Multiverse in Dynamic Equilibrium

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Abstract

Big Bang cosmology is problematic because of the hypothetical beginning that is not in accord with the conservation of energy. Further, it is based on interpretation of astronomical data that is questionable. CMB is not direct proof of the existence of the recombination period in some remote physical past. Cosmological redshift can be seen as the "tired light effect" proposed by Zwicky. On the basis of direct reading of astronomical data, here we introduce a model of the universe which predicts that in AGNs matter is transforming back into the elementary particles in the form of huge jets that are throwing elementary particles into the intergalactic space and so creating "fresh material" for new stars formation. This process occurring in AGNs, invoked by our model, has no beginning, it is in permanent dynamic equilibrium.

Keywords: Multiverse, superfluid quantum space, CMB, cosmological redshift, AGN.

1. Introduction

In respect to the results of our research and Rovelli's research on time, we replaced the space-time model with the superfluid quantum space model. “Superfluid quantum space (SQS) has a general *n*-dimensional complex structure $\mathbb{C}^n$. Every point of $\mathbb{C}^n$ has complex coordinates:

$$z_i = x_i + i\, y_i \quad (1).$$

(x_i, y_i) (i = 1, ... , n) is an ordered *n*-tuple of real numbers ($(x_i, y_i) \in \mathbb{R}^n$); for the purpose of this paper, we consider its subset $\mathbb{C}^4$ where all elementary particles are different structures of $\mathbb{C}^4$ SQS and have four complex dimensions z_i “[1].

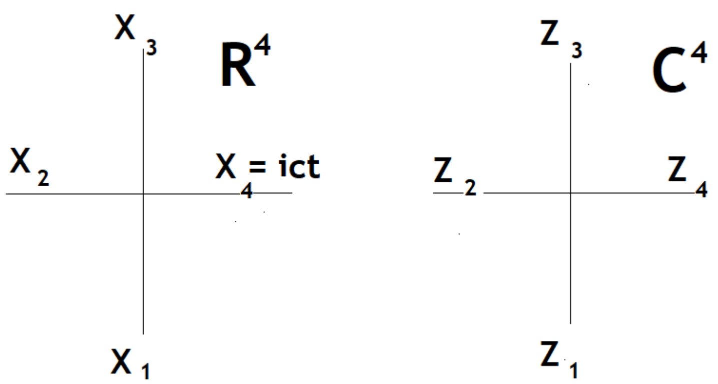

Figure 1: In $\mathbb{C}^4$SQS there is no temporal dimension.

In the cosmology model presented in this article, time does not run independently apart from the change. Time is merely the duration of change. No change in $\mathbb{C}^4$SQS would mean no time. This model is in perfect accord with experimental physics where we measure with clocks the duration of material change that is time. In this sense $\mathbb{C}^4$SQS is timeless, or we say "time-invariant” [1]. In this regard, Rovelli is right in saying that time is an illusion. “According to theoretical physicist Carlo Rovelli, time is an illusion: Our naive perception of its flow doesn’t correspond to physical reality. Indeed, as Rovelli argues in *The Order of Time*, much more is illusory, including Isaac Newton’s picture of a universally ticking clock. Even Albert Einstein’s relativistic space-time — an elastic manifold that contorts so that local times differ depending on one's relative speed or proximity to a mass — is just an effective simplification" [2]. Our research confirms that time is the duration of material changes in universal space that is time-invariant [1,3]. This is an important understanding for cosmology progress.

Time as duration also solves the "four-vector" puzzle. In special relativity, the four-vector is introduced in order to unify space-time coordinates x, y, z, and t into a single entity. The length of this four-vector, called the space-time interval, is shown to be invariant, which means the same for all observers: $A = (A^0, A^1, A^2, A^3)$, where A^0 as a temporal coordinate is $A^0 = ct$. The so-called "temporal coordinate" is a product of time t as the duration of motion and light speed c. The four-vector can be positive or negative and depends on the direction of motion in future or in past:

$$d\tau = \pm\sqrt{dx^{\mu} dx_{\mu}} \qquad (2).$$

where τ is proper time [4].

The idea of motion into past or into future is questionable because it leads to the logical inconsistency where the sum of positive four-vector and negative four-vector is zero:

$$\sqrt{dx^{\mu} dx_{\mu}} + \left(-\sqrt{dx^{\mu} dx_{\mu}}\right) = 0 \qquad (3)\ [4].$$

This means that the value of the space-time interval in the Minkowski manifold from A to B and back from B to A is zero which seems wrong. The idea that a given physical object can move in the future or in the past will be re-examined. In experimental physics, we measure with clocks the duration of motion in space. We do not have any experimental evidence that a given physical object is moving in the direction from the past towards the future. In $\mathbb{C}^4$ space there is no past, and there is no future. A given physical object can move only in a $\mathbb{C}^{\mathbf{4}}$ space and not in time that is the duration of motion. The value of the four-vector $A = (A^1, A^2, A^3, A^4)$ in a $\mathbb{C}^{\mathbf{4}}$ space is always positive. There is no negative time $-t$ and the negative four-vector puzzle is solved.

In the 20th century, the idea of moving back in time was widely accepted. Feynman has defined positron as the electron that is moving backward in time [5]. Time was meant to be the physical reality in which elementary particles move; we do not have a single data that would support this idea. With clocks we measure the duration of motion in space, it is time to abandon the idea of time being the 4th dimension of space. Instead, we developed a $\mathbb{C}^4$ space where time is the duration of change [1].

