



4604 - The source of the gas plumes of Enceladus

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Enceladus-45				
	6	Enceladus-45	NIRSpec IFU Spectroscopy	(2) Enceladus
Enceladus-135				
	4	Enceladus-135	NIRSpec IFU Spectroscopy	(2) Enceladus
Enceladus-225				
	10	Enceladus-225	NIRSpec IFU Spectroscopy	(2) Enceladus
	11	Enceladus-225-LEAKC AL	NIRSpec IFU Spectroscopy	(3) Enceladus-LEAKCAL
Enceladus-315				
	2	Enceladus-315	NIRSpec IFU Spectroscopy	(2) Enceladus
	3	Enceladus-315-LEAKC AL	NIRSpec IFU Spectroscopy	(3) Enceladus-LEAKCAL

ABSTRACT

Ever since the discovery of salt particles in the plumes of Enceladus, these plumes have been widely thought to be directly connected to the subsurface ocean. At least one observation is inconsistent with this interpretation, however. Current plume models predict that the water vapor and

the particle jets in the plume are intimately connected and should vary in sync. The particle jets have been imaged thousands of times and are known to vary in intensity within a single orbit in an extremely repeatable pattern, with a factor of six or more variation between the pericenter and apocenter of the Enceladus orbit. The vapor component of the plume, in contrast, appears to vary by no more than +/-15% over the entire Cassini mission. Unfortunately, the vapor component has been sparsely sampled in both time and space, so its true variability is difficult to assess, and suggestions have been made that the lack of observed variability is just due to coincidences of timing. Resolving this discrepancy is critical. If indeed the vapor component of the plume does not vary with the particle jets, our models of the source mechanism of the plumes, as well as potential connections to the underlying ocean, require serious reevaluation. JWST can resolve this question. We propose to make the first ever observations of the vapor component of the plumes of Enceladus over the course of a single Enceladus orbit. These observations will quickly and definitely determine how much, if any, of the vapor component of the plume varies in sync with the particulate jets, allowing us to determine the true connection between the plumes and subsurface ocean.

OBSERVING DESCRIPTION

These observations are designed to observe the H₂O gas plume of Enceladus at 4 positions over the course of a single Enceladus orbit, in order to determine if the gas emission varies with the known variation of the particle jets. The need to observe over a single orbit requires that two of the observations occur when Saturn will be situated on the MSA, so leak calibrations are also included for these observations by constructing an artificial target which has the orbit of Enceladus but lags behind by 72 minutes, the expected time between the start of the Enceladus and leak observations. The precise position of the artificial target can be easily updated as the observations are better refined.

Proposal 4604 - Targets - The source of the gas plumes of Enceladus

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(2)	Enceladus	STD=SATURN	STD=ENCELADUS	
	<i>Comments: Extended=Unknown</i>				
(3)	Enceladus-LEAKCAL	STD=SATURN	TYPE=SAT,A=2.384135823278123E+05,EPOCH=30-OCT-2024:05:38:00,EpochTimeScale=TDB,N=261.90167,L=23.3273,E=0.,I=0.,RAP=00H00M0.0000S,DECP=+90D00'0.00",EQUINOX=J2000		
	<i>Comments: This target shares the orbital elements of Enceladus, but lags 72 minutes behind, which is the time that the APT currently says will separate the two observations. This position can be tweaked as more precise timing is available.</i>				
	<i>Extended=YES</i>				

Proposal 4604 - Observation 6 - The source of the gas plumes of Enceladus

Tue Oct 15 02:00:10 GMT 2024

Observation	<p>Proposal 4604, Observation 6: Enceladus-45</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Enceladus-45 (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(2)	Enceladus	STD=SATURN				STD=ENCELADUS					
	<i>Comments: Extended=Unknown</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	G235H/F170LP	NRSIRS2RAPI D	2	4	false	true	NONE	4	16	700.267	
Special Requirements	<p>Between Dates 31-OCT-2024:00:00:00 and 03-NOV-2024:00:00:00</p> <p>4 After 6 by 0 Hours to 16 Hours</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF Enceladus BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus TITAN FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE Enceladus FROM JWST LESS THAN 0.075</p> <p>ORBITAL LONGITUDE OF Enceladus BETWEEN 35 55</p>											

Proposal 4604 - Observation 4 - The source of the gas plumes of Enceladus

Tue Oct 15 02:00:10 GMT 2024

Observation	Proposal 4604, Observation 4: Enceladus-135 Diagnostic Status: Warning Observing Template: NIRSspec IFU Spectroscopy											
	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Enceladus-135 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Diagnosics												
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(2)	Enceladus	STD=SATURN				STD=ENCELADUS					
<i>Comments: Extended=Unknown</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	G235H/F170LP	NRSIRS2RAPID	2	4	false	true	NONE	4	16	700.267	
Special Requirements	Between Dates 01-OCT-2024:00:00:00 and 01-JAN-2025:00:00:00 4 After 6 by 0 Hours to 16 Hours 10 After 4 by 0 Hours to 16 Hours DEFAULT WINDOW: NOT OCCULTATION OF Enceladus BY SATURN FROM JWST DEFAULT WINDOW: SEPARATION OF Enceladus RHEA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Enceladus TITAN FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE Enceladus FROM JWST LESS THAN 0.075 ORBITAL LONGITUDE OF Enceladus BETWEEN 125 145											

Proposal 4604 - Observation 10 - The source of the gas plumes of Enceladus

Tue Oct 15 02:00:10 GMT 2024

Observation	<p>Proposal 4604, Observation 10: Enceladus-225</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Enceladus-225 (Obs 10)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1			Level 2			Level 3			
	(2)	Enceladus	STD=SATURN			STD=ENCELADUS						
	<i>Comments: Extended=Unknown</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	G235H/F170LP	NRSIRS2RAPID	2	4	false	true	NONE	4	16	700.267	
Special Requirements	<p>Between Dates 01-OCT-2024:00:00:00 and 01-JAN-2025:00:00:00</p> <p>2 After 10 by 0 Hours to 16 Hours</p> <p>10 After 4 by 0 Hours to 16 Hours</p> <p>11 After 10 by 0 Hours to 1 Hours</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF Enceladus BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus TITAN FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE Enceladus FROM JWST LESS THAN 0.075</p> <p>ORBITAL LONGITUDE OF Enceladus BETWEEN 215 235</p>											

Proposal 4604 - Observation 11 - The source of the gas plumes of Enceladus

Tue Oct 15 02:00:10 GMT 2024

Observation	Proposal 4604, Observation 11: Enceladus-225-LEAKCAL Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy <i>Comments: This is a MSA leakage calibration for the previous exposure. The target is the position of Enceladus 72 minutes earlier, which is the time between observations as calculated by the APT, thus corresponds to the position of Enceladus at the start of the previous observation. This position can be easily tweaked if the timing becomes more accurately known.</i>											
	(Enceladus-225-LEAKCAL (Obs 11)) Warning (Form): NIRSpec IFU LEAKCAL exposure specification has no matching science exposure with the same grating/filter combination. (Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Enceladus-225-LEAKCAL (Obs 11)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Diagnostics												
Solar System Targets	#	Name	Level 1	Level 2				Level 3				
	(3)	Enceladus-LEAKCAL	STD=SATURN	TYPE=SAT,A=2.384135823278123E+05,EPOCH=30-OCT-2024:05:38:00,EpochTimeScale=TDB,N=261.90167,L=23.3273,E=0.,I=0.,RAP=00H00M0.0000S,DECP=+90D00'0.00",EQUINOX=J2000								
<i>Comments: This target shares the orbital elements of Enceladus, but lags 72 minutes behind, which is the time that the APT currently says will separate the two observations. This position can be tweaked as more precise timing is available.</i> Extended=YES												
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	G235M/F170LP	NRSIRS2RAPID	2	4	true	true	NONE	4	16	700.267	
Special Requirements	11 After 10 by 0 Hours to 1 Hours											
	DEFAULT WINDOW: NOT OCCULTATION OF Enceladus-LEAKCAL BY SATURN FROM JWST DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF Enceladus-LEAKCAL BY TITAN FROM JWST DEFAULT WINDOW: SEPARATION OF Enceladus-LEAKCAL RHEA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Enceladus-LEAKCAL TITAN FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE Enceladus-LEAKCAL FROM JWST LESS THAN 0.075											

Proposal 4604 - Observation 2 - The source of the gas plumes of Enceladus

Tue Oct 15 02:00:10 GMT 2024

Observation	<p>Proposal 4604, Observation 2: Enceladus-315</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSPEC IFU Spectroscopy</p>											
	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Enceladus-315 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Diagnostics												
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(2)	Enceladus	STD=SATURN				STD=ENCELADUS					
<p><i>Comments: Extended=Unknown</i></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	G235H/F170LP	NRSIRS2RAPID	2	4	false	true	NONE	4	16	700.267	
Special Requirements	<p>Between Dates 01-OCT-2024:00:00:00 and 01-JAN-2025:00:00:00</p> <p>2 After 10 by 0 Hours to 16 Hours</p> <p>3 After 2 by 0 Hours to 1 Hours</p> <p>DEFAULT WINDOW: NOT OCCULTATION OF Enceladus BY SATURN FROM JWST</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus RHEA FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: SEPARATION OF Enceladus TITAN FROM JWST GREATER THAN 10"</p> <p>DEFAULT WINDOW: ANGULAR RATE Enceladus FROM JWST LESS THAN 0.075</p> <p>ORBITAL LONGITUDE OF Enceladus BETWEEN 305 325</p>											

Proposal 4604 - Observation 3 - The source of the gas plumes of Enceladus

Observation	Proposal 4604, Observation 3: Enceladus-315-LEAKCAL Tue Oct 15 02:00:10 GMT 2024 Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy <i>Comments: This is a MSA leakage calibration for the previous exposure. The target is the position of Enceladus 72 minutes earlier, which is the time between observations as calculated by the APT, thus corresponds to the position of Enceladus at the start of the previous observation. This position can be easily tweaked if the timing becomes more accurately known.</i>																																			
	Diagnostics	(Enceladus-315-LEAKCAL (Obs 3)) Warning (Form): NIRSpec IFU LEAKCAL exposure specification has no matching science exposure with the same grating/filter combination. (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Enceladus-315-LEAKCAL (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																																		
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	#	Name	Level 1	Level 2	Level 3																															
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