16993 - Interconnection between outgassing, fast rotation and mutual orbit in binary main-belt comet 288P

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) 288P	WFC3/UVIS	1	01-Nov-2022 16:00:12.0	yes
02	(1) 288P	WFC3/UVIS	1	01-Nov-2022 16:00:13.0	yes
03	(2) 288P-B	WFC3/UVIS	1	01-Nov-2022 16:00:13.0	yes

3 Total Orbits Used

ABSTRACT

The binary asteroid 288P is unusual both for its sublimation-driven activity and for its peculiar mutual orbit combining similarly-sized components with a wide separation and high eccentricity. The second half if 2022 will witness the 288P system emerging from its second perihelion passage after the binary nature was discovered. We here seek to verify the possibility indicated by earlier HST observations that the mutual orbit was perturbed by an outgassing-induced torque during the 2016/17 perihelion passage. If confirmed, the activity could have led to the unusually wide semimajor axis that cannot be achieved directly from rotational fission. In addition we seek to consolidate the identity of the active component(s) to find out if the activity is a direct consequence of the splitting event leading to binary formation. We also aim to constrain the size of the largest dust particles emitted from the active component(s) that is diagnostic of the strength of sublimation and the potential role played by fast rotation in lifting the dust. Finally, we seek to understand whether the level of activity is constant between apparitions, or if a trend can be identified that would indicate the evolution of exposed ice on main belt asteroids with time.
We request five orbits of HST/WFC3 time to be scheduled at roughly 4 week intervals between August and December 2022. These data will allow us to measure the brightness and separations of the components and the evolution of dust lingering from the perihelion passage in winter 2021/22. Only HST is able to spatially resolve the components (max. separation 0.1 arcsec) and central dust cloud of this faint (V=22mag) target.

OBSERVING DESCRIPTION

The purpose of this proposal is to observe how activity decreases and ends as the binary main-belt comet 288P moves out from perihelion in the second half of 2022. We plan to observe 288P in 4-weeks intervals between mid-August and early December. Hence two of these 1-orbit visits fall into Cycle 29 and three into Cycle 30. This phase 2 proposal is for the three Cycle 30 visits only.

The visits should be carried out around 2022 October 08, November 05, and December 03, with a flexibility of 1 week.

We expect a target brightness of V=22.5 mag, depending on time.

In each orbit, we will take 8 exposures of 239s using the C512C subarray of WFC3 and perform a 2-point dither pattern to mitigate hot pixels and cosmic ray hits, obtaining 4 exposures at each dither point. This provides a total exposure time of 1912 s = 32 min. The ephemeris is known with uncertainty <1arcsec, such that there is no risk of missing the target even using the C512C sub-array.

We will use the wide bandpass filter F606W for an optimum trade-off between sensitivity and highest resolution, and maximum compatibility with data from earlier epochs.

The target will be at solar elongations between 105 and 175deg.

Visit

Proposal 16993, V1 (01), completed Tue Nov 01 20:00:14 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 03-OCT-2022:02:40:00 AND 03-OCT-2022:16:10:00; BETWEEN 03-OCT-2022:17:20:00 AND 04-OCT-2022:23:50:00; BETWEEN 05-OCT-2022:01:00:00 AND 05-OCT-2022:15:40:00; BETWEEN 05-OCT-2022:16:50:00 AND 06-OCT-2022:09:00:00; BETWEEN 06-OCT-2022:10:10:00 AND 08-OCT-2022:17:50:00; BETWEEN 08-OCT-2022:20:10:00 AND 09-OCT-2022:21:30:00

Comments: BETWEENs will be used to avoid times when 288P should not be observed due to the proximity of bright background stars. These need to be updated once the HST orbit for this epoch is known in the JPL/Horizons system.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V1 (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-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=ASTEROID,A=3.048986186274839,E=0.2010716723979907,I=3.240152574320395,O=83.18716341122048,W=281.0201183529284,M=37.18809486522964,EQUINOX=J2000,EPOCH=28-MAY-2017:00:00:00,EpochTimeScale=TDB				EARTH

