



3969 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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Duncan Christie (CoI) (ESA Member)	Max Planck Institute for Astronomy
Dr. Maria Zamyatina (CoI) (ESA Member)	University of Exeter
Zafar Rustamkulov (CoI)	The Johns Hopkins University
Dr. Ryan J MacDonald (CoI)	University of Michigan
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Lili Alderson (CoI) (ESA Member)	University of Bristol
Dr. Nikole Lewis (CoI)	Cornell University
Dr. Emily Rauscher (CoI)	University of Michigan

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Kepler-12 Transits				
	1	Prism transit 1	NIRSpec Bright Object Time Series	(1) KEPLER-12
	5	Prism transit 2	NIRSpec Bright Object Time Series	(1) KEPLER-12
WASP-52 transit				
	3	G395H transit	NIRSpec Bright Object Time Series	(2) WASP-52
HAT-P-65b Transits				
	4	Prism transit 1	NIRSpec Bright Object Time Series	(3) HAT-P-65
	6	Prism transit 2	NIRSpec Bright Object Time Series	(3) HAT-P-65

ABSTRACT

JWST Proposal 3969 (Created: Thursday, September 21, 2023 at 5:00:39 PM Eastern Standard Time) - Overview

JWST is revolutionizing exoplanet atmospheres. The very first few datasets are already showing how, using the technique of transmission spectroscopy in particular, rich chemical inventories and constraints on key atmospheric parameters can be extracted from this data with an unprecedented level of detail for Jovian and sub-Jovian exoplanets. This very same early JWST data, however, is also pushing the limits of how we classically model and interpret transmission spectra. In particular, signatures of inhomogeneous terminators are already arising from these datasets, a trend theoretical models expect will continue in future datasets. Modeling and understanding how common the effects of inhomogeneous terminators are in the gas giant exoplanet population is critical if we aim to properly study and interpret their atmospheres --- in particular if inferences on, e.g., their links with planet formation are ought to be extracted. Here, we propose the very first survey to constrain the physical properties of inhomogeneous terminators in gas giant exoplanets with JWST. Our carefully crafted sample, which spans gas giant exoplanets between 1000 K and 2000 K, is motivated by state-of-the-art atmospheric circulation & cloud formation modelling predictions for the morning and evenings of exoplanets, which we will put to the test. In particular, we aim to constrain whether clouds indeed form higher up in the morning terminators than in the evenings terminators, as predicted by state-of-the-art modelling, and how this cloud location varies with equilibrium temperature.

OBSERVING DESCRIPTION

This proposal aims to obtain:

- 2 transit events for Kepler-12b with NIRSpec/Prism (SUB512 --- 11.14 hours each; 5 groups/int; 29,131 integrations).
- 2 transit events for HAT-P-65b with NIRSpec/Prism (SUB512 --- 10.48 hours each; 3 groups/int; 40,787 integrations).
- 1 transit event for WASP-52b with NIRSpec/G395H (SUB2048 ---- 5.56 hours; 35 groups/int; 616 integrations).

The "dwell equation" was used to obtain the total exposure times quoted above: $0.75 \text{ hr} + \text{MAX}(2, T_{14}) + T_{14} + 1 \text{ hr}$, where T_{14} is the transit duration.

The observations are time-constrained via phase-constraints. The transit ephemerides were obtained from the works of Ivshina & Winn (2022) for WASP-52b and from Kokori et al. (2022) for Kepler-12b and HAT-P-65b. These have uncertainties of under 1 minute during the duration of Cycle 2.

The TA follows the WATA Acquisition mode. Both Kepler-12 and HAT-P-65 are faint enough that TA can be performed directly on the targets; with SUB32/F110W a SNR of 118 and 147 is obtained respectively for the targets with the JWST ETC. For WASP-52, a nearby target had to be selected for TA as WASP-52 itself is too bright for WATA. 2MASS 23140007+0846207 was selected which gives a SNR of 41 with SUB32/CLEAR according to the JWST ETC. All SNR's are > 20 , which is excellent for TA.

Updates September 21, 2023:

- Re-added a TA for WASP-52, which was removed at submission due to the target being at the limit of the splitting visit distance. After exchanges with ISR, the target is fine. Re-calculated TA parameters with the latest ETC version; this gives a SNR of 40.75 with SUB32/CLEAR for 2MASS 23140007+0846207 (GAIA DR3 2666015908639704192).

- For consistency, target coordinates (including proper motions) were updated from Gaia DR3 for WASP-52 (GAIA DR3 2666015878575546496).

Proposal 3969 - Targets - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	KEPLER-12	RA: 19 04 58.4270 (286.2434458d) Dec: +50 02 25.32 (50.04037d) Equinox: J2000	Proper Motion RA: 3.186724579907516E-4 sec of time/yr Proper Motion Dec: 0.003211 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Exoplanets, G dwarfs, G stars] Extended=NO</p>				
(2)	WASP-52	RA: 23 13 58.7501 (348.4947921d) Dec: +08 45 39.86 (8.76107d) Equinox: J2000	Proper Motion RA: -6.941909101132514 mas/yr Proper Motion Dec: -44.3300819351267 mas/yr Parallax: 0.0057261704" Epoch of Position: 2016	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The target TA-WASP-52 (2MASS 23140007+0846207) could be a good target for offset TA, but it's 0.75 arcsec offset with the visit splitting distance. We have also updated the coordinates and proper motions using Gaia DR3 (source ID 2666015878575546496)</i> Category=Star Description=[Exoplanets, K dwarfs, K stars] Extended=NO</p>				
(3)	HAT-P-65	RA: 21 03 37.3175 (315.9054896d) Dec: +11 59 21.72 (11.98937d) Equinox: J2000	Proper Motion RA: 2.8454024682129784E-4 sec of time/yr Proper Motion Dec: -0.006263000000217289 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Exoplanets, G dwarfs, G stars] Extended=NO</p>				
(4)	TA-WASP-52	RA: 23 14 0.0921 (348.5003838d) Dec: +08 46 20.55 (8.77238d) Equinox: J2000	Proper Motion RA: 1.6060556822651024 mas/yr Proper Motion Dec: -7.708389627488911 mas/yr Parallax: 0.000443460933" Epoch of Position: 2016	
<p><i>Comments: While name of the target in the archive is the 2MASS one --- data ingested here was done from Gaia Archive (DR3) for source ID 2666015908639704192.</i> Category=Star Description=[G dwarfs, G stars] Extended=NO</p>				

Fixed Targets

Proposal 3969 - Observation 1 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Thu Sep 21 22:00:39 GMT 2023

Observation	<p>Proposal 3969, Observation 1: Prism transit 1</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
Diagnostics	<p>(Prism transit 1 (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.</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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Template	<p>Subarray</p> <p>SUB512</p>																															
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Special Requirements	<p>Phase 0.93946 to 0.94885 with period 4.4379629 Days and zero-phase 2455004.00915 HJD</p> <p>Time Series Observation</p> <p>No Parallel Attachments</p>																															

Proposal 3969 - Observation 5 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Thu Sep 21 22:00:39 GMT 2023

Observation	<p>Proposal 3969, Observation 5: Prism transit 2</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSspec Bright Object Time Series</p>																															
Diagnostics	<p>(Prism transit 2 (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>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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Proposal 3969 - Observation 3 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Thu Sep 21 22:00:39 GMT 2023

Observation	<p>Proposal 3969, Observation 3: G395H transit</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
	<p>(G395H transit (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.</p> <p>(G395H transit (Obs 3)) Warning (Form): The slew between the acquisition exposure and the farthest science exposure is 45.595 Arcsec (larger than the recommended limit of 45.000 Arcsec) and may result in reduced or no schedulability. See more information in the diagnostic browser.</p> <p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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1	4 TA-WASP-52	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	146825																						
Template	<p>Subarray</p> <p>SUB2048</p>																															
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Proposal 3969 - Observation 3 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Special Requirements

Phase 0.91297 to 0.93679 with period 1.7497798 Days and zero-phase 2456770.05972 HJD
Time Series Observation
No Parallel Attachments

Proposal 3969 - Observation 4 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Thu Sep 21 22:00:39 GMT 2023

Observation	<p>Proposal 3969, Observation 4: Prism transit 1</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
Diagnostics	<p>(Prism transit 1 (Obs 4)) 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>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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Proposal 3969 - Observation 6 - Hot Jupiter Atmospheric Forecast: are mornings cloudier than evenings in other worlds?

Thu Sep 21 22:00:39 GMT 2023

Observation	<p>Proposal 3969, Observation 6: Prism transit 2</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
Diagnostics	<p>(Prism transit 2 (Obs 6)) 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>(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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