14464 - Atmospheric Sodium and a Precise Radius for the Closest Super-Earth

Cycle: 23, 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) HR8832	STIS/CCD	4	29-Jul-2016 13:34:48.0	yes
51	(1) HR8832	STIS/CCD	4	29-Jul-2016 13:35:00.0	yes

8 Total Orbits Used

ABSTRACT

Two months ago our team announced the super-Earth HD219134b orbiting a V = 5.57 star 6.5 pc away from us (Motalebi et al. 2015). This is the brightest and closest transiting system discovered so far. With Spitzer and HARPS-N we confirmed that HD219134b is rocky, but we have no idea how its atmosphere looks like. The star's brightness allows for unprecedented detailed atmospheric studies of a super-Earth via transmission spectroscopy. In a parallel proposal to this one we have requested 5 HST orbits to search for H in the upper atmosphere of the planet with STIS/UV. Here we request mid-Cycle program time to search for NaI. The optical NaI signature is a powerful upper atmospheric temperature probe, and is detectable over several scale heights. Also, in the case of HD219134b, NaI will reveal whether the planet has an atmosphere fully depleted of H and C because of strong evaporation. Even in the case of a non-detection of NaI, these observations will produce an optical transit light curve with fantastic precision, which will represent for super-Earths what the famous STIS observation of HD 209458b in 2002 has represented for giant planets. Four HST orbits are enough to secure a NaI detection. Even if no NaI is detected, this observation will pin down the radius of HD219134b to ~1.5% (currently 5%) so we can can better constrain its interior composition. These observations will also lead the way for thorough atmospheric characterization studies of this planet in the next HST cycles. For that purpose, and so the community gains quick access to these results, we have reduced the priority period to 3 months.

OBSERVING DESCRIPTION

Our program observes a transit of HD219134b in the optical using STIS G750M spectroscopic mode. We observe the target in one visit of four consecutive orbits. Four consecutive orbits are essential to cover in-transit and out-of-transit portions of the event to establish the baseline stellar flux necessary to accurately measure the transit depth. During the visit, the first two orbits will occur before transit, the third orbit during transit and the fourth orbit after transit.

We disable auto-wavecals during the observations to optimize duty cycle and photometric precision, and only collect one GO-wavecal at the end of the visit using a 52" x 0.2" slit, instead of the 52" x 2" science slit, selected to minimize slit loses. This technique has been succesfully employed in several previous programs, e.g. GO-11740 (PI Pont) and GO-12473 (PI Sing).

The transit of HD219134b only lasts 57 min, so to maximize the time of the in-transit observations we request a time window for the start of the first exposure of the first orbit between 0.94298 and 0.94388 in planetary orbital phase.

To optimize duty cycle our observations are 60 sec per exposure. This exposure time oversaturates the STIS CCD by a factor of ~ 2.4, but following the analysis approach described by Gilliland et al. (1999) (PASP, 111, 1009), we will be able to recover all stellar counts by integrating the spectra in the spatial direction over columns containing bled photons. To account for that bleeding, and still keep moderate readout time, we select a subarray of 300 pixels for the observations.

Proposal 14464 - Visit (01) - Atmospheric Sodium and a Precise Radius for the Closest Super-Earth

Visit

Proposal 14464, Visit (01), scheduled Fri Jul 29 17:35:04 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SCHED 100%; Period 3.092926 D AND ZERO-PHASE HJD2457463.82884

Comments: It's essential that the four orbits are scheduled in a single, contiguous block.
We also want to disable wavecals during throughout the visit and do wavelength calibrations only at the end of the four-orbit sequence.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HR8832	RA: 23 13 16.9763 (348.3207346d)	Proper Motion RA: 2075.07 mas/yr	V=5.57+/-0.01	Reference Frame: ICRS
	Alt Name1: HD219134	Dec: +57 10 6.08 (57.16836d)	Proper Motion Dec: 295.45 mas/yr	U = 7.46,	
		Equinox: J2000	Epoch of Position: 2000	B = 6.56,	
			Radial Velocity: -18.83 km/sec	R = 4.76	

