



16111 - Breakup of Long-Period Comet C/2019 Y4 (ATLAS)

Cycle: 27, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) C2019-Y4	WFC3/UVIS	1	10-Apr-2020 15:31:10.0	yes
02	(1) C2019-Y4	WFC3/UVIS	1	10-Apr-2020 15:31:11.0	yes
11	(1) C2019-Y4	WFC3/UVIS	1	10-Apr-2020 15:31:12.0	yes
12	(1) C2019-Y4	WFC3/UVIS	1	10-Apr-2020 15:31:12.0	yes

4 Total Orbits Used

ABSTRACT

We seek HST time with the WFC3 camera in order to study the on-going break-up of long-period comet C/2019 Y4 (ATLAS). Break-up of comets may be the dominant destruction process of these bodies, yet is poorly studied because breakups occur unpredictably and evolve rapidly, require timely observations which are difficult to secure. We propose a 4 orbit allocation to measure the temporal evolution of the fragments, in order to

measure the brightness and velocity distributions and to measure fragment non-gravitational acceleration caused by outgassing forces (the latter are a measure of fragment size). We will also seek evidence for rotational and other modulation of the primary nucleus and fragments, indicative of patchy distribution of surface volatiles. A Monte-Carlo dust model will be applied to images of the diffuse envelope. C/2019 Y4 has the potential to be one of only a handful of disrupting comets ever studied at HST resolution, and to set exciting constraints on models of the breakup mechanism.

