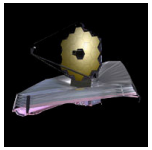

1729 - A NIRSpec Phase Curve for the ultrahot Jupiter WASP-121b

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
WASP-121 NIRSpec-G395H				
	1	Phase Curve	NIRSpec Bright Object Time Series	(1) WASP-121

ABSTRACT

JWST observations of hot Jupiters promise to be spectacular. We propose a 3-5 micron NIRSpec phase curve for one of the most outstanding such targets: WASP-121b. When our NIRSpec phase curve is combined with a NIRISS GTO phase curve, it will be the richest dataset yet acquired for an exoplanet atmosphere. For the first time, we will measure an exoplanet spectrum across the full 0.8-5 micron wavelength range at all 360 degrees of circumplanetary viewing angles. This will unlock a wealth of detail on the 3D atmospheric physics and chemistry, unattainable by isolated transits and eclipses. We will track how H2O and CO abundances vary with longitude, robustly determining the atmosphere's bulk C/O ratio and tightly

constraining the role of molecular thermal dissociation. This cannot be achieved without NIRSpec, as NIRISS will be relatively insensitive to carbon-bearing species. Measured variations of H2O and CO spectral bands will also give a longitudinal map of the atmosphere's vertical thermal structure, revealing in unprecedented detail the dramatic transition from a dayside thermal inversion to a nightside that cools with altitude. Combined with existing optical data, this will allow the global balance between absorbed shortwave radiation and re-emitted longwave radiation to be determined empirically. Dynamics play a crucial role in this story, and our NIRSpec phase curve will probe wind speeds as a function of pressure, as well as the overall efficiency of day-night advective heat transport. Combining our NIRSpec phase curve with those measured by NIRISS and TESS will also provide the most precise measurement of a planetary Bond albedo outside the solar system.

OBSERVING DESCRIPTION

We will acquire a full-orbit phase curve of the hot Jupiter WASP-121b using NIRSpec with the G395H grism. We will use the Bright Object Time Series (BOTS) mode optimized for transiting exoplanet observations, using the 1.6"x1.6" square aperture with no dithering. Since WASP-121 is too bright for WATA, we have selected a fainter nearby star for offset acquisition (using GAIA DR2).

Our observation consists of a single exposure lasting 37.6 hours (charged time of 44.7 hours). Based on HST and Spitzer experience, the exposure is phase-constrained to begin shortly before a secondary eclipse and conclude shortly after the following secondary eclipse. This will allow the stellar baseline flux (i.e. the in-eclipse flux level) to be calibrated at the beginning and end of the exposure to track any instrumental drift. The phase window is 60 minutes wide.

We determined an optimal detector readout pattern and groups per integration using the officially-supported ExoCTK platform (https://exoctk.stsci.edu). Signal-to-noise ratios for the phase-dependent emission spectra were calculated using PandExo (https://exoctk.stsci.edu/pandexo).

Proposal 1729 - Targets - A NIRSpec Phase Curve for the ultrahot Jupiter WASP-121b

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-121	RA: 07 10 24.0555 (107.6002313d) Dec: -39 05 50.17 (-39.09727d) Equinox: J2000	Proper Motion RA: -3.305516266189376E-4 sec of time/yr Proper Motion Dec: 0.025606 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[F dwarfs]*				
(2)	WATASTAR	RA: 07 10 22.3672 (107.5931967d) Dec: -39 05 34.22 (-39.09284d) Equinox: J2000	Proper Motion RA: -2.823 mas/yr Proper Motion Dec: 5.666 mas/yr Parallax: 0.5357" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. *Acquisition star.* *2MASS 07102237-3905342* *GAIA DR2 5565050461859866240* *Jmag 13.934* *Hmag 13.685* *Kmag 13.630* *J-H=0.24899960=>F9.5V* *ra_epoch2000 107.59319649500* *dec_epoch2000 -39.09283936230* *source_id 5565050461859866240* *ra 107.59318083504* *ra_error 0.0180* *dec -39.09281496836* *dec_error 0.0219* *parallax 0.5357* *parallax_error 0.0225* *pmra -2.823* *pmra_error 0.040* *pmdec 5.666* *pmdec_error 0.044* *Category=Star* *Description=[F dwarfs]*				

Observation

Proposal 1729, Observation 1: Phase Curve

Thu Sep 29 23:01:38 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(Phase Curve (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
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Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[F dwarfs]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 WATASTAR	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	64221

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	42	3504	1	1	3504	135977.906	122959

Special Requirements

Phase 0.18012 to 0.19672 with period 2.549851 Days and zero-phase 2456635.70832 HJD
Time Series Observation
No Parallel