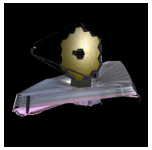

2158 - From East to West : the first simultaneous temperature and cloud map of a hot Jupiter.

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NGTS-10	NIRSpec Bright Object Time Series	(1) NGTS-10

ABSTRACT

With the discovery of 51 peg b in 1995, hot Jupiter atmospheres have challenged our understanding of atmospheric dynamics. Infrared phase curves observed by Spitzer and Hubble have shown positive offsets, meaning that the hottest point of the atmosphere is shifted east of the substellar point. On the other hand optical phase curves observed by Kepler have shown negative offsets, meaning that the cloudiest part of the planet is shifted west of the substellar point. This anti-correlation between temperature and cloud map can provide strong insights into the cloud formation process in hot Jupiters. However it relies on observations carried on two different population of planets with two different instruments.

We propose to observe the full orbit phase curve of NGTS-10b simultaneously from the optical to the infrared using the unique capability of the NIRSpec/PRISM instrument. We will observe the peak of the phase curve continuously shift from a negative to a positive offset on a given planet for the first time. We will map the longitudinal, latitudinal and heigh variation of the cloud, the chemical abundances and the thermal structure of the planet. We will detect chemical disequilibrium on the planet nightside and determine the condensation temperature of the clouds.

By combining optical and infrared phase curves we will create the first isobaric map of a hot Jupiter, a necessary step to benchmark current theoretical models. This will be crucial to inform which level of complexity will be required in future atmospheric retrieval models to obtain unbiased abundances measurements from secondary eclipse and transit observations of hot Jupiter atmospheres with JWST.

OBSERVING DESCRIPTION

We will observe NGTS-10 with the NIRSpec prism for a total exposure time of 20.7 hours to measure its phase curve over an entire orbit plus an eclipse duration to ensure a sufficient baseline when the planet goes behind its host star. This will enable a high fidelity lightcurve of the planet emission through its orbit in reflected light and thermal emission. We also include 0.6 hours of extra baseline before the first contact between the planet and star and after the last contact to allow the detector and telescope to stabilize and remove any transients. The NGTS-10 system is in the right brightness range where the signal to noise in the prism is high but below the saturation level. Each integration of the science exposure will have 6 groups up the ramp to ensure that the target stays below 75% the saturation level and avoid severe non-linearities in the detector. We will perform target acquisition on the NGTS-10 itself with 3 groups up the ramp. The F110W filter ensures that target acquisition will reach a signal to noise of 105 for an accurate centroid without saturation. We provide a phase constraint to ensure that the exposure starts before NGTS-10 b's first eclipse and finishes after its last eclipse.

Proposal 2158 - Targets - From East to West : the first simultaneous temperature and cloud map of a hot Jupiter.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGTS-10	RA: 06 07 29.3400 (91.8722500d) Dec: -25 35 41.62 (-25.59489d) Equinox: J2000	Proper Motion RA: 1.5523283997230904E-4 sec of time/yr Proper Motion Dec: 0.0035 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[K dwarfs]
Extended=NO

Observation

Proposal 2158, Observation 1: NGTS-10

Tue Sep 14 19:00:31 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(NGTS-10 (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)	NGTS-10	RA: 06 07 29.3400 (91.8722500d) Dec: -25 35 41.62 (-25.59489d) Equinox: J2000	Proper Motion RA: 1.5523283997230904E-4 sec of time/yr Proper Motion Dec: 0.0035 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[K 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	SAME	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	58884

Template

Subarray
SUB512

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSRAPID	6	15513	3	1	46539	74629.94	

Special Requirements

Phase 0.20414 to 0.231844 with period 1.5337888 Days and zero-phase 2457518.84377 HJD
Time Series Observation
No Parallel