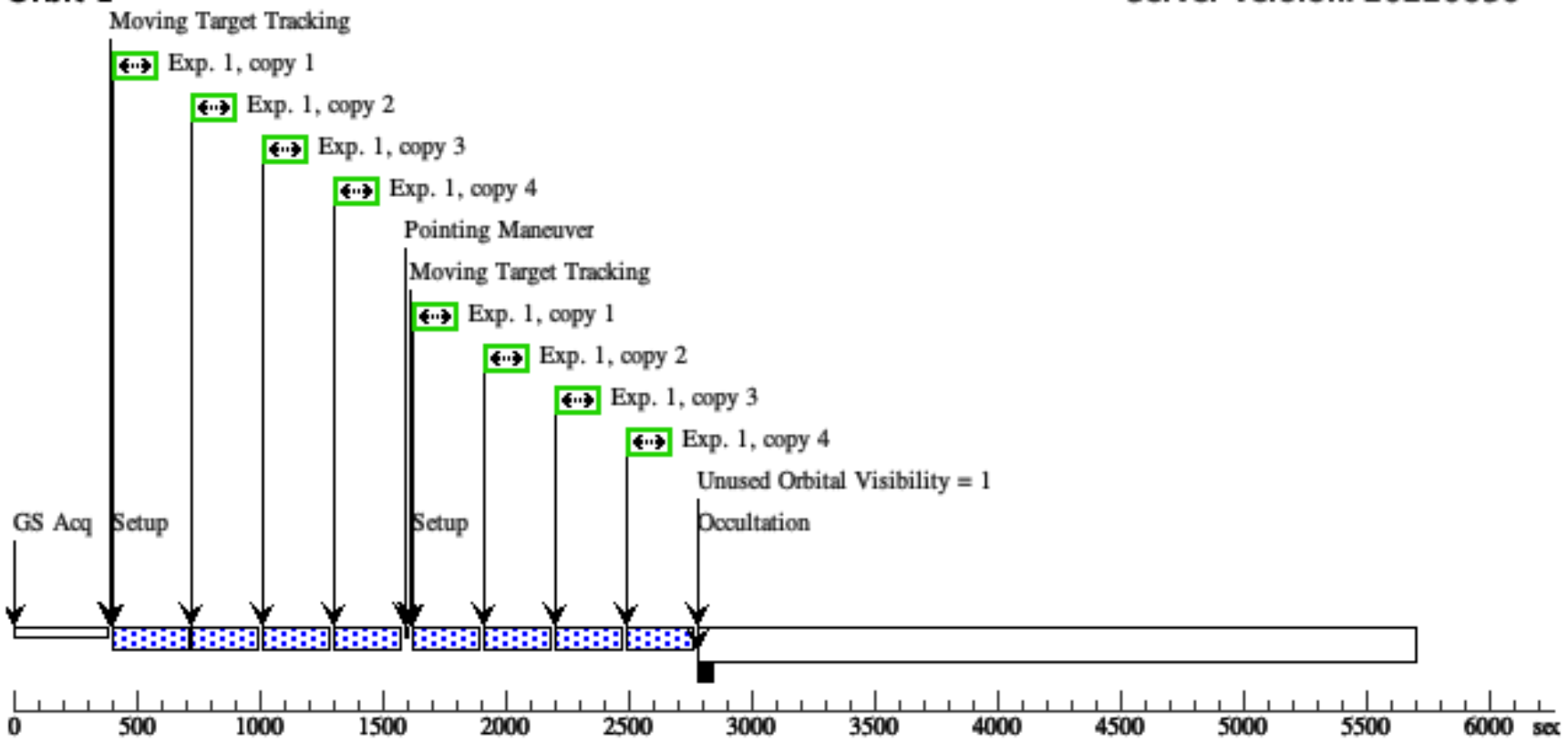
Comments: Description=Binary main-belt comet
Extended=YES

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-C512C-SUB	F606W		GS ACQ SCENARIO BASE1BE	Sequence 1-1 Non-Int in V1 (01) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V1 (01) (1)	239 Secs X 4 (1912 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]*	***[1]***

Comments: When running the ETC for the actual zodiacal light background on Nov-03 (WFC3UVIS.im.1812541, used as reference date for all three visits), the calculated background is 18 electrons, which is only slightly below the recommended 20 electrons. We expect that the true background will be further elevated due to residual dust near the object, and therefore assume that CTE will be acceptable.

