Baby universe picture brought closer to theory

August 4 2014

Last year, the Planck Telescope revealed the most detailed picture of the cosmic microwave background, the relic radiation from the Big Bang. But this map contains features that challenge the standard model of cosmology, the theory that describes our entire Universe from early on. Who is right, the map or the theory? Scientists from EPFL (Switzerland) and CEA (France) have shown that several of these enigmatic features disappear from the map by processing Planck telescope's data differently and including other effects, such as the motion of the Milky Way. The findings are published in the August 4th, 2014 edition of the *Journal of Cosmology and Astroparticle Physics*.

Our eyes see what is called visible light. But there is a lot of light that we can't see, like ultraviolet and microwave radiation. It turns out that a weak glow of microwave radiation fills the entire sky, in regions between stars. But where does this glow come from?

According to our current understanding of the Big Bang, this glow of microwave radiation is relic light emitted by the Universe when it was a mere 380 000 years old. Before that, the Universe was completely opaque, since light was trapped by a hot plasma. But as the Universe expanded and cooled, electrons and protons combined to form stable atoms, and light was free to propagate for the first time.

In principle, this first light has traveled through time and is reaching us now in the form of microwave radiation. Slight variations in this background radiation indicate the seeds of current structure in the

Universe, from planets, solar systems, and galaxies all the way to clusters of galaxies, clusters of clusters.

The European Space Agency set out to map this radiation to unprecedented resolution by launching the Planck space telescope. Scientists collected information from the telescope and processed it to remove unwanted foreground light, like from stars and galaxies. The information was then assembled together to give the most detailed map of microwave radiation of cosmic origin – a microwave photograph of the early Universe.

The Cold Spot: a few tens of millionths of a degree, a big problem for the theory

While the map is generally in agreement with our current theory of the Big Bang, it also contains unexpected features at large-scales, called anomalies. For example, the famous "cold-spot". On Planck's map, this region of the universe is characterized by its unusually low temperature. It is just a matter of a few tens of millionths of a degree difference in temperature, which might seem negligible, but it is enough for the map to no longer entirely fit the theory.

Cosmologists are at odds over the source of these anomalies. Do these large-scale features reveal phenomena that require new physics? Or does the information gathered by the Planck space telescope need to be processed differently?

Tuning the data

A recent European study led by EPFL cosmologist Anaïs Rassat indicates that several of the anomalies disappear if the data from the Planck satellite are processed in a new way. "Using new techniques to separate the foreground light from the background, and taking into account effects like the motion of our Galaxy, we found that most of the claimed anomalies we studied, like the cold spot, stop being problematic," explains Rassat.

Previous methods were left with some regions of unwanted light that needed to be masked in the analysis. Instead, Rassat and her partners from CEA in France, studied a map that avoided masking techniques altogether, giving access to the whole sky. Next, they corrected the data by taking into account the way our Galaxy moves. They also adjusted the data for distortions in the relic light itself as it traveled through moving charged particles in an expanding Universe as well as other known gravitational effects.

Still room for new physics

While Rassat and her collaborators have shown that several anomalies were no longer problematic, others may nevertheless persist in the data. For Rassat, this work is just a first step towards systematically going through all of the possible large-scale irregularities and trying to explain their origin. Until then, there is still room for new physics.

Provided by Ecole Polytechnique Federale de Lausanne

Citation: Baby universe picture brought closer to theory (2014, August 4) retrieved 5 May 2024 from https://phys.org/news/2014-08-baby-universe-picture-brought-closer.html