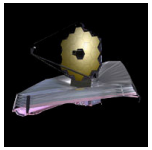

3154 - Testing the C/O Ratio Prediction for Hot Jupiters from Disk-Free Migration

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRSpec transit observation WASP-94Ab	NIRSpec Bright Object Time Series	(1) WASP-94A

ABSTRACT

Almost three decades have passed since the first discovery of a hot Jupiter and many have been discovered since then. However, their formation and migration mechanisms are not yet understood and we lack methods that can clearly determine whether a hot Jupiter has moved through either disk-free or disk-driven migration or has formed in situ.

With this programme we will observe a hot Jupiter that orbits a star in a binary system in a misaligned and retrograde way. Theory predicts that it must have migrated via disk-free migration, which in turn notably restricts the value the carbon-to-oxygen (C/O) ratio of the atmosphere can be. We will test this C/O prediction by measuring the abundances of carbon- and oxygen-bearing molecules in the atmosphere of WASP-94Ab in one transit, utilizing JWST's unique capabilities to provide high-precision time-series observations in the infrared wavelength range.

We will determine the C/O ratio of WASP-94Ab and be able to confirm or refute the theory prediction. If it matches, we will provide the first atmospheric characterization of a hot Jupiter that we know must have migrated via disk-free migration. If it does not match, we will provide evidence for other processes in planet formation theory that have been missed so far.

OBSERVING DESCRIPTION

We will observe one transit of hot Jupiter WASP-94Ab using the G395H/F290LP combination on the NIRSpec instrument in BOTS (Bright Object Time Series) mode. This requires a S1600A1 aperture with a fixed 1.6"x1.6" field of view.

We will use the SUB2048 subarray and the NRSRAPID readout mode.

For our integrations we will use 21 groups which corresponds to a maximum of 80% saturation and a signal-to-noise (SNR) of 80-220 (verified by the ETC) for the stellar spectrum. 1451 exposures correspond to an observation of 8h, which includes the transit duration (4.5h), a settling time of 15min on top of a minimum baseline of 1h pre- and post-transit and a 1h window for scheduling flexibility.

As our target is bright (K mag: 8.9), therefore we will conduct target acquisition (TA) on an alternative target to avoid saturation. For TA we will utilize the Wide Aperture Target Acquisition (WATA) mode on a target that is within the visit splitting distance (20550897-3408314). We have selected it using the 2MASS source catalogue and used the Gaia DR3 proper motions to ensure they are suitable for accurate TA (see comments on the target). The ETC was utilized to determine the setup required: SUB32 subarray, NRSRAPID readout mode, 3 groups per integration, F140X filter. This will result in an SNR of 48.5 for the TA target (H mag: 14.573).

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)	WASP-94A	RA: 20 55 7.9774 (313.7832392d) Dec: -34 08 8.70 (-34.13575d) Equinox: J2000	Proper Motion RA: 26.500228153109326 mas/yr Proper Motion Dec: 44.970822510565206 mas/yr Epoch of Position: 2016	
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Updated the proper motion with GAIA DR3 data.* *Category=Star* *Description=[Exoplanet Systems, Exoplanets, F stars]* *Extended=NO*			
(2)	WASP-94A-TA	RA: 20 55 8.9777 (313.7874071d) Dec: -34 08 31.47 (-34.14207d) Equinox: J2000	Proper Motion RA: 5.947539482687365 mas/yr Proper Motion Dec: -2.8326325742492546 mas/yr Epoch of Position: 2016	
	Comments: This object was generated by the targetselector and retrieved from the 2MASS database. *2MASS J20550897-3408314 with 2MASS source catalogue:* *J mag =15.106* *H mag = 14.573* *K mag = 14.293* *distance = 26.735463 arcsec* *Gaia DR3 6780546165336270336* *ra 313.787411477944 err 0.38588575* *dec -34.14209575840465 err 0.29617956* *pm ra 5.947539482687365 with err 0.43055427* *pm dec -2.8326325742492546 with err 0.40483233* *Category=Star* *Description=[Exoplanets]* *Extended=NO*			

Observation

Proposal 3154, Observation 1: NIRSpec transit observation WASP-94Ab

Wed May 10 23:18:39 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(NIRSpec transit observation WASP-94Ab (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)	WASP-94A	RA: 20 55 7.9774 (313.7832392d)	Proper Motion RA: 26.500228153109326 mas/yr	
		Dec: -34 08 8.70 (-34.13575d)	Proper Motion Dec: 44.970822510565206 mas/yr	
		Equinox: J2000	Epoch of Position: 2016	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Updated the proper motion with GAIA DR3 data.
Category=Star
Description=[Exoplanet Systems, Exoplanets, F stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 WASP-94A-TA	WATA	SUB32	F140X	NRSRAPID	3	1	1	0.08	132981

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	21	1451	1	1	1451	28823.36	132981

Special Requirements

Phase 0.9525339287477311 to 0.9630819445815686 with period 3.95019 Days and zero-phase 2458328.29911 HJD
Time Series Observation
No Parallel Attachments