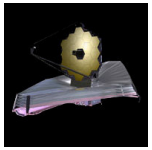

6213 - Unraveling cosmic dust origins: JWST revelations from legacy observations of SN 2023dbc

Cycle: 3, Proposal Category: GO

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Phase 4				
	7	NIRSPEC	NIRSpec Fixed Slit Spectroscopy	(1) SN2023dbc
	8	MIRI/LRS	MIRI Low Resolution Spectroscopy	(1) SN2023dbc
	9	MIRI/Imaging	MIRI Imaging	(1) SN2023dbc
Phase 5				
	10	NIRSPEC	NIRSpec Fixed Slit Spectroscopy	(1) SN2023dbc
	11	MIRI/LRS	MIRI Low Resolution Spectroscopy	(1) SN2023dbc
	12	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.

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 6213, Observation 7: NIRSPEC

Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit 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
(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	ETC Wkbk.Calc ID
1	2 2MASS	WATA	SUB32	F140X	NRSRAPID	3	1	1	0.08	151982.2

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	ETC Wkbk.Calc ID
1	G235M/F170LP	S400A1	NRSRAPID	75	3	1	NONE	3	9	1065.856	177287.6
2	G395M/F290LP	S400A1	NRSRAPID	75	3	2	NONE	3	9	1065.856	177287.4

Special Requirements	Group Observations 7, 8, 9 within 1 Days

Observation

Proposal 6213, Observation 8: MIRI/LRS

Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 8:1) 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	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	10	1	1	27.75	177287.1

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	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	5	1	1	1	1	13.875		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	100	10	20	1	2	5600.031	177287.3

Special Requirements

Group Observations 7, 8, 9 within 1 Days

Observation

Proposal 6213, Observation 9: MIRI/Imaging

Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 9:1) 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	CYCLING	5	4		1	1			LARGE

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	20	1	1	Dither 1	4	4	69.222	177287.11
2	F1800W	FASTR1	60	1	1	Dither 1	4	4	207.667	177287.8
3	F2100W	FASTR1	100	3	1	Dither 1	4	12	1045.258	177287.12
4	F2550W	FASTR1	40	20	1	Dither 1	4	80	2834.657	177287.13

Special Requirements

Group Observations 7, 8, 9 within 1 Days

Observation

Proposal 6213, Observation 10: NIRSPEC

Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 10:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

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	ETC Wkbk.Calc 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	ETC Wkbk.Calc ID
1	G235M/F170LP	S400A1	NRSRAPID	75	3	1	NONE	3	9	1065.856	177345.6
2	G395M/F290LP	S400A1	NRSRAPID	75	3	2	NONE	3	9	1065.856	177345.4

Special Requirements	
	Between Dates 06-NOV-2025:00:00:00 and 05-FEB-2026:00:00:00 Group Observations 10, 11, 12 within 1 Days

Observation

Proposal 6213, Observation 11: MIRI/LRS

Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 11:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

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	ETC Wkbk.Calc ID
1	SAME	F560W	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	PV ETC Wkbk.Calc 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	ETC Wkbk.Calc ID
1	FASTR1	100	16	32	1	2	8963.379	177345.3

Special Requirements

Between Dates 06-NOV-2025:00:00:00 and 05-FEB-2026:00:00:00

Group Observations 10, 11, 12 within 1 Days

Observation

Proposal 6213, Observation 12: MIRI/Imaging Fri Mar 28 15:00:14 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 12:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

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	CYCLING	5	4		1	1			LARGE

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F1500W	FASTR1	70	1	1	Dither 1	4	4	242.278	177345.11
2	F1800W	FASTR1	70	1	1	Dither 1	4	4	242.278	177345.8
3	F2100W	FASTR1	100	3	1	Dither 1	4	12	1045.258	177345.12
4	F2550W	FASTR1	60	45	1	Dither 1	4	180	9497.313	177345.13

Special Requirements

Between Dates 06-NOV-2025:00:00:00 and 05-FEB-2026:00:00:00

Group Observations 10, 11, 12 within 1 Days