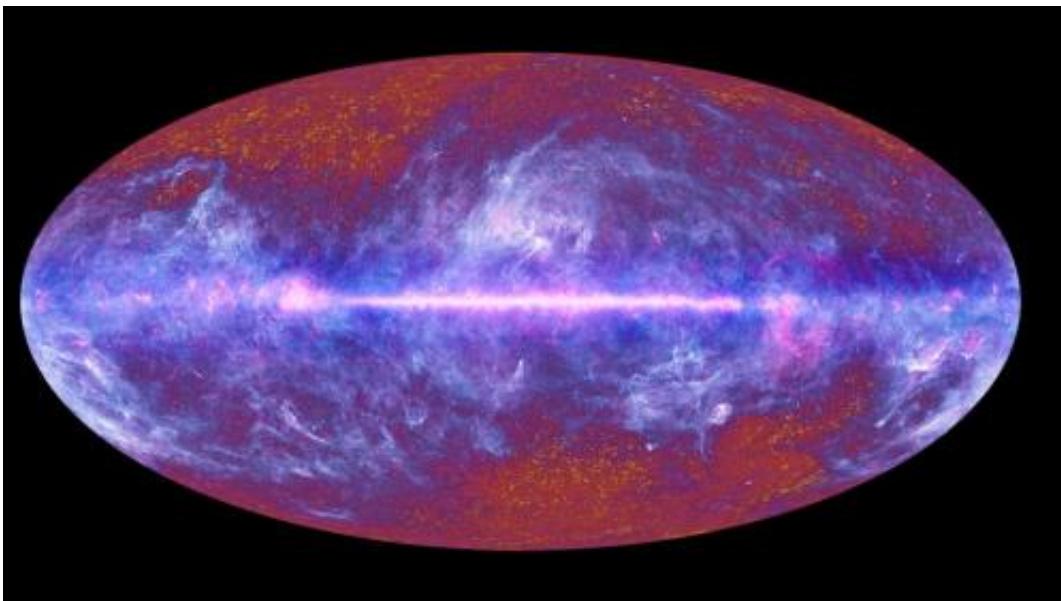


# First hundred thousand years of our universe: Researchers find tantalizing new hints of clues

August 7 2013, by Lynn Yarris

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This is the microwave sky as seen by Planck. Mottled structure of the CMB, the oldest light in the universe is displayed in the high-latitude regions of the map. The central band is the plane of our Galaxy. Credit: European Space Agency

Mystery fans know that the best way to solve a mystery is to revisit the scene where it began and look for clues. To understand the mysteries of our universe, scientists are trying to go back as far they can to the Big Bang. A new analysis of cosmic microwave background (CMB) radiation data by researchers with the Lawrence Berkeley National

Laboratory (Berkeley Lab) has taken the furthest look back through time yet – 100 years to 300,000 years after the Big Bang - and provided tantalizing new hints of clues as to what might have happened.

"We found that the standard picture of an early universe, in which radiation domination was followed by matter domination, holds to the level we can test it with the new data, but there are hints that radiation didn't give way to matter exactly as expected," says Eric Linder, a [theoretical physicist](#) with Berkeley Lab's Physics Division and member of the Supernova Cosmology Project. "There appears to be an excess dash of radiation that is not due to CMB photons."

Our knowledge of the Big Bang and the early formation of the universe stems almost entirely from measurements of the CMB, primordial photons set free when the universe cooled enough for particles of radiation and [particles of matter](#) to separate. These measurements reveal the CMB's influence on the growth and development of the large-scale structure we see in the universe today.

Linder, working with Alireza Hojjati and Johan Samsing, who were then visiting scientists at Berkeley Lab, analyzed the latest satellite data from the European Space Agency's Planck mission and NASA's Wilkinson Microwave Anisotropy Probe (WMAP), which pushed CMB measurements to higher resolution, lower noise, and more sky coverage than ever before.

"With the Planck and WMAP data we're really pushing back the frontier and looking further back in the history of the universe, to regions of high energy physics we previously could not access," Linder says. "While our analysis shows the CMB photon relic afterglow of the Big Bang being followed mainly by dark matter as expected, there was also a deviation from the standard that hints at relativistic particles beyond CMB light."

Linder says the prime suspects behind these relativistic particles are "wild" versions of neutrinos, the phantomlike subatomic particles that are the second most populous residents (after photons) of today's universe. The term "wild" is used to distinguish these primordial neutrinos from those expected within particle physics and being observed today. Another suspect is dark energy, the anti-gravitational force that accelerates our universe's expansion. Again, however, this would be from the dark energy we observe today.

"Early dark energy is a class of explanations for the origin of cosmic acceleration that arises in some [high energy](#) physics models," Linder says. "While conventional dark energy, such as the cosmological constant, are diluted to one part in a billion of total energy density around the time of the CMB's last scattering, early dark energy theories can have 1-to-10 million times more energy density."

Linder says early [dark energy](#) could have been the driver that seven billion years later caused the present cosmic acceleration. Its actual discovery would not only provide new insight into the origin of cosmic acceleration, but perhaps also provide new evidence for string theory and other concepts in [high energy physics](#).

"New experiments for measuring CMB polarization that are already underway, such as the POLARBEAR and SPTpol telescopes, will enable us to further explore primeval physics, Linder says.

Provided by Lawrence Berkeley National Laboratory

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