Astronomy

A galaxy that goes the distance

More brilliant than the galaxies that house them, quasars shine like beacons through the dark reaches of cosmic space. Indeed, these powerhouses are so bright that ever since their discovery in 1963, one or another of them has held court as the most distant visible body in the cosmos.

Now, a galaxy has for the first time snared that title. Researchers estimate that the unnamed galaxy, detected by the Hubble Space Telescope, lies 13 billion light-years from Earth. This calculation assumes the universe is about 14 billion years old. Light now reaching Earth left the starlit body when the cosmos was still in a formative stage.

The galaxy might have gone undetected were it not for a cosmic mirage. According to Einstein's theory of general relativity, massive objects bend light, acting as gravitational lenses. One such lens is a cluster of galaxies that resides 5 billion light-years from Earth and happens to lie directly between the distant galaxy and our planet. The lensing makes the distant galaxy 5 to 10 times brighter, enabling astronomers to study details of star-birth in one of the youngest objects in the universe.

The distorted, arclike shape of the object in Hubble images was a telltale sign that the light had been lensed. It was the galaxy's red color, however, that captivated Marijn Franx of the Kapteyn Institute in Groningen, Netherlands. The reddish hue indicates that the galaxy is very distant and has had much of its blue light absorbed by the vast amount of intergalactic hydrogen gas between it and Earth.

Astronomers including Garth D. Illingworth of the University of California, Santa Cruz verified the faraway location of the galaxy by measuring its redshift, the amount by which its light is shifted to the red end of the spectrum. The more distant the galaxy, the greater the redshift. Spectra taken with one of the twin W.M. Keck telescopes atop Hawaii's Mauna Kea revealed that the galaxy has a redshift of 4.92, the highest of any object recorded to date. The previous record holder, the quasar PC1247+34, has a redshift of 4.90 and lies a few tens of millions of light-years closer to Earth.

Franx, Illingworth, and their colleagues report their find in the Sept. 10 Astrophysical Journal Letters.

The Keck spectra also reveal that gas in the galaxy moves at some 200 kilometers per second, presumably jazzed by a series of supernova explosions. Dense knots of massive stars indicate that the galaxy, seen in its infancy, blazes with a brilliance more than 10 times that of the Milky Way today. —*R.C.*

Big asteroid has big dent

The asteroid called 4 Vesta has long had a special place in the hearts of planetary scientists. Spectra of this rock, the third largest asteroid, have revealed that it is the only known parent of a class of meteorites called basaltic achondrites. This class accounts for 6 percent of all meteorites that fall to Earth.

Because of its placement in the asteroid belt, Vesta can't deliver its fragments to Earth directly. However, a string of small, Vesta-like asteroids is at the right location to do so (SN: 10/24/92, p. 286). Scientists had assumed that these bodies represent pieces of Vesta knocked off during some past collision, but it remained unclear whether the large asteroid had, in fact, ever suffered a mammoth impact.

An analysis of Hubble Space Telescope images of Vesta taken last year, when the rocky body was the closest it had been to Earth in a decade, now reveals a crater 460 kilometers wide and 13 km deep near the asteroid's south pole. Potato-shaped Vesta has an average diameter only slightly bigger, 530 km. The collision gouged 1 percent of the asteroid's volume, enough material to account easily for the family of small, Vesta-like asteroids, Peter C. Thomas of Cornell University and his colleagues report in the Sept. 5 Science. —*R.C.*

Biology

Cellular structure linked to aging

New clues to the cellular basis of aging have emerged from studies of the brewer's yeast *Saccharomyces cerevisiae*. Last year, scientists isolated a *S. cerevisiae* gene, *SGS1*, similar to the human gene responsible for Werner's syndrome—a condition that mimics aspects of aging. Young people with Werner's syndrome acquire gray hair and diseases such as osteoporosis, cataracts, and hardening of the arteries. Like the human gene, *SGS1* controls behavior associated with aging, report Leonard Guarente of the Massachusetts Institute of Technology and his colleagues in the Aug. 29 Science.

"The idea is that by figuring out what this gene does, we can find out not only about disease but also about the aging process itself," says Guarente.

When *S. cerevisiae* divides in two, it splits asymmetrically. Most of the old cellular material remains within the larger—or mother—cell. Researchers obtain a collection of old cells by watching a single yeast cell under the microscope and pushing the daughter cells aside each time a new one emerges.

To analyze yeast containing mutations in *SGS1*, the scientists counted the number of times a cell divided. They found that alterations in *SGS1* shorten the reproductive life of *S. cerevisiae*. The mutations also cause yeast that have undergone relatively few cell divisions to acquire other defects—such as an inability to mate—that usually affect only old cells. Strains with a short reproductive life due to mutations in genes other than *SGS1* did not display such behaviors of old age. Together, these data indicate that many normal activities of aging occur at an accelerated pace in the *SGS1* mutants.

Further results point to the nucleolus—the part of the cell nucleus where the machinery for producing proteins is made—as a center for aging-related activities. The SGS1 protein resides in the nucleolus. Moreover, both *SGS1* mutants and old normal cells display enlarged and fragmented nucleoli.

"We don't know what happens in humans yet, but this work raises the possibility that there may be important things occurring in the nucleoli," says George M. Martin of the University of Washington Medical School in Seattle. —*E.S.*

Trash to one is treasure to another

Macrophages, a kind of cell in the immune system, usually chew up foreign microorganisms. However, disease-causing mycobacteria—the microorganisms that cause tuberculosis and other illnesses—transform these would-be enemies into safe and comfortable homes for themselves.

To gain entry to a macrophage, mycobacteria salvage a protein that their mammalian hosts have discarded, report Eric J. Brown of Washington University School of Medicine in St. Louis and his colleagues in the Aug. 22 Science.

Harmful mycobacteria invade macrophages by seizing a protein that their mammalian hosts had used to target other bacteria for uptake and destruction by macrophages.

"If we could block this process, we could greatly reduce the efficiency with which mycobacteria get into macrophages—and prevent disease," says Brown.

The study adds to the many features that distinguish mycobacteria from each other and presumably contribute to their different abilities to cause disease. Unlike harmless bacteria, the disease-causing strains can counteract the hostile environment within macrophages.

"Age-old studies show that mycobacteria that don't cause disease can also get into macrophages—by a different mechanism—yet they don't survive," says Lalita Ramakrishnan of Stanford University School of Medicine. "Clearly, harmful mycobacteria have developed special ways to persist inside these cells. It makes a lot of sense that they've also devised a way to ensure entry into this safe environmental niche." —*E.S.*