

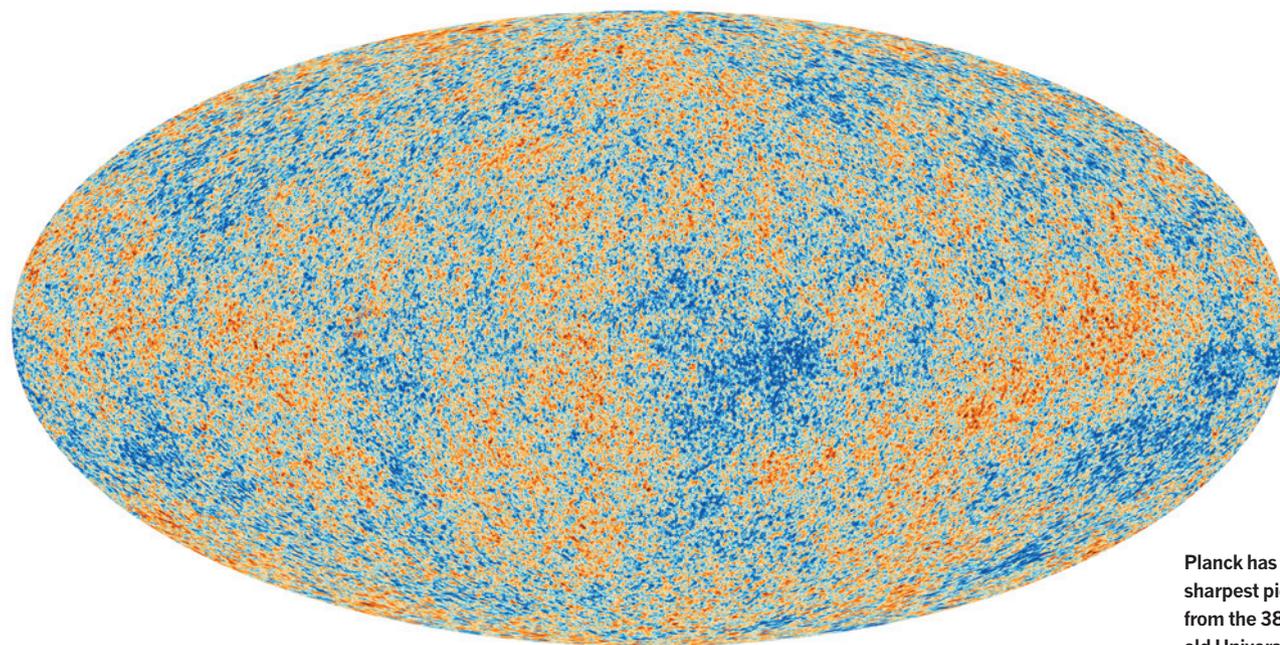
# NEWS IN FOCUS

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Planck has unveiled the sharpest picture of light from the 380,000-year-old Universe.

## COSMOLOGY

# Planck snaps infant Universe

*Space telescope culls exotic creation theories with ultra-precise microwave map.*

BY MARK PELOW

For astronomers, it is the ultimate treasure map. On 21 March, the Planck space telescope team released the highest-precision map yet of the cosmic microwave background (CMB), the faint but ubiquitous afterglow of the Big Bang. Crowning nearly 50 years of CMB study, the map records the precise contours of the nascent Universe — and in doing so pins down key parameters of the Universe today.

The tiny fluctuations embedded in the CMB map reveal a Universe that is expanding slightly more slowly than had been thought. That dials back the amount of gravity-counteracting 'dark energy' to 68.3% of the Universe, and adds a little more unseen dark matter to the mix. It also means that the Universe is a little older: 13.82 billion years old, adding a few tens of millions of years to the previously calculated value. The map even shows that the number of neutrino 'flavours' permeating the cosmos will probably remain at three — had there been

a fourth, the Universe would have expanded more quickly during its first moments.

These results represent refinements of numbers obtained by previous missions such as the Wilkinson Microwave Anisotropy Probe (WMAP). Where the Planck spacecraft, watching the sky from a vantage point 1.5 million kilometres away, breaks the most new ground is in its support for the reigning theory that describes the instant after the Big Bang. The theory, known as inflation, holds that during an unimaginably rapid expansion lasting just  $10^{-32}$  seconds or so, the Universe grew from a subatomic point to something the size of a grapefruit that then continued to expand at a more stately pace. This growth spurt would help to explain why the Universe we see today

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For more on the Planck mission:  
[go.nature.com/ylwzmu](http://go.nature.com/ylwzmu)

is homogeneous on the largest scales, yet riddled with clumps, filaments and sheets of galaxies.

"Planck could have found that there was

something majorly wrong with inflation," says astrophysicist Jo Dunkley at the University of Oxford, UK, who has worked on data from Planck and the WMAP. "Instead, we've got new evidence that this expansion did happen."

In the minutes that followed the burst of inflation, particles such as protons and electrons formed from the cauldron of proto-matter, and photons began to bounce around like pinballs. It was only 380,000 years later, when the charged plasma cooled into neutral atoms, that those photons could fly freely. Today they make up the CMB, and carry with them an imprint of the quantum fluctuations that roiled the inflationary Universe.

Seen in the map as tiny variations around an average temperature of 2.7 kelvins, the fluctuations caused alterations in the density of matter, which ultimately snowballed into the galaxies seen today. "All the structures we see in the Universe are coming from these little perturbations," says Paul Shellard, a Planck cosmologist at the University of Cambridge, UK. ▶

PLANCK COLLABORATION/ESA

► Inflation, proposed in 1980 by Alan Guth, a physicist now at the Massachusetts Institute of Technology in Cambridge, predicts that the range of temperature variations should follow a bell curve — a smooth Gaussian distribution. Cosmologists had found hints in previous missions that the distribution was not so smooth, suggesting that some other process was involved in inflating the Universe (see *Nature* <http://doi.org/bgjd86>; 2008). But so far, Planck's temperature data look almost perfectly Gaussian, and standard theories for inflation are looking ever more secure.

"A lot of baroque inflationary models are gone," says Paul Steinhardt, a theoretical physicist at Princeton University in New Jersey, who has tried to poke holes in inflation by proposing theories such as ekpyrosis, which invokes a cyclical Universe that dies and is reborn in a series of Big Bounces.

But the cosmological case is not quite closed. There are a few details in Planck's map that seem out of place: an odd 'cold patch', for example, and a greater proportion of hotspots on one side of the sky. Moreover, Planck's value for the Hubble constant, which describes the rate of expansion of the Universe, is surprisingly low compared with estimates made with other astronomical techniques — perhaps a hint of new physics in play.

Full confirmation of inflation — and clues about what drove it — will depend on the detailed properties of the CMB's photons. The wrenching moment of inflation should have shaken the very fabric of space-time, resulting in gravitational waves. They in turn may have left a pattern in the polarization of the photons. The Planck team expects to release its polarization data early next year. "If we found gravitational waves, we'd get a Nobel prize — it's a big deal," says George Efstathiou, director of the Kavli Institute for Cosmology in Cambridge, UK, and one of Planck's lead researchers.

The exceedingly faint polarization signal may lie beyond the reach of Planck's detectors. Ground-based microwave telescopes, such as the Keck Array in Antarctica, are also in on the hunt, although they are limited to looking at one hemisphere of the sky, and in certain microwave frequencies, because oxygen in Earth's atmosphere can block some of the CMB photons. Charles Lawrence of NASA's Jet Propulsion Laboratory in Pasadena, California, the lead Planck scientist in the United States, says that it may take another space telescope to finish the job, or perhaps even a mission, decades away, to detect the gravitational waves directly.

But in terms of temperature variations, Lawrence says, astronomers will have to be content with Planck, which "squeezes pretty much all the juice out of the CMB". He finds that juice very sweet, even if it leaves a few questions beyond reach. "We have a pretty good idea of what the Universe is, but we don't have the faintest idea why it is," says Lawrence, adding with impish glee: "It's rather fun, isn't it?" ■



BENVIGNÙ/GUAGLIA/IFEG FOTOSERVIZI

A naked woman joined protesters in Rome calling for stem-cell therapy for all incurably ill patients.

## REGENERATIVE MEDICINE

# Stem-cell ruling riles researchers

*Italian health minister's support for a controversial treatment appals the country's scientists.*

BY ALISON ABBOTT

Clinics that offer unproven stem-cell treatments often end up playing cat and mouse with health regulators, no matter which country they operate in. In Italy, however, one such treatment now has official sanction. The country's health minister, Renato Balduzzi, has decreed that a controversial stem-cell treatment can continue in 32 terminally ill patients, mostly children — even though the stem cells involved are not manufactured according to Italy's legal safety standards.

The unexpected decision on 21 March has horrified scientists, who consider the treatment to be dangerous because it has never been rigorously tested. In the opinion of stem-cell researcher Elena Cattaneo of the University of Milan: "It is alchemy".

The decision followed weeks of media pressure to authorize compassionate use of the therapy, which was developed by the Brescia-based Stamina Foundation and has been repeatedly banned in the past six years. Now,

patient groups are pushing for the treatment to be available to anyone with an incurable illness. Hundreds protested in Rome on 23 March, including a naked woman with pro-Stamina slogans painted on her skin.

Stamina Foundation president Davide Vannoni, a psychologist at the University of Udine, says that the publicity around the treatment has won him 9,000 new patients. He hopes that further modifications to the law will allow him to expand the therapy.

A month ago, an investigatory television programme, *The Hyena*, reported that children with incurable diseases such as spinal muscular atrophy were being denied supposedly important treatment, and Italian show-business personalities joined the call to relax rules on stem-cell treatment.

In Italy, the compassionate use of as-yet-unapproved therapies is allowed on an emergency basis for dying individuals who have no other options, and the national health service must provide them for free. The law requires that health authorities approve the quality of such therapies, but some of its terms