Brightest supernova in a decade captured by Hubble

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A University of California, Berkeley, astronomer has turned the NASA Hubble Space Telescope on the brightest and nearest supernova of the past decade, capturing a massive stellar explosion blazing with the light of 200 million suns. The supernova, called SN 2004dj, is so bright in the Hubble image that it easily could be mistaken for a foreground star in our Milky Way Galaxy. Yet it lies 11 million light-years from Earth in the outskirts of a galaxy called NGC 2403, nestled in a cluster of mostly massive bright blue stars only 14 million years old.

"This has to be a massive star to explode at such a young age," said Alex Filippenko, professor of astronomy at UC Berkeley, who estimates the star's mass at 15 times that of our sun. Massive stars live much shorter lives than the sun; they have more fuel to burn through nuclear fusion, but they use it up at a disproportionately faster rate. The sun, for example, is only halfway through its expected lifetime of about 10 billion years.

"There are probably hundreds of other stars in the cluster ready to blow up, though not in our lifetime," said Filippenko.

Japanese amateur astronomer Koichi Itagaki discovered the supernova on July 31, 2004, with a small telescope. Additional observations soon showed that it is a "Type II supernova," resulting from the explosion of a massive, hydrogen-rich star at the end of its life. Filippenko then used his time on the telescope to take an image of the supernova on Aug. 17, plus spectra using the Advanced Camera for Surveys. Filippenko is principle investigator for a big program to use the Hubble telescope to study nearby Type Ia supernovas to better understand their properties and thus reduce uncertainty in measurements of the acceleration of the universe.

A team of astronomers led by Jesus Maiz of the Space Telescope Science Institute discovered that the supernova was part of a compact cluster of stars known as Sandage 96, whose total mass is about 24,000 times the mass of the sun. The image shows many such clusters — the blue regions — as well as looser associations of massive stars. The large number of massive stars in NGC 2403 leads to a high supernova rate. Two other supernovae have been seen in this galaxy during the past half-century.

The cataclysm probably occurred when the evolved star's central core, consisting of iron, suddenly collapsed to form an extremely dense object

called a neutron star. The surrounding layers of gas bounced off the neutron star and also gained energy from the flood of ghostly "neutrinos" (tiny, almost non-interacting particles) that may have been released, thereby violently expelling these layers.

This explosion is ejecting heavy chemical elements, generated by nuclear reactions inside the star, into the cosmos. Like other Type II supernovas, this exploding star is providing the raw material for future generations of stars and planets. Elements on Earth such as oxygen, calcium, iron and gold came long ago from exploding stars such as this one.

Astronomers will continue to study SN 2004dj over the next few years, as it slowly fades from view, in order to gain a better understanding of how certain types of stars explode and what kinds of chemical elements they eject into space.

This color-composite photograph was obtained by combining images through several filters taken with the Wide Field Camera of the Advanced Camera for Surveys. The colors in the image highlight important features in the galaxy. Hot, young stars are blue. Older stars and dense dust lanes near the heart of the galaxy are red. The hydrogen-rich, star-forming regions are pink. The dense concentration of older stars in the galaxy's central bulge is yellow.

Source: University of California, Berkeley