



# 2961 - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

Cycle: 2, Proposal Category: GO

## INVESTIGATORS

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## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Eclipse of WASP 121 b				
	1	MIRI-LRS_WASP121 b	MIRI Low Resolution Spectroscopy	(1) WASP-121B

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
	2	MIRI-LRS_WASP-121 b_BKGR	MIRI Low Resolution Spectroscopy	(2) WASP-121-background

## ABSTRACT

The James Webb Space Telescope has begun to unambiguously reveal the presence of silicate clouds in exoplanet atmospheres. Here we propose to use it to uniquely identify SiO, a gaseous precursor of said clouds, in the dayside emission of the ultra-hot Jupiter WASP-121b, which is so hot that all condensates evaporate. We estimate that we can detect the fundamental vibration band of SiO at 8 sigma in a single-eclipse measurement with MIRI LRS. Together with archival NIRSpec and NIRISS eclipses from GO 1 and GTO programs, which determine the oxygen abundance, we will constrain the atmospheric silicon-to-oxygen ratio ([Si/O]) with a precision of 0.13 dex. This abundance ratio is a proxy of the relative importance of rock and volatile accretion during planet formation. It is highly informative for formation models, potentially allowing us to constrain the contributions of pebble vs. planetesimal accretion. The relative importance of these two processes in the so-called core accretion paradigm is hotly debated. Our measurements would be complementary to the frequently cited C/O abundance ratio, for which disk processes such as pebble evaporation lead to a much less clear interpretation than previously thought. The first direct detection of SiO may therefore allow us to constrain planet formation from a new and highly informative angle.

## OBSERVING DESCRIPTION

For these observations we require continuous time series spectroscopy with the MIRI/LRS instrument in slitless mode, covering the time of our exoplanet target WASP-121b being eclipsed by its host star, as well as the flux baseline observations shortly before and after. We will use a single long exposure to not break up the time series and to ensure a stable observational sequence.

Special requirements of our observations are that they have to take place during the eclipse of the planet (phase-dependent), should be taken without dithering or other parallel observations, and are limited to certain aperture position angles to prevent contamination of our spectra by nearby sources.

Proposal 2961 - Targets - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-121B	RA: 07 10 24.0555 (107.6002313d) Dec: -39 05 50.17 (-39.09727d) Equinox: J2000	Proper Motion RA: -3.2084467892849527E-4 sec of time/yr Proper Motion Dec: 0.025663 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>  <i>Category=Star</i>  <i>Description=[Exoplanet Systems]</i>  <i>Extended=NO</i></p>				
(2)	WASP-121-background	RA: 07 10 35.0300 (107.6459583d) Dec: -39 04 48.50 (-39.08014d) Equinox: J2000		
<p><i>Comments:</i>  <i>Category=Calibration</i>  <i>Description=[Telescope/sky background]</i>  <i>Extended=YES</i></p>				

Proposal 2961 - Observation 1 - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

Mon Dec 04 20:00:42 GMT 2023

<b>Observation</b>	<b>Proposal 2961, Observation 1: MIRI-LRS_WASP121b</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Low Resolution Spectroscopy Background Observations:[MIRI-LRS_WASP-121b_BKGR (Obs 2)]																												
	(MIRI-LRS_WASP121b (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.																												
<b>Fixed Targets</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>WASP-121B</td> <td>RA: 07 10 24.0555 (107.6002313d) Dec: -39 05 50.17 (-39.09727d) Equinox: J2000</td> <td>Proper Motion RA: -3.2084467892849527E-4 sec of time/yr Proper Motion Dec: 0.025663 arcsec/yr Epoch of Position: 2015.5</td> <td></td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous	(1)	WASP-121B	RA: 07 10 24.0555 (107.6002313d) Dec: -39 05 50.17 (-39.09727d) Equinox: J2000	Proper Motion RA: -3.2084467892849527E-4 sec of time/yr Proper Motion Dec: 0.025663 arcsec/yr Epoch of Position: 2015.5		<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Exoplanet Systems] Extended=NO																	
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	SLITLESSPRISM				true																								
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Proposal 2961 - Observation 1 - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	Special Requirements	1	FASTR1	83	1849	1849	1	1	24701.298
Phase 0.3729 to 0.40565 with period 1.27492550 Days and zero-phase 2458119.72074 HJD Aperture PA Range 60 to 110 Degrees (V3 55.16455103 to 105.16455103) Aperture PA Range 290 to 301 Degrees (V3 285.16455103 to 296.16455103) Aperture PA Range 320 to 360 Degrees (V3 315.16455103 to 355.16455103) Time Series Observation No Parallel Attachments  Sequence Observations 1, 2, Non-interruptible									

Proposal 2961 - Observation 2 - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

Mon Dec 04 20:00:42 GMT 2023

<b>Observation</b>	<b>Proposal 2961, Observation 2: MIRI-LRS_WASP-121b_BKGR</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Low Resolution Spectroscopy Background Observation For: [MIRI-LRS_WASP121b (Obs 1)]								
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.								
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(2)	WASP-121-background	RA: 07 10 35.0300 (107.6459583d) Dec: -39 04 48.50 (-39.08014d) Equinox: J2000						
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	1	1 WASP-121B	F560W	FAST	10	1	1	1.59	142461
<b>Template</b>	<b>Subarray</b>				<b>Obtain Verification Image?</b>				
	SLITLESSPRISM				false				
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>No. Spectral Steps</b>	<b>Spectral Step Offset</b>	<b>No. Spatial Steps</b>	<b>Spatial Step Offset</b>			
	1	NONE							
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	1	FASTR1	83	16	16	1	1	213.591	

Proposal 2961 - Observation 2 - Vaporized rocks: detecting silicate cloud precursors in ultra-hot Jupiters

**Special Requirements**

Time Series Observation  
No Parallel Attachments

Sequence Observations 1, 2, Non-interruptible