



14045 - Longitude-resolved maps of Uranus's radio emission

Cycle: 22, Proposal Category: GO

(Availability Mode: SUPPORTED)

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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) URANUS	WFC3/UVIS	1	22-Jul-2015 21:15:34.0	yes
02	(1) URANUS	WFC3/UVIS	1	22-Jul-2015 21:15:37.0	yes

2 Total Orbits Used

ABSTRACT

We request time in the A-configuration to produce longitude/latitude-resolved maps of Uranus at 1.0 cm (Ka-band), 2.0 cm (Ku-band), 3.6 cm (X-band), 6.0 cm (C-band), and 13 cm (S-band). These data will enable us to resolve features on scales as small as 1000-2000 km, which is essential to characterize Uranus's atmospheric dynamics, both on global and local scales.

Two HST orbits are requested. Quasi-simultaneous HST observations will be used to enhance the scientific return of these data. However, we note that the scientific value of the VLA data alone is very high and does not depend on the HST data. Ideally, the HST data are taken at the same time, but any 2 orbits separated by 24 hrs within a few weeks from the VLA data is acceptable.

OBSERVING DESCRIPTION

The following is mainly the Scientific Justification Text from the VLA proposal.

Introduction

Although Uranus did not show much evidence of clouds during the Voyager era (1986), when the planet approached its 2007 equinox, numerous cloud features "popped" up, indicative of a dramatic increase in dynamic activity. Is this activity a result of seasonal variations, climate evolution, or climate cycles? We know that obliquity plays an important role in seasonal variations (winter--summer) as well as climate change on Earth [24] and Mars [15], but we do not yet know its effect on the giant planets. Seasonal forcing has been observed on Saturn [7,14,16], and may be important on Neptune [8]. Uranus, with its pole almost in the ecliptic plane, provides a planetary obliquity extremum. Hence, if seasonal forcing is important, it should be most apparent on Uranus. Continued observations of Uranus at many wavelengths are necessary to chart changes in dynamics and to interpret these changes in terms of seasonal variations or climate change. As discussed below, recent observations with Keck and the HST have revealed several puzzling features of the dynamics that beg for observations of the deeper atmosphere. Such observations are now possible with the upgraded VLA.

Prominent cloud features: Examples of large clouds observed in 2007 are groups of discrete cloud features both at 30 S and 30 N (Fig. 1); both groups were seen for many years, before exhibiting large changes in brightness and extent near equinox. The group in the north, which appears fixed in latitude [19], exhibits characteristics of a dark spot accompanied by bright companion features. Such dark spots are interpreted as vortices in the deeper atmosphere [9,12] (resembling perhaps Neptune's Great Dark Spot during the Voyager era), but it is not known how deep such vortices might extend.

The group in the south, referred to as the 'Berg', started to drift northward in 2005 [19], and dissipated when approaching the equator [4]. Intermittent clouds/storms continue to show regularly in Keck and HST images of Uranus.

Proposal 14045 (STScI Edit Number: 8, Created: Wednesday, July 22, 2015 8:15:38 PM EST) - Overview

Vertical structure: A quite good indication of cloud heights can be obtained by measuring the contrast of a cloud feature relative to the background atmosphere in different filters, as illustrated for several filters at Keck and HST in Fig. 2. Clouds are typically found between ~ 0.4 and ~ 4 bar [4, 20], the highest of which likely contain methane ice particles. Deeper clouds are possibly composed of H₂S [3].

Polar asymmetry: When Voyager 2 arrived at Uranus in 1986 the south pole was facing the sun and a featureless bright south polar haze was seen at high latitudes. The south polar haze was still present in 2002, and even as the haze subsequently cleared, the region remained free of discrete cloud features. However, with better views of the opposite (north) polar region from the 2007 equinox onward, we found numerous small discrete cloud features, shown in Fig. 3.