Gödel development of Einstein field equations of general relativity shows that they lead to the contradiction, namely, one could move back in time and kill his grandfather and so he could not be born. By 1949, Gödel had produced a remarkable proof: "In any universe described by the Theory of Relativity, time cannot exist." He understood that his development of General Relativity proves that time has no physical existence and nobody can travel in time. Still today he is misunderstood by thinking that his work is proving that time travel is possible [6]. Nobody can travel in time because time is not 4th dimension of universal space. The introduction of the $\mathbb{C}^n$SQS as the fundamental arena of the universe where time is the duration of motion resolves the contradiction of "motion in time" and is an important element of cosmology progress.

In this paper our aim is to develop a model of universe in dynamic equilibrium inside the $\mathbb{C}^n$SQS intended as the fundamental arena. In chapter 2 we will introduce our explanation of cosmological redshift in terms of the fluctuations of the energy density of $\mathbb{C}^n$SQS. In chapter 3 we will mention some unsolved issues of the standard inflation model and how our model can open interesting perspectives of treatment of these issues. In chapter 4 we will mention some unsolved questions of the Hubble law in the context of the expanding universe paradigm. In chapter 5 we will analyse how our model allows to explain the curvature of space and dark energy. In chapter 6 we will provide our interpretation of the cosmic microwave radiation (CMB). In chapter 7 and 8 we will see some important problems regarding Big Bang cosmology. Finally, in chapter 9, in order to introduce new perspectives of solution of the various problems of cosmology mentioned in this paper, we will suggest our model of timeless multiverse in dynamic equilibrium.

2. Cosmological redshift is "tired" light effect

The redshift of the light coming from distant galaxies is today understood as the experimental proof of the universal space expansion. We do not have a theoretical model with mathematical evaluations in scientific literature that exactly predict how the light would behave when moving in the opposite direction of expanding space. This is a serious inconvenience and a puzzle that needs to be solved. The Doppler effect is observed on Earth's surface and Earth is moving around the Sun in the stationary space.

Recent research suggests that the $\mathbb{C}^4$ SQS has the value of Planck energy density ρ_{EP}[1,7,8]. The gravitational constant G can be expressed with Planck energy density ρ_{EP} and Planck time t_P as: $G = \frac{1}{\frac{\rho_{EP}}{c^2} t_P^2}$. If the universe would expand, the energy density of the $\mathbb{C}^4$SQS would diminish and consequently the gravitational constant would increase. The gravitational constant was measured first back in 1798 by Henry Cavendish. Since then, the value of gravitational constant is stable, meaning that the density of $\mathbb{C}^4$ SQS is also stable. This is suggesting that the universe is not expanding.

Not only the gravitational constant, also the magnetic permeability μ_0 and the electric permittivity ε_0 of the $\mathbb{C}^4$SQS are defined by its energy density. The increase and decrease of the energy density of the $\mathbb{C}^4$SQS would be a cause for the change of magnetic permeability μ_0 and electric permittivity ε_0 and would consequently change the light speed. This last was exactly measured by English astronomer James Bradley back in 1729 [9]. The constancy of μ_0, ε_0 and light speed is suggesting that the energy density of the $\mathbb{C}^4$SQS is constant and that universe is not expanding.

Stephen Hawking has predicted that the universe started by the mathematical point [10]. Back in 2014, NASA has measured with the 0,4% of error that the universal space has Euclidean shape by measurement of the sum of angles between three stellar objects and getting 180°: "Recent measurements (c. 2001) by a number of ground-based and balloon-based experiments, including MAT/TOCO, Boomerang, Maxima, and DASI, have shown that the brightest spots are about 1 degree across. Thus, the universe was known to be flat to within about 15% accuracy prior to the WMAP results. WMAP has confirmed this result with very high accuracy and precision. We now know (as of 2013) that the universe is flat with only a 0.4% margin of error. This suggests that the Universe is infinite in extent; however, since the Universe has a finite age, we can only observe a finite volume of the Universe. All we can truly conclude is that the Universe is much larger than the volume we can directly observe" [11]. This means that the universal space can be considered infinite in its volume. On the question how a mathematical point could extend into infinite space of the universe has no answer; we know in mathematics that the mathematical point is dimensionless and cannot be transformed into a given volume.

In FLWR metrics the density parameter Ω ultimately governs whether the curvature is: negative (Ω < 1), positive (Ω > 1), flat (Ω = 1). When density parameter is Ω is 1 in the FLWR metrics universal space has Euclidean shape. In our model, the value 1 of the density parameter Ω is related to the Planck energy density of intergalactic space [1]. In every single point of the universal space, the value of the density parameter Ω is unchanged because in the centre of a given physical object the energy density of superfluid quantum space - $\mathbb{C}^4$SQS is diminishing exactly for the amount of its mass *m* and energy *E* accordingly to the equation below:

$$E = mc^2 = (\rho_{EP} - \rho_{Emin})V \quad (4)\ [1],$$

where ρ_{Emin} is the energy density of the $\mathbb{C}^4$SQS in the centre of the physical object and *V* is the volume of the object. This means that the density parameter Ω has the same value in the centre of a black hole and in the intergalactic space.

Considering that density parameter Ω is 1, the only possible future scenario of the universe is Big Rip where all massive objects will have been ripped apart [12]. In Big Bang cosmology we have to invoke "phantom" moments: According to Hawking universe has started from mathematical point and according to Big Rip scenario galaxies will be ripped apart. The cosmology model presented in this article has no such "phantom" moments, it is based only on astronomical data.

We have a plausible explanation of cosmological redshift. When light is coming to us from remote galaxies, it moves against the space fluctuations which are carrying gravity force. $\mathbb{C}^4$SQS fluctuations are flowing from outer interstellar space where $\mathbb{C}^4$SQS has maximum energy density towards lower energy density of $\mathbb{C}^4$SQS in the centre of stellar objects; these $\mathbb{C}^4$SQS fluctuations are carrying gravity force [1,7,8]. Light from distant galaxies is moving in the opposite direction of these space fluctuation and is that why losing some of its energy. The result is the cosmological redshift. Swiss astronomer Zwicky has named this effect "tired light effect" [13], see Figure 2.

