Astronomy

Earth-sized radiotelescope record

A team of scientists has made observations of the cosmos with a very fine resolution, using an intercontinental array of radiotelescopes. The researchers were able to make observations of distant galaxies and quasars with a resolution of 100 microseconds of arc, which represents "something of a landmark," says Peter Sheuer of Cambridge University in England in a commentary on an article in the July 14 NATURE. This resolution is two to three times better than the best previous resolution available using radiotelescopes, and 10,000 times better than the best optical telescopes.

The team made, in effect, a radiotelescope the size of the earth by using five to ten radio dishes spanning the earth, all observing the same object at the same time. Such a technique—called very long baseline interferometry—is not new in itself, but the network's sensitivity is constantly being improved. Such high-resolution radio astronomy will allow astronomers to see the "engines that power quasars and galaxies," says one of the paper's authors, Norbert Bartel of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass.

Fluoridating the universe

The abundance of fluorine in the universe has puzzled scientists because there is no plausible way so much could be created in the elemental "nursery" at the center of stars. Two astrophysicists now suggest that the usually noninterfering neutrino might have a hand in arranging things.

The burst of neutrinos recorded during the initial explosion of supernova 1987A demonstrated that such supernovas produce prodigious quantities of neutrinos. Although neutrinos are so weakly interactive they can be ejected into space from the center of a star and leave no mark of their passage, the intense flash of neutrinos during a supernova may create fluorine out of the nuclei of its neighbor on the periodic table, neon, say Stanford Woosley of the University of California at Santa Cruz and Wick Haxton of the University of Washington in Seattle in the July 7 NATURE.

According to their theory, a very small fraction of the neutrinos produced by the supernova excite some of the dying star's neon-20 nuclei, which then take a step down the periodic table by ejecting a proton to create fluorine-19. The process would produce just the ratio of neon-20 to fluorine-19 that we see today, and "could account for the fluorine in our galaxy (and in our toothpaste)," say the researchers.

Small foam-mirror telescope built

A standard 12-inch, *f* 5 reflector telescope might weigh 50 pounds and resemble a hot-water heater. A team of researchers at the University of Arizona in Tucson now has made a telescope with the same specifications but weighing only 10 pounds and standing just 1.5 feet high. The group accomplished this trick by developing metal mirrors with metal-foam cores that are lighter than glass mirrors. For instance, a normal 12-inch mirror would weigh about 20 pounds, but the group's foam-core primary mirror weighs only 4.5 pounds, says team leader Dan Vukobratovich. The lighter mirrors also mean the support system can be lighter, Vukobratovich says.

The foam-core mirrors allow shorter telescope design because the very nonspherical surfaces needed in short focal-length mirrors are difficult to grind into glass but can be engineered right into the metal mirrors, Vukobratovich says.

Vukobratovich thinks he will eventually be able to make lightweight mirrors for about $125 a pound. Such small and relatively inexpensive telescopes are in tremendous demand, he says, not only for amateur astronomy but also for military targeting systems, 35-millimeter telephoto photography, laser communications and other applications.

Biology

Rick Weiss reports from the XIII International Congress of Entomology in Vancouver, British Columbia

What wasps do behind closed doors

"For a long time entomologists have been interested in the nocturnal activities and sleep of social insects," says Manfred G. Walzl of the University of Vienna, Austria. Indeed, he asserts, discreet attempts to discern the after-hours activities of insects appeared in the scientific literature as early as 1916.

Recently, with the help of modern technology, Walzl managed to get the lowdown on hornet nightlife. He used an infrared viewing device to make continuous, nightly observations of two separate hornet nests between 5 p.m. and 4 a.m. — recording on videotape much of what he saw. He went so far as to remove a segment of one nest's outer wall and cover it with a piece of transparent plastic. What he saw wouldn't make a social animal blush, but it answers some old questions.

With mating restricted to a single, fertile queen, it seems there's not much to do but sleep. Come bedtime (10:00 p.m. at the latest, Walzl observed), each hornet crawls head and shoulders into a small, horizontal cell, where it spends the night with its abdomen hanging out. During darkness the nests are not guarded continuously, as they are in the day, but every 20 minutes to 1 hour several workers come out to inspect the outside of the nest. While sleeping, hornets experience "reduced ventilatory pumping" (their breathing slows) until it's time to get up. The first workers leave at 4:00 a.m.

Nobody knows if hornets are afraid of the dark, but Walzl's observations and light-meter measurements suggest some lack of nocturnal aeronautical acumen. When the hornets came home for the evening, he found, "With light above 1 lux [a little brighter than moonlight], the hornets reached the nest directly in flight. Below 1 lux the nest was approached by walking."

Clues to night flight wind-drift correction

Radar operators, as well as entomologists, marvel at the ability of some insect swarms not only to maintain a constant compass orientation — even when flying at extremely high altitudes on moonless nights—but also to correct for displacement by crosswind drift. Unable to know that the "parcel" of air they are flying through is itself on the move, how do these insects keep their flight paths on target, relative to the ground? Scientists are more than simply curious about this; they note that an understanding of the migratory abilities of insects such as locusts and some moths might help them forecast insect movements and design novel pest controls.

"It has already been established that low-flying insects use visual cues to steer in a wind," says Chris M. Addison, of the Imperial College at Silwood Park, Berkshire, England. Additionally, "Theoretical work suggests that moths may be able to detect ground features at starlight illumination." But empirical evidence of this is lacking, he says, and some scientists doubt that visual cues can be of much help to high-flying moths and other insects that manage to stay on track at night while cruising at altitudes of hundreds of meters.

To find out what an insect can and cannot do under such conditions, Addison has designed a "flight simulator" for bugs with the Right Stuff. A live insect is glued to a horizontal needle that is attached to a sensitive torque meter. While the bug is suspended over a screen in a darkened room, moving images are projected from below at varying directions and lightings. The torque meter measures the insect's attempts to make in-flight compensatory turns in response to the imagery; the data are digitized and stored in a computer for analysis.

Addison has no answers yet, but a previous experiment using a specially designed wind tunnel suggested that visual cues are not the key to wind-drift correction. Instead, he says, insects may detect occasional, small-scale air movements within a larger air mass, providing clues about the larger mass's speed and direction.