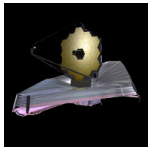

12498 - Rocky Worlds DDT: JWST Observations of LHS 1140 b

Cycle: 4, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
MIRI Imaging Eclipses				
	1	LHS 1140 b Eclipse 1	MIRI Imaging	(1) LHS_1140
	2	LHS 1140 b Eclipse 2	MIRI Imaging	(1) LHS_1140
	3	LHS 1140 b Eclipse 3	MIRI Imaging	(1) LHS_1140
	4	LHS 1140 b Eclipse 4	MIRI Imaging	(1) LHS_1140
	5	LHS 1140 b Eclipse 5	MIRI Imaging	(1) LHS_1140
	6	LHS 1140 b Eclipse 6	MIRI Imaging	(1) LHS_1140
	7	LHS 1140 b Eclipse 7	MIRI Imaging	(1) LHS_1140
	8	LHS 1140 b Eclipse 8	MIRI Imaging	(1) LHS_1140
	9	LHS 1140 b Eclipse 9	MIRI Imaging	(1) LHS_1140

ABSTRACT

Rocky Worlds is a joint JWST and HST Director's Discretionary Program designed to implement the top recommendations from the Working Group on Strategic Exoplanet Initiatives with HST and JWST. The JWST side of the Rocky Worlds DDT focuses on secondary eclipse measurements of rocky exoplanets orbiting nearby M dwarfs. We will take secondary eclipse time series observations at 15 microns with the MIRI/F1500W photometric filter. With these observations we will measure the dayside temperatures of these rocky worlds, which can be compared to planetary models to interpret whether or not an atmosphere may be present. The Rocky Worlds DDT will advance our understanding of individual rocky exoplanets and broadly explore the existence of an M-dwarf Cosmic Shoreline. Follow-up, complementary observations of Rocky Worlds targets are encouraged.

Each rocky world observed by JWST in the Rocky Worlds DDT program has its own set of Program IDs. The observations in this program will focus on LHS 1140 b.

OBSERVING DESCRIPTION

This DDT program will observe secondary eclipses of a sample of rocky planets orbiting M dwarfs with MIRI Imaging photometry at 15 microns using the F1500W filter. The goal of the observations is to measure the dayside temperature as a proxy for the planet's heat redistribution, as well as

to measure possible absorption signatures by CO2. The JWST observations will be combined with HST ultraviolet to blue-optical observations to characterize the host star. The stellar UV spectrum is an essential input for models of atmospheric loss and photochemistry.

The 9 eclipse observations of LHS 1140 b are designed to (a) enable a differentiation, at 3-sigma with a statistical power of 80%, between an exoplanet with full redistribution of energy from the day to the nightside, assuming an albedo of 0.3, and a bare rock scenario (modeled as a blackbody), with an assumed albedo of 0.1, and (b) account for the uncertainty on the time of secondary eclipse. The former definition sets the number of eclipses to observe (9), assuming noise properties coming from the JWST Exposure Time Calculator. The latter defines the observing time and phase-constraints ingested in this APT file, computed using a “Tinker Scheduling” algorithm, for which it was calculated a risk of only ~10% of missing the eclipses if the orbit is truly eccentric. The risk of missing the eclipses if the orbit is circular is zero.

These observations are in turn divided in two “Checkpoints”, after which assessments will be made by the Core Implementation Team (CIT) and the Science Advisory Committee (SAC). Checkpoint 1 (set to Observation 7), will try to detect the eclipse of LHS 1140 b at 3-sigma, which is the best case scenario assuming a bare rock. To add the possibility of slight deviations from the JWST ETC calculations, we have estimated that if the eclipse depth error is 25% larger than the ETC calculation, we should make this detection on the 7th eclipse. In the event that the eclipse is confidently detected after Checkpoint 1, we will be able to shorten the subsequent observing windows for Observations 8-9. This is why Observations 8-9 are put on hold until Observations 1-7 are taken and inspected, and why there is a separation of 6 weeks between Observations 7 and 8 (to allow enough time to perform internal CIT calculations to study the eclipse detectability). If the eclipse is not detected after Checkpoint 1, subsequent observations will continue as planned in the APT submission made in April 2026. The second Checkpoint, set to the 9th eclipse observation (Observations 8-9), completes the set of observations to perform the differentiation between full redistribution and a bare rock described above.

More information about the details of the scheduling constraints can be found in the Rocky Worlds DDT webpage (rockyworlds.stsci.edu), which has a full report of the observing strategy defined for LHS 1140 b.

Proposal 12498 - Targets - Rocky Worlds DDT: JWST Observations of LHS 1140 b

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Observation

Proposal 12498, Observation 1: LHS 1140 b Eclipse 1

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 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.

(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2192	1	None	1	2192	31513.997	

Special Requirements

Between Dates 10-JUL-2026 and 12-JUL-2026
Phase 0.9909463444952163 to 0.9926308826168854 with period 24.7372457 Days and zero-phase 2461034.4784494685 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 2: LHS 1140 b Eclipse 2

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 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.

(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2192	1	None	1	2192	31513.997	

Special Requirements

Between Dates 03-AUG-2026 and 05-AUG-2026
Phase 0.9909463444952163 to 0.9926308826168854 with period 24.7372457 Days and zero-phase 2461034.435937993 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 3: LHS 1140 b Eclipse 3

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 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_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2192	1	None	1	2192	31513.997	

Special Requirements

Between Dates 10-NOV-2026 and 12-NOV-2026
Phase 0.9909463444952163 to 0.9926308826168854 with period 24.7372457 Days and zero-phase 2461034.502188869 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 4: LHS 1140 b Eclipse 4

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 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_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2236	1	None	1	2236	32146.583	

Special Requirements

Between Dates 05-DEC-2026 and 07-DEC-2026
Phase 0.9907963177568362 to 0.9924808558785052 with period 24.7372457 Days and zero-phase 2461034.516040045 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 5: LHS 1140 b Eclipse 5

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 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_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2306	1	None	1	2306	33152.97	

Special Requirements

Between Dates 29-DEC-2026 and 31-DEC-2026
Phase 0.9905613165366033 to 0.9922458546582723 with period 24.7372457 Days and zero-phase 2461034.5218533278 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 6: LHS 1140 b Eclipse 6

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 6 (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.

(Visit 6:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2308	1	None	1	2308	33181.724	

Special Requirements

Between Dates 21-JUN-2027 and 23-JUN-2027
Phase 0.9905541274618478 to 0.9922386655835168 with period 24.7372457 Days and zero-phase 2461034.3823805433 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 7: LHS 1140 b Eclipse 7

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 7 (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.

(Visit 7:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2369	1	None	1	2369	34058.719	

Special Requirements

Between Dates 15-JUL-2027 and 17-JUL-2027
Phase 0.9903502579035214 to 0.9920347960251904 with period 24.7372457 Days and zero-phase 2461034.527074337 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 12498, Observation 8: LHS 1140 b Eclipse 8

Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(LHS 1140 b Eclipse 8 (Obs 8)) 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 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 8:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2412	1	None	1	2412	34676.928	

Special Requirements

Between Dates 09-AUG-2027 and 11-AUG-2027
Phase 0.9902038202622967 to 0.9918883583839657 with period 24.7372457 Days and zero-phase 2461034.530696801 HJD
Time Series Observation
No Parallel Attachments
On Hold On Hold until Checkpoint 1 analysis is complete.

Observation

Proposal 12498, Observation 9: LHS 1140 b Eclipse 9 Wed Apr 15 18:00:20 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Comments: Obs 9 is an exposure that needs to be split due exceeding the maximum frame limit. We follow the proceed done in the GO 3077 program and DDT 9235 (GJ 3929 b) by linking observations 9 and 10 together and non-interruptible.

It was previously found in the 9235 dataset for the split exposure that there was a ramp also present in the start of the obsrvation for both exposures which introduced some complication for the analysis and thus wanted to try to mitigate this for future observation and analyses.

030902026: Observation was split in the middle as the current config will allow it by settiing in the filter dialog box exposure/dither to 2 with dither to none and splitting the total number of integration in half.

Diagnostics

(LHS 1140 b Eclipse 9 (Obs 9)) 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 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS_1140	RA: 00 44 59.6827 (11.2486779d)	Proper Motion RA: 318.152 mas/yr	
		Dec: -15 16 27.09 (-15.27419d)	Proper Motion Dec: -596.623 mas/yr	
		Equinox: J2000	Parallax: 0.06682874472085788"	
			Epoch of Position: 2016.0	

Comments: Target has been updated manually with Gaia DR3 coordinates, proper motions, parallax, and epoch. Done by T. Baines and checked by M. Alam.
Category=Star
Description=[M dwarfs]
Extended=NO

Template

Subarray
SUB256

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1500W	FASTR1	47	2257	2	None	1	4514	64896.998	

Special Requirements

Between Dates 16-NOV-2027 and 18-NOV-2027
Phase 0.9831365417653236 to 0.9848210798869926 with period 24.7372457 Days and zero-phase 2461034.705521805 HJD
Time Series Observation
No Parallel Attachments
On Hold On Hold until Checkpoint 1 analysis is complete.