



12243 - Determining the Size and Shape of Dwarf Planet Haumea from a Mutual Event

Cycle: 18, Proposal Category: GO
(Availability Mode: AVAILABLE)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Darin Ragozzine (PI)	Smithsonian Institution Astrophysical Observatory	dragozzine@cfa.harvard.edu
Dr. Michael E. Brown (CoI)	California Institute of Technology	mbrown@caltech.edu

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) HAUMEA	WFC3/UVIS	10	16-Jun-2010 21:47:16.0	yes

10 Total Orbits Used

ABSTRACT

The history of Haumea is closely intertwined with several unanswered questions relating to the formation and evolution of the outer solar system. Understanding Haumea and its satellites gives us unique insights on the physics of KBO collisions, tides, surfaces, and interiors. Yet, the most important physical properties of this dwarf planet, its density and shape, remain only weakly constrained by degenerate light curve inversions. The existence of mutual events between Haumea and its inner satellite, Namaka, provide a rare opportunity to measure Haumea's size, shape, density, albedo, and spin orientation with HST photometry. These observations also constrain the size of Namaka, the orbits of both satellites, and, through resolved photometry, the totally unexpected rapid rotation of the outer satellite, Hi'iaka. After extensive attempts at ground-based observations, it is clear that only HST photometry is capable of securely observing and characterizing a Haumea-Namaka mutual event. The proposed observations will observe the ~5-hour transit and shadowing of Haumea by Namaka on June 28, 2010 with high signal-to-noise using straightforward photometric observations with WFC3.

OBSERVING DESCRIPTION

Observations of a mutual event between the dwarf planet Haumea and its faint inner satellite (Namaka). The goal is to obtain precise high-cadence photometry of moving object Haumea (located near 13:39:48.5, +19:14:10) as well as resolved photometry of the outer satellite (over 1 arcsecond).

The observations are designed to maximize overall signal-to-noise (by maximizing total exposure time), while taking multiple observations to produce a high-cadence light curve. We would like as many 40-second observations per orbit as possible. As far as the science-case goes, we are willing to observe through the South American Anomaly, assuming that the FGS can continue to guide on the object, as the short exposures aren't as prone to cosmic ray accumulation.

In order to minimize overheads, we're using the 512K subarray of WFC3/UVIS. The target should be centered in a region of good pixels near the center of the subarray.

The observations are very time-sensitive. The ten-orbit sequence should be centered as close as possible to the expected time (28-JUN-2010:11:45:00), approximately JD 2455376.0. Ten consecutive orbits must be taken, with the first exposure occurring between 28-JUN-2010:03:10:00 and 28-JUN-2010:04:58:00. (It is possible, though not desirable, to observe an event on July 16 if this observation is not possible.)

Proposal 12243 (STScI Edit Number: 36, Created: Wednesday, June 16, 2010 8:47:58 PM EST) - Overview

Visit	Proposal 12243, Visit 01, implementation Thu Jun 17 01:47:58 GMT 2010					
	Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 110D TO 120 D; BETWEEN 28-JUN-2010:03:00:00 AND 28-JUN-2010:04:58:00 Comments: All 10 orbits are to be scheduled consecutively (despite the SAA), with the first exposure of the first orbit beginning between 3:00 and 4:58 UT on 28-JUN-2010, so that the observations are centered around 11:45 UT on 28-JUN-2010 (i.e., JD 2455376.0). We have divided the 10 orbits up into 4 sets of 7 observations each, with a dither in between, and each observation lasting about 40 seconds (longer in the last 9 orbits due to less overhead). The number of observations calls for the use of the 512x512 subarray on WFC3. The goal is precise photometry of moving object Haumea. Based on the short exposures, the straightforward photometry, and the importance of not missing the mutual event, I would like to try to observe through the entire SAA (though avoidance contour 2 is listed below). Scaling from WFC3 observations in SAA by Martel et al. 2009 (WFC3 ISR 2009-47), the worst case for our observations will be ~7% of pixels affected by SAA. The maximum expected drift from dropping to gyro guiding is only ~3", which is well under our 20" aperture. We think it is worthwhile to observe through the SAA, with the goal of masking out bad pixels and still obtaining some useful photometry. This requires a manual change to SAA CONTOUR 11 where needed to allow observing through the entire SAA. Please feel free to contact the PI: Darin Ragozzine, dragozzine@cfa.harvard.edu, 617-496-3259 for any questions.					
Diagnostics	(Visit 01) Warning (Orbit Planner): EXPOSURE WITH SAA CONTOUR 11 WILL EXECUTE ON GYRO (Visit 01) Warning (Orbit Planner): LONG SU LIKELY TO INTERSECT THE SAA					
Patterns	#	Primary Pattern		Secondary Pattern		Exposures
	(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=4 Point Spacing=0.8 Line Spacing=		Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=true		(1), (2), (3), (4), (5), (6), (7), (12)
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window
	(1)	HAUMEA	TYPE=ASTEROID,A=43.2887104184 9419,E=0.190681012342355,I=28.212 42423233981,O=122.0154790779308, W=239.0696722526824,M=200.50714 37146738,EQUINOX=J2000,EPOCH =15-FEB-2007:00:00:00			
	Comments: The coordinate epoch in Asteroid Level 1 is reported from JPL HORIZONS in UTC, not TDB as specified by the handbook. At the time of the observations, the approximate RA and Dec are 13:39:48.60 and +19:14:10.00.					
	EARTH					

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	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures	1	7 44 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 1-1 Non-Int Pattern 1, Exps 1-1 (1)	44 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[1]

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2	7 49 sec obs (1) HAUMEA ervations	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 2-2 Non-In t Pattern 1, Exps 2-2 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[2]
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Proposal 12243 (STScI Edit Number: 36, Created: Wednesday, June 16, 2010 8:47:58 PM EST) - Overview

3	7 49 sec obs (1) HAUMEA ervations	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 3-3 Non-In t Pattern 1, Exps 3-3 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[3]
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4	7 49 sec obs (1) HAUMEA ervations	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 4-4 Non-In t Pattern 1, Exps 4-4 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[4]
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5	7 49 sec obs (1) HAUMEA ervations	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 5-5 Non-In t Pattern 1, Exps 5-5 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[5]
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6	7 49 sec obs (1) HAUMEA ervations	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 6-6 Non-In t Pattern 1, Exps 6-6 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[6]
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7	7 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 7-7 Non-Int Pattern 1, Exps 7-7 (1)	49 Secs X 7 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)]	[7]
8	7 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 8-11 Non-Int nt	49 Secs X 7 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)]	[8]
9	7 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 0.546,0.582; SAA CONTOUR 02	Sequence 8-11 Non-Int nt	49 Secs X 7 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)]	[8]

