



# 1958 - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Cycle: 1, 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				
	2	MIRI	MIRI Medium Resolution Spectroscopy	(2) V-CT-CHA-B
	1	MIRI - Background	MIRI Medium Resolution Spectroscopy	(1) BACKGROUND

## ABSTRACT

Several planet-mass companions (PMCs) on wide-orbits have been imaged around young stars (1-10 Myr). Their estimated mass is just around the brown dwarf to giant planet transition (~13 Jupiter masses), which makes them especially interesting for both star and planet formation theories. Several formation scenarios exist, but none of them can explain all properties of the currently known PMCs. There are strong theoretical reasons to

expect disks around PMCs, and indirect evidence for disks around PMCs from optical and near-infrared emission exists. However, attempts to detect the dust and gas emission of the disk directly have been unsuccessful. The high sensitivity of JWST MIRI will allow detecting disks with sizes smaller than one au, masses as low  $1/10000$  of a Jupiter mass and will provide first constraints on the solid and gas composition of disks around PMCs. We propose to observe the PMC CT Cha b with the MIRI spectrograph to detect the dust and gas emission (water lines) of its disk. Those results allow for a comparison to the composition of the primary disk of CT Cha, which is observed simultaneously, and to observations of protoplanetary disks, providing new constraints for possible differences in disk evolution. Those observations, together with forthcoming complementary ALMA observations, will put stringent limits on the mass and size of the companion's disk; quantities most relevant for PMC formation theories and spin-evolution studies. The proposed program will be a big step forward for our understanding of the mysterious nature of wide-orbit planet-mass companions and will serve as a pioneering study for future JWST surveys of PMCs.

## **OBSERVING DESCRIPTION**

We observe the disks around the wide-orbit planet-mass companion CT Cha b and its primary CT Cha with MIRI MRS. We use a standard setup for the MRS to cover the full available wavelength range.

The chosen target is the companion CT Cha b at ICRS coord. 11 04 8.4400 -76 27 18.00. However, the primary ICRS coord.: 11 04 9.0009 -76 27 19.33 will be in the same FOV and is observed simultaneously. To secure that the primary is within the FOV, even at the shortest wavelengths (Channel 1), we request to point between the primary and companion with about 0.5 arcsec offset from the companion ICRS coord.: at 11 04 08.633 -76 27 18 249 . This will be verified again prior to the observations.

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Changes 10.08.2021 (after review)

We rechecked the possibility to provide an offset. However, we decided now to do include an offset as it is not required for the main science goal (to detect CT Cha b). Also the primary will still be on the FOV for several channels even without an offset.

We reduced the data excess from 12187.53 MB to 7358.11 MB by only using the SUB64 subarray in the simultaneous imaging. As switching of the simultaneous imaging does not have a significant effect anymore we like to still include this. This has no impact on the science case.

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Changes 25.07.2022 (new recommendations)

It was recommended to add a dedicated background to science observations. We have done that now by adding new background observation and linking it as non-interruptible with the scientific observations. It was also recommended to do the background observations before the science observations, and we did that by assigning numbers 1 to the background and 2 to the science target.

As adding the background adds to the charged time, we removed the simultaneous imaging. With this configuration, the charged time increases from 4.6 to 4.86 hours, which is an increase of 5.6%. Hence we think a new approval by the Telescope Time Review Board is not required. Removing simultaneous imaging is not affecting our scientific goals.

We were also informed that the distortion solution would be updated in the next couple of weeks. However, we decided to not wait for that and go ahead with the proposal.

Due to the additional background the data data volume only increased slightly (by 500 MB) we assume that is not a problem.

We think the proposal as it is now should be ready to go.

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Changes 04.08.2022 (new recommendations)

Used now 50 groups for the background but no Dither, as now recommended by the MIRI Team. This brings back the charged time to 4.8, wich is an hence no approval by the TTRB is required.

Proposal 1958 - Targets - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	BACKGROUND	RA: 11 04 17.0000 (166.0708333d) Dec: -76 26 49.90 (-76.44719d) Equinox: J2000  <i>Comments:</i> Category=Unidentified Description=[Blank field]		
(2)	V-CT-CHA-B	RA: 11 04 8.4400 (166.0351667d) Dec: -76 27 18.00 (-76.45500d) Equinox: J2000  <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Exoplanets, Pre-main sequence stars, Protoplanetary disks]	Epoch of Position: 2015.5		

Proposal 1958 - Observation 2 - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Thu Aug 04 16:00:57 GMT 2022

<b>Observation</b>	<b>Proposal 1958, Observation 2: MIRI</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[MIRI - Background (Obs 1)]												
	(Visit 2:1) Warning (Form): Data Excess over lower threshold (Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
<b>Diagnosics</b>													
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>				<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>			
	(2)	V-CT-CHA-B	RA: 11 04 8.4400 (166.0351667d) Dec: -76 27 18.00 (-76.45500d) Equinox: J2000				Epoch of Position: 2015.5						
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Star</i> <i>Description=[Exoplanets, Pre-main sequence stars, Protoplanetary disks]</i>													
<b>Acquisition</b>	<b>#</b>	<b>Target</b>											
	1	NONE											
<b>Template</b>	<b>AcqFilter</b>	<b>Primary Channel</b>				<b>Simultaneous Imaging</b>			<b>Imager Subarray</b>				
	F1000W	ALL				NO			FULL				
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>				<b>Optimized For</b>			<b>Direction</b>				
	1	4-Point				POINT SOURCE			NEGATIVE				
<b>Spectral Elements</b>	<b>#</b>	<b>Wavelength Range</b>	<b>Detector</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/E xp</b>	<b>Exposures/Dit h</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	SHORT(A)	MRSLONG		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065
	1	SHORT(A)	MRSSHORT		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065
	2	MEDIUM(B)	MRSLONG		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065
	2	MEDIUM(B)	MRSSHORT		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065
	3	LONG(C)	MRSLONG		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065
	3	LONG(C)	MRSSHORT		FASTR1	50	6	1	Dither 1	4	24	3385.549	59065

Proposal 1958 - Observation 2 - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Special Requirements

Sequence Observations 1, 2, Non-interruptible

Proposal 1958 - Observation 1 - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Thu Aug 04 16:00:57 GMT 2022

<b>Observation</b>	<b>Proposal 1958, Observation 1: MIRI - Background</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [MIRI (Obs 2)]												
	(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: 11 04 17.0000 (166.0708333d) Dec: -76 26 49.90 (-76.44719d) Equinox: J2000  <i>Comments:</i> Category=Unidentified Description=[Blank field]										
<b>Acquisition</b>	<b>#</b>	<b>Target</b>											
	1	NONE											
<b>Template</b>	<b>AcqFilter</b>	<b>Primary Channel</b>				<b>Simultaneous Imaging</b>			<b>Imager Subarray</b>				
	F1000W	ALL				NO			FULL				
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>				<b>Optimized For</b>			<b>Direction</b>				
	1	2-Point				POINT SOURCE			NEGATIVE				
<b>Spectral Elements</b>	<b>#</b>	<b>Wavelength Range</b>	<b>Detector</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/E xp</b>	<b>Exposures/Dit h</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	SHORT(A)	MRSLONG		FASTR1	50	1	1	None	1	1	138.752	59065
	1	SHORT(A)	MRSSHORT		FASTR1	50	1	1	None	1	1	138.752	59065
	2	MEDIUM(B)	MRSLONG		FASTR1	50	1	1	None	1	1	138.752	59065
	2	MEDIUM(B)	MRSSHORT		FASTR1	50	1	1	None	1	1	138.752	59065
	3	LONG(C)	MRSLONG		FASTR1	50	1	1	None	1	1	138.752	59065
	3	LONG(C)	MRSSHORT		FASTR1	50	1	1	None	1	1	138.752	59065

Proposal 1958 - Observation 1 - Spectroscopy of the circumplanetary disk around the young planet-mass companion CT Cha b

Special Requirements

Sequence Observations 1, 2, Non-interruptible