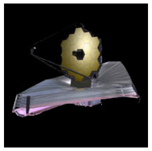

7711 - Warm Dust in the Circumgalactic Medium in Formation around the Makani Galaxy

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	MIRI/MRS MAKANI-Halo	MIRI Medium Resolution Spectroscopy	(1) MAKANI-Halo-MIRI-MRS
	2	MIRI/MRS MAKANI-BG	MIRI Medium Resolution Spectroscopy	(2) MAKANI-BG
	7	NIRSpec MAKANI-Halo	NIRSpec IFU Spectroscopy	(3) MAKANI-Halo-NIRSpec-IFU

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	8	NIRSpec MAKANI-BG	NIRSpec IFU Spectroscopy	(2) MAKANI-BG
	9	NIRSpec MAKANI-Halo	NIRSpec IFU Spectroscopy	(3) MAKANI-Halo-NIRSpec-IFU
	10	NIRSpec MAKANI-BG	NIRSpec IFU Spectroscopy	(2) MAKANI-BG
	11	NIRSpec MAKANI-Halo	NIRSpec IFU Spectroscopy	(3) MAKANI-Halo-NIRSpec-IFU
	12	NIRSpec MAKANI-BG	NIRSpec IFU Spectroscopy	(2) MAKANI-BG

ABSTRACT

Deep NIRCam and MIRI images of Makani, a massive compact galaxy with a record-breaking 100-kpc scale starburst-driven wind at z = 0.459, reveal warm dust (PAHs) out to ~ 30 kpc from the galaxy center. The warm dust emission, detected beyond the inner cool-gas wind associated with the more recent (7 Myr ago) starburst episode, is apparently taking part in the outer warm-ionized gas wind produced by the older (0.4 Gyr ago) episode. This discovery of PAHs in the outer wind indicates that the PAHs have survived the long (r/v > 10 million yrs) journey to the halo despite the harsh environment of the galactic wind. Here we propose deep NIRSpec and MIRI/MRS integral-field spectroscopy (IFS) of the circumgalactic dust to determine whether dust grains experience growth or erosion as they travel to large distances from the host galaxy. The PAH 7.7/3.3 and 11.3/3.3 ratios will provide constraints on the size distribution of the dust grains, while PAH 11.3/7.7 will trace the state of ionization of the PAHs, a marker of PAH destruction or growth. The radial PAH ratio gradients that are tentatively inferred from the images will be put on more quantitative footing with the analysis of the spectra. The new JWST IFS data will also be combined with the published flux and kinematic maps of the warm-ionized, cool-neutral, and cold-molecular gas phases to provide a holistic view of the dust-gas cycle in this galaxy-CGM ecosystem in formation. These data will inform next-generation simulations that incorporate dust physics in multi-phase outflows to explain galaxy formation and evolution and the large amount of dust inferred to exist outside of galaxies in the CGM and IGM.

OBSERVING DESCRIPTION

We will observe the circumgalactic dust of Makani with MIRI/MRS and NIRSpec/IFU using the following strategy:

For the MIRI/MRS observations:

- We use the LONG wavelength setting to capture redshifted PAH 7.7 and 11.3 and the surrounding continuum. We'll also get redshifted H2 S(1)

17.04 um in channel 4 "for free" if it's bright enough.

- We use the SLOWR1 readout mode for all observations.

- We use the 4-point all-wavelength extended source dither pattern for the on-source data cube.

- We obtain a background cube immediately before each on-source cube using the same settings as the on-source data cube.

-The on-source and background observations each consists of (10 groups/integration) x (16 integrations/exposure) x (4 dither positions) to keep the individual integration less than 300 sec, as recommended.

-We select the recommended simultaneous imaging with the F770W during all MIRI/MRS observations to improve astrometric accuracy and thus cube building

-Loose position angle constraints (+/- 50 degrees) are used to position the MIRI/MRS FOV on the circumgalactic dust without including the bright central emission of Makani (except perhaps for channel 4, but this channel is not sensitive enough to detect circumgalactic dust emission anyway).

-Following the recommendation of STScI scientists, we request that the background be no more than 10% of the minimum since ETC shows that (S/N_low - S/N_high)/S/N_low = 0.068 > 0.05, the threshold for such a request, at 11.0 um (redshifted PAH 7.7) and 0.065 at 16.4 um (redshifted PAH 7.7).

For the NIRSpec/IFU observations:

- We use the G395M grating to capture redshifted PAH 3.3 and the surrounding continuum.

- We use the NRSIRS2 readout mode for all observations to get the best S/N according to the ETCs without excessive data products (we avoid NRSIRS2RAPID for this reason).

- We use the 4-point dither pattern for the on-source data cube.

- We obtain a background cube immediately after each on-source cube using the same settings as the on-source data cube.

-The on-source and background exposures are split in three separate observations of (21 groups/integration) x (1 integrations/exposure) x (4 dither positions) each to reduce data rates and volumes.

-We do not have constraints on the position angle of the observations by positioning the NIRSpec 3" x 3" FOV far enough from the center of Makani to avoid the bright nuclear emission at all position angles.

-Following the recommendation of STScI scientists, we request that the background be no more than 10% of the minimum since ETC shows that (S/N_low - S/N_high)/S/N_low = 0.076 > 0.05 at 4.8 um (redshifted PAH 3.3), the threshold for such a request.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MAKANI-Halo-MIRI-MRS	RA: 21 18 23.8000 (319.5991667d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=Galaxy Description=[Active galaxies, Starburst galaxies] Extended=YES				
(2)	MAKANI-BG	RA: 21 18 24.0587 (319.6002446d) Dec: +00 17 21.95 (.28943d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=Unidentified Description=[Blank field]				
(3)	MAKANI-Halo-NIRSpec-IFU	RA: 21 18 23.8500 (319.5993750d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=Galaxy Description=[Active galaxies, Starburst galaxies] Extended=YES				

Observation

Proposal 7711, Observation 1: MIRI/MRS MAKANI-Halo

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[MIRI/MRS MAKANI-BG (Obs 2)]

Diagnostics

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

(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MAKANI-Halo-MIRI-MRS	RA: 21 18 23.8000 (319.5991667d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Active galaxies, Starburst galaxies]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
F560W	All MRS	YES	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	Optional ETC ID
1		IMAGER	F770W	SLOWR1	10	16	1	Dither 1	4	64	16722.944	
1	LONG(C)	MRSLONG		SLOWR1	10	16	1	Dither 1	4	64	16722.944	263238
1	LONG(C)	MRSSHORT		SLOWR1	10	16	1	Dither 1	4	64	16722.944	263238

Special Requirements	
	Aperture PA Range 0.0 to 55.0 Degrees (V3 0.0 to 55.0) Aperture PA Range 95.0 to 140.0 Degrees (V3 95.0 to 140.0) Aperture PA Range 170.0 to 245.0 Degrees (V3 170.0 to 245.0) Aperture PA Range 300.0 to 310.0 Degrees (V3 300.0 to 310.0) Background Limited. Background no more than 10th percentile above minimum Sequence Observations 2, 1 (reordered), Non-interruptible

Observation

Proposal 7711, Observation 2: MIRI/MRS MAKANI-BG

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [MIRI/MRS MAKANI-Halo (Obs 1)]

Diagnostics

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

(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAKANI-BG	RA: 21 18 24.0587 (319.6002446d) Dec: +00 17 21.95 (.28943d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Unidentified
Description=[Blank field]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
FND	All MRS	YES	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	Optional ETC ID
1		IMAGER	F770W	SLOWR1	10	16	1	Dither 1	4	64	16722.944	
1	LONG(C)	MRSLONG		SLOWR1	10	16	1	Dither 1	4	64	16722.944	263238
1	LONG(C)	MRSSHORT		SLOWR1	10	16	1	Dither 1	4	64	16722.944	263238

Special Requirements	Background Limited. Background no more than 10th percentile above minimum Sequence Observations 2, 1 (reordered), Non-interruptible

Observation

Proposal 7711, Observation 7: NIRSpec MAKANI-Halo

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observations:[NIRSpec MAKANI-BG (Obs 8)]

Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	MAKANI-Halo-NIRSpec-IFU	RA: 21 18 23.8500 (319.5993750d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Active galaxies, Starburst galaxies]
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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 7, 8, Non-interruptible

Observation

Proposal 7711, Observation 8: NIRSpec MAKANI-BG

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observation For: [NIRSpec MAKANI-Halo (Obs 7)]

Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAKANI-BG	RA: 21 18 24.0587 (319.6002446d) Dec: +00 17 21.95 (.28943d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Unidentified
Description=[Blank field]

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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 7, 8, Non-interruptible

Observation

Proposal 7711, Observation 9: NIRSpec MAKANI-Halo

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observations:[NIRSpec MAKANI-BG (Obs 10)]

Diagnostics

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	MAKANI-Halo-NIRSpec-IFU	RA: 21 18 23.8500 (319.5993750d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Active galaxies, Starburst galaxies]
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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 9, 10, Non-interruptible

Observation

Proposal 7711, Observation 10: NIRSpec MAKANI-BG

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observation For: [NIRSpec MAKANI-Halo (Obs 9)]

Diagnostics

(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAKANI-BG	RA: 21 18 24.0587 (319.6002446d) Dec: +00 17 21.95 (.28943d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Unidentified
Description=[Blank field]

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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 9, 10, Non-interruptible

Observation

Proposal 7711, Observation 11: NIRSpec MAKANI-Halo

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observations:[NIRSpec MAKANI-BG (Obs 12)]

Diagnostics

(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	MAKANI-Halo-NIRSpec-IFU	RA: 21 18 23.8500 (319.5993750d) Dec: +00 17 31.45 (.29207d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Active galaxies, Starburst galaxies]
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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 11, 12, Non-interruptible

Observation

Proposal 7711, Observation 12: NIRSpec MAKANI-BG

Thu Sep 11 15:00:23 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observation For: [NIRSpec MAKANI-Halo (Obs 11)]

Diagnostics

(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAKANI-BG	RA: 21 18 24.0587 (319.6002446d) Dec: +00 17 21.95 (.28943d) Equinox: J2000	Proper Motion RA: -5.078732401225699E-4 sec of time/yr Proper Motion Dec: 0.002221 arcsec/yr Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Unidentified
Description=[Blank field]

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	Optional ETC ID
1	G395M/F290LP	NRSIRS2	21	1	false	true	NONE	4	4	6185.689	263238

Special Requirements

Background Limited. Background no more than 10th percentile above minimum

Group Observations 11, 12, Non-interruptible