Comments: Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(1) HR8832	STIS/CCD, ACQ, F28X50OII	MIRROR	ACQTYPE=POINT	PHASE 0.9481 TO 0 .9553		0.5 Secs (0.5 Secs)	
								[==>]	***[1]***
2	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO			60 Secs X 27 (1404 Secs)	
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								[==>52.0 Secs (Copy 20)]	
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								[==>52.0 Secs (Copy 25)]	
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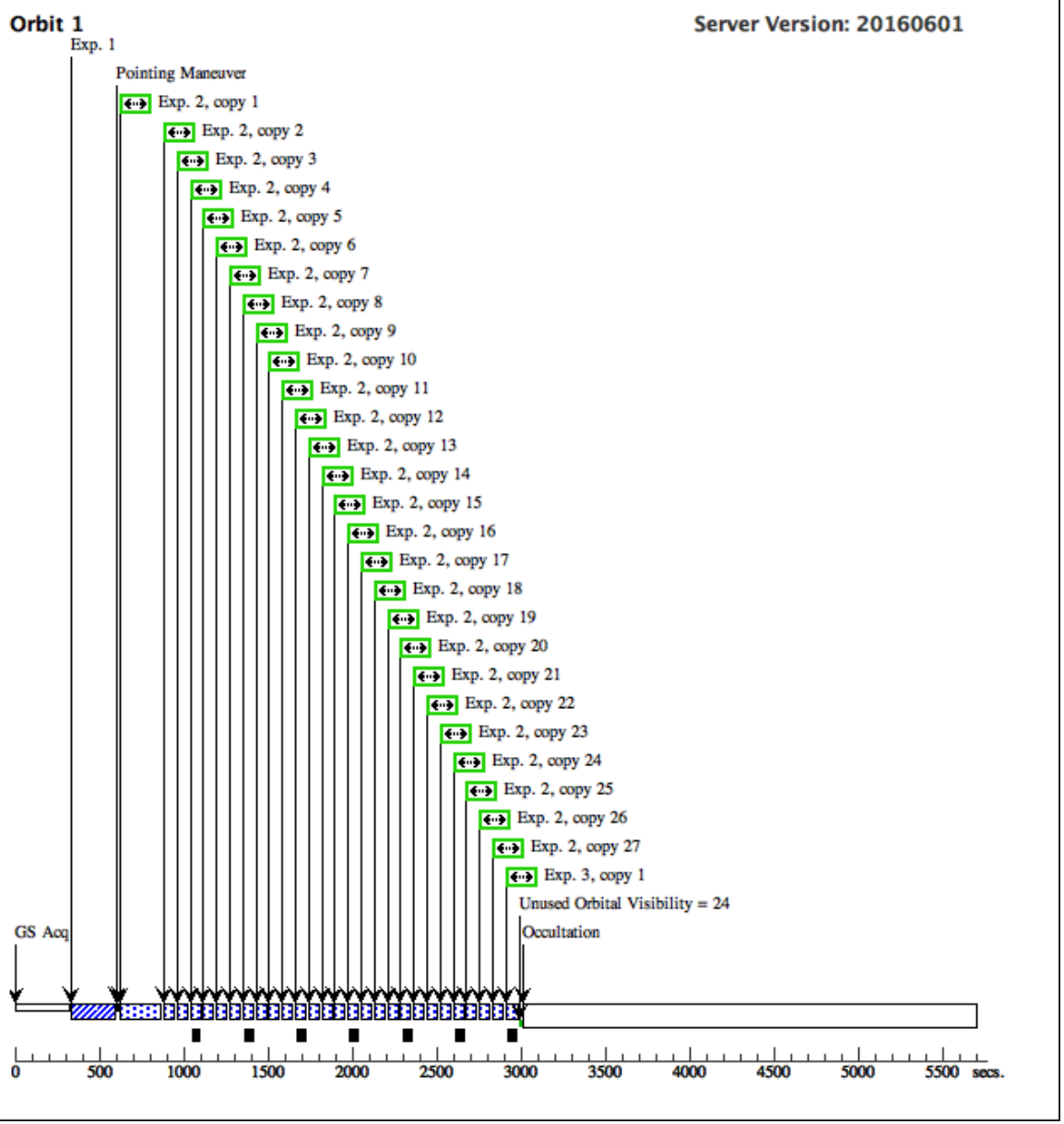
								[==>52.0 Secs (Copy 27)]	

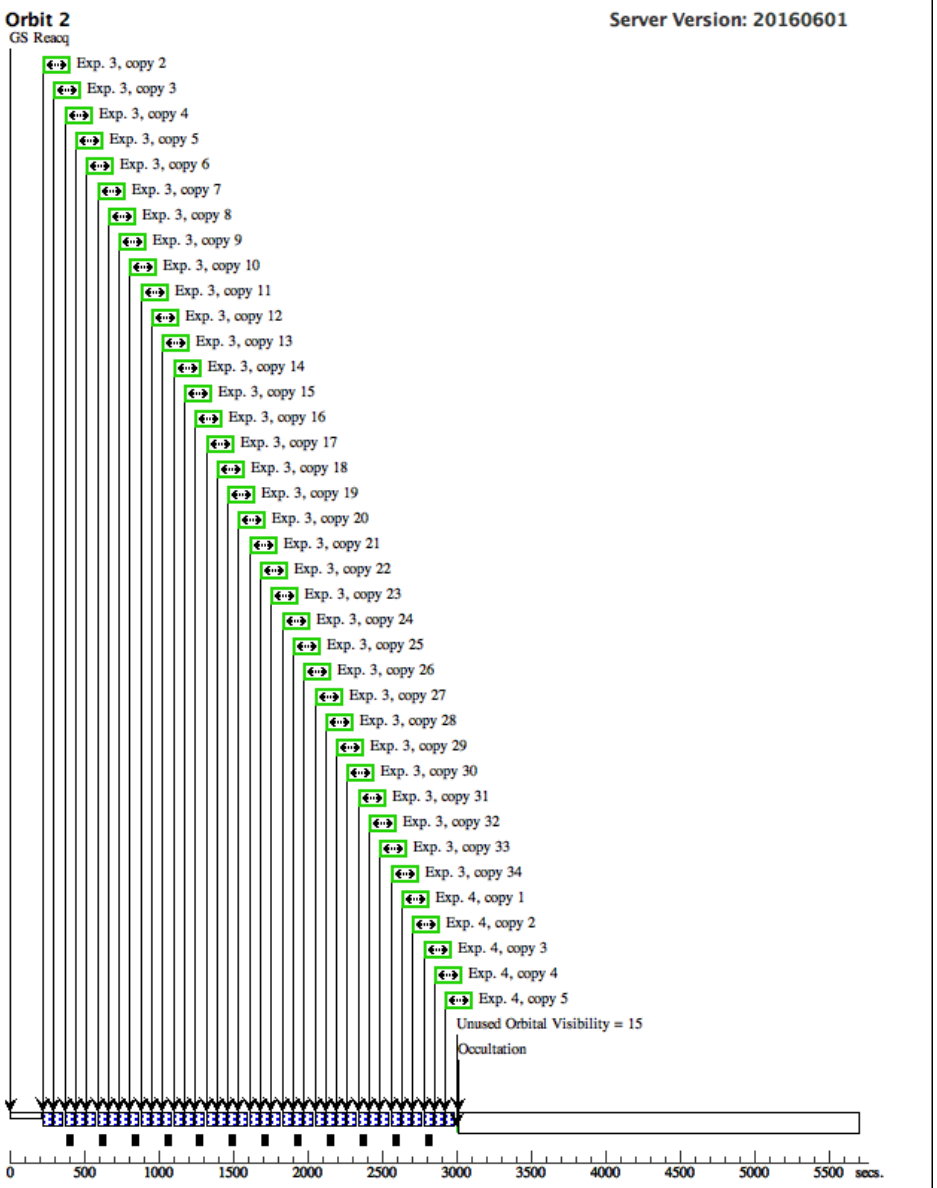
	3	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (1603 Secs) *[==>52.0 Secs (Copy 1)]* *[==>47.0 Secs (Copy 2)]* *[==>47.0 Secs (Copy 3)]* *[==>47.0 Secs (Copy 4)]* *[==>47.0 Secs (Copy 5)]* *[==>47.0 Secs (Copy 6)]* *[==>47.0 Secs (Copy 7)]* *[==>47.0 Secs (Copy 8)]* *[==>47.0 Secs (Copy 9)]* *[==>47.0 Secs (Copy 10)]* *[==>47.0 Secs (Copy 11)]* *[==>47.0 Secs (Copy 12)]* *[==>47.0 Secs (Copy 13)]* *[==>47.0 Secs (Copy 14)]* *[==>47.0 Secs (Copy 15)]* *[==>47.0 Secs (Copy 16)]* *[==>47.0 Secs (Copy 17)]* *[==>47.0 Secs (Copy 18)]* *[==>47.0 Secs (Copy 19)]* *[==>47.0 Secs (Copy 20)]* *[==>47.0 Secs (Copy 21)]* *[==>47.0 Secs (Copy 22)]* *[==>47.0 Secs (Copy 23)]* *[==>47.0 Secs (Copy 24)]* *[==>47.0 Secs (Copy 25)]* *[==>47.0 Secs (Copy 26)]* *[==>47.0 Secs (Copy 27)]* *[==>47.0 Secs (Copy 28)]* *[==>47.0 Secs (Copy 29)]* *[==>47.0 Secs (Copy 30)]* *[==>47.0 Secs (Copy 31)]* *[==>47.0 Secs (Copy 32)]* *[==>47.0 Secs (Copy 33)]* *[==>47.0 Secs (Copy 34)]*	 ***[1]*** ***[2]***