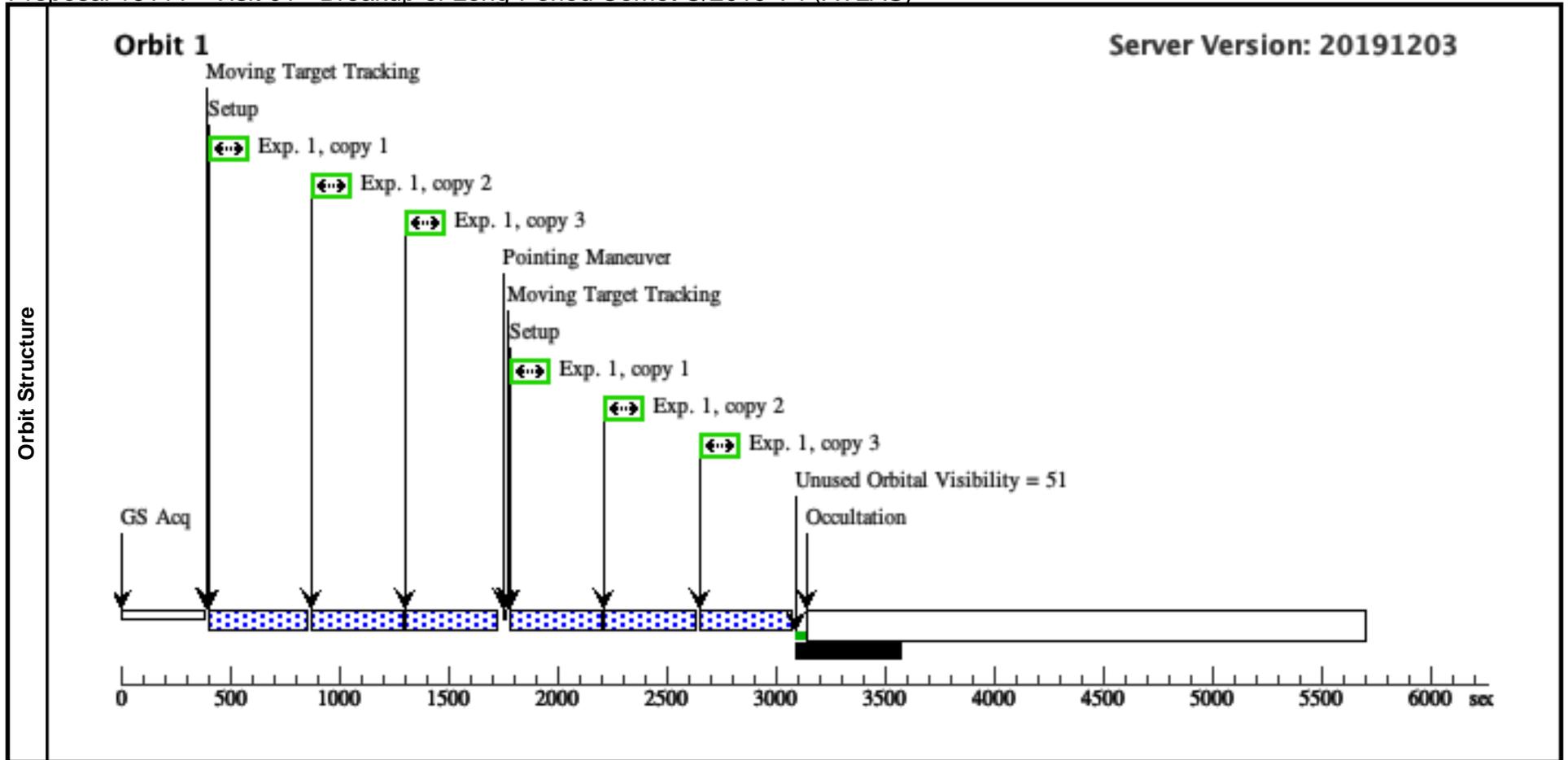
OBSERVING DESCRIPTION

We request observations of comet ATLAS with HST and WFC3, using the F350LP broadband filter. We request 2 to 3 day spacing between visits in order to connect fragments and their motion between orbits, thereby to measure the velocities and accelerations. In each orbit, we will obtain six 260s integrations on the comet, dithered to provide protection from chip defects. The six images, when combined, will also provide adequate protection from cosmic rays. The WFC3 Exposure Time Calculator indicates that, for a point source, solar-type spectrum, a signal-to-noise ratio of 6 is reached in 230 s at $V = 26$ in the F350LP filter (optimal extraction yields $\text{SNR}=13$). For example, at opposition and heliocentric distance $R = 1$ AU, magnitude $V = 26$ corresponds to an object radius 25 m (geometric albedo 0.04 assumed). These are upper limits to the point source thresholds because at least some of the fragments are embedded in their own dust comae. However, it is clear that HST offers unprecedented sensitivity to faint fragments. We use F350LP because the F350LP count rate is 1.6 higher for a target with a solar-type spectrum than other commonly used broadband filters (e.g., F606W), providing a better count rate and signal-to-noise ratio. We also plan to dither the exposures to mitigate the effects from bad pixels, cosmic rays, and the inter-chip gap. Angular non-sidereal rates peak at about 10000 hour⁻¹ and are well within the range of HST capabilities. The ephemeris uncertainty is $3\sigma < 1$ arcsec, of no concern given the field of view of WFC3. We request Disruptive Scheduling for these observations. This is necessary because of the expected rapid photometric and morphological development of the fragments as seen in other disintegrating comets. Comet ATLAS will be in the HST's 55 Sun exclusion zone from UT 2020 April 30 to UT 2020 September 7. Therefore, we must observe with HST before 2020 April 30, but earlier dates are preferred. The apparent rates of motion relative to sidereal are < 1 arcsec/hour, which are easily within Hubble's tracking capabilities. These rates of motion are also slow enough to keep a single pair of guide stars within the FGS pickles for an entire visibility window. The ephemeris uncertainties are typically at the 1 arcsec level. We understand that we will have essentially no control over the spacecraft roll angle.

Proposal 16111 - Visit 01 - Breakup of Long-Period Comet C/2019 Y4 (ATLAS)

