12956 - The First Transmission Spectrum of an Eccentric Cool Jupiter

Cycle: 20, 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) HAT-P-17 CCDFLAT NONE WAVE	STIS/CCD	5	07-Dec-2012 21:01:40.0	yes
02	(1) HAT-P-17	WFC3/IR	5	07-Dec-2012 21:07:00.0	yes

10 Total Orbits Used

ABSTRACT

The techniques of transmission/emission spectroscopy are at the forefront of the characterization of exoplanetary atmospheres, allowing for a direct determination of elemental abundances, chemistry and temperature-pressure profiles. Hot Jupiters have dominated such studies due to their large spectroscopic signals. Despite this well-studied sample of similar exoplanets, the measured spectra exhibit surprising diversity, a fact which remains poorly understood.

Since the hotter gas giants are well-observed, advancing our understanding of exoplanetary atmospheres requires the multi-wavelength detection of transits for exoplanets residing in cooler temperature regimes.

We propose the very first transit observations, from the optical to the near-infrared, of a moderately-irradiated (~650-960 K), Jupiter-like exoplanet residing on an eccentric orbit (e=0.346): HAT-P-17b.

Besides being in a previously unobserved temperature regime, its eccentric orbit allows the atmosphere of HAT-P-17b to periodically cross the condensation curves of sodium and potassium, implying that these alkali metals exist in the gas phase at periapsis and condense out into clouds/hazes at apoapsis. Furthermore, the range of temperatures allow for the carbon budget to be based on comparable amounts of CO and CH4.

Our proposed observations will determine if the spectral features of K I, Na I, CH4 and H2O are present or absent from the optical to the near-infrared, thereby allowing us to constrain elemental abundances and atmospheric temperatures. This first dataset of a unique transition object will provide an insightful compliment to existing transmission observations of hot Jupiters.

OBSERVING DESCRIPTION

This program uses the STIS and WFC3 instruments to perform precision photometry during transit events.

With the STIS instrument, we will observe the target during one transit, with the visit containing five orbits. We will use the STIS G750L grating to cover the wavelength range between 5300-10200 Å and use the 52”x2” slit to minimize slit losses. We will adopt exposure times of 140 seconds, with a sub-array size of 128, which is chosen to provide a sufficient time sampling of the HST orbital-phase trend such that it can be modeled and removed successfully. There will not be any gaps for buffer dumps. For each orbit, we will take 17 exposures of 140 seconds each, with 21 second overheads. We have set Wavecal=No for all STIS observations (as in previous similar programs such as GO 11740) such that the duty cycle and photometric precision is maximized. The zeropoint of the wavelength calibration will be determined from the stellar spectrum itself. We have also scheduled an explicit wavecal exposure after the HST is occulted by the Earth. For each exposure, S/N levels per resolution element of 500 at 7500Å will be reached for the G750L.

The visit using WFC3/G141 will also observe one transit, with the visit containing 5 oribts. We will use the 256 sub-array to reduce the observational overheads. We will also use the new line scan mode which will lengthen the spectrum along the slit during an exposure. This avoids saturation and permits relatively long exposures (66 seconds), greatly increasing the efficiency. By degrading the S/N estimates of the ETC by a factor of sqrt(2) these exposure times give a S/N per resolution element of 2100.

Each visit contains 5 orbits, which ensures high S/N transmission spectra are obtained. For each visit, there are three out-of-transit orbits, and two orbits occur during transit. The first orbit of each visit will likely not be used for primary analysis in the transit light curve, as the telescope thermally relaxes into its new pointing position during that time. This is a well known phenomenon, and all other similar transiting HST programs have adopted this strategy. Therefore, two of the out-of-transit orbits will be used to determine the baseline flux.

ADDITIONAL COMMENTS

Set Wavecal=No for the STIS observations (as in previous similar programs such as GO 11740) such that the duty cycle and photometric precision is maximized.

Visit

Proposal 12956, HAT-P-17 G750L (01), implementation Sat Dec 08 02:07:32 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SCHED 100%; Period 10.338523 D AND ZERO-PHASE HJD2454801.16869

Comments: HAT-P-17 STIS G750L. It is essential that the five orbits be scheduled in a coninuous block.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HAT-P-17	RA: 21 38 8.7316 (324.5363817d)	Proper Motion RA: -76.8 mas/yr	V=10.38+/-0.2	Reference Frame: ICRS
		Dec: +30 29 19.42 (30.48873d)	Proper Motion Dec: -124.8 mas/yr		
		Equinox: J2000	Epoch of Position: 2000		

