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Hypothesis of the Hidden Multiverse Explains Dark Matter and Dark Energy

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Abstract

Analysis of WMAP and Planck spacecraft data has proved that we live in an invisible Multiverse, referred to as hidden, that has a quaternion structure. It explains the reason for the mutual invisibility of parallel universes contained in the hidden Multiverse. It is shown that the hidden Multiverse includes most likely twenty parallel universes from different dimensions, six of which are adjacent to our universe. Besides, edges of the hidden Multiverse are connected to other (from one to four) Multiverses, which are observable neither by electromagnetic nor by gravitational manifestations. The Multiverse described contains four matter-antimatter pairs, annihilation of which is prevented by relative spatial position of the universes. The experimental proof of existence of the hidden Multiverse is explained to be the phenomenon of dark matter and dark energy that correspond to other invisible parallel universes, except ours, included in the hidden Multiverse. General scientific principle of physical reality of imaginary numbers, refuting some of the statements of the existing version of the special theory of relativity, is a physical and mathematical foundation of the outlined conception of the hidden Multiverse. The article presents relativistic formulas of the theory of special relativity adjusted in accordance with the principle. It also offers appropriate interpretation of multidimensional space of the hidden Multiverse.

1. Introduction

In what kind of world do we live in: In Monoverse or Multiverse? And what are dark matter and dark energy like in this world? These are main questions of astrophysics, which are attempted to be answered in this article.

In modern physics there are two main theories: the theory of relativity and the quantum mechanics, which are

absolutely contradictive, since they use different mathematics, different axioms and different physical pictures of the world. There is also a string theory, which attempts to unite quantum mechanics and theory of relativity, but so far without success.

To date, numerous hypotheses of Multiverse [1]-[11] have been proposed according to these theories. However, according to many scientists, they are not scientific [12] [13], because they do not comply[1] with the falsification criterion proposed by Popper [14]. In other words, these hypotheses are such that they can neither be confirmed nor denied. Given this circumstance, the majority of scientists believe that we live in a single universe, *i.e.*, in a Monoverse.

But still there is no answer[2] for the second question. Therefore, the phenomenon of dark matter and dark energy [15] [16] remains unexplained.

These theories either give no answers for many other fundamental questions of astrophysics:

- Why is there no antimatter in our universe [17]?
- Where do tachyons locate [18] [19]?
- Are imaginary numbers physically real [20] [21]?, etc.

So, starting with answering the latter question (whether imaginary numbers[3] are physically real), which seems to have nothing to do with direct content of the article, we proceed to description of a new proposed conception of the Multiverse, which gives answers to the remaining questions mentioned above.

2. Physical Reality of Imaginary Numbers

Imaginary numbers in mathematics were discovered about five hundred years ago by Scipionedel Ferro, Niccolò Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli [22]. However, unlike other numbers, such as integer, fractional, positive and negative, etc., the meaning of which becomes immediately clear as they are appearing, physical sense of imaginary numbers has remained unclear following their discovery. And it is still unclear, despite the fact that:

- To date, the theory of functions of complex variables [22] was developed by Abraham de Moivre, Leonhard Euler, Jean Le Rond D'Alembert, Caspar Wessel, Pierre-Simon de Laplace, Jean-Robert Argand, Johann Carl Friedrich Gauss, Augustin Louis Cauchy, Karl Theodor Wilhelm Weierstrass, William Rowan Hamilton, Pierre Alphonse Laurent, Georg Friedrich Bernhard Riemann, Oliver Heaviside, Jan Mikusiński and many others;
- Currently, complex numbers are widely used in all the exact sciences.

It is still unclear also despite the fact that at the beginning of the 20th century Joseph Larmor, Nobel Prize winner Hendrik Antoon Lorentz, Jules Henri Poincaré, Nobel Prize winner Albert Einstein and others developed the special theory of relativity (STR) [23] [24], which actually postulated the absence of any physical sense in imaginary numbers.

However, this STR statement seems unconvincing [25], as, firstly, it was proposed on the basis of the obvious fact that imaginary mass, imaginary time and other imaginary physical quantities, which were beyond explanation, appeared in relativistic formulas at superluminal speeds. Without explanation of their physical sense, STR turned out to be incomplete. Therefore, in order to avoid the necessity to explain them, the original formulation of the second postulate proposed by Albert Einstein [26], which is now referred to as the principle of light speed constancy, has been, de facto, extended[4] by two more formulations which are actually non-identical to the original one:

- The principle of light speed non-exceedance;
- The statement on lack of physical sense in imaginary numbers.

And secondly, explanation of inability to overcome the light speed barrier was so unconvincing that it could be refuted even at the mundane level. For example, inability to get from one into another room of an apartment through a wall separating them does not mean the inability:

- to get into adjacent room through a door;
- absence of the adjacent room.

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[1]Unlike the conception of the hidden Multiverse considered in the article (see below).
[2]Except that proposed in the article (see below)
[3]We'll actually hereinafter discuss concrete numbers, *i.e.* numbers provided with references to corresponding physical units.
[4]However, it is not customary in science to provide several different formulations for axioms, postulates, theorems and laws, especially if they are non-identical

Therefore, extended interpretation of the second STR postulate did not seem convincing to all physicists. And in the 21st century MINOS [27] and OPERA [28] experiments were conducted at the American Tevatron Collider and the European Large Hadron Collider, respectively. They aimed to refute extended interpretation of the second postulate in the current version of the STR by detecting superluminal neutrinos and thus prove physical reality of imaginary numbers. However, physical community considered the experiments to be not enough reliable and refuted them by ICARUS [29] experiment.

Results of other experiments, which did prove physical reality of imaginary numbers, were published [20] [21] [30] [31] almost at the same time. And since these experiments were conducted using oscillation processes in the linear electric circuits, they could be verified in any electronic laboratory, and therefore be considered as absolutely reliable. These alternative experiments cannot be ever refuted. And they actually have not been refuted by physical community.

We give a brief description of theoretical and experimental studies. They are very important, because they allow using experimentally based approach to invention of theories, which is more consistent with the subject of the study, instead of the axiomatic approach[5] so popular in modern physics. Therefore, the principle of physical reality of imaginary numbers, which is basic due to the conception of the Multiverse described below, has been rather experimentally proved, than postulated. Moreover, it has been proved many times in different ways, so as not to leave the slightest doubt about its reality.

2.1. The First Proof of the Principle of Physical Reality of Imaginary Numbers

The first proof [30] [31] uses Ohm's law[6] [32] known to all educated people in the interpretation proposed by Charles Proteus Steinmetz [33] for electric AC circuits. According to this interpretation, electrical reactance of capacitors and inductors are measured by heteropolar imaginary numbers, unlike the electric resistance of resistors measured by real numbers. Therefore, total reactance of any electric LCR-circuit is measured by complex numbers. In accordance with this interpretation of Ohm's law, when electric LCR-circuit is affected by sinusoidal voltage, sinusoidal electric current with amplitude equal to the ratio of applied voltage amplitude and complex impedance modulus flows through it.

This is open information contained in any textbook on the theory of electric circuits. However, none of textbooks admits that this information is the evidence of physical reality of imaginary numbers, as well as there is no any reference that the principle of physical reality of imaginary numbers is a scientific discovery.

Instead, the authors of textbooks, when wondering how they could answer these inevitable questions asked by students, chose not to develop this topic. Especially, they could refer to the STR, which asserts that there is no physical sense in imaginary numbers. Therefore, students are still told that capacitive and inductive imaginary resistances measured by imaginary numbers are imaginary, *i.e.*, nonexistent.

Nevertheless, this is a misconception. Should capacitive and inductive imaginary resistances be physically nonexistent, amplitude of current flowing through LCR-circuits should not have been changed at change in applied voltage frequency. However, electrical and radio frequency engineers have long known that it does change. Therefore, despite its name "imaginary", capacitive and inductive imaginary resistances are quite real. They are just as real as the resistance of resistors.

