14864 - Tracing rotational fission in the first known active binary asteroid system 288P/300163

Cycle: 24, Proposal Category: GO/DD

(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	09-Nov-2016 12:35:15.0	yes
02	(1) 288P	WFC3/UVIS	1	09-Nov-2016 12:35:16.0	yes
03	(1) 288P	WFC3/UVIS	1	09-Nov-2016 12:35:17.0	yes

3 Total Orbits Used

ABSTRACT

We request six orbits of DD time to monitor the recently discovered, first known active binary asteroid system 288P/300163, using WFC3. The key aim is to establish the Keplerian elements of the mutual orbit, to constrain the individual rotational periods of the nuclei, and to follow up on

indications that tidal effects support the activity. The observations will help us to determine if the 288P system has recently formed by rotational fission (in which case we expect a highly eccentric mutual orbit and rotation periods of 2-4h), or if the dust activity is independent of the binary nature. For the first time, we are seeing two important consequences of rotational break-up in a single object: binary formation and dust ejection. This highlights the importance of the YORP-effect in re-shaping the asteroid belt. In addition, 288P is the first known binary asteroid system having both a high mass ratio (~1) and a large component separation (semi-major axis to radius ~70). A precise characterisation of its orbit is essential to put 288P in context with models of the formation of such systems. As 288P is receding from Earth, the two nuclei will not be resolvable by HST after the end of November 2016, which triggers our request for DD time. The next opportunity to carry out such observations will be in 2021.

OBSERVING DESCRIPTION

We purpose of this proposal is to observe active asteroid 288P during October and November of 2016 in three visits, each consisting of one orbit. The visits should be separated by 8-12 days and start as soon as possible.

The magnitude of a single component is V~22. The orbital visibility for a solar system target near the ecliptic plane is 54 min (Section 6.3 of the HST Primer document). We will follow the same successful observation strategy as for our program GO 14790, ensuring a maximum comparability of the data.

In each orbit, we will take 8 exposures of 230s using the 1k subarray of WFC3. We will perform a subsampling dither box pattern, obtaining 2 exposures at each dither point. We will carefully drizzle our subsampled images to a finer output pixel scale to extract the extra spatial information gathered by our subsampling strategy. This enhanced resolution will allow us to determine the relative position of the nuclei at the highest possible accuracy. The dithering will also enable us to reject hot pixels and cosmic ray hits.

This strategy gives us a total exposure time of 1800s = 30min per orbit, and estimated overheads of 6min for guide-star acquisition, 2.6min for the first exposure, a total of 14.7min for the subsequent 7 exposures, and 1.5min for the three spacecraft maneuvers required for dithering, which adds up to a total execution time of 54min per orbit.

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 24), 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 and 14790, enabling a direct comparison of the data sets.

The WFC3 exposure time calculator returns for a solar-spectrum point source at V=21, exposure time of 230s, F606W filter, and default background values (using zodiacal light conditions of 2016-Nov-01) a signal-to-noise-ratio of 86 within a circle of 0.2 arcsec (ETC Request ID: WFC3UVIS.im.839937).

Visit

Proposal 14864, Visit 01 Wed Nov 09 17:35:18 GMT 2016

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 50%; BETWEEN 10-OCT-2016:00:00:00 AND 10-NOV-2016:00:00:00

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)

