



# 17830 - The Next Interstellar Interloper

Cycle: 32, Proposal Category: GO

(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. David Jewitt (PI) (Contact)</b>	<b>University of California - Los Angeles</b>
Dr. Jessica Agarwal (CoI) (ESA Member)	Technische Universitat Braunschweig
Dr. Jing Li (CoI)	University of California - Los Angeles
Dr. Yoonyoung Kim (CoI)	University of California - Los Angeles
Max Mutchler (CoI) (Contact)	Space Telescope Science Institute

## 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	(3) 3I-ATLAS	WFC3/UVIS	1	03-Nov-2025 13:00:14.0	yes
02	(3) 3I-ATLAS	WFC3/UVIS	1	03-Nov-2025 13:00:14.0	yes
03	(4) 3I-ATLAS-OCT29	WFC3/UVIS	1	03-Nov-2025 13:00:14.0	yes
04	(4) 3I-ATLAS-OCT29	WFC3/UVIS	1	03-Nov-2025 13:00:15.0	yes

4 Total Orbits Used

## ABSTRACT

The recent detection of two interstellar interlopers (1I/Oumuamua and 2I/Borisov) in the solar system has generated enormous scientific and popular interest. A particular surprise is the extreme physical difference between the two objects, with 1I appearing asteroid-like and 2I being much more similar to a normal outgassing, solar system comet. These differences remain unexplained, although speculation abounds. In this proposal we request a 4 orbit disruptive ToO with WFC3 to carry out the earliest possible high resolution assessment of the next interloper object, "3I", so that more

intensive follow-up observations can be rationally planned. Nucleus isolation, coma morphology and activity assessment, and initial search for nucleus rotation, are the objectives. We request a 0 month proprietary period so the observations can be of maximum benefit to the community.

## **OBSERVING DESCRIPTION**

We request four orbits with WFC3 to image the next ISO at the highest sensitivity using the broad F350LP filter. These four orbits will be dithered and combined to optimize the rejection of field object trails, especially from hard-to-remove low surface brightness galaxies. The proposed observations will be triggered upon the identification of the next ISO ( $e > 1.1$ ) object by the Minor Planet Center and/or NASA's Horizons ephemeris service. We will secure six 270 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  $SNR = 5$ . Combining 6 images from one orbit will take us 1 magnitude fainter and will also provide protection from cosmic ray strikes on individual images. Combining data from 4 orbits will take us another 0.75 magnitude deeper, to a point-source sensitivity  $V \sim 28.2$ . Ephemeris uncertainty is unlikely to present a problem given the 160 arcsec field of WFC3, and even if we opt to use a subarray. The evolution of the ephemeris uncertainty on the next ISO can be judged by reference to the examples set by 1I and 2I. For both 1I and 2I, several weeks of ground-based astrometry were needed for the  $e \gg 1$  diagnosis to become irrefutable. With such an arc, the orbits were sufficiently accurately known to predict the position to about 2 arcsecond for about a month. Moreover, high-interest targets such as ISOs attract a continuous stream of astrometric measurements, resulting in steady improvement of the ephemeris accuracy as time goes on. Ephemeris uncertainties will be of no concern for observations using WFC3. Sub-arcsecond astrometry from HST will enable much more accurate orbit fitting and the measurement of non-gravitational accelerations, should they exist. Image saturation is unlikely to be a problem. The wide-field surveys detect most new objects close to their limiting magnitudes, all fainter than  $V \sim 20$  to 21 (Borisov was brighter at discovery, but only because of its extended coma; the central source brightness was faint and HST saturation was not a problem). We request 4 HST orbits triggered upon the discovery of the next interstellar object. This is a disruptive ToO request, with observations desired within a week of the trigger. The orbits should be as nearly consecutive as possible in order to assess possible rotational variation of the object. We understand, however, that the need for a gyro-reset limits the number of consecutive orbits allocated to a solar system target to be at most two. Therefore, our observations would be acquired as two pairs of orbits separated by an orbit gap, spanning  $\sim 8$  hours in total. All observations are with WFC3 and the F350LP filter to provide the highest sensitivity. We request four orbits to be dithered and combined to optimize the rejection of field object trails. Two interlopers were discovered in the last 7 years suggesting that the likelihood of discovery of the next example in Cycle 32 is 30%. This is consistent with the published estimate by Do et al. (2018). We understand that we will have essentially no control over the spacecraft roll angle, which means that we will not be able to optimize the orientation of the dust coma on the CCD (e.g., to orient the tail along the longest dimension of the detector). However, the field-of-view of the camera is large enough and the target coma small enough that we should obtain excellent data, no matter what spacecraft roll angle is used. Finally, we note that our team can prepare and submit a Phase 2 proposal within a day of activation of this program.

Proposal 17830 - Orbit 1 (01) - The Next Interstellar Interloper

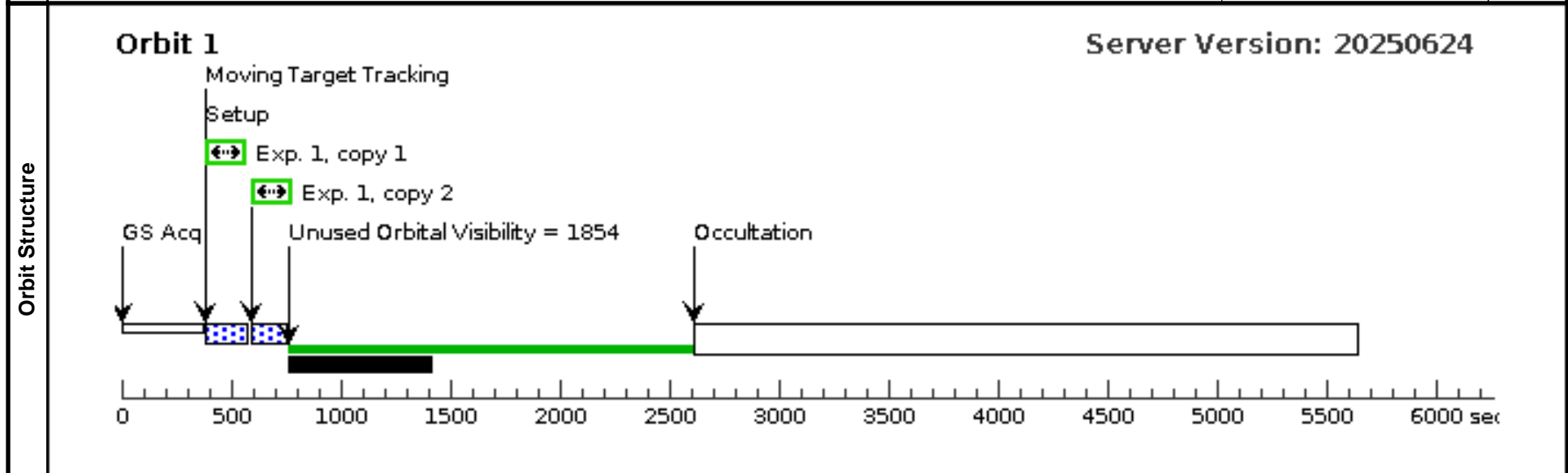
Mon Nov 03 18:00:15 GMT 2025

<b>Visit</b>	<b>Proposal 17830, Orbit 1 (01), completed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: WFC3/UVIS Special Requirements: TOO RESPONSE TIME 10.0D
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<b>Diagnostics</b>	(Exposure 1 (Orbit 1 (01))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser
	(Orbit 1 (01)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