Moreover, should inductive and capacitive imaginary resistances be physically nonexistent, there would be no resonance in electric LCR-circuits discovered by Galileo di Vincento Bonaiutide' Galilei in 1602 [34]. And even such science as radiotechnics also wouldn't have existed.

However, they do exist. Their existence proves physical reality of complex (including imaginary) numbers, and thus refutes extended interpretation of the second STR postulate [25].

2.2. The Second Proof of the Principle of Physical Reality of Imaginary Numbers

For decades students have been explained that imaginary resistances of capacitors and inductors are imaginary and, therefore, physically nonexistent, readers have some doubts about correctness of the given evidence.

Therefore, we provide the second proof [20], which is also very simple. It is so simple, that it should eliminate any suspicion of errors in it.

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[5]Still being more appropriate in mathematics. However, due to Oliver Heaviside even mathematics is an experimental science.
[6]Discovered by Ohm in 1826 for electric DC-circuits.

This proof is based on the undeniable fact of existence of shock oscillations in nature, including tsunami, sound of church bells and even a kid's swing being pushed by parents to get a swinging motion. Existence of shock oscillations turns out to be possible only if imaginary numbers are physically real[7]. Let us prove this.

Any processes in linear electric circuits, including shock oscillations, are described by differential equation (usually second-order)

$$a_n \frac{d^n y}{dt^n} + a_{n-1} \frac{d^{n-1} y}{dt^{n-1}} + \cdots + a_o y = b_m \frac{d^m x}{dt^m} + b_{m-1} \frac{d^{m-1} x}{dt^{m-1}} + \cdots + b_0 x \tag{1}$$

where $x(t)$ is the input action (or the input signal);

$y(t)$ is the response to the action (or the output signal);

$a_n, a_{n-1}, \cdots, a_0, b_m, b_{m-1}, \cdots, b_0$ are constant coefficients;

$n, n-1, \cdots, 0, m, m-1, \cdots, 0$ are the order of derivatives;

Solution of the differential Equation (1) contains two terms

$$y(t) = y_{free}(t) + y_{forc}(t) \tag{2}$$

where $y_{free}(t)$ is the free (or transient) component of response;

$y_{forc}(t)$ is the forced component of response.

Moreover, relative duration of these processes is different in different cases. In case of shock oscillations[8] duration of the component $y_{forc}(t)$ is always much less than duration of the component $y_{free}(t)$. Therefore, it does not prevent observation of transients in experiments. The particular type of the transient $y_{free}(t)$ in the form of a certain function of time is found in the result of solving the so-called algebraic characteristic equation (usually second-order) correspondent to the original differential Equation (1)

$$a_n p^n + a_{n-1} p^{n-1} + \cdots + a_0 = 0 \tag{3}$$

where $a_n, a_{n-1}, \cdots, a_o$ are the same constant coefficients as in Equation (1);

$n, n-1, \cdots, 0$ are exponents with value equal to the order of the corresponding derivatives in the differential Equation (1);

p is the variable that, in case it takes on values in the form of complex numbers $-\sigma \pm i\omega$ is often referred to as complex frequency;

Certain type of transient processes that always exists (aperiodic, critical or oscillatory) is determined on the basis of the result of Equation (3). And for oscillatory transient solution of the algebraic Equation (3) is a pair of complex conjugate numbers. Besides, the solution of algebraic Equation (3) for oscillatory transient process would be a pair of complex conjugate numbers. Therefore, in the case of solution of the characteristic Equation (3) on the set of real numbers, the result $-\sigma \pm i\omega$ could not be obtained. In this case it would have to be concluded that shock oscillations should be nonexistent[9].

However, they do exist. Their existence proves physical reality of complex (including imaginary) numbers, and thus refutes extended interpretation of the second STR postulate [25].

2.3. The Third Proof of the Principle of Physical Reality of Imaginary Numbers

Finally, to definitively dispel any doubts as to the validity of the principle of physical reality of imaginary numbers, which is the base for the new conception of the Multiverse, we provide another proof [21]. This time, we analyze resonance process which (in contrast to the shock oscillations) is characterized by the fact that a forced component $y_{forc}(t)$ of the oscillation process far exceeds the transient process $y_{free}(t)$ in duration. Therefore, the component $y_{free}(t)$ does not interfere with the observations of the forced component $y_{forc}(t)$ in the relevant experiments.

Textbooks on the theory of linear electric circuits state that resonance is characterized by the following features:

- at resonant frequency the forced component of response $y_{forc}(t)$ takes on extreme absolute value;
- at resonant frequency phase shift between force and forced component of response $y_{forc}(t)$ becomes zero;

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[7]Consequently, if the current version of STR was true, there would be no tsunami and kid's swing would not be swinging after been pushed by parents.

[8]Occurring under impulse action.

[9]Therefore, characteristic algebraic equations are solved only on the set of complex numbers.

- resonant frequencies corresponding to the previous two features are equal to each other and to the frequency of free oscillations.

Indeed, such features are peculiar to resonance only in LC-circuits. In LCR-circuits such result is only due to their approximate analysis. Accurate analysis of resonance in LCR-circuits reveals numerous unexplained oddities[10] contradicting the common sense.

For example, accurate formulas for electric LCR-circuit depicted in **Figure 1** corresponding to the first feature of resonance would be as follows

$$\left[\begin{array}{l} \omega'_{res1} = 0 \\ \omega''_{res1} = \sqrt{\omega_0^2 - 4\sigma_0^2} = \omega_0 \dfrac{\sqrt{Q^2 - 1}}{Q} \end{array} \right. \tag{4}$$

Accurate formulas corresponding to the second feature of resonance would have the following form

$$\left[\begin{array}{l} \omega'_{res2} = 0 \\ \omega''_{res2} = \sqrt{\omega_0 \sqrt{\omega_0^2 + 8\sigma_0^2} - 4\sigma_0^2} = \omega_0 \dfrac{\sqrt{Q\sqrt{Q^2 + 2} - 1}}{Q} \end{array} \right. \tag{5}$$

And accurate formula corresponding to the third feature of resonance would be as follows

$$\omega_{free} = \sqrt{\omega_0^2 - \sigma_0^2} = \omega_0 \frac{\sqrt{4Q^2 - 1}}{2Q} \tag{6}$$

where $\omega = 2\pi f$; $2\sigma_0 = \dfrac{R}{L}$; $\omega_0 = \dfrac{1}{\sqrt{LC}}$; $Q = \dfrac{\omega_0}{2\sigma_0} = \dfrac{1}{R}\sqrt{\dfrac{L}{C}}$.

As can be seen, there are, for some reason, many resonant frequencies, though according to the definition resonant frequency should be single. And different features of resonance correspond to different formulas. Some of resonant frequencies even equal zero. Formulas for determining resonant frequencies when applying to different electric LCR-circuits are also different[11]. Frequency of free oscillations is never equal to any of the resonant frequencies[12]. Such a list of unexplained oddities of the existing resonance interpretation is, perhaps, enough to prove its imperfection.

The difference between the accurate formulas for ω''_{res1}, ω''_{res2} and approximate formula given in all textbooks $\omega_{res} \approx 1/\sqrt{LC}$ is very small and does not exceed the experimental error.

On the one hand, practical use of a simpler, but approximate, formula $\omega_{res} \approx 1/\sqrt{LC}$ is justified. On the other hand, since there is still a difference between the accurate and approximate formulas, it requires explanation.

It sometimes happens in physics that a slight discrepancy between obtained and expected results can lead to discoveries. For example, Cherenkov radiation was found in this way. In 1958 Pavel Alekseyevich Cherenkov,
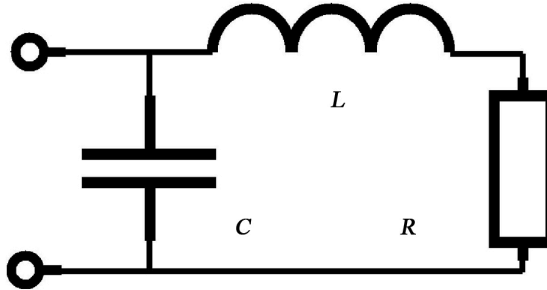

Figure 1. Electric LCR-circuit concerned.

