14616 - Primordial Triplicity: A Census of Hierarchical Triples in the Cold Classical Kuiper Belt

Cycle: 24, Proposal Category: GO

(JWST Initative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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	(2) 2003UN284	WFC3/UVIS	1	09-Nov-2016 11:26:22.0	yes
02	(3) 2006BR284	WFC3/UVIS	1	09-Nov-2016 11:26:23.0	yes
03	(4) 2006CH69	WFC3/UVIS	1	09-Nov-2016 11:26:24.0	yes
04	(5) 2005EO304	WFC3/UVIS	1	09-Nov-2016 11:26:24.0	yes
05	(6) 2006JZ81	WFC3/UVIS	1	09-Nov-2016 11:26:25.0	yes
06	(1) 2001QW322	WFC3/UVIS	1	09-Nov-2016 11:26:26.0	yes

6 Total Orbits Used

ABSTRACT

We propose to observe six wide binaries in the cold classical Kuiper Belt (CCKB) with WFC3 to determine what fraction of them are actually triple systems. The only known hierarchical triple Kuiper Belt object is in the 3:2 Neptune resonance, (47171) 1999 TC36, and so far none have been discovered in the CCKB. Because the CCKB was the least disturbed part of the solar system during giant planet migration, it preserves many primordial aspects of planetesimal formation, including our wide binary targets. If even one of these wide binaries is actually a triple, it would strongly imply that the dominant binary formation mechanism was one that could also create triples. The leading such model is gravitational collapse, which requires that any triples and binaries were formed directly out a single cloud of material. JWST/NIRSpec could further test this theory by comparing the spectra of the three separate objects. In addition, hierarchical triples can uniquely provide independent mass determinations for all three objects. These masses can then be combined with thermal radius measurements from JWST/MIRI and ALMA to determine densities for all three objects in a hierarchical triple. Thus these proposed observations would enable JWST to peer into the interiors of some of the most primordial objects in the outer solar system.

OBSERVING DESCRIPTION

This program will image six wide binary cold classical Kuiper Belt objects with WFC3/UVIS, one target per orbit. The first five targets will be imaged with the UVIS2-M1K1C-SUB subframe to minimize overhead and enable six exposures. The last object has higher heliocentric uncertainty (~10 arcseconds) and will be imaged five times with the full UVIS2 CCD. The binaries will be observed near opposition, when they are the brightest, from December 2016 to August 2017. Each orbit will be co-registered and stacked on the motion of the KBO, using techniques developed in the search for a New Horizons extended mission target, modified to accommodate the subframes and lower star density. The deep stacks will then be searched for faint co-moving objects/companions and fit with Tiny Tim PSFs to split any close, blended binary objects. Finally, the number of triples detected (if any) will be used to constrain the overall triple fraction in the cold classical Kuiper Belt, and the implications of that for binary KBO formation. Because this is a JWST support proposal, no proprietary period has been requested for the data.

Visit

Proposal 14616, 2003UN284 (01), implementation Wed Nov 09 16:26:26 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 19-NOV-2016 AND 17-DEC-2016

