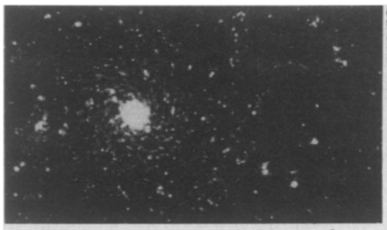
Astronomy

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

Virgo images suggest smaller universe



Computer-processed image of the galaxy NGC 4571 reveals individual luminous stars.

For the first time, astronomers have distinguished individual stars in a galaxy in the Virgo cluster and measured their distance from Earth. Observations of the galaxy NGC 4571, made with a new high-resolution camera, support the notion that objects in the universe may lie about half as far away as previously thought. If so, the cosmos as a whole may be smaller than believed.

Robert D. McClure of the Dominion Astrophysical Observatory in Victoria, British Columbia, and his colleagues conducted their study at the Canada-France-Hawaii Telescope on Hawaii's Mauna Kea. They photographed NGC 4571, obtaining sharp enough resolution to distinguish bright individual stars from groups of fainter stars. By comparing the brightness of the luminous stars with that of Milky Way stars in the same class and at a known distance from Earth, they deduced that NGC 4571 lies 50 million light-years from Earth.

Because astronomers often use the distance to Virgo as a yardstick for assessing the distance of objects farther out in the universe, the new finding indicates that such objects may lie much closer to Earth, McClure says. Since an object's distance serves as an indicator of its age, a smaller cosmos would seem to suggest that the universe is younger than the estimated 10 to 20 billion years. On the other hand, scientists have clearly established an age of 15 billion years for some ancient star groups in the Milky Way.

The high-resolution camera attached to the Mauna Kea telescope uses adaptive optics to correct for the image-distorting effects of Earth's atmosphere (SN: 6/8/91, p.358), yielding an image about five times as sharp as those produced by most other ground-based telescopes, McClure says.

A record-breaking star with flare

The binary star V711 Tau, about 100 light-years from Earth, belongs to a class of binaries that have relatively high magnetic fields. Noting that the sun and other magnetically active stars produce flares with the sudden release of stored magnetic energy, researchers reasoned that sooner or later, V711 Tau might erupt. But after 15 years of study – the last eight with a robotic telescope on Arizona's Mount Hopkins – astronomers found no evidence that this star or any of the other 110 binaries in the same class that they observed had ever undergone such sudden brightening.

V711 Tau's status changed irrevocably on Dec. 14, 1989. Astronomers at the Beijing (China) Astronomical Observatory noted a rapid brightening of the star over just a few hours. After years of negative results, Gregory W. Henry of Tennessee State University in Nashville figured the Chinese had erred. But checking with the Mount Hopkins telescope, he found that 12 hours after the Beijing observation, the star had undergone another, more intense jump in luminosity. That flare may represent not only the first observed in this stellar class, but also the most intense observed on any star, Henry says.

At the peak of the flare-up, which lasted about six hours, the total amount of energy released by the star climbed to 5×10^{34} ergs/second – a rate about 10 times as large as the sun's total output and 100 million times as intense as a typical white-light solar flare, report Henry and Douglas S. Hall of Vanderbilt University in Nashville.

They also found that the star's overall luminosity remained slightly elevated for three months after the record-breaking outburst. This, coupled with the star's orientation relative to Earth, indicates that the flare may have temporarily erased a large, light-obscuring spot – perhaps similar to a sunspot – believed to reside at one of the star's poles, Henry says. The luminosity slowly returned to normal levels, perhaps as the spot began to build back up, he adds.

The flare's origin remains unclear. Because its intensity far exceeded that of a solar flare, it may well have arisen from processes that differ from those causing outbursts on the sun. Even so, V711 Tau's magnetic activity might possibly undergo fluctuations resembling the 11-year sunspot cycle, Henry says.

LDEF maps orbiting junk

When NASA launched the Long Duration Exposure Facility (LDEF) in April 1984, it intended to bring the orbiting, unmanned laboratory back to Earth nine months later. But delays after the 1986 Challenger accident kept LDEF waiting until January 1990, when a space shuttle rescued it just days before the craft would have met a fiery demise in Earth's atmosphere (SN: 11/11/89, p.314).

Researchers analyzing the wealth of LDEF data now report that one of its experiments produced the most comprehensive, high-resolution map ever of debris left in Earth-orbit by other spacecraft. LDEF's Interplanetary Dust Experiment, which operated for 11½ months until its recording tape ran out in March 1985, detected some 15,000 collisions between LDEF and particles ranging in size from fine dust to grains of sand, usually clustered in groups. Some of the debris originated in undetermined extraterrestrial sources, such as meteors, but about 90 percent came from orbiting spacecraft, says John P. Oliver of the University of Florida in Gainesville. He and his colleagues recently completed a report on the LDEF mission.

Oliver notes that LDEF's fixed orientation – one of its sides always faced Earth, while another always faced the craft's direction of motion in orbit – enabled the dust detectors to record the location and direction of each impact. Every 54 days, the experiment mapped the distribution of dust clouds 250 miles above Earth in a swath extending from the terrestrial latitudes of 28.5°N to 28.5°S.

For two weeks in the spring of 1984, the detectors recorded sudden encounters with human-made debris – about five "hits" over a 5-minute interval during each of the craft's orbits, says Oliver. For example, among 1,100 impacts recorded by one detector during May and June 1984, about 900 came from an orbital debris cloud now dubbed the "May swarm," which has an incline relative to the equator of 30° to 40°.

On June 4, 1984, LDEF encountered material in a more steeply inclined orbit of 65° – a trajectory typical of U.S. and Soviet military satellites. In a single 5-minute interval, a detector on LDEF's leading edge recorded more than 130 impacts.

The experiment revealed that most orbital debris concentrates in small clumps. That finding, along with further analysis of LDEF data, may enable researchers to predict the nature and exact location of space debris and even measure the amount left by a particular spacecraft, Oliver says. If so, engineers could equip space-bound structures with strategically positioned shields to protect them from the most intense collisions, which can severely degrade instruments over time.

Just as planners of terrestrial projects file environmental impact statements, "we may have to ask people [who send up spacecraft] to file an orbital impact statement," says Oliver. He suggests international agreements may one day be needed to avoid placing debris in a path that endangers long-term space missions.