

# 1751 - Mapping inclined disk astrochemical signatures (MIDAS)

Cycle: 1, Proposal Category: GO

## **INVESTIGATORS**

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## **OBSERVATIONS**

Folder Observat	tion Label	Observing Template	Science Target
NIRSpec IFU			
6	ESO-Ha569	NIRSpec IFU Spectroscopy	(10) ESO-HA569-NIR
16	Tau042021	NIRSpec IFU Spectroscopy	(11) TAU042021-NIR
MIRI MRS			

JWST Proposal 1751 (Created: Friday, January 20, 2023 at 2:03:39 PM Eastern Standard Time) - Overview

Folder	Observation	Label	Observing Template	Science Target
	10	ESO-ha569	MIRI Medium Resolution Spectroscopy	(5) ESO-HA569
	12	ESO-ha569 sky	MIRI Medium Resolution Spectroscopy	(7) ESO-HA569SKY
	20	Tau042021	MIRI Medium Resolution Spectroscopy	(8) TAU042021
	15	Tau 042021 sky	MIRI Medium Resolution Spectroscopy	(9) TAU042021SKY

#### **ABSTRACT**

Ice-coated grains in protoplanetary disks provide the bulk elements critical for both the emergence of life and observable signatures of exoplanets formed in these disks, while drawing a direct line of comparison to the cold bodies in the Solar System that delivered organics to Earth. The abundance and chemical variety of these elements feeding a newborn planet depend on the radial and vertical chemical gradients of ices in disks. Vertically, the physical processes driving ice chemical evolution (grain size, dust/gas ratio, and UV flux) vary towards the disk midplane, where planets form. Radially, the temperature structure of the disk produces a series of snowlines at which different ice species sublimate. A comprehensive assay of all major ice species has never taken place for disks, let alone a direct assessment of the 2D ice gradients.

We propose to leverage the unique capabilities of JWST's NIRSpec IFU and MIRI MRS to map such spatial variations in the ice species, relative to silicates, and in the degree of physical processing for a sample of isolated, edge-on disks. These disks are large enough to sample radially to 200 AU (<=30 AU resolution) and vertically to at least 100 AU with MIRI, and a factor of 2 larger with NIRSpec. Our observations are a factor of 10 deeper than any of the 5 GTO or Ice Age ERS observations of edge-on disks and contain larger disks, allowing for mapping of even weak ice species (e.g. CH4, CH3OH, and SO2) to within the CO snowline of these systems. This program will profoundly transform our understanding of planetesimal and planetary composition in the upcoming era of exoplanet characterization and asteroid sample return missions.

#### **OBSERVING DESCRIPTION**

We will observe three disks with NIRSpec IFU (G235H and G395H, R~2700) and MIRI MRS (R~2700-3300) modes. Target acquisition is not necessary for our sample, as JWST's blind pointing accuracy is expected to be 0.1".

NIRSpec IFU: The two smaller disks require only one tile of NIRSpec each, while Tau 042021 requires a 2x2 mosaic in order to encompass the larger vertical extent of this disk. To keep these extended targets well within the FOV during dithers, we chose a small, 4-point cycling pattern. There will be enough background signal at the edges of the detector to subtract any sky signal, if necessary, our IFU exposures will also be reprocessed to extract and scale local background flux from the FS, which are always open to the sky.

JWST Proposal 1751 (Created: Friday, January 20, 2023 at 2:03:39 PM Eastern Standard Time) - Overview

The groups/integrations were chosen to reach a S/N per spaxel of 40 over the v-shaped scattering surface of the disk. This S/N was driven by the science case to obtain the grain growth profile for water in the absence of spectral rebinning, in order to also enable the detection of methanol ice overlapping the grain growth signatures in the water feature's red wing.

MIRI MRS: All three of the disks are small enough in scattered dust emission at 5 microns to fit into the MIRI MRS Channel 1 FOV. We constrain the PA of Tau 042021 in order to ensure the array is aligned within 20 degrees of the disk, to ensure that the disk limb fits onto the array. We chose a 4 point dither pattern, and have dedicated background fields selected using WISE images to avoid bright sources. We selected the combination of groups/integrations to get a S/N of 10 per spaxel, driven by the need to obtain CH4 and methanol ice at 3% of the continuum through spectral rebinning. For Tau 042021, the data rate was close to the maximum, so we used the SLOW readout pattern instead of FAST, which was used for the other sources. We also include simultaneous imaging in the off-target field in three different filters in order to check the astrometry a posteri.

Proposal 1751 - Targets - Mapping inclined disk astrochemical signatures (MIDAS)

F10	posai 17		oing inclined disk astrochemical sign		1
	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(5)	ESO-HA569	RA: 11 11 10.8330 (167.7951375d)		
			Dec: -76 41 57.43 (-76.69929d)		
			Equinox: J2000		
			targetselector and retrieved from the SIMBAD database.		
	Category=Sta Description=	ur [Protoplanetary disks] ES			
	Extended=YE	ZS .			
	(7)	ESO-HA569SKY	RA: 11 11 10.1790 (167.7924125d)		
			Dec: -76 42 52.45 (-76.71457d)		
			Equinox: J2000		
			targetselector and retrieved from the SIMBAD database.		
	Category=Ca Description=	uibration [Telescope/sky background] ES			
		ES			
	(8)	TAU042021	RA: 04 20 21.4428 (65.0893450d)	Epoch of Position: 2015.5	
			Dec: +28 13 49.17 (28.23032d)		
S			Equinox: J2000		
Jet	C IC	M .	targetselector and retrieved from the SIMBAD database.		
arç	Description=	M [Pre-main sequence stars] ES			
<u> </u>	Extended=YE	ZS -			
Fixed Targets	(9)	TAU042021SKY	RA: 04 20 19.2100 (65.0800417d)	Epoch of Position: 2015.5	
Ë			Dec: +28 14 13.80 (28.23717d)		
			Equinox: J2000		
	Comments: D Category=Sta	Park sky next to Tau 042021.			
	Description=	[Circumstellar dust, Protoplane	tary disks, T Tauri stars]		
	Extended=YE				
	(10)	ESO-HA569-NIR	RA: 11 11 10.8330 (167.7951375d)		
			Dec: -76 41 57.43 (-76.69929d)		
			Equinox: J2000		
	Comments: T Category=Sta	his object was generated by the	targetselector and retrieved from the SIMBAD database.		
	Description=	[Protoplanetary disks]			
	Extended=YE				
	(11)	TAU042021-NIR	RA: 04 20 21.4428 (65.0893450d)	Epoch of Position: 2015.5	
			Dec: +28 13 49.17 (28.23032d)		
			Equinox: J2000		
	Comments: T Category=IS	his object was generated by the	targetselector and retrieved from the SIMBAD database.		
	Description=	[Pre-main sequence stars]			
	Extended=YE	ZS .			

Pro	posal 1751 - Observa	tion 6 - Ma	pping incli	ned disk ast	rochemic	cal signatur	es (MIDAS)				
	Proposal 1751, Observation 6: Ed Diagnostic Status: Warning									Fri Jan 20 19	:03:39 GMT 2023
Observation	Observing Template: NIRSpec IFU	Spectroscopy									
Diagnostics	(Visit 6:1) Warning (Form): Overh (Visit 6:1) Informational (Form): V	_				inted in direction	of greatest microme	eteoroid impact risk.	This is likely due	to scheduling specia	ıl requirements.
<u>~</u>	# Name	Targ	et Coordinates			Targ. Coord.	Corrections		Miscellaneous		
Targets	(10) ESO-HA569-NIR	RA: 1	11 11 10.8330 (1	67.7951375d)							
arg		Dec:	-76 41 57.43 (-76	5.69929d)							
Ľ		Equin	nox: J2000								
Fixed	Comments: This object was general Category=Star	ted by the targetse	elector and retrie	eved from the SIMBA	AD database.						
ΙÊ	Category=Star   Description=[Protoplanetary disk:   Extended=YES	:]									
0											
ate	TA Method NONE										
Template	NONE										
ร	#	Dither Type		Size		Starting Po	int	Number of Poi	nts	Points	
Dithers	1	CYCLING		SMALL		6		4			
ents	# Grating/Filter	Readout Pattern	Groups/Int	Integrations/Ex	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
lem	1 G395H/F290LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	57019
Щ	2 G235H/F170LP	NRSIRS2RAPI	25	1	false	true	NONE	4	4	1517.245	
Spectral Elements		D									
Special Requirements	Aperture PA Range 134 to 154 De	grees (V3 355.027	46582 to 15.027	46582)							

<u>Pro</u>	oposal 175	1 - Observa	tion 16 - Ma	apping inc	lined disk as	strochem	ical signat	ures (MIDAS	3)			
Observation	Diagnostic Sta	Observation 16: I tus: Warning plate: NIRSpec IFU									Fri Jan 20 19	:03:39 GMT 2023
Diagnostics	(Visit 16:1) Wa	rning (Form): Over	heads are provision	nal until the Visi	t Planner has been ru	un.						
<b>—</b>	# 1	Name	Targe	et Coordinates			Targ. Coord	. Corrections		Miscellaneous		
Fixed Targets	Comments: This		Dec: - Equin ted by the targetse	4 20 21.4428 (6: +28 13 49.17 (28 ox: J2000 lector and retrie		D database.	Epoch of Pos	ition: 2015.5				
ē	TA Method											
Template	NONE											
.≌	Rows	Col	umns	Row O	verlap %	Column (	Overlap %	Row shift	Colu	nn shift	Tile Order	
Mosaic	2	2		10.0		10.0		0.0	0.0		DEFAULT	
ร	#		Dither Type		Size		Starting Po	oint	Number of Poin	nts	Points	
Dithers	1		CYCLING		SMALL		6		4			
ents	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Ex p	Leakcal	Dither	Autocal	<b>Total Dithers</b>	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
leme	1	G395H/F290LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
Spectral Elements	2	G235H/F170LP	NRSIRS2	5	1	false	true	NONE	4	4	1517.245	

Pro	posal 175	1 - Obser	vation 10 -	Mapping	g inclined o	lisk astroch	nemical sig	natures (M	IIDAS)				
		, Observation 10						•				Fri Jan 20 19	9:03:39 GMT 2023
Observation	Diagnostic Sta	tus: Warning											
Į≝	Observing Ten	nplate: MIRI Med	dium Resolution	Spectroscopy									
Se	Background O	bservations:[ESC	)-ha569 sky (Obs	s 12)]									
١ô													
ιχ	(Visit 10:1) Wa	arning (Form): O	verheads are pro	visional until t	he Visit Planner h	as been run.							
Diagnostics			•										
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<b>"</b>	#	Name	7	Target Coordi	nates		Targ. C	oord. Correction	ıs	M	iscellaneous		
Targets	(5)	ESO-HA569	I	RA: 11 11 10.8	330 (167.795137	5d)							
ar g			I	Dec: -76 41 57.	43 (-76.69929d)								
ΙË			I	Equinox: J2000	)								
Fixed			erated by the tar	getselector and	l retrieved from ti	he SIMBAD datab	ase.						
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	Extended=YES	1 1	,										
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Ι <u>Ξ</u>													
Acquisition													
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<u>a</u>	AcqFilter F560W			ALL	y Channel		YES	taneous imaging	<u> </u>		i <u>ager Subarray</u> JLL		
<u>ا</u> م	1.300 W			ALL			ILS			1.0	LL		
Template													
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Je I	1			4-Point				NDED SOURCE	1		EGATIVE		
Dithers													
	#	Wavelength	Detector	Filter	Readout	Groups/Int	Integrations/I	E Exposures/Dit	Dither	Total Dithers	Total	Total	ETC
		Range			Pattern	•	хp	h Î			Integrations	Exposure Time	Wkbk.Calc ID
ts	1	1	IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	90863
l je	1	SHORT(A)	MRSLONG	177044	SLOWR1	28	1	1	Dither 1	4	4	2675.671	90863
e	1	SHORT(A)	MRSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671	70003
Spectral Elements	2	SHOKI(A)	IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
ā	2	MEDIUM(B)	MRSLONG	1770 **	SLOWR1	28	1	1	Dither 1	4	4	2675.671	
ξ	2	MEDIUM(B)	MRSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671	
۱š	3	MEDIUM(B)	IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
1"	3	LONG(C)	MRSLONG	1 / / / / / / /	SLOWR1	28	1	1	Dither 1	4	<del>-</del> Δ	2675.671	
	3	LONG(C)	MRSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671	
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<u>Pr</u>	oposal 1751 - Observation 10 - Mapping inclined disk astrochemical signatures (MIDAS)
	Aperture PA Range 134 to 154 Degrees (V3 134.0 to 154.0)
l e	Sequence Observations 10, 12, Non-interruptible
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Pro	posal 175	1 - Obser	vation 12	- Mapping	inclined o	disk astroch	nemical sig	natures (M	IIDAS)				
		, Observation 12										Fri Jan 20 1	9:03:39 GMT 2023
Iĕ	Diagnostic Sta	tus: Warning											
Įξ	Observing Ten	nplate: MIRI Med	dium Resolution	Spectroscopy									
Observation	Background O	bservation For: []	ESO-ha569 (Obs	10)]									
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SS	(Visit 12:1) W	arning (Form): O	verheads are pro	visional until t	he Visit Planner h	as been run.							
Diagnostics													
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ق													
ွ	#	Name	ŗ	Farget Coordi	nates		Targ. C	oord. Correction	ıs	M	iscellaneous		
Targets	(7)	ESO-HA569SKY	Y I	RA: 11 11 10.1	790 (167.792412	5d)							
arc					45 (-76.71457d)								
ΙĘ				Equinox: J2000									
Fixed	Comments: The Category=Cal	is object was gen ibration	erated by the tar	getselector and	l retrieved from t	he SIMBAD datab	pase.						
证	Description=[	Telescope/sky bad	ckground]										
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Acquisition													
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ıte	AcqFilter			Primar	y Channel		Simul	taneous Imaging		In	nager Subarray		
Template	FND			ALL			YES			FU	JLL		
l E													
ers	#			Dither 7	Гуре			nized For			rection		
Dithers	1			2-Point			EXTE	INDED SOURCE		NI	EGATIVE		
	,,	***	<b>5</b>	7711		G	·		DUI	T	m	m	TITE C
	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/I xp	E Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure	ETC Wkbk.Calc ID
ß										1		Time	
e	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	
ΙĔ	1	SHORT(A)	MRSLONG		SLOWR1	28	1	1	Dither 1	2	2	1337.836	
🛎		SHORT(A)	MRSSHORT	FEEOM	SLOWR1	28	1	1	Dither 1	2	2	1337.836	
Spectral Elements	2	MEDHINAS	IMAGER MRGL ONG	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	
ţ	2	MEDIUM(B)	MRSLONG		SLOWR1	28	1	1	Dither 1	2	2	1337.836	
l g	2	MEDIUM(B)	MRSSHORT	E770W	SLOWR1	28	1	1	Dither 1	2	2	1337.836	
I۳	3	LONG(C)	IMAGER MBSL ONG	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	
	2	LONG(C)	MRSLONG		SLOWR1	28	1	1	Dither 1	2	2	1337.836	
	3	LONG(C)	MRSSHORT		SLOWR1	28	1	1	Dither 1	2	2	1337.836	

<u>Prc</u>	posai 1751 - Observation 12 - Mapping inclined disk astrochemical signatures (MIDAS)
Requirements	Sequence Observations 10, 12, Non-interruptible
pecial l	

Pro	posal 17	51 - Obser	vation 20 -	- Mappin	g inclined o	lisk astroch	nemical sign	natures (M	IDAS)				
_		1, Observation 2						•	•			Fri Jan 20 1	9:03:39 GMT 2023
Observation	Diagnostic St	atus: Warning											
<u>≥</u>	_	mplate: MIRI Med											
pse	Background C	Observations:[Tau	042021 sky (Ob	s 15)]									
Ō													
cs	(Visit 20:1) W	arning (Form): O	verheads are pro	visional until t	he Visit Planner h	as been run.							
Diagnostics													
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iag													
ᅀ													
छ	#	Name		Farget Coordi		•		ord. Correction		M	iscellaneous		
Targets	(8)	TAU042021			428 (65.0893450	1)	Epoch of	Position: 2015.5	1				
عّا					0.17 (28.23032d)								
ات ا	Commontes TI	.i. ahiaataa aa.		Equinox: J2000		h o CIMBAD datah							
Fixed	Catagami-ICA	1		geiseiecior and	a retrievea from ti	he SIMBAD datab	ase.						
ш	Description=[	T Pre-main sequen S	ce stars]										
_		3					Target	1					
1:0	1						NONE						
isi													
Acquisition													
ĕ													
ıte	AcqFilter			Primar	y Channel		Simult	aneous Imaging		In	nager Subarray		
≝	F560W			ALL			YES			FU	JLL		
Template													
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ers	#			Dither '	Гуре		•	ized For		•	rection		
Dithers	1			4-Point			EXTE	NDED SOURCE		Ni	EGATIVE		
H	#	Wavelength	Detector	Filter	Readout	Groups/Int	Integrations/E	Exposures/Dit	Dither	Total Dithers	Total	Total	ETC
l		Range			Pattern		xp	h			Integrations	Exposure Time	Wkbk.Calc ID
Spectral Elements	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
ne	1	LONG(C)	MRSLONG		SLOWR1	69	1	1	Dither 1	4	4	6593.618	
ē	1	LONG(C)	MRSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618	
I۳	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
tra	2	MEDIUM(B)	MRSLONG		SLOWR1	69	1	1	Dither 1	4	4	6593.618	
Š	2	MEDIUM(B)	MRSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618	
Sp	3		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
	3	SHORT(A)	MRSLONG		SLOWR1	69	1	1	Dither 1	4	4	6593.618	
	3	SHORT(A)	MRSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618	

<u> </u>	oposai 1751 - Observation 20 - Mapping Inclined disk astrochemical signatures (MIDAS)
ents	Aperture PA Range 64 to 84 Degrees (V3 64.0 to 84.0) No Parallel Attachments
uirem	Sequence Observations 15, 20, Non-interruptible
Red	
Special	

Pro	posal 175	1 - Observ	vation 15 -	Mappine	a inclined o	lisk astroch	nemical sign	natures (M	IIDAS)				
	roposal 1751 - Observation 15 - Mapping inclined disk astrochemical signatures (MIDAS) Proposal 1751, Observation 15: Tau 042021 sky												9:03:39 GMT 2023
Observation	Diagnostic Status: Warning												
Į Ž	Observing Template: MIRI Medium Resolution Spectroscopy												
pse	Background Observation For: [Tau042021 (Obs 20)]												
_													
Diagnostics	(Visit 15:1) Wa	rning (Form): O	verheads are pro	visional until t	he Visit Planner h	as been run.							
Sti													
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J <u>ä</u>													
H	# Name Target Coordinates						Targ. Coord. Corrections Miscellaneo				liscellaneous		
ţ	(9) TAU042021SKY			RA: 04 20 19.2100 (65.0800417d)				Epoch of Position: 2015.5					
Targets	Dec: +28 14 13.80 (28.23717d)												
<u>a</u>	Equinox: J2000												
Fixed		rk sky next to Tai		•									
lĕ	Category=Star	Sircumstellar dus	st Protonlanetar	v disks T Taus	ri stars1								
匚	Description=[Circumstellar dust, Protoplanetary disks, T Tauri stars] Extended=YES												
ا ا	# Target												
Ξ	1 NONE												
ΙË													
Acquisition													
_	AcqFilter		Primar	y Channel		Simultaneous Imaging				Imager Subarray			
<u>a</u>	FND ALL						YES			FULL			
Template													
_													
SIS	# Dither Type						Optim	ized For		Direction			
Dithers	1 2-Point						EXTE	NDED SOURCE		NEGATIVE			
ഥ	"	***	<b>.</b>	<b></b>		G	T	T	D. J.	m . 1811	m . 1	m	T.T. C
	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/E xp	Exposures/Dit h	Dither	<b>Total Dithers</b>	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
l ts	1	1	IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	·
Spectral Elements	1	LONG(C)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809	
<u> </u>	1	LONG(C)	MRSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809	
1 🚆	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	
Ĭ ž	2	MEDIUM(B)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809	
ĕ	2	MEDIUM(B)	MRSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809	
Ŋ	3		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051	
1	3	SHORT(A)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809	
	3	SHORT(A)	MRSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809	

<u> </u>	oposai 1751 - Observation 15 - Mapping Inclined disk astrochemical signatures (MIDAS)
ents	Sequence Observations 15, 20, Non-interruptible
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Requirem	
Special F	