Radio astronomy gets off the ground

If radio astronomers designed a dream machine, this might be it: a telescope more than twice the diameter of Earth that can observe quasars at the edge of the universe, record in exquisite detail the final gasps of material about to plunge into black holes, and examine regions likely to harbor vast numbers of newborn stars—all at a resolution nearly 1,000 times higher than the Hubble Space Telescope achieves in visible light.

That dream became reality last week when Japan's Institute of Space and Astronautical Science launched an 8-meter radio telescope into an elliptical orbit that takes it from 990 kilometers to nearly 20,000 km away from Earth. On its own, the sensitivity of this lightweight device, a meshwork of gold-coated molybdenum wire, is nothing to write home about. But by observing radio sources in concert with an existing network of some 40 telescopes distributed across the planet, this space-based detector promises to provide astronomers with their sharpest view yet of the universe.

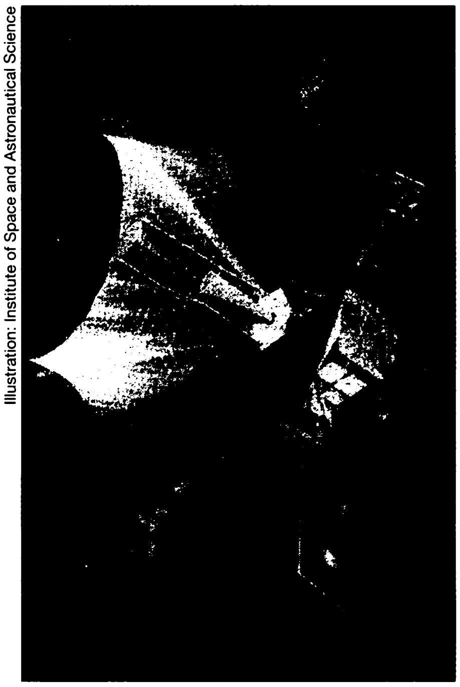
To attain such resolution, astronomers rely on a technique called very long baseline interferometry, which combines images from a group of widely separated telescopes to generate a single, high-resolution image.

Astronomers began using large arrays of radio telescopes on the ground in the 1980s but have been limited by Earth's diameter. "Now . . . we will be able to break this barrier and see fine details of celestial objects that are beyond the reach of a purely ground-based telescope array," says Paul A. Vanden Bout, director of the National Radio Astronomy Observatory in Charlottesville, Va.

With the addition of the Japanese telescope, the resolution of the network has tripled; it now has the sensitivity of a single telescope with a diameter about 2.5 times that of Earth. At that resolution, an observer in Los Angeles could discern a grain of rice in Tokyo.

The Very Long Baseline Space Observatory, as the new, internationally funded system is known, should begin operation in April, recording radio emissions at wavelengths of 18, 6, and 1.3 centimeters. The observatory is best suited to studying bright, compact sources, such as high-speed jets of gas shooting from the center of galaxies, quasars, and other phenomena thought to be fueled by black holes. James M. Moran of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., says the network will enable him to probe emissions from clouds of water molecules orbiting within one-hundredth of a light-year of the black hole believed to reside at the heart of the galaxy NGC 4258.

Illustration: Institute of Space and Astronautical Science



Radio telescope launched last week.

Such clouds constitute cosmic masers—regions that emit intense radio emissions and often indicate sites of new star formation. Calculating precise distances to masers may give astronomers another tool for estimating the scale and age of the universe. —*R. Cowen*

A new direction for microgravity fires

Flames in space sometimes burn into the wind in seeming violation of the laws of physics, report scientists who have studied fire on the space shuttle.

The researchers and shuttle astronauts described their experiments last week at a microgravity conference at the National Academy of Sciences in Washington, D.C. The studies, conducted in February 1996, could improve fire safety aboard the planned international space station.

In one experiment, an astronaut lit the center of a strip of paper clamped inside a wind tunnel. As a slight breeze blew from the right side of the tunnel, the flame bent into the wind and crept toward the right.

"It's almost completely opposite [what happens in] normal gravity," says Takashi Kashiwagi, a fire science researcher with the National Institute of Standards and Technology in Gaithersburg, Md.

Although the phenomenon may strike some people as counterintuitive, Kashiwagi says, it makes sense. In gravity, oxygen flows around the flame, and the airflow determines the direction of the flame's reach. In low gravity, the oxygen downstream becomes depleted, so the flame seeks the most abundant supply of oxygen—the influx of air.

Not all flames in microgravity burn backward, though. In an experiment by Kurt Sacksteder of NASA's Lewis Research Center in Cleveland, the flame

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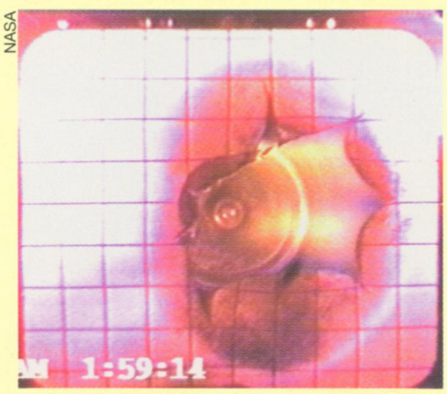

A flame in space, unlike one on Earth, burns into the breeze in this experiment.

traveled in the expected direction.

"At first glance, it may seem that our observations disagree, but they don't," Sacksteder says.

In the first experiment, the flame had paper to burn both upstream and downstream. It headed upstream because that side had more oxygen. In the second experiment, the strip of paper was lit at the end closer to the source of the breeze, with all of the fuel downstream. These flames spread much more quickly than the ones heading upstream in the first experiment.

Sacksteder's experiment also shows that in a slight breeze, materials are more flammable in space than on Earth.

Kashiwagi's research produced what he calls a "crazy, unexplained smoldering phenomenon." A smoldering fire on Earth spreads outward in expanding rings as the fire burns more fuel.

Not in microgravity. A smoldering fire in space sends out tendrils away from the fire source. Each tendril splits into two, and each new tendril divides as the fuel smolders.

Kashiwagi says smoldering fires in space could prove "extremely dangerous" because they are hard to detect and would fill the air with toxins.

Another series of experiments tested how well NASA's smoke detectors work in space. The detectors effectively measured fumes from burning candles, paper, metal wires, and rubber coating, says David L. Urban of NASA's Lewis Research Center. —*P. Smaglik*