



16315 - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

Cycle: 28, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Karen J. Meech (PI) (Contact)	University of Hawaii	meech@ifa.hawaii.edu
Dr. Marc W. Buie (CoI) (Contact)	Southwest Research Institute	buie@boulder.swri.edu
Dr. Jacqueline Keane (CoI) (Contact)	University of Hawaii	jvkeane@hawaii.edu
Dr. Jan Kleyna (CoI)	University of Hawaii	kleyna@ifa.hawaii.edu
Olivier Raoul Hainaut (CoI) (ESA Member)	European Southern Observatory - Germany	ohainaut@eso.org
Dr. Bin Yang (CoI) (ESA Member)	European Southern Observatory - Chile	byang@eso.org
Dr. Davide Farnocchia (CoI)	Jet Propulsion Laboratory	davide.farnocchia@jpl.nasa.gov
Dr. Marco Micheli (CoI) (ESA Member)	ESA NEO Coordination Centre	marco.micheli@esa.int
Dr. Coryn A. L. Bailer-Jones (CoI) (ESA Member)	Max-Planck-Institut für Astronomie, Heidelberg	calj@mpia-hd.mpg.de
Prof. Dina Prialnik (CoI)	Tel Aviv University	dina@planet.tau.ac.il
Dr. Hermann Boehnhardt (CoI) (ESA Member)	Max Planck Institute for Solar System Research	boehnhardt@mps.mpg.de
Erica Bufanda (CoI)	University of Hawaii	ebufanda@hawaii.edu
Dr. David Tholen (CoI)	University of Hawaii	tholen@ifa.hawaii.edu
Dr. Richard Wainscoat (CoI)	University of Hawaii	rjw@hawaii.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) I2-BOROSOV	WFC3/UVIS	1	22-Feb-2021 09:00:13.0	yes
02	(1) I2-BOROSOV	WFC3/UVIS	1	22-Feb-2021 09:00:14.0	yes
03	(1) I2-BOROSOV	WFC3/UVIS	1	22-Feb-2021 09:00:15.0	yes

<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>
04	(1) I2-BOROSOV	WFC3/UVIS	1	22-Feb-2021 09:00:16.0	yes
05	(1) I2-BOROSOV	WFC3/UVIS	1	22-Feb-2021 09:00:16.0	yes

