



2787 - A sensitive search for rings and small moons in the Martian system using JWST

Cycle: 1, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Rings				
	1	RingPA1a	NIRCam Imaging	(1) MARS
	101	RingPA1a	NIRCam Imaging	(1) MARS
	2	RingPA1b	NIRCam Imaging	(1) MARS
	102	RingPA1b	NIRCam Imaging	(1) MARS
	3	RingPA2a	NIRCam Imaging	(1) MARS
	4	RingPA2b	NIRCam Imaging	(1) MARS
	5	Mars	NIRCam Imaging	(1) MARS

ABSTRACT

We propose a sensitive search for rings and small moons around Mars that would radically change our knowledge of the Mars system, and set unprecedented constraints on the existence of rings and the evolution of Mars and its moons. The most sensitive search for Martian rings to date was with the Hubble Space Telescope (Showalter et al., 2006), which set upper limits. The orders of magnitude improvement in sensitivity with JWST will put stringent constraints on how ejecta rings are created, and about the formation and evolution of the Mars system.

We request Director's Discretionary observations for several reasons. 1) JWST's PSF is better than predicted and the residual scattered light from the bright planets is less than expected; these result in exquisite capabilities of JWST to detect faint ring signatures near bright objects as demonstrated for Jupiter and Neptune. 2) The window of opportunity for this observation is exceedingly rare; it occurs in late March 2023 both due to the availability of Mars in the JWST Field of Regard and the edge-on orientation of the Martian rings; the next opportunity is in 2033. 3) The JWST PA can rotate in a very restrictive way, and fortunately, the allowed range is good for our proposed observations in March 2023. 4) The time request is modest but the science return could be major: only a total of 6 hours of observation would lead to orders of magnitude improvement over our current understanding of planetary ring formation, and, if successful, yield an outcome with significant public appeal.

OBSERVING DESCRIPTION

The proposed observations require the large dynamic range provided by JWST. We employ broad band filters to do deep probes for rings, and narrow band filters with sub-array reading to accurately capture the Mars fluxes. The NIRCcam filters targeting the rings were selected to maximize signal-to-noise and to minimize the PSF, while the observations targeting Mars employ small subarray readouts and filters that ensure linearity. The filters for Mars are the same as those employed for our successful GTO observations that took place in September 2022. The sub-sampling mode only captures the center of the planet, and the proposed short integrations in this mode are solely done to provide an auxiliary calibration point to our measurements.

Proposal 2787 - Targets - A sensitive search for rings and small moons in the Martian system using JWST

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	MARS	STD=MARS		
<i>Comments: The observations needd</i>					
<i>Extended=YES</i>					

Proposal 2787 - Observation 1 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 1: RingPA1a</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(RingPA1a (Obs 1)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9SC024389 in Guider 2'.</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Solar System Targets	#	Name	Level 1	Level 2			Level 3			
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module		Subarray				Target Placement			
	B		FULL				Module Gap			
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions
	1	NONE				STANDARD				16
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	<p>After Date 15-MAR-2023</p> <p>Guide Star ID N9SC024389 in Guider 2</p> <p>Sequence Observations 1, 2, Non-interruptible</p> <p>Group Observations 1, 2, 3, 4, 5 within 1.5 Days</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									

Proposal 2787 - Observation 101 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 101: RingPA1a</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(RingPA1a (Obs 101)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9S6002459 in Guider 2'.</p> <p>(Visit 101:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Visit 101:1) Warning (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.</p>									
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module	Subarray			Target Placement					
	B	FULL			Module Gap					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		STANDARD		16				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	<p>After Date 15-MAR-2023</p> <p>Guide Star ID N9S6002459 in Guider 2</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									

Proposal 2787 - Observation 2 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 2: RingPA1b</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(RingPA1b (Obs 2)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9SC024595 in Guider 2'.</p> <p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module	Subarray			Target Placement					
	B	FULL			Module Gap					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		STANDARD		16				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	<p>Guide Star ID N9SC024595 in Guider 2</p> <p>Sequence Observations 1, 2, Non-interruptible</p> <p>Group Observations 1, 2, 3, 4, 5 within 1.5 Days</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									

Proposal 2787 - Observation 102 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 102: RingPA1b</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(RingPA1b (Obs 102)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9S6002507 in Guider 2'.</p> <p>(Visit 102:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Solar System Targets	#	Name	Level 1	Level 2			Level 3			
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module		Subarray			Target Placement				
	B		FULL			Module Gap				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions
	1	NONE				STANDARD				16
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	<p>Guide Star ID N9S6002507 in Guider 2</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									

Proposal 2787 - Observation 3 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 3: RingPA2a</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(RingPA2a (Obs 3)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9SC000167 in Guider 2'.</p> <p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module	Subarray			Target Placement					
	B	FULL			Module Gap					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		STANDARD		16				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	<p>Guide Star ID N9SC000167 in Guider 2</p> <p>Sequence Observations 3, 4, Non-interruptible</p> <p>Group Observations 1, 2, 3, 4, 5 within 1.5 Days</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									

Proposal 2787 - Observation 4 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	Proposal 2787, Observation 4: RingPA2b Diagnostic Status: Error Observing Template: NIRCam Imaging									
	(RingPA2b (Obs 4)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9SC024021 in Guider 2'. (Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
Diagnostics										
Solar System Targets	#	Name	Level 1	Level 2	Level 3					
	(1)	MARS	STD=MARS			Comments: The observations needd Extended=YES				
Template	Module	Subarray			Target Placement					
	B	FULL			Module Gap					
Dithers	#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions				
	1	NONE		STANDARD		16				
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F150W2	F277W	RAPID	2	2	32	16	858.942	
Special Requirements	Guide Star ID N9SC024021 in Guider 2 Sequence Observations 3, 4, Non-interruptible Group Observations 1, 2, 3, 4, 5 within 1.5 Days DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075									

Proposal 2787 - Observation 5 - A sensitive search for rings and small moons in the Martian system using JWST

Thu Mar 23 21:01:14 GMT 2023

Observation	<p>Proposal 2787, Observation 5: Mars</p> <p>Diagnostic Status: Error</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(Mars (Obs 5)) Error (Form): Permission has not been granted for this program to use Special Requirement 'Guide Star ID N9SC023912 in Guider 2'.</p> <p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Solar System Targets	#	Name	Level 1	Level 2			Level 3			
	(1)	MARS	STD=MARS							
	<p><i>Comments: The observations needd</i></p> <p><i>Extended=YES</i></p>									
Template	Module		Subarray			Target Placement				
	B		SUB160P			Module Gap				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions
	1	NONE				STANDARD				2
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F212N	F430M	RAPID	2	10	20	2	16.821	
Special Requirements	<p>Guide Star ID N9SC023912 in Guider 2</p> <p>Group Observations 1, 2, 3, 4, 5 within 1.5 Days</p> <p>DEFAULT WINDOW: ANGULAR RATE MARS FROM JWST LESS THAN 0.075</p>									