



14133 - Establishing an evolutionary sequence for disintegrated minor planets

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. David Polishook (PI) (Contact)	Weizmann Institute of Science	david.polishook@weizmann.ac.il
Dr. Nicholas A. Moskovitz (CoI) (AdminUSPI)	Lowell Observatory	nmosko@lowell.edu
Dr. Seth Andrew Jacobson (CoI) (ESA Member)	Observatoire de la Cote d'Azur	sethajacobson@gmail.com
Dr. Susan D. Benecchi (CoI)	Planetary Science Institute	susank@psi.edu
Dr. Scott Sander Sheppard (CoI)	Carnegie Institution of Washington	sheppard@dtm.ciw.edu

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) 2110	WFC3/UVIS	1	29-Jul-2016 13:07:30.0	yes
02	(2) 5026	WFC3/UVIS	1	29-Jul-2016 13:07:32.0	yes
03	(3) 6070	WFC3/UVIS	1	29-Jul-2016 13:07:34.0	yes
04	(4) 6369	WFC3/UVIS	1	29-Jul-2016 13:07:36.0	yes
05	(5) 8306	WFC3/UVIS	1	29-Jul-2016 13:07:37.0	yes
06	(6) 10123	WFC3/UVIS	1	29-Jul-2016 13:07:39.0	yes

6 Total Orbits Used

ABSTRACT

The exciting HST discovery of the asteroid P/2013 R3 disintegrating into multiple ~100 meter-size bodies (Jewitt et al. 2014) gave us a first "live" glimpse of the formation of a multiple system. The R3 event is explained by the rotational-disruption mechanism while other causes have been

rejected. It is clear that rotational-disruption events contribute to the overall size-frequency distribution of asteroids and are related to the diversity of observed binary and multi-component systems, although different models of disruption have been suggested. We aim to determine if R3-like events are rare by using HST's WFC3/UVIS to observe 6 asteroids known to have recently split ($\sim 10^5$ - 10^6 yr) into at least two objects by the rotational-disruption mechanism. With HST we will search for additional bodies orbiting the larger member of these disrupted asteroid pairs. Finding satellites around known disrupted asteroids will suggest that multi-body disintegration processes are frequent and relevant to binary formation. A null-result will suggest that disintegration events like that of R3 are rare. In addition, both positive or null results will constrain the size distribution of the remnants of rotational-disruption events and will provide a direct probe of asteroids' internal structure and strength.

OBSERVING DESCRIPTION

The goal is to detect satellites around asteroids.

Each visit to a target consists of 12 exposures of 150 sec each using a spiral dither pattern.

Careful characterization of the PSF is essential for resolving faint, close-in companions. The exposures will track at the non-sidereal rates of the asteroid. Dithering between exposures and sets will mitigate the impact of hot pixels and other fixed pattern noise. This observing sequence has been optimized in the APT, minimizing overhead, and will fit within a visibility window of a single orbit.

We need to check the fields for background field stars when the HST windows are selected before they are actually scheduled.

We limit observations to short heliocentric distance and avoid the galactic equator.

