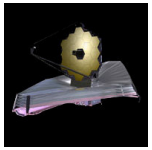

2149 - The nature, origin, and fate of two planets of a newborn system through the lens of their relative atmospheric properties

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	V1298 Tau c	NIRSpec Bright Object Time Series	(1) V-V1298-TAU
	2	V1298 Tau b	NIRSpec Bright Object Time Series	(1) V-V1298-TAU

ABSTRACT

Young planets hold unparalleled keys to understanding planet formation and evolution. Multiple transiting planets form the best laboratories to rigorously test theories; by scaling one planet to another in a multiple system, the host star's uncertain history can be negated. The young (23 Myr) V1298 Tau system offers us the best opportunity to conduct such detailed studies. We propose near-infrared transmission spectroscopy observations of the transiting inflated Neptune and sub-Neptune planets, V1298 Tau b and c, to determine their absolute and relative atmospheric properties, including compositions, metallicities, carbon-to-oxygen ratios, and aerosol properties.

This project will enable comparing the chemical makeup, the formation tracers, the aerosols properties, and the evolution scenarios of two sister planets within one system. It will have major impacts because it will provide crucially needed novel observational constraints to several important areas of the field of exoplanets, including studies of planet interior, atmosphere, evolution and aerosol formation. The strength of this approach is that it will enable a direct and even comparison of planets within one system. This will be transformative since exoplanet atmospheric studies systematically suffer from comparing planets orbiting stars with often unknown histories.

The outcome of this project will shed lights on the entire population of exoplanets. It will be an important legacy for the community, and provide benchmark spectra that will enable comparative planetology studies between the targeted planets, and with other planets, young and mature, including those targeted in the JWST GTO and ERS programs.

OBSERVING DESCRIPTION

Two transits: one transit of W1298 Tau b and another of W1298 Tau c .

The NIRSpec observations are conducted in BOTS (Bright Object Time Series) mode, which requires the S1600A1 aperture with a fixed 1.6"x1.6" field of view (FoV). Both exposures will use the SUB2048 subarray (2048x32 pixels) to record the full spectrum.

The two exposures will use the G395H+F290LP combination (2.87-5.27 microns) with 12 groups per integration (11.75 sec) and 2600 integrations total for planet c and 3525 for planet b.

The 11.5 hour observation for planet b and 8.5 hours for planet c are designed to stay below ~75% of saturation

Because our science target is too bright for target acquisition, we will utilize the Wide Aperture Target Acquisition (WATA) mode on a nearby star

with the F110W filter.
We nominally plan for about 2 hours both before and after the transit.
The observation is scheduled to start between with a phase range large enough timing window.
We used the ExoCTK website to optimize the number of groups per integration to keep the max fluence below 75% of saturation.
We used PandExo to compute the SNR.

Update January 26 2023
This is an update made following the TTRB granting additional time.
To ensure that we measure the transit of planet b and c and we do not miss part of the transits because of TTVs that have been recently discovered for this system, we computed the transit windows and observation duration that are required. We reuested an additional 1 hour for planet b and 5 hour for planet c added to the existing program. Consequently, the program obtained an additional 6 hours to the 24.9 hours initially allocated, thus increasing to a total 30.9 hours.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	V-V1298-TAU	RA: 04 05 19.5970 (61.3316542d) Dec: +20 09 25.31 (20.15703d) Equinox: J2000	Proper Motion RA: 3.712731804603477E-4 sec of time/yr Proper Motion Dec: -0.016077000032055366 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, Exoplanets, T Tauri stars]*				
(2)	GAIA-DR3-51886439046112640	RA: 04 05 18.7613 (61.3281721d) Dec: +20 09 56.20 (20.16561d) Equinox: J2000	Epoch of Position: 2016	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[G stars]*				
(3)	GAIA-DR3-51886331671984640	RA: 04 05 18.6204 (61.3275850d) Dec: +20 09 11.10 (20.15308d) Equinox: J2000	Proper Motion RA: 20.1006 mas/yr Proper Motion Dec: -12.8517 mas/yr Parallax: 0.0010826" Epoch of Position: 2016	
Comments: *Category=Star* *Description=[G stars]*				

Observation

Proposal 2149, Observation 1: V1298 Tau c

Fri Jan 27 14:00:56 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(V1298 Tau c (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)	V-V1298-TAU	RA: 04 05 19.5970 (61.3316542d) Dec: +20 09 25.31 (20.15703d) Equinox: J2000	Proper Motion RA: 3.712731804603477E-4 sec of time/yr Proper Motion Dec: -0.016077000032055366 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, Exoplanets, T Tauri stars]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 GAIA-DR3-5188643904611264 0	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	64177.2

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	4	10988	1	1	10988	49780.914	64177.1

Special Requirements

Between Dates 14-JAN-2023:18:38:03 and 14-JAN-2023:19:38:03
Between Dates 23-JAN-2023:00:35:52 and 23-JAN-2023:01:35:52
Between Dates 31-JAN-2023:06:31:52 and 31-JAN-2023:07:31:52
Between Dates 08-FEB-2023:12:31:59 and 08-FEB-2023:13:31:59
Between Dates 16-FEB-2023:18:29:10 and 16-FEB-2023:19:29:10
Between Dates 25-FEB-2023:00:27:28 and 25-FEB-2023:01:27:28
Time Series Observation
No Parallel Attachments

Observation

Proposal 2149, Observation 2: V1298 Tau b Fri Jan 27 14:00:56 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(V1298 Tau b (Obs 2)) 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 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	V-V1298-TAU	RA: 04 05 19.5970 (61.3316542d) Dec: +20 09 25.31 (20.15703d) Equinox: J2000	Proper Motion RA: 3.712731804603477E-4 sec of time/yr Proper Motion Dec: -0.016077000032055366 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, Exoplanets, T Tauri stars]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	3 GAIA-DR3-5188633167198464 0	WATA	SUB32	F110W	NRSRAPIDD6	3	1	1	0.26	142453.3

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	4	9385	1	1	9385	42518.555	144842.2

Special Requirements

Between Dates 19-JAN-2023:01:49:52 and 19-JAN-2023:02:49:52
Between Dates 12-FEB-2023:04:57:35 and 12-FEB-2023:05:57:35
Time Series Observation
No Parallel Attachments