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

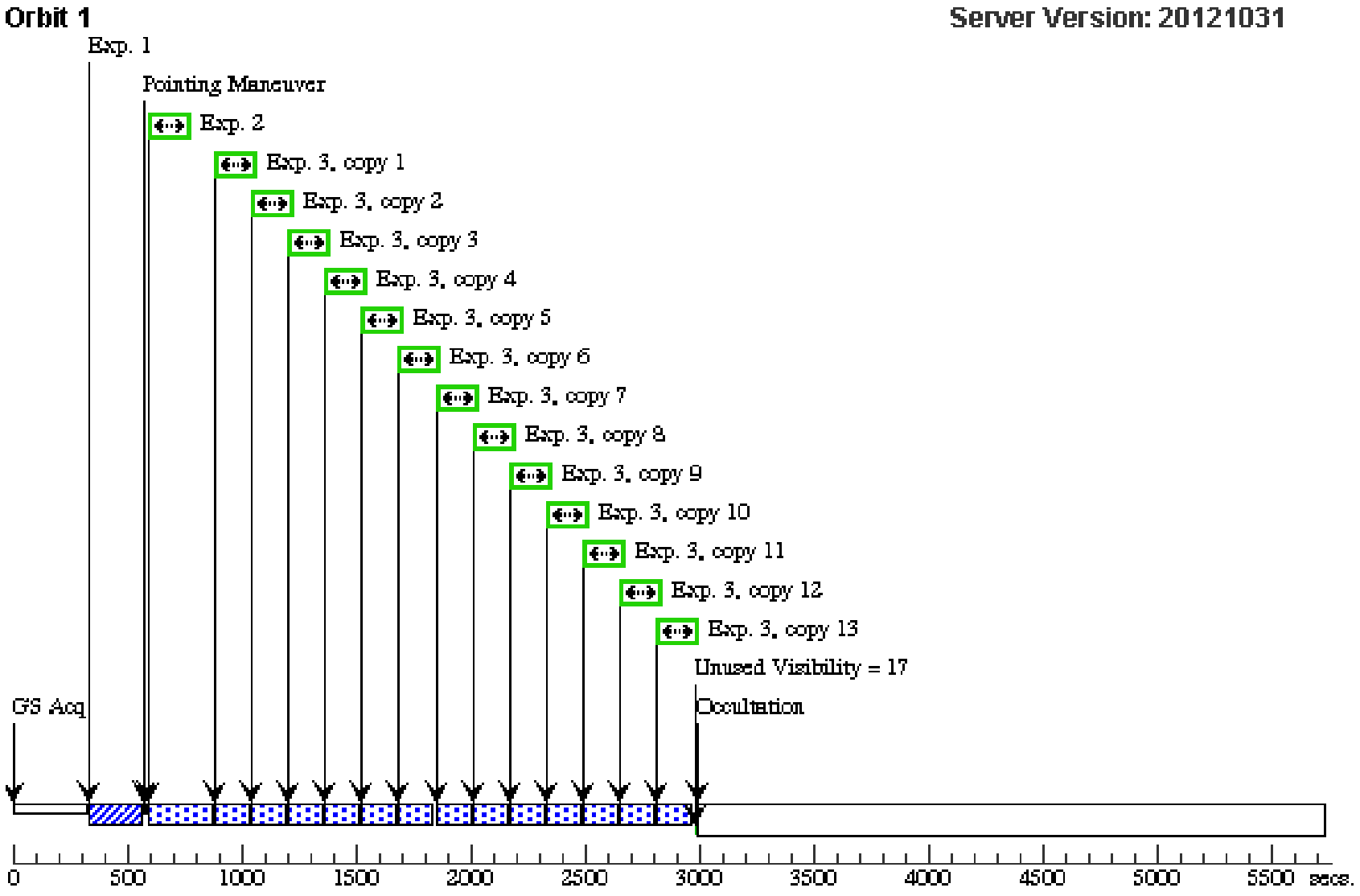
Exposures

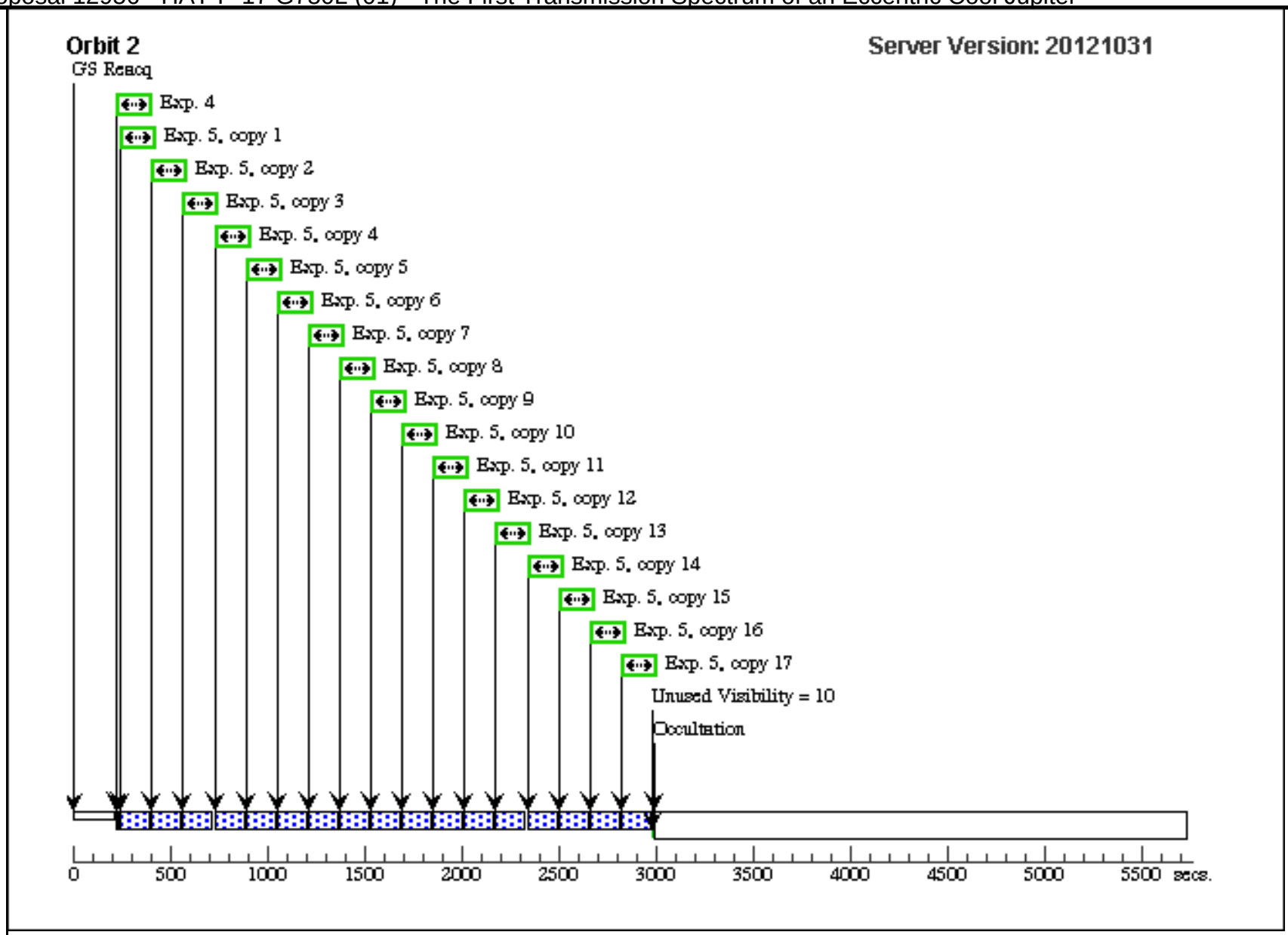
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	ACQ, phase constrained	(1) HAT-P-17	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.98111196 TO 0.98256732		0.2 Secs *[==>]*	***[1]***
2	HAT-P-17 G750L Orbit 1	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			140 Secs *[==>]*	***[1]***
3	HAT-P-17 G750L Orbit 1	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			140 Secs X 13 *[==>(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)]*	***[1]***
4	HAT-P-17 G750L Orbit 2	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			1 Secs *[==>]*	***[2]***
5	HAT-P-17 G750L Orbit 2	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO			140 Secs X 17 *[==>(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]***

6	HAT-P-17 G750L Orbit 3	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	1 Secs *[==>]*	***[3]***
7	HAT-P-17 G750L Orbit 3	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	140 Secs X 17 *[==>(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]***
8	HAT-P-17 G750L Orbit 4	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	1 Secs *[==>]*	***[4]***
9	HAT-P-17 G750L Orbit 4	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	140 Secs X 17 *[==>(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]***

10	HAT-P-17 G750L Orbit 5	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	1 Secs *[==>]*	***[5]***
11	HAT-P-17 G750L Orbit 5	(1) HAT-P-17	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128; WAVECAL=NO	140 Secs X 17 *[==>(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]***
12	WAVE	WAVE	STIS/CCD, ACCUM, 52X0.2	G750L 7751 A		*[==>]*	***[5]***
Comments: Explicit WAVECAL, auto-waves disabled							
13	FRINGEFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A		*[==>(Copy 1)]* *[==>(Copy 2)]*	***[5]***
14	Tungsten Lamp	NONE	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A	LAMP=TUNGSTEN; CR-SPLIT=NO; GAIN=4; SIZEAXIS2=128.0	240 Secs X 4 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]*	***[5]***

Orbit Structure

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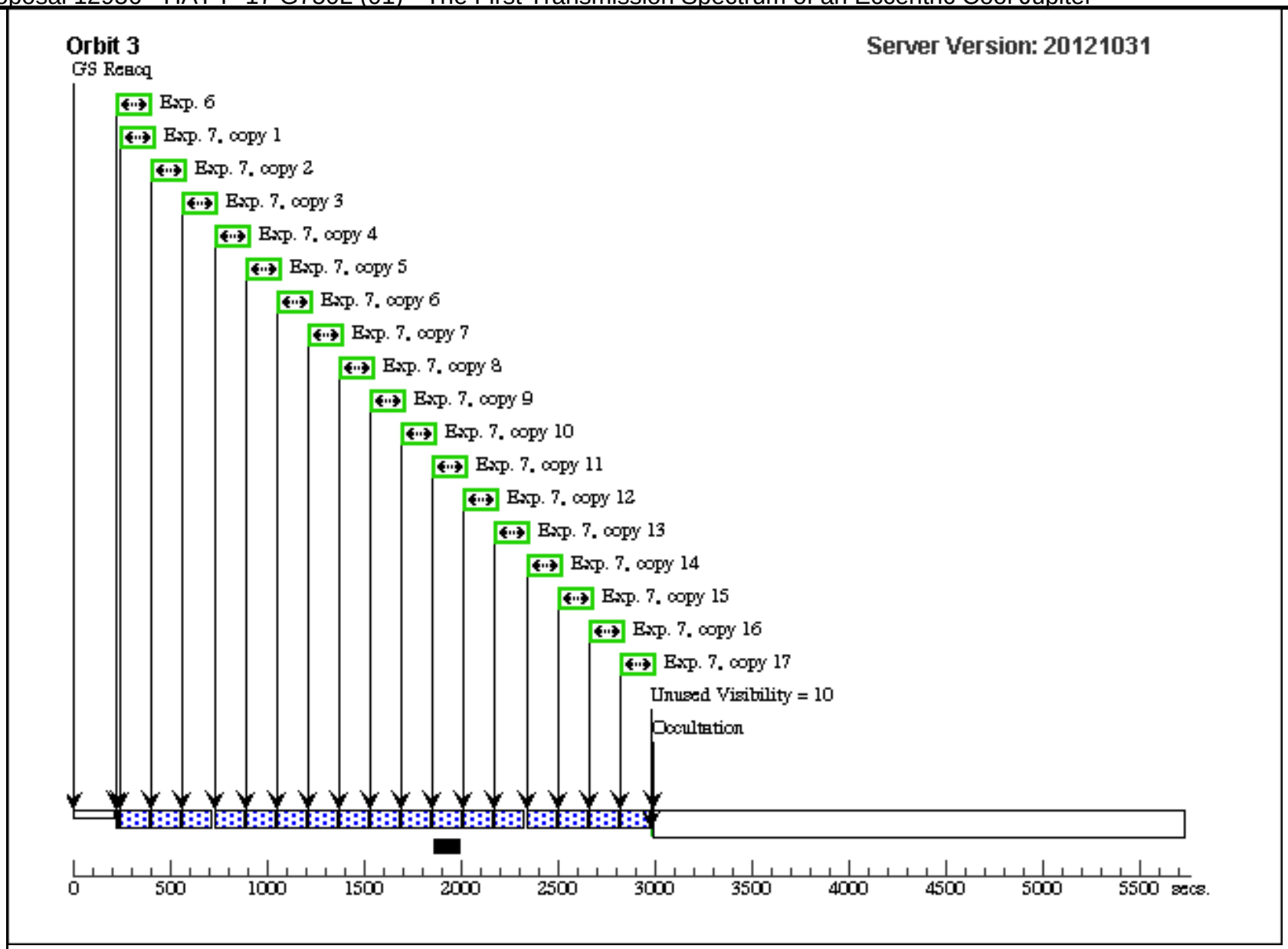
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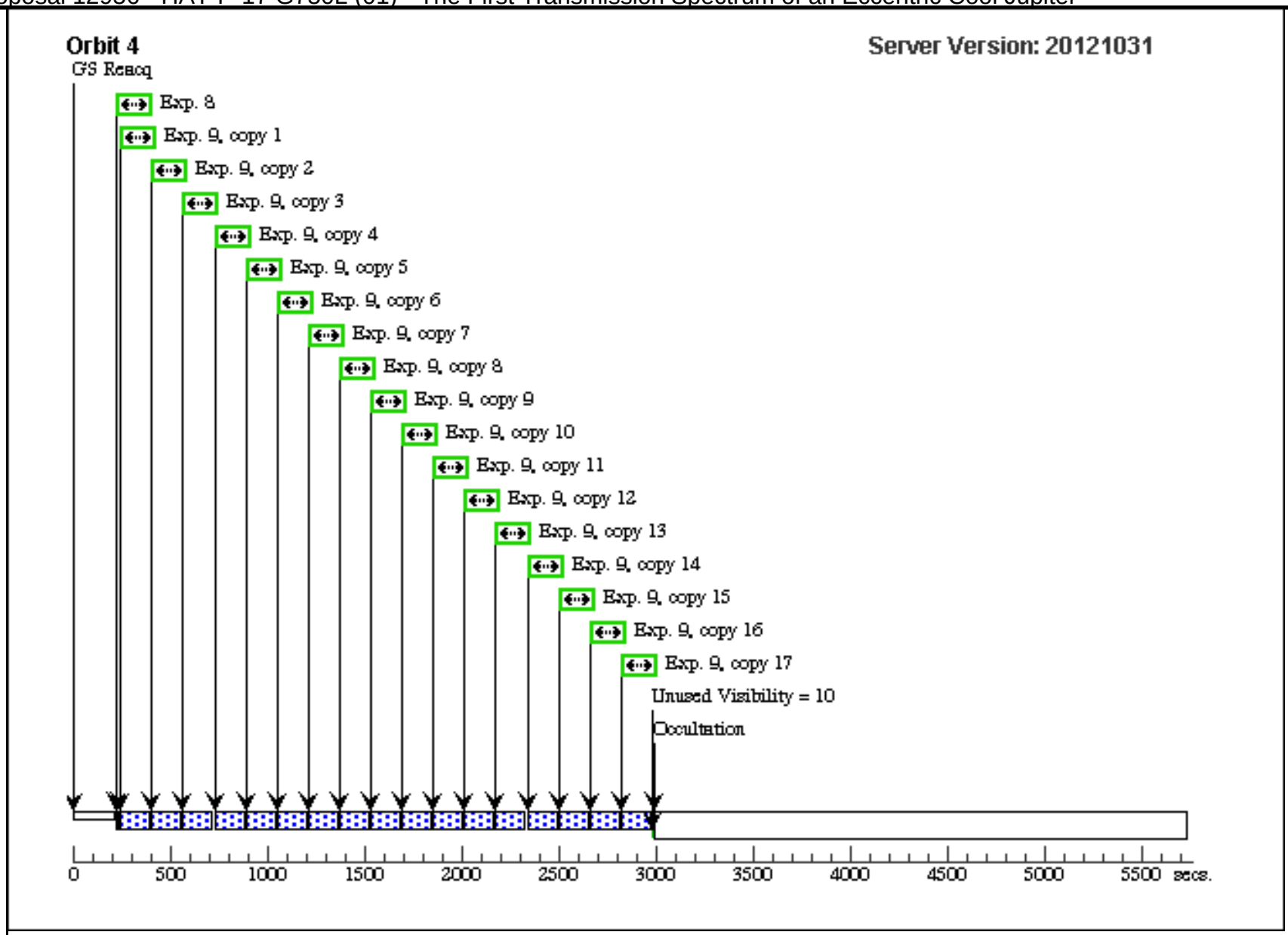
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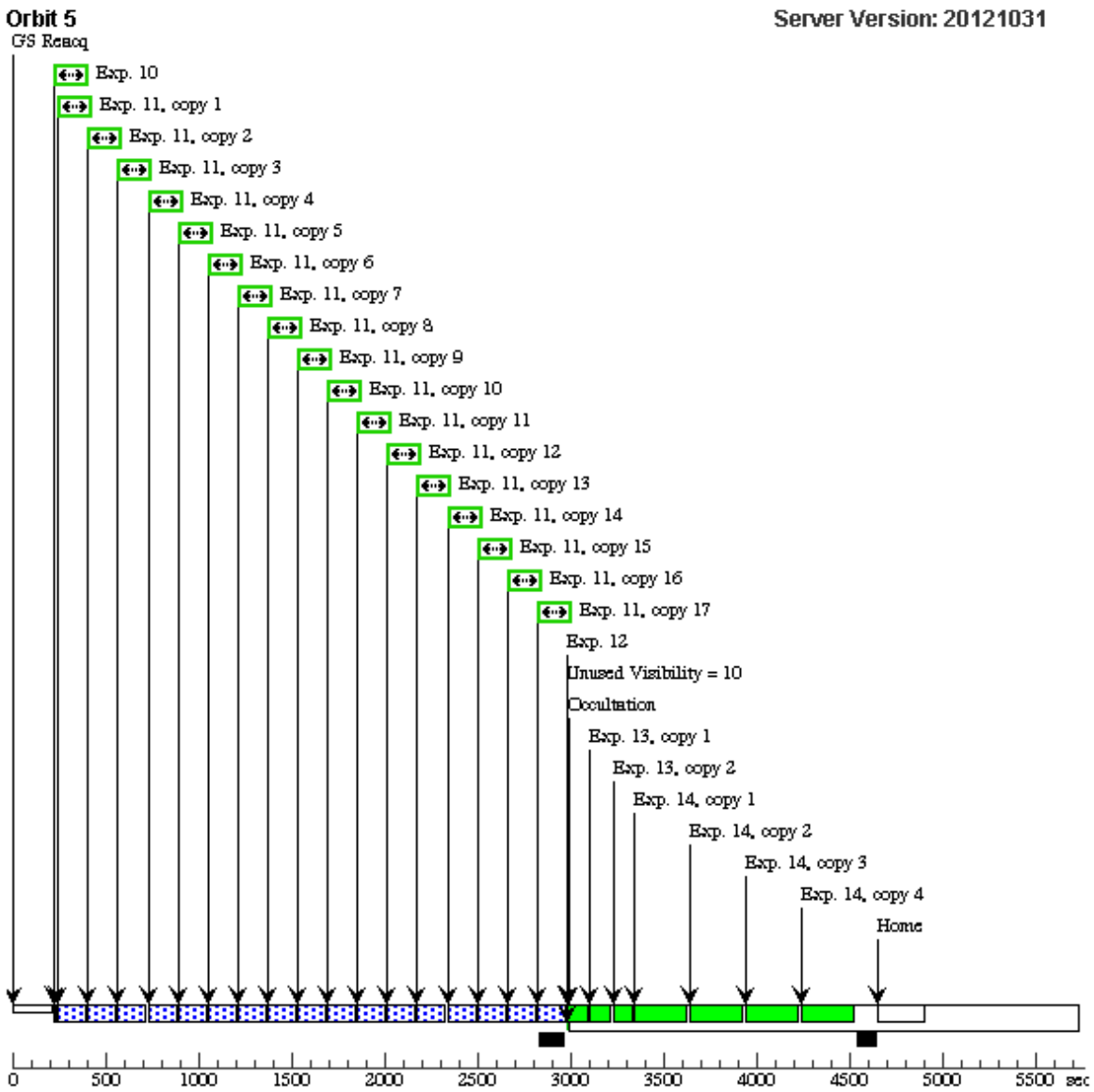
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Visit