5 Total Orbits Used

ABSTRACT

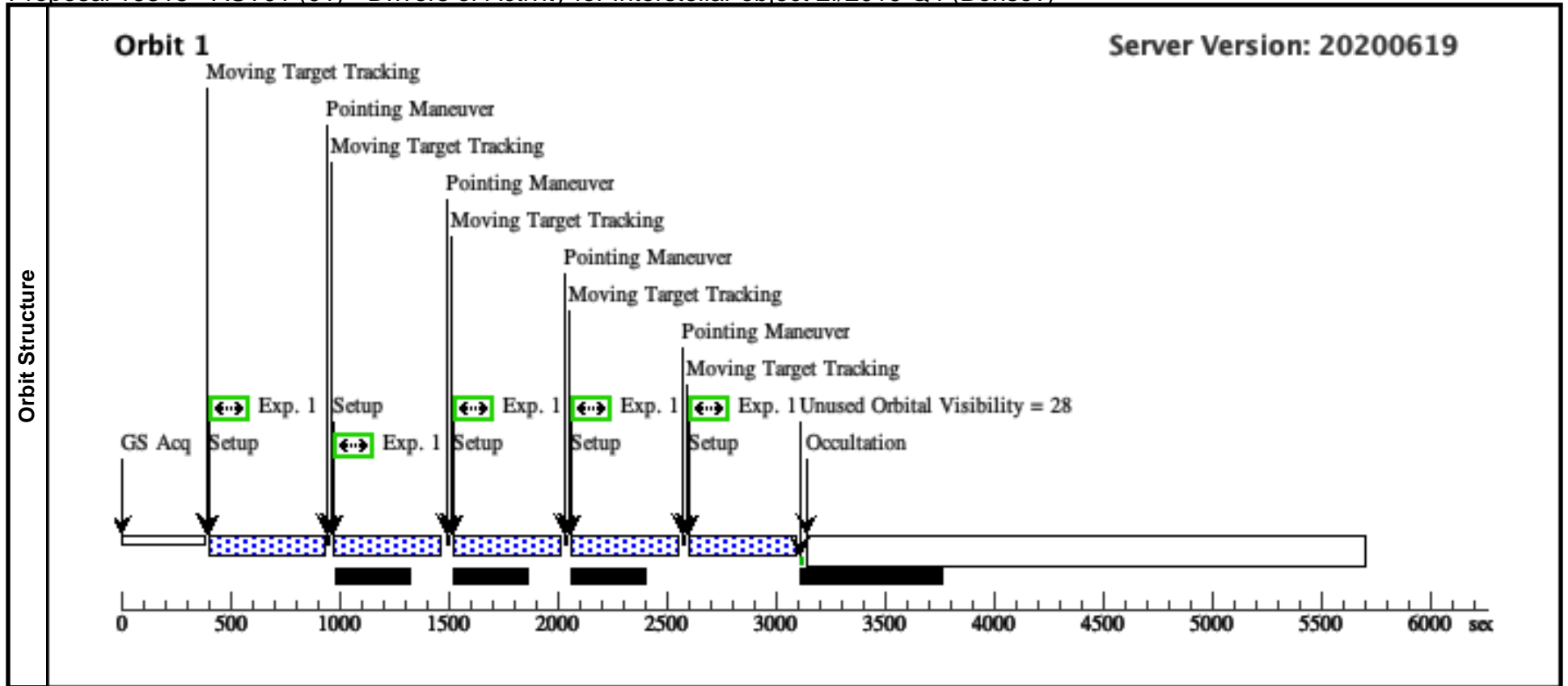
We request 5 orbits to observe the interstellar object 2I/2019 Q4 (Borisov) during the post-perihelion portion of its orbit, once it comes out of the HST solar avoidance region in mid-January 2021. Photometry from HST and from the ground shows that the comet is still bright, consistent with continued CO-driven activity, and that it is likely still to be bright enough to observe when it emerges again from solar conjunction. The requested data will be combined with high quality ground-based data, and HST imaging data obtained from several programs to perform detailed thermal modeling of the comet's activity, search for structures in the coma, and to perform high precision astrometry on the outbound orbit to model the non-gravitational forces acting on the nucleus. This is a unique object, only the second of its class discovered. 2I is now past perihelion at a heliocentric distance of 2.7 au and is heading out of the solar system and will never return. There is intense scientific interest in this object because it is likely a remnant of the planet building process from an exoplanetary system that we have been given the opportunity to observe in close detail, thus it is important to finish the observations necessary to fully utilize the huge scientific investment already made on this object.

OBSERVING DESCRIPTION

Each visit is nearly identical in design, five long exposures that fill the observing window with dithering. The full field of WFC3 is used to facilitate our high-precision astrometric goals. The only difference between the visits is a time constraint. The design is based on the goal of getting regularly spaced observations during Cycle 28 after the target comes out of solar exclusion. Each visit is given a 2 week window for scheduling and the visits are to be spaced 6 weeks apart. This plan assumes the target will continue to be detectable through the entire period of observation and will not be detectable after our last visit. However, the predicted brightness is quite uncertain because the level of outgassing is not known (and is one of our measurement objectives). There is a chance that if all activity stops that the target could be too faint to detect later in the Cycle. Prior to scheduling these observations we will be updating our models of the predicted brightness. If there is no chance of detecting the target we would release the allocated time. There is an intermediate case where the visits can be combined to reach a deeper limiting magnitude at the expense of fewer epochs. Any adjustments in the visit timing will be made early enough to not impact the usual flow of scheduling observations.

