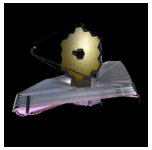

6284 - Searching for Signatures of Surface-Atmosphere Interaction on a Small Planet in its Magma Era

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Transit 1, F332W2	NIRCam Grism Time Series	(1) HD-207496
	3	Transit 1, F332W2 - Repeat of Obs 1	NIRCam Grism Time Series	(1) HD-207496
	2	Transit 2, F444W	NIRCam Grism Time Series	(1) HD-207496

ABSTRACT

Despite early results from JWST, the nature of sub-Neptune atmospheres remains elusive. Models predict that interaction between a sub-Neptune's hydrogen-rich atmosphere and an underlying global magma ocean will outgas large amounts of water vapor to the observable atmosphere. This process would affect many commonly-retrieved observables, such as the C/O ratio, metallicity, and H2O/CO2/CH4 abundances of the planet's atmosphere. The effects of magma-atmosphere interaction are expected to be most pronounced in young and small sub-Neptunes warm enough to

prevent water vapor condensation in the lower atmosphere. The best planet for observing this scenario is the recently discovered warm mini-Neptune HD 207496 b (age 520 Myr, T=743 K, R=2.25 Re).

We propose to use the NIRCam long-wavelength grism to measure the 2.41-5.08 micron transmission spectrum of HD 207496 b to search for signatures of magma-atmosphere interaction. If high mixing ratios of H2O and CO2 alongside a highly-depleted C/O ratio are observed, it will provide the first observational evidence for magma-atmosphere interaction and transform our understanding of water sources for small worlds. Our observations will also provide much-needed constraints on the atmospheric properties of the smallest sub-Neptunes.

OBSERVING DESCRIPTION

We will observe two transits of HD 207496 b using the NIRCam long-wavelength grism and F332W2 & F444W filters. One transit will use the F322W2 filter, BRIGHT1 readout pattern, and 4 groups per integration, for an SNR of 265 per intergration according to the online JWST ETC. The other transit will use the F444W filter, BRIGHT1 readout pattern, and 7 groups per integration for an SNR of 240 per intergration. Target acquistion can be done on the star itself with an SNR of 390.

The duration of each observation will be 297 minutes, which is the sum of twice the transit duration (212 minutes) + 60 minutes + 25 minutes = 297 minutes per visit. We include a 60 minute timing window before our observations to ensure that they can be efficiently scheduled. The additional 25 minutes is needed for thermal settling of the telescope, based on past observations with the same instrument on the similarly bright star HD 149026.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HD-207496	RA: 21 54 51.3013 (328.7137554d)	Proper Motion RA: 224.795 mas/yr	
		Dec: -77 20 16.79 (-77.33800d)	Proper Motion Dec: -186.72799994874367 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

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

Observation

Proposal 6284, Observation 1: Transit 1, F332W2

Fri Aug 08 22:00:09 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Grism Time Series

Diagnostics

(Transit 1, F332W2 (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)	HD-207496	RA: 21 54 51.3013 (328.7137554d) Dec: -77 20 16.79 (-77.33800d) Equinox: J2000	Proper Motion RA: 224.795 mas/yr Proper Motion Dec: -186.72799994874367 mas/yr Epoch of Position: 2000	

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

Acquisition

#	Target	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	SUB32TATSGRISM	F405N+F444W	RAPID	17	1	1	0.272	246337.6

Template

Subarray	No. of Output Channels	SW Channel Mode
SUBGRISM64	4	IMAGING

Spectral Elements

#	Short Pupil+Filter	Long Pupil+Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	CLEAR+WLP4	GRISMR+F322W2	BRIGHT1	4	6621	1	6621	18075.33	246337.10

Special Requirements

Phase 0.9794373109638532 to 0.9859062777259915 with period 6.441008 Days and zero-phase 2458658.78978 HJD
Aperture PA Range 270.24336066 to 350.24336066 Degrees (V3 270.0 to 350.0)
Time Series Observation
No Parallel Attachments

Observation

Proposal 6284, Observation 3: Transit 1, F332W2 - Repeat of Obs 1

Fri Aug 08 22:00:09 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Grism Time Series

Diagnostics

(Transit 1, F332W2 - Repeat of Obs 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)	HD-207496	RA: 21 54 51.3013 (328.7137554d)	Proper Motion RA: 224.795 mas/yr	
		Dec: -77 20 16.79 (-77.33800d)	Proper Motion Dec: -186.72799994874367 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

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

Acquisition

#	Target	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	SUB32TATSGRISM	F405N+F444W	RAPID	17	1	1	0.272	246337.6

Template

Subarray	No. of Output Channels	SW Channel Mode
SUBGRISM64	4	IMAGING

Spectral Elements

#	Short Pupil+Filter	Long Pupil+Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	CLEAR+WLP4	GRISMR+F322W2	BRIGHT1	4	6621	1	6621	18075.33	246337.10

Special Requirements

Phase 0.9794373109638532 to 0.9859062777259915 with period 6.441008 Days and zero-phase 2458658.78978 HJD
Aperture PA Range 240.24336066 to 20.24336066 Degrees (V3 240.0 to 20.0)
Time Series Observation
No Parallel Attachments

Observation

Proposal 6284, Observation 2: Transit 2, F444W

Fri Aug 08 22:00:09 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Grism Time Series

Diagnostics

(Transit 2, F444W (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)	HD-207496	RA: 21 54 51.3013 (328.7137554d)	Proper Motion RA: 224.795 mas/yr	
		Dec: -77 20 16.79 (-77.33800d)	Proper Motion Dec: -186.72799994874367 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

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

Acquisition

#	Target	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	SUB32TATSGRISM	F405N+F444W	RAPID	17	1	1	0.272	246337.6

Template

Subarray	No. of Output Channels	SW Channel Mode
SUBGRISM64	4	IMAGING

Spectral Elements

#	Short Pupil+Filter	Long Pupil+Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	CLEAR+WLP4	GRISMR+F444W	BRIGHT1	7	3786	1	3786	18073.077	246337.11

Special Requirements

Phase 0.9794373109638532 to 0.9859062777259915 with period 6.441008 Days and zero-phase 2458658.78978 HJD
Aperture PA Range 269.62437325 to 349.62437325 Degrees (V3 270.0 to 350.0)
Time Series Observation
No Parallel Attachments