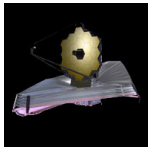

10586 - Swaddled in Dust: Probing K2-33 b’s Circumplanetary Disk

Cycle: 5, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Dr. Andrew Withycombe Mann (PI)	**University of North Carolina at Chapel Hill**
Madyson Barber (CoI) (CoPI)	University of North Carolina at Chapel Hill
Dr. Peter Gao (CoI) (CoPI)	Carnegie Institution of Washington
Dr. Kazumasa Ohno (CoI)	National Astronomical Observatory of Japan (NAOJ)
Prof. Jonathan Fortney (CoI)	University of California - Santa Cruz
Dr. Adam L. Kraus (CoI)	University of Texas at Austin
Dr. Benjamin Tofflemire (CoI)	SETI Institute
Isabel Lopez Murillo (CoI)	University of North Carolina at Chapel Hill
Qiao Xue (CoI)	University of Chicago

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRSpec	NIRSpec Bright Object Time Series	(1) K2-33
	2	MIRI	MIRI Low Resolution Spectroscopy	(1) K2-33

ABSTRACT

We propose to observe two transits of the 9 Myr planet K2-33b with JWST/NIRSpec-PRISM and MIRI-LRS to obtain the first direct characterization of circumplanetary material around a transiting exoplanet. K2-33b shows an extreme optical–infrared transit-depth difference (nearly twice as deep in the optical) that cannot be explained by stellar spots or atmospheric hazes. If confirmed, this would represent the first detection of a circumplanetary disk around a close-in planet and demonstrate that accretion and disk–planet interactions can persist for as long as ~$9 Myr, after the dispersal of the natal protoplanetary disk. JWST’s broad coverage uniquely probes wavelengths dominated by disk scattering (0.6–1.5 μm), signal

from the planetary atmosphere (1.5–5 μm), and key absorption features of the circumplanetary material (5–12 μm). Together these data will constrain the disk's orientation and composition, isolate the planetary atmosphere, and control for stellar contamination. They will establish the physical and chemical conditions of late-stage planet growth and provide an empirical timescale for circumplanetary disk dispersal beyond the Solar System.

OBSERVING DESCRIPTION

We will observe Time Series Observations of a young planet, K2-33b. We will observe 1 transit with the Bright Object Time Series mode on NIRSpec using the low-resolution prism (0.6-5 microns), and 1 transit with the Low Resolution Spectrometer on MIRI using the slitless mode (5-14 microns). The observations must be timed to coincide with a transit. The starting phase constraints have been determined using the ExoCTK tool, Phase Constraint Calculator with the latest ephemeris.

We used PandExo 3.0 to simulate our proposed observations and to determine the optimal observing readout patterns and groups per integration for each mode. These parameters were also used in the JWST Exposure Time Calculator to ensure that our observations were below the saturation limit.

For the NIRSpec data, there will be 26 pixels saturated at the end of the first group. This is intentional to get more wavelength coverage. Previous work from the ERS Team was able to recover the spectrum at lower precision with a brighter target (WASP-39; J=10.633). This is factored into our analysis and will not impact our science goals.

For the NIRSpec acquisition, our target is too bright (J=11.095) for WATA so we will use a nearby star (Gaia DR3 6245758900889486464; J=15.048). For the MIRI observations, we will use our primary source for acquisition.

For the MIRI observations, the stare duration is too long to be accommodated by one visit, so we split the observations into two sequenced visits.

The planet has a period of 5.4 days with a transit duration of 4.10 hours, and we plan to secure an out-of-transit baseline equivalent to this duration with an additional 0.5 hours both pre- and post-transit to account for stellar variability. Although stellar variability is minimal at MIRI wavelengths, we are requesting 1 additional hour pre-transit to model the ramp effect, following the ERS team's recommendation, as well as the 0.5 hours post-transit. Including overhead, the total requested time for the two transits is 24.3 hours.

Proposal 10586 - Targets - Swaddled in Dust: Probing K2-33 b's Circumplanetary Disk

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	K2-33	RA: 16 10 14.7377 (242.5614071d)	Proper Motion RA: -9.592 mas/yr	
		Dec: -19 19 9.41 (-19.31928d)	Proper Motion Dec: -23.963999910847633 mas/yr	
		Equinox: J2000	Parallax: 0.0071928999999999995"	
			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.* *Category=Star* *Description=[Exoplanet Systems, Exoplanets, Young stellar objects]* *Extended=NO*				
(2)	Gaia_DR3_6245758900889486464	RA: 16 10 13.0195 (242.5542479d)	Proper Motion RA: -4.233388608295888 mas/yr	
		Dec: -19 19 27.95 (-19.32443d)	Proper Motion Dec: -8.667808955909832 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=Star* *Description=[Young stellar objects]*				

Observation

Proposal 10586, Observation 1: NIRSpec

Mon May 04 22:00:09 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Diagnostics

(NIRSpec (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)	K2-33	RA: 16 10 14.7377 (242.5614071d) Dec: -19 19 9.41 (-19.31928d) Equinox: J2000	Proper Motion RA: -9.592 mas/yr Proper Motion Dec: -23.963999910847633 mas/yr Parallax: 0.0071928999999999995" 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.
Category=Star
Description=[Exoplanet Systems, Exoplanets, Young stellar objects]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 Gaia_DR3_6245758900889486464	WATA	SUB32	F140X	NRSRAPID	3	1	1	0.08	275456

Template

Subarray
SUB512

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	NRSRAPID	2	47502	1	1	47502	33201.998	275456

Special Requirements	
	Phase 0.9609821 to 0.9686628 with period 5.424865 Days and zero-phase 2456898.69288 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 10586, Observation 2: MIRI

Mon May 04 22:00:09 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(MIRI (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)	K2-33	RA: 16 10 14.7377 (242.5614071d)	Proper Motion RA: -9.592 mas/yr	
		Dec: -19 19 9.41 (-19.31928d)	Proper Motion Dec: -23.963999910847633 mas/yr	
		Equinox: J2000	Parallax: 0.0071928999999999995"	
			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.
Category=Star
Description=[Exoplanet Systems, Exoplanets, Young stellar objects]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	F560W	FAST	4	1	1	0.636	275456

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	Optional ETC 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	Optional ETC ID
1	FASTR1	174	640	1280	2	1	35624.642	275456

Special Requirements

Phase 0.9571418 to 0.9648225 with period 5.424865 Days and zero-phase 2456898.69288 HJD
Time Series Observation
No Parallel Attachments