Astronomy

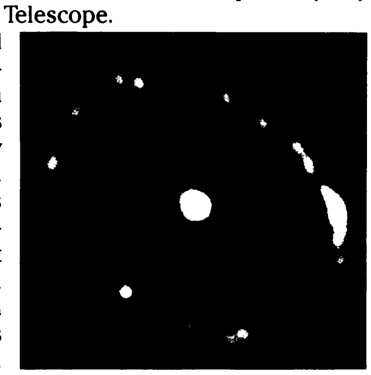
Ron Cowen reports from Philadelphia at a meeting of the American Astronomical Society

Supernova yields cosmic yardstick

Observations of remnants of supernova 1987A by camera and spectrograph have furnished new clues to the life of a star whose catastrophic explosion — as a supernova — astronomers witnessed four years ago. The observations may also lead to an even greater cosmic payoff — a more accurate determination of the distance between Earth and the Large Magellanic Cloud, the galaxy containing the burned-out star.

Astronomers say their new estimate of the distance to that galaxy represents a first step toward developing a better yardstick for the age and size of the universe, says Nino Panagia of the Space Telescope Science Institute in Baltimore. Attaining such a yardstick, he believes, might also lead to an eventual recalibration with unprecedented accuracy of the Hubble constant — the change in the expansion velocity of the universe with distance.

Panagia and his colleagues, including scientists from Harvard University and the Space Telescope European Coordinating Facility in Garching, Germany, based their work on observations by the International Ultraviolet Explorer (IUE) satellite and Hubble Space Telescope.



NASA/European Space Agency

Instruments aboard these craft examined nitrogen-rich gas ejected from 1987A thousands of years before this heavenly body exploded as a supernova. Most of this wispy gas envelope eventually collapsed into a ring. But that ring went undetected until the supernova explosion heated it, causing the gas to radiate ultraviolet light. Finding this ring, Panagia notes, ends a debate about the geometry of the ejected gas.

A Hubble image of 1987A (see photo), taken in August and released last week, shows the supernova core surrounded by a ring of glowing gas tilted 47° from an imaginary plane cutting through the Earth and the stellar core.

Once they glimpsed the ring, Panagia and his co-workers set about precisely calculating its distance from Earth. From Hubble data, they determined that the ring has an angular diameter of 1.66 arcseconds — comparable to the separation of two auto headlights viewed from 100 miles away. The astronomers then measured the diameter of the ring, a second factor needed to calculate its distance from Earth.

In analyzing spectroscopic IUE data, they found that light from the edge of the ring closest to Earth reached the satellite 80 days after the first detection of the supernova explosion. Ultraviolet emissions from the ring's farthest edge did not arrive until 340 days later. This time difference allowed the researchers to calculate the ring's diameter of 1.37 light years. Using straightforward geometry, they then determined that the supernova lies 169,000 light years from Earth. Previous estimates ranged from 143,000 to 179,000 light years.

At the Cerro Tololo Inter-American Observatory in La Serena, Chile, other astronomers used a high-resolution spectrograph to deduce the speed at which 1987A's gas ring is moving out from the supernova's core. Based on this velocity and the location of a still-wispy shell of gas about 12 light years from the ring, Arlin P.S. Crotts of Columbia University in New York City and Stephen B. Heathcote of Cerro Tololo conclude that 1987A began ejecting its gas cloud at least 400,000 years before it went supernova. They also estimate that the star ended the ejection and evolved from a red supergiant to a blue supergiant some 20,000 years before it exploded.

Biomedicine

Kathy A. Fackelmann reports from Savannah, Ga., at the American Heart Association's 18th science writers forum

Proteins guide early heart development

During the first few months of development, a human embryo's single-chambered heart must somehow transform itself into the four-chambered heart that, if all goes well, will serve as a powerful pump throughout life. If embryonic heart development goes awry, a life-threatening defect — such as a hole in the heart — can result.

In a quest that may someday lead to treatments for infants with heart defects, scientists are homing in on a set of proteins that may guide this *in utero* development.

The embryo's single-cavity heart contains a layer of jelly-like material sandwiched between an outer layer of muscle tissue and an inner tissue layer known as the endocardium. Between the fourth and eighth weeks of gestation, certain cells lining the endocardium, called endothelial cells, break away and migrate through the cardiac jelly, eventually forming tissue pads that divide the heart into four chambers.

But what triggers the cellular journey? Roger R. Markwald, a biologist at the Medical College of Wisconsin in Milwaukee, and his colleagues suggested in 1989 that so-called adherons — packets of proteins carrying a glue-like substance — adhere to embryonic endothelial cells and somehow cause them to begin their migration. The team reported experiments demonstrating that chick-embryo endothelial cells placed atop a gel layer in a petri dish broke away from their neighbors and started to travel into the gel when exposed to adherons isolated from the cardiac jelly of embryonic chick hearts.

The researchers have now begun to characterize the mysterious adherons. Their unpublished results suggest that cardiac adherons contain at least five key proteins, Markwald told SCIENCE NEWS. The team now hopes to identify each of these proteins and find out how they guide the crucial transformation to a four-chamber heart. Ultimately, says Markwald, such knowledge might enable researchers to develop drugs that spur self-repair in a newborn's defective heart.

Brain neurons blamed for dizzy spells

In a bygone era, fainting or dizzy spells signified a response to great passion or trauma. Modern science has since taken the romance out of these episodes, ascribing many of them to the mundane activity of standing up too quickly.

When a person stands up, a complex system called the baroreflex kicks into action: Nerve endings in key blood vessels detect the resulting drop in pressure and send a message to brain neurons, which respond by boosting blood pressure. Scientists know that the baroreflex often begins to fail with age, leading to dizziness, fainting spells and even stroke. But the exact nature of this failure has remained elusive.

George Hajduczok, a physiologist at the University of Iowa in Iowa City, now reports evidence suggesting that the blame lies with malfunctioning neurons. He and his colleagues studied 11 elderly purebred beagles and five young beagles. They increased blood pressure within the dogs' carotid arteries, which contain pressure-sensing nerve endings. Young dogs quickly sensed that change and lowered the activity of the sympathetic nervous system — which boosts blood pressure — by 70 percent, whereas elderly beagles damped such activity by only 20 percent, the researchers found.

A separate experiment showed that elderly dogs can lower sympathetic nervous system activity as much as young dogs, but only for a few seconds — a finding that suggests the problem lies with the brain neurons rather than the nerve endings.

Such studies may help explain why some elderly people experience dangerous swings in blood pressure. A faulty baroreflex, says Hajduczok, can cause fainting when pressure dips too low, or a stroke when pressure soars too high.