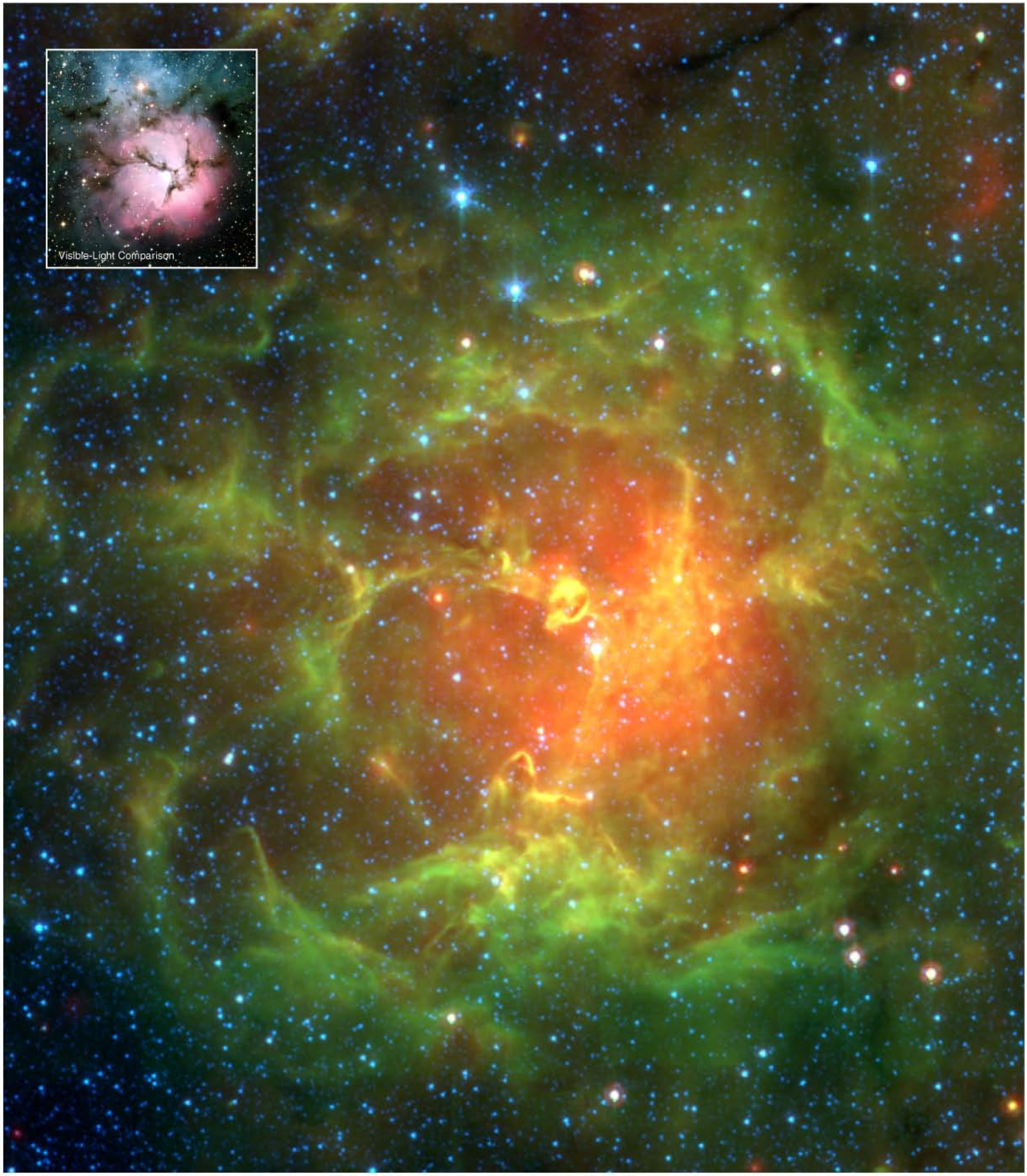
Spitzer Space Telescope

Trifid Nebula



National Aeronautics and Space Administration
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Trifid Nebula (M20)

Stars Born in Clouds of Dust

Rapidly growing embryonic stars are revealed for the first time in this stunning infrared image of the famous Trifid Nebula taken by NASA's Spitzer Space Telescope.

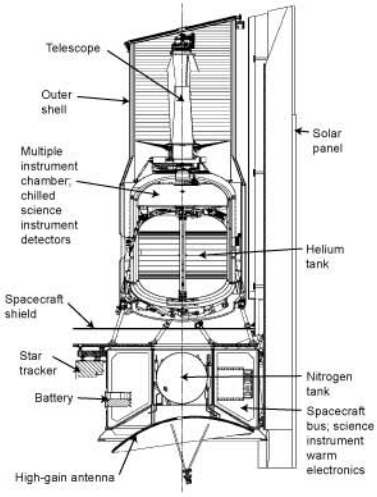
The Trifid Nebula is a giant region of star formation located approximately 5,400 light-years away in the constellation Sagittarius. Star-forming regions are very rich in gas and dust. When a cloud of gas and dust collapses under its own gravity, new stars can form. Since these stars are still embedded in the thick clouds of gas and dust from which they formed, they are very difficult to detect in visible light. Only during the later stages—when a young star is hot enough for its radiation to blow away most of the material surrounding it—can it be seen in visible light. Until then, these forming stars can be detected only in infrared light, which is better able to penetrate the obscuring material surrounding the stars.

Invisible in the Visible

In the visible-light image (inset), several dark lanes of thick dust can easily be seen crossing the Trifid Nebula. This obscuring dust hides places where new stars are being formed. Infrared light, however, can easily penetrate regions of thick dust, revealing what cannot be seen in a visible-light image. In the Spitzer image, the dark lanes seen in the visible-light image appear as bright, infrared clouds with cold, dense knots containing embryonic stars. The Spitzer image reveals many regions of glowing, warm dust that cannot be seen in the visible-light image. Notice in particular the regions near the top of the image and the area surrounding the visible-light portion of the Trifid Nebula. This dust is warmed by radiation from the newly forming stars, causing it to glow in the infrared.

Central Star Carves Nebula Structure

The Trifid Nebula is unique in that it is dominated by one massive central star, which is estimated to be only about 300,000 years old (in comparison, our Sun is a star that is about 5,000,000 years old). The formation of the embryonic stars in the Trifid Nebula is thought to have been triggered by this massive star, which can be seen in both the visible-light and Spitzer images as a white spot at the center of the nebula. The radiant energy and stellar winds emanating from the star have sculpted the Trifid cloud into its current cavernous shape. The winds have also compressed gas and dust into numerous dark cores, whose gravity caused more material to fall inward until embryonic stars were formed. In time, the forming stars will accumulate enough mass to ignite thermonuclear fusion and emerge from their cores.



The Spitzer Telescope spacecraft is about 4 meters tall, with a mass of 865 kg.

Spitzer uncovered 30 developing stars in the Trifid Nebula's four cores and dark clouds. These stars are seen in the Spitzer image as yellow or red spots. Multiple forming stars were found inside two massive cores, while a single forming star was seen in each of the other two cores. This is one of the first times that clusters of forming stars have been observed in individual cores at this early stage of stellar development. Spitzer also revealed about 120 very young, small stars buried inside the outer clouds of the nebula. These newborns were probably formed around the same time as the massive, central star, so they are its smaller siblings.

The Moment Before Birth

This new view of the Trifid Nebula offers a rare glimpse at the earliest stages of massive star formation—a time when developing stars are about to burst into existence. Infrared studies of star-forming regions provide important information about how stars are born, and thus, about how our own Sun and solar system were formed.

The Spitzer image is a three-color composite of infrared light, showing emission from wavelengths of 4.5 microns (blue), 8.0 microns (green), and 24 microns (red). A micron is one millionth of a meter; a human hair is about 100 microns thick.

For more images from the Spitzer Space Telescope, see http://www.spitzer.caltech.edu.

The Jet Propulsion Laboratory, California Institute of Technology, manages the Spitzer Space Telescope for NASA.

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