14455 - Orbit and Atmospheric Composition of the Warm Sub-Saturn EPIC-2037b

Cycle: 23, Proposal Category: GO

(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?*
02	(1) EPIC-2037B	WFC3/IR	9	27-Apr-2016 21:10:35.0	yes

9 Total Orbits Used

ABSTRACT

We propose a joint Spitzer/HST proposal to observe transits of two warm, sub-Saturn sized planets orbiting EPIC-203771098 (EPIC-2037 hereafter), a bright G dwarf observed by K2. EPIC-2037b and c are 5.7+-0.6 and 7.6+-0.8 Earth-radii. Sine the two planets are close to the 2:1 mean-motion resonance, transit timing variations (TTVs) are expected to be large (several hours). Our proposed Spitzer transit observations will yield precise transit times for EPIC-2037b and c. We will model the TTVs to constrain the eccentricities of EPIC-2037b and c which are linked to the formation pathway for this system. EPIC-2037b and c have low densities of 0.4 g/cc and 0.2 g/cc, respectively. Their large size and low surface gravities make

these planets favorable targets for transmission spectroscopy by Spitzer, HST, and JWST. In addition to their favorable observability, the planets have low equilibrium temperatures of ~710 K and ~560 K, respectively. These temperatures have not been well-explored in previous studies with transmission spectroscopy. While over a dozen HST+Spitzer transmission spectra have been published in the literature, only GJ1214b, GJ346b, HAT-P-11b, and HAT-P-12b have comparable temperatures. While Spitzer can detect wavelength-dependent variation in transit depth, the Spitzer measurements alone cannot discriminate between various atmospheric compositions. Therefore we propose to use HST/WFC3 to probe the atmosphere of EPIC-2037b. The HST transmission spectrum will probe water vapor in the atmosphere, which reflects the planet's oxygen abundance, a proxy for the planet's heavy element enrichment.

OBSERVING DESCRIPTION

In this program we will observe a GIII star, EPIC-203771098, during the transit of a sub-Saturn sized planet, EPIC-203771098b. This program consists of a single visit of nine orbits, and it is essential for the nine orbits to be scheduled as a contiguous block. Orbit 1 allows for thermal settling, orbits 2 and 3 measure out-of-transit flux, orbits 4-7 observe EPIC-2037 during the transit of EPIC-2037B, and orbits 8 and 9 measure out-of-transit flux. The total allowed window for the start of the first exposure in orbit 1 is 0.9830-0.9865 in planet orbital phase, corresponding to a 105 minute interval. APT warns that a program with 9 contiguous orbits will likely intersect the SAA. If possible, please schedule so that if there is an SAA crossing, it intersects at orbit 1, the thermal settling orbit. The spectrum of a neighboring star 26 arcsec to the SW should not overlap with the first order spectrum of EPIC-2037. Please schedule observations when the telescope has the following oreintations: 130-235 and 315-55 deg. Please avoid the following orientations: 55-130, 235-315 deg.

Visit

Proposal 14455, Visit 02, implementation Thu Apr 28 01:10:44 GMT 2016

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR

Special Requirements: Period 20.891097 D AND ZERO-PHASE HJD2457323.6161

Comments: In this program we will observe a GIII star, EPIC-203771098, during the transit of a sub-Saturn sized planet, EPIC-203771098b. This program consists of a single visit of nine orbits, and it is essential for the nine orbits to be scheduled as a contiguous block. Orbit 1 allows for thermal settling, orbits 2 and 3 measure out-of-transit flux, orbits 4-7 observe EPIC-2037 during the transit of EPIC-2037B, and orbits 8 and 9 measure out-of-transit flux. The total allowed window for the start of the first exposure in orbit 1 is 0.9830-0.9865 in planet orbital phase, corresponding to a 105 minute interval. APT warns that a program with 9 contiguous orbits will likely intersect the SAA. If possible, please schedule so that if there is an SAA crossing, it intersects at orbit 1, the thermal settling orbit. The spectrum of a neighboring star 26 arcsec to the SW should not overlap with the first order spectrum of EPIC-2037. Please schedule observations when the telescope has the following oreintations: 130-235 and 315-55 deg. Please avoid the following orientations: 55-130, 235-315 deg.

Diagnostics

(Visit 02) Warning (Orbit Planner): LONG SU LIKELY TO INTERSECT THE SAA

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	EPIC-2037B	RA: 16 10 17.6900 (242.5737083d)	Proper Motion RA: -60.6 mas/yr	V=11.28+/-0.10	Reference Frame: ICRS
	Alt Name1: EPIC-203771098	Dec: -24 59 25.20 (-24.99033d)	Proper Motion Dec: -65.4 mas/yr		
	Alt Name2: 2MASSJ16101770-2459251	Equinox: J2000	Epoch of Position: 2000		

Comments: Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Epic2037, ACQ, phase constrained	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, IRSUB256	F130N	NSAMP=3; SAMP-SEQ=RAPID	PHASE 0.9830 TO 0.9865	Sequence 1-3 Non-Int in Visit 02	0.833445 Secs (0.833 Secs) *[==>]*	 ***[1]***
2	G141 Science Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.16,90.0 Degrees,Round trip	Sequence 1-3 Non-Int in Visit 02	103.128633 Secs X 9 (1856.315 Secs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]*	 ***[1]***
3	G141 Science Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.16,90.0 Degrees,Forward	Sequence 1-3 Non-Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	 ***[1]***

	4	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 4-5 Non-In t in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[2]***
	5	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 4-5 Non-In t in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[2]***

	6	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 6-7 Non-In t in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[3]***
	7	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 6-7 Non-In t in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[3]***

	8	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 8-9 Non-In t in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[4]***
	9	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 8-9 Non-In t in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[4]***

10	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 10-11 Non -Int in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[5]***
11	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 10-11 Non -Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[5]***

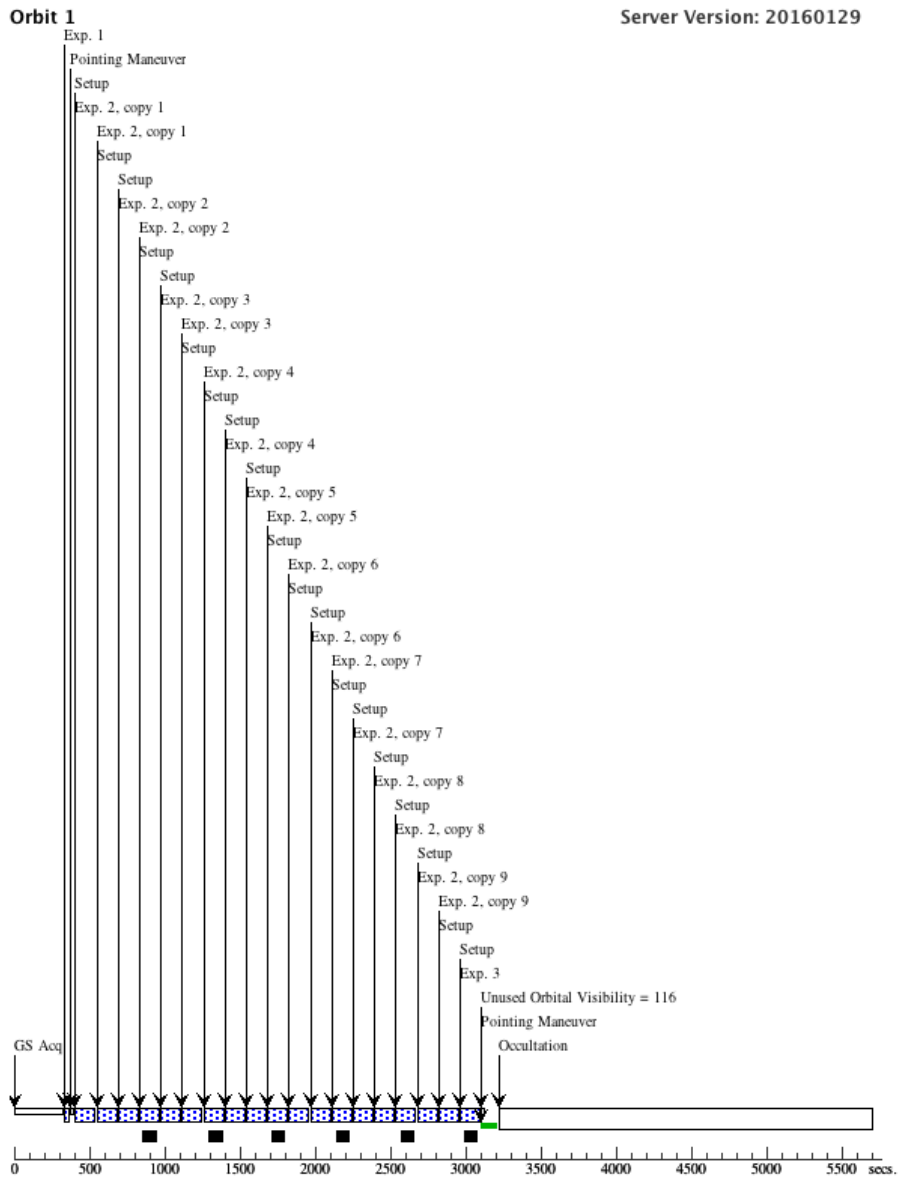
	12	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 12-13 Non -Int in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[6]***
	13	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 12-13 Non -Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[6]***

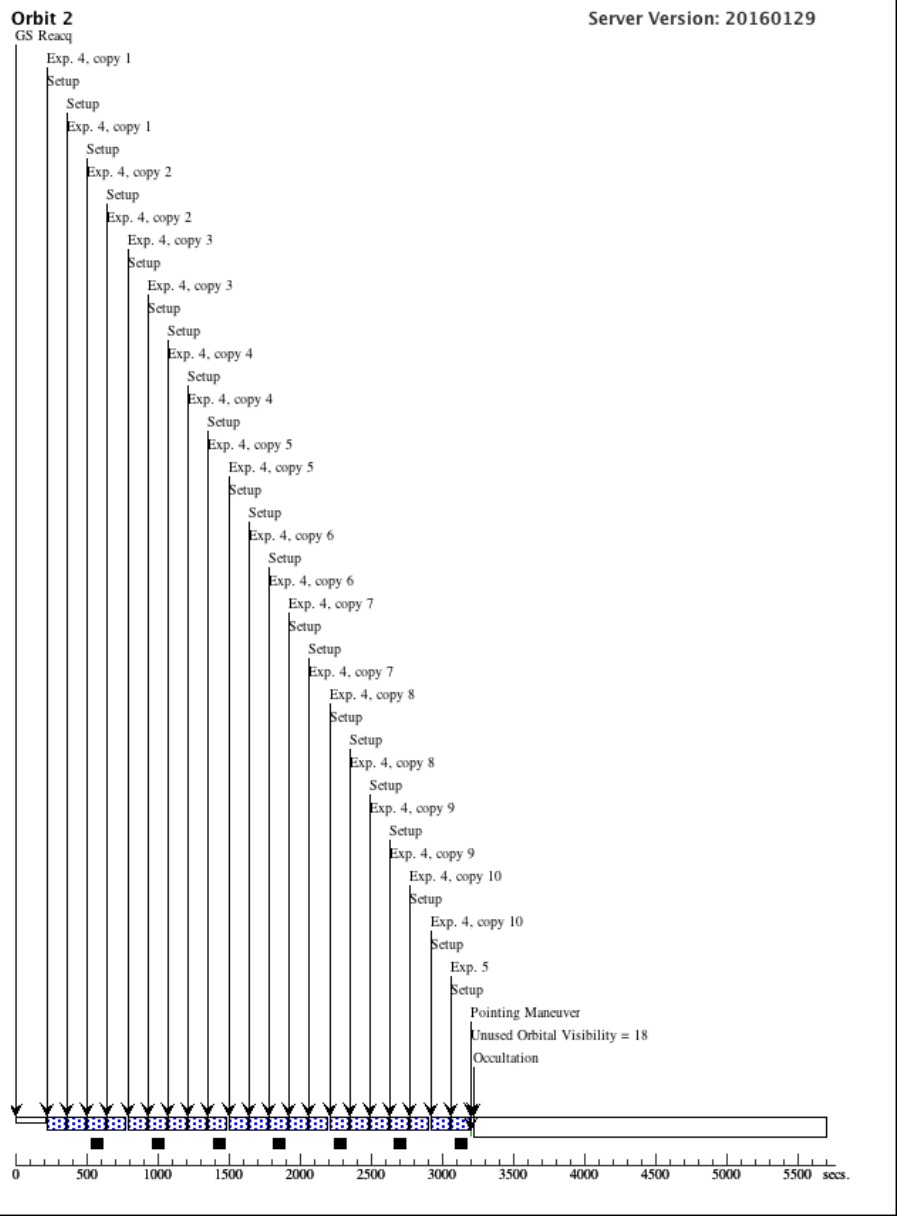
	14	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 14-15 Non -Int in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[7]***
	15	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 14-15 Non -Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[7]***

	16	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 16-17 Non -Int in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[8]***
	17	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 16-17 Non -Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[8]***

	18	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Roun d trip	Sequence 18-19 Non -Int in Visit 02	103.128633 Secs X 10 (2062.573 Se cs) *[==>(Copy 1, Forward)]* *[==>(Copy 1, Reverse)]* *[==>(Copy 2, Forward)]* *[==>(Copy 2, Reverse)]* *[==>(Copy 3, Forward)]* *[==>(Copy 3, Reverse)]* *[==>(Copy 4, Forward)]* *[==>(Copy 4, Reverse)]* *[==>(Copy 5, Forward)]* *[==>(Copy 5, Reverse)]* *[==>(Copy 6, Forward)]* *[==>(Copy 6, Reverse)]* *[==>(Copy 7, Forward)]* *[==>(Copy 7, Reverse)]* *[==>(Copy 8, Forward)]* *[==>(Copy 8, Reverse)]* *[==>(Copy 9, Forward)]* *[==>(Copy 9, Reverse)]* *[==>(Copy 10, Forward)]* *[==>(Copy 10, Reverse)]*	***[9]***
	19	G141 Scienc e Data	(1) EPIC-2037B	WFC3/IR, MULTIACCUM, GRISM256	G141	SAMP-SEQ=SPARS 10; NSAMP=15	POS TARG 0,-11; SPATIAL SCAN 0.1 6,90.0 Degrees,Forw ard	Sequence 18-19 Non -Int in Visit 02	103.128633 Secs (103.129 Secs) *[==>]*	***[9]***

Orbit Structure

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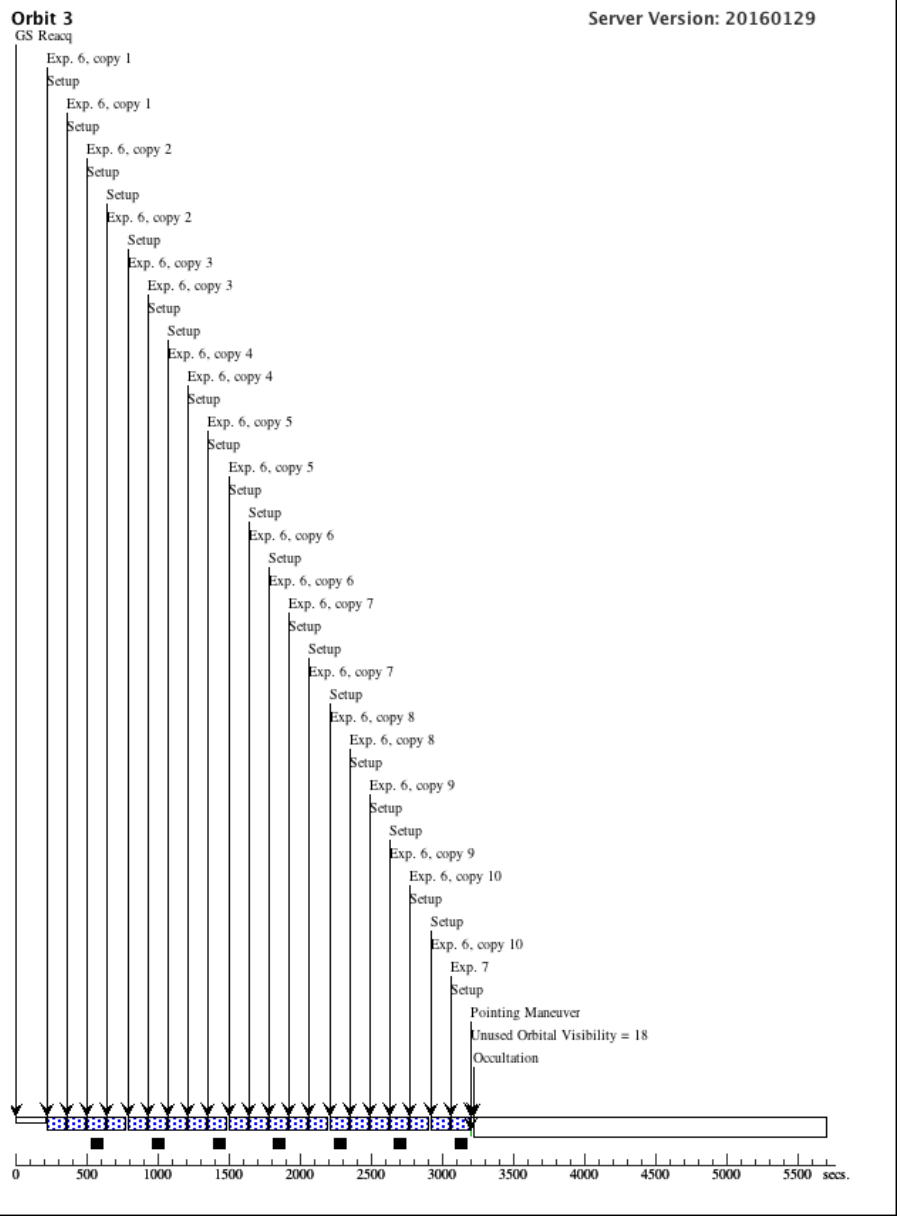
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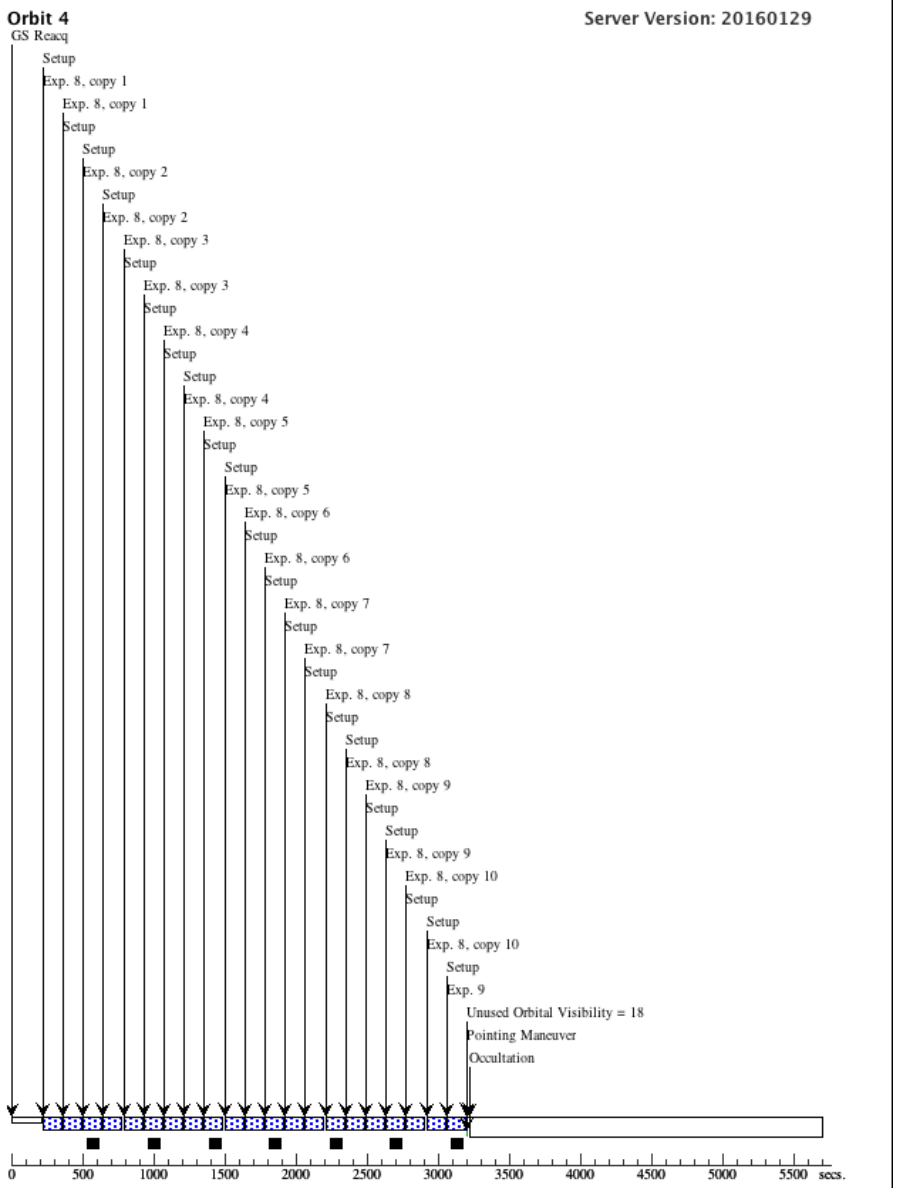
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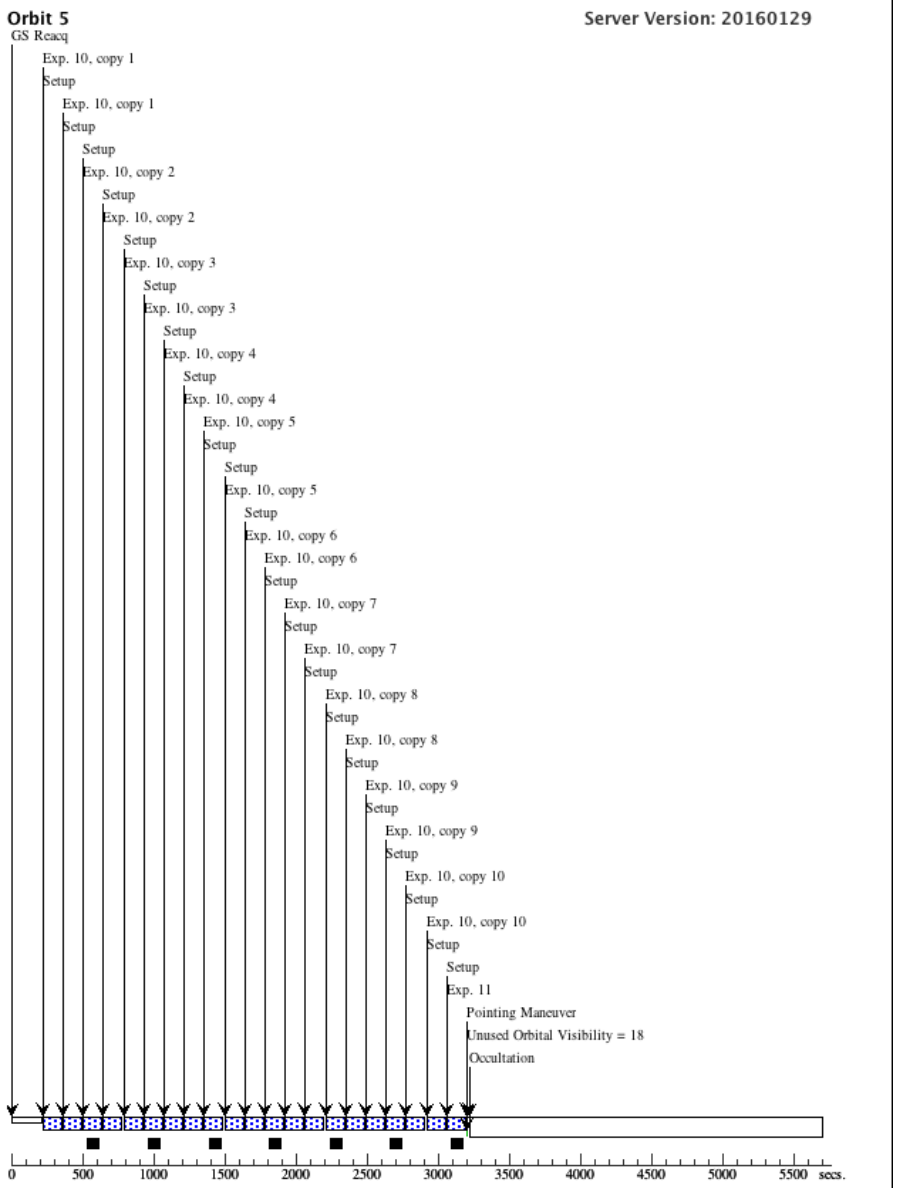
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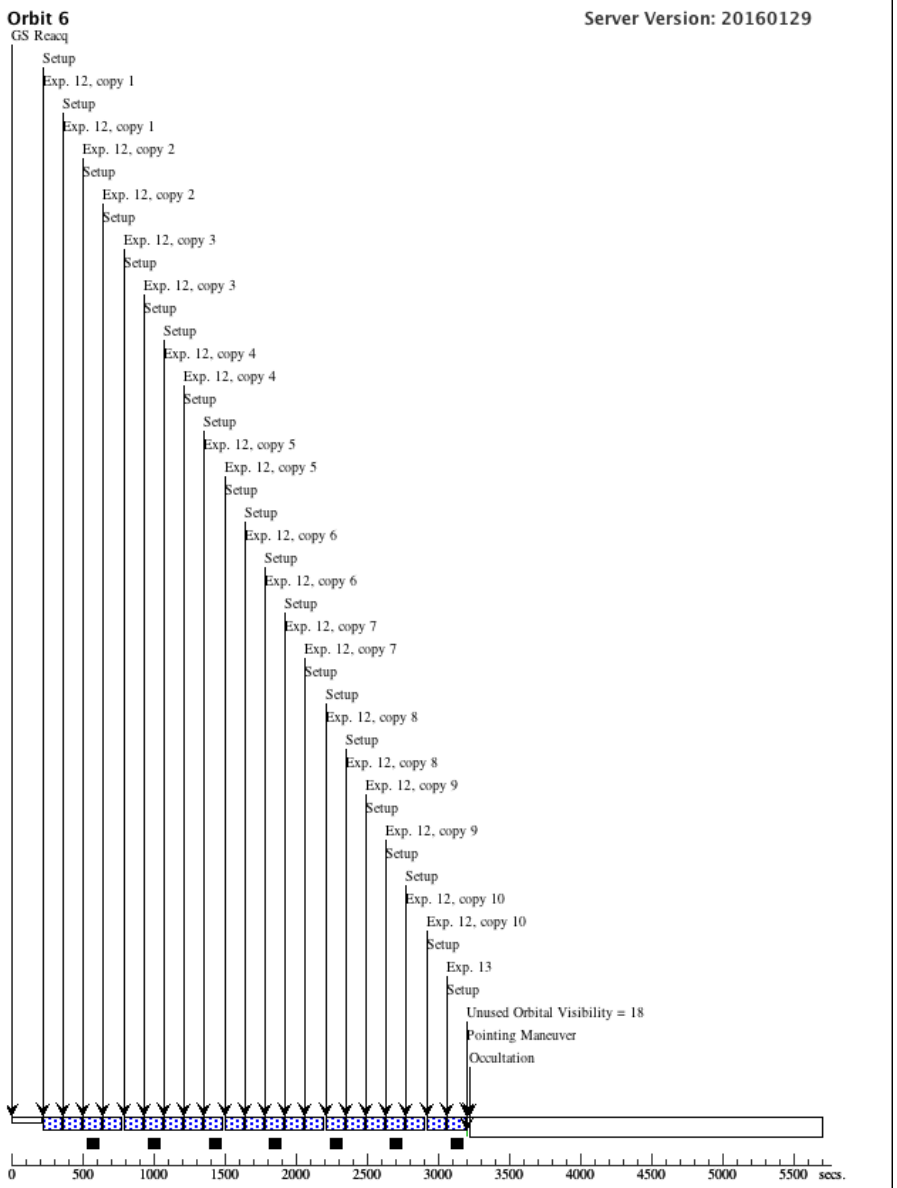
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Exp. 13
