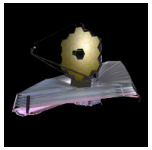

4225 - First spatially resolved characterization of the warm molecular torus in the Circinus galaxy

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Circinus Galaxy				
	1	Circinus-MRS-Nucleus	MIRI Medium Resolution Spectroscopy	(1) CIRCINUS-NUCLEUS
	2	Circinus-MRS-Sky	MIRI Medium Resolution Spectroscopy	(2) CIRCINUS-BACKGROUND

ABSTRACT

The unified scheme of active galactic nuclei (AGN) postulates that the central engine is surrounded by an optically and geometrically thick torus. One of the most promising models to explain the origin of the torus, after accounting for the MIR polar dust elongation, is the radiation-driven fountain model, in which AGN-driven outflows are the key process to form the structure. While strong supportive evidence for this model has been obtained by recent ALMA observations, little is known about the geometrically thick volume of the torus as cold gas and dust is predominantly reside in the mid-plane of the disk.

Here we propose MIRI/MRS observations over the full wavelength coverage to detect multiple rotational H2 lines. Our hydrodynamic + radiative transfer simulations indeed reveal that these lines trace the geometrically thick volume. Thanks to the high resolution of MRS (~4-6 pc), we can for the first time map the torus-scale (~30 pc) at these warm molecular lines. We will investigate spatial distribution of the warm gas, which directly

constrains the torus shape. The molecular gas temperature and mass will be directly measured by making spatially resolved rotation diagrams, which will also be used to investigate if there is Compton-thick material in the geometrically thick volume. Warm molecular outflows and backflows will be searched based on the resolved dynamics. We will also make a visual extinction map by using the accurately constrained silicate absorption feature.

Combined with high resolution multiwavelength data, our JWST observations will finally provide
the first spatially resolved, complete understanding of the multiphase AGN torus.

OBSERVING DESCRIPTION

We request MIRI/MRS observations of the torus scale region of the nearby AGN, the Circinus galaxy. The full spectral coverage of MIRI (4.9-28 micon) will be observed to detect multiple rotational H2 lines and 9.7 micron silicate absorption feature. The smallest MIRI/MRS field of view surely covers the area of our interst (< 3"), hence we only request a single pointing centered on the AGN.

The 4-pt dithering for extended source will be performed to enhance the spatial and spectral samplings, with the primary channel = ALL as every channel contains important lines. The FASTR1 readout mode will be used as the target is the bright source. For each of the dither point, the number of the groups per integration (N_group) and the number of integrations per exposure (N_int) are set to 3-8 and 4-12, respectively, to avoid possible saturation and to cope with setup restrictions.

The simultaneously conducted imaging will be done with the filter set of F770W, F1000W, and F1130W to cover PAH and silicate absorption feature.
We also request a target acquisition for this observation. A bright star near the Circinus galaxy will be observed for this purpose with the Neutral Density Filter and FASTGRPAVG readout.

Special requirements: regarding the background observations, we request non-interruptible sequence observations.

Proposal 4225 - Targets - First spatially resolved characterization of the warm molecular torus in the Circinus galaxy

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CIRCINUS-NUCLEUS	RA: 14 13 9.9473 (213.2914471d) Dec: -65 20 21.02 (-65.33917d) Equinox: J2000	Proper Motion RA: 0 mas/yr Proper Motion Dec: 0 mas/yr Parallax: 0" Epoch of Position: 2018.5	
Comments: The corrdinates of the nucleus is determined from high-resolution ALMA observations. *Category=Galaxy* *Description=[Active galactic nuclei, Seyfert galaxies]* *Extended=YES*				
(2)	CIRCINUS-BACKGROUND	RA: 14 13 0.0000 (213.2500000d) Dec: -65 18 0.00 (-65.30000d) Equinox: J2000	Epoch of Position: 2018.5	
Comments: The region to obtain background emission for the main observation of the Circinus galaxy. This point provides a good "blank" sky with a least contamination from Galactic emission, as can be seen in a Spitzer IRAC4 image. *Category=Calibration* *Description=[External flat field]* *Extended=YES*				

Observation

Proposal 4225, Observation 1: Circinus-MRS-Nucleus

Thu Apr 18 16:01:42 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[Circinus-MRS-Sky (Obs 2)]

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)	CIRCINUS-NUCLEUS	RA: 14 13 9.9473 (213.2914471d)	Proper Motion RA: 0 mas/yr	
		Dec: -65 20 21.02 (-65.33917d)	Proper Motion Dec: 0 mas/yr	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2018.5	

Comments: The corrdinates of the nucleus is determined from high-resolution ALMA observations.
Category=Galaxy
Description=[Active galactic nuclei, Seyfert galaxies]
Extended=YES

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	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	F1130W	FASTR1	5	6	1	Dither 1	4	24	388.506	
1	LONG(C)	MRSLONG		FASTR1	5	6	1	Dither 1	4	24	388.506	197448
1	LONG(C)	MRSSHORT		FASTR1	5	6	1	Dither 1	4	24	388.506	197448
2		IMAGER	F770W	FASTR1	5	6	1	Dither 1	4	24	388.506	
2	MEDIUM(B)	MRSLONG		FASTR1	5	6	1	Dither 1	4	24	388.506	197448
2	MEDIUM(B)	MRSSHORT		FASTR1	8	4	1	Dither 1	4	16	388.506	197448
3		IMAGER	F1000W	FASTR1	5	10	1	Dither 1	4	40	654.909	
3	SHORT(A)	MRSLONG		FASTR1	5	10	1	Dither 1	4	40	654.909	197448
3	SHORT(A)	MRSSHORT		FASTR1	5	10	1	Dither 1	4	40	654.909	197448

Special Requirements	Sequence Observations 1, 2, Non-interruptible

Observation

Proposal 4225, Observation 2: Circinus-MRS-Sky Thu Apr 18 16:01:42 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [Circinus-MRS-Nucleus (Obs 1)]

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)	CIRCINUS-BACKGROUND	RA: 14 13 0.0000 (213.2500000d) Dec: -65 18 0.00 (-65.30000d) Equinox: J2000	Epoch of Position: 2018.5	

Comments: The region to obtain background emission for the main observation of the Circinus galaxy. This point provides a good "blank" sky with a least contamination from Galactic emission, as can be seen in a Spitzer IRAC4 image.
Category=Calibration
Description=[External flat field]
Extended=YES

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	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	F1130W	FASTR1	5	6	1	Dither 1	4	24	388.506	
1	LONG(C)	MRSLONG		FASTR1	5	6	1	Dither 1	4	24	388.506	
1	LONG(C)	MRSSHORT		FASTR1	5	6	1	Dither 1	4	24	388.506	
2		IMAGER	F770W	FASTR1	5	6	1	Dither 1	4	24	388.506	
2	MEDIUM(B)	MRSLONG		FASTR1	5	6	1	Dither 1	4	24	388.506	
2	MEDIUM(B)	MRSSHORT		FASTR1	8	4	1	Dither 1	4	16	388.506	
3		IMAGER	F1000W	FASTR1	5	10	1	Dither 1	4	40	654.909	
3	SHORT(A)	MRSLONG		FASTR1	5	10	1	Dither 1	4	40	654.909	
3	SHORT(A)	MRSSHORT		FASTR1	5	10	1	Dither 1	4	40	654.909	

Special Requirements	Sequence Observations 1, 2, Non-interruptible