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THE THEORY OF BIG BANG AND THE EARLY-CHRISTIAN TEACHING ABOUT THE 'EX NIHILO' CREATION OF THE UNIVERSE

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Abstract

The Big Bang Theory considers that the Universe, space and time have a beginning. Similar is the position of the Christian writers of the early Christian Church, who support the ex nihilo - ἐκ μὴὴ ὄντος (ek me ontos = from the 'non-being') creation of the world through the divine 'energy', with the two theories converging to the fact that space and time have a beginning. But according to the Father of the Eastern Church Basilius the Great and the Greek Christian philosopher, theologian and natural scientist John Philoponus, the 'non-being' does not represent 'nothing' but something beyond space and time, inaccessible to human senses. Parallel, though not coincident, in contemporary Cosmology is supported the hypothesis of the existence of the 'false vacuum', an imperceptible state before the Big Bang. A major question that philosophers as well as modern scholars have considered over the years is whether our Universe has a beginning. Some Christian scholars of the Early Christian Church considered that the Universe had a principle reigning exclusively in the divine will and envisaged its creation as a transition from the 'non-being' to being. In modern Astrophysics, space and time originate from the Big Bang. The principal aim of this work is to investigate the common points between the early Christian version of the creation of the Universe and modern Cosmology. Hence we will present the main scientific data supporting the Big Bang Theory. Also, will be discussed the first Christian version of the creation of the Cosmos from the 'non-being', being interpreted as a state inaccessible to human senses. At the end, there is a discussion about the false vacuum from which our visible Universe originated, according to the theory of inflation complementing Big Bang theory.

Keywords: history, astronomy, archaeoastronomy, ancient, Greek philosophy

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1. Introduction

The Big Bang Concept, introduced in 1922 by Alexander Friedmann and independently in 1927 by the Belgian priest Abbé Georges Éduard Lemaître (1894-1966), refers to the beginning of the Universe, which originates from a singularity, a theory so far verified by the observational data. According to this theory, the Universe, space and time have a beginning. Similar is the position of the Christian writers of the early Christian Church, who support the ex nihilo - ἐκ μὴ ὄντος (ek me ontos = from the 'non-being') creation of the world through the divine 'energy', with the two theories converging to the fact that space and time have a beginning. But according to the Father of the Eastern Church Basilius the Great and the Greek Christian philosopher, theologian and natural scientist John Philoponus, the 'non-being' does not represent 'nothing' but something beyond space and time, inaccessible to human senses. Parallel, though not coincident, in contemporary Cosmology is the hypothesis of the existence of the 'false vacuum', an unreasonable situation before the Big Bang.

The basic question that philosophers and modern scholars have had over the years is whether the world has a beginning. Some Christian thinkers of the Early Christian Church considered that the Cosmos had a principle that reigned exclusively in the divine will and described its creation as a transition from the 'non-being' to being. Correspondingly, in modern Astrophysics, it is argued that the beginning of space and time is located in the Big Bang. The aim of this work is therefore to highlight the common points between the early Christian version of the creation of the Cosmos and modern Cosmology. In this context, the main scientific data supporting the Theory of Great Explosion will be presented. Next, will be discussed the first Christian version of the creation of the Cosmos from the 'non-being', the predominant element which is the origin of the Universe from an inappropriate state inaccessible to human senses. Finally, there is discussion about the false vacuum in quantum field theory from which our visible Universe is believed to have been derived, according to the theory of inflation ('inflation'), which complements Big Bang theory.

2. The Big Bang Theory

A milestone in the history of Natural Sciences was the formulation by Albert Einstein first of the Theory of Special Relativity and subsequently of Theory of General Relativity. Concerning the extraction of a cosmological model from his theory, Albert Einstein noticed that from his equations follows an Universe dominated by gravity. Additionally they indicated that the Universe should collapse because of its colossal gravity. But that has not happened! To explain this 'paradox', he added in his equations - without having observable data at his disposal - an arbitrary term, the 'cosmological constant' symbolized by the Greek letter 'Λ', which acts counter to gravity [1] in order to obtain a static universe.

In 1922, just three years after the eclipse confirmation, Alexander Friedmann found an elegant way to save the Universe eliminating the cosmological constant and the assumption that it is static. Friedmann concluded, that the Cosmos is just in accordance with our observations, full of matter and radiation, and additionally, that it can be curved. Moreover, let's suppose that we can assume that it is isotropic and homogeneous, i.e. 'the same in all directions' and 'the same at all locations'. Adopting such assumptions, Friedmann obtained a set of equations within the context of general relativity that govern the expansion of such homogeneous and isotropic universe, which are now called Friedmann equations. According to them the Universe is not static, but it expands or contracts depending on the expansion rate and the contents of the Universe. Moreover, they tell *how* the Universe evolves with time, into the future or past.

Georges Lemaitre [2] proposed independently the solution to the question of the static Universe elaborating the 'hypothesis of the primeval atom', which evolved into the well-known Theory of the Big Bang, which however owes the name to the one of its major adversaries, astronomer Fred Hoyle (1915-2001), who referred to it 1949 in a critical commentary on the BBC radio. G. Lemaitre did not know for the older and more general equations of the Russian physicist and mathematician Aleksandr Friedmann. This great Russian mathematician, assuming that the radius of the Universe changes, was the first to solve the General Relativity equations in 1922, considering purely mathematically various cases of a non-static universe. Assuming the change of the spatial curvature as a function of time he obtained as the result three possible scenarios of the development of the Universe.

A) In the first case (M1) the Universe starts at zero radius at t = 0, expands slowly to a bend point where the expansion is then accelerated.
B) The second scenario (M2) refers to self-accelerating dilation but with a non-zero radius for t = 0. This model also leads to a flat Universe [3].
C) The third scenario (P), also called the 'Oscillating Universe', describes an oscillating universe between zero ray and a critical value. Until the critical value, the Universe expands in a slowdown, and then begins to contract, leading to the Great Crushing (closed Universe). It also illustrates as two special cases of solutions the static model of Einstein and the mathematician and astronomer/cosmologist Vilém de Sitter (Willem de Sitter, 1872-1934).

According to the model proposed by G. Lemaitre, in 1931, at the beginning, the Universe was in a very high density state, where the whole mass was concentrated on a primitive atom. Its explosion was the beginning of the expansion that formed the Universe we know. According to the later research the original atom must have been very small, even smaller than the atoms of the chemical elements, containing however the entire mass of the Universe. Many scientists assume that it was an initial 'singularity' with zero radius and time values (R = 0, t = 0) and infinite density, where the Theory of Relativity [4] is not applicable. Since 1980, to the Theory of Bing Bang has been added an ultra-

rapid 'exponential expansion' in the beginning. However, this theory attempts to answer the philosophical question of whether the Universe has a beginning, while seemingly consistent with the original Christian interpretation of the origin of the world from 'nothing', as there is no mention of ' before ' the Big Bang [5]. Lemaitre's theory of the primordial atom from which the expansion of the Universe began was supported in 1929, by the observational results of astronomer Edwin Hubble (1889-1953), that galaxies recede from us. Namely, investigating distant galaxies, Hubble found that their spectrum is shifted towards the red, in dependence on their distance (Hubble's Law) and he explained this result with the Doppler-Fizeau effect, which influences the spectrum of receding objects. This confirmed that we live in a continuously expanding Universe as well as the Big Bang Theory.

Namely, the farther away a galaxy is, the faster it is removed from the observer and the consequence is the increase in the wavelength of spectral lines in its spectrum. It is logically then, that if we return to the past we will find them even closer to each other, and when we reach the beginning of expansion, they all will be united in a solid mass, just as described by Big Bang theory.