Proposal 16315 - AST01 (01) - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

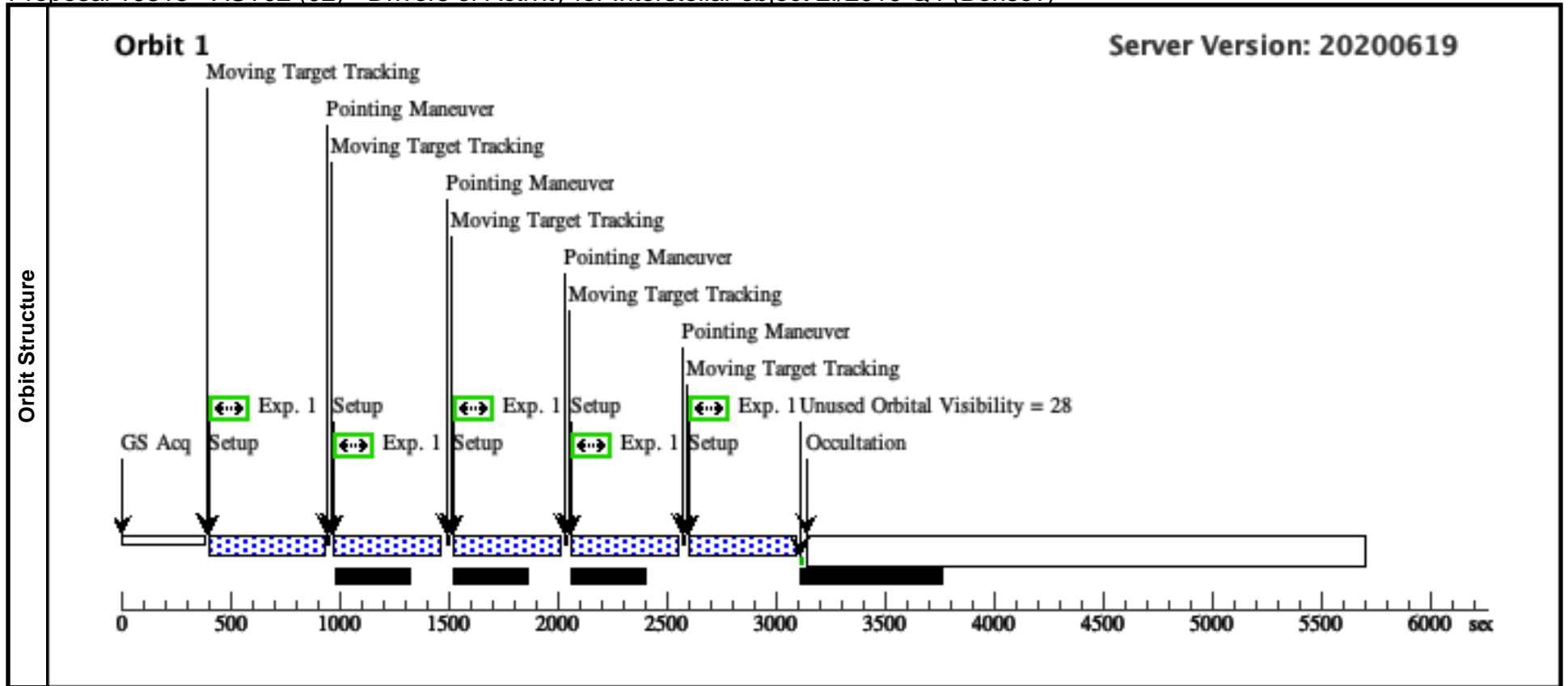
Visit	Proposal 16315, AST01 (01), completed Mon Feb 22 14:00:17 GMT 2021 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: BETWEEN 29-JAN-2021:19:51:00 AND 29-JAN-2021:20:11:00; BETWEEN 31-JAN-2021:13:12 AND 31-JAN-2021:13:22; BETWEEN 01-FEB-2021:13:00 AND 01-FEB-2021:16:21; BETWEEN 02-FEB-2021:11:14 AND 02-FEB-2021:13:00; BETWEEN 02-FEB-2021:15:59 AND 02-FEB-2021:16:09; BETWEEN 02-FEB-2021:19:10 AND 02-FEB-2021:19:20 Comments: <i>The five long, dithered exposures are intended to fill a single visibility window to get the relative timing we need. This is a stand-alone visit with a window provided to give a time constraint that is loose but holds it in roughly the right timeframe for the overall temporal sequence needed for the observing. Successful observations require a minimum number of suitable Gaia DR2 sources in the full field of UVIS. As the observations are scheduled, the proposal team needs to check potential windows for suitable guide stars and avoidance of field star contamination of the target and provide guidance on which windows will work best. If the fields are sparse enough, we may need to provide adjusted POSTARG values to ensure there are enough stars.</i>									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
(1)		Pattern Type=LINE Purpose=OTHER Number Of Points=5 Point Spacing=0.03 Line Spacing= Coordinate Frame=CELESTIAL Pattern Orientation=0 Angle Between Sides= Center Pattern=true		(1)						
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	I2-BOROSOV	TYPE=COMET,Q=2.0066240085872 65,E=3.356191268153205,I=44.05262 620283894 ,O=308.1489154698829,W=209.12460 56235187,T=08-DEC- 2019:13:04:38,TTIME=Scale=TDB,EQ UINOX=J2000,EPOCH=31-JUL- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 ,DT=0. ,A1=7.312064170837E-8,A2=- 3.252092599869E-8,A3=0. ,ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.				EARTH			
<i>Comments: Description=Interstellar Object</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) I2-BOROSOV	WFC3/UVIS, ACCUM, UVIS	F350LP				Sequence 1-1 Non-Int in AST01 (01) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in AST01 (01) (1)	380 Secs (1900 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]



