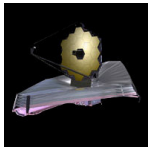

4082 - Putting it all Together: Dynamics and Chemistry Probed Through Transmission Spectroscopy of a Cloud-Free Exoplanet

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Transit 1				
	1		NIRSpec Bright Object Time Series	(1) WASP-96

ABSTRACT

It has long been recognized that the atmosphere composition of hot-Jupiters can inform us about their formation and migration processes. Recent studies have highlighted, however, that atmosphere composition is also significantly affected by three-dimensional dynamical effects, and photochemistry driven by irradiation from the host star. Assessing the interplay between these physical and chemical processes and obtaining robust and precise atmosphere composition measurements is inherently difficult, especially given the ubiquity of clouds in hot-Jupiter atmospheres. As one of the few confirmed cloud-free planets, WASP-96b is a prime target to study these effects. We propose the observation of one transit of the cloud-free hot-Jupiter WASP-96b with NIRSpec/G395H to complement the existing NIRISS/SOSS spectrum taken as part of the Early Release Observations program. The full 0.6-5.0μm transmission spectrum will allow us to robustly constrain the composition of WASP-96b's atmosphere, and particularly of carbon-bearing species which are not present in the SOSS waveband. This will in turn provide some of the tightest-yet constraints on the formation history of an exoplanet. Moreover, our observations will enable some of the first direct evidence for dynamics-induced chemistry in an exoplanet, as well as to probe the degree to which photochemistry sculpts its upper atmosphere; effects only observable in the NIRSpec waveband. As WASP-96b is one of the few confirmed cloud-free planets, it is the ideal target with which to study such a large ensemble of physical and chemical processes.

OBSERVING DESCRIPTION

We propose to observe ine transits of the inflated and cloud free hot-Jupiter WASP-96b with NIRSpec/G395H+F290LP. When combined with the existing NIRISS/SOSS transmission spectrum taken as part of the ERO program, we will be able to construct the full 0.6--5.0μm transmission spectrum for this planet. The SOSS observations confirm the cloud-free nature of the planet, as well as point to a solar-to-super-solar metallicity atmosphere. With NIRSpec/G395H, we wish to observe, for the first time, signatures of C-bearing species, which have no opacity in the SOSS waveband, in the atmosphere of WASP-96b, which provide insights into this planet's formation history. Furthermore, we wish to determine the extent to which wind-dirven and photochemical effects shape the composition of WASP-96b's atmosphere --- questions which are not possible to answer with SOSS alone. Our program will enable one of the most complete studies of the ensemble of processes governing the atmospheres of exoplanets that has ever been attempted to date.

The NIRSpec/G395H+F290LP observations are conducted in BOTS mode with 128 groups and 152 integrations. This provides coverage of the 2.4 hour transit, as well as sufficient baseline observations (with a 1:1 in-transit-to-out-of-transit ratio) before and after the transit. Target acquisition is carried out on the target itself with WATA and the F110W filter. The central TA pixel is saturated, however this should not effect the overall TA success, as was shown in the ERS program (#1366). The science exposure is not saturated anywhere on the detector. The total time ask is only 6.7 hours, including all overheads.

One APT warning remains, which concerns a High Gain Antenna move during the time series. This is expected and acceptable for exoplanet time series observations, and there is so far no evidence that HGA moves during exposures have negatively impacted data.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-96	RA: 00 04 11.1767 (1.0465696d) Dec: -47 21 38.29 (-47.36064d) Equinox: J2000	Proper Motion RA: 0.0025189152082340975 sec of time/yr Proper Motion Dec: 0.0021920000000000004 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems]

Observation

Proposal 4082, Observation 1 Tue Apr 30 20:00:20 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: Period and T0 from Patel & Espinoza (2022)
Phase constraints calculated as 1 - (T14)/P, 1 - (T14)/P - 1hr/P
One pixel saturated at center in TA. NIRSpec TA uses a 3x3 area, so losing one pixel should be ok. TA with one saturated pixel was successful in program #1366.

Diagnostics

(Observation 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-96	RA: 00 04 11.1767 (1.0465696d) Dec: -47 21 38.29 (-47.36064d) Equinox: J2000	Proper Motion RA: 0.0025189152082340975 sec of time/yr Proper Motion Dec: 0.0021920000000000004 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 WASP-96	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	140315.2

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	128	152	1	1	152	17689.529	140315.1

Special Requirements

Phase 0.9583194377851726 to 0.9704839726365698 with period 3.4252577 Days and zero-phase 2459111.30170 HJD
Time Series Observation
No Parallel Attachments