Orbit Structure



Visit

Proposal 16993, V2 (02), scheduled Tue Nov 01 20:00:14 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 31-OCT-2022:00:00:00 AND 31-OCT-2022:17:50:00; BETWEEN 31-OCT-2022:19:00:00 AND 02-NOV-2022:12:50:00; BETWEEN 02-NOV-2022:15:00:00 AND 03-NOV-2022:22:10:00; BETWEEN 04-NOV-2022:00:30:00 AND 04-NOV-2022:06:00:00; BETWEEN 04-NOV-2022:09:50:00 AND 06-NOV-2022:00:20:00; BETWEEN 06-NOV-2022:01:30:00 AND 06-NOV-2022:13:30:00; BETWEEN 06-NOV-2022:14:40:00 AND 07-NOV-2022:00:00:00

Comments: BETWEENs will be used to avoid times when 288P should not be observed due to the proximity of bright background stars. These need to be updated once the HST orbit for this epoch is known in the JPL/Horizons system.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V2 (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-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

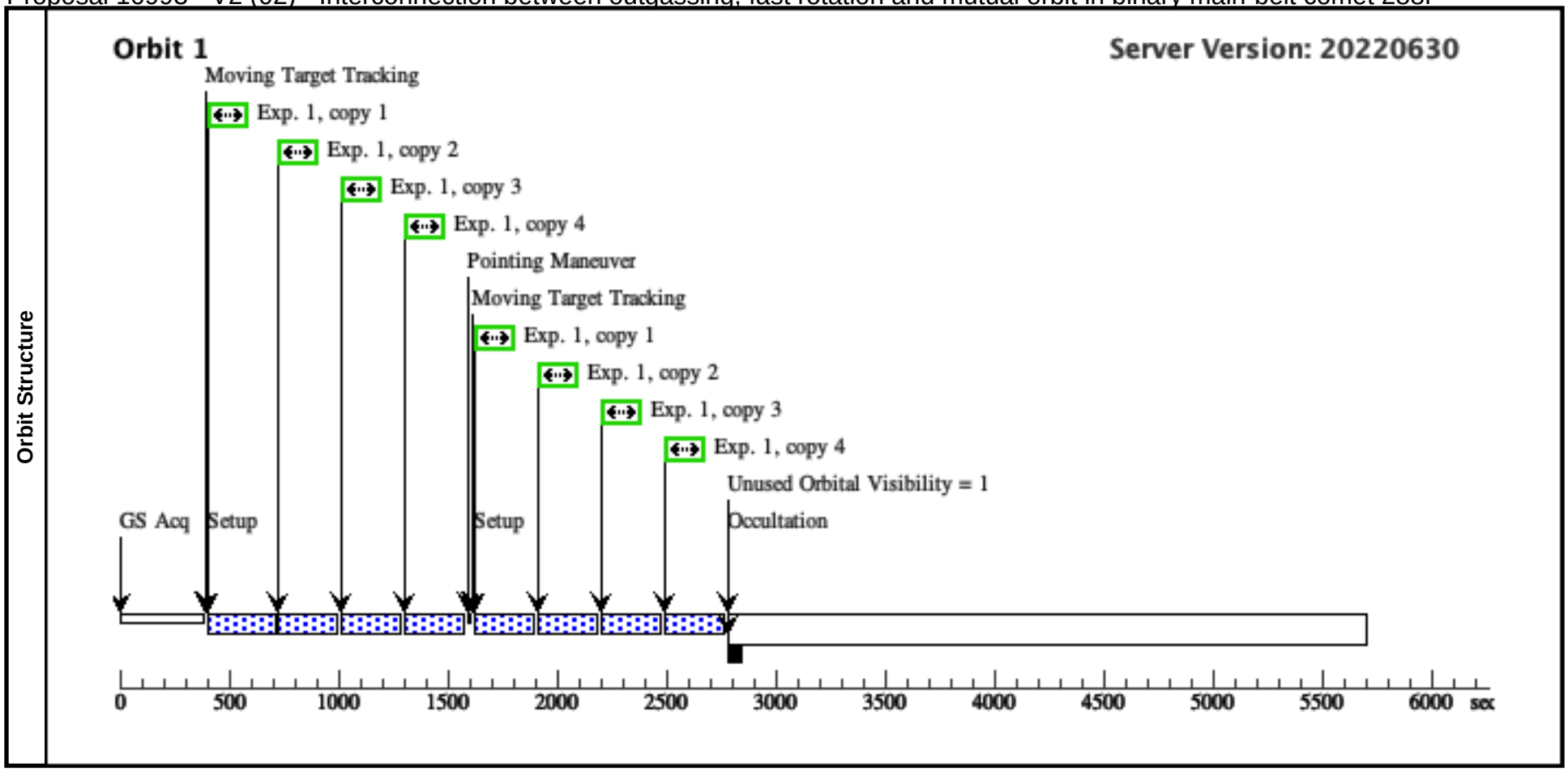
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=ASTEROID,A=3.048986186274839,E=0.2010716723979907,I=3.240152574320395,O=83.18716341122048,W=281.0201183529284,M=37.18809486522964,EQUINOX=J2000,EPOCH=28-MAY-2017:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=Binary main-belt comet
Extended=YES