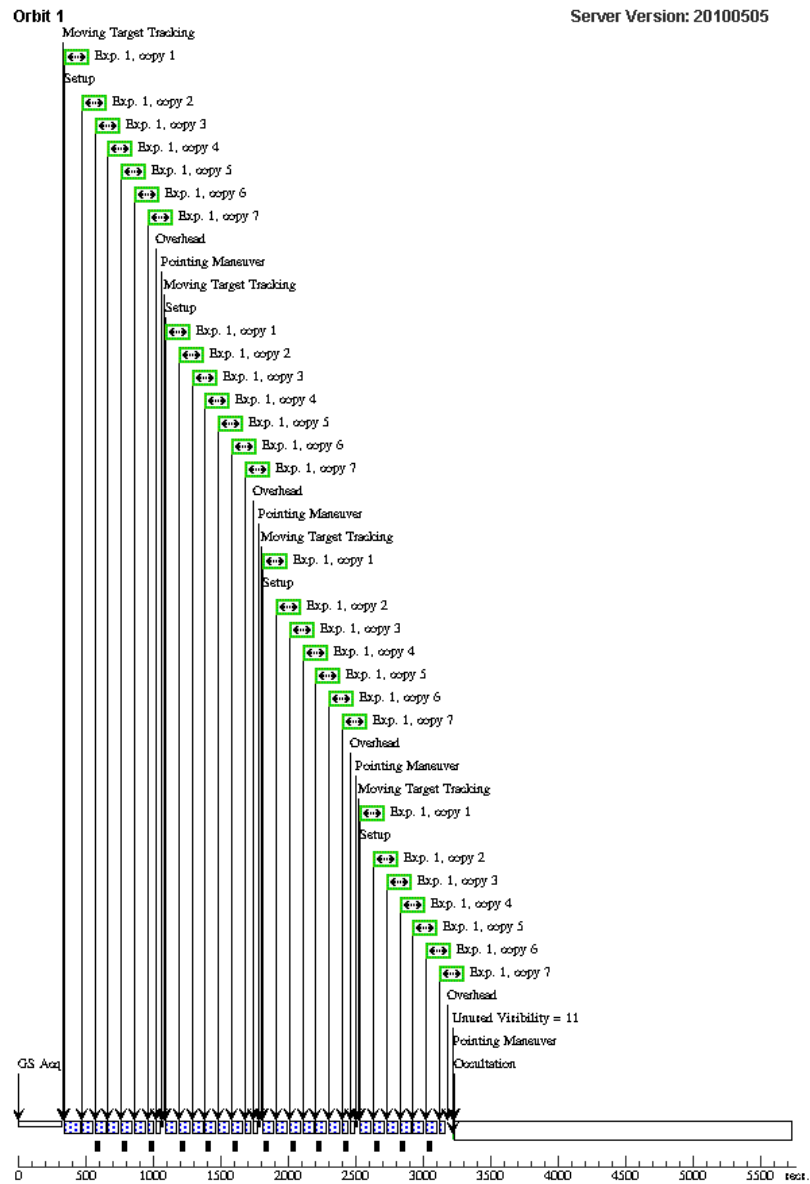
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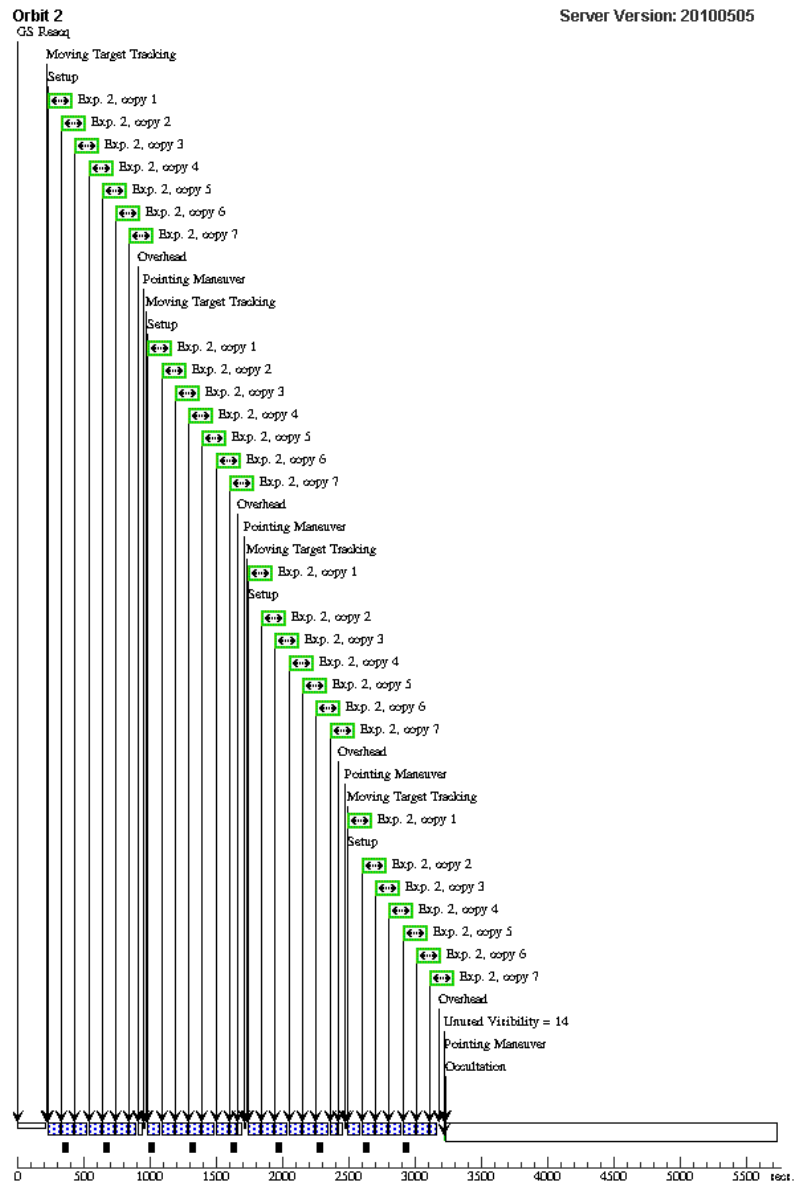
10	6 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 1.092,1. 164; SAA CONTOUR 02	Sequence 8-11 Non-I nt	49 Secs X 6 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	[8]
11	6 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 1.639,1. 746; SAA CONTOUR 02	Sequence 8-11 Non-I nt	49 Secs X 6 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	[8]
12	6 49 sec obs ervations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 02	Sequence 12-12 Non- Int Pattern 1, Exps 12-1 2 (1)	49 Secs X 6 [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)]	[9]

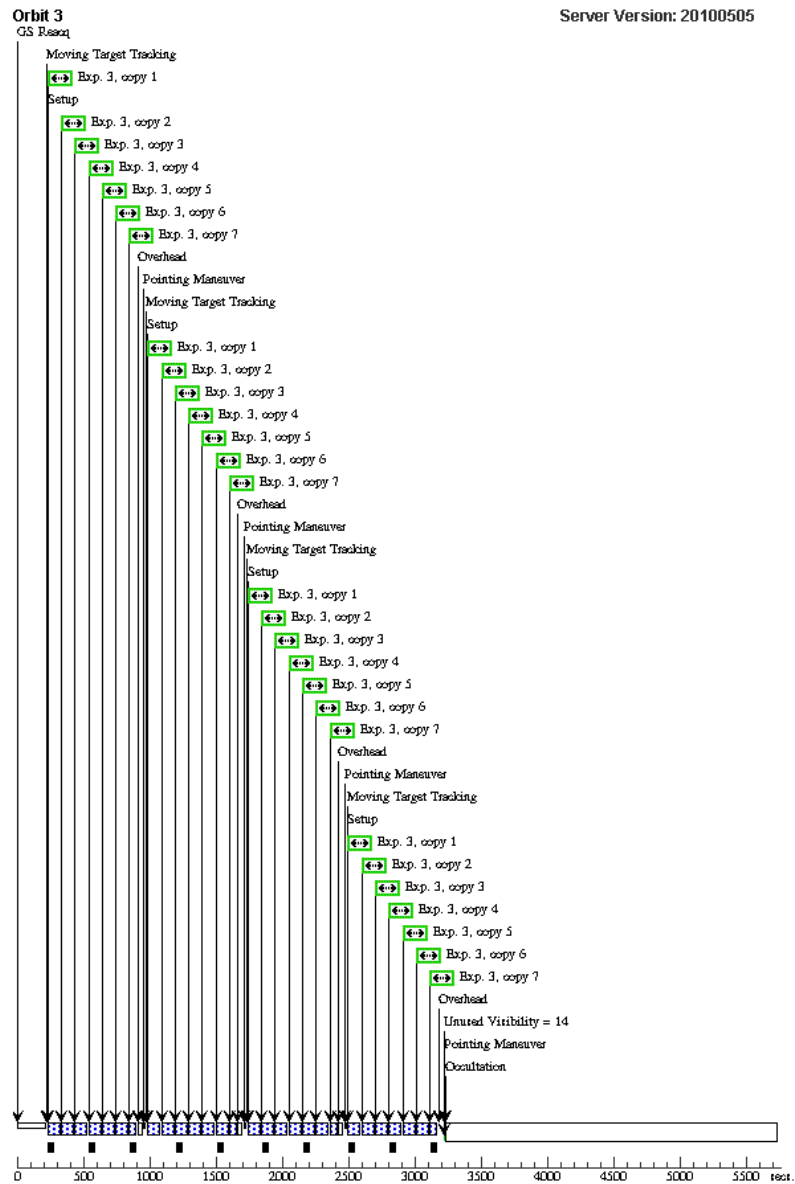
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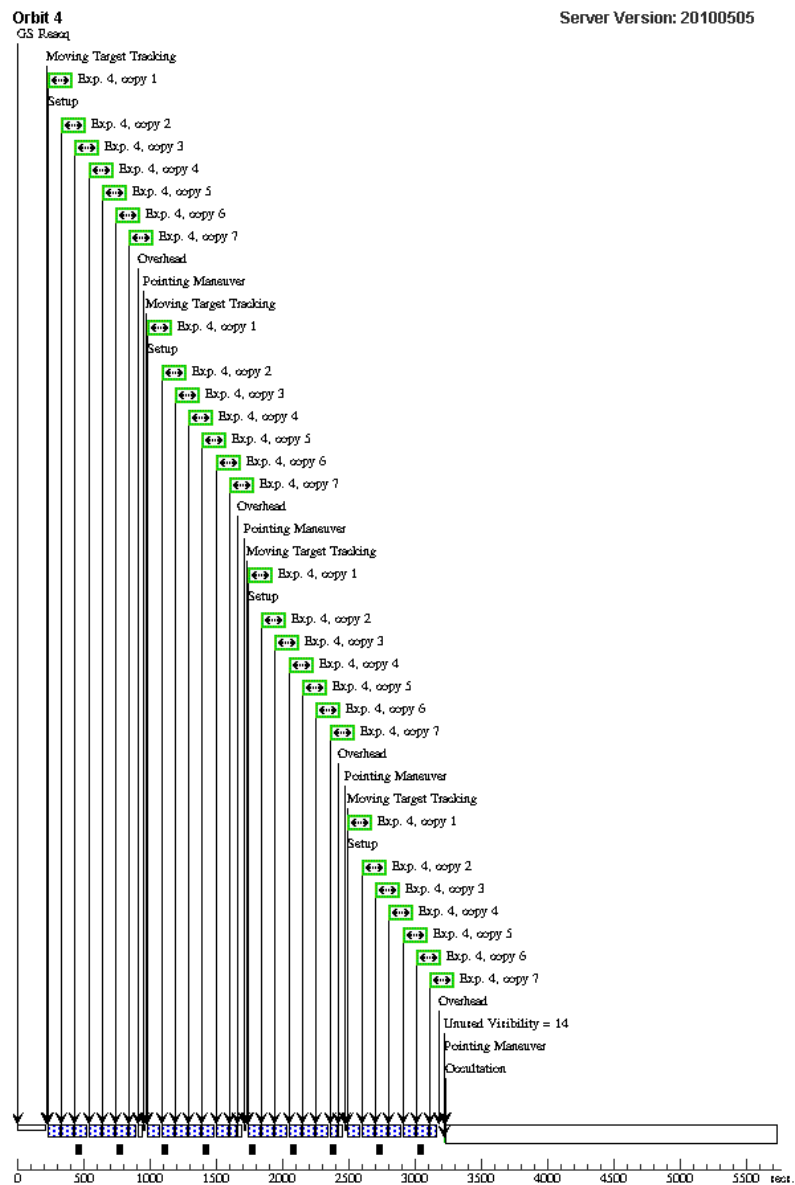
13	6 49 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	SAA CONTOUR 11; Sequence 13-17 Non-Int NEW OBSET	49 Secs X 6	[10]
							[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	
14	1 49 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 0.546,0.582; SAA CONTOUR 02; NEW OBSET	49 Secs	[10]
							[==>]	
15	5 49 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 0.546,0.582; SAA CONTOUR 02	49 Secs X 5	[10]
							[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)]	
16	6 49 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 1.092,1.164; SAA CONTOUR 02	49 Secs X 6	[10]
							[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	
17	6 49 sec observations	(1) HAUMEA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F350LP	CR-SPLIT=NO	POS TARG 1.639,1.746; SAA CONTOUR 02	49 Secs X 6	[10]
							[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	

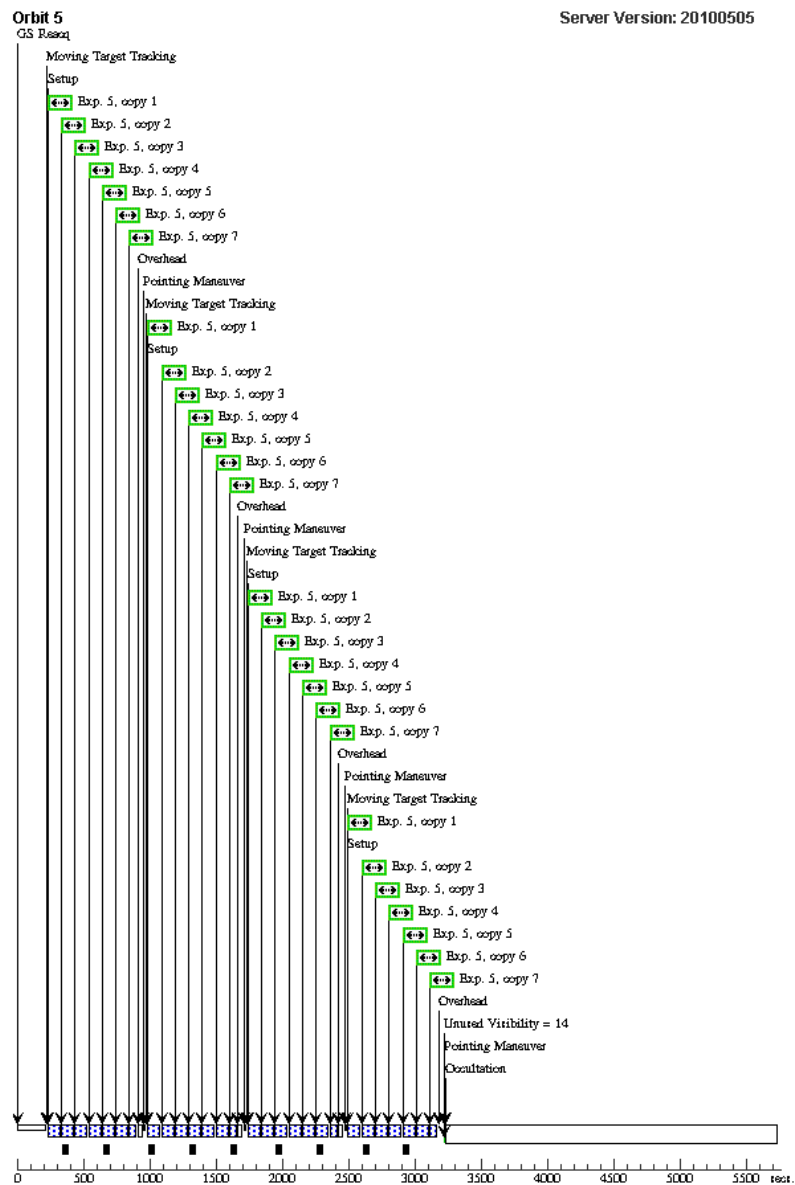
Orbit Structure

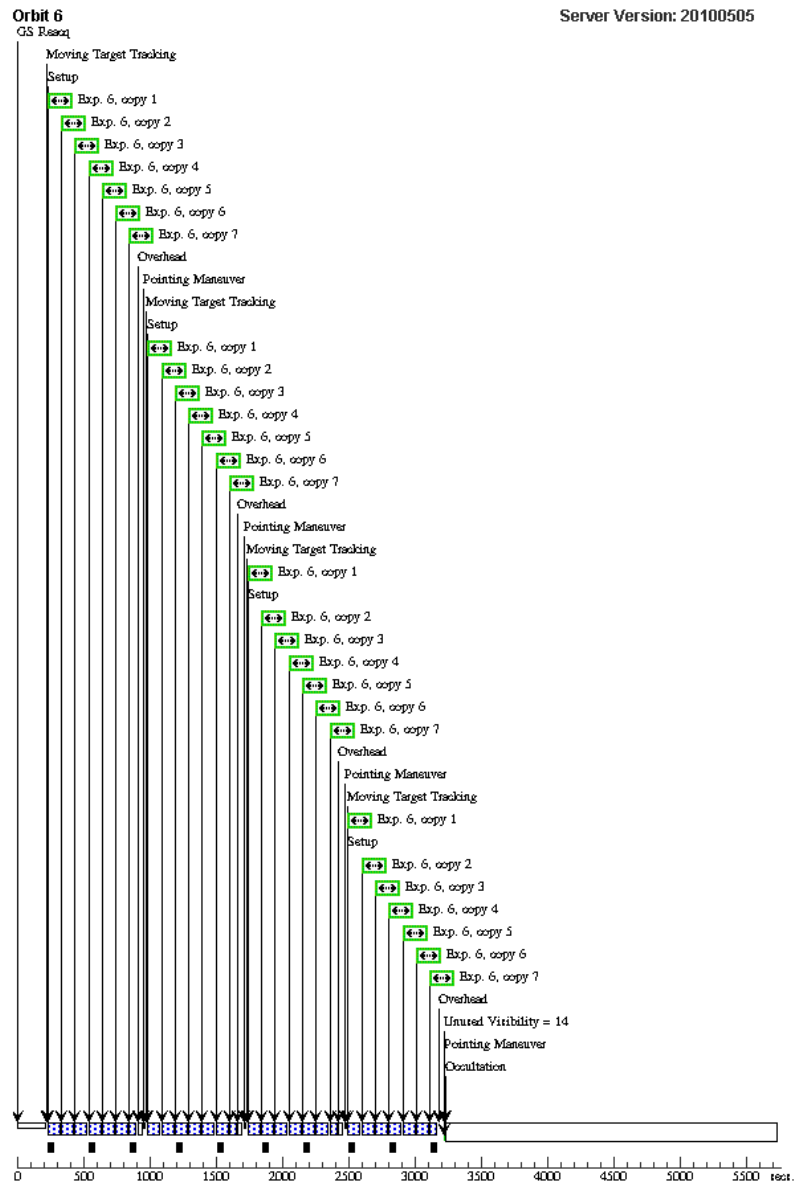


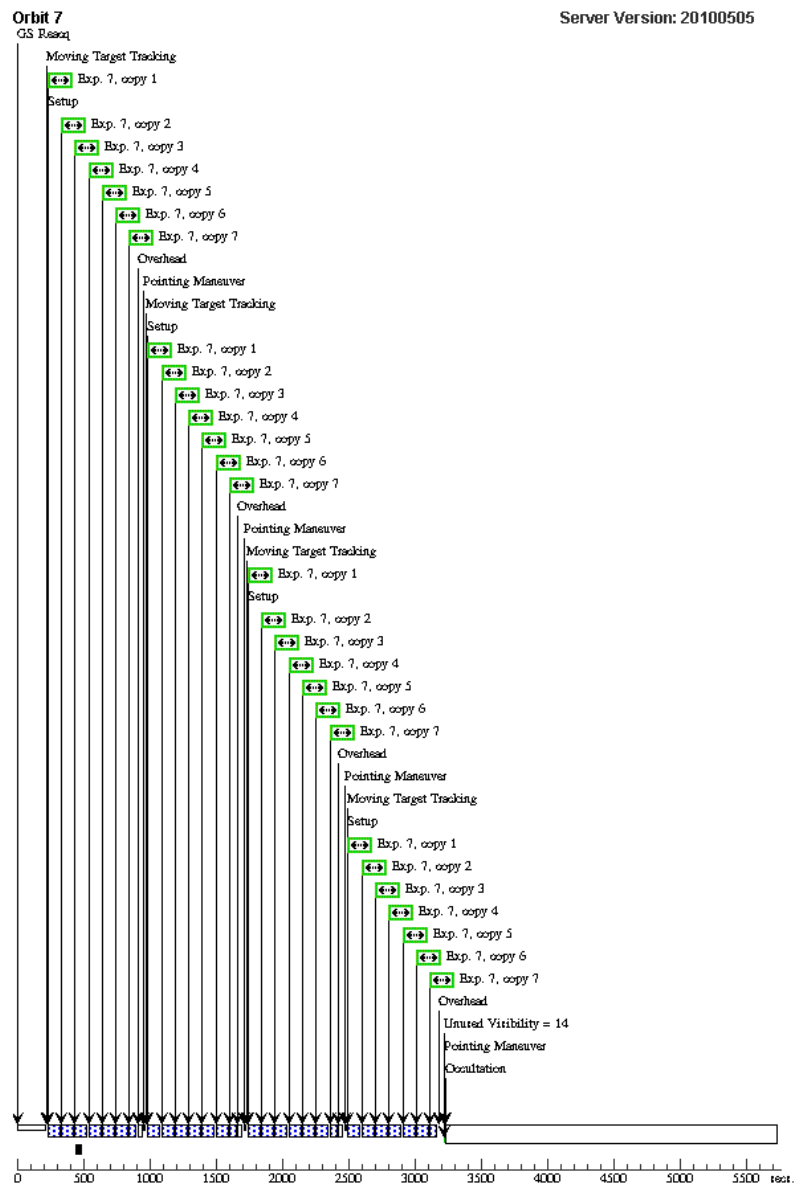


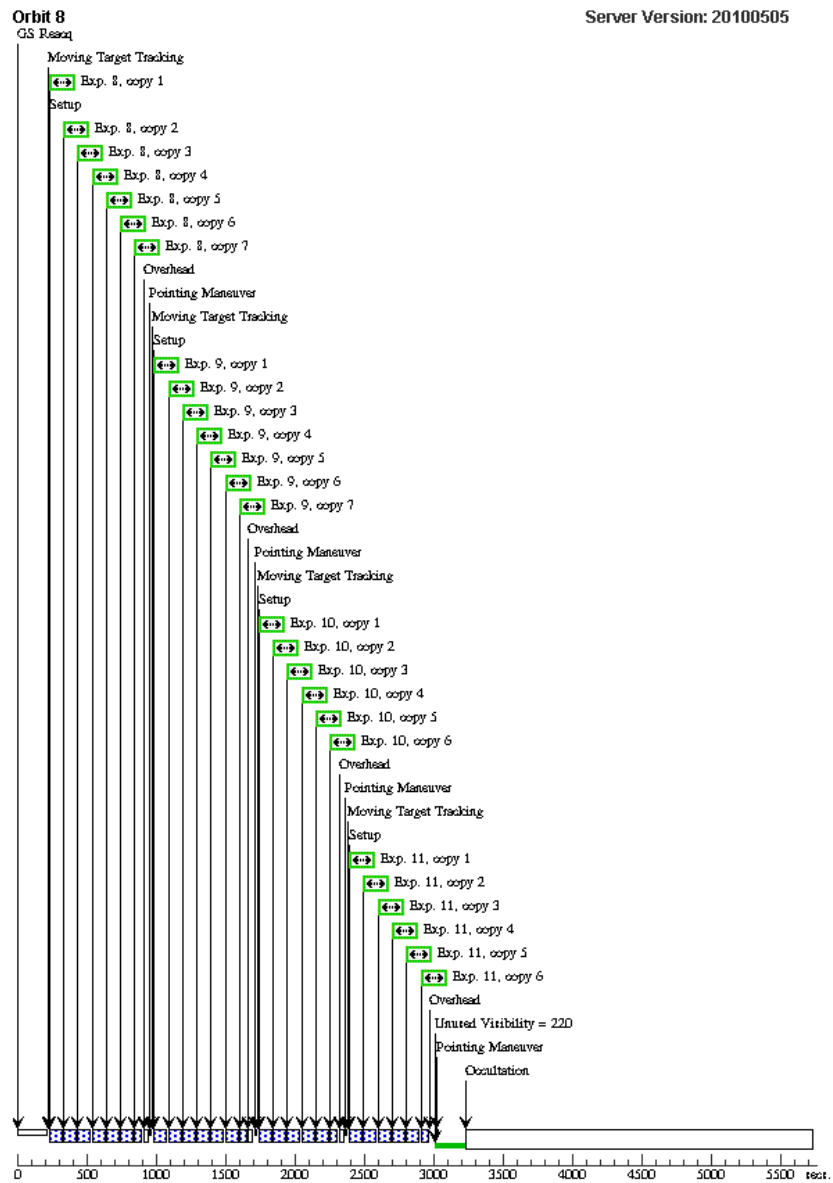


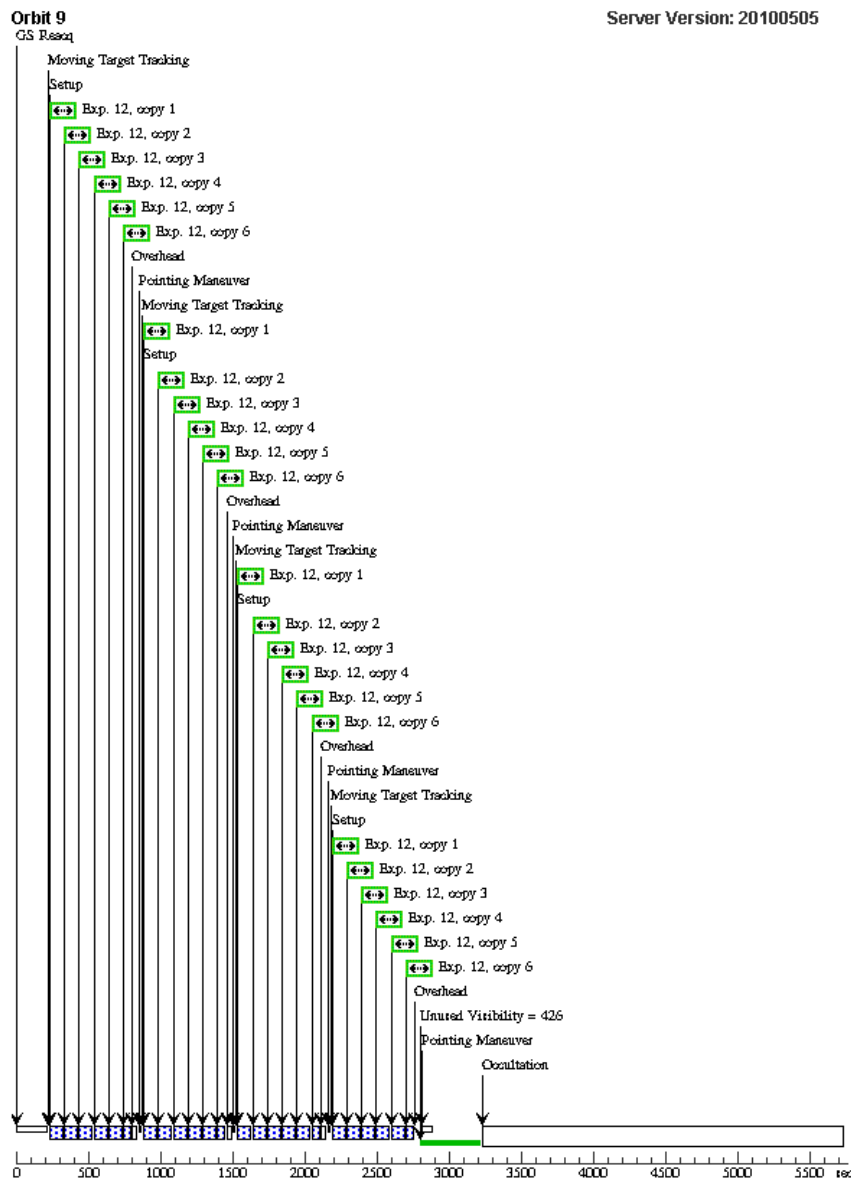












Proposal 12243 - Visit 01 - Determining the Size and Shape of Dwarf Planet Haumea from a Mutual Event