In 1948, Russian physicist George Gamow (1904-1968) found another case in support of the Bing Bang theory. He argued that if such a colossal explosion had taken place, then it should leave 'traces' that could be traced. He concluded that if the Universe was hot and matter within ionized, by cooling it will be neutralized followed by releasing of a radiation dispersed into the Universe, which would be the 'echo' of the Great Explosion. This was finally confirmed in 1965, by, physicists and radio astronomers Allan Penzias and Robert Woodrow Wilson in Holmdel of New Jersey, which identified a kind of isotropic and highly homogeneous black body radiation of $3.5^{o} \pm 1^{o}K$ [6], coming from everywhere from the sky, which proved to be the cosmic background radiation mapped in 1992 by the COBE satellite [7] and then in 2003 by the Wilkinson Microwave Anisotropy Probe-WMAP Cosmic Anisotropy Detector (WK).

As another fact in support of the Big Bang, George Gamow proposed in the forties the abundance of chemical elements in the Universe. According to the theoretical model in the beginning (t = 0.1-100 sec), the primordial nucleosynthesis led to the production of important quantities of D (deuterium), ^{3}He, ^{4}He as well as ^{7}Li, apart from the dominant hydrogen (H). After calculations, the quantity of atoms generated in the first moments of creation of the Universe was around 75% H and 25% ^{4}He, as well as traces of (0.01%) ^{3}He, D and ^{7}Li. Observational data from the WMAP mission confirms with great precision the calculations for D and ^{4}He. For ^{3}He there is a small system error, but in essence without much deviation. Conversely, for ^{7}Li we have a severe deviation of the order 3.4 in relation to observational data [8].

Furthermore, the Big Bang model, including inflation, comes in very good agreement with simulations on the creation and evolution of large structures such as galaxies and galaxy clusters. As Primack sums up, the model can predict incredibly accurate large structures as well as the observed distribution of nearby

and near-distance galaxies [J. Primack, *Cosmological Structure Formation*, arXiv 1505.02821, 2015].

A remarkable case of observational confirmation is the study of the spectrum of two 'prime' gas clouds, LLS1134a and LLS0956B [9] which, on the basis of the red shift presenting ($z = 3.52$ and $z = 3.29$ respectively) we notice that it was only 2 billion years after the Big Bang. The analysis of their spectra did not show any absorption line for elements beyond deuterium (D) and hydrogen (H). This observation gives us a very strong confirmation of the nucleus synthesis in the early moments of the Great Explosion as predicted by theory, since the heavier elements were later synthesized inside the stars and very heavy during supernovae explosions.

All of these facts have established the Big Bang Theory as the most acceptable version of Cosmology for the creation of the Universe. However, for the moment, the 'weak' point of the theory is that scientists still cannot to advance beyond the limit of 10^{-43} sec (Planck era), where the quantum phenomena of gravity were very strong, and the four fundamental forces of nature were united. Consequently, the philosophical question that arises is whether the Big Bang should be considered as the beginning of the Universe.

3. The 'ex nihilo' creation of the Universe according to the scholars of the early Christian Church

The Big Bang model has a remarkable resemblance to the philosophical cosmodel of the early Christian Church, where the Universe, space and time should have a beginning. In particular, the first Christian scholars argued that for the creation of the Universe, the eternal existence of matter is not necessary as it is created by non-being, thanks to the divine effect [10]. It is obvious that the creation of the Universe according to Christian thinkers does not go back to a natural cause such as matter but is attributed to God. So, the point of convergence between modern Cosmology and Christian thought about the creation of the Universe is the existence of a principle. On the contrary, the point of divergence is that the beginning of the Universe in modern cosmology has a natural cause, due to the Big Bang, whereas according to Christian thinkers the cause is metaphysical, reigning to God.

Saint Basilius the Great, one of the most significant Christian scholars, points out that God must be pre-existing in relation to the world, the creation of which is instantaneous and takes place *ἀχρόνως* (*achronos - without needing time*) [11 - 1,3, 26-28 & 1, 6, 30]. In this case it is obvious that before the creation of the Universe there is no mention on time the existence of which presupposes that the Universe has already been created. That is why he claims that time is *συμφυής* with the Cosmos *(symphiis - being created at the same time)* [11, *Homilia 1*, section 5, line 20]. The same view was also supported by John Philoponus (490-570) who argues that *both time and the motion are merely measured the one through the other* [12] and in order for the movement to take place, the world must have been created. Also in order to talk about time, there

is a need for an observer to record the motion [13]. Consequently, the existence of time presupposes the creation of the physical world, and its recording through the observation of motion of the celestial bodies. Therefore time is by definition interwoven with the creation of the Cosmos [10].

The issue that arises is if indeed the world is created 'ex nihilo'. This Latin term means 'out of nothing' and is similar to the ancient Greek philosophical term *μη όν* which has the meaning of 'non being'. Saint Basilius the Great claims that Θεός (God) creates everything "from non being into being" [11, *Homilia 8*, section 7, lines 7-10]. If we accept that before the creation of the Cosmos there is God, then the non-being should not be correlated with 'nothing'. There is an interesting mention of Saint Basilius, according to which "*before the creation of the world there was something that was perceived only by our intellect, but it was not told because it was inappropriate for people who are apprentices and are infants in knowledge. There was a situation earlier than the genesis of the world, appropriate to superhuman powers, beyond time and eternal.*" [11, *Homilia 1*, section 5, lines 1-8]. In this case, there is obviously no mention of the existence of matter, but of a situation that precedes cosmic creation unobjectionable by the senses and identified with God. As can be seen from the above, the notion of non-being in early Christian thought should not be confused with non-existence, that is, 'nothing'. Instead, it refers to an imperceptible condition that precedes the creation of the observable Universe. It is clear, therefore, that in the early Christianity the creation of the Cosmos is a path from the non-perceptive to the perceptible. Moreover, the concept 'before creation' in the early Christian cosmological view has no meaning, since the world is created at the same time and has no eternal existence [14]. At this point there is absolute convergence with the words of G. Lemaitre, where space and time are created at the time of the Big Bang.

4. 'Before' the Big Bang - the false vacuum

In modern Inflationary Cosmology there is supported the existence of a non-perceivable situation that precedes the creation of the Universe. In this context, it has been argued that there may be a state that preceded the creation of the Universe and which is called *false vacuum*. The main features are its consistently high energy density even in the event of expansion of the space, due to the Inflation fields, related to the Higgs fields, to which is attributed even the cause of symmetry rupture in G.U.T. (Grand Unified Theories), when the basic forces of the Universe except from gravity were united and prevailed at very high temperatures [7, p. 96-98; 15].

According to the fact that the theory of false-vacuum has not been proven experimentally or observationally, it is an indication that research into the beginning of the Universe does not end in defining the circumstances of the Big Bang, but it is designed to study the causes that caused it. The point of convergence observed in relation to the thinking of the Christian thinkers of the early Christian Eastern Church lies in the fact that before the creation of the

perceivable Universe precedes a period beyond space and time, which is not accessible to our senses. So the course of creation of the Universe is made from the non-perceivable to the perceptible and approached either by scientific assumptions and mathematical models, or by philosophical and theological meditation. The aim of both philosophical reflection and scientific research is to determine what happened 'before' the creation of everything.

5. Epilogue

In the early Christian teaching the world originates from a state of the non-being, not identical to non being, but with a non-perceivable state, not defined by space or time. In the modern Cosmology there is also the existence of a non-perceivable situation – the false vacuum - preceding the Big Bang. So it exist a kind of similarity of the views of early Christian writers considering this question philosophically-theologically, and some parts of the mathematical models of modern Cosmology. Universe has a beginning and originates from a non-perceivable state. Certainly, these are similar but not identical. The false-vacuum and the super-sensual spiritual-divine world of early Christian thinkers are not the same.

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