Star streams reveal galaxy's dining habits

Extra! Extra! Big galaxy eats little galaxy!

Cannibalism runs rampant throughout the cosmos (see p. 312), and now astronomers have some of the first direct evidence that our own Milky Way grew bigger by devouring galaxies around it.

Analyzing precise measurements of the motion of old stars, researchers have identified the remnants of a dwarf galaxy snatched and torn apart by the Milky Way some 10 billion years ago. The captured galaxy could have contributed about 10 percent of the elderly stars in our galaxy's halo, the spherical distribution of material that surrounds the Milky Way's core, the astronomers assert.

The dwarf galaxy could be one of dozens snared by the Milky Way during its formative years, notes Amina Helmi of the Leiden Observatory in the Netherlands. The Milky Way's tug would have stretched these galaxies into thin sheets of stars that then spread throughout the halo. Helmi and her colleagues, including Simon D.M. White of the Max Planck Institute for Astrophysics in Garching, Germany, describe their work in the Nov. 4 NATURE.

Previous observations hinted at collections of Milky Way stars that move together, suggesting a common origin, but "this is the first definitive evidence that something in the past has been shredded" to create such groups, says Kathryn V. Johnston of Wesleyan University in Middletown, Conn.

The piecemeal growth suggested by the new findings agrees with the cold-dark-matter theory, which predicts that the cosmos evolved from the bottom up, beginning with small objects and then developing large ones. Observations of distant galaxies, which reveal how they appeared long ago, show that they were much smaller than the typical galaxy today and that mergers with neighbors were more common.

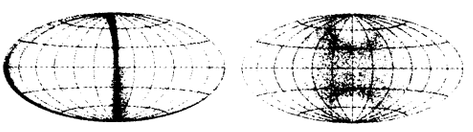
To search for remnants of ancient galaxies, Helmi and her colleagues sorted through measurements of the motion of Milky Way stars recorded by the Hipparcos satellite and telescopes on Earth. Homing in on 275 stars that have less than one-thirtieth the concentration of iron found in the sun—an indication that they formed long ago—the team discovered that a dozen move coherently, in two streams.

One stream, consisting of nine stars, travels southward through the spiral disk of the Milky Way at about 250 kilometers per second, while the other, made of three stars, moves northward at nearly the same speed. The team's analysis suggests that the stars should move in concert only if they came from the same structure. Comparing the stellar motions with computer simulations, the researchers find that both streams represent debris from a single galaxy that the Milky Way disrupted long ago.

With a larger sample of old stars, the team expects to find fossils of many more cannibalized galaxies, Helmi says. Future satellites devoted to tracking the motion of stars, including FAME (see p. 314) and the Space Interferometer Mission, should provide precise data.

Already studying a larger catalog of halo stars, Timothy C. Beers of Michigan State University in East Lansing and his colleagues have confirmed the streams found by Helmi's team, he told SCIENCE NEWS. His team has also identified a trail of stars that may be associated with the streams and that might have arisen when the captured galaxy collided with the Milky Way.

Simulations by Helmi and her colleagues suggest that before being devoured, the galaxy orbited the Milky Way at a distance no greater than 50 light-years. It probably resembled present-day dwarf galaxies that circle at larger distances and are just now being torn apart, she adds (SN: 4/9/94, p. 228).



Helmi, White, *et al.*

Simulation on left shows a small galaxy being torn apart by the Milky Way. Captured stars form a band near the galaxy's path. Black indicates the core. Simulation on right depicts dispersed stars from a dwarf galaxy captured billions of years ago.

In another report in the Nov. 4 NATURE, Young-Wook Lee of Yonsei University in Seoul, South Korea, and his colleagues examine the Milky Way's most massive globular cluster, a dense grouping of stars. The team finds that this cluster, Omega Centauri, is the nucleus of a small galaxy swallowed by the Milky Way. Just 15,000 light-years from the sun, the cluster constitutes the closest known galaxy remnant to Earth, Lee says. —*R. Cowen*

Schizophrenia may involve bad timing

People diagnosed with schizophrenia display a wide-ranging breakdown of perception and thought. A glitch in the timing of cell responses across broad swaths of brain tissue may help account for these people's fragmented experience of the world, according to a new study.

In the brains of schizophrenia sufferers, electrical activity fails to synchronize with a specific sound frequency as it does in the brains of mentally healthy people, report psychiatrist Robert W. McCarley of Brockton (Mass.) Veterans Affairs Medical Center and his coworkers.

In healthy individuals, widely separated clusters of neurons harmonize their electrical activity to the so-called gamma frequency of around 40 bursts per second. This match may help produce unified perceptions and memories (SN: 2/20/99, p. 122).

Much research on schizophrenia and other severe mental disorders focuses on activity in specific parts of the brain as measured by imaging devices. McCarley's group instead examined the timing of electrical responses across much of the brain's outer layer, or cortex, using electroencephalogram (EEG) sensors placed on the scalp.

The researchers recruited 15 men currently hospitalized for schizophrenia treatment, most of whom had been diagnosed with the disorder around 20 years ago and had received antipsychotic medication ever since. Another 15 men, none of whom had psychiatric disorders or any immediate relatives with a mental ailment, served as controls.

EEG recordings were made in experimental sessions as each volunteer listened through headphones to series of tones with frequencies of either 20, 30, or 40 vibrations per second.

Neural firing quickly became synchronized with each of the three sound frequencies in the control group. In the schizophrenia group, the brain's electrical output aligned itself with the two lower frequencies but took longer to do so than it did in the control group. Even after an extended period, however, the schizophrenia patients' brain activity did not speed up to the gamma frequency.

McCarley and his team report their findings in the November ARCHIVES OF GENERAL PSYCHIATRY.

Earlier studies suggested that the coordination of gamma-frequency neural activity depends on the chemical messenger GABA, which has also been implicated in schizophrenia, they add.

Gamma activity in the brain offers "considerable promise in understanding sensory and perceptual deficits in schizophrenia," remark Michael F. Green and Keith H. Nuechterlein, both psychologists at the University of California, Los Angeles, in a commentary published in the same journal.

Difficulty in establishing this level of neural activity may partly account for visual problems observed in schizophrenia, the UCLA researchers say. For example, when two images are flashed on a computer screen in succession, schizophrenia sufferers have trouble seeing the first image unless the second one appears only after a relatively long interval. —*B. Bower*