<b>Solar System Targets</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Level 1</th> <th>Level 2</th> <th>Level 3</th> <th>Window</th> <th>Ephem Center</th> </tr> </thead> <tbody> <tr> <td>(3)</td> <td>3I-ATLAS</td> <td>TYPE=COMET,Q=1.3558540737262 17,E=6.132907187787578,I=175.1123 912604994 ,O=322.1448470069185,W=128.01037 53852145,T=29-OCT- 2025:12:15:37,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=03-JUL- 2025:00:00:00,EpochTimeScale=TDB</td> <td></td> <td></td> <td></td> <td>EARTH</td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center	(3)	3I-ATLAS	TYPE=COMET,Q=1.3558540737262 17,E=6.132907187787578,I=175.1123 912604994 ,O=322.1448470069185,W=128.01037 53852145,T=29-OCT- 2025:12:15:37,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=03-JUL- 2025:00:00:00,EpochTimeScale=TDB				EARTH
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Comments: Description=interstellar object Extended=NO															

<b>Exposures</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Label</th> <th>Target</th> <th>Config,Mode,Aperture</th> <th>Spectral Els.</th> <th>Opt. Params.</th> <th>Special Reqs.</th> <th>Groups</th> <th>Exp. Time (Total)/[Actual Dur.]</th> <th>Orbit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>(3) 3I-ATLAS</td> <td>WFC3/UVIS, ACCUM, UVIS2-FIX</td> <td>F350LP</td> <td></td> <td></td> <td></td> <td>40 Secs X 2 (80 Secs)</td> <td></td> </tr> </tbody> </table>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	1		(3) 3I-ATLAS	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP				40 Secs X 2 (80 Secs)	
	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit											
1		(3) 3I-ATLAS	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP				40 Secs X 2 (80 Secs)													
[=>(Copy 1)] [=>(Copy 2)]																					



