The COBE universe: Portrait at 300,000

Now there's no place left for anomalies to hide. After operating for five months, two instruments aboard the Cosmic Background Explorer (COBE) spacecraft have completed maps showing the distribution of microwave and infrared radiation across the whole sky. Like the preliminary results reported last January (SN: 1/20/90, p.36), the latest measurements of the radiation left over from the Big Bang reveal no distortions that suggest the universe had anything other than a remarkably uniform, smooth beginning.

"We've looked everywhere, and the sky is very smooth," says Charles L. Bennett of the NASA Goddard Space Flight Center in Greenbelt, Md. "This is what the universe looked like only 300,000 years after the Big Bang." Bennett and other members of the COBE team reported their findings at this week's American Physical Society meeting in Washington, D.C.

The most prominent features visible in the new sky maps are two broad regions or lobes — one slightly warmer than the average sky temperature and the other slightly cooler — at diametrically opposite corners of each map. New analyses of COBE data clearly demonstrate that these features result from Doppler shifts in wavelength caused by the motion of the solar system relative to the microwave background.

That result goes a long way toward settling a long-standing question as to whether this so-called dipole effect represents the remnant of some kind of structure or density fluctuation present in the early universe, or is simply the result of solar-system and galactic motion. "We've never really understood whether or not that dipole we see in the sky is due to our velocity . . . or is intrinsic in the background radiation," says David T. Wilkinson of Princeton (N.J.) University. "This shows it's not intrinsic. That's an important result."

The finding also provides additional confirmation that the solar system, the Milky Way and its galactic neighbors are all moving at a significant velocity toward an apparent concentration of mass — a velocity above and beyond that resulting from the expansion of the universe.

Subtracting from the sky map the observed dipole effect and the band of microwave emission from the Milky Way leaves a startling uniformity. "We see nothing," Bennett says. "That suggests, in some sense, a very simple cosmology." Whatever turbulence occurred in the universe's early days after the Big Bang must have been minimal.

The team is now trying to identify possible sources of error in the measurements. "We have a big job ahead of us in that we're looking for deviations from a very simple picture," says Goddard's Michael G. Hauser. "We have to understand our instruments very well. We have to understand what the sky is doing, and that job is still largely before us."

COBE itself continues to collect data. "It's an astonishingly successful instrument," Wilkinson says. "Very little has gone wrong." The only major problem surfaced when one of the spacecraft's gyroscopes failed early in the mission.

— I. Peterson

Sunspots and neutrinos

According to the so-called standard solar model, nuclear fusion reactions at the sun's center pump out vast quantities of energy. About 2 percent of that energy should appear in the form of neutrinos — fundamental particles that interact only weakly with matter.

But that's not what researchers see. Data collected by an Earth-based detector over a period of 20 years suggest that the neutrino flow from the sun varies from time to time rather than remaining constant. Moreover, the flux seems to follow a pattern that runs counter to the rise and fall in the number of sunspots visible on the sun's surface.

"This time variation of the neutrino flux coincides with the well-known 11-year cycle of solar activity," says physicist Kenneth Lande of the University of Pennsylvania in Philadelphia. The neutrino flux is high when solar activity is low and declines to near-zero values as the number of sunspots rises to a peak.

Lande reported the latest measurements from a neutrino detector deep in the Homestake gold mine near Lead, S.D., at this week's American Physical Society meeting in Washington, D.C. The measurements clearly show a sharp drop in neutrino flux starting last year — just as the present solar cycle approached its maximum.

Such a rise and fall in neutrino flow, detected now for the second time in two decades, hints that the effect is real, Lande says. The chance of such a pattern happening randomly is less than 1 percent, according to computer simulations.

At its peak, the neutrino flux is reasonably close to the value theorists predict the flux from the sun should have. "You can think of the peak level as being the real neutrino flux and the reduced level as being the attenuated or modulated level," Lande says. "Something does something to the neutrinos."

No one yet has a clear picture of what exotic mechanism may be responsible for altering the fundamental nature of neutrinos coming from the sun's center or for the apparent link between solar activity and neutrino physics. Preliminary results expected later this year from two new neutrino detectors should help clarify the matter (SN: 10/28/89, p.282). □

Breast cancer rise: Due to dietary fat?

Roughly one in 10 U.S. women will eventually develop breast cancer. Moreover, the incidence of the disease has risen steadily in women over age 44 — by almost 2 percent a year since 1960, according to a new study. Trends uncovered in this and another analysis suggest that fatty diets may help drive the increase.

Andrew G. Glass at the Kaiser Permanente (KP) Center for Health Research in Portland, Ore., and Robert N. Hoover, an epidemiologist with the National Cancer Institute (NCI) in Bethesda, Md., focused on 1,765 Portland women on the KP health plan who were diagnosed with invasive breast cancer between 1960 and 1985. Over the 25-year period, breast cancer incidence rose from an average of 69.2 cases per 100,000 women to 100.3 — but only among women age 45 and older, the researchers report in the April 18 JOURNAL OF THE NATIONAL CANCER INSTITUTE.

Rates also varied dramatically for the two major types of breast malignancies — those with receptors for the hormone estrogen and those without. Between 1974 (when KP began regularly assaying estrogen-receptor status) and 1985, the incidence of estrogen-negative breast cancers rose 27 percent, while that of estrogen-positive cancers increased 131 percent. Increases for both types occurred mainly in women over age 60.

Several previous studies have indicated rising breast cancer rates in several countries, but this is the first to suggest the increase occurs primarily in estrogen-positive malignancies, says NCI medical oncologist F. Andrew Dorr. Because obesity can elevate circulating estrogen levels in older women, potentially making them more prone to estrogen-positive breast cancers, the new data imply that "dietary fat reduction may be important in decreasing the risk of breast cancer," Dorr says.

Geoffrey R. Howe of the National Cancer Institute of Canada concurs that "there is a real possibility" the Portland cancer increase relates to diet. In the April 4 JOURNAL OF THE NATIONAL CANCER INSTITUTE, the Toronto epidemiologist and his colleagues review data from 12 studies of diet and breast cancer. They say their analysis suggests that if all North American women were to lower their daily saturated-fat consumption to 9 percent of total calories — down 30 percent from today's typical level — the breast cancer rate in postmenopausal women would probably fall 10 percent. They also suggest that eating enough produce to achieve a daily vitamin C intake of 380 milligrams might reduce breast cancer incidence by another 16 percent among women over age 20.

— J. Raloff