15249 - An observational test of the dynamical instability hypothesis in the Solar System

Cycle: 25, Proposal Category: GO

(UV Initiative)

(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?*
01	(1) 1437 WAVE	STIS/CCD STIS/NUV-MAMA	1	09-May-2018 20:04:09.0	yes
02	(2) 3451 WAVE	STIS/CCD STIS/NUV-MAMA	1	09-May-2018 20:04:11.0	yes
03	(3) 659 WAVE	STIS/CCD STIS/NUV-MAMA	2	09-May-2018 20:04:12.0	yes
04	(4) 624 WAVE	STIS/CCD STIS/NUV-MAMA	1	09-May-2018 20:04:13.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
05	(5) 911 WAVE	STIS/CCD STIS/NUV-MAMA	1	09-May-2018 20:04:15.0	yes
06	(6) 1143 WAVE	STIS/CCD STIS/NUV-MAMA	1	09-May-2018 20:04:16.0	yes

7 Total Orbits Used

ABSTRACT

Recent theories of solar system evolution describe a period of chaotic dynamical restructuring that greatly altered the orbital architecture of the giant planets. A key prediction of these models is that the Jupiter Trojans originated in the outer Solar System and were scattered inward during this period of dynamical instability and captured into resonance. Therefore, understanding the composition of Trojans serves as a crucial observational test of these models. While optical spectroscopy has so far not revealed any spectral features, the bimodality in visible color indicates that Trojans are comprised of two subpopulations. In the context of dynamical instability models, both of these groups must originate in the outer Solar System. We have hypothesized that the color bimodality is due to differential sublimation loss of volatile ices and irradiation, with retention or depletion of hydrogen sulfide ice being the determining factor in the surface color. Laboratory spectra of irradiated ice samples analogous to our proposed volatile ice mixtures display an intriguing collection of absorption features in the ultraviolet. The experimental spectra corresponding to the two Trojan color groups show distinct shapes at these wavelengths. We propose using STIS to obtain UV spectra of the brightest 3 Trojans in each color subpopulation. Finding spectral features in this data that match the laboratory spectra would not only confirm our hypothesis for the Trojan color bimodality, but also directly validate dynamical instability models of solar system evolution.

OBSERVING DESCRIPTION

We plan on observing six Trojans near opposition at UV wavelengths using the STIS instrument. The targets are the brightest objects within each of the two attested Trojan color subpopulations: less-red (LR: 1437 Diomedes, 3451 Mentor, 659 Nestor) and red (R: 624 Hektor, 911 Agamemnon, 1143 Odysseus). Two spectral settings will be used to provide continuous low resolution wavelength coverage from 160 to 570 nm: MAMA/G230L grism and CCD/G430L grism, utilizing the 52x0.2 slit.

The objective of our observations is to probe the 200-550 nm region for several diagnostic absorption features that are predicted by laboratory experiments and theoretical work modeling the surfaces of these objects within the framework of current dynamical instability models of solar

system evolution. We constructed synthetic spectra of LR and R Trojans using the results of laboratory experiments in order to estimate the necessary sensitivity and exposure times needed to discern the predicted absorption features. Our observations are designed to achieve a signal-to-noise per resolution element of 2-3 and 8-10 at 250 nm and 375 nm in the G230L and G430L grisms, respectively.

To successfully observe the objects in our target list at the required sensitivity (and accounting for additional overhead for instrumental setup, spectral setting changes, guide star acquisition, target acquisition, readout, etc.), 7 orbits are needed: two orbits for the faintest target (659 Nestor) and one orbit each for the other 5 Trojans. We have ensured that none of our observations exceed the MAMA buffer imposed limit of 65536 counts/pix or the CCD full well limits. None of our targets require more than the 30 minute limit of total CCD/G430L observing time imposed on mixed STIS MAMA/CCD visits.

In order to efficiently achieve the necessary sensitivity, while allowing for flexibility in scheduling, we propose to observe each target when it is within 0.4-0.5 mag of its maximum brightness during Cycle 25. CCD subarray readout and MAMA binning are utilized to increase science exposure time.

