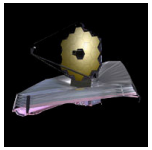

2571 - Unveiling the Atmospheric Composition and Haze Formation Rates in the Young, Cool, Super-Puff Kepler-51d

Cycle: 1, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Kepler-51d				
	1	Kepler-51d	NIRSpec Bright Object Time Series	(1) KEPLER-51

ABSTRACT

To date, the atmospheres of young, cool, and low-mass exoplanets have remained a largely unexplored mystery to us. As the majority of these types of planets have transmission spectra with features too small to detect with Hubble/WFC3's precision, we know very little about how these planets form and evolve. Much of what we do know from observations, we have had to extrapolate from hotter, older, or more massive exoplanets. But is this a valid assumption? Do cool and low-mass planets form and evolve under the same conditions, following similar pathways? Webb is poised to answer these questions over the next decade by observing the spectra of these cooler, less-massive worlds. With these observations we can finally

integrate new planets spanning new parameters into our models, enabling us to test current planetary formation and evolution theories. To accomplish this, we are proposing to observe the transmission spectrum of Kepler-51d, a cool, young, low-mass super-puff planet. By capitalizing on Kepler-51d's large scale height, we will characterize the chemical composition of its atmosphere and the structure of its haze layer, which was previously observed by Hubble/WFC3. In doing so, we will begin to quantitatively understand where Kepler-51d formed in its disk and what atmospheric evolution processes this young planet is currently undergoing as it moves towards its final quiescent state.

OBSERVING DESCRIPTION

We are proposing to observe 1 transit of Kepler-51d with the BOTS mode on NIRSpec using the low-resolution prism. The observation will utilize the S1600A1 with the SUB1024B subarray and nsrapid readout. We will use 8 groups/integration with 14818 integrations/exposures which will place us below the 70% saturation limit according to the JWST ETC. This will give us a SNR of 320 in one integration.

Observations must be centered on the mid-transit time of Kepler-51d. This planet demonstrates extreme transit timing variations up to 100 minutes. While the mid-transit time of each transit is known to a 20 minute precision window (99% confidence), we plan to update the ephemeris once we know the schedule window that is under consideration. Also, with a period of 130 days, the APT Visit Finder finds two observable transits in 2022 and one in 2023.

The transit duration for Kepler-51d is 8.48 hours. While it is standard procedure to request equal in and out of transit time for systematics characterization, we are asking for 16.81 hours (science+instrument overhead) for the transit observation in order to utilize the SUB1024B array. Combined we are requesting 14.87 hours for science and 21.45 hours total (including all overheads).

Kepler-51 has a J-band magnitude of 13.56, enabling us to use WATA to acquire directly on our target. We propose using the 140X filter to maximize our S/N with the SUB32 subarray and 3 groups per integration.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	KEPLER-51	RA: 19 45 55.1430 (296.4797625d) Dec: +49 56 15.54 (49.93765d) Equinox: J2000	Proper Motion RA: 6.214838901307212E-7 sec of time/yr Proper Motion Dec: -0.0074579999136403785 arcsec/yr Epoch of Position: 2015.5	

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

Observation

Proposal 2571, Observation 1: Kepler-51d

Tue Jun 20 16:01:40 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(Kepler-51d (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=[Exoplanets]

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	F140X	NRSRAPID	3	1	1	0.08	63263

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	12	9041	2	1	18082	53532.846	90885

Special Requirements

Phase 0.9974397181641755 to 0.9977597533936535 with period 130.1845 Days and zero-phase 2459991.7465 HJD
Time Series Observation
No Parallel Attachments