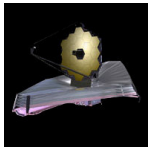

5394 - Untangling the Nature of the Kennicutt Relation at the Low End: the Iconic Case of the Giant Low Surface Brightness Galaxy Malin 1

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Malin 1				
	1	Malin 1	MIRI Imaging	(1) Malin_1

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	2	Background	MIRI Imaging	(2) Sky_background

ABSTRACT

Star formation is the basis for galaxy evolution, but how this process occurs in extremely low gas density environments is not understood. The Kennicutt relation correlates the star formation rate surface density to the gas surface density in galaxies. On the low end of the relation, there is a break in the profile and a steepening of the slope where HI efficiently converts to H2. What is unclear is the physical process or ISM conditions that cause the steepness in the relation. Either galaxies have an HI-dominated disk with low H2 filling factor or there is low star formation efficiency within the H2 in this regime. At the extreme low end of the Kennicutt relation sits low surface brightness galaxies (LSBGs), which can be used to distinguish between these two scenarios. Recent work has placed a stringent upper limit on the H2 gas surface density within the giant LSBG Malin 1, seeming to point towards a low H2 filling factor. However, the true answer cannot be determined without quantifying the amount of H2 gas within the disk. Here we propose to observe Malin 1 with MIRI in the F770W dust emission filter and F1280W dust continuum filter to map out the gaseous disk (HI and H2) using dust as a tracer. These observations will enable us to determine the spatially-resolved gas surface density of Malin 1 to the disk edge. By comparing the total gas surface density to the previously measured HI gas surface density, we will identify the cause of the steepening in the Kennicutt relation through the difference of the two values. This work will deepen our understanding of the star formation process in the most extreme gas conditions.

OBSERVING DESCRIPTION

We will obtain MIRI/F770W and F1280W imaging of the giant low surface brightness galaxy Malin 1 to identify where the gas (HI and H2) resides using PAH emission as a tracer. These observations will allow us to map the gas surface density to extremely low values in the disk and compare the dust morphology with high surface brightness galaxies. We will utilize a 4-point extended source dither pattern. The values of groups and integrations have been chosen to achieve a minimum SNR~5 at the disk edge for the F770W dust emission filter and the F1280W dust continuum filter. We use the FULL subarray and the FASTR1 readout. To cover the full galaxy, we use a 1x2 mosaic. Background observations are taken at the same exposure time with a 4-point dither. We constrain the PA to be the same for each filter observation of science and background, respectively. The background and science observations are grouped and non-interruptable.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	Malin_1	RA: 12 36 59.3500 (189.2472917d) Dec: +14 19 49.16 (14.33032d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Low Surface Brightness galaxies, Spiral arms]* *Extended=YES*				
(2)	Sky_background	RA: 12 37 7.9650 (189.2831875d) Dec: +14 19 26.24 (14.32396d) Equinox: J2000		
Comments: background region to the east of Malin 1 *Category=Calibration* *Description=[Telescope/sky background]* *Extended=NO*				

Observation

Proposal 5394, Observation 1: Malin 1

Mon Mar 31 13:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Background Observations:[Background (Obs 2)]

Diagnostics

(Malin 1 (Obs 1)) Warning (Form): Target requiring background exposure selected for template that doesn't require background exposure

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

(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Malin 1 (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	Malin_1	RA: 12 36 59.3500 (189.2472917d) Dec: +14 19 49.16 (14.33032d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Low Surface Brightness galaxies, Spiral arms]
Extended=YES

Template

Subarray
FULL

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	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	6	4						DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F770W	FASTR1	17	10	1	Dither 1	4	40	1986.929	172028.23
2	F1280W	FASTR1	32	10	1	Dither 1	4	40	3651.953	172028.26

Special Requirements	
	Group Visits within 53.0 Days Visits Same PA Group Observations 1, 2, Non-interruptible Same Aperture PA 1

Observation

Proposal 5394, Observation 2: Background

Mon Mar 31 13:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Background Observation For: [Malin 1 (Obs 1)]

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Background (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	Sky_background	RA: 12 37 7.9650 (189.2831875d) Dec: +14 19 26.24 (14.32396d) Equinox: J2000		

Comments: background region to the east of Malin 1
Category=Calibration
Description=[Telescope/sky background]
Extended=NO

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	6	4						DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F770W	FASTR1	17	10	1	Dither 1	4	40	1986.929	172028.23
2	F1280W	FASTR1	32	10	1	Dither 1	4	40	3651.953	172028.26

Special Requirements

Group Observations 1, 2, Non-interruptible
Same Aperture PA 2