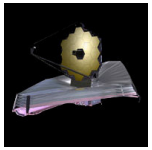

8739 - Precise Direct Interior Composition Measurements of a New Disintegrating Terrestrial Planet

Cycle: 4, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Marc Teng Yen Hon (PI)	**Massachusetts Institute of Technology**
Nick Tusay (CoI) (CoPI)	University of Washington
Avi Shporer (CoI) (US Admin CoI)	Massachusetts Institute of Technology
Dr. Andrew Vanderburg (CoI)	Massachusetts Institute of Technology
Prof. Saul A Rappaport (CoI)	Eureka Scientific Inc.
Dr. Jason T Wright (CoI)	The Pennsylvania State University

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Phase Curve	MIRI Low Resolution Spectroscopy	(1) BD+05-4868
	2	Background Observation	MIRI Low Resolution Spectroscopy	(2) Background

ABSTRACT

BD+05 4868 b is a recently discovered short-period exoplanet with a comet-like dust tail. At an apparent magnitude of V~10, the star is the brightest known host to an evaporating low-mass planet candidate. We propose to measure transmission spectra along the phase curve of the transiting dust tail from BD+05 4868 b using MIRI LRS slitless spectroscopy. Comparing the transit transmission spectra to extinction and scattering models will probe the mineralogical and gaseous content of the dust tail, which will determine the elementary composition of the disintegrating planet's interior. The composition of the dust tail will reveal the evaporating planetary layer producing the dust grains while the dust's temperature and the tail's spatial

extent -- which are measured with the phase curve data -- will yield further constraints on grain composition through grain size and the dynamics of the gas outflow producing such grains. The high signal-to-noise offered by these observations offers the best opportunity to precisely infer the composition of a rocky planet, providing insights into the formation background of terrestrial planets and their habitability.

OBSERVING DESCRIPTION

We propose to observe the phase curve of BD+05 4868 b using MIRI's low resolution spectrometer (LRS) in slitless spectroscopy mode to collect spectrophotometry from 5um to 12um. We will use the P750L disperser with the SLITLESSPRISM subarray in FAST readout mode. Our observations will use 5 exposures of 9830 integrations comprising 16 groups, for a total duration of approximately 132,885 seconds (36.9 hours). Given the long period of BD+05 4868 b (30.52 hours), this sequence of exposures at the very least is guaranteed to capture one complete transit from ingress to egress, which is the minimum for our science goal. With the large number of integrations, we expect to have events from the high-gain antenna repointing during the phase curve observation, but given that the transients from the HGA repoints are expected to damp out within a few seconds, we expect these to have a negligible effect on our observations. In all readouts BD+05 4868 (K=7.45) is at roughly 80% of the detector's saturation threshold. For target acquisition we will use the standard TA for MIRI LRS slitless observations, acquiring directly on BD+05 4868 itself. We will use the F560W filter with the SLITLESSPRISM subarray in FAST readout mode, and we will have 12 groups in a single integration. This will give the TA image a signal-to-noise ratio of approximately 220, and a peak flux at roughly 60% of the saturation limit.

Since we aim to obtain a full phase curve of BD+05 4868 b, the observations will need to be scheduled specifically for these events. A transit of BD+05 4868b occurs once every 1.272 days (30.52 hours), and a phase requirement of 0.1-0.25 (adjusted to an APT-specified period of 2.544 days) is applied to capture the transit ingress. We have also specified a V3PA range requirement of 88.3 to 94.6 degrees to provide a minimum of 1 arcsecond separation between BD+05 4868 and its binary companion to minimize flux contamination. We have verified that BD+05 4868 b has a visibility window from 07 Oct 2025 to 15 Oct 2025 that satisfies all these requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	BD+05-4868	RA: 21 47 26.7438 (326.8614325d) Dec: +06 36 19.20 (6.60533d) Equinox: J2000	Proper Motion RA: 205.59309162786917 mas/yr Proper Motion Dec: 106.35945551759173 mas/yr Parallax: 0.022932200000000003" Epoch of Position: 2016.0	
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=[K dwarfs]*				
(2)	Background	RA: 21 47 26.5800 (326.8607500d) Dec: +06 36 37.00 (6.61028d) Equinox: J2000		
Comments: *Category=Calibration* *Description=[Telescope/sky background]*				

Observation

Proposal 8739, Observation 1: Phase Curve Mon Jun 09 11:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Background Observations:[Background Observation (Obs 2)]

Diagnostics

(Phase Curve (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)	BD+05-4868	RA: 21 47 26.7438 (326.8614325d) Dec: +06 36 19.20 (6.60533d) Equinox: J2000	Proper Motion RA: 205.59309162786917 mas/yr Proper Motion Dec: 106.35945551759173 mas/yr Parallax: 0.022932200000000003" Epoch of Position: 2016.0	

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=[K dwarfs]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 BD+05-4868	F560W	FAST	12	1	1	1.908	220980

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	12	1	1	1	1	1.908		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	16	9770	48850	5	1	132073.973	220980

Special Requirements

Phase -0.0813801 to -0.065 with period 2.543738 Days and zero-phase 2460556.28921965 HJD
Aperture PA Range 93.13544897 to 99.43544897 Degrees (V3 88.3 to 94.6)
Time Series Observation
No Parallel Attachments

Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 8739, Observation 2: Background Observation Mon Jun 09 11:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Background Observation For: [Phase Curve (Obs 1)]

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	Background	RA: 21 47 26.5800 (326.8607500d) Dec: +06 36 37.00 (6.61028d) Equinox: J2000		

Comments:
Category=Calibration
Description=[Telescope/sky background]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Subarray	Obtain Verification Image?
F560W	SLITLESSPRISM	false

Dithers

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

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	16	10	50	5	1	134.389	

Special Requirements	
	Time Series Observation No Parallel Attachments Sequence Observations 1, 2, Non-interruptible