautions:

- We set WAVECAL=NO for the visit and perform manual wavelength calibrations during Earth occultation to acquire a consevutive time series in each orbit.

- A short exposure (1 sec) is performed before the scientific time series, following the method indicated in Sing et al., 2015, MNRAS, 446, 2428. This is to minimize the impact of possible systematics in the first exposure.
- Again following past proposals, we set the other STIS settings in order to maximize counts and reduce readout time overheads: CR-SPLIT=NO, GAIN=4, SIZEAXIS2=128.

Visit

Proposal 14782, First visit (01), implementation Tue Dec 13 02:00:47 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: Period 0.813473978 D AND ZERO-PHASE HJD2455528.868634

Comments: For this proposal it is necessary to have a visit of four orbits in a continuous block, because the transit of the planet has to be fully sampled.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GSC-05490-00141	RA: 10 19 38.0080 (154.9083667d)	Proper Motion RA: -43.2 mas/yr	V=12.5+/-0.1	Reference Frame: ICRS
		Dec: -09 48 22.59 (-9.80628d)	Proper Motion Dec: -43.2 mas/yr	APASS r = 11.9	
		Equinox: J2000	Epoch of Position: 2000.0		
			Radial Velocity: -3.6 km/sec		

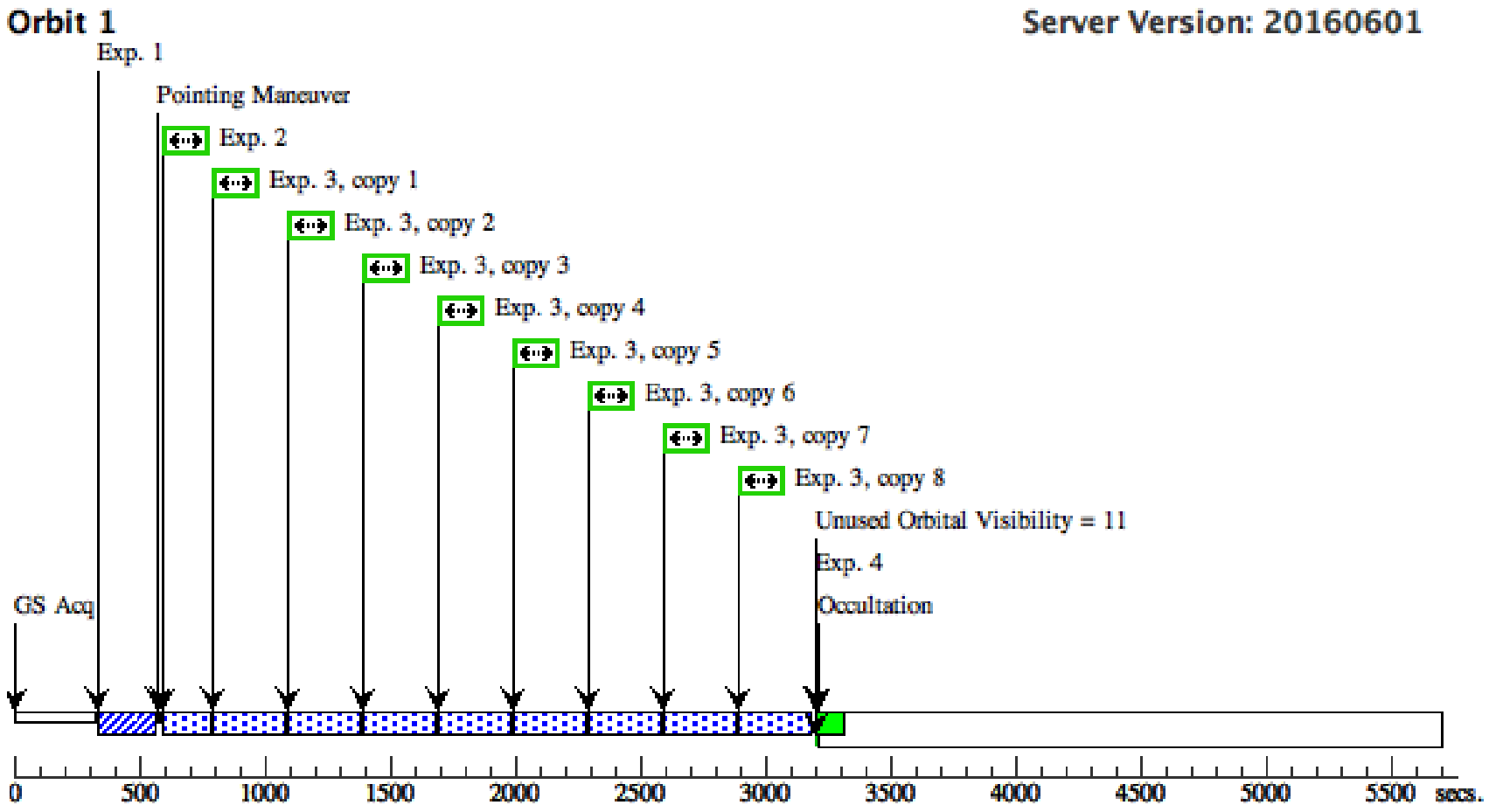
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