Proposal 16315 - AST02 (02) - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

Mon Feb 22 14:00:17 GMT 2021

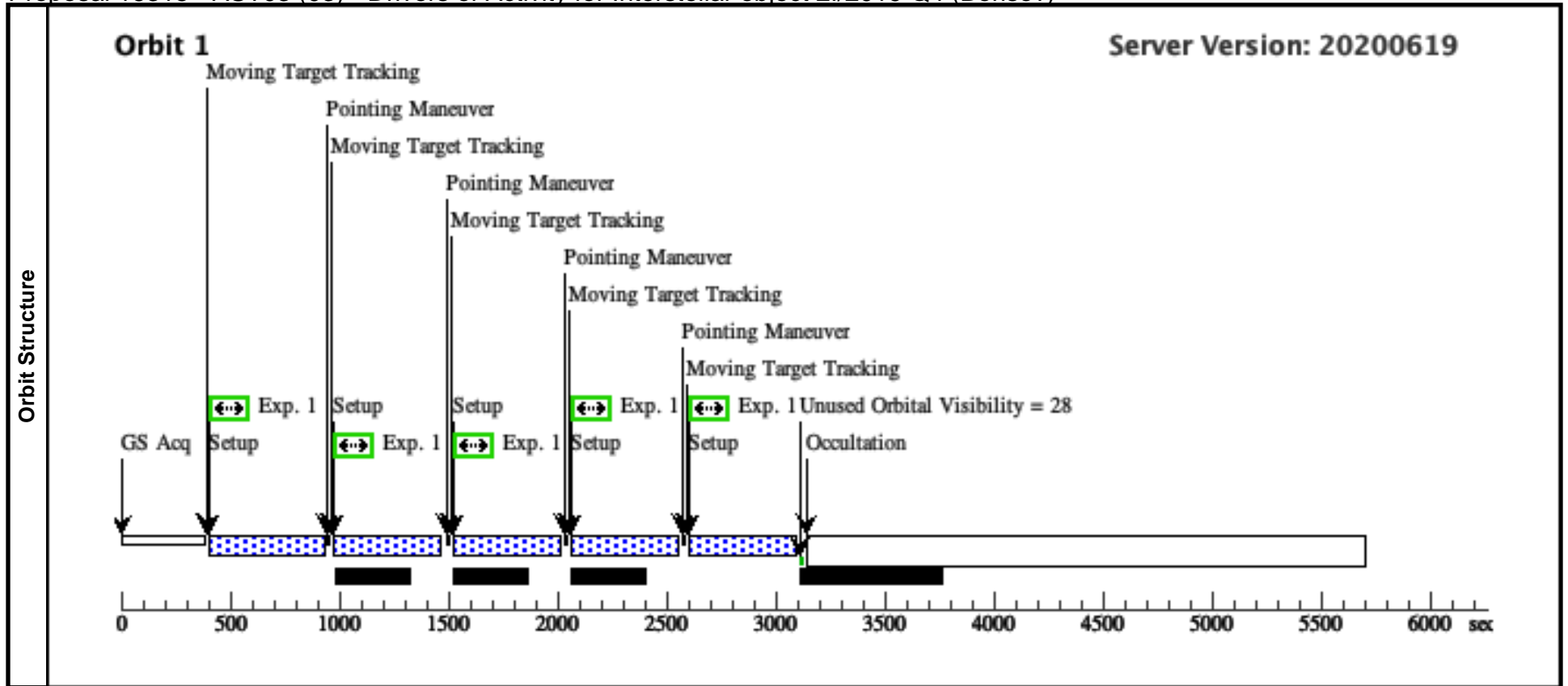
Visit	<p>Proposal 16315, AST02 (02), implementation</p> <p>Diagnostic Status: No Diagnostics</p> <p>Scientific Instruments: WFC3/UVIS</p> <p>Special Requirements: BETWEEN 17-MAR-2021:00:00:00 AND 31-MAR-2021:00:00:00; SEQ 02,03,04,05 WITHIN 12 H</p> <p><i>Comments: The five long, dithered exposures are intended to fill a single visibility window to get the relative timing we need. This is a stand-alone visit with a window provided to give a time constraint that is loose but holds it in roughly the right timeframe for the overall temporal sequence needed for the observing. Successful observations require a minimum number of suitable Gaia DR2 sources in the full field of UVIS. As the observations are scheduled, the proposal team needs to check potential windows for suitable guide stars and avoidance of field star contamination of the target and provide guidance on which windows will work best. If the fields are sparse enough, we may need to provide adjusted POSTARG values to ensure there are enough stars.