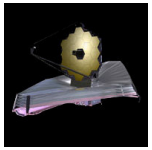

1178 - Ram Pressure Stripping in ESO 137-001

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Inner Tail [MRS+Imaging]	MIRI Medium Resolution Spectroscopy	(18) Group INNER-TAIL
	2	Outer Tail [MRS+Imaging]	MIRI Medium Resolution Spectroscopy	(21) Group OUTER-TAIL-BACKGROUND

ABSTRACT

Once thought to be rare, the number of known ram pressure stripping (RPS) events has been steadily rising, observed as truncated or disturbed gaseous disks or one-sided tails in the X-ray through the radio. These events hold key information regarding the relation between galaxy transformation and environment. We propose MIRI MRS observations of ESO 137-001, a well studied local galaxy (z=0.01625) with a spectacular double ram pressure stripped tail. At both high spectral (R~2700) and spatial (~0.1 arcsec) resolution over 5-28.8m, we will detect multiple transitions of rotational H2 lines as well as a suite of fine structure lines at high significance. From these observables, we will deduce the kinematics and the temperature/density structure of warm and hot gas components in the tail on sub-kpc scales as well as the excitation mechanism(s) responsible. This information will reveal how the (star forming) interstellar medium of the host galaxy responds to strong RPS and how the stripped gas subsequently interactions with the intra-cluster medium. Notably, the detailed state of H2 will identify the spatial extent of shocked gas and constrain the mechanisms and timescales for the cooling of molecular gas, revealing whether star-forming regions in the tail were formed in situ or

from molecular gas stripped directly from the galactic disk. Additionally, high resolution MIRI 7.7m imaging obtained simultaneously with MRS pointings in the far-tail (~40 kpc from the main galaxy) will fall back on the main galaxy and near- to mid-tail regions, providing a measure of the aromatic features and a SFR indicator.

FRIEDMAN_0001

OBSERVING DESCRIPTION

This program targets multiple regions at the galaxy-tail interface and along the stripped tail of ESO 137-001 with the MIRI MRS. The full MRS wavelength range with all channels will be observed. The 16 science targets have been grouped into the inner tail region (14 targets in target group INNER-TAIL) and the outer tail region (2 targets in a 2x1 mosaic). Our science goal is to detect and characterize warm molecular hydrogen emission and fine structure lines in key regions, selected HII regions with evidence for star formation and/or cold molecular gas, at the galaxy-tail interface and along the RPS tail. Our primary objective is the H2 S(1) emission line at 17.035um (rest). As this line is in the MRS channel 3 at z=0.01625, our pointings and dither strategy are optmized for this channel. Secondary objectives include the H2 S(2)-S(7) lines, fine structure lines such as [NeII]-[NeVI], [SIII], [OIV], [FeII], etc. and PAH features. The H2 S(0) emission line, which falls at the low sensitivity edge of channel 4 long, will be recovered if possible using spatial and spectral binning.

One dedicated background pointing, with the same exposure setup as our science pointings, is included in the target group OUTER-TAIL for calibration purposes in order to ensure proper subtraction of the sky/telescope background. This background pointing must be taken during the same epoch as our observations and therefore this entire program is non-interruptible and needs to be executed at the same PA.

MIRI imaging, taken simultaneously with MRS mosaic in the outer tail, will provide a F770W image of the galaxy ESO 137-001 and its RPS tail out to a distance of ~25 kpc. This imaging requires a position angle of ~334-346 deg (V3). For this APT file, we have fixed the PA to 334 deg (V3) to satisfy the special requirement that target groups have a fix, zero-width PA range. Since this imaging can imporve spatial registration of the MRS exposures, we include it in the inner tail region as well at a minimum increase to program duration.

Given that our targets are extended, the absolute pointing accuracy of JWST is adequate for our needs and target acquisition is not required for this program.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	KNOT-2	RA: 16 13 24.9680 (243.3540333d) Dec: -60 45 43.51 (-60.76209d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions, Molecular gas]* *Extended=YES*				
(3)	KNOT-3	RA: 16 13 26.4800 (243.3603333d) Dec: -60 45 32.85 (-60.75912d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions]* *Extended=YES*				
(4)	KNOT-4	RA: 16 13 25.4500 (243.3560417d) Dec: -60 45 35.19 (-60.75977d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions, Molecular gas]* *Extended=YES*				
(5)	KNOT-5	RA: 16 13 23.9300 (243.3497083d) Dec: -60 45 53.60 (-60.76489d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions]* *Extended=YES*				
(6)	KNOT-6	RA: 16 13 24.5400 (243.3522500d) Dec: -60 46 5.92 (-60.76831d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions, Molecular gas]* *Extended=YES*				
(7)	KNOT-7	RA: 16 13 24.1300 (243.3505417d) Dec: -60 45 33.46 (-60.75929d) Equinox: J2000		
Comments: Coordinates from Sivanandam+10, Table 4. *We are observing one background (fixed target 10, observation 2) for all MRS pointings.* *Category=ISM* *Description=[H II regions, Molecular gas]* *Extended=YES*				

(8)	KNOT-11	RA: 16 13 22.8300 (243.3451250d) Dec: -60 45 20.55 (-60.75571d) Equinox: J2000

Comments: Coordinates from Sivanandam+10, Table 4.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=ISM
Description=[H II regions, Molecular gas]
Extended=YES

(10)	BACKGROUND	RA: 16 13 11.5000 (243.2979167d) Dec: -60 45 0.00 (-60.75000d) Equinox: J2000

Comments: Choosen to have no 8um emission.
Category=Calibration
Description=[Telescope/sky background]
Extended=YES

(11)	ESO137-001-TILE-2	RA: 16 13 26.1575 (243.3589896d) Dec: -60 45 42.12 (-60.76170d) Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(12)	ESO137-001-TILE-4	RA: 16 13 25.7573 (243.3573221d) Dec: -60 45 49.48 (-60.76374d) Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Active galactic nuclei, Spiral galaxies, Tidal tails]
Extended=YES

(13)	ESO137-001-TILE-5	RA: 16 13 26.4339 (243.3601412d) Dec: -60 45 47.68 (-60.76324d) Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(14) ESO137-001-TILE-6 RA: 16 13 27.1105 (243.3629604d)
Dec: -60 45 45.88 (-60.76274d)
Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(15) ESO137-001-TILE-7 RA: 16 13 26.0337 (243.3584737d)
Dec: -60 45 55.05 (-60.76529d)
Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(16) ESO137-001-TILE-8 RA: 16 13 26.7103 (243.3612929d)
Dec: -60 45 53.24 (-60.76479d)
Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(17) ESO137-001-TILE-9 RA: 16 13 27.3869 (243.3641121d)
Dec: -60 45 51.44 (-60.76429d)
Equinox: J2000

Comments: Tile in mosaic of galaxy-tail interface covering the base of the ram pressure stripped tail of ESO137-001. Mosaic was designed using the APT mosaic tool with 15% overlap, but then the tiles were split into individual targets in order to include them in Target Group INNER-TAIL. This allows us to observe the mosaic and Knots 2, 3, 4, 5, 6, 7, 11 in the same visit as they are within the visit splitting distance.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=Galaxy
Description=[Spiral galaxies, Tidal tails]
Extended=YES

(18) Group INNER-TAIL

Comments:
Target Selection=[2 KNOT-2, 3 KNOT-3, 4 KNOT-4, 5 KNOT-5, 6 KNOT-6, 7 KNOT-7, 8 KNOT-11, 11 ESO137-001-TILE-2, 12 ESO137-001-TILE-4, 13 ESO137-001-TILE-5, 14 ESO137-001-TILE-6, 15 ESO137-001-TILE-7, 16 ESO137-001-TILE-8, 17 ESO137-001-TILE-9]

(19) OUTER-TAIL-1 RA: 16 13 14.6400 (243.3110000d)
Dec: -60 44 45.30 (-60.74592d)
Equinox: J2000

Comments: We are observing one background (fixed target 10, observation 2) for all MRS pointings.
Category=ISM
Description=[H II regions, Molecular gas]

	(20)	OUTER-TAIL-2	RA: 16 13 14.3800 (243.3099167d) Dec: -60 44 39.40 (-60.74428d) Equinox: J2000
	Comments: We are observing one background (fixed target 10, observation 2) for all MRS pointings. *Category=ISM* *Description=[H II regions, Molecular gas]*		
	(21)	Group OUTER-TAIL-BACKGROUND	
	Comments: *Target Selection=[10 BACKGROUND, 19 OUTER-TAIL-1, 20 OUTER-TAIL-2]*		

Observation

Proposal 1178, Observation 1: Inner Tail [MRS+Imaging] Tue Jun 25 20:00:26 GMT 2019

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Comments: PA is set to 334 because target groups require a zero-width PA range as a special requirement. However, as long as all pointings have the same PA, any PA between 334 and 346 deg (V3) would be suitable for this program.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.

Diagnostics

(Visit 1:1) Warning (Form): Data volume for this visit 45858.19 MB exceeds half the maximum allowed of 58000.0 MB.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(18)	Group INNER-TAIL			

Comments:
Target Selection=[2 KNOT-2, 3 KNOT-3, 4 KNOT-4, 5 KNOT-5, 6 KNOT-6, 7 KNOT-7, 8 KNOT-11, 11 ESO137-001-TILE-2, 12 ESO137-001-TILE-4, 13 ESO137-001-TILE-5, 14 ESO137-001-TILE-6, 15 ESO137-001-TILE-7, 16 ESO137-001-TILE-8, 17 ESO137-001-TILE-9]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray
F560W	CHANNEL3	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	FAST	10	1	1	Dither 1	2	2	55.501	
1	SHORT(A)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
1	SHORT(A)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204
2		IMAGER	F770W	FAST	10	1	1	Dither 1	2	2	55.501	
2	MEDIUM(B)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
2	MEDIUM(B)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204
3		IMAGER	F770W	FAST	10	1	1	Dither 1	2	2	55.501	
3	LONG(C)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
3	LONG(C)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204

Special Requirements	
	Aperture PA Range 334 to 334 Degrees (V3 334.0 to 334.0) Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 1178, Observation 2: Outer Tail [MRS+Imaging] Tue Jun 25 20:00:26 GMT 2019

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Comments: PA is set to 334 because target groups require a zero-width PA range as a special requirement. However, as long as all pointings have the same PA, any PA between 334 and 346 deg (V3) would be suitable for this program.

We are observing one background (fixed target 10, observation 2) for all MRS pointings.

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
(21)	Group OUTER-TAIL-BACKGROUND			

Comments:
Target Selection=[10 BACKGROUND, 19 OUTER-TAIL-1, 20 OUTER-TAIL-2]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray
F560W	CHANNEL3	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	FAST	95	1	1	Dither 1	2	2	527.258	25204
1	SHORT(A)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
1	SHORT(A)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204
2		IMAGER	F770W	FAST	95	1	1	Dither 1	2	2	527.258	25204
2	MEDIUM(B)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
2	MEDIUM(B)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204
3		IMAGER	F770W	FAST	95	1	1	Dither 1	2	2	527.258	25204
3	LONG(C)	MRSLONG		FAST	95	1	1	Dither 1	2	2	527.258	25204
3	LONG(C)	MRSSHORT		FAST	95	1	1	Dither 1	2	2	527.258	25204

Special Requirements	
	Aperture PA Range 334 to 334 Degrees (V3 334.0 to 334.0) Sequence Observations 1, 2, Non-interruptible