Steady State Theory

Introduction

A few different theories about the origin of the universe exist today. The Steady State Theory was developed in the late 1940s. This chapter offers an overview of this theory as well as comparing it to the Big Bang theory.

What is the Steady State Theory?

The term 'steady state' means a stable condition that does not change over time or in which change in one direction is continually balanced by change in another. The Steady State Theory of the origin of the universe is also referred to as the infinite universe theory or continuous creation. This theory was proposed by Hermann Bondi, Thomas Gold, and Sir Fred Hoyle.

The Steady State Theory states that our universe looks the same from every spot in it and at every time. A steady state universe has no beginning or end. Bondi and Gold suggested that in order to understand the universe we need to observe its distant parts. To interpret these observations we must use the laws of physics. For Bondi and Gold the laws of physics would have to be the same in all parts of the universe and at all times. The Steady State Theory states that although the universe is expanding, it does not change its look over time. For this to work, new matter must be formed to keep the density equal over time.

According to the Big Bang theory, the matter around us was created out of nothing in the beginning. Hoyle tried to solve the problem of creation mathematically. He proposed that the decrease in the density of the universe caused by its expansion is balanced by the continuous creation of matter. The matter condenses into new galaxies that replace receded galaxies. The expansion and creation work against each other and a steady state of energy is maintained.

Helium and hydrogen are the most common elements in the universe. A helium atom is created from a hydrogen atom in the process of nuclear fusion that occurs within stars. The steady state astronomers stated that these large quantities of hydrogen and helium in the universe are created by supernovae. The Big Bang theory suggests that all elements were produced at the start of the universe out of nothing. Now, both theories accept that supernovae play an important role in the formation of heavy elements.

Problems of the Steady State Theory

The Steady State Theory began to fade in the 1960s after the discovery of quasars. A quasar is thought to be a luminous galactic core, powered by a super-massive black hole. Quasars are so far away from us that their light has taken several billion years to reach the Earth. So, quasars are objects from the past which indicate that a few billion years ago the structure of the universe was very different from how it is today.

The final 'blow' to the Steady State Theory was delivered by radio astronomers Arno Penzias and Robert Wilson. These scientists discovered the cosmic microwave (high frequency radio wave) background which is thought to be leftover radiation from the Big Bang. The Steady State Theory has explained this background radiation as the light from ancient stars which has been absorbed and emitted in all directions by galactic particles. Most astronomers were not convinced by this explanation because the discovered microwave background was very smooth, meaning that it did not come from different small sources. Also, its spectrum is close to that of an ideal black body. In physics a black body is the body that absorbs all electromagnetic radiation. The Steady State Theory is now no longer accepted by most cosmologists. Today the majority of astronomers consider the Big Bang theory to be the best description of the origin of the universe.

Source: http://www.skwirk.com.au/p-c_s-4_u-138_t-402_c-1413/nsw/science/the-big-bang-and-our-universe/the-formation/steady-state-theory

Big Bang Theory

Introduction

This chapter covers the Big Bang theory of the origin of the universe. The theory was proposed by American scientist Edwin Hubble. Today the Big Bang theory is accepted by most astronomers as the best explanation of the origin of the universe.

What is the Big Bang theory?

The term 'universe' means all of time, space, matter and energy. It is everything that we know. The universe holds everything from the tiniest particle to the clusters of galaxies, known as super-clusters.

The Big Bang theory states that the universe was formed about 14 billion years ago as the result of a giant explosion of very dense and hot matter. This matter expanded and started to cool down, going through different transitional phases. The universe has been expanding ever since.

The first scientist to come up with the idea of a 'big bang' was the astrophysicist Friedrich Franz Friedmann who used relativity field equations to prove that the universe is expanding. Edwin Hubble's observations later proved this theory. Hubble discovered the red shift of galaxies. He measured their distances from Earth by observing variable stars called Cepheids. The red shift distance law of galaxies is now referred to as Hubble's Law.

The discovery of cosmic microwave background radiation in 1965 made the Big Bang theory the best theory of the origin and evolution of the universe. Radio astronomers Arno Penzias and Robert Wilson discovered the cosmic microwave (high frequency radio wave) background which is thought to be leftover radiation from the initial explosion of matter - the 'Big Bang'.