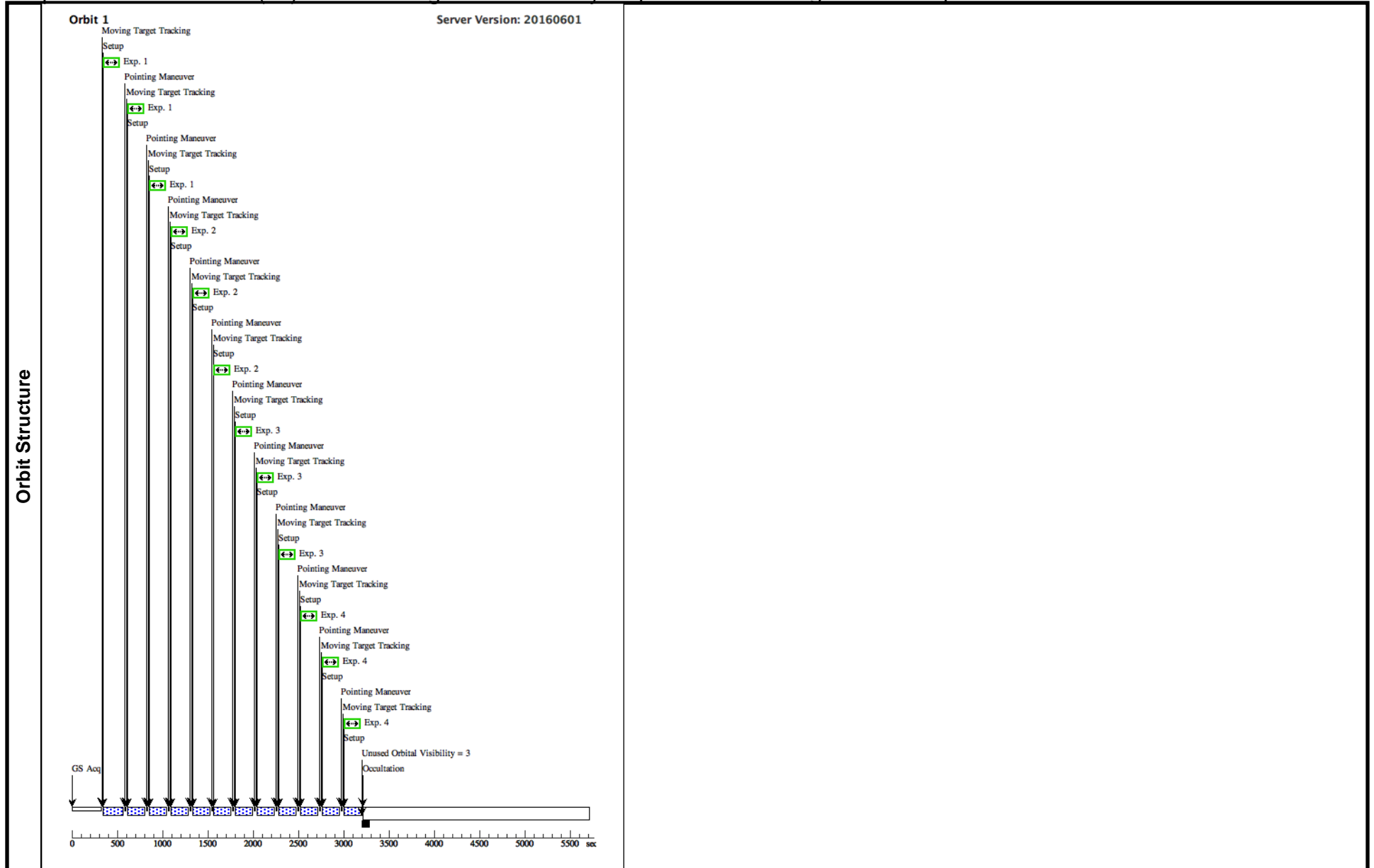
we change the filters according to the object magnitude, while fixing the exposure times and sequences using the following table:

Vmag range	filter	post-FLASH	reduce exptime by
≥ 17.6	F475X	6 e	6 sec
17.1 to 17.5	F475W	9 e	6 sec
16.2 to 17	F850LP	11 e	7 sec
15.4 to 16.1	F336W	12 e	7 sec

Proposal 14133 - V2110 (01) - Establishing an evolutionary sequence for disintegrated minor planets

