



4565 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Cycle: 2, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Kurt David Retherford (PI)	Southwest Research Institute
Dr. Fran Bagenal (CoI) (CoPI)	University of Colorado at Boulder
Dr. Lorenz Roth (CoI) (ESA Member)	Royal Institute of Technology
Prof. Katherine de Kleer (CoI) (Contact)	California Institute of Technology
Dr. Tracy M Becker (CoI)	Southwest Research Institute
Dr. Nathaniel J. Cunningham (CoI)	Nebraska Wesleyan University
Dr. G. Randall Gladstone (CoI)	Southwest Research Institute
Dr. Vincent Hue (CoI) (ESA Member)	Aix-Marseille University
Dr. Joshua Kammer (CoI)	Southwest Research Institute
Dr. Pippa Molyneux (CoI)	Southwest Research Institute
Dr. Jonathan David Nichols (CoI) (ESA Member)	University of Leicester
Dr. Samantha Trumbo (CoI)	Cornell University
Michael Velez (CoI)	University of Texas at San Antonio
Matthew Burger (CoI)	Space Telescope Science Institute
Dr. Vincent J Dols (CoI)	University of Colorado at Boulder
Dr. Edward Nerney (CoI)	University of Colorado at Boulder
Dr. Carl Schmidt (CoI)	Boston University
Dr. Howard Todd Smith (CoI)	The Johns Hopkins University Applied Physics Laboratory
Dr. Lori M. Feaga (CoI)	University of Maryland
Dr. Amanda R. Hendrix (CoI)	Planetary Science Institute
Dr. Kandis Lea Jessup (CoI)	Southwest Research Institute
Emmanuel Lellouch (CoI) (ESA Member)	Observatoire de Paris - Section de Meudon
Dr. Melissa A. McGrath (CoI)	SETI Institute

<i>Name</i>	<i>Institution</i>
Dr. Joachim Saur (CoI) (ESA Member)	Universitat zu Koeln
Dr. John R. Spencer (CoI)	Southwest Research Institute
Dr. Shawn Brueshaber (CoI)	Michigan Technological University
Dr. Thomas Kirk Greathouse (CoI)	Southwest Research Institute
Dr. Candice Hansen (CoI)	Planetary Science Institute
Mr. Thomas Momary (CoI)	Jet Propulsion Laboratory
Dr. Alessandro Mura (CoI) (ESA Member)	INAF - Istituto di Astrofisica e Planetologia Spaziali
Dr. Glenn S. Orton (CoI)	Jet Propulsion Laboratory

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 PJ66 Fly-by	MIRI Medium Resolution Spectroscopy	(1) IO
	2	Io Leading Hemisphere - MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) IO
	3	MIRI Background - Io Leading 5x16	MIRI Medium Resolution Spectroscopy	(2) BG-IO-N

ABSTRACT

Io is the most volcanically active body in the solar system and its escaping atmosphere is the dominant source of material for the Jovian magnetosphere. Despite decades of research and major advances in understanding individual processes and features, the connections between Io's volcanos, surface volatiles, atmosphere, magnetospheric plasma-interaction, and beyond to Io's neutral cloud, the Io Plasma Torus, and Jupiter's ionosphere, all remain difficult to quantify and understand. Juno, a polar orbiter originally designed to study Jupiter's deep interior, magnetosphere, and aurora, is now in an extended mission focused on studying the Galilean satellites. Juno's upcoming Io flybys in Cycle 31 offer an excellent opportunity for combining Juno's intensive in situ measurements with Earth-based remote sensing to advance our understanding of Io's role in driving coupled phenomena within the Jupiter system. Two flybys come within ~1500 km of Io, with a third more distant encounter at ~120,000 km. Our HST-Juno Io campaign performs numerous coordinated Io observations to take full advantage of this opportunity for combining in situ and remote sensing datasets within a comprehensive modeling framework (not otherwise possible until the late 2030's). We plan multi-spectral, multi-instrument HST observations of the following types: Io neutral cloud profiling and ansae stares, Io FUV aurora imaging, Io transit imaging, Io eclipse imaging (with hot spot and time series studies), and Io surface mapping. Coordinated JWST MIRI/MRS IFU measurements of Io's 7.3 um SO₂ band and

JWST Proposal 4565 (Created: Wednesday, June 5, 2024 at 11:01:09 AM Eastern Standard Time) - Overview
newly detected 5 um features are requested for Juno's Sep. 2024 encounter (following plans for JWST program 4078).

OBSERVING DESCRIPTION

TBD

Proposal 4565 - Targets - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

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	STD=IO		TYPE=POS_ANGLE,RAD=89.4,ANG=0,REF=NORTH
<i>Comments: MIRI MRS background target for Io. Position is north of Io, at approximately the same distance from Jupiter as the Io MIRI observation itself.</i>					
<i>Extended=YES</i>					

Proposal 4565 - Observation 1 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Wed Jun 05 16:01:09 GMT 2024

Observation	<p>Proposal 4565, Observation 1: Io Atmosphere during Juno PJ66 Fly-by</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Medium Resolution Spectroscopy</p> <p>Background Observations:[Io Leading Hemisphere - MIRI MRS (Obs 2), MIRI Background - Io Leading 5x16 (Obs 3)]</p>												
	<p>(Io Atmosphere during Juno PJ66 Fly-by (Obs 1)) Warning (Form): Dithers are not used with the Time Series special requirement.</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Io Atmosphere during Juno PJ66 Fly-by (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)	IO	STD=JUPITER				STD=IO						
<p><i>Comments: Extended=YES</i></p>													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray		Grating Wheel Direction		
		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	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 4565 - Observation 1 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Special Requirements

Between Dates 22-OCT-2024:14:22:00 and 22-OCT-2024:14:32:00
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 4565 - Observation 2 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Wed Jun 05 16:01:09 GMT 2024

Observation	<p>Proposal 4565, Observation 2: Io Leading Hemisphere - MIRI MRS</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Medium Resolution Spectroscopy</p> <p>Background Observations:[Io Atmosphere during Juno PJ66 Fly-by (Obs 1), MIRI Background - Io Leading 5x16 (Obs 3)]</p> <p><i>Comments: We'd like to be sure we observe Io's 5 um features while in transit of Jupiter and also out of transit, egress time is ~16:08.</i></p>																																																																												
Diagnostics	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Io Leading Hemisphere - MIRI MRS (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>																																																																												
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> </tbody> </table> <p><i>Comments: Extended=YES</i></p>												#	Name	Level 1	Level 2	Level 3	(1)	IO	STD=JUPITER	STD=IO																																																								
#	Name	Level 1	Level 2	Level 3																																																																									
(1)	IO	STD=JUPITER	STD=IO																																																																										
Acquisition	<table border="1"> <thead> <tr> <th>#</th> <th>Target</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>NONE</td> </tr> </tbody> </table>												#	Target	1	NONE																																																													
#	Target																																																																												
1	NONE																																																																												
Template	<table border="1"> <thead> <tr> <th>AcqFilter</th> <th>Primary Channel</th> <th>Simultaneous Imaging</th> <th>Imager Subarray</th> <th>Grating Wheel Direction</th> </tr> </thead> <tbody> <tr> <td>F560W</td> <td>Channel 1</td> <td>NO</td> <td>FULL</td> <td>NEUTRAL</td> </tr> </tbody> </table>												AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction	F560W	Channel 1	NO	FULL	NEUTRAL																																																							
AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction																																																																									
F560W	Channel 1	NO	FULL	NEUTRAL																																																																									
Dithers	<table border="1"> <thead> <tr> <th>#</th> <th>Dither Type</th> <th>Optimized For</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4-Point</td> <td>EXTENDED SOURCE</td> <td>NEGATIVE</td> </tr> </tbody> </table>												#	Dither Type	Optimized For	Direction	1	4-Point	EXTENDED SOURCE	NEGATIVE																																																									
#	Dither Type	Optimized For	Direction																																																																										
1	4-Point	EXTENDED SOURCE	NEGATIVE																																																																										
Spectral Elements	<table border="1"> <thead> <tr> <th>#</th> <th>Wavelength Range</th> <th>Detector</th> <th>Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Exposures/Dith</th> <th>Dither</th> <th>Total Dithers</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>SHORT(A)</td> <td>MRSLONG</td> <td></td> <td>FASTR1</td> <td>5</td> <td>16</td> <td>1</td> <td>Dither 1</td> <td>4</td> <td>64</td> <td>1054.515</td> <td></td> </tr> <tr> <td>1</td> <td>SHORT(A)</td> <td>MRSSHORT</td> <td></td> <td>FASTR1</td> <td>5</td> <td>16</td> <td>1</td> <td>Dither 1</td> <td>4</td> <td>64</td> <td>1054.515</td> <td></td> </tr> <tr> <td>2</td> <td>MEDIUM(B)</td> <td>MRSLONG</td> <td></td> <td>FASTR1</td> <td>5</td> <td>16</td> <td>1</td> <td>Dither 1</td> <td>4</td> <td>64</td> <td>1054.515</td> <td></td> </tr> <tr> <td>2</td> <td>MEDIUM(B)</td> <td>MRSSHORT</td> <td></td> <td>FASTR1</td> <td>5</td> <td>16</td> <td>1</td> <td>Dither 1</td> <td>4</td> <td>64</td> <td>1054.515</td> <td></td> </tr> </tbody> </table>												#	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	
	#	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 4565 - Observation 2 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

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 4565 - Observation 3 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Wed Jun 05 16:01:09 GMT 2024

Observation	Proposal 4565, Observation 3: MIRI Background - Io Leading 5x16 Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [Io Atmosphere during Juno PJ66 Fly-by (Obs 1), Io Leading 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 Leading 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>STD=IO</td> <td>TYPE=POS_ANGLE,RAD=89.4,ANG=0,REF=NORTH</td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	(2)	BG-IO-N	STD=JUPITER	STD=IO	TYPE=POS_ANGLE,RAD=89.4,ANG=0,REF=NORTH	<i>Comments: MIRI MRS background target for Io. Position is north of Io, at approximately the same distance from Jupiter as the Io MIRI observation itself.</i> Extended=YES										
	#	Name	Level 1	Level 2	Level 3																	
(2)	BG-IO-N	STD=JUPITER	STD=IO	TYPE=POS_ANGLE,RAD=89.4,ANG=0,REF=NORTH																		
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/Exp	Exposures/Dith	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 4565 - Observation 3 - HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Special Requirements

Sequence Observations 1, 2, 3, Non-interruptible

DEFAULT WINDOW: NOT OCCULTATION OF BG-IO-N BY JUPITER FROM JWST

DEFAULT WINDOW: ANGULAR RATE BG-IO-N FROM JWST LESS THAN 0.075