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[10]Which are not admitted in textbooks. Therefore, resonance in LCR-circuits is explained in textbooks only on the basis of approximate formulas, masking the real situation.

[11]It can be easily showed.

[12]However, the attempt [36] to explain this circumstance was unsuccessful.

Igor Evgenyevich Tamm and Ilya Mikhaylovich Frank received the Nobel Prize [35] for its discovery and explanation.

The situation concerned is also the case of discovery, as it has been proved that resonance actually exists at complex frequencies, rather than at real ones, as is commonly believed. As for the real frequencies, only some near-resonance oscillation processes are observed. Moreover, as it turned out, real resonance can occur even when affected by exponential radio and video pulses.

Physical reality of resonance at complex frequencies is confirmed by numerous experiments. Let us describe one of them, which can be repeated by any interested reader. It is all the more convincing because it is inexplicable within the existing theory of electric circuits.

Figure 2 shows two similar, but slightly different, electric diagrams the inputs of which are supplied by the same signals. These signals U_{inp} can be represented as a sum of rectangular U_1 and exponential U_2 radio
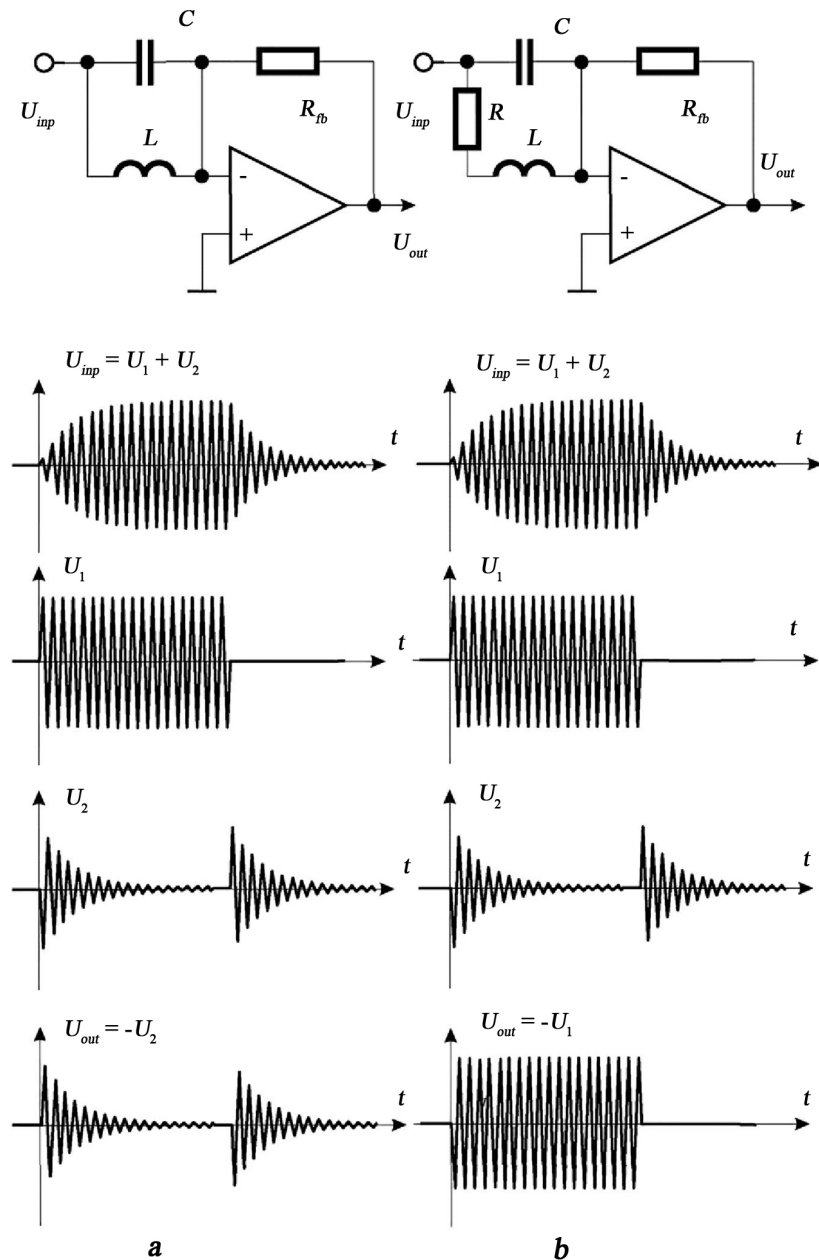

Figure 2. The proof of resonance at complex frequencies.

pulses that cannot be separated by existing filters because their spectra substantially interfere with each other. However, since their complex frequencies $p = \pm i\omega$ and $p = -\sigma \pm i\omega$ are different, they are easily separated by filters of complex frequencies, which are actually electric diagrams depicted. The diagram in **Figure 2(a)** depicts electric LC-circuit in the input, complex resonant frequencies of which $\pm i\omega$ coincide with complex frequencies of rectangular radio pulses U_1. Therefore, rectangular radio pulses are not supplied[13] to the output of such a diagram, whereas exponential radio pulses $U_{out} = -U_2$ are. The diagram in **Figure 2(b)** presents electric LCR-circuit in the input, complex resonant frequencies of which $-\sigma \pm i\omega$ coincide with complex frequencies of exponential radio pulses U_2. Therefore, exponential radio pulses are not supplied to the output of such a diagram, whereas rectangular radio pulses $U_{out} = -U_1$ are.

Similarly, rectangular and exponential video pulses corresponding to different complex frequencies $p = 0$ and $p = -\sigma$ can be separated.

Similar resonant processes take place in different electric circuits at complex frequencies. The existence of such a resonance proves, in turn, physical reality of complex frequencies, and, thus, physical reality of any other[14] complex (and therefore imaginary) numbers. And, therefore, denies the extended interpretation of the second postulate of STR [25].

Resonance at complex frequencies is even patented [37].

3. Physical Nature of Imaginary Numbers

If the proofs of reality of imaginary numbers mentioned above were known to a physical community, there would be no need in such extremely difficult experiments as MINOS, OPERA and ICARUS, as the alternative radio-electronic experiments which are much simpler would comprehensively solve the problem.

To understand the problem more deeply it would be also appropriate to explain what physical entities imaginary numbers correspond to in nature. As people do not have senses allowing them to register imaginary[15] physical entities, to believe that imaginary numbers are physically real they should somehow ascertain their existence experimentally. This requires at least a small number of situations to be provided as examples where imaginary numbers are proved to be physically real.

Processes in electric LCR-circuits, analyzed given the actual physical existence of the so-called 'imaginary' capacitive and inductive imaginary resistances, are one of the examples of such situations, as shown above. These imaginary resistances are measured by instruments available in any electronic laboratory, just as the resistance of resistors, physical reality of which has never been in doubt. Consequently, capacitive and inductive imaginary resistances[16] in the theory of electric circuits are an example of actually existing imaginary physical entities, known to everyone.

Another popular example, confirming physical reality of imaginary numbers is shock oscillations in the form of tsunami, sound of church bells, kid's swing being pushed by parents to get a swinging motion, etc., existing in nature only because their complex frequencies are physically real.

One more example that confirms physical reality of imaginary numbers is a well-known phenomenon of resonance, which turns out to exist at physically real complex frequencies.

Since the Nature is unified and consistent, the Science, striving to cognize It, should also be consistent, even being divided into many different scientific disciplines because of limited intellectual capacity of people. Consequently, the principle of physical reality of imaginary numbers proved in the theory of electric circuits is generally scientific. All exact sciences, such as theory of relativity, quantum mechanics optics, radioelectronics and others, should be adjusted in accordance with this principle.

Let us provide an example of how it can be done in the STR. Adjusted version of the STR will serve as one more proof of actual existence of imaginary physical entities.

4. Adjustment of the STR

Imaginary mass, imaginary time and other imaginary physical quantities appearing at superluminal speeds in re-

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[13]As the filter is band-stop.

[14]Let us remember that resonance can be also in oscillation systems of other physical nature.

[15]And not only imaginary. People cannot hear infra and ultrasounds, see dark matter and dark energy, feel magnetic field and X-ray radiation and touch elementary particles, stars and many other physical entities, the parameters of which are measured by real numbers.

[16]As well as values derived from them: electric currents, voltages, capacities and energies.

lativistic formulas of the STR [38] adjusted due to the principle of physical reality of imaginary numbers should be recognized as actually existing. They also should be considered as imaginary quantities that have a certain physical sense, which is now to be explained. For example, with respect to the Lorentz-Einstein formula

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \tag{7}$$

where m_0 is the rest mass of a moving entity;

m is the relativistic mass of a moving entity;

v is the velocity of a physical entity;

c is the speed of light.

The explanation is as follows. As can be seen from the formula (7), relativistic mass of moving entities, e.g. tachyons [18] [19], becomes imaginary at $v > c$. Since, according to the principle of physical reality of imaginary numbers, the moving entities really exist, they are in some another place. Owing to the condition $v > c$ this another place is beyond the event horizon and is therefore invisible to us. For clarity we should call it a tachyon universe. Subsequently, our universe should be called "tardyon" by the name of elementary particles, moving with sub-light speed.

It should be logically concluded that we live in a Multiverse [39], which includes at least tardyon and tachyon universes. And since the Multiverse is invisible, it should be referred to as hidden [40].

In this regard it is appropriate to note that the MINOS and OPERA experiments could be successful only if mass of neutrinos was zero, since at $v > c$ it would remain to be a real number. Otherwise, neutrinos with non-zero mass at $v > c$ would have imaginary mass and be invisible to us just as other tachyons. Therefore, a negative result of the OPERA and MINOS experiments, as mentioned in [41] [42], can be considered as evidence of non-zero neutrino mass.

The Nobel Prize in Physics 2015 was awarded jointly to Takaaki Kajita and Arthur B. McDonald "for the discovery of neutrino oscillations, which shows that neutrinos have mass", which has been proved as a result of similar arguments, but with the use of the results of previously conducted experiment [43].

However, let's return to the hidden Multiverse. According to the first postulate of the STR tachyon universe is an inertial reference system, *i.e.*, it has the same physical and other laws of nature that operate in our universe. Consequently, inhabitants of tachyon universe perceive their universe just as people of the Earth perceive their tardyon universe.

However, the formula (7) does not correspond to this condition and should, therefore, be adjusted as follows:

$$m = \frac{m_0 \exp(iq\pi/2)}{\sqrt{1-(v/c-q)^2}} = \frac{m_0 \exp(iq\pi/2)}{\sqrt{1-(w/c)^2}} \tag{8}$$

where $q = \lfloor v/c \rfloor$ is the discreet 'floor' function of argument v/c;

$w = v - qc$ is the local velocity for each universe, which can take values only in the range $0 \le w \le c$;

v is the velocity measured from our tardyon universe, which, therefore, can be called a tardyon velocity.

Other relativistic formulas of the STR can be adjusted in a similar manner.

5. The Hidden Multiverse

As follows from the formula (8), tardyon universe corresponds to the parameter $q = 0$, and tachyon universe[17] corresponds to the parameter $q = 1$. However, the hidden Multiverse can contain more than two universes. Tardyon antiverse[18] corresponds to $q = 2$, tachyon antiverse[19] corresponds to $q = 3$, another tardyon universe corresponds to $q = 4$ and another tachyon universe corresponds to $q = 5$ and so on[20]. There can be muchof the universes. They can be called parallel, because universes never intersect despite their infinity. Annihilation of universes and antiverses, both tardyon and tachyon, is certainly excluded, as they alternate in a strictly defined order in the Multiverse. Besides, the order is that the structure of the hidden Multiverse can be called heli-

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[17]In which time flows in perpendicular direction in relation to the time in our tardyon universe, *i.e.* for us it "stands still".

[18]In which time flows in opposite direction in relation to the time in our tardyon universe.

[19]In which time also flows in perpendicular direction in relation to the time in our tardyon universe, but in opposite direction in relation to time in tachyon universe, *i.e.* for us it "stands still".

[20]Here we got an answer for the question about the location of antimatter and tachyons.

cal (see **Figure 3**, **Figure 4** and **Figure 7**).

The structure may be either closed or open. If the structure is closed, as shown in **Figure 3**, our Multiverse would be the only one. If the structure is open, as shown in **Figure 4** and **Figure 7**, the Multiverse would probably be connected by its edges to other Multiverses[21], together forming Supermultiverse. Other Multiverses of the Supermultiverse are unavailable to us not only by electromagnetic, but also by gravitational manifestations.

If the parameter q in the formula (8) is assumed to be independent variable[22], universes of the hidden Multiverse could be assumed to exist in different dimensions. These dimensions are, in a way, always beside us, wherever we are. Therefore, appropriate technologies, which are still unavailable to us, will allow transiting from one dimension to another[23].

Relative spatial position of parallel universes in such multidimensional space is stabilized by some automatic regulation process still unknown to us, without which the hidden Multiverse would have ceased to exist long ago.
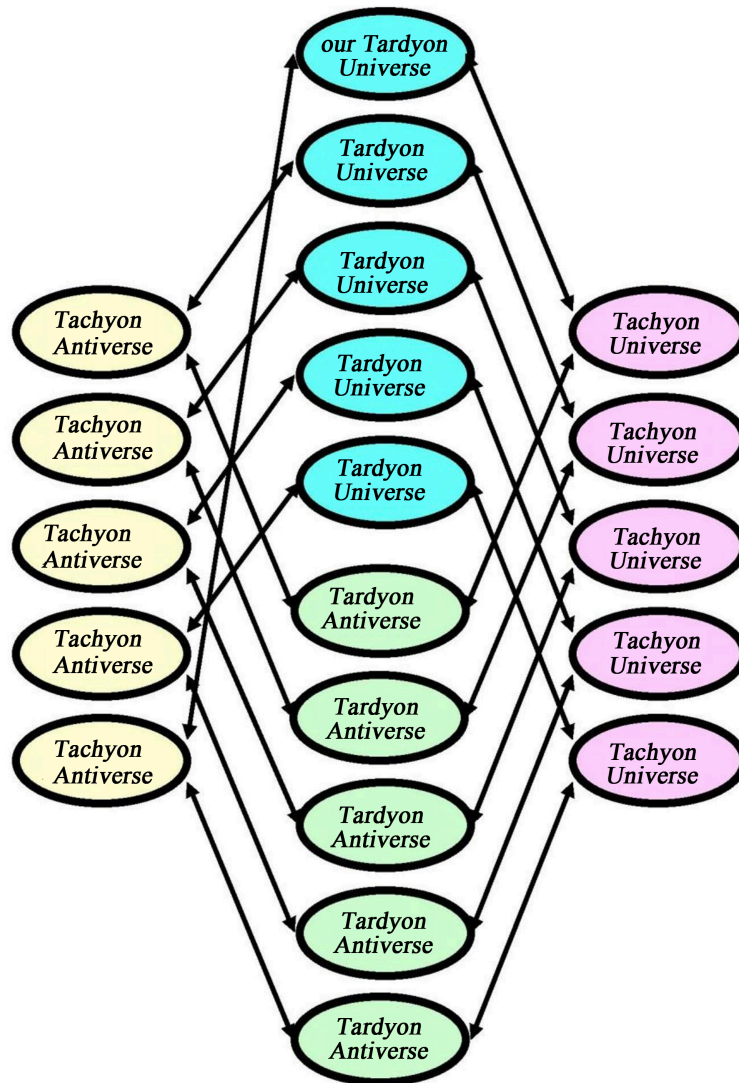

Figure 3. Possible structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers.

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[21]If existence of other Multiverses is not recognized, it would be very difficult to explain what is behind open edges of our Multiverse.

[22]As the value q under the influence of unknown factors changes in accordance with the function $\exp(iq\pi/2)$ in portals (see below), through which transition from one parallel universe to another is available.

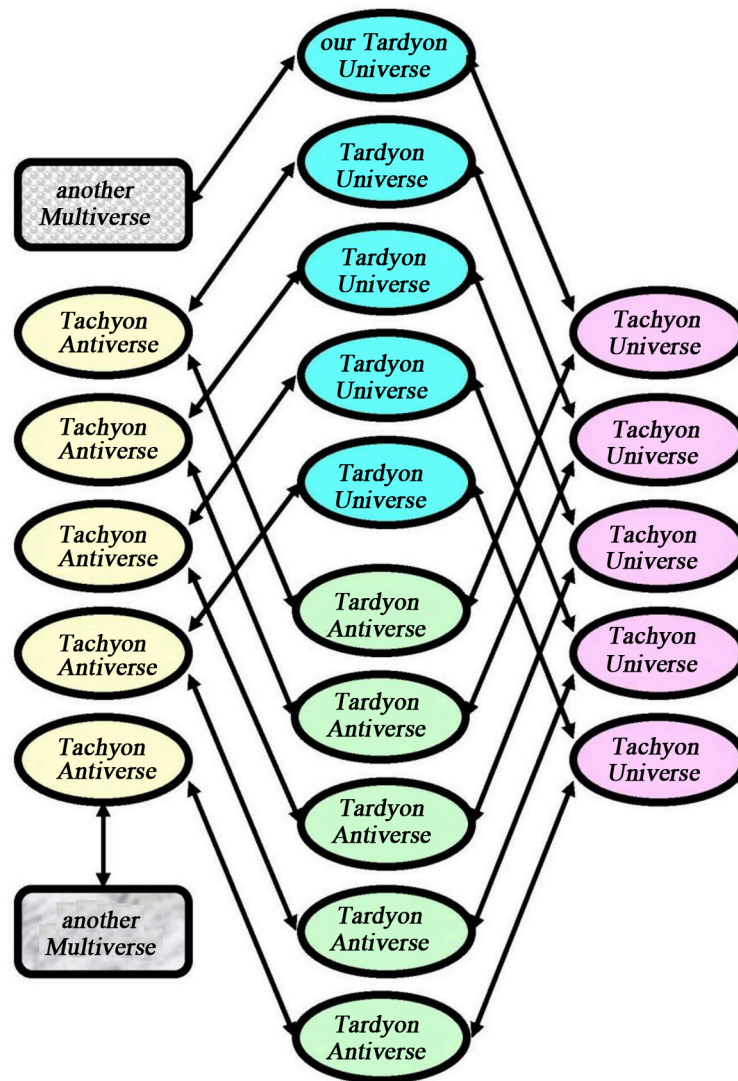[23]Or, equivalently, from one parallel universe to another.

Figure 4. Another possible structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers.

In the course of such process, as well as other processes of automatic regulation, the regulated objects, *i.e.* parallel universes, slightly move relative to each other and sometimes even partially penetrate into each other in some spots. Such penetration generates certain transition zones, which are also referred to as portals or star gates[24] [44]. Relatively small physical bodies, such as elementary particles and inhabitants of universes, can pass from one universe to another through the portals. Exception is stars, planets and galaxies, as otherwise universes could be destabilized.

On the other hand, transition of material objects from one universe to another allows averaging mass-energy of different universes to some extent. Transitions through portals are likely to be relatively safe[25], since according to the law of communicating vessels characteristics of pre-portal and after-portal areas of space should be almost identical[26]. In the examples of possible structures of the hidden Multiverse given in **Figures 3-7** portals between adjacent universes are denoted by single bidirectional arrows. Indeed, there are a lot of such portals.

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[24]Which have nothing to do with molehills and wormholes.

[25]As, for instance, mains are relatively safe, if no one touches them.

[26]Therefore, should at least one portal between the Earth and space be opened, the Earth would have remained without its atmosphere and hydrosphere. This might supposedly have once happened on Mars.
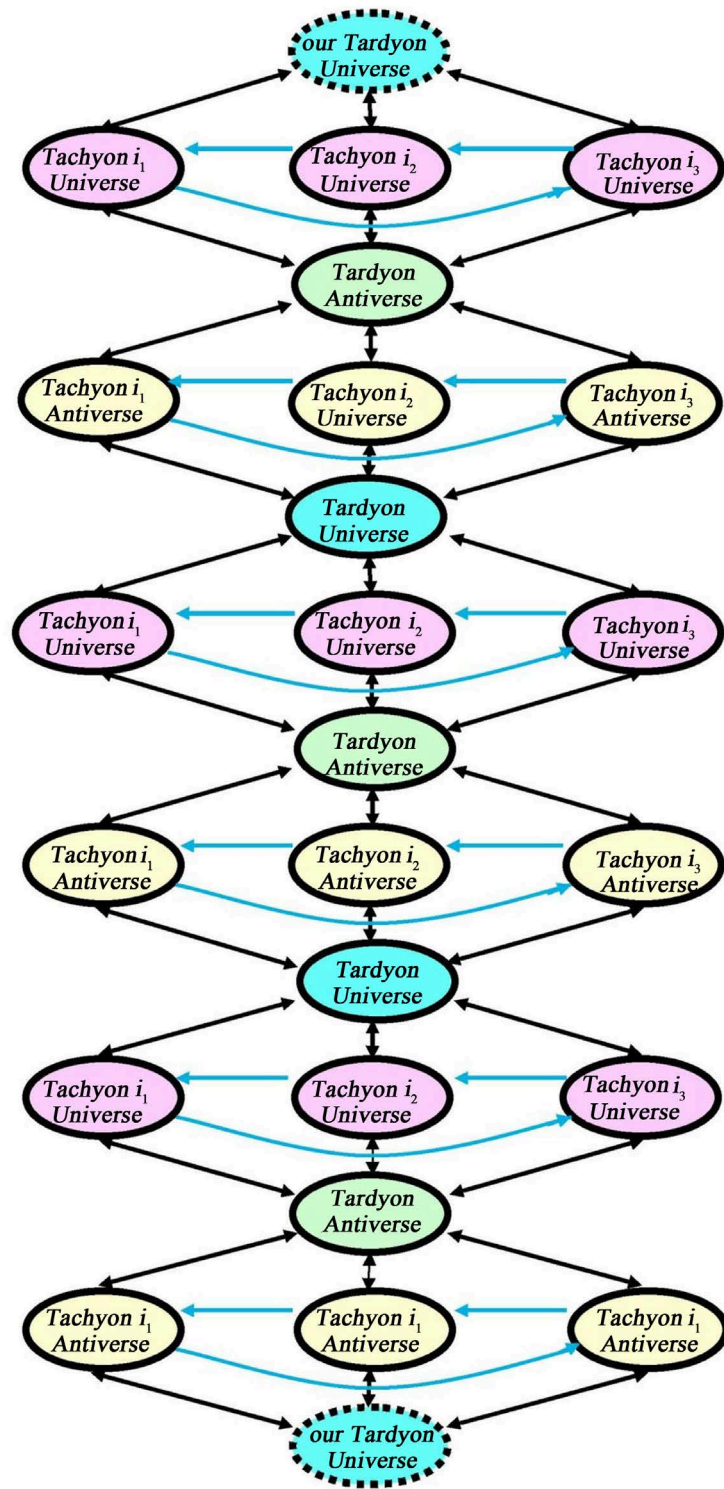
Figure 5. Possible structure of the hidden Multiverse, corresponding to the principle of physical reality of hypercomplex numbers.