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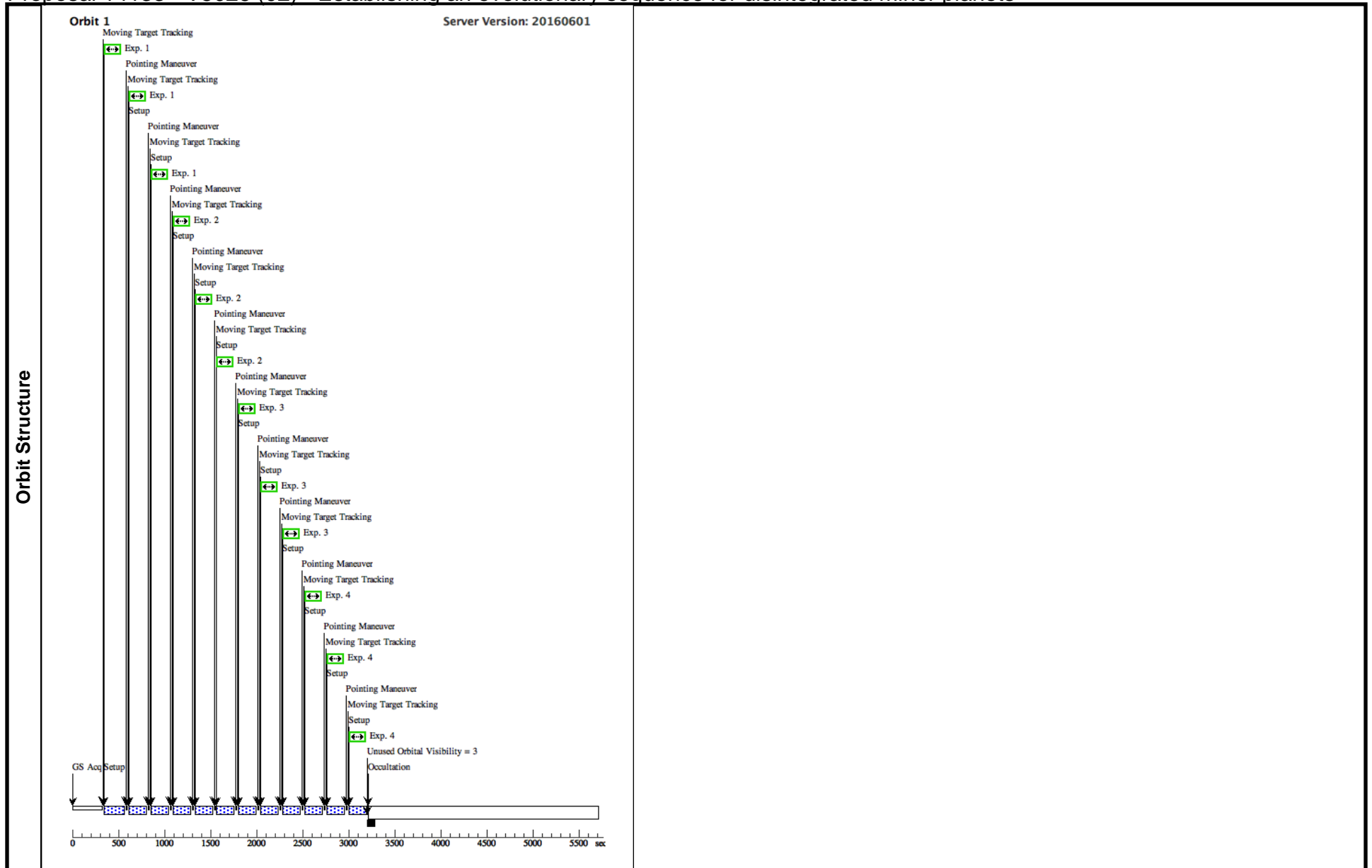
Visit	Proposal 14133, V2110 (01), completed Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 06-JAN-2016:00:00:00 AND 07-MAR-2016:00:00:00 Comments: Date range Jan 6 - Mar 7 Magnitude range 16.41 - 17.32 +- 1/2 amp=0.2. Galaxy lat - 35 - 45 deg Earth dist - 1.58 - 1.72 AU Phase angle 0 - 15 deg									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
(6)		Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=				Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)	
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	2110		TYPE=ASTEROID,A=2.19828083010 1407,E=0.1774794495040591,I=1.129 419708617657,O=140.4369933934491 ,W=192.5865100023737,M=106.8921 178887146,EQUINOX=J2000,EPOCH =11-FEB- 2009:00:00:00,EpochTimeScale=UTC				EARTH		
Comments: Extended=NO										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E2110a	(1) 2110	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=11	POS TARG 0,0	Pattern 6, Exps 1-1 i n V2110 (01) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	2	E2110b	(1) 2110	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=11	POS TARG 0,0.14	Pattern 6, Exps 2-2 i n V2110 (01) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	3	E2110c	(1) 2110	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=11	POS TARG 0,0	Pattern 6, Exps 3-3 i n V2110 (01) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	4	E2110d	(1) 2110	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=11	POS TARG 0,0.14	Pattern 6, Exps 4-4 i n V2110 (01) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]



