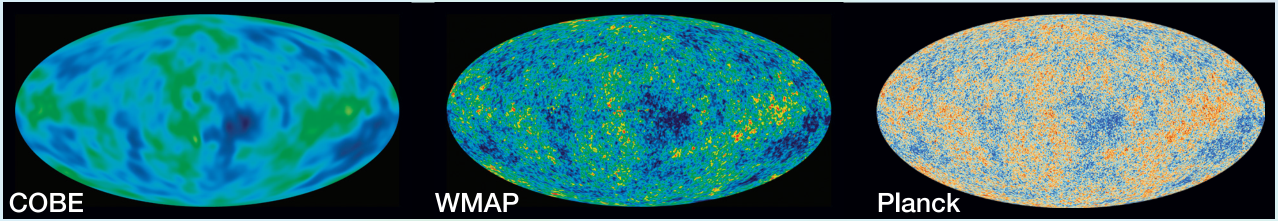

Looking Back In Time

The Big Bang theory predicts that our universe emerged from a tremendously dense and hot state. At first, photons were completely trapped by the cloud of hot, charged, primordial matter that made up the early universe in much the same way that car headlights are unable to penetrate a dense fog. As the universe continued to expand, it began to cool, allowing the charged particles to combine to form atoms; there came a point in time when the interactions between photons and charged particles subsided enough to allow light to escape into space.

When scientists measure cosmic microwave background radiation (CMB), they capture a glimpse of the faint “afterglow” of the radiation that initially escaped into space about 370,000 years after the Big Bang and has only now reached the Earth. The CMB is very “cold” (2.725 Kelvin) and can only be “seen” in the microwave region of the electromagnetic spectrum. When scientists first measured CMB, it appeared uniform across the entire sky, but as observations improved, it soon became apparent that this was not the case. Tiny fluctuations in CMB provide scientists with great insight into the origin, evolution, and content of the “infant” universe.

Maps of the CMB have been produced in the 1990s by NASA’s Cosmic Background Explorer (COBE) (top left) and in the 2000s by NASA’s Wilkinson Microwave Anisotropy Probe (WMAP) (top middle), and most recently by ESA’s Planck space telescope-top right. These maps depict an all-sky picture of the infant universe, when it was about 370,000 years old. The signal from our galaxy has been removed. The COBE, WMAP, and Planck observations of the microwave sky have progressively improved our understanding of detailed composition and structure of our universe. In order to appreciate the full resolution of the Planck data, this card would have to be the size of a poster. Zoomed-in images of the WMAP and Planck maps (bottom) reveal the details this improvement in resolution enables. In these skymaps, hot regions, shown in red, are 0.0004 Kelvin hotter than the cold regions, shown in blue and purple. More information about the recent Planck data release is available here: http://planck.ipac.caltech.edu.

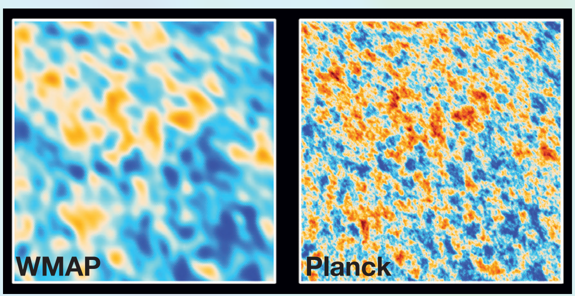

Image credit: ESA and the Planck Collaboration; NASA / WMAP Science Team