

Edited by Emma Sanders

Latest news from the early universe

This month the first elements of the Very Small Array will be installed on Mount Teide in Tenerife. This is one of a number of new projects studying the cosmic microwave background.

Observations of the cosmic microwave background (CMB) are the closest that astronomers can get to the beginning of the universe. It dates from 300 000 years after the Big Bang, when radiation decoupled from matter. Fluctuations in the CMB are evidence for the first clumping of matter particles – the seeds of the galaxies we see today.

The 14 antennae of the Very Small Array (VSA) will map small areas of the sky from 26 to 36 GHz with a sensitivity of 5–10 μ K. The VSA will be capable of the two-dimensional mapping of real features and it is expected to be up and running by next summer.

By then, results from the Boomerang balloon experiment will be out. This experiment uses the polar wind to stay aloft and enables the balloon to circle the South Pole for more than 10 days. Thus it avoids the fate of other

balloon experiments, which only have a short observation time. The VSA, with its greater resolution, will be able to follow up in more detail any areas of interest identified by the balloon. Balloon observations have different systematic errors than ground-based telescopes, so results are complementary.

Future projects include the US Cosmic Background Imager, to be installed in the Atacama desert, Chile, and the Degree Angular Scale Interferometer at the South Pole.

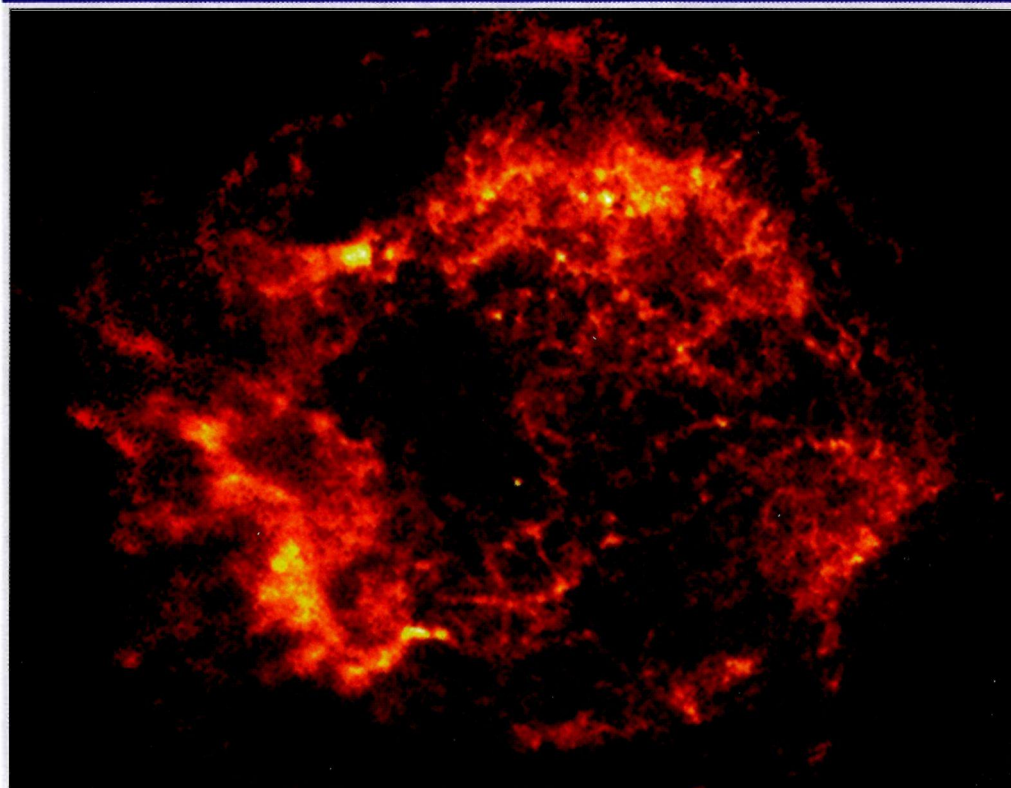
It is an interesting time for CMB observations. Following the great leap forward made by the COBE satellite in 1992, which measured the background fluctuations for the first time, years of data analysis and new ground-based experiments are providing fuller and more detailed results. A recent analysis of CMB data has even cast doubt on inflation – the most stalwart theory of the early evolution of the universe. However, other investigations suggest that the discrepancy may be due to instrumental error. The VSA and Boomerang

experiments will be in a position to find out.

The study of foreground microwave radiation has also progressed. New sources of microwave emission have been discovered, such as spinning dust grains in our galaxy. When this is better understood, it will make for more accurate CMB results. NASA's Microwave Anisotropy Probe, which is scheduled for launch late next year, will perform the next all-sky survey as a follow up to COBE. At the other end of the spectrum, NASA's X-ray satellite, Chandra, may provide crucial data with its observations of galaxy clusters, the largest scale clumping seen in the universe today. Cosmologists are hoping for some real advances. At worst, they will have to wait for the launch of ESA's Planck satellite some time after 2007 (*CERN Courier* July p14).

The VSA is a collaboration between Cambridge University, Jodrell Bank and the Canary Islands Institute for Astrophysics. The Boomerang partners are the US and Italy, with contributions from the UK and CERN.

Picture of the month

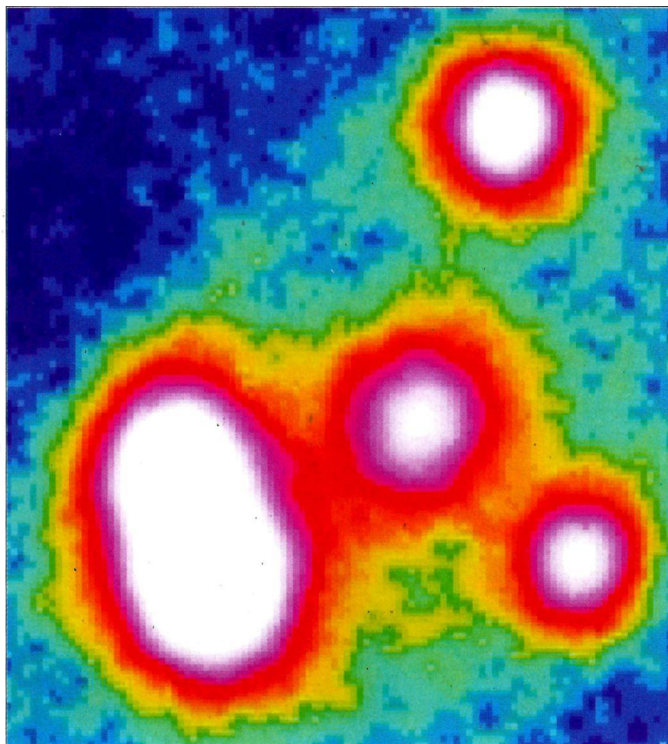


This image of the Cassiopeia A supernova remnant is the first from the new Chandra X-ray satellite, which was launched this summer (*CERN Courier* September p15). Cassiopeia A is an expanding shell of gas, of about 10 light-years in diameter with a temperature of about 50 million degrees centigrade. It is the remnant of a star that exploded about 300 years ago. (NASA/CXC/SAO.)

New study of distant quasars

Subaru, Japan's new 8.3 m telescope on Mauna Kea in Hawaii (*CERN Courier* March p9), is being used for a new study of gravitationally lensed quasars. A luminosity of more than 100 galaxies is emitted from a quasar, which has a volume no larger than our solar system.

Einstein's theory of General Relativity shows that the gravitational pull from massive objects is able to deflect rays of light like a lens. For example, astronomers see four bright images of the quasar PG1115+080 more than 10 billion light years away. The four lensed images appear around a much nearer, massive galaxy in the centre, which acts as the lens. The relative brightness and position of the individual images gives a measure of how rapidly the universe is expanding.



Gravitationally lensed image of a distant quasar (PG1115+080) viewed through the Japanese Subaru telescope. (National Astronomy Observatory of Japan.)

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