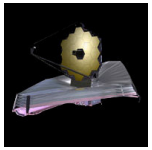

6457 - Thermal emission of a cool, potentially volcanically active exo-Earth

Cycle: 3, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Prof. Bjorn Benneke (PI)	**University of California - Los Angeles**
Dr. Caroline Piaulet Ghorayeb (CoI)	University of Chicago
M. Pierre-Alexis Roy (CoI) (CSA Member)	Universite de Montreal

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Eclipse	MIRI Imaging	(1) LP-791-18
	2	Eclipse	MIRI Imaging	(1) LP-791-18
	3	Eclipse	MIRI Imaging	(1) LP-791-18
	4	Eclipse	MIRI Imaging	(1) LP-791-18
	5	Eclipse	MIRI Imaging	(1) LP-791-18

ABSTRACT

Rocky planets are abundant in the Universe; yet our understanding of which and how many of them host atmospheres remains highly limited. Empirical evidence is needed in our quest of understanding the complex interplay between the initial volatile content of rocky planets and the atmospheric loss and replenishment processes that drive the atmospheric evolution. Here, we propose to observe the mid-IR thermal emission of the recently discovered cool exo-Earth LP 791-18d to determine whether an atmosphere is present or not. LP 791-18d orbits a nearby M6 dwarf and is proposed to be volcanically active due to strong tidal heating of its interior, similar to Jupiter's moon Io. The volcanic activity would result in continuous replenishment of LP 791-18d's atmosphere, which our observations will probe for. Our observations are designed to distinguish at 4 sigma confidence between a bare-rock scenario and a CO2-rich atmosphere that efficiently transports heat around the planets, even in the presence of Venus-like clouds. The presence of an atmosphere on LP 791-18d would be a first signal that cool rocky planet around M dwarf can host

atmospheres, motivating a larger campaign to probe the prevalence and diversity of secondary atmospheres.

OBSERVING DESCRIPTION

Our observations consist of time series photometry during five eclipses of the tidally-heated rocky planet LP 791-18d. For each eclipse, the observations will be performed with the MIRI F1500W filter and SUB256 subarray. They must be executed in a continuous sequence.

Each of the five visits must be timed to coincide with eclipses of the planet. They occur every 2.75 days.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LP-791-18	RA: 11 02 45.9546 (165.6914775d)	Proper Motion RA: -221.291 mas/yr	
		Dec: -16 24 22.29 (-16.40619d)	Proper Motion Dec: -58.840999963649665 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Observation

Proposal 6457, Observation 1: Eclipse

Wed Oct 23 16:00:18 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Eclipse (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)	LP-791-18	RA: 11 02 45.9546 (165.6914775d)	Proper Motion RA: -221.291 mas/yr	
		Dec: -16 24 22.29 (-16.40619d)	Proper Motion Dec: -58.840999963649665 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	130	298	1	None	1	298	11692.362	178734

Special Requirements

Phase 0.4666 to 0.4817 with period 2.753436 Days and zero-phase 2458772.16211 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 6457, Observation 2: Eclipse Wed Oct 23 16:00:18 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Eclipse (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
(1)	LP-791-18	RA: 11 02 45.9546 (165.6914775d) Dec: -16 24 22.29 (-16.40619d) Equinox: J2000	Proper Motion RA: -221.291 mas/yr Proper Motion Dec: -58.840999963649665 mas/yr Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	130	298	1	None	1	298	11692.362	178734

Special Requirements

Phase 0.4666 to 0.4817 with period 2.753436 Days and zero-phase 2458772.16211 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 6457, Observation 3: Eclipse

Wed Oct 23 16:00:18 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Eclipse (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
(1)	LP-791-18	RA: 11 02 45.9546 (165.6914775d)	Proper Motion RA: -221.291 mas/yr	
		Dec: -16 24 22.29 (-16.40619d)	Proper Motion Dec: -58.840999963649665 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	130	298	1	None	1	298	11692.362	178734

Special Requirements

Phase 0.4666 to 0.4817 with period 2.753436 Days and zero-phase 2458772.16211 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 6457, Observation 4: Eclipse

Wed Oct 23 16:00:18 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Eclipse (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
(1)	LP-791-18	RA: 11 02 45.9546 (165.6914775d)	Proper Motion RA: -221.291 mas/yr	
		Dec: -16 24 22.29 (-16.40619d)	Proper Motion Dec: -58.840999963649665 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	130	298	1	None	1	298	11692.362	178734

Special Requirements

Phase 0.4666 to 0.4817 with period 2.753436 Days and zero-phase 2458772.16211 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 6457, Observation 5: Eclipse

Wed Oct 23 16:00:18 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Eclipse (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
(1)	LP-791-18	RA: 11 02 45.9546 (165.6914775d)	Proper Motion RA: -221.291 mas/yr	
		Dec: -16 24 22.29 (-16.40619d)	Proper Motion Dec: -58.840999963649665 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M dwarfs]

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	130	298	1	None	1	298	11692.362	178734

Special Requirements

Phase 0.4666 to 0.4817 with period 2.753436 Days and zero-phase 2458772.16211 HJD
Time Series Observation
No Parallel Attachments