16309 - Long-Period Comet C/2017 K2

Cycle: 28, 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	(2) C2017-K2	WFC3/UVIS	1	18-Aug-2021 10:02:03.0	yes
02	(3) C2017-K2-2	WFC3/UVIS	1	18-Aug-2021 10:02:04.0	yes
03	(4) C2017-K2-3	WFC3/UVIS	1	18-Aug-2021 10:02:04.0	yes
04	(5) C2017-K2-4	WFC3/UVIS	1	18-Aug-2021 10:02:05.0	yes
05	(6) C2017-K2-5	WFC3/UVIS	1	18-Aug-2021 10:02:06.0	yes

5 Total Orbits Used

ABSTRACT

Extraordinary long-period comet C/2017 K2 offers our best opportunity to study the rise of activity in a body entering the solar system from Oort cloud distances. Active initially at 26 AU, the comet is now near 8 AU and will approach the nominal distance for the onset of water ice sublimation by the end of Cycle 28. We seek HST observations 1) to measure the 3D morphology of the coma and to search for jet activity associated with local crystallization 2) to photometrically isolate the nucleus from its massive coma background and so to estimate its size and 3) to contribute to a unique record of cometary development from the largest distances. Already active when first detected beyond Uranus, K2 will cross both the crystallization zone (10 AU) and the water ice sublimation zone (5 AU) on its way to perihelion at 1.8 AU in late 2022. It is predicted to exceed naked-eye visibility and will be subject to increasingly intense astronomical study using the full range of techniques and wavelengths. It offers a unique opportunity to understand the degree to which comets evolve even before entry into the terrestrial planet region where they are more normally studied.

OBSERVING DESCRIPTION

We request 5 orbits with WFC3 to study K2 on approach to the water sublimation zone. The proposed observations will be the first to examine an approach to the Sun from far beyond the planetary region. WFC3-UVIS and the F350LP filter provide maximum sensitivity to faint and structured emission. In each orbit, we will obtain 6 images each of 285s duration, with a dither between groups of three in order to provide protection from chip and flat-field defects. Combination of the images allows the elimination of essential all cosmic ray tracks that otherwise would compromise the measurements. Our science objectives follow.

Objective 1: Determine the photometric and morphological changes occurring as K2 enters the range of distances where water sublimation is expected to begin. Published observations (Jewitt et al. 2017, 2019) establish the status at larger distances (13 to 16 AU). They reveal a massive (1010 kg), slowly expanding (4 m/s), spherical coma of submillimeter and larger grains unlike anything expected from standard models. We want to observe the evolution of this coma with time, both due to the action of radiation pressure and to the injection of fresh material at the center, especially that expected from the onset of water ice sublimation, in addition to continued activity from the supervolatiles. Deflection of the dust by radiation pressure allows us to make comparison with dust dynamics models to estimate dust parameters. We want to know to what extent the changes in K2 represent the loss of supervolatile interstellar frosting as opposed to other physical processes in the nucleus. We expect to detect bursty activity from the expelled gas, brightening near the nucleus, and a sudden steepening of the coma surface brightness relative to its value at larger rH (Jewitt et al. 2019). Localized activity will also produce near-nucleus jets, in stark contrast to the spherical coma evident in existing data. In order to optimally extract information about the dust coma of K2, we plan measurements as follows.

Visit 1 is scheduled as early as possible to assess the initial state of the comet in Cycle 28, and will permit comparisons with existing imaging data (Cycle 27 data will become public in 2020 April). Visit 2 observes the comet as the Earth crosses its orbit plane from north to south. This in-plane geometry provides special sensitivity to the largest particles, whose low ejection speeds confine them to the cometary orbit plane, giving a line-line tail or trail appearance. The thickness of this line is a direct measure of the ejection speed, and a primary constraint on the ejection mechanism. Visit 3 is timed to image K2 from the largest angle below the orbital plane. This provides the best perspective on the distribution of material in the plane, and we expect to detect the first fan-like tail in K2 owing to ongoing mass-loss. New material from sublimation activity will reveal itself by its spatial distribution in the plane (c.f. Finson & Probstein 1968). Visit 4 again records the comet from its orbital plane but as the Earth moves from south to north, about 6 months after the first plane-crossing and at rH = 6 AU instead or 7.5 AU. Comparison with Visit 2 will allow us to assess changes from exactly the same viewing angle. Visit dates within 2 to 3 days are desirable. Final Visit 5 occurs from the maximum angle above the orbital plane, providing a stereo view when compared with Visit 3. This combination of times and angles will give us maximum leverage in the application of our dust dynamics model, needed to extract fundamental parameters of the coma.

Objective 2: Isolate the nucleus from the adjacent dust coma to estimate its size. This must be done using a convolution coma model to interpret the innermost surface brightness profile and to subtract off the effects of the coma. This is an extremely challenging measurement, but attempts with existing data hint at a nucleus detection with an upper limit radius < 9 km. Knowing the nucleus radius is important for understanding the relation between size and activity level, and may impact the evolution and survival of the nucleus. Small nuclei, for instance, are much more susceptible to non-gravitational acceleration and spin-up torques than are large nuclei. The size may also foretell the brightness to be expected of this comet at perihelion in 2022. Our observing strategy is to take WFC3 exposures using a wide bandpass filter (F350LP) for maximum sensitivity. The predicted brightness of a 9 km nucleus in the range 8.0 AU to 5.2 AU is V = 21.8 to 19.9 which would be trivial to detect in the absence of coma. However, given the presence of the massive coma, and the reality that 9 km is an upper limit to the nucleus radius (Jewitt et al. 2017), we cannot hope to isolate the nucleus without the fine resolution and PSF stability of HST and may not be able to do so even then. In order to attain the maximum resolution, we will perform a subsampling dither box pattern, obtaining 2 exposures at each dither point. We will carefully drizzle our subsampled images to a finer output pixel scale (0.025 arcsec/pixel) to extract the extra spatial information gathered by our subsampling strategy. This enhanced resolution (0.067 arcsec FWHM) will allow us to improve the nucleus vs. coma contrast over what is possible from the ground by about a factor of 50. The dithering will also enable us to reject hot pixels and cosmic ray hits.

Visit

Proposal 16309, Visit 01, completed Wed Aug 18 14:02:06 GMT 2021

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 57D TO 71 D; BETWEEN 05-OCT-2020:00:00:00 AND 12-OCT-2020:00:00:00

Diagnostics

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

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=86 Angle Between Sides= Center Pattern=false		(2)
(4)	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

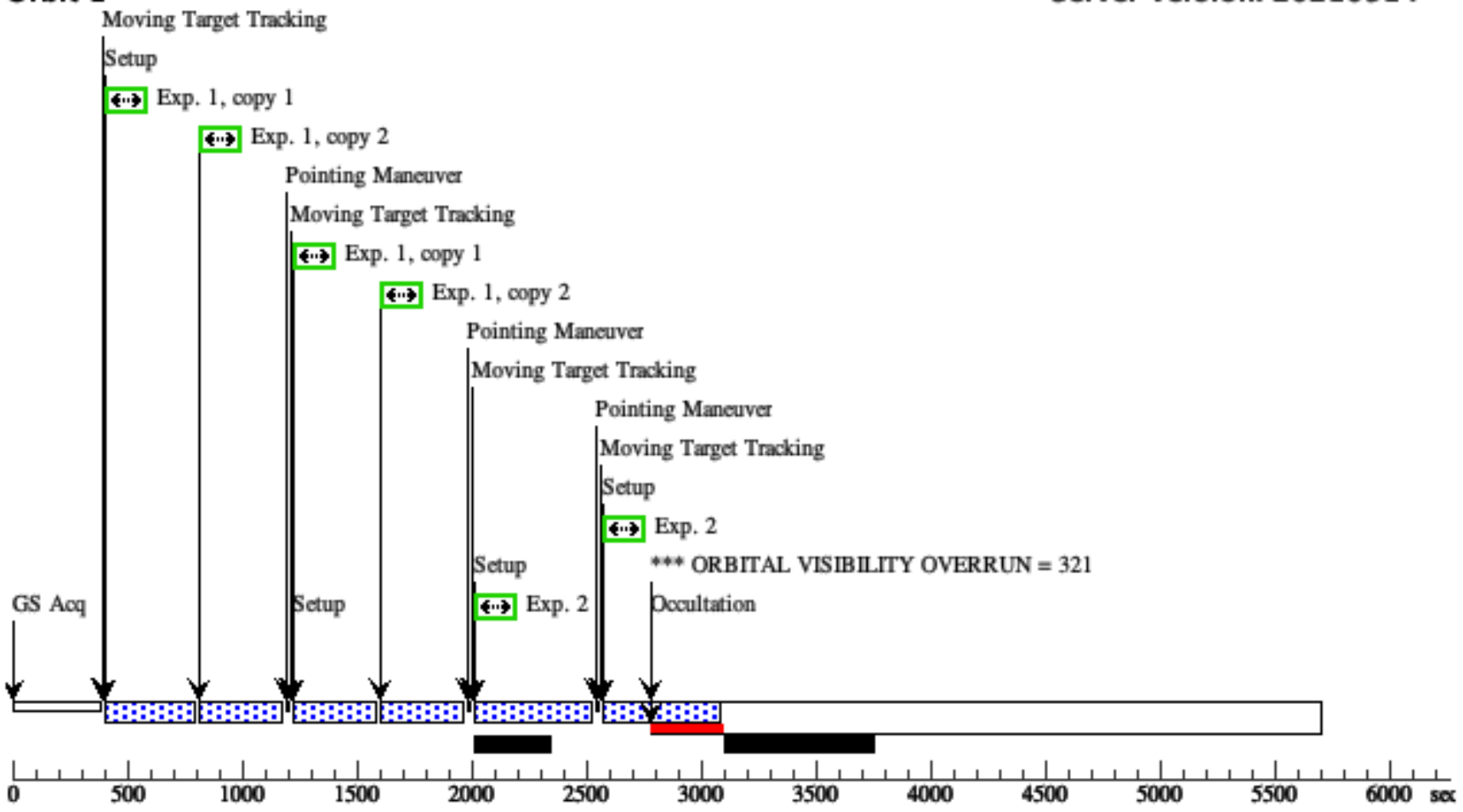
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	C2017-K2	TYPE=COMET,Q=1.8033638631159 6,E=1.00036668185704,I=87.5414407 5815482 ,O=88.2703559960372,W=236.107558 7592327,T=20-DEC-2022:09:46:55,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=23-MAY-2019:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=distant comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) C2017-K2	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 15,10	Sequence 1-2 Non-Int in Visit 01 Pattern 4, Exps 1-1 in Sequence 1-2 Non-Int in Visit 01 (4)	200 Secs X 2 (800 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]*	***[1]***
2		(2) C2017-K2	WFC3/UVIS, ACCUM, UVIS1-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 01 Pattern 3, Exps 2-2 in Sequence 1-2 Non-Int in Visit 01 (3)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 16309, Visit 02, completed Wed Aug 18 14:02:07 GMT 2021

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 18-DEC-2020:21:00:00 AND 20-DEC-2020:06:00:00; BETWEEN 21-DEC-2020:09:00:00 AND 23-DEC-2020:00:00:00

Diagnostics

(Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=86 Angle Between Sides= Center Pattern=false		(2)
(4)	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

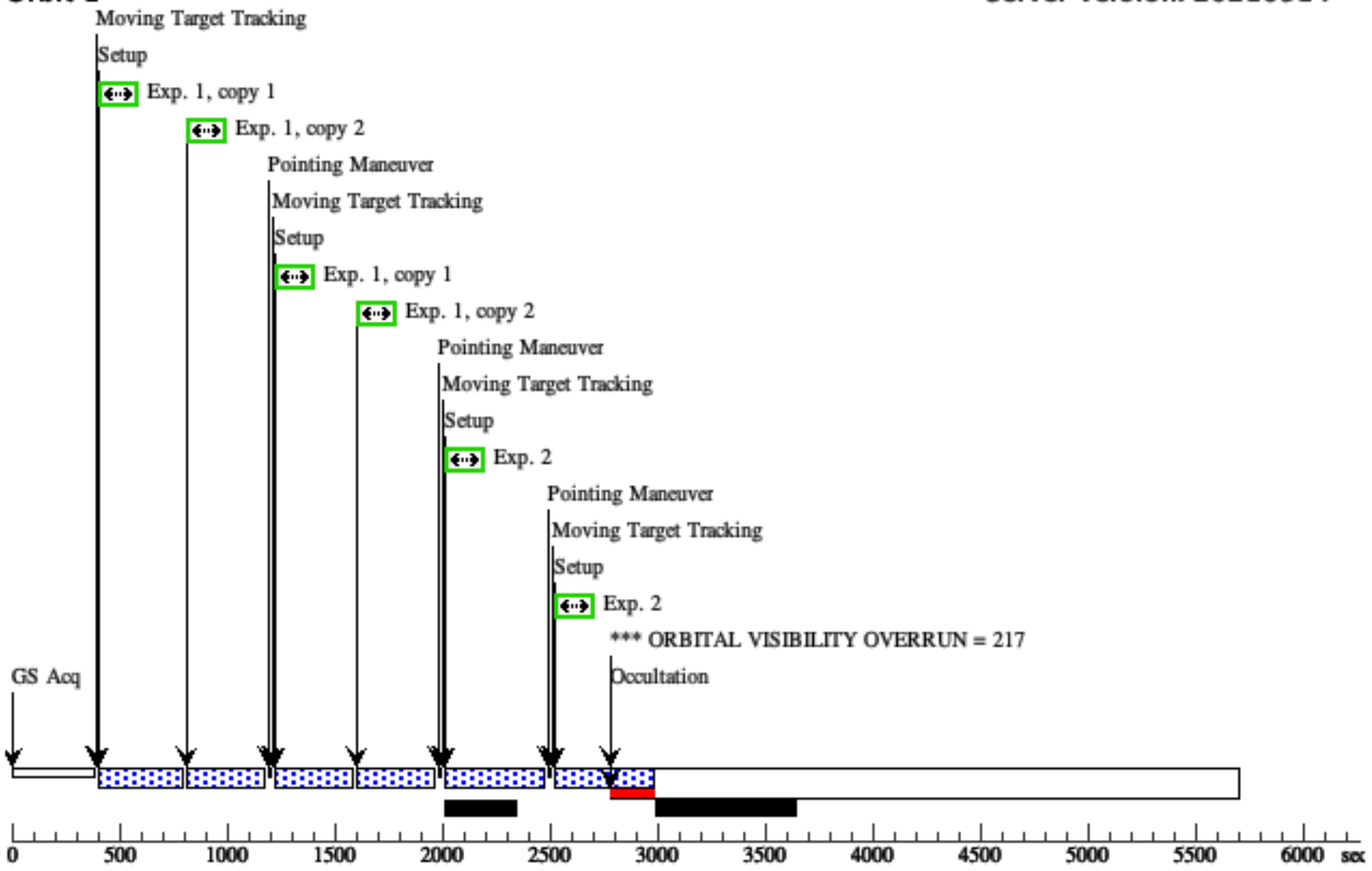
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	C2017-K2-2	TYPE=COMET,Q=1.802802851169086,E=1.000370469000311,I=87.54131033034835,O=88.27093088001131,W=236.1149816010203,T=20-DEC-2022:08:14:46,TTimeScale=TDB,EQUINOX=J2000,EPOCH=11-JUL-2019:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=distant comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) C2017-K2-2	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,15	Sequence 1-2 Non-Int in Visit 02 Pattern 4, Exps 1-1 in Sequence 1-2 Non-Int in Visit 02 (4)	200 Secs X 2 (800 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]*	***[1]***
2		(3) C2017-K2-2	WFC3/UVIS, ACCUM, UVIS1-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 02 Pattern 3, Exps 2-2 in Sequence 1-2 Non-Int in Visit 02 (3)	348 Secs (696 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 16309, Visit 03, completed Wed Aug 18 14:02:07 GMT 2021

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 272D TO 277 D; BETWEEN 23-MAR-2021:18:00:00 AND 27-MAR-2021:06:00:00

Diagnostics

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

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=86 Angle Between Sides= Center Pattern=false		(2)
(4)	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

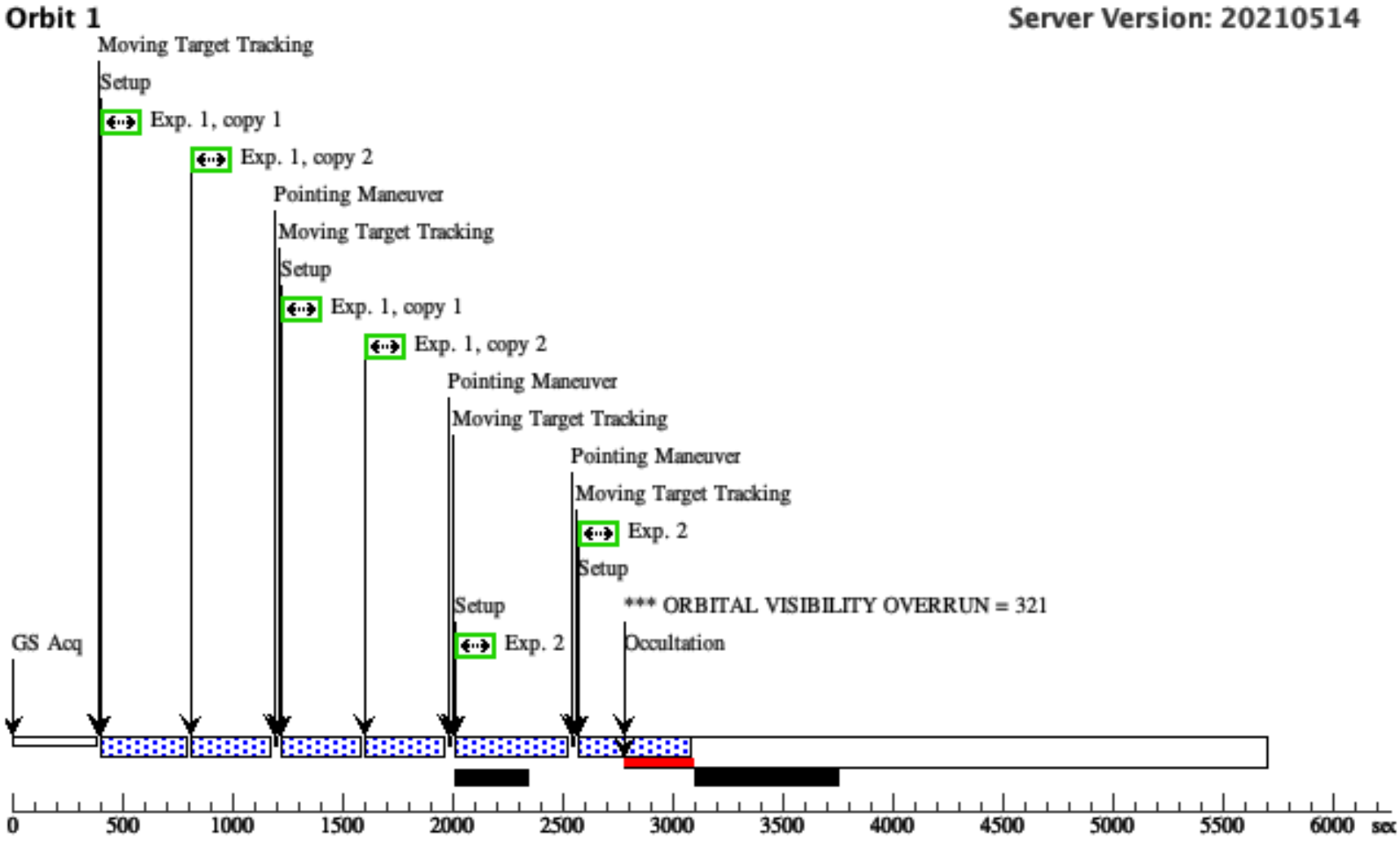
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	C2017-K2-3	TYPE=COMET,Q=1.8024967979777 71,E=1.000372873245172,I=87.54124 199211779 ,O=88.27121986972777,W=236.11906 68008936,T=20-DEC- 2022:07:24:39,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=08-AUG- 2019:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=distant comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) C2017-K2-3	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 5,10	Sequence 1-2 Non-Int in Visit 03 Pattern 4, Exps 1-1 in Sequence 1-2 Non-Int in Visit 03 (4)	200 Secs X 2 (800 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]*	***[1]***
2		(4) C2017-K2-3	WFC3/UVIS, ACCUM, UVIS1-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 03 Pattern 3, Exps 2-2 in Sequence 1-2 Non-Int in Visit 03 (3)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 16309, Visit 04, completed Wed Aug 18 14:02:07 GMT 2021

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 161D TO 162 D; BETWEEN 13-JUN-2021:14:00:00 AND 15-JUN-2021:20:00:00; BETWEEN 16-JUN-2021:04:00:00 AND 19-JUN-2021:00:00:00

Diagnostics

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

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=86 Angle Between Sides= Center Pattern=false		(2)
(4)	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

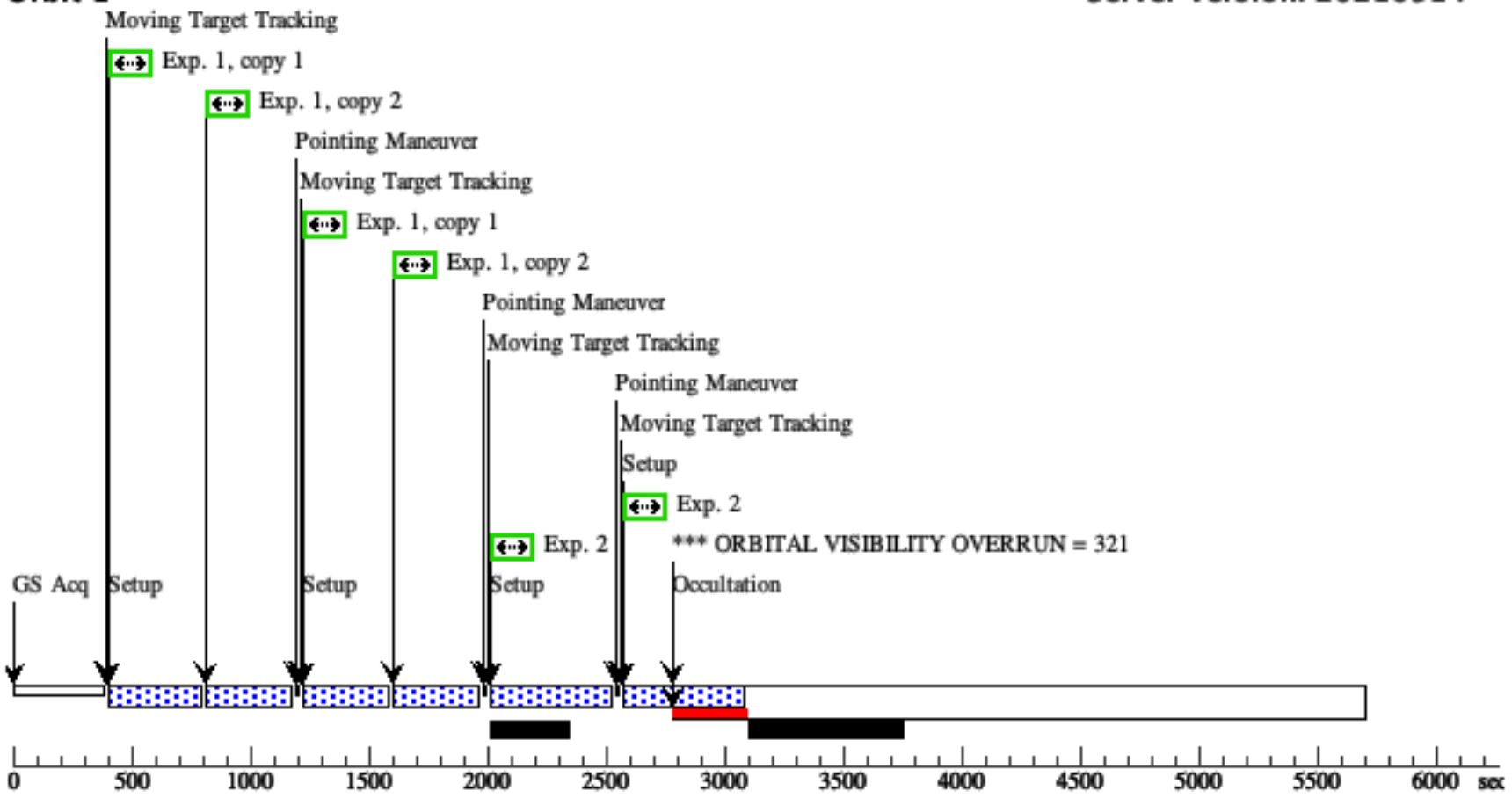
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	C2017-K2-4	TYPE=COMET,Q=1.802002642886023,E=1.000374482326085,I=87.54106073961911,O=88.27195428426677,W=236.1258629200095,T=20-DEC-2022:06:06:37,TTimeScale=TDB,EQUINOX=J2000,EPOCH=21-SEP-2019:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=distant comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) C2017-K2-4	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,5	Sequence 1-2 Non-Int in Visit 04 Pattern 4, Exps 1-1 in Sequence 1-2 Non-Int in Visit 04 (4)	200 Secs X 2 (800 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]*	***[1]***
2		(5) C2017-K2-4	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 04 Pattern 3, Exps 2-2 in Sequence 1-2 Non-Int in Visit 04 (3)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 16309, Visit 05, implementation Wed Aug 18 14:02:07 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 78D TO 92 D; BETWEEN 16-SEP-2021:08:00:00 AND 16-SEP-2021:22:00:00; BETWEEN 17-SEP-2021:02:00:00 AND 17-SEP-2021:10:00:00; BETWEEN 18-SEP-2021:08:00:00 AND 18-SEP-2021:22:00:00; BETWEEN 19-SEP-2021:04:00:00 AND 20-SEP-2021:03:00:00; BETWEEN 20-SEP-2021:18:00:00 AND 21-SEP-2021:04:00:00; VISIBILITY INTERVAL NO GYRO BIAS UPDATE ON MOVING TARGET

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=86 Angle Between Sides= Center Pattern=false		(2)
(4)	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
(6)	C2017-K2-5	TYPE=COMET,Q=1.800557446902831,E=1.000385549098293,I=87.54218835728831,O=88.26798465637555,W=236.1463652133023,T=20-DEC-2022:02:24:53,TTimeScale=TDB,EQUINOX=J2000,EPOCH=08-FEB-2020:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=distant comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(6) C2017-K2-5	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,5	Sequence 1-2 Non-Int in Visit 05 Pattern 4, Exps 1-1 in Sequence 1-2 Non-Int in Visit 05 (4)	200 Secs X 2 (800 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]*	***[1]***
2		(6) C2017-K2-5	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP	CR-SPLIT=NO		Sequence 1-2 Non-Int in Visit 05 Pattern 3, Exps 2-2 in Sequence 1-2 Non-Int in Visit 05 (3)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure