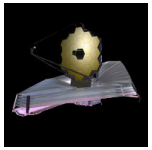

2708 - The Thermal Emission Spectrum of the Closest M Dwarf Transiting Rocky Planet

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
First Visit with Wider Baseline				
	1	Visit 1	MIRI Low Resolution Spectroscopy	(1) LTT1445A
Second Visit				
	2	Visit 1	MIRI Low Resolution Spectroscopy	(1) LTT1445A
Third Visit				
	3	Visit 1	MIRI Low Resolution Spectroscopy	(1) LTT1445A

ABSTRACT

The rocky planets in our Solar System each have their own complicated stories to tell, and we have decades of data observing them up close. Yet, looking at the innermost worlds of Mercury and Venus, we still don't have complete answers to simple questions. How much bigger would Mercury need to be, in order for it to have retained an atmosphere? How much more closely to the Sun could Venus orbit, without its thick atmosphere eroding into space? Observations of exoplanets can help answer these questions. Both thanks to exoplanet discovery efforts that have provided worlds starting to resemble those our Solar System and thanks to Webb for providing the long-wavelength sensitivity needed to observe these cool

planets, we can start to directly observe planets that resemble our own. Here, we propose to use MIRI/LRS to observe the emission spectrum of the exoplanet LTT1445Ab and use its dayside temperature to determine whether or not it has an atmosphere. At mere 6.9pc away, the LTT1445 system is the closest M dwarf know to host a transiting planet, and determining whether or not it has an atmosphere provides crucial context for the decade of exoplanetary science ahead. This work would provide valuable insight to atmospheric escape from rocky planets both within the Solar System and beyond.

OBSERVING DESCRIPTION

We plan to observe three eclipses of LTT1445Ab the the MIRI/LRS. We will use the SLITLESSPRISM subarray and FASTR1 readout mode, with 5 groups/integration. This strategy reaches 80% of saturation at the peak of the spectrum.

The total time for the first eclipse visit is 6.06 hours; after the recommended 0.5 hours of detector settling time at the start of the observation (which was broadly confirmed by the TSO commissioning dataset showing a ~20 minute ramp), this leaves 5.56 hours centered on the predicted time of eclipse for circular orbit. The total time for the later two visits is 3.76 hours each, leaving 3.26 hours after settling time. The predicted eclipse duration is 1.38 hours, leaving sufficient out-of-eclipse time in all visits to characterize the out-of-eclipse baseline flux level.

The star is bright, so the photon noise of the observations could exceed the the often-quoted 50ppm systematic noise floor for MIRI observations. Again, we would love to consult with the instrument team experts after commissioning to identify any possible nudges we can make to the program scheduling to optimize performance and correct this noise ass best we can.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LTT1445A	RA: 03 01 50.9800 (45.4624167d)	Proper Motion RA: -369.97184335074684 mas/yr	
		Dec: -16 35 40.32 (-16.59453d)	Proper Motion Dec: -267.931311928784 mas/yr	
		Equinox: J2000	Parallax: 0.1456922"	
			Epoch of Position: 2016	

Comments: Coordinates from Gaia EDR3, epoch=2016. We added the annual parallax, as it is comparable to the FWHM of the MIRI PSF at the shortest wavelengths.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, Multiple stars]
Extended=NO

Observation

Proposal 2708, Observation 1: Visit 1 Thu Dec 08 16:00:26 GMT 2022

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: The phase constraint corresponds to 1 hour of flexibility. To provide time to make changes if necessary for the later visits, Observation Links have been defined to introduce a gap after the first visit (and to order the visits in time). Position angle constraints have been added to keep the projected separation between the A component we want to observe and the BC pair larger than 4", which is 10X the FWHM of the MIRI PSF at 12 microns.

Diagnostics

(Visit 1 (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)	LTT1445A	RA: 03 01 50.9800 (45.4624167d)	Proper Motion RA: -369.97184335074684 mas/yr	
		Dec: -16 35 40.32 (-16.59453d)	Proper Motion Dec: -267.931311928784 mas/yr	
		Equinox: J2000	Parallax: 0.1456922"	
			Epoch of Position: 2016	

Comments: Coordinates from Gaia EDR3, epoch=2016. We added the annual parallax, as it is comparable to the FWHM of the MIRI PSF at the shortest wavelengths.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, Multiple stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LTT1445A	F1500W	FAST	10	1	1	1.59	119285

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

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

Pointing Verification

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	FAST	10	1	1	1.59	119285

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	5	22862	22862	1	1	21815.676	119285

Special Requirements

Phase 0.469364835886244 to 0.47714025825014145 with period 5.3587657 Days and zero-phase 2458412.70851 HJD
Aperture PA Range 0 to 90 Degrees (V3 355.16455103 to 85.16455103)
Aperture PA Range 180 to 270 Degrees (V3 175.16455103 to 265.16455103)
Time Series Observation
No Parallel Attachments
No Parallel Attachments

Observation

Proposal 2708, Observation 2: Visit 1 Thu Dec 08 16:00:26 GMT 2022

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: The phase constraint corresponds to 1 hour of flexibility. Once we look at the data first visit and refine the timing of the eclipse, we will want to nudge the phase constraints to center more accurately on the exact eclipse time. To provide time to make changes if necessary, Observation Links have been defined to introduce a gap after the first visit (and to order the visits in time). Position angle constraints have been added to keep the projected separation between the A component we want to observe and the BC pair larger than 4", which is 10X the FWHM of the MIRI PSF at 12 microns.

Diagnostics

(Visit 1 (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)	LTT1445A	RA: 03 01 50.9800 (45.4624167d)	Proper Motion RA: -369.97184335074684 mas/yr	
		Dec: -16 35 40.32 (-16.59453d)	Proper Motion Dec: -267.931311928784 mas/yr	
		Equinox: J2000	Parallax: 0.1456922"	
			Epoch of Position: 2016	

Comments: Coordinates from Gaia EDR3, epoch=2016. We added the annual parallax, as it is comparable to the FWHM of the MIRI PSF at the shortest wavelengths.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, Multiple stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LTT1445A	F1500W	FAST	10	1	1	1.59	119285

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

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

Pointing Verification

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	FAST	10	1	1	1.59	119285

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	5	14185	14185	1	1	13535.735	119285

Special Requirements

Phase 0.4789545234683842 to 0.4867299458322817 with period 5.3587657 Days and zero-phase 2458412.70851 HJD
Aperture PA Range 0 to 90 Degrees (V3 355.16455103 to 85.16455103)
Aperture PA Range 180 to 270 Degrees (V3 175.16455103 to 265.16455103)
Time Series Observation
No Parallel Attachments
No Parallel Attachments

Observation

Proposal 2708, Observation 3: Visit 1 Thu Dec 08 16:00:26 GMT 2022

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: The phase constraint corresponds to 1 hour of flexibility. Once we look at the data first visit and refine the timing of the eclipse, we will want to nudge the phase constraints to center more accurately on the exact eclipse time. To provide time to make changes if necessary, Observation Links have been defined to introduce a gap after the first visit (and to order the visits in time). Position angle constraints have been added to keep the projected separation between the A component we want to observe and the BC pair larger than 4", which is 10X the FWHM of the MIRI PSF at 12 microns.

Diagnostics

(Visit 1 (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)	LTT1445A	RA: 03 01 50.9800 (45.4624167d)	Proper Motion RA: -369.97184335074684 mas/yr	
		Dec: -16 35 40.32 (-16.59453d)	Proper Motion Dec: -267.931311928784 mas/yr	
		Equinox: J2000	Parallax: 0.1456922"	
			Epoch of Position: 2016	

Comments: Coordinates from Gaia EDR3, epoch=2016. We added the annual parallax, as it is comparable to the FWHM of the MIRI PSF at the shortest wavelengths.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, Multiple stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LTT1445A	F1500W	FAST	10	1	1	1.59	119285

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

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

Pointing Verification

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	FAST	10	1	1	1.59	119285

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	5	14185	14185	1	1	13535.735	119285

Special Requirements

Phase 0.4789545234683842 to 0.4867299458322817 with period 5.3587657 Days and zero-phase 2458412.70851 HJD
Aperture PA Range 0 to 90 Degrees (V3 355.16455103 to 85.16455103)
Aperture PA Range 180 to 270 Degrees (V3 175.16455103 to 265.16455103)
Time Series Observation
No Parallel Attachments
No Parallel Attachments