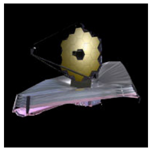

7675 - Confirming a Tentative Terrestrial Atmosphere Detection on LHS 1478 b with JWST/MIRI

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
LHS-1478_MIRI_LRS				
	1	LHS-1478_LRS_1	MIRI Low Resolution Spectroscopy	(1) LHS-1478
	2	LHS-1478_LRS_2	MIRI Low Resolution Spectroscopy	(1) LHS-1478
	3	LHS-1478_LRS_3	MIRI Low Resolution Spectroscopy	(1) LHS-1478
	4	LHS-1478_LRS_4	MIRI Low Resolution Spectroscopy	(1) LHS-1478
	5	LHS-1478_LRS_5	MIRI Low Resolution Spectroscopy	(1) LHS-1478
LHS-1478_MIRI_F1500W				
	6	LHS-1478_F1500W_1	MIRI Imaging	(1) LHS-1478
	7	LHS-1478_F1500W_2	MIRI Imaging	(1) LHS-1478

ABSTRACT

We have yet to definitively detect an atmosphere around a rocky exoplanet, and LHS 1478 b (R_p = 1.24 R_Earth, M_p = 2.33 M_Earth; Soto et al. 2021) is currently the most promising candidate. Initial observations from the Hot Rocks Survey (GO 3730) suggest tentative evidence of an atmosphere, with JWST/MIRI 15um photometric data revealing a shallow eclipse inconsistent with a bare-rock, A_B = 0.1 Bond albedo blackbody at 3.1 sigma significance. However, inconsistencies between the two eclipse observations necessitate follow-up to confirm this result. Our proposed program will provide follow-up observations with broader spectral coverage using MIRI LRS and additional observations at 15um to definitely confirm or reject the presence of an atmosphere. If confirmed, this program would enable the first detection of a rocky planet atmosphere and allow for subsequent characterization of its atmosphere, focusing on likely constituents such as CO2 and H2O. Conversely, in the event of no atmosphere, this program would challenge the current atmospheric diagnostic methods based on single-band photometry and offer a unique opportunity to study the composition and surface properties of rocky exoplanets. Either outcome will significantly advance our understanding of rocky planets orbiting M dwarfs and guide future atmospheric studies.

OBSERVING DESCRIPTION

We will perform secondary eclipse observations of LHS 1478 b to measure its mid-infrared thermal emission spectrum. We request 38.4 hours of observations with JWST/MIRI, split into five visits timed around secondary eclipse events with LRS as well as two visits in Imaging mode with the F1500W photometric filter.

The duration of an eclipse event for LHS 1478 b is 42 minutes. Following a 3 to 1 baseline to eclipse time ratio, we include 1.4 hours of out-of-eclipse observations in order to accurately measure the baseline flux. We also add an extra hour to account for the uncertainty around the starting time of observations, as well as 45 minutes of settling time.

We use Pandexo-v3.0 to simulate our observations.
For MIRI LRS, we use the FASTR1 readout pattern with 32 groups/integration and 2647 integrations/exposure. This gives a total of 3.85 hours of observing time per visit (5.5 total charged). MIRI LRS uses the SLITLESSPRISM mode without dithers.
For the MIRI F1500W observation, we use the FASTR1 readout pattern on the sub256 subarray, as was done in GO 3730 (PI Diamond-Lowe, Co-PI Mendonca). We use 39 groups/integration and 1160 integrations/exposure. This also gives a total of 3.85 hours of observing time per visit (5.3 total charged). We do not use a dither.

For the MIRI LRS observations, we will use the F1500W filter for a single target acquisition, with 4 groups, giving a SNR of 757 while staying at 57% of the saturation limit.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Observation

Proposal 7675, Observation 1: LHS-1478_LRS_1

Tue Jul 08 22:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(LHS-1478_LRS_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)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LHS-1478	F1500W	FAST	4	1	1	0.636	223322

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	7	1	1	1	1	1.113		F770W

Proposal 7675 - Observation 1 - Confirming a Tentative Terrestrial Atmosphere Detection on LHS 1478 b with JWST/MIRI

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	32	2647	2647	1	1	13892.144	223322

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Aperture PA Range 74.11544897 to 174.93544897 Degrees (V3 69.28 to 170.1)
Aperture PA Range 252.33544897 to 352.93544897 Degrees (V3 247.5 to 348.1)
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 2: LHS-1478_LRS_2

Tue Jul 08 22:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(LHS-1478_LRS_2 (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)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LHS-1478	F1500W	FAST	4	1	1	0.636	223322

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	7	1	1	1	1	1.113		F770W

Proposal 7675 - Observation 2 - Confirming a Tentative Terrestrial Atmosphere Detection on LHS 1478 b with JWST/MIRI

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	32	2647	2647	1	1	13892.144	223322

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Aperture PA Range 74.11544897 to 174.93544897 Degrees (V3 69.28 to 170.1)
Aperture PA Range 252.33544897 to 352.93544897 Degrees (V3 247.5 to 348.1)
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 3: LHS-1478_LRS_3

Tue Jul 08 22:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(LHS-1478_LRS_3 (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)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LHS-1478	F1500W	FAST	4	1	1	0.636	223322

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	7	1	1	1	1	1.113		F770W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	32	2647	2647	1	1	13892.144	223322

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Aperture PA Range 74.11544897 to 174.93544897 Degrees (V3 69.28 to 170.1)
Aperture PA Range 252.33544897 to 352.93544897 Degrees (V3 247.5 to 348.1)
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 4: LHS-1478_LRS_4

Tue Jul 08 22:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(LHS-1478_LRS_4 (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)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LHS-1478	F1500W	FAST	4	1	1	0.636	223322

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	7	1	1	1	1	1.113		F770W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	32	2647	2647	1	1	13892.144	223322

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Aperture PA Range 74.11544897 to 174.93544897 Degrees (V3 69.28 to 170.1)
Aperture PA Range 252.33544897 to 352.93544897 Degrees (V3 247.5 to 348.1)
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 5: LHS-1478_LRS_5

Tue Jul 08 22:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(LHS-1478_LRS_5 (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)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 LHS-1478	F1500W	FAST	4	1	1	0.636	223322

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	7	1	1	1	1	1.113		F770W

Proposal 7675 - Observation 5 - Confirming a Tentative Terrestrial Atmosphere Detection on LHS 1478 b with JWST/MIRI

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	32	2647	2647	1	1	13892.144	223322

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Aperture PA Range 74.11544897 to 174.93544897 Degrees (V3 69.28 to 170.1)
Aperture PA Range 252.33544897 to 352.93544897 Degrees (V3 247.5 to 348.1)
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 6: LHS-1478_F1500W_1

Tue Jul 08 22:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS-1478_F1500W_1 (Obs 6)) 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 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

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	39	1160	1	None	1	1160	13897.428	223840

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 7675, Observation 7: LHS-1478_F1500W_2

Tue Jul 08 22:00:11 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS-1478_F1500W_2 (Obs 7)) 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 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS-1478	RA: 02 57 21.4288 (44.3392867d) Dec: +76 33 4.86 (76.55135d) Equinox: J2000	Proper Motion RA: 690.9197545650943 mas/yr Proper Motion Dec: -399.8937562024991 mas/yr Parallax: 0.054903649218226874" Epoch of Position: 2016	

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.

Updated by PI August to Gaia DR3 values using astroquery.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M dwarfs, M stars]

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	39	1160	1	None	1	1160	13897.428	223840

Special Requirements

Phase 0.4390346949586375 to 0.4604072821773448 with period 1.9495378 Days and zero-phase 2458786.753429028 HJD
Time Series Observation
No Parallel Attachments