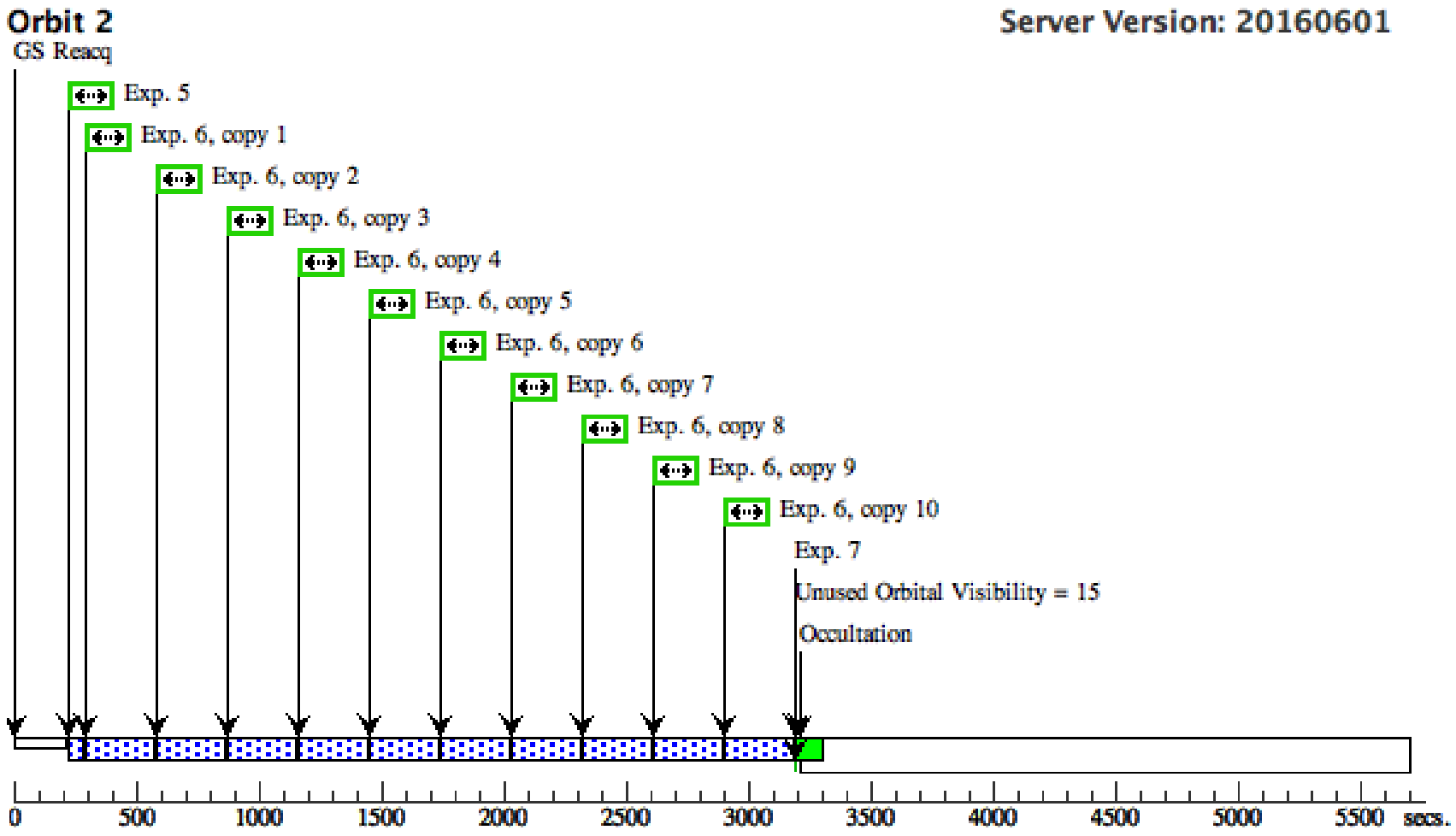
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target ACQ uisition (827472)	(1) GSC-05490-00141	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.8058 TO 0.8161; GS ACQ SCENARIO BASE1B3		1 Secs (1 Secs) *[==>]*	***[1]***
2	Short exposure orbit 1	(1) GSC-05490-00141	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			1 Secs (1 Secs) *[==>]*	***[1]***
Comments: Short exposure to minimize instrument systematic of first exposure in each orbit (e.g. HST proposal 12473).									
3	Science exposure orbit 1	(1) GSC-05490-00141	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; SIZEAXIS2=128; GAIN=4; WAVECAL=NO			279 Secs X 8 (2232 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***
4	GO Wavecal orbit 1	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A				*[==>]*	***[1]***
Comments: Explicit WAVECAL, auto-wave disabled									
5	Short exposure orbit 2	(1) GSC-05490-00141	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			1 Secs (1 Secs) *[==>]*	***[2]***
Comments: Short exposure to minimize instrument systematic of first exposure in each orbit (e.g. HST proposal 12473).									
6	Science exposure orbit 2	(1) GSC-05490-00141	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; SIZEAXIS2=128; GAIN=4; WAVECAL=NO			269 Secs X 10 (2690 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]*	***[2]***
7	GO Wavecal orbit 2	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A				*[==>]*	***[2]***
8	Short exposure orbit 3	(1) GSC-05490-00141	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			1 Secs (1 Secs) *[==>]*	***[3]***
Comments: Short exposure to minimize instrument systematic of first exposure in each orbit (e.g. HST proposal 12473).									

