BBC

HOW DO WE KNOW THE BIG BANG ACTUALLY HAPPENED?

Audio slideshow transcript: Capturing the afterglow of the Big Bang

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This is one of the most detailed pictures ever taken of the entire night sky. You can see the band of the Milky Way running all the way across.

There's a bright patch at the centre, which is the middle of our galaxy. Because light takes time to travel through the vast distances of space, we're looking at our galaxy as it was 27 thousand years ago. But what if we could peer even further back in time? What would the universe look like then?

In 1964, Arno Penzias and Robert Wilson did exactly that. And they did it by accident.

Penzias and Wilson were trying to study space by looking at microwaves rather than visible light. While testing their equipment, they noticed a constant signal that was the same in whatever direction they looked. Where could this signal be coming from?

If it came from our own galaxy, it would be stronger in some directions than in others.

Beyond our own galaxy the universe is clustered into galaxies with empty space between. So a signal that came from somewhere in particular would vary in strength depending on where the sensors were pointing.

Penzias and Wilson thought that the signal could have come from a time when all the matter in the universe was spread evenly through space.

This indicated that the universe had once looked very different from today: The first strong evidence that the universe had begun with a Big Bang. But the story doesn't end there.

Astronomers realised that to learn more about this background microwave radiation, they would have to go to space.

In 1992, the Cosmic Background Explorer showed that Penzias and Wilson's signal wasn't quite as uniform as we thought.

The data it gathered were just as surprising as the original signal. They showed that the early universe wasn't entirely uniform after all. And while these ripples are tiny, they might suggest reasons why matter is clumped together the way it is today. They hint at the starting conditions which seeded the stars and the galaxies, which we all know now so well.

In 2013, ESA's Plank Telescope made the most accurate map of the universe yet. And it revealed a strange asymmetry in the background radiation. Astronomers still don't know

what caused this. And while the new pictures don't challenge the Big Bang theory, they do mean there's still plenty left to explain about how the universe came to be the way it is today.

Images (in order of appearance):

- *Image of the deep sky. Credit: Axel Mellinger*
- *Image of Arno Penzias and Robert Wilson. Credit: Emilio Segre Visual Archives/American Institute of Physics/Science Photo Library*
- *Image of ECHO horn antenna. Credit: NASA/Science Photo Library*
- *Image of Messier 81. Credit: Adrian Jones, courtesy of the BBC The Sky At Night Flickr group: http://www.flickr.com/groups/bbcskyatnight*
- *Image of the Horsehead and Flame Nebulae. Credit: Terry Hancock, courtesy of the BBC The Sky At Night Flickr group: http://www.flickr.com/groups/bbcskyatnight*
- *Diagram and images of the Cosmic Background Explorer by NASA*
- *First "baby picture" of the universe. Credit: NASA*
- *Artist's impression of the Planck spacecraft. Credit: ESA - C. Carreau*
- *Image of Planck enhanced anomalies. Credit: ESA and the Planck Collaboration*
- *Image of the night sky. Credit: DC, courtesy of the BBC The Sky At Night Flickr group: http://www.flickr.com/groups/bbcskyatnight*