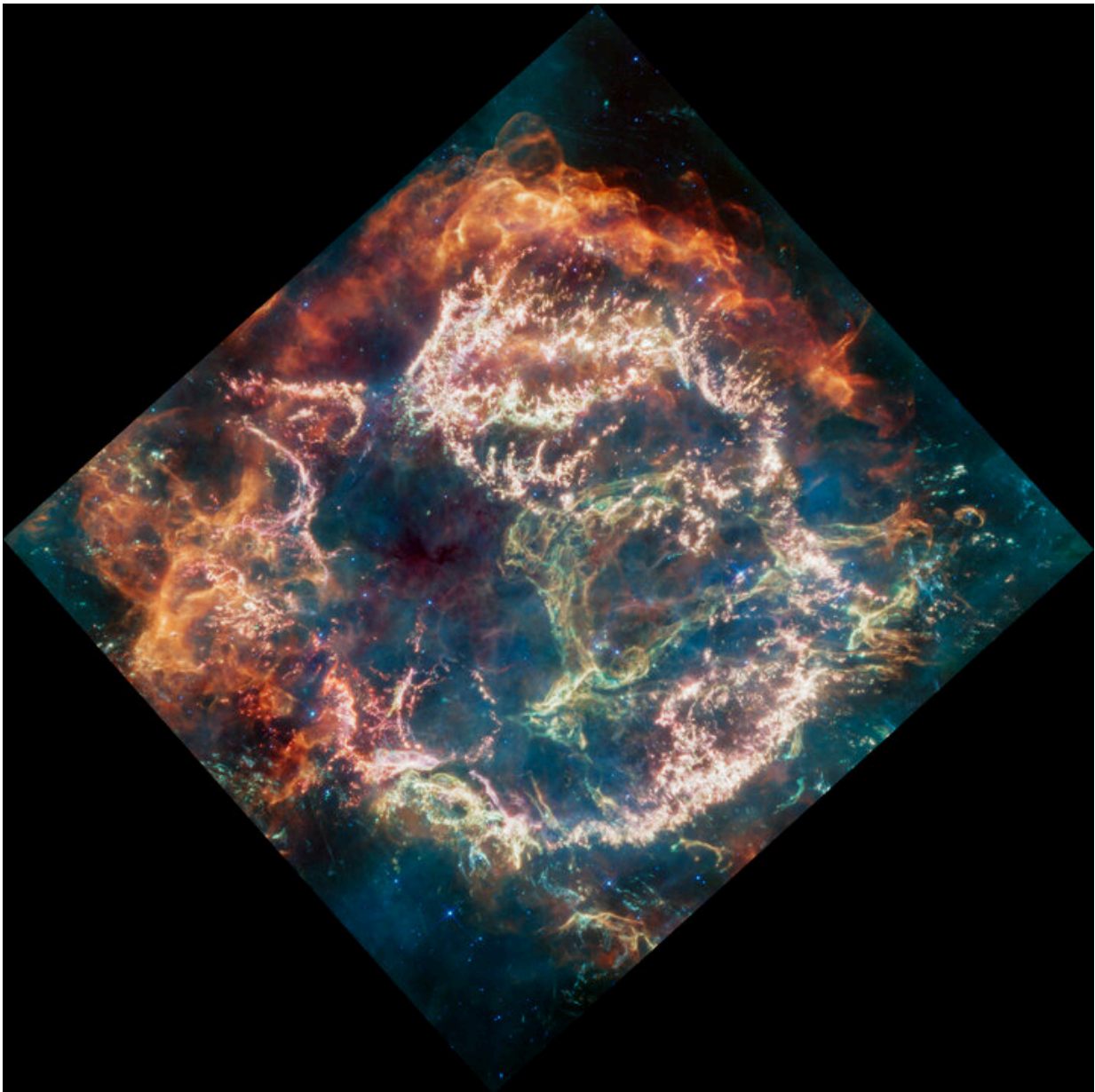


New Webb telescope image reveals secrets of star structure and building blocks of life

April 7 2023, by Brittany Steff



Danny Milisavljevic's research on the James Webb Space Telescope led to his new detailed image of stellar remnant Cassiopeia A in which infrared light is translated into visible-light wavelengths. Credit: NASA image

To gaze at the stars is human. To be able to see them in three-dimensional detail is very nearly divine.

Divine vision is what the James Webb Space Telescope has granted Earthbound scientists in a new near-infrared, detailed image of Cassiopeia A (Cas A), a [stellar remnant](#)—the clouds of gas, dust and other material left behind when a star dies. Danny Milisavljevic, assistant professor of physics and astronomy in Purdue University's College of Science, studies [supernova remnants](#) and leads a year one research team on the JWST examining Cas A.

"I have spent 17 years studying stars and their titanic explosions. I've used dozens of telescopes—both ground- and space-based—covering the electromagnetic spectrum from gamma rays to radio wavelengths," Milisavljevic said. "And yet, I was still unprepared for the data that Webb has provided. I am awestruck by their quality and beauty."

Cassiopeia A is the youngest known remnant from an exploding, massive star in our galaxy, which makes it a unique opportunity to learn more about how such supernovae occur. The light from its explosion first arrived at Earth 340 years ago.

"Cas A represents our best opportunity to look at the debris field of an exploded star and run a kind of stellar autopsy to understand what type of star was there beforehand and how that star exploded," Milisavljevic said.

Supernovae like the one that formed Cas A are crucial for life. Stars create a variety of elements, and subsequent supernovae create additional elements—everything from the calcium in our bones to the iron in our blood—and spread them across interstellar space, seeding new generations of stars and planets.

"By understanding the process of exploding stars, we are reading our own origin story," Milisavljevic said.

Looking with new eyes

Located about 11,000 light-years away, the remnant is in the section of the sky considered to be of the constellation Cassiopeia. An arrangement of five [bright stars](#) in a "W," Cas A is invisible to [human eyes](#) from Earth but occupies the space that appears to be off to the right of the last stroke of the W.

For decades, scientists have studied Cas A. Examining the structure using different wavelengths gives astronomers new insights into star anatomy, the same way infrared cameras give humans different information than cameras that see only in the visible light spectrum.

The new image collected by JWST's golden honeycomb of 18 mirrors shows incredible detail. In it, mid-infrared light has been translated into visible light, allowing scientists to analyze details and structures. Great curtains of material, shaded red and orange, represent where the star's material is crashing into circumstellar gas and dust. Among those rosy swaths, bursts of pink show where the star's composite elements, including oxygen, argon and neon, are shining.

For the researchers, one of the most puzzling elements of the image is the large green loop on the image's right side.

"We've nicknamed it the Green Monster, in honor of Fenway Park in Boston," Milisavljevic said. "If you look closely, you'll notice that it's pockmarked with what look like little bubbles. The shape and complexity are unexpected and challenging to understand."

Higher resolution images, in more wavelengths especially the infrared, give astronomers a clearer look at the intricacies of the structure. Like picking up binoculars to help resolve the colors and patterns on a bird's wing, the more detail scientists have, the more information they can infer and analyze.

"Compared to previous infrared images, we see incredible detail that we haven't been able to access before," said Tea Temim, a program co-investigator from Princeton University.

Dust to dust

Counterintuitively, some of the most exciting matter in the picture may seem the most prosaic: dust. While the substance is irritating to housekeepers, it is intriguing to astronomers.

Massive quantities of dust suffuse even very young galaxies in the early universe. It's difficult to explain the origins of this dust without crediting supernovae, which spew large quantities of heavy elements—the building blocks of dust—across space.

But supernovae can also destroy dust, and it's unclear how much survives the trip to interstellar space. By studying Cas A with JWST, astronomers hope to gain a better understanding of its dust content, which can help inform our understanding of where the building blocks of planets—and ourselves—are created.

"In Cas A, we can spatially resolve regions that have different gas

compositions and look at what types of dust were formed in those regions," Temim said.

Carl Sagan famously assured humanity that we are made of "star stuff." Milisavljevic's team and JWST's observations are helping scientist understand that process.

"Webb is an incredible achievement," Milisavljevic said. "I feel fortunate to be among the first scientists to test its unrivaled power to explore the universe. I am going to spend the rest of my career trying to understand what's in this data set."

Provided by Purdue University

Citation: New Webb telescope image reveals secrets of star structure and building blocks of life (2023, April 7) retrieved 26 June 2024 from <https://phys.org/news/2023-04-webb-telescope-image-reveals-secrets.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.