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CLASSY ANTARCTIC BALLOON CAPTURES EARLIEST LIGHT OF THE UNIVERSE

McMurdo Station, Antarctica -- If you think penguins in Antarctica look classy in their tuxedos, you should see our scientific balloon wearing a top hat.

TopHat, an innovative hat-shaped astronomy experiment that sits on top of a balloon, launched successfully from McMurdo Station, Antarctica, on January 4 at 8:00 p.m. local time (2:00 a.m. EST) and is now circling the frozen continent at 120,000 feet, collecting light from the cosmic microwave background radiation.

Tophat is the second balloon experiment currently flying over Antarctica. The first, launched Dec. 28, 2000, is carrying an experiment for Louisiana State University, the Advanced Thin Ionization Calorimeter, that is gathering data on galactic cosmic rays.

TopHat has already collected enough data to satisfy its minimum mission success criteria. Depending on operational conditions and constraints, it may fly for another several days to several weeks before the payload is cut down and recovered.

Observing the microwave background, formed 300,000 years after the big bang, enables scientists to understand the nature of our Universe when it was an infant. The radiation comes from an era before the creation of stars and galaxies.

"The cosmic microwave background allows us to determine very basic things about our Universe, such as its size and mass," said Edward Cheng, the TopHat Team Leader at NASA's Goddard Space Flight Center in Greenbelt, Md.

TopHat was built by a collaboration consisting of NASA's Goddard Space Flight Center, the University of Chicago, University of Wisconsin, and the Danish Space Research institute.

Since the Universe is now about 10 to 15 billion years old, knowing its properties at early times gives crucial "snapshots" of the state of the Universe that allow scientists to build detailed theories of how it changes over time.

"It is remarkable that we can determine so much with such data," said Stephan Meyer, the TopHat Team Lead at the University of Chicago. "For instance, they will measure the mass of the Universe to about 10 percent accuracy. The data will also help to establish whether the Universe will expand forever, or eventually collapse upon itself."

TopHat measures the clumpiness of matter when the Universe was very young. This is seen as slight intensity differences in the cosmic microwave background radiation. By comparing the clumpiness of the Universe back then with what we observe today, we can test various theories of how this change, or "evolution", takes place. These theories depend in detail on the fundamental properties of the Universe: its mass, size and age.

Last year, two balloon experiments (MAXIMA and BOOMERANG) determined that the Universe is geometrically flat, that is, obeys Euclidean geometry; will expand forever; and comprises about 5 percent ordinary matter we can see, 30 percent dark matter of an unknown nature, and 65 percent dark energy, a mysterious force that is accelerating the

expansion rate of the Universe. Much of this information comes from the larger scale clumpiness (about the size of the Moon or Sun in the sky) that is seen in that data.

TopHat is designed to look at this size of clumpiness, as well as things that are down to half this size, with greater accuracy. It is expected by theory, and hinted at by the previous experiments, that the TopHat data will provide a powerful way to tell which of several explanations of the current data are correct.

The TopHat experiment includes a spinning telescope and a detector system. It maps a 48-degree diameter disk of the sky above the Southern Polar Cap. The telescope simply spins at a constant rate about its vertical axis. As the Earth rotates, this entire cap is observed each day. There is a payload at the bottom of the balloon as well, in the traditional location. This bottom payload provides the power and computer support for the top payload, which is restricted in weight because of its location. TopHat took six years to design and build.

"This is the first time we have ever attempted to fly a complex payload on the top of a balloon," Cheng said. "This unique vantage point allows the payload an unobstructed view of the entire sky, and it minimizes the worry of stray emission and reflected Earth light from the balloon and the structure supporting the bottom payload."

TopHat requires two balloons for launching. A smaller balloon lifts the top payload from above until the larger, main balloon is strong enough to support its 200-pound mass from beneath. The smaller balloon is detached before the main balloon is released. After release, the balloon picks up the bottom payload as it rises.

TopHat and similar Antarctic experiments can only fly once a year when the weather and winds are agreeable. TopHat may fly once more in 2002. Data from the current flight will take up to one year to analyze.

TopHat's data will serve as an excellent pathfinder for the Microwave Anisotropy Probe (MAP), a space mission planned for a June 2001 launch that will map the cosmic microwave background with unprecedented accuracy.

TopHat's development is supported by grants from NASA and the National Science Foundation. The NSF Office of Polar Programs also supports all the Antarctic logistical elements of the project. Balloon launch and flight operations are provided by NASA's National Scientific Balloon Facility.

"We're very excited about the science from this new data set as well as the promise of this new ballooning technique," said Cheng. "We have worked hard over the past six years with the talented and innovative folks at NASA's National Scientific Balloon Facility in Palestine, Texas, to develop these techniques. It is wonderful and exhilarating to see them come to fruition."

For more information about the cosmic microwave background and TopHat, including daily images and live video feed, refer to <http://topweb.gsfc.nasa.gov>. Both Antarctica flights can be tracked live on the Internet at <http://192.149.107.13/ice0001.htm>.