



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 3, March 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

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# BIG BANG THEORY: The Genesis of the Universe in Relativistic Cosmology

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**ABSTRACT:** According to the Big Bang theory, the expansion of the observable universe began with the explosion of a single particle at a definite point in time. The Big Bang event is a physical theory that illustrates how the universe expanded from an initial state of high density and temperature. Various cosmological models of the Big Bang explain the evolution of the observable universe from the earliest known periods through its subsequent large-scale form.

**KEYWORDS:** Big Bang, universe, red shift, expansion.

## I. INTRODUCTION

According to the Big Bang Theory, the universe began 13.8 billion years ago as a rapid expansion of space, energy, and matter.

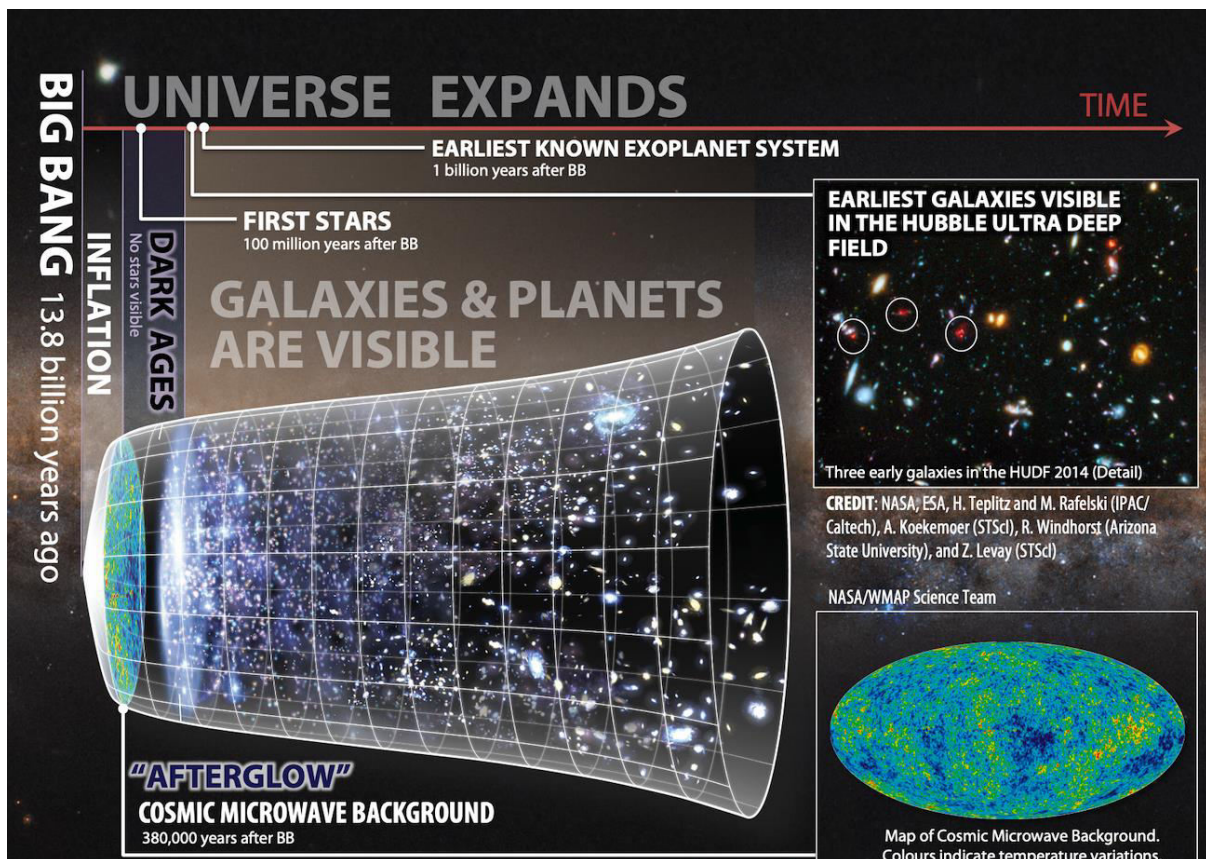


Figure: 1.1

In Figure 1.1 the pointed end of the universe in the form of the vessel, represents the big bang. With the advancement of time (moving to the right in the diagram), the vessel gets wider signifying the exponential expansion of the universe.

According to the Big Bang Theory, the universe continues to expand. In the figure 1.1, the timeline of the universe is moving to the right direction. The vessel shape represents the movement of the big bang. The vessel gets wider as time progresses, representing the expansion of the universe. At the top of the right corner, the red patches represent light from galaxies which were formed within 100 million years of big bang. At the right bottom corner, Mollwiede projection of the cosmic microwave background(CMB), a fog density showing that from when the universe was still very dense. Temperature variations indicate clumping of matter in the early universe. Earth’s story begins at the *very* beginning with the construction of the elements that comprise it.

In the Figure, 1.1, the fog is referred to as the Cosmic Microwave Background or shortly CMB and it has been carefully mapped throughout the sky. The colourful patch at the narrow end of the universe vessel represents the fog which is measured today as the CMB. The inset CMB map of the universe is a Mollwiede projection. This projection is usually used to show Earth’s geography on a flat surface.

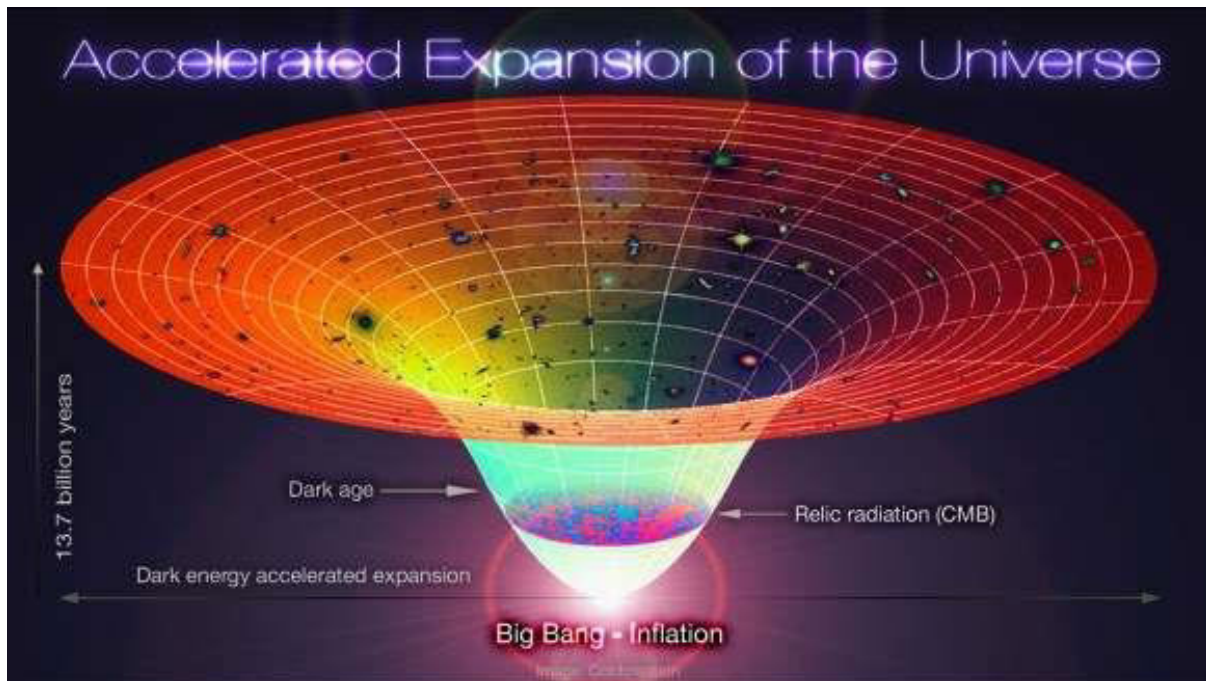


Figure 1.2

Colour variations in the Figure 1.2, CMB map represent temperature variations. These variations translate to differences in the density at which matter was distributed in the early universe. The red patches are the highest density regions and the blue patches are the lowest density. Higher density regions represent the eventual beginnings of stars and planets.

## II. THE BIG BANG IS A THEORY RATHER THAN A HYPOTHESIS

We know that the Big Bang Theory suggests that the universe began almost 14 billion years ago with a rapid expansion of matter, energy, and space. Although the name big bang depicts an explosion there is a big difference between an explosion and the big bang is that the explosion ends. Whereas the Big Bang continues to expand before someone’s eyes. The universe is infinitely big that it is convenient to describe distances between the celestial bodies in terms of light years i.e., the distance light travels in one year. Let us illustrate the example of the star Proxima Centauri. This star is 4.24 light years from the Sun. When this star was viewed in early October 2013, this star was comparatively closer from the planet Earth in terms of light years than the star Proxima Centauri is viewed from Earth on 1<sup>st</sup> January 2018 which is strongly depicting the phenomenon that the universe is expanding at an accelerated rate.

### III. THE UNIVERSE IS EXPANDING TILL TODAY

The expansion that started with the Big Bang Cosmology never stopped. It continues till today. It happens when we observe the large clusters of billions of stars called Galaxies, are moving away from us. The exception to this phenomenon is the Andromeda Galaxy with which our planet Earth is on a course of collision. The astronomer Edwin Hubble came to this conclusion when he observed that the light from other galaxies was red-shifted. The Red shift is a consequence of the Doppler effect. This refers to how we see waves when the object that is creating the waves is moving toward us or away from us.

### IV. THE REVOLUTIONARY THEORY OF THE RED SHIFT

The universe is expanding and that the expansion stretches light travelling through space in a phenomenon known as cosmological redshift. The greater the redshift, the greater the distance the light has travelled. Red Shift is attributed to the Doppler Effect which is a change in wavelength that results when a source of wave and an observer, both are in motion with respect to each other. In a simple sense, Red Shift is associated with the concept that as the wavelength of the light is stretched, the light is seen as shifted towards the red part of the spectrum.

The analysis regarding the Red Shift is that the Red Shift indicate that Galaxies look red because they are moving away from us. The ancient galaxies in the Hubble Ultra Deep Field look red because they are moving away from us so rapidly. For other galaxies, the colour we see is shifted toward the red end of the spectrum and longer wavelengths, but not necessarily actually red.

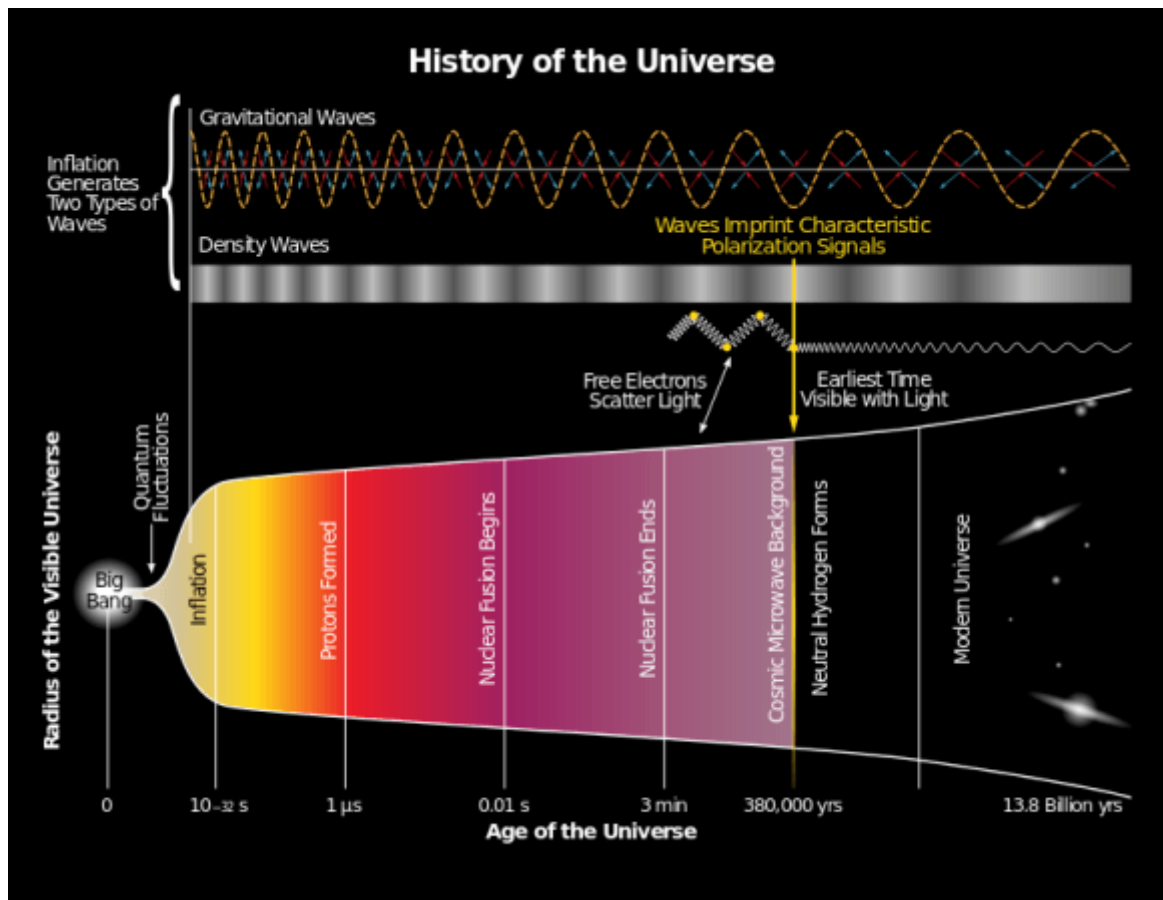


Figure 1.3

The upper part of the sun's spectrum has black lines in it. The black lines are there because some colours are missing from the sun's light that reaches the Earth. Different elements absorb lights of specific wavelengths. Many of the black lines in the Sun's spectrum represent colours that are absorbed by hydrogen and helium within the sun.



The lower portion of the Sun's spectrum represents the light coming from BAS11 which is an enormous cluster of approximately 10,000 galaxies located 1 billion light years away. The black lines represent the same elements as in the sun's spectrum, but they are shifted to the right toward the red end of the spectrum, because BAS11 is moving away from us as the universe continues to expand. Almost all of the galaxies we can see have light that is red-shifted which summarizes that they are all moving away from planet Earth. This phenomenon evidences that the universe is still expanding.

#### V. ANALYSIS REGARDING EVOLUTION OF THE UNIVERSE IN TERMS OF THE BIG BANG

In Figure 1.1, the contents of the vessel change as time progresses. A few minutes after the big bang, the universe was still too hot and dense to be anything but a sizzle of particles smaller than atoms. But as it expanded, it also cooled. Eventually particles that collided were able to stick together to form atoms, rather than being smashed apart again when other particles crashed into them. Those collisions produced the most common elements of the universe, viz., hydrogen and helium.

For a long time after the big bang, clouds of hydrogen and helium atoms drifted about a dark universe. At the bottom of the Figure 1.1, the Dark Ages were a time when the basic elements for the formation of stars existed. The first stars apparently appeared within 100 million years of the big bang but the universe remained in the Dark Ages for several 100 million years more because there were a huge number of other material around the stars for their light to be visible from a distance (this distance may be in light years). The space scientists cum astronomers today are carrying on their studies on the wavelengths of light that these stars emitted, although they are unable to see visible lights from these stars.

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**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.118**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
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