



10900 - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/MIRI

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	Europa Leading	MIRI Medium Resolution Spectroscopy	(1) EuropaL
	2	Europa Leading bkg	MIRI Medium Resolution Spectroscopy	(2) EuropaLBkg

ABSTRACT

Beneath its icy shell, Jupiter's moon Europa hosts a global salty ocean that is a prime target for astrobiological consideration. The potential for life depends critically on the ocean's chemical inventory, particularly the abundance and speciation of carbon, which remains poorly constrained. Recent JWST observations have revealed that Europa's abundant CO is enhanced in the leading hemisphere chaos terrains, suggesting an internal source, but it is uncertain whether this CO is delivered directly from the ocean or is formed as part of a radiolytic carbon cycle. Our analysis of existing MIRI observations of the sulfur-bombarded trailing hemisphere has yielded the first convincing detection of carbonates on Europa, but their interpretation is fundamentally ambiguous without the leading hemisphere context. We therefore propose to obtain observations of Europa's more sheltered leading hemisphere with JWST/MIRI MRS to search for endogenic carbonates, confirm and characterize the radiolytic carbon cycle, and directly probe the ocean chemistry. This program, when combined with the existing trailing hemisphere MIRI observations, will disentangle Europa's dual radiolytic

cycles to identify the composition of the ocean-derived salts, providing a foundational dataset to assess Europa's habitability and ground-truth compositional context for the upcoming Europa Clipper mission, which does not have mid-IR capabilities.

OBSERVING DESCRIPTION

This very small program will utilize MIRI MRS to constrain the composition of Europa's leading hemisphere. The observations are specifically designed to center the Tara Regio chaos terrain at 75°W, thus maximizing the signal from exposed endogenic material. We will employ all three MRS gratings to ensure full spectral coverage from 5 to 28 μ m, using a 4-point dither pattern optimized for extended solar system objects. We target a S/N approximately twice that of previous trailing hemisphere data in order to ensure a 10-sigma detection of key carbonate bands at the upper limit concentration from NIRSpec, or a 1-sigma detection of a 10x's weaker band. Our exposure strategy uses 12 groups per integration and 15 integrations per exposure, carefully configured to prevent saturation of a majority of the data in Channel 3. Immediately following the science observation, a dedicated background measurement will be acquired using a 2-point dither pattern offset perpendicular to Europa's orbital plane, ensuring comparable scattered light conditions while keeping Europa well outside the field of view. The total execution requires 1.8 hours of science time and 4.6 hours of total charge time.

Proposal 10900 - Targets - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/MIRI

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	EuropaL	STD=JUPITER	STD=EUROPA	
<i>Comments: Extended=YES</i>					
(2)	EuropaLBkg	STD=JUPITER	STD=EUROPA		TYPE=POS_ANGLE,RAD=20,ANG=0,REF=NORTH
<i>Comments: Extended=YES</i>					

Proposal 10900 - Observation 1 - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/...

Fri Mar 13 20:03:06 GMT 2026

Observation	Proposal 10900, Observation 1: Europa Leading Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[Europa Leading bkg (Obs 2)]												
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Europa Leading (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.												
Diagnostics													
Solar System Targets	#	Name	Level 1				Level 2				Level 3		
	(1)	EuropaL	STD=JUPITER				STD=EUROPA						
<i>Comments: Extended=YES</i>													
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	12	15	1	Dither 1	4	60	2153.431	
	1	SHORT(A)	MRSSHORT		FASTR1	12	15	1	Dither 1	4	60	2153.431	
	2	MEDIUM(B)	MRSLONG		FASTR1	12	15	1	Dither 1	4	60	2153.431	
	2	MEDIUM(B)	MRSSHORT		FASTR1	12	15	1	Dither 1	4	60	2153.431	
	3	LONG(C)	MRSLONG		FASTR1	12	15	1	Dither 1	4	60	2153.431	
	3	LONG(C)	MRSSHORT		FASTR1	12	15	1	Dither 1	4	60	2153.431	

Proposal 10900 - Observation 1 - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/...

Special Requirements

Group Observations 1, 2, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF EuropaL BY JUPITER FROM JWST
DEFAULT WINDOW: SEPARATION OF EuropaL IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EuropaL GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EuropaL CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE EuropaL FROM JWST LESS THAN 0.075
CENTRAL MERIDIAN LONGITUDE OF EuropaL FROM JWST BETWEEN 65 85

Proposal 10900 - Observation 2 - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/...

Fri Mar 13 20:03:06 GMT 2026

Observation	Proposal 10900, Observation 2: Europa Leading bkg Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [Europa Leading (Obs 1)]												
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Europa Leading bkg (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)	EuropaLBkg	STD=JUPITER	STD=EUROPA	TYPE=POS_ANGLE,RAD=20,ANG=0,REF=NORTH	<i>Comments: Extended=YES</i>							
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	2-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	12	1	1	Dither 1	2	2	66.601	
	1	SHORT(A)	MRSSHORT		FASTR1	12	1	1	Dither 1	2	2	66.601	
	2	MEDIUM(B)	MRSLONG		FASTR1	12	1	1	Dither 1	2	2	66.601	
	2	MEDIUM(B)	MRSSHORT		FASTR1	12	1	1	Dither 1	2	2	66.601	
	3	LONG(C)	MRSLONG		FASTR1	12	1	1	Dither 1	2	2	66.601	
	3	LONG(C)	MRSSHORT		FASTR1	12	1	1	Dither 1	2	2	66.601	

Proposal 10900 - Observation 2 - Unlocking Europa's Ocean Chemistry: Disentangling Native Salts from Radiolytic Cycles with JWST/...

Special Requirements

Group Observations 1, 2, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF EuropaLBkg BY JUPITER FROM JWST
DEFAULT WINDOW: SEPARATION OF EuropaLBkg IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EuropaLBkg GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EuropaLBkg CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE EuropaLBkg FROM JWST LESS THAN 0.075