Astronomy

Ron Cowen reports from Berkeley, Calif., at a meeting of the American Astronomical Society

Supernova with a split personality

When it was discovered by amateur astronomers on March 28, the supernova known as SN 1993J ranked as the brightest seen in the northern sky in 56 years (SN: 4/17/93, p.246). But the luminosity of this exploded star isn't the only reason it has captured the attention of researchers. It may represent the suspected link between two kinds of supernovas.

Supernovas are thought to come in two varieties. Type I supernovas lack hydrogen and are believed to arise when a small, compact star, called a white dwarf, steals so much matter from a companion that it explodes. Type II supernovas emit lots of hydrogen and are thought to form when the core of a supermassive star collapses, generating a shock wave that triggers an explosion.

Researchers at first found that the bulk of emission from SN 1993J came from the glow of hydrogen, making this exploded star a type II supernova. But in May, Alexei V. Filippenko and Thomas D. Matheson of the University of California, Berkeley, found that SN 1993J had undergone a remarkable transformation. The hydrogen emission had been replaced by helium, a characteristic of a type I supernova known as Ib.

According to the Berkeley astronomers, these observations suggest that the star that became SN 1993J had only a thin outer layer of hydrogen; the rest was stolen by an unidentified companion. Soon after the explosion, the hydrogen layer would still be dense enough to be visible; later on, helium emissions could easily penetrate the thinning hydrogen envelope. This scenario suggests that type Ib actually has more in common with type II supernovas than with type I. If Filippenko and Matheson are right, both type Ib and type II supernovas result from the collapse of supermassive stars.

Cosmic survey yields surprise

When astronomers last year used a balloon-borne telescope to observe a small patch of sky in the far infrared, they were intent only on studying the faint microwave glow left over from the birth of the universe. But they now report that their 10-hour survey may have uncovered a puzzling new class of objects.

Edward S. Cheng of NASA's Goddard Space Flight Center in Greenbelt, Md., and his colleagues launched the far-infrared telescope to search for faint hot and cold spots in the cosmic microwave background. Such temperature fluctuations may signify primordial lumps that later gave rise to the present-day collection of galaxies and galaxy clusters.

The team's experiment, known as the Medium-Scale Anisotropy Measurement (MSAM), measured the temperature variation in the microwave background over patches of sky 0.5° in diameter – the width of the full moon on the sky. MSAM found that the temperature varied by about one part in 100,000. But MSAM also detected two luminous, point-like sources of radiation that don't appear to be part of the microwave background.

Moreover, the sources don't correspond to any objects compiled in well-known infrared and radio-wave catalogs, says Cheng. He adds that MSAM detected these puzzling emissions only at the two longest far-infrared wavelengths in the survey – 1.1 and 1.8 millimeters. Cheng speculates that the sources might be distant, radio-quiet quasars. Alternatively, the emissions may stem from an exotic celestial object that either doesn't emit radio waves below a certain frequency or is surrounded by material that absorbs radio waves. "This is the beginning of a hunting expedition," he notes.

Cheng says he's of two minds about the findings. On the one hand, they could represent the first celestial sources discovered by observing in the far infrared. On the other hand, if the sky is littered with such point-like sources, it will make the task of deciphering the structure of the microwave background at small angular scales far more difficult.

Earth Science

Nuclear submarine aids Arctic research

Though the partners come from disparate backgrounds, it seems a promising marriage on paper. Oceanographers need a means of reaching inaccessible parts of the ocean, and the U.S. Navy is looking for new opportunities for its fleet of nuclear submarines in the post-cold-war world. Late this summer, both groups will see how well the match works in practice when a team of civilian researchers takes part in the first unclassified scientific mission on board a U.S. nuclear submarine.

The trial cruise will explore the central Arctic basin, a region particularly difficult to study even by plane or ice-breaker, says geophysicist Marcus G. Langseth of the Lamont-Doherty Earth Observatory in Palisades, N.Y. The Navy has conducted research for decades with nuclear submarines, but this cruise marks the first time the scientific community will have access to the data collected, says Langseth, who chaired the science steering committee for the mission.

One aspect of the expedition will focus on Arctic pack ice, a potentially important indicator of climate change. Upward-looking sonar on the submarine will survey the ice from below while a satellite images the top of the ice. The submarine will also surface in openings in the ice, where researchers will deploy buoys that measure air and water conditions. In addition, the team of five scientists will survey the ocean floor, take water samples, and record the temperature and salinity at various depths.

Before planning future missions, researchers and Navy officials will look closely at the results of the cruise. "This is sort of like a blind date. Neither the Navy nor the scientific community has done this in the recent past and therefore they're both anxious for it to go smoothly," says George Newton of Arlington, Va., a former submarine captain and a member of the U.S. Arctic Research Commission.

Increased ultraviolet in Argentina

The thinning of Earth's protective ozone layer in the stratosphere should allow more ultraviolet (UV) light to reach the planet's surface. But clouds and pollution can complicate that relationship by absorbing UV radiation, making it hard to detect the effect of ozone loss from the ground. U.S. and Argentine researchers now report finding the first evidence of large increases in UV light over a populated part of the world.

Since 1988, atmospheric scientists have monitored UV levels at a station in Ushuaia, Argentina, on the southern tip of South America. While UV levels remained near normal for some years, biologically harmful UV frequencies grew significantly stronger during the austral summers of 1990 and 1992. In one month, December 1990, UV levels averaged 45 percent above the expected levels, says John E. Frederick of the University of Chicago. He and his colleagues describe their results in the May 20 JOURNAL OF GEOPHYSICAL RESEARCH.

They suggest that the UV surges stem from the annual breakup of the ozone hole over Antarctica. As the ozone hole forms during September, it is surrounded by a swirling band of winds that herds the ozone-poor air, keeping it concentrated mostly over the Antarctic. But the vortex of winds eventually loses strength, allowing blobs of ozone-depleted air to break away. Frederick believes that some of these passed over South America during December of 1990 and 1992.

The surges came at a time of year when UV radiation is naturally strongest. But researchers lack the measurements to tell whether the changes actually harmed plants, animals, or people in southern South America. Nor can they say whether the ozone-poor blobs remained intact long enough to drift over more northern regions and cause increases in UV radiation there. Argentina is now installing a network of stations to track such changes across the entire country.