Proposal 12956, HAT-P-17 WFC G141 (02), implementation Sat Dec 08 02:07:42 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: SCHED 100%; Period 10.338523 D AND ZERO-PHASE HJD2454801.16869

Comments: HAT-P-17 WFC G141. It is essential that the five orbits be scheduled in a coninuous block.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HAT-P-17	RA: 21 38 8.7316 (324.5363817d)	Proper Motion RA: -76.8 mas/yr	V=10.38+/-0.2	Reference Frame: ICRS
		Dec: +30 29 19.42 (30.48873d)	Proper Motion Dec: -124.8 mas/yr		
		Equinox: J2000	Epoch of Position: 2000		

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

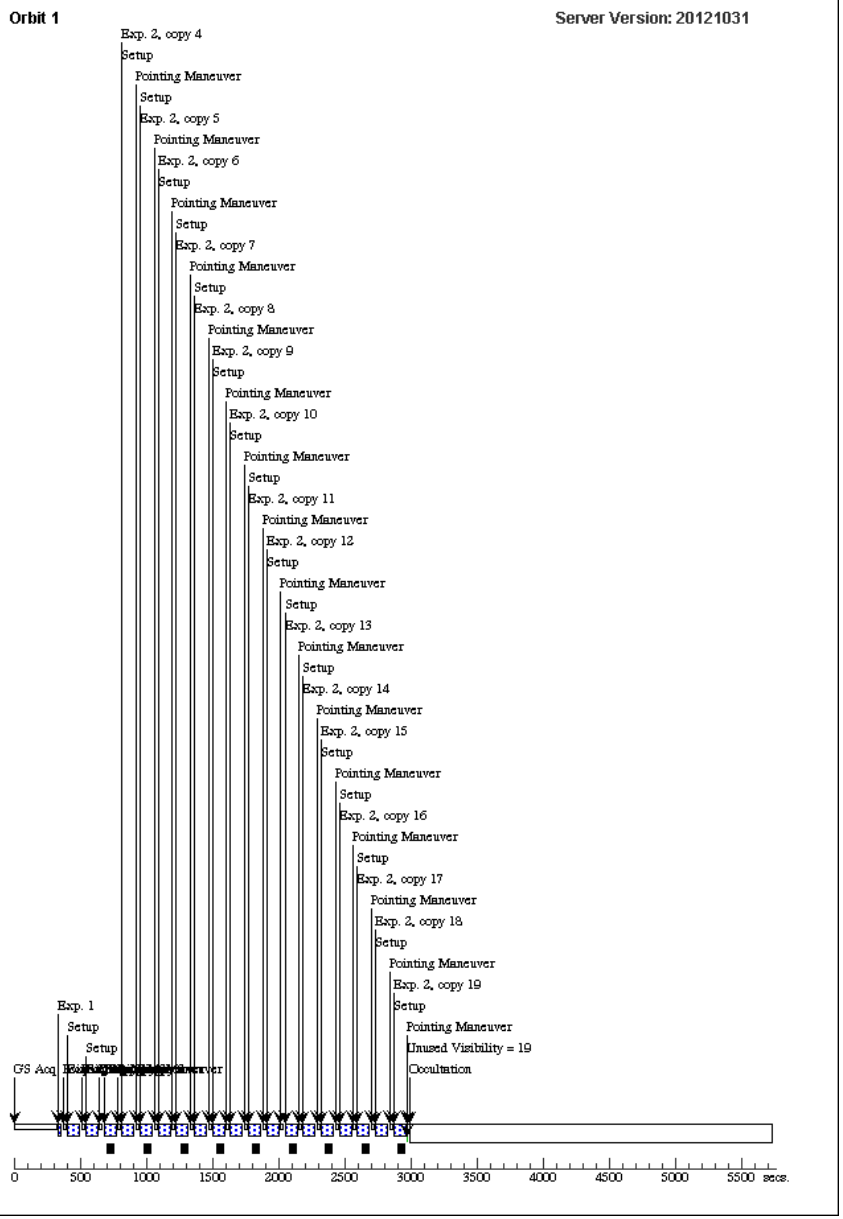
Exposures

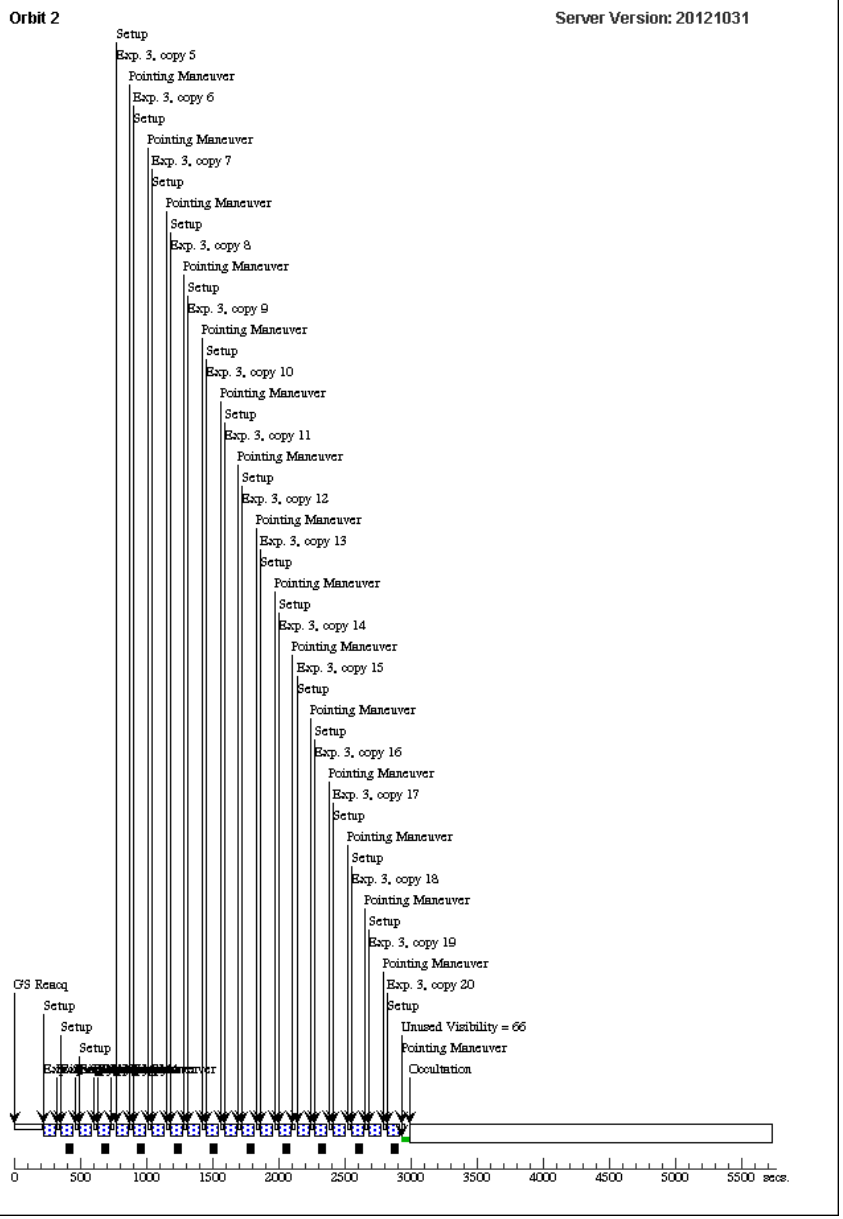
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	Acquisition, phase constrained	(1) HAT-P-17	WFC3/IR, MULTIACCUM, IRSUB256	F139M	SAMP-SEQ=RAPID; NSAMP=1	PHASE 0.98111196 TO 0.98256732		*[==>]*	***[1]***
2	HAT-P-17 G141 Orbit 1	(1) HAT-P-17	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS10; NSAMP=10	POS TARG 0.0,+0.817; SPATIAL SCAN 0.134,90.0 Degrees,Forward		*[==>(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)]* *[==>(Copy 18)]* *[==>(Copy 19)]*	***[1]***
3	HAT-P-17 G141 Orbit 2	(1) HAT-P-17	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS10; NSAMP=10	POS TARG 0.0,+0.817; SPATIAL SCAN 0.134,90.0 Degrees,Forward		*[==>(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)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]*	***[2]***

	4	HAT-P-17 G141 Orbit 3	(1) HAT-P-17	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=10	POS TARG 0.0,+0.8 17; SPATIAL SCAN 0.1 34,90.0 Degrees,Forward	*[==>(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)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]*	***[3]***
	5	HAT-P-17 G141 Orbit 4	(1) HAT-P-17	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=10	POS TARG 0.0,+0.8 17; SPATIAL SCAN 0.1 34,90.0 Degrees,Forward	*[==>(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)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]*	***[4]***

