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Fate of Universe: The Ways in Which Universe will End

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Abstract:- Accounts of creation and the end of the universe have always been complex and controversial. There have always been varying theories from the biblical, archaeological, and scientific among other points of view. The cosmology point of view is one of the common and main accounts used as an explanation for both the creation and the future of the universe. From a scientific point of view, cosmology makes the description and evaluation of possible scenarios of the creation, evolution, and final state of the universe, without the untestable limitations of myths and theological basis.

Keywords:- *Universe, Big Bang, Big Rip, Hubble Constant.*

I. INTRODUCTION

Modern cosmology is dominated by key theories such as the Big Bang theory, weaving in key astronomy and physics principles. Regarding the end of the universe, the cosmology point of view offers five different ways through which the universe could end. These different scenarios describe the different scientific hypotheses of the future of the universe. A major consensus among these different accounts is that the universe is "flat" and expansion may continue infinitely. They also account for similar factors in their determination of fate such as average motions of galaxies, the shape and structure of the universe, and the quantity of dark matter and dark energy within the universe.

1. Big Freeze or Heat Death

This is one of the main possibilities given for the future of the universe from the scientific point of view. This hypothesis, supported by the Big Rip scenario has become one of the most accepted cosmology theories for the fate of the universe. Basically "the Big Freeze" (Big Chill) is a scenario through which continuous expansion causes a universe to asymptotically approach absolute zero temperature. According to the hypothesis, its only possibility of happening is under a flat or hyperbolic geometry (which is in without dark energy). Also, it can happen in a closed universe if there is a positive cosmological constant.

In the scenario, the stars are assumed to usually form for about 1–100 trillion years. Eventually, however, there will be inadequate gas required for the formation of stars. Consequently, the already existing stars will eventually drain out and seize shining after which the universe will become engulfed in darkness (Kragh, 23). From here the universe will be filled with black holes which will also disappear with time while also releasing Hawking radiation. Infinitely a reduction of entropy by the Poincaré recurrence theorem, thermal fluctuations, and the fluctuation theorem will be witnessed.

Related to the Big Freeze is the Heat Death as an explanation of how the universe might die.

The Heat Death scenario maintains that the universe enters a state of maximum entropy whereby there is even distribution of everything and there are no gradients, yet these gradients are required for sustaining information processing, such as life (Kragh**, 23).** While the Heat Death scenario agrees with the basis outlined in three spatial models, there is a need for the universe to eventually attain the minimum temperature required for its occurrence.

2. Big Rip

The big rip theory is authored by Robert R. Caldwell of Dartmouth College and relies on the Hubble constant. According to the Hubble constant, the universe's rate of acceleration has been defined as inadequate for destroying local structures such as galaxies, as they are held together by gravity. However, they are acknowledged to be large enough for increasing the space between them. According to the theory, a constant rise in the Hubble constant towards infinity would lead to the disintegration of all forms and object found in the universe (Alonso-Serrano, Bouhmadi-López & Martín-Moruno 231). Regardless of the size of the objects, they would disintegrate into free basic particles, and radiation, among others. The objects include stars, galaxies to atoms, and subatomic particles, among others. The galaxies would be the first to disintegrate and later all other forms in infinite time. As the universe approaches the infinity of energy density, scale factor, and expansion rate, it ends as what is effectively a singularity.

This explanation of the end of the universe has a special case, as it is dependent on the type of dark energy found in the universe. Should there be phantom dark energy, a more sudden big rip than the one described above would occur. This is because phantom dark energy is assumed to have negative kinetic energy which results in a higher rate of acceleration. When the increase of dark energy in the universe limitlessly happens, it might overpower the key forces keeping the universe composed. This is a state where the universe as we see it ultimately gets to zero sizes and distances diverging infinitely. However, by observing the galaxy cluster speeds using the Chandra X-ray Observatory, scientists have suggested that the time it takes from now to when the Big Rip would happen to be approximately −0.991, hence the Big Rip is unlikely to happen.

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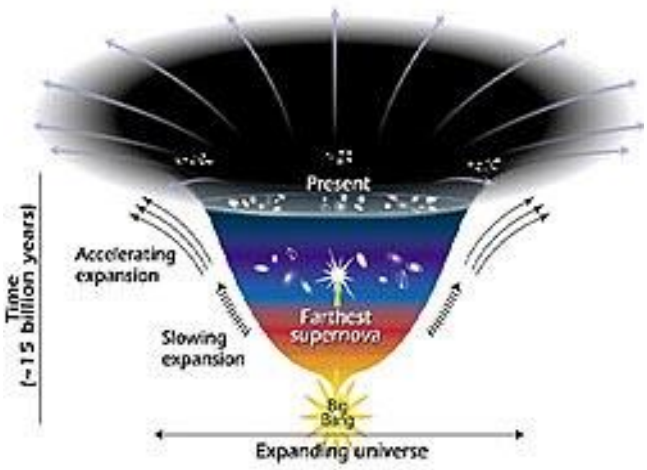

Figure 1: Image: changes in the rate of expansion - Source: NASA

3. Big Crunch

The Big Crunch universe hypothesis views the final state of the universe symmetrically. The universe expansion ultimately reverses and the universe collapses, eventually making the cosmic scale factor zero out, whereby a reformation of the universe may follow, setting off another Big Bang. Its main assumption is that the average density of the universe can stop its expansion and the universe will begin to contract. The results of this are unknown but the theory estimates that all the matter and space-time in the universe will collapse into a singularity with no dimensions (Biradar&Hote 141). This is a state where the universe started with the Big Bang.

The Big Crunch cases paves ways for the Big Bang to occur after the Big Crunch of a preceding universe. In this case, a cyclic model also referred to as an oscillatory universe is created. The universe would resemble an infinitely sequencing universe, whereby every finite universe ends with a Big Crunch and the Big Bang start of the next universe. A key weakness of the cyclic universe is that it is not compatible with the 2nd law of thermodynamics, as entropy would come out of the oscillation to oscillation causing the eventual heat death of the universe.

Further present evidence shows that the universe is not “closed”, making cosmologists disregard the oscillating universe model. Considering the relevant quantum effects, evidence suggests that the big crunch scenario is unlikely to happen but cannot be completely ruled out. This is mainly because the measurement data has been collected over a short period and hence the situation might change in the future (Biradar& Hote 236). Another observation has been that the expansion of the universe is speeding up and not slowing down from gravity as assumed, hence a suggestion is given that the most likely end of the universe is Heat Death or a Big Rip**.**

4. Big Bounce

The Big Bounce scientific theory is often linked to the formation of the current universe. It stems from the oscillatory universe or cyclic repetition scenario of the Big Bang whereby the first cosmological event ended up in the collapse of a previous universe. It original use implicated a phase of the cyclic model or oscillatory universe interpretation of the Big Bang, in the case where the first cosmological event came into because of the end of a previous one (Moriconi & Montani 95). It sees the Big Bang as the start of an expansion phase following a contraction phase.

The quantum mechanics resulted in an alternative Big Bang theory version. Contrary to the Big Bang theory of cosmology, the theory states that the universe will continuously repeat the cycle of a Big Bang, followed up with a Big Crunch. In this view, it is a Big Crunch followed by a Big Bang, i.e., a Big Bounce. The suggestion is that we could be living at any point in an infinite sequence of universes, or conversely the current universe could be the very first iteration.

The Big Bounce contradicts the Big Bang theory where it states that in the beginning, the universe was infinitely dense. Also, this description is argued against by other more widely accepted theories, such as quantum mechanics and its uncertainty principle. Further, if the universe is closed, this theory would predict that once this universe collapses it will spawn another universe in an event like the Big Bang after a universal singularity is reached or a repulsive quantum force cause’s re-expansion.

The main concept for the Big Bounce quantum theory is that, as density nears infinity, there is a change in how the quantum foam behaves. All the key constancy of features, such as light speed within a vacuum, is no longer possible during a Big Crunch, more so in the interval lesser than it is possible to measure, crossing the point of inflection (Moriconi& Montani 112). If the state of the interval phase "from one bounce to another", allowed for the 'hypothesis of the primeval atom', to be considered into full contingency, such a scenario would be impossible, since that condition could be a representation of a singularity in time and each event would be complete and homogenous.

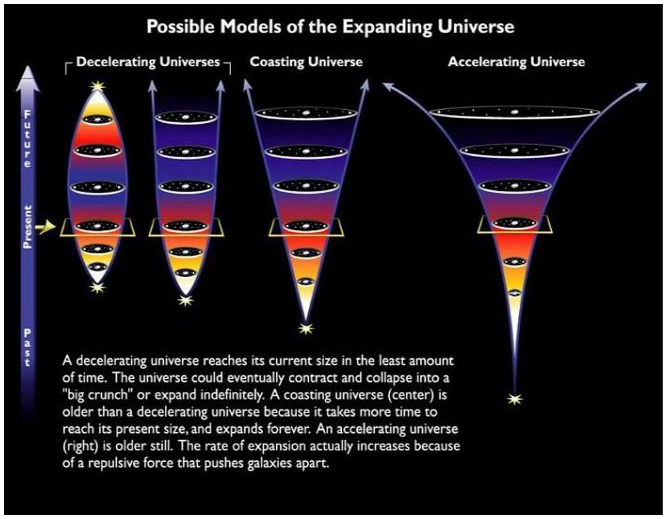

Figure 2: Possible fates of the expanding Universe – Source: The Cosmic Perspective

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5. Big Slurp

The Big Slurp theory suggests that the universe presently lives in a false vacuum which could become a true vacuum at any given time. The theory explanation largely borrows from the Higgs field which infuses the universe. Like an electromagnetic field, a vacuum's strength changes depending on its abilities. A vacuum is a space with as little as possible energy but still has quantum fields in it. A true vacuum remains in existence if the universe stays in its lowest energy state, and hence false vacuum theory would not be applicable. In quantum field theory hypothesis, a false vacuum is a stable vacuum, but its most stable state has not been achieved yet.

If the vacuum is not in its lowest energy state, it might be able to burrow into a lower energy state. A false vacuum occurs at that local minimum of energy and may last long in this state but may end up decaying to a more stable state. In contrast, a true vacuum occurs at a global minimum and in a stable state. An explanation given for how the decay may occur in a false vacuum is through bubble nucleation (Blackledge 64). This is a scenario whereby if a small area of the universe reaches a more stable vacuum by chance, this "bubble" might multiply. A vacuum decay can essentially change the universe in various ways. For instance, the different physical constants may assume different values, critically influencing the foundations of matter, energy, and space-time. Unpredictable instantaneous destruction of all structures is possible.

It is important to note that energy is higher in the false vacuum than that in the true vacuum or ground state (Blackledge 51). However, the rolling of the universe into a true vacuum state is prevented by a barrier. As such the switch to a true vacuum state needs to be accelerated by the creation of high-energy particles or through quantum-mechanical tunneling.

II. CONCLUSION

The cosmology point of view explains the fate of the universe from a scientific point of view in various accounts. The Big Freeze or Heat Death theory, The Big Rip theory, The Big Crunch theory, the Big Bounce theory, and the Big Slurp theory all use physics of the universe and scientific evidence to explain the fate of the future of the universe. Despite their scientific basis, these cosmology theories have a weakness. Each scenario in all theories is grounded on a very simple form for the dark energy equation of state. Given that there is little knowledge about the physics of dark energy, the credibility weight of these theories drops. There is a possibility of the dark energy equation of state-changing which may have unpredictable results. Under this basis, their role in the universe form is unknown and hence uncertainty of these cosmology theories is not guaranteed.

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