Astronomy

Ivars Peterson reports from Ann Arbor, Mich., at a meeting of the American Astronomical Society

A sprinkling of distant star clusters

Our own galaxy has about 150 satellites, each one a compact cluster containing a million or so stars. How and when these "globular clusters" formed is still something of a puzzle, and astronomers have been looking for clues by examining globular clusters surrounding nearby galaxies. Two astronomers have now detected a population of globular clusters around a remote galaxy known as NGC 6166. This particular "supergiant" galaxy, about 400 million light-years from Earth, lies at the center of a large group of galaxies called Abell 2199.

"This is the most distant galaxy in which globular clusters have been found," says William E. Harris of McMaster University in Hamilton, Ontario. Harris and C.J. Pritchet of the University of Victoria in British Columbia detected faint, star-like objects in the NGC 6166 vicinity with exactly the characteristics expected of bright globular clusters at the outskirts of a galaxy.

Unlike other supergiant, elliptical galaxies, which may have 15,000 or more globular clusters, NGC 6166 has a more modest complement of satellites. Harris and Pritchet suspect this particular galaxy may be the result of an extended series of mergers with other galaxies in a relatively congested region of the universe. Such mergers would swallow up a significant proportion of any globular clusters present, gradually reducing the cluster population to a level below that expected for a galaxy of this size. The astronomers say this scenario supports the argument that globular clusters, which typically contain old stars, have existed from the very start of the period of galaxy formation. It strongly argues against the idea that globular clusters surrounding giant galaxies form continuously as a result of the condensation of high-temperature gas flowing from a galaxy's fringes toward its center.

Throwing tantrums in stellar nurseries

The world of a young star is a turbulent one. Recent radio-wave and infrared observations of stellar nurseries reveal complicated patterns of gas flow, stellar winds, jets shooting out of newly formed stars and a variety of compact and extended structures, some moving at high speeds. One particularly unusual object lies embedded in a dark cloud rich in gas and dust, located about 2,000 light-years from Earth in the direction of the constellation Serpens. The object's radio-wave signature shows it has three aligned components: a stationary, central component and two blobs flying away from the central component at more than 300 kilometers per second.

The central component probably represents a very young star about 300 times more luminous than the sun, says Luis F. Rodríguez of the Universidad Nacional Autónoma de México in Mexico City. The outer components prove more puzzling because they seem to emit synchrotron radiation — a process that requires the presence of magnetic fields and charged particles moving near the speed of light. Present star-formation theories don't account for the production of such high-speed particles in the environment of very young stars.

Polar winds and excretion disks

Red giants and white dwarfs are two of the more familiar types of stars. But stars come in a wide range of colors and sizes. In particular, one recently studied class of stars, known as B[e] supergiants, has a number of remarkable characteristics. These hot, bright, blue stars have surface temperatures higher than 10,000 kelvins. (The sun's surface temperature is 6,000 kelvins.) They are several hundred thousand times more luminous than the sun. However, unlike other known types of supergiant stars, B[e] supergiants have spectra that include unusual emission lines from hydrogen, iron and oxygen atoms. Other spectral features suggest that these stars are surrounded by cool dust and clouds containing molecules such as carbon monoxide.

To account for the unusual spectral features, Franz-Josef Zickgraf and Roberta M. Humphreys of the University of Minnesota in Minneapolis propose that such stars have a two-component stellar wind. Whereas some gas escapes as fast, radiation-driven wind from the star's two polar regions, the bulk flows out slowly from the star's equatorial region to create a cool, dense "excretion disk" encircling the star. The outflows appear to be so strong that such a star sheds a mass equal to the sun's mass in only 10,000 years.

B[e] supergiants apparently represent an advanced stage in the evolution of massive stars. This phase may last less than 100,000 years, during which time the star loses a large fraction of its mass. Such an evolutionary process could lead to the kind of star that exploded as supernova 1987A in the Large Magellanic Cloud, several astronomers suggest.

New echoes of supernova 1987A

Astronomers are now seeing light reflected from dust clouds behind supernova 1987A as viewed from Earth. The two new light echoes, discovered by Arlin P.S. Crotts of the NASA Goddard Space Flight Center in Greenbelt, Md., and William E. Kunkel of the Las Campanas Observatory in La Serena, Chile, appear to represent reflections from two inclined sheets of interstellar dust located only 200 and 380 light-days (light travels about 16 billion miles in one day) from the supernova. Seen as elliptical loops, they are considerably smaller than previously discovered light echoes, which represent reflections from material lying between the supernova and Earth (SN: 6/18/88, p.388).

Careful study of the light echoes shows that the dust clouds are dense but thin sheets of material, perhaps only a light-day or so thick. Because the echoes are quite faint in visible light, the dust particles must also have very dark surfaces. Indeed, infrared measurements suggest that the brighter, inner sheet may actually consist of graphite particles. However, says Crotts, "there's no satisfactory explanation for why [the sheet] is there or how it got there." The discovery of dust clouds so close to the supernova may explain why recent infrared observations show the supernova as larger than it ought to appear. The dust clouds themselves would be absorbing light, then emitting it as infrared radiation, adding to the amount of infrared light coming from the supernova.

Low-budget stellar spectroscopy

Modern telescopes for serious astronomical research don't necessarily have to cost large sums. A group of astronomers at Georgia State University in Atlanta plans to build the equivalent of a 1-meter telescope by putting together a cluster of nine separate, smaller telescopes, each having a 13.1-inch mirror. They call their project the Multi-Telescope Telescope. Whereas a conventional 1-meter telescope would cost $500,000, these researchers expect their instrument to cost only $50,000. Located at Hard Labor Creek State Park, about 55 miles east of Atlanta, it should be completed late next year.

The telescope is designed to collect enough light to obtain spectra of stellar objects. Each mirror directs light into a separate optical fiber, which conducts the light to a spectrograph. Such an instrument will be useful for studying the distinctive spectral features of hot, rapidly rotating B[e] supergiant stars and for measuring shifts in the positions of spectral lines to determine the radial velocities of stars in binary systems. By combining such radial-velocity data with information about the orbits of binary stars, astronomers can calculate the masses of both stars.