	4	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (1656 Secs) *[==>47.0 Secs (Copy 1)]* *[==>47.0 Secs (Copy 2)]* *[==>47.0 Secs (Copy 3)]* *[==>47.0 Secs (Copy 4)]* *[==>47.0 Secs (Copy 5)]*	 ***[2]***
							[==>49.0 Secs (Copy 6)] *[==>49.0 Secs (Copy 7)]* *[==>49.0 Secs (Copy 8)]* *[==>49.0 Secs (Copy 9)]* *[==>49.0 Secs (Copy 10)]* *[==>49.0 Secs (Copy 11)]* *[==>49.0 Secs (Copy 12)]* *[==>49.0 Secs (Copy 13)]* *[==>49.0 Secs (Copy 14)]* *[==>49.0 Secs (Copy 15)]* *[==>49.0 Secs (Copy 16)]* *[==>49.0 Secs (Copy 17)]* *[==>49.0 Secs (Copy 18)]* *[==>49.0 Secs (Copy 19)]* *[==>49.0 Secs (Copy 20)]* *[==>49.0 Secs (Copy 21)]* *[==>49.0 Secs (Copy 22)]* *[==>49.0 Secs (Copy 23)]* *[==>49.0 Secs (Copy 24)]* *[==>49.0 Secs (Copy 25)]* *[==>49.0 Secs (Copy 26)]* *[==>49.0 Secs (Copy 27)]* *[==>49.0 Secs (Copy 28)]* *[==>49.0 Secs (Copy 29)]* *[==>49.0 Secs (Copy 30)]* *[==>49.0 Secs (Copy 31)]* *[==>49.0 Secs (Copy 32)]* *[==>49.0 Secs (Copy 33)]* *[==>49.0 Secs (Copy 34)]*	 ***[3]***

	5	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (2212 Secs) *[==>49.0 Secs (Copy 1)]* *[==>49.0 Secs (Copy 2)]* *[==>49.0 Secs (Copy 3)]* *[==>49.0 Secs (Copy 4)]* *[==>49.0 Secs (Copy 5)]* *[==>49.0 Secs (Copy 6)]* *[==>49.0 Secs (Copy 7)]* *[==>49.0 Secs (Copy 8)]* *[==>70.0 Secs (Copy 9)]* *[==>70.0 Secs (Copy 10)]* *[==>70.0 Secs (Copy 11)]* *[==>70.0 Secs (Copy 12)]* *[==>70.0 Secs (Copy 13)]* *[==>70.0 Secs (Copy 14)]* *[==>70.0 Secs (Copy 15)]* *[==>70.0 Secs (Copy 16)]* *[==>70.0 Secs (Copy 17)]* *[==>70.0 Secs (Copy 18)]* *[==>70.0 Secs (Copy 19)]* *[==>70.0 Secs (Copy 20)]* *[==>70.0 Secs (Copy 21)]* *[==>70.0 Secs (Copy 22)]* *[==>70.0 Secs (Copy 23)]* *[==>70.0 Secs (Copy 24)]* *[==>70.0 Secs (Copy 25)]* *[==>70.0 Secs (Copy 26)]* *[==>70.0 Secs (Copy 27)]* *[==>70.0 Secs (Copy 28)]* *[==>70.0 Secs (Copy 29)]* *[==>70.0 Secs (Copy 30)]* *[==>70.0 Secs (Copy 31)]* *[==>70.0 Secs (Copy 32)]* *[==>70.0 Secs (Copy 33)]* *[==>70.0 Secs (Copy 34)]*	 ***[3]*** ***[4]***
	6	GO-wavecal	(1) HR8832	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A		100 Secs (120 Secs) *[==>60.0 Secs (Split 1)]* *[==>60.0 Secs (Split 2)]*	 ***[4]***

