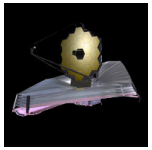

3838 - Does atmospheric composition actually trace formation? Observing aligned vs misaligned hot Jupiters as a testbed

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	TRES-4 transit	NIRSpec Bright Object Time Series	(1) TRES-4
	2	KELT-7 transit	NIRSpec Bright Object Time Series	(2) KELT-7
	3	NGTS-2 transit	NIRSpec Bright Object Time Series	(3) NGTS-2
	4	WASP-15 transit	NIRSpec Bright Object Time Series	(4) WASP-15
	5	HAT-P-30 transit	NIRSpec Bright Object Time Series	(5) HAT-P-30

ABSTRACT

A primary motivation behind measuring the composition of exoplanetary atmospheres is to understand planet formation and evolution. A key challenge is determining what variations in atmospheric composition can be attributed to different planet formation histories; a problem made more challenging by the various uncertainties affecting protoplanetary disc composition and planetary evolution. Thus, it needs to be proven that the field's desire to measure atmospheric composition will lead to insights into their origins. The obvious first step is to identify groups of planets that likely had very different formation pathways and determine whether these planets show any significant differences in their composition. We propose to compare the composition of a sample of hot Jupiters whose orbits are aligned and misaligned relative to their host stars' spin axes. It is believed that aligned hot Jupiters are the outcome of disc migration, while misaligned ones arise from high-eccentricity migration. This dichotomy in their origins means formation models robustly predict that aligned planets should be oxygen-rich at high atmospheric metallicities. By comparing the relative composition of an aligned and misaligned hot Jupiter sample, we will test if atmospheric composition depends on planet migration and, thus, if atmospheric composition can be used to make inferences about formation.

OBSERVING DESCRIPTION

For this proposal we will observe 1 transit each of 5 gas giant exoplanets: HAT-P-30b (Kmag = 9.15), KELT-7b (Kmag = 7.54), NGTS-2b (Kmag = 9.80), WASP-15b (Kmag = 9.69), and TrES-4b (Kmag = 10.33). We will observe these with the G395H grism and F290LP filter on the NIRSpec instrument. This will provide us with spectrophotometry covering the wavelength range of 3--5 microns with a resolving power of R=2700. By

measuring the wavelength-dependence of our planets' transit depths we will identify, and measure the abundance of, opacity sources within the planets' atmospheres. We will use the 2048 subarray and perform a single exposure for each target consisting of several hundred to several thousand integrations covering a continuous baseline of several hours. We are aware that 1 continuous exposure per target might mean some integrations are affected by a high gain antenna move. If this occurs, we will clip out the affected frames at no significant loss of science information, as was done in the JWST ERS analysis of WASP-39b (Rustamkulov et al. 2023). For all of our targets, we set the number of groups/integration = 80% of the saturation threshold. We request a total observation duration per target equal to the planet's transit duration + 4 hours which includes sufficient out-of-transit baseline to accurately and precisely measure the in-transit absorption, along with a 1h window for scheduling flexibility.

As all our science targets are too bright to use them for target acquisition (TA), we will utilize nearby (within splitting distance) fainter stars to conduct TA via the Wide Aperture Target Acquisition (WATA) mode. We have selected them using both the 2MASS and GAIA DR3 catalogues. The first one ensures that we have the necessary brightness for each star to achieve successful TA (SNR > 20 as verified with the ETC), while the latter ensures that the positions and proper motions of each star are accurate. The stars have K magnitudes between 14.3 and 15.5 and are listed here with their 2MASS identifier: 08154583+0550218 (HAT-P-30), 05131299+3319194 (KELT-7), 14203188-3112273 (NGTS-2), 13554509-3209041 (WASP-15) and 17531241+3712396 (TrES-4). For each TA we used the CLEAR filter, SUB32 subarray and 3 groups per integration. We will double check this setup with scheduling prior to the observation to ensure success.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TRES-4	RA: 17 53 13.0407 (268.3043363d) Dec: +37 12 42.26 (37.21174d) Equinox: J2000	Proper Motion RA: -6.382239205141325 mas/yr Proper Motion Dec: -20.890767631883378 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Includes Gaia DR3 proper motion measurements. *Category=Star* *Description=[Exoplanet Systems, F dwarfs]* *Extended=NO*		
(2)	KELT-7	RA: 05 13 10.9419 (78.2955913d) Dec: +33 19 4.63 (33.31795d) Equinox: J2000	Proper Motion RA: 10.477254011320916 mas/yr Proper Motion Dec: -49.62042234593807 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Includes Gaia DR3 proper motion measurements. *Category=Star* *Description=[Exoplanet Systems, F dwarfs]* *Extended=NO*		
(3)	NGTS-2	RA: 14 20 29.4628 (215.1227617d) Dec: -31 12 7.45 (-31.20207d) Equinox: J2000	Proper Motion RA: -21.78586375161945 mas/yr Proper Motion Dec: -0.9062014722355057 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Includes Gaia DR3 proper motion measurements. *Category=Star* *Description=[Exoplanets, F dwarfs]* *Extended=NO*		
(4)	WASP-15	RA: 13 55 42.7227 (208.9280112d) Dec: -32 09 34.96 (-32.15971d) Equinox: J2000	Proper Motion RA: 8.723477241208652 mas/yr Proper Motion Dec: -22.327605525225746 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Includes Gaia DR3 proper motion measurements. *Category=Star* *Description=[Exoplanet Systems, F dwarfs]* *Extended=NO*		
(5)	HAT-P-30	RA: 08 15 47.9623 (123.9498429d) Dec: +05 50 12.72 (5.83687d) Equinox: J2000	Proper Motion RA: -17.231496224173426 mas/yr Proper Motion Dec: 23.87539405164545 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Includes Gaia DR3 proper motion measurements. *Category=Star* *Description=[Exoplanet Systems, F dwarfs]* *Extended=NO*		
(6)	TRES-4-TA	RA: 17 53 12.4121 (268.3017171d) Dec: +37 12 39.65 (37.21101d) Equinox: J2000	Proper Motion RA: -2.7974143820574207 mas/yr Proper Motion Dec: -9.448888113522848 mas/yr Epoch of Position: 2016	
		Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Includes Gaia DR3 proper motion measurements. Gaia ID: 4609062381822880768. SNR = 73, clear filter, SUB32 *Category=Star* *Description=[Exoplanet Systems]* *Extended=NO*		

(7)	KELT-7-TA	RA: 05 13 12.9936 (78.3041400d)	Proper Motion RA: -5.333980632495631 mas/yr
		Dec: +33 19 19.48 (33.32208d)	Proper Motion Dec: -1.5578911101626793 mas/yr
		Equinox: J2000	Epoch of Position: 2016
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Includes Gaia DR3 proper motion measurements. Gaia ID: 1819081171449740 80. SNR = 61, clear filter, sub32 Category=Star Description=[Exoplanet Systems] Extended=NO			
(8)	NGTS-2-TA	RA: 14 20 31.8816 (215.1328400d)	Proper Motion RA: -9.204110255003911 mas/yr
		Dec: -31 12 27.35 (-31.20760d)	Proper Motion Dec: -4.143053000239418 mas/yr
		Equinox: J2000	Epoch of Position: 2016
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Includes Gaia DR3 proper motion measurements. Gaia ID: 6220602173626070784. SNR = 67, clear filter, sub32. Category=Star Description=[Exoplanet Systems] Extended=NO			
(9)	WASP-15-TA	RA: 13 55 45.0970 (208.9379042d)	Proper Motion RA: -10.462195232162617 mas/yr
		Dec: -32 09 4.11 (-32.15114d)	Proper Motion Dec: -0.7997292955143389 mas/yr
		Equinox: J2000	Epoch of Position: 2016
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Includes Gaia DR3 proper motion measurements. Gaia ID: 6171009152628413568. SNR = 37, clear filter, sub32 Category=Star Description=[Exoplanet Systems] Extended=NO			
(10)	HAT-P-30-TA	RA: 08 15 45.8395 (123.9409979d)	Proper Motion RA: -3.2441254249172404 mas/yr
		Dec: +05 50 21.82 (5.83939d)	Proper Motion Dec: -3.049106782143458 mas/yr
		Equinox: J2000	Epoch of Position: 2016
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Includes Gaia DR3 proper motion measurements. Gaia ID: 3096441729861716480. SNR = 33, clear filter, sub32 Category=Star Description=[Exoplanet Systems] Extended=NO			

Observation

Proposal 3838, Observation 1: TRES-4 transit Thu May 11 05:02:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: Using ephemeris of Ishvina & Winn 2022

Diagnostics

(TRES-4 transit (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)	TRES-4	RA: 17 53 13.0407 (268.3043363d)	Proper Motion RA: -6.382239205141325 mas/yr	
		Dec: +37 12 42.26 (37.21174d)	Proper Motion Dec: -20.890767631883378 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Includes Gaia DR3 proper motion measurements.
Category=Star
Description=[Exoplanet Systems, F dwarfs]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	6 TRES-4-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	139668

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G395H/F290LP	NRSRAPID	80	378	1	1	378	27625.177	139668

Special Requirements

Phase 0.9492486608458173 to 0.960972773568554 with period 3.55392921 Days and zero-phase 2455321.96190 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3838, Observation 2: KELT-7 transit

Thu May 11 05:02:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: Using ephemeris of Ivshina & Winn 2022

Diagnostics

(KELT-7 transit (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
(2)	KELT-7	RA: 05 13 10.9419 (78.2955913d)	Proper Motion RA: 10.477254011320916 mas/yr	
		Dec: +33 19 4.63 (33.31795d)	Proper Motion Dec: -49.62042234593807 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Includes Gaia DR3 proper motion measurements.
Category=Star
Description=[Exoplanet Systems, F dwarfs]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	7 KELT-7-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	139668

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G395H/F290LP	NRSRAPID	5	4976	1	1	4976	27032.02	139668

Special Requirements

Phase 0.9353996992529342 to 0.9506356192404497 with period 2.73476539 Days and zero-phase 2458816.51857 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3838, Observation 3: NGTS-2 transit

Thu May 11 05:02:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: Using the ephemeris of Ivshina & Winn 2022

Diagnostics

(NGTS-2 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.

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	NGTS-2	RA: 14 20 29.4628 (215.1227617d)	Proper Motion RA: -21.78586375161945 mas/yr	
		Dec: -31 12 7.45 (-31.20207d)	Proper Motion Dec: -0.9062014722355057 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Includes Gaia DR3 proper motion measurements.
Category=Star
Description=[Exoplanets, F dwarfs]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	8 NGTS-2-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	139668

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G395H/F290LP	NRSRAPID	48	706	1	1	706	31218.247	139668

Special Requirements

Phase 0.9553621846280339 to 0.9645986138971876 with period 4.5111228 Days and zero-phase 2458602.70654 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3838, Observation 4: WASP-15 transit Thu May 11 05:02:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: Using the ephemeris of Ivshina & Winn 2022

Diagnostics

(WASP-15 transit (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.

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	WASP-15	RA: 13 55 42.7227 (208.9280112d)	Proper Motion RA: 8.723477241208652 mas/yr	
		Dec: -32 09 34.96 (-32.15971d)	Proper Motion Dec: -22.327605525225746 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Includes Gaia DR3 proper motion measurements.
Category=Star
Description=[Exoplanet Systems, F dwarfs]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	9 WASP-15-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	139668

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G395H/F290LP	NRSRAPID	44	685	1	1	685	27818.179	139668

Special Requirements

Phase 0.9516226430052841 to 0.9627275362645614 with period 3.75209970 Days and zero-phase 2456036.76051 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3838, Observation 5: HAT-P-30 transit Thu May 11 05:02:51 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(HAT-P-30 transit (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.

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	HAT-P-30	RA: 08 15 47.9623 (123.9498429d)	Proper Motion RA: -17.231496224173426 mas/yr	
		Dec: +05 50 12.72 (5.83687d)	Proper Motion Dec: 23.87539405164545 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Includes Gaia DR3 proper motion measurements.
Category=Star
Description=[Exoplanet Systems, F dwarfs]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	10 HAT-P-30-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	139668

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G395H/F290LP	NRSRAPID	26	925	1	1	925	22546.394	139668

Special Requirements

Phase 0.9462081291460034 to 0.9610329523109467 with period 2.81060126 Days and zero-phase 2457426.69746 HJD
Time Series Observation
No Parallel Attachments