17288 - A New Asteroid Pair

Cycle: 30, 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	(1) 2010UM26	WFC3/UVIS	1	02-Dec-2022 15:00:52.0	yes
02	(1) 2010UM26	WFC3/UVIS	1	02-Dec-2022 15:00:52.0	yes
03	(1) 2010UM26	WFC3/UVIS	1	02-Dec-2022 15:00:53.0	yes
04	(1) 2010UM26	WFC3/UVIS	1	02-Dec-2022 15:00:53.0	yes

4 Total Orbits Used

ABSTRACT

Main belt asteroids 2010 UM26 and 2010 RN221 share almost identical orbital elements and currently appear as comoving objects only 35 arcsec apart in the plane of the sky. They are products of the recent breakup of a parent body, but the nature of this body and the details of the breakup are unknown. Breakup through rotational instability is suspected based on the very small (cm/sec) separation velocity, and this process is increasingly recognised as of particular importance in the evolution and disintegration of small asteroids. With a separation age measured in decades rather than millions of years as for other asteroid pairs, this pair presents the opportunity to study breakup in its earliest stages. We propose deep, high resolution

imaging with HST and WFC3 to examine 1) the number and distribution of fragments and 2) the debris sheet expected from rotational instability. These observations will set the baseline appearance and provide a reference for the sensible planning of additional observations in future cycles.

OBSERVING DESCRIPTION

We propose deep imaging observations with WFC3 and the F350LP filter. The latter filter has an extraordinarily wide bandpass that provides maximum sensitivity to faint objects and has become the filter of choice for numerous solar system programs where deep imaging is needed. The main penalty of using this broad filter is that the color term is significant at the 0.1 magnitude level, but this is not a hindrance for the proposed observations. We request 4 HST orbits to accumulate a deep image, and will obtain 6 images each of 300 s duration in each orbit, dithered to provide protection from CCD defects. For this measurement, the greater the amount of on-source time the better. However, in realistic view of the scarcity of Hubble time, we here request a minimum of 4 orbits in order to conduct the observations. This request has two motivations. First, we need the deepest images to detect faint (small) fragments in this system and so to define the size distribution. As in 331P, we expect that the faintest objects are numerically dominant, putting a high premium on deep data. The WFC3 exposure time calculator indicates that in 4 orbits with this exposure and filter, we will reach a 5 limiting magnitude V = 26.8. At this limit, the corresponding object diameter is 40 m (for the same 0.24 albedo). Bodies this small contain 104 of the mass contained in 2010 UM26. This sensitivity calculation neglects any noise contribution from diffuse light in a background particle trail, but there is no meaningful way to estimate the trail brightness or the noise contribution in detail. However, observations of comets and other solar system bodies with particle trails suggest that the loss due to elevated background signal might be a few tenths of a magnitude in the detection of embedded point sources. Second, a major problem in deep solar system imaging is set by background sources which are trailed across the images as a result of parallactic motion of the target. Images secured in a single orbit are often insufficient to remove trailed background objects but better suppression is possible when combining data from several orbits having completely different stellar and galactic backgrounds. Therefore, combining data from 4 orbits will give us a deeper limiting magnitude and a better suppression of background structure due to trailed objects. The request for 4 orbits is further buttressed by examination of archival data from 331P (GO 14192, 14475, 14798, and 15360) where 4 orbits with the best trailed galaxy elimination schemes were needed to reveal a majority of the faint fragments and to define the trail surface brightness profile. The two asteroids 2010 UM26 and 2010 RN221 are co-moving objects separated by about 35 in the plane of the sky, which fit neatly within the 210 field of view of WFC3. The distribution of smaller (fainter) fragments is unknown, however, and the fragment train could be longer. We will position the asteroid pair so as to obtain maximum visibility along the UM26 - RN221 line, which is closely approximated by the projected orbital line as cal- culated from JPL Horizons. The ephemeris uncertainties of 2010 UM26 and 2010 RN221 are <1 and therefore of no consequence for the planning of these observations. We request observations as soon as possible before UT 2023 January 7, after which the elon- gation of the target will fall below the 55 limit for observations with HST. After January 7, the elongation will remain too small for HST until 2023

September 18. Observations in Cycle 31 will be possible but with a considerably less favorable observing geometry. For example, the heliocentric, rH, and geocentric, distances, will change from rH, = 1.750, 2.114 AU on UT 2023 January 7 to rH, = 2.513, 2.943 AU on UT 2023 September 18, corresponding to a m = 1.50 magnitude (factor of 4.0) loss in brightness. Observations at later dates would require integration times longer by roughly 42 = 16, or more, than those secured before 2023 January 7, in order to reach the same absolute sensitivity to faint components. The Earth (and HST) will cross the orbit plane on UT November 17, but will remain within 1.4 of the orbit plane until the observing window closes on January 7. Observations from small out-of-plane angles confer an advantage in the detection of low surface brightness, low velocity material, which remains close to the orbit plane of the source body.

Visit

Proposal 17288, Visit 01, implementation Fri Dec 02 20:00:54 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 30%; SEQ 01,02,03,04 WITHIN 12 H

Diagnostics

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

Solar System Targets

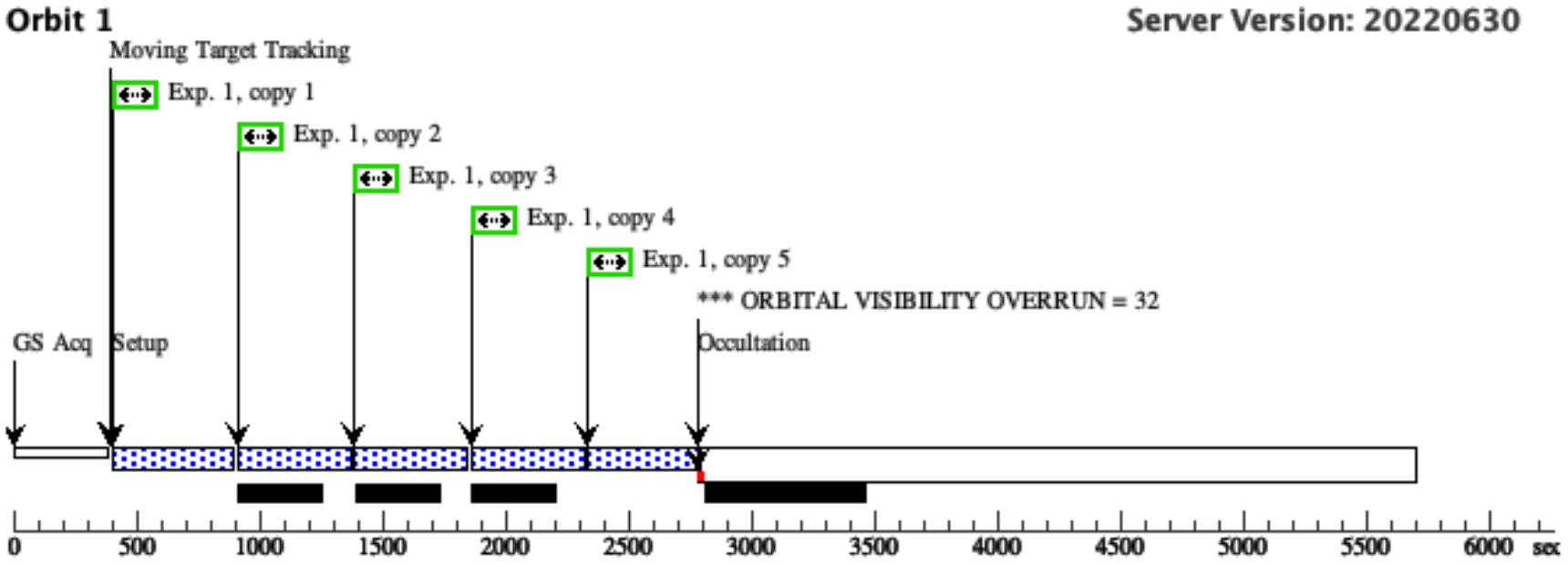
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2010UM26	TYPE=ASTEROID,A=2.576600452914094,E=0.3261426763028916,I=3.860178858863982,O=235.388737551938,W=119.1361691836958,M=54.50043230195645,EQUINOX=J2000,EPOCH=12-APR-2015:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=asteroid pair

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2010UM26	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP			Sequence 1-1 Non-Int in Visit 01	348 Secs X 5 (1740 Secs)	
								[==>(Copy 1)]	
								[==>(Copy 2)]	
								[==>(Copy 3)]	***[1]***
								[==>(Copy 4)]	
								[==>(Copy 5)]	

Orbit Structure



Visit

Proposal 17288, Visit 02, implementation Fri Dec 02 20:00:54 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 30%

Diagnostics

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

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2010UM26	TYPE=ASTEROID,A=2.576600452914094,E=0.3261426763028916,I=3.860178858863982,O=235.388737551938,W=119.1361691836958,M=54.50043230195645,EQUINOX=J2000,EPOCH=12-APR-2015:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=asteroid pair

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2010UM26	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP		POS TARG 0.4,3.0	Sequence 1-1 Non-Int in Visit 02	348 Secs X 5 (1740 Secs)	
								[==>(Copy 1)]	***[1]***
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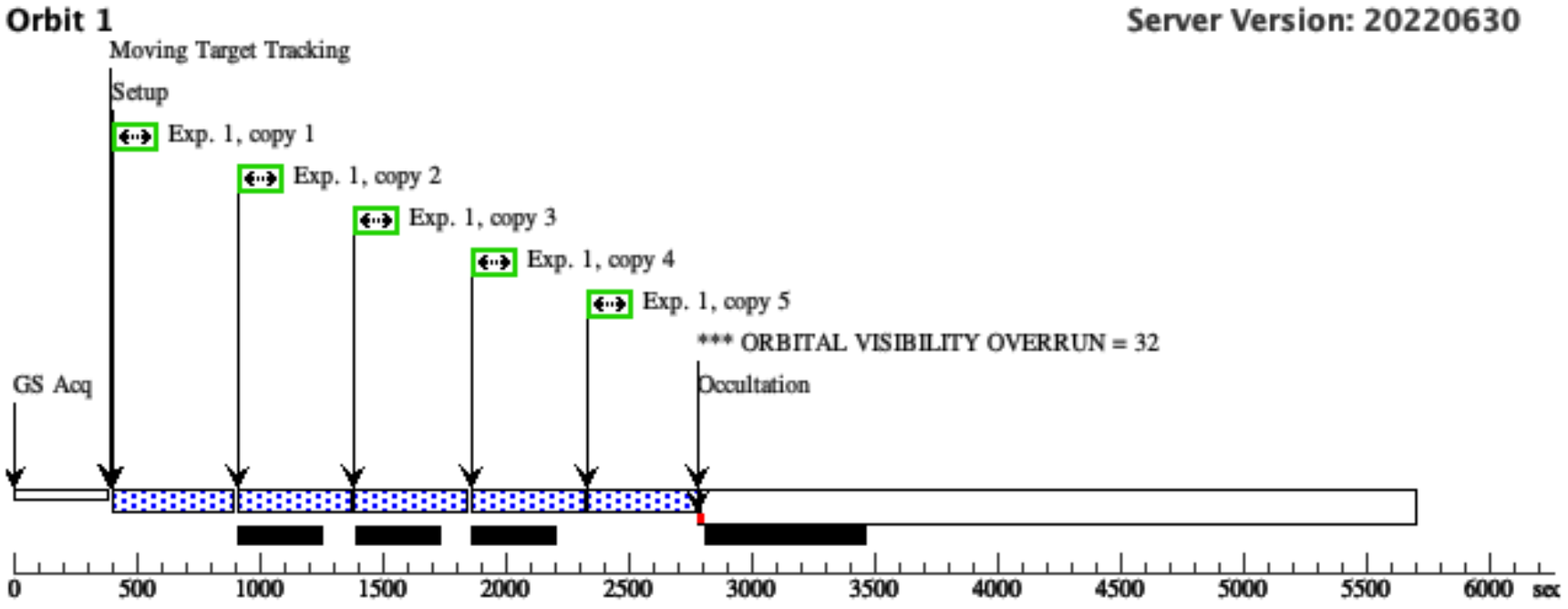
Orbit Structure



Visit

Proposal 17288, Visit 03, implementation Fri Dec 02 20:00:54 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 30%

Diagnostics

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

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2010UM26	TYPE=ASTEROID,A=2.576600452914094,E=0.3261426763028916,I=3.860178858863982,O=235.388737551938,W=119.1361691836958,M=54.50043230195645,EQUINOX=J2000,EPOCH=12-APR-2015:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=asteroid pair

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2010UM26	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP		POS TARG 0.8,6.0	Sequence 1-1 Non-Int in Visit 03	348 Secs X 5 (1740 Secs)	
								[==>(Copy 1)]	
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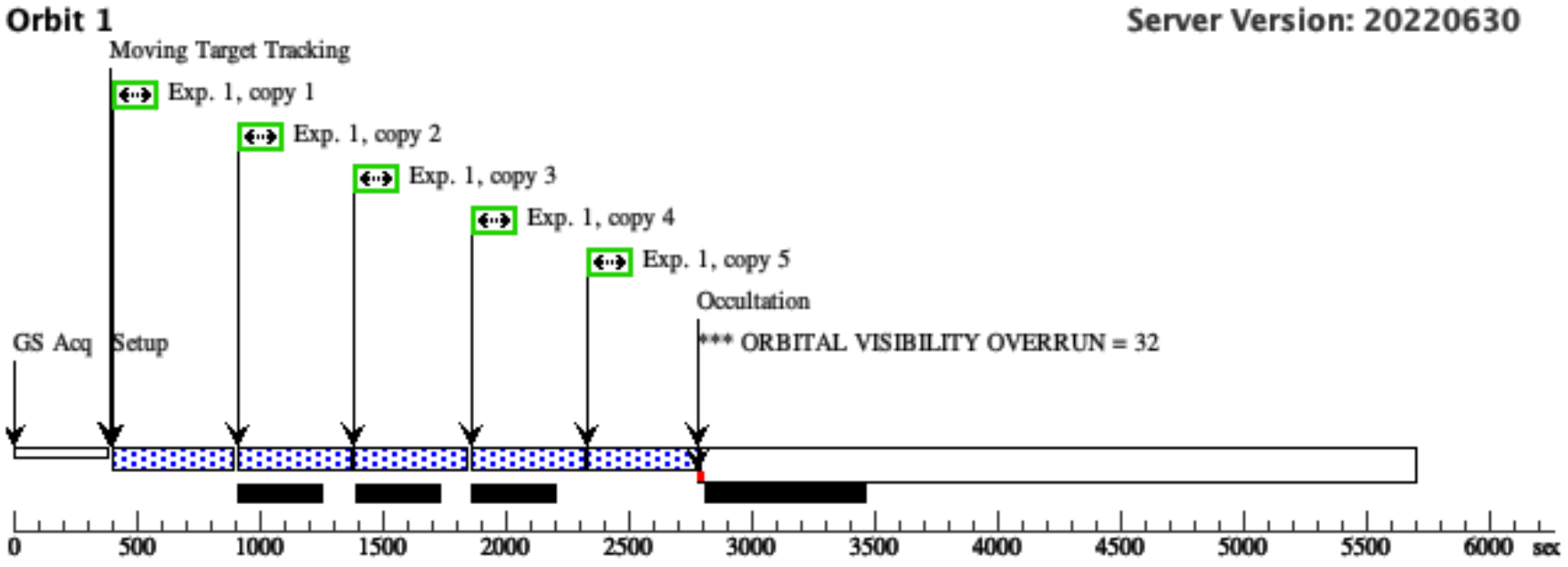
								[==>(Copy 5)]	

Orbit Structure



Visit

Proposal 17288, Visit 04, implementation Fri Dec 02 20:00:54 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 30%

Diagnostics

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

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	2010UM26	TYPE=ASTEROID,A=2.576600452914094,E=0.3261426763028916,I=3.860178858863982,O=235.388737551938,W=119.1361691836958,M=54.50043230195645,EQUINOX=J2000,EPOCH=12-APR-2015:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=asteroid pair

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2010UM26	WFC3/UVIS, ACCUM, UVIS2-FIX	F350LP		POS TARG 1.2,9.0	Sequence 1-1 Non-Int in Visit 04	348 Secs X 5 (1740 Secs)	
								[==>(Copy 1)]	
								[==>(Copy 2)]	
								[==>(Copy 3)]	***[1]***
								[==>(Copy 4)]	
								[==>(Copy 5)]	

Orbit Structure