Fri Apr 10 19:31:13 GMT 2020

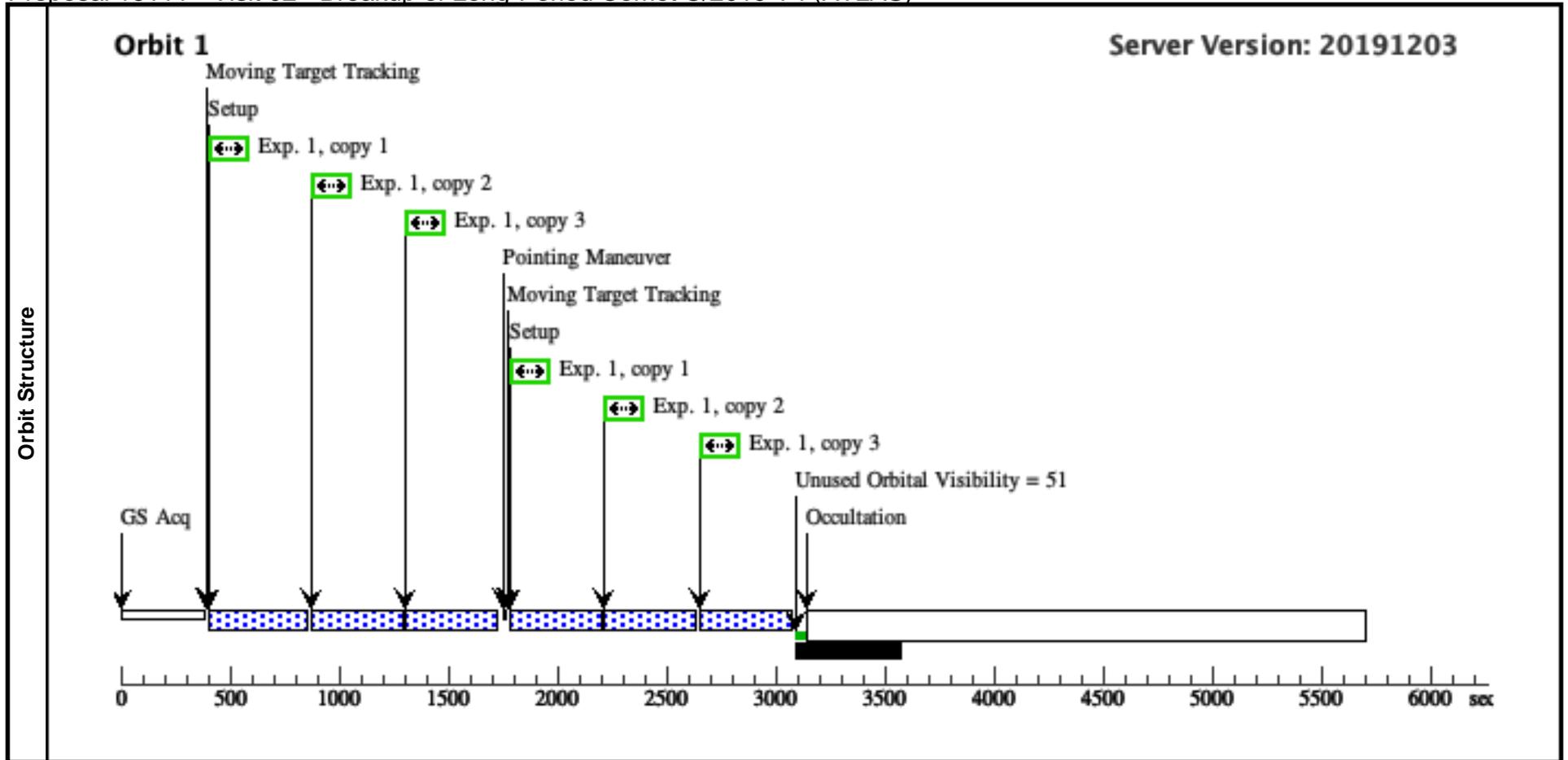
Visit	Proposal 16111, Visit 01, scheduling Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 20-APR-2020:12:00:00 AND 21-APR-2020:21:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)					
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	C2019-Y4	TYPE=COMET,Q=0.2528326026905 927,E=0.9992444279234513,I=45.385 07225915464 ,O=120.5732078366555,W=177.40753 53245124,T=31-MAY- 2020:00:22:46,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=06-MAR- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 ,DT=0. ,A1=4.282845687866E-7,A2=0.,A3=0. ,ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.				EARTH			
	<i>Comments: Description=disintegrating comet</i> <i>Extended=YES</i>									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,-5	Sequence 1-1 Non-Int in Visit 01 Pattern 1, Exps 1-1 i n Sequence 1-1 Non- Int in Visit 01 (1)	260 Secs X 3 (1560 Secs) [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)]	[1]



Proposal 16111 - Visit 02 - Breakup of Long-Period Comet C/2019 Y4 (ATLAS)