Apparently this theory was called 'The big bang' by a radio commentator who was mocking it. Initially the theory was called 'The primeval atom'. Today astrophysicists with a sense of humor sum up the Big Bang theory as the following: First there was nothing, then there was the bang and then there was everything.

The formation of the solar system

According to the Big Bang theory, the solar system was formed from a cloud of space dust and gas that was 'squeezed' by a supernova explosion. As the nebula contracted, it spun increasingly rapidly, leading to frequent collisions between dust grains. Gravity pulled the gas and dust together, forming a **solar nebula.** This solar nebula grew hotter and denser, forming a disk of gas and dust in its centre. Particles of nebula dust started to stick together, forming clumps that eventually formed planets and their satellites. Eventually the hot centre of the solar nebula formed a star - the sun. Different planetary particles left over from this initial explosion can still be found flying around in space. These particles are called **meteorites.** By studying these meteorites**,** scientists have found that our solar system is about 4 600 million years old.

Problems with the Big Bang theory

Like all scientific theories, the Big Bang theory has its pros and cons. For example, the cosmic background radiation, which is the main proof of the Big Bang Theory, comes from widely separated parts of the sky. These regions are too far from each other to be able to interact with each other, even with signals travelling at the speed of light. But according to the smooth background radiation whose sources have similar properties, they must have interacted with each other. This problem is referred to as the 'horizon problem'.

Another problem with the Big Bang theory is the 'flatness' problem. The experimental evidence is that the present universe has very low geometrical curvature in its space-time. In other words, it is flat. According to the Big Bang theory, the universe expands but unless this expansion is confined to an incredibly narrow range of possibilities, it would not have stayed 'flat'.

Scientists and philosophers have been arguing over different theories of the origin of the universe for centuries. All scientific theories are subject to constant re-evaluation and change.

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Formation of Earth

Introduction

This chapter offers an overview of the formation of the Earth. The Earth is a part of the solar system and it has been influenced by its elements since it was formed. This chapter also discusses the inner structure of the Earth.

Rocks of the Earth

Our physical environment consists of different parts like stars, planets, air and water. Earth is one of the eight planets that form the solar system. A planet is a large celestial body which orbits around a star. The solar system consists of a star called the sun and a group of planets called Mars, Venus, Earth, Mercury, Jupiter, Saturn, Uranus, and Neptune. Satellite photographs of the Earth show that it is a sphere.

Calculating the ages of rocks is very important for establishing not only the history of geological events, but also for determining the rates of geological processes. The radiometric method is the most accurate method used for dating rocks. This method is based on calculating the age of rocks according to the radioactive decay of chemical elements that are natural components of all rocks.

Scientists studying the geological history of Earth are called geochronologists. The oldest rocks that have been found on Earth are about 4600 million years old. That is how old our planet is considered to be.

The Earth is born

According to the Big Bang Theory, the solar system was formed from a cloud of space dust and gas that was 'squeezed' by a supernova explosion. Gravity pulled the gas and dust together, forming a **solar nebula.** This solar nebula grew hotter and denser, forming a disk of gas and dust at its centre. Particles of nebula dust started to stick together, forming clumps that eventually formed planets and their satellites.

At first, the Earth looked like a ball of hot bubbling liquid rocks made from different chemical elements and compounds. Some rocks were heavier than others. After a while heavy rocks started to 'sink', moving toward the centre of the Earth. Lighter rocks moved towards the Earth's surface. This separation of rocks took millions of years. As the light-weight surface rocks were cooling down they became harder. The hard surface of the Earth is called the crust.

The Earth became a planet with a hard crust about 4000 million years ago. Even though it was a much cooler place by then, it was still too hot to support any forms of life. Also at that stage, the Earth did not have any water or air. Earthquakes, volcanic eruptions, comets and meteors were common events at that time. They were the main forces shaping the newly-formed surface of the Earth. Plate tectonics and crashing meteors led to the formation of mountains and waterbeds.

All the above-mentioned data come mostly from studying how seismic waves travel through rocks.