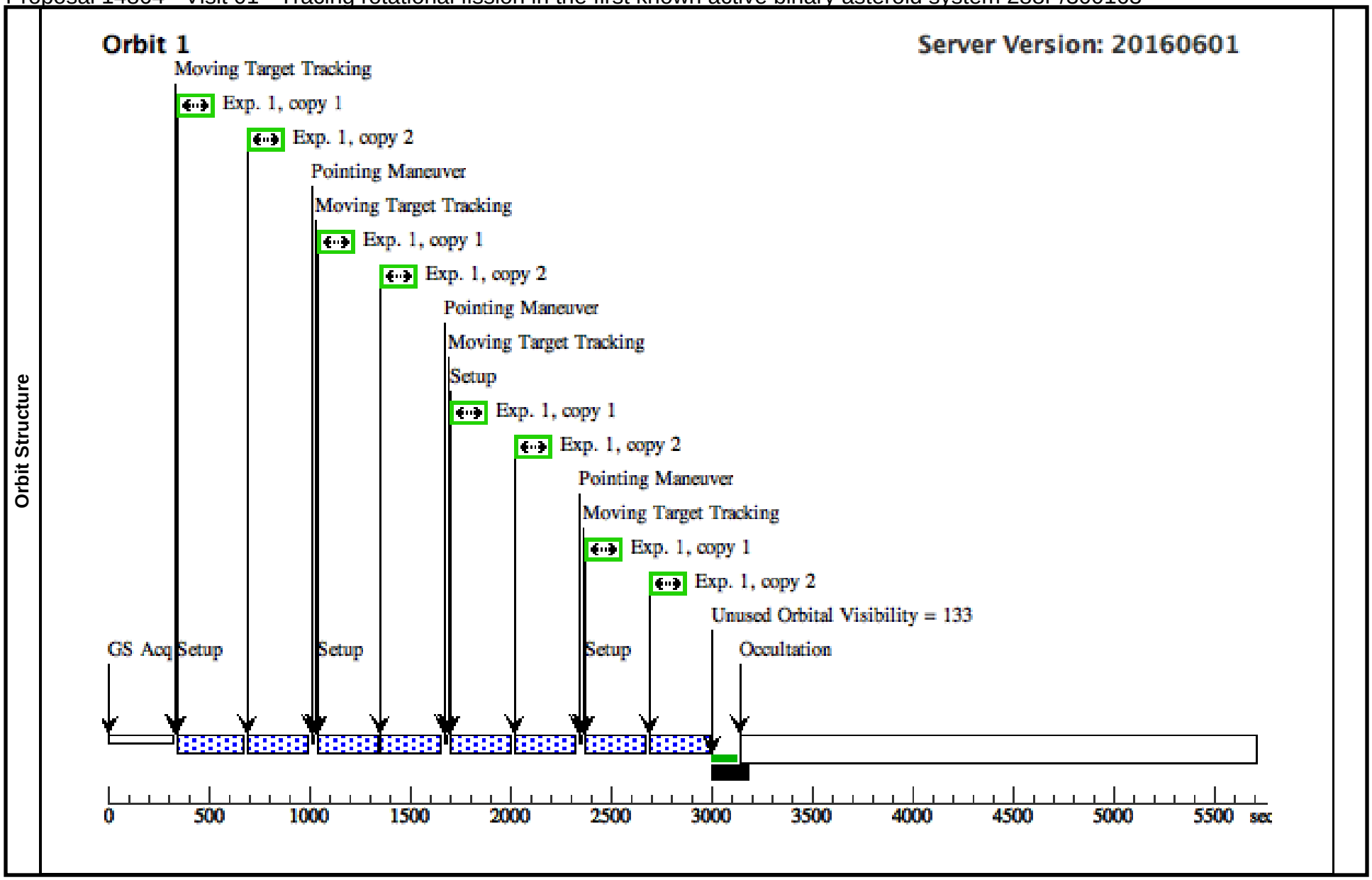
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.437997636061935,E=.2002773126787514,I=3.239254302184838,O=83.22502588733704,W=281.9669249151093,T=18-JUL-2011:22:51:20,TTimeScale=UTC,EQUINOX=J2000,EPOCH=19-JUN-2010:00:00:00,EpochTimeScale=TDB				EARTH

Comments: 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.839937)	(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)]* *[==>(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 1
Server Version: 20160601
Orbit Structure
Moving Target Tracking
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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 = 133
GS Acq Setup
Setup
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14864, Visit 02 Wed Nov 09 17:35:18 GMT 2016

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 50%; AFTER 01 BY 8 D TO 12 D