Proposal 14133 - V5026 (02) - Establishing an evolutionary sequence for disintegrated minor planets

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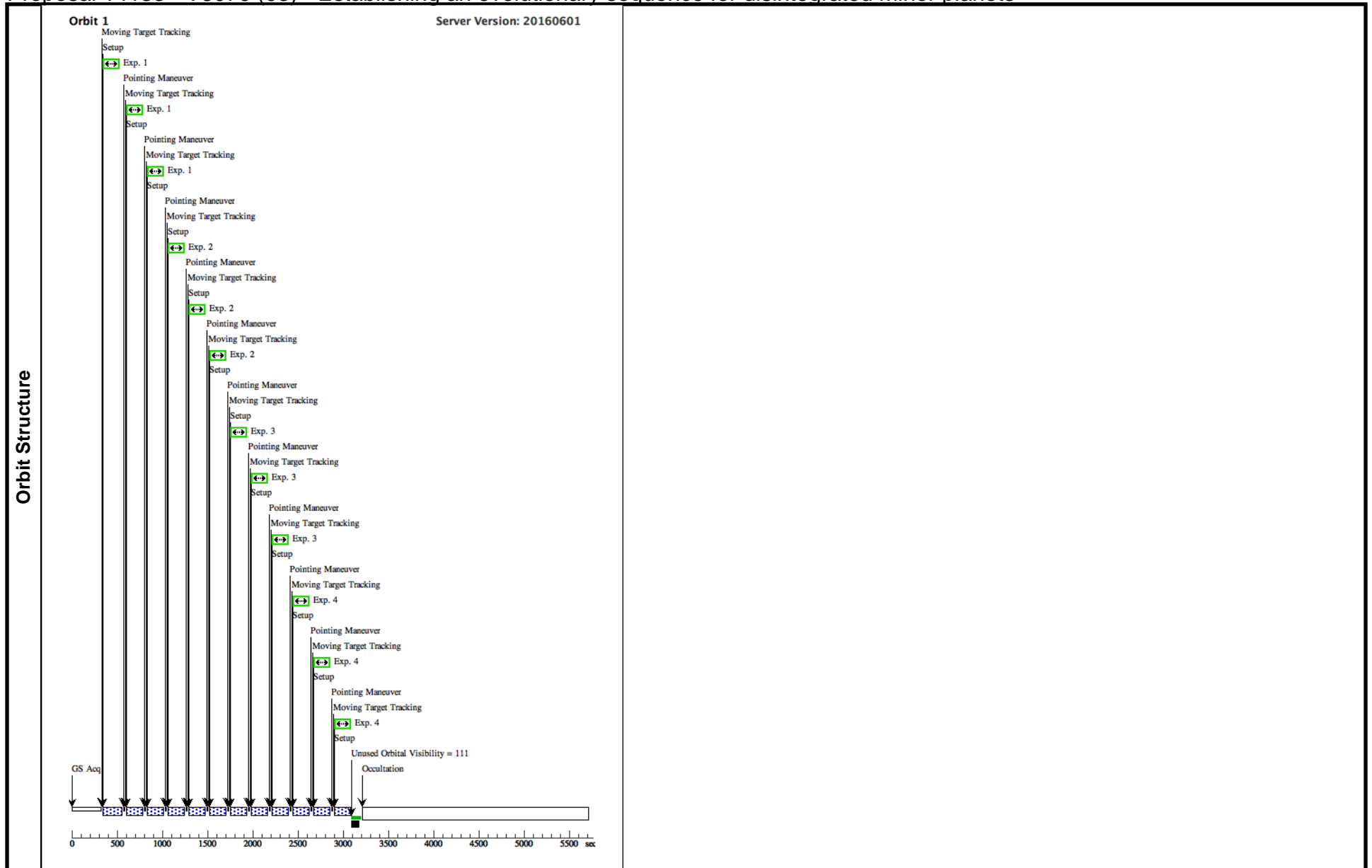
Visit	Proposal 14133, V5026 (02), completed Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 10-MAY-2016:00:00:00 AND 11-JUL-2016:00:00:00 Comments: Date range May 10 - Jul 11 Magnitude range 16.03 - 16.81 +- 1/2 amp=0.3. Galaxy lat - 12 - 22 deg Earth dist - 1.08 - 1.19 AU Phase angle 3 - 11 deg									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
(6)		Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=				Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)	
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(2)	5026		TYPE=ASTEROID,A=2.37687800974 0429,E=0.2423956451833642,I=4.290 177239935781,O=304.8602422548554 ,W=16.97696045339897,M=71.84665 036892254,EQUINOX=J2000,EPOCH =20-APR- 2010:00:00:00,EpochTimeScale=TDT				EARTH		
Comments: Extended=NO										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E5026a	(2) 5026	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F336W	FLASH=12	POS TARG 0,0	Pattern 6, Exps 1-1 i n V5026 (02) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	2	E5026b	(2) 5026	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F336W	FLASH=12	POS TARG 0,0,14	Pattern 6, Exps 2-2 i n V5026 (02) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	3	E5026c	(2) 5026	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F336W	FLASH=12	POS TARG 0,0	Pattern 6, Exps 3-3 i n V5026 (02) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	4	E5026d	(2) 5026	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F336W	FLASH=12	POS TARG 0,0,14	Pattern 6, Exps 4-4 i n V5026 (02) (6)	143 Secs (429 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]



