



9825 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

Cycle: 5, Proposal Category: GO

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<i>Name</i>	<i>Institution</i>
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Konstantinos Plainos (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Mr. Aaron Werlen (CoI)	University of California - Los Angeles
Matthias Heim (CoI) (ESA Member)	Ludwig Maximilian Universität of Munich
Dr. Alexander J Cridland (CoI) (ESA Member)	Universitäts-Sternwarte München

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	Eclipse 1	NIRISS Single-Object Slitless Spectroscopy	(1) -rho01-Cnc
	2	Eclipse 2	NIRISS Single-Object Slitless Spectroscopy	(1) -rho01-Cnc
	3	Eclipse 3	NIRISS Single-Object Slitless Spectroscopy	(1) -rho01-Cnc
	4	Eclipse 4	NIRISS Single-Object Slitless Spectroscopy	(1) -rho01-Cnc
	5	Eclipse 5	NIRISS Single-Object Slitless Spectroscopy	(1) -rho01-Cnc

ABSTRACT

Optical and infrared secondary eclipse measurements of the hot rocky super-Earth 55 Cnc e have shown variable eclipse depths, implying that the albedo and the day-side temperature vary on time-scales comparable to or shorter than the orbital period. Episodes of particularly low brightness temperature recently observed with JWST NIRCams suggest efficient heat redistribution and thus the presence of an atmosphere, at least episodically. Explanations for the planet's variability connect varying atmospheric temperature structure, composition, pressure or dust emission to outgassing from the molten surface, but a quantitative understanding is not yet forthcoming.

Simultaneous measurements of the optical and infrared eclipse depths are needed to gain new insight: Episodes of reflective volcanically expelled dust suspended in the atmosphere could both explain the strong variability the optical as well as the infrared eclipse depths. JWST observations of 55 Cnc are challenged by the brightness of the host star, but the newly commissioned substripe readout modes of NIRISS SOSS uniquely allow us to observe this system at short wavelengths for the first time. We will measure secondary eclipse depths between 0.7 to 2.7 μ m to determine whether the

optical and infrared eclipse depths are correlated, and allow us to distinguish different scenarios for the atmosphere: including cases of reflective dust, clear CO/CO₂ or H₂O/CH₄ dominated atmospheres, or high (>3000 K) thermal emission that contaminates the optical. These observations will provide crucial context for all previous CHEOPS, Spitzer and JWST observations carried out to date, with strong implications for exoplanet geology.

OBSERVING DESCRIPTION

This proposal is to observe five secondary eclipse time-series observations with NIRISS SOSS of the hot rocky super Earth 55 Cnc e.

The host star 55 Cnc is very bright, and so we will make use of the newly commissioned multistripe modes of NIRISS SOSS, taking 655 integrations per visit in SUB60STRIPE mode. Because these are highly time-critical observations, we have provided the appropriate phase constraints. The observations are to be separated from each other by at least 3 days, as indicated in our special requirements.

Target acquisition is possible on target without risk of saturation.

Proposal 9825 - Targets - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-rho01-Cnc	RA: 08 52 35.8111 (133.1492129d) Dec: +28 19 50.95 (28.33082d) Equinox: J2000	Proper Motion RA: -485.681 mas/yr Proper Motion Dec: -233.51700001512654 mas/yr Epoch of Position: 2000	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Star</i> <i>Description=[Exoplanets, K dwarfs]</i> <i>Extended=NO</i></p>				
(2)	rho01CncB_TA	RA: 08 52 40.8627 (133.1702613d) Dec: +28 18 58.82 (28.31634d) Equinox: J2000	Proper Motion RA: -481.176 mas/yr Proper Motion Dec: -244.5439999746668 mas/yr Epoch of Position: 2000	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>This is an optional target acquisition star.</i> <i>Category=Star</i> <i>Description=[M dwarfs]</i></p>				

Proposal 9825 - Observation 1 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

Wed May 06 23:00:10 GMT 2026

Observation	Proposal 9825, Observation 1: Eclipse 1 Diagnostic Status: Warning Observing Template: NIRISS Single-Object Slitless Spectroscopy <i>Comments: Ephemeris taken from Nasa exoplanet archive Kokori et al 2023. I have established that the transit timing difference with Bourrier 2020 increases to 0.4 hours in 2035, meaning that the difference is only ~10 minutes in 2027, well within our scheduling margin anyway.</i>																													
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Proposal 9825 - Observation 2 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

Wed May 06 23:00:10 GMT 2026

Observation	Proposal 9825, Observation 2: Eclipse 2 Diagnostic Status: Warning Observing Template: NIRISS Single-Object Slitless Spectroscopy <i>Comments: Ephemeris taken from Nasa exoplanet archive Kokori et al 2023. I have established that the transit timing difference with Bourrier 2020 increases to 0.4 hours in 2035, meaning that the difference is only ~10 minutes in 2027, well within our scheduling margin anyway.</i>																												
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Proposal 9825 - Observation 3 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

Wed May 06 23:00:10 GMT 2026

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Proposal 9825 - Observation 4 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

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Proposal 9825 - Observation 5 - What causes the infrared and optical variability of the hot rocky super-Earth 55 Cnc e?

Wed May 06 23:00:10 GMT 2026

Observation	<p>Proposal 9825, Observation 5: Eclipse 5</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRISS Single-Object Slitless Spectroscopy</p> <p><i>Comments: Ephemeris taken from Nasa exoplanet archive Kokori et al 2023. I have established that the transit timing difference with Bourrier 2020 increases to 0.4 hours in 2035, meaning that the difference is only ~10 minutes in 2027, well within our scheduling margin anyway.</i></p>																															
	<p>(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.</p> <p>(Eclipse 5 (Obs 5)) 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.</p> <p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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