Orbit Structure

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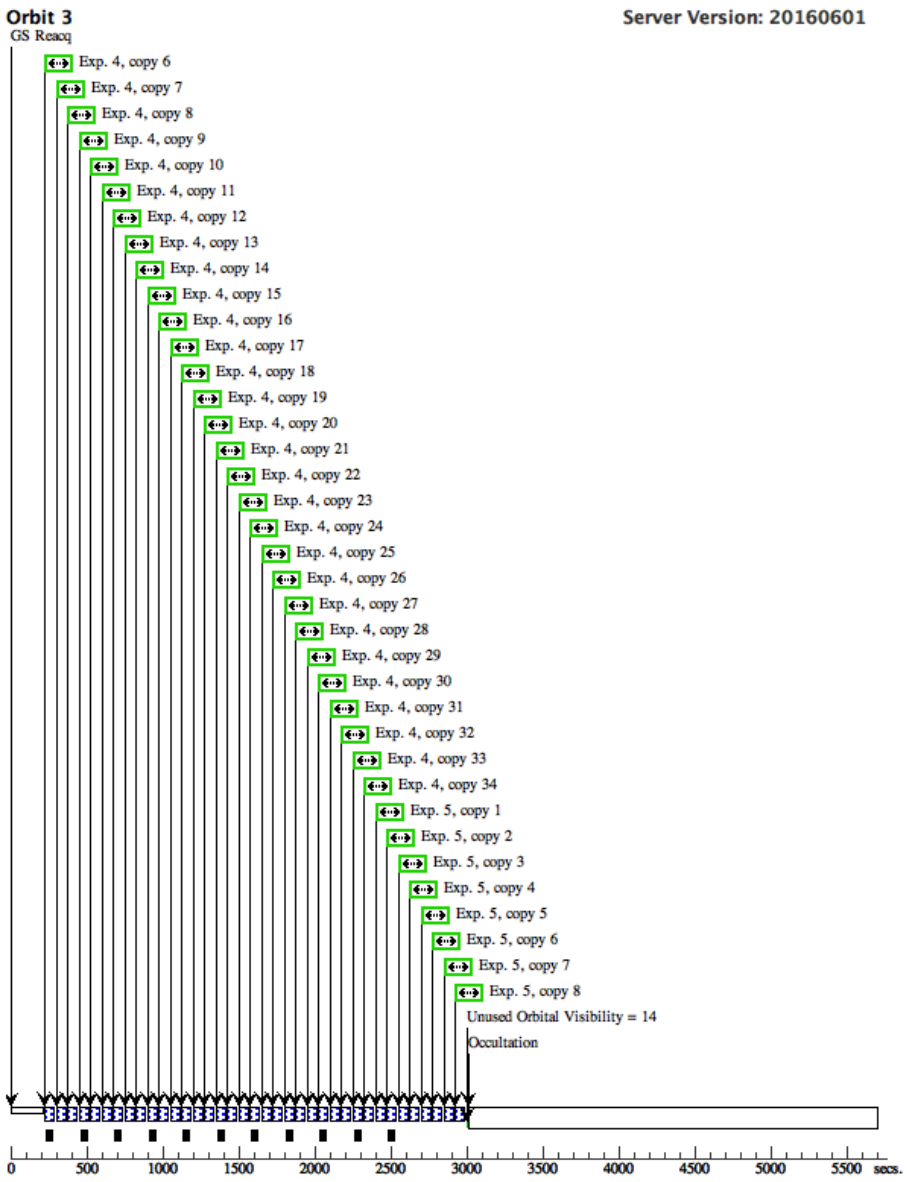
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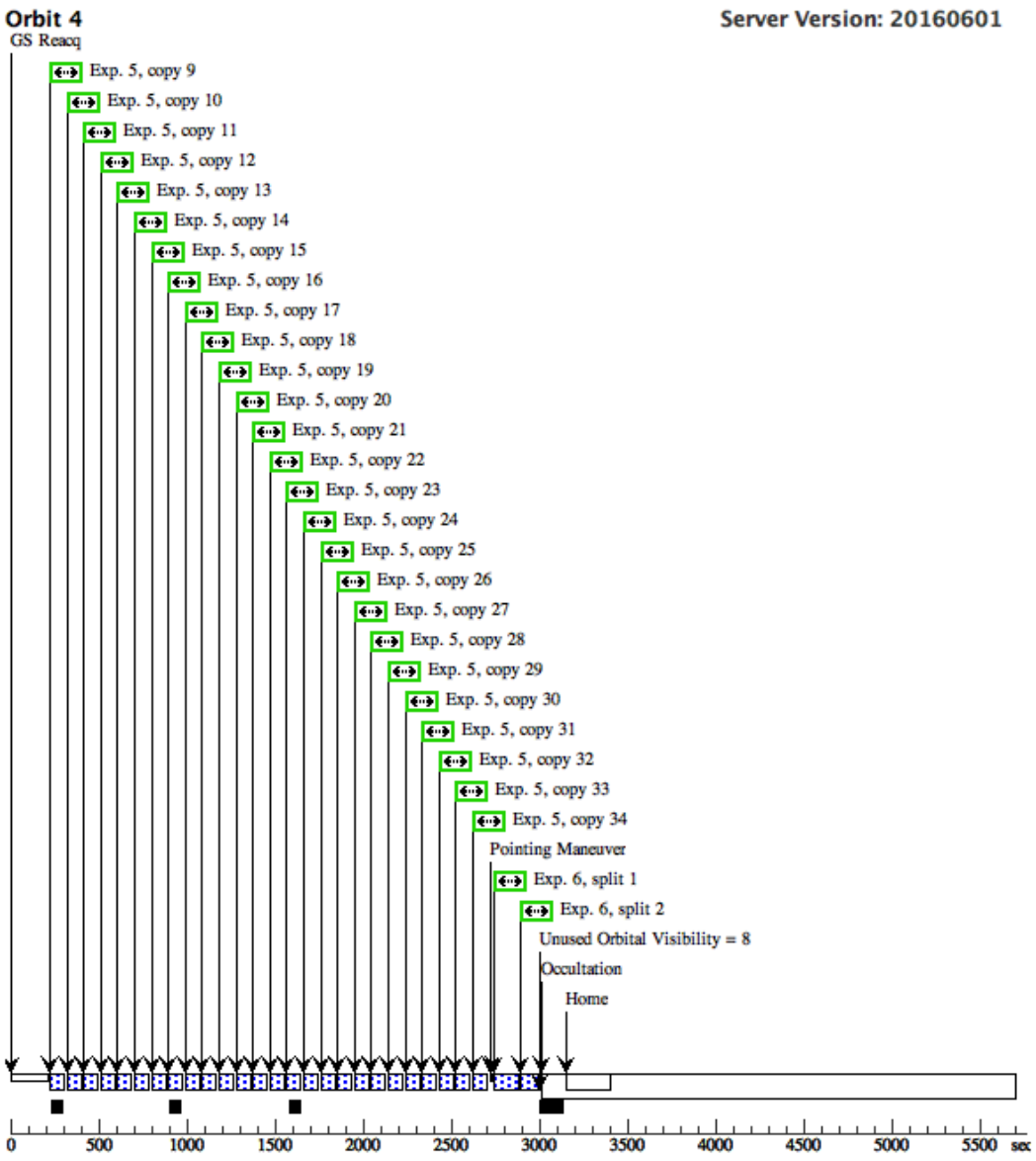
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Exp. 5, copy 29
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Exp. 5, copy 33
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Pointing Maneuver
Exp. 6, split 1
Exp. 6, split 2
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Occultation
Home
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Visit

