



## 13402 - Remote sensing of the energy of Jovian auroral electrons with STIS: a clue to unveil plasma acceleration processes

Cycle: 21, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

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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	(3) SPECTRUM-NORTH-1	STIS/FUV-MAMA	1	24-Feb-2014 21:32:14.0	yes
02	(4) SPECTRUM-NORTH-2	STIS/FUV-MAMA	1	24-Feb-2014 21:32:26.0	yes
03	(5) SPECTRUM-SOUTH	STIS/FUV-MAMA	1	24-Feb-2014 21:32:36.0	yes
12	(6) SPECTRUM-NORTH-3	STIS/FUV-MAMA	1	24-Feb-2014 21:32:46.0	yes

4 Total Orbits Used

## **ABSTRACT**

The polar aurora, an important energy source for the Earth's upper atmosphere, is about two orders of magnitude more intense at Jupiter where it releases approximately 10 GW in Jupiter's thermosphere. So far, HST observations of Jupiter's aurora have concentrated on the morphology and the relationship between the solar wind and the brightness distribution. While STIS-MAMA is still operational, time is now critical to move into a new era where FUV long-slit spectroscopy and the spatial scanning capabilities of HST are combined. We propose to use this powerful tool to remotely sense the characteristics of the precipitated electrons by slewing the spectral slit over the different auroral components. It will then be possible to associate electron energies with spatial auroral components and constrain acceleration mechanisms (field-aligned acceleration, magnetic field reconnection, pitch angle electron scattering) associated with specific emission regions. For this, a combination of FUV imaging with STIS long slit spectroscopy will map the spatial variations of the auroral depth and thus the energy of the precipitated electrons. These results will be compared with current models of the Jovian magnetosphere-ionosphere interactions and will provide key inputs to a 3-D model of the Jupiter's atmosphere global heat budget and dynamics currently under development. This compact timely program is designed to provide a major step forward for a better understanding of the physical interactions taking place in Jupiter's magnetosphere and their effects on giant planets' atmospheres, a likely paradigm for many giant fast spinning planets with massive magnetic field in the universe.

## **OBSERVING DESCRIPTION**

Spectral observations will be made with the 52x0.5 arcsec long slit aperture and the G140L grating to cover the full FUV spectral range necessary for electron energy studies. The spectra will be collected in the time-tag mode. The slit will scan the auroral oval from equatorward of the auroral boundary to above the planetary limb. This spatial scan will be continuous across the aurora. It will be oriented with the minimum possible inclination on the equatorial plane compatible with the spacecraft orientations constraints. Once the HST orbit is accurately known, the slew rate during the time-tag observations will be determined in order to best cover the entire auroral oval. Experience gained during execution program 12883 (where telescope slews were performed to scan the Jovian aurora) will be used to program the detailed observations. Indeed, the amplitude of the slews depends on the angular size of Jupiter which varies with the exact date of the observations. Ideally, the observations should be performed within one month from opposition (Jan. 5, 2014).

STIS spectra of Jupiter previously obtained by the PI and team members have demonstrated that the STIS count rate limit is far from being reached during to the spectral observations with the STIS long slit.

The strategy for the observations will be as follows:

VISIT 1 (1 orbit):

One spatial scan with the 52x0.5 arc sec long slit and G140L grating from above the north limb to equatorward (southward) of the auroral emission. The exposure will be timetagged. Jupiter's System III central meridian longitude (CML) will be in the range 150-190 deg offering optimal view of the north polar region. Io will be visible within a specified range from the central meridian.

VISITS 2 (1 orbit):

Repeat of the same sequence with Jupiter's CML in the range 200-240 deg, providing a view complementary to visit 1.

VISITS 3 (1 orbit):

Repeat of the same sequence in the South polar region, starting from above the south limb till equatorward (northward) of the auroral emission. Jupiter's CML will be in the range 20-60 deg, offering optimal view of the south polar region. Io will be visible within a specified range from the central meridian.

