Balloon Survey Backs COBE Cosmos Map

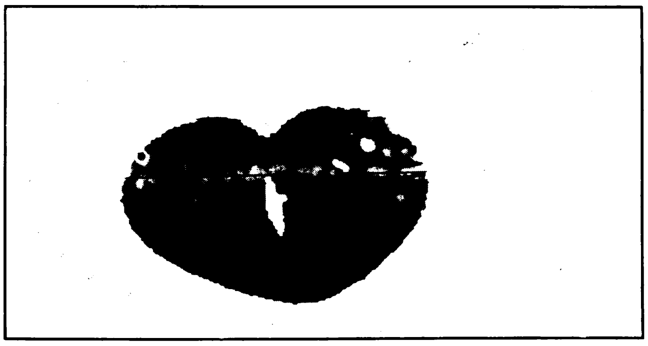
Astronomers made headlines last April when they announced that a NASA satellite had detected what appeared to be tiny temperature fluctuations in the microwave radiation left over from the explosive birth of the universe. Such fluctuations represent gravitational ripples that could have triggered the smooth, youthful cosmos to begin lumping matter together, eventually forming the galaxies and galaxy clusters visible today.

But some scientists worried that the fluctuations might simply reflect errors made by instruments carried aboard the satellite, known as the Cosmic Microwave Background Explorer (COBE) (SN: 5/2/92, p.292). After all, COBE's initial sky map contains about twice as much "noise" as signal.

However, researchers now report that a separate, balloon-borne experiment shows similar microwave variations, strongly supporting COBE's results.

"It's a beautiful result and a beautiful experiment," says cosmologist P.J.E. Peebles of Princeton University in New Jersey. "It's almost certain now that the COBE observations are real and that it has indeed detected the background radiation [left over from the Big Bang]."

Launched from Fort Sumner, N.M., in October 1989, the balloon experiment mapped the microwave background at four frequencies across one-third of the sky, notes team member Edward S. Cheng of NASA's Goddard Space Flight Center in Greenbelt, Md. Its sensitive silicon detectors, which flew for a second time in May 1990, surveyed higher-frequency microwaves than COBE. Thus, the balloon experiment viewed a different part of the microwave background than COBE.



Cheng, Meyer, Ganga, Page

New sky map contains tiny temperature variations that statistically match those mapped by the COBE spacecraft. Bright spot at top left is Jupiter; bright horizontal stripe is our galaxy.

Moreover, emissions from our galaxy – caused by warm dust or by electrons spiraling around magnetic fields, for example – show up with varying intensity on maps developed from the balloon data and COBE data. These differences make the match between the two maps, which agree on both the magnitude of the temperature fluctuations and the average distribution of hot and cold spots, all the more striking, says Cheng. His team, which includes Stephan S. Meyer of the Massachusetts Institute of Technology and Ken Ganga and Lyman Page of Princeton University, reported their findings this week and last at astrophysics meetings in Berkeley, Calif.

"With two totally different systems, it's very unlikely that random noise would give rise to the same lumps at the same places on the sky. People will have a lot harder time imagining errors in the measurements," says Cheng. At the same time, he cautions, the match doesn't prove the signals are left over from the Big Bang.

Temperature fluctuations recorded on the COBE and balloon maps are so faint that the charted hot and cold spots – which vary a mere 30 millionths of a kelvin from the background – represent only average variations over a large scale rather than particular hot and cold regions of the sky, Cheng explains. Furthermore, he notes, the location of a hot spot on one map doesn't necessarily correspond to the precise placement of a hot spot on the other.

For this reason, the researchers relied on statistics to compare a COBE all-sky map at a frequency of 53 gigahertz with their balloon survey of one-third of the sky at 170 gigahertz. The correlation between the two maps was so strong that random noise has no more than a 5 percent chance of accounting for the similarity. This means that, on average, the fluctuations in the COBE map line up with those on the balloon map, says Meyer.

Indeed, at last week's workshop on the cosmic microwave background, COBE scientist George F. Smoot of the University of California, Berkeley, overlaid a COBE map with the balloon survey and expressed delight at the fit.

While the balloon survey detects fluctuations on an angular scale of 3.8 degrees – about twice the resolution of COBE – both examine variations over regions of the sky so widely separated that the variations must have existed soon after the birth of the universe. Angular scale maps of 1 degree or less are required to examine later fluctuations, which are associated with galaxy formation. Peebles suggests that, given the new support for COBE's results, more astronomers will begin ferreting out the evolutionary secrets hidden in such smaller-angle maps. *– R. Cowen*

VOCs: Smog's indoor legacy

Several federal studies have indicated that most exposures to volatile organic chemicals (VOCs), such as benzene and formaldehyde, occur indoors. Now scientists report finding that smog ozone fosters the emission of VOCs from nylon carpets – and presumably from a host of other home materials as well.

The finding provides yet another argument for managing smog, a seemingly intractable problem in many urban areas. However, "what really excites me," says chemist Charles J. Weschler, who led the new study, "is this evidence for indoor chemistry." Until now, he observes, "we've tended to view the indoor environment as relatively static, [pretending] chemistry only occurs outdoors."

Previously, Weschler, of Bell Communications Research in Red Bank, N.J., showed that smog ozone can infiltrate buildings, sometimes attaining near outdoor levels (SN: 9/23/89, p.198). In the December ENVIRONMENTAL SCIENCE & TECHNOLOGY, he and his colleagues report finding that indoor ozone interacts with nylon carpets and their backings.

In each of four experiments, the researchers carpeted a stainless steel reaction chamber whose ventilation system changed the air once each hour. After measuring VOCs for a week, they introduced ozone. When it stabilized at a concentration of 28 to 44 parts per billion in the air, they sampled again.

The presence of ozone boosted the carpets' emission of two suspected carcinogens – formaldehyde, by as much as three-fold, and acetaldehyde, by as much as 20 times. Ozone also generated several other irritating aldehydes not seen earlier, apparently by reacting with the carpets' nylon pile. However, the ozone caused levels of several irritating and potentially toxic VOCs to drop precipitously; these chemicals – including one largely responsible for "new carpet" odor – were apparently given off by the carpets' adhesive and backing. □