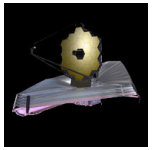

3315 - Measuring the Interior Composition of a Terrestrial Planet

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Transit 1	MIRI Low Resolution Spectroscopy	(1) K2-22B
	2	Transit 2	MIRI Low Resolution Spectroscopy	(1) K2-22B
	3	Phase Curve	MIRI Low Resolution Spectroscopy	(1) K2-22B

ABSTRACT

The disintegrating ultra-short period exoplanet K2-22b offers us the opportunity to probe the interior composition of a rocky exoplanet for the first time. We propose to do so by measuring the transmission spectrum and phase curve of the dust evaporating from K2-22b using MIRI LRS slitless spectroscopy. We propose to observe two transits, as well as a complete phase curve of the orbit from one transit to another, for a total of four transit observations of K2-22b. By comparing the transit transmission spectra to detailed extinction and scattering models, we can determine the

mineralogical make-up of the dust outflowing from K2-22b, and therefore the composition of the planet's interior. The phase curve data will allow us to measure the temperature and spatial extent of the dust, which will further constrain its morphological properties, as well as the dynamics of the dust-outflow around the planet itself. The relative mineralogical abundances in the dust will allow us to determine whether it is crustal, mantle or core material that is evaporating. Assuming mantle material is evaporating, these observations will determine the Mg/Si and Fe/Si ratios of the planet -- which drives important questions of interior dynamics and habitability.

OBSERVING DESCRIPTION

We wish to observe two transits and one phase curve (containing another two transits) of K2-22b using MIRI's low resolution spectrometer (LRS) in slitless spectroscopy mode, to collect spectrophotometry from 5um to 12um. All of our observations will use the P750L disperser with the SLITLESSPRISM subarray in FAST readout mode. We will observe each transit as a single exposure, using 450 groups per integration and 151 integrations per exposure. The phase curve data will use 3 exposures of 205 integrations, for a total duration of approximately 44,000 seconds. We therefore 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 cases K2-22 (K=11.91) 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 K2-22 itself. We will use the F560W filter with the SLITLESSPRISM subarray in FAST readout mode, and we will have 44 groups in a single integration. This will give the TA image a signal-to-noise ratio of approximately 270, and a peak flux at roughly 41\% of the saturation limit.

Since these observations are targeting the transits and a phase curve of K2-22b, they will need to be scheduled specifically for these events. A transit of K2-22b occurs once every 0.381 days (9.15 hours). We have verified that K2-22b has 2 large (~ 50 day) visibility windows from 12-06-2023 to 01-24-2024 and 04-24-2024 to 06-14-2024.

Proposal 3315 - Targets - Measuring the Interior Composition of a Terrestrial Planet

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	K2-22B	RA: 11 17 55.8491 (169.4827046d) Dec: +02 37 8.53 (2.61904d) Equinox: J2000	Proper Motion RA: -0.001809089697416325 sec of time/yr Proper Motion Dec: -0.004712000031759089 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M stars]
Extended=NO

Observation

Proposal 3315, Observation 1: Transit 1

Mon Oct 02 17:01:07 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(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)	K2-22B	RA: 11 17 55.8491 (169.4827046d) Dec: +02 37 8.53 (2.61904d) Equinox: J2000	Proper Motion RA: -0.001809089697416325 sec of time/yr Proper Motion Dec: -0.004712000031759089 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M 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	44	1	1	6.998	139375

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	44	1	1	1	1	6.998		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	450	151	151	1	1	10830.624	139375

Special Requirements

Phase 0.780866 to 0.890205 with period 0.3810771 Days and zero-phase 2458876.939 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3315, Observation 2: Transit 2

Mon Oct 02 17:01:07 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Transit 2 (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)	K2-22B	RA: 11 17 55.8491 (169.4827046d) Dec: +02 37 8.53 (2.61904d) Equinox: J2000	Proper Motion RA: -0.001809089697416325 sec of time/yr Proper Motion Dec: -0.004712000031759089 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M 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	44	1	1	6.998	139375

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	44	1	1	1	1	6.998		F560W

Proposal 3315 - Observation 2 - Measuring the Interior Composition of a Terrestrial Planet

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	450	151	151	1	1	10830.624	139375

Special Requirements

Phase 0.780866 to 0.890205 with period 0.3810771 Days and zero-phase 2458876.939 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3315, Observation 3: Phase Curve Mon Oct 02 17:01:07 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Phase Curve (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)	K2-22B	RA: 11 17 55.8491 (169.4827046d) Dec: +02 37 8.53 (2.61904d) Equinox: J2000	Proper Motion RA: -0.001809089697416325 sec of time/yr Proper Motion Dec: -0.004712000031759089 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Exoplanet Systems, Exoplanets, M 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	44	1	1	6.998	139375

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	44	1	1	1	1	6.998		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	450	305	610	2	1	43753.176	139375

Special Requirements

Phase 0.890433 to 0.9451026 with period 0.7621542 Days and zero-phase 2458876.939168 HJD
Time Series Observation
No Parallel Attachments