15481 - The orbital evolution of binary main-belt comet 288P/300163

Cycle: 25, 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) 288P	WFC3/UVIS	1	15-Apr-2019 10:00:24.0	yes
02	(1) 288P	WFC3/UVIS	1	15-Apr-2019 10:00:25.0	yes
03	(1) 288P	WFC3/UVIS	1	15-Apr-2019 10:00:26.0	yes
04	(1) 288P	WFC3/UVIS	1	15-Apr-2019 10:00:27.0	yes
05	(1) 288P	WFC3/UVIS	1	15-Apr-2019 10:00:27.0	yes

5 Total Orbits Used

ABSTRACT

We request 5 orbits of mid-cycle time, spaced at 50-day intervals between 2018, November and 2019, June, to continue studying the orbital evolution of the unique binary main-belt comet 288P/300163. HST/WFC3 observations from 2016/17 revealed that 288P is unusual due to its combination of

nearly equal component size, wide separation, high eccentricity, and sublimation-driven activity. Possible formation scenarios include a collision, rotational break-up or a combination of both. The interrelation of activity and orbital evolution seems probable but is highly model-dependent and unconfirmed. In data from 2017/18, we find indications of a change of the orbital elements during the past year, which has significant consequences for modelling the past and future evolution of the system. We request renewed observations of 288P to investigate if the orbit change was induced by the several months of activity in 2016/17, or if the orbit keeps changing also without activity. In order to link the new data to those from previous arcs, the observations should start as soon as possible when 288P emerges from HST's solar exclusion zone in late October 2018, which is why we request mid-cycle time.

OBSERVING DESCRIPTION

The goal of the observations is to repeatedly measure the projected component separation of the binary asteroid 288P in order to derive the orbital elements of the binary system during Cycle 26. Five visits are the minimum requirement to contrain the orbital elements, assuming that the binary and heliocentric orbital planes are parallel.

We propose to observe the 288P system during 5 epochs in ~50-day intervals during the visibility period between 2018 October and 2019 June. The timing of each visit is flexible within +/-1 week. All five orbits will be suited to measure the absolute magnitude of the components and its rotational variability. We expect each component to have V~23, and component separations up to 0.03 arcsec. We will employ a subsampling dither box pattern combined with careful PSF-fitting to measure the sub-pixel component separations.

In each orbit, we will take 8 exposures of ~225s using the 1k subarray of WFC3 and perform a subsampling dither box pattern, obtaining 2 exposures at each dither point.
The orbital visibility for a solar system target near the ecliptic plane is 54 min (Section 6.3 of the HST Primer document). The described strategy provides a total exposure time of 1800s = 30 min, and estimated overheads of 6 min for guide-star acquisition, 2.6 min for the first exposure, a total of 14.7 min for the subsequent 7 exposures, and 1.5 min for the three spacecraft maneuvers required for dithering, which adds up to a total execution time of 54 min per orbit. This dither strategy is identical to the one employed successfully for this target during Cycles 24 and 25, ensuring maximum comparability of the data.

We will use the wide bandpass filter F606W for an optimum trade-off between sensitivity and highest resolution: the bandpass (475 - 700 nm) covers the maximum of the solar spectrum, and is in the wavelength range where the PSF is smallest (FWHM<0.07 arcsec, from the WFC3 Instrument

Handbook for Cycle 25), such that we can optimally exploit our subsampling dither strategy. In addition, F606W is the same filter we used to observe 288P in GO 12597, 14790, 14864, 14884, and 15328, enabling a direct comparison of the data sets.

The WFC3 exposure time calculator returns for a solar-spectrum point source at V=22.3 (combined for both components), exposure time of 450 s, F606W filter, and default background values a signal-to-noise-ratio of 105 within a circle of 0.2 arcsec (ETC Request ID: WFC3UVIS.im.1154717). This signal will be sufficient to reliably fit the PSFs.

