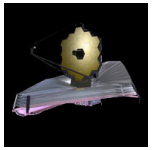

5357 - Sailing with the winds of HL Tau towards the origin of rings and gaps in protoplanetary disks

Cycle: 3, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
HL Tau NIRSpec				
	3		NIRSpec IFU Spectroscopy	(4) V-HL-TAU-NIRSPEC
HL Tau MIRI				

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	1	HL Tau MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) V-HL-TAU
	2	HL Tau MIRI MRS Background	MIRI Medium Resolution Spectroscopy	(3) BACKGROUND
HL TAU MIRI 2				
	4	HL TAU MIRI MRS 2	MIRI Medium Resolution Spectroscopy	(2) V-HL-TAU-1
	5	HL Tau MIRI MRS Background	MIRI Medium Resolution Spectroscopy	(5) BACKGROUND-2

ABSTRACT

We propose to map with the MIRI-MRS and NIRSpec IFUs the atomic jet and the warm (T = 400-3000 K) molecular H2 winds from the young star HL Tau (a prototypical jet/outflow/disk system at 140 pc). The observations will target the first 6-10 arcseconds squared of the south-western red-shifted lobe, in a position coincident with the opening of a well defined conical wind imaged by ALMA at 0."25 resolution in the 1.3 mm CO line. The comparison between the JWST and ALMA datasets, of similar angular resolution, will provide critical constraints on the nature of the flows and on their feedback on the protoplanetary disk. In particular we will check if the arc-shaped and bubble features observed in the ALMA channel maps are replicated with continuity in the inner warm H2 wind. Such evidence would support a scenario in which the various components of the molecular outflow at different excitation are arranged in nested, detached flow surfaces within a global extended layered disk wind. The interest in such a picture is that it would support recent models of magnetized inhomogeneous disk winds that see the formation, at the same time, of detached flow surfaces and of a ring-gap substructure in the disk. These models therefore introduce a justification of the ringed disk structure alternative to the action of the yet elusive protoplanets.

The program also sees the study of the jet in mid-IR atomic lines, with the purpose of testing alternative models of internal bow-shocks as the origin of the arc-shaped features in the outer molecular layers.

The high sensitivity and angular resolution offered by JWST in the mid-IR domain are crucial for this investigation.

OBSERVING DESCRIPTION

We propose to map the inner region of the redshifted lobe of the atomic jet and molecular wind from the young star HL Tau with MIRI-MRS in all spectral channels. Two 1x2 mosaics will cover an area of 6"x6" to 10"x10" depending on the channel. We aim for line brightness sensitivity in the range SNR=5 at the peak of the line and per spaxel for a brightness of 1e-15 erg/s/cm2/arcsec2.

Short exposures (ngroups=18) will be used with MIRI to avoid saturation from the strong central continuum source.

A separated off field background exposure will be obtained for both MIRI mosaics.

The spectral range includes the H2 rotational transitions that probe the warm molecular component at 400-1000 K, as well as the [FeII] forbidden

lines that provide a high angular resolution image of the inner jet close to the source, to search for jet/wind interaction signatures.

We also propose to map with NIRSpec-IFU the central 5”x5” of the same outflow in a 2x2 mosaic. We will observe in the two spectral settings G235H and G395H that cover diagnostic lines of the warm molecular component, in particular the H2 2.12 and CO 4.5 micron lines.
We aim at reaching a SNR=7 for a brightness of 2e-15 erg/s/cm2/arcsec2, achievable with ngroups=5, nintegrations=8. Two leakcal calibration exposures are also included. These observations will be critical to probe the probe the warmer molecular gas component at T>1000 K. The near-IR H2 line properties will be combined with the mid-IR ones to test the wind stratification and shock scenarii.

In all observations a four point dithering for extended source will be used.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	V-HL-TAU	RA: 04 31 38.3563 (67.9098179d) Dec: +18 13 54.66 (18.23185d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protostars]* *Extended=YES*				
(2)	V-HL-TAU-1	RA: 04 31 38.1197 (67.9088321d) Dec: +18 13 55.79 (18.23216d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protoplanetary disks, Protostars]* *Extended=YES*				
(3)	BACKGROUND	RA: 04 31 35.2427 (67.8968446d) Dec: +18 14 11.57 (18.23655d) Equinox: J2000		
Comments: *Category=Calibration* *Description=[Telescope/sky background]* *Extended=YES*				
(4)	V-HL-TAU-NIRSPEC	RA: 04 31 38.3016 (67.9095900d) Dec: +18 13 55.56 (18.23210d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protostars]* *Extended=YES*				
(5)	BACKGROUND-2	RA: 04 31 35.5375 (67.8980729d) Dec: +18 14 9.57 (18.23599d) Equinox: J2000		
Comments: *Category=Calibration* *Description=[Telescope/sky background]* *Extended=YES*				

Observation

Proposal 5357, Observation 3

Mon Nov 18 21:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 3:1) Warning (Form): Data Excess over lower threshold

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	V-HL-TAU-NIRSPEC	RA: 04 31 38.3016 (67.9095900d) Dec: +18 13 55.56 (18.23210d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Protostars]
Extended=YES

Template

TA Method
NONE

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
2	2	10.0	10.0	0.0	0.0	DEFAULT

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	G235H/F170LP	NRSIRS2RAPID	5	8	false	true	NONE	4	32	2801.067	174891
2	G235H/F170LP	NRSIRS2RAPID	5	2	true	true	NONE	4	8	700.267	174891
3	G395H/F290LP	NRSIRS2RAPID	5	8	false	true	NONE	4	32	2801.067	174891
4	G395H/F290LP	NRSIRS2RAPID	5	2	true	true	NONE	4	8	700.267	174891

Special Requirements	Aperture PA Range 218.97164917 to 258.97164917 Degrees (V3 80.0 to 120.0)

Observation

Proposal 5357, Observation 1: HL Tau MIRI MRS Mon Nov 18 21:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[HL Tau MIRI MRS Background (Obs 2)]

Diagnostics

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

(HL Tau MIRI MRS (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	V-HL-TAU	RA: 04 31 38.3563 (67.9098179d) Dec: +18 13 54.66 (18.23185d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Protostars]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	NO	FULL	Allow Auto Reorder

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
1	2	10.0	10.0	0.0	0.0	DEFAULT

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	SHORT(A)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
1	SHORT(A)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891

Special Requirements	
	Aperture PA Range 80.0 to 120.0 Degrees (V3 80.0 to 120.0) Sequence Observations 1, 2, Non-interruptible Same Aperture PA 1, 4 Same Aperture PA 1, 5

Observation

Proposal 5357, Observation 2: HL Tau MIRI MRS Background Mon Nov 18 21:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [HL Tau MIRI MRS (Obs 1)]

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
(3)	BACKGROUND	RA: 04 31 35.2427 (67.8968446d) Dec: +18 14 11.57 (18.23655d) Equinox: J2000		

Comments:
Category=Calibration
Description=[Telescope/sky background]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	NO	FULL	Allow Auto Reorder

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	SHORT(A)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
1	SHORT(A)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891

Special Requirements	
	Aperture PA Range 80.0 to 120.0 Degrees (V3 80.0 to 120.0) Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 5357, Observation 4: HL TAU MIRI MRS 2 Mon Nov 18 21:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[HL Tau MIRI MRS Background (Obs 5)]

Diagnostics

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

(HL TAU MIRI MRS 2 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	V-HL-TAU-1	RA: 04 31 38.1197 (67.9088321d) Dec: +18 13 55.79 (18.23216d) Equinox: J2000	Proper Motion RA: 2.9480083314157375E-4 sec of time/yr Proper Motion Dec: -0.015300000063689367 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[Protoplanetary disks, Protostars]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	Channel 1	NO	FULL	Allow Auto Reorder

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
1	2	10.0	10.0	0.0	0.0	DEFAULT

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	SHORT(A)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
1	SHORT(A)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	17489

Special Requirements	
	Sequence Observations 4, 5, Non-interruptible Same Aperture PA 1, 4

Observation

Proposal 5357, Observation 5: HL Tau MIRI MRS Background Mon Nov 18 21:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [HL TAU MIRI MRS 2 (Obs 4)]

Diagnostics

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

(HL Tau MIRI MRS Background (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	BACKGROUND-2	RA: 04 31 35.5375 (67.8980729d) Dec: +18 14 9.57 (18.23599d) Equinox: J2000		

Comments:
Category=Calibration
Description=[Telescope/sky background]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
	All MRS	NO	FULL	Allow Auto Reorder

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	SHORT(A)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
1	SHORT(A)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
2	MEDIUM(B)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSLONG		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891
3	LONG(C)	MRSSHORT		FASTR1	18	7	1	Dither 1	4	28	1465.221	174891

Special Requirements	Sequence Observations 4, 5, Non-interruptible Same Aperture PA 1, 5