6. Explanation of Dark Matter and Dark Energy

Description of the structure of the actually existing hidden Multiverse will be incomplete without explanation of
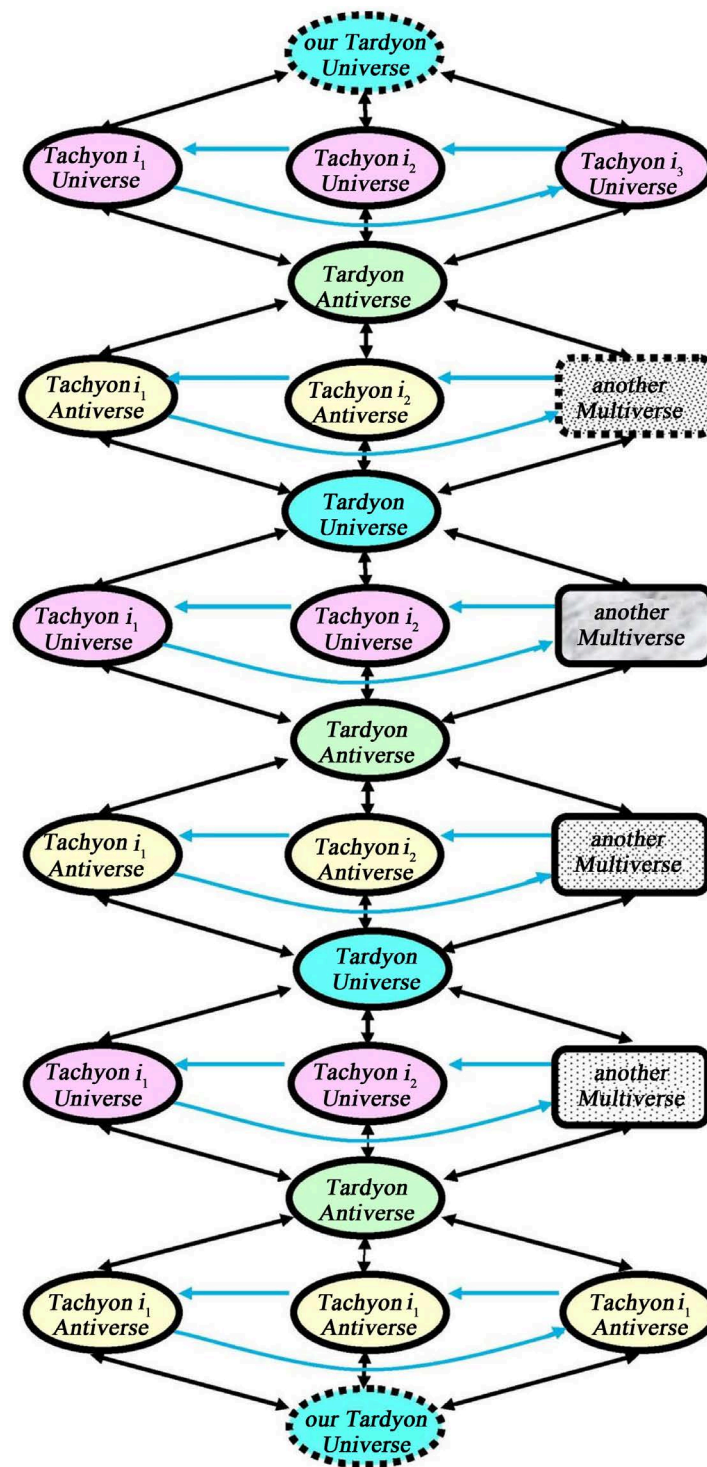
Figure 6. The most probable structure of the hidden Multiverse, corresponding to the principle of physical reality of hypercomplex numbers.

the phenomenon of dark matter and dark energy [15] [16]. Dark matter has become known as a result of research carried out by Jan Hendrik Oort and Fritz Zwikky in 1932-33, and dark energy has been discovered by Nobel Prize winners Saul Perlmutter, Brian P. Schmidt and Adam G. Riess in 1998-99. However, this astrophysical phenomenon is still incomprehensible. It is absolutely invisible. Therefore, it could be detected only
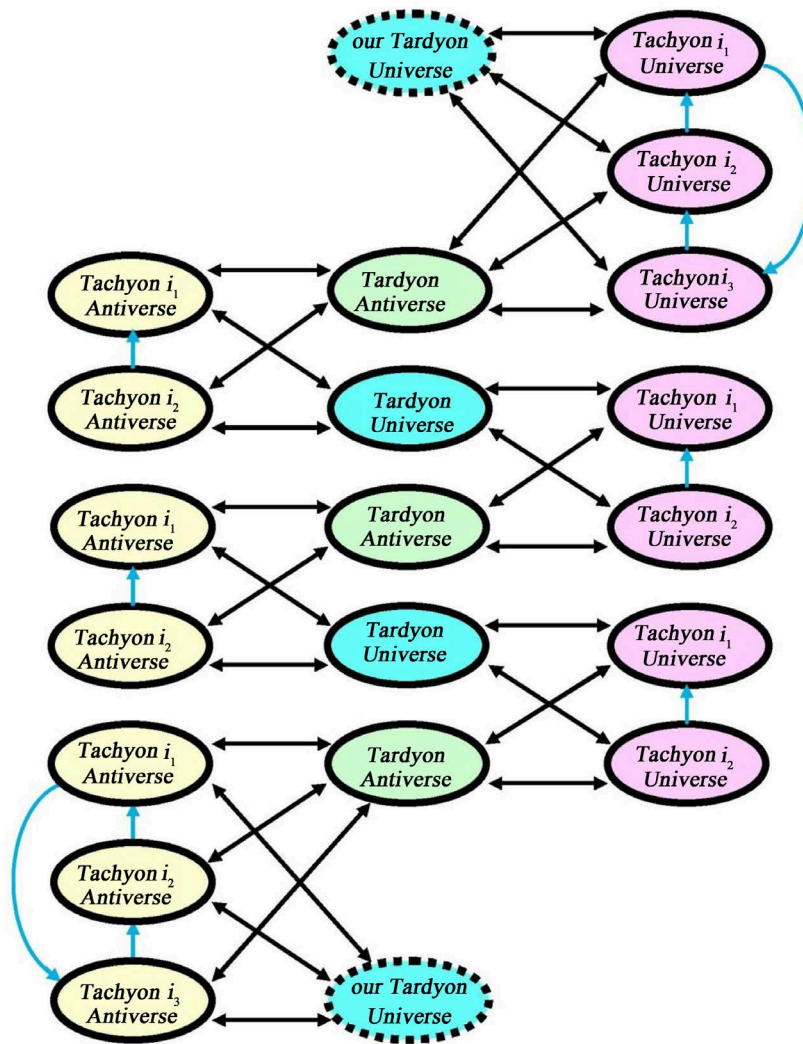
Figure 7. Structure of the hidden Multiverse, corresponding to WMAP and Planck spacecraft data.

indirectly by the effect of gravitational lensing. Dark matter and dark energy contain no chemical elements known to us. It would seem to even destroy the modern understanding of the term "matter". Although a very large number of research results have been published over the past few years, scientists have failed to get closer to understanding its nature.

Given the situation it can be assumed that the current formulation of the problem concerning explanation of the phenomenon of dark matter and dark energy within the conception of Monoverse, corresponding to the existing version of the STR, is wrong, as wrong is this version of STR itself.

Alternative explanation of dark matter and dark energy is as follows. They are the other parallel universes of the hidden Multiverse [45]-[47] unobservable from our universe. That is why dark matter and dark energy are invisible. As they are in other parallel universe, rather than in ours, their chemical composition cannot be determined. Whereas, the Earth, having available all tools for chemical analysis, contains no chemical elements of other universes.

7. Analysis of WMAP and Planck Spacecraft Data

Explanation of dark matter and dark energy given above based on WMAP [48] and Planck [49] spacecraft observations allows us to determine basic parameters of the hidden Multiverse, and thus clarify its structure.

Since according to Planck data total mass-energy of the whole Multiverse consists of 4.9% ordinary (baryonic) matter (earlier WMAP estimate-4.6%), 26.8% dark matter (according to WMAP-22.4%) and 68.3% dark energy (according to WMAP-73%),

- the hidden Multiverse consists of $100\%/4.9\% = 20.4$ parallel universes according to Planck and of $100\%/4.6\% = 21.7$ parallel universes according to WMAP;
- dark matter consists of $26.8\%/4.9\% = 5.5$ parallel universes according to Planck and of
- $22.4\%/4.6\% = 4.9$ parallel universes according to WMAP;
- dark energy consists of $68.3\%/4.9\% = 13.9$ parallel universes according to Planck and of
- $73.9\%/4.6\% = 15.9$ parallel universes according to WMAP.

Therefore, taking into account possible measurement errors and some inequality of mass-energy of different parallel universes, it is permissible to assume that the hidden Multiverse contains twenty parallel universes, six of which are adjacent to our universe.

However, the structure of the hidden Multiverse shown in **Figure 3** and **Figure 4** does not correspond to the results of calculations. Besides that it is unclear why the hidden Multiverse contains twenty parallel universes, it is even more unclear why six parallel universes turned out to be adjacent to ours, rather than two.

Thus, the principle of physical reality of imaginary numbers within the STR wouldn't seem to justify our expectations, because the experimental data obtained from WMAP and Planck spacecrafts, do not correspond to the possible structure of the hidden Multiverse given in **Figure 3** and **Figure 4**.

8. Quaternion Structure of the Hidden Multiverse

Let us try, however, to find solution to the situation. Why there are six adjacent universes? This means that three parallel tachyon universes and three parallel tachyon antiverses are adjacent. However, several parallel universes presented in **Figure 3** and **Figure 4** cannot be parallel in one and the same dimension, because the structure of such parallel dimensions is determined by complex numbers, including a single imaginary unit.

In other words, WMAP and Planck data actually refute compliance of the structure of the hidden Multiverse with the principle of physical reality of complex numbers, rather than the principle of physical reality of imaginary numbers.

However, imaginary units are part of not only complex, but also hypercomplex numbers [50]. Besides, quaternions $a + bi_1 + ci_2 + di_3$ include exactly three imaginary units i_1, i_2, i_3 connected by the following relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \tag{9a}$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1 \tag{9b}$$

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \tag{9c}$$

As can be seen, the relation (9a) is the same as for the imaginary units in complex numbers. Relations (9b) and (9c) are possible only with respect to quaternions. Consequently, they allow tachyon universes and antiverses operate in parallel. In other words, WMAP and Planck data actually correspond to the assertion, that the structure of the hidden Multiverse is based on the principle of physical reality of quaternions.

The structure of such hidden Multiverse is determined by the formula of Lorentz-Einstein, adjusted once more

$$m = \frac{m_0 \exp(i_1 q \pi/2)\exp(i_2 r \pi/2)\exp(i_3 s \pi/2)}{\sqrt{1 - \left[v/c - (q+r+s)\right]^2}}$$
$$= \frac{m_0 \exp(i_1 q \pi/2)\exp(i_2 r \pi/2)\exp(i_3 s \pi/2)}{\sqrt{1 - (w/c)^2}} \tag{10}$$

where q is the total number of parallel universes, penetration into which was made through bidirectional portals, corresponding to the imaginary unit i_1, with increasing distance from our tardyon universe;

r is the total number of parallel universes, penetration into which was made through bidirectional portals, corresponding to the imaginary unit i_2, with increasing distance from our tardyon universe;

s is the total number of parallel universes, penetration into which was made through bidirectional portals, corresponding to the imaginary unit i_3, with increasing distance from our tardyon universe;

v is the velocity measured from our tardyon universe, which, therefore, can be called tardyon velocity;

c is the speed of light;

$w = v - (q + r + s)c$ is the local velocity for corresponding universe, which can take values only in the range $0 \leq w < c$.

Other relativistic formulas of the STR can be adjusted in a similar manner.

Consequently, the structure of multidimensional space containing parallel universes of the hidden Multiverse is determined by three independent variables q, r and s. Therefore, the total number of parallel universes given the helical structure of the Multiverse should be a multiple of eight. According to the WMAP and Planck date it is likely equaled to twenty-four for a closed helical structure, as shown in **Figure 5**. In this figure, as in **Figure 3**, our tardyon universe is denoted by a dashed line in the form of a screw collar. In the structure of the Multiverse it serves as the beginning and the end, so it is depicted twice.

The structure of the hidden Multiverse in **Figure 6** and **Figure 4** is depicted as partially closed. Therefore, it can be connected by its unclosed edges with other Multiverses, collectively forming Supermultiverse. However, while, as noted above, other Multiverses, external to our Multiverse, are unobservable not only by electromagnetic, but also gravitational manifestations, WMAP and Plank data enables determination of their number. As shown in **Figure 6** it equals the difference between the theoretically expected twenty-four and the experimentally observed twenty universes, *i.e.*, four Multiverses. Therefore, information obtained by WMAP and Plank devices corresponds to the block diagram[27] depicted in **Figure 7**.

Thus, WMAP and Plank data conclusively demonstrates not only that our hidden Multiverse contains exactly twenty parallel universes, six of which are adjacent to our universe, but also the fact that one to four[28] other Multiverses are also adjacent to our hidden Multiverse. Besides, these data prove quaternion structure of the hidden Multiverse and, thus, physical reality of quaternions.

A peculiarity of quaternion structure of the hidden Multiverse is that in addition to bidirectional portals based on the relation (9a), which are denoted by bidirectional black arrows, it contains unidirectional portals[29] based on the relations (9b) and (9c), which are denoted by unidirectional blue arrows. Location of these portals in **Figure 6** and **Figure 7** are consistent with the principles of their operation discussed below in relation to one of the links of the hidden Multiverse (see **Figure 8**), including tardyon and tachyon universes and tardyon antiverses.

To explain these principles of operation, corresponding to the relation (9b), we should rewrite it as a set of non-commutative products

$$
\begin{aligned}
i_1 i_2 &= i_3 \\
i_2 i_3 &= i_1 \\
i_3 i_1 &= i_2
\end{aligned}
\tag{11}
$$

The first product $i_1 i_2 = i_3$ means that penetration from the tachyon universe i_1 into the tachyon universe i_3 is possible through the unidirectional portal i_2. The second product $i_2 i_3 = i_1$ means that penetration from the tachyon universe i_2 into the tachyon universe i_1 is possible through the unidirectional portal i_3. The third product $i_3 i_1 = i_2$ means that that penetration from the tachyon universe i_3 into the tachyon universe i_2 is possible through the unidirectional portal i_1.

The algorithm of operation of unidirectional portals is shown in **Figure 8(b)**. Besides, penetration from tardyon universeinto tachyon universes i_1, i_2, i_3, and from tachyon universes i_1, i_2, i_3 into tardyon antiverse is possible through the respective bidirectional portals i_1, i_2, i_3. The algorithm of operation of bidirectional portals i_1, i_2, i_3 is shown separately in **Figure 8(a)** and jointly with the algorithm of operation of unidirectional portals i_1, i_2, i_3 in **Figure 8(b)** and **Figure 8(c)**.

Relation (9c) can also be rewritten in the form of a set of non-commutative products

$$
\begin{aligned}
i_1 (-i_3) &= i_2 \\
i_2 (-i_1) &= i_3 \\
i_3 (-i_2) &= i_1
\end{aligned}
\tag{12}
$$