Proposal 14464, Visit (51) Fri Jul 29 17:35:04 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SCHED 100%; Period 3.092926 D AND ZERO-PHASE HJD2457463.82884

Comments: It's essential that the four orbits are scheduled in a single, contiguous block.
We also want to disable wavecals during throughout the visit and do wavelength calibrations only at the end of the four-orbit sequence.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HR8832	RA: 23 13 16.9763 (348.3207346d)	Proper Motion RA: 2075.07 mas/yr	V=5.57+/-0.01	Reference Frame: ICRS
	Alt Name1: HD219134	Dec: +57 10 6.08 (57.16836d)	Proper Motion Dec: 295.45 mas/yr	U = 7.46,	
		Equinox: J2000	Epoch of Position: 2000	B = 6.56,	
			Radial Velocity: -18.83 km/sec	R = 4.76	

Comments: Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(1) HR8832	STIS/CCD, ACQ, F28X50OII	MIRROR	ACQTYPE=POINT	PHASE 0.9481 TO 0 .9553		0.5 Secs (0.5 Secs)	
								[==>]	***[1]***
2	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO			60 Secs X 27 (1404 Secs)	
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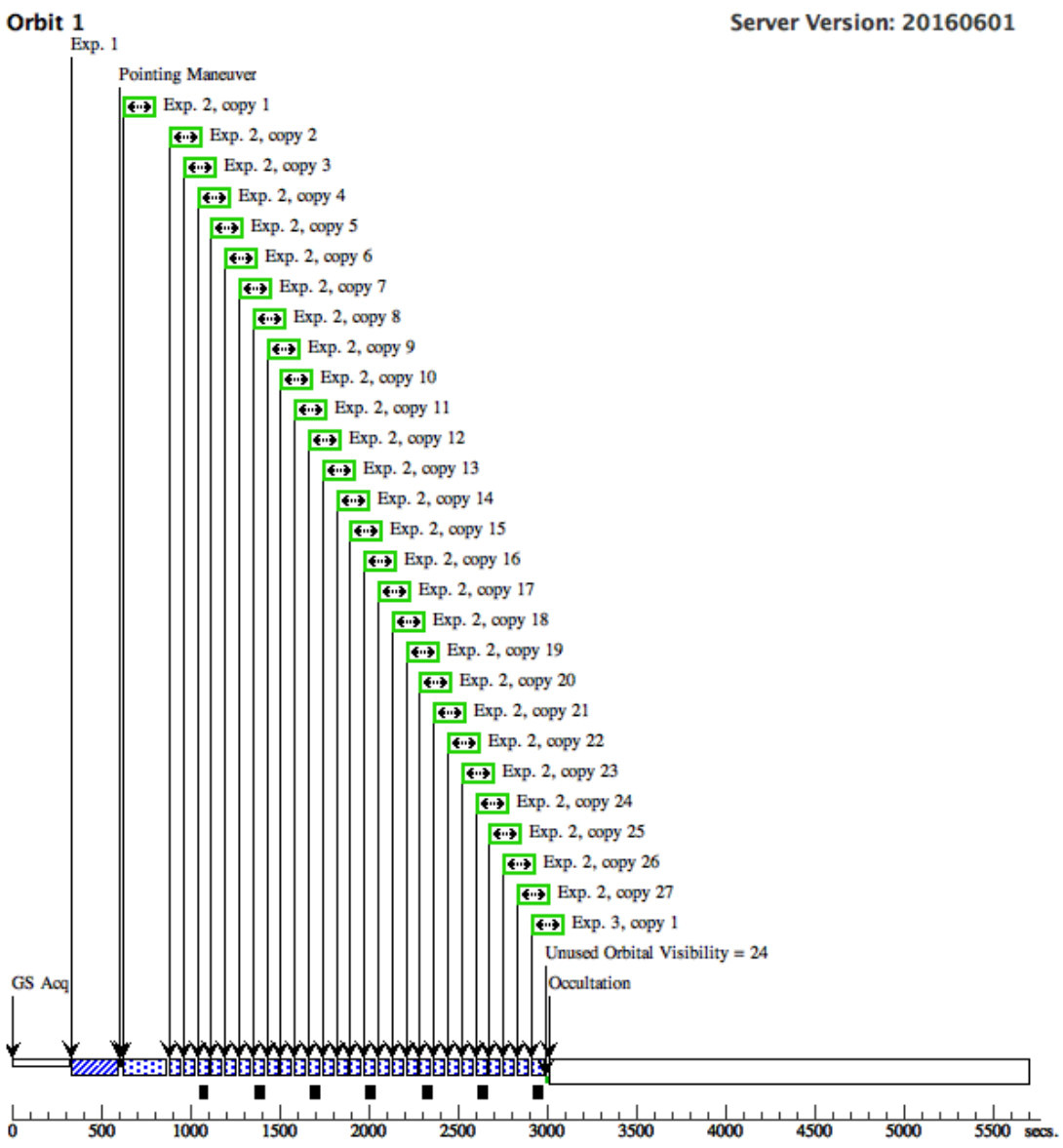
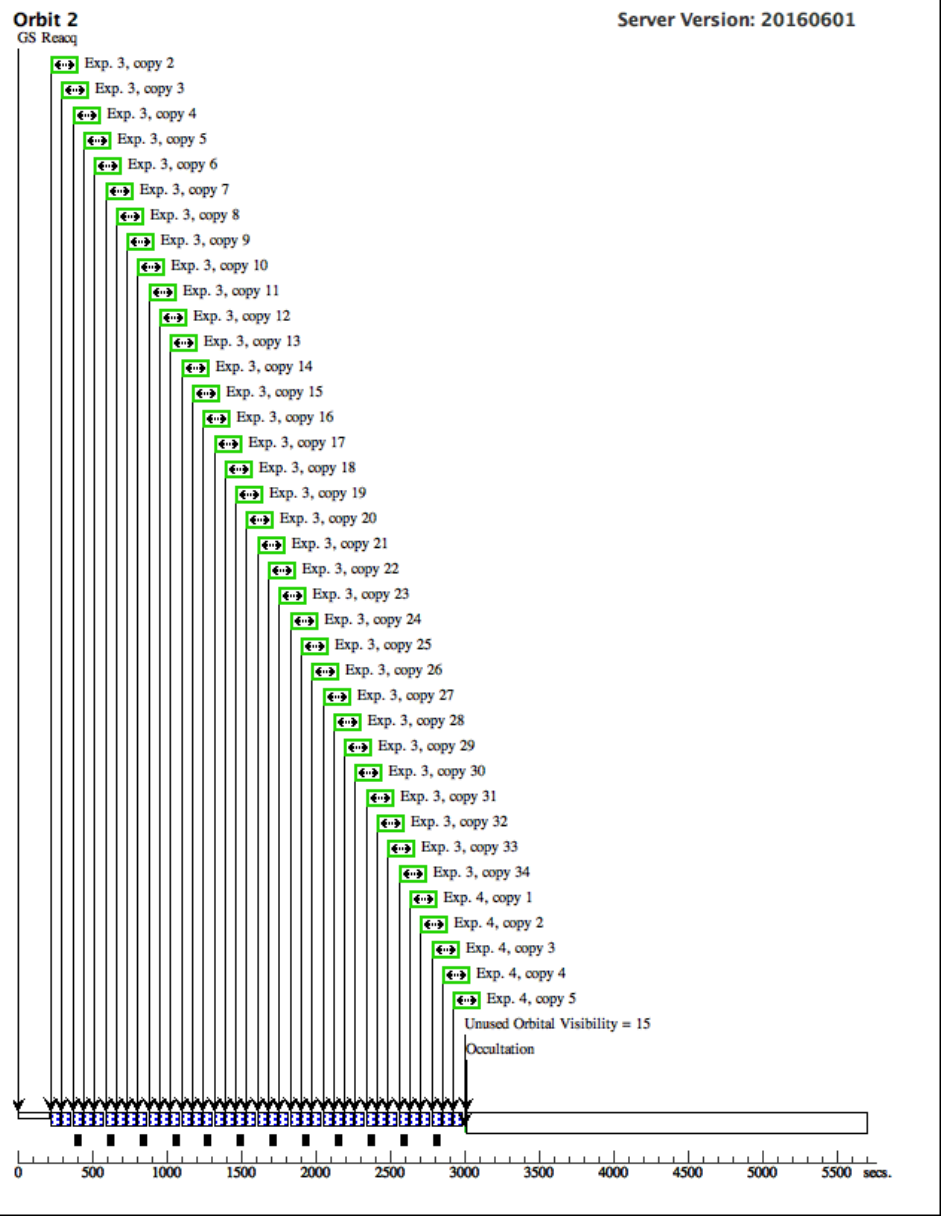
	3	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (1603 Secs) *[==>52.0 Secs (Copy 1)]* *[==>47.0 Secs (Copy 2)]* *[==>47.0 Secs (Copy 3)]* *[==>47.0 Secs (Copy 4)]* *[==>47.0 Secs (Copy 5)]* *[==>47.0 Secs (Copy 6)]* *[==>47.0 Secs (Copy 7)]* *[==>47.0 Secs (Copy 8)]* *[==>47.0 Secs (Copy 9)]* *[==>47.0 Secs (Copy 10)]* *[==>47.0 Secs (Copy 11)]* *[==>47.0 Secs (Copy 12)]* *[==>47.0 Secs (Copy 13)]* *[==>47.0 Secs (Copy 14)]* *[==>47.0 Secs (Copy 15)]* *[==>47.0 Secs (Copy 16)]* *[==>47.0 Secs (Copy 17)]* *[==>47.0 Secs (Copy 18)]* *[==>47.0 Secs (Copy 19)]* *[==>47.0 Secs (Copy 20)]* *[==>47.0 Secs (Copy 21)]* *[==>47.0 Secs (Copy 22)]* *[==>47.0 Secs (Copy 23)]* *[==>47.0 Secs (Copy 24)]* *[==>47.0 Secs (Copy 25)]* *[==>47.0 Secs (Copy 26)]* *[==>47.0 Secs (Copy 27)]* *[==>47.0 Secs (Copy 28)]* *[==>47.0 Secs (Copy 29)]* *[==>47.0 Secs (Copy 30)]* *[==>47.0 Secs (Copy 31)]* *[==>47.0 Secs (Copy 32)]* *[==>47.0 Secs (Copy 33)]* *[==>47.0 Secs (Copy 34)]*	 ***[1]*** ***[2]***

