A new Hubble image reveals a shredded star in a nearby galaxy

December 7 2022, by Seth Lockman

The latest composite image of supernova remnant DEM L 190, released in November 2022. Credit: ESA/Hubble & NASA, S. Kulkarni, Y. Chu

The Hubble Space Telescope, to which we owe our current estimates for the age of the universe and the first detection of organic matter on an exoplanet, is very much doing science and still alive. It's latest

masterpiece remixes an old hit—apparently a growing trend in science as well as music.

The story of this image begins roughly 165,000 years ago, when an unnamed O-type star in the Large Magellanic Cloud died in a type II supernova. Light from the explosion shot out in all directions, and about 160,000 years later a tiny cross section of that expanding sphere of light reached Earth. If humanity had modern telescopes around 3,000 BC, automated systems might have logged a blip in the southern constellation Dorado, well under the limits of human perception from such a great distance.

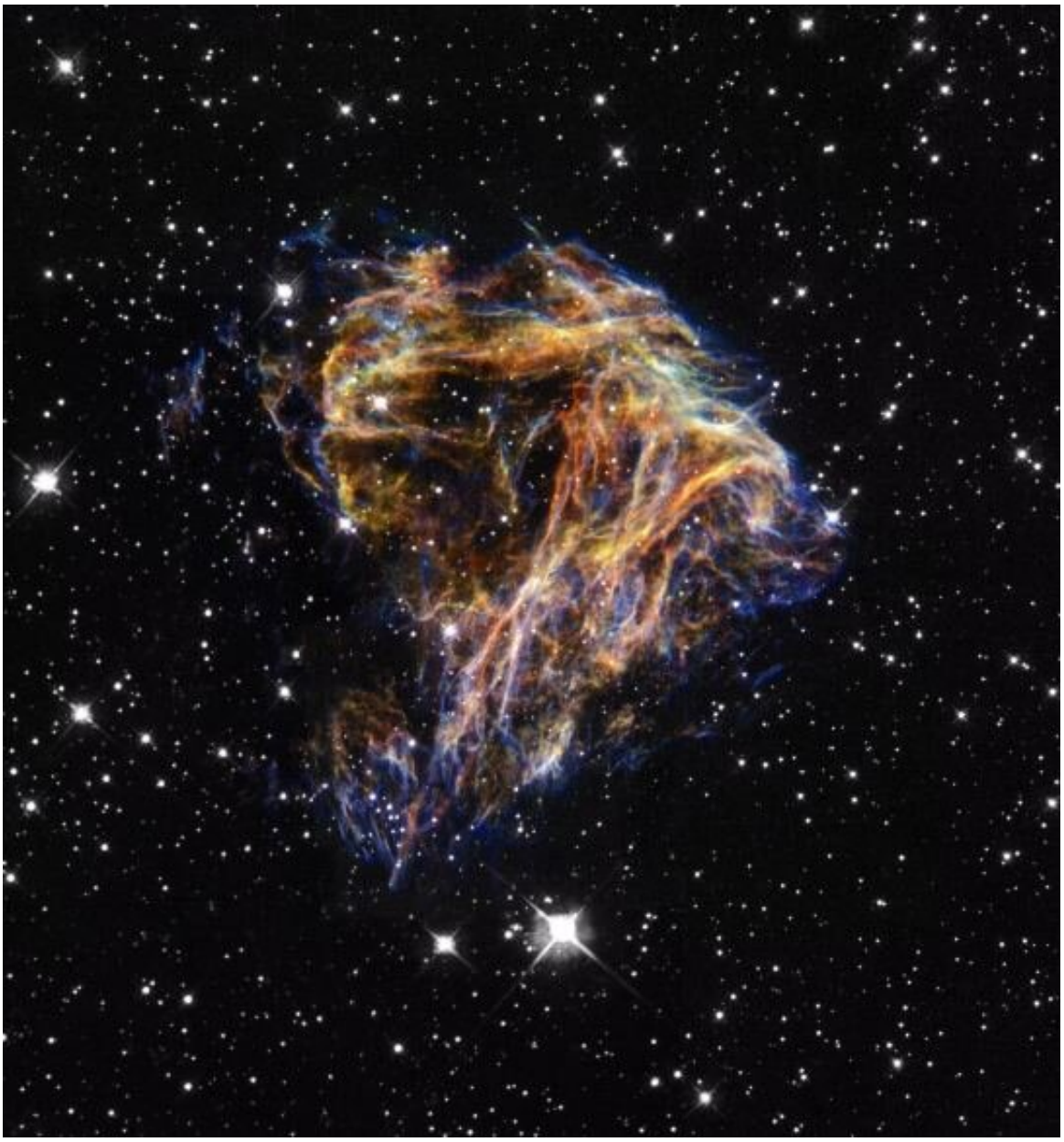
The supernova remnant took on a familiar form: a beautiful glowing cloud of expanding gas surrounding a pulsar—a super-dense and rapidly spinning neutron star with a powerful magnetic field. Shockwaves from the collapsing stellar core interacted with the nebula, coalescing the diffuse gas into filaments. Two especially hot and dense regions of gas shot away from the central pulsar in opposite directions, "bullets" likely fired off by the core's powerful magnetic field. Within 5,000 years the nebula would be 75 light-years across, its heart still glowing at a million degrees.

People are noticing

The remnant was cataloged by Karl Henize in 1956 as part of a survey of emission nebulae in the Magellanic Clouds. Dubbed N49 (sometimes LMC N49) it was immediately recognized as a powerful radio emitter, and to this day it is the brightest supernova remnant in the Large Magellanic Cloud. On March 5, 1979 a historically powerful gamma ray burst was detected by all nine spacecraft of the interplanetary gamma-ray burst network. The source was quickly pinpointed as N49, which at this point was a usual suspect for this sort of mischief.

But The March 5 transient was so insanely powerful that a second otherwise-invisible neutron star in that region was hypothesized. The term "pulsar" wasn't going to cut it for N49. This and other similar events spurred on the study of "soft gamma ray repeaters," and eventually the creation of the "magnetar" classification in 1992.

The Hubble Space Telescoped first imaged N49 over 3 hours between November of 1998 and July of 2000. Three false-color images in the classic "Hubble Palette"—red for sulfur, blue for oxygen, and green for hydrogen—were captured using its Wide Field Planetary Camera 2 and superimposed on a black-and-white base image, also captured by Hubble. The composited image was used in studies mainly focused on better understanding the nebula's structure and environment.



Hubble image of supernova remnant DEM L 190, released in July of 2003. Credit: NASA/ESA and The Hubble Heritage Team (STScI/AURA)Acknowledgment: Y.-H. Chu (UIUC), S. Kulkarni (Caltech), and R. Rothschild (UCSD)

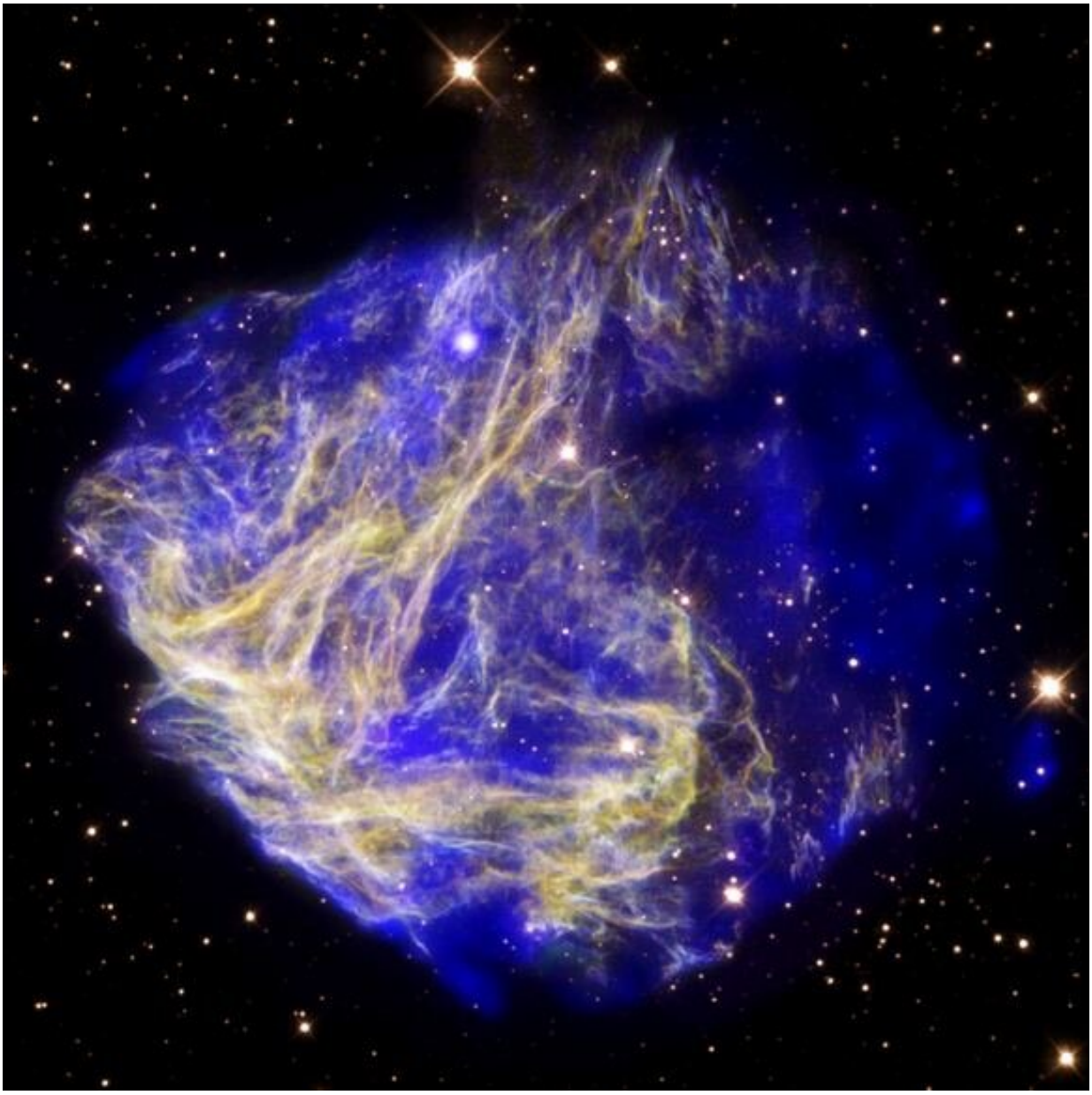
N49 has at least 26 other identifiers across different catalogs. The most common byname in the press is DEM L 190. The remnant has been

imaged by notables like ROSAT, Chandra, and Spitzer, and was even mentioned in Chapter 9 of the companion book to Carl Sagan's Cosmos.

The remnant's intrigue comes not just from its brightness and powerful EM bursts, but also its asymmetry. Think of the stunning Ring Nebula, the Cat's Eye, or the Lion Nebula. Each of these monuments to the awesome beauty of the cosmos was created by the same basic process as N49. An observer of most planetary nebulae could be forgiven for entertaining the thought of a cosmic watchmaker.

By comparison N49 looks like that watchmaker tried to flip an omelet and really messed up. Pinning down why and how the occasional stellar remnant gets so messy will help us understand stellar life cycles more completely.

Composite image of DEM L 190, released in November of 2006. Optical data from Hubble was overlaid with X-ray data from the Chandra Observatory in blue and infrared data from the Spitzer Space Telescope in red. The result suggests a dense region in the Interstellar Medium around N49 may have contributed to the uneven expansion of the planetary nebula. Credit: X-ray: NASA/CXC/Caltech/S.Kulkarni et al., Optical: NASA/STScI/UIUC/Y.H.Chu & R.Williams et al., IR: NASA/JPL-Caltech/R.Gehrz et al.



Composite image of DEM L 190, released in May of 2010. Optical data from Hubble was overlaid with X-ray data from the Chandra Observatory in blue. The magnetar can be seen as a blue-white light source in the upper-middle of the image. The result shows a “bullet” in the lower-right corned and a “bullet candidate” opposite, suggesting that the supernova itself may have been asymmetrical. Credit: X-ray: NASA/CXC/Penn State/S.Park et al. Optical: NASA/STScI/UIUC/Y.H.Chu & R.Williams et al.

Synthesis

As imaging technology improves, from time to time the ESA/Hubble team revisits targets. For example, back in 2003 a dataset was captured at the same time as the others but was not included in the original composite. That data was added to this newest image, and improved image processing techniques have now revealed an unprecedented level of detail, including new structures within the nebula. What will this new photo reveal to discerning eyes? That's the fun part. In a few years this photo may help answer questions we don't even have yet.

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