Patterns

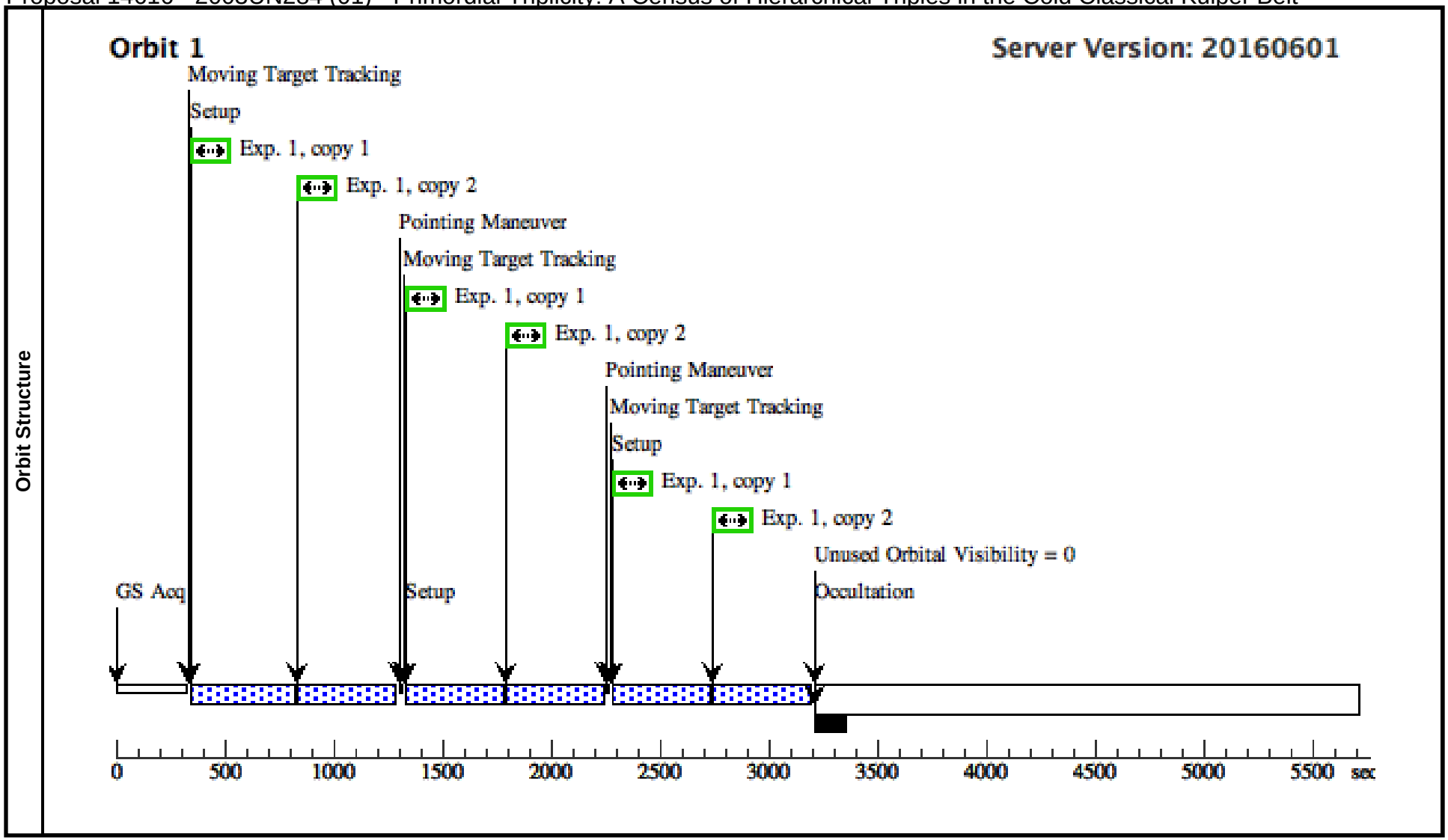
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	2003UN284	TYPE=ASTEROID,A=42.519037111645,E=0.000440445629,I=3.075377917875,O=36.076789460802,W=14.985766052552,M=20.074487666474,EQUINOX=J2000,EPOCH=03-DEC-2016:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) 2003UN284	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in 2003UN284 (01) (1)	300 Secs X 2 (2232 Secs) *[==>372.0 Secs (Pattern 1, Copy 1)]* *[==>372.0 Secs (Pattern 1, Copy 2)]* *[==>372.0 Secs (Pattern 2, Copy 1)]* *[==>372.0 Secs (Pattern 2, Copy 2)]* *[==>372.0 Secs (Pattern 3, Copy 1)]* *[==>372.0 Secs (Pattern 3, Copy 2)]*	***[1]***


Orbit 1
Server Version: 20160601
Orbit Structure
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
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Unused Orbital Visibility = 0
Occultation
GS Acq
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14616, 2006BR284 (02), implementation Wed Nov 09 16:26:26 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 18-JAN-2017 AND 01-MAR-2017

Patterns

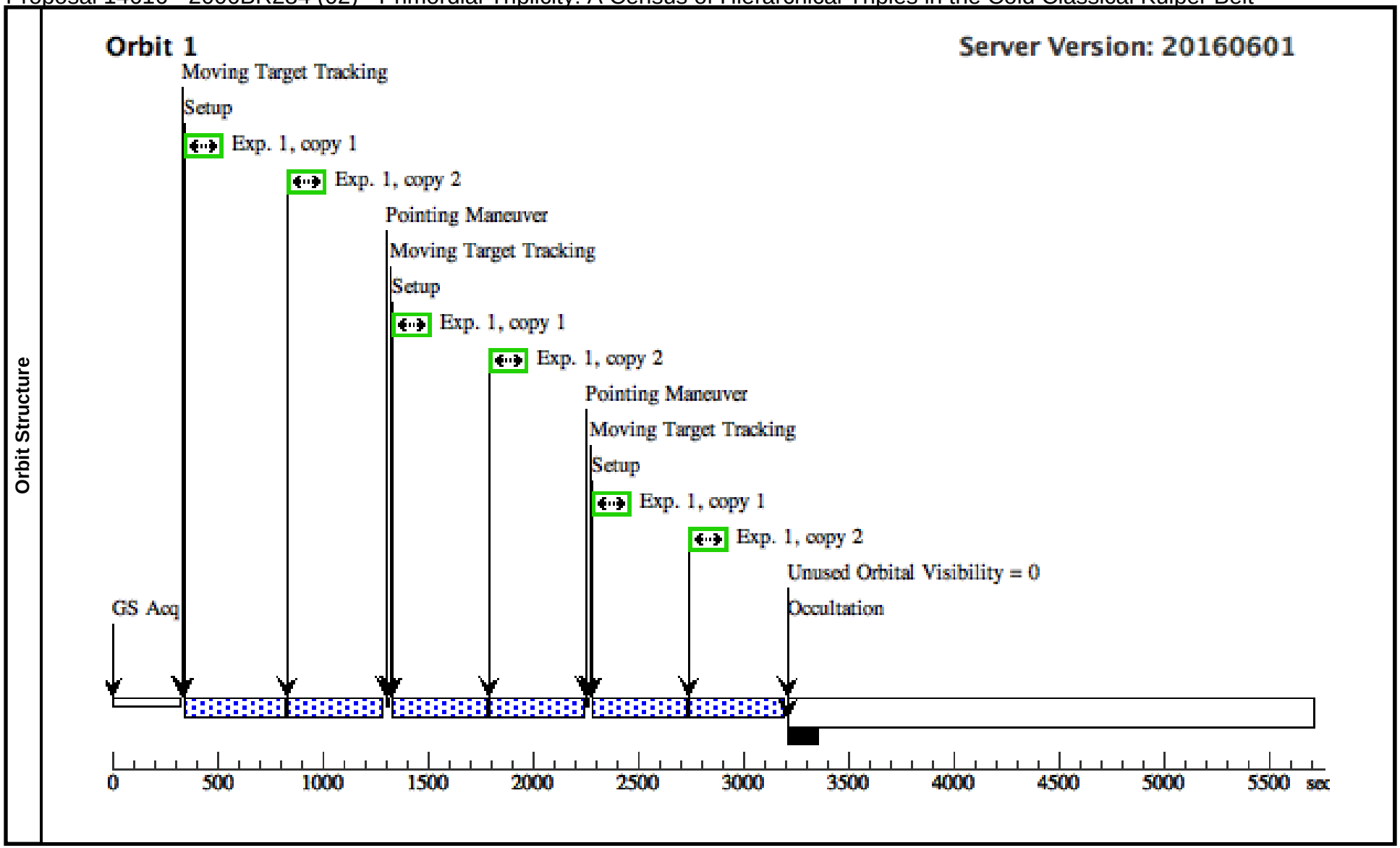
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	2006BR284	TYPE=ASTEROID,A=43.969608088195,E=0.042123842173,I=1.155502424203,O=15.337214480072,W=108.000038911465,M=14.914120077841,EQUINOX=J2000,EPOCH=08-FEB-2017:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) 2006BR284	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in 2006BR284 (02) (1)	300 Secs X 2 (2232 Secs) *[==>372.0 Secs (Pattern 1, Copy 1)]* *[==>372.0 Secs (Pattern 1, Copy 2)]* *[==>372.0 Secs (Pattern 2, Copy 1)]* *[==>372.0 Secs (Pattern 2, Copy 2)]* *[==>372.0 Secs (Pattern 3, Copy 1)]* *[==>372.0 Secs (Pattern 3, Copy 2)]*	***[1]***


Orbit 1
Server Version: 20160601
Orbit Structure
Moving Target Tracking
Setup
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Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Setup
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 = 0
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14616, 2006CH69 (03), implementation Wed Nov 09 16:26:26 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 26-JAN-2017 AND 09-MAR-2017

Patterns

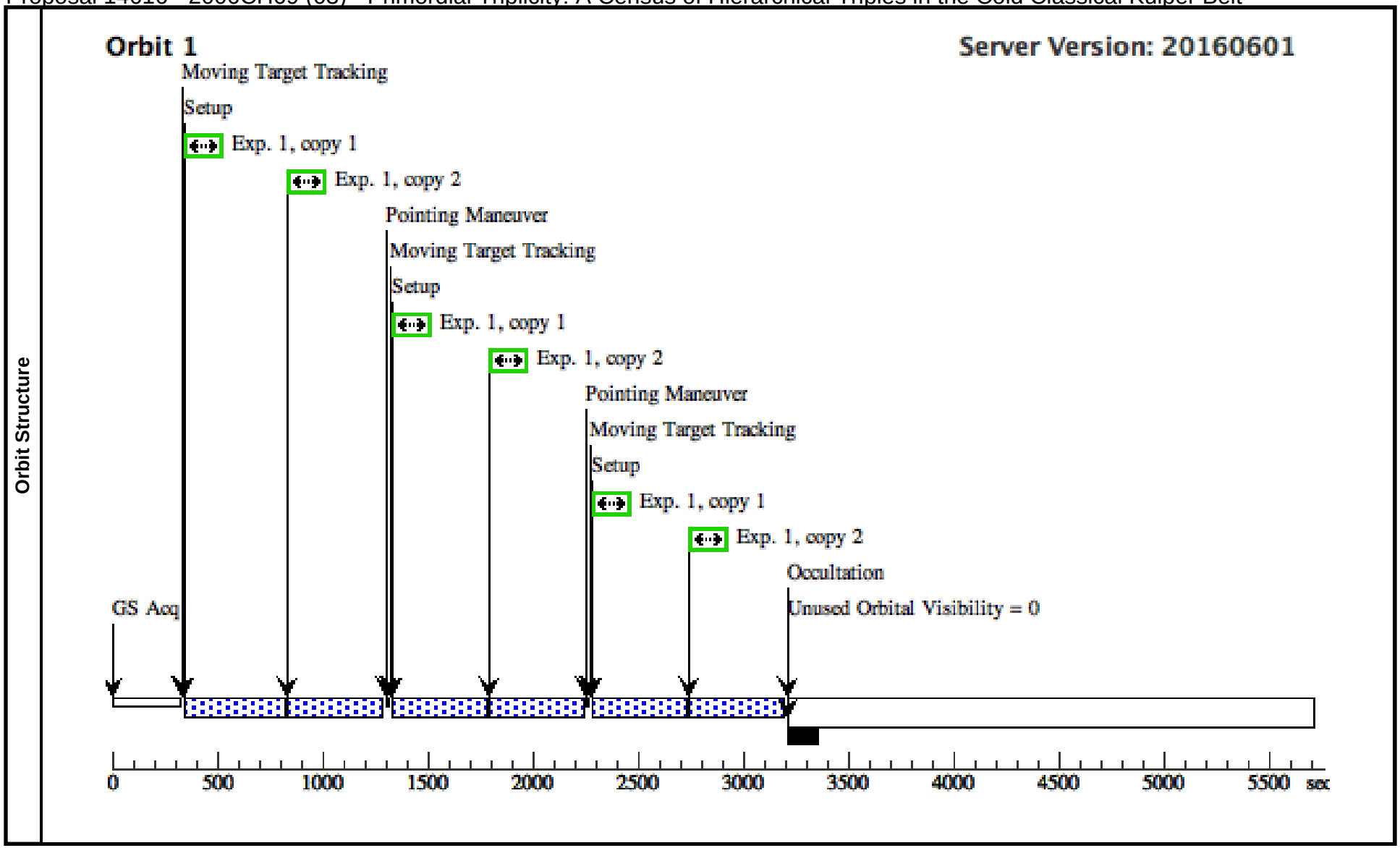
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	2006CH69	TYPE=ASTEROID,A=45.952489229119,E=0.038547632435,I=1.790192065757,O=41.105878814095,W=72.002915021005,M=32.137553603537,EQUINOX=J2000,EPOCH=16-FEB-2017:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) 2006CH69	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in 2006CH69 (03) (1)	300 Secs X 2 (2232 Secs) *[==>372.0 Secs (Pattern 1, Copy 1)]* *[==>372.0 Secs (Pattern 1, Copy 2)]* *[==>372.0 Secs (Pattern 2, Copy 1)]* *[==>372.0 Secs (Pattern 2, Copy 2)]* *[==>372.0 Secs (Pattern 3, Copy 1)]* *[==>372.0 Secs (Pattern 3, Copy 2)]*	***[1]***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Server Version: 20160601
Orbit Structure
Moving Target Tracking
Setup
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Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
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Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 1, copy 1
Exp. 1, copy 2
Occultation
Unused Orbital Visibility = 0
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14616, 2005EO304 (04), implementation Wed Nov 09 16:26:27 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 26-MAR-2017 AND 21-MAY-2017

Patterns

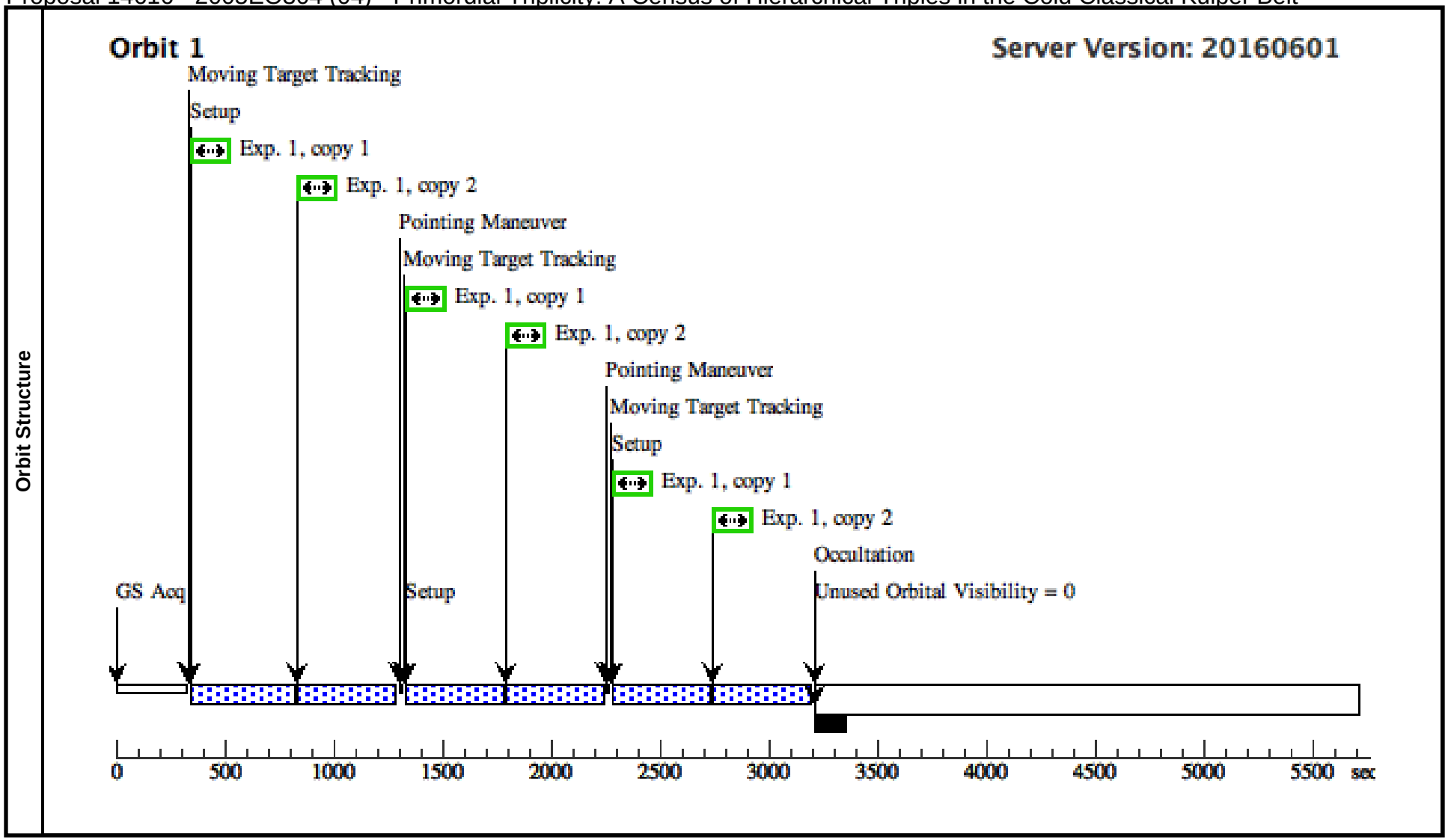
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	2005EO304	TYPE=ASTEROID,A=45.990990009298,E=0.074376005285,I=3.413612387331,O=93.949850306376,W=146.341043381081,M=330.222153662787,EQUINOX=J2000,EPOCH=15-APR-2017:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) 2005EO304	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in 2005EO304 (04) (1)	300 Secs X 2 (2232 Secs) *[==>372.0 Secs (Pattern 1, Copy 1)]* *[==>372.0 Secs (Pattern 1, Copy 2)]* *[==>372.0 Secs (Pattern 2, Copy 1)]* *[==>372.0 Secs (Pattern 2, Copy 2)]* *[==>372.0 Secs (Pattern 3, Copy 1)]* *[==>372.0 Secs (Pattern 3, Copy 2)]*	***[1]***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Server Version: 20160601
Orbit Structure
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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
Occultation
Unused Orbital Visibility = 0
GS Acq
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14616, 2006JZ81 (05), implementation Wed Nov 09 16:26:27 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 19-APR-2017 AND 31-MAY-2017

