



## 2760 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Cycle: 2, Proposal Category: GTO

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Prof. Jonathan I. Lunine (PI)</b>	<b>Cornell University</b>
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### OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	2	Titan45	NIRSpec IFU Spectroscopy	(7) TITAN-NIRSPEC
	3	Titan135	NIRSpec IFU Spectroscopy	(7) TITAN-NIRSPEC
	4	Titan225	NIRSpec IFU Spectroscopy	(7) TITAN-NIRSPEC
	5	Titan315	NIRSpec IFU Spectroscopy	(7) TITAN-NIRSPEC
	6	Titan MIRI	MIRI Medium Resolution Spectroscopy	(5) TITAN-MIRI
	7	Titan MIRI BG	MIRI Medium Resolution Spectroscopy	(6) TITAN-MIRI-BG

### ABSTRACT

Titan's atmosphere is time variable, and characterizing that variability in stratospheric gases (MIRI) and haze (NIRSpec) is a major goal of these observations. We will also look at four hemispheres of Titan from JWST, at wavelengths corresponding to both surface and atmosphere, to compare with Cassini observations, provide new data for surface composition identification, and establish a baseline for possible future JWST observations of temporal changes.

Science objectives:

1) NIRSpec IFU spectral imaging of 4 hemispheres of Titan (longitude =45, 135, 225, 315) primarily for surface composition mapping. Additional science for Titan atmosphere, including clouds, PAHs, methane humidity, dayside fluorescence.

2) MIRI-MRS spectral imaging of Titan atmosphere to derive seasonal changes in the stratospheric gas composition.

### **OBSERVING DESCRIPTION**

NIRSPEC IFU: Four hemispheres of Titan (longitude =45, 135, 225, 315)

MIRI MRS: Titan leading hemisphere only for atmosphere. Background observation of 'mirror image' empty position opposite side of Saturn to get stray light.

Proposal 2760 - Targets - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Solar System Targets	#	Name	Level 1	Level 2	Level 3	
	(5)	TITAN-MIRI	STD=SATURN	STD=TITAN		
	<i>Comments: Background required for Titan target. Background should be symmetric mirror location to Titan but on opposite side of Saturn.</i> <i>Extended=YES</i>					
	(6)	TITAN-MIRI-BG	STD=SATURN	TYPE=TORUS, LONG=90, LAT=0, RAD=1221870, POLE_LONG=0, POLE_LAT=90, O_LONG=0, O_LAT=0, O_RAD=0		
<i>Comments: Background required for Titan target. Background should be symmetric mirror location to Titan but on opposite side of Saturn.</i> <i>Extended=YES</i>						
(7)	TITAN-NIRSPEC	STD=SATURN	STD=TITAN			
<i>Comments: Titan ffor NIRSPEC - no linked background</i> <i>Extended=YES</i>						

Proposal 2760 - Observation 2 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Fri May 10 23:00:28 GMT 2024

<b>Observation</b>	<p><b>Proposal 2760, Observation 2: Titan45</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
<b>Diagnostics</b>	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Titan45 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>			<b>Level 2</b>			<b>Level 3</b>			
	(7)	TITAN-NIRSPEC	STD=SATURN			STD=TITAN						
	<p><i>Comments: Titan ffor NIRSPEC - no linked background</i></p> <p><i>Extended=YES</i></p>											
<b>Template</b>	<p><b>TA Method</b></p> <p>NONE</p>											
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>		<b>Size</b>	<b>Starting Point</b>		<b>Number of Points</b>		<b>Points</b>			
	1	CYCLING		SMALL	1		4					
<b>Spectral Elements</b>	<b>#</b>	<b>Grating/Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Leakcal</b>	<b>Dither</b>	<b>Autocal</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	G140H/F070LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	2	G140H/F100LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	3	G235H/F170LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	4	G395H/F290LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
<b>Special Requirements</b>	<p>Between Dates 03-NOV-2025:00:00:00 and 22-DEC-2025:00:00:00</p> <p>Between Dates 16-NOV-2026:00:00:00 and 04-JAN-2027:00:00:00</p> <p>Group Observations 2, 3, 6, 7 within 16 Days</p> <p>CENTRAL MERIDIAN LONGITUDE OF TITAN FROM JWST BETWEEN 40 50</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF TITAN-NIRSPEC BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF TITAN-NIRSPEC RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE TITAN-NIRSPEC FROM JWST LESS THAN 0.03</p>											

Proposal 2760 - Observation 3 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Fri May 10 23:00:28 GMT 2024

<b>Observation</b>	<p><b>Proposal 2760, Observation 3: Titan135</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
<b>Diagnostics</b>	<p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Titan135 (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>			<b>Level 2</b>			<b>Level 3</b>			
	(7)	TITAN-NIRSPEC	STD=SATURN			STD=TITAN						
	<p><i>Comments: Titan ffor NIRSPEC - no linked background</i></p> <p><i>Extended=YES</i></p>											
<b>Template</b>	<b>TA Method</b>											
	NONE											
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>		<b>Size</b>	<b>Starting Point</b>		<b>Number of Points</b>		<b>Points</b>			
	1	CYCLING		SMALL	1		4					
<b>Spectral Elements</b>	<b>#</b>	<b>Grating/Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Leakcal</b>	<b>Dither</b>	<b>Autocal</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	G140H/F070LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	2	G140H/F100LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	3	G235H/F170LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	4	G395H/F290LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
<b>Special Requirements</b>	<p>Between Dates 03-NOV-2025:00:00:00 and 22-DEC-2025:00:00:00</p> <p>Between Dates 16-NOV-2026:00:00:00 and 04-JAN-2027:00:00:00</p> <p>Group Observations 2, 3, 6, 7 within 16 Days</p> <p>CENTRAL MERIDIAN LONGITUDE OF TITAN FROM JWST BETWEEN 130 140</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF TITAN-NIRSPEC BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF TITAN-NIRSPEC RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE TITAN-NIRSPEC FROM JWST LESS THAN 0.03</p>											

Proposal 2760 - Observation 4 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Fri May 10 23:00:28 GMT 2024

<b>Observation</b>	<p><b>Proposal 2760, Observation 4: Titan225</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
	<p>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Titan225 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
<b>Diagnostics</b>												
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>			<b>Level 2</b>			<b>Level 3</b>			
	(7)	TITAN-NIRSPEC	STD=SATURN			STD=TITAN						
<p><i>Comments: Titan ffor NIRSPEC - no linked background</i></p> <p><i>Extended=YES</i></p>												
<b>Template</b>	<b>TA Method</b>											
	NONE											
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>		<b>Size</b>	<b>Starting Point</b>		<b>Number of Points</b>	<b>Points</b>				
	1	CYCLING		SMALL	1		4					
<b>Spectral Elements</b>	<b>#</b>	<b>Grating/Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Leakcal</b>	<b>Dither</b>	<b>Autocal</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	G140H/F070LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	2	G140H/F100LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	3	G235H/F170LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	4	G395H/F290LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
<b>Special Requirements</b>	<p>Between Dates 18-JUN-2025:00:00:00 and 09-AUG-2025:00:00:00</p> <p>Between Dates 02-JUL-2026:00:00:00 and 22-AUG-2026:00:00:00</p> <p>Group Observations 4, 5 within 16 Days</p> <p>CENTRAL MERIDIAN LONGITUDE OF TITAN FROM JWST BETWEEN 220 230</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF TITAN-NIRSPEC BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF TITAN-NIRSPEC RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE TITAN-NIRSPEC FROM JWST LESS THAN 0.03</p>											

Proposal 2760 - Observation 5 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

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<b>Observation</b>	<p><b>Proposal 2760, Observation 5: Titan315</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
<b>Diagnostics</b>	<p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Titan315 (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>				<b>Level 2</b>				<b>Level 3</b>	
	(7)	TITAN-NIRSPEC	STD=SATURN				STD=TITAN					
	<p><i>Comments: Titan ffor NIRSPEC - no linked background</i></p> <p><i>Extended=YES</i></p>											
<b>Template</b>	<b>TA Method</b>											
	NONE											
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>			<b>Size</b>	<b>Starting Point</b>			<b>Number of Points</b>	<b>Points</b>		
	1	CYCLING			SMALL	1			4			
<b>Spectral Elements</b>	<b>#</b>	<b>Grating/Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Leakcal</b>	<b>Dither</b>	<b>Autocal</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	G140H/F070LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	2	G140H/F100LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	3	G235H/F170LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
	4	G395H/F290LP	NRSRAPID	5	1	false	true	NONE	4	4	257.682	
<b>Special Requirements</b>	<p>Between Dates 18-JUN-2025:00:00:00 and 09-AUG-2025:00:00:00</p> <p>Between Dates 02-JUL-2026:00:00:00 and 22-AUG-2026:00:00:00</p> <p>Group Observations 4, 5 within 16 Days</p> <p>CENTRAL MERIDIAN LONGITUDE OF TITAN FROM JWST BETWEEN 310 320</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF TITAN-NIRSPEC BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF TITAN-NIRSPEC RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE TITAN-NIRSPEC FROM JWST LESS THAN 0.03</p>											

Proposal 2760 - Observation 6 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Fri May 10 23:00:28 GMT 2024

<b>Observation</b>	<b>Proposal 2760, Observation 6: Titan MIRI</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[Titan MIRI BG (Obs 7)] Comments: See ticket INC0165672, approved by Dean Hines 2021-02-23 10:57 for approval of NGROUPS=2 for the MIRI MRS observations of Titan.												
	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Titan MIRI (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.												
<b>Solar System Targets</b>	#	Name	Level 1				Level 2				Level 3		
	(5)	TITAN-MIRI	STD=SATURN				STD=TITAN						
Comments: Background required for Titan target. Background should be symmetric mirror location to Titan but on opposite side of Saturn. Extended=YES													
<b>Acquisition</b>	#	Target											
	1	NONE											
<b>Template</b>	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray		Grating Wheel Direction		
		All MRS				NO			FULL		NEUTRAL		
<b>Dithers</b>	#	Dither Type				Optimized For				Direction			
	1	4-Point				EXTENDED SOURCE				NEGATIVE			
<b>Spectral Elements</b>	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SHORT(A)	MRSLONG		FASTR1	2	25	1	Dither 1	4	100	821.412	
	1	SHORT(A)	MRSSHORT		FASTR1	5	13	1	Dither 1	4	52	854.712	
	2	MEDIUM(B)	MRSLONG		FASTR1	2	25	1	Dither 1	4	100	821.412	
	2	MEDIUM(B)	MRSSHORT		FASTR1	5	13	1	Dither 1	4	52	854.712	
	3	LONG(C)	MRSLONG		FASTR1	2	25	1	Dither 1	4	100	821.412	
	3	LONG(C)	MRSSHORT		FASTR1	5	13	1	Dither 1	4	52	854.712	



## Proposal 2760 - Observation 6 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

### Special Requirements

Sequence Observations 6, 7, Non-interruptible  
Group Observations 2, 3, 6, 7 within 16 Days

SEPARATION OF TITAN-MIRI SATURN FROM JWST GREATER THAN 1.8'  
DEFAULT WINDOW: NOT OCCULTATION OF TITAN-MIRI BY SATURN FROM JWST  
DEFAULT WINDOW: SEPARATION OF TITAN-MIRI RHEA FROM JWST GREATER THAN 10"  
DEFAULT WINDOW: ANGULAR RATE TITAN FROM JWST LESS THAN 0.03  
CENTRAL MERIDIAN LONGITUDE OF TITAN-MIRI FROM JWST BETWEEN 85 95

Proposal 2760 - Observation 7 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

Fri May 10 23:00:28 GMT 2024

<b>Observation</b>	<b>Proposal 2760, Observation 7: Titan MIRI BG</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [Titan MIRI (Obs 6)] <i>Comments: See ticket INC0165672, approved by Dean Hines 2021-02-23 10:57 for approval of NGROUPS=2 for the MIRI MRS observations of Titan.</i>												
	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Titan MIRI BG (Obs 7)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.												
<b>Diagnosics</b>													
<b>Solar System Targets</b>	#	Name	Level 1				Level 2				Level 3		
	(6)	TITAN-MIRI-BG	STD=SATURN				TYPE=TORUS, LONG=90, LAT=0, RAD=1221870, POLE_LONG=0, POLE_LAT=90, O_LONG=0, O_LAT=0, O_RAD=0						
<i>Comments: Background required for Titan target. Background should be symmetric mirror location to Titan but on opposite side of Saturn. Extended=YES</i>													
<b>Acquisition</b>	#	Target											
	1	NONE											
<b>Template</b>	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray		Grating Wheel Direction		
		All MRS				NO			FULL		NEUTRAL		
<b>Spectral Elements</b>	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SHORT(A)	MRSLONG		FASTR1	2	25	1	None	1	25	205.353	
	1	SHORT(A)	MRSSHORT		FASTR1	5	13	1	None	1	13	213.678	
	2	MEDIUM(B)	MRSLONG		FASTR1	2	25	1	None	1	25	205.353	
	2	MEDIUM(B)	MRSSHORT		FASTR1	5	13	1	None	1	13	213.678	
	3	LONG(C)	MRSLONG		FASTR1	2	25	1	None	1	25	205.353	
	3	LONG(C)	MRSSHORT		FASTR1	5	13	1	None	1	13	213.678	

## Proposal 2760 - Observation 7 - Titan Surface and Atmosphere - JWST Cycle 2 GTO Project

### Special Requirements

Sequence Observations 6, 7, Non-interruptible  
Group Observations 2, 3, 6, 7 within 16 Days

NOT OCCULTATION OF TITAN-MIRI-BG BY TITAN-MIRI FROM JWST  
DEFAULT WINDOW: NOT OCCULTATION OF TITAN-MIRI-BG BY SATURN FROM JWST  
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF TITAN-MIRI-BG BY TITAN FROM JWST  
DEFAULT WINDOW: SEPARATION OF TITAN-MIRI-BG RHEA FROM JWST GREATER THAN 10"  
DEFAULT WINDOW: SEPARATION OF TITAN-MIRI-BG TITAN FROM JWST GREATER THAN 10"  
DEFAULT WINDOW: ANGULAR RATE TITAN-MIRI-BG FROM JWST LESS THAN 0.03