Visit

Proposal 15481, Visit 01, completed Mon Apr 15 14:00:28 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 01-NOV-2018:00:00:00 AND 15-NOV-2018:00:00:00

Comments: The flash warning disappears when using the zodiacal light model for the actual position of the target close to the ecliptic.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 01)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Solar System Targets

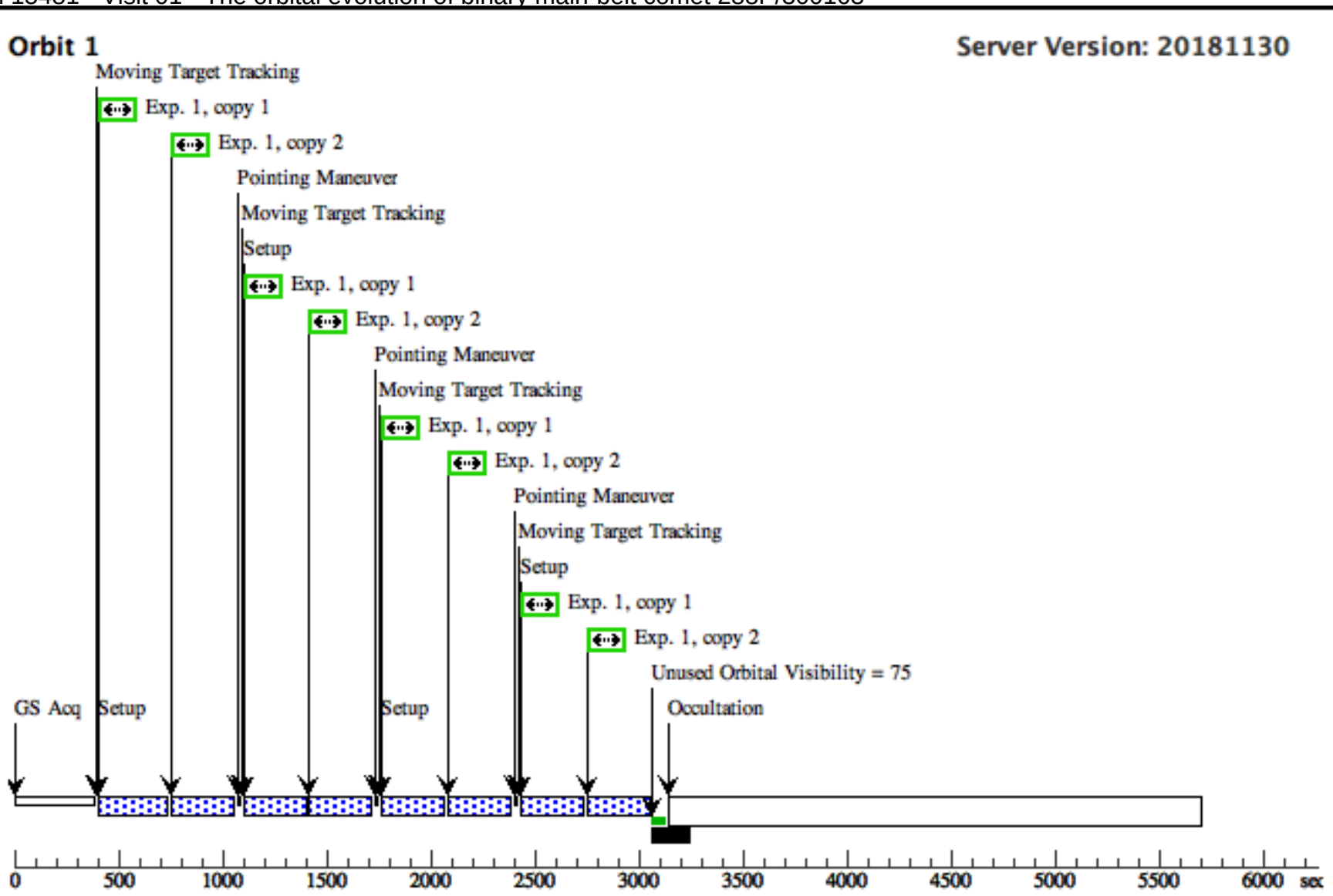
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.434091859832713,E=0.2011952883437459,I=3.240682641168021,O=83.19068811025544,W=281.2529259614446,T=08-NOV-2016:21:17:35,TTimeScale=TDB,EQUINOX=J2000,EPOCH=29-APR-2014:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=COMET 288P, ASTEROID 300163 Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 288P	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in Visit 01 (1)	230 Secs X 2 (1840 Secs)	
								[==>(Pattern 1, Copy 1)]	***[1]***
								[==>(Pattern 1, Copy 2)]	
								[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]	
								[==>(Pattern 3, Copy 1)]	
								[==>(Pattern 3, Copy 2)]	
								[==>(Pattern 4, Copy 1)]	
								[==>(Pattern 4, Copy 2)]	

