



# 17471 - Elucidating Jupiter's auroral processes with HST and JWST

Cycle: 31, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Jonathan David Nichols (PI) (ESA Member) (Contact)</b>	<b>University of Leicester</b>
Dr. Henrik Melin (CoI) (ESA Member)	University of Leicester
Prof. Imke de Pater (CoI)	University of California - Berkeley
Prof. John T. Clarke (CoI) (AdminUSPI)	Boston University
Dr. Chihiro Tao (CoI)	National Institute of Information and Com. Technology (NICT)

## 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) JUPITER-NORTH-1	STIS/FUV-MAMA	1	04-Jan-2024 13:00:16.0	yes
02	(2) JUPITER-NORTH-2	STIS/FUV-MAMA	1	04-Jan-2024 13:00:16.0	yes
03	(3) JUPITER-NORTH-3	STIS/FUV-MAMA	1	04-Jan-2024 13:00:17.0	yes
04	(4) JUPITER-NORTH-4	STIS/FUV-MAMA	1	04-Jan-2024 13:00:17.0	yes
05	(5) JUPITER-NORTH-5	STIS/FUV-MAMA	1	04-Jan-2024 13:00:18.0	yes
06	(6) JUPITER-NORTH-6	STIS/FUV-MAMA	1	04-Jan-2024 13:00:18.0	yes

6 Total Orbits Used

## ABSTRACT

The unique partnership between HST and JWST available at this juncture presents an exciting new prospect to understand planetary auroral processes as never before, representing the most powerful remote sensing tool ever available to understand this phenomenon. We propose joint HST-JWST observations of Jupiter's prompt electron-excited far-ultraviolet (FUV) auroral emissions and near-infrared (NIR) H<sub>3</sub><sup>+</sup> thermal auroral emissions that will reveal the true nature and physics behind Jupiter's enigmatic and spectacular auroras. While the two observatories have observed Jupiter's auroras separately, they never observed them simultaneously. The next step in understanding the auroral processes is to compare simultaneous images of FUV and NIR emissions to address the following questions:

\*How does the instantaneous FUV emission relate to the slower H<sub>3</sub><sup>+</sup> emission?

\*How does the instantaneous energy input and temperature seen in FUV emission relate to H<sub>3</sub><sup>+</sup> thermal emissions?

\*How do the H<sub>3</sub><sup>+</sup> thermal emissions relate to well-known FUV features, i.e. the main oval emission, polar emissions, satellite footprints, and dawn storms?

\*What is the lifetime of H<sub>3</sub><sup>+</sup> ions in Jupiter's auroral ionosphere?

\*What processes govern the energy balance in Jupiter's upper atmosphere?

Only HST can obtain the FUV high time- and spatial resolution auroral images and high-resolution spectra of Jupiter's FUV emissions, and only JWST can obtain the high time- and spatial resolution images and spectral images of Jupiter's polar H<sub>3</sub><sup>+</sup> emission required to address these science questions. These observations will yield high-profile discoveries and vital context for ongoing Juno observations of Jupiter's auroras.

## **OBSERVING DESCRIPTION**

These observations will comprise 6 HST orbits using the STIS/FUV-MAMA instrument. Two groups of observations will be obtained, each comprising 3 visits of 1 orbit. All visits will observe the northern auroras. For the first group of observations, all observations will be STIS FUV auroral imaging, and will cover one interval when the northern auroras are presented toward Earth. Auroral images will be obtained using the F25SRF2 filter. Jupiter will be positioned using POS and ANG such that only the auroral region and nearby disc will be in the 25x25" field of view, and thus <1/4 of the detector is filled with the planet. We will obtain ~2200 s time-tagged exposures. The second set of observations will again observe one interval when the northern auroras are presented toward Earth, but will comprise 2 orbits of STIS imaging either side of one orbit of STIS FUV spectroscopy with the G140M grating at the 1222 Å central wavelength and the 25 x 0.5 arcsec aperture with ~400s integrations. The aperture will be positioned across the auroral region and scanned across the auroral region in four ~400 s steps. The exact nature of this scan (i.e. slow smooth or stepped) will be determined once the guide star and ORIENT is known.

