University of Sheffield in the U.K. Knapp sees an additional value: Grasslands may serve as "early warning systems" that ecosystems are being altered by a changing climate—long before the trees migrate northward. **–JOCELYN KAISER**

ASTROPHYSICS

Microwave Telescope Data Ring True

Scientists listening for the faint hiss of radiation left over from the big bang have just gotten an earful. Data from a telescope in Chile designed to hear the cosmic background radiation are providing strong support for theories about how the universe evolved during the first few hundred thousand years after the big bang. The result—which shows a signal that other experiments have missed—is the first from the Cosmic Background Imager (CBI) and the beginning of what scientists say could be a banner year for cosmology.

"It's really an exciting time," says Scott Dodelson, a cosmologist at Fermi National Accelerator Laboratory in Batavia, Illinois. The CBI is catching the whispers of radiation born about 300,000 years after the big bang, when the universe was too hot for atoms to form. Light was constantly scattered in the monstrous plasma fireball, which reverberated with echoes of the great explosion. But as the universe cooled, electrons settled down with nuclei to form atoms. The opaque plasma became transparent, and the light that had been scattered and rescattered broke free.

That light, in the form of microwaves, now bombards Earth from all directions, allowing telescopes sensitive to that radiation to take pictures of the 300,000-year-old universe. Most recently, BOOMERANG, a balloon-borne experiment that circled the South Pole, made an exquisite map of the background radiation in a small region of the sky (*Science*, 28 April 2000, p. 595). But excited astronomers were puzzled when the data failed to show an expected pattern in the distribution of the radiation.

The early universe, scientists knew, rang like a bell after the big bang. Pressure waves rattled throughout the cosmos, causing variations in density that now show up as ripples in the amount of background radiation. And just as a bell's sound is made up of a fundamental frequency and a number of weaker higher-frequency overtones, the pressure waves in the universe had a "fundamental" of large-size peaks and dips in density and "overtones" of smaller and weaker peaks. BOOMERANG detected the fundamental's first peak but failed to detect the overtone second peak—as if theorists had predicted a bell but heard a horn instead. The missing second peak challenged observations of the amount of matter in the universe and threatened theories about how atomic nuclei formed. "It's a dilemma. The cosmic background is telling us one thing, but nucleosynthesis is telling us another," says Dodelson.

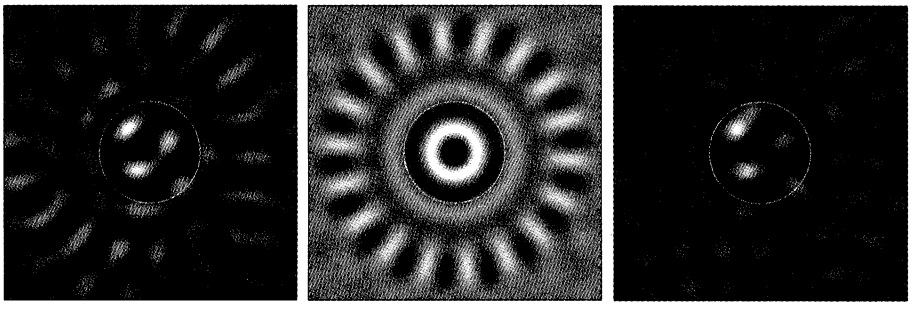
Now, to cosmologists' relief, the latest observations suggest that the second peak is there after all. "I think the discrepancy is real," says Anthony Readhead, an astronomer at the California Institute of Technology in Pasadena who was on the CBI team. "I don't think it is likely to go away."

Unlike the balloon experiments, which detect incoming radiation by converting it into heat, the CBI uses interferometry—detecting the phase and amplitude of incoming microwaves directly. Because interferometers have only recently become sensitive enough to measure cosmic background radiation, it's too early to say that the missing signal is definitely there, says Jeffrey Peterson, a cosmologist at Carnegie Mellon University in Pittsburgh. "But it takes a little of the sting out of the worries about the second peak."

However, Peterson says that another aspect of CBI's observations is worth celebrating now as support for an important theory about the acoustics of the early universe. The data show a drop-off in ripple size as the angular scale gets smaller and smaller, indicating that the overtones are weaker and weaker. "It's kind of exciting. It's the first time it's been seen in one experiment," Peterson says. "The acoustic oscillations in the early universe were dying away. It shows we're on the right track, that the acoustic model is right."

