12245 - Orbital Evolution and Stability of the Inner Uranian Moons

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Mark R. Showalter (PI)	**SETI Institute**	**mshowalter@seti.org**
Dr. Jack J. Lissauer (CoI)	NASA Ames Research Center	Jack.J.Lissauer@nasa.gov
Prof. Imke de Pater (CoI)	University of California - Berkeley	imke@astron.berkeley.edu
Dr. Richard G. French (CoI)	Wellesley College	rfrench@wellesley.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) URANUS-PERDITA-SOUTH-MAB	WFC3/UVIS	1	20-Oct-2010 21:13:43.0	yes
02	(2) URANUS-PERDITA-NORTH-MAB	WFC3/UVIS	1	20-Oct-2010 21:13:48.0	yes
03	(3) URANUS-MAB-SOUTH	WFC3/UVIS	1	20-Oct-2010 21:13:51.0	yes
04	(4) URANUS-MAB-NORTH	WFC3/UVIS	1	20-Oct-2010 21:13:54.0	yes
13	(3) URANUS-MAB-SOUTH	WFC3/UVIS	1	20-Oct-2010 21:13:57.0	yes
14	(4) URANUS-MAB-NORTH	WFC3/UVIS	1	20-Oct-2010 21:14:00.0	yes
05	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS	1	20-Oct-2010 21:14:03.0	yes
06	(6) URANUS-CUPID-NORTH-MAB	WFC3/UVIS	1	20-Oct-2010 21:14:06.0	yes
07	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR WFC3/UVIS	1	20-Oct-2010 21:14:11.0	yes
11	(11) URANUS-PERDITA-SOUTH	WFC3/UVIS	1	20-Oct-2010 21:14:15.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
12	(12) URANUS-PERDITA-NORTH	WFC3/UVIS	1	20-Oct-2010 21:14:18.0	yes
15	(15) URANUS-CUPID-SOUTH	WFC3/UVIS	1	20-Oct-2010 21:14:20.0	yes
16	(16) URANUS-CUPID-NORTH	WFC3/UVIS	1	20-Oct-2010 21:14:23.0	yes
25	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS	1	20-Oct-2010 21:14:25.0	yes

14 Total Orbits Used

ABSTRACT

Nine densely-packed inner moons of Uranus show signs of chaos and orbital instability over a variety of time scales. Many moons show measureable orbital changes within a decade or less. Long-term integrations predict that some moons could collide in less than one million years. One faint ring embedded in the system may, in fact, be the debris left behind from an earlier such collision. Meanwhile, the nearby moon Mab falls well outside the influence of the others but nevertheless shows rapid, as yet unexplained, changes in its orbit. It is embedded within a dust ring that also shows surprising variability. A highly optimized series of observations with WFC3 over the next three cycles will address some of the fundamental open questions about this dynamically active system: Do the orbits truly show evidence of chaos? If so, over what time scales? What can we say about the masses of the moons involved? What is the nature of the variations in Mab's orbit? Is Mab's motion predictable or random? Astrometry will enable us to derive the orbital elements of these moons with 10-km precision. This will be sufficient to study the year-by-year changes and, combined with other data from 2003-2007, the decadal evolution of the orbits. The pairing of precise astrometry with numerical integrations will enable us to derive new dynamical constraints on the masses of these moons. Mass is the fundamental unknown quantity currently limiting our ability to reproduce the interactions within this system. This program will also capitalize upon our best opportunity for nearly 40 years to study the unexplained variations in Uranus's faint outer rings.

OBSERVING DESCRIPTION

Astrometry of the Uranian satellites is accomplished via eight visits, each consisting of a sequence of long exposures through the broad F606W filter. Each orbit begins with one unsaturated image of the planet for geometric reference and calibration checking. The orbital plane is oriented within 20 degrees of the X-axis in the images to separate the moons from the wide vertical band caused by saturation bloom from the planet. From orbit to orbit, Uranus is shifted upward and downward by ~ 40 pixels within the 512x512 subarray to achieve some of the benefits of dithering; however, moons can always be distinguished from hot pixels by their motion. Each visit is timed to place one of the smallest moons near its maximum orbital

elonagation, because this is where such moons are most detectable. The larger moons will be captured by chance and require no special targeting. Mab is the target of repeated observations in order to study its orbital variations. A ninth visit will be used to determine the color of Mab and that of its neighboring moons, Puck and Miranda. With measurements spanning blue to the IR, it will be possible to determine which of the two neighbors most resembles Mab, and thereby reduce the large uncertainties in Mab's albedo and size.

Visit

Proposal 12245, Visit 01, completed Thu Oct 21 01:14:29 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00

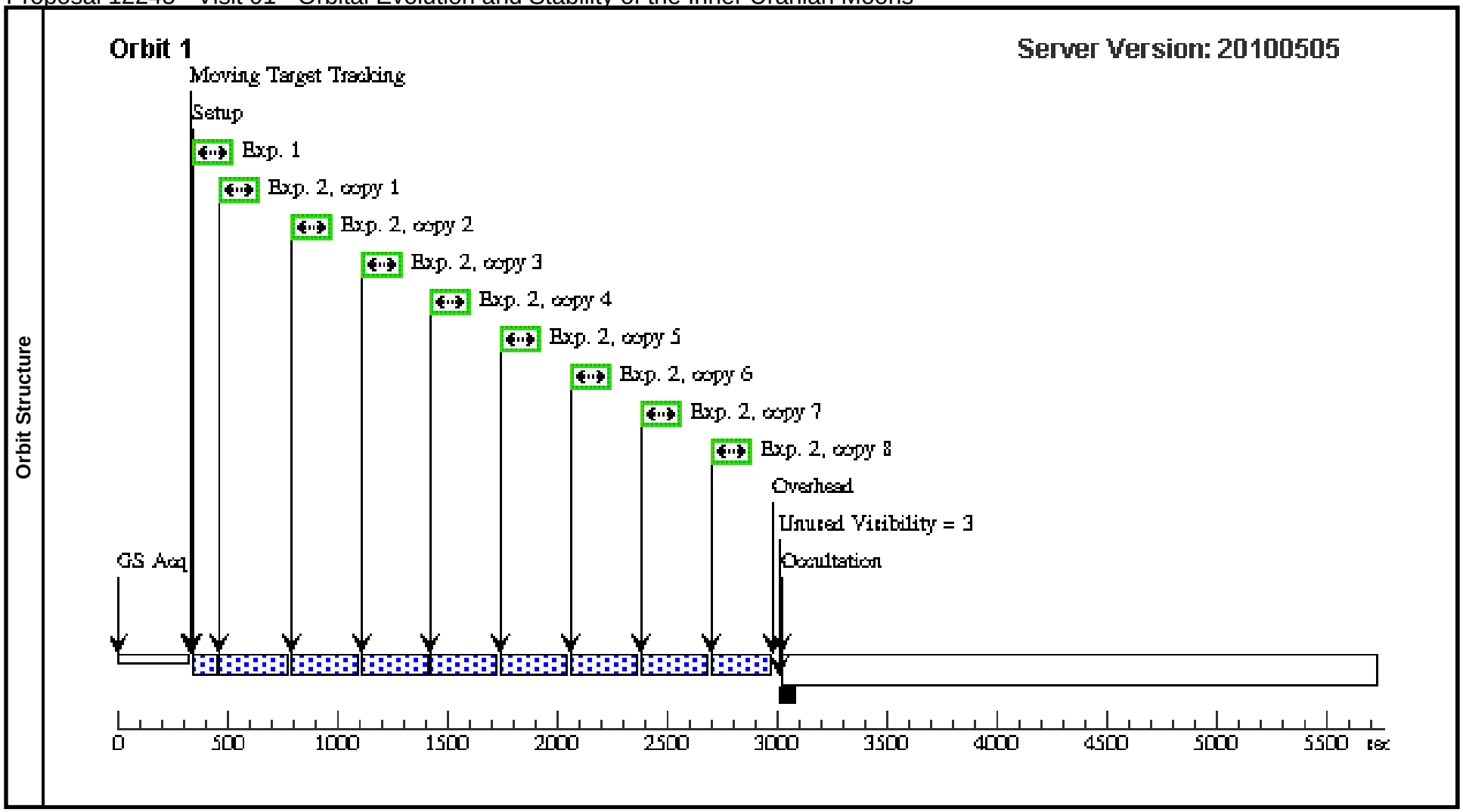
Comments: Uranus timed to position Perdita near its southern orbital elongation. Mab is also visible. The ring plane is oriented within 20 degrees of horizontal.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS-PERDITA-SOUTH-MAB	STD=URANUS			OLG OF PERDITA BETWEEN 70 110, SEP OF PERDITA ARIEL FROM EARTH GT 4", SEP OF PERDITA UMBRIEL FROM EARTH GT 4", SEP OF PERDITA TITANIA FROM EARTH GT 5", SEP OF PERDITA OBERON FROM EARTH GT 5", SEP OF PERDITA MIRANDA FROM EARTH GT 4", SEP OF PERDITA PUCK FROM EARTH GT 2", SEP OF PERDITA BELINDA FROM EARTH GT 1", NOT OLG OF MAB BETWEEN 0 45, NOT OLG OF MAB BETWEEN 135 225, NOT OLG OF MAB BETWEEN 315 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(1) URANUS-PERDITA-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5	Sequence 1-2 Non-Int	35 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(1) URANUS-PERDITA-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 02, completed Thu Oct 21 01:14:30 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00

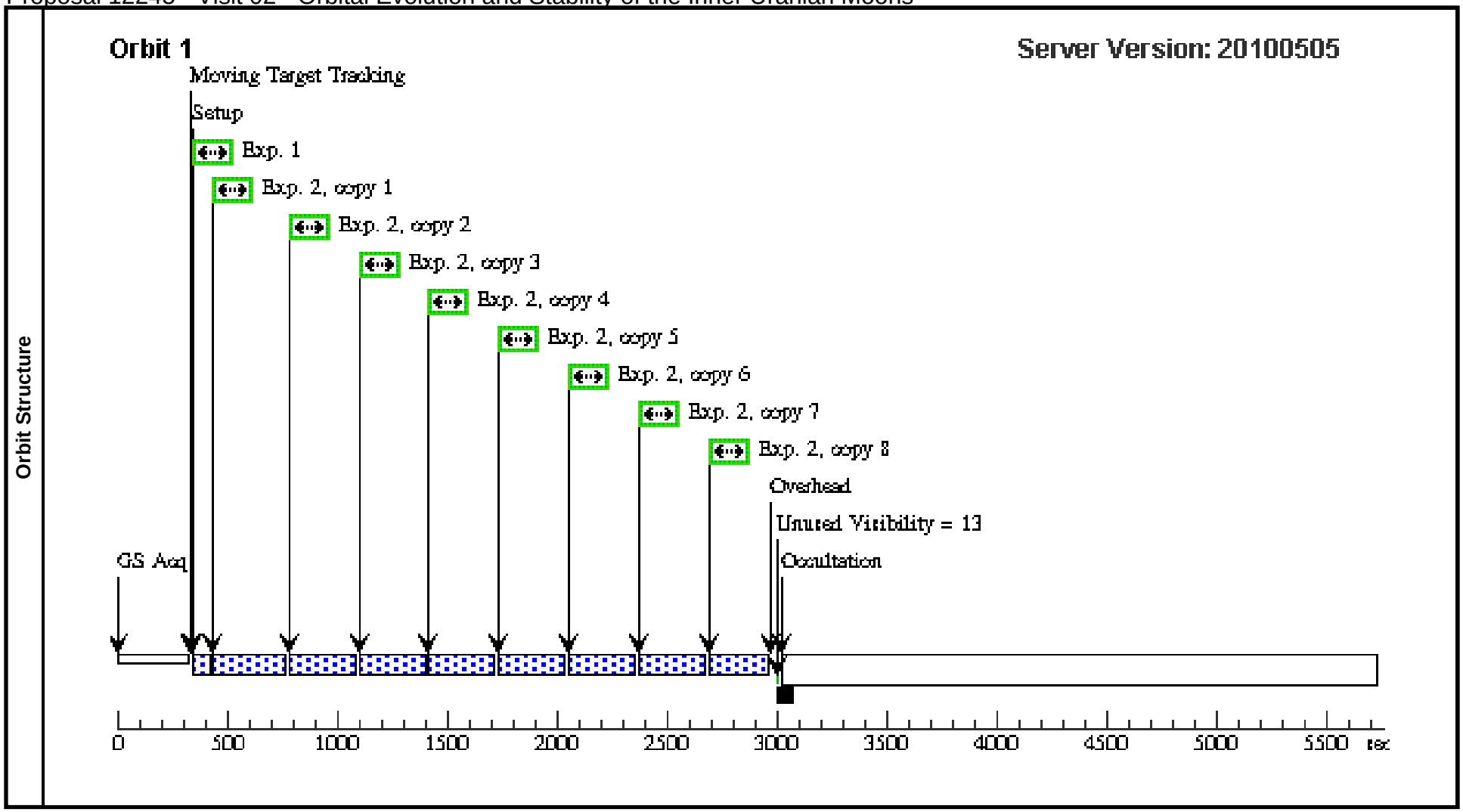
Comments: Uranus timed to position Perdita near its northern orbital elongation. Mab is also visible. The ring plane is oriented within 20 degrees of horizontal.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	URANUS-PERDITA-NORTH-MAB	STD=URANUS			OLG OF PERDITA BETWEEN 250 290, SEP OF PERDITA ARIEL FROM EARTH GT 4", SEP OF PERDITA UMBRIEL FROM EARTH GT 4", SEP OF PERDITA TITANIA FROM EARTH GT 5", SEP OF PERDITA OBERON FROM EARTH GT 5", SEP OF PERDITA MIRANDA FROM EARTH GT 4", SEP OF PERDITA PUCK FROM EARTH GT 2", SEP OF PERDITA BELINDA FROM EARTH GT 1", NOT OLG OF MAB BETWEEN 0 45, NOT OLG OF MAB BETWEEN 135 225, NOT OLG OF MAB BETWEEN 315 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F467M, 10 s	(2) URANUS-PERDITA-NORTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F467M	CR-SPLIT=NO	POS TARG 0,-1.5	Sequence 1-2 Non-Int	10 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(2) URANUS-PERDITA-NORTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 13
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 03, completed Thu Oct 21 01:14:30 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 18-SEP-2010:00:00:00

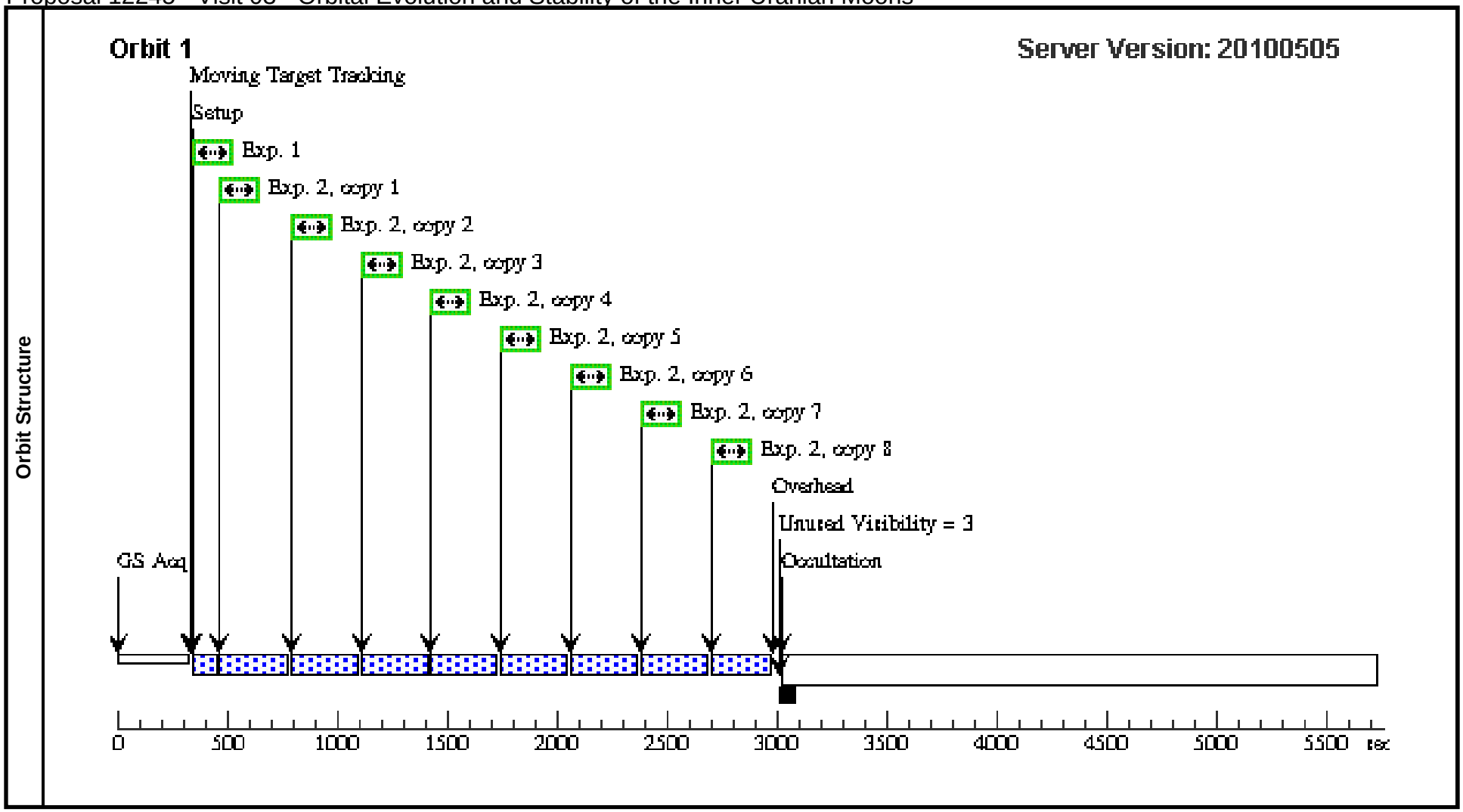
Comments: Uranus timed to position Mab near its southern orbital elongation. The ring plane is oriented within 20 degrees of horizontal. Schedule early in observing window, preferably before September 18.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	URANUS-MAB-SOUTH	STD=URANUS			OLG OF MAB BETWEEN 60 120, SEP OF MAB ARIEL FROM EARTH GT 4", SEP OF MAB UMBRIEL FROM EARTH GT 4", SEP OF MAB TITANIA FROM EARTH GT 5", SEP OF MAB OBERON FROM EARTH GT 5", SEP OF MAB MIRANDA FROM EARTH GT 4"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(3) URANUS-MAB-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5; GS ACQ SCENARIO BASE1B3	Sequence 1-2 Non-Int	35 Secs *[==>]*	 ***[1]***
2	F606W, 8 x 268 s	(3) URANUS-MAB-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	 ***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 04, completed Thu Oct 21 01:14:31 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; AFTER 03 BY 4 D TO 10 D; BEFORE 01-DEC-2010:00:00:00

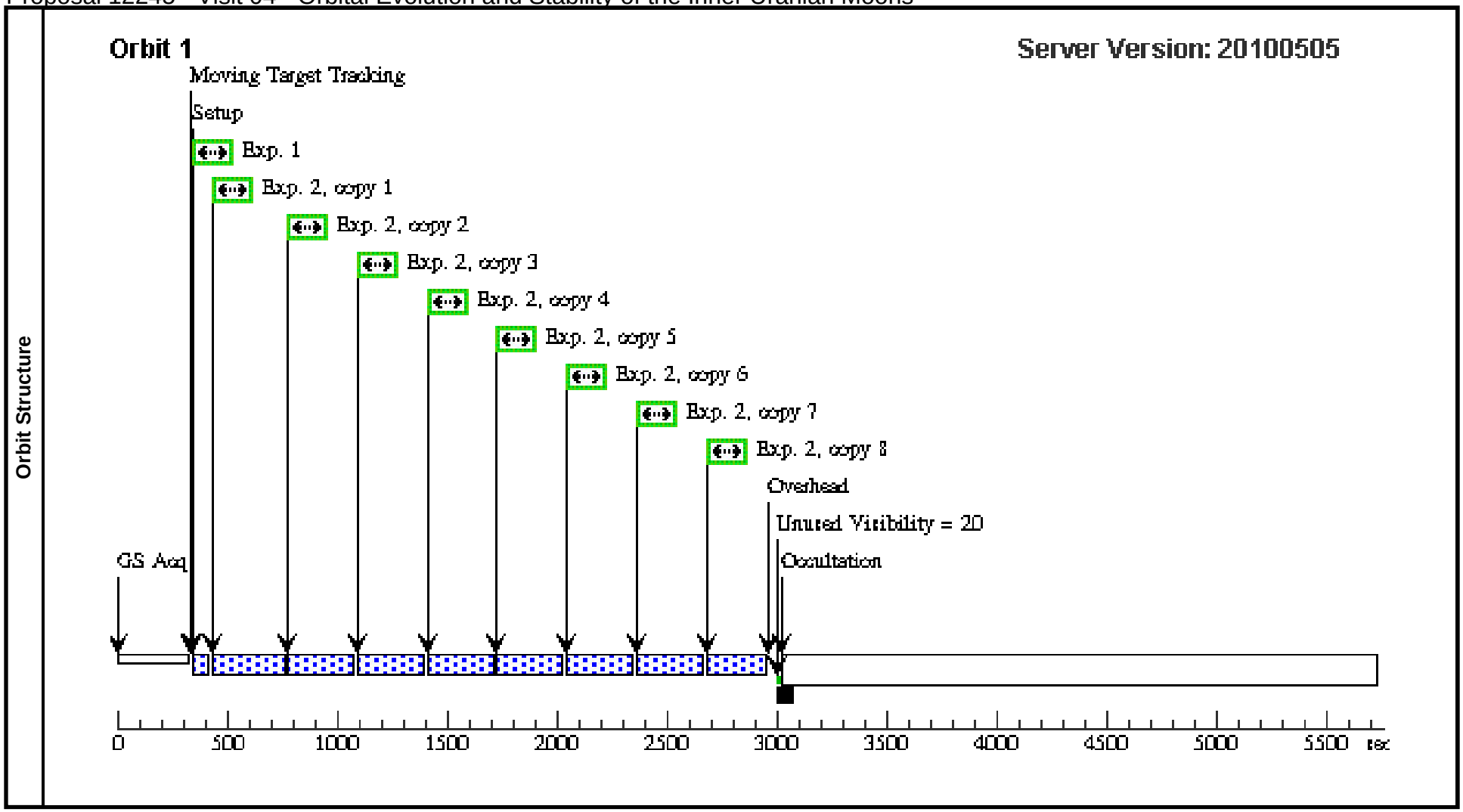
Comments: Uranus timed to position Mab near its northern orbital elongation. The ring plane is oriented within 20 degrees of horizontal. Shedule 4-10 days after Visit 03.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	URANUS-MAB-NORTH	STD=URANUS			OLG OF MAB BETWEEN 240 300, SEP OF MAB ARIEL FROM EARTH GT 4", SEP OF MAB UMBRIEL FROM EARTH GT 4", SEP OF MAB TITANIA FROM EARTH GT 5", SEP OF MAB OBERON FROM EARTH GT 5", SEP OF MAB MIRANDA FROM EARTH GT 4"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F621M, 3 s	(4) URANUS-MAB-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F621M	CR-SPLIT=NO	POS TARG 0,-1.5; GS ACQ SCENARIO BASE1B3	Sequence 1-2 Non-Int	3 Secs *[==>]*	 ***[1]***
2	F606W, 8 x 268 s	(4) URANUS-MAB-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	 ***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 20
GS Acq
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 13, completed Thu Oct 21 01:14:31 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; AFTER 04 BY 14 D TO 28 D; BEFORE 15-NOV-2010:00:00:00

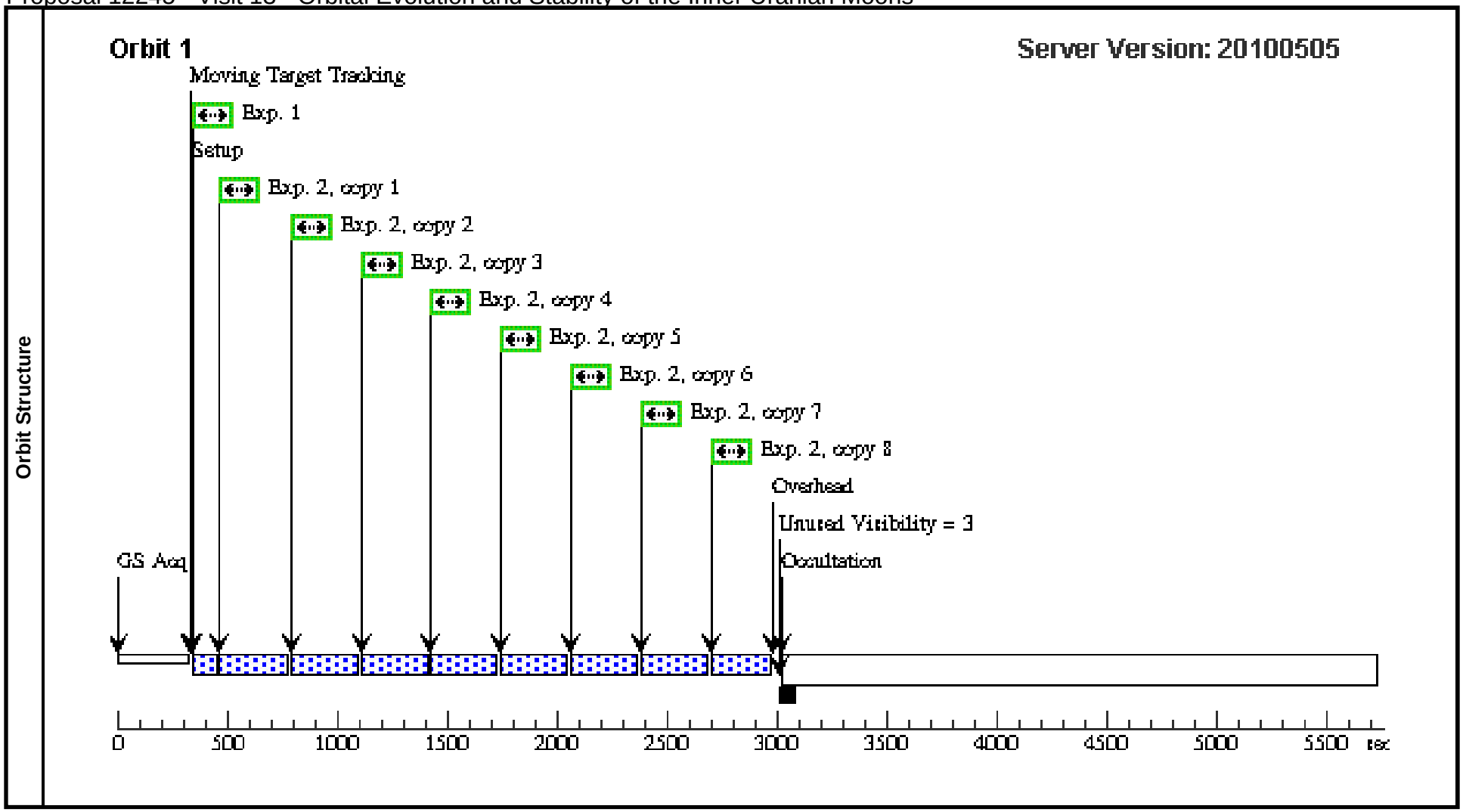
Comments: Uranus timed to position Mab near its southern orbital elongation. The ring plane is oriented within 20 degrees of horizontal. Schedule 14-28 days after Visit 04.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	URANUS-MAB-SOUTH	STD=URANUS			OLG OF MAB BETWEEN 60 120, SEP OF MAB ARIEL FROM EARTH GT 4", SEP OF MAB UMBRIEL FROM EARTH GT 4", SEP OF MAB TITANIA FROM EARTH GT 5", SEP OF MAB OBERON FROM EARTH GT 5", SEP OF MAB MIRANDA FROM EARTH GT 4"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(3) URANUS-MAB-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5	Sequence 1-2 Non-Int	35 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(3) URANUS-MAB-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Exp. 1
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 14, scheduling Thu Oct 21 01:14:32 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BETWEEN 01-NOV-2010:00:00:00 AND 01-JUL-2011:00:00:00

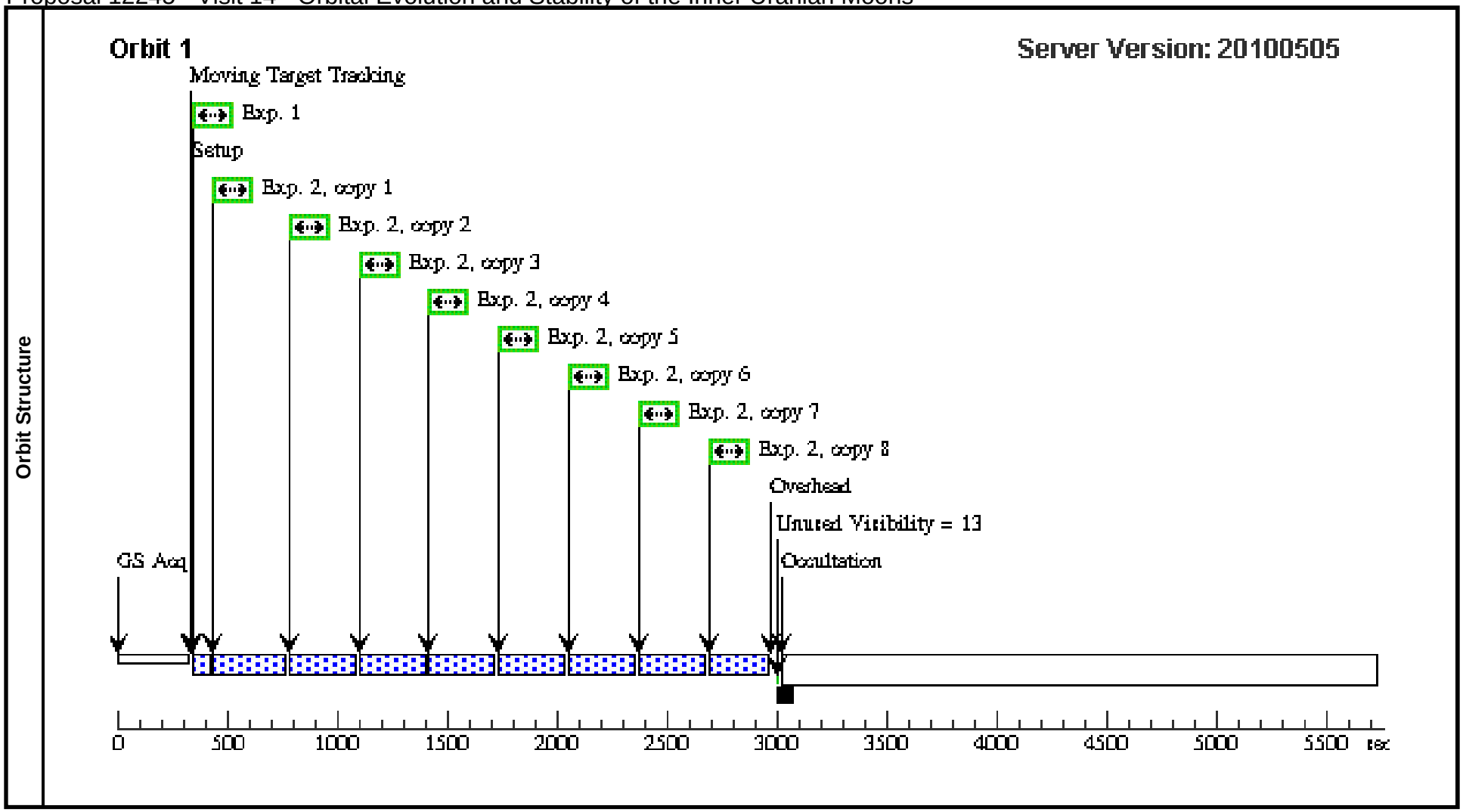
Comments: Uranus timed to position Mab near its northern orbital elongation. The ring plane is oriented within 20 degrees of horizontal. Shedule near the end of the observing window, preferably after 1 November, 2010.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	URANUS-MAB-NORTH	STD=URANUS			OLG OF MAB BETWEEN 240 300, SEP OF MAB ARIEL FROM EARTH GT 4", SEP OF MAB UMBRIEL FROM EARTH GT 4", SEP OF MAB TITANIA FROM EARTH GT 5", SEP OF MAB OBERON FROM EARTH GT 5", SEP OF MAB MIRANDA FROM EARTH GT 4"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F467M, 10 s	(4) URANUS-MAB-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F467M	CR-SPLIT=NO	POS TARG 0,-1.5; GS ACQ SCENARIO BASE1B3	Sequence 1-2 Non-Int	10 Secs *[==>]*	 ***[1]***
2	F606W, 8 x 268 s	(4) URANUS-MAB-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	 ***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Exp. 1
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 13
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 05, failed Thu Oct 21 01:14:32 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00

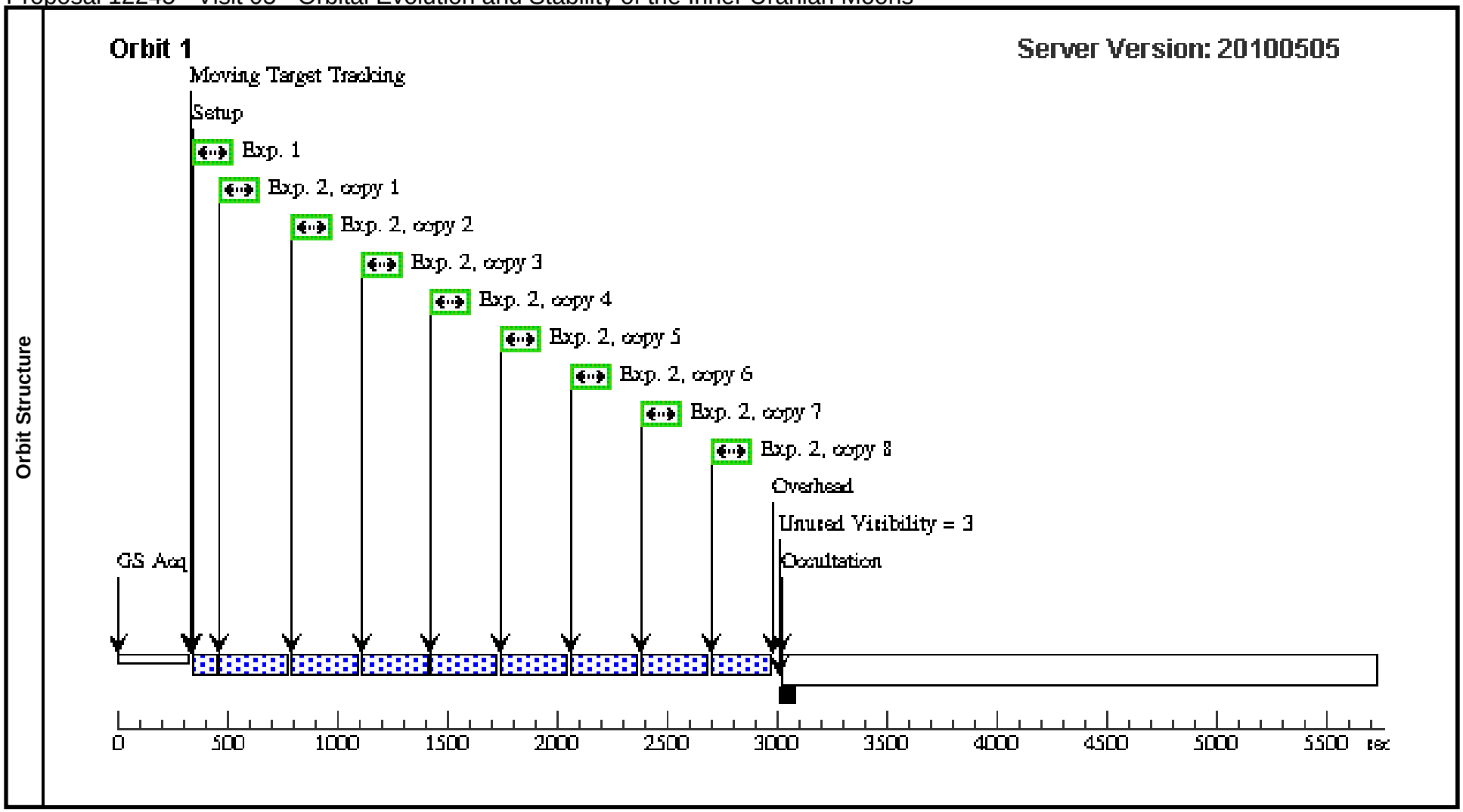
Comments: Uranus timed to position Cupid near its southern orbital elongation. Mab is also visible. The ring plane is oriented within 20 degrees of horizontal.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	URANUS-CUPID-SOUTH-MAB	STD=URANUS			OLG OF CUPID BETWEEN 70 110, SEP OF CUPID ARIEL FROM EARTH GT 4", SEP OF CUPID UMBRIEL FROM EARTH GT 4", SEP OF CUPID TITANIA FROM EARTH GT 5", SEP OF CUPID OBERON FROM EARTH GT 5", SEP OF CUPID MIRANDA FROM EARTH GT 4", SEP OF CUPID PUCK FROM EARTH GT 2", SEP OF CUPID BELINDA FROM EARTH GT 1", NOT OLG OF MAB BETWEEN 0 45, NOT OLG OF MAB BETWEEN 135 225, NOT OLG OF MAB BETWEEN 315 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5	Sequence 1-2 Non-Int	35 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 06, withdrawn Thu Oct 21 01:14:33 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00

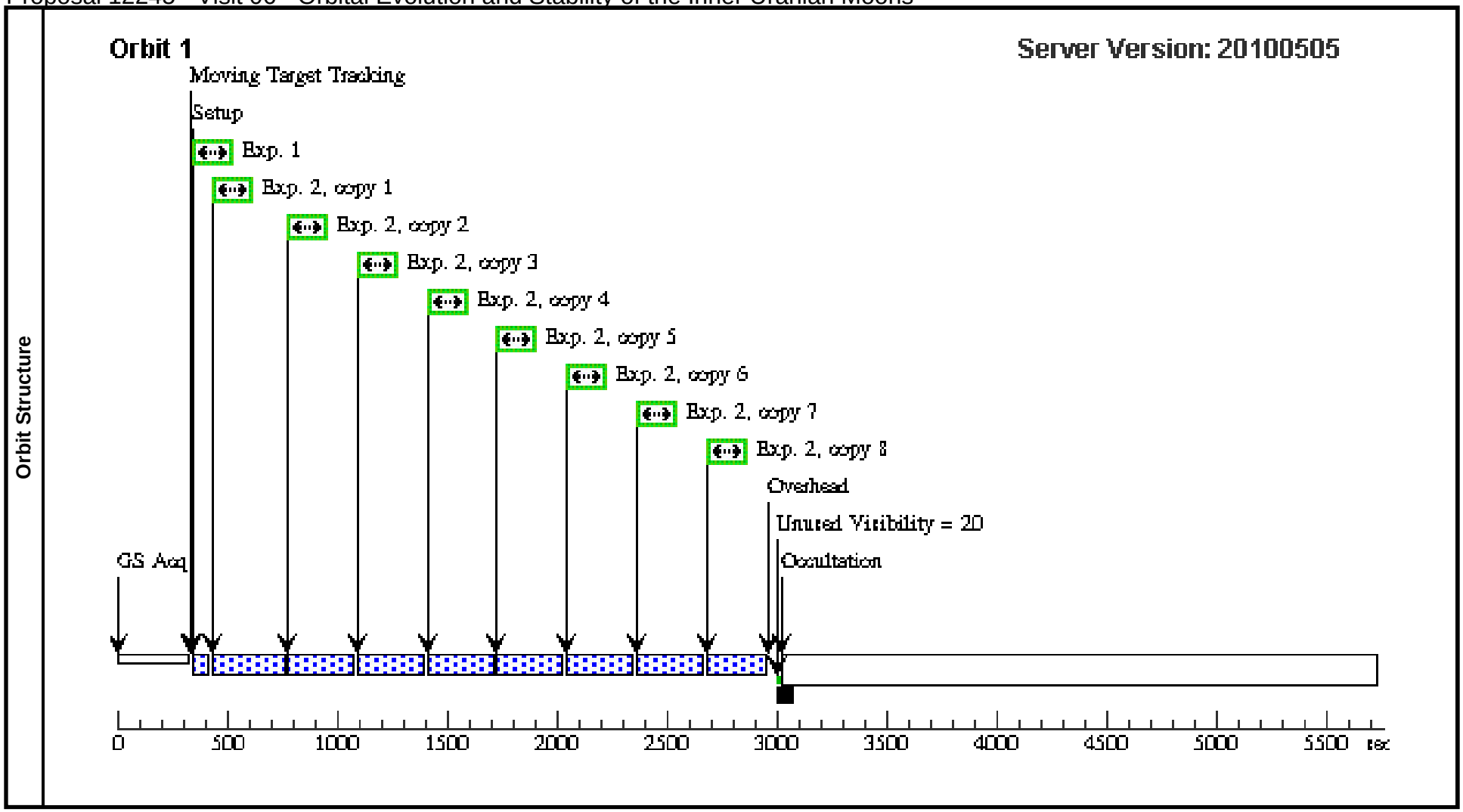
Comments: Uranus timed to position Cupid near its northern orbital elongation. Mab is also visible. The ring plane is oriented within 20 degrees of horizontal.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(6)	URANUS-CUPID-NORTH-MAB	STD=URANUS			OLG OF CUPID BETWEEN 250 290, SEP OF CUPID ARIEL FROM EARTH GT 4", SEP OF CUPID UMBRIEL FROM EARTH GT 4", SEP OF CUPID TITANIA FROM EARTH GT 5", SEP OF CUPID OBERON FROM EARTH GT 5", SEP OF CUPID MIRANDA FROM EARTH GT 4", SEP OF CUPID PUCK FROM EARTH GT 2", SEP OF CUPID BELINDA FROM EARTH GT 1", NOT OLG OF MAB BETWEEN 0 45, NOT OLG OF MAB BETWEEN 135 225, NOT OLG OF MAB BETWEEN 315 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F621M, 3 s	(6) URANUS-CUPID-NORTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F621M	CR-SPLIT=NO	POS TARG 0,-1.5	Sequence 1-2 Non-Int	3 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(6) URANUS-CUPID-NORTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 20
GS Acq
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 07, completed Thu Oct 21 01:14:33 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-NOV-2010:00:00:00

Comments: UVIS and IR color measurements of Mab, Puck and Miranda. The ring plane is oriented within 20 degrees of horizontal. Bracketing to ensure un-saturated images of Miranda, plus respectable detections of Mab (signal-to-noise > ~ 10). Schedule as close as possible to opposition (September 21, 2010).

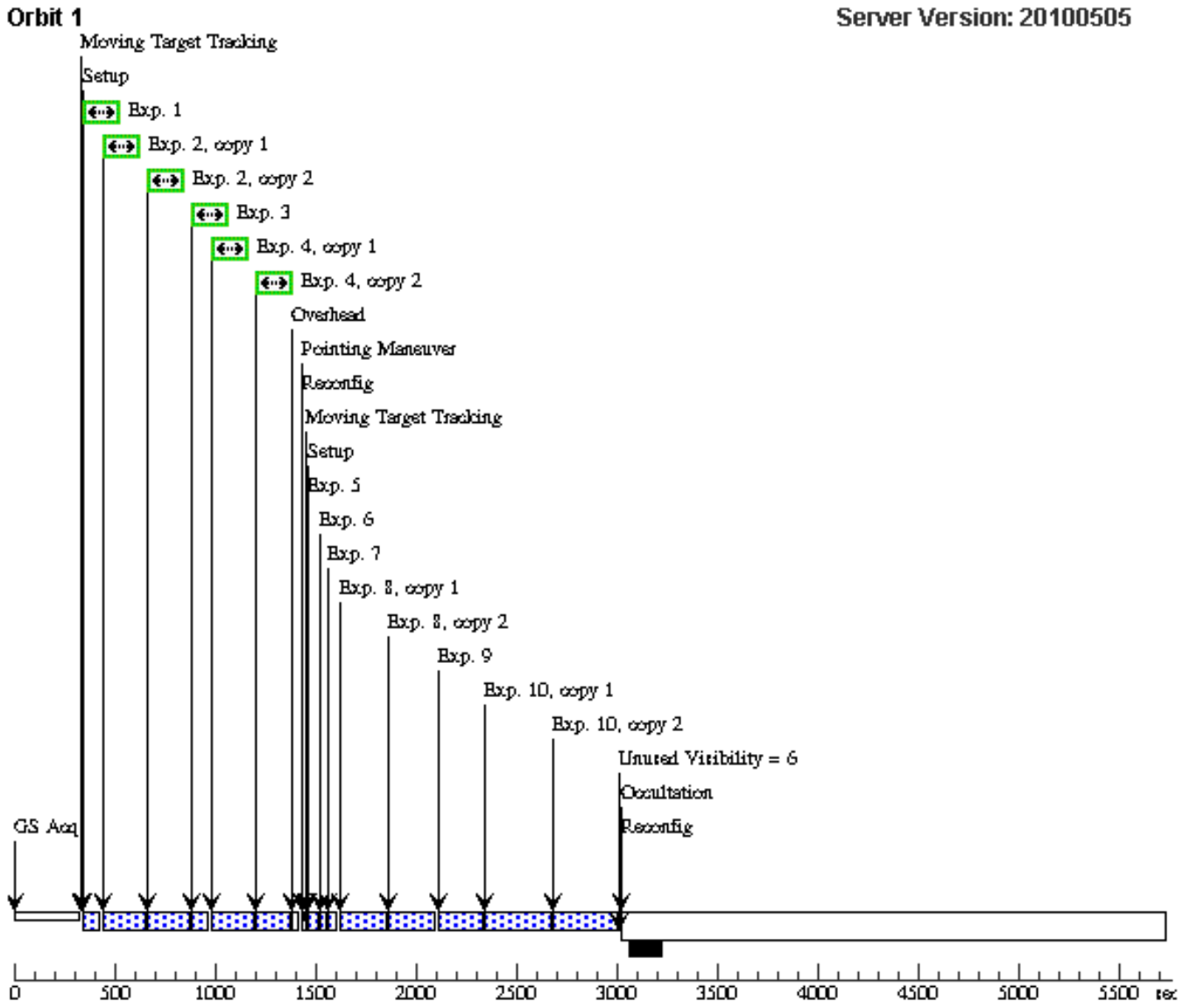
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(7)	URANUS-MAB-PUCK-MIRANDA	STD=URANUS			NOT OLG OF MAB BETWEEN 0 60, SEP OF MAB ARIEL FROM EARTH GT 5", SEP OF MAB UMBRIEL FROM EARTH GT 5", SEP OF MAB TITANIA FROM EARTH GT 5", SEP OF MAB OBERON FROM EARTH GT 5", SEP OF MAB MIRANDA FROM EARTH GT 5", NOT OLG OF MAB BETWEEN 120 240, NOT OLG OF MAB BETWEEN 300 360, SEP OF MAB PUCK FROM EARTH GT 3", NOT OLG OF PUCK BETWEEN 0 45, NOT OLG OF PUCK BETWEEN 135 225, NOT OLG OF PUCK BETWEEN 315 360, NOT OLG OF MIRANDA BETWEEN 0 15, NOT OLG OF MIRANDA BETWEEN 165 195, NOT OLG OF MIRANDA BETWEEN 345 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	UVIS, F814W, 12 s	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W	CR-SPLIT=NO	GS ACQ SCENARIO BASE1B3	Sequence 1-10 Non-Int	12 Secs *[==>]*	***[1]***
2	UVIS, F814W, 2 x 170 s	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W	CR-SPLIT=NO		Sequence 1-10 Non-Int	170 Secs X 2 *[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
3	UVIS, F475W, 12 s	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475W	CR-SPLIT=NO		Sequence 1-10 Non-Int	12 Secs *[==>]*	***[1]***
4	UVIS, F475W, 2 x 170 s	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F475W	CR-SPLIT=NO		Sequence 1-10 Non-Int	170 Secs X 2 *[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
5	IR, F125W, SPARS10x4 (22 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F125W	SAMP-SEQ=SPARS10; NSAMP=4		Sequence 1-10 Non-Int	*[==>]*	***[1]***
6	IR, F105W, SPARS10x3 (15 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F105W	SAMP-SEQ=SPARS10; NSAMP=3		Sequence 1-10 Non-Int	*[==>]*	***[1]***
7	IR, F160W, SPARS10x4 (22 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F160W	SAMP-SEQ=SPARS10; NSAMP=4		Sequence 1-10 Non-Int	*[==>]*	***[1]***
8	IR, F125W, 2 x SPARS25x11 (224 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F125W	SAMP-SEQ=SPARS25; NSAMP=11		Sequence 1-10 Non-Int	*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
9	IR, F105W, SPARS25x10 (201 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F105W	SAMP-SEQ=SPARS25; NSAMP=10		Sequence 1-10 Non-Int	*[==>]*	***[1]***
10	IR, F160W, 2 x SPARS25x15 (313 s)	(7) URANUS-MAB-PUCK-MIRANDA	WFC3/IR, MULTIACCUM, IRSUB256	F160W	SAMP-SEQ=SPARS25; NSAMP=15		Sequence 1-10 Non-Int	*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***

Orbit Structure



Visit

Proposal 12245, Visit 11, withdrawn Thu Oct 21 01:14:34 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00; ON HOLD

Comments: Uranus timed to position Perdita near its southern orbital elongation. The ring plane is oriented within 20 degrees of horizontal.

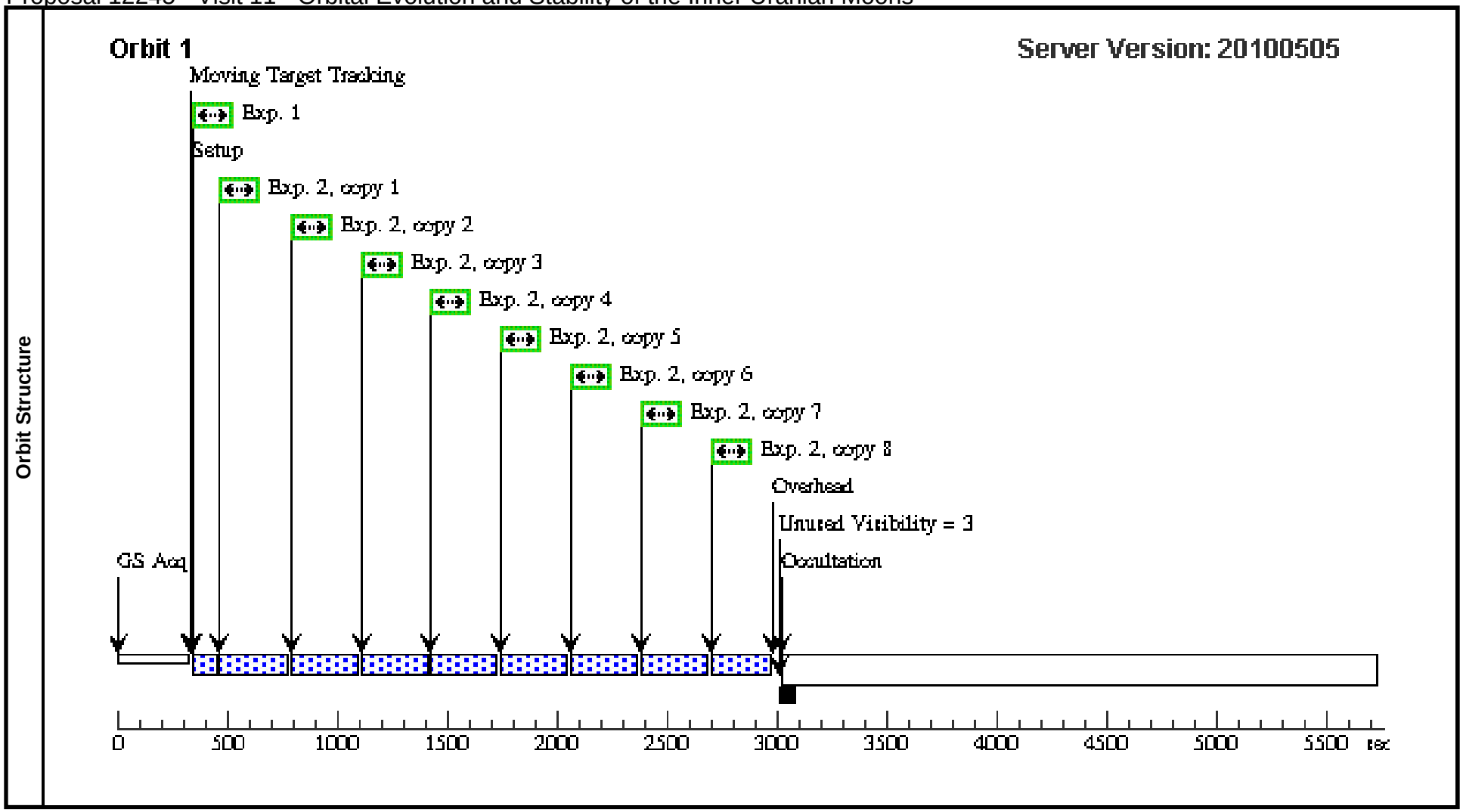
On Hold Comments: Use as an alternative to Visit 01, if Visit 01 (with additional constraints on the orbital position of Mab) is too difficult to schedule.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(11)	URANUS-PERDITA-SOUTH	STD=URANUS			OLG OF PERDITA BETWEEN 70 110, SEP OF PERDITA ARIEL FROM EARTH GT 4", SEP OF PERDITA UMBRIEL FROM EARTH GT 4", SEP OF PERDITA TITANIA FROM EARTH GT 5", SEP OF PERDITA OBERON FROM EARTH GT 5", SEP OF PERDITA MIRANDA FROM EARTH GT 4", SEP OF PERDITA PUCK FROM EARTH GT 2", SEP OF PERDITA BELINDA FROM EARTH GT 1"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(11) URANUS-PERDITA-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5	Sequence 1-2 Non-Int	35 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(11) URANUS-PERDITA-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Exp. 1
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 12, withdrawn Thu Oct 21 01:14:34 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00; ON HOLD

Comments: Uranus timed to position Perdita near its northern orbital elongation. The ring plane is oriented within 20 degrees of horizontal.

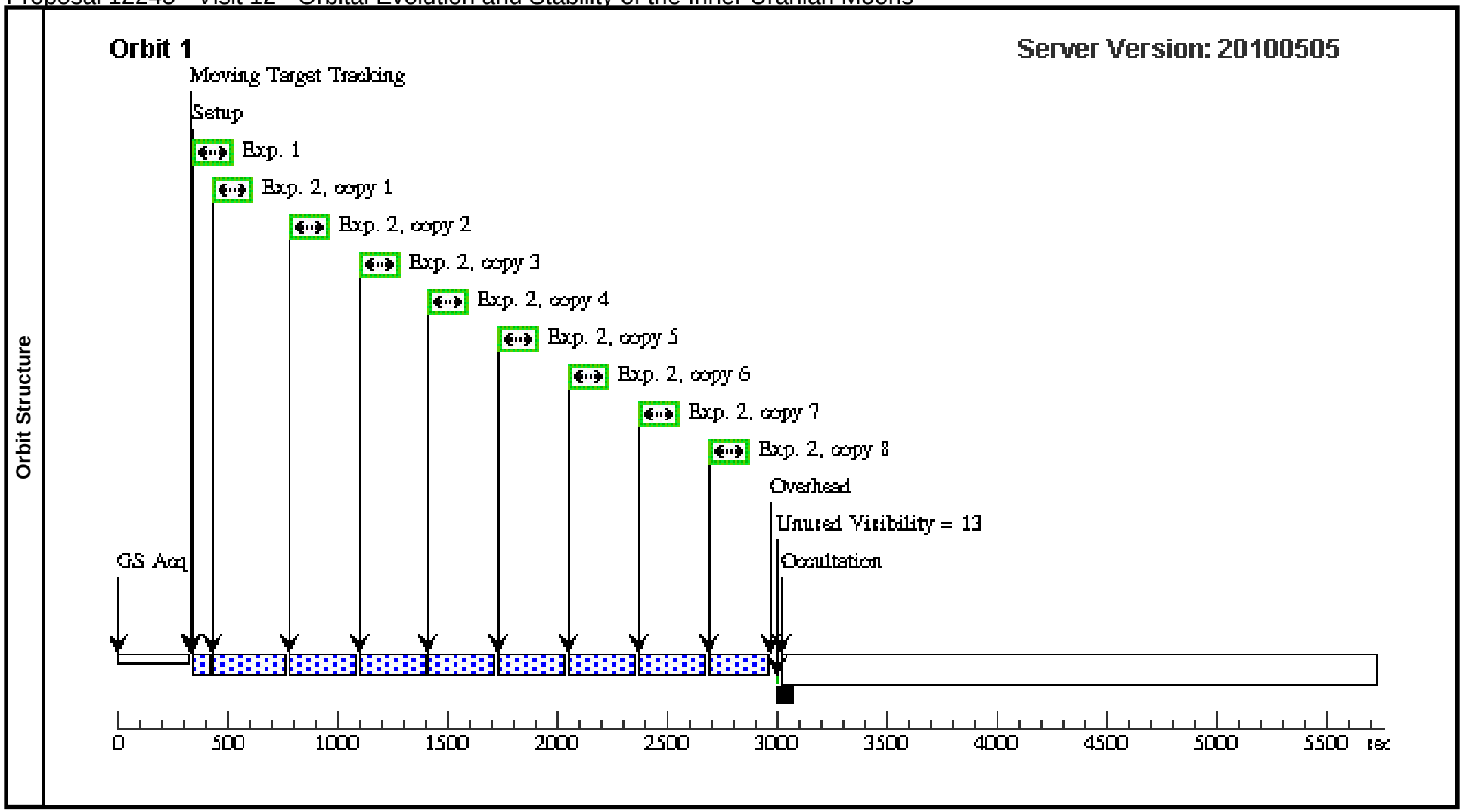
On Hold Comments: Use as an alternative to Visit 02, if Visit 02 (with additional constraints on the orbital postion of Mab) is too difficult to schedule.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(12)	URANUS-PERDITA-NORTH	STD=URANUS			OLG OF PERDITA BETWEEN 250 290, SEP OF PERDITA ARIEL FROM EARTH GT 4", SEP OF PERDITA UMBRIEL FROM EARTH GT 4", SEP OF PERDITA TITANIA FROM EARTH GT 5", SEP OF PERDITA OBERON FROM EARTH GT 5", SEP OF PERDITA MIRANDA FROM EARTH GT 4", SEP OF PERDITA PUCK FROM EARTH GT 2", SEP OF PERDITA BELINDA FROM EARTH GT 1"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F467M, 10 s	(12) URANUS-PERDITA-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F467M	CR-SPLIT=NO	POS TARG 0,-1.5	Sequence 1-2 Non-Int	10 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(12) URANUS-PERDITA-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 13
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 15, scheduling Thu Oct 21 01:14:35 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00; ON HOLD

Comments: Uranus timed to position Cupid near its southern orbital elongation. The ring plane is oriented within 20 degrees of horizontal.

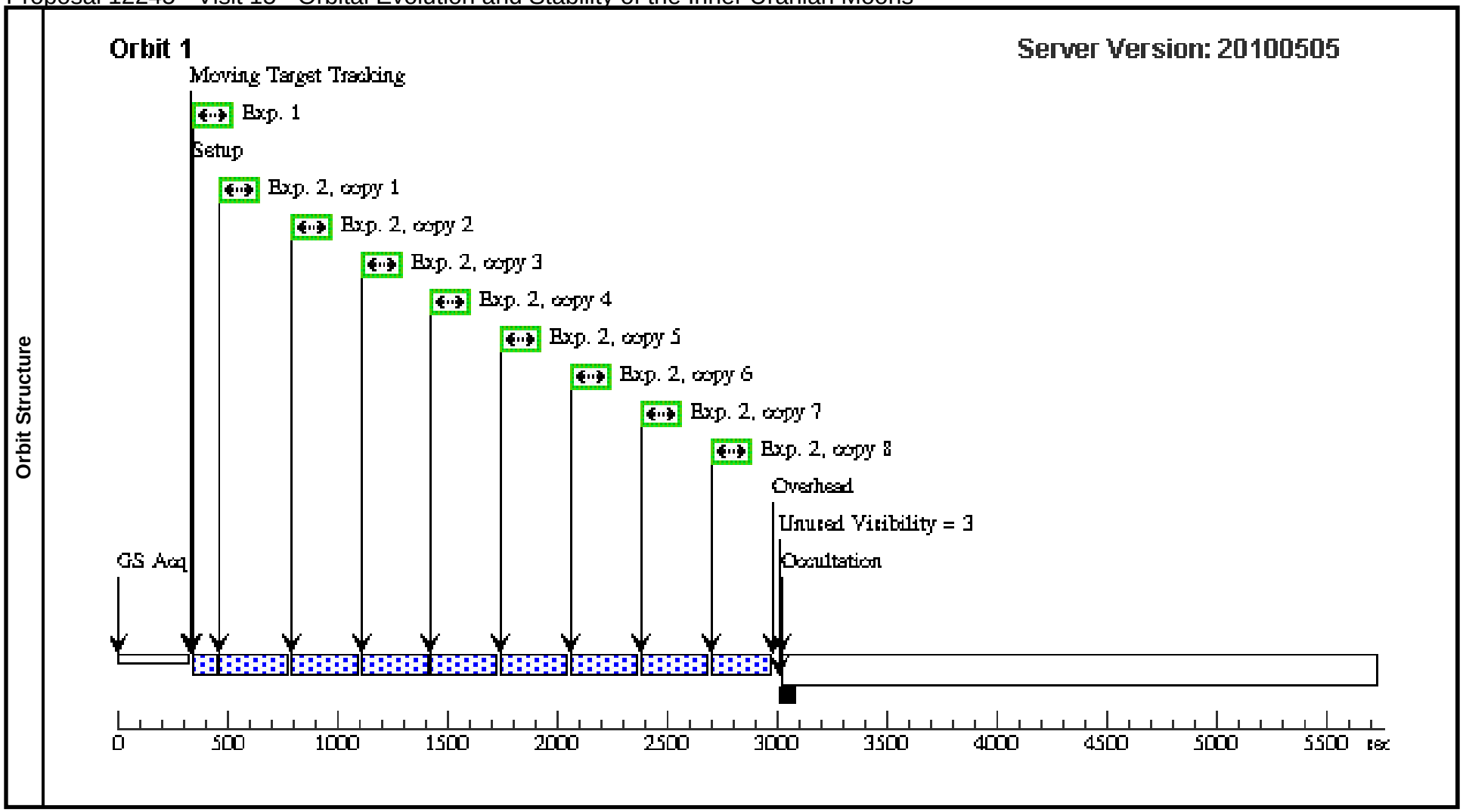
On Hold Comments: Use as an alternative to Visit 05, if Visit 05 (with its additional constraints on the orbital position of Mab) is too difficult to schedule.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(15)	URANUS-CUPID-SOUTH	STD=URANUS			OLG OF CUPID BETWEEN 70 110, SEP OF CUPID ARIEL FROM EARTH GT 4", SEP OF CUPID UMBRIEL FROM EARTH GT 4", SEP OF CUPID TITANIA FROM EARTH GT 5", SEP OF CUPID OBERON FROM EARTH GT 5", SEP OF CUPID MIRANDA FROM EARTH GT 4", SEP OF CUPID PUCK FROM EARTH GT 2", SEP OF CUPID BELINDA FROM EARTH GT 1"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(15) URANUS-CUPID-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5	Sequence 1-2 Non-Int	35 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(15) URANUS-CUPID-SOUTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Exp. 1
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 3
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 16, completed Thu Oct 21 01:14:35 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00; ON HOLD

Comments: Uranus timed to position Cupid near its northern orbital elongation. The ring plane is oriented within 20 degrees of horizontal.

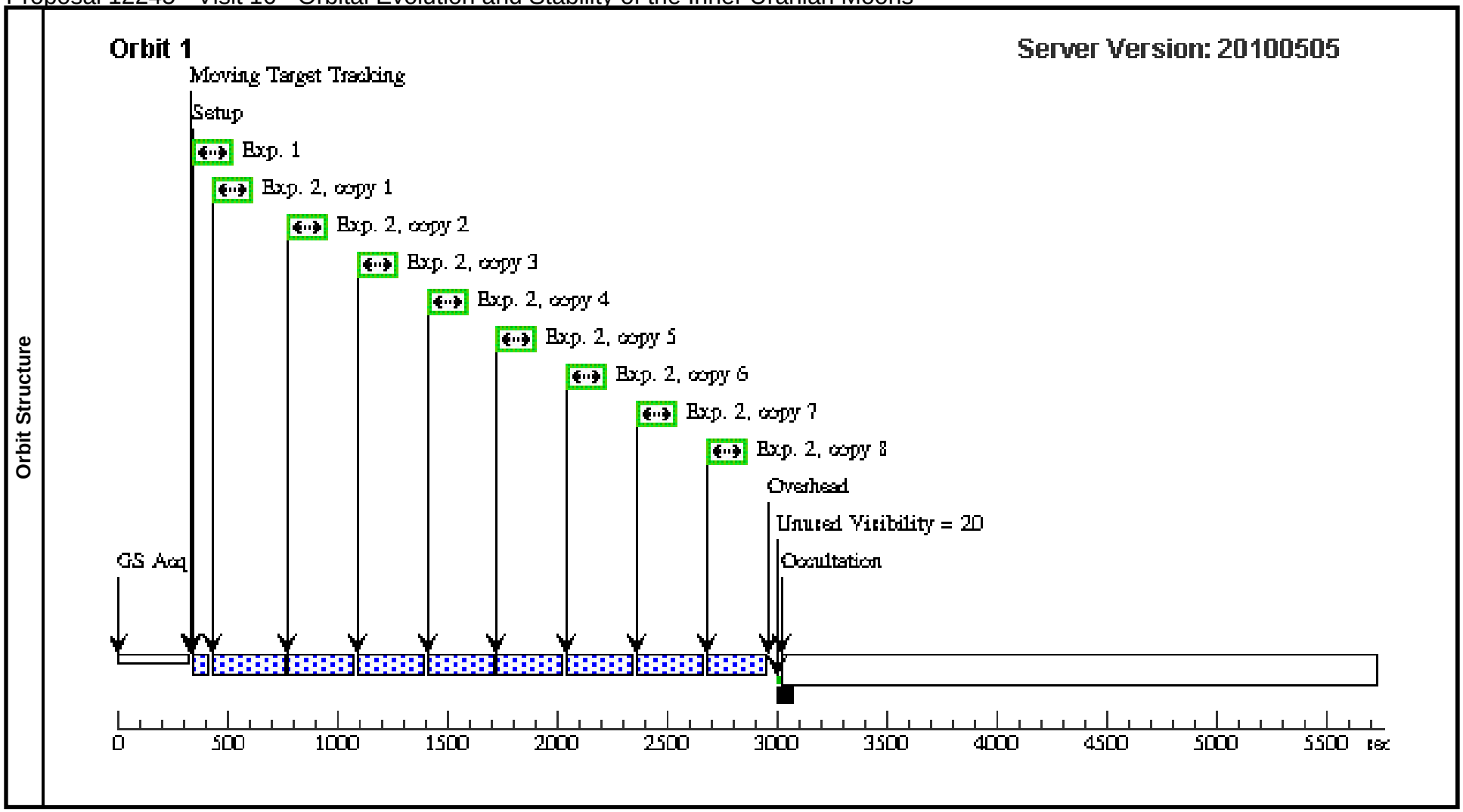
On Hold Comments: Use as an alternative to Visit 06, if Visit 06 (with additional constraints on the orbital position of Mab) is too difficult to schedule.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(16)	URANUS-CUPID-NORTH	STD=URANUS			OLG OF CUPID BETWEEN 250 290, SEP OF CUPID ARIEL FROM EARTH GT 4", SEP OF CUPID UMBRIEL FROM EARTH GT 4", SEP OF CUPID TITANIA FROM EARTH GT 5", SEP OF CUPID OBERON FROM EARTH GT 5", SEP OF CUPID MIRANDA FROM EARTH GT 4", SEP OF CUPID PUCK FROM EARTH GT 2", SEP OF CUPID BELINDA FROM EARTH GT 1"	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F621M, 3 s	(16) URANUS-CUPID-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F621M	CR-SPLIT=NO	POS TARG 0,-1.5	Sequence 1-2 Non-Int	3 Secs	
								[==>]	***[1]***
2	F606W, 8 x 268 s	(16) URANUS-CUPID-NORTH	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20100505
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Visibility = 20
GS Acq
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12245, Visit 25, implementation Thu Oct 21 01:14:35 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; ORIENT 6D TO 46 D; ORIENT 186D TO 226 D; BEFORE 01-JUL-2011:00:00:00

Comments: Repeat of failed visit 05.

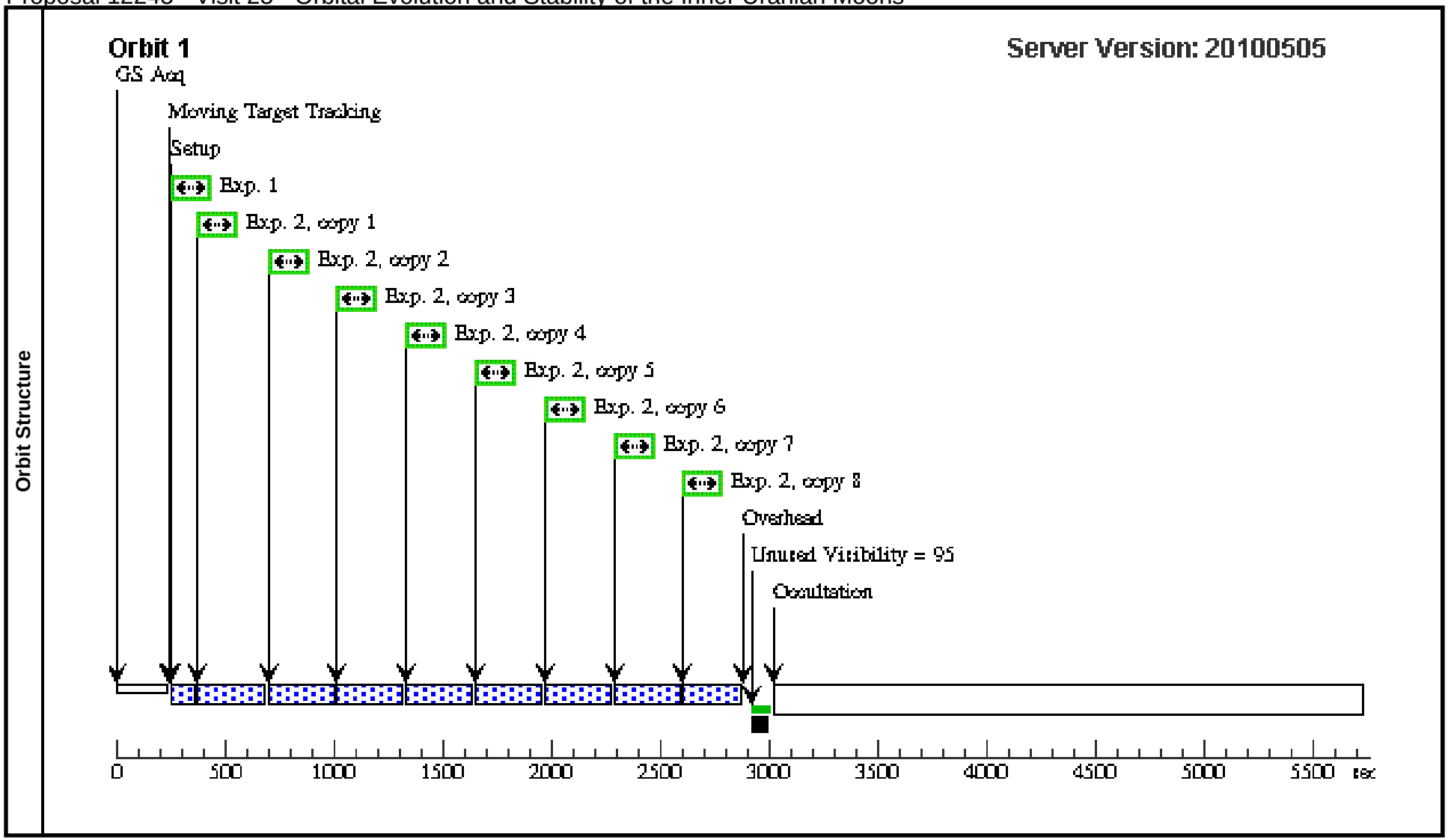
Uranus timed to position Cupid near its southern orbital elongation. Mab is also visible. The ring plane is oriented within 20 degrees of horizontal.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	URANUS-CUPID-SOUTH-MAB	STD=URANUS			OLG OF CUPID BETWEEN 70 110, SEP OF CUPID ARIEL FROM EARTH GT 4", SEP OF CUPID UMBRIEL FROM EARTH GT 4", SEP OF CUPID TITANIA FROM EARTH GT 5", SEP OF CUPID OBERON FROM EARTH GT 5", SEP OF CUPID MIRANDA FROM EARTH GT 4", SEP OF CUPID PUCK FROM EARTH GT 2", SEP OF CUPID BELINDA FROM EARTH GT 1", NOT OLG OF MAB BETWEEN 0 45, NOT OLG OF MAB BETWEEN 135 225, NOT OLG OF MAB BETWEEN 315 360	EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F845M, 35 s	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F845M	CR-SPLIT=NO	POS TARG 0,1.5; GS ACQ SCENARIO SINGLE	Sequence 1-2 Non-Int	35 Secs *[==>]*	 ***[1]***
2	F606W, 8 x 268 s	(5) URANUS-CUPID-SOUTH-MAB	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W	CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	268 Secs X 8 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	 ***[1]***


Orbit 1
Server Version: 20100505
Orbit Structure
GS Acq
Moving Target Tracking
Setup
Exp. 1
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Exp. 2, copy 4
Exp. 2, copy 5
Exp. 2, copy 6
Exp. 2, copy 7
Exp. 2, copy 8
Overhead
Unused Vitibility = 95
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec