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Correction of the Big Bang theory and cyclic universe

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Abstract

In the present paper we establish, that the universe is eternal, that is it has no beginning and no end in the time. If we accept the original Big Bang theory, i.e. that the universe has arose from an extremely small, dense and hot fireball by an unique big bang and an inflation which continues until now, then we prove, using the axiomatic method, that (i) there exists an infinite number of big bangs in the past and in the future and (ii) the universe is cyclic.

Furthermore we prove directly that the universe is cyclic without an using of a big bang of the universe.

The statement (i) can be regarded as a correction of the original Big Bang theory.

Keywords: Big bang, axiomatic method, cyclic universe

Mathematical Subject Classification (2020): 83F05, 85A40

1. Introduction

The basic question whether the universe has no beginning in time or has a beginning is not resolved in philosophy, physics and cosmology. This question is considered from a physical,

philosophical and mathematical point of view. For the existence of the universe there are two main physical and philosophical models that contradict each other: a model without a beginning of the time of the universe so that it undergoes an infinite number of expansions and contractions in the past and the future and a model in which the universe has a beginning in time. In the first case the universe is called cyclic. The above two models are connected with the concept of infinity, which complicates the question of their truth. Namely, in view of the realized infinity in time of the universe we do not have still perfect physical and philosophical models either for a beginning of the universe in time or for a negation of this beginning. In this direction we note the following.

"The concept of infinity has been used widely in mathematics. We cannot imagine the existence of this science without using of this concept, notwithstanding the unique maxim of the German mathematician Dawid Hilbert, according to whom no concept in mathematics needs from a precision so much as the concept an infinity" [6]. This is valid also for the physics and the philosophy, which use the concept of infinity. In particular the existent physical and philosophical models for a cyclic universe and for a universe with a beginning in time do not give still a final solution of the problem. We note also the following. By the theoretical physicists P. Steinhardt and N. Turok "It appears that we now have two disparate possibilities: a universe with a definite beginning and a universe that is made and remade forever. The ultimate arbiter will be Nature" [12]. In this way P. Steinhardt and N. Turok acknowledge in fact, that the physical and the philosophical models either for a beginning of the universe in time or for a negation of its beginning represent conjectures. For the above statement we note explicitly that the Nature cannot be an arbiter for this, what from the last two opposite assertions is true.

In the beginning we mention some physical and philosophical models. A physical model for a future cyclic universe is proposed by A. Einstein in the 1920s as an alternative of the expanding universe. However, in 1934 R. Tolman [14] renounces this model.

In 1955 the Bulgarian physicist A. Polikarov in his PhD thesis raises a philosophical and physical assertion for a stationary universe, that is for an unchanging universe in entirety [10] .

The idea for a cyclic universe can also be regarded and from a mathematical view point. Using the axiomatic method, we prove in 1965 Year, that the consciousness and the perfect consciousness of the universe as well as the forms of a motion of the matter (the universe) have no beginning and no end in time [5]. As a corollary we obtain in this paper that the universe is cyclic.

In the beginning of the 21 century the idea for a dark energy and a dark matter of the universe appears and, in this connection new cyclic physical models are created. One of the basic such models is the model of P. Steinhardt and N. Turok [11, 12] , created in 2001 Year, which is connected with the theory of the strings as well as the model of L. Baum and P. Frampton [1, 2], created in 2007 Year, which uses the phantom energy of the universe.

The famous English physicist Penrose creates model, which is called a conformal cyclic cosmology [8]. According to this model the existence of the universe is in endless cycles called zones and with the completion of one cycle a Big Bang and a new cycle begin. The conformal cyclic cosmology is a cosmological model within general relativity. The development of this model is obtained in the joint work of Penrose and Gurzadian [3]. Penrose also presents this model in his book [9].

We will note that according to the site Nobelprize.org, Roger Penrose, along with Reinhard Gentzel and Andrea Ghez, receive in 2020 joint Nobel Prize in Physics for their discoveries related to one of the most exotic phenomena in the universe - the black hole.

