# 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 of the time. If we accept the original Big Bang theory, i.e. that the universe has arised from a extremely small, dense and hot fireball by a unique big bang and an inflation which continues until now, then we prove, using the axiomatic method, that (i) there exist an infinite number of big bangs in the past and in the future, and (ii) the universe is cyclic.*

*Besides we prove directly that the universe is cyclic without a using of a big bang of the universe.*

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

**Key words:** big bang, axiomatic method, cyclic universe.

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## 1. Introduction

The question for the existence of the universe is considered from physical, philosophical and mathematical view point. For its existence there are two basic physical and philosophical models which contradict one another: a model in which the universe has a beginning in time and a cyclic model without a beginning of the universe such that it undergoes infinite number of expansions and contractions in the past and in the future. In the second case the universe is called cyclic. The above two models are connected with the concept of infinity, which complicates the question for it truth. Namely, in view of the accomplished 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 this concept,

notwithstanding the unique maxim of the German mathematician Dawid Hilbert, according to whom no concept in mathematics needs precision so much as the concept of infinity" [5]. This is valid also for the physics and the philosophy, which use the concept of infinity. In particular the extant physical and philosophical models for a cyclic universe and a universe with a beginning in time do not give still a final solution to 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" [8]. 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 attitude we note explicitly that the Nature cannot be an arbiter for this, what from the last two contrary 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 [9] renounces this model.

In 1955 A. Polikarov in his PHD thesis raises a philosophical and physical assertion for a stationary universe, that is for an unchanging universe in entirety [6].

The idea for a cyclic universe can also be regarded and from a mathematical view point. Using the axiomatic method, we prove in 1965, that the consciousness and the perfect consciousness of the universe as well as the forms of motion of the matter (the universe) have no beginning and no end in time [4]. 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 [7, 8], created in 2001, which is connected with the theory of the brans as well as the model of L. Baum and P. Frampton [1, 2], created in 2007, which uses the phantom energy of the universe.

Since the indicated results in [4] for a cyclic universe remain without a response and discussion then we develop further this ideas in [5], in which

a strong mathematical interpretation of the above statements is made.

There are many physical models in which the universe has a beginning. We do not review them in detail. We shall mention only the physical model of A. Mithani and A. Vilenkin [3].

Recently physical models for parallel universes appear and also models for destructions of old universes and generation of new universes. The concepts parallel and other universes are admissible from a physical view point. However these concepts contradict to a general concept for the 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.

Lately the concept for a mega-universe appears which joins parallel, old and new universes.

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 a extremely small, dense and hot fireball by a unique big bang. The initial inflation continues until now.

In this paper we establish, that the universe is eternal, that is it have no beginning and no end of the time (Proposition 2.1) and we prove (Theorem 2.1), 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 2.1).

Besides 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 2.1 is an negation of the original Big Bang theory according to 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 [4, 5], we do not consider the physical nature of the universe. We treat the universe from a neat mathematical visible point.

## 2. Correction of the Big Bang theory

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

*Proof.* The law of the conservation of the energy holds for every closed material system. Therefore it is applied to the universe. This fact implies that the universe exists eternally and it will exist eternally. Consequently, there exists an infinite time axis $(-\infty, +\infty)$.

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 fix moment on the axis $t$.

□

**Definition 2.1.** *Every expansion of the universe with an initial moment and a corresponding contraction after this with a final moment is called a cycle of the universe. If the universe has an infinite number of cycles and they have no beginning and no end in the time, then the universe is called cyclic.*

If the eternal existence of the universe generates at least one big bang, then one can accept the following conditional statement.

**Axiom 2.1.** *(conditional). The existence of the universe in an arbitrary infinite interval* $(-\infty, t)$ *or* $(t, +\infty)$ *of the time axis generates some big bang at one moment* $t_0$ *in the indicated interval.*

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

**Theorem 2.1.** *If the universe has generated some big bang, then there exist an infinite number of its big bangs, unbounded from below and from above on the time axis.*

*Proof.* 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 the interval $(-\infty, t_1)$ on the axis $t$ is infinite, then, by Axiom 2.1, the universe has generated some big bang at one moment $a_1 < t_1$. Therefore, $a_1 < -1$. Let $t_2$ be an arbitrary point on the axis $t$, such that $t_2 < a_1$ and $t_2 < -2$. Since the interval $(-\infty, t_2)$ is infinite, then, by Axiom 2.1, the universe has generated some

big bang at one moment $a_2 < t_2$ on the axis $t$. Therefore, $a_2 < -2$ and $a_2 < a_1$.

Suppose, that for an arbitrary natural number $n$ the strongly decreasing sequences $t_1, t_2, \ldots, t_n$ and $a_1, a_2, \ldots, a_n$ are constructed on the axis $t$, such that $a_i < t_i < -i, 1 \leq i \leq n$ and in every moment $a_i, 1 \leq i \leq n$, the universe has generated 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 the interval $(-\infty, t_{n+1})$ is infinite, then, by Axiom 2.1, the universe has generated some big bang at one moment $a_{n+1} < t_{n+1}$ on the axis $t$. Therefore, $a_{n+1} < -(n+1)$ and $a_{n+1} < a_n$.

We proved by induction, that there exists an infinite strongly decreasing sequence $a_1, a_2, \ldots, a_n, \ldots$ of moments on the time axis, unbounded from below, in which the universe generates big bangs and also, for the completeness of the induction, an infinite strongly decreasing sequence $t_1, t_2, \ldots, t_n, \ldots$ on this axis.

By analogy, using intervals from the kind $(t, +\infty)$ and Axiom 2.1, we prove, that there exists an infinite strongly increasing sequence $a_1, a_2, \ldots, a_n, \ldots$ of moments on the time axis, unbounded from above, in which the universe will generate big bangs.

The theorem is proved.

□

Theorem 2.1 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 2.1 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 2.1.** *If there exists some big bang of the universe, then it is cyclic.*

*Proof.* By Theorem 2.1 the universe has an infinite number of big bangs in the past and in the future. Every big bangs begin with expansions. These expansions have corresponding contractions. 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 do not have, i.e. that the big bangs are bounded from above on the time axis, which contradict

to Theorem 2.1. Therefore, the universe possesses an infinite number of expansions with initial moments and corresponding contractions with final moments, 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 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 an expansion of the universe. This expansion has a beginning since otherwise we had not see for the present galaxies, different from our galaxy. Therefore, we can accept the following statement.

**Axiom 3.1.** *Every eternal existence of the universe, namely every its existence in an arbitrary infinite interval* $(-\infty, t_0)$ *or* $(t_0, +\infty)$ *of the time axis generates some its expansion in the indicated interval with an 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.* 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 the interval $(-\infty, t_1)$ on the axis $t$ is infinite, then, by Axiom 3.1, the universe has generated some its expansion in the indicated interval with the initial moments $a_1 < t_1$ of this expansion. Therefore, $a_1 < -1$. Let $t_2$ be an arbitrary moment of the existence of the universe, that is $t_2$ is a point on the axis $t$ and $t_2 < -2$. Since the interval $(-\infty, t_2)$ on the axis $t$ is infinite, then, by Axiom 3.1, the universe has generated some its expansion in the indicated interval with the initial moments $a_2 < t_2$ of this expansion. Therefore, $a_2 < -2$ and and $a_2 < a_1$.

Farther we continue the proof as the proof of Theorem 2.1 by an induction and by an using of Axiom 3.1 In this way we prove, that there exists an infinite number expansions of the universe such that every such expansion is in a finite interval on the time axis and the initial moments of these expansions are unbounded from below and from above on this 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, i.e. that the expansions are bounded from above on the time axis, which contradict to the point 1 of the proof.

Therefore, the universe possesses an infinite number of expansions with initial moments and corresponding contractions with final moments, 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.

□

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