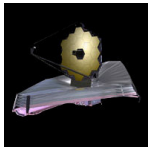

4687 - Constraining the Composition and Thermal Histories of Silicate Minerals on Callisto

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Callisto Leading	MIRI Medium Resolution Spectroscopy	(1) Callisto
	2	Callisto Trailing	MIRI Medium Resolution Spectroscopy	(1) Callisto
	3	Callisto Leading - Background	MIRI Medium Resolution Spectroscopy	(2) Callisto-Bkg
	4	Callisto Trailing - Background	MIRI Medium Resolution Spectroscopy	(2) Callisto-Bkg

ABSTRACT

The heavily cratered surface of Callisto, the outermost of Jupiter’s Galilean moons, presents a unique opportunity to study the largest object in the solar system with a primordial surface affected only by cratering and irradiation. Callisto’s surface is dominated by crystalline water ice inter-mixed with a dark non-ice component. Yet, despite nearly 50 years of spectroscopic study, the mineral composition of the dark material on Callisto remains unknown and we lack a clear understanding of its source - with possibilities ranging from primordial endogenic silicates to exogenic dust. We

propose to observe the leading and trailing hemispheres of Callisto with MIRI MRS in order to confirm the presence of silicates on Callisto, determine ther abundances, trace their thermal histories through the Fe/Mg ratio, and better understand the relationship between the endogenic material and exogenic processes that have shaped Callisto’s surface over time.

OBSERVING DESCRIPTION

This small program obtains MIRI MRS observations of the leading and trailing hemispheres of Callisto with a total science time of around 8.33 hours and total charge time of 15.96 hours. With a targeted S/N to identify a 5% contrast silicate emission peak near the 10 m silicate fundamental bands, we aim to provide robust constraints on the composition of silicate minerals on Callisto and gain insights into their thermal history by determining the Fe/Mg ratio to better than 10%. The somewhat stringent leading hemisphere sub-observer longitude constraints ensure sufficient coverage of the Valhalla impact basin in order to allow direct comparison of the mineral compositions in the leading and trailing hemispheres and between Valhalla and the nearby leading hemisphere mid-latitues, which have been shown to be potentially compositionally distinct.

We will use MIRI MRS with all three grating settings to ensure full spectral coverage through 12 microns. We will use the 4-point dither pattern for extended targets and acquire simultaneous background observations with a 20 arcsec offset perpendicular to Callisto's orbital plane. Since integration groups higher than 5 are likely to saturate beyond 9 microns, we model this portion of our observing plan off of the successful Ganymede MIRI observations and use 5 groups per integration. We select 60 integrations at each grating setting, as required to match our targeted 10 micron S/N.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	Callisto	STD=JUPITER	STD=CALLISTO	
Comments: Extended=YES				
(2)	Callisto-Bkg	STD=JUPITER	STD=CALLISTO	TYPE=POS_ANGLE,RAD=20,ANG=-4,REF=NORTH
Comments: MIRI MRS background should be 20 arcsec N of Callisto, to make sure it is off the MIRI FOV, and taken immediately after the science observation. Extended=YES				

Observation

Proposal 4687, Observation 1: Callisto Leading Thu Feb 29 19:01:07 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 1:1) Warning (Form): Data Excess over lower threshold

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Callisto Leading (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	Callisto	STD=JUPITER	STD=CALLISTO	

Comments: Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	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	60	1	Dither 1	4	240	3984.957	
1	SHORT(A)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	
2	MEDIUM(B)	MRSLONG		FASTR1	5	60	1	Dither 1	4	240	3984.957	
2	MEDIUM(B)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	
3	LONG(C)	MRSLONG		FASTR1	5	60	1	Dither 1	4	240	3984.957	
3	LONG(C)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	

Special Requirements	
	Group Observations 1, 3, Non-interruptible DEFAULT WINDOW: NOT OCCULTATION OF Callisto BY JUPITER FROM JWST DEFAULT WINDOW: SEPARATION OF Callisto IO FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto EUROPA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto GANYMEDE FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE CALLISTO FROM JWST LESS THAN 0.075 CENTRAL MERIDIAN LONGITUDE OF Callisto FROM JWST BETWEEN 70 100

