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Infinite Universe, an Occurrence and a Development

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ABSTRACT

In the present paper we establish, that

(i) The universe is infinite,

(ii) If in its own eternal existence the infinite universe obtains some state (some death), then it receives this state (this death) countless many times and the initial moments of these states (these deaths) are unbounded from below and from above in the time axis. Besides

(iii) We do a review of some results, connected with the occurrence and the development of the universe.

Result (i) solves one from the basic opened questions in the cosmology, namely whether the universe is finite or not. Result (ii) implies some previous results: (a) the consciousness and the perfection of the consciousness of the universe have no beginning and no end in the time, (b) the universe is cyclic and (c) if the universe has had a Big Bang, then it has had an infinite number of Big Bangs.

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Introduction

In this paper we consider the following basic questions for the occurrence and the development of the universe

- Has the universe a beginning in the time
- Is the universe infinite or finite
- The question how many times the infinite universe can obtain an arbitrary death or an arbitrary state
- The Big Bang theory and
- Whether the universe is cyclic.

In the paper [5] it is supposed automatically, that the time of the universe does not have a beginning and it is proved, that

- 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) and
- The universe is cyclic.

"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: 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 in 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. ... 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." [7].

By the Bulgarian physicist A Polikarov the universe is stationary, that is it is unchanged in entirety [10].

In the beginning of the 21-century new cyclic physical models are obtained, connected with a dark energy and a dark matter of the universe and, in this connection new cyclic physical models are created. Such models are the model of P Steinhardt and N Turok [11,12], connected with the theory of the strings as well as the model of L Baum and P Frampton [1,2], which uses the phantom energy of the universe.

The famous English physicist Penrose, received in 2020-year joint Nobel Prize in Physics along with Reinhard Gentzel and Andrea Ghez for the black holes of the universe, creates model, namely a conformal cyclic cosmology [8,9]. In it 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. This model is continued in the joint work of Gurzadyan and Penrose [3].

Since the results of [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 made a strict mathematical interpretation of the above statements in [6].

There are many physical models in which the universe has a beginning in the time. We will not consider them in detail and 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 for a mega-universe. The concept for a mega-universe joins parallel, old and new universes. These concepts are admissible from a physical view point. However, they 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 concepts a parallel universe and a mega-universe and we keep the traditional concept a universe instead of these universes.

By the 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 and the initial inflation continues until now.

In [7] we establish, that the universe is eternal (Proposition 2.1), that is the universe does not have a beginning in the time. If we accept the original Big Bang theory, then we prove in [7], using the axiomatic method, that (i) there exists an infinite number of Big Bangs in the past and in the future (Theorem 2.2) and (ii) the universe is cyclic (Corollary 2.3). Besides we prove directly also in [7], using the axiomatic method, that the universe is cyclic without an using of a Big Bang of the universe (Theorem 3.1). The statement (i) is a negation and a correction of the original Big Bang theory. according to which the universe possesses only one Big Bang.

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

Infinite Universe, an Occurrence and a Development

"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. In [7] it is proved the following proposition, in which we use the law of the conservation of the energy: namely the full energy of a closed material system is a constant in a relation to the time" [7].

Proposition 2.1: [7] 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, since the universe as a whole is a closed material system. 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 exists 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*." [7].

Under states of the universe, we understand for example an expansion, a contraction, a cycle, a consciousness, a big bang, different types of death like a Heat Death, a Big Freeze, a Big Gap, a False Vacuum, a Big Rip, a Big Rift and others.

Axiom 2.1. In its own eternal existence the universe obtains some state.

Axiom 2.2. If the universe is finite, then it cannot repeat its states countless many times.

Now we can prove the following result, which solves one from the basic opened questions in the cosmology, namely whether the universe is finite or not.

Theorem 2.2: The universe is infinite.

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

We will construct by an induction an infinite series of moments on the time axis, such that in each such moment the universe obtains some state.

Let t_1 be a present moment of the existence of the universe, that is t_1 is a point on the axis t. Since in the interval $(-\infty,t_1)$ of the axis *t* the universe has existed eternally, then, by Axiom 2.1, the universe has obtained some state with an initial moment $a_1, a_1 < t_1$.

Suppose, that the universe, along with the said state, obtains *n* times some states, where *n* is an arbitrary natural and the strongly decreasing sequences $t_1,t_2,...,t_n$ and $a_1,a_2,...,a_n$ exist on the axis t, such that $a_i < t_i, i = 1,...,n$, and every moment $a_i, i = 1,...,n$ is an initial moment of the i- state. We choose an arbitrary point t_{n+1} on the axis t, such that $t_{n+1} < a_n$. Since in the interval $(-\infty,t_{n+1})$ on the axis t the universe has existed eternally, then, by Axiom 2.1, the universe has obtained some state with an initial moment $a_{n+1} < t_{n+1}$ on the axis t. Therefore, $a_{n+1} < a_n$. The last state is different from the mentioned, since for the initial moments a_i, $1 \le i \le n + 1$, of the created states $a_{n+1} < a_n < a_{n-1} < ... < a_2 < a_1$ holds.

