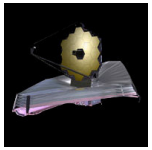

2452 - The Vanishing Act: PAHs and Heavy Element Abundance in M101

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	2	NIRCAM	NIRCam Imaging	(2) MESSIER-101

ABSTRACT

One of Spitzer's hallmark extragalactic discoveries was the sensitive dependence of PAH emission on metallicity. PAHs seem simply to vanish in galaxies below approximately one-quarter of the solar abundance. Understanding the physical origin of this unexpected phenomenon is urgent, and will have major implications for all upcoming JWST proposals using the mid-IR PAH bands to trace star formation at high redshift.

We outline a modest imaging-only program to map the 3.3μm PAH feature along a radial strip in the galaxy M101, beyond 1/5th solar metallicity. M101 is the ideal laboratory for this simple experiment. Thanks to impressively deep 8m-class "auroral-line" spectroscopy from the CHAOS program, M101's steep radial abundance gradient is the most accurately known of any galaxy in the Universe. Additionally, ~50 hours of ultra-deep Spitzer/IRS mapping spectroscopy probe a strip extending 20kpc from its center. Spitzer provided no access to the shortest and highest excitation 3.3μm PAH feature. This band provides a crucial missing piece of the puzzle since it is highly diagnostic of the very smallest PAH grains which are most likely to be affected by changes in low-metallicity environments. NIRCAM's high surface brightness sensitivity and perfectly matched filter set enable a deep measurement of 3.3μm PAH emission at ~4pc resolution, simultaneously tracing signs of mechanical heating with H_2 2.12μm narrowband imaging. Armed with new models for PAH band variations driven by grain destruction, inhibited formation, and changes in the starlight spectrum, we can definitively answer: how & why do PAH grains respond so sensitively to the varying heavy metal content of galaxies?

OBSERVING DESCRIPTION

MOSAIC & CONSTRAINTS:

To efficiently cover pre-existing ultra-deep Spitzer/IRS strip mapping of M101, we allocate a simple 2 step mosaic, constraining NIRCAM roll angles to align the mosiac pattern with the strip position angle. This leaves approximately a one month long scheduling window.

FILTERS:

We utilize 3 red (F300M, F335M, F360M) and 2 blue (F212N, F200W) to provide deep continuum-subtracted imaging of the PAH 3.3um band and H2 1-0 S(1) 2.12 emission line.

READOUT:

To keep data rate below the maximum, we employ SHALLOW2 NIRCAM readout ramps, achieving a final data rate near 0.7MB/s for this short 7hr program. We allocate 3 primary and 2 sub-pixel dithers in the 3TIGHT pattern. Together with a 57% mosaic overlap, this provides excellent uniformity of coverage across the full strip and excellent point-spread function recovery.

EXPOSURE:

Ramp details and exposure times were validated using the ETC with surface brightness scaled from the pre-existing 11.3um Spitzer PAH band intensity and both "diffuse" and "structured" extraction apertures. Using 5 group readout ramps with our 6 dither positions leads to high quality detections meeting the scientific requirements.

Proposal 2452 - Targets - The Vanishing Act: PAHs and Heavy Element Abundance in M101

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MESSIER-101	RA: 14 03 3.0406 (210.7626692d) Dec: +54 17 16.75 (54.28799d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Spiral galaxies]

Observation

Proposal 2452, Observation 2: NIRCAM Wed Dec 14 15:01:07 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
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(Visit 2:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
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Comments:
Category=Galaxy
Description=[Spiral galaxies]

Template

Module	Subarray
ALL	FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
1	2	10.0	57.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULL	3TIGHT	SMALL-GRID-DITHER		2

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F212N	F335M	SHALLOW2	5	1	6	6	1417.254	59390
2	F200W	F300M	SHALLOW2	5	1	6	6	1417.254	59390
3	F212N	F360M	SHALLOW2	5	1	6	6	1417.254	59390

Special Requirements

Group Visits within 53.0 Days
Aperture PA Range 283.88744876 to 294.88744876 Degrees (V3 283.95880186 to 294.95880186)
Visits Same PA