12463 - Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus

Cycle: 19, 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) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:20.0	yes
02	(1) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:29.0	yes
03	(1) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:39.0	yes
04	(1) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:45.0	yes
05	(1) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:53.0	yes
06	(1) URANUS	WFC3/UVIS	1	14-Dec-2011 21:01:59.0	yes

6 Total Orbits Used

ABSTRACT

The planet Uranus demonstrated increased atmospheric activity around the time of the 2007 equinox, likely in response to extreme insolation change (Sromovsky et al. 2009, Icarus 203, 265). Convective sites in the planet's southern hemisphere reached unprecedented altitudes in 2003 (Hammel et

al. 2005, Icarus 175, 284); a bright northern feature showed the highest contrast yet detected in an outer planet atmosphere (Sromovsky et al. 2007, Icarus 192, 558); and a dark atmospheric feature was detected by Hubble (Hammel et al. 2009, Icarus 201, 257). The historical record makes references to discrete structures (both bright and dark) on Uranus during previous equinoctial apparitions (the last equinox occurred in 1965). The best amateur facilities are now just able to resolve the disk of Uranus and detect such activity if it is very large or has very high contrast. Amateurs also have access to a great many nights of telescope time. If a discrete cloud feature on Uranus is reported through the amateur network, we propose to obtain follow-up images with Hubble's WFC3. The proposed TOO images will permit determination of detailed structure of the feature at visible wavelengths, and will provide vertical and horizontal constraints on the feature's scattering properties. Hubble is the only facility that can provide such information at visible wavelengths. The proposal was accepted in earlier cycles, but not executed because the defined criteria for activation were not met. Because the timescales of change on Uranus are unknown, we resubmit this for consideration in the current cycle.

OBSERVING DESCRIPTION

Proposed Observations: We request three orbits of WFC3 imaging in Cycle 18 to obtain disk-resolved images of an anomalous feature on Uranus. In the first and third orbits, we use the following filters: most of a filter set designed for outer planet observations near the methane absorption band near 889 nm as well as a matched methane-continuum pair near 727 nm; filters corresponding to StrÃ¶mgren b and y filters used for long-term brightness monitoring; and the F658N filter similar to one that showed maximum contrast for the Uranus dark spot in C15. In the second orbit, we sample slightly different wavelengths: some of the same 889-nm methane filters; a matched methane-continuum pair near 619 nm; and filters with good contrast for discrete features. We will not dither due to short exposure times (dithering imposes a 2.5-min penalty for splitting the exposure, and dithering several exposures could require a 5.6-min buffer readout). We will use sub-arrays to avoid the need for buffer readouts during our planned visits. Comparisons with images at nearby wavelengths will permit identification of artifacts and cosmic rays.

Filter Specifics: The methane sets are specifically crafted to probe the vertical aerosol distribution of cloud features as a function of altitude. In addition, our filter choices provide continuity both with those used for past HST observations and with past ground-based observations (e.g., Lockwood’s long-term photometry program). The exposures are based on prior HST images made with similar filters, or ETC calculations using ground-based spectroscopy as input. These times are optimized for the “typical” Uranus, and are appropriate for an anomalously dark feature. If an anomalously bright feature is seen, then the times will be reduced further, and perhaps one additional filter might be included. Timings for each orbit will be optimized in Phase 2 sequencing. To compute total times, we assumed a 6-minute guide-star acquisition, 2.6 minutes for each filter change, and an addition 2 minutes for each quad “Q” filter change.

Timing: The first orbit should be as soon as possible after discovery, preferably within a few days but this is not critical. The convective episode

reported by Hammel et al. (2005a) lasted at least 4 days, perhaps as long as a month. The bright feature tracked by Sromovsky et al. (2007) lasted for at least a year and perhaps significantly longer. The Uranus Dark Spot and its companion material lasted for at least four months (Hammel et al. 2008). Since the triggering feature for this TOO will necessarily have higher contrast than any feature observed by Keck, we estimate the TOO feature would have a similar or even longer lifetime, i.e., many months.

Each orbit should have the feature as close as possible to the central meridian to permit optimal imaging of detailed structure. The TOO trigger conditions require that the feature's rotation period be known prior to TOO execution; thus the location of the feature relative to the central meridian will be known as well. The feature will likely have a rotation period of order 16-17.5 hours, based on past HST and Keck imaging (Karkoschka 1998; de Pater et al. 2002; Hammel et al. 2001, 2005b; Sromovsky et al. 2007; Hammel et al. 2008).
The second orbit should occur about 35 hours (two rotations of Uranus, or 22 HST orbits) after the first orbit. The third should follow about 35 hours after that. The function of the two additional orbits is to characterize the horizontal and vertical evolution of the feature in much the same manner as was done for Saturn's Great White Spot (Barnet et al. 1992; Beebe et al. 1992) and for the Uranus dark spot and its companions (Hammel et al. 2008). Evolution of smaller, lower-contrast Uranus features is seen on this time scale with Keck and HST (Hammel et al. 2005a, 2005b; Sromovsky et al. 2007; Hammel et al. 2008).

Proprietary period: We are not requesting any proprietary data period for this proposal.

Proposal 12463 - Visit 01 - Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus

Visit

Proposal 12463, Visit 01, withdrawn Thu Dec 15 02:02:05 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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		(9)

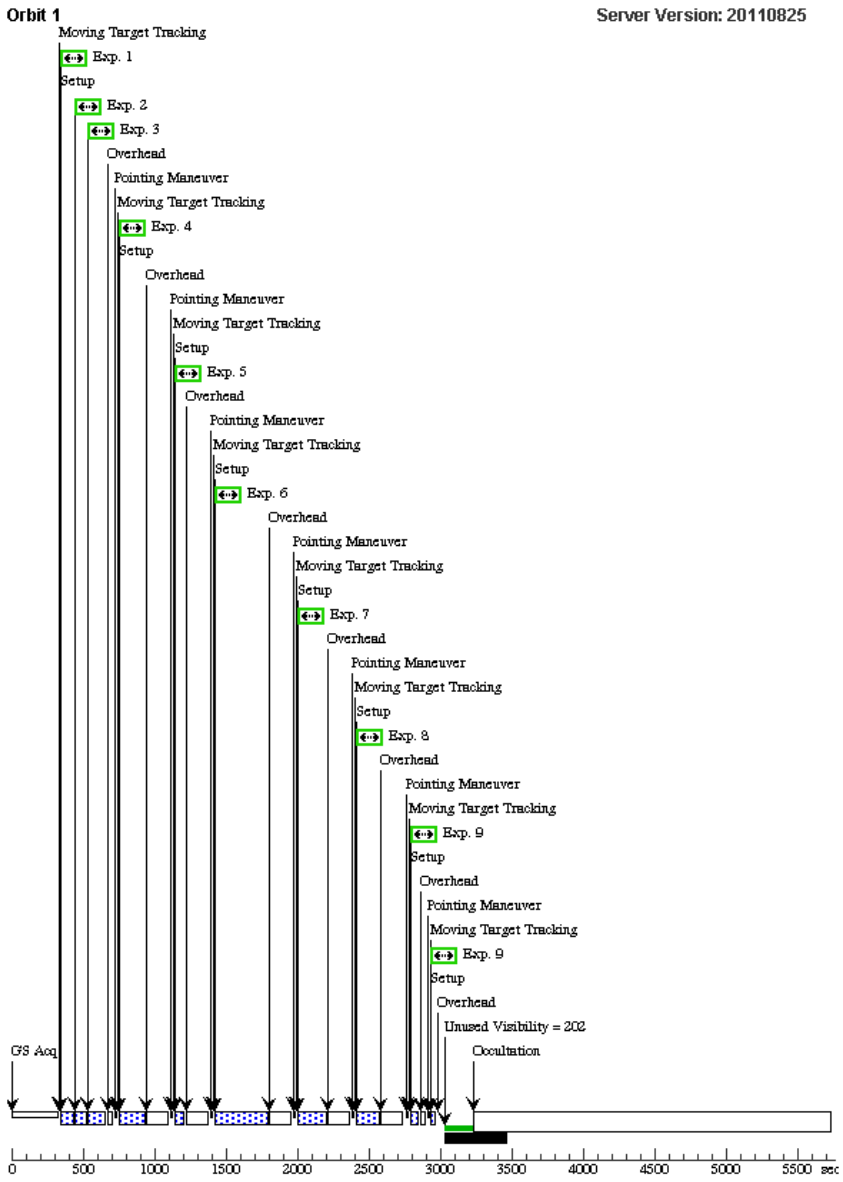
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M		GS ACQ SCENARIO BASE1B3		16 Secs *[==>]*	 ***[1]***
2		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	 ***[1]***
3		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	 ***[1]***
4		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N				160 Secs *[==>]*	 ***[1]***
5		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N				60 Secs *[==>]*	 ***[1]***
6		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N				360 Secs *[==>]*	 ***[1]***
7		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ924N				200 Secs *[==>]*	 ***[1]***
8		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N				160 Secs *[==>]*	 ***[1]***
9		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 2, Exps 9-9 in Visit 01 (2)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Proposal 12463 - Visit 02 - Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus

Visit

Proposal 12463, Visit 02, scheduled Thu Dec 15 02:02:06 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

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		(5)

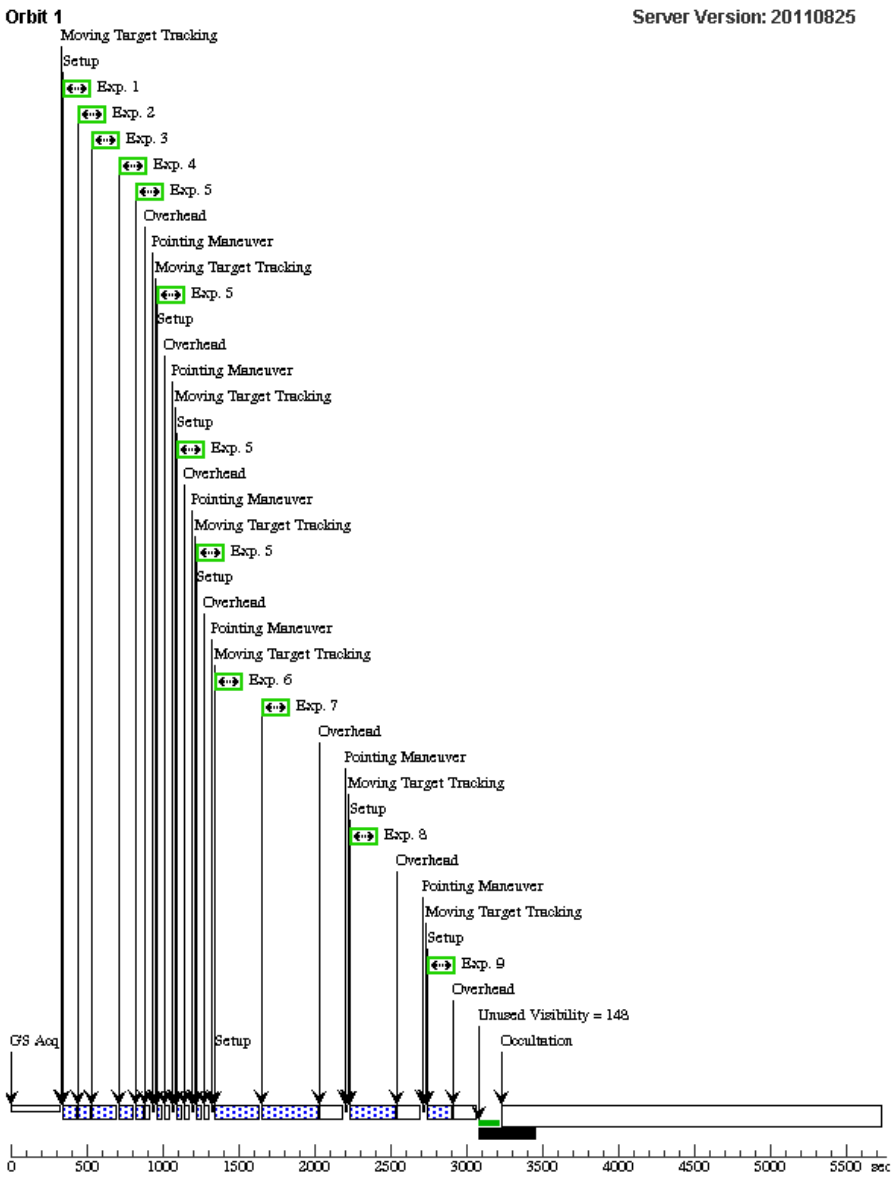
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M		GS ACQ SCENARIO BASE1B3		16 Secs *[==>]*	*[1]*
2		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	*[1]*
3		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	*[1]*
4		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F775W				20 Secs *[==>]*	*[1]*
5		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 1, Exps 5-5 in Visit 02 (1)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	*[1]*
6		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N				100 Secs *[==>]*	*[1]*
7		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N				360 Secs *[==>]*	*[1]*
8		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ906N				300 Secs *[==>]*	*[1]*
9		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N				160 Secs *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 12463, Visit 03, withdrawn Thu Dec 15 02:02:08 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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		(9)

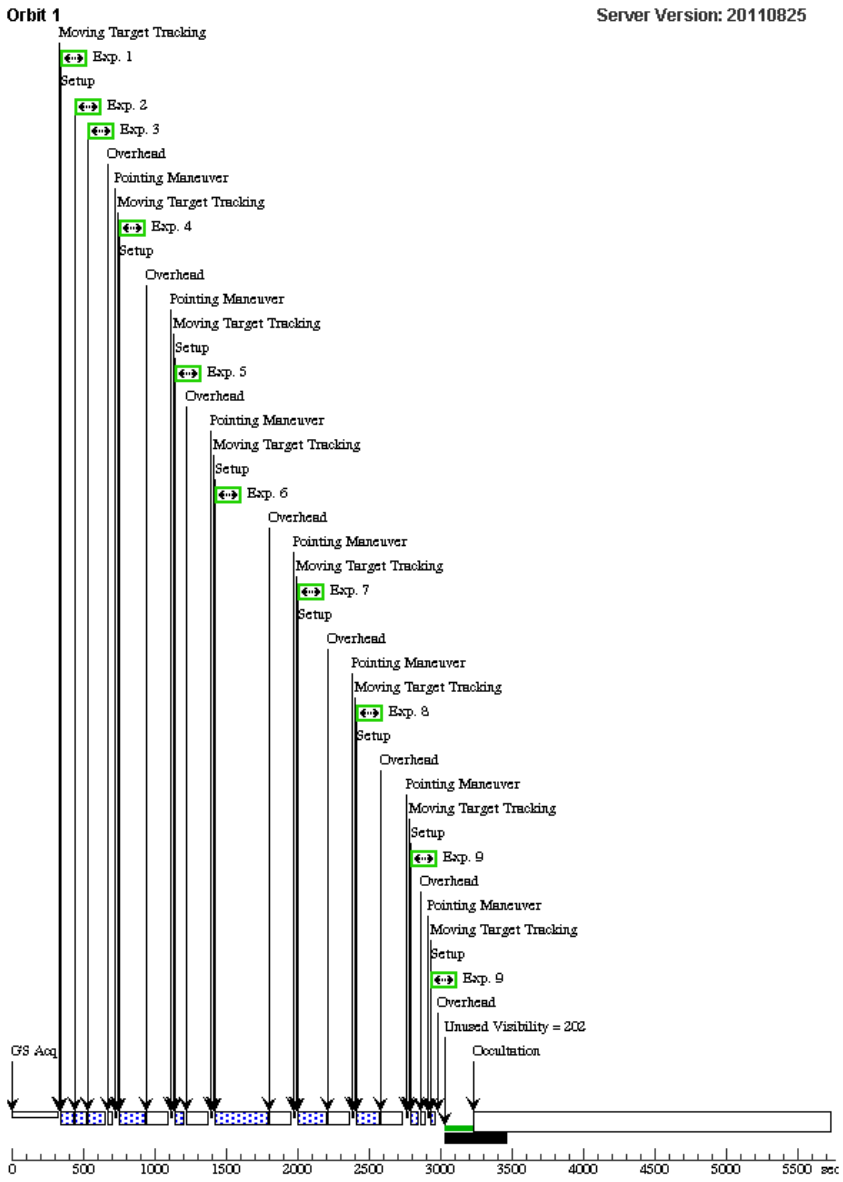
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M		GS ACQ SCENARIO BASE1B3		16 Secs *[==>]*	 ***[1]***
2		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	 ***[1]***
3		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	 ***[1]***
4		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N				160 Secs *[==>]*	 ***[1]***
5		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N				60 Secs *[==>]*	 ***[1]***
6		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N				360 Secs *[==>]*	 ***[1]***
7		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ924N				200 Secs *[==>]*	 ***[1]***
8		(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N				160 Secs *[==>]*	 ***[1]***
9		(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 2, Exps 9-9 in Visit 03 (2)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 12463, Visit 04, scheduled Thu Dec 15 02:02:09 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(FQ889N A (04.005)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ750N B (04.006)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ937N B (04.007)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ727N D (04.008)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ924N D (04.009)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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		(4)

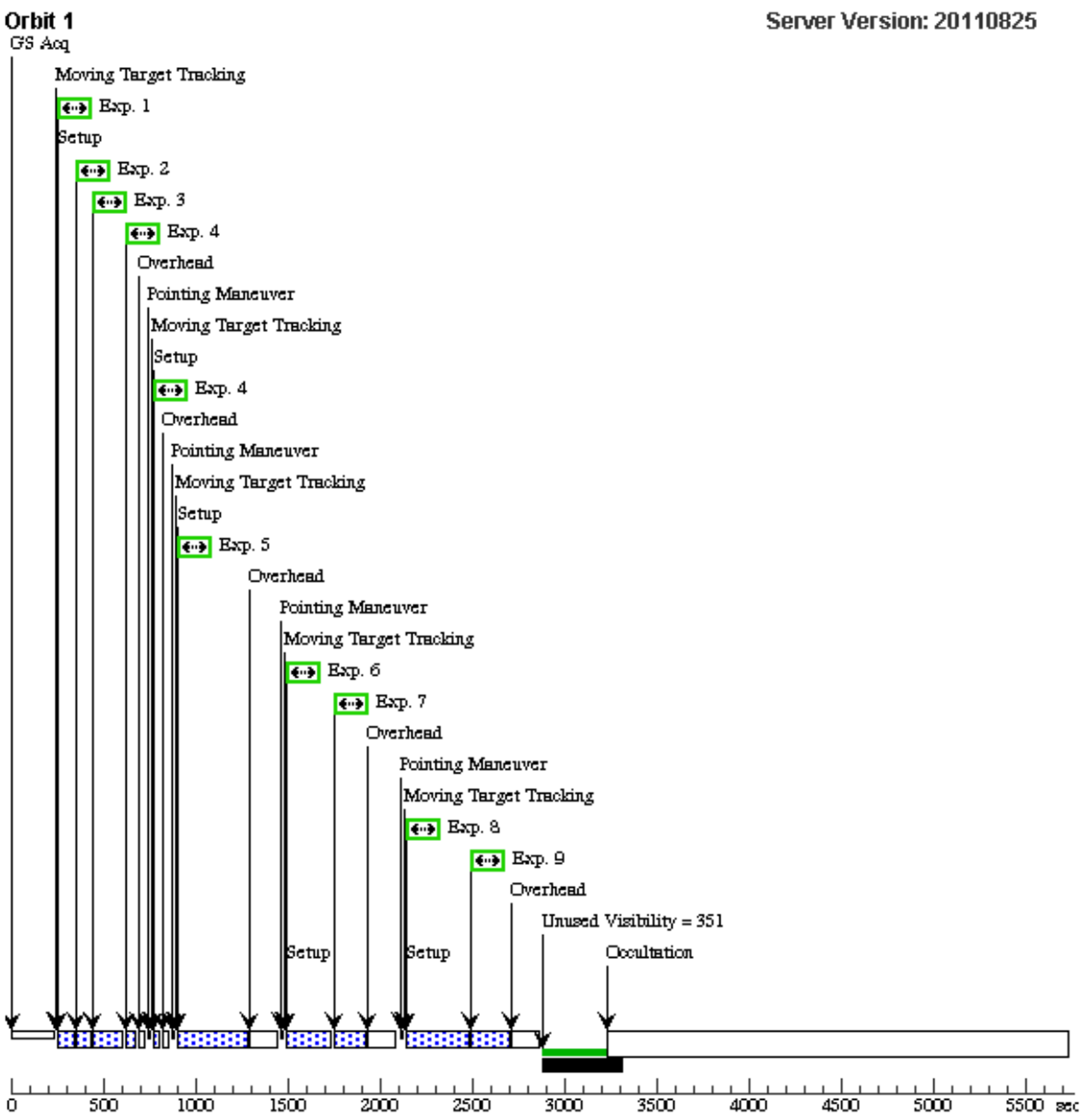
Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F467M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M		GS ACQ SCENARIO SINGLE		16 Secs *[==>]*	*[1]*
2	F547M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	*[1]*
3	F658N C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	*[1]*
4	F845Mx2 C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 2, Exps 4-4 in Visit 04 (2)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*
5	FQ889N A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N		POS TARG 10,-10		360 Secs *[==>]*	*[1]*
6	FQ750N B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N		POS TARG -10,-10		60 Secs *[==>]*	*[1]*
7	FQ937N B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N		POS TARG -10,-10		160 Secs *[==>]*	*[1]*
8	FQ727N D	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N		POS TARG -10,10		160 Secs *[==>]*	*[1]*
9	FQ924N D	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ924N		POS TARG -10,10		200 Secs *[==>]*	*[1]*

Orbit Structure



Proposal 12463 - Visit 05 - Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus

Visit

Proposal 12463, Visit 05, withdrawn Thu Dec 15 02:02:09 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(FQ906N C (05.001)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ619N A (05.007)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ889N A (05.008)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ937N B (05.009)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

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		(6)

Solar System Targets

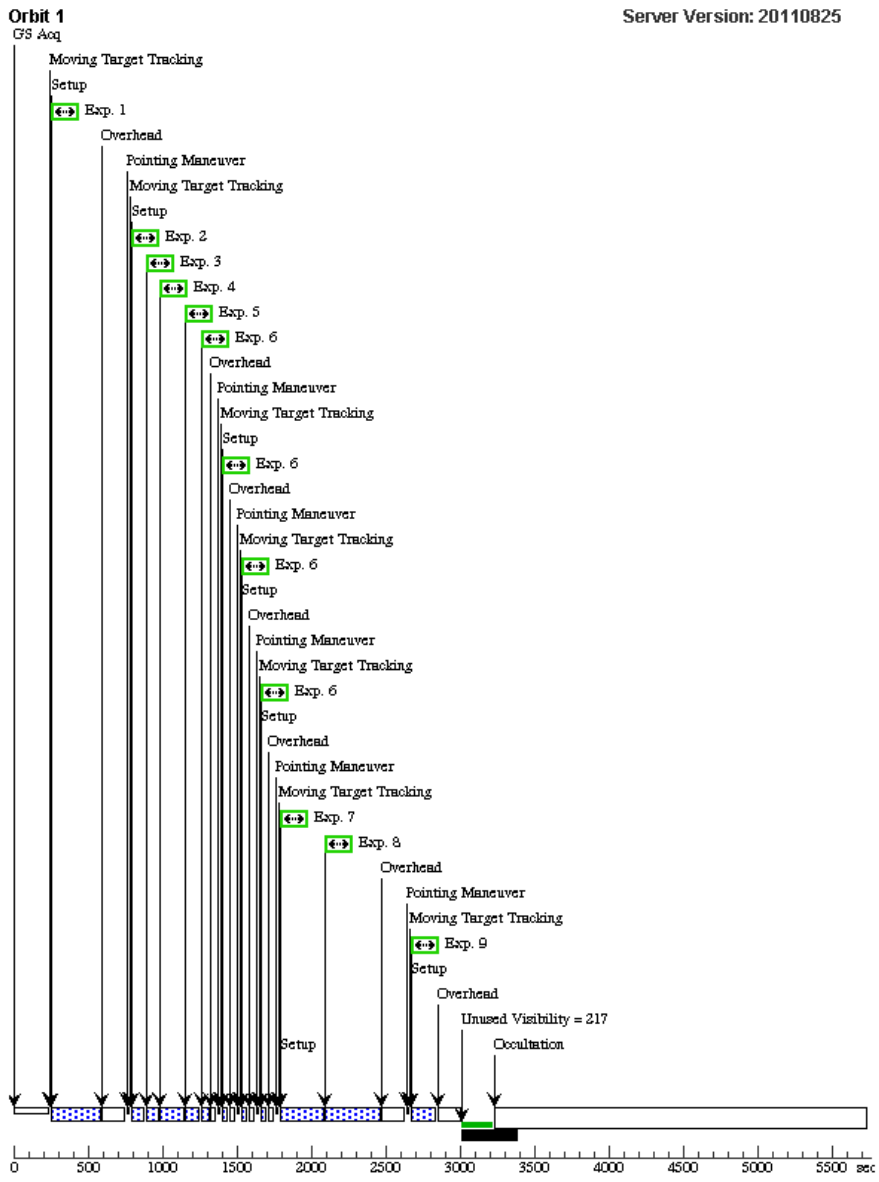
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Proposal 12463 - Visit 05 - Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	FQ906N C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ906N		POS TARG 10,10; GS ACQ SCENARIO SINGLE		300 Secs *[==>]*	 ***[1]***
2	F467M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M				16 Secs *[==>]*	 ***[1]***
3	F547M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	 ***[1]***
4	F658N C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	 ***[1]***
5	F775W C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F775W				20 Secs *[==>]*	 ***[1]***
6	F845Mx4 C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 1, Exps 6-6 in Visit 05 (1)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]***
7	FQ619N A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N		POS TARG 10,-10		100 Secs *[==>]*	 ***[1]***
8	FQ889N A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N		POS TARG 10,-10		360 Secs *[==>]*	 ***[1]***
9	FQ937N B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N		POS TARG -10,-10		160 Secs *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 12463, Visit 06, implementation Thu Dec 15 02:02:10 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(FQ889N A (06.005)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ750N B (06.006)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ937N B (06.007)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ727N (06.008)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

(FQ924N D (06.009)) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp or WFC3 quad filters as central wavelengths & transmission efficiencies vary within the apertures.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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		(4)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	URANUS	STD=URANUS				EARTH

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F467M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M		GS ACQ SCENARIO SINGLE		16 Secs *[==>]*	*[1]*
2	F547M C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M				6 Secs *[==>]*	*[1]*
3	F658N C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F658N				100 Secs *[==>]*	*[1]*
4	F845Mx2 C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M			Pattern 2, Exps 4-4 in Visit 06 (2)	35 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*
5	FQ889N A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N		POS TARG 10,-10		360 Secs *[==>]*	*[1]*
6	FQ750N B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N		POS TARG -10,-10		60 Secs *[==>]*	*[1]*
7	FQ937N B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N		POS TARG -10,-10		160 Secs *[==>]*	*[1]*
8	FQ727N	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N		POS TARG -10,10		160 Secs *[==>]*	*[1]*
9	FQ924N D	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ924N		POS TARG -10,10		200 Secs *[==>]*	*[1]*

Orbit Structure