16041 - Interstellar Comet C/2019 Q4 (Borisov)

Cycle: 27, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. David Jewitt (PI) (Contact)	**University of California - Los Angeles**	**jewitt@ucla.edu**
Max Mutchler (CoI) (Contact)	Space Telescope Science Institute	mutchler@stsci.edu
Dr. Yoonyoung Kim (CoI) (ESA Member)	Max Planck Institute for Solar System Research	ynyoung.kim@gmail.com
Dr. Harold A. Weaver (CoI) (Contact)	The Johns Hopkins University Applied Physics Laboratory	hal.weaver@jhuapl.edu
Dr. Man-To Hui (CoI)	University of Hawaii	manto@ifa.hawaii.edu
Dr. Jessica Agarwal (CoI) (ESA Member)	Max Planck Institute for Solar System Research	agarwal@mps.mpg.de

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
08	(2) C2019-Q4-V8	WFC3/UVIS	1	10-Mar-2020 12:01:28.0	yes
09	(3) C2019-Q4-V9	WFC3/UVIS	1	10-Mar-2020 12:01:29.0	yes
10	(3) C2019-Q4-V9	WFC3/UVIS	1	10-Mar-2020 12:01:30.0	yes

3 Total Orbits Used

ABSTRACT

C/2019 Q4 (Borisov) is the first interstellar comet and only the second interstellar object ever identified within the solar system. We propose high resolution observations with WFC3 and HST in order to probe the development of this body in the post-perihelion, mid-cycle period ending March 31. In three orbits, we will map the coma and tail from a variety of perspectives in order to constrain the nucleus and dust properties. Observation as the Earth passes through the projected orbit plane (January 29) will provide a model-free estimate of the dust extent perpendicular to the plane,

allowing a determination of the normal component of the dust ejection velocity. Additional observations at monthly intervals provide perspectives up to 13 degree above the orbit plane. The high resolution of HST is needed to isolate faint near-nucleus structures (jets, fans), to search for fragments of the type which accompany the appearance of many long-period (solar system) comets, and to photometrically separate the nucleus itself from the background coma. The proposed observations complement GO/DD 16009 by extending the temporal coverage of the evolution of this unique object and taking advantage of new perspectives. The comet is expected to soon become invisible as it moves rapidly away from perihelion: Q4 will pass Jupiter's distance in July 2020 and Saturn's seven months later.

OBSERVING DESCRIPTION

We request 3 mid-cycle orbits with WFC3 and the F350LP filter to image C/2019 Q4. The broad F350LP filter (effective center ~6230A, FWHM ~4760A) gives maximum sensitivity to faint coma. The three orbits would be spaced by about one month (nominally late January, February and March) giving coverage complementary to that expected from GO 16009. These orbits will provide additional perspectives on the dust distribution, needed to limit the dust properties. In addition, these orbits will enable measurement of longer-term changes in this unique target. We will secure six 260 s integrations in each orbit, with dithering to provide protection from chip defects. According to the WFC3 ETC, a single exposure of this length reaches V = 26.5 at SNR = 5. Combing 6 images will take us 1 magnitude fainter and will also provide protection from cosmic ray strikes on individual images. Deep imaging is needed to assess the near-nucleus environment and identify fragments, or set limits to their presence. We will also use individual images to examine photometric stability of the core on the (~1 hour) orbital timescale. Sub-pixel astrometry from all orbits will assist with orbit fitting and the search for non- gravitational acceleration. The current 1 sigma ephemeris uncertainty is under 1 arcsec but grows rapidly with time. This is not a problem for the proposed observations because, as with all high profile targets, continuous additions to the astrometric database by astronomers around the world will shrink this uncertainty month-by-month. The ephemeris accuracy for HST observations is expected to remain at the 1 sigma = 1 arcsec level, of no concern to these observations. Q4 is outside the 55 deg HST exclusion zone from UT 2019 October 10 until UT 2020 October 9, encapsulating the entire proposal period. We request a single-orbit observation at orbit plane crossing on January 29. This will provide a unique viewing geometry with strong diagnostic power. Motions of dust perpendicular to the orbit cannot be induced by radiation pressure and instead give a direct measure of the normal component of the ejection velocity. This observation would also fall slightly less than 1 month from the last scheduled DDT observation January 7, continuing the approximately monthly sampling of the near-nucleus environment. The second orbit is requested one month later, near February 29. The observatory will then be 9 degrees above the orbit plane, giving a perspective on the two-dimensional distribution of dust over the plane. The third orbit is requested near March 31, by which time Q4 will be outbound at 3.4 AU from the Sun (greater than the discovery distance) and we will be near the maxmum 13 degrees above the orbit plane. The first visit is the only orbit for which the constraint is tight: we need to be within 1 day of January 29.0 in order to attain the in-plane geometry and the closer to this time the better.

The next two visits are more flexible; being within about +/- 7 days is sufficient.

Visit

Proposal 16041, Visit 08, completed Tue Mar 10 16:01:30 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 282D TO 283 D; BETWEEN 29-JAN-2020:07:00:00 AND 29-JAN-2020:15:00:00; BETWEEN 29-JAN-2020:21:00:00 AND 30-JAN-2020:00:00:00

Comments: orient at V3-105 for scheduling ease, between adjusted to avoid the time of 29 Jan 2020 from 16:00 to 21:00 UT (bright background objects)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=45		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.8	Center Pattern=false		
	Line Spacing=			

Solar System Targets

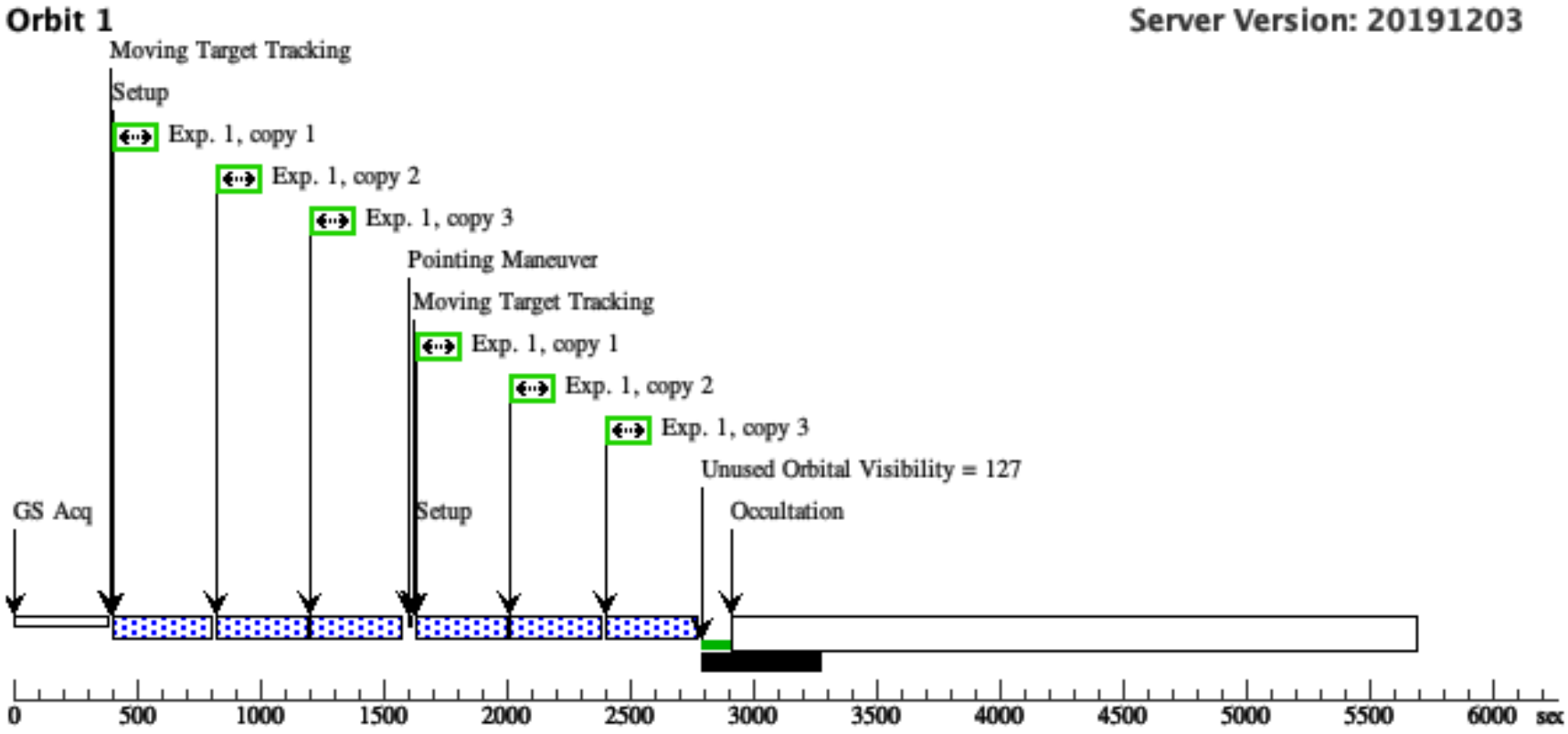
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	C2019-Q4-V8	TYPE=COMET,Q=2.006616039924964,E=3.35705587897315,I=44.05351923993201,O=308.1499849748581,W=209.1244471001688,T=08-DEC-2019:13:18:19,TTimeScale=TDB,EQUINOX=J2000,EPOCH=05-JAN-2020:00:00:00,EpochTimeScale=TDB,A1=-4.515200138092E-8,A2=-3.231415748596E-8,A3=-1.17710609436E-7				EARTH

Comments: Description=Interstellar comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) C2019-Q4-V8	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,15	Sequence 1-1 Non-Int in Visit 08	210 Secs X 3 (1260 Secs)	
							Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in Visit 08 (1)	*[==>(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]***

Orbit Structure



Visit

Proposal 16041, Visit 09, completed Tue Mar 10 16:01:30 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 24-FEB-2020:00:00:00 AND 24-FEB-2020:05:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=45		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.8	Center Pattern=false		
	Line Spacing=			

Solar System Targets

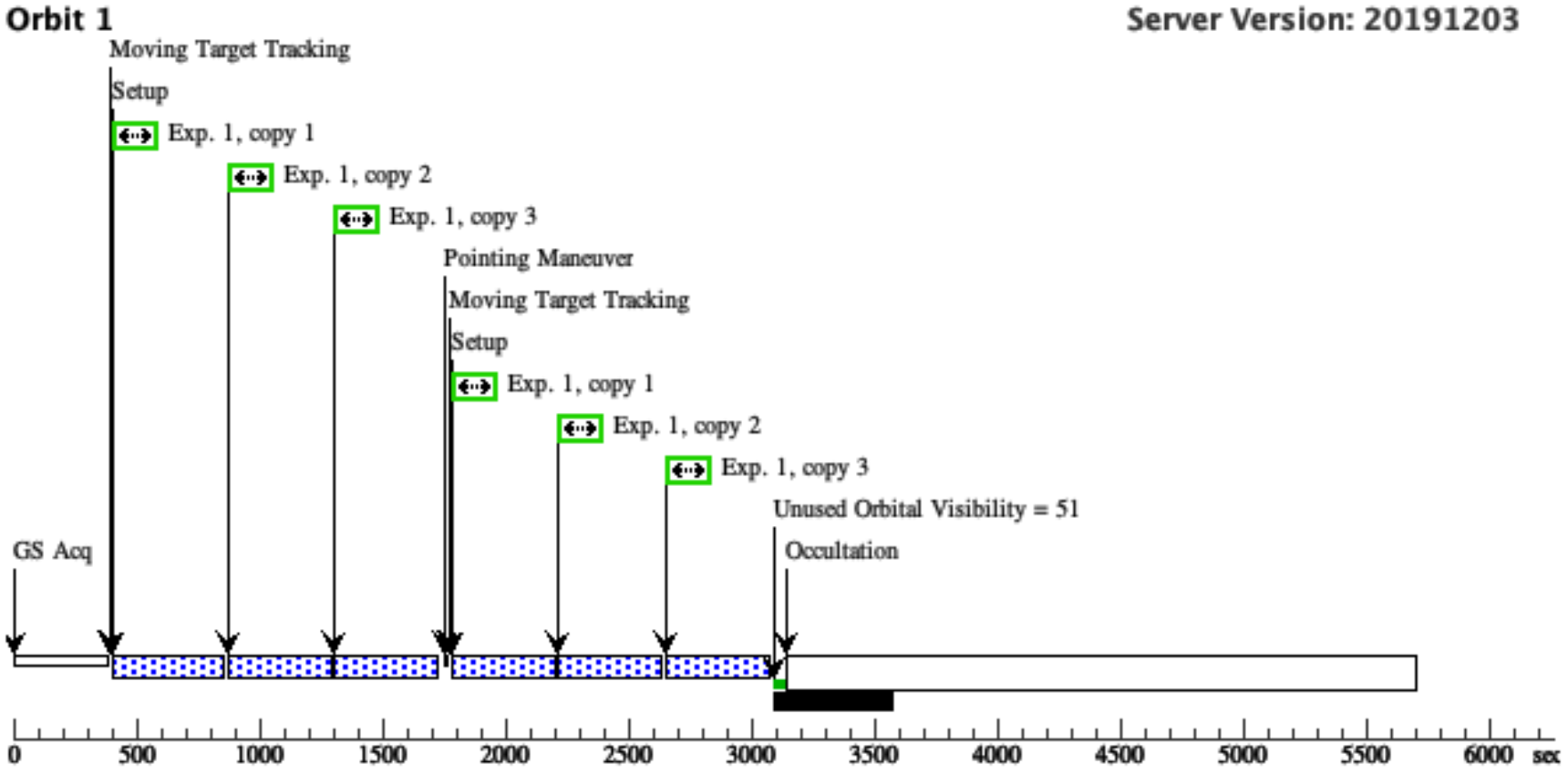
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	C2019-Q4-V9	TYPE=COMET,Q=2.006615476559197,E=3.357057274677898,I=44.05348671638512,O=308.1499528970442,W=209.124397765598,T=08-DEC-2019:13:18:12,TTimeScale=TDB,EQUINOX=J2000,EPOCH=05-JAN-2020:00:00:00,EpochTimeScale=TDB,A1=-4.111801624298E-8,A2=-2.939796209335E-8,A3=-1.149449539185E-7				EARTH

Comments: Description=Interstellar comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) C2019-Q4-V9	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,15	Sequence 1-1 Non-Int in Visit 09 Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in Visit 09 (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]***

Orbit Structure



Visit

Proposal 16041, Visit 10, implementation Tue Mar 10 16:01:30 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 23-MAR-2020:08:00:00 AND 23-MAR-2020:13:00:00; BETWEEN 26-MAR-2020:09:00:00 AND 26-MAR-2020:20:00:00; BETWEEN 27-MAR-2020:03:00:00 AND 28-MAR-2020:02:00:00; BETWEEN 29-MAR-2020:03:00:00 AND 29-MAR-2020:22:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=45		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.8	Center Pattern=false		
	Line Spacing=			

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	C2019-Q4-V9	TYPE=COMET,Q=2.006615476559197,E=3.357057274677898,I=44.05348671638512,O=308.1499528970442,W=209.124397765598,T=08-DEC-2019:13:18:12,TTimeScale=TDB,EQUINOX=J2000,EPOCH=05-JAN-2020:00:00:00,EpochTimeScale=TDB,A1=-4.111801624298E-8,A2=-2.939796209335E-8,A3=-1.149449539185E-7				EARTH

Comments: Description=Interstellar comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) C2019-Q4-V9	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP	CR-SPLIT=NO	POS TARG 10,15	Sequence 1-1 Non-Int in Visit 10	260 Secs X 3 (1560 Secs)	
							Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in Visit 10 (1)	*[==>(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]***

Orbit Structure