Since the stated result in [5] about a cyclic universe and about the infinite repetition of the consciousness and the perfect consciousness of the universe remain unanswered and without discussion, we develop this idea in [6], in which a strict mathematical interpretation of the statements is made.

There are many physical models in which the universe has a beginning. We will not consider them in detail. We shall mention only the physical model of A. Mithani and A. Vilenkin [4].

Recently physical models for parallel universes are created, for example [13], that is for universes which have an empty intersection among themselves and also models for destruction of old universes and a generation of new universes. Lately the concept for a mega-universe appears which joins parallel, old and new universes. The concepts parallel and other universes and also for a mega-universe, are admissible from a physical view point. However these concepts contradict to a general concept a universe: the universe is the whole matter and energy which had existed, exists and will exist and all "parallel and other universes", if they exist, are a part of the whole universe.

We do not use the concept for a parallel universe and for a mega-universe and we keep the traditional concept a universe instead of a mega-universe.

By the well known Big Bang theory, that is by the Big Bang model the universe arises before 13,7-13,8 billion years from an extremely small, dense and hot fireball by a unique big bang. The initial inflation continues until now.

This paper is a detailed exposition of [7]. We establish, that the universe is eternal, that is it have no beginning and no end in time (Proposition 2.1) and we prove (Theorem 2.2), using the axiomatic method, that if the universe has had a big bang, then there exists an infinite number of big bangs in the past and in the future and that the universe is cyclic (Corollary 2.3). Furthermore we prove directly, using the axiomatic method, that the universe is cyclic without an using of the big bangs of the universe (Theorem 3.1).

Theorem 2.2 is a negation of the original Big Bang theory according to which the universe possesses only one big bang. This theorem can be regarded as a correction of this theory.

We will point out that here, as well as in [5- 7], we do not consider the physical nature and laws of the universe. We treat the universe from a neat mathematical view point.

2. Correction of the Big Bang theory

As we noted, there are two unproven basic physical and philosophical models of the universe that contradict each other: a model in which the universe has a beginning in time and a model with no beginning of the weather. The common sense dictates us, that the second model is true. This implies that there is a single infinite axis of time for the universe. We will prove the following statement which establishes this fact, i.e. that the second model holds.

Proposition 2.1. *The universe is eternal and for it there exists an infinite time axis* $(-\infty, +\infty)$.

Proof. The law of the preservation of the energy holds for every closed material system. Therefore it is applied for the universe. This fact implies that the universe exists

eternally and it will exist eternally. Consequently, there exists an infinite time axis

$(-\infty, +\infty)$.

Proposition 2.1 implies, that the universe has no beginning and that the time has existed eternally along with the universe. The indicated time axis is called an axis t. In this axis we shall enter distinct intervals either $(-\infty, t)$ or $(t, +\infty)$ from the existing of the universe, where t is a fixed moment on the axis t.

Definition. *Every expansion of the universe with a corresponding contraction is called a cycle of the universe. If the universe has an infinite number cycles and they*

are unbounded from below and above on the time axis, then the universe is called cyclic.}

If the eternal existence of the universe generates a big bang, then one can accept the following axiom.

Axiom 2.1. *The eternal existence of the universe generates a big bang with some initial moment t_0 in the time axis.*

If we accept this axiom, then we can prove the following result.

Theorem 2.2. *If the universe is produced at least one big bang, then there exists an infinite number of its big bangs, unbounded from below and from above on the time axis.*

Proof. By Proposition 2.1 for the universe there exists an infinite time axis $(-\infty, +\infty)$.

We will construct by induction an infinite, decreasing, and unbounded from below series of moments on the time axis, such that at each such moment the universe produces a big bang. Let t_1 be an arbitrary moment of the existence of the universe, that is t_1 is a point on the axis t and $t_1 < -1$. Since in the interval $(-\infty, t_1)$ of the axis t the universe is exited eternally, then, by Axiom 2.1, the universe has created some big bang with an initial moment $a_1 < t_1$. Therefore, $a_1 < -1$.

Suppose, that the universe, along with the said big bang, creates n big bangs, where n is an arbitrary natural, and the strongly decreasing sequences $t_1, t_2, \ldots, t_n$

and $a_1, a_2, \ldots, a_n$ exist on the axis t, such that $a_i < t_i < -i$, i=1,..., n and every moment a_i, i=1,...,n, is an initial moment of a big bang. We choose an arbitrary point t_{n+1} on the axis t, such that $t_{n+1} < a_n$ and $t_{n+1} < -(n+1)$. Since in the interval $(-\infty, t_{n+1})$ on the axis t the universe is exited eternally, then, by Axiom 2.1, the universe has created some big bang with an initial moment $a_{n+1} < t_{n+1}$ on the axis t. Therefore, $a_{n+1} < -(n+1)$ and $a_{n+1} < a_n$. The last big bang is different from the mentioned big bangs, since for the initial moments a_i, i=1,… n+1, of the created big bangs $a_{n+1} < a_n < a_{n-1} < \ldots < a_2 < a_1$ holds.

We proved by an induction, that there exists an infinite number different big bangs of the universe and the initial moments $a_1, a_2, \ldots, a_n$ of these big bangs are unbounded from below in this axis, since for every initial moment a_n, where n is an arbitrary natural,

$a_n < -n$ is fulfilled. For the completeness of the induction, we receive an infinite strictly decreasing sequence $t_1, t_2, \ldots, t_n$ from moments which are also unbounded from below in this axis.

Let t_1 be again an arbitrary moment of the existence of the universe and $t_1 > 1$. Since in the interval $(t_1, +\infty)$ on the axis t the universe exits eternally,

then, by Axiom 2.1, the universe creates some big bang with initial moment $a_1 > t_1$. Therefore, $a_1 > 1$.

Suppose, that the universe, along with the said big bang, creates n big bangs, where n is an arbitrary natural, and the strongly increasing sequences $t_1, t_2, \ldots, t_n$ and $a_1, a_2, \ldots, a_n$ exist on the axis t, such that $a_i > t_i > i$, i=1,...,n, and every moment a_i, i=1,...,n, is an initial moment of a big bang. We choose an arbitrary point t_{n+1} on the axis t, such that $t_{n+1} > a_n$ and $t_{n+1} > n+1$. Since in the interval $(t_{n+1}, +\infty)$ on the axis t the universe exits eternally, then, by Axiom 2.1, the universe creates some big bang with an initial moment $a_{n+1} > t_{n+1}$ on the axis t. Therefore, $a_{n+1} > n+1$ and $a_{n+1} > a_n$. This big bang is different from the mentioned big bangs, since for the initial moments a_i, i=1,...,n+1, of the created big bangs $a_{n+1} > a_n > a_{n-1} > \ldots > a_2 > a_1$ holds.

In this way we prove, that there exists an infinite strictly increasing sequence $a_1, a_2, \ldots, a_n$ from the initial moments of the big bangs on the time axis, unbounded from above, since for every initial moment a_n, where n is an arbitrary natural, $a_n > n$ is fulfilled.

For the completeness of the induction, we receive an infinite strictly increasing sequence $t_1, t_2, \ldots, t_n$ and also unbounded from above on this axis. The theorem is proved.

Theorem 2.2 can be formulated more simply as follows: the universe has an infinite number of big bangs in the past and in the future.

The proved Theorem 2.2 is a negation of the original Big Bang theory, that is it is not true that the universe possesses only one big bang. However, this theorem can be regarded as a correction of this theory.

Corollary 2.3. *If there exists some Big Bang of the universe, then it is cyclic.*

Proof. By Theorem 2.2 the universe has an infinite number of Big Bangs in the past and in the future. All Big Bangs start with an expansion and each of them has a corresponding contraction. If we assume the contrary, that there exists some Big Bang of the universe

without corresponding contraction, then it follows, that a next Big Bang does not have, i.e. the Big Bangs are bounded from above on the time axis, which contradict of Theorem 2.2. Therefore, the universe possesses an infinite number of expansions and corresponding contractions, that is an infinite number of cycles are created and they are unbounded from below and from above on this axis.

In this way we can conclude, that the universe is cyclic. The corollary is proved.

3. Cyclic universe

We shall prove directly that the universe is cyclic without an using of the big bangs of the universe. At present we observe some expansion of the universe. This expansion has a beginning since otherwise we had not see the present galaxies, different from our galaxy. Therefore, we can accept the following statement.

Axiom 3.1. *The eternal existence of the universe gives rise to at least one of its expansions with some initial moment.*

Theorem 3.1. *The universe has an infinite number of cycles and they have no beginning and no end in the time. Therefore, the universe is cyclic.*

Proof. By Proposition 2.1 for the universe there exists an infinite time axis

$(-\infty, +\infty)$.

1. Let t_1 be an arbitrary moment of the existence of the universe, that is t_1 is a point on the axis t and t_1<-1. Since in the interval $(-\infty, t_1)$ on the time axis the universe is exited eternally, then, by Axiom 3.1, in this interval the universe has created some its expansion with an initial moment $a_1 < t_1$ of this expansion. Therefore, a_1<-1.

Suppose, that n expansions of the universe, along with the said expansion, are created, where n is an arbitrary natural, and the strongly decreasing sequences $t_1, t_2, \ldots, t_n$ and $a_1, a_2, \ldots, a_n$ exist on the axis such that $a_i < t_i$ <-i, i= 1 ,..., n and every moment a_i, i=1,...,n, is an initial moment of the ith expansion

Let t_{n+1} be an arbitrary moment of the existence of the universe, that is t_{n+1} is a point on the axis t, $t_{n+1} < a_n$ and t_{n+1} < -(n+1). Since in the interval $(-\infty, t_{n+1})$ on the time axis the universe is exited eternally, then, by Axiom 3.1, in this interval the universe has created some expansion with initial moments $a_{n+1} < t_{n+1}$. Therefore, a_{n+1} <-(n+1),

$a_{n+1} < a_n$ and the last expansion is different from the mentioned expansions, since for the initial moments a_i, i=1,...,n+1, of the created expansions $a_{n+1} < a_n < a_{n-1} < \ldots < a_2 < a_1$ holds.

In this way we prove, that there exists an infinite number different expansions of the universe which are unbounded from below on the time axis. For the completeness of the induction, we receive an infinite strongly decreasing sequence $t_1, t_2, \ldots, t_n$ on this axis and also unbounded from below.

Let t_1 be again an arbitrary moment of the existence of the universe, that is t_1 is a point on the axis t and $t_1>1$. Since in the interval $(t_1, +\infty)$ on the time axis the universe exists eternally, then, by Axiom 3.1, in this interval the universe creates some expansion with an initial moment $a_1 > t_1$ of this expansion. Therefore, $a_1>1$.

Suppose, that the universe, along with the said expansion, creates n expansions, where n is an arbitrary natural, and the strongly increasing sequences

$t_1, t_2, \ldots, t_n$ and $a_1, a_2, \ldots, a_n$ exist on the axis t, such that $a_i > t_i > i$, i=1,...,n and every moment a_i, i=1,...,n, is an initial moment of the ith expansion.

Let t_{n+1} be an arbitrary moment of the existence of the universe, that is t_{n+1} is a point on the axis t, $t_{n+1} > a_n$ and $t_{n+1} > n+1$. Since in the interval $(t_{n+1}, +\infty)$ on the time axis the universe exists eternally, then, by Axiom 3.1, in this interval the universe creates some expansion with an initial moment $a_{n+1} > t_{n+1}$. Therefore, $a_{n+1} > n+1$,

$a_{n+1} > a_n$ and the last expansion is different from the mentioned expansions, since for the initial moments a_i, i=1,...,n+1, of the created expansions $a_{n+1} > a_n > a_{n-1} > \ldots > a_2 > a_1$ holds.

In this way we prove, that there exists an infinite number different expansions of the universe which are unbounded from above on this axis. For the completeness of the induction, we receive an infinite strongly increasing sequence $t_1, t_2, \ldots, t_n, \ldots$ on this axis and also unbounded from above on this axis.

Therefore the universe possesses an infinite number of expansions, which are unbounded from below and from above in the time axis.

2. All indicated expansions are with corresponding contractions. If we assume the contrary, that there exists some expansion of the universe without corresponding contraction, then it follows, that next expansions do not have. In this way all expansions are bounded from above on the time axis, which contradict of the point 1 of the proof.

Therefore, the universe possesses an infinite number of expansions with corresponding contractions, that is an infinite number of cycles and they are unbounded from below and from above on this axis. In this way we can conclude, that the universe is cyclic. The theorem is proved.

4. Conclusion

This paper and [5-7] imply that the following results are valid.

1) The universe is eternal. The consciousness and the perfection of the consciousness of the universe have no beginning and no end in the time, the primacy of the matter is not absolute and it is relative in regard to its forms of motion (the primacy is relative only to the genesis).

2) If the universe had a Big Bang, then it has had an infinite number of Big Bangs in the past and will have an infinite number of Big Bangs in the future.

The last result is a continuation of the original Big Bang theory, according to which the universe possesses only one Big Bang.

3) The universe is cyclic.

References

[1] Baum L., P. Frampton, Turnaround in Cyclic Cosmology. Phys. Rev. Lett. 98, 071301 2007, https://doi.org/10.1103/PhysRevLett.98.071301

[2] Baum L., P. Frampton, Entropy of Contracting Universe in Cyclic Cosmology. Modern Physics Letters A, 23: 33, 2007. https://doi.org/10.1142/S0217732308026170

[3] Gurzadyan, V.G., Penrose, R "On CCC-predicted concentric low-variance circles in the CMB sky". Eur. Phys. J. Plus. 128 (2): 22, (2013). arXiv:1302.5162. Bibcode:2013EPJP..128...22G. doi:10.1140/epjp/i2013-13022-4. S2CID 55249027.

[4] Mithani A., A, Vilenkin, Did the Universe have a beginning? 2007: arHiv1204.4658vl [hep-th] 20 Apr..

[5] Mollov T. Zh., On the problems of the Forms of Motion in the Universe (Bulgarian), Philosophical Thought, No 2, year XXI, 116-119, 1965.

[6] Mollov T. Zh., Consciousness and Cyclicity of the Universe, International Journal of Pure and Applied Mathematics, {\bf 52} No 5, 687-692, 2009. https://ijpam.eu/contents/2009-52-5/9/9.pdf

[7] Mollov, T., Correction of the Big Bang theory and cyclic universe, Anniversary International Scientific Conference, Resurch and education in mathematics, informatics and their applications, Remia, 2021, October 22-24, 2021, Plovdiv, Bulgaria, Section A: Mathematics, p. 81-88

[8] Penrose R., "Before the Big Bang: An Outrageous New Perspective and its Implications for Particle Physics", Proceedings of the EPAC 2006, Edinburgh, Scotland: 2759–2762, 2006.

[9] Penrose R., Cycles of Time: An Extraordinary New View of the Universe, 2010.

[10] Polikarov, A. P. On the Infinite Existence of the Universe (Bulgarian), PhD Thesis, Sofia, 1955.

[11] Steinhardt P., N. Turok, Cosmic Evolution in a Cyclic Universe. Phys. Rev. D, 65, 126003, 2001, https://doi.org/10.1103/PhysRevD.65.126003

[12] Steinhardt P., N. Turok, A Cyclic Model of the Universe. Science. 296 (5572): 1436-1439, 2001. https://doi.org/10.1126/science.1070462

[13] Tegmark, M. Parallel Universes. // Scientific American 288 (5). May 2003. DOI:10.1038/scientificamerican0503-40. c. 40 – 51.

[14] Tolman R.C., Relativity, Thermodynamics and Cosmology, Oxford U. Press, Clarendon Press, 1934.