Getting the Blues

Picturing the universe in the far ultraviolet

By RON COWEN

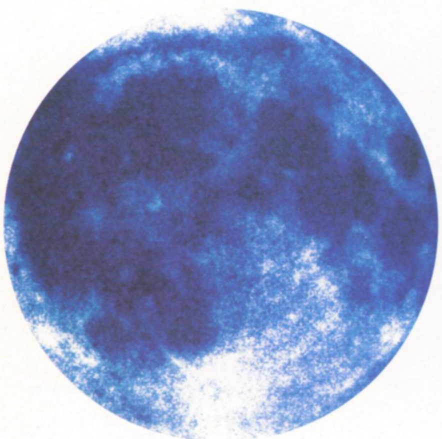
If you want a snapshot of ordinary, sunlike stars, look in visible light. But if you're searching for fireworks, cast your eyes into the blue.

It's at ultraviolet wavelengths that hot, energetic stars begin to stand out from the crowd, no longer swamped by emissions from the much larger population of cooler stars similar in mass to the sun.

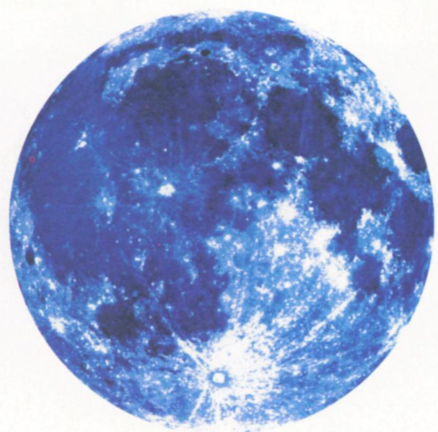
Although a number of Earth-orbiting telescopes have studied X-ray emissions, few have ever before viewed the cosmos in the part of the electromagnetic spectrum known as the far ultraviolet. During a recent 16-day sojourn above Earth's atmosphere as part of the Astro-2 Observatory, the Ultraviolet Imaging Telescope (UIT) did just that, capturing some 750 images of stars, supernovas, colliding galaxies, and regions of recent starbirth (SN: 4/8/95, p.213). It also recorded the first detailed ultraviolet image of the moon.

Precision pointing enabled the telescope to stare at 52 of the targets for more than 1,000 seconds each, recording radiation that can't penetrate Earth's ultraviolet-absorbing atmosphere. Because dust in galaxies also obscures ultraviolet light, the telescope can glimpse only those few massive stars that happen to lie in relatively dustfree regions.

Left: Southwest Research Institute; right: Lick Observatory



Ultraviolet



Visible

Shooting the moon: *Imagine sitting in a speeding car, trying to take a sharp picture of a motorcycle whizzing past in the opposite direction. A team of astronauts and ground-based engineers faced a similar challenge last March when they commanded the shuttleborne UIT to photograph the moon. The rapid relative motion of the Earth-orbiting space shuttle and the moon set the stage for the most difficult photo shoot of the entire mission, says Randy Gladstone of the Southwest Research Institute in San Antonio, Texas.*

After a few successes at photographing the waxing moon and one failed attempt at imaging the entire body, scientists were given a last chance to capture the full moon. On the very last orbit of the science mission, they succeeded in recording the first detailed view of the full moon in the far ultraviolet.

The photos had presented astronomers with something of a puzzle, but Gladstone now believes he has solved the mystery.

Studies of moon dust collected during the Apollo missions in the 1970s suggested that the ultraviolet images would look like the negatives of pictures taken in visible light, with areas that appeared bright in one kind of image being dark in the other. Instead, UIT images show a remarkable similarity to those taken in visible light, note Gladstone and his colleagues, Chan Na and S. Alan Stern.

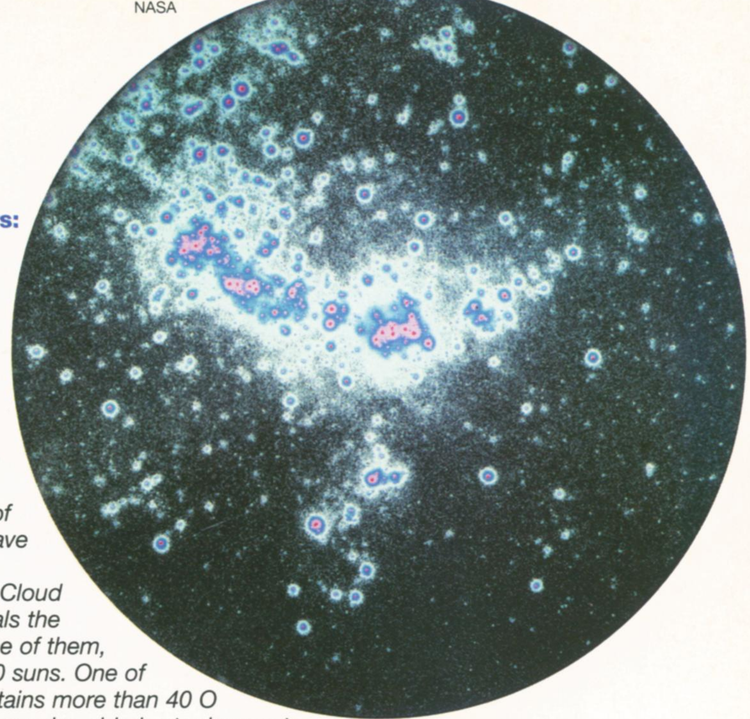
Gladstone told Science News that he now suspects the UIT filters used to image the moon let through slightly more than the expected amount of ultraviolet radiation at wavelengths greater than 180 nanometers. The moon's surface reflects these longer wavelengths in a manner similar to visible light.