	4	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (1656 Secs) *[==>47.0 Secs (Copy 1)]* *[==>47.0 Secs (Copy 2)]* *[==>47.0 Secs (Copy 3)]* *[==>47.0 Secs (Copy 4)]* *[==>47.0 Secs (Copy 5)]*	 ***[2]***
							[==>49.0 Secs (Copy 6)] *[==>49.0 Secs (Copy 7)]* *[==>49.0 Secs (Copy 8)]* *[==>49.0 Secs (Copy 9)]* *[==>49.0 Secs (Copy 10)]* *[==>49.0 Secs (Copy 11)]* *[==>49.0 Secs (Copy 12)]* *[==>49.0 Secs (Copy 13)]* *[==>49.0 Secs (Copy 14)]* *[==>49.0 Secs (Copy 15)]* *[==>49.0 Secs (Copy 16)]* *[==>49.0 Secs (Copy 17)]* *[==>49.0 Secs (Copy 18)]* *[==>49.0 Secs (Copy 19)]* *[==>49.0 Secs (Copy 20)]* *[==>49.0 Secs (Copy 21)]* *[==>49.0 Secs (Copy 22)]* *[==>49.0 Secs (Copy 23)]* *[==>49.0 Secs (Copy 24)]* *[==>49.0 Secs (Copy 25)]* *[==>49.0 Secs (Copy 26)]* *[==>49.0 Secs (Copy 27)]* *[==>49.0 Secs (Copy 28)]* *[==>49.0 Secs (Copy 29)]* *[==>49.0 Secs (Copy 30)]* *[==>49.0 Secs (Copy 31)]* *[==>49.0 Secs (Copy 32)]* *[==>49.0 Secs (Copy 33)]* *[==>49.0 Secs (Copy 34)]*	 ***[3]***

	5	Science	(1) HR8832	STIS/CCD, ACCUM, 52X2	G750M 6094 A	GAIN=4; SIZEAXIS2=300; CR-SPLIT=NO; WAVECAL=NO	60 Secs X 34 (2212 Secs) *[==>49.0 Secs (Copy 1)]* *[==>49.0 Secs (Copy 2)]* *[==>49.0 Secs (Copy 3)]* *[==>49.0 Secs (Copy 4)]* *[==>49.0 Secs (Copy 5)]* *[==>49.0 Secs (Copy 6)]* *[==>49.0 Secs (Copy 7)]* *[==>49.0 Secs (Copy 8)]* *[==>70.0 Secs (Copy 9)]* *[==>70.0 Secs (Copy 10)]* *[==>70.0 Secs (Copy 11)]* *[==>70.0 Secs (Copy 12)]* *[==>70.0 Secs (Copy 13)]* *[==>70.0 Secs (Copy 14)]* *[==>70.0 Secs (Copy 15)]* *[==>70.0 Secs (Copy 16)]* *[==>70.0 Secs (Copy 17)]* *[==>70.0 Secs (Copy 18)]* *[==>70.0 Secs (Copy 19)]* *[==>70.0 Secs (Copy 20)]* *[==>70.0 Secs (Copy 21)]* *[==>70.0 Secs (Copy 22)]* *[==>70.0 Secs (Copy 23)]* *[==>70.0 Secs (Copy 24)]* *[==>70.0 Secs (Copy 25)]* *[==>70.0 Secs (Copy 26)]* *[==>70.0 Secs (Copy 27)]* *[==>70.0 Secs (Copy 28)]* *[==>70.0 Secs (Copy 29)]* *[==>70.0 Secs (Copy 30)]* *[==>70.0 Secs (Copy 31)]* *[==>70.0 Secs (Copy 32)]* *[==>70.0 Secs (Copy 33)]* *[==>70.0 Secs (Copy 34)]*	 ***[3]*** ***[4]***
	6	GO-wavecal	(1) HR8832	STIS/CCD, ACCUM, 52X0.2	G750M 6094 A		100 Secs (120 Secs) *[==>60.0 Secs (Split 1)]* *[==>60.0 Secs (Split 2)]*	 ***[4]***