We proved by an induction, that there exists an infinite number states of the universe. For the completeness of the induction, we receive an infinite strictly decreasing sequence $t_1,t_2,...,t_n,...$ from moments. The induction is complied. The proved contradicts to Axiom 2.2. Therefore, the universe is infinite. The theorem is proved.

In the following axiom and a theorem, we shall designate with A an arbitrary state of the universe.

Axiom 2.3: In the own eternal existence the universe has obtained a state A.

Analogously to Theorem 2.2, we shall prove the following result.

Theorem 2.3: If in its own eternal existence the infinite universe obtains some state, then it receives this state countless many times and the initial moments of these states are unbounded from below and from above in the time axis.

Proof: We will construct by an induction an infinite and unbounded from below and from above series of moments on the time axis, such that in each such moment the universe obtains the indicated state.

Let t_1 be 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 has existed eternally, then, by Axiom 2.3, it is obtained some state A with an initial moment $a_1 < t_1$. Therefore, $a_1 < -1$.

Suppose, that along with the said state A, the universe obtains it n times, where n is an arbitrary natural, and the strongly decreasing sequences $t_1,t_2,...,t_n$ and $a_1,a_2,...,a_n$ 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 indicated state. We choose an arbitrary point t_{n+1} on the axis t, such that $t_{n+1} <$ an and $t_{n+1} < -(n + 1)$. Since in the interval $(-\infty,t_{n+1})$ on the axis t the universe has existed eternally, then, then, by Axiom 2.3, the universe has obtained the state A with an initial moment $a_{n+1} < t_{n+1}$ on the axis t. Therefore, $a_{n+1} < -(n + 1)$ and $a_{n+1} <$ an. The last state is different from the mentioned states, since for the initial moments a_i, $1 \le i \le n + 1$ of the created states $a_{n+1} < a_n < a_{n-1} < ... < a_2 < a_1$ holds.

We proved by an induction, that there exists an infinite number states A of the universe and the initial moments $a_1,a_2,...,a_n,...$ of these states are unbounded from below in the time 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 $t_1,t_2,...,t_n,...$ 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 exists eternally, then, by Axiom 2.3, the universe creates the state A with initial moment $a_1 > t_1$. Therefore, $a_1 > 1$.

Suppose, that the universe, along with the said state A, creates n states A, where n is an arbitrary natural, the strongly increasing sequences $t_1,t_2,...,t_n$ and $a_1,a_2,...,a_n$ 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 state A. 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 exists eternally, then, by Axiom 2.3, the universe creates the state A 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 state A is different from the mentioned states A, since for the initial moments a_i, $1 \le i \le n+1$, of the created states A, $a_{n+1} > a_n > a_{n-1} > ... > a_2 > a_1$ holds. In this way we prove, that there exists an infinite strictly increasing sequence $a_1,a_2,...,a_n,...$ from the initial moments of the states A 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 $t_1,t_2,...,t_n,...$ and also unbounded from above on this axis.

The induction is complied. The theorem is proved.

Since a death of the infinite universe is a state, then we receive from Theorem 2.3, for example, the following result.

Corollary 2.4: If in its own eternal existence the universe obtains some death, then the universe receives this death countless many times and the initial moments of these deaths are unbounded from below and from above in the time axis.

Corollary 2.5: The universe is cyclic.
Proof: Since, by Theorem 2.3, the infinite universe receives countless many times every your state and the initial moments of the indicated states are unbounded from below and from above in the time axis, then we can conclude, with a substitution of state with cyclic, that the universe is cyclic. The corollary is proved.

Besides, Theorem 2.3 implies the following previous results.

Corollary 2.6: The consciousness and the perfection of the consciousness of the universe have no beginning and no end in the time.

Corollary 2.7. If the universe has had a Big Bang, then it has had an infinite number of Big Bangs.

Conclusion

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

- The universe is eternal [7]. 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 of the universe (the primacy is relative only to the genesis) [5,6].
- The universe is infinite (Theorem 2.2). This result is an answer of one from the basic opened questions in the cosmology, namely whether the universe is finite or not.
- If in its own eternal existence, the infinite universe obtains some state (some death), then it receives this state (this death) countless many times and the initial moments of these states (these deaths) are unbounded from below and from above in the time axis (Theorem 2.3 and Corollary 2.4).
- If the universe has had a Big Bang, then it has had an infinite number of Big Bangs and the initial moments of these Big Bangs are unbounded from below and from above in the time axis [7].
- The last result 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 result can be regarded as a correction of this theory.
- The universe is cyclic [5, 6, 7 and Corollary 2.5].

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