Patterns

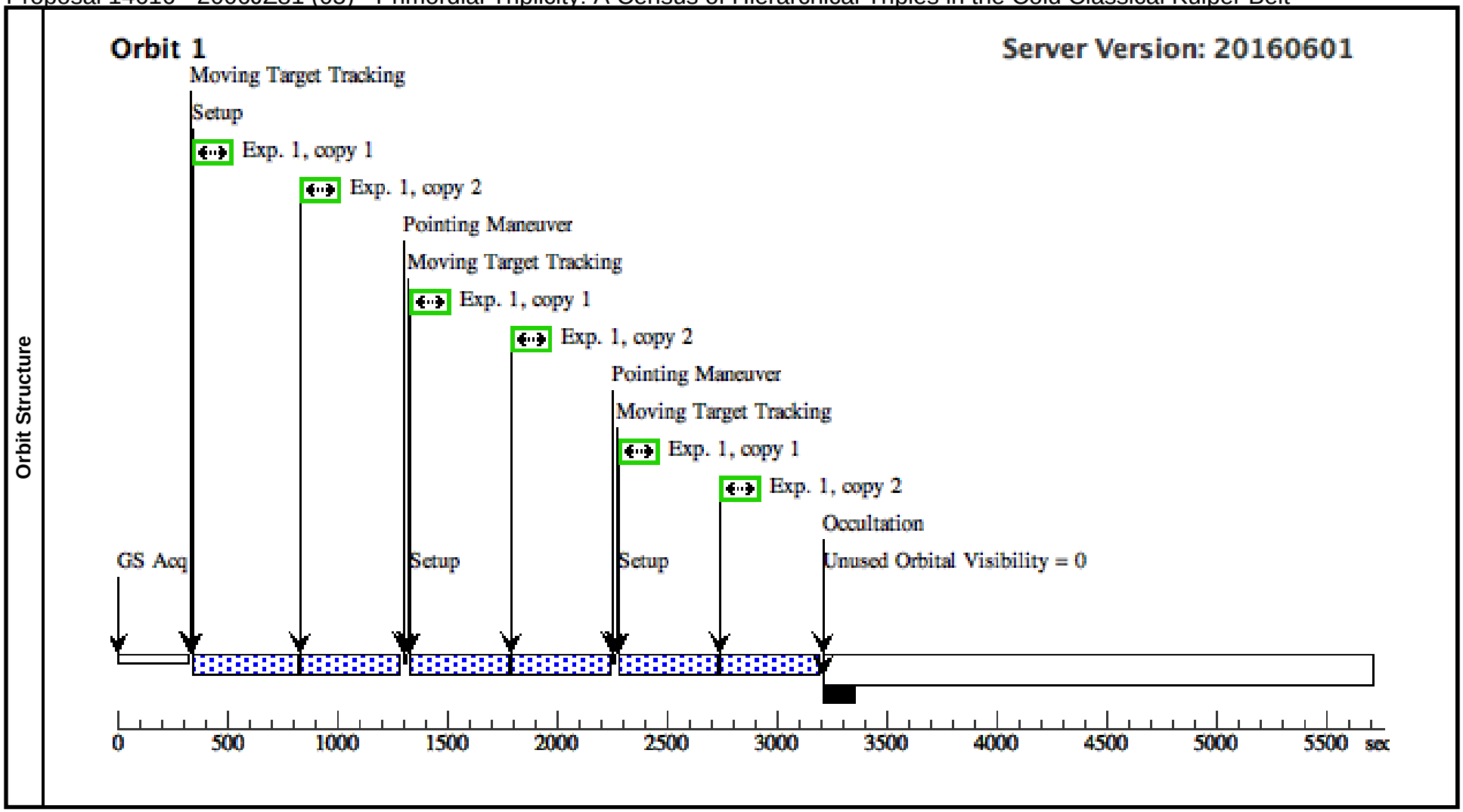
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(6)	2006JZ81	TYPE=ASTEROID,A=45.051778752672,E=0.087527214089,I=3.541593651310,O=36.363613867534,W=182.251804331559,M=9.255024848797,EQUINOX=J2000,EPOCH=10-MAY-2017:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(6) 2006JZ81	WFC3/UVIS, ACCUM, UVIS2-M1K1C-SUB	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in 2006JZ81 (05) (1)	300 Secs X 2 (2232 Secs) *[==>372.0 Secs (Pattern 1, Copy 1)]* *[==>372.0 Secs (Pattern 1, Copy 2)]* *[==>372.0 Secs (Pattern 2, Copy 1)]* *[==>372.0 Secs (Pattern 2, Copy 2)]* *[==>372.0 Secs (Pattern 3, Copy 1)]* *[==>372.0 Secs (Pattern 3, Copy 2)]*	***[1]***


Orbit Structure
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Server Version: 20160601
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
Occultation
GS Acq
Setup
Setup
Unused Orbital Visibility = 0
0
500
1000
1500
2000
2500
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sec

Visit

Proposal 14616, 2001QW322 (06), implementation Wed Nov 09 16:26:27 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 28-JUL-2017 AND 20-SEP-2017

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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)	2001QW322	TYPE=ASTEROID,A=43.989277211136,E=0.026590290580,I=4.808983088686,O=124.691105493391,W=77.987607528307,M=120.389300980194,EQUINOX=J2000,EPOCH=17-AUG-2017:00:00:00,EpochTimeScale=UTC				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2001QW322	WFC3/UVIS, ACCUM, UVIS2	F350LP		GS ACQ SCENARIO BASE1B3	Pattern 2, Exps 1-1 in 2001QW322 (06) (2)	430 Secs (2216 Secs) *[==>554.0 Secs (Pattern 1)]* *[==>554.0 Secs (Pattern 2)]* *[==>554.0 Secs (Pattern 3)]* *[==>554.0 Secs (Pattern 4)]*	***[1]***

Orbit Structure