



14468 - Characterizing an extreme planet on the verge of tidal disruption

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) WASP-121	WFC3/IR	5	09-Jan-2016 21:03:31.0	yes

5 Total Orbits Used

ABSTRACT

We propose to use WFC3 G141 to observe a transit of the recently discovered hot gas giant WASP-121b, the latest exoplanet that is ideally suited for atmospheric characterization. With an equilibrium temperature well above 2000K and an inflated radius of nearly 2 Jupiter radii, the predicted

transmission signal is the largest of all known exoplanets in this temperature regime. Our transmission observations will provide detailed insight into the atmosphere of this extreme world, which sits in a polar orbit just beyond the Roche limit and is likely to be undergoing tidal disruption. We will measure the water absorption feature centered at 1.4 micron at high signal-to-noise, and use this information to determine fundamental properties of the atmosphere, including whether WASP-121b is clear or cloudy. The proposed observations will also be sensitive to absorption by TiO/VO, which is expected to be in the gas phase. A detection/non-detection of TiO/VO would be significant, providing valuable constraints on the chemistry and circulation of hot Jupiters. Being one of the most favorable targets known for both transmission and emission spectroscopy, it is anticipated that WASP-121b will be intensely studied by HST in the future. The information gleaned from the single transit observation proposed here will allow observing strategies to be optimized in time for the HST Cycle 24 proposal round.

OBSERVING DESCRIPTION

Our WFC3 observations will provide a transmission spectrum for the transiting exoplanet WASP-121b across the 1.1-1.6 micron wavelength range. We are targeting the absorption signature of water, centered at 1.4 micron.

****Observing strategy:**

To construct the transmission spectrum, we require a single transit of WASP-121b to be observed with WFC3 G141. The observations will be made in slitless spectroscopic mode. Our observing setup is very similar to that used in previous successful exoplanet transit programs, such as for the similar-brightness GJ1214 in Program 13021 (PI Bean).

At the start of the HST visit, a standard phase-constrained acquisition image will be taken. The subsequent observing strategy consists of taking repeated exposures for the duration of the transit, plus time before and after the transit to establish the out-of-transit baseline flux.

We will use the forward spatial scanning mode with a scan rate of 0.12 arcsec/sec, using SPARS10 and NSAMP=15. We will read out a subarray size of 256 pixels to reduce overheads. Individual exposure times will be 103.1 sec, resulting in a scan across 12.37 arcsec = 102 pixels per exposure. We will apply an offset of -8 arcsec = -66 pixel along the cross-dispersion y-axis of the array at the start of each exposure. This will leave plenty of room on the detector to estimate the background flux.

Each transit of WASP-121b lasts 173 minutes. We therefore require 5 consecutive HST orbits. The first orbit serves to allow the telescope to

thermally relax into its new pointing position, which is a standard procedure adopted by all HST transiting exoplanet observations. The remaining orbits will provide good phase coverage during transit, and allow for sufficient time (2 HST orbits - one before transit, one after transit) to establish the baseline stellar flux necessary to accurately measure the transit depth. We will obtain 17 science exposures per HST orbit, coming to a total of 34 in-transit and 34 out-of-transit exposures.

We choose not to use bi-directional spatial scanning, e.g. as has been done for GJ1214 in Program 13021 (PI Bean). This is because although bi-directional spatial scanning would allow an additional 2 exposures to be acquired per HST orbit (i.e. 19 per orbit), the instrumental systematics are different for each scan direction, which is likely more of a disadvantage.

****Signal-to-noise estimates:**

WASP-121b is a bright target in the conventional sense ($V=10.5\text{mag}$, $J=9.6\text{mag}$). The challenge with exoplanet transmission spectroscopy is to measure subtle changes in the system brightness across different wavelength channels, via variations in the transit depth. We used the HST Exposure Time Calculator with the observational setup described above to calculate a SNR of ~ 1800 per resolution element per exposure. Note that this flux will be spread over ~ 100 pixel columns due to the spatial scan (see above), so there is no risk of saturation. Furthermore, the same scan rate was used for GJ1214 as part of Program 13021 (PI Bean) and the flux levels were well below saturation, despite GJ1214 being brighter than WASP-121 in the G141 bandpass.