Proposal 17830 - Orbit 2 (02) - The Next Interstellar Interloper

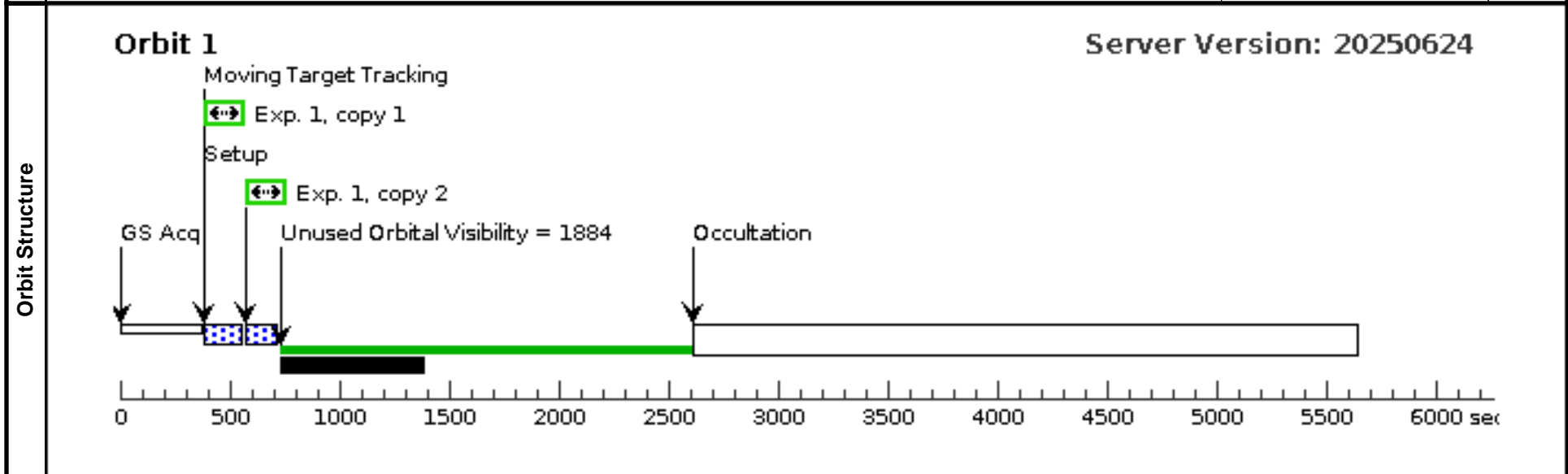
Mon Nov 03 18:00:15 GMT 2025

<b>Visit</b>	<p><b>Proposal 17830, Orbit 2 (02), completed</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Scientific Instruments: WFC3/UVIS</p> <p>Special Requirements: TOO RESPONSE TIME 10.0D</p>
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<b>Diagnostics</b>	<p>(Exposure 1 (Orbit 2 (02))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser</p> <p>(Orbit 2 (02)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>
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(3)	3I-ATLAS	TYPE=COMET,Q=1.3558540737262 17,E=6.132907187787578,I=175.1123 912604994 ,O=322.1448470069185,W=128.01037 53852145,T=29-OCT- 2025:12:15:37,TTimeScale=TDB,EQ UINOX=J2000,EPOCH=03-JUL- 2025:00:00:00,EpochTimeScale=TDB				EARTH									

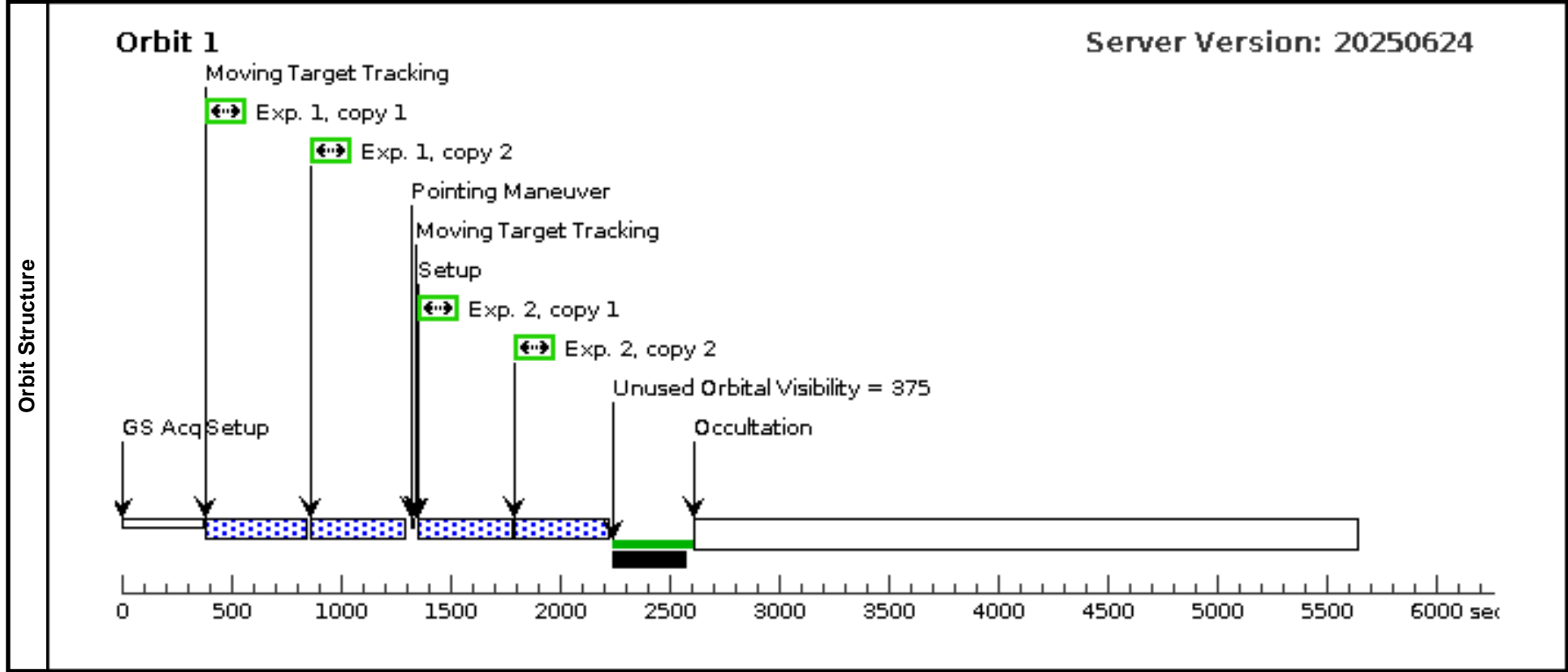
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	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit												
1		(3) 3I-ATLAS	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP				25 Secs X 2 (50 Secs)														