In a recent paper [21] we show, based on HST/STIS data, that methane gas is depleted in both the north and south polar regions of Uranus, analogous to the inferred depletion of gases at radio wavelengths [3,10]. The similarities between the poles is remarkable because the appearance of clouds in the two polar regions is very different. The methane depletion increases both in magnitude and in depth (down to ~ 20 bars) poleward from about 30 degrees. The latitudinal variations in degree and depth of the depletions are important constraints on models of the global circulation. In the context of these observations, we discuss [21] two possible circulation models (Fig. 4): in the first, there is a single deep circulation cell in each hemisphere. Air rises from the deep atmosphere at low latitudes; while rising, gases condense out and at higher altitudes (lower pressures) the dry air is transported to high latitudes, where it descends to higher pressures. This model agrees with previous low resolution microwave observation which indicate a high brightness temperature at the poles: air above the polar regions is dry and therefore at radio wavelengths one probes the deep warm layers in the atmosphere. In the second circulation model, we consider a 3-layer cell structure in each hemisphere. This more complex model provides more opportunities for cloud formation through condensation: we expect NH₄SH and CH₄ clouds to form at low latitudes; the former at a few tens of bars and the CH₄ cloud around one bar. At high latitudes, the 3-cell model results in the formation of H₂S clouds at roughly the 5-bar level. This picture, while inconsistent with the low resolution microwave data, does a better job at producing the observed condensation clouds. Both of the proposed circulation models fail to provide a complete match to the observations, and in both models convection would be inhibited in some regions where clouds are seen. Perhaps localized convective storms, as seen on Jupiter, are also common on Uranus. However, such phenomena would lead to localized cloud features, as opposed to observed bands of aerosols.

Proposed Observations

We propose to construct longitude-resolved maps at several frequencies to characterize the dynamics in the atmosphere of Uranus on global as well

Proposal 14045 (STScI Edit Number: 8, Created: Wednesday, July 22, 2015 8:15:38 PM EST) - Overview

as local scales. The main condensable gases in Uranus's atmosphere are CH₄, H₂S, NH₃ and H₂O; all of these, except CH₄, are strong microwave absorbers. Water vapor is confined to the deep atmosphere, >~50 bars, NH₃ to levels over ~20 bars; the main microwave absorber at higher altitudes is H₂S gas[3]. At radio wavelengths between 1 and 13 cm we probe depths of a few up to almost 50 bars (Fig. 5), and hence by mapping the planet at different wavelengths we trace out spatial and altitude variations in H₂S gas, together with NH₃ gas at the deeper layers; i.e., we build up a 3D picture of the microwave absorbers. Up- and downdrafts in the atmosphere will be visible in the form of dark (high opacity, probing shallow cool layers in the atmosphere) and bright (low opacity, probing deep warm layers) patches, similar to that seen in the atmospheres of Jupiter [5,6] and Saturn [11]. We will use this 3-dimensional picture of the deep atmosphere to explain previous, seemingly inconsistent, observations of Uranus' global circulation and to understand localized features of the dynamics. In particular we will address:

- (1) 1- vs. 3- cell circulation model: As mentioned above, both models have pros and cons, but neither one can fully explain the data. Higher resolution data are essential to provide the full picture of the dynamics in Uranus's atmosphere.
- (2) midlatitude clouds: Bright clouds at midlatitudes, in particular the long lasting cloud at 30 N, is not explained in terms of current models of the global circulation. This cloud may be tied to a vortex in the deeper atmosphere, which should be observable in radio data, as a vortex usually consists of rising gas (low radio brightness) surrounded by descending dry gas (high brightness). Detection of the deep structure of this storm requires high resolution, longitude resolved microwave maps.
- (3) polar asymmetry: differences between the North and South poles are intriguing. How can we explain the presence of popcorn-like clouds at the now-visible North pole? Such clouds were absent over the South pole, which was observed during its fall season. Radio data at high spatial resolution (0.1-0.3") may help identify rising and sinking gas parcels in this region, which will permit a better understanding of how these clouds form.

Broader Context: The Kepler mission has revolutionized our thinking and knowledge of extrasolar planets; ~4000 planet candidates and ~1000 confirmed planets have been reported (<http://kepler.nasa.gov/>). Microlensing [22] and the Kepler results [1] suggest that Neptunes may be several times more common than Jupiters, while super-Earths dominate the exoplanets in numbers [17]. Atmospheres of transiting [2,23] and directly imaged [13] exoplanets are now characterized; the interpretation of these depends on our understanding of the atmospheric dynamics, which influences the composition and cloud formation in the observable atmosphere. Many aspects of these phenomena remain elusive for our own giant planets, especially our ice giants. The proposed observations will provide unprecedented detail into several aspects of atmospheric dynamics on an ice giant that, due to its geometry, displays extrema in its seasons.

Proposal 14045 (STScI Edit Number: 8, Created: Wednesday, July 22, 2015 8:15:38 PM EST) - Overview

Analysis: By analyzing VLA maps at 1--13 cm with our radiative transfer code [5], we can build-up a 3D picture of the microwave absorbers, as we probe depths from ~1--50 bar.

HST, Keck and Gemini Data: We request 2 orbits of WFC3 imaging data, to be taken in close temporal proximity to each of our VLA tracks, in order to study how cloud features and CH₄ opacity in Uranus's atmosphere are related to the turbulence and convective motions revealed by the VLA data. We will observe Uranus in several filters that probe different depths in the atmosphere, determined primarily by the strength of the CH₄ and H₂ (collisionally induced, CIA) absorption bands. We will perform a radiative transfer analysis of these data to retrieve the vertical aerosol distribution of these features and the CH₄ abundance to enhance the 3D picture of the atmospheric motions. Although the VLA data by themselves are most valuable, the scientific value would be considerably enhanced by adding HST data. To probe different depths in the atmosphere and to distinguish opacity due to CH₄ from that due to H₂, we plan to use the following filters:

Filter, Seconds, Dithers

F336W, 30.0, 1

F467M, 16.0, 1

F547M, 6.0, 1

F631N, 65.0, 1

F665N, 52.0, 1

F763M, 26.0, 1

F845M, 35.0, 1

F953N, 250.0, 1

FQ889N, 450.0, 1

FQ937N, 160.0, 1

FQ727N. 240, 1

We will also request Keck and Gemini time to image Uranus in the infrared.

Previous VLA data: Some data (usually snapshots) were taken in 2011 before the full bandwidth was available. In 2012 data at K, Ka, Ku, and X bands were taken in the B array, which have too low a resolution. None of these tracks covered a full rotation. Time variations and differential rotation make it impossible to combine new data with the older ones.

Summary

Uranus is rotating around its axis in 17 hr. We therefore request 8 hrs on each of two consecutive days in the A array to map the entire globe at the highest spatial resolution at different frequencies. We will observe both days in the Ka, Ku, and X bands; on day 1 we will add C-band data, on day 2 S-band, so the pole gets full wavelength coverage, while each hemisphere does have sensitivity to deep levels (Fig. 5). The frequencies will be interleaved to get coverage of the full globe. These data will enable us to resolve spatial and altitude variations in composition that are critical to determine our understanding of the global circulation pattern, localized storm systems and turbulent motions in Uranus's atmosphere. We will complement our data with HST, Keck and Gemini observations for a one-to-one correlation with respect to clouds and variations in the CH₄ abundance.

Timing and Other Considerations

Best timing: September, when Uranus is up at night. Maximum elevation is 63 deg. We need two consecutive days/nights to cover a full rotation. We will observe at 4 different frequencies each night: On night 1 we will use: C, Ka, Ku, X bands; on night 2 we will use: S, Ka, Ku and X bands. We choose to observe at 4 frequencies on a given night in order to obtain high enough sensitivity per band on each day. We will interleave frequencies so as to cover all rotational aspects of the planet. We will have full longitudinal coverage in the two bands that will be used on consecutive nights (Ka, Ku and X bands); these bands probe different depths and have a spatial resolution of 0.06-0.2". In addition, we will have one hemisphere each in C and S bands (which have a lower resolution than the shorter wavelength bands) to get coverage of the deep atmosphere. The inclusion of all 5 bands will facilitate the retrieval of atmospheric composition from depths of 1 to 50 bar, as described in the the proposal. We sample the pole in all 5 bands.

Ka, Ku, X, C, and S bands are needed to probe Uranus's atmosphere from ~1 to ~50 bar, as explained in proposal. (exact depth depends on abundance of absorbing gases and emission angle of position on the disk).

References

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Proposal 14045 - Orig Phase I + FQ750N + FQ619N (01) - Longitude-resolved maps of Uranus's radio emission

Thu Jul 23 01:15:38 GMT 2015

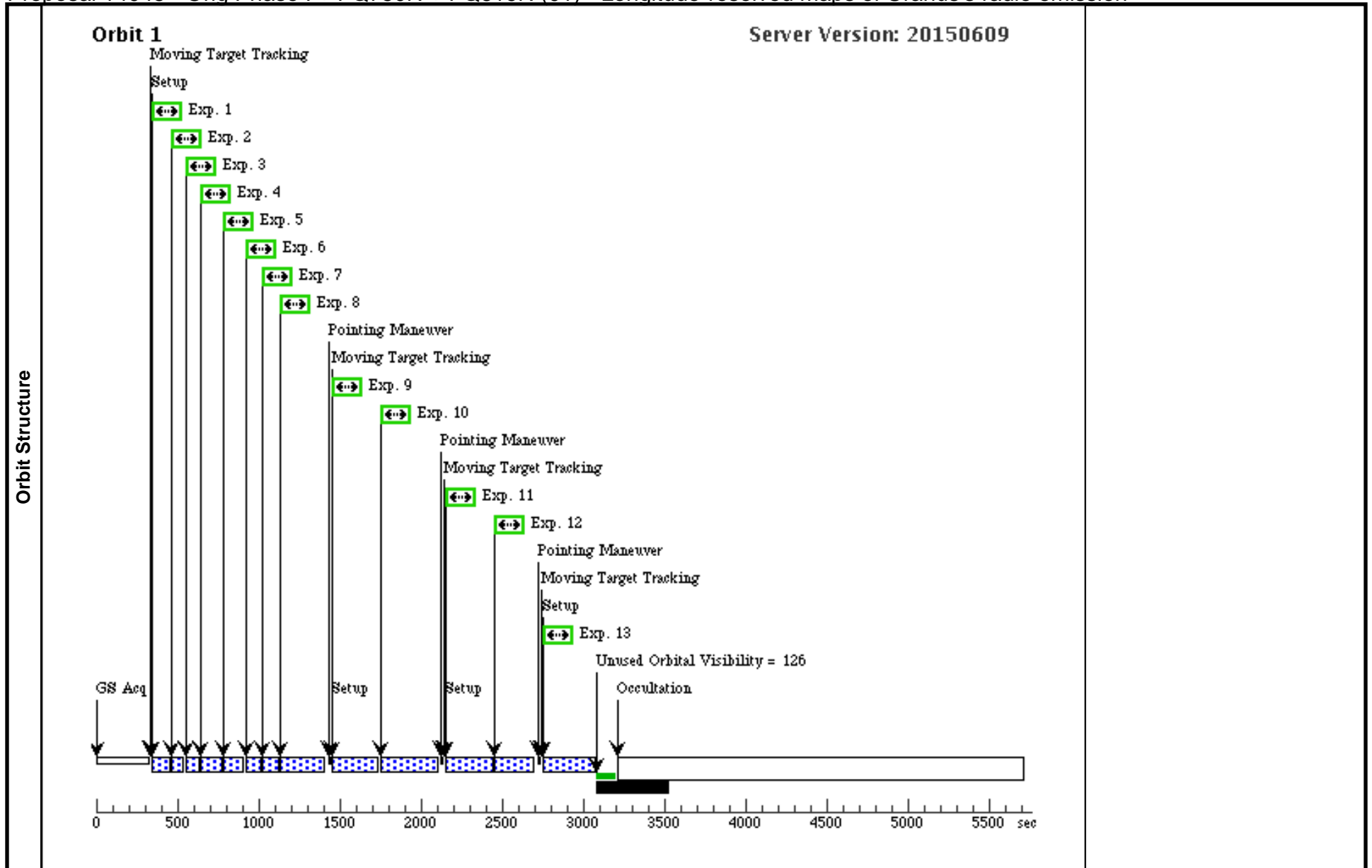
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Solar System Targets		<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Level 1</th> <th>Level 2</th> <th>Level 3</th> <th>Window</th> <th>Ephem Center</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>URANUS</td> <td>STD=URANUS</td> <td></td> <td></td> <td></td> <td>EARTH</td> </tr> </tbody> </table>							#	Name	Level 1	Level 2	Level 3	Window	Ephem Center	(1)	URANUS	STD=URANUS				EARTH
		#	Name	Level 1	Level 2	Level 3	Window	Ephem Center														
(1)		URANUS	STD=URANUS				EARTH															

Proposal 14045 - Orig Phase I + FQ750N + FQ619N (01) - Longitude-resolved maps of Uranus's radio emission

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	F336W-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	CR-SPLIT=NO	GS ACQ SCENARI O BASE1B3	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	30 Secs (30 Secs) [==>]	[1]
	<i>Comments: IBXW02SRQ on 2012-09-30, prog 12894</i>									
	2	F467M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	14 Secs (14 Secs) [==>]	[1]
	<i>Comments: ICPF11NGQ on 2014-11-08, prog 13937.</i>									
	3	F547M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	6 Secs (6 Secs) [==>]	[1]
	<i>Comments: ICPF11NHQ on 2014-11-08, prog 13937.</i>									
	4	F631N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F631N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	65 Secs (65 Secs) [==>]	[1]
	<i>Comments: IBXW02SUQ on 2012-09-30, prog 12894.</i>									
	5	F665N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F665N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	52 Secs (52 Secs) [==>]	[1]
	<i>Comments: IBXW02SVQ on 2012-09-30, prog 12894.</i>									
6	F763M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F763M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	26 Secs (26 Secs) [==>]	[1]	
<i>Comments: IBXW02SWQ on 2012-09-30, prog 12894.</i>										
7	F845M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	35 Secs (35 Secs) [==>]	[1]	
<i>Comments: IB3801T2Q on 2009-11-11, prog 11573.</i>										
8	F953N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F953N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	210 Secs (210 Secs) [==>]	[1]	
<i>Comments: IBXW02SYQ on 2012-09-30, prog 12894.</i>										
<i>Exp submitted with 250 sec exp time.</i>										
9	FQ619N-A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	90 Secs (90 Secs) [==>]	[1]	
<i>Comments: ICMF03W0Q on 2014-10-14, prog 13712.</i>										
<i>Exp submitted with 100 sec exp time</i>										
10	FQ889N-A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	174 Secs (174 Secs) [==>]	[1]	
<i>Comments: IB3822QCQ on 2010-06-03, prog 11573.</i>										
<i>Exp submitted with 200 sec exp time.</i>										

Proposal 14045 - Orig Phase I + FQ750N + FQ619N (01) - Longitude-resolved maps of Uranus's radio emission

11	FQ937N-B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	125 Secs (125 Secs) [==>]	[1]
<p><i>Comments: ICMF01UBQ on 2014-10-14, prog 13712.</i></p> <p><i>Exp submitted with 140 sec exp time.</i></p>									
12	FQ750N-B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	60 Secs (60 Secs) [==>]	[1]
<p><i>Comments: ICMF03W2Q on 2014-10-14, prog 13712.</i></p>									
13	FQ727N-D	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	153 Secs (153 Secs) [==>]	[1]
<p><i>Comments: ICPF08VBQ on 2014-11-09, prog 13937.</i></p> <p><i>Exp submitted with 200s exp time.</i></p>									



Proposal 14045 - Orig Phase I + FQ750N + FQ619N (02) - Longitude-resolved maps of Uranus's radio emission

Thu Jul 23 01:15:39 GMT 2015

Visit	Proposal 14045, Orig Phase I + FQ750N + FQ619N (02), implementation Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: AFTER 01 BY 23 H TO 25 H						
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Solar System Targets		#	Name	Level 1	Level 2	Level 3	Window
		(1)	URANUS	STD=URANUS			EARTH

Proposal 14045 - Orig Phase I + FQ750N + FQ619N (02) - Longitude-resolved maps of Uranus's radio emission

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	F336W-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	CR-SPLIT=NO	GS ACQ SCENARI O BASE1B3	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	30 Secs (30 Secs) [==>]	[1]
	<i>Comments: IBXW02SRQ on 2012-09-30, prog 12894</i>									
	2	F467M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	14 Secs (14 Secs) [==>]	[1]
	<i>Comments: ICPF11NGQ on 2014-11-08, prog 13937.</i>									
	3	F547M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	6 Secs (6 Secs) [==>]	[1]
	<i>Comments: ICPF11NHQ on 2014-11-08, prog 13937.</i>									
	4	F631N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F631N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	65 Secs (65 Secs) [==>]	[1]
	<i>Comments: IBXW02SUQ on 2012-09-30, prog 12894.</i>									
	5	F665N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F665N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	52 Secs (52 Secs) [==>]	[1]
	<i>Comments: IBXW02SVQ on 2012-09-30, prog 12894.</i>									
6	F763M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F763M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	26 Secs (26 Secs) [==>]	[1]	
<i>Comments: IBXW02SWQ on 2012-09-30, prog 12894.</i>										
7	F845M-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	35 Secs (35 Secs) [==>]	[1]	
<i>Comments: IB3801T2Q on 2009-11-11, prog 11573.</i>										
8	F953N-C	(1) URANUS	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F953N	CR-SPLIT=NO		Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	210 Secs (210 Secs) [==>]	[1]	
<i>Comments: IBXW02SYQ on 2012-09-30, prog 12894.</i>										
<i>Exp submitted with 250s exp time.</i>										
9	FQ619N-A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	90 Secs (90 Secs) [==>]	[1]	
<i>Comments: ICMF03W0Q on 2014-10-14, prog 13712.</i>										
<i>Exp submitted with 100s exp time.</i>										
10	FQ889N-A	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO; FLASH=12	POS TARG +15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	153 Secs (153 Secs) [==>]	[1]	
<i>Comments: IB3822QCQ on 2010-06-03, prog 11573.</i>										
<i>Exp submitted with 200s exp time.</i>										

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11	FQ937N-B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N	CR-SPLIT=NO; FLASH=12	POS TARG -15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	125 Secs (125 Secs) [==>]	[1]
<p><i>Comments: ICMF01UBQ on 2014-10-14, prog 13712.</i></p> <p><i>Exp submitted with 140 sec exp time.</i></p>									
12	FQ750N-B	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	60 Secs (60 Secs) [==>]	[1]
<p><i>Comments: ICMF03W2Q on 2014-10-14, prog 13712.</i></p>									
13	FQ727N-D	(1) URANUS	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO; FLASH=12	POS TARG -15,+15	Sequence 1-13 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	153 Secs (153 Secs) [==>]	[1]
<p><i>Comments: ICPF08VBQ on 2014-11-09, prog 13937.</i></p> <p><i>Exp submitted with 200s exp time.</i></p>									

