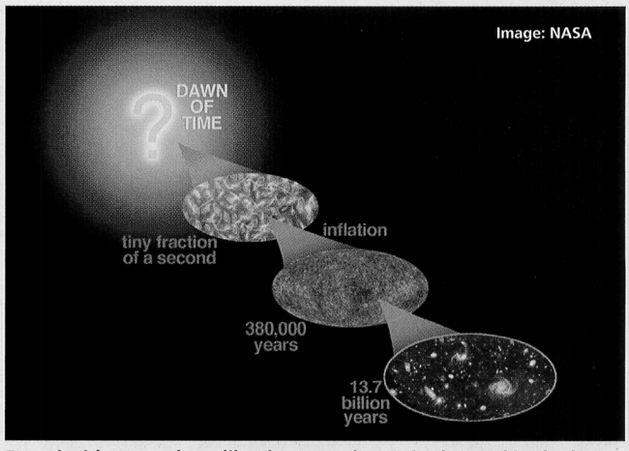
Closer to the BIG BANG

A new satellite has discovered the first stars in the Universe, writes Charles Lineweaver.



From inside our galaxy, like the ones shown in the oval in the lower right, the WMAP satellite has been able to see the faint glow of the Big Bang – a glow that we can still see coming to us from every direction from the most distant reaches of the Universe, and from a time when the Universe was only 380,000 years old. The hot and cool spots (red and blue, respectively) depicted 380,000 years after the Big Bang are the seeds of structure that grow through gravitational collapse and become galaxies. It is believed that these hot and cool spots were imprinted on the Universe a tiny fraction of a second after the Big Bang during a period called "inflation". Scientists are still trying to work out what might have happened before inflation at the dawn of time.

On 12 February 2003, the Universe became a different place when a flurry of results from a new NASA satellite were released. The first stars in the Universe had been detected only 200 million years after the Big Bang – much earlier than expected. With years worth of new data, the Wilkinson Microwave Anistropy Probe (WMAP) satellite had determined the age of the Universe with unprecedented precision: 13.7 billion years with an error of only 2%. The Big Bang sailed through another detailed test.

The most revolutionary new result is the precision with which WMAP has confirmed our strangest ideas about the contents of the Universe. It confirmed that we have no idea what 95% of the stuff in the Universe is made of. We know this mysterious 95% is there because it gravitates; some of it holds galaxies together and some of it is making the expansion of the Universe speed up. WMAP was able to measure this effect, confirming that there is a lot of stuff in the Universe that we know very little about.

Imagine you buy a well-stocked restaurant, fully supplied with utensils, dishes, pots, pans, oven, tables and chairs. The place is big and spacious. You're happy -- you have everything you need.

But while you're poking around in your new digs you find a mysterious door. It opens into a huge warehouse full of stuff – unlabelled boxes that are heavy. In fact, you now have 20 times more stuff in your warehouse than you had in your restaurant. Where did all this stuff come from? What is it?

This is our situation today. We don't know what is in the boxes. We haven't been able to open them. Of the boxes, 22% are labelled "cold dark matter". No one has ever detected cold dark matter in a laboratory so we don't really know what that means.

Another 73% are labelled "energy of the vacuum". This is the stuff that is making the expansion of the Universe speed up. This is the foot on the accelerator. You can't really get your hands on it because it really is nothing. It had a particularly powerful effect during the Universe's "inflationary period", which probably happened about 10^{-33} of a second after the Big Bang.

During this period, the Universe expanded by many orders of magnitude. Since then the expansion has slowed down and the Universe is now being more gently pushed apart by the energy of the vacuum. Luckily, 5% of our Universe is made of normal run-of-the-mill atoms -- the stuff that humans, stars and computers are made of. But who ordered all the stuff in the warehouse?

Over the past 5 years, astronomers have been collecting strong evidence that 95% of the stuff in the Universe is not normal atomic matter. But the WMAP results are the strongest and most precise evidence for this bizarre situation.

Skeptical astronomers have never liked the idea of cold dark matter, and we all had to swallow hard when the energy of the vacuum started showing up in the data. Now the WMAP has depleted the ranks of the skeptics even further and we are left to wonder: "What is all this stuff?"

With exceptionally sensitive measurements, accurate to a few millionths of a degree, the WMAP satellite was able to map in great detail the fading glow of the hot Big Bang, or the creation of the Universe. From this information we have been able to piece together the evolution of the Universe from then until now.

Astronomers are incredibly excited about these results. The first stars have been found. The age of the Universe has been pinned down. Our weirdest ideas about the composition of the Universe have been confirmed. Now we can ask new questions about the time before the first stars. And we can wonder what all that weird stuff really is.

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