



4078 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Io Observing Sequence				
	1	Io Atmosphere during Juno Fly-by	MIRI Medium Resolution Spectroscopy	(1) IO
	2	Io Trailing Hemisphere - MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) IO
	3	MIRI Background - Io Trailing 5x16	MIRI Medium Resolution Spectroscopy	(2) BG-IO-N

ABSTRACT

Material outgassed from Io's volcanic activity forms its tenuous SO₂-based atmosphere, and ultimately becomes ionized to populate Jupiter's magnetosphere. However, the direct link between Io's volcanoes and the plasma in the jovian system remains unclear; the gas is not vented at sufficient velocities to escape Io, and the atmosphere should therefore act as a buffer, with mass-loss occurring from the upper bulk atmosphere rather than directly from plumes. The mechanics of this process, and the role of the atmosphere, remain elusive in part because every component of this system is highly time-variable so that linking different components observed at different times is nearly impossible. The Juno extended mission's close Io fly-by provides a truly unique opportunity to measure particles in the vicinity of Io in situ with Juno, while simultaneously mapping the temperature and column density of Io's dayside atmosphere with JWST. We propose to measure the SO₂ gas in Io's atmosphere during the 1 hour surrounding Juno's closest approach, via the 7.3 micron gas band observed with MIRI/MRS. This gas band is clearly seen in JWST ERS observations of Io, which targeted Io's leading hemisphere. Fortunately, the Juno fly-by takes place downstream of Io, measuring the lost matter, and also while Io's trailing hemisphere is visible to JWST. This hemispheric coverage complements the viewing geometry of the ERS data, and we will additionally observe Io across 5-6 microns to measure hemispheric differences in 5.4 and 5.95 micron bands that were newly detected in the ERS data of Io.

OBSERVING DESCRIPTION

We propose to obtain spectra with MIRI/MRS of Io's trailing hemisphere, simultaneous with the Juno close approach of Io on 2023-12-30 (08:35 UTC). Our observations are in two sequential parts: (1) We will observe Io in MRS Band C in time-series observing mode, for 60 minutes surrounding Juno's closest approach, at a cadence of 5 minutes. These observations will measure the variability of Io's atmosphere via the SO₂ band at 7.3 um; (2) We will then obtain single exposures in MIRI's Band A and B. This completes the 5.0-7.5 um spectral coverage of newly-detected SO₂ frost absorption bands on Io's trailing hemisphere, complementing ERS leading hemisphere data. Finally, we request a dedicated background exposure at the same jovian distance as Io is during the target observations.

Proposal 4078 - Targets - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	IO	STD=JUPITER	STD=IO	
<i>Comments: Extended=YES</i>					
(2)	BG-IO-N	STD=JUPITER		TYPE=POS_ANGLE,RAD=120,ANG=112,REF=NO RTH	
<i>Comments: MIRI MRS background target for Io. Position is mirrored across sky North from Io's position during C/A, which is 248 degrees east of north, 120" from the center of Jupiter. Extended=YES</i>					

Proposal 4078 - Observation 1 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Wed Oct 18 21:00:11 GMT 2023

Observation	Proposal 4078, Observation 1: Io Atmosphere during Juno Fly-by Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[Io Trailing Hemisphere - MIRI MRS (Obs 2), MIRI Background - Io Trailing 5x16 (Obs 3)]																											
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Io Atmosphere during Juno Fly-by (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																											
Diagnosics																												
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>(1)</td> <td>IO</td> <td>STD=JUPITER</td> <td>STD=IO</td> <td></td> </tr> <tr> <td colspan="5"><i>Comments: Extended=YES</i></td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	(1)	IO	STD=JUPITER	STD=IO		<i>Comments: Extended=YES</i>																
	#	Name	Level 1	Level 2	Level 3																							
(1)	IO	STD=JUPITER	STD=IO																									
<i>Comments: Extended=YES</i>																												
Acquisition	#	Target																										
	1	NONE																										
Template	AcqFilter	Primary Channel			Simultaneous Imaging			Imager Subarray			Grating Wheel Direction																	
		Channel 1			NO			FULL			NEUTRAL																	
Spectral Elements	#	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	LONG(C)	MRSLONG		FASTR1	5	192	1	None	1	192	3194.071																
	1	LONG(C)	MRSSHORT		FASTR1	5	192	1	None	1	192	3194.071																

Proposal 4078 - Observation 1 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Special Requirements

Between Dates 30-DEC-2023:08:00:00 and 30-DEC-2023:08:10:00
Time Series Observation
No Parallel Attachments

Sequence Observations 1, 2, 3, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF IO BY JUPITER FROM JWST
DEFAULT WINDOW: ANGULAR RATE IO FROM JWST LESS THAN 0.075

Proposal 4078 - Observation 2 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Wed Oct 18 21:00:11 GMT 2023

Observation	Proposal 4078, Observation 2: Io Trailing Hemisphere - MIRI MRS Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[Io Atmosphere during Juno Fly-by (Obs 1), MIRI Background - Io Trailing 5x16 (Obs 3)]												
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Io Trailing Hemisphere - MIRI MRS (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			
	(1)	IO	STD=JUPITER				STD=IO						
<i>Comments: Extended=YES</i>													
Acquisition	#											Target	
	1											NONE	
Template	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray		Grating Wheel Direction		
	F560W	Channel 1				NO			FULL		NEUTRAL		
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	ETC Wkbk.Calc ID
	1	SHORT(A)	MRSLONG		FASTR1	5	16	1	Dither 1	4	64	1054.515	
	1	SHORT(A)	MRSSHORT		FASTR1	5	16	1	Dither 1	4	64	1054.515	
	2	MEDIUM(B)	MRSLONG		FASTR1	5	16	1	Dither 1	4	64	1054.515	
	2	MEDIUM(B)	MRSSHORT		FASTR1	5	16	1	Dither 1	4	64	1054.515	

Proposal 4078 - Observation 2 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Special Requirements

Sequence Observations 1, 2, 3, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF IO BY JUPITER FROM JWST

DEFAULT WINDOW: ANGULAR RATE IO FROM JWST LESS THAN 0.075

Proposal 4078 - Observation 3 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Wed Oct 18 21:00:11 GMT 2023

Observation	Proposal 4078, Observation 3: MIRI Background - Io Trailing 5x16 Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [Io Atmosphere during Juno Fly-by (Obs 1), Io Trailing Hemisphere - MIRI MRS (Obs 2)] <i>Comments: Revised MIRI MRS background for Io. Position is north of Io, at approximately the same distance from Jupiter as the Io MIRI observation itself.</i>																					
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (MIRI Background - Io Trailing 5x16 (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																					
Diagnosics																						
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>BG-IO-N</td> <td>STD=JUPITER</td> <td>TYPE=POS_ANGLE,RAD=120,ANG=112,REF=NO RTH</td> <td></td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	(2)	BG-IO-N	STD=JUPITER	TYPE=POS_ANGLE,RAD=120,ANG=112,REF=NO RTH		<i>Comments: MIRI MRS background target for Io. Position is mirrored across sky North from Io's position during C/A, which is 248 degrees east of north, 120" from the center of Jupiter. Extended=YES</i>										
	#	Name	Level 1	Level 2	Level 3																	
(2)	BG-IO-N	STD=JUPITER	TYPE=POS_ANGLE,RAD=120,ANG=112,REF=NO RTH																			
Acquisition	#	Target																				
	1	NONE																				
Template	AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction																	
	F1000W	Channel 1	NO	FULL	NEUTRAL																	
Dithers	#	Dither Type	Optimized For	Direction																		
	1	4-Point	EXTENDED SOURCE	NEGATIVE																		
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/E xp	Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID									
	1	SHORT(A)	MRSLONG		FASTR1	5	4	1	None	1	4	63.826										
	1	SHORT(A)	MRSSHORT		FASTR1	5	4	1	None	1	4	63.826										
	2	MEDIUM(B)	MRSLONG		FASTR1	5	4	1	None	1	4	63.826										
	2	MEDIUM(B)	MRSSHORT		FASTR1	5	4	1	None	1	4	63.826										
	3	LONG(C)	MRSLONG		FASTR1	5	4	1	None	1	4	63.826										
	3	LONG(C)	MRSSHORT		FASTR1	5	4	1	None	1	4	63.826										

Proposal 4078 - Observation 3 - Mass-loss from Io's volcanic atmosphere: A unique synergy with the Juno Io fly-by

Special Requirements

Sequence Observations 1, 2, 3, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF BG-IO-N BY JUPITER FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF BG-IO-N BY IO FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF BG-IO-N BY EUROPA FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF BG-IO-N BY GANYMEDE FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF BG-IO-N BY CALLISTO FROM JWST
DEFAULT WINDOW: SEPARATION OF BG-IO-N IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF BG-IO-N EUROPA FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF BG-IO-N GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF BG-IO-N CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE BG-IO-N FROM JWST LESS THAN 0.075