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Unused Orbital Visibility = 18
Pointing Maneuver
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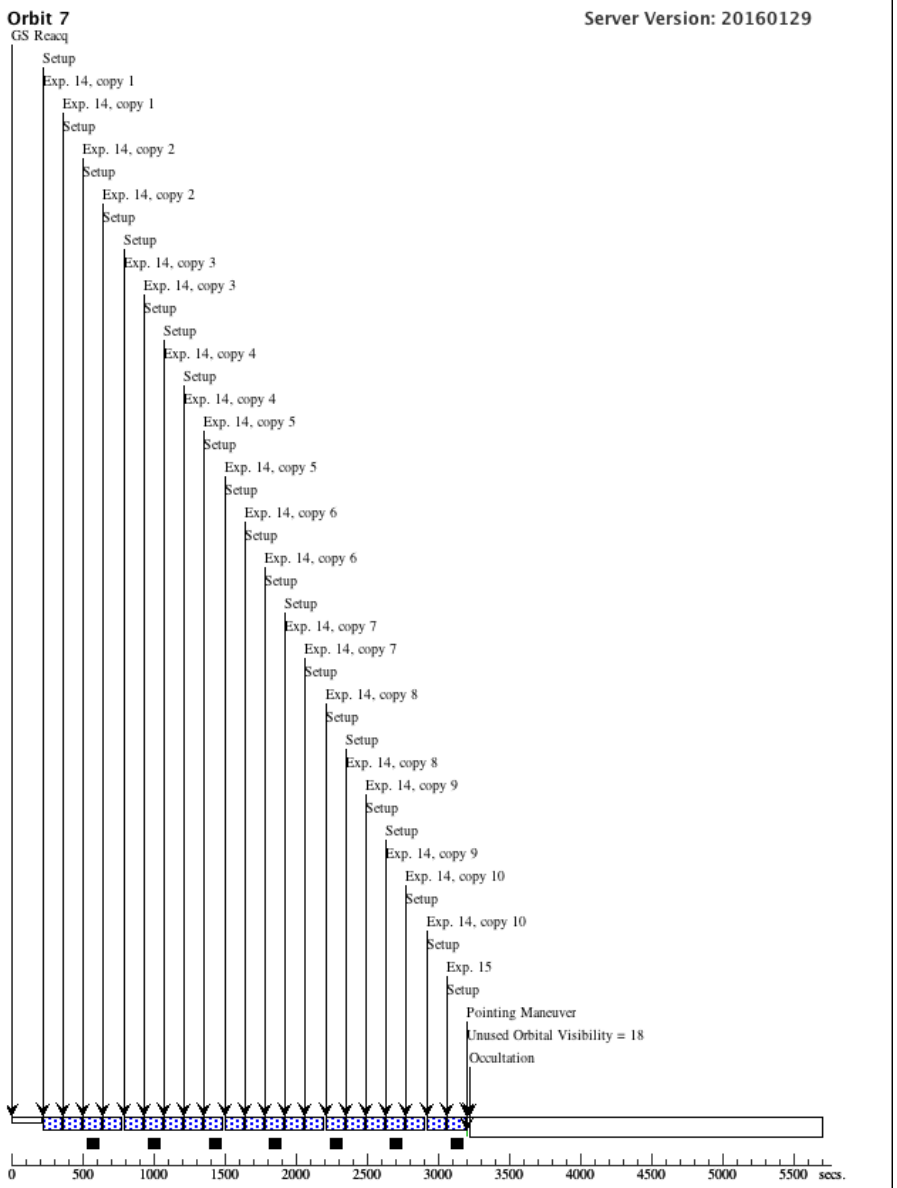
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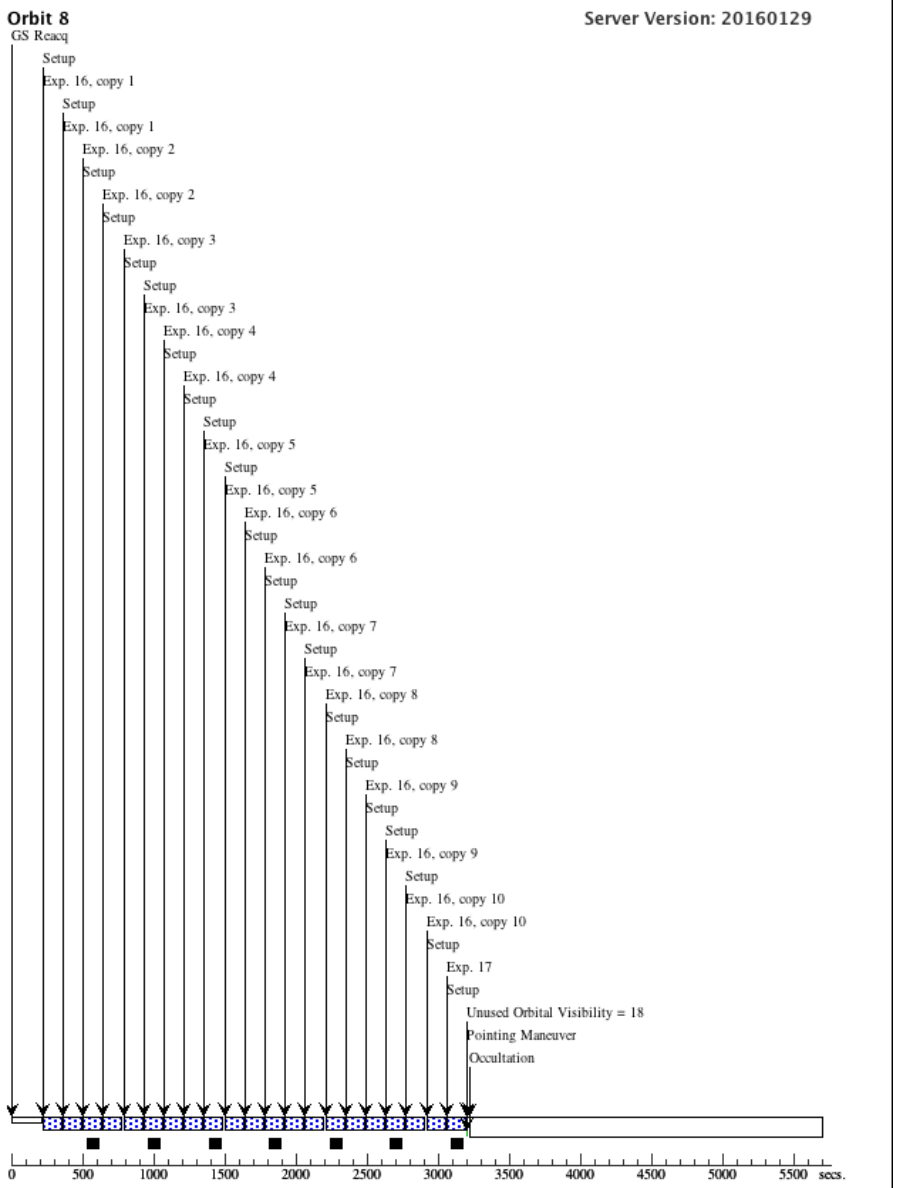
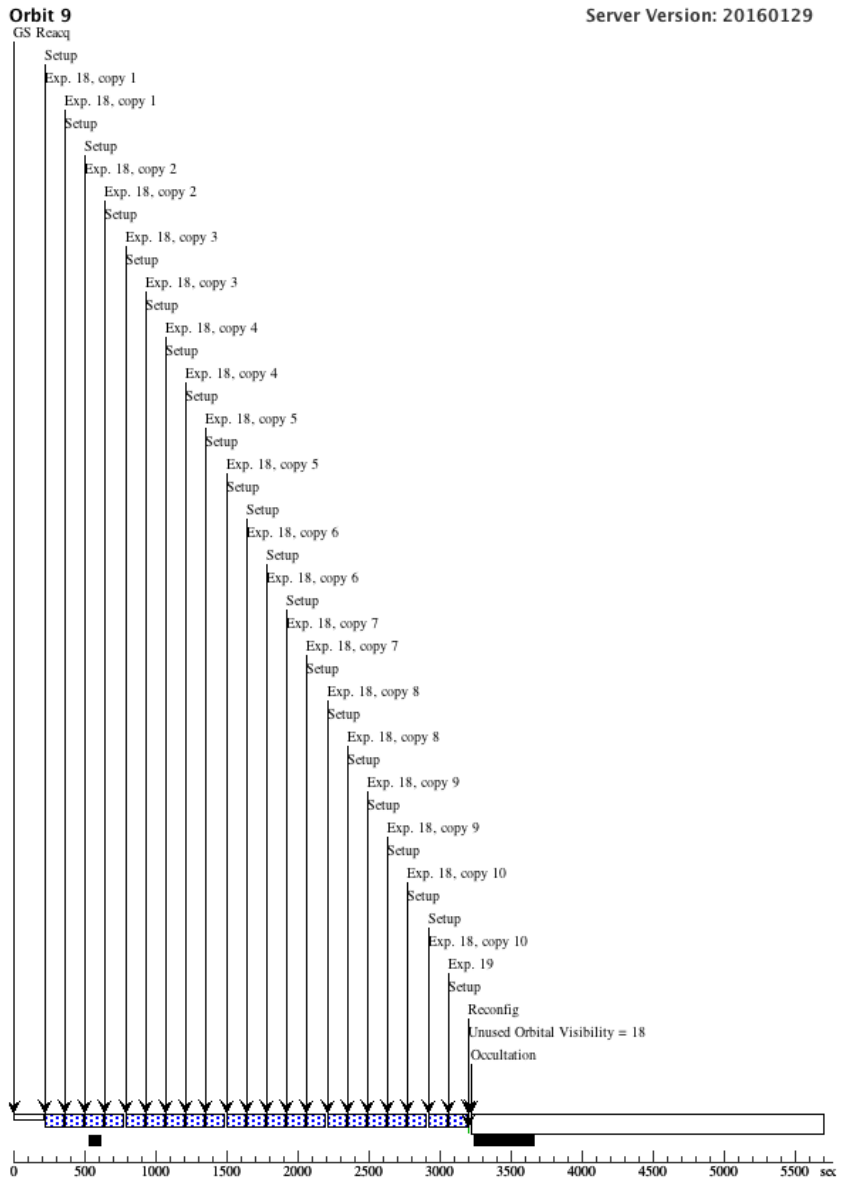
Exp. 14, copy 9
Exp. 14, copy 10
Setup
Exp. 14, copy 10
Setup
Exp. 15
Setup
Pointing Maneuver
Unused Orbital Visibility = 18
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 8
Server Version: 20160129
GS Reacq
Setup
Exp. 16, copy 1
Setup
Exp. 16, copy 1
Exp. 16, copy 2
Setup
Exp. 16, copy 2
Setup
Exp. 16, copy 3
Setup
Setup
Exp. 16, copy 3
Exp. 16, copy 4
Setup
Exp. 16, copy 4
Setup
Setup
Exp. 16, copy 5
Setup
Exp. 16, copy 5
Exp. 16, copy 6
Setup
Exp. 16, copy 6
Setup
Setup
Exp. 16, copy 7
Setup
Exp. 16, copy 7
Exp. 16, copy 8
Setup
Exp. 16, copy 8
Setup
Exp. 16, copy 9
Setup
Setup
Exp. 16, copy 9
Setup
Exp. 16, copy 10
Exp. 16, copy 10
Setup
Exp. 17
Setup
Unused Orbital Visibility = 18
Pointing Maneuver
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 9
Server Version: 20160129
GS Reacq
Setup
Exp. 18, copy 1
Exp. 18, copy 1
Setup
Setup
Exp. 18, copy 2
Exp. 18, copy 2
Setup
Exp. 18, copy 3
Setup
Exp. 18, copy 3
Setup
Exp. 18, copy 4
Setup
Exp. 18, copy 4
Setup
Exp. 18, copy 5
Setup
Exp. 18, copy 5
Setup
Setup
Exp. 18, copy 6
Setup
Exp. 18, copy 6
Setup
Exp. 18, copy 7
Exp. 18, copy 7
Setup
Exp. 18, copy 8
Setup
Exp. 18, copy 8
Setup
Exp. 18, copy 9
Setup
Exp. 18, copy 9
Setup
Exp. 18, copy 10
Setup
Setup
Exp. 18, copy 10
Exp. 19
Setup
Reconfig
Unused Orbital Visibility = 18
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec