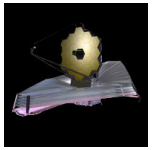

9942 - Searching for the Fire Within: Investigating the Impact of Tidal Heating on Exoplanet Interiors and Atmospheres with JWST

Cycle: 5, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	HAT-P-17b G395H Transit	NIRSpec Bright Object Time Series	(2) HAT-P-17b
	6	K2-287b G395H Transit	NIRSpec Bright Object Time Series	(6) K2-287b
	7	WASP-148b G395H Transit	NIRSpec Bright Object Time Series	(8) WASP-148b

ABSTRACT

We propose to leverage JWST NIRSpec/G395H to investigate the effects of tidal heating on the interior structure and atmospheric properties of three high-eccentricity gas-giant exoplanets. Tidal heating plays a critical role in shaping planetary atmospheres and driving interior heat, but its effects remain poorly understood. Our carefully curated sample of planets span a range of densities and eccentricities, providing a unique opportunity to study how tidal dissipation influences their thermal and structural evolution.

Using transmission spectroscopy from 2.7–5.0 μm, we will measure key molecular species, including H2O, CH4, CO, and CO2. CH4 serves as a sensitive thermometer for probing interior heat, allowing us to constrain the planets' internal temperatures. From these observations, we will measure atmospheric metal enrichment and provide envelope-to-core mass fractions for a population of exoplanets for the first time. The results of our survey will offer critical insights into the connection between exoplanet atmospheres and their interiors, thereby testing the planet formation via core accretion.

Our results will also provide the first empirical distribution of tidal dissipation factors, Q, for gas-giant exoplanets, offering key comparisons to

Jupiter and Saturn in our own solar system. This legacy dataset will enhance our understanding of exoplanet migration and formation pathways, potentially revealing chemical imprints left by high-eccentricity migration. By combining constraints on atmospheric composition and internal structure, our program will provide a comprehensive view of how tidal forces shape the evolution of exoplanets.

OBSERVING DESCRIPTION

We propose to observe one transit each of HAT-P-17b, K2-287b, and WASP-148b using NIRSpec/G395H.

Because all three science target stars saturate NIRSpec TA, we have located nearby offset-TA stars that are listed in both the 2MASS and Gaia DR3 catalogues to give precise positions and infrared magnitudes; our ETC calculations show that we will achieve >100 SNR for all TA stars and less than 80% saturation.

For all science observations, we will use the SUB2048 array with the NRSRAPID readout pattern, the number of groups were set to give <=80% saturation, and the number of integrations then chosen to give equal in-transit and out-of-transit measurements plus an initial 30 minutes of detector settling. To avoid excessively constraining the observation start times, we have also added 1 hour to all of our observations and have broadened the phase windows to allow for 1 hour of start time uncertainty. We also expect these proposed observations will be minimally impacted by any high-gain antenna moves, since the transients from the HGA repoints have been seen to damp out within a few seconds.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HAT-P-17b_TA_Star	RA: 21 38 7.0845 (324.5295188d) Dec: +30 29 34.97 (30.49305d) Equinox: J2000	Proper Motion RA: 5.213 mas/yr Proper Motion Dec: -14.190 mas/yr Parallax: 0.0012862" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Based on (J-H) and (H-K) indices, this is a late-G star. This 2MASS source is linked to the source Gaia DR3 1849786549750778496 with high confidence, giving us precise infrared magnitudes, positions, proper motions, and parrallax measurements. *Category=Star* *Description=[G stars]* *Extended=NO*				
(2)	HAT-P-17b	RA: 21 38 8.7310 (324.5363792d) Dec: +30 29 19.45 (30.48874d) Equinox: J2000	Proper Motion RA: -80.28 mas/yr Proper Motion Dec: -127.037 mas/yr Parallax: 0.0108195" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.* *Category=Star* *Description=[Exoplanets, G stars]* *Extended=NO*				
(3)	K2-232b_TA_Star	RA: 04 55 2.5336 (73.7605567d) Dec: +18 39 50.50 (18.66403d) Equinox: J2000	Proper Motion RA: 17.530 mas/yr Proper Motion Dec: -16.566 mas/yr Parallax: 0.0013077" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Based on (J-H) and (H-K) indices, this is a mid- to late-M star. This 2MASS source is linked to the source Gaia DR3 3406688069717352832 with high confidence, giving us precise infrared magnitudes, positions, proper motions, and parrallax measurements. *Category=Star* *Description=[M stars]* *Extended=NO*				
(4)	K2-232b	RA: 04 55 3.9626 (73.7665108d) Dec: +18 39 16.31 (18.65453d) Equinox: J2000	Proper Motion RA: 61.996 mas/yr Proper Motion Dec: -48.141 mas/yr Parallax: 0.0077059" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.* *Based on (J-H) and (H-K) indices, this is a late-F or early-G star.* *Category=Star* *Description=[Exoplanets, G stars]* *Extended=NO*				
(5)	K2-287b_TA_Star	RA: 15 32 19.4061 (233.0808588d) Dec: -22 20 57.17 (-22.34921d) Equinox: J2000	Proper Motion RA: 0.385 mas/yr Proper Motion Dec: -6.217 mas/yr Parallax: 0.0002781" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Based on (J-H) and (H-K) indices, this is a mid- to late-K star. This 2MASS source is linked to the source Gaia DR3 6251711691204301568 with high confidence, giving us precise infrared magnitudes, positions, proper motions, and parrallax measurements. *Category=Star* *Description=[K stars]* *Extended=NO*				

(6)	K2-287b	RA: 15 32 17.8470 (233.0743625d)	Proper Motion RA: -4.772 mas/yr
		Dec: -22 21 29.76 (-22.35827d)	Proper Motion Dec: -17.847 mas/yr
		Equinox: J2000	Parallax: 0.0063771"
			Epoch of Position: 2000

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.

Based on (J-H) and (H-K) indices, this is a late-G or early-K star.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

(7)	WASP-148b_TA_Star	RA: 16 56 29.5940 (254.1233083d)	Proper Motion RA: -3.925 mas/yr
		Dec: +44 17 51.47 (44.29763d)	Proper Motion Dec: 3.890 mas/yr
		Equinox: J2000	Parallax: 0.0011339"
			Epoch of Position: 2000

Comments: This object was generated by the targetselector and retrieved from the 2MASS database. Based on (J-H) and (H-K) indices, this is a mid-M star. This 2MASS source is linked to the source Gaia DR3 1358355700249866496 with high confidence, giving us precise infrared magnitudes, positions, proper motions, and parrallax measurements.
Category=Star
Description=[M stars]
Extended=NO

(8)	WASP-148b	RA: 16 56 31.3397 (254.1305821d)	Proper Motion RA: -13.243 mas/yr
		Dec: +44 18 9.55 (44.30265d)	Proper Motion Dec: -27.016 mas/yr
		Equinox: J2000	Parallax: 0.0040154"
			Epoch of Position: 2000

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Observation

Proposal 9942, Observation 1: HAT-P-17b G395H Transit Fri Mar 13 18:01:48 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: The science target saturates NIRSpec target acquisition; the central pixel is 11x saturated, and the 4 adjacent pixels (+) are also saturated. We will instead use a nearby star (offset by ~26") which is in both the 2MASS and Gaia DR3 catalogues and within the visit splitting distance.

Diagnostics

(HAT-P-17b G395H Transit (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
(2)	HAT-P-17b	RA: 21 38 8.7310 (324.5363792d)	Proper Motion RA: -80.28 mas/yr	
		Dec: +30 29 19.45 (30.48874d)	Proper Motion Dec: -127.037 mas/yr	
		Equinox: J2000	Parallax: 0.0108195"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	1 HAT-P-17b_TA_Star	WATA	SUB32	F140X	NRSRAPID	3	1	1	0.08	275312.8

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	G395H/F290LP	NRSRAPID	18	2017	1	1	2017	34608.654	275312.1

Special Requirements	
	Phase 0.977606 to 0.981638 with period 10.33853522 Days and zero-phase 2456703.460703 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 9942, Observation 6: K2-287b G395H Transit Fri Mar 13 18:01:48 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: The science target saturates NIRSpec target acquisition; the central pixel is 5.4x saturated. We will instead use a nearby star (offset by ~40") which is in both the 2MASS and Gaia DR3 catalogues and within the visit splitting distance.

Diagnostics

(K2-287b G395H Transit (Obs 6)) 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 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(6)	K2-287b	RA: 15 32 17.8470 (233.0743625d) Dec: -22 21 29.76 (-22.35827d) Equinox: J2000	Proper Motion RA: -4.772 mas/yr Proper Motion Dec: -17.847 mas/yr Parallax: 0.0063771" Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.

Based on (J-H) and (H-K) indices, this is a late-G or early-K star.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	5 K2-287b_TA_Star	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	275312.19

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	G395H/F290LP	NRSRAPID	32	1173	1	1	1173	34939.541	275312.17

Special Requirements	
	Phase 0.984771 to 0.987569 with period 14.893291 Days and zero-phase 2458001.72138 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 9942, Observation 7: WASP-148b G395H Transit Fri Mar 13 18:01:48 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: The science target saturates NIRSpec target acquisition; the central pixel is 1.6x saturated. We will instead use a nearby star (offset by ~26") which is in both the 2MASS and Gaia DR3 catalogues and within the visit splitting distance.

Diagnostics

(WASP-148b G395H Transit (Obs 7)) 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 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(8)	WASP-148b	RA: 16 56 31.3397 (254.1305821d)	Proper Motion RA: -13.243 mas/yr	
		Dec: +44 18 9.55 (44.30265d)	Proper Motion Dec: -27.016 mas/yr	
		Equinox: J2000	Parallax: 0.0040154"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	7 WASP-148b_TA_Star	WATA	SUB32	CLEAR	NRSRAPIDD6	3	1	1	0.26	275312.22

Template

Subarray
SUB2048

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	G395H/F290LP	NRSRAPID	109	280	1	1	280	27787.334	275312.21

Special Requirements	
	Phase 0.978625 to 0.983358 with period 8.803544 Days and zero-phase 2459163.62033 HJD Time Series Observation No Parallel Attachments