Observation

Proposal 4687, Observation 2: Callisto Trailing Thu Feb 29 19:01:07 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 2:1) Warning (Form): Data Excess over lower threshold

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Callisto Trailing (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	Callisto	STD=JUPITER	STD=CALLISTO	

Comments: Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	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	60	1	Dither 1	4	240	3984.957	
1	SHORT(A)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	
2	MEDIUM(B)	MRSLONG		FASTR1	5	60	1	Dither 1	4	240	3984.957	
2	MEDIUM(B)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	
3	LONG(C)	MRSLONG		FASTR1	5	60	1	Dither 1	4	240	3984.957	
3	LONG(C)	MRSSHORT		FASTR1	5	60	1	Dither 1	4	240	3984.957	

Special Requirements	
	Group Observations 2, 4, Non-interruptible DEFAULT WINDOW: NOT OCCULTATION OF Callisto BY JUPITER FROM JWST DEFAULT WINDOW: SEPARATION OF Callisto IO FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto EUROPA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto GANYMEDE FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE CALLISTO FROM JWST LESS THAN 0.075 CENTRAL MERIDIAN LONGITUDE OF Callisto FROM JWST BETWEEN 240 300

Observation

Proposal 4687, Observation 3: Callisto Leading - Background Thu Feb 29 19:01:07 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Callisto Leading - Background (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	Callisto-Bkg	STD=JUPITER	STD=CALLISTO	TYPE=POS_ANGLE,RAD=20,ANG=-4,REF=NORTH

Comments: MIRI MRS background should be 20 arcsec N of Callisto, to make sure it is off the MIRI FOV, and taken immediately after the science observation. Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	NO	FULL	NEUTRAL

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	ETC Wkbk.Calc ID
1	SHORT(A)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
1	SHORT(A)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	
2	MEDIUM(B)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
2	MEDIUM(B)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	
3	LONG(C)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
3	LONG(C)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	

Special Requirements	
	Group Observations 1, 3, Non-interruptible DEFAULT WINDOW: NOT OCCULTATION OF Callisto-Bkg BY JUPITER FROM JWST DEFAULT WINDOW: SEPARATION OF Callisto-Bkg IO FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto-Bkg EUROPA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto-Bkg GANYMEDE FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE Callisto-Bkg FROM JWST LESS THAN 0.075

Observation

Proposal 4687, Observation 4: Callisto Trailing - Background Thu Feb 29 19:01:07 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Callisto Trailing - Background (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	Callisto-Bkg	STD=JUPITER	STD=CALLISTO	TYPE=POS_ANGLE,RAD=20,ANG=-4,REF=NORTH

Comments: MIRI MRS background should be 20 arcsec N of Callisto, to make sure it is off the MIRI FOV, and taken immediately after the science observation. Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	NO	FULL	NEUTRAL

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	ETC Wkbk.Calc ID
1	SHORT(A)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
1	SHORT(A)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	
2	MEDIUM(B)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
2	MEDIUM(B)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	
3	LONG(C)	MRSLONG		FASTR1	5	60	1	Dither 1	2	120	1992.479	
3	LONG(C)	MRSSHORT		FASTR1	5	60	1	Dither 1	2	120	1992.479	

Special Requirements	
	Group Observations 2, 4, Non-interruptible DEFAULT WINDOW: NOT OCCULTATION OF Callisto-Bkg BY JUPITER FROM JWST DEFAULT WINDOW: SEPARATION OF Callisto-Bkg IO FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto-Bkg EUROPA FROM JWST GREATER THAN 10" DEFAULT WINDOW: SEPARATION OF Callisto-Bkg GANYMEDE FROM JWST GREATER THAN 10" DEFAULT WINDOW: ANGULAR RATE Callisto-Bkg FROM JWST LESS THAN 0.075