Fri Apr 10 19:31:13 GMT 2020

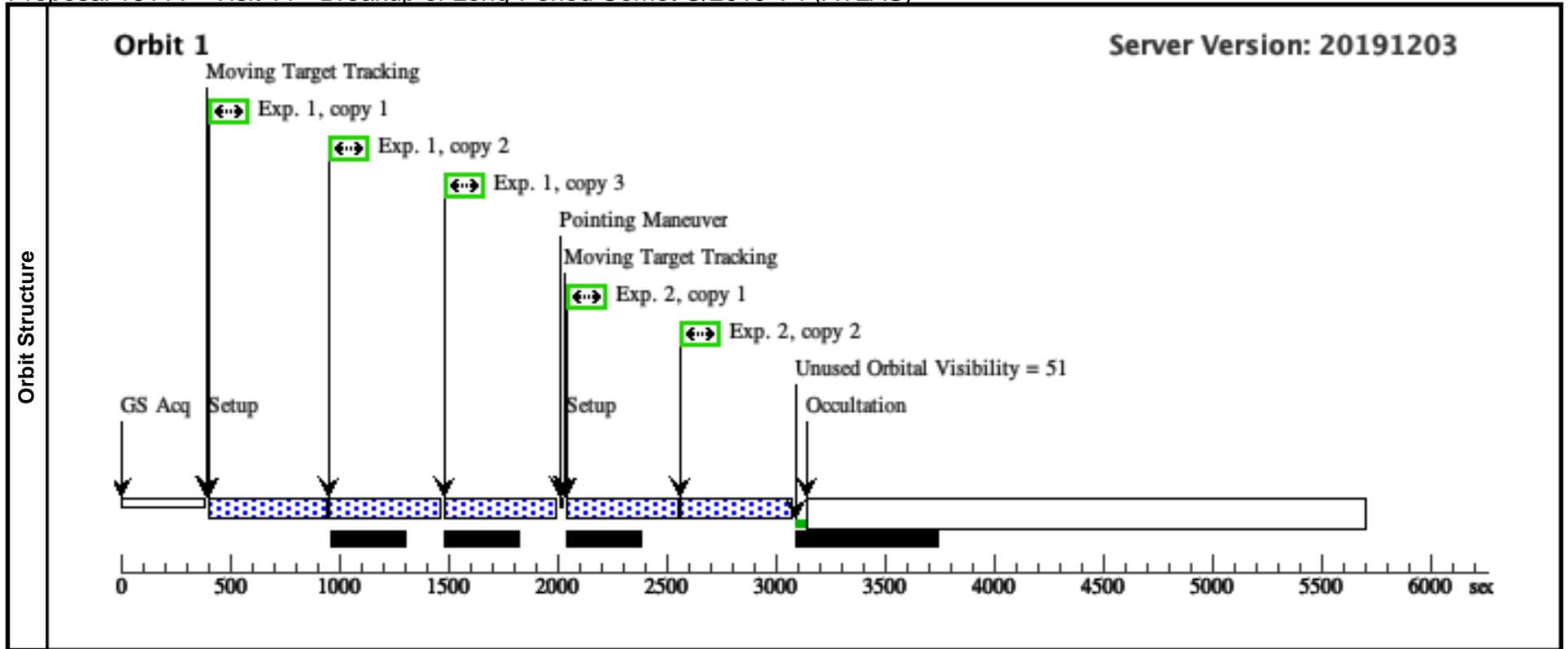
Visit	Proposal 16111, Visit 02, scheduling Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 23-APR-2020:06:00:00 AND 23-APR-2020:23:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)					
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	C2019-Y4	TYPE=COMET,Q=0.2528326026905 927,E=0.9992444279234513,I=45.385 07225915464 ,O=120.5732078366555,W=177.40753 53245124,T=31-MAY- 2020:00:22:46,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=06-MAR- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 ,DT=0. ,A1=4.282845687866E-7,A2=0.,A3=0. ,ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.				EARTH			
	<i>Comments: Description=disintegrating comet</i> <i>Extended=YES</i>									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,-5	Sequence 1-1 Non-Int in Visit 02 Pattern 1, Exps 1-1 i n Sequence 1-1 Non- Int in Visit 02 (1)	260 Secs X 3 (1560 Secs) [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)]	[1]



Proposal 16111 - Visit 11 - Breakup of Long-Period Comet C/2019 Y4 (ATLAS)

Fri Apr 10 19:31:13 GMT 2020

Visit	Proposal 16111, Visit 11 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 20-APR-2020:12:00:00 AND 21-APR-2020:21:00:00									
	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
Solar System Targets	(1)	C2019-Y4	TYPE=COMET,Q=0.2528326026905 927,E=0.9992444279234513,I=45.385 07225915464 .O=120.5732078366555,W=177.40753 53245124,T=31-MAY- 2020:00:22:46,TimeScale=TDB,EQ UINOX=J2000,EPOCH=06-MAR- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=4.282845687866E-7,A2=0.,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
	Comments: Description=disintegrating comet Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 11	396 Secs X 3 (1188 Secs)	
									[==>(Copy 1)]	
									[==>(Copy 2)]	[1]
									[==>(Copy 3)]	
2		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO	POS TARG 0.5,-5		Sequence 1-2 Non-Int in Visit 11	397 Secs X 2 (794 Secs)	
									[==>(Copy 1)]	
									[==>(Copy 2)]	[1]



Proposal 16111 - Visit 12 - Breakup of Long-Period Comet C/2019 Y4 (ATLAS)

Fri Apr 10 19:31:13 GMT 2020

Visit	Proposal 16111, Visit 12 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 23-APR-2020:06:00:00 AND 23-APR-2020:23:00:00									
	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
Solar System Targets	(1)	C2019-Y4	TYPE=COMET,Q=0.2528326026905 927,E=0.9992444279234513,I=45.385 07225915464 .O=120.5732078366555,W=177.40753 53245124,T=31-MAY- 2020:00:22:46,TimeScale=TDB,EQ UINOX=J2000,EPOCH=06-MAR- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=4.282845687866E-7,A2=0.,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
	Comments: Description=disintegrating comet Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 12	396 Secs X 3 (1188 Secs) [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)]	[1]
2		(1) C2019-Y4	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO	POS TARG 0.5,-5	Sequence 1-2 Non-Int in Visit 12	397 Secs X 2 (794 Secs) [=>(Copy 1)] [=>(Copy 2)]	[1]	