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-C512C-SUB	F606W		GS ACQ SCENARIO BASE1BE	Sequence 1-1 Non-Int in V2 (02) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V2 (02) (1)	239 Secs X 4 (1912 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]*	***[1]***

Comments: When running the ETC for the actual zodiacal light background on Nov-03 (WFC3UVIS.im.1812541, used as reference date for all three visits), the calculated background is 18 electrons, which is only slightly below the recommended 20 electrons. We expect that the true background will be further elevated due to residual dust near the object, and therefore assume that CTE will be acceptable.


Orbit Structure
Orbit 1
Server Version: 20220630
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Unused Orbital Visibility = 1
GS Acq
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16993, V3 (03), implementation Tue Nov 01 20:00:14 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 28-NOV-2022:00:30:00 AND 28-NOV-2022:08:50:00; BETWEEN 28-NOV-2022:11:20:00 AND 28-NOV-2022:15:10:00; BETWEEN 28-NOV-2022:16:30:00 AND 29-NOV-2022:16:10:00; BETWEEN 29-NOV-2022:17:30:00 AND 30-NOV-2022:02:20:00; BETWEEN 30-NOV-2022:03:30:00 AND 30-NOV-2022:08:40:00; BETWEEN 30-NOV-2022:09:50:00 AND 30-NOV-2022:21:10:00; BETWEEN 30-NOV-2022:22:20:00 AND 01-DEC-2022:03:40:00; BETWEEN 01-DEC-2022:05:50:00 AND 01-DEC-2022:10:10:00; BETWEEN 01-DEC-2022:12:00:00 AND 02-DEC-2022:07:20:00; BETWEEN 02-DEC-2022:08:50:00 AND 02-DEC-2022:10:00:00; BETWEEN 02-DEC-2022:11:10:00 AND 02-DEC-2022:14:30:00; BETWEEN 02-DEC-2022:15:40:00 AND 03-DEC-2022:00:50:00; BETWEEN 03-DEC-2022:02:00:00 AND 04-DEC-2022:06:50:00; BETWEEN 04-DEC-2022:08:20:00 AND 04-DEC-2022:17:30:00; BETWEEN 04-DEC-2022:18:40:00 AND 05-DEC-2022:12:20:00; BETWEEN 05-DEC-2022:13:30:00 AND 06-DEC-2022:13:30:00; BETWEEN 06-DEC-2022:14:40:00 AND 07-DEC-2022:03:40:00; BETWEEN 07-DEC-2022:05:00:00 AND 07-DEC-2022:18:50:00; BETWEEN 07-DEC-2022:20:10:00 AND 08-DEC-2022:03:50:00; BETWEEN 08-DEC-2022:05:00:00 AND 08-DEC-2022:19:50:00; BETWEEN 08-DEC-2022:21:40:00 AND 09-DEC-2022:21:10:00; BETWEEN 10-DEC-2022:00:50:00 AND 11-DEC-2022:23:00:00

Comments: BETWEENs are defined to avoid times when 288P should not be observed due to the proximity of bright background stars. A new target (288P-B) has been defined compared to V1+V2, to reflect the updated JPL ephemeris.

