



14044 - Longitude-resolved maps of Neptune's radio emission

Cycle: 22, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Prof. Imke de Pater (PI) (Contact)	University of California - Berkeley	imke@berkeley.edu
Dr. Robert Sault (CoI)	Associated Universities, Inc.	rsault@nrao.edu
Dr. Bryan Butler (CoI)	Associated Universities, Inc.	bbutler@nrao.edu
Dr. David DeBoer (CoI)	University of California - Berkeley	ddeboer@berkeley.edu
Dr. Statia Cook (CoI)	American Museum of Natural History	shcook@amnh.org
Michael H. Wong (CoI) (Contact)	University of California - Berkeley	mikewong@astro.berkeley.edu
Mr. Patrick M. Fry (CoI) (Contact)	University of Wisconsin - Madison	pat.fry@ssec.wisc.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) NEPTUNE	WFC3/UVIS	1	22-Jul-2015 21:14:44.0	yes
02	(1) NEPTUNE	WFC3/UVIS	1	22-Jul-2015 21:14:47.0	yes

2 Total Orbits Used

ABSTRACT

We request time in the A-configuration to produce longitude/latitude-resolved maps of Neptune 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 2000 km, essential information to characterize Neptune'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

Recent analyses of multi-frequency observations of Neptune reveal variations in latitude and altitude of its condensable gases that is suggestive of complex dynamics on both global and local scales. We propose to use the VLA in its A-array to produce maps of the planet that are resolved in both latitude and longitude. The A-array enables resolutions of order $< \sim 0.06''\text{--}0.35''$ at 1--6 cm, and 0.7'' at 13 cm. With this resolution, we will resolve variations in composition on scales as small as 2000 km or 5 deg. in latitude/longitude at disk center. As discussed below, such data are critical for understanding the global circulation pattern, localized storm systems and turbulent motions in Neptune's atmosphere.

We recently analyzed data of Neptune taken quasi-simultaneously at radio (0.7--6 cm; VLA), near-infrared (NIR: 1--2 micrometers, Keck II) and mid-infrared wavelengths (MIR: 8--13, 18--22 micrometers; Keck I) [6] to constrain Neptune's global dynamics from $< \sim 0.1$ mbar levels down to tens of bars. At MIR and radio wavelengths combined we observe Neptune's thermal emission over this entire range of altitudes; in the NIR we receive sunlight reflected off clouds and hazes in the upper troposphere and lower stratosphere. Representative images in each wavelength band are shown in Fig. 1.

From variations in the longitudinally-averaged physical temperature across Neptune's disk as discerned at MIR wavelengths, and latitudinal variations in the radio brightness temperature, we identified a pattern of warm and cool regions on the disk: i) southern midlatitudes (~ 20 -- 60 S, cool), ii) northern midlatitudes (~ 20 -- 40 N, cool), iii) the equator (latitudes $\sim \pm 20$ degrees, warm), and iv) the south polar region (latitudes ~ 66 -- 90 S, hot). This led to the proposed global circulation model sketched in Fig. 2. In this figure we also indicate which cloud layers are expected to form under thermo-chemical equilibrium conditions for an atmosphere in which H₂S, H₂O, and CH₄ are enhanced ~ 50 times above the solar S, O, and C values, with NH₃ equal to the solar N abundance (the H₂S, H₂O and NH₃ abundances were derived from the disk-averaged radio spectrum in Fig. 3). Although this scenario largely agrees with models pertaining to the stratosphere/upper troposphere (down to ~ 1 bar level) as derived by previous authors from MIR Voyager data [1,5], our circulation model extends all the way from the stratosphere ($< \sim 0.1$ mbar levels) down to tens of

bars in the deep troposphere. Adiabatic cooling is prevalent at latitudes where air is rising, both in the troposphere and the stratosphere; this cooling is seen in the MIR, and cloud condensation is prominent in the NIR. Adiabatic heating is seen over regions where air is descending: the south pole and the equator are warm as seen in the MIR, and these regions are generally relatively free of clouds. At radio wavelengths one is sensitive to opacity by gaseous H₂S, H₂O and NH₃, gases that condense out in the rising branch of the circulation. In all calculations (e.g., Fig. 3) we assumed a 100% relative humidity. The high radio brightness temperature over the pole, however, can only be matched if the relative humidity of H₂S is no more than 5% down to ~40 bar, the altitude of the NH₄SH cloud, over an area extending from the south pole down to a latitude of 66 S. This latitude coincides with the south polar prograde jet, which surrounds the warm polar vortex as shown in our MIR data [6,8].

Other observations also corroborate this global circulation. The spatial distribution of the ortho/para-H₂ ratio derived from the Voyager/IRIS data [8] show anomalous sub-equilibrium concentrations of para-H₂ at both the southern and northern midlatitudes and super-equilibrium concentrations of para-H₂ above the equator and south pole. These anomalous concentrations indicate upwelling and subsidence that are in accord with Fig. 2. The methane abundance above the pole is also several times lower than above the equator [11], as expected for subsiding air.

Despite the fact that many observations support this circulation pattern, some data are hard to reconcile with this model. i) The NIR cloud at the south pole (Fig. 1a) is in a region of subsiding air; how to explain the presence of clouds here? We have compared it with the eye of Saturn's south polar vortex, which is dominated by descending air but with local thunderstorms bringing condensables up to higher elevations [13]. ii) Ephemeral clouds in Neptune's equatorial region, dominated by subsiding air (Fig. 2), come and go; sometimes we see a complex cloud structure spanning tens of degrees in latitude. Such complexes have been interpreted as companion clouds of deep atmospheric vortices [14,17,18]. iii) The methane abundance at mid-southern latitudes between 1.2 and 3.3 bar is low compared to the deep atmosphere and the equator [11], which is opposite to expectations of rising air. iv) A 1~cm radio map, obtained with the EVLA in 2011, shows a slight enhancement in the radio brightness temperature at mid-southern latitudes [3], which contradicts the simple model in Fig. 2.

Proposed Observations

We propose to construct longitude-resolved maps at Ka, Ku, X, C, and S bands to characterize the dynamics in Neptune's atmosphere on global as well as local scales. At these wavelengths we probe depths in the atmosphere from ~1--100 bar (Fig. 4). The main condensable gases at the altitudes probed are CH₄ and H₂S (and NH₃ and H₂ deeper in the atmosphere). Since H₂S is a strong microwave absorber, up- and down-drafts and turbulence down to tens of bars should be visible in longitude-resolved radio maps of Neptune. Previously published [16] plus preliminary new VLA

maps of Jupiter [7] and Cassini maps of Saturn [9] reveal a tremendous amount of spatial structure (e.g., east and west of the Great Red Spot and smaller vortices on Jupiter and the Great Northern Storm of 2010-2011 on Saturn), attributed to variations in the ammonia abundance, the main microwave absorber and condensable gas in the upper atmosphere of these planets.

Previous radio maps of Neptune (Fig. 1) have shown an overall depletion in H_2S gas over the pole. If our conjecture about Neptune's south pole is right, we should not only see an overall depletion in H_2S gas, but with the $\sim 0.1''$ spatial resolution we should see both rising (i.e., dark/cold) and sinking (bright/warm) parcels of air at the S. pole. Near the south polar jet one would expect baroclinic instabilities [6], which could be the cause of the South Polar Features (SPFs) at latitudes of $60\text{--}70$ degrees. Observations of SPFs and South Polar Waves in Voyager and $> \sim 20$ years of HST data revealed a large structure of latitudinal motions that has been stationary with the System II rotational period for over 20 years, and may be explained by a deep convective pattern [10]. Our proposed radio maps should reveal such a deep convection pattern, and/or baroclinic instabilities.

Although our previous microwave observations did not reveal an equatorial brightening, and therefore do not indicate a low humidity supporting the existence of a sinking motion over the equator, a map at ~ 1 cm obtained with the upgraded VLA in 2011 does show such an equatorial brightening [3], and therefore supports the picture of equatorial subsidence. This map was averaged over longitude. To explain the presence of ephemeral clouds at these latitudes, some air must be rising, which should be visible in radio maps in the form of adjacent bright and dark regions. Moreover, if there are indeed deeper vortices in the atmosphere such as hypothesized to explain northern cloud complexes, our new maps at spatial resolutions of $< \sim 0.1\text{--}0.3''$ should show such a structure quite prominently. Since we usually see only one such complex on the globe, we do have to map the entire surface to not miss such structures. In analogy, if only one hemisphere of Jupiter would be mapped, one could easily miss the Great Red Spot.