Proposal 17471 - Group 1 Visit 1 (01) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

<b>Visit</b>	Proposal 17471, Group 1 Visit 1 (01), completed <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: SCHED 40% <i>Comments: Group 1, imaging observation 1. To execute simultaneously with Observation 1 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set once the orbit of HST is known.</i>									
	(Exposure 1 (Group 1 Visit 1 (01))) Warning (Form): Sensitive exposures should have an ETC run number provided. (Group 1 Visit 1 (01)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(1)	JUPITER-NORTH-1	STD=JUPITER	TYPE=POS_ANGLE,RAD=23,ANG=355,REF=NORTH		CML OF JUPITER FROM EARTH BETWEEN 100 240	EARTH			
<i>Comments: Description=Jupiter aurora north Extended=YES</i>										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) JUPITER-NORTH-1	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			2455 Secs (2095 Secs) [==>2095.0 Secs ]	[1]
<b>Orbit Structure</b>	<b>Orbit 1</b> <span style="float: right;">Server Version: 20230626</span>									

Proposal 17471 - Group 1 Visit 2 (02) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

<b>Visit</b>	Proposal 17471, Group 1 Visit 2 (02), completed <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: SCHED 40%; AFTER 01 BY 0 Orbits TO 1.1 Orbits <i>Comments: Group 1, imaging observation 2. To execute simultaneously with Observation 1 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set once the orbit of HST is known.</i>									
	(Exposure 1 (Group 1 Visit 2 (02))) Warning (Form): Sensitive exposures should have an ETC run number provided. (Group 1 Visit 2 (02)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(2)	JUPITER-NORTH-2	STD=JUPITER	TYPE=POS_ANGLE,RAD=23,ANG=340,REF=NORTH		CML OF JUPITER FROM EARTH BETWEEN 100 240	EARTH			
<i>Comments: Description=Jupiter aurora north Extended=YES</i>										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(2) JUPITER-NORTH-2	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99				2455 Secs (2095 Secs) [=>2095.0 Secs ]
<b>Orbit Structure</b>	Orbit 1 <span style="float: right;">Server Version: 20230626</span>									

Proposal 17471 - Group 1 Visit 3 (03) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

<b>Visit</b>	Proposal 17471, Group 1 Visit 3 (03), completed <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: SCHED 40%; AFTER 02 BY 0 Orbits TO 1.1 Orbits <i>Comments: Group 1, imaging observation 3. To execute simultaneously with Observation 1 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set once the orbit of HST is known.</i>									
	(Exposure 1 (Group 1 Visit 3 (03))) Warning (Form): Sensitive exposures should have an ETC run number provided. (Group 1 Visit 3 (03)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(3)	JUPITER-NORTH-3	STD=JUPITER	TYPE=POS_ANGLE,RAD=23,ANG=328,REF=NORTH		CML OF JUPITER FROM EARTH BETWEEN 100 260	EARTH			
<i>Comments: Description=Jupiter aurora north Extended=YES</i>										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(3) JUPITER-NORTH-3	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99				2455 Secs (2095 Secs) [=>2095.0 Secs ]
<b>Orbit Structure</b>	<b>Orbit 1</b> <span style="float: right;">Server Version: 20230626</span>									

Proposal 17471 - Group 2 Visit 1 (04) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

<b>Visit</b>	Proposal 17471, Group 2 Visit 1 (04), scheduling <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: SCHED 40%; BETWEEN 07-JAN-2024:22:15:00 AND 07-JAN-2024:23:15:00 <i>Comments: Group 2, imaging observation 1. To execute simultaneously with Observation 2 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set once the orbit of HST is known.</i>									
	(Exposure 1 (Group 2 Visit 1 (04))) Warning (Form): Sensitive exposures should have an ETC run number provided. (Group 2 Visit 1 (04)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(4)	JUPITER-NORTH-4	STD=JUPITER	TYPE=POS_ANGLE,RAD=23,ANG=355,REF=NORTH		CML OF JUPITER FROM EARTH BETWEEN 100 240	EARTH			
<i>Comments: Description=Jupiter aurora north Extended=YES</i>										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(4) JUPITER-NORTH-4	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99				2455 Secs (2095 Secs) [=>2095.0 Secs ]
<b>Orbit Structure</b>	<b>Orbit 1</b> <span style="float: right;">Server Version: 20230626</span>									

Proposal 17471 - Group 2 Visit 2 (05) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

**Visit**  
**Proposal 17471, Group 2 Visit 2 (05), implementation**  
**Diagnostic Status: Warning**  
 Scientific Instruments: STIS/FUV-MAMA  
 Special Requirements: SCHED 40%; BETWEEN 07-JAN-2024:23:50:00 AND 08-JAN-2024:00:50:00  
*Comments: Group 2, spectral observation. To execute simultaneously with Observation 2 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set (along with RRAD and RANG if necessary) once the orbit of HST is known.*

**Diagnostics**  
 (Group 2 Visit 2 (05)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.  
 (Group 2 Visit 2 (05)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

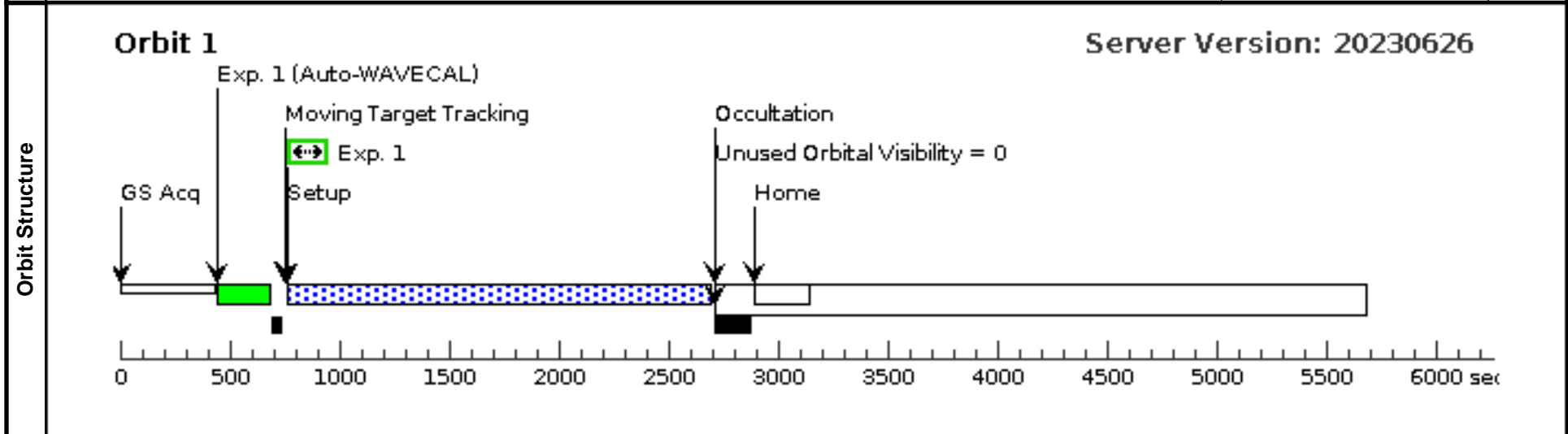
**Solar System Targets**

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(5)	JUPITER-NORTH-5	STD=JUPITER	TYPE=POS_ANGLE,RAD=20.3,ANG=339,REF=NORTH,R_RAD=-390,R_ANG=90,EPOCH=08-JAN-2024:00:25:00,EpochTimeScale=UTC		CML OF JUPITER FROM EARTH BETWEEN 100 240	EARTH

*Comments: Description=Jupiter aurora north  
Extended=YES*

**Exposures**

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.sp.18 98207)	(5) JUPITER-NORT H-5	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=10 00			1873 Secs (1873 Secs) [=>]	[1]



Proposal 17471 - Group 2 Visit 3 (06) - Elucidating Jupiter's auroral processes with HST and JWST

Thu Jan 04 18:00:19 GMT 2024

<b>Visit</b>	Proposal 17471, Group 2 Visit 3 (06), implementation <b>Diagnostic Status: Warning</b> Scientific Instruments: STIS/FUV-MAMA Special Requirements: SCHED 40%; BETWEEN 08-JAN-2024:01:30:00 AND 08-JAN-2024:02:30:00 <i>Comments: Group 2, imaging observation 2. To execute simultaneously with Observation 2 of JWST proposal 4566. RAD and ANG are reasonable placeholders, and will be set once the orbit of HST is known.</i>									
	(Exposure 1 (Group 2 Visit 3 (06))) Warning (Form): Sensitive exposures should have an ETC run number provided. (Group 2 Visit 3 (06)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnostics</b>										
<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center			
	(6)	JUPITER-NORTH-6	STD=JUPITER	TYPE=POS_ANGLE,RAD=23,ANG=325,REF=NORTH			CML OF JUPITER FROM EARTH BETWEEN 100 260	EARTH		
<i>Comments: Description=Jupiter aurora north Extended=YES</i>										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(6) JUPITER-NORTH-6	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99				2455 Secs (2095 Secs) [=>2095.0 Secs ]
<b>Orbit Structure</b>	Orbit 1 <span style="float: right;">Server Version: 20230626</span>									