Proposal 14133 - V6070 (03) - Establishing an evolutionary sequence for disintegrated minor planets

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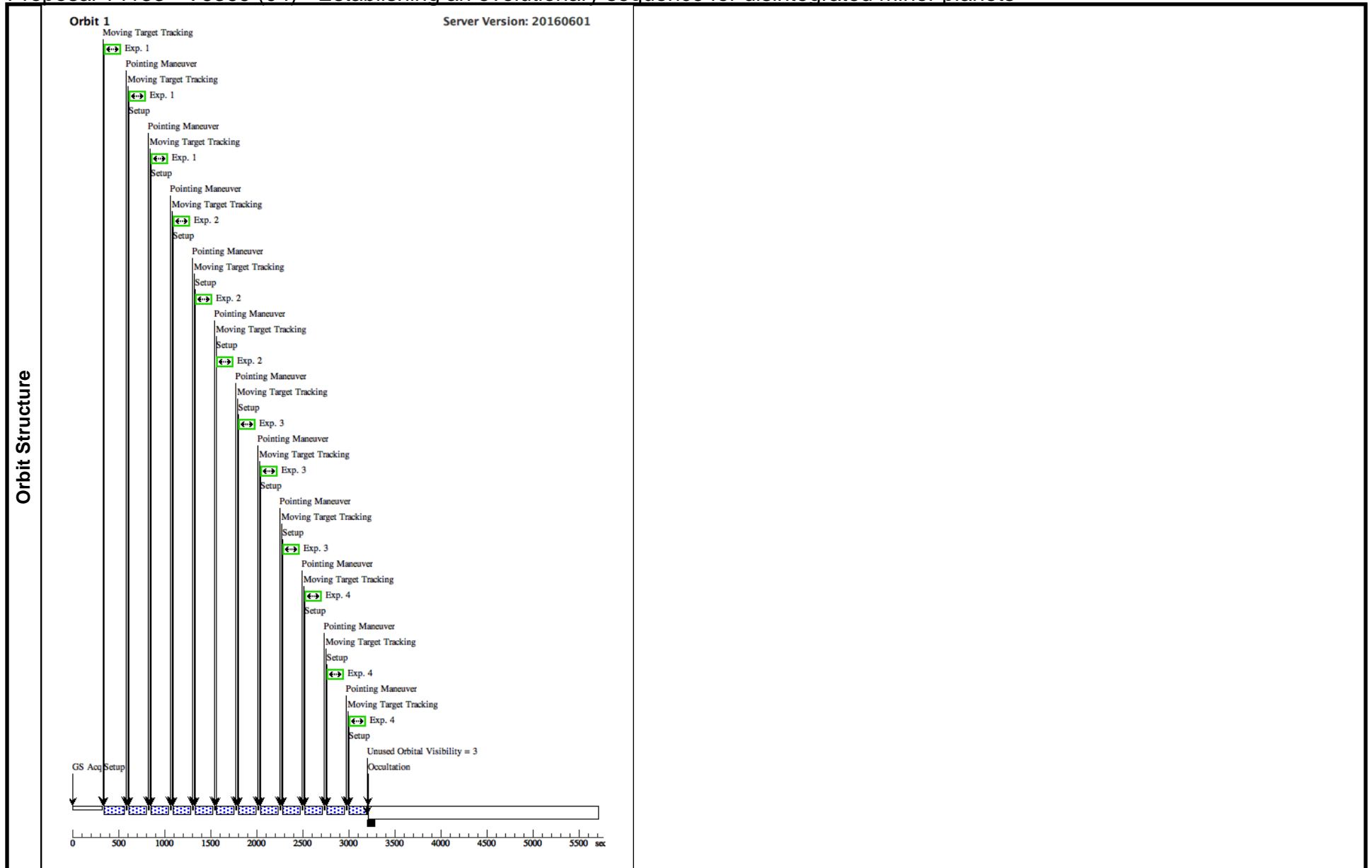
Visit	Proposal 14133, V6070 (03), scheduled Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 27-APR-2016:00:00:00 AND 06-JUL-2016:00:00:00 Comments: Date range Apr 27 - Jul 6 Magnitude range 16.25 - 18.19 +- 1/2 amp=0.3. Galaxy lat - -10 - -15 deg Earth dist - 1.31 - 1.94 AU Phase angle 1 - 23 deg									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
(6)		Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=				Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)	
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(3)	6070		TYPE=ASTEROID,A=2.38834089628 82,E=0.210587042488547,I=3.130958 931019846,O=84.00955757576497,W =292.5320250476903,M=328.7191634 237433,EQUINOX=J2000,EPOCH=1 3-JUL- 2009:00:00:00,EpochTimeScale=UTC				EARTH		
<i>Comments: Extended=NO</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E6070a	(3) 6070	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=12	POS TARG 0,0; GS ACQ SCENARI O BASE1B3	Pattern 6, Exps 1-1 i n V6070 (03) (6)	134 Secs (402 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	2	E6070b	(3) 6070	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=12	POS TARG 0,0.14	Pattern 6, Exps 2-2 i n V6070 (03) (6)	134 Secs (402 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	3	E6070c	(3) 6070	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=12	POS TARG 0,0	Pattern 6, Exps 3-3 i n V6070 (03) (6)	134 Secs (402 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	4	E6070d	(3) 6070	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F850LP	FLASH=12	POS TARG 0,0.14	Pattern 6, Exps 4-4 i n V6070 (03) (6)	134 Secs (402 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]



Proposal 14133 - V6369 (04) - Establishing an evolutionary sequence for disintegrated minor planets

