



10908 - Sources and Seasonal Evolution of CO₂ on Ocean World Enceladus

Cycle: 5, 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>
Observation Folder				
	1	Enceladus C5	NIRSpec IFU Spectroscopy	(1) Enceladus

ABSTRACT

Saturn's moon Enceladus is actively erupting material via geysers along large fractures called the "Tiger Stripes" in its South Polar Terrain (SPT). These ocean-fed geysers form a large H₂O-rich plume that the Cassini spacecraft sampled, measuring notable amounts of CO₂ and other bioessential compounds. It has been hypothesized that ocean-derived CO₂ gas might exsolve from liquid H₂O as it travels through fractures near the surface, causing a "soda bottle" effect that drives geyser activity. Alternatively, CO₂-driven activity may be more sporadic, resulting from bursting gas pockets in Enceladus' interior that jet CO₂ into the plume. During winter, when the SPT is in darkness and temperatures plummet (< 70 K), geyser-erupted CO₂ might condense in a transient frost layer. Cassini also collected reflectance spectra of the SPT and plume, but the low quality of these

data limit assessment of solid-state CO₂ on the SPT and CO₂ gas in the plume. Recent JWST observations of Enceladus occurred during northern summer, when the SPT was largely out of sight, preventing assessment of CO₂ and its role in activity. Over the next 5 cycles (2026-2031), Enceladus will transition through southern spring (sub-obs. latitudes ~10-27°S), gradually revealing the entire SPT. Long Term Monitoring during this period would provide an ideal opportunity to study CO₂, its role in geyser activity, and its potential seasonal behavior, using NIRSpec IFU with the G235H and G395H gratings. These processes cannot be disentangled without LTM observations over southern spring. Furthermore, it is crucial that these LTM observations start now in Cycle 5, right as the Tiger Stripes start to come into view.

OBSERVING DESCRIPTION

This proposed project will collect NIRSpec IFU spectra with the G235H and G395H gratings, once each cycle from C5 through C9 (2026-2031) for a total of five G235H and five G395H spectra. These observations will target the same range of subobserver longitudes on Enceladus' leading hemisphere (45-135 degrees W) to ensure that regional geologic contributions in collected data are consistent each cycle. These observations will need to be scheduled in JWST's trailing FOR to keep Saturn off the NIRSpec MSAs. All exposure time estimates were made using the NIRSpec ETC, with uploaded NIRSpec data of Enceladus, collected in Cycles 1 and 2. Based on the ETC modeling, this proposal requests 1809 s of science time with the G235H (30 groups, 1 integration, 4 dithers) and 8053 s of science time with the G395H (45 groups, 3 integrations 4 dithers). This leads to a total of 2.7 hours of science time and 4.7 hours of charged time, per cycle (23.5 hours total over 5 cycles). All observing requirements are included under the "Solar System Target Window" tab in the APT file and in the "Special Requirements" section of the technical case.

Proposal 10908 - Targets - Sources and Seasonal Evolution of CO2 on Ocean World Enceladus

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	Enceladus	STD=SATURN	STD=ENCELADUS	
<i>Comments: Extended=YES</i>					

Proposal 10908 - Observation 1 - Sources and Seasonal Evolution of CO2 on Ocean World Enceladus

Tue Apr 28 22:00:28 GMT 2026

Observation	<p>Proposal 10908, Observation 1: Enceladus C5</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
	<p>(Visit 1:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Enceladus C5 (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)	Enceladus	STD=SATURN				STD=ENCELADUS					
<p><i>Comments: Extended=YES</i></p>												
Template	TA Method						HFF Readout Mode					
	NONE						false					
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	Optional ETC ID
	1	G235H/F170LP	NRSIRS2RAPI D	30	1	false	true	NONE	4	4	1809.022	
	2	G395H/F290LP	NRSIRS2RAPI D	45	3	false	true	NONE	4	12	8053.067	
Special Requirements	<p>Between Dates 16-NOV-2026:00:00:00 and 04-JAN-2027:00:00:00</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>SEPARATION OF Enceladus MIMAS FROM JWST GREATER THAN 10"</p> <p>SEPARATION OF Enceladus TETHYS FROM JWST GREATER THAN 10"</p> <p>SEPARATION OF Enceladus DIONE FROM JWST GREATER THAN 10"</p> <p>SEPARATION OF Enceladus IAPETUS FROM JWST GREATER THAN 10"</p> <p>CENTRAL MERIDIAN LONGITUDE OF Enceladus FROM JWST BETWEEN 45 135</p>											