



10488 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Cycle: 5, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Prof. Leigh Fletcher (PI) (ESA Member)	University of Leicester
Dr. Matthew M. Hedman (CoI) (US Admin CoI)	University of Idaho
Dr. Ricardo Hueso (CoI) (ESA Member)	Universidad del Pais Vasco
Prof. Imke de Pater (CoI)	University of California - Berkeley
Dr. Henrik Melin (CoI) (ESA Member)	Northumbria University
Adam Masters (CoI) (ESA Member)	Imperial College London
Dr. Maryame El Moutamid (CoI)	Southwest Research Institute
Prof. Patrick Irwin (CoI) (ESA Member)	University of Oxford
Dr. Michael Roman (CoI) (ESA Member)	University of Leicester
Mr. Joseph Penn (CoI) (ESA Member)	University of Oxford
Dr. Oliver King (CoI) (ESA Member)	University of Leicester
Mr. Simon Toogood (CoI) (ESA Member)	University of Leicester
Dr. Tom Stallard (CoI) (ESA Member)	Northumbria University
Dr. Heidi B. Hammel (CoI)	Space Science Institute
Dr. Amy Simon (CoI)	NASA Goddard Space Flight Center
Michael H. Wong (CoI)	University of California - Berkeley
Dr. Glenn S. Orton (CoI)	Jet Propulsion Laboratory
Dr. Julianne I. Moses (CoI)	Space Science Institute
Prof. Jonathan David Nichols (CoI) (ESA Member)	University of Leicester
Sandrine Guerlet (CoI)	Laboratoire de Meteorologie Dynamique

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Uranus Cycle 5				
	5	NIRCam-Atmos1	NIRCam Imaging	(1) URANUS
	6	NIRCam-Deep1	NIRCam Imaging	(1) URANUS
	8	NIRCam-Deep2	NIRCam Imaging	(1) URANUS
	7	NIRCam-Atmos2	NIRCam Imaging	(1) URANUS
	3	MRS	MIRI Medium Resolution Spectroscopy	(1) URANUS
	4	NIRSpec	NIRSpec IFU Spectroscopy	(1) URANUS
	2	MRS-Background	MIRI Medium Resolution Spectroscopy	(2) URANUS-BACKGROUND
	1	NIRSpec-Background	NIRSpec IFU Spectroscopy	(2) URANUS-BACKGROUND

ABSTRACT

Uranus is approaching northern summer solstice in 2030, a unique moment in the seasonal cycle that occurs once every 42 years. We propose a JWST program of annual imaging and spectroscopy of Uranus' atmosphere, ionosphere, and ring-moon interactions to capture changes as we approach solstice. Exploration of temporally varying phenomena in the Uranian system will challenge our understanding of seasonal atmospheres, extreme magnetospheres, and the gravitational interactions of tightly-packed ring-moon systems. The Uranus Solstice Explorer will test hypotheses within three science themes: (1) exploring how high-amplitude solar forcing and deep circulation shape the dynamics, chemistry, and winds in the seasonal atmosphere; (2) revealing the unique interaction of Uranus' thermosphere with the solar cycle, via both solar wind pressure and ultraviolet radiation, to understand the source of a long-term cooling trend in the thermospheres of both Ice Giants; and (3) scrutinizing the complex gravitational interactions between the inner moons and rings, searching for orbital shifts in ring/moon locations and determining the source of temporal variations in the structure/brightness of the dusty inner rings. Until a mission to Uranus becomes a reality, JWST's exquisite sensitivity and spectral coverage provides the ideal observatory for understanding this unique world. Our JWST program will culminate in 2031, creating a legacy dataset to coincide with the 250th anniversary of the discovery of Uranus (Mar'31), and the 45th anniversary of the Voyager-2 flyby (Jan'31).

OBSERVING DESCRIPTION

Long-term monitoring proposal to explore the Uranian system as the planet approaches northern summer solstice in 2030. This is the equivalent of a VERY-SMALL proposal each Cycle, repeated from Cycles 5 through 9, but incorporates all imaging and spectroscopic modes needed to identify the causes of temporal changes in the atmosphere, ionosphere, and ring-moon system. The program consists of the following:

JWST Proposal 10488 (Created: Thursday, April 23, 2026, 12:00:34PM Eastern Standard Time) - Overview

1. NIRCams-Atmosphere: Two sets of six medium filters, spaced ~17 hours (1 Uranus rotation) apart to (i) enable cloud tracking at different atmospheric pressures to study zonal winds and their vertical/latitudinal shears; and (ii) to provide spatial context for subsequent spectroscopy. Level-2 images will be de-rotated and desaturated to sharpen the images.
2. NIRSpec/IFU: Three high-resolution spectral cubes, spanning 0.97-5.3 μm , with a single observation (and LARGE 5-point dither) to characterise the whole northern hemisphere. Short wavelengths enable cloud characterisation and tropospheric compositional mapping; 3-4 μm enables ionospheric mapping through H3+ emission; and the longest wavelengths (4-5 μm) sound temperatures and clouds in the deep atmosphere. A single offset for NIRSpec background is also included.
3. MIRI/MRS: all four channels and three gratings are required to span the spectrum from 4.9-28.5 μm , with an extended source 4-point dither to maximize coverage of the disc. A single set of observations is required, capturing the entire northern hemisphere (and thermal emission from the rings) in one shot. A single offset for MRS background is also included.
4. NIRCams-Deep: Two sets of two wide-band filters, with deep integrations, are required to study the motions of the rings and small inner moons. The observations will be spaced by 8-9 hours, a half rotation of Uranus. We will use a single dither for the long-exposure images because all the moons and the longitudinal structures in the rings move over several pixels during the exposure. This eliminates most of the risks from cosmic rays and bad pixels.