Neptune's north and south midlatitudes should, overall, be relatively cool (rising air); however, some data suggest the opposite (iii, iv) above). Both tropospheric and stratospheric clouds exist at these latitudes [6]. Longitude-resolved maps with a spatial resolution of $0.1\text{--}0.2''$ should help to unravel the dynamics at these latitudes.

Broader Context: The Kepler mission has revolutionized our thinking and knowledge of extrasolar planets, with the detection of ~ 4000 planet candidates and ~ 1000 confirmed planets (<http://kepler.nasa.gov/>). Both microlensing [19] and the Kepler results [2] suggest that Neptunes may be several times more common than Jupiters, while super-Earths dominate the exoplanets in numbers [15]. Atmospheres of transiting [4,20] and directly imaged [12] exoplanets can now be characterized; however the interpretation of the data strongly 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 ice giants, which are essential to furthering our knowledge of exoplanet atmospheres.

Analysis: By analyzing VLA maps at 0.7--13 cm with our radiative transfer code [6], we can build-up a 3D picture of the H₂S abundance, as we probe depths from ~1--100 bar.

HST 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 Neptune's atmosphere are related to the turbulence and convective motions revealed by the VLA data. We will observe Neptune 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 three dimensional picture of the atmospheric motions. Although the VLA data by themselves are most valuable, the scientific value would be considerably enhanced by adding simultaneous 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

Previous VLA data: Some data were taken in 2011 before the full bandwidth was available [3]. These tracks did not cover a full rotation. Time variations and differential rotation make it impossible to combine new data with those from 2011.

Summary

Neptune is rotating around its axis in 16 hr. We therefore request ~7 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. 4). 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 Neptune's atmosphere. We will complement our data with HST 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 Neptune is up at night. Maximum elevation is 46 deg. We need two consecutive days/nights to cover a full Neptune 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 100 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 Neptune's atmosphere from ~1 to almost ~100 bar, as explained in proposal. (exact depth depends on abundance of absorbing gases and emission angle of location on the disk).

References

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Proposal 14044 - Orig Phase I + FQ750N + FQ619N (01) - Longitude-resolved maps of Neptune's radio emission

Thu Jul 23 01:14:49 GMT 2015

Visit	Proposal 14044, Orig Phase I + FQ750N + FQ619N (01), implementation Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: (none)							
	Diagnostics	(F336W-C (01.001)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F467M-C (01.002)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F547M-C (01.003)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F631N-C (01.004)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F763M-C (01.005)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F845M-C (01.006)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F953N-C (01.007)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ619N-A (01.008)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ619N-A (01.008)) 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. (FQ889N-A (01.009)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ889N-A (01.009)) 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. (FQ937N-B (01.010)) 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 (01.010)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ750N-B (01.011)) 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 (01.011)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ727N-D (01.012)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ727N-D (01.012)) 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.						
Solar System Targets		#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
		(1)	NEPTUNE	STD=NEPTUNE				EARTH

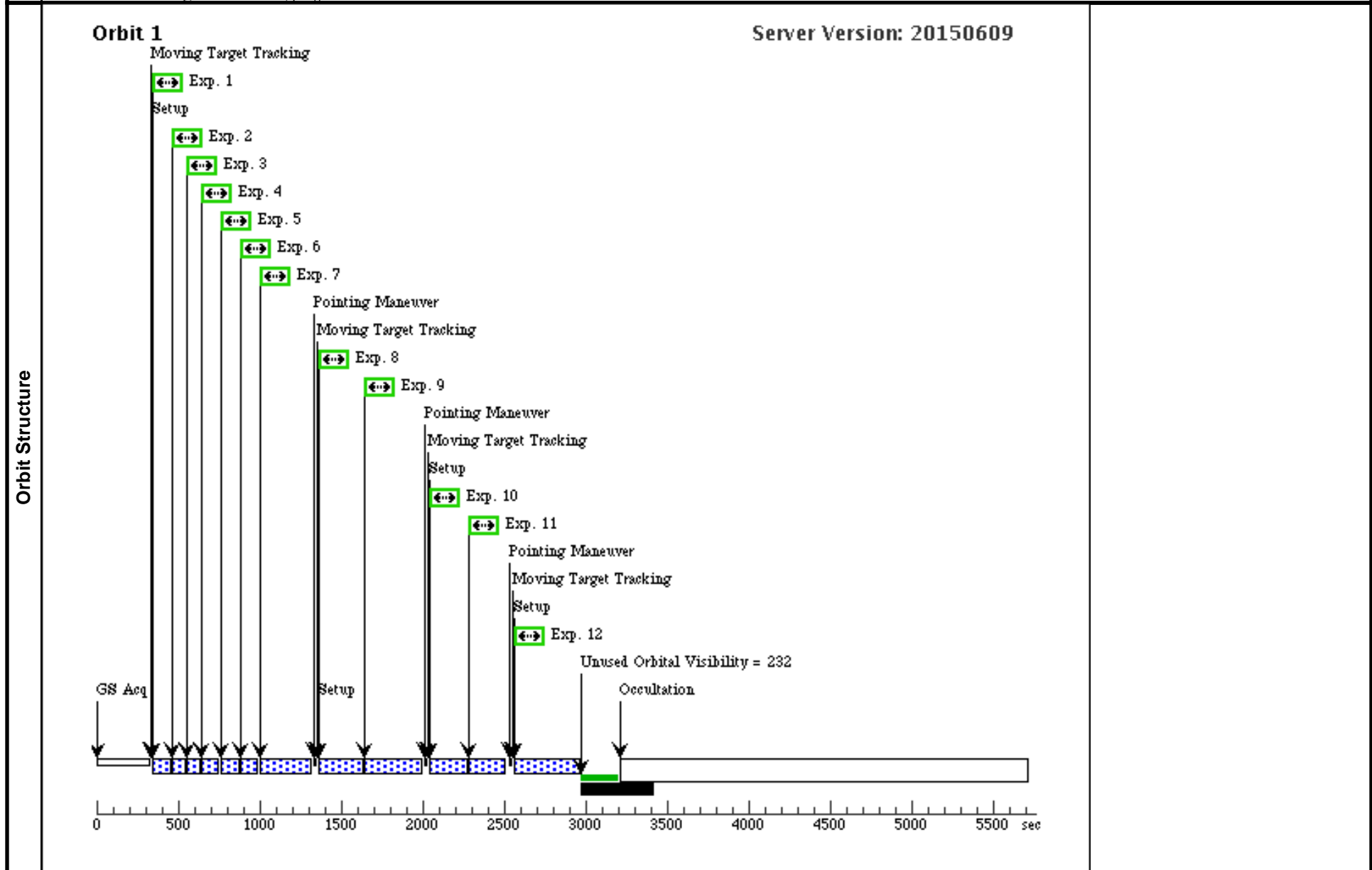
Proposal 14044 - Orig Phase I + FQ750N + FQ619N (01) - Longitude-resolved maps of Neptune's radio emission

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F336W-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	CR-SPLIT=NO	GS ACQ SCENARI O BASE1B3	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	30 Secs (30 Secs) [==>]	[1]
<i>Comments: Exp 30s per Mike Wong spreadsheet: 14545 e-, SN=121, ETC: WFC3UVIS.im.662370</i>									
2	F467M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	18 Secs (18 Secs) [==>]	[1]
<i>Comments: IBOL02BRQ on 2011-06025, prog 12675.</i>									
3	F547M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	6 Secs (6 Secs) [==>]	[1]
<i>Comments: IB2S04JWQ on 2009-08-29, prog 11630.</i>									
4	F631N-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F631N	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	40 Secs (40 Secs) [==>]	[1]
<i>Comments: IBOL05FVQ on 2011-06026, prog 12675.</i>									
5	F763M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F763M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	45 Secs (45 Secs) [==>]	[1]
<i>Comments: Exp 45s per Mike Wong spreadsheet: 15846 e-, S/N=126. ETC: WFC3UVIS.im.662377</i>									
6	F845M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	35 Secs (35 Secs) [==>]	[1]
<i>Comments: IB2S54B5Q on 2010-08-09, prog 11630.</i>									
7	F953N-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F953N	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	250 Secs (250 Secs) [==>]	[1]
<i>Comments: Exp 250s, mean disk signal 1389 e-, SN=37. ETC: WFC3UVIS.im.662401</i>									
8	FQ619N-A	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	80 Secs (80 Secs) [==>]	[1]
<i>Comments: IB2S16XWQ on 2010-08-28, prog 11630.</i>									
9	FQ889N-A	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	175 Secs (175 Secs) [==>]	[1]
<i>Comments: IB2S23N3Q on 2010-05-05, prog 11630.</i>									
10	FQ937N-B	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	60 Secs (60 Secs) [==>]	[1]
<i>Comments: IB2S23N6Q on 2010-05-05, prog 11630.</i>									
11	FQ750N-B	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (01)	40 Secs (40 Secs) [==>]	[1]
<i>Comments: IB2S16XVO on 2010-08-28, prog 11630.</i>									

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12	FQ727N-D	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-12 Non-Int in Orig Phase I + FQ750N + FQ619N (01)	240 Secs (240 Secs)	[I]
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Comments: IB2S16XXO on 2010-08-23, prog 11630.