	6	HAT-P-17 G141 Orbit 5	(1) HAT-P-17	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=10	POS TARG 0.0,+0.8 17; SPATIAL SCAN 0.1 34,90.0 Degrees,Forward	*[==>(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)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]*	***[5]***

Orbit Structure

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Occultation
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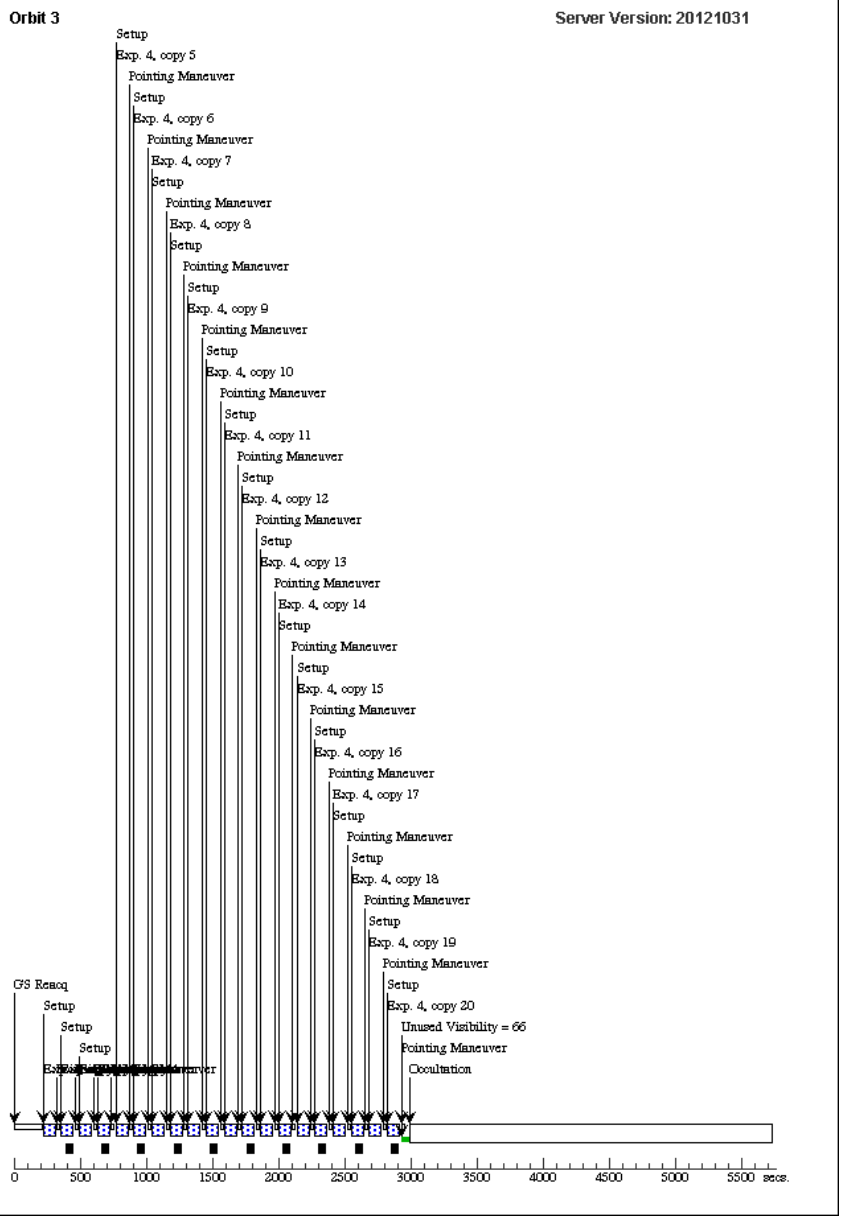
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Unused Visibility = 66
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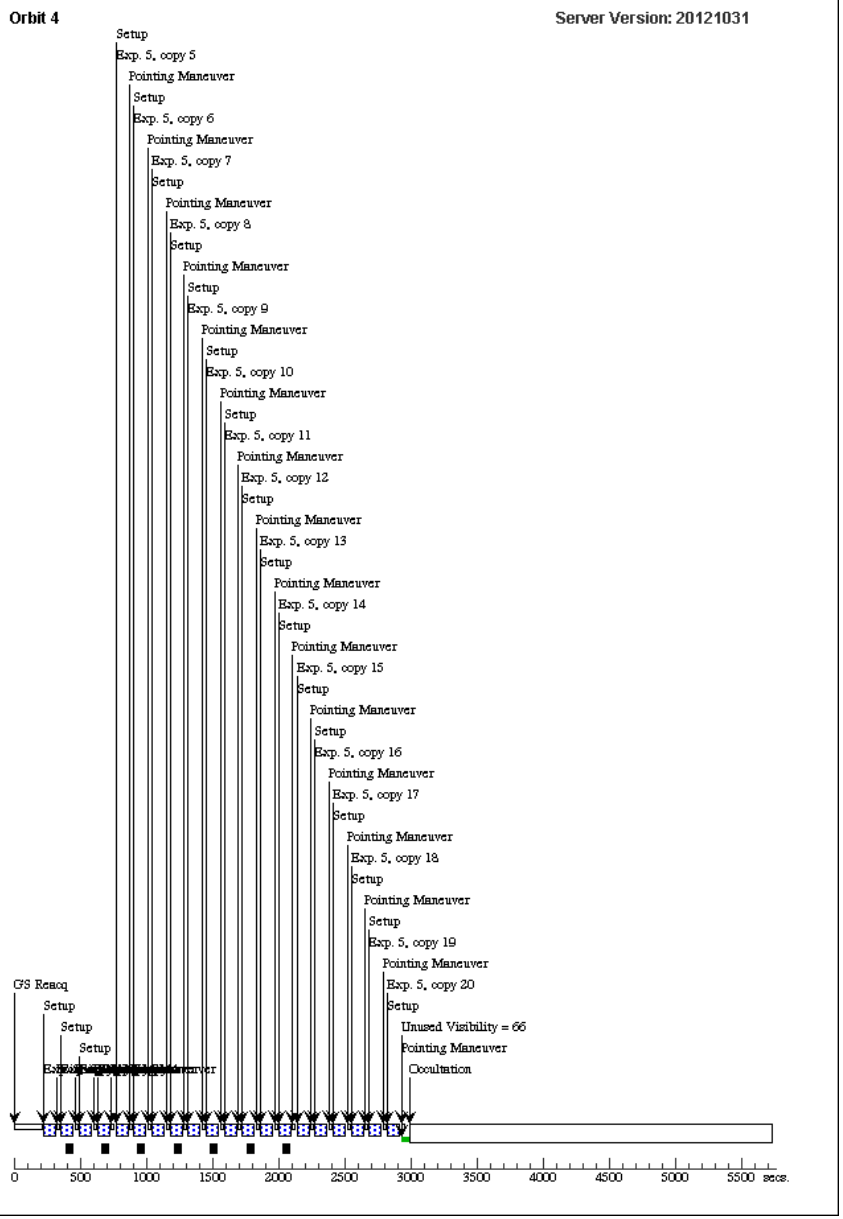
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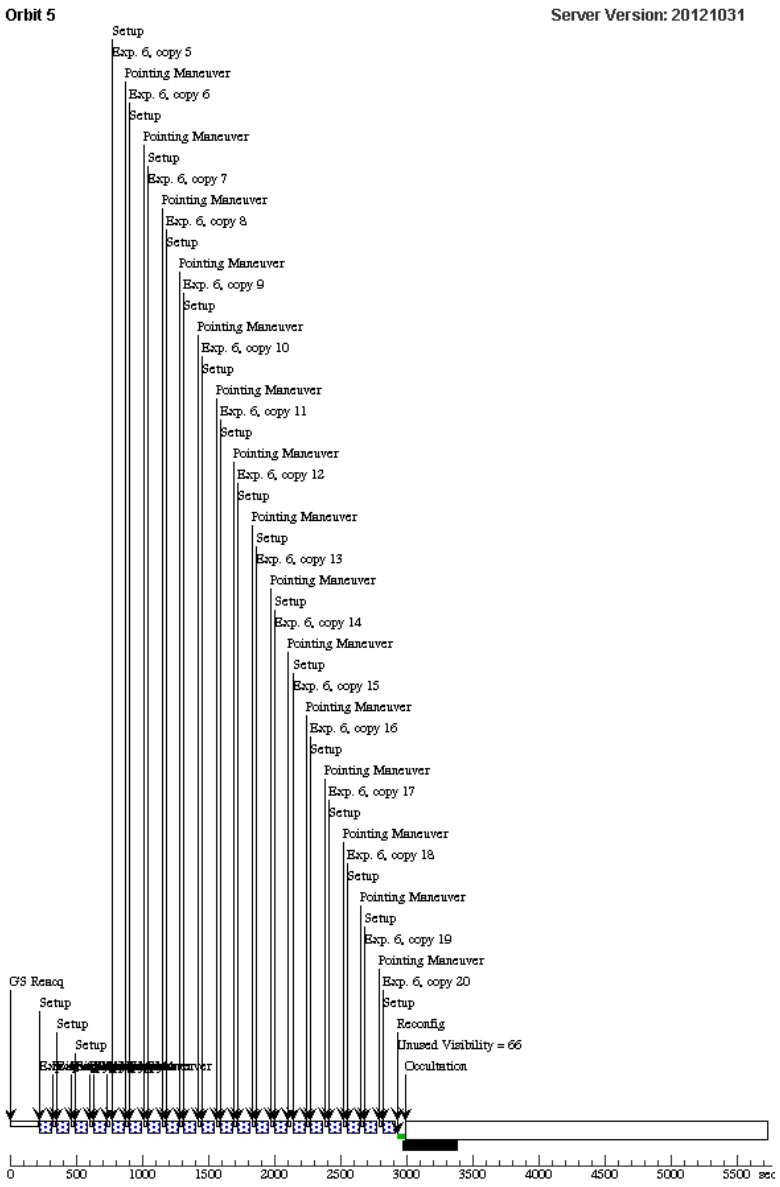
Setup
Exp. 5, copy 19
Pointing Maneuver
Exp. 5, copy 20
Setup
Unused Visibility = 66
Pointing Maneuver
Occultation
GS Reacq
Setup
Setup
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 5
Server Version: 20121031
Setup
Exp. 6, copy 5
Pointing Maneuver
Exp. 6, copy 6
Setup
Pointing Maneuver
Setup
Exp. 6, copy 7
Pointing Maneuver
Exp. 6, copy 8
Setup
Pointing Maneuver
Exp. 6, copy 9
Setup
Pointing Maneuver
Exp. 6, copy 10
Setup
Pointing Maneuver
Exp. 6, copy 11
Setup
Pointing Maneuver
Exp. 6, copy 12
Setup
Pointing Maneuver
Setup
Exp. 6, copy 13
Pointing Maneuver
Setup
Exp. 6, copy 14
Pointing Maneuver
Setup
Exp. 6, copy 15
Pointing Maneuver
Exp. 6, copy 16
Setup
Pointing Maneuver
Exp. 6, copy 17
Setup
Pointing Maneuver
Exp. 6, copy 18
Setup
Pointing Maneuver
Setup
Exp. 6, copy 19
Pointing Maneuver
Exp. 6, copy 20
Setup
Reconfig
Unused Visibility = 66
Occultation
GS Reacq
Setup
Setup
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec