



1751 - Mapping inclined disk astrochemical signatures (MIDAS)

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
NIRSpec IFU				
	6	ESO-Ha569	NIRSpec IFU Spectroscopy	(10) ESO-HA569-NIR
	16	Tau042021	NIRSpec IFU Spectroscopy	(11) TAU042021-NIR
MIRI MRS				

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
	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 sublime. 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 posteriori.

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

Fixed Targets	#	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 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Star</i> <i>Description=[Protoplanetary disks]</i> <i>Extended=YES</i>		
	(7)	ESO-HA569SKY	RA: 11 11 10.1790 (167.7924125d) Dec: -76 42 52.45 (-76.71457d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Calibration</i> <i>Description=[Telescope/sky background]</i> <i>Extended=YES</i>		
	(8)	TAU042021	RA: 04 20 21.4428 (65.0893450d) Dec: +28 13 49.17 (28.23032d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=ISM</i> <i>Description=[Pre-main sequence stars]</i> <i>Extended=YES</i>	Epoch of Position: 2015.5	
	(9)	TAU042021SKY	RA: 04 20 19.2100 (65.0800417d) Dec: +28 14 13.80 (28.23717d) Equinox: J2000 <i>Comments: Dark sky next to Tau 042021.</i> <i>Category=Star</i> <i>Description=[Circumstellar dust, Protoplanetary disks, T Tauri stars]</i> <i>Extended=YES</i>	Epoch of Position: 2015.5	
	(10)	ESO-HA569-NIR	RA: 11 11 10.8330 (167.7951375d) Dec: -76 41 57.43 (-76.69929d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Star</i> <i>Description=[Protoplanetary disks]</i> <i>Extended=YES</i>		
	(11)	TAU042021-NIR	RA: 04 20 21.4428 (65.0893450d) Dec: +28 13 49.17 (28.23032d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=ISM</i> <i>Description=[Pre-main sequence stars]</i> <i>Extended=YES</i>	Epoch of Position: 2015.5	

Proposal 1751 - Observation 6 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 6: ESO-Ha569											Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(Visit 6:1) 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		
	(10)	ESO-HA569-NIR	RA: 11 11 10.8330 (167.7951375d) Dec: -76 41 57.43 (-76.69929d) Equinox: J2000									
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.											
	Category=Star Description=[Protoplanetary disks] Extended=YES											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	CYCLING		SMALL		6		4				
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395H/F290LP	NRSIRS2RAPID	25	1	false	true	NONE	4	4	1517.245	57019
	2	G235H/F170LP	NRSIRS2RAPID	25	1	false	true	NONE	4	4	1517.245	
Special Requirements	Aperture PA Range 134 to 154 Degrees (V3 355.02746582 to 15.02746582)											

Proposal 1751 - Observation 16 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 16: Tau042021											Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 16:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
Fixed Targets	#	Name	Target Coordinates				Targ. Coord. Corrections			Miscellaneous		
	(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: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=ISM Description=[Pre-main sequence stars] Extended=YES									
Template	TA Method											
	NONE											
Mosaic	Rows	Columns	Row Overlap %			Column Overlap %		Row shift		Column shift		Tile Order
	2	2	10.0			10.0		0.0		0.0		DEFAULT
Dithers	#	Dither Type			Size		Starting Point		Number of Points		Points	
	1	CYCLING			SMALL		6		4			
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395H/F290LP	NRSIRS2RAPID	25	1	false	true	NONE	4	4	1517.245	
	2	G235H/F170LP	NRSIRS2	5	1	false	true	NONE	4	4	1517.245	

Proposal 1751 - Observation 10 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 10: ESO-ha569													Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning													
	Observing Template: MIRI Medium Resolution Spectroscopy													
	Background Observations:[ESO-ha569 sky (Obs 12)]													
Diagnostics	(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.													
Fixed Targets	#	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											
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.													
	Category=Star Description=[Protoplanetary disks] Extended=YES													
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel				Simultaneous Imaging				Imager Subarray				
	F560W	ALL				YES				FULL				
Dithers	#	Dither Type				Optimized For				Direction				
	1	4-Point				EXTENDED SOURCE				NEGATIVE				
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	90863	
	1	SHORT(A)	MRSLONG		SLOWR1	28	1	1	Dither 1	4	4	2675.671	90863	
	1	SHORT(A)	MRSSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671		
	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102		
	2	MEDIUM(B)	MRSLONG		SLOWR1	28	1	1	Dither 1	4	4	2675.671		
	2	MEDIUM(B)	MRSSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671		
	3		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102		
	3	LONG(C)	MRSLONG		SLOWR1	28	1	1	Dither 1	4	4	2675.671		
	3	LONG(C)	MRSSSHORT		SLOWR1	28	1	1	Dither 1	4	4	2675.671		

Proposal 1751 - Observation 10 - Mapping inclined disk astrochemical signatures (MIDAS)

Special Requirements	Aperture PA Range 134 to 154 Degrees (V3 134.0 to 154.0) Sequence Observations 10, 12, Non-interruptible
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Proposal 1751 - Observation 12 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 12: ESO-ha569 sky													Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning													
	Observing Template: MIRI Medium Resolution Spectroscopy													
	Background Observation For: [ESO-ha569 (Obs 10)]													
Diagnostics	(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.													
Fixed Targets	#	Name	Target Coordinates				Targ. Coord. Corrections				Miscellaneous			
	(7)	ESO-HA569SKY	RA: 11 11 10.1790 (167.7924125d) Dec: -76 42 52.45 (-76.71457d) Equinox: J2000											
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.													
	Category=Calibration													
	Description=[Telescope/sky background] Extended=YES													
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel				Simultaneous Imaging				Imager Subarray				
	FND	ALL				YES				FULL				
Dithers	#	Dither Type				Optimized For				Direction				
	1	2-Point				EXTENDED SOURCE				NEGATIVE				
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	1	SHORT(A)	MRSLONG		SLOWR1	28	1	1	Dither 1	2	2	1337.836		
	1	SHORT(A)	MRSSHORT		SLOWR1	28	1	1	Dither 1	2	2	1337.836		
	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	2	MEDIUM(B)	MRSLONG		SLOWR1	28	1	1	Dither 1	2	2	1337.836		
	2	MEDIUM(B)	MRSSHORT		SLOWR1	28	1	1	Dither 1	2	2	1337.836		
	3		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	3	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		

Proposal 1751 - Observation 12 - Mapping inclined disk astrochemical signatures (MIDAS)

Special Requirements	Sequence Observations 10, 12, Non-interruptible
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Proposal 1751 - Observation 20 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 20: Tau042021													Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning													
	Observing Template: MIRI Medium Resolution Spectroscopy													
	Background Observations:[Tau 042021 sky (Obs 15)]													
Diagnostics	(Visit 20:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.													
Fixed Targets	#	Name	Target Coordinates					Targ. Coord. Corrections				Miscellaneous		
	(8)	TAU042021	RA: 04 20 21.4428 (65.0893450d) Dec: +28 13 49.17 (28.23032d) Equinox: J2000					Epoch of Position: 2015.5						
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.													
	Category=ISM													
	Description=[Pre-main sequence stars]													
Extended=YES														
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel					Simultaneous Imaging				Imager Subarray			
	F560W	ALL					YES				FULL			
Dithers	#	Dither Type					Optimized For				Direction			
	1	4-Point					EXTENDED SOURCE				NEGATIVE			
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102		
	1	LONG(C)	MRSLONG		SLOWR1	69	1	1	Dither 1	4	4	6593.618		
	1	LONG(C)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618		
	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102		
	2	MEDIUM(B)	MRSLONG		SLOWR1	69	1	1	Dither 1	4	4	6593.618		
	2	MEDIUM(B)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618		
	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)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	4	4	6593.618		

Proposal 1751 - Observation 20 - Mapping inclined disk astrochemical signatures (MIDAS)

Special Requirements	Aperture PA Range 64 to 84 Degrees (V3 64.0 to 84.0) No Parallel Attachments Sequence Observations 15, 20, Non-interruptible
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Proposal 1751 - Observation 15 - Mapping inclined disk astrochemical signatures (MIDAS)

Observation	Proposal 1751, Observation 15: Tau 042021 sky													Fri Jan 20 19:03:39 GMT 2023
	Diagnostic Status: Warning													
	Observing Template: MIRI Medium Resolution Spectroscopy													
	Background Observation For: [Tau042021 (Obs 20)]													
Diagnostics	(Visit 15:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.													
Fixed Targets	#	Name	Target Coordinates					Targ. Coord. Corrections			Miscellaneous			
	(9)	TAU042021SKY	RA: 04 20 19.2100 (65.0800417d) Dec: +28 14 13.80 (28.23717d) Equinox: J2000					Epoch of Position: 2015.5						
	Comments: Dark sky next to Tau 042021.													
	Category=Star													
	Description=[Circumstellar dust, Protoplanetary disks, T Tauri stars]													
Extended=YES														
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel					Simultaneous Imaging			Imager Subarray				
	FND	ALL					YES			FULL				
Dithers	#	Dither Type					Optimized For			Direction				
	1	2-Point					EXTENDED SOURCE			NEGATIVE				
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	1	LONG(C)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809		
	1	LONG(C)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809		
	2		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	2	MEDIUM(B)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809		
	2	MEDIUM(B)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809		
	3		IMAGER	F770W	FASTR1	11	1	1	Dither 1	2	2	61.051		
	3	SHORT(A)	MRSLONG		SLOWR1	69	1	1	Dither 1	2	2	3296.809		
	3	SHORT(A)	MRSSSHORT		SLOWR1	69	1	1	Dither 1	2	2	3296.809		

Proposal 1751 - Observation 15 - Mapping inclined disk astrochemical signatures (MIDAS)

Special Requirements	Sequence Observations 15, 20, Non-interruptible
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