15342 - Active Asteroids Target of Opportunity P/2017 S5

Cycle: 25, 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) P2017S5	WFC3/UVIS	1	02-Aug-2018 17:42:02.0	yes
02	(1) P2017S5	WFC3/UVIS	1	02-Aug-2018 17:42:03.0	yes

2 Total Orbits Used

ABSTRACT

Active asteroids are a recently discovered solar system population in which diverse mechanisms generate unexpected asteroid mass loss. They are interesting scientifically because the mechanisms (rotational disruption, impact, volatile sublimation and others not yet identified) have not previously been observed in the asteroid belt. Our past work with HST has shown that high resolution is crucially important for understanding the properties of the active asteroids. Here, we seek 2 orbits of Target of Opportunity time so that we can quickly respond to a new active asteroid

discovery, obtain and initial assessment of its properties and rates of change, and then make an evidence-based decision about the need for requesting more time in order to understand the object. The orbit of new active asteroid P/2017 S5 was just established using new and prediscovery observations. It is in the outer belt and has a Tisserand parameter 3.09, which exceeds our targeting criterion. It has the additional benefit of being dynamically stable and a member of a known asteroid family.

OBSERVING DESCRIPTION

This proposal extends our very productive HST target-of-opportunity (ToO) program to explore the active asteroids. We here request 2 ToO orbits to be used to characterize the early-time morphology (at 60 km/pixel at 2 AU geocentric distance) and establish the initial rates of change in the appearance. The first orbit would be scheduled as soon as possible after the discovery of the target active asteroid. The second should be scheduled 1 to 2 weeks after the first, to assess the nature and rates of change in the morphology and photometry. The two visits together will allow us to make a rational decision about the need for (and type of) further observations with HST. If needed, additional time will be requested through a different (Director's Discretionary Time) route. The advantage in having an allocated ToO proposal (as opposed to requesting DDT once a new object is discovered) is to reduce the lead time before the first observations are secured. From experience, DDT proposals incur a 4 to 5 week delay from the time of request, owing to the need to secure community reviews and make a determination. We can be on-target in less than half this time by having a ToO program at the ready. These savings can be crucial in determining the early-time behavior of the object, and in planning additional observations. On the other hand, immediate (few days) observations would in most cases be overkill. Accordingly, we request a non-disruptive Target of Opportunity program, which will not require heroic scheduling. Our basic observing strategy is to take multiple long exposures (348 s) using WFC3 and a wide bandpass filter (F350LP) for maximum sensitivity. If the nucleus is bright, we also plan some shorter exposures, possibly with a filter having a narrower bandpass (e.g., F621M). Asteroid Scheila, with its ultra-bright nucleus V=13.7, represents an end-member case. We used an exposure time of 4 s with the F621M filter to obtain S/N=200 on the nucleus itself in search of structure at 100 km scales. We used long exposures of 390s through the F606W filter to provide a deep search for debris. The F350LP filter provides an 1.6 higher count rate for a target with a solar-type spectrum, so we plan to use it in cycle 25. If the target requires two different exposure times (Scheila did, but other active asteroids did not), and has a sufficiently accurate ephemeris, we plan to use the M1K1C-SUB subarray aperture for the short exposures (only the region around the nucleus is important in this case, and using the subarray prevents the loss of observing efficiency associated with CCD memory dumps) and the full UVIS aperture for the long exposures. We also plan to dither the exposures to mitigate the effects from bad pixels, cosmic rays, and the inter-chip gap. Main-belt targets have apparent rates of motion typically less than 50 arcsec/hr, which are easily within Hubble's tracking capabilities. This rate of motion is also slow enough to keep a single pair of guide stars within the FGS pickles for an entire visibility window. The ephemeris uncertainty of numbered asteroids is negligible (sub-arcsecond), compared to the WFC3 field-of-view of 162x162 arcsec. For newly discovered objects the

uncertainty can be larger but, as we showed even for the low surface brightness and morphologically complex example set by P/2010 A2, attaining 1 to 2 arcsec accuracy is straightforward. Ephemeris issues are of no concern to this observation. We understand that we may have essentially no control over the spacecraft roll angle, which means we will not be able to optimize the orientation of the dust tail on the CCD (i.e., to orient the tail along the longest dimension of the detector). However, the field-of-view of the camera is large enough that we should obtain excellent data on a portion of the tail, no matter what spacecraft roll angle is used. Finally, we note that our team can prepare and submit a revised Phase 2 proposal within a day of activation of this ToO program. The trigger for these observations is the discovery of an object in the main-belt having a Tisserand parameter with respect to Jupiter TJ > 3.08 (Jewitt et al. 2015) and showing a coma or tail. Comets have TJ < 3, asteroids have TJ > 3. The parameter is useful only in the context of the circular, restricted three-body approximation. As a result, objects with TJ very close to 3 can be either cometary or asteroidal in nature. In practice, we take TJ > 3.08 as the dividing line, since objects with larger TJ cannot be dynamically linked to the classical comets. The Tisserand constraint is quite stringent, and avoids any possibility of confusion with classical comets. With one exception, the known active asteroids have been discovered serendipitously by sky surveys conducted for other purposes. We expect this mode of discovery to continue, and we estimate that the probability that an MBC will be discovered in the next HST Cycle is 75% to 100%.

The orbit of new active asteroid P/2017 S5 was just established using new and prediscovery observations. It is in the outer belt and has a Tisserand parameter 3.09, which exceeds our targeting criterion. It has the additional benefit of a numerical integration by Novakovic, showing that it is dynamically stable and a member of a known asteroid family. The magnitude is approximately V = 18 to 19 (diffuse). These properties make it the ideal target for our program. Two consecutive orbits would be ideal. If a gap between them is necessary, so be it. Observations as soon as practical are desired. The observing window opens September 6 when P/2017 S5 comes out of the 50 degree Sun exclusion zone. This is close to the nominal end of Cycle 25 but, if it is necessary to take data in October because September is impossible, we would be happy with that. Too long a delay, however, risks the possibility that the activity will subside before we take data.

Visit

Proposal 15342, Visit 01, implementation Thu Aug 02 21:42:04 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SEQ 01,02 WITHIN 3 H

Diagnostics

(Exposure 1 (Visit 01)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(Exposure 3 (Visit 01)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

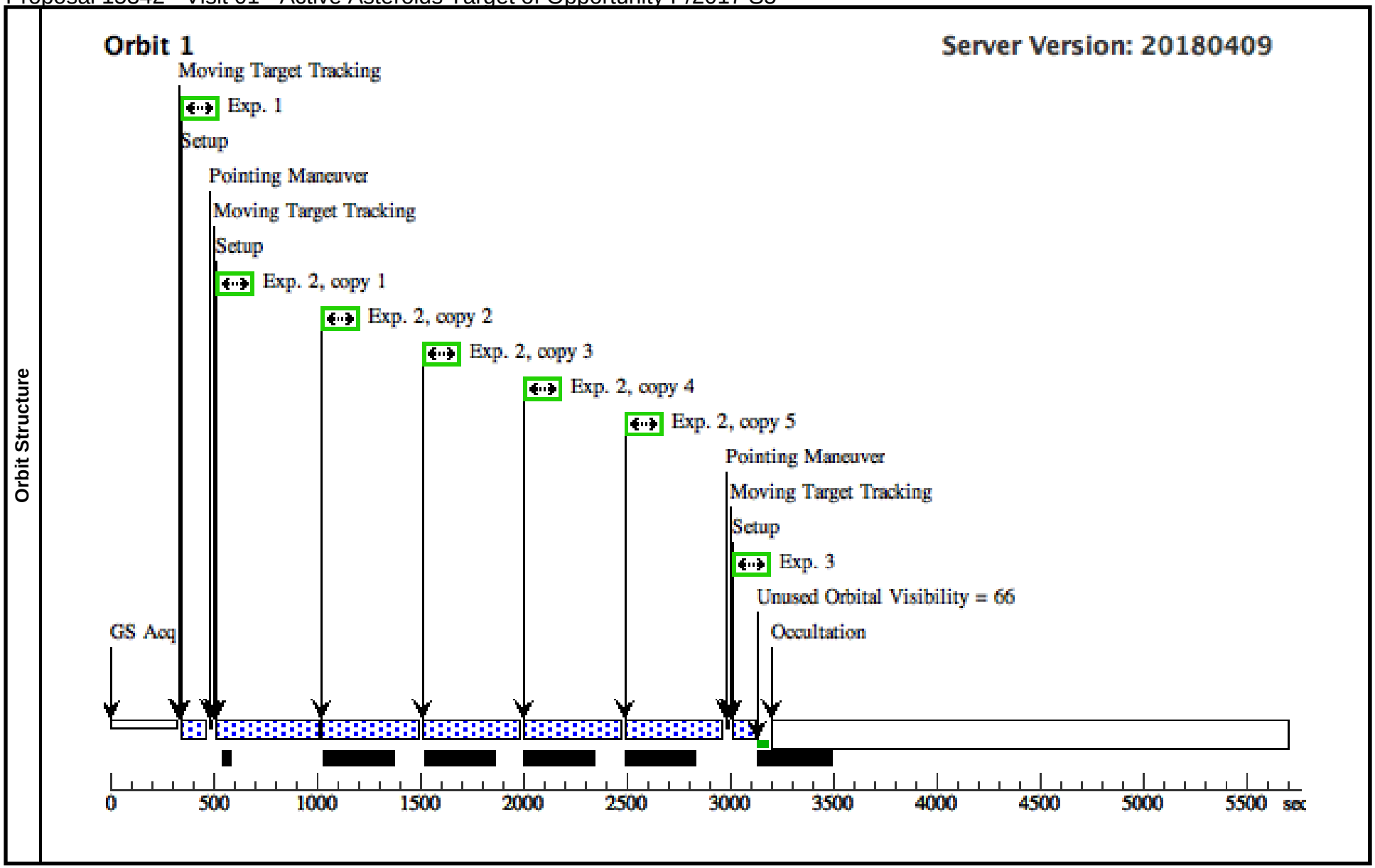
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	P2017S5	TYPE=COMET,Q=2.178128635831613,E=0.3131090886136528,I=11.84911189109378,O=252.3925621657555,W=99.91774755650221,T=27-JUL-2017:22:56:03,TTimeScale=TDB,EQUINOX=J2000,EPOCH=24-OCT-2017:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=Main Belt Comet, active asteroid

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F621M	CR-SPLIT=NO			10 Secs (10 Secs)	
								[==>]	***[1]***
2		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO			360 Secs X 5 (1800 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]*	***[1]***
3		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F621M	CR-SPLIT=NO			10 Secs (10 Secs)	
								[==>]	***[1]***


Orbit 1
Server Version: 20180409
Orbit Structure
Moving Target Tracking
Exp. 1
Setup
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 3
Unused Orbital Visibility = 66
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15342, Visit 02 Thu Aug 02 21:42:04 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Visit 02)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(Exposure 3 (Visit 02)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