The three visits are independent and should be distant in time by at least one week.

**REAL TIME JUSTIFICATION**

None

**CALIBRATION JUSTIFICATION**

None

Proposal 13402 - North1 (01) - Remote sensing of the energy of Jovian auroral electrons with STIS: a clue to unveil plasma accelerati...

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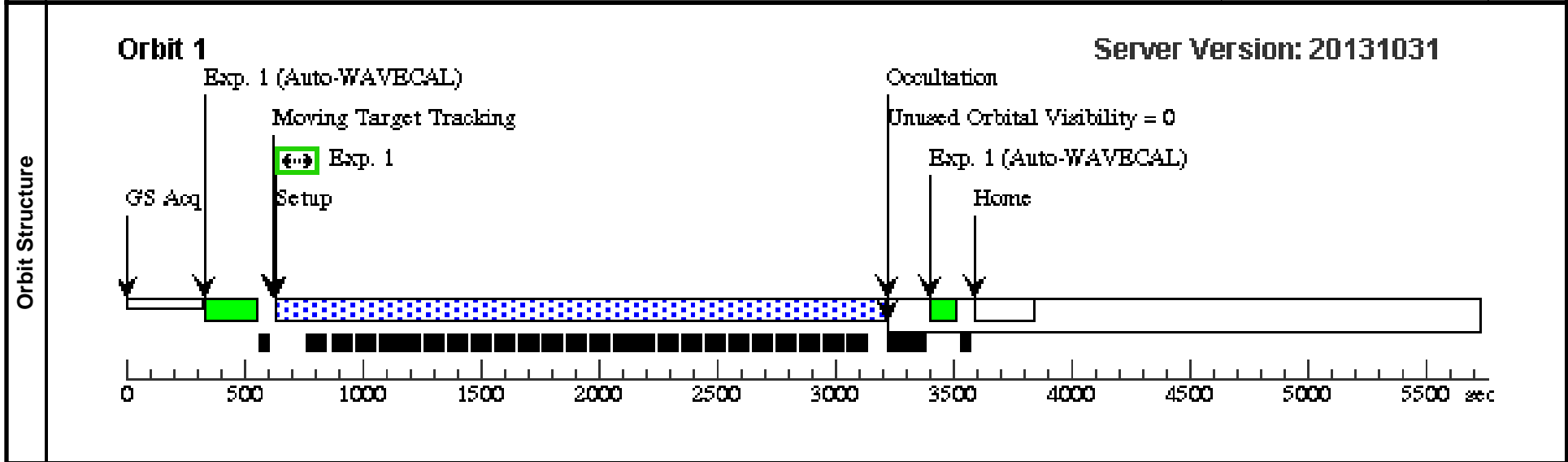
<b>Visit</b>	<p><b>Proposal 13402, North1 (01), completed</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Scientific Instruments: STIS/FUV-MAMA</p> <p>Special Requirements: ORIENT 129D TO 129 D; BETWEEN 08-JAN-2014:22:30:00 AND 08-JAN-2014:23:30:00</p> <p><i>Comments: BETWEENs for are for coordinated ground based observing. Each visit may be considered independently. Ideally, orbits should be executed at least 1 week apart.</i></p>
	<p>(North1 (01)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p>

<b>Diagnosics</b>	<p>(North1 (01)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p>
	<p>(North1 (01)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p>

<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
	(3)	SPECTRUM-NORTH-1	STD=JUPITER	TYPE=POS_ANGLE,RAD=24.6,ANG G=7,REF=NORTH,R_RAD=- 417.6,R_ANG=0,EPOCH=08-JAN- 2014:23:04:47,EpochTimeScale=UTC			OLG OF IO BETWEEN 90 240, CML OF JUPITER FROM EARTH BETWEEN 150 190

*Comments: -Constraints on CML and OLG may be relaxed by +/-10deg.  
-POS\_ANGLE RAD and ANG are date and ROLL dependent. Current values are suitable for 5-JAN-2014.  
-Ideally, the spectral slit should be as parallel as possible to Jupiter's equatorial plane.  
-POS\_ANGLE R\_RAD depends on actual exposure time.  
-The slew rate R\_RAD is negative, meaning that the motion is from above Jupiter's pole towards Jupiter's center.  
-It will be necessary to iterate with our Program Coordinator to adjust these values once final execution date and ROLL are known.*

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.im.41 4797)	(3) SPECTRUM-NO RTH-1	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140L 1425 A	BUFFER-TIME=99				2528 Secs (2528 Secs) [==>]



Proposal 13402 - North2 (02) - Remote sensing of the energy of Jovian auroral electrons with STIS: a clue to unveil plasma accelerati...

Tue Feb 25 02:32:58 GMT 2014

<b>Visit</b>	<b>Proposal 13402, North2 (02), failed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: ORIENT 122D TO 148 D; BETWEEN 13-JAN-2014:23:45 AND 14-JAN-2014:01:15 <i>Comments: BETWEENs for are for coordinated ground based observing. Each visit may be considered independently. Ideally, orbits should be executed at least 1 week apart.</i>										
	(North2 (02)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.										
<b>Diagnostics</b>											
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center				
	(4)	SPECTRUM-NORTH-2	STD=JUPITER	TYPE=POS_ANGLE,RAD=24.6,ANG=7,REF=NORTH,R_RAD=-417.6,R_ANG=0,EPOCH=14-JAN-2014:00:12:23,EpochTimeScale=UTC			CML OF JUPITER FROM EARTH BETWEEN 200 258	EARTH			
<i>Comments: -Constraints on CML and OLG may be relaxed by +/-10deg.                  -POS_ANGLE RAD and ANG are date and ROLL dependent. Current values are suitable for 5-JAN-2014.                  -Ideally, the spectral slit should be as parallel as possible to Jupiter's equatorial plane.                  -POS_ANGLE R_RAD depends on actual exposure time.                  -The slew rate R_RAD is negative, meaning that the motion is from above Jupiter's pole towards Jupiter's center.                  -It will be necessary to iterate with our Program Coordinator to adjust these values once final execution date and ROLL are known.</i>											
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(STIS.im.41 4797)	(4) SPECTRUM-NO RTH-2	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140L 1425 A	BUFFER-TIME=99			2528 Secs (2528 Secs) [==>]	[1]	
<b>Orbit Structure</b>	Server Version: 20131031										
	<p>The diagram illustrates the orbit structure over a 5500-second period. It shows various phases: GS Acq (Green Signal Acquisition) at the start, followed by Exp. 1 (Auto-WAVECAL) at approximately 400 seconds. A period of Moving Target Tracking and Setup leads to another Exp. 1 at 600 seconds. An occultation occurs at 3200 seconds, resulting in zero unused orbital visibility. A final Exp. 1 (Auto-WAVECAL) is scheduled at 3500 seconds, followed by a Home phase at 3700 seconds. The observation period is highlighted with a blue checkered pattern from 600 to 3200 seconds.</p>										

Proposal 13402 - South (03) - Remote sensing of the energy of Jovian auroral electrons with STIS: a clue to unveil plasma acceleratio...

Tue Feb 25 02:32:59 GMT 2014

<b>Visit</b>	Proposal 13402, South (03), completed <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: ORIENT 124D TO 124 D; BETWEEN 12-JAN-2014:22 AND 12-JAN-2014:23 <i>Comments: BETWEENs for are for coordinated ground based observing. Each visit may be considered independently. Ideally, orbits should be executed at least 1 week apart.</i>										
	(South (03)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.										
<b>Diagnostics</b>											
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center				
	(5)	SPECTRUM-SOUTH	STD=JUPITER	TYPE=POS_ANGLE,RAD=25,ANG=187,REF=NORTH,R_RAD=-340,R_ANG=0,EPOCH=12-JAN-2014:22:42:21,EpochTimeScale=UTC			CML OF JUPITER FROM EARTH BETWEEN 20 100	EARTH			
<i>Comments: -Constraints on CML and OLG may be relaxed by +/-10deg.                  -POS_ANGLE RAD and ANG are date and ROLL dependent. Current values are suitable for 5-JAN-2014.                  -Ideally, the spectral slit should be as parallel as possible to Jupiter's equatorial plane.                  -POS_ANGLE R_RAD depends on actual exposure time.                  -The slew rate R_RAD is negative, meaning that the motion is from above Jupiter's pole towards Jupiter's center.                  -It will be necessary to iterate with our Program Coordinator to adjust these values once final execution date and ROLL are known.</i>											
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(STIS.im.41 4797)	(5) SPECTRUM-SOUTH	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140L 1425 A	BUFFER-TIME=99			2528 Secs (2528 Secs) [==>]	[1]	
<b>Orbit Structure</b>	Orbit 1 Exp. 1 (Auto-WAVECAL) Moving Target Tracking Setup Exp. 1 Occultation Exp. 1 (Auto-WAVECAL) Home Unused Orbital Visibility = 0 Server Version: 20131031										
	<p>The diagram shows a timeline for Orbit 1 from 0 to 5500 seconds. Key events include: GS Acq (0-50s), Exp. 1 (Auto-WAVECAL) (50-100s), Moving Target Tracking (100-3200s), Setup (3200-3300s), Exp. 1 (3300-3400s), Occultation (3400-3500s), Exp. 1 (Auto-WAVECAL) (3500-3600s), and Home (3600-3700s). A blue checkered bar indicates the duration of the Moving Target Tracking phase. A green box highlights the first Exp. 1. A black bar at the bottom indicates the occultation period. The x-axis is labeled 'sec' and has major ticks every 500 units.</p>										

Proposal 13402 - North3 (12) - Remote sensing of the energy of Jovian auroral electrons with STIS: a clue to unveil plasma accelerati...

Tue Feb 25 02:33:00 GMT 2014

<b>Visit</b>	<p><b>Proposal 13402, North3 (12), implementation</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Scientific Instruments: STIS/FUV-MAMA</p> <p>Special Requirements: ORIENT 117D TO 117 D; BETWEEN 15-MAR-2014:18 AND 15-MAR-2014:19</p> <p><i>Comments: Each visit may be considered independently. Ideally, orbits should be executed at least 1 week apart.</i></p>
	<p>(North3 (12)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p>

<b>Diagnosics</b>	<p>(North3 (12)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p>

<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
	(6)	SPECTRUM-NORTH-3	STD=JUPITER	TYPE=POS_ANGLE,RAD=21.1,ANG G=-7,REF=NORTH,R_RAD=-291.35,R_ANG=0,EPOCH=15-MAR-2014:18:30:44,EpochTimeScale=UTC			CML OF JUPITER FROM EARTH BETWEEN 200 240
<p><i>Comments: -Constraints on CML and OLG may be relaxed by +/-10deg.                  -POS_ANGLE RAD and ANG are date and ROLL dependent. Current values are suitable for 5-JAN-2014.                  -Ideally, the spectral slit should be as parallel as possible to Jupiter's equatorial plane.                  -POS_ANGLE R_RAD depends on actual exposure time.                  -The slew rate R_RAD is negative, meaning that the motion is from above Jupiter's pole towards Jupiter's center.                  -It will be necessary to iterate with our Program Coordinator to adjust these values once final execution date and ROLL are known.</i></p>							

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Req.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.im.41 4797)	(6) SPECTRUM-NO RTH-3	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140L 1425 A	BUFFER-TIME=99	POS TARG 0,3			2528 Secs (2528 Secs) [==>]