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Sun Jan 10 02:03:36 GMT 2016

Visit	<p>Proposal 14468, WASP-121 WFC3 (01), implementation</p> <p>Diagnostic Status: No Diagnostics</p> <p>Scientific Instruments: WFC3/IR</p> <p>Special Requirements: ORIENT 25D TO 50 D; ORIENT 125D TO 140 D; ORIENT 310D TO 325 D; ORIENT 200D TO 220 D; Period 1.2749255 D AND ZERO-PHASE HJD2456635.70832</p> <p><i>Comments: It is essential that the five HST orbits be scheduled in a contiguous block, free of the SAA. We have defined each HST orbit within a non-interruptible sequence, to ensure that all exposures defined within the sequence are taken during the same HST orbit.</i></p> <p><i>We will use forward spatial scanning mode to avoid saturation on relatively long exposures and increase observing efficiency.</i></p> <p><i>Visit orientation requirements have been defined to avoid spectra from nearby stars overlapping the target spectrum.</i></p>																												
	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>WASP-121</td> <td>RA: 07 10 24.0580 (107.6002417d)</td> <td>Proper Motion RA: -3.4 mas/yr</td> <td>V=10.51</td> <td>Reference Frame: SIMBAD</td> </tr> <tr> <td></td> <td>Alt Name1: TYC7630-352-1</td> <td>Dec: -39 05 50.55 (-39.09737d)</td> <td>Proper Motion Dec: 28.7 mas/yr</td> <td>H=9.625</td> <td></td> </tr> <tr> <td></td> <td>Alt Name2: 2MASSJ07102406-3905506</td> <td>Equinox: J2000</td> <td>Epoch of Position: 2000</td> <td></td> <td></td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p>						#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	WASP-121	RA: 07 10 24.0580 (107.6002417d)	Proper Motion RA: -3.4 mas/yr	V=10.51	Reference Frame: SIMBAD		Alt Name1: TYC7630-352-1	Dec: -39 05 50.55 (-39.09737d)	Proper Motion Dec: 28.7 mas/yr	H=9.625			Alt Name2: 2MASSJ07102406-3905506	Equinox: J2000	Epoch of Position: 2000	
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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition 1	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	F130N	NSAMP=3; SAMP-SEQ=RAPID	PHASE 0.85 TO 0.86	Sequence 1-2 Non-Int in WASP-121 WFC3 (01)	0.833445 Secs (0.833 Secs) [==>]	[1]
<i>Comments: Phase-constrained</i>									
2	Science 1	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=15; SAMP-SEQ=SPARS10	POS TARG null,-8; SPATIAL SCAN 0.1 2,90.0 Degrees,Forward	Sequence 1-2 Non-Int in WASP-121 WFC3 (01)	103.128633 Secs X 16 (1650.058 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)] [==>(Copy 11)] [==>(Copy 12)] [==>(Copy 13)] [==>(Copy 14)] [==>(Copy 15)] [==>(Copy 16)]	[1]
3	Science 2	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=15; SAMP-SEQ=SPARS10	POS TARG null,-8; SPATIAL SCAN 0.1 2,90.0 Degrees,Forward	Sequence 3-3 Non-Int in WASP-121 WFC3 (01)	103.128633 Secs X 17 (1753.187 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)] [==>(Copy 11)] [==>(Copy 12)] [==>(Copy 13)] [==>(Copy 14)] [==>(Copy 15)] [==>(Copy 16)] [==>(Copy 17)]	[2]

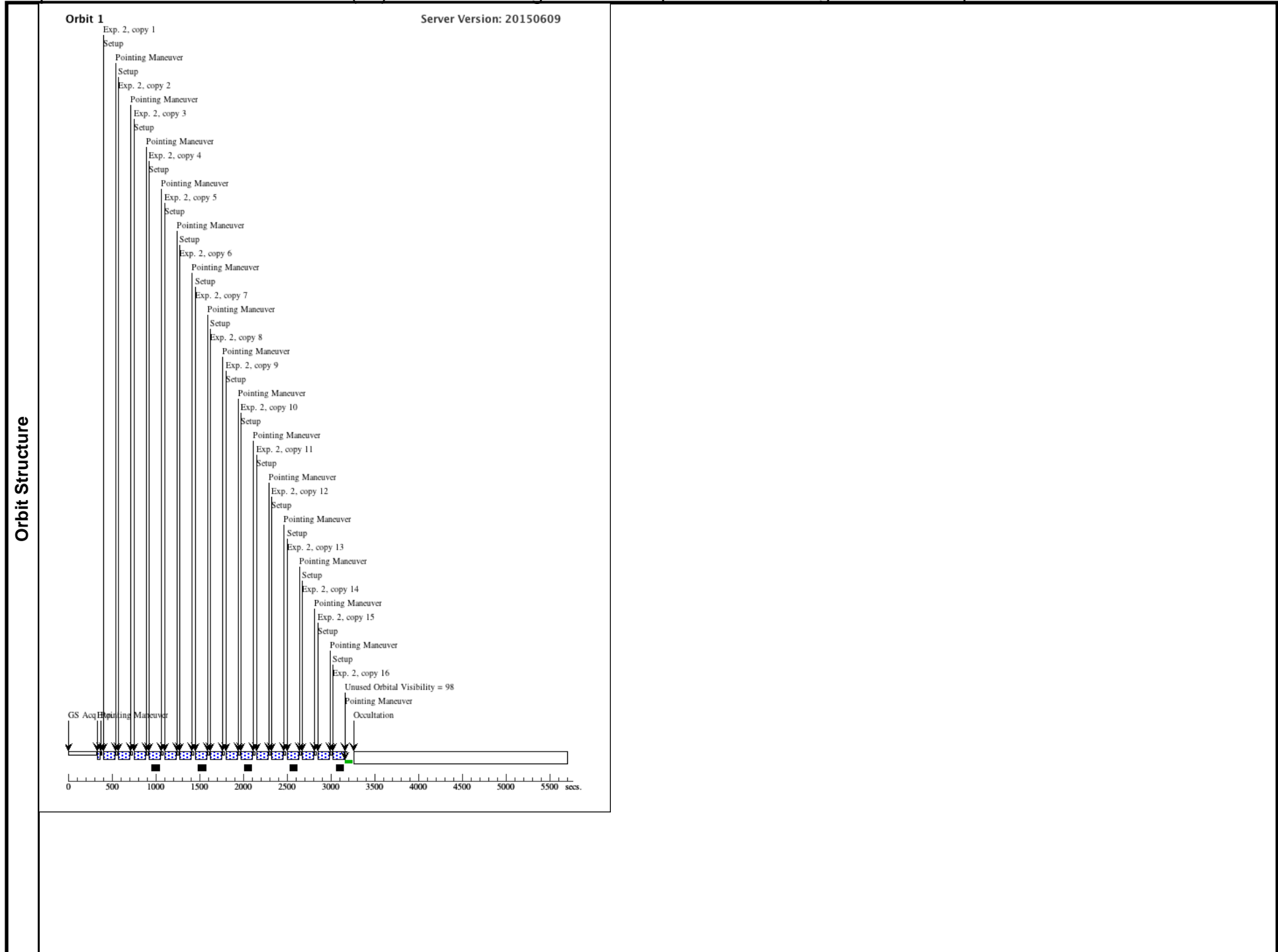
Exposures

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4	Science 3	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=15; SAMP-SEQ=SPAR S10	POS TARG null,-8; SPATIAL SCAN 0.1 2,90.0 Degrees,Forw ard	Sequence 4-4 Non-Int in WASP-121 WFC 3 (01)	103.128633 Secs X 17 (1753.187 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)] [==>(Copy 11)] [==>(Copy 12)] [==>(Copy 13)] [==>(Copy 14)] [==>(Copy 15)] [==>(Copy 16)] [==>(Copy 17)]	[3]
5	Science 4	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=15; SAMP-SEQ=SPAR S10	POS TARG null,-8; SPATIAL SCAN 0.1 2,90.0 Degrees,Forw ard	Sequence 5-5 Non-Int in WASP-121 WFC 3 (01)	103.128633 Secs X 17 (1753.187 