The brightest, mostly highly reflective areas in the ultraviolet (left image) correspond to regions pummeled relatively recently by space debris. These bombarded areas include the impact crater Tycho near the lunar south pole.

Astronomers weren't able to develop UIT's film and see the new images until the shuttle had returned to Earth. Now, those pictures promise to shed light on the nature and timing of starbirth in a variety of galaxies. The sharpness of the pictures and their wide field of view may serve to guide follow-up observations by the Hubble Space Telescope, says UIT co-investigator Susan G. Neff of NASA's Goddard Space Flight Center in Greenbelt, Md. Hubble can zero in on selected regions of a galaxy, imaging them at longer ultraviolet wavelengths, but at considerably higher resolution, than the UIT can at far-ultraviolet wavelengths.

Team leader and UIT designer Theodore P. Stecher of Goddard, along with Neff, Robert H. Cornett of Hughes STX Corp. in Lanham, Md., and their colleagues, presented several of the new images in June at a meeting of the American Astronomical Society in Pittsburgh. The following represent a sample of those pictures. □

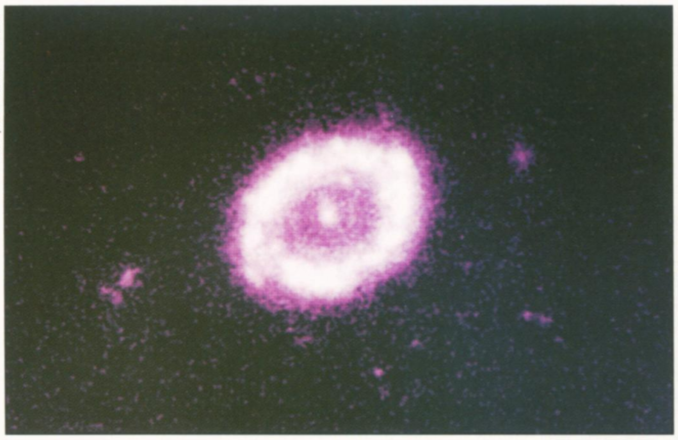
NASA



A view of two neighbors: *Casting its ultraviolet eye on one of our nearest galactic neighbors, the Large Magellanic Cloud, the UIT recorded several clusters of young, hot stars (right). Arrayed along an arc some 1,000 light-years in length, these massive, fiercely burning stars live for only a few million years. A wave of star formation sweeping through the galaxy may have sculpted the arc.*

Another nearby galaxy is the Small Magellanic Cloud (left). This mosaic of ultraviolet photographs reveals the galaxy's hottest and youngest massive stars. Some of them, known as O stars, may have as much mass as 100 suns. One of the cloud's star clusters, NGC 346 (top circle), contains more than 40 O stars. The cluster also contains a Wolf-Rayet star, a massive elderly star known to blow off surface material in a strong wind. UIT investigator Joel Parker of Hughes STX Corp., created this composite image from photographs taken by the UIT during the recent Astro 2 flight and the Astro 1 flight in December 1990.

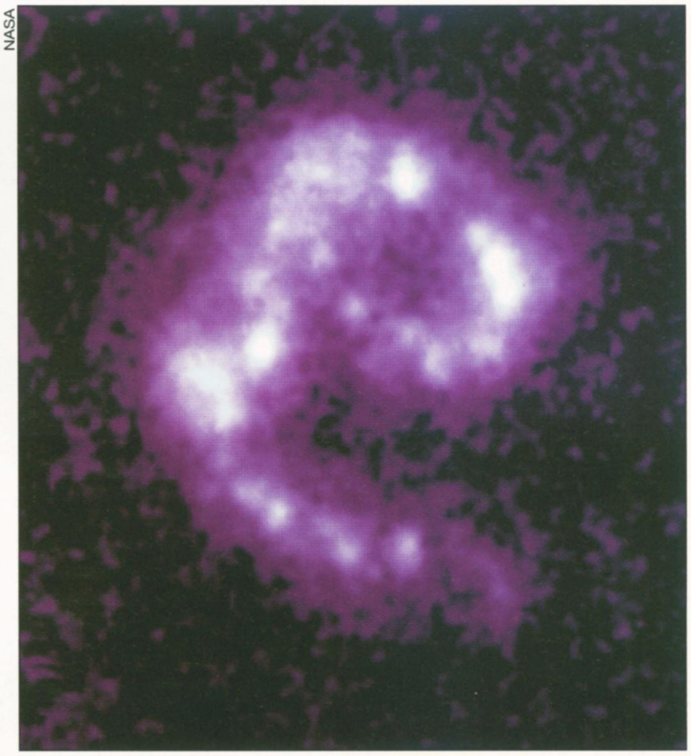
Neff, UIT team/NASA



Ring of Starbirth: *Astronomers classify the spiral galaxy NGC 4736 as a starburst galaxy because of the large number of hot, young stars it harbors. Images taken by the UIT in the far ultraviolet now reveal where most of the action takes place. Viewed in red light, NGC 4736 shows a bright core composed primarily of old, cool stars; a main disk with short spiral arms; and a faint outer ring (bottom image). But UIT observations show a bright ring of young, massive stars (top).*

William Waller/Kitt Peak National Observatory

NASA



Galaxies in collision: *The Antennae form one of the most spectacular examples of two large spiral galaxies caught in the act of colliding. Far-ultraviolet emissions come from well-ordered arcs, suggesting that star formation takes place along curved shock fronts, where the collision has compressed gas. The UIT also detected ultraviolet radiation adjacent to radiowave emissions known to come from carbon monoxide. The presence of carbon monoxide indicates cool, dense gas associated with molecular clouds, the birthplace of stars. Ultraviolet radiation can't escape this dense molecular gas, but its appearance alongside the carbon monoxide emissions suggests that starbirth occurred here relatively recently.*