Orbit Structure

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Exp. 3, copy 10
Exp. 3, copy 11
Exp. 3, copy 12
Exp. 3, copy 13
Exp. 3, copy 14
Exp. 3, copy 15
Exp. 3, copy 16
Exp. 3, copy 17
Exp. 3, copy 18
Exp. 3, copy 19
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Exp. 3, copy 34
Exp. 4, copy 1
Exp. 4, copy 2
Exp. 4, copy 3
Exp. 4, copy 4
Exp. 4, copy 5
Unused Orbital Visibility = 15
Occultation
0
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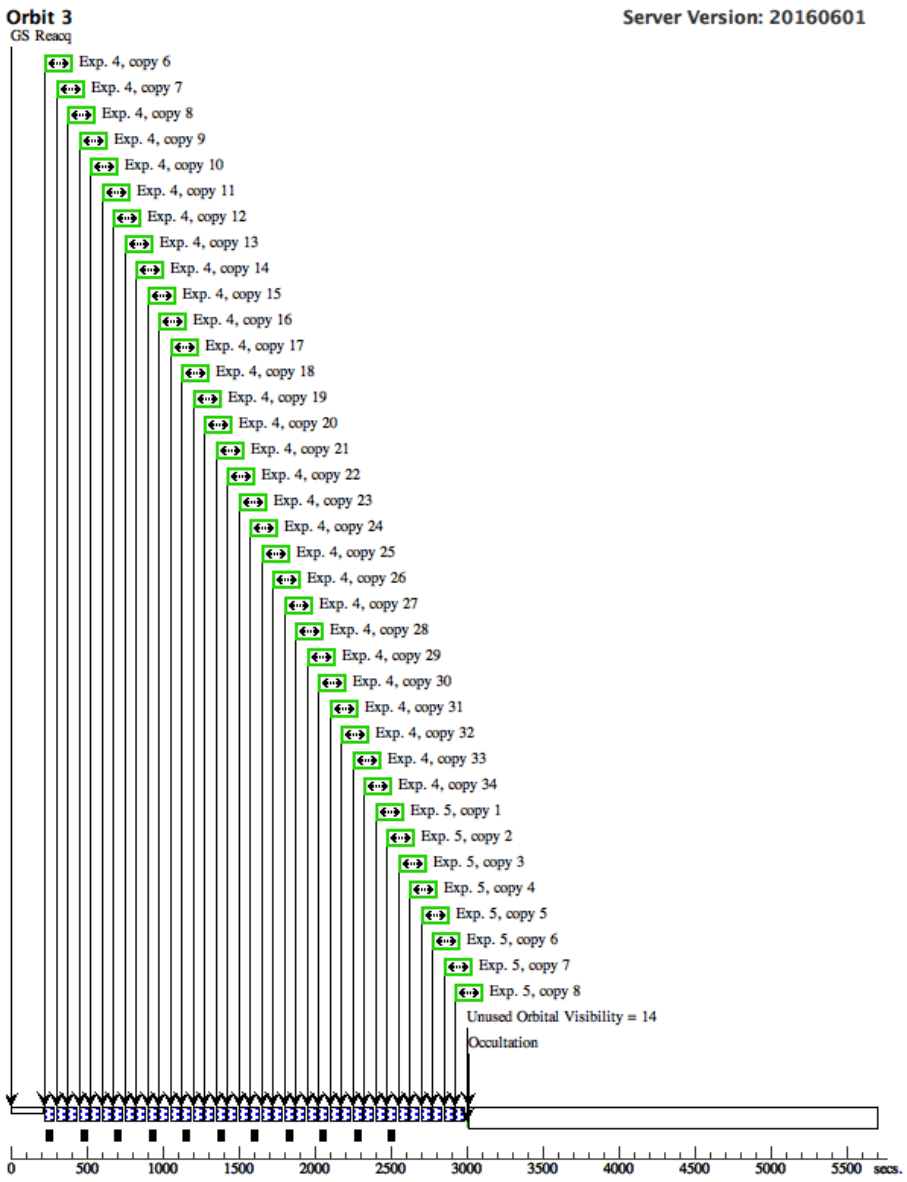
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.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Exp. 5, copy 4
Exp. 5, copy 5
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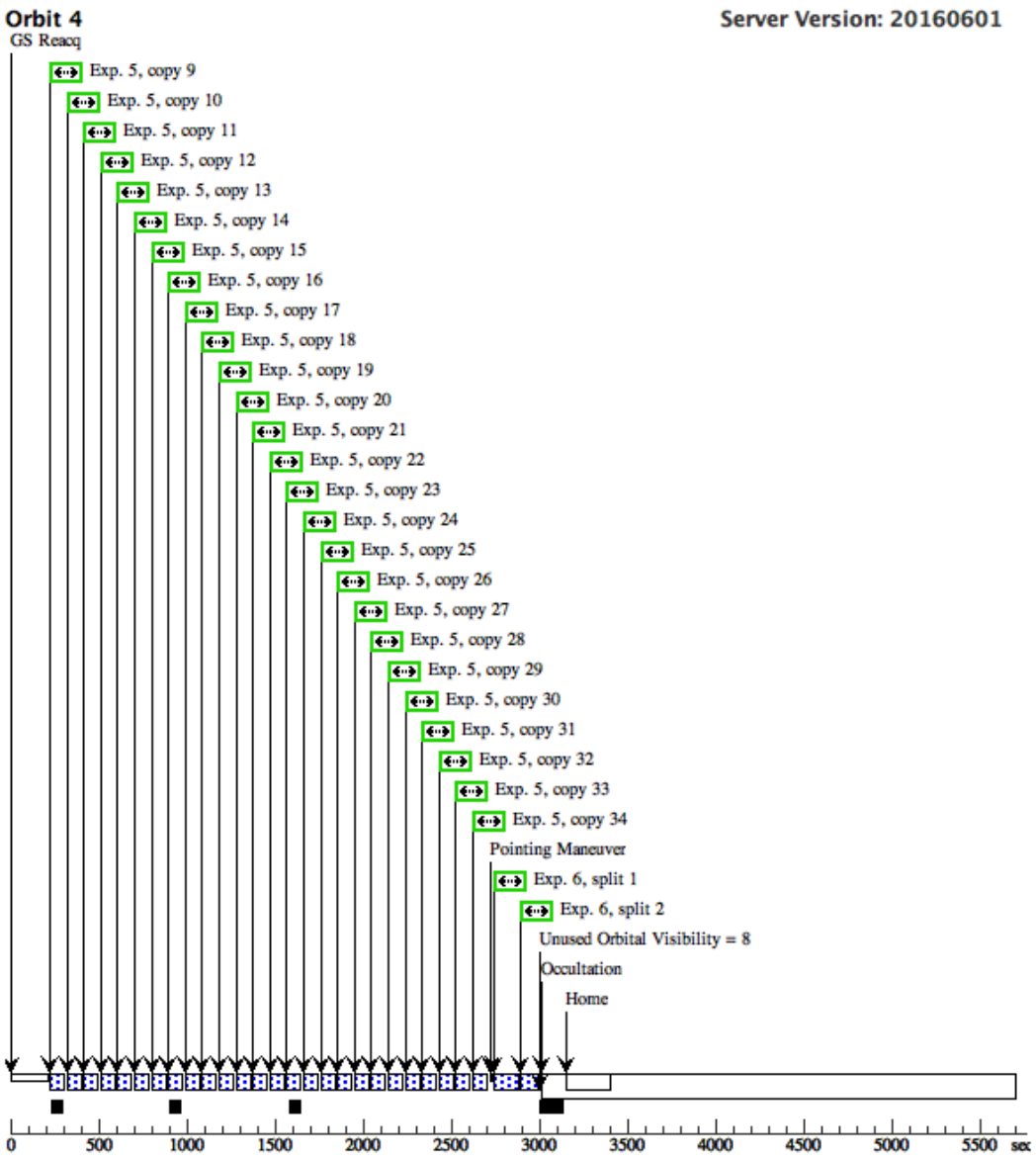
Unused Orbital Visibility = 14
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.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Exp. 5, copy 22
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Exp. 5, copy 25
Exp. 5, copy 26
Exp. 5, copy 27
Exp. 5, copy 28
Exp. 5, copy 29
Exp. 5, copy 30
Exp. 5, copy 31
Exp. 5, copy 32
Exp. 5, copy 33
Exp. 5, copy 34
Pointing Maneuver
Exp. 6, split 1
Exp. 6, split 2
Unused Orbital Visibility = 8
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec