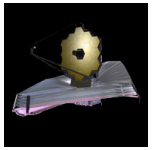

9964 - The Electron-Capture Supernova Candidate SN 2018zd and the Tip of the Red Giant Branch Distance to Its Host Galaxy NGC 2146

Cycle: 5, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRCam Imaging	(1) NGC2146-TRGB

ABSTRACT

Supernova (SN) 2018zd shows the unprecedented features that resemble theoretical predictions of the electron-capture SN (ECSN) explosion of a super-asymptotic giant branch (SAGB) star. SAGB stars represent the lowest mass end of the core-collapse SN progenitors (below the typical red supergiants), providing the unique opportunity to test massive star evolution and their end products: a white dwarf or SN+neutron star. Unlike an iron core-collapse SN explosion, an ECSN explosion is initiated by electron capture reaction in the degenerate O+Ne+Mg core, resulting in a lower explosion energy and distinctive nucleosynthesis. SAGB stars are expected to be surrounded by chemically-enriched dense circumstellar material due to their efficient dredge-up and high mass loss. These make testable predictions for ECSNe, most of which have been observed in SN 2018zd, making it the best-yet candidate since the first theoretical formulation in 1980. However, the main remaining uncertainty arises from the large uncertainty in the luminosity distance to its host galaxy NGC 2146, preventing the absolute calibrations of the radioactive nickel mass, explosion energy, and progenitor luminosity in the pre-explosion HST image. Therefore, an accurate distance estimate is required to further test this claim. Here we propose to obtain the necessary JWST/NIRCam observations of the galaxy halo in order to precisely locate the optical Tip of the Red Giant Branch and establish this distance to NGC 2146. This measurement will either rule in or out the ECSN origin of SN 2018zd, providing insights into the complex stellar evolution and supernova physics in the transitional progenitor mass range.

OBSERVING DESCRIPTION

We have a single visit setup with NIRCam using both modules. One module will be on the main body of the galaxy, with SN 2018zd plus an offset on A3 (using the “A3 corner” target placement). A modest range of roll angles will allow us ensure the B module of NIRCam falls on the halo of the galaxy, providing us an optimal field for measurement of the Tip of the Red Giant Branch (TRGB). Observations are taken with four subpixel dithers in each of F090W and F150W, with depths allowing us to reach at least 1.5 mag below the F090W TRGB at a distance of 18 Mpc. Simultaneous observations in F277W will also allow us to measure a distance from the J-region Asymptotic Giant Branch, providing an additional check of the TRGB measurement.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC2146-TRGB	RA: 06 18 3.0234 (94.5125975d) Dec: +78 22 1.18 (78.36699d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Galaxy
Description=[Spiral galaxies, Starburst galaxies]
Extended=YES

Observation

Proposal 9964, Observation 1

Tue May 12 18:00:42 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC2146-TRGB	RA: 06 18 3.0234 (94.5125975d) Dec: +78 22 1.18 (78.36699d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Galaxy
Description=[Spiral galaxies, Starburst galaxies]
Extended=YES

Template

Module	Subarray	Target Placement
ALL	FULL	Module A center (small extended source)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		SMALL-GRID-DITHER		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
1	F090W	F277W	MEDIUM8	6	1	4	4	2490.931	
2	F150W	F277W	SHALLOW4	7	1	4	4	1460.201	

Special Requirements

Aperture PA Range 146.86565232 to 174.86565232 Degrees (V3 147.0 to 175.0)
Offset 15.0 arcsec, -15.0 arcsec
Fiducial Point Override NRCAS_FULL