

BIG BANG THEORY AND EXPANSION OF UNIVERSE

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Abstract:

One of the most challenging problem in Physics. Recent research work suggest that the whole universe is expanding in an accelerated frame. What causes this acceleration? Big Bang theory explains that.

Introduction: Big Bang Theory - The Premise:

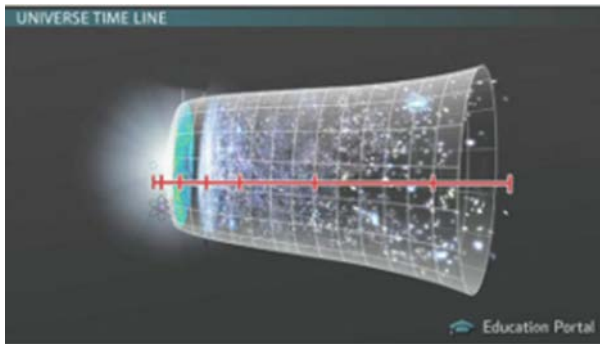
The Big Bang theory is an effort to explain what happened at the very beginning of our universe. Discoveries in astronomy and physics have shown beyond a reasonable doubt that our universe did in fact have a beginning. Prior to that moment there was nothing; during and after that moment there was something: our universe. The big bang theory is an effort to explain what happened during and after that moment.

According to the standard theory, our universe sprang into existence as "singularity" around 13.7 billion years ago. What is a "singularity" and where does it come from? Well, to be honest, we don't know for sure. Singularities are zones which defy our current understanding of physics. They are thought to exist at the core of "black holes." Black holes are areas of intense gravitational pressure. The pressure is thought to be so intense that finite matter is actually squished into infinite density (a mathematical concept which truly boggles the mind). These zones of infinite density are called "singularities." Our universe is thought to have begun as an infinitesimally small, infinitely hot, infinitely dense, something - a singularity. Where did it come from? We don't know. Why did it appear? We don't know.

After its initial appearance, it apparently inflated (the "Big Bang"), expanded and cooled, going from very, very small and very, very hot, to the size and temperature of our current universe. It continues to expand and cool to this day and we are inside of it: incredible creatures living on a unique planet, circling a beautiful star clustered together with several hundred billion other stars in a galaxy soaring through the cosmos, all of which is inside of an expanding universe that began as an infinitesimal singularity which appeared out of nowhere for reasons unknown. This is the Big Bang theory.

Big Bang Theory:

Have you ever wondered how the universe started? How all of this came into being? Ever hear of the Big Bang theory? No, not the TV show. The Big Bang is the theory astronomers use to explain how our universe came into being, and it's too bad we couldn't be there to witness it because the Big Bang was quite a show! The **Big Bang theory** is the current model that describes the early development of the universe.



Big Bang Theory - Common Misconceptions:

There are many misconceptions surrounding the Big Bang theory. For example, we tend to imagine a giant explosion. Experts however say that there was no explosion; there was (and continues to be) an expansion. Rather than imagining a balloon popping and releasing its contents, imagine a balloon expanding: an infinitesimally small balloon expanding to the size of our current universe.

Another misconception is that we tend to image the singularity as a little fireball appearing somewhere in space. According to the many experts however, space didn't exist prior to the Big Bang. Back in the late '60s and early '70s, when men first walked upon the moon, "three British astrophysicists, Steven Hawking, George Ellis, and Roger Penrose turned their attention to the Theory of Relativity and its implications regarding our notions of time. In 1968 and 1970, they published papers in which they extended Einstein's Theory of General Relativity to include measurements of time and space. According to their calculations, time and space had a finite beginning that corresponded to the origin of matter and energy. The singularity didn't appear *in* space; rather, space began inside of the singularity. Prior to the singularity, *nothing* existed, not space, time, matter, or energy - nothing. So where and in what did the singularity appear if not in space? We don't know. We don't know where it came from, why it's here, or even where it is. All we really know is that we are inside of it and at one time it didn't exist and neither did we.

Universe Time Line:



Big Bang Theory - Evidence for the Theory:

What are the major evidences which support the Big Bang theory?

- First of all, we are reasonably certain that the universe had a beginning.
- Second, galaxies appear to be moving away from us at speeds proportional to their distance. This is called "Hubble's Law," named after Edwin Hubble (1889-1953) who discovered this phenomenon in 1929. This observation supports the expansion of the universe and suggests that the universe was once compacted.
- Third, if the universe was initially very, very hot as the Big Bang suggests, we should be able to find some remnant of this heat. In 1965, Radio-astronomers Arno Penzias and Robert Wilson discovered a 2.725 degree Kelvin (-454.765 degree Fahrenheit, -270.425 degree Celsius) Cosmic Microwave Background radiation (CMB) which pervades the observable universe. This is thought to be the remnant which scientists were looking for. Penzias and Wilson shared in the 1978 Nobel Prize for Physics for their discovery.
- Finally, the abundance of the "light elements" Hydrogen and Helium found in the observable universe are thought to support the Big Bang model of origins.

Big Bang Theory - The Only Plausible Theory?

Is the standard Big Bang theory the only model consistent with these evidences? No, it's just the most popular one. Internationally renowned Astrophysicist George F. R. Ellis explains: "People need to be aware that there is a range of models that could explain the observations. For instance, I can construct you a spherically symmetrical universe with Earth at its centre, and you cannot disprove it based on observations. You can only exclude it on philosophical grounds. In my view there is absolutely nothing wrong in that. What I want to bring into the open is the fact that we are using philosophical criteria in choosing our models. A lot of cosmology tries to hide that.

In 2003, Physicist Robert Gentry proposed an attractive alternative to the standard theory, an alternative which also accounts for the evidences listed above. Dr. Gentry claims that the standard Big Bang model is founded upon a faulty paradigm (the Friedmann-lemaitre expanding-spacetime paradigm) which he claims is inconsistent with the empirical data. He chooses instead to base his model on Einstein's static-spacetime paradigm which he claims is the "genuine cosmic Rosetta." Gentry has published several papers outlining what he considers to be serious flaws in the standard Big Bang model. Other high-profile dissenters include Nobel laureate Dr. Hannes Alfvén, Professor Geoffrey Burbidge, Dr. Halton Arp, and the renowned British astronomer Sir Fred Hoyle, who is accredited with first coining the term "the Big Bang" during a BBC radio broadcast in 1950.

Big Bang Theory - What about God?

Any discussion of the Big Bang theory would be incomplete without asking the question, what about God? This is because cosmogony (the study of the origin of the universe) is an area where science and theology meet. Creation was a supernatural event. That is, it took place outside of the natural realm. This fact begs the question: is there anything else which

exists outside of the natural realm? Specifically, is there a master Architect out there? We know that this universe had a beginning. Was God the "First Cause"? We won't attempt to answer that question in this short article. We just ask the question:

Does God Exist?

References:

1. Steven W. Hawking, George F.R. Ellis, "The Cosmic Black-Body Radiation and the Existence of Singularities in our Universe," *Astrophysical Journal*, 152, (1968) pp. 25-36.
2. Steven W. Hawking, Roger Penrose, "The Singularities of Gravitational Collapse and Cosmology," *Proceedings of the Royal Society of London, series A*, 314 (1970) pp. 529-548
3. Mark Eastman, Chuck Missler, *The Creator: Beyond Time and Space*, (1996) p. 11.
4. W. Wayt Gibbs, "Profile: George F. R. Ellis," *Scientific American*, October 1995, Vol. 273, No.4, p. 55.

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