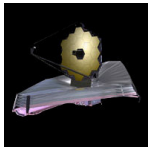

1952 - Determining the Atmospheric Composition of the Super-Earth 55 Cancri e

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRCAM F444W Eclipse	NIRCam Grism Time Series	(1) -RHO01-CNC
	2	MIRI LRS Eclipse	MIRI Low Resolution Spectroscopy	(1) -RHO01-CNC

ABSTRACT

One of the primary inquiries of astronomy is to determine for small exoplanets (1) whether they have an atmosphere, and (2) what their atmospheres are made of. To date, we have answered the first question for only one planet that is rocky in composition and lacking an H2-dominated atmosphere (i.e., a super-Earth): 55 Cancri e. Here we propose to use JWST's spectral capabilities in the mid-infrared to answer the second question for this planet. Prior observations with Spitzer photometry showed that the planet must have either a thick volatile-rich atmosphere, or a molten lava surface

shrouded by a mineral atmosphere while rotating at an asynchronous rate. The Spitzer measurements also ruled out H2O, CO, or CO2 as the main component of the atmosphere. The remaining possibility for the volatile-rich atmosphere are either an O2 atmosphere formed by the loss of hydrogen from a primordial water world, or an N2 atmosphere with varied abundances of CO2, CO, and HCN resulted from the accretion of rocky materials. The mineral atmosphere would otherwise be dominated by Na, O, K, Fe, and SiO. We request the JWST time to observe two secondary eclipses of 55 Cancri e, one with NIRCam using the F444W filter and the other with MIRI/LRS in the slitless mode. These observations will be able to distinguish the thick atmosphere scenario versus the mineral atmosphere scenario at high significance via spectral features of H2O, CO, CO2, and SiO. The proposed observations would provide the first direct detection of a non-H2-dominated atmosphere on an exoplanet and demonstrate JWST's unique capability to characterize super-Earths in thermal emission.

OBSERVING DESCRIPTION

We will acquire a thermal emission spectrum of the hot super-Earth 55 Cancri e using NIRCam and MIRI -- the former in grism time series mode with the F444W filter, the latter in low resolution slitless mode. The combination of the two instruments will allow us to measure the thermal emission spectrum from 3.8-12 micron at a resolution of R ~ 200.

Whenever possible, exposure parameters are chosen to maximize the observational efficiency while keeping all pixels below 80% saturation. For MIRI, it is not possible to keep all pixels below this limit. We thus use the parameters that minimize the number of saturated pixels. For both instruments, we perform target acquisition (TA) on the target itself.

As is standard with eclipse observations, we include an out-of-eclipse portion of the light curve. This is necessary to establish a baseline from which the eclipse depth can be determined and using which instrumental systematics can be modelled. We include 3.2 hours of baseline for the 1.6-hour eclipse, half of which is before the eclipse, and half of which is after. Additionally, since any timing constraint narrower than 1 hour is considered "tight" and incurs an 1-hour scheduling overhead penalty, we use a timing window of exactly 1 hour, centered 1.6+0.5 = 2.1 hours before the predicted start of eclipse. The extra baseline also gives the instruments time to stabilize, thus reducing systematics.

Proposal 1952 - Targets - Determining the Atmospheric Composition of the Super-Earth 55 Cancri e

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-RHO01-CNC	RA: 08 52 35.8113 (133.1492138d)	Proper Motion RA: -485.87 mas/yr	
		Dec: +28 19 50.96 (28.33082d)	Proper Motion Dec: -233.65 mas/yr	
		Equinox: J2000	Parallax: 0.08103"	
			Epoch of Position: 2000	

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

Observation

Proposal 1952, Observation 1: NIRCAM F444W Eclipse Wed Aug 25 16:00:43 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRCam Grism Time Series

Diagnostics

(NIRCAM F444W Eclipse (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): Data Excess over lower threshold

(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)	-RHO01-CNC	RA: 08 52 35.8113 (133.1492138d) Dec: +28 19 50.96 (28.33082d) Equinox: J2000	Proper Motion RA: -485.87 mas/yr Proper Motion Dec: -233.65 mas/yr Parallax: 0.08103" Epoch of Position: 2000	

Comments: This object was generated by the target selector and retrieved from the SIMBAD database.
Category=Star
Description=[G 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	3	1	1	0.062	58264.5

Template

Subarray	No. of Output Channels
SUBGRISM64	4

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	RAPID	2	20471	1	20471	21022.693	58264.4

Special Requirements

Phase 0.3076 to 0.3642 with period 0.73654604 Days and zero-phase 2458723.38328 HJD
Time Series Observation
No Parallel

Observation

Proposal 1952, Observation 2: MIRI LRS Eclipse

Wed Aug 25 16:00:43 GMT 2021

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(MIRI LRS Eclipse (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)	-RHO01-CNC	RA: 08 52 35.8113 (133.1492138d) Dec: +28 19 50.96 (28.33082d) Equinox: J2000	Proper Motion RA: -485.87 mas/yr Proper Motion Dec: -233.65 mas/yr Parallax: 0.08103" Epoch of Position: 2000	

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

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 -RHO01-CNC	FND	FAST	22	1	1	3.499	58264.6

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

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	FAST	22	1	1	3.499	58264.6

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	5	22033	22033	1	1	21024.611	58264.3

Special Requirements

Phase 0.28497 to 0.34157 with period 0.73654604 Days and zero-phase 2458723.38328 HJD
Time Series Observation
No Parallel