



4093 - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
DustarSurvey				
	1	WR125	MIRI Imaging	(1) WR125
	2	WR48a	MIRI Imaging	(2) WR48A
	3	WR137	MIRI Imaging	(3) WR137
	4	WR 112	MIRI Imaging	(4) WR112

ABSTRACT

Star and planet formation theory, especially relating to the early Universe, requires an accurate dust budget. One source of dust at very low metallicity is thought to be from carbon-rich Wolf-Rayet stars (WCd) in binary systems formed through Roche lobe overflow. In July 2022, JWST+MIRI imaged seventeen dust shells around the WCd binary WR 140, which creates dust every periastron passage (every ~8 years), revealing that the dust survives for at least 150 years following its creation. Such infrared imaging allows us to measure the temperature evolution of the dust and to model the geometry of the shocks that led to the observed emission. We propose to widen the sample with four additional systems (WR 48a, WR 112, WR 125, and WR 137), which allows for the exploration of WCd dust creation over larger physical scales as the binaries are more distant than WR 140, and testing of the survivability of carbon-rich WCd dust in multiple environments. The understanding of the dust survival is crucial to a complete accounting of the dust budget in both early and modern galaxies as these binary stars can form dust faster than the first supernovae in their parent galaxy, and at timescales of millions of years rather than the billions of years needed to form dust with AGB stars or planetary nebulae.

OBSERVING DESCRIPTION

We are proposing a MIRI imaging program to resolve the dust clouds surrounding 4 carbon-rich WC binaries. The target stars have resolved dust plumes with ground-based imaging, but we are limited on the ground to only the closest and hottest dust. We aim to use the wide field of view and sensitivity of MIRI to search for fossil dust shells to prove that the dust created is long-lived. The observations of the four binaries will be taken in three filters spanning the MIR with observations at 7.7, 15, and 21 microns to then fit black body distributions to the shells that are further out from the stars and trace the temperature evolution of the dust with time. For at least two of the stars, the central source and dust will be saturated. However, this is not a concern given we are searching for distant, faint emission rather than the bright central dust probing distances up to 200,000 AU from the stars. We will also use the geometries to fit the dust distribution and infer orbital geometry for these stars, something that is extremely difficult to assess for these stars.

Proposal 4093 - Targets - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WR125	RA: 19 28 15.6104 (292.0650433d) Dec: +19 33 21.45 (19.55596d) Equinox: J2000	Proper Motion RA: -2.4910282242372094E-4 sec of time/yr Proper Motion Dec: -0.00510300005771569 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]</p>				
(2)	WR48A	RA: 13 12 39.5895 (198.1649562d) Dec: -62 42 55.95 (-62.71554d) Equinox: J2000	Proper Motion RA: -0.0010200508866646195 sec of time/yr Proper Motion Dec: -5.999999984851456E-4 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]</p>				
(3)	WR137	RA: 20 14 31.7632 (303.6323467d) Dec: +36 39 39.51 (36.66098d) Equinox: J2000	Proper Motion RA: -2.228088131189951E-4 sec of time/yr Proper Motion Dec: -0.005739000084759027 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]</p>				
(4)	WR112	RA: 18 16 33.4900 (274.1395417d) Dec: -18 58 42.40 (-18.97844d) Equinox: J2000	Proper Motion RA: -6.175705200875022E-5 sec of time/yr Proper Motion Dec: -0.0037199999496806413 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]</p>				

Fixed Targets

Proposal 4093 - Observation 1 - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

Thu May 11 15:05:08 GMT 2023

Observation	<p>Proposal 4093, Observation 1: WR125</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Imaging</p>										
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)	WR125	RA: 19 28 15.6104 (292.0650433d) Dec: +19 33 21.45 (19.55596d) Equinox: J2000			Proper Motion RA: -2.4910282242372094E-4 sec of time/yr Proper Motion Dec: -0.00510300005771569 arcsec/yr Epoch of Position: 2015.5					
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]										
Template	<p>Subarray</p> <p>FULL</p>										
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	F770W	FASTR1	100	1	1	Dither 1	4	4	1110.016	141968.5
	2	F1500W	FASTR1	100	2	1	Dither 1	4	8	2231.132	141968.5
	3	F2100W	FASTR1	100	6	1	Dither 1	4	24	6715.597	141968.5

Proposal 4093 - Observation 2 - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

Thu May 11 15:05:08 GMT 2023

Observation	<p>Proposal 4093, Observation 2: WR48a</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Imaging</p>										
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)	WR48A	RA: 13 12 39.5895 (198.1649562d) Dec: -62 42 55.95 (-62.71554d) Equinox: J2000			Proper Motion RA: -0.0010200508866646195 sec of time/yr Proper Motion Dec: -5.999999984851456E-4 arcsec/yr Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Dust shell, WC stars, Wolf-Rayet stars]</i></p>										
Template	<p>Subarray</p> <p>FULL</p>										
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	F770W	FASTR1	100	1	1	Dither 1	4	4	1110.016	
	2	F1500W	FASTR1	100	1	1	Dither 1	4	4	1110.016	
	3	F2100W	FASTR1	100	4	1	Dither 1	4	16	4473.364	

Proposal 4093 - Observation 3 - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

Thu May 11 15:05:08 GMT 2023

Observation	<p>Proposal 4093, Observation 3: WR137</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Imaging</p>										
Diagnostics	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(3)	WR137	RA: 20 14 31.7632 (303.6323467d) Dec: +36 39 39.51 (36.66098d) Equinox: J2000			Proper Motion RA: -2.228088131189951E-4 sec of time/yr Proper Motion Dec: -0.005739000084759027 arcsec/yr Epoch of Position: 2015.5					
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Dust shell, WC stars, Wolf-Rayet stars]										
Template	<p>Subarray</p> <p>FULL</p>										
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	F770W	FASTR1	100	1	1	Dither 1	4	4	1110.016	
	2	F1500W	FASTR1	100	2	1	Dither 1	4	8	2231.132	
	3	F2100W	FASTR1	100	4	1	Dither 1	4	16	4473.364	

Proposal 4093 - Observation 4 - Fingerprinting the history of episodic dust creation in Wolf-Rayet binaries

Thu May 11 15:05:08 GMT 2023

Observation	<p>Proposal 4093, Observation 4: WR 112</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Imaging</p>										
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		
	(4)	WR112	RA: 18 16 33.4900 (274.1395417d) Dec: -18 58 42.40 (-18.97844d) Equinox: J2000			Proper Motion RA: -6.175705200875022E-5 sec of time/yr Proper Motion Dec: -0.0037199999496806413 arcsec/yr Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Dust shell, WC stars, Wolf-Rayet stars]</i></p>										
Template	<p>Subarray</p> <p>FULL</p>										
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	F770W	FASTR1	20	1	1	Dither 1	4	4	222.003	
	2	F1500W	FASTR1	10	1	1	Dither 1	4	4	111.002	
	3	F2100W	FASTR1	25	4	1	Dither 1	4	16	1143.316	