with the draft human genome sequence (www.ensembl.org). NHGRI is encouraging a bioinformatics group led by David Haussler and Jim Kent at the University of California, Santa Cruz, to do the same on their Web site (genome.ucsc.edu). "I can't give you a timetable for completion" of this work, says Haussler, but "people in the mouse community should stay tuned." —ELIOT MARSHALL

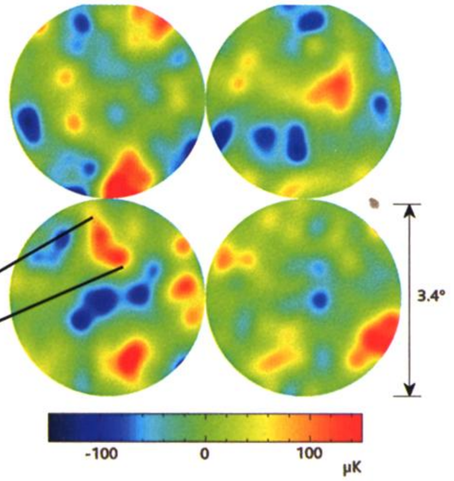
ASTROPHYSICS

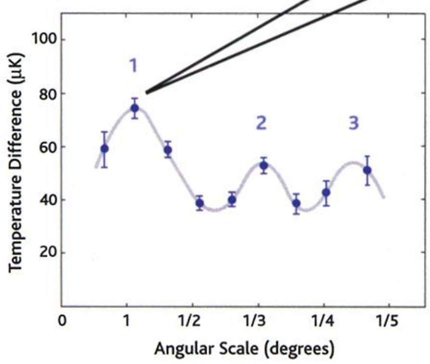
Echoes of the Big Bang Put Theories in Tune

WASHINGTON, D.C.—What once was lost has now been found, and cosmologists are rejoicing. On 29 April at a meeting here of the American Physical Society,* three research groups announced that independent measurements of the cosmic background radiation had solved a troubling mystery posed by earlier data. As a result, scientists from two different branches of cosmology are putting aside their differences and are coming to a long-anticipated concord on a model of the early cosmos and the fraction of "ordinary" matter the universe contains.

"This weekend, I think, is going to be a benchmark that's going to be remembered for a long time in this field," says Andrew Lange, a physicist at the California Institute of Technology in Pasadena. Physicist Max Tegmark of the University of Pennsylvania in Philadelphia agrees. "This is like Santa Claus is arriving," he says.

What has everyone so excited is a follow-up to arguably the biggest physics story of 2000: preliminary results from BOOMERANG, a balloon-borne instrument tuned to listen for the microwave whispers from the early universe (*Science*, 28 April 2000, p. 595). Until about 300,000 years after the big bang, the universe was a roiling blob of plasma, ringing with pressure waves from the cataclysm that created it. According to the reigning acoustic model of the early cosmos, those waves caused density fluctuations in the plasma—fluctuations that now show up as ripples in the microwave background radiation that bombards us from every direction. Last year, BOOMERANG made a celebrated measurement of the characteristic size of those ripples. The data not only supported the acoustic model, but also implied that the universe is flat in a four-dimensional sense and gave some idea of its composition.





Good vibrations. Size distribution of cosmic ripples shows a major peak near 1°.

But something very important was missing. The acoustic model also predicts that overtones from the big bang should have produced smaller ripples—relatively faint second and higher peaks in the microwave spectrum. BOOMERANG heard the fundamental note loud and clear, but where scientists expected to hear overtones, there was merely an awkward silence. Although a ground-based telescope heard hints of an overtone (*Science*, 19 January 2001, p. 414), the missing second peak posed a potentially huge problem for the acoustic model.

No longer. At the meeting, BOOMERANG researchers presented their analysis of 14 times the amount of data that went into last year's result. "We see the first peak very well again, and we do see two more bumps and wiggles out here that indicate the acoustic oscillation of the early universe," said team member John Ruhl, a physicist at the University of California, Santa Barbara. At the same session, John Carlstrom of the University of Chicago presented the first results from the Degree Angular Scale Interferometer, an Antarctic telescope that uses an entirely different technique to measure the microwave background. "We see the first peak, see the second peak, and it strongly suggests a third peak," Carlstrom said. Yet another project, MAXIMA, a balloon-borne experiment similar to BOOMERANG, also sees evidence of a third peak.

"This is a really great party," beams University of Chicago physicist Mike Turner, who says that the acoustic theory has just "passed a very important test."

The new results also iron out a nagging disagreement about how much of the universe consists of so-called baryonic matter, the familiar stuff of atoms, stars, and people. Measurements of the relative abundance of various atoms in the universe give a figure of about 4% of all the mass and energy that scientists think is out there. Until this weekend, cosmic background experiments put the total at 5%—a statistically significant difference. The new, more precise cosmic background measurements bring the two methods into agreement. "The whole controversy business about baryon fraction? Forget about it," says Tegmark.

These results are just the beginning; several experiments were gathering data even as the meeting was going on. Within a year or two, scientists expect to see measurements of the polarization of the background radiation, which carries previously inaccessible information about the early universe, as well as even more precise data from the entire sky. Theorists are worried, Turner jokes. "Now our ideas get tested as soon as we write them down," he says. "We're living dangerously." —CHARLES SEIFE

QUANTUM PHYSICS

Loopy Electron Model Solves Ion Mystery

Newton's laws usually fly out the window in the subatomic realm. Unlike planets around a star, electrons don't loop around their nuclei in nice, elliptical orbits—at least according to the traditional interpretation of quantum theory. But now, an international team of scientists has shown that a nearly Newtonian set of electron orbits can explain

* 28 April–1 May.

CREDITS: DASI