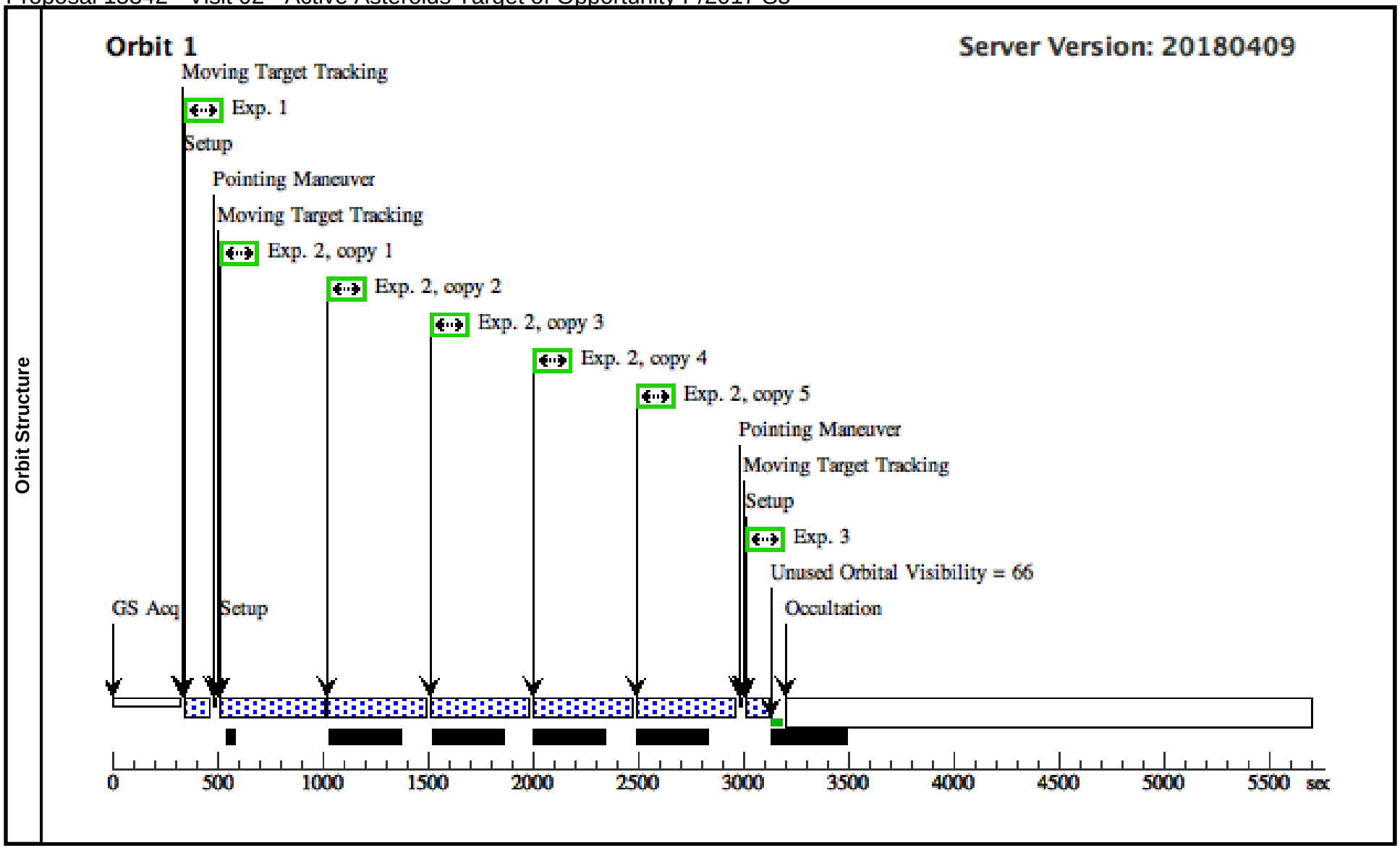
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	P2017S5	TYPE=COMET,Q=2.178128635831613,E=0.3131090886136528,I=11.84911189109378,O=252.3925621657555,W=99.91774755650221,T=27-JUL-2017:22:56:03,TTimeScale=TDB,EQUINOX=J2000,EPOCH=24-OCT-2017:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=Main Belt Comet, active asteroid

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F621M	CR-SPLIT=NO	POS TARG 0.4,0.4		10 Secs (10 Secs)	
								[==>]	***[1]***
2		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO	POS TARG 0.4,0.4		360 Secs X 5 (1800 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]*	***[1]***
3		(1) P2017S5	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F621M	CR-SPLIT=NO	POS TARG 0.4,0.4		10 Secs (10 Secs)	
								[==>]	***[1]***


Orbit 1
Server Version: 20180409
Orbit Structure
Moving Target Tracking
Exp. 1
Setup
Pointing Maneuver
Moving Target Tracking
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 3
Unused Orbital Visibility = 66
GS Acq
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec