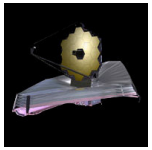

8309 - It’s (poly)Morphin’ Time! Solving the quartz quandary of WASP-17b

Cycle: 4, Proposal Category: GO

INVESTIGATORS

Name	***Institution***
Elijah Mullens (PI)	**Cornell University**
Dr. Sarah E. Moran (CoI) (CoPI) (Contact)	NASA Goddard Space Flight Center
Dr. Hannah Wakeford (CoI) (ESA Member)	University of Bristol
Dr. Nikole Lewis (CoI) (US Admin CoI)	Cornell University
Daniel Valentine (CoI) (ESA Member)	University of Bristol
Dr. Jeff A. Valenti (CoI)	Space Telescope Science Institute
Ana Glidden (CoI)	Massachusetts Institute of Technology
Dr. Ryan Challener (CoI)	Cornell University
Dr. Knicole Colon (CoI)	NASA Goddard Space Flight Center
Dr. Ryan J MacDonald (CoI) (ESA Member)	University of St Andrews
Dr. Lili Alderson (CoI)	Cornell University
Dr. Kevin Stevenson (CoI)	The Johns Hopkins University Applied Physics Laboratory
Dr. Roeland P. van der Marel (CoI)	Space Telescope Science Institute
Dr. Caleb Canas (CoI)	NASA Goddard Space Flight Center
Dr. Dana R. Louie (CoI)	Catholic University of America
Dr. Natasha Batalha (CoI)	NASA Ames Research Center
Prof. Sara Seager (CoI)	Massachusetts Institute of Technology
Dr. Laurent Pueyo (CoI)	Space Telescope Science Institute
Maura Lally (CoI)	Cornell University

OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
MIRI LRS Transits				

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	1	WASP-17b transit 1	MIRI Low Resolution Spectroscopy	(1) WASP-17
	3	WASP-17b transit 2	MIRI Low Resolution Spectroscopy	(1) WASP-17
MIRI LRS Eclipse				
	5	WASP-17b eclipse 1	MIRI Low Resolution Spectroscopy	(1) WASP-17

ABSTRACT

The discovery of SiO2 clouds on the hot Jupiter WASP-17b marked the first time the composition of clouds on a transiting exoplanet has been conclusively determined. This initial detection gives us a unique opportunity to dive deeper and reveal the structure of cloud particles themselves.

It is still a mystery of whether SiO2 condenses out on the limb and sublimates on the dayside, or if it is thermally processed via advection. Silicate materials can have different polymorphs --i.e., crystal arrangements-- depending on their initial formation mechanism and thermal processing. Leveraging the large scale height and fantastic signal-to-noise of WASP-17b, we will be able to understand the planet's overall atmospheric composition, thermal gradients throughout its atmosphere, and its ongoing cloud processing.

Our program will observe two transits and one eclipse (29.6 hours total) using MIRI-LRS to obtain spectra from 7-12 microns with an observing plan optimized to 1) precisely determine the polymorph of SiO2 and constrain the thermal and dynamical conditions on the limb, 2) unearth the full story of SiO2 processing by probing for dayside silicate gas or quartz, and 3) additionally probe for forsterite clouds and cloud grain orientation. Our findings will paint a full picture of quartz in WASP-17b, which can be applied to silicate mineralogy in hot Jupiters, brown dwarfs, and discs as a whole

OBSERVING DESCRIPTION

We will use MIRI-LRS to observe two transit events and one eclipse event of the hot Jupiter WASP-17b. We will combine these observations with the existing MIRI-LRS spectra from GTO-1353 to increase SNR, enabling the detection of specific polymorph cloud species. Each transit/eclipse exposure is 9.86 hours (without overheads) which include pre-, during, and post-event integrations for a total of 29.6 hours.

We set the saturation to 0.65 of the ETC full well and will bin the observations in time to ensure we reach the needed signal-to-noise in the reddest wavelengths where the polymorph features are prominent.

Due to the number of groups and integrations required to cover the full transit event we need to split our observations into at least two exposures.

To ensure that this split does not occur in the ingress/egress of the transit event we split them using three exposures each consisting of the same number of integrations. With this set-up the exposures will be split into three with the first 'gap' in the pre-transit baseline and the second 'gap' during the transit but not impacting ingress or egress. This multi-exposure set-up is preferred to linking two seperate visits as a consecutive non-interupted sequence as the time lost between exposures is minimal compared to ~6 min expected for a non-interupted sequence.
All of our three observations have the same set-up with only the phase constraints differing for the eclipse measurement.

We perform TA on our target star using 8 groups for a single intergration and the same set-up for a LRS verification image taken at the start of the first visit for each paring.

The telescope will need to be oriented from given constraints in the APT to prevent overlap from nearby stars. Additionally, TA will be performed on the target (WASP-17) directly.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-17	RA: 15 59 50.9492 (239.9622883d)	Proper Motion RA: -8.263 mas/yr	
		Dec: -28 03 42.31 (-28.06175d)	Proper Motion Dec: -9.427000031791977 mas/yr	
		Equinox: J2000	Parallax: 0.0024811"	
			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.

User comment: High proper motion star. All numbers checked with Simbad and cross checked with Gaia DR3 catalogue file
K mag = 10.224
Category=Star
Description=[Exoplanets, F stars]
Extended=NO

Observation

Proposal 8309, Observation 1: WASP-17b transit 1 Wed Jul 09 22:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: Full well is set to 65% using the ETC.
Multiple exposures are used to avoid hitting the frame limit. We split into 3 exposures (over 2) to avoid a split between exposures occuring during ingress or egress.
Orient constraints are placed to avoid contamination from nearby stars and match the constraints used in GTO 1353.

Diagnostics

(WASP-17b transit 1 (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-17	RA: 15 59 50.9492 (239.9622883d)	Proper Motion RA: -8.263 mas/yr	
		Dec: -28 03 42.31 (-28.06175d)	Proper Motion Dec: -9.427000031791977 mas/yr	
		Equinox: J2000	Parallax: 0.0024811"	
			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.

User comment: High proper motion star. All numbers checked with Simbad and cross checked with Gaia DR3 catalogue file
K mag = 10.224
Category=Star
Description=[Exoplanets, F stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	8	1	1	1.272	220582

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	8	1	1	1	1	1.272		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	168	448	1344	3	1	36123.232	220582

Special Requirements

Phase 0.9338272086 to 0.9449814929 with period 3.73548546 Days and zero-phase 2457569.988220 HJD
Aperture PA Range 31.83544897 to 48.83544897 Degrees (V3 27.0 to 44.0)
Aperture PA Range 93.83544897 to 141.83544897 Degrees (V3 89.0 to 137.0)
Aperture PA Range 210.83544897 to 226.83544897 Degrees (V3 206.0 to 222.0)
Aperture PA Range 272.83544897 to 310.83544897 Degrees (V3 268.0 to 306.0)
Time Series Observation
No Parallel Attachments

Observation

Proposal 8309, Observation 3: WASP-17b transit 2 Wed Jul 09 22:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: Full well is set to 65% using the ETC.
Multiple exposures are used to avoid hitting the frame limit. We split into 3 exposures (over 2) to avoid a split between exposures occuring during ingress or egress.
Orient constraints are placed to avoid contamination from nearby stars and match the constraints used in GTO 1353.

Diagnostics

(WASP-17b transit 2 (Obs 3)) 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 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-17	RA: 15 59 50.9492 (239.9622883d)	Proper Motion RA: -8.263 mas/yr	
		Dec: -28 03 42.31 (-28.06175d)	Proper Motion Dec: -9.427000031791977 mas/yr	
		Equinox: J2000	Parallax: 0.0024811"	
			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.

User comment: High proper motion star. All numbers checked with Simbad and cross checked with Gaia DR3 catalogue file
K mag = 10.224
Category=Star
Description=[Exoplanets, F stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	8	1	1	1.272	220582

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	8	1	1	1	1	1.272		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	168	448	1344	3	1	36123.232	220582

Special Requirements

Phase 0.9338272086 to 0.9449814929 with period 3.73548546 Days and zero-phase 2457569.988220 HJD
Aperture PA Range 31.83544897 to 48.83544897 Degrees (V3 27.0 to 44.0)
Aperture PA Range 93.83544897 to 141.83544897 Degrees (V3 89.0 to 137.0)
Aperture PA Range 210.83544897 to 226.83544897 Degrees (V3 206.0 to 222.0)
Aperture PA Range 272.83544897 to 310.83544897 Degrees (V3 268.0 to 306.0)
Time Series Observation
No Parallel Attachments

Observation

Proposal 8309, Observation 5: WASP-17b eclipse 1 Wed Jul 09 22:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

*Comments: PLANET Teq Transit time (HJD) Period T14 Observing time (= 1 + (MAX(1 + K2/2, K2))*2) time from center pre transit baseline post transit baseline min phase max phase*
WASP-17b 1770 2457569.988220 3.73548546 4.4232 9.865 5.9325 3.7209 1.7209 0.4338272086 0.4449814929 N
Transit time calculated with https://britastro.org/computing/applets_dt.html using Tc from NASA Exoplanet Archive and Ref Kokori et al. 2023 https://ui.adsabs.harvard.edu/abs/2023ApJS..265....4K/abstract
Phase allowing for 1hour window and assuming a zero eccentricity

Full well is set to 65% using the ETC.
Multiple exposures are used to avoid hitting the frame limit. We split into 3 exposures (over 2) to avoid a split between exposures occuring during ingress or egress.
Orient constraints are placed to avoid contamination from nearby stars and match the constraints used in GTO 1353.

Diagnostics

(WASP-17b eclipse 1 (Obs 5)) 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 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-17	RA: 15 59 50.9492 (239.9622883d)	Proper Motion RA: -8.263 mas/yr	
		Dec: -28 03 42.31 (-28.06175d)	Proper Motion Dec: -9.427000031791977 mas/yr	
		Equinox: J2000	Parallax: 0.0024811"	
			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.

User comment: High proper motion star. All numbers checked with Simbad and cross checked with Gaia DR3 catalogue file
K mag = 10.224
Category=Star
Description=[Exoplanets, F stars]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	8	1	1	1.272	220582

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	8	1	1	1	1	1.272		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	168	448	1344	3	1	36123.232	220582

Special Requirements

Phase 0.4338272086 to 0.4449814929 with period 3.73548546 Days and zero-phase 2457569.988220 HJD
Aperture PA Range 31.83544897 to 48.83544897 Degrees (V3 27.0 to 44.0)
Aperture PA Range 93.83544897 to 141.83544897 Degrees (V3 89.0 to 137.0)
Aperture PA Range 210.83544897 to 226.83544897 Degrees (V3 206.0 to 222.0)
Aperture PA Range 272.83544897 to 310.83544897 Degrees (V3 268.0 to 306.0)
Time Series Observation
No Parallel Attachments