The Crab Nebula

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In the year 1054 A.D., Chinese astronomers were startled by the appearance of a new star, so bright that it was visible in broad daylight for several weeks. Today, the Crab Nebula is visible at the site of this violent stellar explosion. In this view, NASA's Hubble Space Telescope has zoomed in on a portion of the Crab to reveal its detailed structure.

Located about 2 kpc (6,500 ly) from Earth in the direction of the constellation Taurus, the Crab Nebula is the remnant of a star that began its life with about 8-10 times the mass of our Sun. Such a massive star consumes its nuclear fuel so rapidly that it lives only about 50 million years before exploding as a supernova. For this star, the end came on July 4, 1054. The explosion was witnessed as a naked-eye "Guest Star" by Chinese astronomers, and is also depicted in rock paintings of native Americans in the southwestern United States.

This image was created by he Hubble Heritage Team from data obtained by Hubble's Wide Field and Planetary Camera 2. Images taken with five different color filters, totaling over 10 hours of exposure time, have been combined to construct this false-color picture. Resembling an abstract painting, the image shows ragged gaseous shreds of the original star that are expanding away from the explosion site at over 1,500 km/s (3.4 million mph). The colorful network of filaments is the material from the outer layers of the star that was expelled during the explosion.

The core of the star has survived the explosion as a "pulsar," visible in the Hubble image as the lower right of the two moderately bright stars near the center. The pulsar has about 1.4 times the mass of the Sun, crammed by gravity into an object only about 10 miles in diameter. This incredible object, a "neutron star," is even more remarkable because it spins on its axis 30 thirty times a second. The spinning pulsar heats its surroundings, creating the ghostly diffuse bluish-green synchrotron cloud in its vicinity, including a blue arc toward the upper right of the neutron star.

The picture is somewhat deceptive in that the filaments appear to be close to the pulsar. In reality, the yellowish green filaments toward the right side of the image are closer to us, and approaching at some 350-800 km/s.The orange and pink filaments toward the top of the picture, including the "backwards question mark." is material behind the pulsar, rushing away from us at 200-1000 km/s.

The various colors in the picture arise from different chemical elements in the expanding gas, including hydrogen (orange), nitrogen (red), sulfur (pink), and oxygen (greenish-blue). The shades of color represent variations in the temperature and density of the gas, as well as changes in the elemental composition.

These chemical elements, some of them newly created during the evolution and explosion of the star and now blasted back into space, will eventually be incorporated into new stars and planets. Astronomers believe that the chemical elements in the Earth and even in our own bodies, such as carbon, oxygen, and iron, were made in other exploding stars billions of years ago.

Blair, W. P., Davidson, K., Fesen, R. A., Uomoto, A., MacAlpine, G. M., & Henry, R. B. C., "HST/WFPC2 Imaging of the Crab Nebula. I. Observational Overview," 1997, ApJS, **109**, 473

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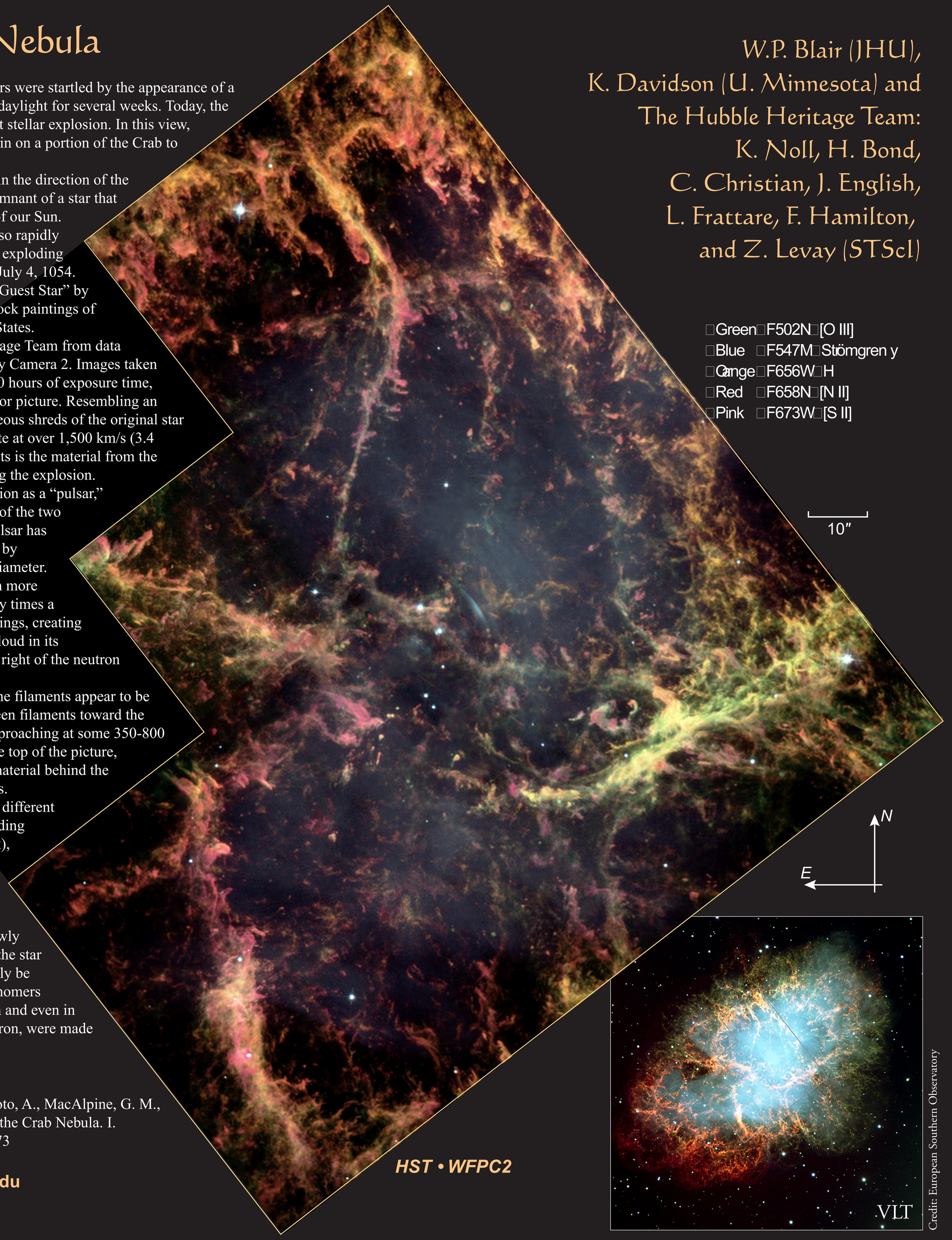

Credit: European Southern Observatory