The sequence of the observations has been designed to minimize major slews and maximize efficiency:

- * NIRCams-Atmos-1 and NIRCams-Deep1 will start the programme.
- * NIRSpec-background, NIRSpec-planet, MIRI-background, and MIRI-planet.
- * NIRCams-Deep2 will follow the spectroscopy, all within the ~8-9hours required.
- * NIRCams-Atmos-2 will then follow another 8-9 hours later, capturing the same longitudes as NIRCams-Atmos-1.

UPDATE Post-Review [April 2026]:

After iterating with instrument scientists, and a request to increase the amount of time between "NIRCams-Deep" observations, we propose a more optimal sequencing of these observations:

1. NIRSpec background
2. MIRI background (reduce persistence compared to having background follow science)

JWST Proposal 10488 (Created: Thursday, April 23, 2026, 12:00:34PM Eastern Standard Time) - Overview

3. MIRI science
4. NIRSpec science
5. NIRCam Atmos1
6. NIRCam Deep1 (deep after atmos to avoid persistence issues)
7. [~16hrs later] NIRCam Atmos 2
8. NIRCam Deep 2

We now have [7] after [5] by 16-17hrs; [1]-[6] in sequence/non-interruptible; and [7]-[8] in sequence/non-interruptible.

Proposal 10488 - Targets - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	URANUS	STD=URANUS		
<i>Comments: Extended=YES</i>					
(2)	URANUS-BACKGROUND	STD=URANUS		TYPE=POS_ANGLE,RAD=60,ANG=0,REF=NORTH	
<i>Comments: Extended=YES</i>					

Proposal 10488 - Observation 5 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 5: NIRCam-Atmos1 Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRCam-Atmos1 (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
Diagnostics										
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	URANUS	STD=URANUS							
<i>Comments: Extended=YES</i>										
Template	Module				Subarray					
	B				FULLP					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	INTRAMODULEBOX	5	STANDARD		1				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F140M	F480M	RAPID	8	1	5	5	429.471	
	2	F182M	F300M	RAPID	8	1	5	5	429.471	
	3	F210M	F410M	BRIGHT1	8	1	5	5	805.258	
Special Requirements	Offset -11.0 arcsec, -11.0 arcsec 7 After 5 by 16 Hours to 17 Hours Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.03									

Proposal 10488 - Observation 6 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 6: NIRCam-Deep1 Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(NIRCam-Deep1 (Obs 6)) Warning (Form): No dither offsets specified for observation (Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRCam-Deep1 (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
Diagnostics										
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	URANUS	STD=URANUS							
Comments: Extended=YES										
Template	Module				Subarray					
	B				FULLP					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		SMALL-GRID-DITHER		1				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F150W2	F322W2	BRIGHT1	10	10	10	1	2136.617	
Special Requirements	Offset -11.0 arcsec, -11.0 arcsec Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.03									

Proposal 10488 - Observation 8 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 8: NIRCam-Deep2 Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(NIRCam-Deep2 (Obs 8)) Warning (Form): No dither offsets specified for observation (Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRCam-Deep2 (Obs 8)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
Diagnostics										
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	URANUS	STD=URANUS							
Comments: Extended=YES										
Template	Module				Subarray					
	B				FULLP					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		SMALL-GRID-DITHER		1				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F150W2	F322W2	BRIGHT1	10	10	10	1	2136.617	
Special Requirements	Offset -11.0 arcsec, -11.0 arcsec Sequence Observations 7, 8, Non-interruptible DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.03									

Proposal 10488 - Observation 7 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 7: NIRCam-Atmos2 Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRCam-Atmos2 (Obs 7)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
Diagnostics										
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	URANUS	STD=URANUS							
<i>Comments: Extended=YES</i>										
Template	Module					Subarray				
	B					FULLP				
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	INTRAMODULEBOX	5	STANDARD		1				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F140M	F480M	RAPID	8	1	5	5	429.471	
	2	F182M	F300M	RAPID	8	1	5	5	429.471	
	3	F210M	F410M	BRIGHT1	8	1	5	5	805.258	
Special Requirements	Offset -11.0 arcsec, -11.0 arcsec 7 After 5 by 16 Hours to 17 Hours Sequence Observations 7, 8, Non-interruptible DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.03									

Proposal 10488 - Observation 3 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 3: MRS Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy												
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (MRS (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.												
Diagnosics													
Solar System Targets	#	Name	Level 1			Level 2			Level 3				
	(1)	URANUS	STD=URANUS										
Comments: Extended=YES													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel			Simultaneous Imaging			Imager Subarray		Grating Wheel Direction			
		All MRS			NO			FULL		Allow Auto Reorder			
Dithers	#	Dither Type			Optimized For			Direction					
	1	4-Point			EXTENDED SOURCE			NEGATIVE					
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	SHORT(A)	MRSLONG		FASTR1	26	3	1	Dither 1	4	12	888.013	
	1	SHORT(A)	MRSSHORT		FASTR1	26	3	1	Dither 1	4	12	888.013	
	2	MEDIUM(B)	MRSLONG		FASTR1	26	3	1	Dither 1	4	12	888.013	
	2	MEDIUM(B)	MRSSHORT		FASTR1	26	3	1	Dither 1	4	12	888.013	
	3	LONG(C)	MRSLONG		FASTR1	26	3	1	Dither 1	4	12	888.013	
	3	LONG(C)	MRSSHORT		FASTR1	26	3	1	Dither 1	4	12	888.013	

Proposal 10488 - Observation 3 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Special Requirements

Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.075

Proposal 10488 - Observation 4 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 4: NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRSpec (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Diagnostics												
Solar System Targets	#	Name	Level 1			Level 2			Level 3			
	(1)	URANUS	STD=URANUS									
Comments: Extended=YES												
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	CYCLING		LARGE		1		5				
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	G395H/F290LP	NRSIRS2RAPID	10	3	false	true	NONE	5	15	2407.167	
	2	G235H/F170LP	NRSIRS2RAPID	10	3	false	true	NONE	5	15	2407.167	
	3	G140H/F100LP	NRSIRS2RAPID	10	3	false	true	NONE	5	15	2407.167	
Special Requirements	Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible											
	DEFAULT WINDOW: ANGULAR RATE URANUS FROM JWST LESS THAN 0.075											

Proposal 10488 - Observation 2 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 2: MRS-Background Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy												
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (MRS-Background (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.												
Diagnosics													
Solar System Targets	#	Name	Level 1				Level 2				Level 3		
	(2)	URANUS-BACKGROUND	STD=URANUS				TYPE=POS_ANGLE,RAD=60,ANG=0,REF=NORTH						
Comments: Extended=YES													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray		Grating Wheel Direction		
	F1500W	All MRS				NO			FULL		Allow Auto Reorder		
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	SHORT(A)	MRSLONG		FASTR1	26	3	1	None	1	3	222.003	
	1	SHORT(A)	MRSSHORT		FASTR1	26	3	1	None	1	3	222.003	
	2	MEDIUM(B)	MRSLONG		FASTR1	26	3	1	None	1	3	222.003	
	2	MEDIUM(B)	MRSSHORT		FASTR1	26	3	1	None	1	3	222.003	
	3	LONG(C)	MRSLONG		FASTR1	26	3	1	None	1	3	222.003	
	3	LONG(C)	MRSSHORT		FASTR1	26	3	1	None	1	3	222.003	

Proposal 10488 - Observation 2 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Special Requirements

Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF URANUS-BACKGROUND BY URANUS FROM JWST
DEFAULT WINDOW: ANGULAR RATE URANUS-BACKGROUND FROM JWST LESS THAN 0.075

Proposal 10488 - Observation 1 - Uranus Solstice Explorer: Temporal Change in the Atmosphere, Ionosphere, and Ring-Moon System

Thu Apr 23 17:00:34 GMT 2026

Observation	Proposal 10488, Observation 1: NIRSpec-Background Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy																																																											
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRSpec-Background (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																																																											
Diagnostics																																																												
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> </tr> </thead> <tbody> <tr> <td>(2)</td> <td>URANUS-BACKGROUND</td> <td>STD=URANUS</td> <td>TYPE=POS_ANGLE,RAD=60,ANG=0,REF=NORTH</td> <td></td> </tr> <tr> <td colspan="5"><i>Comments: Extended=YES</i></td> </tr> </tbody> </table>												#	Name	Level 1	Level 2	Level 3	(2)	URANUS-BACKGROUND	STD=URANUS	TYPE=POS_ANGLE,RAD=60,ANG=0,REF=NORTH		<i>Comments: Extended=YES</i>																																					
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Template	TA Method						HFF Readout Mode																																																					
	NONE						false																																																					
Dithers	<table border="1"> <thead> <tr> <th>#</th> <th>Dither Type</th> <th>Size</th> <th>Starting Point</th> <th>Number of Points</th> <th>Points</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>NONE</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>												#	Dither Type	Size	Starting Point	Number of Points	Points	1	NONE																																								
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	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID																																																
	1	G395H/F290LP	NRSIRS2RAPI D	10	3	false	false	NONE	1	3	481.433																																																	
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3	G140H/F100LP	NRSIRS2RAPI D	10	3	false	false	NONE	1	3	481.433																																																		
Special Requirements	Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible DEFAULT WINDOW: NOT OCCULTATION OF URANUS-BACKGROUND BY URANUS FROM JWST DEFAULT WINDOW: ANGULAR RATE URANUS-BACKGROUND FROM JWST LESS THAN 0.075																																																											