Readhead and his colleagues will publish their work in *Astrophysical Journal Letters*. Meanwhile, they are just beginning to analyze the flood of data from CBI. With more BOOMERANG results to come and other cosmic background experiments in sight, astronomers expect that the infant universe will soon snap into sharper-than-ever focus.

–CHARLES SEIFE



CREDIT: S. PADIN *ET AL.*

High fidelity. Raw microwave readings from the Cosmic Background Imager (left), minus instrument noise (center), reveal reverberations left over from the big bang.

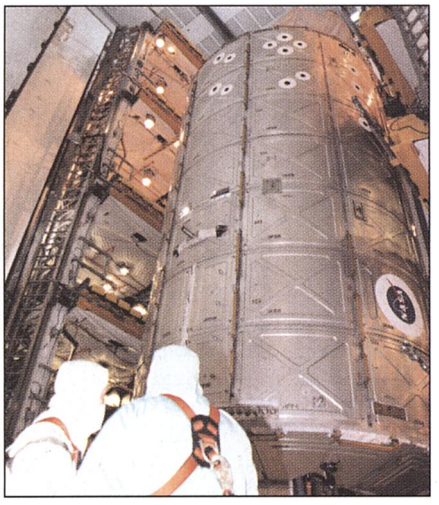
SPACE STATION

U.S. Module to Offer Long-Term Lab Space

CAPE CANAVERAL, FLORIDA—Destiny has arrived for U.S. microgravity scientists. After 17 years of planning, dozens of reviews and redesigns, and billions of dollars, the U.S. scientific centerpiece of the international space station is ready to open its hatches for business. Called Destiny, the 8.5-meter-long aluminum vessel is scheduled for launch next month from Kennedy Space Center here. But putting the laboratory module into orbit—a 19 January launch was delayed 3 weeks due to electrical problems—is only the first step in a long and difficult road toward making the space station a scientifically credible venture.

About 120 researchers have already been chosen to conduct experiments in the lab. But the station's long-term value to U.S. commercial and academic researchers—nearly half the current portfolio is from industry—hinges on the ease of operations in space as well as on NASA's ability to fund, streamline, and provide a clear scientific direction for its troubled life and microgravity sciences effort. "This is going to be our Hubble" Space Telescope, says Kathie Olsen, NASA's chief scientist and acting life and microgravity sciences chief. "We need to get the community involved to do the right type of research."

With space station assembly expected to continue until 2006, the lab initially will look more like a construction site than a haven for research. But NASA managers say the module represents a quantum leap in doing science in orbit, with more room, a bigger crew, and far more computer and electrical power than the aging Russian Mir, due for a fiery death in the atmosphere late next month. It's also expected to be open all day, every day, for more than a decade. Once fully outfitted, 13 of the new module's 24 closet-sized racks holding equipment will be devoted to research, and the rest to operational systems. In time, the space station's scientific capacity will be augmented by modules with European and



Science in motion. The U.S. lab Destiny being moved into the payload bay of the shuttle.

Japanese labs, and the fretwork of metal outside the pressurized labs will provide real estate for astrophysics research. "We now will have more time on orbit, new technology, and a lab built to stay current," says Roger Crouch, chief scientist for the station. "This is an entirely new paradigm for research in space."

Researchers are withholding judgment. "Nobody knows how the station will operate—it's all been on paper for so many years," says Jay Buckey, a medical researcher at Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire, who serves on the National Research Council's (NRC's) space biology and medicine panel. "It's a great opportunity to do research, but it's going to be a challenge," says Peter Voorhees, chief of NRC's committee on microgravity research and a materials scientist at Northwestern University in Evanston, Illinois.

Each rack provides room for individual experiments. The station's crew already is performing some nominal research, including growing corn and soybean seeds, examining movement of structures in a microgravity environment, and photographing Earth. But the seed work is considered "education and outreach" rather than hard science, and the structures experiment has run into technical problems.

With crew time and cargo space devoted to construction, "research for now will be very limited," admits Olsen. And like in any Earth-bound lab, equipment is essential. In March, a Human Research Facility with devices to monitor astronauts will be added, followed a year later by a glove box for performing microgravity experiments, such as combustion research, and a freezer for storing tissue cultures. In the meantime, research will consist of growing crystals and measuring the space environment and its impact on the crew. The station's research future also depends on leadership and money, and both are in doubt. Applications are due by 15 March for the job to head up the life and microgravity sciences office, leaderless since May, and researchers worry that the program is drifting (*Science*, 12 May 2000, p. 938). Last week, NASA informed principal investigators in the program of a 5% budget cut to accommodate pork projects imposed by Congress. "It's not the best message, but we had to come up with some strategy," says Olsen, who is advocating a bigger research budget and finding a seasoned and credible chief to put the program on track.

That credibility won't come easily. Many mainstream biologists and materials scientists remain skeptical of the high cost and low return of space research, noting that last year the NRC criticized NASA's crystallography and biotechnology programs for being too parochial. Voorhees's panel is about to begin a study examining other aspects of space station microgravity science—such as fluid and combustion research—and provide guidance for ground-based efforts, which traditionally have been underfunded.

Getting the lab off the ground could help boost support for station science, but it's only the start. "It will take a while for people to believe this is real," says Kathryn Clark, NASA's chief scientist for human exploration. "After all, it's been on the drawing board for so long." **–ANDREW LAWLER**

CREDITS: (TOP TO BOTTOM) NASA; DAVID GUTTENFELDER/AP

TAIWAN

Political Spat Delays Funding for Academy

TOKYO—Lee Yuan-tseh, the Nobel Prize–winning president of Taiwan's Academia Sinica, is paying a price for his political activism. Opponents of Taiwan President Chen Shui-bian, to whom Lee gave a pivotal endorsement just before last spring's election, have taken out their unhappiness with Lee by withholding legislative approval of Academia Sinica's 2001 budget. The move followed an intense all-day grilling of Lee during what is normally a routine budget hearing and has raised questions about whether partisan politics will hobble Taiwan's premier collection of research institutes.

Costly friendship. Taiwanese legislators may be punishing Lee Yuan-tseh *(left)* for backing President Chen Shui-bian last year.

Lee, a chemist who returned to Taiwan in 1994 after a long career in the United States, is credited with revitalizing the academy by attracting new talent and launching several research programs (*Science*, 19 May 2000, p. 1164). So great is his popularity that he was widely touted as a candidate for premier, and his endorsement of Chen, who was locked in a tight three-way race, was front-page news in Taipei. But his latest initiatives are now on hold after the imposition of what amounts to a budget freeze.

The drama played out through December during the annual budget review. As he has every year since taking the academy post, Lee appeared before the legislature, which is still controlled by an opposition coalition, to explain his request and take questions. This year the legislature was out for blood. "From 9 in the morning until 4:30, all they asked about was his politics," says Sunney Chan, the academy's vice president for academic affairs. The tension grew when Lee, out of the country for a conference, missed a second budget hearing. Miffed at a perceived snub, the legislature withheld $200 million for the academy from a budget it passed on 4 January pending another appearence by Lee after it reconvenes in late February. But the academy is allowed to continue paying salaries and ongoing expenses.

Legislators say they are simply trying to be careful stewards of public money. But newspaper editorialists have characterized their decision as foolish retaliation for Lee's support of Chen. Observers expected the impasse to be resolved after Lee's return engagement. "I don't think [the legislators] will really withhold the budget; they just want some respect from Academia Sinica," says a spokesperson for Taiwan's Government Information Office.

In the meantime, academy officials have rallied behind Lee and are trying to make the best of things. "We are working and everybody's salary is being paid," says (Fred) K. Y. Lo, director of the Institute for Astronomy and Astrophysics. Large expenses have been deferred, however, and a dozen or so new research projects are stalled because of an inability to recruit technicians or postdocs. "It's going to mean a 6-month delay in starting these programs," says James Shen, director of the Institute for Molecular Biology.

Lo says the real worry is that the skirmish could undermine the "stability and continuity" of support for Academia Sinica and for scientific research in general. "If this goes on every year," he adds, "it could discourage [top researchers] from coming to Taiwan. I don't think the legislature has considered these consequences." **–DENNIS NORMILE**