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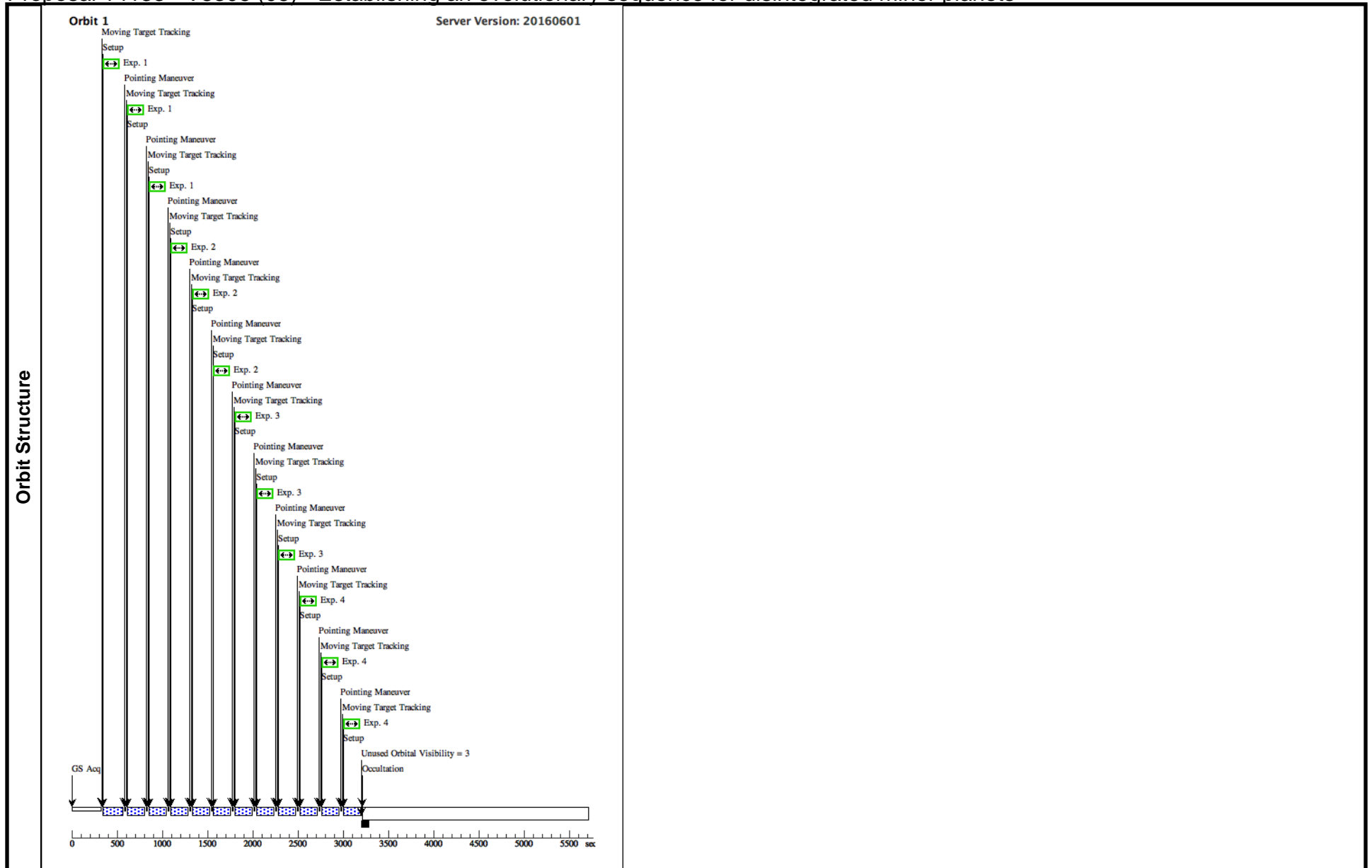
Visit	Proposal 14133, V6369 (04), completed Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 29-DEC-2015:00:00:00 AND 31-MAR-2016:00:00:00 Comments: Date range Dec 29 - Mar 31 Magnitude range 17.33 - 18.43. Galaxy lat - 51 - 62 deg Earth dist - 1.47 - 1.79 AU Phase angle 4 - 22 deg									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
(6)		Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=				Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)	
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(4)	6369	TYPE=ASTEROID,A=2.29277551419 383,E=0.143328621685503,I=5.98942 5477108043,O=35.57177870334641, W=351.7006988463702,M=222.95117 44187058,EQUINOX=J2000,EPOCH =07-APR- 2010:00:00:00,EpochTimeScale=UTC					EARTH		
<i>Comments: Extended=NO</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E6369a	(4) 6369	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0; GS ACQ SCENARI O BASE1B3	Pattern 6, Exps 1-1 i n V6369 (04) (6)	144 Secs (432 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	2	E6369b	(4) 6369	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0.14	Pattern 6, Exps 2-2 i n V6369 (04) (6)	144 Secs (432 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	3	E6369c	(4) 6369	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0	Pattern 6, Exps 3-3 i n V6369 (04) (6)	144 Secs (432 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	4	E6369d	(4) 6369	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0.14	Pattern 6, Exps 4-4 i n V6369 (04) (6)	144 Secs (432 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]