Visit

Proposal 15249, 1437 (01), implementation Thu May 10 00:04:17 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 21-JUL-2018:00:00:00 AND 24-SEP-2018:00:00:00

Diagnostics

(1437 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

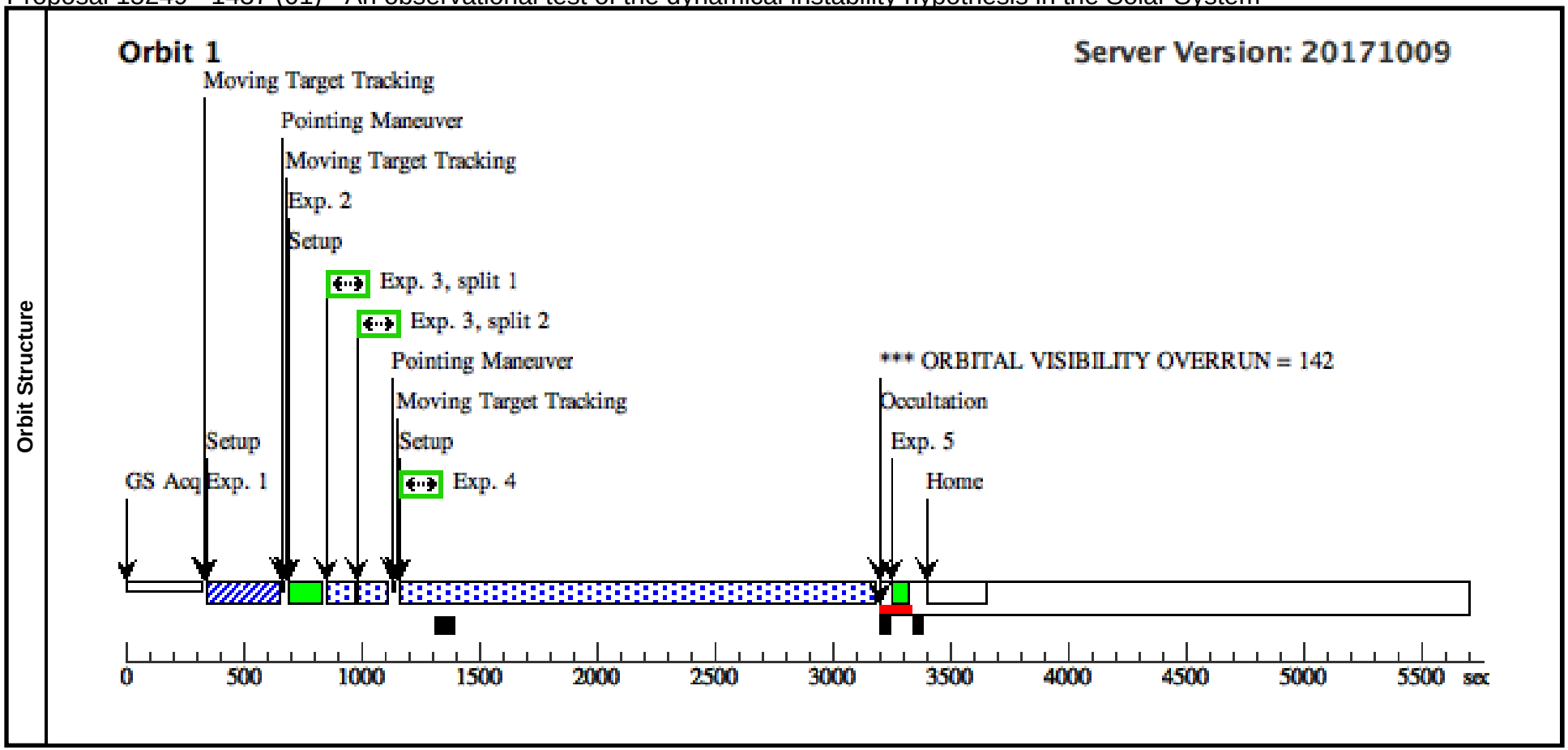
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	1437	TYPE=ASTEROID,A=5.159533988224353,E=0.04337508653727421,I=20.52304023492648,O=315.8382440061976,W=129.8928448172086,M=237.2093229761014,EQUINOX=J2000,EPOCH=02-JUL-2006:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(1) 1437	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	***[1]***
2	CCDwaveca l	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	***[1]***
3	CCDscience	(1) 1437	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=2; WAVECAL=NO			180 Secs (180 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
4	MAMAScience (STIS.sp.1011584)	(1) 1437	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO; BINAXIS1=YES; BINAXIS2=YES			1853 Secs (1853 Secs) *[==>]*	***[1]***
5	MAMAwavecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20171009
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Exp. 2
Setup
Exp. 3, split 1
Exp. 3, split 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 4
*** ORBITAL VISIBILITY OVERRUN = 142
Occultation
Exp. 5
Home
Setup
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15249, 3451 (02), completed Thu May 10 00:04:17 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 20-FEB-2018:00:00:00 AND 24-APR-2018:00:00:00

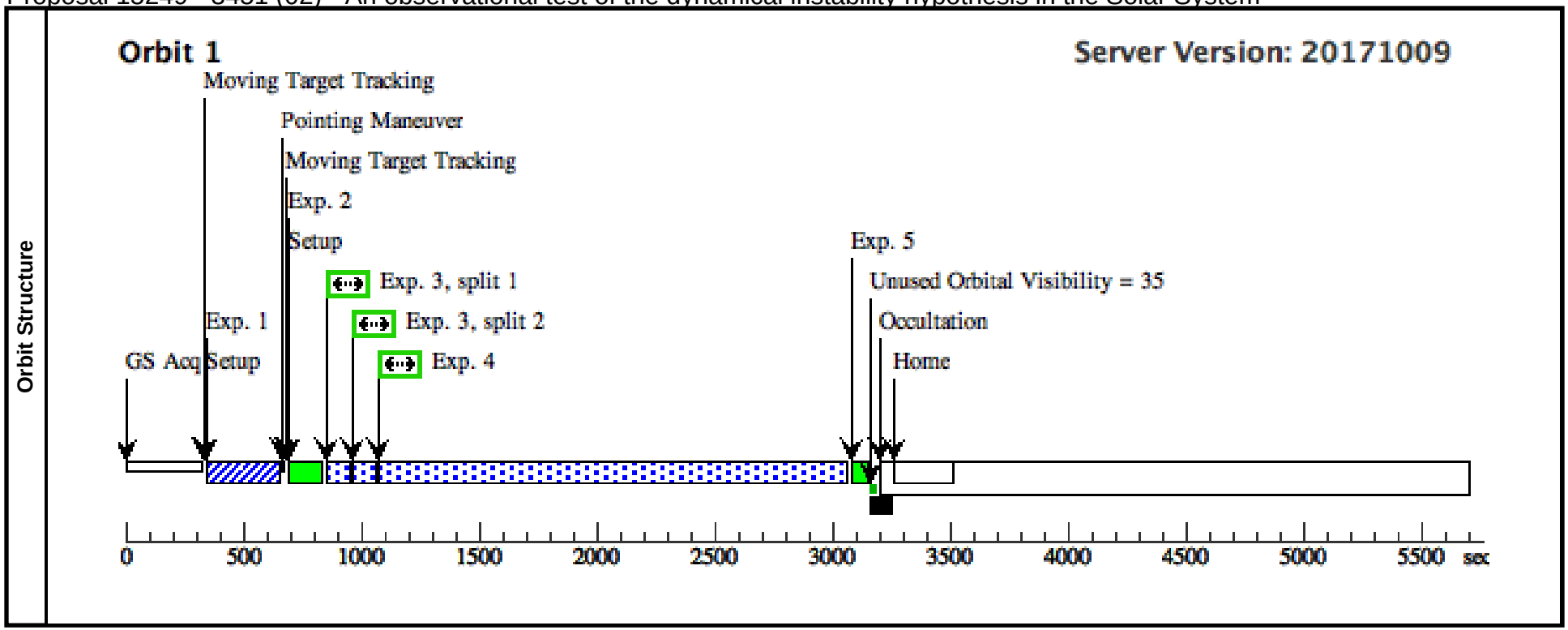
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	3451	TYPE=ASTEROID,A=5.112538606970747,E=0.07273377412577345,I=24.6919631935671,O=179.7350158862094,W=131.3185979626035,M=31.88554467267942,EQUINOX=J2000,EPOCH=24-AUG-2011:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(2) 3451	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	***[1]***
2	CCDwavecal	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	***[1]***
3	CCDscience	(2) 3451	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2; WAVECAL=NO; SIZEAXIS2=120			180 Secs (180 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
4	MAMAScience (STIS.sp.1011957)	(2) 3451	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO; BINAXIS1=YES; BINAXIS2=YES			1820 Secs (1820 Secs) *[==>]*	***[1]***
5	MAMAwavecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20171009
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Exp. 2
Setup
Exp. 3, split 1
Exp. 3, split 2
Exp. 4
Exp. 1
GS Acq Setup
Exp. 5
Unused Orbital Visibility = 35
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15249, 659 (03), implementation Thu May 10 00:04:17 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 04-JUN-2018:00:00:00 AND 04-AUG-2018:00:00:00

Diagnostics

(659 (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Solar System Targets

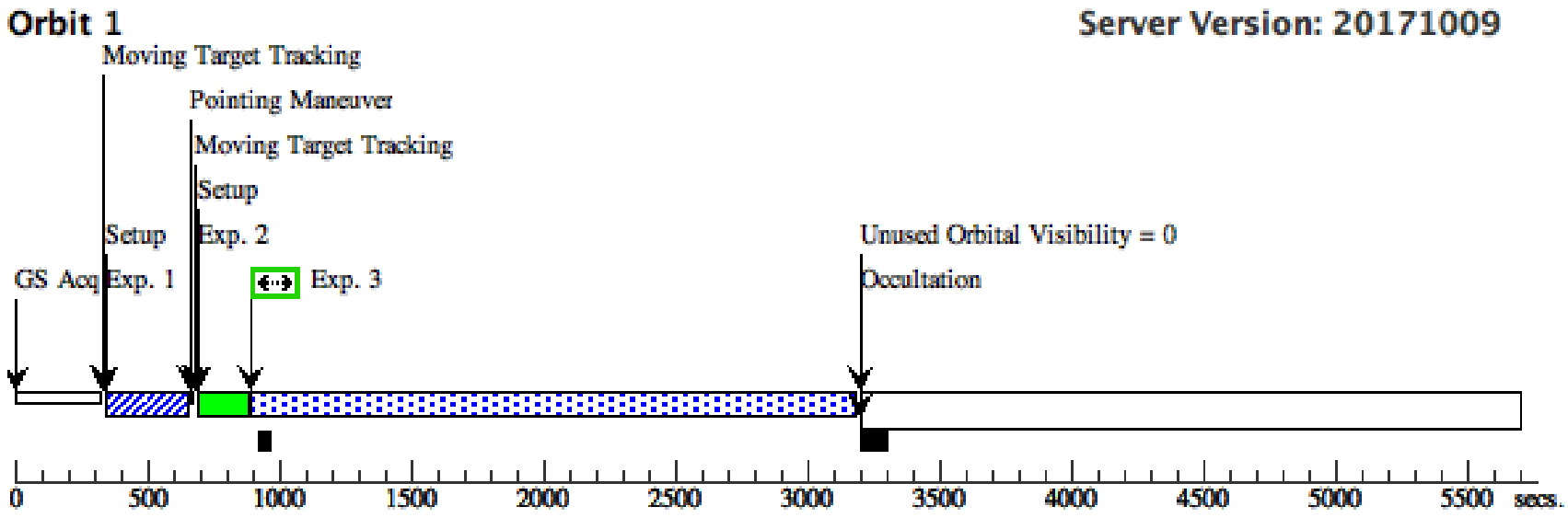
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	659	TYPE=ASTEROID,A=5.188694498473398,E=0.1155298393340581,I=4.52091114237396,O=350.8633704121841,W=342.4576456464608,M=81.15977816176995,EQUINOX=J2000,EPOCH=15-OCT-2010:00:00:00,EpochTimeScale=TDB				EARTH

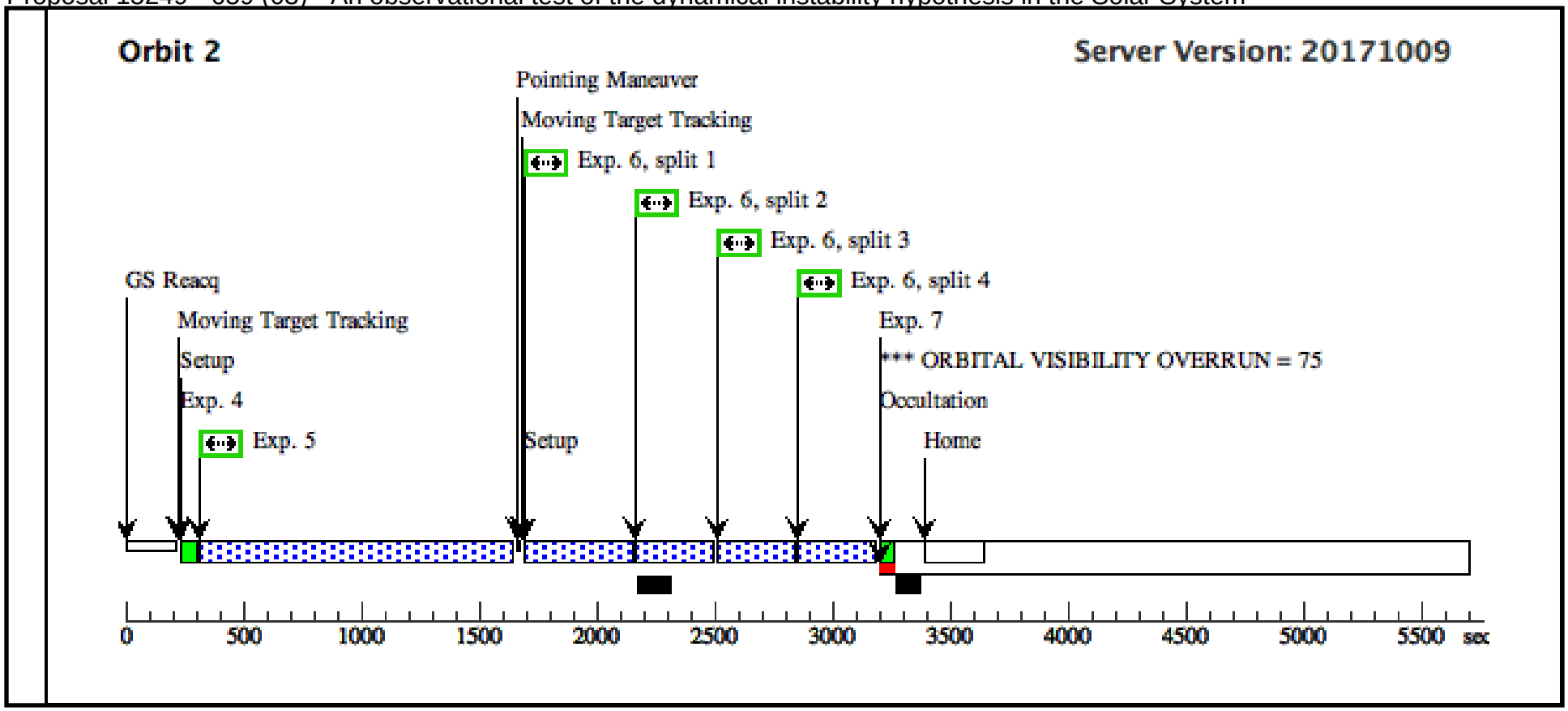
Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(3) 659	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	***[1]***
2	MAMAwavecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[1]***
3	MAMAscience (STIS.sp.1011967)	(3) 659	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO			2276 Secs (2276 Secs) *[==>]*	***[1]***
4	MAMAwavecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[2]***
5	MAMAscience (STIS.sp.1011967)	(3) 659	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO			1317 Secs (1317 Secs) *[==>]*	***[2]***
6	CCDscience	(3) 659	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=4; WAVECAL=NO			1200 Secs (1200 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[2]***
7	CCDwavecal	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20171009
Pointing Maneuver
Moving Target Tracking
Exp. 6, split 1
Exp. 6, split 2
Exp. 6, split 3
Exp. 6, split 4
Exp. 7
*** ORBITAL VISIBILITY OVERRUN = 75
Occultation
Home
GS Reacq
Moving Target Tracking
Setup
Exp. 4
Exp. 5
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15249, 624 (04), implementation Thu May 10 00:04:17 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 04-JUL-2018:00:00:00 AND 19-SEP-2018:00:00:00

Diagnostics

(624 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

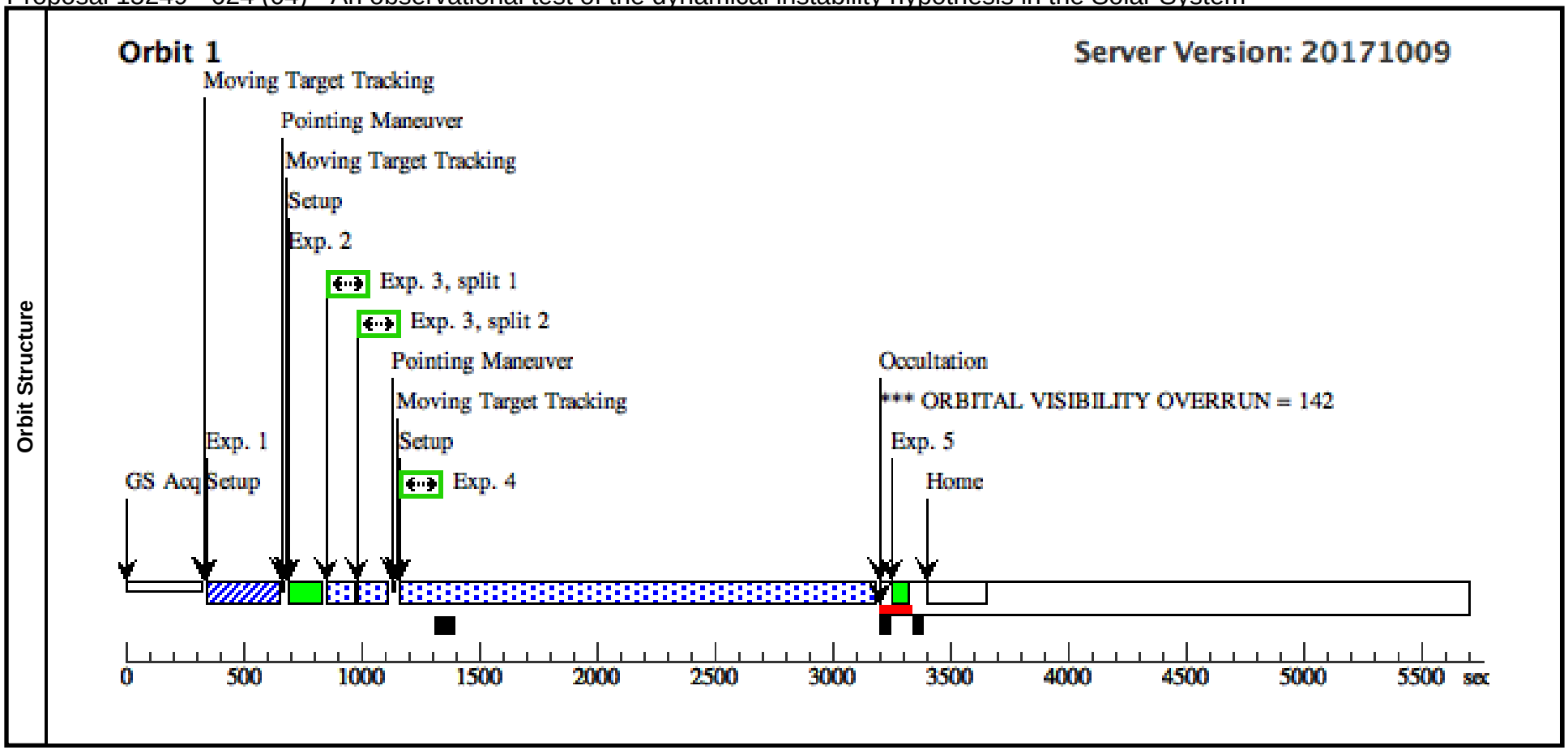
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	624	TYPE=ASTEROID,A=5.230512653197949,E=0.0228792278641838,I=18.18760284338413,O=342.8071355844293,W=184.8732525052816,M=186.8097363865895,EQUINOX=J2000,EPOCH=27-NOV-2007:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(4) 624	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	*[1]*
2	CCDwaveca l	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	*[1]*
3	CCDscience	(4) 624	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=2; WAVECAL=NO			180 Secs (180 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	*[1]*
4	MAMAScie nce (STIS.sp.10 11971)	(4) 624	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO; BINAXIS1=YES; BINAXIS2=YES			1853 Secs (1853 Secs) *[==>]*	*[1]*
5	MAMAwav ecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	*[1]*


Orbit Structure
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Server Version: 20171009
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 2
Exp. 3, split 1
Exp. 3, split 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 4
Occultation
*** ORBITAL VISIBILITY OVERRUN = 142
Exp. 5
Home
Exp. 1
GS Acq Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15249, 911 (05), implementation Thu May 10 00:04:17 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 09-JUN-2018:00:00:00 AND 10-SEP-2018:00:00:00

Diagnostics

(911 (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

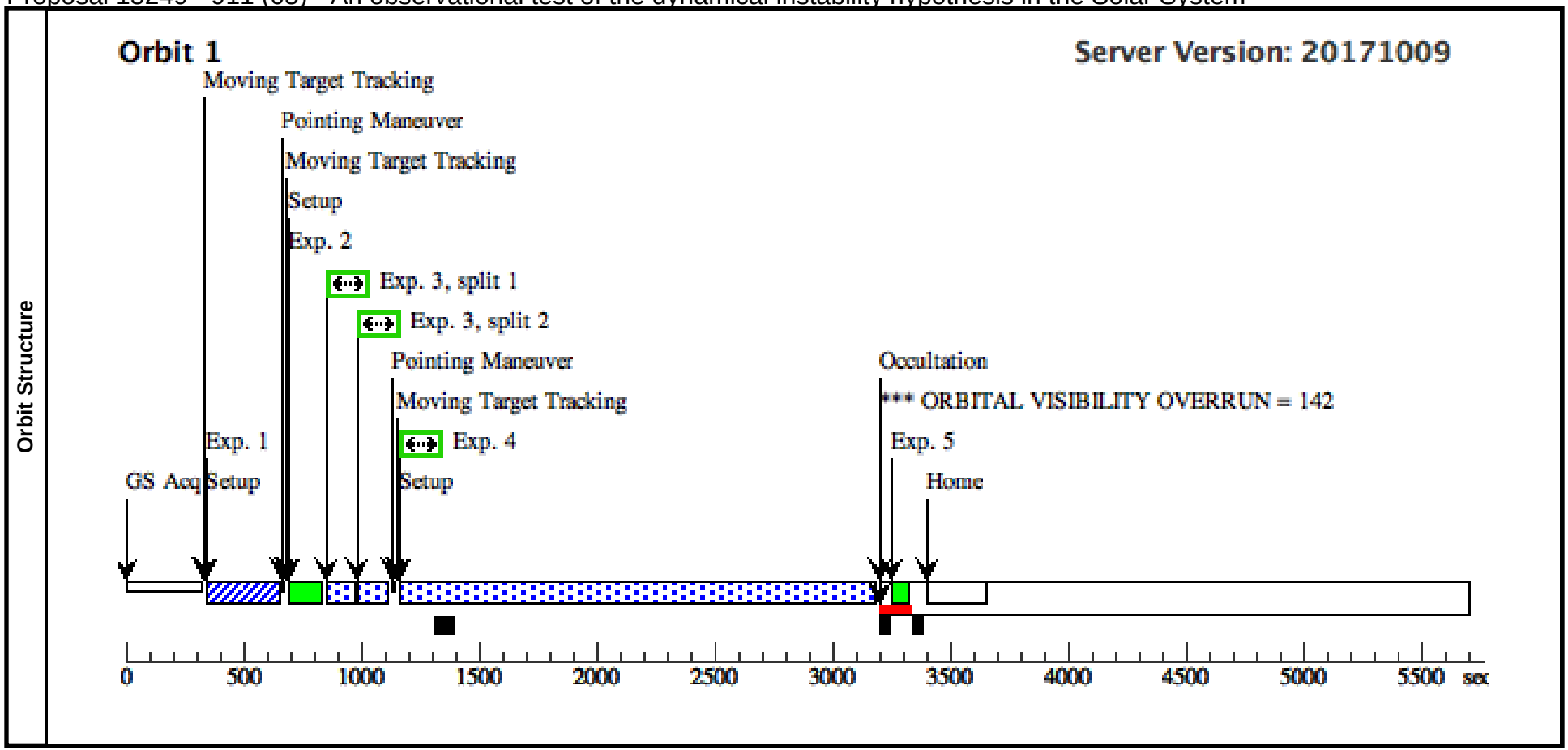
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	911	TYPE=ASTEROID,A=5.25843204129491,E=0.06674871651864867,I=21.78111098287296,O=338.0213980243912,W=79.93752395121545,M=322.9676482457472,EQUINOX=J2000,EPOCH=12-JAN-2009:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(5) 911	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	***[1]***
2	CCDwavecal	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	***[1]***
3	CCDscience	(5) 911	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=2; WAVECAL=NO			180 Secs (180 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
4	MAMAScience (STIS.sp.1011975)	(5) 911	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO; BINAXIS1=YES; BINAXIS2=YES			1853 Secs (1853 Secs) *[==>]*	***[1]***
5	MAMAwavecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20171009
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 2
Exp. 3, split 1
Exp. 3, split 2
Pointing Maneuver
Moving Target Tracking
Exp. 4
Setup
Occultation
*** ORBITAL VISIBILITY OVERRUN = 142
Exp. 5
Home
Exp. 1
GS Acq Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15249, 1143 (06), implementation Thu May 10 00:04:17 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 10-JUN-2018:00:00:00 AND 13-AUG-2018:00:00:00