Orbit Structure



Visit

Proposal 15481, Visit 02, completed Mon Apr 15 14:00:28 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 20-DEC-2018:00:00:00 AND 03-JAN-2019:00:00:00

Comments: The flash warning disappears when using the zodiacal light model for the actual position of the target close to the ecliptic.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 02)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Solar System Targets

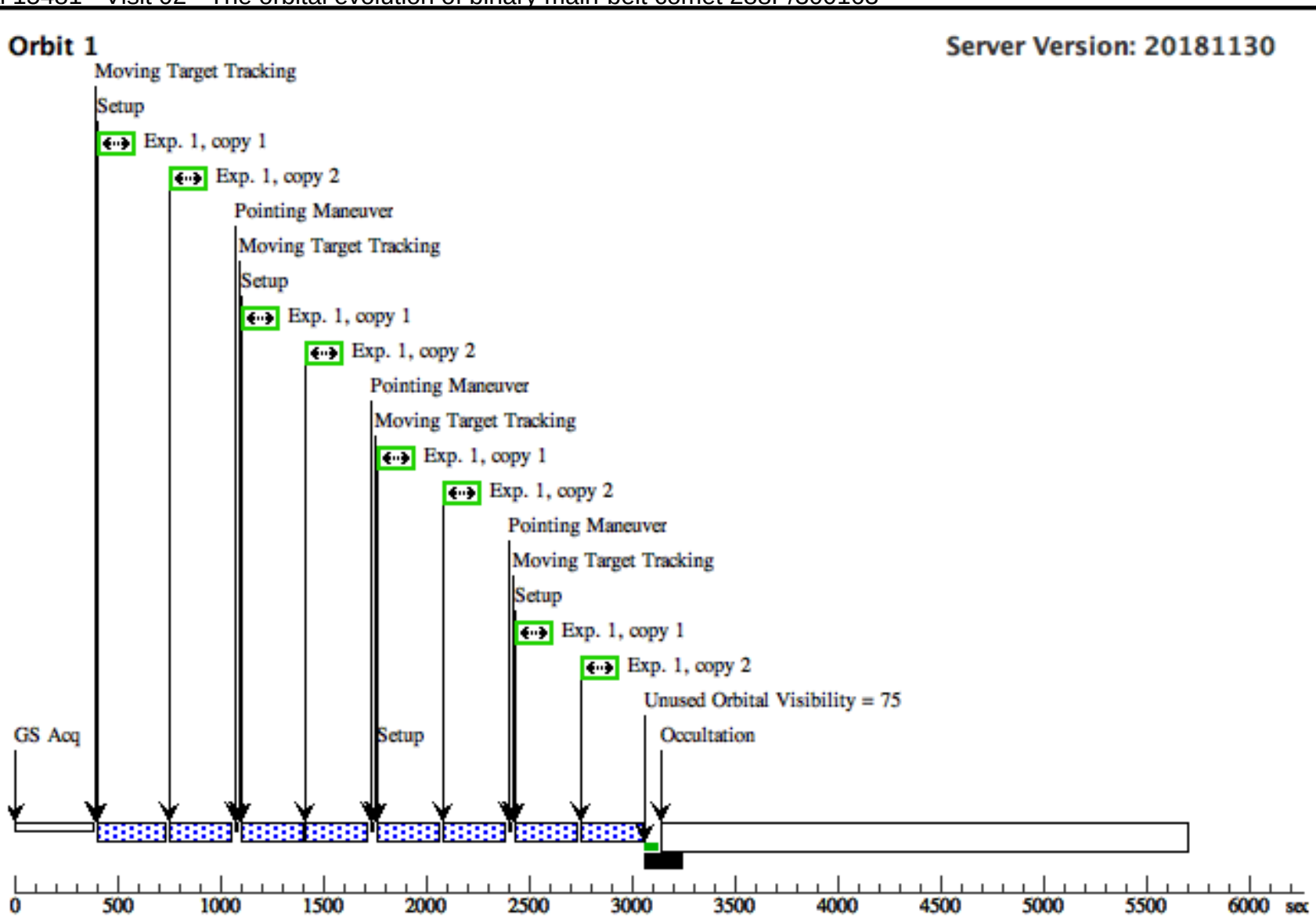
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.434091859832713,E=0.2011952883437459,I=3.240682641168021,O=83.19068811025544,W=281.2529259614446,T=08-NOV-2016:21:17:35,TTimeScale=TDB,EQUINOX=J2000,EPOCH=29-APR-2014:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=COMET 288P, ASTEROID 300163
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1163772)	(1) 288P	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in Visit 02 (1)	230 Secs X 2 (1840 Secs)	
								[==>(Pattern 1, Copy 1)]	***[1]***
								[==>(Pattern 1, Copy 2)]	
								[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]	
								[==>(Pattern 3, Copy 1)]	
								[==>(Pattern 3, Copy 2)]	
								[==>(Pattern 4, Copy 1)]	
								[==>(Pattern 4, Copy 2)]	

Orbit Structure



Visit

Proposal 15481, Visit 03, completed Mon Apr 15 14:00:28 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 15-JAN-2019:00:00:00 AND 30-JAN-2019:00:00:00

Comments: The flash warning disappears when using the zodiacal light model for the actual position of the target close to the ecliptic.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 03)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

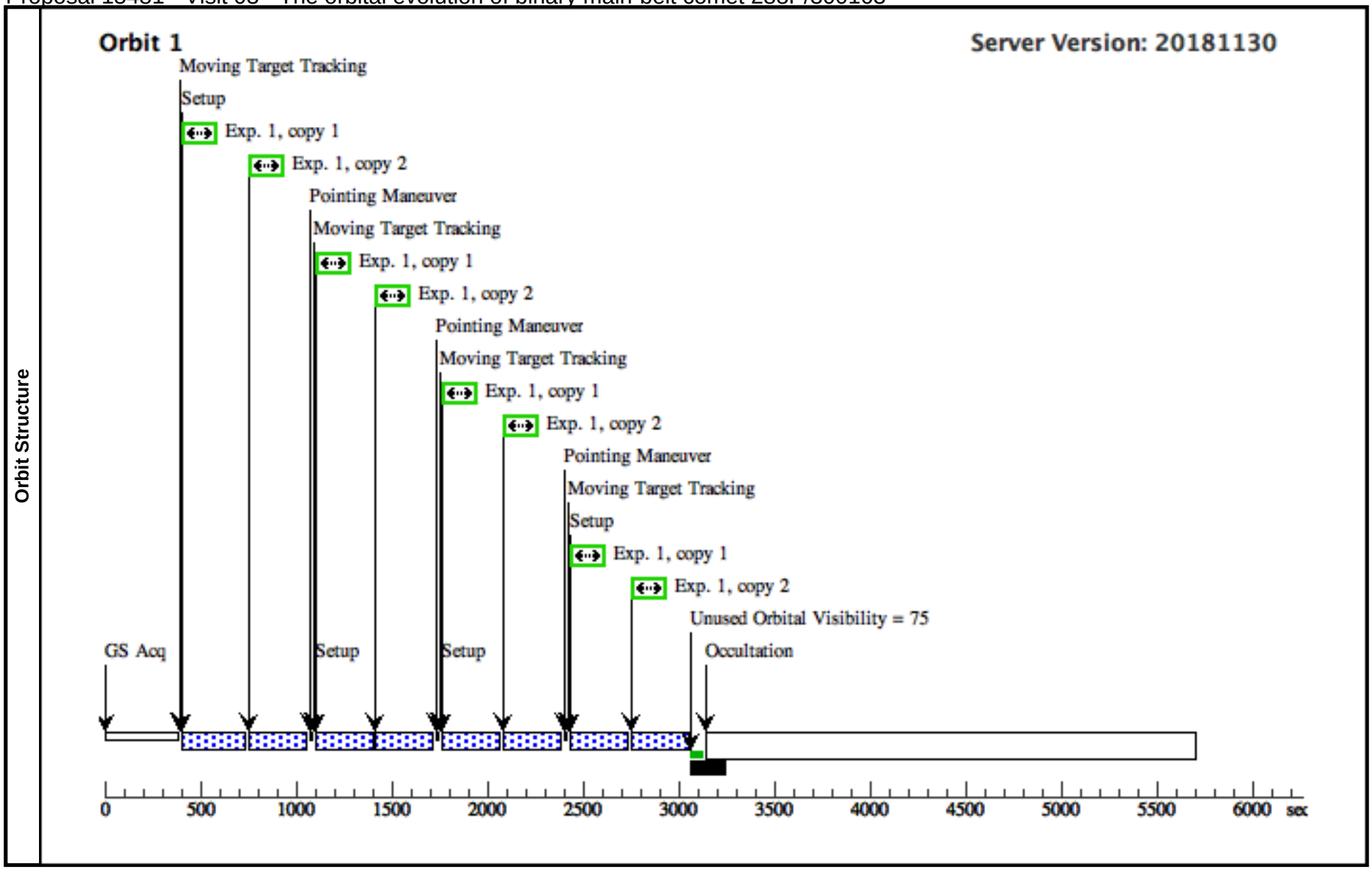
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.434091859832713,E=0.2011952883437459,I=3.240682641168021,O=83.19068811025544,W=281.2529259614446,T=08-NOV-2016:21:17:35,TTimeScale=TDB,EQUINOX=J2000,EPOCH=29-APR-2014:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=COMET 288P, ASTEROID 300163 Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1163773)	(1) 288P	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in Visit 03 (1)	230 Secs X 2 (1840 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20181130
Moving Target Tracking
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Unused Orbital Visibility = 75
GS Acq
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15481, Visit 04, completed Mon Apr 15 14:00:28 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 16-FEB-2019:00:00:00 AND 06-MAR-2019:00:00:00

Comments: The flash warning disappears when using the zodiacal light model for the actual position of the target close to the ecliptic.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 04)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

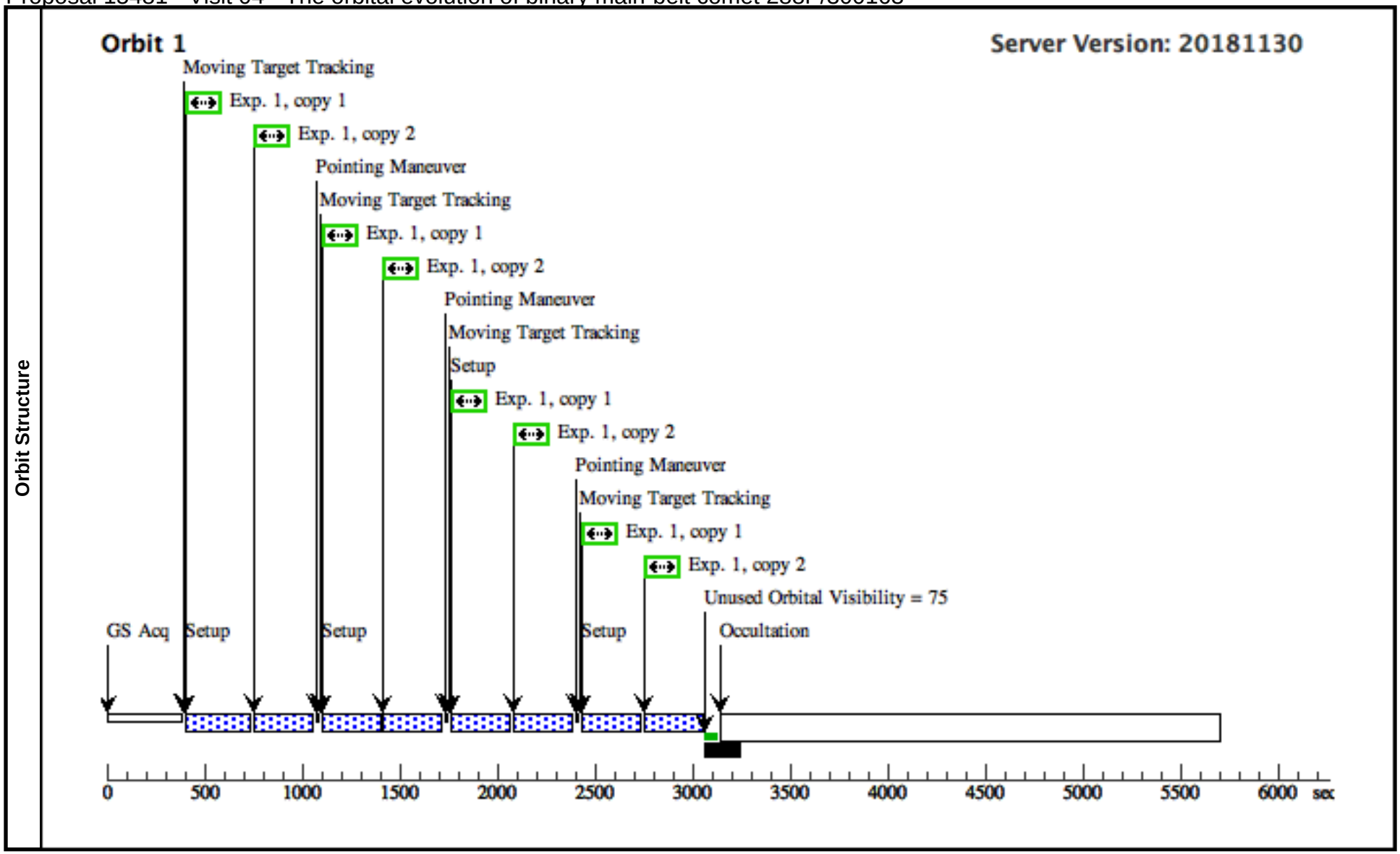
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.434091859832713,E=0.2011952883437459,I=3.240682641168021,O=83.19068811025544,W=281.2529259614446,T=08-NOV-2016:21:17:35,TTimeScale=TDB,EQUINOX=J2000,EPOCH=29-APR-2014:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=COMET 288P, ASTEROID 300163 Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1163775)	(1) 288P	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in Visit 04 (1)	230 Secs X 2 (1840 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20181130
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Unused Orbital Visibility = 75
GS Acq
Setup
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15481, Visit 05, implementation Mon Apr 15 14:00:28 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 06-MAY-2019:00:00:00 AND 27-MAY-2019:00:00:00

Comments: The flash warning disappears when using the zodiacal light model for the actual position of the target close to the ecliptic.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Visit 05)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