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)] [==>(Copy 11)] [==>(Copy 12)] [==>(Copy 13)] [==>(Copy 14)] [==>(Copy 15)] [==>(Copy 16)] [==>(Copy 17)]	[4]

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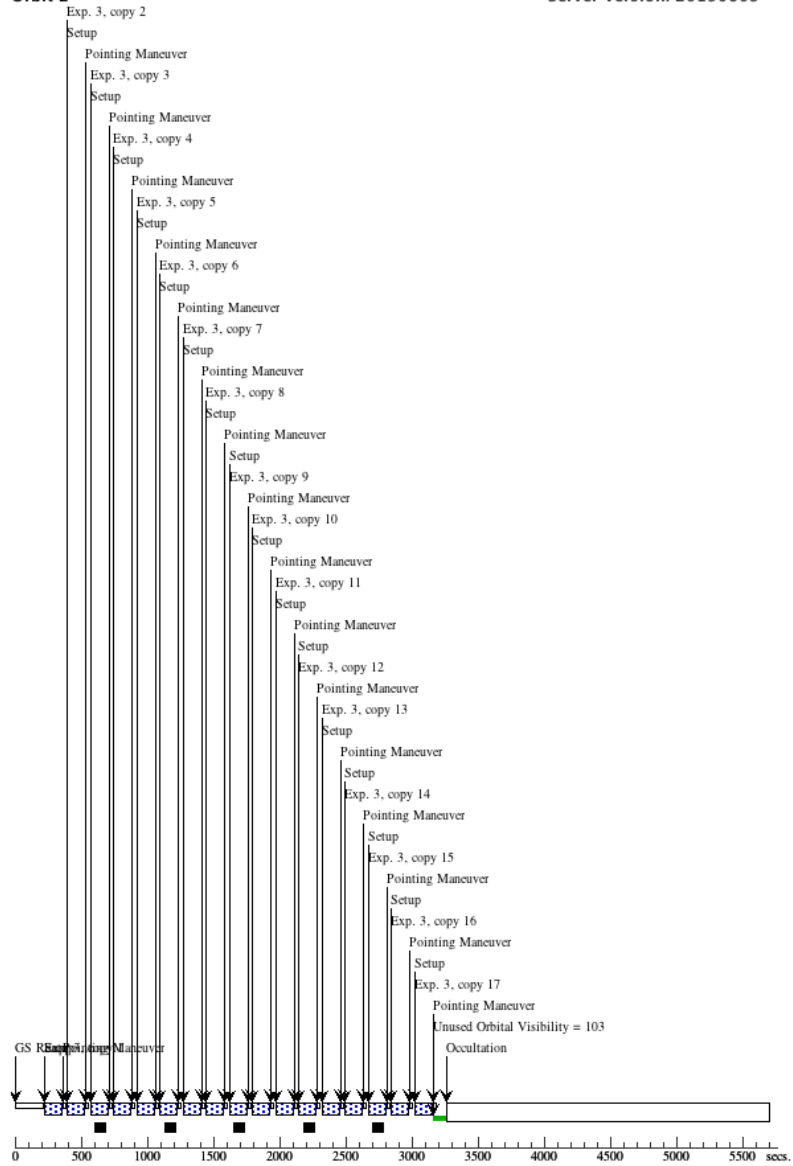
6	Science 5	(1) WASP-121	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=15; SAMP-SEQ=SPAR S10	POS TARG null,-8; SPATIAL SCAN 0.1 2,90.0 Degrees,Forw ard	Sequence 6-6 Non-In t in WASP-121 WFC 3 (01)	103.128633 Secs X 17 (1753.187 Se cs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)] [==>(Copy 9)] [==>(Copy 10)] [==>(Copy 11)] [==>(Copy 12)] [==>(Copy 13)] [==>(Copy 14)] [==>(Copy 15)] [==>(Copy 16)] [==>(Copy 17)]	[5]
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Orbit 2

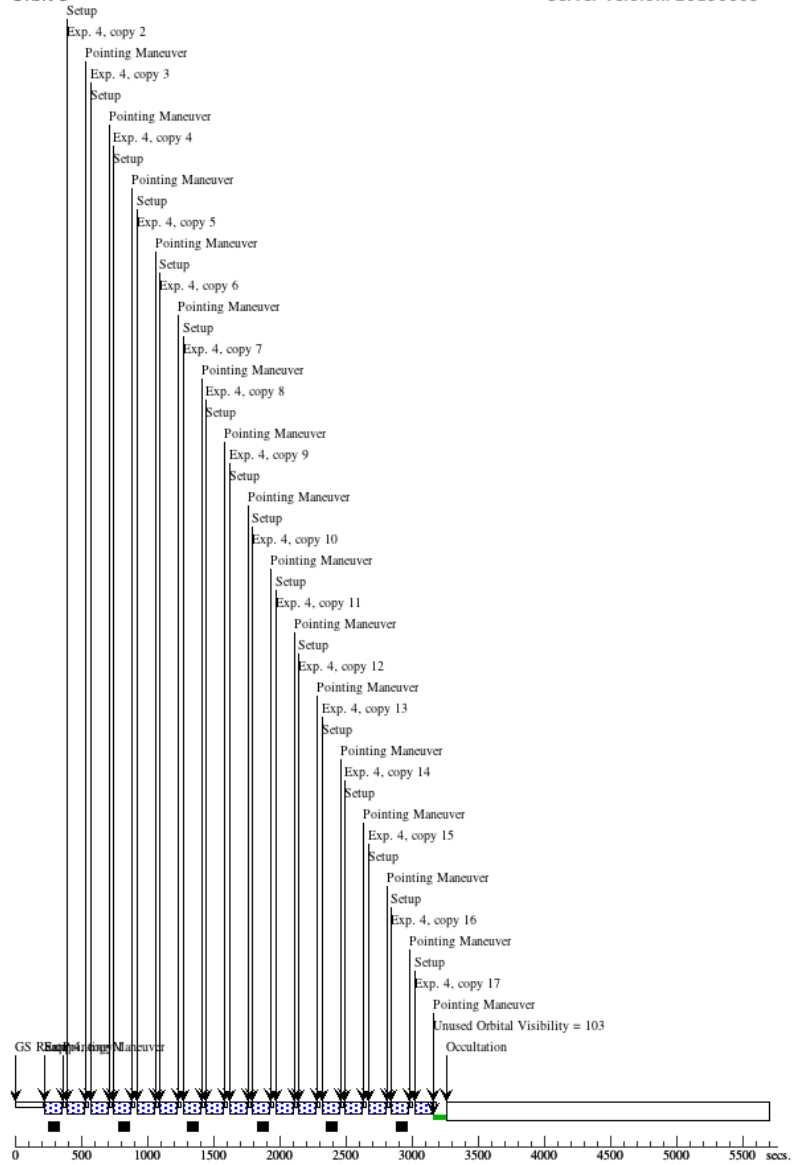
Server Version: 20150609



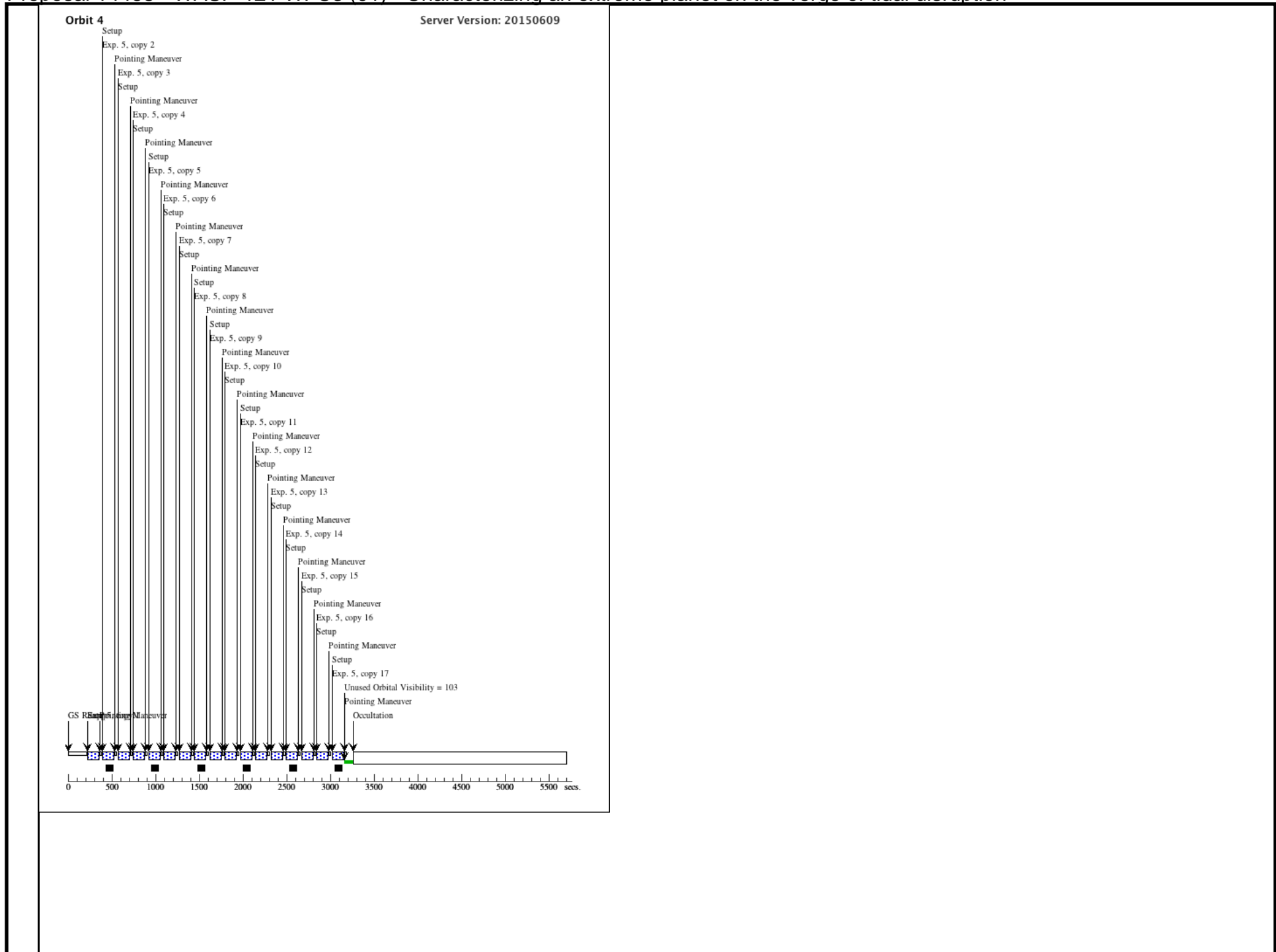
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Orbit 3

Server Version: 20150609



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