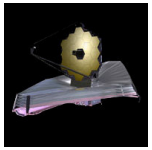

4538 - Exo-Asteroid Belts with JWST: Pinpointing the Warm Dust Emission

Cycle: 3, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
BET LEO				
	1	MIRI Background	MIRI Imaging	(3) Background-Beta-Leo
	2	MIRI	MIRI Imaging	(1) -bet-Leo
	3	NRC-Rot1_BetaLeo	NIRCam Coronagraphic Imaging	(1) -bet-Leo
	4	NRC-Rot2_BetaLeo	NIRCam Coronagraphic Imaging	(1) -bet-Leo
	5	MIRI PSF	MIRI Imaging	(8) -del-Leo
	6	NRC PSF	NIRCam Coronagraphic Imaging	(8) -del-Leo
Eta Corvi				
	7	Background	MIRI Imaging	(6) Background-Eta-Crv
	8	Science	MIRI Imaging	(4) -eta-Crv
	9	PSF	MIRI Imaging	(7) -alf-Crv

ABSTRACT

Resolved images of debris disks from optical to millimeter wavelengths have advanced the understanding of star and planet formation in recent decades, but have thus far been limited to the cold, outer, Kuiper belt analogues. For the first time, the warm, inner, asteroid belt analogues are

accessible for a handful of targets with JWST, probing signatures of planet formation histories inside of the ice line. We aim to triple the sample of nearby debris disks with exo-asteroid belt components detectable with JWST using the MIRI imager. We have identified the two sources with the highest probability of hosting a resolvable warm debris disk via modelling of spectral energy distributions and marginally resolved IR imaging from the literature. These warm disks, like our own asteroid belt, are composed of rocky bodies and are likely shepherded by planets. Only JWST is able to observe this phenomenon with a spatial resolution never before achieved in the Mid-IR and at the peak in thermal emission from dust a few tens of microns in size where the star/disk contrast is more favorable. The warm dust disk morpholgies will be linked to shepherding planets and the radial distribution of dust, when combined with multiwavelength photometry, will probe the dust size distributions and test the collisional histories and radial transport mechanisms in the intermediate disk (i.e. between the Kuiper Belt and zodiacal dust analogues). With this legacy dataset, JWST will do for asteroid belt analogues what ALMA and HST have achieved for Kuiper belt analogs; revolutionizing the field of circumstellar astrophysics.

OBSERVING DESCRIPTION

We will image the exo-asteroid belts of five nearby debris disk systems with MIRI. Building up the experiences of the JWST GTO 1193 team (private communication) we forgo use of the MIRI coronagraphs and instead use the imager for a smaller inner working angle at longer wavelengths. We combine observations of the science targets with contemporaneous PSF reference star observations and will perform classical PSF subtraction to retrieve the disk signal in the inner regions of these disks. Observations for all targets will use the filter/subarray combination F2100W/SUB128. This wavelength is near the peak of the disk emission in IR photometry and the smaller subarray provides a snapshot of the inner disk while limiting saturation of the PSF core for these bright, nearby sources. For one source, Zeta Lep, with an unusually large warm dust population (inferred from IR excess) we also obtain images using the F1130W/SUB64 combination for an even smaller inner working angle to probe inside of the exo-asteroid belt to the rocky planet zone. For all sources and observing modes we opt for the minimum 5 groups per integration, a total integration time of roughly 900 seconds per exposure, and use a 4 point dither pattern with the extended pattern where available. Lastly, a set of background observations with the same exposure properties will be performed at both filter/subarray combinations to aid in the high fideltiy residual stellar PSF subtraction for all science targets.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-bet-Leo	RA: 11 49 3.5783 (177.2649096d) Dec: +14 34 19.41 (14.57206d) Equinox: J2000	Proper Motion RA: -497.68 mas/yr Proper Motion Dec: -114.67000006177841 mas/yr Parallax: 0.09090999999999999" 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.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=[A stars]*				
(3)	Background-Beta-Leo	RA: 11 49 12.2360 (177.3009833d) Dec: +14 39 34.21 (14.65950d) Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=Calibration* *Description=[Telescope/sky background]* *Extended=NO*				
(4)	-eta-Crv	RA: 12 32 4.2264 (188.0176100d) Dec: -16 11 45.62 (-16.19601d) Equinox: J2000	Proper Motion RA: -424.597 mas/yr Proper Motion Dec: -58.24099996516452 mas/yr Parallax: 0.0548135" 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.This object was generated by the targetselector and retrieved from the SIMBAD database.* *Category=Star* *Description=[F stars]*				
(6)	Background-Eta-Crv	RA: 12 32 25.7430 (188.1072625d) Dec: -16 14 8.50 (-16.23569d) Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=Calibration* *Description=[Telescope/sky background]* *Extended=NO*				
(7)	-alf-Crv	RA: 12 08 24.8173 (182.1034054d) Dec: -24 43 43.95 (-24.72888d) Equinox: J2000	Proper Motion RA: 96.976 mas/yr Proper Motion Dec: -40.0229999286239 mas/yr Parallax: 0.0667696" 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.This object was generated by the targetselector and retrieved from the SIMBAD database.* *Category=Star* *Description=[F stars]*				

	(8)	-del-Leo	RA: 11 14 6.5014 (168.5270892d) Dec: +20 31 25.39 (20.52372d) Equinox: J2000	Proper Motion RA: 143.42 mas/yr Proper Motion Dec: -129.8800000540723 mas/yr Parallax: 0.05582" 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.This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[A stars]

Observation

Proposal 4538, Observation 1: MIRI Background

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	Background-Beta-Leo	RA: 11 49 12.2360 (177.3009833d) Dec: +14 39 34.21 (14.65950d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Calibration
Description=[Telescope/sky background]
Extended=NO

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	EXTENDED SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	109	1	Dither 1	4	436	782.346	

Special Requirements

Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

Observation

Proposal 4538, Observation 2: MIRI

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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)	-bet-Leo	RA: 11 49 3.5783 (177.2649096d)	Proper Motion RA: -497.68 mas/yr	
		Dec: +14 34 19.41 (14.57206d)	Proper Motion Dec: -114.67000006177841 mas/yr	
		Equinox: J2000	Parallax: 0.09090999999999999"	
			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.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=[A stars]

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	99	4		1	1			MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	436	1	Dither 1	4	1744	3132.979	

Special Requirements	Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

Observation

Proposal 4538, Observation 3: NRC-Rot1_BetaLeo Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(NRC-Rot1_BetaLeo (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-bet-Leo	RA: 11 49 3.5783 (177.2649096d)	Proper Motion RA: -497.68 mas/yr	
		Dec: +14 34 19.41 (14.57206d)	Proper Motion Dec: -114.67000006177841 mas/yr	
		Equinox: J2000	Parallax: 0.09090999999999999"	
			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.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=[A stars]

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	RAPID	17	1	1	0.905	140139

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	NONE

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F210M	F444W	RAPID	10	290	1	290	3416.177	

PSF References	NRC PSF (Obs 6) (PSF Reference; Filters [F210M/F444W]) Additional Justification: false
Special Requirements	Offset -0.01 arcsec, -0.018 arcsec Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible Aperture PA Offset 3 from 4 by 10 to 14 Degrees (Same offsets in V3)

Observation

Proposal 4538, Observation 4: NRC-Rot2_BetaLeo Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(NRC-Rot2_BetaLeo (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-bet-Leo	RA: 11 49 3.5783 (177.2649096d)	Proper Motion RA: -497.68 mas/yr	
		Dec: +14 34 19.41 (14.57206d)	Proper Motion Dec: -114.67000006177841 mas/yr	
		Equinox: J2000	Parallax: 0.09090999999999999"	
			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.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=[A stars]

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	RAPID	17	1	1	0.905	140139

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	NONE

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F210M	F444W	RAPID	10	290	1	290	3416.177	

PSF References	NRC PSF (Obs 6) (PSF Reference; Filters [F210M/F444W]) Additional Justification: false
Special Requirements	Offset -0.01 arcsec, -0.018 arcsec Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible Aperture PA Offset 3 from 4 by 10 to 14 Degrees (Same offsets in V3)

Observation

Proposal 4538, Observation 5: MIRI PSF

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(8)	-del-Leo	RA: 11 14 6.5014 (168.5270892d) Dec: +20 31 25.39 (20.52372d) Equinox: J2000	Proper Motion RA: 143.42 mas/yr Proper Motion Dec: -129.8800000540723 mas/yr Parallax: 0.05582" 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.This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[A stars]

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	99	4		1	1			MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	436	1	Dither 1	4	1744	3132.979	

Special Requirements

Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

Observation

Proposal 4538, Observation 6: NRC PSF Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(8)	-del-Leo	RA: 11 14 6.5014 (168.5270892d) Dec: +20 31 25.39 (20.52372d) Equinox: J2000	Proper Motion RA: 143.42 mas/yr Proper Motion Dec: -129.8800000540723 mas/yr Parallax: 0.05582" 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.This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[A stars]

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	RAPID	33	1	1	1.708	140139

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	5-POINT-DIAMOND

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F210M	F444W	RAPID	10	58	5	290	3416.177	

PSF References

PSF Reference: true

Special Requirements	
	Offset -0.01 arcsec, -0.018 arcsec Sequence Observations 1, 2, 3, 4, 5, 6, Non-interruptible

Observation

Proposal 4538, Observation 7: Background

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(6)	Background-Eta-Crv	RA: 12 32 25.7430 (188.1072625d) Dec: -16 14 8.50 (-16.23569d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Calibration
Description=[Telescope/sky background]
Extended=NO

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	EXTENDED SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	109	1	Dither 1	4	436	782.346	

Special Requirements

Sequence Observations 7, 8, 9, Non-interruptible

Observation

Proposal 4538, Observation 8: Science

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	-eta-Crv	RA: 12 32 4.2264 (188.0176100d)	Proper Motion RA: -424.597 mas/yr	
		Dec: -16 11 45.62 (-16.19601d)	Proper Motion Dec: -58.24099996516452 mas/yr	
		Equinox: J2000	Parallax: 0.0548135"	
			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.This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[F stars]

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	99	4		1	1			MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	436	1	Dither 1	4	1744	3132.979	

Special Requirements

Sequence Observations 7, 8, 9, Non-interruptible

Observation

Proposal 4538, Observation 9: PSF

Mon Mar 03 14:00:16 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(7)	-alf-Crv	RA: 12 08 24.8173 (182.1034054d)	Proper Motion RA: 96.976 mas/yr	
		Dec: -24 43 43.95 (-24.72888d)	Proper Motion Dec: -40.0229999286239 mas/yr	
		Equinox: J2000	Parallax: 0.0667696"	
			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.This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[F stars]

Template

Subarray
SUB256

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	99	4		1	1			MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	5	436	1	Dither 1	4	1744	3132.979	

Special Requirements

Sequence Observations 7, 8, 9, Non-interruptible