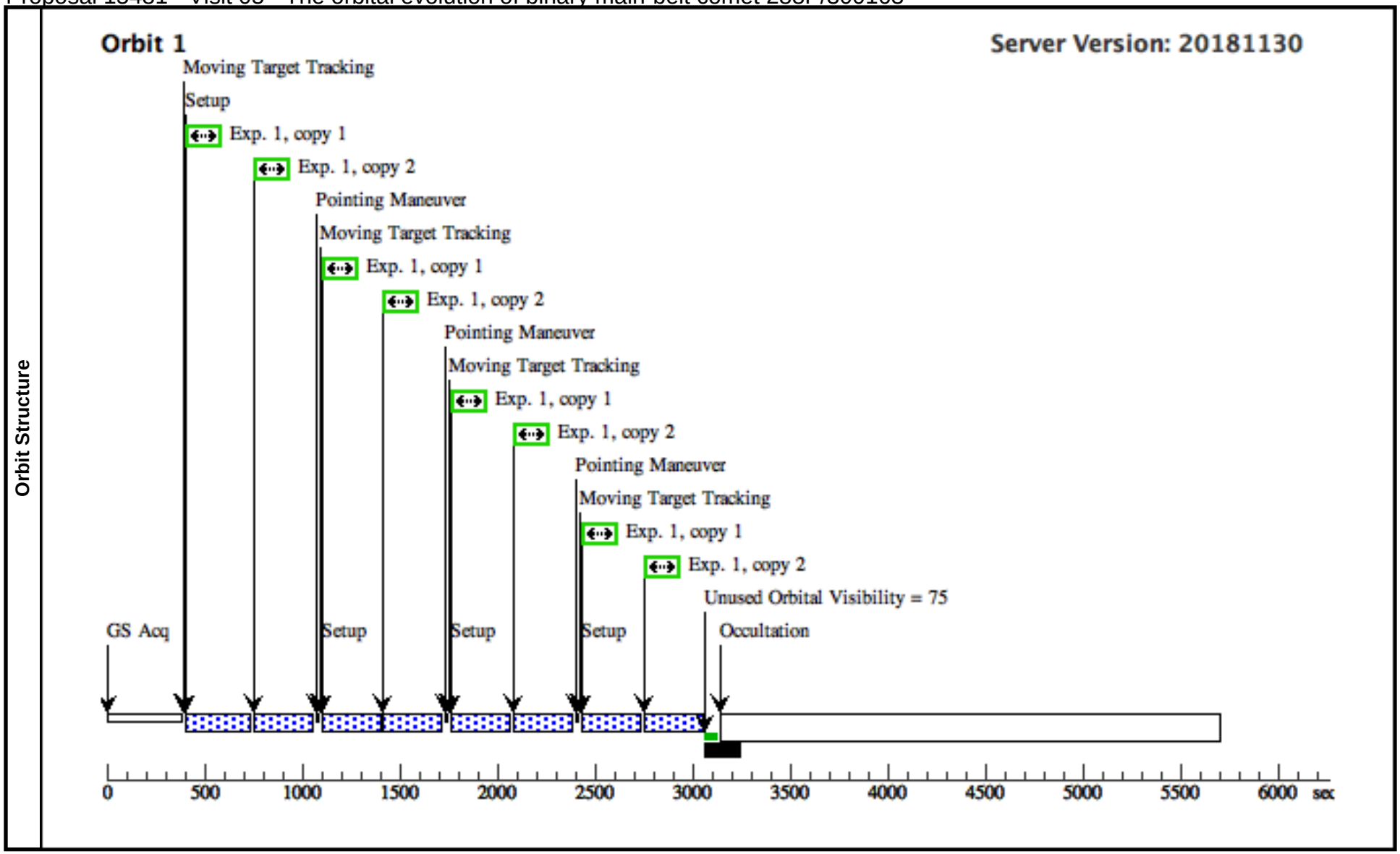
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.434091859832713,E=0.2011952883437459,I=3.240682641168021,O=83.19068811025544,W=281.2529259614446,T=08-NOV-2016:21:17:35,TTimeScale=TDB,EQUINOX=J2000,EPOCH=29-APR-2014:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=COMET 288P, ASTEROID 300163 Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1163776)	(1) 288P	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in Visit 05 (1)	230 Secs X 2 (1840 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20181130
Moving Target Tracking
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Unused Orbital Visibility = 75
GS Acq
Setup
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec