



12487 - CEE it happen: Common-Envelope Evolution in action with early JWST observations of a stellar merger in M31

Cycle: 4, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	2	MIRI Imaging	MIRI Imaging	(1) LRN2025abao
	3	MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) LRN2025abao

ABSTRACT

Common-envelope evolution (CEE) is a crucial, but poorly understood phase in the lives of binary stars, that plays an important role in the formation pathways of double compact object gravitational wave sources. Luminous Red Novae are a class of transient eruptions originating in stellar mergers following CEE, and offer rare probes of this process. A remarkable new LRN - AT2025abao - has just erupted in M31 in late October 2025. Uniquely, this source was discovered and extensively observed in its pre-merger phase, making it the first ever LRN to be captured during the 'dynamical inspiral phase' of CEE. As such, AT2025abao offers an unprecedented probe of CEE, and will likely be a cornerstone for future CEE studies.

In this proposal, we request JWST MIRI MRS spectroscopy and imaging observations to capture the immediate aftermath of AT2025abao's merger, with a goal to robustly constrain the mass of surviving pre-merger dust ejected during its inspiral phase. Our observations will provide the first constraints on dynamical mass loss processes during CEE, mass of the secondary star in the binary system, test theoretical predictions about dust-formation around CEE systems, and provide the most complete view of this elusive process to date. They will also deliver the earliest IR SED post-merger; together with the rich precursor data obtained just before merger, this will constitute the best dataset for a CE transient. We estimate that the pre-merger dust around this source is expected to be intact, however, it will soon be destroyed as the new ejecta collide with it, by February 2026. We therefore request a ToO observation with JWST before this window closes.

OBSERVING DESCRIPTION

We propose to observe AT2025abao with MIRI MRS spectroscopy and imaging in F1800W, F2100W, and F2550W filters.

Proposal 12487 - Targets - CEE it happen: Common-Envelope Evolution in action with early JWST observations of a stellar merger in ...

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1) <i>Comments:</i> Category=Star Description=[Novae] Extended=NO	LRN2025abao	RA: 00 38 48.6000 (9.7025000d) Dec: +40 46 8.23 (40.76895d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Epoch of Position: 2000.0	

Proposal 12487 - Observation 2 - CEE it happen: Common-Envelope Evolution in action with early JWST observations of a stellar mer...

Tue Dec 02 23:00:45 GMT 2025

Observation	<p>Proposal 12487, Observation 2: MIRI Imaging</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		
	(1)	LRN2025abao	RA: 00 38 48.6000 (9.7025000d) Dec: +40 46 8.23 (40.76895d) Equinox: J2000			Proper Motion RA: 0 Proper Motion Dec: 0 Epoch of Position: 2000.0					
	<p><i>Comments:</i> <i>Category=Star</i> <i>Description=[Novae]</i> <i>Extended=NO</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	CYCLING	1	4						DEFAULT	
Spectral Elements	#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	F1800W	FASTR1	5	1	1	Dither 1	4	4	55.501	
	2	F2100W	FASTR1	5	1	1	Dither 1	4	4	55.501	
	3	F2550W	FASTR1	5	1	1	Dither 1	4	4	55.501	
Special Requirements	Group Observations 2, 3, Non-interruptible										

Proposal 12487 - Observation 3 - CEE it happen: Common-Envelope Evolution in action with early JWST observations of a stellar mer...

Tue Dec 02 23:00:45 GMT 2025

Observation	Proposal 12487, Observation 3: MIRI MRS Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy												
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous				
	(1)	LRN2025abao	RA: 00 38 48.6000 (9.7025000d) Dec: +40 46 8.23 (40.76895d) Equinox: J2000			Proper Motion RA: 0 Proper Motion Dec: 0 Epoch of Position: 2000.0							
Comments: Category=Star Description=[Novae] Extended=NO													
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID				
	1	SAME	F560W	FAST	4	1	1	11.1	281068				
Template	Primary Channel		Simultaneous Imaging			Imager Subarray			Grating Wheel Direction				
	All MRS		YES			FULL			Allow Auto Reorder				
Dithers	#	Dither Type			Optimized For			Direction					
	1	4-Point			POINT 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	FASTR1	50	1	1	Dither 1	4	4	555.008	
	1	SHORT(A)	MRSLONG		FASTR1	100	1	1	Dither 1	4	4	1110.016	
	1	SHORT(A)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	
	2		IMAGER	F770W	FASTR1	50	1	1	Dither 1	4	4	555.008	
	2	MEDIUM(B)	MRSLONG		FASTR1	100	1	1	Dither 1	4	4	1110.016	
	2	MEDIUM(B)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	
	3		IMAGER	F770W	FASTR1	50	1	1	Dither 1	4	4	555.008	
	3	LONG(C)	MRSLONG		FASTR1	100	1	1	Dither 1	4	4	1110.016	
	3	LONG(C)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	

Proposal 12487 - Observation 3 - CEE it happen: Common-Envelope Evolution in action with early JWST observations of a stellar mer...

Special Requirements

Between Dates 22-NOV-2025:00:00:00 and 27-JAN-2026:00:00:00

Group Observations 2, 3, Non-interruptible