Proposal 14133 - V8306 (05) - Establishing an evolutionary sequence for disintegrated minor planets

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Visit	Proposal 14133, V8306 (05), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 21-JUN-2016:00:00:00 AND 27-JUL-2016:00:00:00 Comments: Date range Jun 21 - Jul 26 Magnitude range 17.23 - 17.92 +- 1/2 amp=0.1. Galaxy lat - 10 - 15.5 deg Earth dist - 1.09 - 1.18 AU Phase angle 5 - 22 deg									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
(6)		Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=				Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)	
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(5)	8306		TYPE=ASTEROID,A=2.24137775030 865,E=0.2205638175239091,I=4.7772 41148469024,O=208.7882914167977, W=143.1380673827167,M=31.637889 24646727,EQUINOX=J2000,EPOCH =15-AUG- 2010:00:00:00,EpochTimeScale=UTC				EARTH		
Comments: Extended=NO										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E8306a	(5) 8306	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0	Pattern 6, Exps 1-1 i n V8306 (05) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2	E8306b	(5) 8306	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0.14	Pattern 6, Exps 2-2 i n V8306 (05) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3	E8306c	(5) 8306	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0	Pattern 6, Exps 3-3 i n V8306 (05) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	4	E8306d	(5) 8306	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0.14	Pattern 6, Exps 4-4 i n V8306 (05) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]



Proposal 14133 - V10123 (06) - Establishing an evolutionary sequence for disintegrated minor planets

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Visit	Proposal 14133, V10123 (06), completed Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 26-NOV-2015:00:00:00 AND 10-JAN-2016:00:00:00 Comments: Date range Nov 26 - Jan 10 Magnitude range 17.27 - 17.88. Galaxy lat - 9.9 - 17.9 deg Earth dist - 1.41 - 1.52 AU Phase angle 1 - 18 deg									
	Patterns		<table border="1"> <thead> <tr> <th>#</th> <th>Primary Pattern</th> <th>Secondary Pattern</th> <th>Exposures</th> </tr> </thead> <tbody> <tr> <td>(6)</td> <td> Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= </td> <td> Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false </td> <td>(1), (2), (3), (4)</td> </tr> </tbody> </table>	#	Primary Pattern	Secondary Pattern	Exposures	(6)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false
#	Primary Pattern	Secondary Pattern	Exposures							
(6)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false	(1), (2), (3), (4)							
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(6)	10123	TYPE=ASTEROID,A=2.26974642279 0353,E=0.2057444196861953,I=4.052 743634224846,O=76.91396833779066 ,W=267.5316869651617,M=109.0812 040011487,EQUINOX=J2000,EPOCH =21-APR- 2009:00:00:00,EpochTimeScale=UTC				MOSS Planning Start: 04-NOV- 2015:00:00:00 MOSS Planning End: 31-JAN- 2016:00:00:00	EARTH		
Comments: Extended=NO										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	E10123a	(6) 10123	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0	Pattern 6, Exps 1-1 i n V10123 (06) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2	E10123b	(6) 10123	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0,14	Pattern 6, Exps 2-2 i n V10123 (06) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3	E10123c	(6) 10123	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0	Pattern 6, Exps 3-3 i n V10123 (06) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	4	E10123d	(6) 10123	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475X	FLASH=9	POS TARG 0,0,14	Pattern 6, Exps 4-4 i n V10123 (06) (6)	144 Secs (432 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]

