Astronomy

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

Fooled by gravity

Four years ago, astronomers heralded the discovery of the brightest object in the heavens. A galaxy dubbed FSC 10214+4724, it appeared to shine 100 trillion times as brightly as the sun (SN: 6/29/91, p.406).

But now the spotlight on this distant body has dimmed.

Independent observations from the W.M. Keck Telescope atop Hawaii's Mauna Kea and the Hubble Space Telescope reveal that a cosmic mirage led astronomers astray. The new images indicate that an object in the foreground acts as a gravitational lens for light emitted by FSC 10214+4724, stretching it into the shape of an arc and brightening it considerably. In fact, the galaxy may have only one-tenth to one-thirtieth the brightness originally ascribed to it.

"Its identification as the most luminous galaxy in the universe was an astronomical blooper," says Keck observer James R. Graham of the University of California, Berkeley.

He and his Berkeley colleague Michael C. Liu used the telescope last March to take a detailed near-infrared portrait of the bright body. A lower-resolution Keck image, taken 2 years earlier by other researchers, had already shown the infrared-bright galaxy to have a suspiciously curved appearance. But scientists thought the arclike shape signified the tug of a neighboring galaxy, not an optical illusion.

The new, sharper image, however, looks like a textbook example of a gravitational lens, Liu and Graham assert. They note, for example, that the object believed to be a massive foreground galaxy lies at the center of the arc's curve—just where a lensing galaxy should reside.

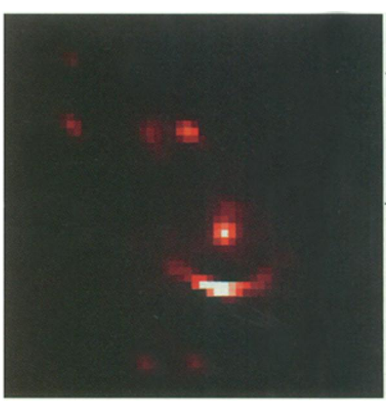
The team subtracted the presumed lensing galaxy from the Keck image and found a faint mirror image of the arc on the opposite side of the galaxy. Theory predicts that such a pair of images should straddle the lensing galaxy.

The researchers say they can't confirm the lensing scenario until observations establish whether the presumed foreground object indeed lies in front of FSC 10214+4724 and at the right distance from Earth. In an earlier study, Peter R. Eisenhardt of NASA's Jet Propulsion Laboratory in Pasadena, Calif., and his colleagues report that images of even higher resolution recently taken with the Hubble Space Telescope offer compelling evidence that the bright galaxy is indeed lensed.

"I have to say that it looks very plausible that this is a gravitational lens," says Michael Rowan-Robinson of Imperial College in London. Robinson accidentally discovered the luminous galaxy during a follow-up study of objects surveyed a decade ago by the Infrared Astronomical Satellite.

The adjusted brightness of FSC 10214+4724 would match that of several infrared-bright galaxies in our vicinity that seem to be evolving into ellipticals. Liu and Graham say that the more distant galaxy may rank as one of the earliest examples of a fledgling elliptical. In another intriguing Keck study, Joseph S. Miller of the University of California, Santa Cruz, and his collaborators have found evidence of a quasar at the heart of the galaxy.

"Although it's not the most luminous object, it still may inhabit a special place in the evolution of galaxies," comments Robinson.


Graham, Liu/Keck Telescope

Infrared, computer-enhanced image of the galaxy FSC 10214+4724 (arc) appears brightened and distorted because of gravitational lensing by a foreground galaxy (center square).

Physics

Probing mercury's atomic skin

Like the atoms of any liquid, those within a droplet of mercury move around randomly. They settle into no particular orderly arrangement. The situation is somewhat different at the drop's surface, however. There, the dense liquid abruptly gives way to a thin atomic vapor. Theoretical studies and computer simulations predict that the surface atoms of a liquid metal organize themselves into distinct layers, creating a kind of skin that extends a few atomic widths into the liquid.

Now, using special X-ray techniques, researchers have for the first time measured and characterized this surface layering in a liquid metal. Olaf M. Magnussen and Benjamin M. Ocko of the Brookhaven National Laboratory in Upton, N.Y., and their collaborators at Harvard University and Bar-Ilan University in Ramat-Gan, Israel, report their findings in the May 29 PHYSICAL REVIEW LETTERS.

The researchers used intense X rays from Brookhaven's National Synchrotron Light Source to probe a sample of mercury, measuring the angles and intensities of X rays reflected off the metal's smooth liquid surface. From these measurements, they could deduce the degree of orderliness among the surface atoms.

"Our results provide the only conclusive experimental proof of surface layering in liquid metals to date," the researchers report. They note that liquid metals other than mercury may also show surface layering. Indeed, very recent experiments indicate that liquid gallium displays such an arrangement.

Research on the surface structure of liquids may prove useful for achieving a better understanding of such processes as soldering, welding, and casting and for developing chemical sensors and other devices that consist of thin films of organic materials layered atop mercury.

Powering up a UV laser for fusion

As part of an effort to develop nuclear fusion into a reliable energy source, engineers at the University of Rochester (N.Y.) Laboratory for Laser Energetics earlier this month inaugurated the world's most powerful ultraviolet laser. Called Omega, this new laser will enable scientists to study the conditions necessary to initiate and sustain fusion by heating and compressing a tiny hydrogen fuel pellet. Results from this research may well have a significant impact on the design of the planned National Ignition Facility (SN: 11/5/94, p.303).

Maintaining chaos in the face of order

Over the last few years, researchers have learned how to suppress and control chaotic behavior in a variety of physical and biological systems. By making small adjustments to one of the parameters governing the system's behavior, they can subdue the erratic motions of a vibrating, metallic magnetoelastic ribbon (SN: 1/26/91, p.60), the fluctuating output of a high-power laser (SN: 2/22/92, p.119), the irregular rhythms of a beating heart (SN: 9/5/92, p.156), and the seemingly random patterns in the electrical activity of nerve cells (SN: 8/27/94, p.134).

Sometimes, however, a system may require chaotic rather than strictly periodic behavior in order to function properly. For example, some medical researchers have suggested that extreme regularity can lead to certain types of heart failure and brain seizures.

Now, William L. Ditto of the Georgia Institute of Technology in Atlanta and his coworkers have developed a scheme for maintaining chaos in a system. By slightly perturbing a system parameter according to a simple recipe, they can keep a system from ever settling into a repeating mode. The researchers describe their "anticontrol" technique and an application in the May 29 PHYSICAL REVIEW LETTERS.