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

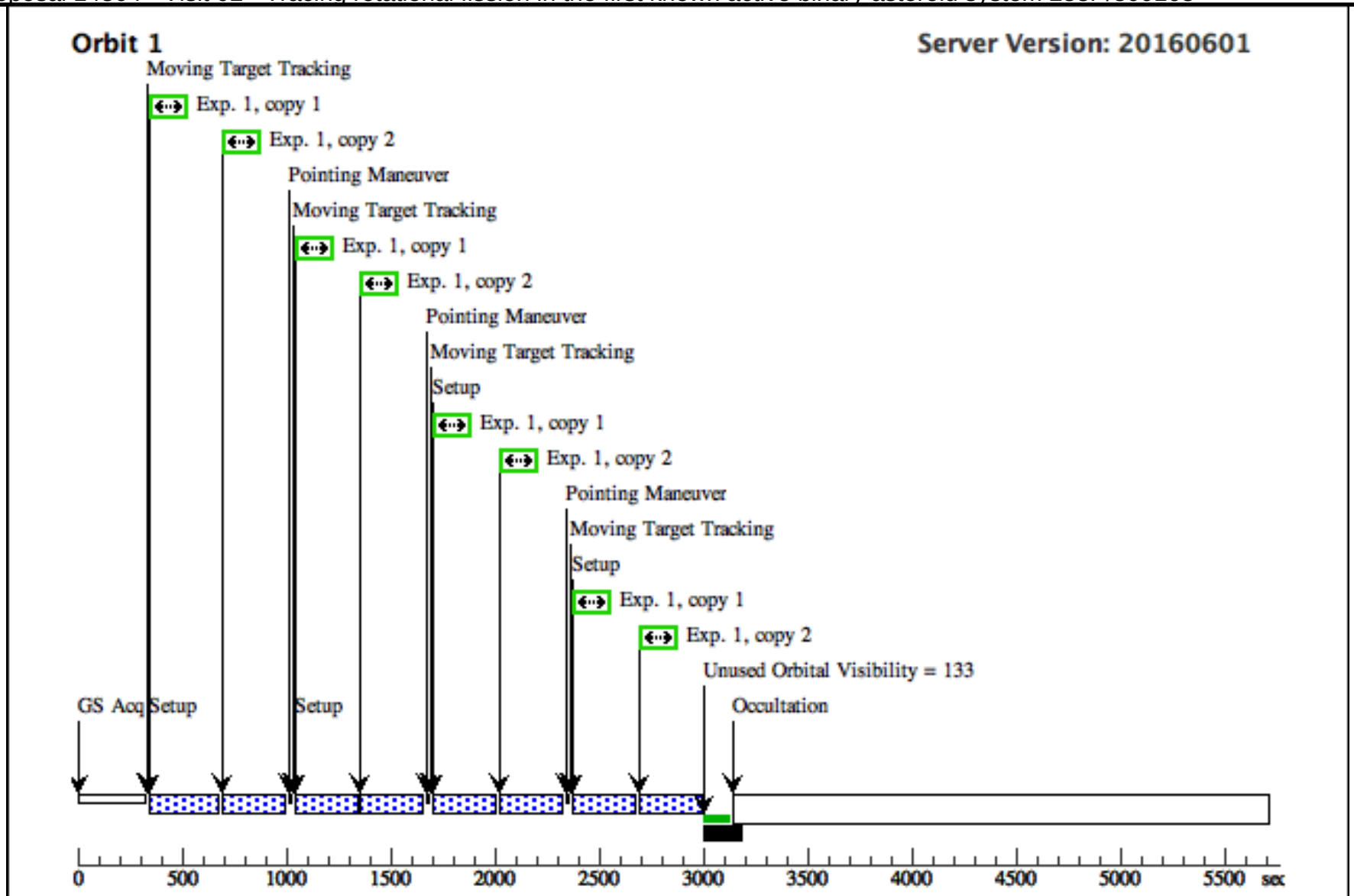
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	288P	TYPE=COMET,Q=2.437997636061935,E=.2002773126787514,I=3.239254302184838,O=83.22502588733704,W=281.9669249151093,T=18-JUL-2011:22:51:20,TTimeScale=UTC,EQUINOX=J2000,EPOCH=19-JUN-2010:00:00:00,EpochTimeScale=TDB				EARTH

Comments: 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.839937)	(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)]* *[==>(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



Visit

Proposal 14864, Visit 03 Wed Nov 09 17:35:18 GMT 2016

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 50%; AFTER 02 BY 8 D TO 12 D

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=2.437997636061935,E=.2002773126787514,I=3.239254302184838,O=83.22502588733704,W=281.9669249151093,T=18-JUL-2011:22:51:20,TTimeScale=UTC,EQUINOX=J2000,EPOCH=19-JUN-2010:00:00:00,EpochTimeScale=TDB				EARTH

Comments: 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.839937)	(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