16077 - Determining the cause of activity of the first active Trojan, 2019 LD2

Cycle: 27, 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?*
01	(1) 2019LD2	WFC3/UVIS	1	07-Apr-2020 17:02:41.0	yes
02	(1) 2019LD2	WFC3/UVIS	1	07-Apr-2020 17:02:43.0	yes
03	(1) 2019LD2	WFC3/UVIS	1	07-Apr-2020 17:02:44.0	yes

3 Total Orbits Used

ABSTRACT

We request three orbits of observing time to study the recently discovered activity of 2019 LD2, the first Jupiter Trojan asteroid observed to have a comet-like, active appearance. Dynamical models predict that most Trojan Asteroids originated in the TransNeptunian belt and should, therefore, contain volatiles that should be active at the present-day heliocentric distances of the Trojans. The main objective of this program is to observe the coma and near-nucleus region of 2019 LD2 to constrain the cause of its activity as to whether caused by the sublimation of volatiles as the origins of Trojans might suggest, or if the activity is caused by impact or rotational disruption. Thus we will be constraining the possible volatile content of Trojan asteroids by studying 2019 LD2 with HST. We will accomplish this goal by using the high-resolution capabilities to observe the dust behavior

of 2019 LD2 and its evolution as it approaches perihelion in March and April 2020 where the sublimation of volatiles is expected to increase and when the orbital plane angle is minimized allowing for the measurement of the perpendicular velocity component of the ejected dust. We will also constrain the 2019 LD2's nucleus size using the advanced high-resolution capabilities of HST. The discovery and confirmation of the activity of 2019 LD2 did not occur until after the regular GO proposal deadline and waiting for cycle 28 will mean the dispersal of dust diagnosing the activity by Solar Radiation pressure. The detection of volatile-driven activity on the first known active Trojan will be tremendously exciting and will be useful for leveraging subsequent observations of this novel type of object.

OBSERVING DESCRIPTION

We request a total of three visits each consisting of 1 orbit to characterize the coma of 2019 LD2 with WFC3/UVIS at three different epochs around when the Earth crosses its orbital plane during the first week of April 2020, a few weeks after perihelion passage of this comet on 2020 April 4 UTC and a few weeks to a month after the second visit. Our observation dates for the last two observations are flexible, but we require stricter scheduling for the first observation at around the orbital plane crossing during early April for our science goal of measuring the dust ejection velocity. We will acquire images in the F350LP filter for a maximum throughput of a Solar-like source which is expected for 2019 LD2. Each visit will consist of five 380 s exposures using the F350LP filter and the UVIS2 detector set up. This filter gives us the maximum throughput enabled by WFC3/UVIS in the 300 nm - 800 nm wavelength range for a Solar-like source which is expected of Solar System objects while allowing for a 0.04" pixel scale. We will use the methodology of Jewitt et al. 2020 for color calibrations of the F350LP filter observations. This will give us a total exposure time of 1900 s while also providing image stacks robust to cosmic-rays. We will use line dithering to reduce the noise from flat-field calibration errors, cosmic rays, and residual images.

We also request moving object support due to the nature of the target. 2019 LD2's apparent motion rate is currently ~25"/hr, which is well within the tracking capability of HST. According to the ephemerides provided by the JPL HORIZONS system (on 2019-10-08 UT), the positional uncertainty of 2019 LD2 is less than a few arcseconds in early April 2020, and should not pose any problem to the pointing. We understand that we have no control over the spacecraft roll angle and will plan our observations so that they place the target within the center of the UVIS2 chip so that the entire extent of the target will appear in the chip regardless of roll angle.

Visit

Proposal 16077, Visit 01, completed Tue Apr 07 21:02:44 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 15-MAR-2020:00:00:00 AND 04-APR-2020:00:00:00

Comments: I have a strong preference for this observations being carried out as soon as possible so that we can observe as close as possible to the orbital plane crossing occuring in the last week of March.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 01) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=CELESTIAL		(1)
	Purpose=OTHER	Pattern Orientation=0		
	Number Of Points=5	Angle Between Sides=		
	Point Spacing=0.03	Center Pattern=true		
	Line Spacing=			

Solar System Targets

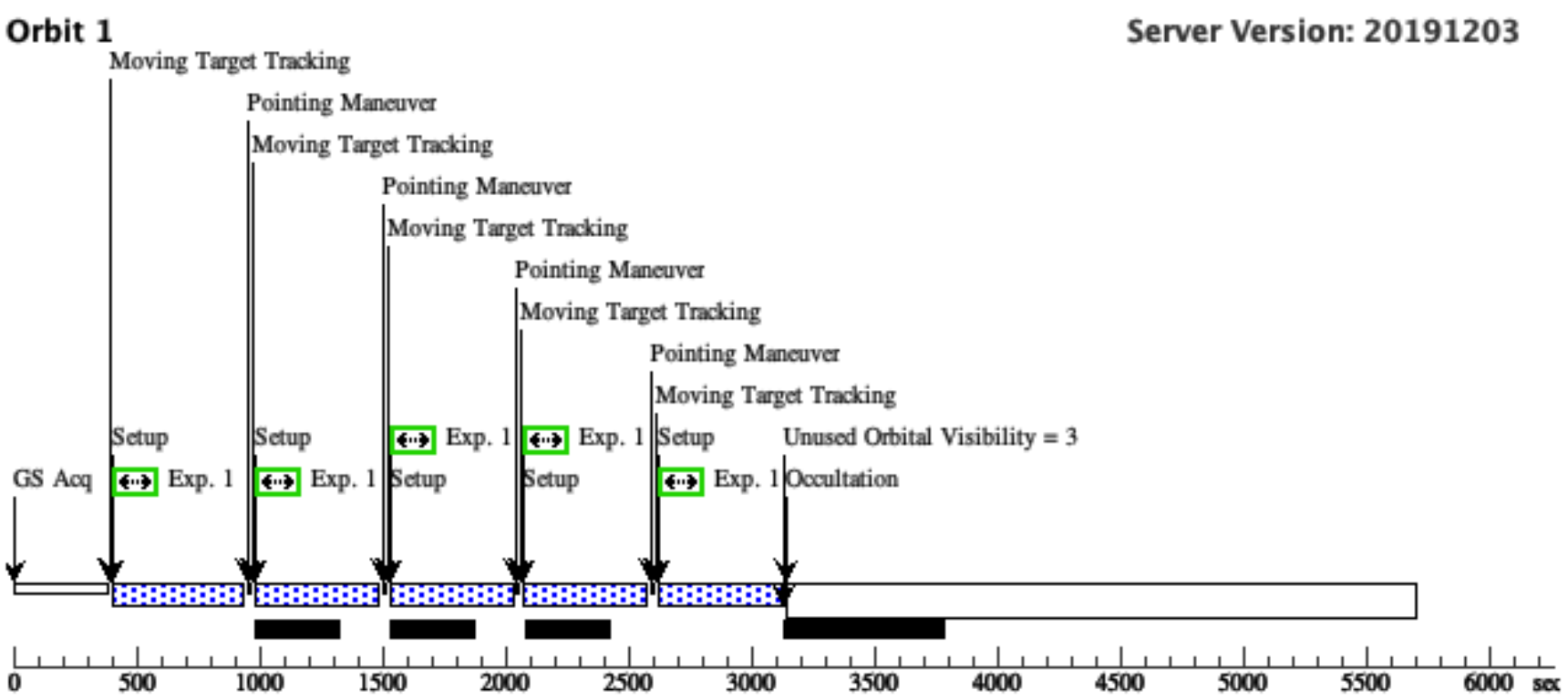
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2019LD2	TYPE=COMET,Q=4.581143657178035,E=0.1462955970904501,I=11.54447123343416,O=181.0493574718406,W=120.7533777397608,T=27-MAR-2020:01:04:37,TTimeScale=TDB,EQUINOX=J2000,EPOCH=20-NOV-2018:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=2019_LD2
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2019LD2	WFC3/UVIS, ACCUM, UVIS2	F350LP		POS TARG 0.099,0.106	Pattern 1, Exps 1-1 in Visit 01 (1)	380 Secs (1925 Secs)	
								[==>385.0 Secs (Pattern 1)]	
								[==>385.0 Secs (Pattern 2)]	
								[==>385.0 Secs (Pattern 3)]	***[1]***
								[==>385.0 Secs (Pattern 4)]	
								[==>385.0 Secs (Pattern 5)]	

Orbit Structure



Visit

Proposal 16077, Visit 02, implementation Tue Apr 07 21:02:44 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 08-MAY-2020:00:00:00 AND 12-JUN-2020:00:00:00

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 02) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=CELESTIAL		(1)
	Purpose=OTHER	Pattern Orientation=0		
	Number Of Points=5	Angle Between Sides=		
	Point Spacing=0.03	Center Pattern=true		
	Line Spacing=			

