

A closer view of our galaxy's center

By combining high resolution and high sensitivity, astronomers have produced the most revealing infrared images ever made of our galaxy's star-packed core. Using the European Southern Observatory's New Technology Telescope in La Serena, Chile, German researchers imaged about 340 bright stars within 1.3 light-years of the Milky Way's center, resolving features as small as 0.02 light-year across. Andreas Eckart and his colleagues at the Max Planck Institute for Extraterrestrial Physics in Garching report their findings in the April 20 *ASTROPHYSICAL JOURNAL LETTERS*.

The bright stars they detected at two near-infrared wavelengths are just a hint of the total number of stars that reside at the galaxy's center. Eckart's team used infrared detectors because visible-light emissions from these stars are absorbed by surrounding dust and thus don't reach Earth.

Using the new images and previous estimates of stellar velocities at the center of the galaxy, Eckart and his co-workers calculate that the heart of the Milky Way contains about 1 million stars per cubic light-year — several hundred times the density of other star-packed regions in the galaxy.

The high density could explain a puzzling feature, notes Eckart. His team identified many of the imaged stars as blue supergiants. These massive stars survive for only a few million years and thus must have been born recently in order to be seen at all. Yet the galactic center lacks the dense gas clouds needed to form new stars. The German astronomers suggest that the high rate of collisions within the densely packed star cluster could create the blue supergiants from existing stars.

An illuminating look at the full moon

Just as the full moon makes its monthly debut, the brightness of the lunar surface rises dramatically, far exceeding the luminosity of four quarter moons. For more than a century, astronomers have attributed this surge to a phenomenon known as shadow hiding, in which particles the size of sand grains on the moon's rocky surface play the dominant role in reflecting sunlight.

As seen from Earth, sunlight strikes a less-than-full moon at an angle, not head on. In the shadow-hiding scenario, this illumination causes sand-grain-sized dust particles on the lunar surface to cast shadows on neighboring particles, making the moon look darker from Earth. In contrast, when the moon is full and sunlight strikes head on, the shadows are hidden by the particles that cast them. This would seem to account for the full moon's enhanced brightness.

Now, however, astronomers report that an entirely different phenomenon causes the jump in brightness. Simulating the sun by shining laser light on lunar soil samples, these researchers found that a mechanism called coherent backscattering accounts for the brightening. In backscattering, smaller, soot-grain-sized particles that are stuck to the sand-sized particles on the lunar surface play the featured role. When the moon is full, certain rays reflected by the smaller particles pair up to produce an intensity of light greater than the two rays could produce separately. Thus, the full moon appears brighter than expected, explains Bruce W. Hapke of the University of Pittsburgh.

Coherent backscattering may also account for the brightness surge of other planetary moons, Hapke says. If so, the surface character of each moon may differ from that suggested by reflection measurements. Hapke speculates, for example, that Jupiter's moon Europa may have a fluffier layer of surface ice than scientists thought.

He and his co-workers, Robert M. Nelson and William D. Smythe of the Jet Propulsion Laboratory in Pasadena, Calif., describe their work in the April 23 *SCIENCE*.

Hazardous incinerators?

Each year, 184 incinerators in the United States destroy millions of tons of hazardous materials. Many communities have expressed concerns about the health risks those facilities might pose. Now, epidemiologic studies add weight to those concerns by linking respiratory and neurologic problems to working at or living near such plants. Scientists presented the findings in Atlanta this month at the International Congress on the Health Effects of Hazardous Waste.

Charles E. Feigley and his co-workers at the University of South Carolina in Columbia surveyed a random sample of 894 residents — 508 living downwind of a commercial hazardous-waste incinerator and 386 living upwind in a demographically similar community. Downwinders reported a 50 to 100 percent greater prevalence of coughing, phlegm, wheezing, sore throat, and eye irritation than upwinders. Even after the researchers accounted for age and for exposure to cigarette smoke, mold, and pets, downwinders were 20 to 90 percent more likely than upwinders to have been diagnosed with emphysema, pneumonia, sinus trouble, asthma, or allergies.

Using the same questionnaire, Dietrich Rothenbacher and his colleagues at the University of North Carolina at Chapel Hill polled some 400 households in two communities near a hazardous-waste incinerator — one upwind, the other downwind. Here, too, downwinders reported more diagnosed emphysema, sinus trouble, and sleep-rousing or morning coughs.

Michael Straight and his co-workers at the Agency for Toxic Substances and Disease Registry in Atlanta compared 713 people living within 1.5 miles of a hazardous-waste incinerator to 588 people about 8 miles from the plant. The closer community reported almost nine times more coughing and wheezing, 2.4 times as much neurologic disease (such as seizures and tremors), and 40 percent more neurologic symptoms (including tingling, blackouts, and incoordination).

Melody M. Kawamoto of the National Institute for Occupational Safety and Health in Cincinnati followed up documented reports of headaches, hot flashes, irritability, memory problems, tremors, and erratic blood pressure changes in workers from a then-closed hazardous-waste incinerator. All 14 symptomatic former employees ultimately examined suffered headaches, dizziness, and memory problems.

Researchers led by Woodhall Stopford of Duke University Medical Center in Durham, N.C., examined 29 men who complained of chronic nausea, headache, dizziness, and feelings of intoxication. Between 23 and 50 years of age, all the men had worked at hazardous-waste incinerators. Eight of the 15 men with joint pain had arthritis of unknown cause; more than half the men had middle-ear disease causing vertigo or gait problems; roughly half had memory problems; and 22 exhibited abnormal sweating or wide fluctuations in pulse and blood pressure. Moreover, sleep disorders, severe depression, and recurring suicidal thoughts plagued 27 of the 29 men. "And all [27] had difficulty controlling impulses — rage reactions — either verbally or physically," Stopford says. Indeed, he notes, 16 described "homicidal" thoughts.

None of these studies proves that incinerators harm health. But they do raise strong suspicions that the apparent links are real, Feigley says. He and many other researchers will now begin correlating individuals' symptoms with specific exposures to pollutant plumes or particular chemicals.

"It has been 12 years since federal rules governing the safety of hazardous-waste incinerators have been reviewed or strengthened," says EPA Administrator Carol M. Browner. On May 18, she pledged not only to begin tightening emission controls on new and existing incinerators, but also to convene a task force to evaluate the role of incineration in disposing of the nation's hazardous wastes.