9	Science exposure orbit 3	(1) GSC-05490-0014 1	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; SIZEAXIS2=128; GAIN=4; WAVECAL=NO	269 Secs X 10 (2690 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]*	***[3]***
10	GO Wavecal orbit 3	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A		*[==>]*	***[3]***
11	Short exposure orbit 4	(1) GSC-05490-0014 1	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	1 Secs (1 Secs) *[==>]*	***[4]***
Comments: Short exposure to minimize instrument systematic of first exposure in each orbit (e.g. HST proposal 12473).								
12	Science exposure orbit 4	(1) GSC-05490-0014 1	STIS/CCD, ACCUM, 52X2	G750M 6094 A	CR-SPLIT=NO; SIZEAXIS2=128; GAIN=4; WAVECAL=NO	269 Secs X 10 (2690 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]*	***[4]***
13	GO Wavecal orbit 4	WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A		*[==>]*	***[4]***

Orbit Structure

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Exp. 6, copy 8
Exp. 6, copy 9
Exp. 6, copy 10
Exp. 7
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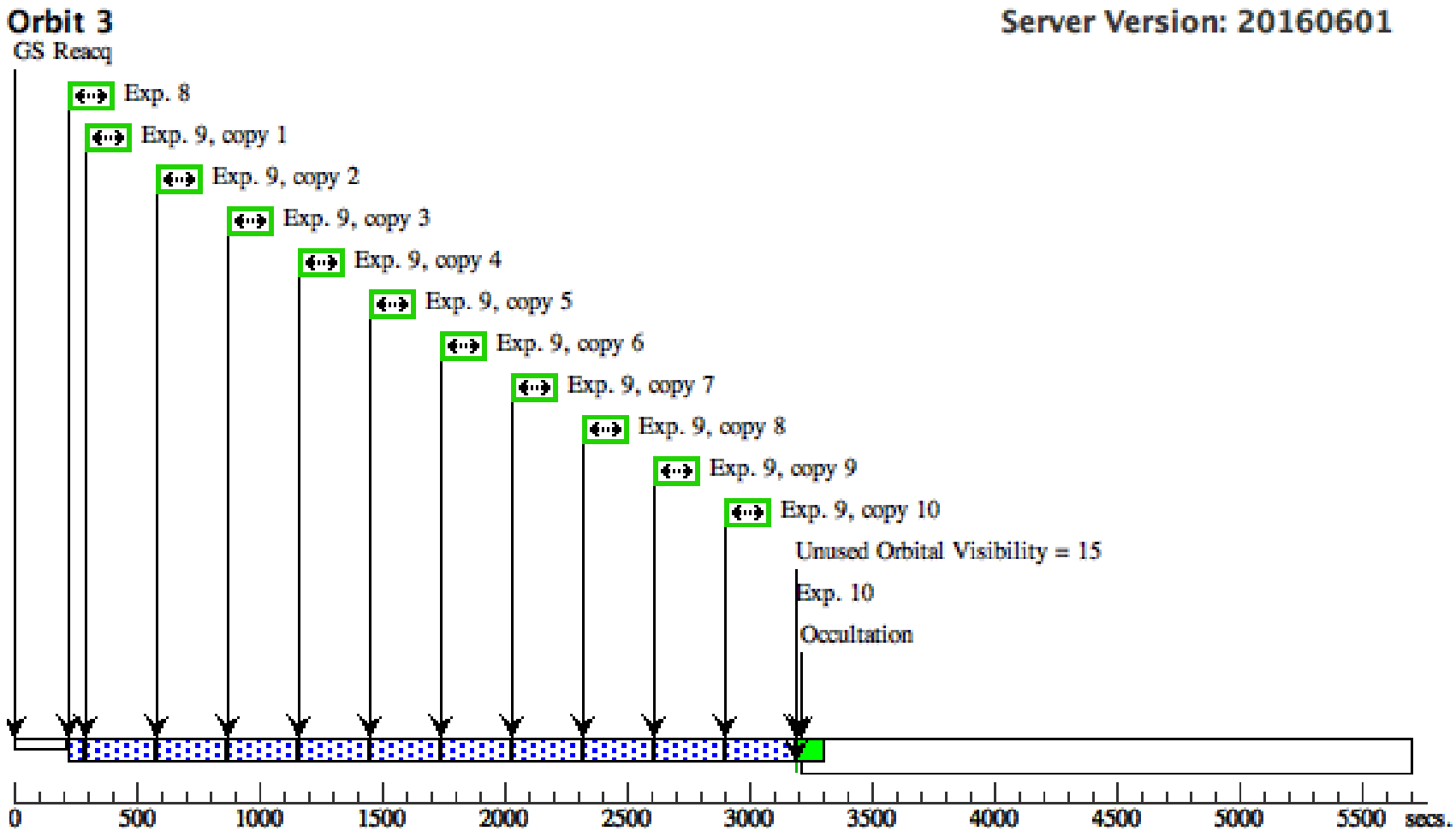
secs.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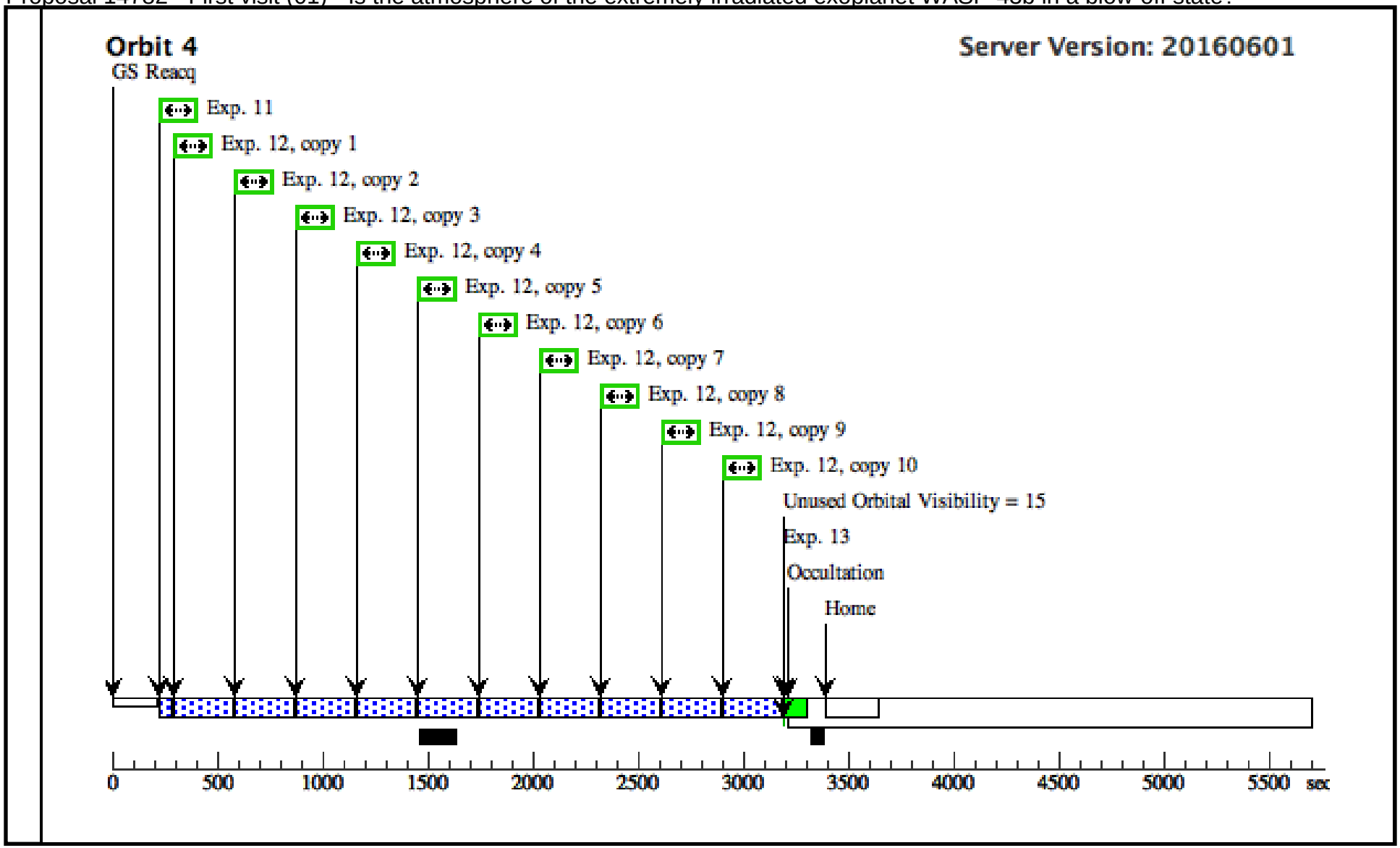
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Exp. 12, copy 7
Exp. 12, copy 8
Exp. 12, copy 9
Exp. 12, copy 10
Unused Orbital Visibility = 15
Exp. 13
Occultation
Home
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