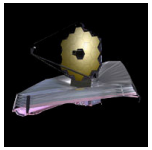

8017 - Resolving Atmospheric Uncertainties and Building a Legacy Dataset for WASP-39b

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRSpec G140H	NIRSpec Bright Object Time Series	(1) WASP-39b
	2	NIRSpec G235H	NIRSpec Bright Object Time Series	(1) WASP-39b

ABSTRACT

Despite extensive observations of WASP-39b with multiple JWST instruments, the atmospheric metallicity and elemental abundance ratios of this benchmark planet remain unconstrained, with current estimates of O/H in particular ranging from solar to over 100× solar. The lack of precision in the at wavelengths from 1-3 μm, due to NIRSpec/PRISM saturation and unresolved degeneracies in the NIRISS/SOSS spectrum, has prevented a definitive determination of the planet's metallicity and water abundance.

We propose to observe two additional transits of WASP-39b using JWST's NIRSpec/G140H and NIRSpec/G235H, which will cover the critical 1–3 μm range at higher resolution and precision. These observations will resolve the current bimodal solutions for WASP-39b's atmospheric composition, allowing us to constrain the metallicity and determine the planet's true elemental abundances, including its C/O and S/O ratios. By achieving closure on this long-standing mystery, our program will cement the legacy of the JWST Transiting Exoplanet Early Release Science Program and provide a robust dataset for future studies of exoplanet atmospheres.

In addition to resolving WASP-39b's atmospheric properties, our observations will contribute to broader planetary science by testing mass-metallicity trends and core accretion models of planet formation. With the Saturn-mass WASP-39b serving as a fulcrum in these analyses, we expect our results to provide key insights into the relationship between atmospheric and bulk planetary metallicity. Our data will also enable further studies of atmospheric escape and photochemistry, setting the stage for future high-resolution atmospheric characterization efforts.

OBSERVING DESCRIPTION

We will observe two transits of WASP-39b with NIRSpec G140H/F100LP and G235H/F170LP to measure the planet's transmission spectrum from 1-3 microns. The observation set up is similar to that of exoplanet ERS transiting exoplanet program (JWST-ERS-1366).

We will use 21 groups per integration and 1288 integrations for the G140H visit, and we will use 38 groups per integration and 727 integrations for the G235H visit; this setup will keep us below 80% saturation. For each transit observation, this will give us an equal number of in-transit and out-of-transit measurements, plus 1 hour to permit a 1 hour scheduling window, plus 30 minutes of detector settling time at the start of each observation.

The central pixel will saturate during TA, but we expect this to still provide sufficient TA precision based on the results of the successful G395H visit from the ERS program which used the exact same TA setup.

We also acknowledge that a high-gain antenna move may occur during our observations; this will not be an issue for our science, as past observations

have demonstrated that any effects from HGA moves dampens out within seconds.

We also request zero proprietary period for these observations, as these data seek to serve the entire exoplanet community by resolving an urgent and outstanding issue raised by the transiting exoplanet ERS program (which itself had zero proprietary period).

Proposal 8017 - Targets - Resolving Atmospheric Uncertainties and Building a Legacy Dataset for WASP-39b

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-39b	RA: 14 29 18.4152 (217.3267300d)	Proper Motion RA: -19.041 mas/yr	
		Dec: -03 26 40.20 (-3.44450d)	Proper Motion Dec: 0.437 mas/yr	
		Equinox: J2000	Parallax: 0.0046435"	
			Epoch of Position: 2000	

Comments: Values were manually updated using the properties listed in VizieR for Gaia DR3 3643098875168270592.
Category=Star
Description=[Exoplanets, G stars]
Extended=NO

Observation

Proposal 8017, Observation 1: NIRSpec G140H

Tue Mar 11 22:01:22 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(NIRSpec G140H (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)	WASP-39b	RA: 14 29 18.4152 (217.3267300d)	Proper Motion RA: -19.041 mas/yr	
		Dec: -03 26 40.20 (-3.44450d)	Proper Motion Dec: 0.437 mas/yr	
		Equinox: J2000	Parallax: 0.0046435"	
			Epoch of Position: 2000	

Comments: Values were manually updated using the properties listed in VizieR for Gaia DR3 3643098875168270592.
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	ETC Wkbk.Calc ID
1	1 WASP-39b	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	227370.1

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	G140H/F100LP	NRSRAPID	21	1288	1	1	1288	25585.45	227370.2

Special Requirements

Phase 0.955786 to 0.966061 with period 4.0552842 Days and zero-phase 2459783.5015000 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 8017, Observation 2: NIRSpec G235H

Tue Mar 11 22:01:22 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(NIRSpec G235H (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)	WASP-39b	RA: 14 29 18.4152 (217.3267300d)	Proper Motion RA: -19.041 mas/yr	
		Dec: -03 26 40.20 (-3.44450d)	Proper Motion Dec: 0.437 mas/yr	
		Equinox: J2000	Parallax: 0.0046435"	
			Epoch of Position: 2000	

Comments: Values were manually updated using the properties listed in VizieR for Gaia DR3 3643098875168270592.
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	ETC Wkbk.Calc ID
1	1 WASP-39b	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	227370.1

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	G235H/F170LP	NRSRAPID	38	727	1	1	727	25589.295	227370.3

Special Requirements

Phase 0.955786 to 0.966061 with period 4.0552842 Days and zero-phase 2459783.5015000 HJD
Time Series Observation
No Parallel Attachments