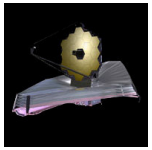

12237 - A Definitive Transmission Survey of the Atmosphere of 55 Cnc e

Cycle: 5, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
55 Cnc e				
	1	NIRISS SOSS	NIRISS Single-Object Slitless Spectroscopy	(1) 55-Cnc-e

ABSTRACT

We propose simultaneous observations of one transit of 55 Cnc e through JWST NIRISS/SOSS and HST WFC3/IR G141 to resolve inconsistencies in its atmospheric spectrum. JWST dayside emission studies have claimed detection of a high mean molecular weight (mmw) atmosphere rich in CO/CO2, at odds with HST transmission study claims of a low mmw atmosphere rich in H2 and HCN. Systematic differences between these

instruments may be to blame, complicating efforts to interpret exoplanet atmospheres through multi-observatory studies. However, 55 Cnc e is a tidally-locked lava world with evidence for dayside variability, possibily originating from volcanic super-plumes or cloud condensation cycles. As a result, the contrasting results between JWST and HST may be astrophysical, and could yield the first evidence of spatial atmosphere variations due to extreme thermal and wind gradients, or the first evidence of transmission variability due to atmospheric and/or geologic activity. Our study leverages the observing power of both JWST and HST to confidently distinguish between all three of these scenarios, definitively revealing the true nature of this standout tidally-locked ultra-short-period super-Earth.

OBSERVING DESCRIPTION

We will observe a single transit of the tidally-locked ultra-short-period super-Earth 55 Cnc e with JWST NIRISS/SOSS (0.8-2.8 micron) and HST WFC3/IR G141 (1.1-1.7 micron) simultaneously to identify the cause of its inconsistent atmospheric composition. In doing so, we may reveal (1) systematic differences between JWST and HST that are more significant than yet detected, OR (2) spatially varying atmospheric composition owing to the extreme thermal and wind gradients expected on tide-locked ultra-short-period super-Earths, OR (3) temporal variability of the terminator atmosphere's composition and mean molecular weight (mmw), a probable extension of the variability seen in 55 Cnc e's dayside eclipse depth.

Our JWST NIRISS/SOSS observation will use the new multistripe readout mode to avoid saturation when observing this target's bright host star (J=4.768). We will use the SUB17STRIPE readout mode with 0.37 s of exposure time per stripe and a total exposure time to collect one full array of 44.4 s, not including read time and overheads. A total of 354 full-array integrations are requested to span the 1.5439-hour transit, equivalent out-of-transit baseline, an additional 30 minutes for instrument settling to minimize systematics, and a 1-hour starting window to facilitate scheduling. Target acquisition will be performed directly on-target using the F480M filter, SOSS or AMI TA subarray, NISRAPID readout mode, and 9 groups per integration. We additionally include F277W filter observations to minimize the impact of background contaminants.

We pair this observation with a simultaneous HST WFC3/IR G141 transit observation duplicating the observation performed in 2015 as part of HST-GO 13665. The simultaneity of this duplicate observation allows us to robustly disentangle systematic differences, spatial variation, and temporal variability as the possible causes of 55 Cnc e's inconsistent atmosphere. Duplication is necessary to confidently disentangle these three explanations, as using the previous observations from 2015 will leave interpretation open to unknown temporal variability. These observations will span 4 HST orbits and use the WFC3/IR G141 on the GRISM512 subarray in MULTIACCUM mode with 3 up-the-ramp samples per frame. Our frames will be collected as spatial scans using the Round Trip scan direction and SPARS10 sample sequence with a total exposure time per frame of 8.774724 seconds. A total of 32 frames are requested per orbit, with 128 frames in all.

Our JWST NIRISS/SOSS observation is phase-constrained to a 1-hour starting window such that observations begin no later than 2.0439 hours (1 transit duration + 30 minute instrument settling period) before the mid-transit time. This corresponds to a starting phase constraint between 0.8278 and 0.8844. The additional planets in the 55 Cnc system do not transit and thus impose no additional phase constraints. This observation also has pointing angle (PA) constraints based on when 55 Cnc e is visible to JWST and to prevent near-field stars from contaminating our spectrum. Of the available PAs, none are affected by contamination and so the full span from 100 to 125 and from 269 to 291 degrees may be used. Finally, our observations are time-constrained to occur between 30 Oct 2026 and 13 Dec 2026, when HST is also capable of observing this target.

Our HST WFC3/IR observation is phase-constrained to capture the full trough of the transit and equivalent pre- and post-transit baseline. This corresponds to a starting phase constraint between 0.7869 and 0.8058. These observations are also time-constrained to occur between 30 Oct 2026 and 13 Dec 2026, when JWST is also capable of observing this target.

Proposal 12237 - Targets - A Definitive Transmission Survey of the Atmosphere of 55 Cnc e

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	55-Cnc-e	RA: 08 52 35.8111 (133.1492129d)	Proper Motion RA: -485.681 mas/yr	
		Dec: +28 19 50.95 (28.33082d)	Proper Motion Dec: -233.51700001512654 mas/yr	
		Equinox: J2000	Parallax: 0.0794482"	
			Epoch of Position: 2000	

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.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Observation

Proposal 12237, Observation 1: NIRISS SOSS

Tue Apr 21 20:00:26 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRISS Single-Object Slitless Spectroscopy

Diagnostics

(NIRISS SOSS (Obs 1)) Warning (Form): The slew between the acquisition exposure and the farthest science exposure is 61.790 Arcsec (larger than the recommended limit of 50.000 Arcsec) and may result in reduced or no schedulability. See more information in the diagnostic browser.

(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)	55-Cnc-e	RA: 08 52 35.8111 (133.1492129d)	Proper Motion RA: -485.681 mas/yr	
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Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Acquisition

#	Target	Acquisition Mode	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	SOSSBRIGHT	F480M	NISRAPID	9	1	1	0.475	265198

Template

Subarray	Include Short First Exposure and F277W Exposure?
SUB17STRIPE_SOSS	true

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	NISRAPID	1	1	1	1	1	17.251	
2	NISRAPID	5	177	2	1	354	16580.794	265198
3	NISRAPID	5	10	1	1	10	468.384	265198

Special Requirements	
	Between Dates 30-OCT-2026:00:00:00 and 13-DEC-2026:23:59:59 Phase 0.8278058320935399 to 0.8843760768146083 with period 0.7365474 Days and zero-phase 2459511.487987 HJD Aperture PA Range 100 to 125 Degrees (V3 99.43873283 to 124.43873283) Aperture PA Range 269 to 291 Degrees (V3 268.43873283 to 290.43873283) Time Series Observation No Parallel Attachments