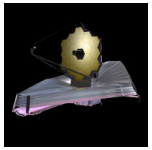

3050 - A Hot View of Cold Gas

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Background	MIRI Medium Resolution Spectroscopy	(1) background
	20	TAURUS-DARK-CLOUD-EDGE0	MIRI Medium Resolution Spectroscopy	(20) TAURUS-DARK-CLOUD-EDGE0
	25	TAURUS-DARK-CLOUD-EDGE5	MIRI Medium Resolution Spectroscopy	(25) TAURUS-DARK-CLOUD-EDGE5
	30	TAURUS-DARK-CLOUD-PEAK0	MIRI Medium Resolution Spectroscopy	(30) TAURUS-DARK-CLOUD-PEAK0
	35	TAURUS-DARK-CLOUD-PEAK5	MIRI Medium Resolution Spectroscopy	(35) TAURUS-DARK-CLOUD-PEAK5

ABSTRACT

We propose to carry out MRS observations of molecular hydrogen (H2) in a region at the edge of the Taurus molecular cloud to investigate turbulent dissipation (TD). H2, the main gas component of the star-forming interstellar medium, has largely evaded detection in molecular clouds due to its

lack of permanent electric dipole moment and wide energy level spacing. Even its lowest rotational transitions require higher energy collisions than those at molecular clouds temperatures, but can be excited in regions of intense TD. The Spitzer detection of H2 emission in the proposed region indicates temperatures far in excess of what could be produced by standard heating sources. JWST offers, for the first time, angular resolution and sensitivity sufficient to resolve the expected scale size of TD regions. By measuring the flux and distribution of H2 rotational emission, we will determine the rate of TD and its importance for heating molecular regions and thereby controlling the rate of star formation. Models predict SNR>10 H2 detection in the 0.25" (0.0002 pc) MRS pixels. Two 4x4 mosaics of the S(1) line (a total FoV of 21”x25”) will fully sample the TD regions in two representative environments. The huge resolution improvement provided by JWST will allow the first definitive observation of TD and will be a significant step forward in understanding the turbulence regulation of star formation, and hence the evolution of galaxies. The TD in Taurus should not be unique, but this is a favorable region to isolate TD-produced H2 emission. Thus, if successful, the proposed observations promise a view in JWST's infrared window of ‘hot’ gas in previously assumed 'cold’ molecular clouds.

OBSERVING DESCRIPTION

This proposal focuses on observation of emission from the lower rotational transitions of molecular hydrogen (H2). We plan to detect two H2 lines, S(1) at 17.04 microns and S(2) at 12.2 microns, using MRS Channel 3 sub-band C and A, respectively. In this program we request MRS exposures of only two sub-bands, i.e., A and C. We employ a 4x4 mosaicing of MRS sub-band C pointings to cover S(1) in a combined FoV of 21”x25”. In each one of the MRS pointings, we adopt a detector setup of 12 groups per integration and 2-pt dither pattern reaching an exposure time of 573 sec. We take 1 deep MRS sub-band A pointing to detect the fainter S(2) line, using a detector setup of 80 groups per integration and 4 integrations in total. This forms an efficient “wedding cake” strategy for our proposed MRS observations. We have identified appropriate point sources for MRS target acquisition. We propose simultaneous MIRI imaging data on two targets in the adjacent region to study their silicate absorption using one silicate band (F1000W), two PAH band (F770W and F1130W), and two continuum bands (F560W and F1280W).

The target region is in the Taurus molecular cloud boundary between dense molecular and diffuse atomic gas, where Spitzer observations indicated H2 emission far stronger than could be produced by standard heating sources. The vastly higher JWST angular resolution and superior sensitivity will allow us to resolve the scale size of turbulent dissipation (TD) regions and for the first time determine whether TD is the additional heating source that provides support for molecular clouds against gravitational collapse.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	background	RA: 04 36 58.8568 (69.2452367d) Dec: +26 49 44.35 (26.82899d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: *Category=ISM* *Description=[Intergalactic clouds]*				
(20)	TAURUS-DARK-CLOUD-EDGE0	RA: 04 37 50.5057 (69.4604404d) Dec: +27 00 3.15 (27.00088d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Interstellar clouds]*				
(25)	TAURUS-DARK-CLOUD-EDGE5	RA: 04 37 50.5057 (69.4604404d) Dec: +27 00 3.15 (27.00088d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Interstellar clouds]*				
(26)	WISEA-J043749.92+270022.2	RA: 04 37 49.8768 (69.4578200d) Dec: +27 00 22.07 (27.00613d) Equinox: J2000		
Comments: This object was generated by the targetselector and retrieved from the NED database. *Category=Calibration* *Description=[G stars]*				
(30)	TAURUS-DARK-CLOUD-PEAK0	RA: 04 38 22.6980 (69.5945750d) Dec: +27 06 9.54 (27.10265d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Interstellar clouds]*				
(35)	TAURUS-DARK-CLOUD-PEAK5	RA: 04 38 22.6980 (69.5945750d) Dec: +27 06 9.54 (27.10265d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Interstellar clouds]*				
(36)	WISEA-J043821.03+270559.4	RA: 04 38 21.0456 (69.5876900d) Dec: +27 05 59.28 (27.09980d) Equinox: J2000		
Comments: This object was generated by the targetselector and retrieved from the NED database. *Category=Calibration* *Description=[G stars]*				

Observation

Proposal 3050, Observation 1: Background Fri Sep 22 20:00:25 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [TAURUS-DARK-CLOUD-EDGE0 (Obs 20), TAURUS-DARK-CLOUD-PEAK0 (Obs 30)]

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	background	RA: 04 36 58.8568 (69.2452367d) Dec: +26 49 44.35 (26.82899d) Equinox: J2000	Epoch of Position: 2015.5	

Comments:
Category=ISM
Description=[Intergalactic clouds]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
FND	All MRS	YES	FULL	NEUTRAL

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	BACKGROUND	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	F560W	SLOWR1	5	1	1	Dither 1	4	4	477.798	
1	LONG(C)	MRSLONG		FASTR1	46	1	1	Dither 1	4	4	510.607	165452.119
1	LONG(C)	MRSSHORT		FASTR1	46	1	1	Dither 1	4	4	510.607	

Special Requirements	Sequence Observations 1, 20, 30, Non-interruptible

Observation

Proposal 3050, Observation 20: TAURUS-DARK-CLOUD-EDGE0 Fri Sep 22 20:00:25 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[Background (Obs 1)]

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
(20)	TAURUS-DARK-CLOUD-EDGE0	RA: 04 37 50.5057 (69.4604404d) Dec: +27 00 3.15 (27.00088d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=ISM
Description=[Interstellar clouds]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	26 WISEA-J043749.92+270022.2	FND	FAST	4	1	1	11.1	165563.4

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	NEUTRAL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
4	4	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		IMAGER	F560W	SLOWR1	5	1	1	Dither 1	4	4	477.798	
1	LONG(C)	MRSLONG		FASTR1	46	1	1	Dither 1	4	4	510.607	165452.119
1	LONG(C)	MRSSHORT		FASTR1	46	1	1	Dither 1	4	4	510.607	

Special Requirements	
	Aperture PA Range 83 to 85 Degrees (V3 83.0 to 85.0) Sequence Observations 1, 20, 30, Non-interruptible

Observation

Proposal 3050, Observation 25: TAURUS-DARK-CLOUD-EDGE5 Fri Sep 22 20:00:25 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 25:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(25)	TAURUS-DARK-CLOUD-EDGE5	RA: 04 37 50.5057 (69.4604404d) Dec: +27 00 3.15 (27.00088d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=ISM
Description=[Interstellar clouds]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	26 WISEA-J043749.92+270022.2	FND	FAST	4	1	1	11.1	165563.4

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	NEUTRAL

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	SLOWR1	79	1	1	Dither 1	4	4	7549.215	
1	SHORT(A)	MRSLONG		SLOWR1	79	1	1	Dither 1	4	4	7549.215	165452.94
1	SHORT(A)	MRSSHORT		SLOWR1	79	1	1	Dither 1	4	4	7549.215	
2		IMAGER	F1000W	SLOWR1	79	1	1	Dither 1	4	4	7549.215	
2	SHORT(A)	MRSLONG		SLOWR1	79	1	1	Dither 1	4	4	7549.215	165452.94
2	SHORT(A)	MRSSHORT		SLOWR1	79	1	1	Dither 1	4	4	7549.215	

Special Requirements	Aperture PA Range 83 to 85 Degrees (V3 83.0 to 85.0)

Observation

Proposal 3050, Observation 30: TAURUS-DARK-CLOUD-PEAK0 Fri Sep 22 20:00:25 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[Background (Obs 1)]

Diagnostics

(Visit 30:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(30)	TAURUS-DARK-CLOUD-PEAK0	RA: 04 38 22.6980 (69.5945750d) Dec: +27 06 9.54 (27.10265d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=ISM
Description=[Interstellar clouds]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	36 WISEA-J043821.03+270559.4	FND	FAST	4	1	1	11.1	165563.4

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	NEUTRAL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
4	4	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		IMAGER	F560W	SLOWR1	5	1	1	Dither 1	4	4	477.798	
1	LONG(C)	MRSLONG		FASTR1	46	1	1	Dither 1	4	4	510.607	165452.94
1	LONG(C)	MRSSHORT		FASTR1	46	1	1	Dither 1	4	4	510.607	

Special Requirements	
	Aperture PA Range 83 to 85 Degrees (V3 83.0 to 85.0) Sequence Observations 1, 20, 30, Non-interruptible

Observation

Proposal 3050, Observation 35: TAURUS-DARK-CLOUD-PEAK5 Fri Sep 22 20:00:25 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Diagnostics

(Visit 35:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(35)	TAURUS-DARK-CLOUD-PEAK5	RA: 04 38 22.6980 (69.5945750d) Dec: +27 06 9.54 (27.10265d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=ISM
Description=[Interstellar clouds]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	36 WISEA-J043821.03+270559.4	FND	FAST	4	1	1	11.1	165563.5

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	NEUTRAL

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	SLOWR1	79	1	1	Dither 1	4	4	7549.215	
1	SHORT(A)	MRSLONG		SLOWR1	79	1	1	Dither 1	4	4	7549.215	165452.94
1	SHORT(A)	MRSSHORT		SLOWR1	79	1	1	Dither 1	4	4	7549.215	
2		IMAGER	F1000W	SLOWR1	79	1	1	Dither 1	4	4	7549.215	
2	SHORT(A)	MRSLONG		SLOWR1	79	1	1	Dither 1	4	4	7549.215	165452.94
2	SHORT(A)	MRSSHORT		SLOWR1	79	1	1	Dither 1	4	4	7549.215	

Special Requirements	Aperture PA Range 83 to 85 Degrees (V3 83.0 to 85.0)