Diagnostics

(1143 (06)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

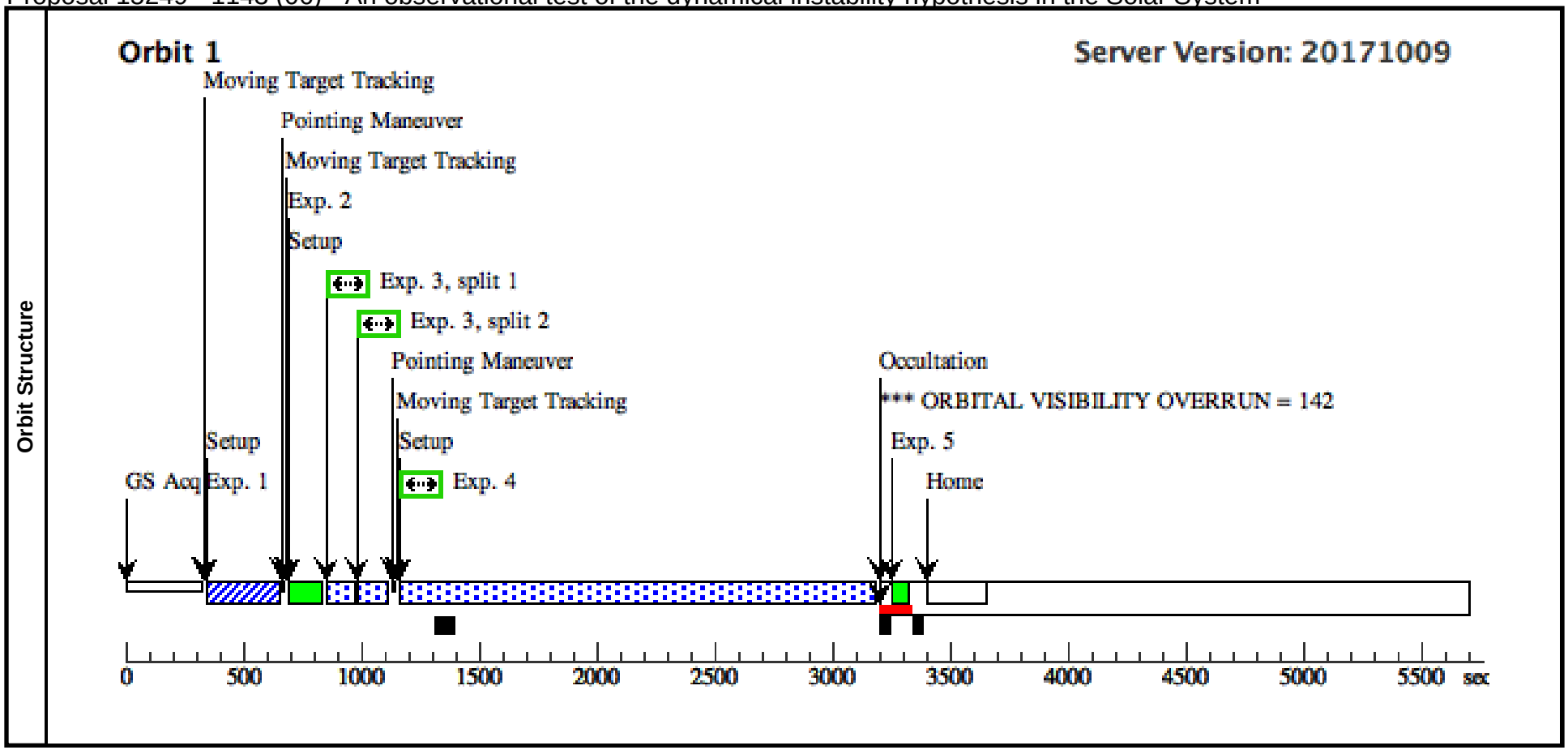
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(6)	1143	TYPE=ASTEROID,A=5.25798935678 2309,E=0.09124805333240484,I=3.13 5184279117223,O=221.296950208084 2,W=235.1547662909868,M=272.370 0881440353,EQUINOX=J2000,EPOC H=13-FEB-2009:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(6) 1143	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs) *[==>]*	***[1]***
2	CCDwaveca l	WAVE	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				*[==>]*	***[1]***
3	CCDscience	(6) 1143	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=2; WAVECAL=NO			180 Secs (180 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
4	MAMAScie nce (STIS.sp.10 11976)	(6) 1143	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A	WAVECAL=NO; BINAXIS1=YES; BINAXIS2=YES			1853 Secs (1853 Secs) *[==>]*	***[1]***
5	MAMAwav ecal	WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20171009
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Exp. 2
Setup
Exp. 3, split 1
Exp. 3, split 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 4
Occultation
*** ORBITAL VISIBILITY OVERRUN = 142
Exp. 5
Home
Setup
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec