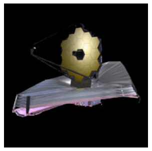

6543 - Stellar Activity Characterization of LHS 1140 - Is LHS 1140 b a Mini-Neptune or a Water World?

Cycle: 2, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Transit spectroscopy of LHS 1140 b with NIRISS				
	1	LHS 1140 b	NIRISS Single-Object Slitless Spectroscopy	(1) LHS1140
	2	LHS 1140 b	NIRISS Single-Object Slitless Spectroscopy	(2) LHS-1140

ABSTRACT

The masses and radii of the two transiting exoplanets around LHS 1140 (M4.5, J = 9.61) were recently revised with unprecedented precision of 3% (mass) and 2% (radius) for both planets. The LHS 1140 system now stands out as the most favorable system together with the TRAPPIST-1 system

to characterize small planets inside the Habitable Zone. These new mass and radius measurements provide new insights on the temperate world LHS 1140 b (Rp = 1.730 Rearth, Teq = 226K). This planet is either a small mini-Neptune with a 0.1% H/He mass envelope (possibly a Hycean world) or a water world (H2O between 9-19% by mass) with a patch of liquid water at the sub-stellar point according to interior structure models and global climate simulations. Cycle 1 observations (GO2334) taken last July 2023, one visit with NIRSpec/G235H and one with NIRSpec/G395H, will be key to confirm/reject the first scenario of a low mean molecular weight atmosphere around LHS 1140 b. However we demonstrate that this instrumental setup is partially blind to stellar contamination that could generate a fake H/He-rich atmosphere signal. Since only 4 transits per year of LHS 1140 b are observable with JWST, we propose to secure the last two remaining transits in Cycle 2 (December 2023) to characterize the star with the shorter wavelengths coverage of NIRISS/SOSS and firmly disentangle unocculted spots/faculae signals from the atmosphere of this keystone temperate world.

OBSERVING DESCRIPTION

We propose to acquire the transmission spectrum of LHS 1140 b with NIRISS/SOSS to quantify the Transit Light Source effect (stellar heterogeneities) on LHS 1140. The shorter wavelength domain of NIRISS/SOSS will constrain stellar parameters such as the spot and faculae covering fractions and temperatures.

We focus on the two remaining observable transits of LHS 1140\,b during Cycle 2 (December 1 and 25, 2023). We provide an observation start window (1 hr) expressed in minimum and maximum phases in APT. The observations are carried with small and acceptable contamination from nearby field sources. We include 10 integrations per visit with the F277W filter to calibrate NIRISS order 2 contamination on order 1.

Proposal 6543 - Targets - Stellar Activity Characterization of LHS 1140 - Is LHS 1140 b a Mini-Neptune or a Water World?

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LHS1140	RA: 00 44 59.3309 (11.2472121d) Dec: -15 16 17.54 (-15.27154d) Equinox: J2000	Proper Motion RA: 0.02198678206141362 sec of time/yr Proper Motion Dec: -0.5966230000922224 arcsec/yr Parallax: 0.0668287" Epoch of Position: 2015.5	
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[M dwarfs]*			
(2)	LHS-1140	RA: 00 44 59.6827 (11.2486779d) Dec: -15 16 27.09 (-15.27419d) Equinox: J2000	Proper Motion RA: 318.152 mas/yr Proper Motion Dec: -596.623 mas/yr Parallax: 0.0668287" Epoch of Position: 2016	
	Comments: This object was generated by the target selector and retrieved from the SIMBAD database. Updated using Gaia EDR3. *Category=Star* *Description=[M dwarfs]*			

Observation

Proposal 6543, Observation 1: LHS 1140 b

Thu Dec 21 20:00:19 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Single-Object Slitless Spectroscopy

Comments: Phase range calculated with ExoCTK tool (https://exoctk.stsci.edu/phase_constraint)

Diagnostics

(LHS 1140 b (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.

(Exposure) 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)	LHS1140	RA: 00 44 59.3309 (11.2472121d) Dec: -15 16 17.54 (-15.27154d) Equinox: J2000	Proper Motion RA: 0.02198678206141362 sec of time/yr Proper Motion Dec: -0.5966230000922224 arcsec/yr Parallax: 0.0668287" Epoch of Position: 2015.5	

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

Acquisition

#	Target	Acquisition Mode	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	SOSSFAINT	F480M	NISRAPID	3	1	1	0.202	178257

Template

Subarray	Include Short First Exposure and F277W Exposure?
SUBSTRIP256	true

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	NISRAPID	3	949	1	949	20874.66	178257
2	NISRAPID	3	10	1	10	219.965	178257

Special Requirements

Phase 0.993852046759749 to 0.9955364175105027 with period 24.73723 Days and zero-phase 2458399.9300 HJD
Aperture PA Range 51 to 55 Degrees (V3 50.43873283 to 54.43873283)
Time Series Observation
No Parallel Attachments

Observation

Proposal 6543, Observation 2: LHS 1140 b

Thu Dec 21 20:00:19 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Single-Object Slitless Spectroscopy

Comments: Phase range calculated with ExoCTK tool (https://exoctk.stsci.edu/phase_constraint)

Diagnostics

(LHS 1140 b (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.

(Exposure) 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
(2)	LHS-1140	RA: 00 44 59.6827 (11.2486779d) Dec: -15 16 27.09 (-15.27419d) Equinox: J2000	Proper Motion RA: 318.152 mas/yr Proper Motion Dec: -596.623 mas/yr Parallax: 0.0668287" Epoch of Position: 2016	

Comments: This object was generated by the target selector and retrieved from the SIMBAD database. Updated using Gaia EDR3.
Category=Star
Description=[M dwarfs]

Acquisition

#	Target	Acquisition Mode	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	SOSSFAINT	F480M	NISRAPID	3	1	1	0.202	178257

Template

Subarray	Include Short First Exposure and F277W Exposure?
SUBSTRIP256	true

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	NISRAPID	3	949	1	949	20874.66	178257
2	NISRAPID	3	10	1	10	219.965	178257

Special Requirements

Phase 0.993852046759749 to 0.9955364175105027 with period 24.73723 Days and zero-phase 2458399.9300 HJD
Aperture PA Range 68 to 72 Degrees (V3 67.43873283 to 71.43873283)
Time Series Observation
No Parallel Attachments