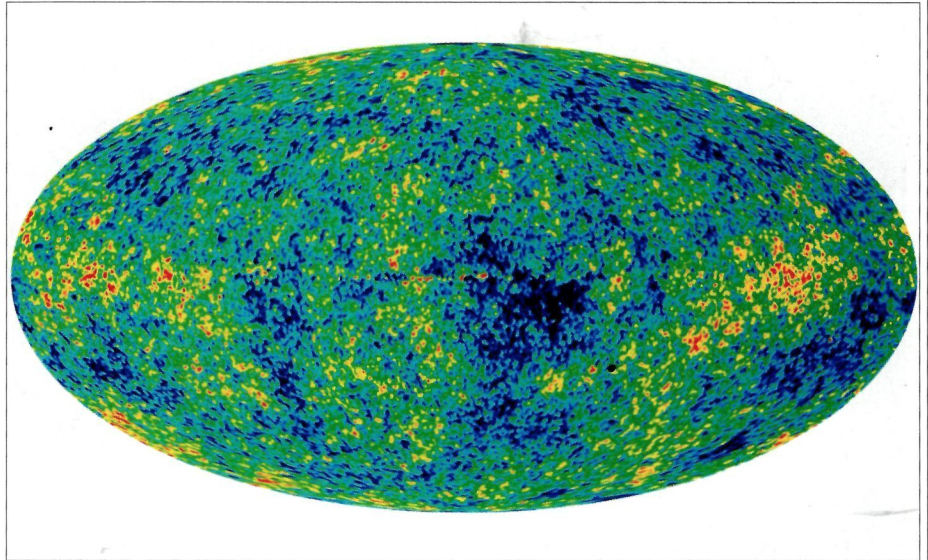


Microwaves map the early universe in detail...

The eagerly awaited first full-sky map from the Wilkinson Microwave Anisotropy Probe (WMAP) has been released by NASA. The satellite, which has been observing the cosmic microwave background radiation from its orbit around the L2 Sun–Earth Lagrange Point since October 2001, provides the sharpest view yet of the early universe. Among the satellite's new findings is that 73% of the universe is in the form of dark energy, while only 4% is in the form of ordinary, baryonic matter.

WMAP (formerly MAP) – named after David Wilkinson of Princeton University who was a pioneer of cosmic background studies and who died last year – has an angular resolution some 40 times better than that of its predecessor, the Cosmic Background Explorer (COBE). This improved resolution enables it to resolve temperature fluctuations in the 2.73 K background radiation of only millionths of a degree.

By combining the new data with other kinds of measurements, the WMAP team can say that this radiation dates back to 380 000 years after the Big Bang, and that stars first ignited 200 million years after the Big Bang. The new results also imply that the



The oldest light in the universe as revealed by the WMAP satellite. Red indicates the warmer regions, blue the cooler ones. (NASA/WMAP Science Team.)

universe is 4% baryonic matter, 23% cold dark matter and 73% dark energy in a form more like a cosmological constant than a negative-pressure energy field. The WMAP satellite is also able to measure the polarization of the radiation, and this has provided new evidence for inflation in the

early universe. The results have already ruled out a "textbook example" of a particular inflation model.

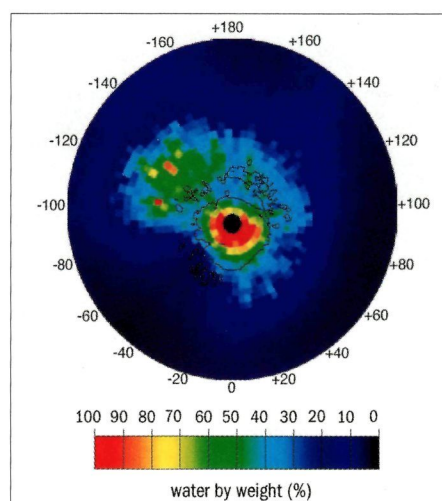
Further reading

http://map.gsfc.nasa.gov/m_mm/pub_papers/firstyear.html

...while neutrons map the ice on Mars

The Los Alamos National Laboratory (LANL) has released the first global map showing the distribution of hydrogen just below the surface of Mars, as measured by the instruments on NASA's Mars Odyssey spacecraft. The neutron spectrometer, which was built by LANL, detects the neutrons emitted when cosmic rays strike the Martian surface. Hydrogen in the soil can slow down and absorb the neutrons, and so regions where a low intensity of intermediate-energy neutrons is found, indicate soil enriched in hydrogen, most probably in the form of water-ice.

The Mars Odyssey spacecraft has been observing the planet for an Earth year, which is equivalent to a little more than half a year on Mars. This has allowed the team at LANL to see both poles without the



Water abundance on Mars north of 45 degrees latitude; the southern pole shows a similar distribution. (LANL.)

obscuring seasonal layer of frozen carbon dioxide. The poles are the main regions where the hydrogen occurs, but the LANL researchers were surprised to find areas near the equator with relatively large concentrations of hydrogen, close to 10% in some places.

The LANL researchers estimate that there is a sufficient amount of water to cover the planet to a depth of 13 cm or more. The challenge now is to work out just how the water ended up in the soil and the rocks beneath the Martian surface, and to develop further theories of hydrology and climate on Mars.

Further reading

<http://www.lanl.gov/worldview/news/releases/archive/03-019.html>

Picture of the month



At 1.9 K, the superconducting magnets for CERN's Large Hadron Collider may be colder than the cosmic background radiation, but astronomers have now found an even colder place, the Boomerang Nebula, 5000 light-years from Earth. The two-lobed cloud, shown in this false-colour image that was made by the Hubble Space Telescope, has apparently been created by gas and dust expanding rapidly from an old central star. The gas has cooled to about 1 K as a result of the expansion.
(R Sahai and J Trauger (JPL), NASA/ESA.)

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