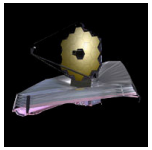

4244 - Are Luminous Red Novae major factories of cosmic dust?

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
MIRI Imaging				
	1	AT2018bwo	MIRI Imaging	(1) AT2018BWO
	2	M31-LRN-2015	MIRI Imaging	(2) M31-LRN-2015
	4	AT2021blu_img	MIRI Imaging	(3) AT2021BLU
	6	AT2021biy_img	MIRI Imaging	(4) AT2021BIY
MIRI LRS Spectroscopy				
	5	AT2021blu_spec	MIRI Low Resolution Spectroscopy	(3) AT2021BLU
	7	AT2021biy_spec	MIRI Low Resolution Spectroscopy	(4) AT2021BIY

ABSTRACT

Despite their vital importance to several astrophysical processes, the major sources of dust grains in the interstellar medium (ISM) are still not fully understood. In this proposal, we aim to investigate a previously unexplored but potentially important source of cosmic dust - extragalactic Luminous Red Novae (LRNe). LRNe are energetic outbursts representing the final stages of common envelope evolution (CEE), which results in either a

stellar merger or the ejection of the CE. Extragalactic LRNe are prolific sites of dust production, evidenced by their rapid reddening and long lasting (>1000 day) infrared (IR) lightcurves. Their volumetric rate is high enough (~80% of the core-collapse supernova rate) to make their dust contribution comparable to known major dust sources (AGBs, RSGs and SNe). However, dust masses have not been measured for any extragalactic LRN to date. Here, we propose to utilize the unprecedented mid-IR sensitivity of JWST to obtain the first dust mass measurements in a variety of LRNe. During JWST Cycle 2, we aim to observe four extragalactic LRNe that span a wide range in luminosities and progenitor masses (4-20 Msun) with the Mid-Infrared Instrument (MIRI). Our observations use a combination of 5-12 um low-resolution spectroscopy and 5-25 um imaging to derive the dust masses produced by these LRNe. These observations will directly test whether LRNe are major factories of cosmic dust. Additionally, our dust mass measurements will probe the total mass ejected in these LRNe and shed light on whether the binaries that produced them merged, or survived by ejecting the CE.

OBSERVING DESCRIPTION

The aim of this proposal is to use 10.14 hours of JWST observations to observe four extragalactic luminous red novae (LRNe) with the Mid Infrared Instrument (MIRI) to measure the amount of dust produced in them. The dust masses will be used to investigate whether LRNe are major sources of cosmic dust, and to shed light on the final fates of binaries undergoing common envelope evolution that produce LRNe.

This targets of this proposal are four well-studied extragalactic LRNe - M31-LRN-2015, AT 2018bwo, AT 2021blu and AT 2021biy. We aim to obtain 5-25 um spectroscopic and photometric observations for these transients, to measure the dust masses produced in them. As shown in Figure 3 (Scientific Justification), 5-12 um observations are required to measure masses if the dust formation is low. Longer wavelength (>15 um) observations are required to measure higher dust masses that produce a larger optical depth.

Two of our targets - AT 2021blu and AT 2021biy are bright enough for MIRI-LRS spectroscopy. We obtain a S/N > 10 in the 5-12 um for an exposure time of 1112 seconds for each target. For the other two, we aim to cover this wavelength range by imaging in the F560W, F770W, F1000W, F1130W and F1280W filters. In addition to these, we propose imaging observations in F1500W, F1800W, F2100W and F2550W filters for all four targets to cover wavelengths from 15 - 25 um. The total exposure time required to obtain S/N > 10 in the imaging observations is 448 seconds each for AT 2021blu and AT 2021biy and 1736 seconds each for M31-LRN-2015 and AT 2018bwo.

We request that all observations of the same target be conducted back-to-back, as our targets are time varying and simulataneous observations are required to measure their spectral energy distribution. We do not place any constraint on the timing of observations of different targets. All four targets have Micrometeoroid safe visibility windows during JWST Cycle 2.

Proposal 4244 - Targets - Are Luminous Red Novae major factories of cosmic dust?

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	AT2018BWO	RA: 00 14 1.7200 (3.5071667d) Dec: -23 11 35.84 (-23.19329d) Equinox: J2000		
Comments: *Category=Star* *Description=[Novae]*				
(2)	M31-LRN-2015	RA: 00 42 7.9900 (10.5332917d) Dec: +40 55 1.10 (40.91697d) Equinox: J2000		
Comments: *Category=Star* *Description=[Novae]*				
(3)	AT2021BLU	RA: 10 42 34.3400 (160.6430833d) Dec: +34 26 14.60 (34.43739d) Equinox: J2000		
Comments: *Category=Star* *Description=[Novae]*				
(4)	AT2021BIY	RA: 12 42 4.0250 (190.5167708d) Dec: +32 32 7.88 (32.53552d) Equinox: J2000		
Comments: *Category=Star* *Description=[Novae]*				

Observation

Proposal 4244, Observation 1: AT2018bwo

Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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)	AT2018BWO	RA: 00 14 1.7200 (3.5071667d) Dec: -23 11 35.84 (-23.19329d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	15	1	1	Dither 1	4	4	166.502	
2	F770W	FASTR1	7	1	1	Dither 1	4	4	77.701	
3	F1000W	FASTR1	20	1	1	Dither 1	4	4	222.003	
4	F1130W	FASTR1	20	1	1	Dither 1	4	4	222.003	
5	F1280W	FASTR1	7	1	1	Dither 1	4	4	77.701	
6	F1500W	FASTR1	6	1	1	Dither 1	4	4	66.601	
7	F1800W	FASTR1	10	1	1	Dither 1	4	4	111.002	
8	F2100W	FASTR1	28	1	1	Dither 1	4	4	310.804	
9	F2550W	FASTR1	14	3	1	Dither 1	4	12	488.407	

Observation

Proposal 4244, Observation 2: M31-LRN-2015

Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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)	M31-LRN-2015	RA: 00 42 7.9900 (10.5332917d) Dec: +40 55 1.10 (40.91697d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	15	1	1	Dither 1	4	4	166.502	
2	F770W	FASTR1	7	1	1	Dither 1	4	4	77.701	
3	F1000W	FASTR1	20	1	1	Dither 1	4	4	222.003	
4	F1130W	FASTR1	20	1	1	Dither 1	4	4	222.003	
5	F1280W	FASTR1	7	1	1	Dither 1	4	4	77.701	
6	F1500W	FASTR1	6	1	1	Dither 1	4	4	66.601	
7	F1800W	FASTR1	10	1	1	Dither 1	4	4	111.002	
8	F2100W	FASTR1	28	1	1	Dither 1	4	4	310.804	
9	F2550W	FASTR1	14	3	1	Dither 1	4	12	488.407	

Special Requirements

Aperture PA Range 59.83544897 to 69.83544897 Degrees (V3 55.0 to 65.0)

Observation

Proposal 4244, Observation 4: AT2021blu_img

Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	AT2021BLU	RA: 10 42 34.3400 (160.6430833d) Dec: +34 26 14.60 (34.43739d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	POINT SOURCE	POSITIVE	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	F1280W	FASTR1	5	1	1	Dither 1	4	4	55.501	
2	F1500W	FASTR1	5	1	1	Dither 1	4	4	55.501	
3	F1800W	FASTR1	5	1	1	Dither 1	4	4	55.501	
4	F2100W	FASTR1	5	1	1	Dither 1	4	4	55.501	
5	F2550W	FASTR1	10	2	1	Dither 1	4	8	233.103	

Special Requirements

Group Observations 4, 5, Non-interruptible

Observation

Proposal 4244, Observation 6: AT2021biy_img Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	AT2021BIY	RA: 12 42 4.0250 (190.5167708d) Dec: +32 32 7.88 (32.53552d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	1	POINT SOURCE	POSITIVE	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	F1280W	FASTR1	5	1	1	Dither 1	4	4	55.501	
2	F1500W	FASTR1	5	1	1	Dither 1	4	4	55.501	
3	F1800W	FASTR1	5	1	1	Dither 1	4	4	55.501	
4	F2100W	FASTR1	5	1	1	Dither 1	4	4	55.501	
5	F2550W	FASTR1	10	2	1	Dither 1	4	8	233.103	

Special Requirements

Group Observations 6, 7, Non-interruptible

Observation

Proposal 4244, Observation 5: AT2021blu_spec Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	AT2021BLU	RA: 10 42 34.3400 (160.6430833d) Dec: +34 26 14.60 (34.43739d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	3 AT2021BLU	F560W	FASTGRPAVG	4	1	1	44.401	145980

Template

Subarray	Obtain Verification Image?
FULL	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	200	1	2	1	2	1110.016	

Special Requirements	Group Observations 4, 5, Non-interruptible

Observation

Proposal 4244, Observation 7: AT2021biy_spec Tue Jun 25 22:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

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
(4)	AT2021BIY	RA: 12 42 4.0250 (190.5167708d) Dec: +32 32 7.88 (32.53552d) Equinox: J2000		

Comments:
Category=Star
Description=[Novae]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	4 AT2021BIY	F560W	FASTGRPAVG	4	1	1	44.401	145980

Template

Subarray	Obtain Verification Image?
FULL	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	200	1	2	1	2	1110.016	

Special Requirements	Group Observations 6, 7, Non-interruptible