</i></p> <p><i>The plan is revised based on the non-detection of the object in visit 01. The revision calls for using visit 2-5 in aggregate to generate a deep stack from which to detect the target. These visits should be scheduled as close together as possible. We still need to review the scheduling windows for stellar contamination.</i></p>									
Patterns	#	Primary Pattern		Secondary Pattern		Exposures				
	(1)	Pattern Type=LINE Purpose=OTHER Number Of Points=5 Point Spacing=0.03 Line Spacing=	Coordinate Frame=CELESTIAL Pattern Orientation=0 Angle Between Sides= Center Pattern=true			(1)				
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	I2-BOROSOV	TYPE=COMET,Q=2.0066240085872 65,E=3.356191268153205,I=44.05262 620283894 .O=308.1489154698829,W=209.12460 56235187,T=08-DEC- 2019:13:04:38,TTIMEscale=TDB,EQ UINOX=J2000,EPOCH=31-JUL- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=7.312064170837E-8,A2=- 3.252092599869E-8,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
<i>Comments: Description=Interstellar Object</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) I2-BOROSOV		WFC3/UVIS, ACCUM, UVIS	F350LP			Sequence 1-1 Non-Int in AST02 (02) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in AST02 (02) (1)	380 Secs (1900 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)]	[1]



Proposal 16315 - AST03 (03) - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