Diagnostics

(Exposure 1 (Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V3 (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-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	288P-B	TYPE=ASTEROID,A=3.048895795723726,E=0.2010747670269393,I=3.240200267468515,O=83.18689950470417,W=281.0089661495639,M=50.34116073331901,EQUINOX=J2000,EPOCH=07-AUG-2017:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Description=Binary main-belt comet
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) 288P-B	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W		GS ACQ SCENARIO BASE1BE	Sequence 1-1 Non-Int in V3 (03) Pattern 1, Exps 1-1 in Sequence 1-1 Non-Int in V3 (03) (1)	239 Secs X 4 (1912 Secs) *[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]*	***[1]***

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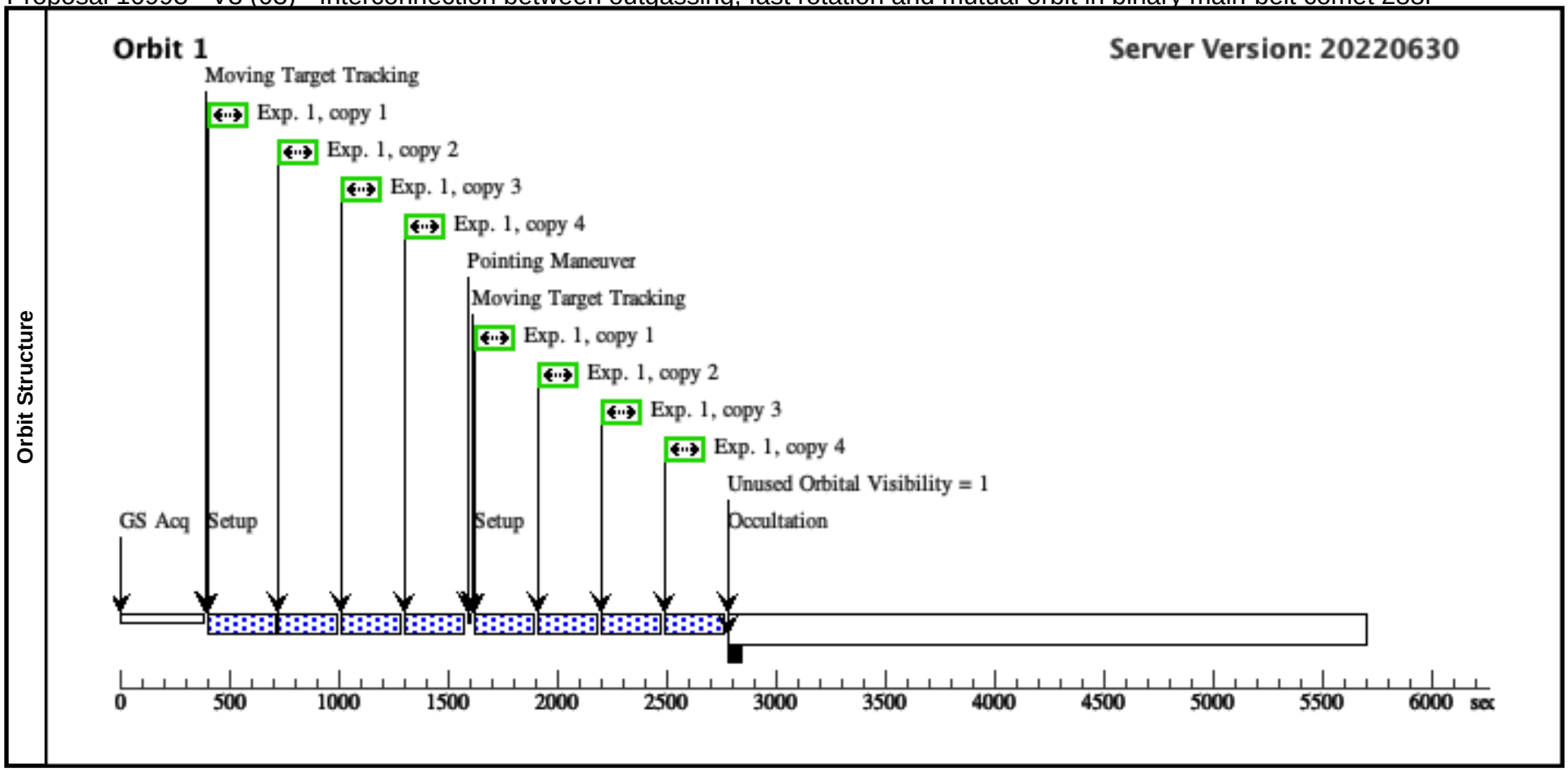
Orbit Structure
Orbit 1
Server Version: 20220630
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Pointing Maneuver
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Unused Orbital Visibility = 1
GS Acq
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec