Describe different methods to estimate the age of the Universe.

OR

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

Introduction:

Astronomers have employed various methods to estimate the age of the Universe. These methods often rely on observations of cosmic phenomena and the principles of astrophysics. But there are two widely accepted methods that astronomers mainly rely on for calculating the age of the Universe. Which are follows:

1- Looking at the Age of the Oldest Stars

This method is based on observations of globular clusters. A globular cluster is essentially a group of a large number of stars (approximately one million stars) gathered close together in space. As the stars in a globular cluster are pretty close, their individual distances can be taken as equal from the Earth, and it is easier to calculate the distance to a globular

cluster than it is to estimate the distance to a single star. Stars can have different masses, and their masses are generally expressed as multiples of the mass of our sun (that is, the solar mass). The life cycle of a star depends on the mass the higher the mass of the star, the brighter it shines, and the faster it burns through its fuel.

Our sun contains enough fuel to burn for around 9 billion years. so stars lower in mass than our sun will burn longer and vice versa. Now, the oldest globular clusters have stars with masses lower than 0.7 times the solar mass. Based on the above argument, these stars are dimmer than our sun, and they have been burning for around 11-18 billion years. That gives us an approximate estimate of the age of the Universe, assuming that these globular clusters have been burning since the beginning of the Universe.

2- Extrapolating Back to the Big Bang

An alternative approach to estimate

the age of the Universe is to measure the "Hubble Constant." The Hubble constant is a measure of the current expansion rate of the Universe. Cosmologists use this measurement to extrapolate back to the Big Bang (theory that is the most widely accepted about the origin of the Universe). This extrapolation depends on the history of the expansion rate which in turn depends on the current density of the Universe and on the composition of the Universe.

If the Universe is flat and composed mostly of matter, then the age of the Universe is:

$$2/3(H_0)$$

where H_0 is the value of the Hubble constant.

If the Universe ~~is~~ has a very low density of matter, then its extrapolated age is larger:

$$1/H_0$$

If the Universe contains a form of matter similar to the cosmological constant, then the inffered age can be even larger.

Many astronomers are working hard

to measure the Hubble constant using a variety of different techniques. Until recently, the best estimates ranged from 65 km/sec/Megaparsec to 80 km/sec/Megaparsec, with the best value being about 72 km/sec/Megaparsec. In more familiar units, astronomers believe that $1/H_0$ is between 12 and 14 billion years.

Conclusion:

In short, combining these methods and refining observational techniques has led to a consensus age estimate for the Universe, which is currently around 13.7 billion years.