Mon Feb 22 14:00:17 GMT 2021

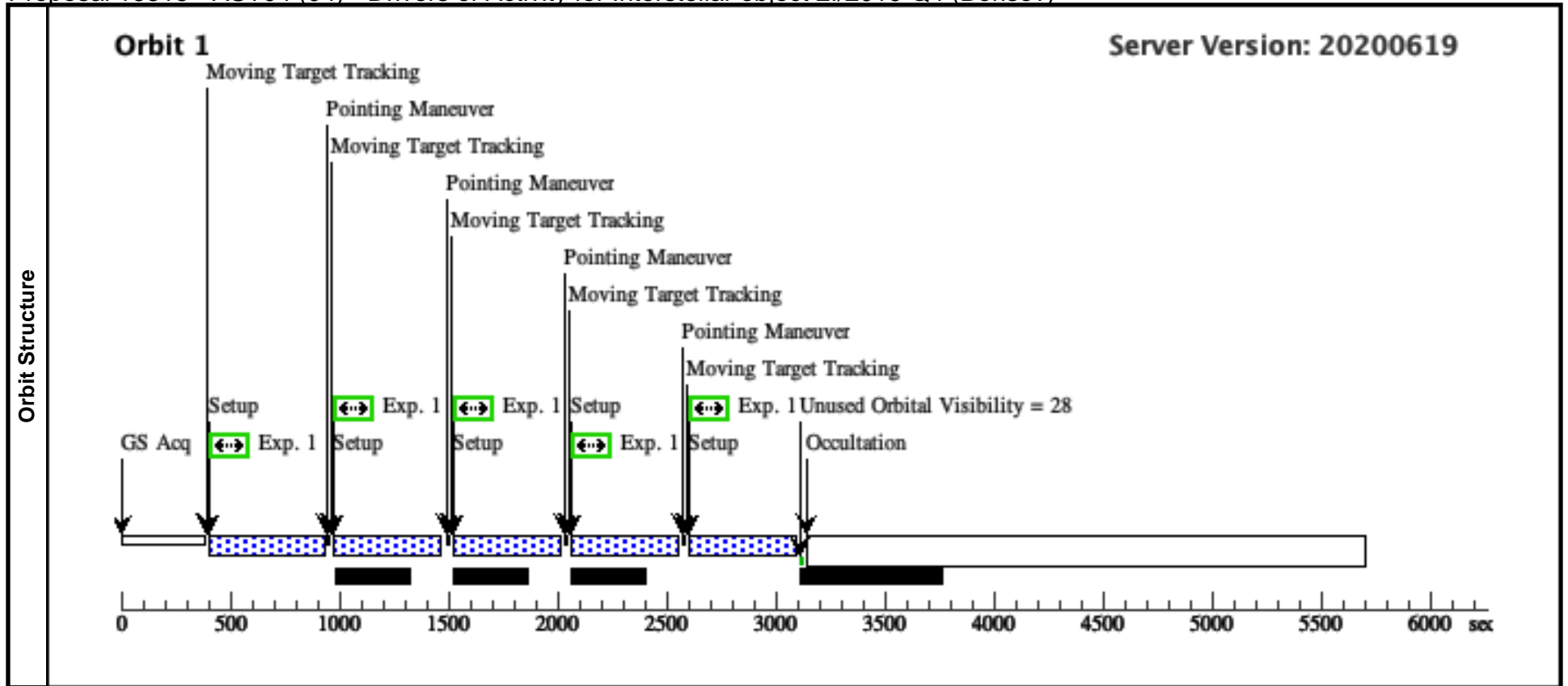
Visit	Proposal 16315, AST03 (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: The five long, dithered exposures are intended to fill a single visibility window to get the relative timing we need. This is a stand-alone visit with a window provided to give a time constraint that is loose but holds it in roughly the right timeframe for the overall temporal sequence needed for the observing. Successful observations require a minimum number of suitable Gaia DR2 sources in the full field of UVIS. As the observations are scheduled, the proposal team needs to check potential windows for suitable guide stars and avoidance of field star contamination of the target and provide guidance on which windows will work best. If the fields are sparse enough, we may need to provide adjusted POSTARG values to ensure there are enough stars.</i>									
Patterns	#	Primary Pattern		Secondary Pattern		Exposures				
	(1)	Pattern Type=LINE Purpose=OTHER Number Of Points=5 Point Spacing=0.03 Line Spacing=	Coordinate Frame=CELESTIAL Pattern Orientation=0 Angle Between Sides= Center Pattern=true			(1)				
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	I2-BOROSOV	TYPE=COMET,Q=2.0066240085872 65,E=3.356191268153205,I=44.05262 620283894 .O=308.1489154698829,W=209.12460 56235187,T=08-DEC- 2019:13:04:38,TTIMEscale=TDB,EQ UINOX=J2000,EPOCH=31-JUL- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=7.312064170837E-8,A2=- 3.252092599869E-8,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.				EARTH			
<i>Comments: Description=Interstellar Object</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) I2-BOROSOV		WFC3/UVIS, ACCUM, UVIS	F350LP			Sequence 1-1 Non-Int in AST03 (03) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in AST03 (03) (1)	380 Secs (1900 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]



Proposal 16315 - AST04 (04) - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

Mon Feb 22 14:00:17 GMT 2021

Visit	Proposal 16315, AST04 (04), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: The five long, dithered exposures are intended to fill a single visibility window to get the relative timing we need. This is a stand-alone visit with a window provided to give a time constraint that is loose but holds it in roughly the right timeframe for the overall temporal sequence needed for the observing. Successful observations require a minimum number of suitable Gaia DR2 sources in the full field of UVIS. As the observations are scheduled, the proposal team needs to check potential windows for suitable guide stars and avoidance of field star contamination of the target and provide guidance on which windows will work best. If the fields are sparse enough, we may need to provide adjusted POSTARG values to ensure there are enough stars.</i>									
Patterns	#	Primary Pattern		Secondary Pattern		Exposures				
	(1)	Pattern Type=LINE Purpose=OTHER Number Of Points=5 Point Spacing=0.03 Line Spacing=	Coordinate Frame=CELESTIAL Pattern Orientation=0 Angle Between Sides= Center Pattern=true			(1)				
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	I2-BOROSOV	TYPE=COMET,Q=2.0066240085872 65,E=3.356191268153205,I=44.05262 620283894 .O=308.1489154698829,W=209.12460 56235187,T=08-DEC- 2019:13:04:38,TTIMEscale=TDB,EQ UINOX=J2000,EPOCH=31-JUL- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=7.312064170837E-8,A2=- 3.252092599869E-8,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
<i>Comments: Description=Interstellar Object</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) I2-BOROSOV		WFC3/UVIS, ACCUM, UVIS	F350LP			Sequence 1-1 Non-Int in AST04 (04) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in AST04 (04) (1)	380 Secs (1900 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)]	[1]



Proposal 16315 - AST05 (05) - Drivers of Activity for Interstellar object 2I/2019 Q4 (Borisov)

Mon Feb 22 14:00:17 GMT 2021

Visit	Proposal 16315, AST05 (05), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: The five long, dithered exposures are intended to fill a single visibility window to get the relative timing we need. This is a stand-alone visit with a window provided to give a time constraint that is loose but holds it in roughly the right timeframe for the overall temporal sequence needed for the observing. Successful observations require a minimum number of suitable Gaia DR2 sources in the full field of UVIS. As the observations are scheduled, the proposal team needs to check potential windows for suitable guide stars and avoidance of field star contamination of the target and provide guidance on which windows will work best. If the fields are sparse enough, we may need to provide adjusted POSTARG values to ensure there are enough stars.</i>									
Patterns	#	Primary Pattern		Secondary Pattern		Exposures				
	(1)	Pattern Type=LINE Purpose=OTHER Number Of Points=5 Point Spacing=0.03 Line Spacing=	Coordinate Frame=CELESTIAL Pattern Orientation=0 Angle Between Sides= Center Pattern=true			(1)				
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	I2-BOROSOV	TYPE=COMET,Q=2.0066240085872 65,E=3.356191268153205,I=44.05262 620283894 .O=308.1489154698829,W=209.12460 56235187,T=08-DEC- 2019:13:04:38,TTIMEscale=TDB,EQ UINOX=J2000,EPOCH=31-JUL- 2020:00:00:00,EpochTimeScale=TDB, R0=2.808 .DT=0. .A1=7.312064170837E-8,A2=- 3.252092599869E-8,A3=0. .ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
<i>Comments: Description=Interstellar Object</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) I2-BOROSOV		WFC3/UVIS, ACCUM, UVIS	F350LP			Sequence 1-1 Non-Int in AST05 (05) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in AST05 (05) (1)	380 Secs (1900 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)]	[1]

