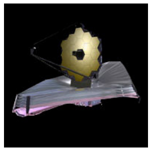

8864 - Surveying Hellish Worlds: Lava Planets as Time Capsules of Thermal Evolution

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
MIRI Phase Curve				
	1	TOI-1807b	MIRI Low Resolution Spectroscopy	(1) TOI-1807b
	2	TOI-2260b	MIRI Low Resolution Spectroscopy	(2) TOI-2260b
	3	TOI-431b	MIRI Low Resolution Spectroscopy	(3) TOI-431b
	4	TOI-2431b	MIRI Low Resolution Spectroscopy	(4) TOI-2431b
	5	TOI-6255b	MIRI Low Resolution Spectroscopy	(5) TOI-6255b

ABSTRACT

Stripped of their primordial atmospheres and heated to extremes that expose a molten surface, lava planets offer a rare and unparalleled opportunity to directly probe the interior of rocky exoplanets. We propose a comparative study of thermal phase curves for five lava worlds, spanning a wide range of ages, to move beyond the typical snapshot view of exoplanets. Our proposed MIRI LRS phase curves will map the atmosphere and surface thermal emission of the planet which uniquely their nightside temperatures and constrain total energy budgets to infer whether their interior is fully molten or has solidified. Moreover, our observations will measure emission spectra of their dayside –predicted to harbor a tenuous atmosphere

outgassed from the dayside magma ocean– to unveil its composition which is influenced by its interior state. Volcanic activity driven by a molten interior beneath the planet's crust—much like what occurs on Io– could release sulfur into the atmosphere. Together, the energy budgets and atmospheric compositions will allow us to connect atmospheric properties to the interior thermal states of lava planets, offering a first step toward answering key questions about the formation and evolution of rocky planets. Since all terrestrial planets start as molten bodies, permanent lava planets provide a unique window into the geophysics of early stages of rocky bodies in and beyond the Solar System.

OBSERVING DESCRIPTION

We propose to observe each full-orbit phase curve using MIRI LRS, starting approximately 2.7 hours before the secondary eclipse and ending about 1.7 hours after the second eclipse. The extended baseline before the first eclipse includes a one-hour burn-in period. This baseline also accounts for uncertainties in transit times. For each observation, we will use the F1500W filter with the FAST readout mode for target acquisition, ensuring an SNR > 700.

Each MIRI LRS science phase curve will use the SLITLESSPRISM subarray with FAST readout. The JWST ETC was used to estimate the optimal number of groups per integration to avoid detector saturation. The total requested science time for 5 full-orbit phase curves, including target acquisition, amounts to approximately 74.5 hours, with a total charged time of 100.4 hours and a data volume of 133745.79 MB.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TOI-1807b	RA: 13 25 7.9957 (201.2833154d) Dec: +38 55 20.94 (38.92248d) Equinox: J2000	Proper Motion RA: -124.608 mas/yr Proper Motion Dec: -27.30000003339228 mas/yr Parallax: 0.0234804" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]
Extended=NO

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	TOI-2260b	RA: 16 30 40.1197 (247.6671654d) Dec: +49 02 47.49 (49.04652d) Equinox: J2000	Proper Motion RA: -25.207 mas/yr Proper Motion Dec: 61.451 mas/yr Parallax: 0.0098885" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[G stars]
Extended=NO

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	TOI-431b	RA: 05 33 4.6005 (83.2691688d) Dec: -26 43 28.27 (-26.72452d) Equinox: J2000	Proper Motion RA: 16.886 mas/yr Proper Motion Dec: 150.779 mas/yr Parallax: 0.0306517" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]
Extended=NO

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	TOI-2431b	RA: 02 31 3.2802 (37.7636675d) Dec: +08 22 55.18 (8.38199d) Equinox: J2000	Proper Motion RA: 374.862 mas/yr Proper Motion Dec: -85.68700002342666 mas/yr Parallax: 0.0277716" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]

	(5)	TOI-6255b	RA: 22 06 0.6662 (331.5027758d) Dec: +39 18 2.90 (39.30081d) Equinox: J2000	Proper Motion RA: 69.116 mas/yr Proper Motion Dec: -459.05300005415484 mas/yr Parallax: 0.0490544" Epoch of Position: 2000

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[M stars]
Extended=NO

Observation

Proposal 8864, Observation 1: TOI-1807b

Thu May 08 20:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(TOI-1807b (Obs 1)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TOI-1807b	RA: 13 25 7.9957 (201.2833154d) Dec: +38 55 20.94 (38.92248d) Equinox: J2000	Proper Motion RA: -124.608 mas/yr Proper Motion Dec: -27.30000003339228 mas/yr Parallax: 0.0234804" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	22	1	1	3.499	226483.2

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	10	13492	40476	3	1	70809.856	226483.1

Special Requirements	
	Phase 0.10808774272588947 to 0.16497066765499058 with period 1.098748 Days and zero-phase 2458899.3449 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 8864, Observation 2: TOI-2260b Thu May 08 20:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(TOI-2260b (Obs 2)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	TOI-2260b	RA: 16 30 40.1197 (247.6671654d) Dec: +49 02 47.49 (49.04652d) Equinox: J2000	Proper Motion RA: -25.207 mas/yr Proper Motion Dec: 61.451 mas/yr Parallax: 0.0098885" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[G stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	44	1	1	6.998	226483.4

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	25	4928	19712	4	1	81509.272	226483.3

Special Requirements	
	Phase 0.03425164226375687 to 0.0933578579301383 with period 1.0574184 Days and zero-phase 2458928.239 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 8864, Observation 3: TOI-431b

Thu May 08 20:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(TOI-431b (Obs 3)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	TOI-431b	RA: 05 33 4.6005 (83.2691688d) Dec: -26 43 28.27 (-26.72452d) Equinox: J2000	Proper Motion RA: 16.886 mas/yr Proper Motion Dec: 150.779 mas/yr Parallax: 0.0306517" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	10	1	1	1.59	226483.6

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	5	16992	67968	4	1	64857.148	226483.5

Special Requirements	
Special Requirements	Phase 0.095797691715753 54 to 0.15956708526371935 with period 0.980094 Days and zero-phase 2458627.538 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 8864, Observation 4: TOI-2431b

Thu May 08 20:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(TOI-2431b (Obs 4)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	TOI-2431b	RA: 02 31 3.2802 (37.7636675d)	Proper Motion RA: 374.862 mas/yr	
		Dec: +08 22 55.18 (8.38199d)	Proper Motion Dec: -85.68700002342666 mas/yr	
		Equinox: J2000	Parallax: 0.0277716"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[K stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	22	1	1	3.499	226483.8

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	10	11035	22070	2	1	38609.823	226483.7

Special Requirements	
	Phase -0.02610364390491314 to 0.06682137244617274 with period 0.6725853 Days and zero-phase 2459145.116151 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 8864, Observation 5: TOI-6255b Thu May 08 20:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(TOI-6255b (Obs 5)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	TOI-6255b	RA: 22 06 0.6662 (331.5027758d) Dec: +39 18 2.90 (39.30081d) Equinox: J2000	Proper Motion RA: 69.116 mas/yr Proper Motion Dec: -459.05300005415484 mas/yr Parallax: 0.0490544" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[M stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	36	1	1	5.725	226483.10

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	13	8705	17410	2	1	38764.092	226483.9

Special Requirements	
	Phase -0.0007734972217443421 to 0.08669446781099834 with period 0.71454732 Days and zero-phase 2458738.71248 HJD Time Series Observation No Parallel Attachments