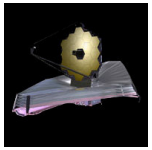

1743 - Constraining the Atmosphere of the Terrestrial Exoplanet Gl486b

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Gl 486b				
	1	Gl486_visit1	MIRI Low Resolution Spectroscopy	(1) GL486
	2	Gl486_visit2	MIRI Low Resolution Spectroscopy	(1) GL486

ABSTRACT

JWST will provide the first opportunity to search for signs of habitability on terrestrial planets orbiting M dwarf stars. However, it is currently unknown whether planets around M dwarfs can retain atmospheres given the relatively violent history of extreme UV irradiation from their host stars. The first step to understanding the habitability of rocky planets is therefore to establish whether M dwarf terrestrial planets can retain significant atmospheres. Furthermore, terrestrial exoplanets well inside the inner edge of the habitable zone offer a chance to test theories of atmospheric evolution in a previously unexplored regime.

We propose to use MIRI/LRS secondary eclipse observations to search for the presence of an atmosphere on the terrestrial M dwarf planet Gl 486b

(TOI 1827.01) and to constrain its composition. Gl 486b is the highest signal-to-noise terrestrial planet for these observations other than LHS 3844b, which has been previously observed with Spitzer and found to not posess an atmosphere. Additionally, Gl 486b has less than one quarter of the integrated XUV flux of LHS 3844b, which means it is much more likely to have retained an atmosphere. We find that with two secondary eclipse observations of Gl 486b we can determine whether or not it has an atmosphere with a surface pressure of P1 bar at the 5-sigma significance level. The observed spectrum will also constrain the composition of its atmosphere (if one is observed) or surface (if no atmosphere is detected) at the 3-sigma significance level. These observations will provide valuable data for constraining the impact of M dwarf irradiation on terrestrial planet atmospheres.

OBSERVING DESCRIPTION

We will perform time-series observations to measure the secondary eclipse of the exoplanet Gl 486b. The fundamental parameter that determines the length of our time-series observations is the eclipse duration of Gl 486b, which is 1.08 hours. In addition to this length of time, we need to observe out-of-eclipse baseline in order to identify and effectively model any instrument systematics. Such systematics typically introduce red noise, which can occur on varying timescales and requires longer observational baselines to identify, characterize, and remove. We include 3 hours of baseline, as a 3/1 ratio of baseline to in-eclipse observing should allow us to successfully identify and remove systematics. We also include 30 minutes to allow the telescope to settle. Including such a settling time has become standard in space-based exoplanet observations because of the increased influence of instrument systematics immediately after repointing. For example, Spitzer Space Telescope observations often included 30 minutes of settling time and Hubble Space Telescope observations frequently included an orbit (about 45 minutes) of settling time. Including overheads, the total time we request for these observations is therefore 6.3 hours per eclipse, or a total of 12.6 hours for the two eclipse observations.

MIRI/LRS time-series observations use the SLITLESSPRISM mode without dithers. We used PandExo to simulate our proposed observations and determine the optimal observing pattern. We will use the FAST readout pattern with 5 groups/integration and 20735 integrations/exposure, for a total of 4.58 hours of observing time per visit. This observing strategy will ensure we remain below 76% of the saturation limit and has an overall efficiency of 80%. The visit must cover the secondary eclipse of Gl 486b, so the phase constraints we have placed ensure that there will be at least 1 hour of out-of-eclipse baseline on either side of the eclipse.

We will use the F1500W filter for target acquisition. Our single target acquisition integration will consist of 4 groups, which will result in a SNR of 420 for target acquisition while staying at 17% of the saturation limit.

Proposal 1743 - Targets - Constraining the Atmosphere of the Terrestrial Exoplanet Gl486b

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GL486	RA: 12 47 55.5675 (191.9815313d) Dec: +09 44 57.91 (9.74942d) Equinox: J2000	Proper Motion RA: -0.06822546051816196 sec of time/yr Proper Motion Dec: -0.45979999993051024 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanets]
Extended=NO

Observation

Proposal 1743, Observation 1: Gl486_visit1

Tue Aug 27 19:00:09 GMT 2024

Diagnostic Status: Error

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Gl486_visit1 (Obs 1)) Error (Form): Permission has not been granted for this program to use Special Requirement 'No Parallel Attachments'.

(Gl486_visit1 (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.

(Gl486_visit1 (Obs 1)) Warning (Form): Groups/Int cannot be 1, Groups/Int = 2 requires permission and Groups/Int of 3-4 is allowed but not recommended.

(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)	GL486	RA: 12 47 55.5675 (191.9815313d) Dec: +09 44 57.91 (9.74942d) Equinox: J2000	Proper Motion RA: -0.06822546051816196 sec of time/yr Proper Motion Dec: -0.45979999993051024 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanets]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	4	1	1	0.636	59209.2

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

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	4	1	1	1	1	0.636		F1500W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	6	14810	14810	1	1	16487.518	82457.1

Special Requirements

Phase 0.414 to 0.456 with period 1.46713 Days and zero-phase 2458931.1593 HJD
Time Series Observation
No Parallel Attachments
No Parallel Attachments

Observation

Proposal 1743, Observation 2: Gl486_visit2

Tue Aug 27 19:00:09 GMT 2024

Diagnostic Status: Error

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Gl486_visit2 (Obs 2)) Error (Form): Permission has not been granted for this program to use Special Requirement 'No Parallel Attachments'.

(Gl486_visit2 (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.

(Gl486_visit2 (Obs 2)) Warning (Form): Groups/Int cannot be 1, Groups/Int = 2 requires permission and Groups/Int of 3-4 is allowed but not recommended.

(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)	GL486	RA: 12 47 55.5675 (191.9815313d) Dec: +09 44 57.91 (9.74942d) Equinox: J2000	Proper Motion RA: -0.06822546051816196 sec of time/yr Proper Motion Dec: -0.45979999993051024 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanets]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F1500W	FAST	4	1	1	0.636	59209.2

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

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	4	1	1	1	1	0.636		F1500W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	6	14810	14810	1	1	16487.518	82457.1

Special Requirements

Phase 0.414 to 0.456 with period 1.46713 Days and zero-phase 2458931.1593 HJD
Time Series Observation
No Parallel Attachments
No Parallel Attachments