

Q The age of the universe is estimated to be 13.8 billion years. How was it estimated?

Introduction:

The totality of everything that exists or has existed both space and time is known as the universe. Age of universe means the total time from hot bigbang to the present age, which scientists estimated to be 13.8 billion years.

Methods:

Scientists estimate the age of the universe using several methods, mainly based on the study of light from distant objects and expansion of the universe.

a) By age of galaxies from travelled time of light:

$$A.O.U = \frac{v_f - v_i}{a_{exp}} \quad \because v_i = 0 \text{ at beginning}$$

$$A.O.U = \frac{v_f}{a_{exp}} = 13.8 \text{ billion years}$$

• The light from a_{exp} distant galaxies is red shifted.

b) Studying oldest stars and star clusters

By studying the oldest stars, like those in globular clusters, scientists estimate the minimum age of the universe. The oldest stars are about 13 billion years old, so the universe must be older than that.

c) By observing Cosmic Microwave Background:

CMB is the leftover heat radiation from the big bang.

Satellites like WMAP and Planck measured this radiation.

The temperature variations in CMB give clues about the universe age.

d) Hubble Expansion Formula:

In 1929, Edwin Hubble discovered that galaxies are moving away from us. According to Hubble's law, the farther a galaxy is, the faster it moves away.

By calculating the Hubble constant (rate of expansion), scientists can estimate how long the universe has been expanding.

$$A.O.U = \frac{1}{H_0} \quad \text{where } H_0 = \text{Hubble constant}$$

$$A.O.U = 13.8 \text{ billion years}$$

Based on all of these methods, scientists estimate the age of the universe to be approximately 13.8 billion years."

good attempt!!!