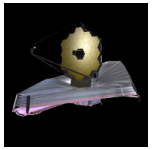

9436 - The Night of Several Transits: Probing Stellar Behavior and Planetary Diversity in K2-384

Cycle: 4, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRSpec	NIRSpec Bright Object Time Series	(1) K2-384
	2	NIRSpec	NIRSpec Bright Object Time Series	(1) K2-384

ABSTRACT

We propose a highly efficient Director’s Discretionary Time (DDT) observation of the active mid-M dwarf K2-384, which hosts five transiting planets, including a potential water-world. On July 10–11, 2025, three of these planets—K2-384c, e, and f—will transit in a rare, non-overlapping configuration within a 13-hour window. This unique opportunity enables us to empirically isolate stellar contamination using the Transit Light Source Effect (TLSE) and jointly model stellar heterogeneity across all three transits. We will use NIRSpec/PRISM spectroscopy to constrain the

atmospheric composition of K2-384f and place upper limits on planetsc ande. The proposed observation also provides a benchmark dataset for developing and publicly releasing a new retrieval module that models unified stellar heterogeneity across multiple transits. This program will directly inform future JWST strategies for characterizing planets around active stars like M dwarfs, maximizing scientific return in a single short visit.

OBSERVING DESCRIPTION

We propose a time-critical NIRSpec/PRISM observation of the K2-384 system on July 10–11, 2025, when three of its five transiting planets—K2-384 c, e, and f—will undergo non-overlapping transits within a 13-hour window. This rare alignment provides a unique opportunity to disentangle stellar contamination using the Transit Light Source Effect (TLSE) and place atmospheric constraints on each planet—particularly the potential water-world K2-384 f—within a single, efficient visit.

This configuration does not recur in any of the next three JWST cycles, making this date the only viable opportunity to observe all three transits together. No alternative date will capture this geometry or enable the joint stellar heterogeneity modeling essential to our science goals.

We selected NIRSpec/PRISM for its broad wavelength coverage and sensitivity to molecular features like water, critical for both atmospheric retrieval and modeling of unocculted stellar regions. Observations will use the SUB512S subarray and NRSRAPID readout mode, optimized to prevent saturation while maximizing observing efficiency. We set 5 groups per integration over 49,000 integrations and will perform target acquisition using WATA with the F110W filter.

We will reduce the data using multiple pipelines—both the official JWST pipeline and custom routines developed by our team—to ensure robust results. Atmospheric retrievals will be conducted using SCARLET, petitRADTRANS, TauREx, and other tools to cross-validate findings and evaluate model sensitivity.

Importantly, this observation will support the development of a new retrieval module for modeling unified stellar contamination across multiple transits in a single dataset. The module will be made publicly available and will provide critical functionality for the broader community studying planets orbiting active stars.

Proposal 9436 - Targets - The Night of Several Transits: Probing Stellar Behavior and Planetary Diversity in K2-384

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	K2-384	RA: 01 21 59.8551 (20.4993963d)	Proper Motion RA: 103.139 mas/yr	
		Dec: +00 45 4.41 (.75123d)	Proper Motion Dec: -59.32500002927554 mas/yr	
		Equinox: J2000	Parallax: 0.0122174"	
			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=[M dwarfs]

Observation

Proposal 9436, Observation 1: NIRSpec

Thu Jun 26 20:00:17 GMT 2025

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.

(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	K2-384	RA: 01 21 59.8551 (20.4993963d) Dec: +00 45 4.41 (.75123d) Equinox: J2000	Proper Motion RA: 103.139 mas/yr Proper Motion Dec: -59.32500002927554 mas/yr Parallax: 0.0122174" 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=[M dwarfs]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 K2-384	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	255399

Template

Subarray
SUB512S

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSRAPID	5	39300	1	1	39300	34741.2	255399

Special Requirements	
	Between Dates 10-JUL-2025:19:30:00 and 10-JUL-2025:20:30:00 Time Series Observation No Parallel Attachments Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 9436, Observation 2: NIRSpec

Thu Jun 26 20:00:17 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

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
(1)	K2-384	RA: 01 21 59.8551 (20.4993963d) Dec: +00 45 4.41 (.75123d) Equinox: J2000	Proper Motion RA: 103.139 mas/yr Proper Motion Dec: -59.32500002927554 mas/yr Parallax: 0.0122174" 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=[M dwarfs]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 K2-384	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	255399

Template

Subarray
SUB512S

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSRAPID	5	9700	1	1	9700	8574.8	255399

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