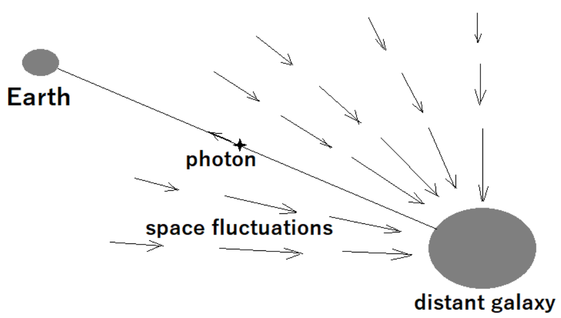

Figure 2: Light is losing some of its energy when moving in the opposite direction of the space fluctuations that carry gravity.

Theory of vector gravity is a model that supports the reinterpretation of gravitational redshift: "Similarly to general relativity, vector gravity postulates that the gravitational field is coupled to matter through a metric tensor f_{ik} which is, however, not an independent variable but rather a functional of the vector gravitational field. In particular, action for a point particle with mass m moving in the gravitational field reads:

$$S_{matter} = -mc \int \sqrt{f_{ik}\, dx^i dx^k} \qquad (5)$$

where c is the speed of light. Action (5) has the same form as in general relativity, however, the tensor gravitational field g_{ik} of general relativity is now replaced with the equivalent metric f_{ik} (f_{ik} is a tensor under general coordinate transformations)" [14].

Our model provides the physical origin of vector gravity that is in the $\mathbb{C}^4$SQS quantum fluctuations that are directed from the higher energy density of $\mathbb{C}^4$SQS towards the lover density of $\mathbb{C}^4$SQS. These fluctuations interact with photons to diminish their frequency, which is referred to as 'gravitational redshift.' When light from distant galaxies reaches the Earth, its frequency is lower. On its path to Earth, light loses some of its energy because it is moving against the $\mathbb{C}^4$SQS fluctuations that points toward the direction of galaxies, so that

$$E_{photon.Earth} = E_{photon.galaxy} - \Delta E \qquad (6),$$

where $E_{photon.galaxy}$ is the energy of the photon at the galaxy, $E_{photon.Earth}$ is the energy of the arrived photon at the Earth, and ΔE is the loss of energy due to the fluctuations of the $\mathbb{C}^4$SQS,

$$\Delta E = h\Delta \nu \qquad (7),$$

where h is Planck's constant and $\Delta \nu$ is the decrease of the photon frequency due to $\mathbb{C}^4$SQS fluctuations (Figure 2) [15].

Because of different densities of the $\mathbb{C}^4$SQS, the frequency of light also changes when moving from the source to the receiver above the Earth's surface. In a Harvard University experiment, a source on the Earth's surface and a receiver at the height of 22,5 meters were positioned, as illustrated in Figure 3.

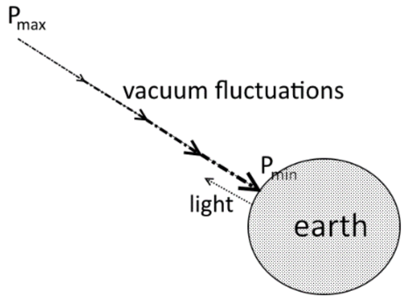

Figure 3. The redshift of light moving from the Earth's surface upwards.

The Mössbauer effect was used to measure the difference between y-ray emission and absorption frequencies at each end of the experiment. The measurement accuracy was $\Delta\omega / \omega \approx 10^{-15}$, which shows a change of light frequency as

$$\frac{\Delta\omega}{\omega} = \frac{GM}{R^2c^2}h \qquad (8),$$

where M and R are the mass and radius of the Earth, respectively [16].
In our approach, Equation (8) may be conveniently rewritten by substituting the Earth mass M with the $\frac{(\rho_{Emax}-\rho_{Emin})V}{c^2}$ from Equation (4) as:

$$\frac{\Delta\omega}{\omega} = \frac{G(\rho_{Emax}-\rho_{Emin})V}{R^2c^4}\,\mathrm{h} \qquad (9),$$

which can be expressed as:

$$\frac{\Delta\omega}{\omega} = \frac{G(\rho_{Emax}-\rho_{Emin})4\pi R^3}{3R^2c^4}\,\mathrm{h}$$

$$\frac{\Delta\omega}{\omega} = \frac{4\pi RG(\rho_{Emax}-\rho_{Emin})}{3c^4}\,\mathrm{h} \qquad (10).$$

Equation (10) confirms that gravitational redshift at Mössbauer effect depends on the minimal energy density of the $\mathbb{C}^4$SQS ρ_{Emin} in the Earth's centre.

$\mathbb{C}^4$SQS quantum fluctuation in distant galaxies in the direction from ρ_{Emax} (outer space) towards ρ_{Emin} (centre of galaxy) are the physical origin of so called "tired light" model of astronomer Fritz Zwicky. What we call "cosmological redshift" is "tired light effect".

Recent research is confirming that cosmological redshift has its origin in the gravitational field of galaxies from which light is reaching the Earth. When light is moving from the galaxy in the opposite direction of gravity it has a minimal diminishment of velocity. This causes the loss of frequency and consequently the redshift effect [17].

3. NASA's discovery means the end of expansion model of the universe and the end of inflation model

NASA has measured back in 2014 that universal space is flat, it has a Euclidean shape [11]. In FLWR metric the density parameter Ω ultimately governs whether the curvature is: negative (Ω < 0), positive (Ω > 0), flat (Ω = 0). When the density parameter is Ω is 1 in the FLWR metric universal space has a Euclidean shape and FLWR metrics predict that such a space can expand. This is against the metrics of Euclidean geometry where the distance between two points is always constant. In an n-dimensional Euclidean space the distance d between point p and point q is calculated accordingly:

$$d\sigma = \left(\sum_{i=1}^{n} (p_i - q_i)^2 \right)^{½} \quad (11).$$

We do not have any possibility in the frame of Euclidean geometry that the distance d would be changed. We cannot expand or shrink Euclidean space. This means that such a space is homogeneous and isotropic. But in spherical geometry or hyperbolic geometry, the situation is different. For example, in a spherical geometry considered as a model for universe, all relative distances increase at a rate proportional to their magnitudes. When using spherical geometry universe is closed. In the hyperbolic case which is an open universe, when the radial coordinate increases away from the origin, the circumferences increase more rapidly with proper radius. One can observe the differences between these three types of spaces from the following:

$$d\sigma^2 = \frac{\sum_{i=1}^{n} (p_i - q_i)^2}{(1 + \frac{k}{4} (\sum_{i=1}^{n} (p_i - q_i)^2)^2} \qquad (12)$$

1. Flat space: k=0
2. Spherical space: k > 0
3. Hyperbolic space: k < 0.

Eq. (12) confirms that when $k = 0$, the distance d cannot increase or decrease. The idea that universal space has been inflating immediately after the hypothetical explosion is inspired by the fact that in mathematics, we can increase the radius of the Riemann manifold, and its volume will increase. We have shown in the previous section that we cannot apply Riemann geometry in cosmology because universal space has a Euclidean shape and cannot expand. We do not have a single direct measurement that would prove that universal space is expanding. The idea that universal space could expand has no mathematical basis and has no support in astronomical observations. We have shown in the previous section that the Mössbauer effect is a direct proof of the cosmological gravitational redshift.

Back in 2011 Steinhardt published an article in *Scientific American* questioning if inflation is a flawed model: "Is the theory at the heart of modern cosmology deeply flawed?" [18]. In his article he did not give final conclusions. He pointed out that the inflation model has some unbridgeable problems that seems are no solvable.

Back in 2017 Steinhardt published together with Anna Ijjas and Abraham Loeb another article in *Scientific American* titled "Cosmic Inflation Theory Faces Challenges - The latest astrophysical measurements, combined with theoretical problems, cast doubt on the long-cherished inflationary theory of the early cosmos and suggest we need new ideas". The three authors question the dominant idea of the inflation, the fact that the early cosmos underwent an extremely rapid expansion, suggesting the necessity to consider other scenarios, and in particular the possibility that our universe began with a bounce from a previously contracting cosmos. Their article has opened a feverish debate among world-leading cosmologists. For example, Cornellussen writes in a 2017 *Physics Today* paper: "The trio's aggressive reappraisal of a scientific consensus inspired an energetic rebuttal, also in *Scientific American*, from 33 prominent physicists, including four Nobel laureates" [19].

We are proposing in this article a new way of solving the problems of the inflation model and also other problems of Big Bang cosmology. We suggest here a cosmological model that will be based on the direct reading of obtained data. Mössbauer effect is directly observed and measured. It confirms that light when moving in the opposite direction of gravity force diminishes its frequency. This is the so-called "gravitational redshift". Cosmological redshift has the same physical origin. When light is pulling out of the strong gravitational fields of distant galaxies their frequency diminishes. This is the manner in which in our model the idea of inflation can be avoided and abandoned. According to our model, universal space is flat, of Euclid nature, and cannot expand; in the light of the Mössbauer effect, when light moves in the opposite direction of the gravitational fields of galaxies their frequencies diminishes.

Alan Guth's view is that universe run in some physical time. With the Big Bang this physical time has entered into existence. How this has happened we do not know yet: "There is much evidence that at earlier times the universe underwent inflation, but the details of how and when inflation happened are still far from certain. There is even more uncertainty about what happened before inflation, and how inflation began. I will describe the possibility of "eternal" inflation, which proposes that our universe evolved from an infinite tree of inflationary spacetime. Most likely, however, inflation can be eternal only into the future, but still must have a beginning [20]. In the same article Guth has continued: "Since inflation is eternal into the future, it is natural to ask if it might also be eternal into the past. The explicit models that have been constructed are eternal only into the future and not into the past, but that does not show whether or not is possible for inflation to be eternal into the past" [20]. Guth sees universe running in some physical time that we show is non-existent. His speculations about eternal inflation into future and possible eternal inflation from the past are strictly theoretical and have no experimental evidence.

Guth and the co-authors admitted that inflation model is not self-consistent: "Thus inflationary models require physics other than inflation to describe the past boundary of the inflating region of spacetime" [21]. Cosmology model presented in this article is self-consistent.

Guth' way of incorporating gravity in his inflation model is not convincing: "The expansion of the universe may be described by introducing a time-dependent "scale factor," $a(t)$, with the separation between any two objects in the universe being proportional to $a(t)$. Einstein's equations prescribe how this scale factor will evolve over time, t. The rate of acceleration is proportional to the density of mass-energy in the universe, p, plus three times its pressure, p: $\frac{d^2a}{dt^2} = -\frac{4\pi G(\rho+3p)a}{3}$, where G is Newton's gravitational constant (and we use units for which the speed of light $c = 1$). The minus sign is important: ordinary matter under ordinary circumstances has both positive mass-energy density and positive (or zero) pressure, so that $(\rho + 3p) > 0$. In this case, gravity acts as we would expect it to: All of the matter in the universe tends to attract all of the other matter, causing the expansion of the universe as a whole to slow down" [22]. By adding the negative mathematical sign in the formula gravity in the universe will not change. In our model gravity cannot be seen as positive or negative in the mathematical sense. Gravity is the result of the diminished energy density of $\mathbb{C}^4$SQS in the centre of a given physical object [1,7,8].

The radius of the mapped universe measured on the basis of astronomic observations is about $4{,}4 \cdot 10^{26}\ m$. The age of the universe is about $4{,}35 \cdot 10^{17} s$. According to these data the universe should expand with a velocity of $1{,}011 \cdot 10^{9}\ m/s$, that is about 3,3 light speed to reach the mapped size of the universe [23]. The idea that the universe could expand with the average velocity of a 3,3-time of light speed seems unacceptable; we do not have a single theory in physics that would predict such a velocity. The discrepancy between the measured mapped universe and the hypothetical size and expansion of the universe is a big unresolved question of the Big Bang cosmology model.

4. **Hubble law and Doppler effect in an expanding space**

Hubble law states that acceleration of the universe increases by the distance:

$$v = H_0 \mathrm{D} \qquad (13),$$

where v is the velocity typically expressed in kms^{-1}, H_0 is Hubble constant and D is the distance of the galaxy from the observer measured in megaparsecs (Mpc). One Mpc is $3{,}261 \cdot 10^{6}$ light-years. Velocity v of the expansion is defined on the basis of the redshift of a given galaxy. Universal space is expanding and so distances to the galaxies are increasing. The velocity of the galaxies is determined by their redshift that occurs because of Doppler effect. We have shown in section 2 that there is no appropriate mathematical model existing that would describe the Doppler effect in an expanding space. Equation of the Doppler effect is following:

$$f = \left(\frac{c \pm v_r}{c \pm v_s}\right) f_0 \qquad (14),$$

f is observed frequency, f_0 is emitted frequency, v_r is the speed of receiver relative to the medium, c is the light speed, and v_s is the speed of the source relative to the medium. Eq. (10) is valid when the medium is at rest. Doppler effect is observed only in the stationary space where electric primitivity ε_0 and magnetic permeability μ_0 of space that define light speed are unchanged. We do not know how the Doppler effect would work in an expanding space where the energy density of the $\mathbb{C}^4$SQS would diminish and electromagnetic properties of space would be changed. Masanori research confirms that gravity influences the electromagnetic properties of space: “It is known that the speed of light depends on the gravitational potential.

In the gravitational fields, the speed of light becomes slow, and time dilation occurs. In this discussion, the permittivity and permeability of free space are assumed to depend on gravity and are variable" [24]. Applying the Doppler effect in Hubble law without knowing how the expansion of the universe changes electromagnetic properties of expanding space seems unacceptable.

Back in 2019, NASA has reported on universe expansion: "The new estimate of the Hubble constant is 74 kilometers (46 miles) per second per megaparsec. This means that for every 3.3 million light-years farther away a galaxy is from us, it appears to be moving 74 kilometers (46 miles) per second faster, because of the expansion of the universe. The number indicates that the universe is expanding at a 9% faster rate than the prediction of 67 kilometers (41.6 miles) per second per megaparsec, which comes from Planck's observations of the early universe, coupled with our present understanding of the universe" [25].

In section 3. we calculated the average velocity of the universe expansion that is according to the size of the mapped universe and age of the universe 3.3-time of light speed which yield $9.893 \cdot 10^8 ms^{-1}$. Hubble constant is measured to be 74 kilometers per second which yield $7.4 \cdot 10^4 ms^{-1}$. According to the value of the Hubble constant universe should be much smaller. This is the second weak point of Hubble law.

Hubble law predicts the existence of the Hubble sphere, a spherical region of the observable universe beyond which objects recede at a rate greater than the speed of light due to the expansion of the universe [26]. How galaxies could have velocity higher than light speed is also an unanswered question of Hubble law. Research published in 2013 has confirmed that photons form matter [27]. This means that every physical object accelerated to the light speed would turn into light. No physical object can move with light speed. Only photons can move with light speed. The Hubble sphere model is suggesting that beyond the Hubble sphere there are only photons in the universe and that they move faster than light speed. This seems unacceptable.

Measurements of the Hubble constant based on the astrophysics of stars and CMB have a 10% of the discrepancy: "It is certainly worth noting that the local measurement of H_0 is based on the astrophysics of stars, and the CMB results are based on the physics of the early universe: the results are entirely independent of each other. 13.8 billion years of evolution of the universe has occurred since the surface of last scattering of the CMB and the present day, and yet the two measures agree to within 10%. Viewed from a historical perspective, the agreement is actually rather remarkable" [28]. Wendy L. Freedman is pointing out that this discrepancy is signalling the cosmology beyond the standard model: “Over the past 15 years, measurements of the fluctuations in the temperature of the remnant radiation from the Big Bang have provided a relatively new means of estimating the value of the Hubble constant. This very different approach has led us to an interesting crossroads, yielding a lower derived value of H_0 (see Figure 1). If this discrepancy persists in the face of newer and higher precision and accuracy data, it may be signaling that there is new physics to be discovered beyond the current standard model of cosmology” [28].

Lucas Lombriser has tried to solve this discrepancy with the proposal of a higher local density of matter: “A significant tension has become manifest between the current expansion rate of our Universe measured from the cosmic microwave background by the *Planck* satellite and from local distance probes, which has prompted for interpretations of that as evidence of new physics. Within conventional cosmology a likely source of this discrepancy is identified here as a matter density fluctuation around the cosmic average of the 40 Mpc environment in which the calibration of Supernovae Type Ia separations with Cepheids and nearby absolute distance anchors is performed” [29]. Lucas Lombriser is applying in his calculations FLWR metrics as that the cosmic bubble of the 40 Mpc environment would be a universe apart. This seems unacceptable, you cannot take a part of the universe out of the context and calculate the local expansion rate. It makes no sense; if we imagine Big Bang as an initial explosion there is no way according to the known physics that some parts of the explosion would have a different rate of expansion. L. Freedman's proposal of searching beyond Big Bang cosmology deserves serious consideration.

5. **Super-fluid quantum space, dark energy and dark matter**

Super-fluid four-dimensional complex quantum space $\mathbb{C}^4$SQS is the primordial energy of the universe. According to the law of energy conservation, this energy cannot be created and cannot be destroyed. Every physical object with the mass m is diminishing the energy density of $\mathbb{C}^4$SQS in its centre exactly for the amount of its energy E. Variable energy density of $\mathbb{C}^4$SQS is generating inertial mass m_i and gravitational mass m_g of a given physical object: “From the macro to the microscale, it holds that a given physical object is interacting with the $\mathbb{C}^4$SQS in which is existing; the result of this interaction are the inertial mass m_i and the gravitational mass m_g:

$$m_i = m_g = \frac{(\rho_{EP} - \rho_{Emin})V}{c^2} \quad (15)\ [1].$$

The inertial mass of a given physical object is not its rest mass, it is the result of the interaction of rest mass with the $\mathbb{C}^4$SQS [1]. Gravity force between two physical objects is as follows:

$$F_g = \frac{m1_g m2_g G}{r^2} \qquad (16),$$

where $m1_g$ is the inertial mass of the first object and $m2_g$ is the inertial mass of the second object:

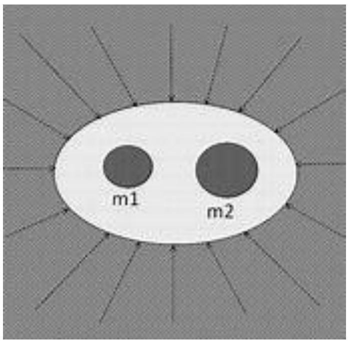

Figure 4: Gravity for acts from outer space towards the centre of physical objects

Higher pressure of outer $\mathbb{C}^4$SQS is pushing together physical objects. $\mathbb{C}^4$SQS is the "unknown fluid" of the universe. It cannot have negative pressure as suggested in recent research: "This acceleration in the universe may driven by an exotic type of unknown fluid that have positive energy density and huge negative pressure. This fluid is usually known as Dark Enegry (DE) but its nature is still unknown. The most suitable candidate of this DE is the Λ. However, there is a huge dissimilarity in the value of Λ predicted by observations and particle physics ground that leads tuning problem" [30]. Negative pressure of the "unknown fluid" is a theoretical proposal that was never observed in experimental physics and cannot be taken as a stable ground to build cosmology.

Dark energy, also named "unknown fluid is 68% of the energy in the universe. About 5% of the energy in the universe is in the form of visible matter, while about 27% is in the form of dark matter and about 68% of the energy of the universe is in the form of dark energy [31]. Since the 1980s, the dominant paradigm for the nature of dark matter has been that of the weakly interacting massive particle (WIMP) [32].

In our model, the energy of the $\mathbb{C}^4$SQS is the dark energy; the idea that universal space is empty and dark energy is hidden somewhere in the space seems wrong. $\mathbb{C}^4$SQS model offers the solution for the discrepancy between measured and theoretically valued cosmological constant: "The measured value of cosmological constant $\Lambda = 5.96 \cdot 10^{-27}$ kg/m^3 is different from its calculated value following the Planck metrics for the magnitude of $10^{123:}$ this discrepancy is an unsolved subject of physics for decades [33]. Regarding the suggested energy density of space proposed in this article, we are defending our proposal by the fact that the gravitational constant G is obtained by measurement and is expressed by the Planck energy density ρ_{EP} and the Planck time t_P as:

$$G = \frac{c^2}{\rho_{EP}\, t_P^2} \quad (17).$$

This means that the Planck energy density ρ_{EP} reflects the real energy density of a 4-D universal space. In the absence of stellar objects, the energy density of the universal space has a value of Planck energy density which is $\rho_{EP} = 4.64 \cdot 10^{113} Jm^{-3}$ "[1]. Einstein had proposed that universal space is four-dimensional. In his vision time is the 4th dimension of space. In our model also 4th dimension is spatial, time is the duration of the change in space. We are introducing the variable energy density of the four-dimensional superfluid quantum space that is proportional to the amount of matter accordingly to Eq. (4) that represents the mass-energy equivalence principle extension on the $\mathbb{C}^4 SQS$ superfluid quantum space.

6. CMB is the radiation of the existent universal space

We propose also that CMB should not be interpreted as a proof of recombination period. Astronomical observations confirm that the universal space is radiating uniform CMB radiation [34]. The Big Bang model suggests that the CMB radiation is the relic radiation from some remote physical past. The universal space is timeless; no signal can move through some hypothetical physical time; all signals move in the timeless space. The idea that CMB is radiation from some remote physical time is not falsifiable and should be abandoned in the name of cosmology progress. CMB has its source in present time-invariant universal space. Experimental physics is confirming a given signal we can only reach from the existent physical source, and the remote physical past is physically non-existent. Any kind of radiation must have a physical source; the remote past event cannot be this physical source. The proposal that the CMB signal is relic radiation that was created in some remote physical past and is still present is an ad-hoc proposal that was never confirmed by an experiment. The discovery of CMB absolutely does not prove the existence of a recombination period that should be existing around 380000 years after some hypothetical Big Bang. The scientific fact on the basis of observations is that CMB is the radiation of existent universal space that has its physical origin in $\mathbb{C}^4$SQS that is timeless. The CMB has a thermal black body spectrum at a temperature of $2.72548 \pm 0{,}00057K$ [35].

7. Big Bang cosmology and Einstein's steady-state cosmology have no answer about matter creation

Alan Gut hypothesis is that the energy of gravity and that of matter have been multiplying in inflation period. The energy of gravity E_g is negative, the energy of matter E_m is positive, their sum is zero and in inflation on the contrary they multiply [36]. We can describe his idea mathematically as follows:

$$nE_m + (-nE_g) = 0 \quad (18).$$

Firstly, we never observed negative gravitational energy. Secondly, we never observed that energies are multiplying out of nothing. Gut's idea is against the first law of thermodynamics and is not bijective. There is no logical answer also about where both energies came into existence in the hypothetical inflation. Eq. (14) is mathematically right, but it does not fulfil the test of bijectivity, meaning that it does not correspond to some real process in physical world. The Big Bang model is not falsifiable.

The model of the universe presented in this article is based only on the obtained experimental data, is falsifiable. There are no theoretical speculations as in the case of the Big Bang model. The cosmology model presented in this article is based only on direct reading of experimental data. Thinking that the gravitational energy could be negative is logically inconsistent, because we never observed to date positive or negative energy in the universe. We know that there are precise conventions on the sign of energy, conventions adopted in all areas of physics, such as thermodynamics (absorbed energy = positive; energy released energy = negative). But these are adopted conventions, no one has ever measured that energy has an associated mathematical sign. This is also in line with the principle of bijectivity introduced in the article. Also, the idea that the energy of the universe is multiplying in the hypothetical inflation is logically inconsistent, because we have no experimental evidence that energy can get multiplied. The inflation is against the first law of thermodynamics.

In the past century, gravity was understood as the force produced directly by the matter, the idea was that universe must be finite. We can read in the article of Sir James Jeans in Nature back in 1943: “If, however, the distribution is uniform throughout the whole of space, then space must be finite; otherwise, it would contain an infinite amount of matter, and the gravitational force from this would be infinite, which is contrary to the fact” [37].

NASA has measured that the universe has Euclidean shape and is infinite [11]. The idea of $\mathbb{C}^4$SQS being infinite does not mean that gravity should be infinite, as suggested by Sir James Jeans. Considering universal space is infinite there is no gravity force between the stellar objects that are on the infinite distance.

The energy of the infinite universe in the form of matter E_m and in the form of superfluid quantum space energy E_{SQS} is infinite:

$$E_m + E_{SQS} = \infty \quad (19).$$

The human mind can only imagine a finite amount of matter and a finite amount of energy and finite space which is not the case with the universe. The universe is infinite by means of matter, energy, and volume. That’s why is opportune we study the universe that is at a finite distance and we predict that the rest of the unobservable universe on the infinite distance is behaving in the same way as our observable universe.

Mass of every physical object in the universe diminishes the energy density of space, the variable energy density of space is carrying gravity that is the fundamental force of the universal dynamics. Defining gravitational energy negative, as done by Hawking and Guth, is questionable; energy is not positive, it is not negative, energy simply is, it cannot be created and it cannot be destroyed, it transforms continuously.

Einstein has proposed on his steady—state theory of the universe that matter is continuously created out of the universal space: “In the final part of the manuscript, Einstein proposes a physical mechanism to allow the density of matter remain constant in a universe of expanding radius - namely, the continuous formation of matter from empty space: “If one considers a physically bounded volume, particles of matter will be continually leaving it. For the density to remain constant, new particles of matter must be continually formed within that volume from space” [38]. How the matter is formed out of space Einstein did not explain. Both, Hawking's and Einstein's solution for how matter appears in the universe are pure theoretical speculations. In our model appearance of matter in the universe is not questionable. In AGNs' matter is constantly disintegrating in elementary particles that are fresh energy for matter formation.

8. Multiverse is in permanent dynamic equilibrium

$\mathbb{C}^n$ SQS is multidimensional. All elementary particles are different structures of a $\mathbb{C}^4$SQS [1]. Physical objects are made out of atoms that are three-dimensional. Different layers of $\mathbb{C}^n$SQS are coexisting, they are interwoven. In our view of the multiverse theory, we do not have some parallel universes that are coexisting in some unexplainable way. The universe we perceive and observe is a multiverse. We can only perceive and measure the 3D and the 4D realms of the multiverse. Higher dimensions are not reachable with apparatuses but this does not mean that they are non-existent. The idea of the multiverse or "multiple universes" is present in the human culture for ages: "Widely propounded in cosmology, physics, astronomy and hypothesized in philosophical and religious literature, the concept of multiple universes under the names of multiverse, parallel universes, quantum universes or interpenetrating dimensions has been under the debate among the prominent physicists since middle ages" [39]. 5D and higher dimensionalities of $\mathbb{C}^n$SQS represent the mathematical model that can describe "hidden variables" of Einstein: "Albert Einstein never liked some of the counterintuitive predictions of quantum theory, arguing instead that there was a further, hidden layer to reality it failed to describe" [40], and "implicate order" of David Bohm [41].

In the cosmology model proposed in this article the energy density of $\mathbb{C}^4$ SQS in interstellar space has a value of Planck energy density $\rho_{EP} = 4.64 \cdot 10^{113} Jm^{-3}$. Every stellar object is diminishing energy density of the 4th dimension of $\mathbb{C}^4$SQS in its centre exactly for the amount of its mass m and energy E accordingly to the Eq. (3). Let's see the values of $\mathbb{C}^4$SQS energy density in the centre of some stellar objects on the table below [5]:

Table 1. Comparation values of the energy density of space with respect to the centre of indicated objects.

Centre of objects	$\rho_{EP} = 4.64 \cdot 10^{113} Jm^{-3}$
Black hole with mass of the Sun	$\rho_{EP} - 1.58 \cdot 10^{36} Jm^{-3}$
Earth	$\rho_{EP} - 4.94 \cdot 10^{20} Jm^{-3}$

Moon	$\rho_{EP} - 3.00 \cdot 10^{20} Jm^{-3}$
Sun	$\rho_{EP} - 1.26 \cdot 10^{20} Jm^{-3}$

In the centre of a black hole with the mass of the Sun and corresponded Schwarzschild radius $r_{Sch} = 3 \cdot 10^3\ m$, the minimal energy density of $\mathbb{C}^4$SQS is for the order of 10^{16} lower than in the centre of the Sun. Because of this special physical circumstance atoms become unstable. In the huge black holes in the centre of AGNs matter is falling apart into elementary particles that form jets. Black holes in the centre of galaxies are throwing these jets into intergalactic space. These jets are fresh energy for new stars formation; black holes are rejuvenating systems of the universe [8]. AGNs in the centres of galaxies are keeping entropy of the universe constant: "old" matter is transformed into "fresh" energy in the form of elementary particles (Figure 5).

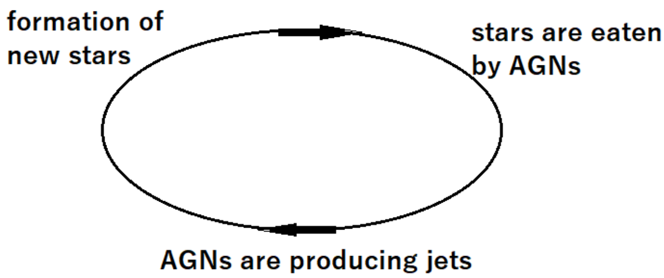

Figure 5: Energy circulation in the universe is permanent.

This process did not start and will never end, it is in permanent dynamic equilibrium. There was no creation of the energy of the universe and there will be no destruction of the energy. An increase of matter entropy in the universe is only a partial process that does not influence the total entropy of the universe that is constant. In AGN-s the universe is rejuvenating itself.

9. Big Bang cosmology model timeline seems wrong

There is a strong astronomical evidence that the star HD 140283 has an age of 14.27 billion years [42] that is a new difficulty for Big Bang model according to which the age of the universe is calculated by about 13.7 billion years. This astronomical observation is another puzzle Big Bang cosmology cannot solve.

The next problem of the existing big bang timeline is the formation of the galaxies in the early universe, the so-called "early galaxies problem". Several galaxies with such a high redshift are discovered that they should be formed earlier as the big bang model is predicting: "We have shown that recent observations of high-redshift galaxies are inconsistent with current theoretical models of galactic assembly. As a general principle, when theory and observation disagree, it is historically best to believe the observational result. However, in this case the observations also rely on untested theoretical assumptions about stellar evolution. Thus, something is wrong, but what?" [43]. We suggest in our article that the theoretical assumption of the universe starting with some hypothetical big bang seems wrong.

The next problem of the existing big bang timeline is the discovery of a giant arch behind galaxy cluster IDCS J1426.5+3508 that should accordingly to the big bang cosmology should not exists: "Very simply, the arc we have discovered behind IDCS J1426.5+3508 is not predicted to exis" [44]. In our cosmological model universe has no "timeline". All stellar objects and formations that we observe do not pose any problem.

Comparing with the big bang cosmology our cosmological model is incorporating the existence of methuselah star HD 140283, the existence of giant arch behind galaxy cluster IDCS J1426.5+3508 and is solving the "early galaxy problem". We developed a cosmology model without the beginning of the universe, the problem of creation is solved. Penrose and Gurzadyan's "Conformal cyclic cosmology" (CCC) model also suggest that the universe is non-created, eternal, and in the permanent cyclic transformation [45]. CCC cosmology is accepting the inflation period that the "CPT – Symmetric universe" model is denying. CPT model predicts that before the big explosion there was an anti-universe in some negative time [46]. We categorically exclude that universe could exist in some negative time or could exist in some positive time. CCC cosmology model and CPT – Symmetric universe model weak points are that both models predict some events in the past that were never observed directly, their existence is questionable. **M**ultiverse in **d**ynamic **e**quilibrium (MDE) is advanced in the sense it is based only on astronomical observations; it has no theoretical speculations about some past events in some remote physical past. MDE model is based on the astronomical observations of the existing observable universe. In MDE model atoms are 3D structures composed out of elementary particles that are different 4D structures of $\mathbb{C}^4$SQS [1]. 5% of the energy in the universe is in the form of matter that is 3D and 95% is in the form of 4D and higher dimensional layers of $\mathbb{C}^4$SQS; dark energy and represent about 68% of the energy of the universe, the weakly interacting massive particle (WIMP) that represent around 27% of the energy of the universe [32]. In an MDE model, the proportion (5% - 27% - 68%) between ordinary matter, dark matter, and dark energy that is the $\mathbb{C}^4 SQS$ energy is more or less constant. A multiverse is a dynamic system in permanent equilibrium. The transformation of mater into elementary particles in the centre of AGNs is permanent; the multiverse is continuously recreating itself. Multiverse is non-created and eternal.

10. Conclusions

Our research shows that direct reading of CMB means the end of Big Bang cosmology. Cosmological redshift has a valuable interpretation in a tired light effect. Big Bang cosmology does not explain the origin of energy at the moment of creation. On the other hand, the cosmology model presented in this article is without theoretical speculations and is based only on astronomical data.

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