



1786 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible ocean world activity

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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Dr. Noemi Pinilla-Alonso (CoI)	University of Central Florida Board of Trustees
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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	Ariel Leading NIRSpec	NIRSpec IFU Spectroscopy	(1) ARIEL
	2	Umbriel Leading NIRSpec	NIRSpec IFU Spectroscopy	(2) UMBRIEL
	3	Titania Leading NIRSpec	NIRSpec IFU Spectroscopy	(3) TITANIA
	4	Oberon Leading NIRSpec	NIRSpec IFU Spectroscopy	(4) OBERON

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
	5	Ariel Trailing NIRSpec	NIRSpec IFU Spectroscopy	(1) ARIEL
	6	Umbriel Trailing NIRSpec	NIRSpec IFU Spectroscopy	(2) UMBRIEL
	7	Titania Trailing NIRSpec	NIRSpec IFU Spectroscopy	(3) TITANIA
	8	Oberon Trailing NIRSpec	NIRSpec IFU Spectroscopy	(4) OBERON
	17	Titania Trailing NIRSpec, reschedule	NIRSpec IFU Spectroscopy	(3) TITANIA

ABSTRACT

We propose to observe the leading and trailing hemispheres of the Uranian moons Ariel, Umbriel, Titania, and Oberon using NIRSpec IFU (G395M, 2.87 – 5.27 microns) to determine whether NH₃-rich species, organics, and carbonates are present and measure CO₂ ice and H₂O ice features on these moons. These observations will provide an ideal opportunity to investigate the spectral evidence for past ocean world activity on these moons, assess the organic constituents on their surfaces, and measure carbon and hydrogen isotopes to assess the formation conditions in the Uranian subnebula. These science goals are highly challenging to investigate with ground-based facilities because of strong overprinting telluric bands over the 2.9 to 3.5 microns wavelength range. Furthermore, Earth’s atmosphere is opaque between 4.2 and 4.5 microns, making detection and measurement of the 4.27-micron CO₂ ice band on the Uranian moons and other planetary surfaces impossible to do using ground-based facilities. JWST is therefore the only existing facility that can make these observations. We require 9.96 hours of science time, and 20.72 hours of total charged time, to make the eight observations required to complete this project’s science objectives. These observations will generate an important dataset that will inform the spectroscopic priorities of future spacecraft mission concepts that aim to explore Uranus and its moons.

OBSERVING DESCRIPTION

We propose to observe the leading and trailing hemispheres of the Uranian moons Ariel, Umbriel, Titania, and Oberon with NIRSpec IFU (G395M/F290LP), for a total of eight observations that require 9.96 hours of science time and 20.72 hours of total charged time. The charged time breakdown, per hemisphere, is as follows: Ariel, 2.35 hours; Umbriel, 3.88 hours; Titania, 1.97 hours; Oberon, 2.16 hours. The required amount of science time was estimated using the online JWST ETC. Our input ETC model was an H₂O ice-rich synthetic spectra that accounts for these moons’ strong 3-micron H₂O ice absorption bands. Charged time includes utilizing 4-point dithering for each observation.

Although scattered light from the disk of Uranus contributes to ground-based spectra of Ariel, the far superior point spread function of JWST will

lead to vastly diminished scattered light contributions compared to ground-based facilities and will be negligible for each moon's entire orbit. To characterize compositional variations on these moons, we require NIRSpec observations to occur when their leading and trailing hemispheres are facing JWST (sub-observer longitudes of 90 degrees and 270 degrees, respectively). Observations occurring within ± 45 degrees of these central sub-observer longitudes are sufficient to achieve our observing objectives: sub-observer longitudes 45 to 135 degrees (leading hemispheres) and 235 to 315 degrees (trailing hemispheres). These sub-observer longitude requirements cover half of each moon's orbit and will be routinely met by JWST.

Proposal 1786 - Targets - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible ocean wo...

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	ARIEL	STD=URANUS	STD=ARIEL	
	<i>Comments: Extended=NO</i>				
	(2)	UMBRIEL	STD=URANUS	STD=UMBRIEL	
	<i>Comments: Extended=NO</i>				
(3)	TITANIA	STD=URANUS	STD=TITANIA		
<i>Comments: Extended=NO</i>					
(4)	OBERON	STD=URANUS	STD=OBERON		
<i>Comments: Extended=NO</i>					

Proposal 1786 - Observation 1 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 1: Ariel Leading NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
	<p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Ariel Leading NIRSpec (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Diagnostics												
Solar System Targets	#	Name	Level 1			Level 2			Level 3			
	(1)	ARIEL	STD=URANUS			STD=ARIEL						
<p>Comments: Extended=NO</p>												
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	64	1	false	true	NONE	4	4	3793.111	
Special Requirements	<p>DEFAULT WINDOW: NOT OCCULTATION OF ARIEL BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE ARIEL FROM JWST LESS THAN 0.03</p> <p>CENTRAL MERIDIAN LONGITUDE OF ARIEL FROM JWST BETWEEN 45 135</p>											

Proposal 1786 - Observation 2 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 2: Umbriel Leading NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>																																			
Diagnostics	<p>(Visit 2:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Umbriel Leading NIRSpec (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>																																			
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>UMBRIEL</td> <td>STD=URANUS</td> <td>STD=UMBRIEL</td> <td></td> </tr> <tr> <td colspan="5"><i>Comments: Extended=NO</i></td> </tr> </tbody> </table>												#	Name	Level 1	Level 2	Level 3	(2)	UMBRIEL	STD=URANUS	STD=UMBRIEL		<i>Comments: Extended=NO</i>													
#	Name	Level 1	Level 2	Level 3																																
(2)	UMBRIEL	STD=URANUS	STD=UMBRIEL																																	
<i>Comments: Extended=NO</i>																																				
Template	<p>TA Method</p> <p>NONE</p>																																			
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>4-POINT-DITHER</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>												#	Dither Type	Size	Starting Point	Number of Points	Points	1	4-POINT-DITHER																
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#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID																									
1	G395M/F290LP	NRSIRS2RAPID	145	1	false	true	NONE	4	4	8519.912																										
Special Requirements	<p>DEFAULT WINDOW: NOT OCCULTATION OF UMBRIEL BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE UMBRIEL FROM JWST LESS THAN 0.03</p> <p>CENTRAL MERIDIAN LONGITUDE OF UMBRIEL FROM JWST BETWEEN 45 135</p>																																			

Proposal 1786 - Observation 3 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	Proposal 1786, Observation 3: Titania Leading NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Titania Leading NIRSpec (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			
	(3)	TITANIA	STD=URANUS			STD=TITANIA						
Comments: Extended=NO												
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	44	1	false	true	NONE	4	4	2626.0	
Special Requirements	DEFAULT WINDOW: NOT OCCULTATION OF TITANIA BY URANUS FROM JWST DEFAULT WINDOW: ANGULAR RATE TITANIA FROM JWST LESS THAN 0.03 CENTRAL MERIDIAN LONGITUDE OF TITANIA FROM JWST BETWEEN 45 135											

Proposal 1786 - Observation 4 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 4: Oberon Leading NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Oberon Leading NIRSpec (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1			Level 2			Level 3			
	(4)	OBERON	STD=URANUS			STD=OBERON						
	<i>Comments: Extended=NO</i>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	54	1	false	true	NONE	4	4	3209.556	
Special Requirements	<p>DEFAULT WINDOW: NOT OCCULTATION OF OBERON BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE OBERON FROM JWST LESS THAN 0.03</p> <p>CENTRAL MERIDIAN LONGITUDE OF OBERON FROM JWST BETWEEN 45 135</p>											

Proposal 1786 - Observation 5 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 5: Ariel Trailing NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Ariel Trailing NIRSpec (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(1)	ARIEL	STD=URANUS				STD=ARIEL					
	<i>Comments: Extended=NO</i>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	65	1	false	true	NONE	4	4	3851.467	
Special Requirements	<p>DEFAULT WINDOW: NOT OCCULTATION OF ARIEL BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE ARIEL FROM JWST LESS THAN 0.03</p> <p>CENTRAL MERIDIAN LONGITUDE OF ARIEL FROM JWST BETWEEN 225 315</p>											

Proposal 1786 - Observation 6 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	Proposal 1786, Observation 6: Umbriel Trailing NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy																																			
	(Visit 6:1) Warning (Form): Data Excess over lower threshold (Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Umbriel Trailing NIRSpec (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																																			
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	#	Name	Level 1	Level 2	Level 3																															
(2)	UMBRIEL	STD=URANUS	STD=UMBRIEL																																	
<i>Comments: Extended=NO</i>																																				
Solar System Targets																																				
Template	TA Method NONE																																			
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#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID																									
1	G395M/F290LP	NRSIRS2RAPID	145	1	false	true	NONE	4	4	8519.912																										
Special Requirements	DEFAULT WINDOW: NOT OCCULTATION OF UMBRIEL BY URANUS FROM JWST DEFAULT WINDOW: ANGULAR RATE UMBRIEL FROM JWST LESS THAN 0.03 CENTRAL MERIDIAN LONGITUDE OF UMBRIEL FROM JWST BETWEEN 225 315																																			

Proposal 1786 - Observation 7 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	Proposal 1786, Observation 7: Titania Trailing NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Titania Trailing NIRSpec (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			
	(3)	TITANIA	STD=URANUS			STD=TITANIA						
Comments: Extended=NO												
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	44	1	false	true	NONE	4	4	2626.0	
Special Requirements	DEFAULT WINDOW: NOT OCCULTATION OF TITANIA BY URANUS FROM JWST DEFAULT WINDOW: ANGULAR RATE TITANIA FROM JWST LESS THAN 0.03 CENTRAL MERIDIAN LONGITUDE OF TITANIA FROM JWST BETWEEN 225 315											

Proposal 1786 - Observation 8 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible oc...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 8: Oberon Trailing NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Oberon Trailing NIRSpec (Obs 8)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(4)	OBERON	STD=URANUS				STD=OBERON					
	<i>Comments: Extended=NO</i>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	54	1	false	true	NONE	4	4	3209.556	
Special Requirements	<p>CENTRAL MERIDIAN LONGITUDE OF OBERON FROM JWST BETWEEN 225 315</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF OBERON BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE OBERON FROM JWST LESS THAN 0.03</p>											

Proposal 1786 - Observation 17 - The moons of Uranus: A NIRSpec investigation of their origins, organic constituents, and possible o...

Fri Sep 08 23:00:36 GMT 2023

Observation	<p>Proposal 1786, Observation 17: Titania Trailing NIRSpec, reschedule</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 17:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Titania Trailing NIRSpec, reschedule (Obs 17)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1			Level 2			Level 3			
	(3)	TITANIA	STD=URANUS			STD=TITANIA						
	<i>Comments: Extended=NO</i>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	44	1	false	true	NONE	4	4	2626.0	
Special Requirements	<p>DEFAULT WINDOW: NOT OCCULTATION OF TITANIA BY URANUS FROM JWST</p> <p>DEFAULT WINDOW: ANGULAR RATE TITANIA FROM JWST LESS THAN 0.075</p> <p>CENTRAL MERIDIAN LONGITUDE OF TITANIA FROM JWST BETWEEN 225 315</p>											