



# 5650 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner belts?

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

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## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	Background	MIRI Imaging	(1) Background
	2	PSF Reference-roll1	MIRI Imaging	(3) HD-105298
	3	Target-roll1	MIRI Imaging	(2) eta-Cru
	4	Target-roll2	MIRI Imaging	(2) eta-Cru
	5	PSF Reference-roll2	MIRI Imaging	(3) HD-105298

## ABSTRACT

Determining the origin of warm dust interior to outer exocometary belts in planetary systems is our only chance to test whether inward transport of icy material to the terrestrial planet region is taking place in nearby planetary systems, and determine the physical mechanism driving it. We propose

a JWST/MIRI F2550W resolved imaging program to investigate the structure of warm dust interior to an outer belt in the nearby eta Crucis system. This system has a rare ALMA mm-wave resolved detection of warm dust as well as its outer belt, enabling the first JWST+ALMA joint resolved analysis of warm dust in a planetary system.

Our main goal with JWST/MIRI imaging (0.8" resolution) is to determine the origin of the warm dust, by resolving either (1) an inner belt or belts, with planet-induced gap(s), or (2) a continuous inner disk of emission, which would prove that inward transport of icy material from the outer belt is ongoing. In the latter case, joint modelling of the new JWST/MIRI image and the existing ALMA image will deliver an independent measurement of the size distribution for the warm dust and the cold belt - distinguishing whether transport is induced by Poynting-Robertson (P-R) drag, or inward scattering. Overall, this pilot study on eta Crucis will uniquely leverage the high resolution capabilities of both JWST and ALMA, and demonstrate that multiwavelength resolved imaging is the key to understand the link, if any, between warm and cold dust in planetary systems.

### **OBSERVING DESCRIPTION**

We request two non-interruptible sequences, each with identical visits on target eta Cru and PSF Reference star HD105298, which have similar brightnesses and spectral shape, and are located ~2.9 degrees apart. We require use of the JWST/MIRI instrument, with filter F2550W, in its BRIGHTSKY subarray mode to avoid strong saturation by the central star. Even in this mode, we have partial saturation with 5 groups on target (3 usable) on the central pixels within 0.4" of the star (with the conservative ETC saturation limits), but we prefer this compared to using the SUB256 subarray because we need the large BRIGHTSKY field of view (56") with the LARGE 4-point dither pattern to include the entirety of emission from the extended disk (~14" diameter expected) while keeping the dither pattern size large enough for effective background subtraction. Crucial to the program is accurate PSF subtraction to reveal low surface brightness structure from the outer belt and the warm dust disks, our main science goal, which is why we request identical observations of a suitable standard star. We choose a number of integrations per dither well below the dwell time, and request two sequences to achieve the SNR needed on low-surface-brightness disk emission in our simulated MIRI observations for each of our model scenarios.

Proposal 5650 - Targets - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner belts?

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	Background	RA: 12 07 22.8094 (181.8450392d) Dec: -64 36 0.72 (-64.60020d) Equinox: J2000	Epoch of Position: 2000	
<p>Comments: Category=Unidentified Description=[Blank field]</p>				
(2)	eta-Cru	RA: 12 06 52.8981 (181.7204087d) Dec: -64 36 49.43 (-64.61373d) Equinox: J2000	Proper Motion RA: 34.27 mas/yr Proper Motion Dec: -36.902 mas/yr Parallax: 0.0507919" Epoch of Position: 2000	
<p>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. MIPS 24 micron flux density: 0.361 Jy. Point-like in images up to 1.33" resolution with ALMA, so expect unresolved single source + extended disk emission. Another star expected 15" to the SE of eta Cru, with a PA of ~150 degrees (east of north). Category=Star Description=[F stars] Extended=YES</p>				
(3)	HD-105298	RA: 12 07 28.2372 (181.8676550d) Dec: -61 44 7.66 (-61.73546d) Equinox: J2000	Proper Motion RA: -6.968 mas/yr Proper Motion Dec: 0.56 mas/yr Parallax: 0.0004554" Epoch of Position: 2000	
<p>Comments: This object was generated by the target selector and retrieved from the SIMBAD database. MIPS 24 micron flux density: 0.402 Jy (very close in brightness to target star. Distance to target: 2.88degrees. Spectral Type: K2/3 (III). Looks Rayleigh-Jeans already at this wavelength from SED - so same spectral slope as expected for target star. Star expected at edge of 56" field to the NNE of HD105298. Category=Star Description=[K giants]</p>				

Fixed Targets

Proposal 5650 - Observation 1 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner be...

Mon Feb 24 20:00:15 GMT 2025

<b>Observation</b>	<b>Proposal 5650, Observation 1: Background</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Imaging										
<b>Diagnostics</b>	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(1)	Background	RA: 12 07 22.8094 (181.8450392d) Dec: -64 36 0.72 (-64.60020d) Equinox: J2000			Epoch of Position: 2000					
	<i>Comments:</i> Category=Unidentified Description=[Blank field]										
<b>Template</b>	<b>Subarray</b> BRIGHTSKY										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets	1	4		5	1	EXTENDED SOURCE	POSITIVE	LARGE	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F2550W	FASTR1	5	80	1	Dither 1	4	320	1657.876	
<b>Special Requirements</b>	Sequence Observations 1, 2, 3, 4, 5, Non-interruptible										

Proposal 5650 - Observation 2 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner be...

Mon Feb 24 20:00:15 GMT 2025

<b>Observation</b>	<p><b>Proposal 5650, Observation 2: PSF Reference-roll1</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(PSF Reference-roll1 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(3)	HD-105298	RA: 12 07 28.2372 (181.8676550d) Dec: -61 44 7.66 (-61.73546d) Equinox: J2000			Proper Motion RA: -6.968 mas/yr Proper Motion Dec: 0.56 mas/yr Parallax: 0.0004554" Epoch of Position: 2000					
	<p><i>Comments: This object was generated by the target selector and retrieved from the SIMBAD database.</i></p> <p><i>MIPS 24 micron flux density: 0.402 Jy (very close in brightness to target star. Distance to target: 2.88degrees. Spectral Type: K2/3 (III). Looks Rayleigh-Jeans already at this wavelength from SED - so same spectral slope as expected for target star. Star expected at edge of 56" field to the NNE of HD105298.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[K giants]</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>BRIGHTSKY</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets	1	4		5	1	EXTENDED SOURCE	POSITIVE	LARGE	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F2550W	FASTR1	5	80	1	Dither 1	4	320	1657.876	
<b>Special Requirements</b>	<p>Sequence Observations 1, 2, 3, 4, 5, Non-interruptible</p> <p>Same Aperture PA 2, 3</p>										

Proposal 5650 - Observation 3 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner be...

Mon Feb 24 20:00:15 GMT 2025

<b>Observation</b>	<p><b>Proposal 5650, Observation 3: Target-roll1</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	<p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Target-roll1 (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(2)	eta-Cru	RA: 12 06 52.8981 (181.7204087d) Dec: -64 36 49.43 (-64.61373d) Equinox: J2000			Proper Motion RA: 34.27 mas/yr Proper Motion Dec: -36.902 mas/yr Parallax: 0.0507919" Epoch of Position: 2000					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>MIPS 24 micron flux density: 0.361 Jy. Point-like in images up to 1.33" resolution with ALMA, so expect unresolved single source + extended disk emission. Another star expected 15" to the SE of eta Cru, with a PA of ~150 degrees (east of north).</i></p> <p><i>Category=Star</i></p> <p><i>Description=[F stars]</i></p> <p><i>Extended=YES</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>BRIGHTSKY</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets	1	4		5	1	EXTENDED SOURCE	POSITIVE	LARGE	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F2550W	FASTR1	5	80	1	Dither 1	4	320	1657.876	
<b>Special Requirements</b>	<p>Sequence Observations 1, 2, 3, 4, 5, Non-interruptible</p> <p>Aperture PA Offset 4 from 3 by 10 to 14 Degrees (Same offsets in V3)</p> <p>Same Aperture PA 2, 3</p>										

Proposal 5650 - Observation 4 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner be...

Mon Feb 24 20:00:15 GMT 2025

<b>Observation</b>	<p><b>Proposal 5650, Observation 4: Target-roll2</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	<p>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Target-roll2 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(2)	eta-Cru	RA: 12 06 52.8981 (181.7204087d) Dec: -64 36 49.43 (-64.61373d) Equinox: J2000			Proper Motion RA: 34.27 mas/yr Proper Motion Dec: -36.902 mas/yr Parallax: 0.0507919" Epoch of Position: 2000					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>MIPS 24 micron flux density: 0.361 Jy. Point-like in images up to 1.33" resolution with ALMA, so expect unresolved single source + extended disk emission. Another star expected 15" to the SE of eta Cru, with a PA of ~150 degrees (east of north).</i></p> <p><i>Category=Star</i></p> <p><i>Description=[F stars]</i></p> <p><i>Extended=YES</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>BRIGHTSKY</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets	1	4		5	1	EXTENDED SOURCE	POSITIVE	LARGE	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F2550W	FASTR1	5	80	1	Dither 1	4	320	1657.876	
<b>Special Requirements</b>	<p>Sequence Observations 1, 2, 3, 4, 5, Non-interruptible</p> <p>Aperture PA Offset 4 from 3 by 10 to 14 Degrees (Same offsets in V3)</p> <p>Same Aperture PA 4, 5</p>										

Proposal 5650 - Observation 5 - A multi-wavelength view of warm dust in the eta Crucis planetary system: inward transport or inner be...

Mon Feb 24 20:00:15 GMT 2025

<b>Observation</b>	<p><b>Proposal 5650, Observation 5: PSF Reference-roll2</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	<p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(PSF Reference-roll2 (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(3)	HD-105298	RA: 12 07 28.2372 (181.8676550d) Dec: -61 44 7.66 (-61.73546d) Equinox: J2000			Proper Motion RA: -6.968 mas/yr Proper Motion Dec: 0.56 mas/yr Parallax: 0.0004554" Epoch of Position: 2000					
	<p><i>Comments: This object was generated by the target selector and retrieved from the SIMBAD database.</i></p> <p><i>MIPS 24 micron flux density: 0.402 Jy (very close in brightness to target star. Distance to target: 2.88degrees. Spectral Type: K2/3 (III). Looks Rayleigh-Jeans already at this wavelength from SED - so same spectral slope as expected for target star. Star expected at edge of 56" field to the NNE of HD105298.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[K giants]</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>BRIGHTSKY</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets	1	4		5	1	EXTENDED SOURCE	POSITIVE	LARGE	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F2550W	FASTR1	5	80	1	Dither 1	4	320	1657.876	
<b>Special Requirements</b>	<p>Sequence Observations 1, 2, 3, 4, 5, Non-interruptible</p> <p>Same Aperture PA 4, 5</p>										