

2420 - Probing the Terrestrial Planet TRAPPIST-1c for the Presence of an

Atmosphere

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder Observation	Label	Observing Template	Science Target
Transit observations		-	-

JWST Proposal 2420 (Created: Wednesday, March 31, 2021 at 12:04:48 AM Eastern Standard Time) - Overview

_	Folder	Observation	Label	Observing Template	Science Target
		1	Transit 1	NIRSpec Bright Object Time Series	(1) TRAPPIST-1
		2	Transit 2	NIRSpec Bright Object Time Series	(1) TRAPPIST-1
		3	Transit 3	NIRSpec Bright Object Time Series	(1) TRAPPIST-1
		4	Transit 4	NIRSpec Bright Object Time Series	(1) TRAPPIST-1

ABSTRACT

Since the discovery of the first exoplanets, a prime aspiration has been characterization of planets akin to our own Earth. JWST will, for the first time, enable observations of the atmospheres of terrestrial planets, allowing us to understand the nature and diversity and ultimately the habitability of Earth-like worlds. Facilitated by the broad spectral coverage of the NIRSpec Prism, we propose to characterize the atmosphere of the terrestrial-sized exoplanet TRAPPIST-1c, which is one of the most favorable such targets due to its significant transit depth and proximity to Earth. The seven terrestrial planets in the TRAPPIST-1 system receive between 0.1 to 4 times the irradiation of Earth and thus form a unique natural laboratory for testing and understanding planetary environments, their composition and their habitability. Planets b, d, e, and f are part of GTO programs and observations of planet c will thus allow comparative atmospheric characterization of all the inner planets in the TRAPPIST-1 system. Our program will enable the detection of the most probable types of clear atmospheres for TRAPPIST-1c, and its atmospheric constituents. Distinguishing between a cloudy/hazy atmosphere and no atmosphere is extremely challenging for any terrestrial planet, including planet c, and will require occupying JWST for close to 100 hours. We submit that the most fruitful use of JWST will be to reveal the clear-atmosphere Earth-like planets early, using short visits like this proposal, enabling ground-breaking exhaustive characterization of the most favorable Earth-like planets with clear atmospheres before the end of JWST's lifetime.

OBSERVING DESCRIPTION

We will observe four primary transits of the terrestrial planet TRAPPIST-1c ($R = 1.1 R_{earth}$, $M = 1.3 M_{earth}$). We plan to carry out these observations with NIRSpec Prism, utilizing the S1600A1 slit, with the SUB512s subarray, and with the NRSRAPID readout pattern. As no enchanced readout patterns are enabled in cycle 1, we maximize our signal-to-noise by setting Exp/Dith = 1, Groups/Int = 3, and Integrations/Exp = 27459 during each of the four transit events. This leads to a total exposure time of 16369.957 per visit. As recommended, this total exposure time reflects 0.75hr of detector settling, 1hr timing window, 1hr of pre-transit baseline, 0.7hr transit duration and 1hr of post-transit baseline. The observations needs to be timed with the transit of TRAPPIST-1c (P = 2.4 days). The TRAPPIST-1 system resides near the ecliptic and are thus only observable in two visibility windows per year, totalling approximately 100 days/year. This yields 45 opportunities to observe the planet during transit in cycle 1.

Proposal 2420 - Targets - Probing the Terrestrial Planet TRAPPIST-1c for the Presence of an Atmosphere

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