Solar System Targets

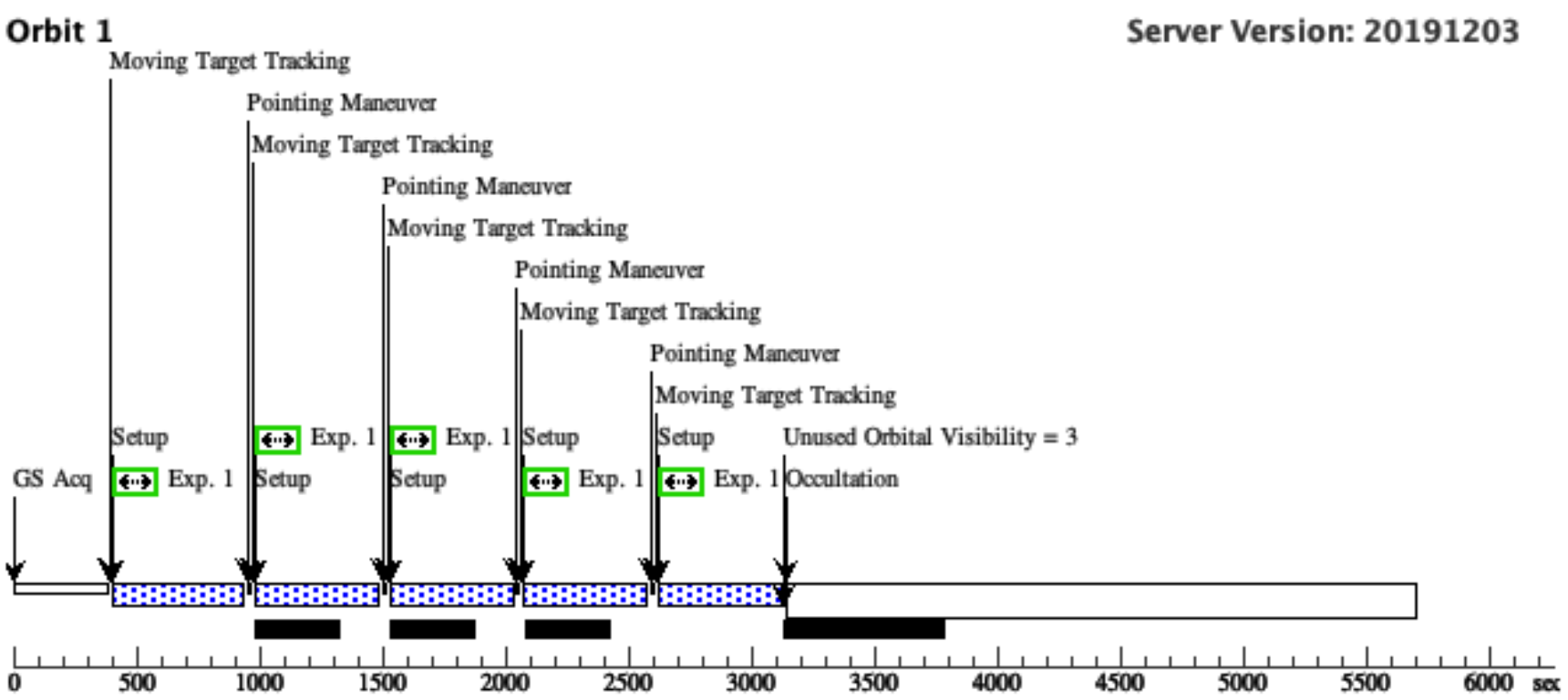
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2019LD2	TYPE=COMET,Q=4.581143657178035,E=0.1462955970904501,I=11.54447123343416,O=181.0493574718406,W=120.7533777397608,T=27-MAR-2020:01:04:37,TTimeScale=TDB,EQUINOX=J2000,EPOCH=20-NOV-2018:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=2019_LD2
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2019LD2	WFC3/UVIS, ACCUM, UVIS2	F350LP		POS TARG 0.297,0.318	Pattern 1, Exps 1-1 in Visit 02 (1)	380 Secs (1925 Secs)	
								[==>385.0 Secs (Pattern 1)]	
								[==>385.0 Secs (Pattern 2)]	
								[==>385.0 Secs (Pattern 3)]	***[1]***
								[==>385.0 Secs (Pattern 4)]	
								[==>385.0 Secs (Pattern 5)]	

Orbit Structure



Visit

Proposal 16077, Visit 03, implementation Tue Apr 07 21:02:44 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 18-JUL-2020:00:00:00 AND 20-AUG-2020:00:00:00

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 03) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=CELESTIAL		(1)
	Purpose=OTHER	Pattern Orientation=0		
	Number Of Points=5	Angle Between Sides=		
	Point Spacing=0.03	Center Pattern=true		
	Line Spacing=			

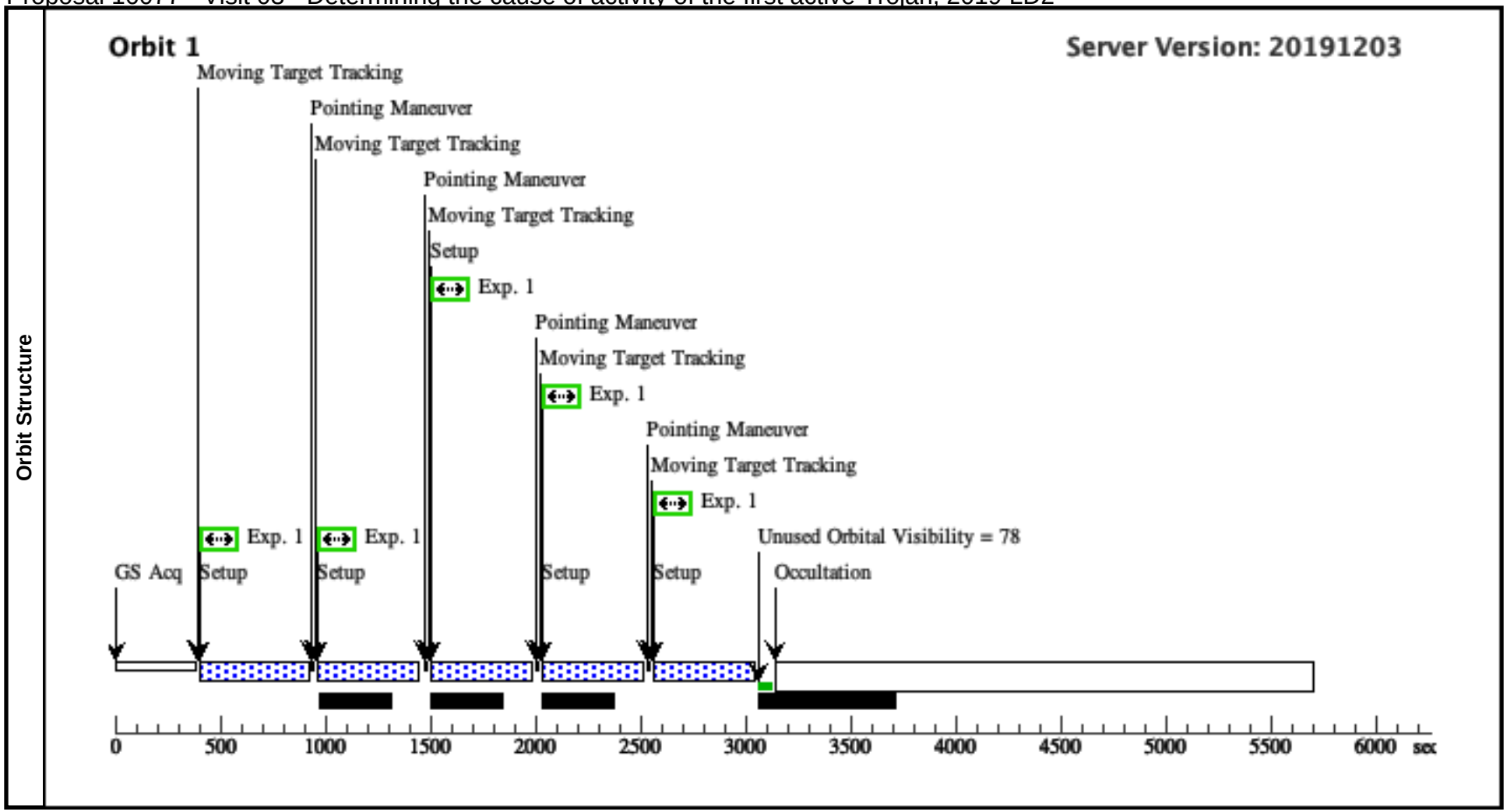
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2019LD2	TYPE=COMET,Q=4.581143657178035,E=0.1462955970904501,I=11.54447123343416,O=181.0493574718406,W=120.7533777397608,T=27-MAR-2020:01:04:37,TTimeScale=TDB,EQUINOX=J2000,EPOCH=20-NOV-2018:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=2019_LD2
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2019LD2	WFC3/UVIS, ACCUM, UVIS2	F350LP		POS TARG 0.198,0.212	Pattern 1, Exps 1-1 in Visit 03 (1)	380 Secs (1850 Secs)	
								[==>370.0 Secs (Pattern 1)]	
								[==>370.0 Secs (Pattern 2)]	
								[==>370.0 Secs (Pattern 3)]	***[1]***
								[==>370.0 Secs (Pattern 4)]	
								[==>370.0 Secs (Pattern 5)]	


Orbit Structure
Orbit 1
Server Version: 20191203
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 1
Pointing Maneuver
Moving Target Tracking
Exp. 1
Pointing Maneuver
Moving Target Tracking
Exp. 1
Exp. 1
Exp. 1
Unused Orbital Visibility = 78
GS Acq
Setup
Setup
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec