Scientists size up the supernova

The explosion of supernova 1987A in the Large Magellanic Cloud (SN: 8/22/87, p.122) has given astronomers a very rare opportunity to watch the development of a supernova from close by. The detailed shape and dynamics of the exploding volume fascinate both those interested in the supernova as an astrophysical event — the last stage in a star's existence — and those whose primary interest is in large explosions for their own sake. The nearness of the Large Magellanic Cloud offers the possibility of obtaining actual images of the explosion at various stages.

A project to do just that was undertaken by four astronomers from the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., Margarita Karovska, Peter Nisenson, Costas Papaliolios and Clive Standley. The group has just calculated diameters for the explosion on two days last spring, April 2 and June 1. This is the first time a direct imaging method has accomplished this for a supernova. As the project continues, Nisenson told SCIENCE NEWS, they hope to get actual images.

Because of the turbulence of the atmosphere, it is impossible to get an image of something as small as SN 1987A by simply taking a photograph through a telescope. What one sees is a point of light that jumps around. But the Harvard-Smithsonian group's method, known as speckle interferometry, takes a lot of images, sometimes through special masks, as the point of light jumps around. A computer program searches the collection of images, called a speckle pattern, for geometric correlations, out of which it can generate either images or dimensions of the object. In this case about 30,000 frames were used.

For the two days they cite, the calculation produced some surprising diameters at various wavelengths. The diameters differ by wavelength and, of course, by day. At 450 nanometers wavelength on April 2, the supernova was 12 milliarcseconds across, which corresponds to 600 astronomical units. (One AU is the mean radius of the earth's orbit, or about 100 million miles.) At 533 nm on the same day, it measured 11 milliarcseconds or 550 AU. On June 1, at 450 nm, it was 23 milliarcseconds or 1,150 AU; at 533 nm, 18 milliarcseconds or 900 AU; at 656 nm, 8 milliarcseconds or 400 AU.

Astrophysicists would expect different diameters at different wavelengths. They believe that at different wavelengths they are seeing to different depths in the photosphere, the glowing mass of the supernova. However, the theoretical expectation is for the reverse of what's here. At lower wavelengths, the available theoretical models would predict smaller diameters than at higher ones.

At the moment there is no good theoretical explanation of the discrepancy, but Nisenson suggests that at the shorter wavelengths the observer may be seeing not the supernova, but material outside it that is illuminated by it. He believes the 656-nm figure, which represents the Lyman alpha radiation of hydrogen, is a good measure of the actual photosphere of the supernova.

On the two days calculated so far, Nisenson says, the supernova's size was just below the telescope's diffraction limit, the point at which the telescope would be optically incapable of resolving detail even if the atmosphere were not present. Later, as the supernova grows, the group hopes to get actual images. Even if they are very coarse images, only one or two pixels, Nisenson says, they ought to show whether or not the supernova's expansion is symmetrical. On the basis of how the light from the supernova is polarized, some astronomers have suggested that the expansion is asymmetric.

— D. E. Thomsen

Cancer gene gap mapped

As chromosome mapping techniques improve, more and more diseases are being linked to specific genetic defects. Last week, small-cell lung cancer — a particularly deadly form of lung cancer — became the latest disease to have its genetic origins identified. And although scientists still don't know what *causes* the genetic defect that leads to the disease, the researchers who discovered the link say cigarette smoking is a candidate.

The research, which points to a missing pair of genes on chromosome 3 as the cause of the cancer, was performed by scientists at the National Cancer Institute and the Uniformed Services University of the Health Sciences in Bethesda, Md., and the University of Texas Health Sciences Center in San Antonio. Their findings are reported in the Oct. 1 NATURE.

As in a handful of other genetically linked cancers, the genes that are missing in small-cell lung cancer appear to be cancer-suppressing "antioncogenes." When present, antioncogenes prevent the rampant replication characteristic of cancer cells (SN: 1/5/85, p.10). The mapping of such genes is the first step toward identifying the biological product for which they code, and may in turn lead to improved diagnosis and treatment of the diseases they normally prevent. Small-cell lung cancer accounts for about 20 percent of the 30,000 to 40,000 new cases of lung cancer that appear in the United States each year. Overall, lung cancer is the country's leading cause of cancer death. □

Sounding out chemical hot spots

Irradiating a liquid hydrocarbon with high-frequency, high-intensity sound waves can produce an effect much like the burning of fuels, say researchers at the University of Illinois at Urbana-Champaign. Their experiments show that ultrasonic irradiation of a cold liquid creates microscopic hot spots that emit light similar to that given off by high-temperature flames.

"Light emission under ultrasonic irradiation of water has been known for 30 or 40 years," says chemist Kenneth S. Suslick. "But to our surprise, no one had examined the nature of the emissions from nonaqueous liquids." Using sound waves inaudible to the human ear but considerably more intense than the sound generated by a jet engine, Suslick and colleague Edward B. Flint looked for evidence of "sonoluminescence" in liquids such as dodecane, tetrachloroethylene and nitroethane.

Ultrasonic irradiation of a liquid creates a swarm of tiny gas bubbles that grow, then suddenly collapse. This effect is known as acoustic cavitation (SN: 12/13/86, p.372). The rapid collapse produces intense local heating. As a result, vapor enclosed within imploding bubbles can reach temperatures as high as 5,000°C. At such temperatures, says Suslick, "we ought to see chemistry similar to flame chemistry."

In fact, hydrocarbon vapor molecules are torn apart into highly reactive, chemically excited molecular fragments, just as they are in a flame. These excited fragments emit light that matches the blue color seen when hydrocarbons burn. If oxygen were present, the final products would be carbon dioxide and water. In the absence of oxygen, the long hydrocarbon chains originally present are cracked to form smaller hydrocarbons.

"This work is just the beginning of our sonoluminescence studies," says Suslick. "We're interested in using sonoluminescence as a spectroscopic probe of what happens inside hot spots." One possibility that the researchers would like to explore is the way emissions change when various substances are dissolved in the liquids.

Suslick's investigation of sonoluminescence complements other research he and his colleagues are doing on the effect of ultrasound on catalysis and the rates of chemical reactions (SN: 6/20/87, p.388). "Sonochemistry is a fundamental and different way of interacting energy with matter," says Suslick. The high peak temperatures over short time periods produced by ultrasound provide reaction conditions and chemical information sometimes not obtainable in other ways.

— I. Peterson