Proposal 17830 - Orbit 3 (03) - The Next Interstellar Interloper

Mon Nov 03 18:00:15 GMT 2025

<b>Visit</b>	<b>Proposal 17830, Orbit 3 (03), implementation</b> <b>Diagnostic Status: Informational</b> Scientific Instruments: WFC3/UVIS Special Requirements: BEFORE 08-DEC-2025:00:00:00; TOO RESPONSE TIME 20.0D										
	(Orbit 3 (03)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.										
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Window</b>	<b>Ephem Center</b>				
	(4)	3I-ATLAS-OCT29	TYPE=COMET,Q=1.3560521921964 07,E=6.13730558284557,I=175.11288 19539053 ,O=322.1526311088164,W=128.01218 73542861,T=29-OCT- 2025:11:36:07,TimeScale=TDB,EQ UINOX=J2000,EPOCH=26-JUL- 2025:00:00:00,EpochTimeScale=TDB, R0=2.808 ,DT=0. ,A1=1.662339477539E- 6,A2=7.089414978027E-7,A3=0. ,ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH			
Comments: Description=interstellar object Extended=YES											
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>		<b>Orbit</b>
	1		(4) 3I-ATLAS-OCT 29	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP				270 Secs X 2 (540 Secs)		
									[==>(Copy 1)]		[1]
									[==>(Copy 2)]		
2		(4) 3I-ATLAS-OCT 29	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP		POS TARG 0.2,0.2			270 Secs X 2 (540 Secs)		
								[==>(Copy 1)]		[1]	
								[==>(Copy 2)]			



Proposal 17830 - Orbit 4 (04) - The Next Interstellar Interloper

Mon Nov 03 18:00:15 GMT 2025

<b>Visit</b>	<b>Proposal 17830, Orbit 4 (04), implementation</b> <b>Diagnostic Status: Informational</b> Scientific Instruments: WFC3/UVIS Special Requirements: AFTER 03 BY 2 D TO 8 D; TOO RESPONSE TIME 20.0D									
	(Orbit 4 (04)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Window</b>	<b>Ephem Center</b>			
	(4)	3I-ATLAS-OCT29	TYPE=COMET,Q=1.3560521921964 07,E=6.13730558284557,I=175.11288 19539053 ,O=322.1526311088164,W=128.01218 73542861,T=29-OCT- 2025:11:36:07,TimeScale=TDB,EQ UINOX=J2000,EPOCH=26-JUL- 2025:00:00:00,EpochTimeScale=TDB, R0=2.808 ,DT=0. ,A1=1.662339477539E- 6,A2=7.089414978027E-7,A3=0. ,ALN=0.1112620426,NM=2.15,NN=5. 093,NK=4.6142,AMRAT=0.					EARTH		
Comments: Description=interstellar object Extended=YES										
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1		(4) 3I-ATLAS-OCT 29	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP				270 Secs X 2 (540 Secs)	
									[==>(Copy 1)]	[1]
									[==>(Copy 2)]	
2		(4) 3I-ATLAS-OCT 29	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F350LP		POS TARG 0.2,0.2			270 Secs X 2 (540 Secs)	
								[==>(Copy 1)]	[1]	
								[==>(Copy 2)]		

