



# 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

## INVESTIGATORS

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## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
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.

Proposal 9964 - Targets - The Electron-Capture Supernova Candidate SN 2018zd and the Tip of the Red Giant Branch Distance to Its...

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	NGC2146-TRGB	RA: 06 18 3.0234 (94.5125975d)	Epoch of Position: 2000	
			Dec: +78 22 1.18 (78.36699d)		
			Equinox: J2000		
	<i>Comments:</i> Category=Galaxy Description=[Spiral galaxies, Starburst galaxies] Extended=YES				

Proposal 9964 - Observation 1 - The Electron-Capture Supernova Candidate SN 2018zd and the Tip of the Red Giant Branch Distanc...

Fri Mar 13 18:02:26 GMT 2026

<b>Observation</b>	<p><b>Proposal 9964, Observation 1</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCcam 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)	NGC2146-TRGB	RA: 06 18 3.0234 (94.5125975d) Dec: +78 22 1.18 (78.36699d) Equinox: J2000		Epoch of Position: 2000					
	<p><i>Comments:</i>  <i>Category=Galaxy</i>  <i>Description=[Spiral galaxies, Starburst galaxies]</i>  <i>Extended=YES</i></p>									
<b>Template</b>	<b>Module</b>		<b>Subarray</b>			<b>Target Placement</b>				
	ALL		FULL			Module A center (small extended source)				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>		<b>Subpixel Dither Type</b>		<b>Dither Size</b>		<b>Subpixel Positions</b>
	1	NONE				SMALL-GRID-DITHER				4
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>Optional ETC ID</b>
	1	F090W	F277W	MEDIUM8	6	1	4	4	2490.931	
	2	F150W	F277W	SHALLOW4	7	1	4	4	1460.201	
<b>Special Requirements</b>	<p>Aperture PA Range 139.86565232 to 174.86565232 Degrees (V3 140.0 to 175.0)                  Offset 15.0 arcsec, -15.0 arcsec                  Fiducial Point Override NRCAS_FULL</p>									