Dim Galaxies Shed Light on Early Cosmos

Astronomers who probe the early universe use their telescopes like time machines, peering at galaxies near the edge of the observable cosmos. Since looking into deep space is the same as looking back in time, these distant, luminous galaxies would seem to offer the best opportunity to study the young cosmos.

But new evidence suggests that a group of faint, quiescent galaxies, less than 5 percent as distant, may serve as a Rosetta stone for understanding conditions in the very early universe. After lurking in the dark for billions of years, these massive, gassy structures appear to have only recently begun forming stars. Unlike the typical luminous galaxy, which has evolved dramatically since its birth, they seem to have been frozen in time, preserving several key features—such as low density and low metal abundance—since their creation.

Two independent research teams presented the new evidence in Atlanta this week at a meeting of the American Astronomical Society.

As recently as 1989, astronomers had identified only a few of these "low-surface-brightness galaxies," although some speculated that many more existed (SN: 7/22/89, p.60). That hunch has now proved correct: While scanning photographic plates from a new sky survey conducted at Palomar Observatory, James Schombert of the California Institute of Technology in Pasadena identified about 500 previously unseen low-surface-brightness galaxies. Analyzing visible-light emissions from 24 of these galaxies, Stacy S. McGaugh of the University of Michigan in Ann Arbor and his colleagues found that their oxygen, neon, sulfur and nitrogen concentrations ranged from one-tenth to one-fiftieth of those in the Milky Way.

Since all galaxies start out with hydrogen and helium as their sole chemical constituents, generating heavier elements only through the birth and death of stars, McGaugh says the low concentrations measured by his group indicate that the dim galaxies produced their first glimmers of starlight sometime in the past few hundred thousand years.

The 24 galaxies, whose diameters average about one-tenth that of the Milky Way, represent a crazy quilt of objects lying between 30 million and 500 million light-years from Earth. In contrast, a group of 300 galaxies recently discovered by Patricia M. Knezek and Stephen E. Schneider of the University of Massachusetts at Amherst lie farther from Earth, with diameters ranging from three to 100 times that of the Milky Way.

Since these giant galaxies were too dim to find on visible-light images, Knezek and Schneider used the radio telescope at Arecibo Observatory in Puerto Rico to home in on regions containing ionized hydrogen—an indicator of new starbirth. They then photographed the newly found structures with light detectors known as charge-coupled devices.

Knezek, Schneider

Visible-light images depict newly discovered dim galaxy (far left) and a typical luminous galaxy (near left), about equally distant from Earth.

As researchers continue to find faint galaxies, some astronomers speculate that the universe may harbor billions of them. If so, says McGaugh, these galaxies may account for a significant amount of "dark matter"—the missing mass needed to explain the evolution of large-scale structure in the universe. The cold-dark-matter theory, which holds that some dark matter takes the form of exotic material that interacts only with gravity, predicts that low-surface-brightness galaxies should reside in the empty spaces between clusters of luminous galaxies, McGaugh notes. But so far, the distribution of the dim bodies does not follow that pattern, he says.

The low gas density of the faint galaxies — about one-twentieth that of the Milky Way — may shed light on other cosmic mysteries, he adds. For instance, McGaugh speculates, this density may represent the smallest primeval "lumps" in the smooth broth of the early universe. Such lumps may have helped trigger the expansion of the cosmos. S. George Djorgovski of Caltech disagrees, arguing that the dim galaxies actually evolved over billions of years, and thus would not constitute ancient, pristine galaxies.

McGaugh suggests that all galaxies went through an early phase characterized by diffuse gas and low abundances of elements heavier than helium. But what prompted the faint galaxies to remain dormant for so long? The low gas density may have been too tenuous to coalesce into stars, he postulates. And unlike most luminous galaxies, these dim galaxies reside in isolation, lacking neighbors that could provide the extra gravitational tug needed to convert gas into stars, Knezek says.

The intense blue of the faint galaxies poses another puzzle, Knezek notes. Blue light typically connotes a lack of metals, which absorb those wavelengths, and the presence of young, massive stars, which radiate at those wavelengths. But the radiation emitted by such stars readily ionizes hydrogen gas, and researchers have found few ionized regions in these galaxies, Knezek observes. One possibility: The galaxies may undergo a unique kind of star formation that has gone undetected in other galaxies. —*R. Cowen*

Dyslexia: New twist on 'word blindness'

A new scientific study challenges the traditional view of dyslexia as an all-or-nothing phenomenon. Instead, the new data suggest that this reading disorder occurs in a spectrum of cases ranging from mild to severe.

"Dyslexia is currently envisioned as a discrete entity—either you have it or you don't," says Sally E. Shaywitz, a pediatrician with the Yale University School of Medicine in New Haven, Conn. But data collected by Shaywitz and her colleagues indicate that "dyslexia is much more like hypertension, occurring along a continuum with gradations or degrees," she told SCIENCE NEWS.

Dyslexia, also known as "word blindness," is broadly defined as the failure to read at expected levels. Dyslexic children exhibit normal intelligence and often perform well in other academic areas such as mathematics. Yet these children have difficulty translating strings of letters into verbal utterances. Thus, a dys-