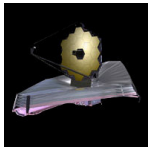

6161 - Following the water throughout star formation via its deuteration ratio in ices

Cycle: 3, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Prestellar cores				
	1	2MASS J12014301-6508422	NIRSpec IFU Spectroscopy	(1) 2MASS-J12014301-6508422
	2	2MASS J17112005-2727131	NIRSpec IFU Spectroscopy	(2) 2MASS-J17112005-2727131
	3	2MASS J18171181-0814012	NIRSpec IFU Spectroscopy	(3) 2MASS-J18171181-0814012
LYSOs				
	4	BHR 71 IRS1	NIRSpec IFU Spectroscopy	(4) BHR-71-IRS1

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	5	L483	NIRSpec IFU Spectroscopy	(5) L483
	6	IRAS 15398-3359	NIRSpec IFU Spectroscopy	(6) IRAS-15398-3359

ABSTRACT

The question of how water forms and evolves throughout star and planet formation is not only crucial for understanding how life was able to evolve on Earth, but also whether life can evolve in other solar systems. Due to the sensitivity of deuteration processes to physicochemical conditions, the deuterium abundance of water provides a window into the environment in which it formed and existed. Recent JWST data show that the unprecedented sensitivity of the NIRSpec IFU at 4.1 um enables robust measurement of the HDO/H2O ratio of interstellar ices for the first time, providing a clear path to characterizing the link between prestellar water ice and the water found in solar system bodies such as our Earth, comets, moons, and water-rich asteroids.

We propose to search for HDO ice with NIRSpec IFU in three prestellar cores and three low-mass protostars. In these objects, we will constrain the column densities and morphologies of H2O ice via the O-H stretching band at 3 um and HDO ice via the O-D stretching band at 4.1 um, which can only be observed via G395M when observing with NIRSpec IFU. We will also constrain the CH3OH ice column density via the 3.53 um band to ensure that any observed absorptions at 4.1 um cannot be attributed instead to CH3OH. The use of the IFU will enable correlation of ice morphologies in extended sources. In two of the low-mass protostars, the ratios in measured in the ices will be compared to their gas-phase HDO/H2O ratios obtained by ALMA. The proposed observations will probe more deeply than before the physicochemical history of water and evaluate if prestellar water ice is inherited by protoplanetary disks and bodies that form within them.

OBSERVING DESCRIPTION

We propose to observe three prestellar cores and three isolated low-mass protostars with NIRSpec IFU single pointing using the G395M grating to cover the 2.87-5.14 um range relevant for quantifying HDO ice via its band at 4.1 um as well as the G235M grating (for bright sources) or PRISM (for dimmer sources) to define the short-wavelength continuum <2.87 um, enabling quantification of the H2O water ice via its 3 um band. The G395M observations aim for SNR >400 in order to detect the predicted HDO column densities above 3 sigma levels. These observations will result in quantification of the HDO/H2O ratio in the ices located along the lines of sight in the selected targets. Target acquisition is not needed due to the use of the IFU. A 4-point dither was selected for all observations to optimize spatial and spectral sampling. Leakcal is not requested as no particularly bright objects are located in the vicinity of our selected targets. We select NRSIRS2RAPID readout for all objects except one, which requires the NRSRAPID readout due to saturation issues.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	2MASS-J12014301-6508422	RA: 12 01 42.9640 (180.4290167d) Dec: -65 08 42.53 (-65.14515d) Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Dense interstellar clouds]*				
(2)	2MASS-J17112005-2727131	RA: 17 11 20.0500 (257.8335417d) Dec: -27 27 13.10 (-27.45364d) Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Dense interstellar clouds]*				
(3)	2MASS-J18171181-0814012	RA: 18 17 11.8110 (274.2992125d) Dec: -08 14 1.29 (-8.23369d) Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Dense interstellar clouds]*				
(4)	BHR-71-IRS1	RA: 12 01 36.4890 (180.4020375d) Dec: -65 08 49.40 (-65.14706d) Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=ISM* *Description=[Protostars]* *Extended=YES*				
(5)	L483	RA: 18 17 29.9832 (274.3749300d) Dec: -04 39 39.87 (-4.66107d) Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Protostars]* *Extended=YES*				
(6)	IRAS-15398-3359	RA: 15 43 2.2102 (235.7592092d) Dec: -34 09 7.71 (-34.15214d) Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[Protostars]* *Extended=YES*				

Observation

Proposal 6161, Observation 1: 2MASS J12014301-6508422

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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)	2MASS-J12014301-6508422	RA: 12 01 42.9640 (180.4290167d) Dec: -65 08 42.53 (-65.14515d) Equinox: J2000	Epoch of Position: 2000	

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

Template

TA Method	HFF Readout Mode
NONE	false

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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.1
2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.2
3	G395M/F290LP	NRSIRS2RAPID	5	1	true	true	NONE	4	4	350.133	

Observation

Proposal 6161, Observation 2: 2MASS J17112005-2727131

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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
(2)	2MASS-J17112005-2727131	RA: 17 11 20.0500 (257.8335417d) Dec: -27 27 13.10 (-27.45364d) Equinox: J2000	Epoch of Position: 2000	

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

Template

TA Method	HFF Readout Mode
NONE	false

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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.3
2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.4

Observation

Proposal 6161, Observation 3: 2MASS J18171181-0814012

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	2MASS-J18171181-0814012	RA: 18 17 11.8110 (274.2992125d) Dec: -08 14 1.29 (-8.23369d) Equinox: J2000	Epoch of Position: 2000	

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

Template

TA Method	HFF Readout Mode
NONE	false

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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.5
2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	176698.6
3	G395M/F290LP	NRSIRS2RAPID	5	1	true	true	NONE	4	4	350.133	

Observation

Proposal 6161, Observation 4: BHR 71 IRS1

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	BHR-71-IRS1	RA: 12 01 36.4890 (180.4020375d) Dec: -65 08 49.40 (-65.14706d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=ISM
Description=[Protostars]
Extended=YES

Template

TA Method	HFF Readout Mode
NONE	false

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	PRISM/CLEAR	NRSIRS2RAPID	20	1	false	true	NONE	4	4	1225.467	176698.7
2	G395M/F290LP	NRSIRS2RAPID	8	1	false	true	NONE	4	4	525.2	176698.8
3	G395M/F290LP	NRSIRS2RAPID	8	1	true	true	NONE	4	4	525.2	

Observation

Proposal 6161, Observation 5: L483

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	L483	RA: 18 17 29.9832 (274.3749300d) Dec: -04 39 39.87 (-4.66107d) Equinox: J2000	Epoch of Position: 2000	

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

Template

TA Method	HFF Readout Mode
NONE	false

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	G235M/F170LP	NRSIRS2RAPID	16	1	false	true	NONE	4	4	992.045	176698.10
2	G395M/F290LP	NRSRAPID	4	2	false	true	NONE	4	8	429.471	176698.11
3	G395M/F290LP	NRSRAPID	4	2	true	true	NONE	4	8	429.471	

Observation

Proposal 6161, Observation 6: IRAS 15398-3359

Wed Apr 09 19:01:06 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(6)	IRAS-15398-3359	RA: 15 43 2.2102 (235.7592092d) Dec: -34 09 7.71 (-34.15214d) Equinox: J2000	Epoch of Position: 2000	

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

Template

TA Method	HFF Readout Mode
NONE	false

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	PRISM/CLEAR	NRSIRS2RAPID	9	1	false	true	NONE	4	4	583.556	176698.12
2	G395M/F290LP	NRSIRS2RAPID	9	1	false	true	NONE	4	4	583.556	176698.14