

Briefly describe the most popular theory about the origin of the universe?

Briefly describe what is Big Bang theory?

## Introduction to the Universe

"There was 'no' before the beginning of the universe, because once upon a time there was no time"

John D. Barrow.

Our universe is collections of galaxies and superclusters. It came into ~~was created~~ existence 13.7 billion years ago.

Although there are many theories and ancient myths explaining about the mysteries of the universe, the Big bang theory is the most popular and accepted one.

## Big Bang Theory

The Big bang theory states that the universe ~~was~~ exploded from an infinitely hot and dense point, <sup>thousand times</sup> smaller than a pinhead - called primeval atom, into the vast universe we look today. This explosion brought about matter, time, energy and space. Scientists are uncertain what existed before that triggered the massive explosion.

## Discovery of the Big bang theory

The theory was given by George Lemaitre in 1927, also known as the father of <sup>the</sup> Big bang. Two years later, the theory was confirmed by another astronomer Edwin Hubble.

## Stages of Big bang.

The big bang theory is divided into several stages from a big "bang" of the primordial atom into the universe.

### 1) Cosmic Inflation

The period when the universe exploded from singularity into the universe - is called cosmic inflation. According to the physicist Alan Guth's 1980 theory "the cosmic inflation lasted  $10^{-32}$  of a second." The expansion went ~~to~~ <sup>up to</sup> 100 billion km in just a second and it continues to expand till now.

### 2) Proton formation

According to NASA, "After the cosmic inflation, the temperature of the universe was intensely hot - 100 billion degrees Fahrenheit". The universe quickly cooled down enough within 3 minutes to form protons, neutrons, electrons, and other particles.

### 3) Nucleosynthesis

At this temperature, neutrons combined with protons to make nuclei of deuterium - an isotope of hydrogen.

and most of deuterium nuclei combined to form nuclei of Helium. This nuclei formation is called nucleosynthesis which occurred within the first 3 minutes of the explosion. However, the temperature was still unfavorable for electrons to attach to protons. Therefore, they scattered around the universe for many years.

#### 4) The Dark age

After 380,000 years, the temperature decreased below 1 billion degree Celsius allowing the electron to combine with protons and ~~make~~ formed neutral atoms, the first 2 elements - Hydrogen and Helium. Scientists called this period ~~as~~ dark age as the hydrogen gas did not allow the <sup>visible-</sup>light to move around.

#### 5) Proto stars formation

After millions of years, hydrogen gases lumped together into a mass by gravitational force attracting more particles <sup>of dust</sup> released from the explosion. These dust particles <sup>formed cloud</sup> called nebula. Nebula's center grew harder and denser attracting more materials to generate heat. When the temperature reached 15 million degree Celsius,

The lumps became small dense bodies called Proto-stars. They looked like stars but their core was not hard enough to fuse hydrogen gas.

### 6) Star formation.

Proto-stars kept collecting more material and releasing more heat, ~~converting~~ <sup>fusing</sup> hydrogen into helium called thermonuclear fusion which led the formation of stars. This thermonuclear fusion caused the stars to release heat, energy, and shine which illuminated the pitch black cosmos.

### 7) Formation of first galaxies

The new massive stars exerted huge amount of gravitational force and the stars began to collect in a dense region making the formation of first galaxies and finally the universe.

# Flow chart of Big Bang Theory -

Primeval atom exploded.



Cosmic inflation.

The atom expanded up to 1 billion km in  $10^{-32}$  of a second.



Proton formation.

After 3 minutes, temp reduced to form protons, neutrons, electrons, etc.



Nucleosynthesis -

within the first 3 mins, Protons + neutrons = deuterium (isotope of H), deuteriums combined =  $He^4$  nuclei called ~~new~~ nuclei formation.



Dark Age.

Temperature further decreased, electrons + protons = neutral atoms (H and He). H gases did not let the light pass = Dark cosmos.



Proto-stars

H gases lumped and formed denser and hotter center called Proto stars



Universe

Galaxies collectively made Universe.



Galaxies

Gravitational pull bound the stars in dense regions called Galaxies



Star formation

from Proto stars thermo nuclear fusion ~~made~~ stars formed.