



6582 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Cycle: 3, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. James M DerKacy (PI)	Space Telescope Science Institute
Dr. Peter A. Hoeflich (CoI) (CoPI)	Florida State University
Dr. Eddie Baron (CoI) (CoPI)	Planetary Science Institute
Dr. Melissa Shahbandeh (CoI) (CoPI)	Space Telescope Science Institute
Prof. Chris Ashall (CoI)	Virginia Polytechnic Institute and State University
Dr. Dietrich Baade (CoI) (ESA Member)	European Southern Observatory - Germany
Dr. Peter J. Brown (CoI)	Texas A & M University
Christopher Burns (CoI)	Carnegie Institution of Washington
Anthony Burrow (CoI)	University of Oklahoma Norman Campus
Dr. Aleksandar Cikota (CoI)	NOIRLab - Gemini South (Chile)
Dr. Thomas de Jaeger (CoI) (ESA Member)	Laboratoire de Physique Nucleaire des Hautes Energies
Aaron Joshua Matsuo Do (CoI)	University of Hawaii
Mr. Tyco Brahe Mera Evans (CoI)	Florida State University
Dr. Lluís Galbany (CoI) (ESA Member)	Institute of Space Sciences (CSIC-IEEC)
Prof. Eric Hsiao (CoI)	Florida State University
Sahana Kumar (CoI)	Florida State University
Dr. Kevin Krisciunas (CoI)	Texas A & M University
Jing Lu (CoI)	Florida State University
Dr. Nidia Morrell (CoI)	Carnegie Institution of Washington
Dr. Ferdinando Patat (CoI) (ESA Member)	European Southern Observatory - Germany
Dr. Mark M. Phillips (CoI)	Carnegie Institution of Washington

JWST Proposal 6582 (Created: Tuesday, September 3, 2024, 8:00:14PM Eastern Standard Time) - Overview

<i>Name</i>	<i>Institution</i>
Prof. Benjamin John Shappee (CoI)	University of Hawaii
Dr. Maximillian Stritzinger (CoI) (ESA Member)	Aarhus University
Prof. Charles Telesco (CoI)	University of Florida
Michael Tucker (CoI)	The Ohio State University
Dr. Lifan Wang (CoI)	Texas A & M University
Dr. Yi Yang (CoI)	Tsinghua University
Catherine Paige Stevens (CoI)	Virginia Polytechnic Institute and State University
Dr. Nicholas B. Suntzeff (CoI)	Texas A & M University
Inmaculada Dominguez (CoI) (ESA Member)	Universidad de Granada
Prof. Paolo A. Mazzali (CoI) (ESA Member)	Liverpool John Moores University
Dr. Kyle Medler (CoI)	Virginia Polytechnic Institute and State University

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
MIRI				
	2	Day 1000 MIR	MIRI Low Resolution Spectroscopy	(1) SN2021AEFX
	3	Day 1150 MIR	MIRI Low Resolution Spectroscopy	(1) SN2021AEFX
NIRSPEC				
	5	Day 1000 NIR	NIRSpec Fixed Slit Spectroscopy	(1) SN2021AEFX
	6	Day 1150 NIR	NIRSpec Fixed Slit Spectroscopy	(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 still unknown. 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 elements formed in nuclear statistical equilibrium. NIR and MIR ultra-late time spectra with NIRSpec and MIRI are a new probe, enabled by the sensitivity of JWST to address these longstanding questions. We request 19.8 hrs of JWST time to obtain 3 NIR+MIR spectra of SN 2021aefx between 750-1150 days after B-band max light. These observations will be the first ever ultra-late time SNe Ia spectra in the NIR and MIR. These data will: (1) reveal the ions responsible for flux redistribution to the IR in late-time SNe Ia, enabling full use of accurate bolometric light curves; (2) measure the location, composition, and mass of radioactive electron capture elements like ^{57}Co and ^{55}Fe ; (3) determine the origin, strength, and evolution of the magnetic field in the SN; (4) probe macroscopic mixing between the electron capture and nuclear

statistical equilibrium regions; and (5) and monitor for potential late-onset H/He interaction signatures. This data will be truly groundbreaking and push SN physics and observations into previously unexplored areas. Significant progress will be made in our understanding of the heavy elements in the Universe and SNe Ia as distance indicators.

OBSERVING DESCRIPTION

We propose obtaining three ultra-late time NIR+MIR spectra of SN 2021aefx with NIRSpec and MIRI/LRS near +750, +1000, and +1150 days after B-band maximum light, totaling 19.76 hours of charged time spread over Cycles 2 and 3. NIRSpec observations will be obtained in fixed-slit configuration with the PRISM/CLEAR filter, with target acquisition images taken in the F140X filter. MIRI observations with the Low Resolution Spectrograph will use P750L grating, and use the F1000W filter for target acquisition. 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.

Proposal 6582 - Targets - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

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: SN 2021aefx is a Type Ia supernova in NGC 1566</i> Category=Star Description=[Supernovae] Extended=NO		

Proposal 6582 - Observation 2 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Wed Sep 04 01:00:14 GMT 2024

Observation	<p>Proposal 6582, Observation 2: Day 1000 MIR</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: MIRI Low Resolution Spectroscopy</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)	SN2021AEFX	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000						
	<p><i>Comments: SN 2021aefx is a Type Ia supernova in NGC 1566</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Supernovae]</i></p> <p><i>Extended=NO</i></p>								
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	F1000W	FASTGRPAVG32	6	1	1	532.808	141791.8
Template	Subarray				Obtain Verification Image?				
	FULL				false				
Dithers	#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset			
	1	ALONG SLIT NOD							
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	FASTR1	134	16	32	1	2	11982.623	141791.7

Proposal 6582 - Observation 2 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Special Requirements

Before Date 30-SEP-2024:00:00:00

Group Observations 2, 5, Non-interruptible

Proposal 6582 - Observation 3 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Wed Sep 04 01:00:14 GMT 2024

Observation	Proposal 6582, Observation 3: Day 1150 MIR Diagnostic Status: Warning Observing Template: MIRI Low 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)	SN2021AEFX	RA: 04 19 53.4000 (64.9725000d) Dec: -54 56 53.09 (-54.94808d) Equinox: J2000 <i>Comments: SN 2021aefx is a Type Ia supernova in NGC 1566</i> <i>Category=Star</i> <i>Description=[Supernovae]</i> <i>Extended=NO</i>						
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SAME	F1000W	FASTGRPAVG64	6	1	1	1065.615	141791.12
Template	Subarray				Obtain Verification Image?				
	FULL				false				
Dithers	#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset			
	1	ALONG SLIT NOD							
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	FASTR1	134	26	52	1	2	19475.231	141791.11

Proposal 6582 - Observation 3 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Special Requirements

Between Dates 07-JAN-2025:00:00:00 and 06-FEB-2025:00:00:00

Group Observations 3, 6, Non-interruptible

Proposal 6582 - Observation 5 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Wed Sep 04 01:00:14 GMT 2024

Observation	<p>Proposal 6582, Observation 5: Day 1000 NIR</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>											
Diagnostics	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
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									
	<p><i>Comments: SN 2021aefx is a Type Ia supernova in NGC 1566</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Supernovae]</i></p> <p><i>Extended=NO</i></p>											
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	SAME	WATA	FULL	CLEAR	NRSRAPIDD6	3	1	1	171.788	141791.6	
Template	Slit					Subarray						
	S200A1					FULL						
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern					
	1	3					NONE					
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	28	3	1	NONE	3	9	3807.7	141791.5

Proposal 6582 - Observation 5 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Special Requirements

Before Date 30-SEP-2024:00:00:00

Group Observations 2, 5, Non-interruptible

Proposal 6582 - Observation 6 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Wed Sep 04 01:00:14 GMT 2024

Observation	<p>Proposal 6582, Observation 6: Day 1150 NIR</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p>											
Diagnostics	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
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									
	<p><i>Comments: SN 2021aefx is a Type Ia supernova in NGC 1566</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Supernovae]</i></p> <p><i>Extended=NO</i></p>											
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	SAME	WATA	FULL	CLEAR	NRSRAPIDD6	3	1	1	171.788	141791.10	
Template	Slit				Subarray							
	S200A1				FULL							
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern					
	1	3					NONE					
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	PRISM/CLEAR	S200A1	NRSIRS2	16	3	1	NONE	3	9	10635.301	210266.15

Proposal 6582 - Observation 6 - Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra

Special Requirements

Between Dates 07-JAN-2025:00:00:00 and 06-FEB-2025:00:00:00

Group Observations 3, 6, Non-interruptible