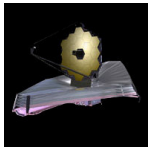

9264 - Unraveling cosmic dust origins: JWST revelations from legacy observations of SN 2023dbc

Cycle: 4, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Dr. Melissa Shahbandeh (PI)	**Space Telescope Science Institute**
Dr. Ori Dosovitz Fox (CoI)	Space Telescope Science Institute
Dr. Eddie Baron (CoI)	Planetary Science Institute
Prof. Chris Ashall (CoI)	University of Hawaii
Dr. James M DerKacy (CoI)	Space Telescope Science Institute
Dr. Stan Woosley (CoI)	University of California - Santa Cruz
Dr. Tamas Szalai (CoI) (ESA Member)	University of Szeged
Dr. Justin Pierel (CoI)	Space Telescope Science Institute
Dr. Jacob Jencson (CoI)	California Institute of Technology
Dr. Armin Rest (CoI)	Space Telescope Science Institute
Dr. Sebastian Gomez (CoI)	University of Texas at Austin
Dr. Louis-Gregory Strolger (CoI)	Space Telescope Science Institute
Prof. Eric Hsiao (CoI)	Florida State University
Jing Lu (CoI)	Florida State University
Sahana Kumar (CoI)	The University of Virginia
Dr. Mark M. Phillips (CoI)	Carnegie Institution of Washington
Dr. Dietrich Baade (CoI) (ESA Member)	European Southern Observatory - Germany
Dr. Robert E. Williams (CoI)	Space Telescope Science Institute
Christopher Burns (CoI)	Carnegie Institution of Washington
Dr. Arkaprabha Sarangi (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Prof. Maryam Modjaz (CoI)	The University of Virginia

Name	***Institution***
Prof. Benjamin John Shappee (CoI)	University of Hawaii
Dr. Maximillian Stritzinger (CoI) (ESA Member)	Aarhus University
Anthony Burrow (CoI)	University of Oklahoma Norman Campus
Dr. Peter A. Hoeflich (CoI)	Florida State University
Mike Engesser (CoI)	Space Telescope Science Institute
Dr. Suvi Gezari (CoI)	University of Maryland
Prof. Alex V. Filippenko (CoI)	University of California - Berkeley
Prof. Ryan Foley (CoI)	University of California - Santa Cruz
Dr. Tea Temim (CoI)	Princeton University
Dr. Dan Milisavljevic (CoI)	Purdue University
Dr. Schuyler D. Van Dyk (CoI)	California Institute of Technology
Dr. Adam Miller (CoI)	Northwestern University

OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Phase 6				
	13	NIRSPEC	NIRSpec Fixed Slit Spectroscopy	(1) SN2023dbc
	14	MIRI/LRS	MIRI Low Resolution Spectroscopy	(1) SN2023dbc
	15	MIRI/Imaging	MIRI Imaging	(1) SN2023dbc

ABSTRACT

During JWST Cycle 1, a "once-in-a-decade" event transpired -- SN 2023dbc, a Type Ic supernova, exploded in M108 at only ~10 Mpc. The proximity of this SN offers a unique opportunity to study the details of dust formation in the early Universe and to probe its total "dust budget." While asymptotic giant branch (AGB) stars have been considered to be the primary producers of dust in the local Universe, at high redshifts they are not expected to significantly contribute to the dust budget of the Universe. Stripped-envelope supernovae (SESNe) come from the death of the most massive, shorter-lived stars, and are therefore one of the earliest possible sources of cosmic dust in the Universe. No SESN has occurred close enough to monitor dust formation from early to late times, until now. Remarkably, JWST Cycle 1 observations of SN 2023dbc have revealed both the fundamental and first vibrational bands of CO and SiO (dust precursors), and scheduled Cycle 2 observations will trace their early evolution. Yet, to fully understand how dust is formed in SESNe, a longer time series of data is required. By analyzing the evolution of molecular bands at later epochs, as well as capturing the early formation of dust features, the exact conditions in the ejecta during the dust formation can be determined. Here we request 23.9 hr of JWST time to follow SN 2023dbc at three epochs from 600-1200 d past maximum. With these data, the molecular emissions will

be used to measure the exact conditions for dust formation in the ejecta. The observations will also create a legacy data set that can be used to model dust formation and investigate the poorly-constrained ejecta composition of SESNe.

OBSERVING DESCRIPTION

We request 23.9 hr of JWST time to to obtain a NIRSpec+MIRI time-series of the nearby SN Ic 2023dbc at three epochs from 600-1200 d past maximum. With these data, the molecular emissions will be used to measure the exact conditions for dust formation in the ejecta. The observations will also provide a legacy data set from which to model dust formation and uniquely probe the poorly constrained ejecta composition of SESNe.

Proposal 9264 - Targets - Unraveling cosmic dust origins: JWST revelations from legacy observations of SN 2023dbc

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	SN2023dbc	RA: 11 11 39.2110 (167.9133792d) Dec: +55 40 29.23 (55.67479d) Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=Star* *Description=[Supernovae]* *Extended=NO*				
(2)	2MASS	RA: 11 11 42.8438 (167.9285158d) Dec: +55 40 17.96 (55.67166d) Equinox: J2000	Proper Motion RA: -13.469 mas/yr Proper Motion Dec: -4.410 mas/yr Parallax: 0.0012646" Epoch of Position: 2024.28	
Comments: *Category=Star* *Description=[A stars]* *Extended=NO*				

Observation

Proposal 9264, Observation 13: NIRSPEC

Wed Mar 18 21:01:18 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 13:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	SN2023dbc	RA: 11 11 39.2110 (167.9133792d) Dec: +55 40 29.23 (55.67479d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Supernovae]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 2MASS	WATA	SUB32	F140X	NRSRAPID	3	1	1	0.08	177345.2

Template

HFF Readout Mode	Slit	Subarray
false	S400A1	SUBS400A1

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	G235M/F170LP	S400A1	NRSRAPID	100	1	1	NONE	3	3	472.135	177345.6
2	G395M/F290LP	S400A1	NRSRAPID	100	1	2	NONE	3	3	472.135	177345.4
3	PRISM/CLEAR	S400A1	NRS	100	1	3	NONE	3	3	1874.335	

Special Requirements	
	Between Dates 01-APR-2026:00:00:00 and 18-MAY-2026:00:00:00 Group Observations 13, 14, 15 within 1 Days

Observation

Proposal 9264, Observation 14: MIRI/LRS

Wed Mar 18 21:01:18 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 14:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	SN2023dbc	RA: 11 11 39.2110 (167.9133792d) Dec: +55 40 29.23 (55.67479d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Supernovae]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 2MASS	F1000W	FAST	10	1	1	27.75	177345.1

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

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

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	Optional ETC ID	Filter
1	FASTR1	8	1	1	1	1	22.2		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	Optional ETC ID
1	FASTR1	100	12	24	1	2	6721.147	177345.3

Special Requirements

Between Dates 01-APR-2026:00:00:00 and 18-MAY-2026:00:00:00

Group Observations 13, 14, 15 within 1 Days

Observation

Proposal 9264, Observation 15: MIRI/Imaging

Wed Mar 18 21:01:18 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 15:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	SN2023dbc	RA: 11 11 39.2110 (167.9133792d) Dec: +55 40 29.23 (55.67479d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Supernovae]
Extended=NO

Template

Subarray
BRIGHTSKY

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	Optional ETC ID
1	F1500W	FASTR1	80	3	1	Dither 1	4	12	837.591	177345.11
2	F1800W	FASTR1	80	3	1	Dither 1	4	12	837.591	177345.8
3	F2100W	FASTR1	80	6	1	Dither 1	4	24	1678.643	177345.12
4	F2550W	FASTR1	50	45	1	Dither 1	4	180	7939.809	177345.13

Special Requirements

Between Dates 01-APR-2026:00:00:00 and 18-MAY-2026:00:00:00

Group Observations 13, 14, 15 within 1 Days