



# 6023 - The Full Picture: Determining the Ultra-Late Time MIR Flux Redistribution in SN 2021aefx

Cycle: 3, Proposal Category: GO

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JWST Proposal 6023 (Created: Monday, February 3, 2025, 5:00:11PM Eastern Standard Time) - Overview

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**OBSERVATIONS**

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
MIRI Imaging				
	1	Day 1000	MIRI Imaging	(1) SN2021aefx
	4	Day 1150	MIRI Imaging	(1) SN2021aefx
Makeup Observations				
	5	Makeup - Day 1150	MIRI Imaging	(1) SN2021aefx

**ABSTRACT**

Type Ia supernovae (SNe Ia) are the explosive, thermonuclear deaths of white dwarf stars in multi-star systems. Despite decades of intensive study, the true nature of their progenitors and the physical mechanism by which they explode are highly debated. SNe Ia provide crucial insights into other areas of astronomy, including: understanding sources of systematic errors in the use of SNe Ia as cosmological probes, the final phases of stellar evolution, and the origin and distribution of heavy elements. Enabled by the sensitivity of JWST, ultra-late MIR imaging with MIRI is key to addressing longstanding questions about flux redistribution to the MIR (estimated to be up to 80% of the total flux) and the bolometric luminosities of SN Ia at ultra-late times. We request 14.01 hours of MIRI imaging of SN 2021aefx at 1000 and 1150 days after maximum light to complete a legacy data-set which includes approved contemporaneous HST imaging and JWST NIRSpec and MIRI/LRS spectroscopy. The combined observations will obtain the first ever ultra-late time SED of a SN Ia from 0.4–28  $\mu\text{m}$ , enabling full use of accurate bolometric light curves. These data will: (1) reveal the amount of flux redistributed to the IR at late-times in SNe Ia and its time-dependence; (2) determine the masses and isotopic ratios of radioactive electron capture elements including  $^{57}\text{Co}$  and  $^{55}\text{Fe}$ ; and (3) constrain the strength and evolution of the magnetic field in the SN. This

ground-breaking data will provide the foundation upon which future studies of late-time SN Ia light curves are built. It will enormously enhance our understanding of heavy element production and the reliability of SNe Ia as distance indicators.

### **OBSERVING DESCRIPTION**

We propose obtaining two sets of MIRI imaging of SN 2021aefx with the F1280W, F1500W, F1800W, F2100W, and F2550W filters at +1000, and +1150 days after B-band maximum light, totaling 14.01 hours of charged time in Cycle 3 (15.32 hours if not scheduled contemporaneously with those of JWST-GO-3726). Observations fall near the edges of the JWST visibility windows for SN 2021aefx but can be classically scheduled within +/- 15 days of the requested epoch to allow for scheduling flexibility. These observations should be scheduled in coordination with those planned under program 3726, which has been approved for NIRSpec and MIRI/LRS observations of the same target at the same phases.

Proposal 6023 - Targets - The Full Picture: Determining the Ultra-Late Time MIR Flux Redistribution in SN 2021aefx

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	SN2021aefx	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000  <i>Comments: This object was generated by the targetselector and retrieved from the NED database.</i> Category=Star Description=[Supernovae] Extended=NO		

Proposal 6023 - Observation 1 - The Full Picture: Determining the Ultra-Late Time MIR Flux Redistribution in SN 2021aefx

Mon Feb 03 22:00:11 GMT 2025

<b>Observation</b>	<p><b>Proposal 6023, Observation 1: Day 1000</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(1)	SN2021aefx	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000								
	<p><i>Comments: This object was generated by the targetselector and retrieved from the NED database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Supernovae]</i></p> <p><i>Extended=NO</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>FULL</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	DEFAULT	
	2	4-Point-Sets				4	3	POINT SOURCE	POSITIVE	DEFAULT	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F1280W	FASTR1	15	5	1	Dither 1	4	20	876.913	174095.1
	2	F1500W	FASTR1	15	5	1	Dither 1	4	20	876.913	174095.2
	3	F1800W	FASTR1	15	5	1	Dither 1	4	20	876.913	174095.3
	4	F2100W	FASTR1	15	5	1	Dither 1	4	20	876.913	174095.4
	5	F2550W	FASTR1	15	5	1	Dither 2	12	60	2630.738	174095.5
<b>Special Requirements</b>	Between Dates 10-AUG-2024 and 09-SEP-2024										

Proposal 6023 - Observation 4 - The Full Picture: Determining the Ultra-Late Time MIR Flux Redistribution in SN 2021aefx

Mon Feb 03 22:00:11 GMT 2025

<b>Observation</b>	<p><b>Proposal 6023, Observation 4: Day 1150</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: MIRI Imaging</p>										
<b>Diagnostics</b>	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(1)	SN2021aefx	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000								
	<p><i>Comments: This object was generated by the targetselector and retrieved from the NED database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Supernovae]</i></p> <p><i>Extended=NO</i></p>										
<b>Template</b>	<p><b>Subarray</b></p> <p>FULL</p>										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	DEFAULT	
	2	4-Point-Sets				5	2	POINT SOURCE	POSITIVE	DEFAULT	
	3	4-Point-Sets				1	10	POINT SOURCE	POSITIVE	DEFAULT	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F1280W	FASTR1	50	5	1	Dither 1	4	20	2819.441	174095.6
	2	F1500W	FASTR1	40	5	1	Dither 2	8	40	4528.865	174095.7
	3	F1800W	FASTR1	30	5	1	Dither 2	8	40	3418.849	174095.8
	4	F2100W	FASTR1	30	5	1	Dither 2	8	40	3418.849	174095.9
	5	F2550W	FASTR1	15	7	1	Dither 3	40	280	12321.178	174095.10
<b>Special Requirements</b>	Between Dates 08-JAN-2025 and 06-FEB-2025										

Proposal 6023 - Observation 5 - The Full Picture: Determining the Ultra-Late Time MIR Flux Redistribution in SN 2021aefx

Mon Feb 03 22:00:11 GMT 2025

<b>Observation</b>	<b>Proposal 6023, Observation 5: Makeup - Day 1150</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Imaging <i>Comments: Visit 5:1 added as TTRB approved repeat observations of Visit 4:1 connected to WOPR 89310, which was skipped following a pointing error with the JWST attitude control system.</i>										
	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
<b>Diagnostics</b>											
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>			
	(1)	SN2021aefx	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000								
<i>Comments: This object was generated by the targetselector and retrieved from the NED database.</i> Category=Star Description=[Supernovae] Extended=NO											
<b>Template</b>	<b>Subarray</b>										
	FULL										
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>	<b>Starting Point</b>	<b>Number of Points</b>	<b>Points</b>	<b>Starting Set</b>	<b>Number of Sets</b>	<b>Optimized For</b>	<b>Direction</b>	<b>Pattern Size</b>	
	1	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	DEFAULT	
	2	4-Point-Sets				5	2	POINT SOURCE	POSITIVE	DEFAULT	
	3	4-Point-Sets				1	10	POINT SOURCE	POSITIVE	DEFAULT	
<b>Spectral Elements</b>	<b>#</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Exposures/Dith</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F1280W	FASTR1	50	5	1	Dither 1	4	20	2819.441	174095.6
	2	F1500W	FASTR1	40	5	1	Dither 2	8	40	4528.865	174095.7
	3	F1800W	FASTR1	30	5	1	Dither 2	8	40	3418.849	174095.8
	4	F2100W	FASTR1	30	5	1	Dither 2	8	40	3418.849	174095.9
	5	F2550W	FASTR1	15	7	1	Dither 3	40	280	12321.178	174095.10