Proposal 14044 - Orig Phase I + FQ750N + FQ619N (02) - Longitude-resolved maps of Neptune's radio emission

Thu Jul 23 01:14:49 GMT 2015

Visit	Proposal 14044, Orig Phase I + FQ750N + FQ619N (02), implementation Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: AFTER 01 BY 23 H TO 25 H							
	Diagnostics	(F336W-C (02.001)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F467M-C (02.002)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F547M-C (02.003)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F631N-C (02.004)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F763M-C (02.005)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F845M-C (02.006)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (F953N-C (02.007)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ619N-A (02.008)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ619N-A (02.008)) 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. (FQ889N-A (02.009)) 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. (FQ937N-B (02.010)) 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 (02.011)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser (FQ750N-B (02.011)) 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 (02.012)) 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.						
Solar System Targets		#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
		(1)	NEPTUNE	STD=NEPTUNE				EARTH

Proposal 14044 - Orig Phase I + FQ750N + FQ619N (02) - Longitude-resolved maps of Neptune's radio emission

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F336W-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	CR-SPLIT=NO	GS ACQ SCENARI O BASE1B3	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	30 Secs (30 Secs) [==>]	[1]
<i>Comments: Exp 30s per Mike Wong spreadsheet: 14545 e-, SN=121. ETC: WFC3UVIS.im.662370</i>									
2	F467M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F467M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	18 Secs (18 Secs) [==>]	[1]
<i>Comments: IBOL02BRQ on 2011-06025, prog 12675.</i>									
3	F547M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F547M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	6 Secs (6 Secs) [==>]	[1]
<i>Comments: IB2S04JWQ on 2009-08-29, prog 11630.</i>									
4	F631N-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F631N	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	40 Secs (40 Secs) [==>]	[1]
<i>Comments: IBOL05FVQ on 2011-06026, prog 12675.</i>									
5	F763M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F763M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	45 Secs (45 Secs) [==>]	[1]
<i>Comments: Exp 45s per Mike Wong spreadsheet: 15846 e-, S/N=126. ETC: WFC3UVIS.im.662377</i>									
6	F845M-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F845M	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	35 Secs (35 Secs) [==>]	[1]
<i>Comments: IB2S54B5Q on 2010-08-09, prog 11630.</i>									
7	F953N-C	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F953N	CR-SPLIT=NO		Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	250 Secs (250 Secs) [==>]	[1]
<i>Comments: Exp 250s, mean disk signal 1389 e-, SN=37. ETC: WFC3UVIS.im.662401</i>									
8	FQ619N-A	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ619N	CR-SPLIT=NO	POS TARG +15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	80 Secs (80 Secs) [==>]	[1]
<i>Comments: IB2S16XWQ on 2010-08-28, prog 11630.</i>									
9	FQ889N-A	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO; FLASH=12	POS TARG +15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	175 Secs (175 Secs) [==>]	[1]
<i>Comments: IB2S23N3Q on 2010-05-05, prog 11630.</i>									
10	FQ937N-B	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ937N	CR-SPLIT=NO; FLASH=12	POS TARG -15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	60 Secs (60 Secs) [==>]	[1]
<i>Comments: IB2S23N6Q on 2010-05-05, prog 11630.</i>									
11	FQ750N-B	(1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ750N	CR-SPLIT=NO	POS TARG -15,-15	Sequence 1-12 Non-I nt in Orig Phase I + FQ750N + FQ619N (02)	40 Secs (40 Secs) [==>]	[1]
<i>Comments: IB2S16XVO on 2010-08-28, prog 11630.</i>									

Proposal 14044 - Orig Phase I + FQ750N + FQ619N (02) - Longitude-resolved maps of Neptune's radio emission

12	FQ727N-D (1) NEPTUNE	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO; FLASH=12	POS TARG -15,+15	Sequence 1-12 Non-Int in Orig Phase I + FQ750N + FQ619N (02)	218 Secs (218 Secs) [=>]	[1]
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Comments: IB2S16XXO on 2010-08-23, prog 11630.