---

[27]Which does not depict other Multiverses, as they have not been detected by WMAP and Plank devices.
[28]Since our hidden Multiverse can touch the same Multiverses by its edges several times.
[29]From and through which one cannot return to its universe.
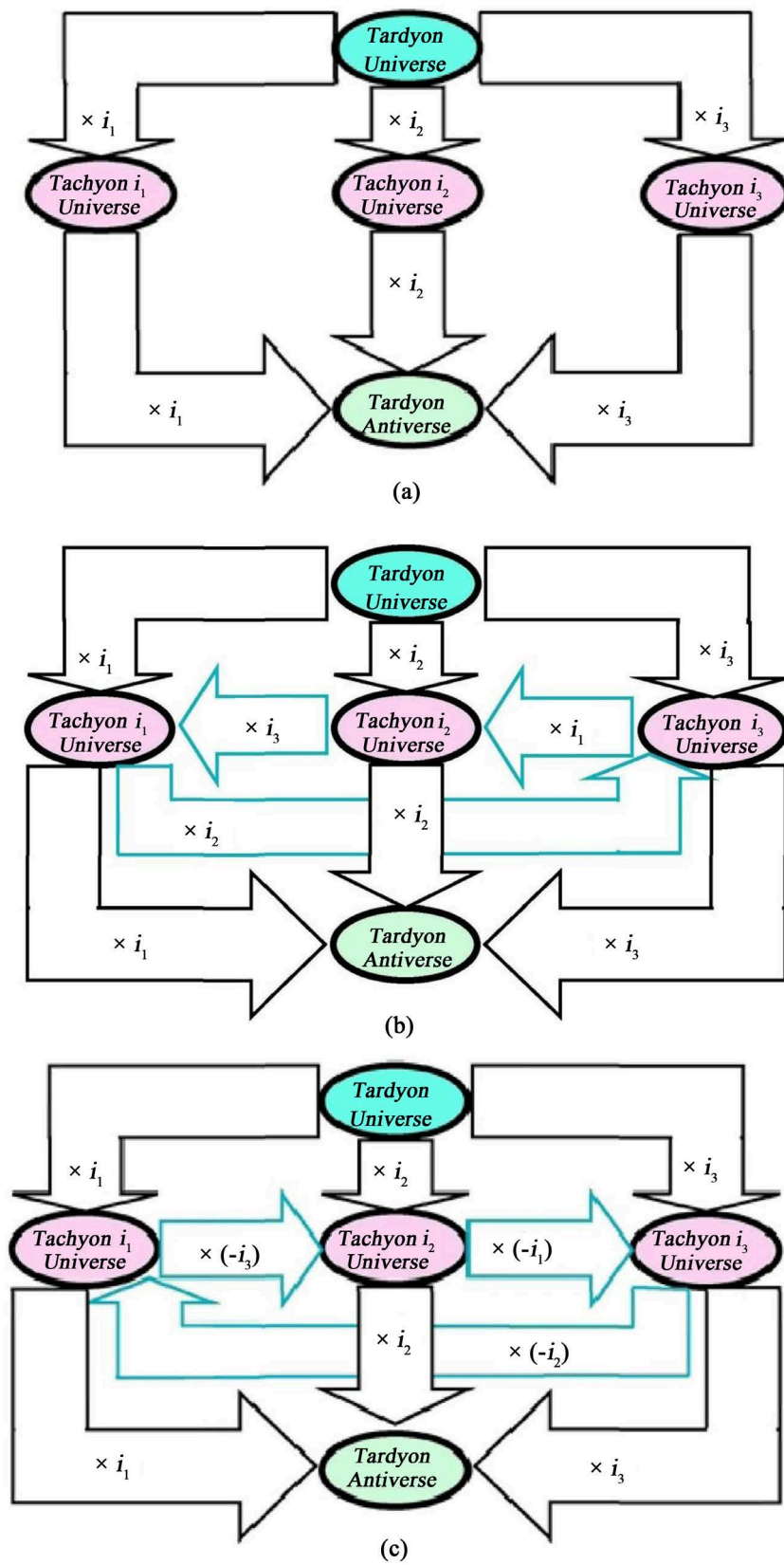
Figure 8. The algorithm of operation of hidden Multiverse's portals.

It would seem that products of imaginary units included in the set (12) differ from the products of imaginary units included in the previous set. However, they actually don't (see **Figure 8(c)**). Indeed, according to the reasoning given above the product $i_1 i_3 = i_2$ can mean that penetration from the tachyon universe i_1 into the tachyon universe i_2 is possible through the unidirectional portal i_3. But then the first product $i_1(-i_3) = i_2$ in the set (12) means that movement is also possible in the opposite direction, *i.e.* penetration from the tachyon universe i_2 into the tachyon universe i_1 may be done through the unidirectional portal i_3. Such transition corresponds to the non-commutative product $i_2 i_3 = i_1$. And this is the second product in the set (11). Similarly, the product $i_2 i_1 = i_3$ can mean that penetration from the tachyon universe i_2 into the tachyon universe i_3 is possible through the unidirectional portal i_1. But then the second product $i_2(-i_1) = i_3$ in the set (12) means that movement is possible in the opposite direction, *i.e.* penetration from the tachyon universe i_3 into the tachyon universe i_2 may be done through the unidirectional portal i_1. Such transition corresponds to the product $i_3 i_1 = i_2$. And this is the third product in the set (11). Finally, the product $i_3 i_2 = i_1$ can mean that penetration from the tachyon universe i_3 into the tachyon universe i_1 is possible through the unidirectional portal i_2. But then the third product $i_3(-i_2) = i_1$ in the set (12) means that movement is possible in the opposite direction, *i.e.* penetration from the tachyon universe i_1 into the tachyon universe i_3 may be done through the unidirectional portal i_2. Such transition corresponds to the product $i_1 i_2 = i_3$. And this is the first product in the set (11). Consequently, the algorithm corresponding to the set of non-commutative products of imaginary units (12) shown in **Figure 8(c)** is actually equivalent to the previous algorithm corresponding to the set of non-commutative products of imaginary units (11) shown in **Figure 8(b)**.

The remaining links of the hidden Multiverse operate in a similar manner, as is easy to show.

Thus, the foregoing allows us to give the following answer for a question about existence of antimatter and tachyons, put in the beginning of the article: Quaternion Multiverse contains four pairs of different types of matters and antimatters, as well as tachyons in six different types of tachyon universes and antiverses.

9. Review of the Conception of the Hidden Multiverse for Compliance with Popper's Falsification Criterion

So, presentation of the conception of hidden Multiverse is completed.

There is the last question, whether this conception complies with Popper's falsification criterion, or, in other words, whether this conception can be confirmed or refuted experimentally.

It turns out that it can, for example, as follows.

Existence of the hidden Multiverse has been allegedly confirmed by those experiments at the Large Hadron Collider, which showed that there was a mass defect near the point of singularity when $v \to c$. *i.e.*, there were situations, when total mass of elementary particles at the beginning of the experiment turned out to be greater than total mass of elementary particles at the end of the experiment[30]. In such situations mass defect can be explained by formation of tachyons that, having overcome the light speed barrier, disappeared in tachyon universes and/or tachyon antiverses, e.g., as a result of formation of short-term micro and mini portals, similar to formation of macro portal in the episode with the Eldridge destroyer. Therefore, such situations can be interpreted as experimental confirmation of tachyon existence, and, thus, the existence of the hidden Multiverse containing tachyon universes and antiverses.

10. Conclusions

So, the article provides answers to all the questions raised therein:
- physical reality of imaginary, complex and hypercomplex numbers has been proved theoretically and experimentally;
- resonance has been proved to exist at complex frequencies, rather than real ones;
- extended interpretation of the second postulate of the current version of the STR has been thereby refuted;
- it has been shown that failure of attempts to explain the phenomenon of dark matter and dark energy is caused by incorrect formulation of task aimed at searching for explanation within the conception of Monoverse, corresponding to the current incorrect version of the STR;
- the adjusted formulation of the task aimed at searching for explanation of the phenomenon of dark matter

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[30]For example, with frequent disappearance of elementary particles before their collision.

and dark energy within the conception of Multiverse has been suggested;

- relativistic formulas of the STR have been suggested given the principle of physical reality of imaginary numbers;
- conception of quaternion structure of the hidden Multiverse, which, according to the WMAP and Planck data, contains twenty mutually invisible universes existing in different dimensions, has been suggested on the basis of the adjusted relativistic formulas of the STR;
- according to the WMAP and Planck data six parallel universes among those twenty mutually invisible universes existing in different dimensions are adjacent to our universe;
- it has been shown that dark matter and dark energy correspond both to other invisible parallel universes of the hidden Multiverse, except ours;
- it has been shown that dark matter corresponds to the adjacent invisible parallel universes and dark energy corresponds to the rest of the parallel universes, shielded from us by parallel universes of dark matter;
- it has been explained how portals sometimes appear between adjacent parallel universes of the hidden Multiverse, enabling inhabitants of one universe to penetrate into another;
- since time in different parallel universes of the hidden Multiverse flows in different directions, movement through portals make it possible to travel not only through space, but also through time;
- it has been shown that quaternion structure of the hidden Multiverse contains four pairs of different matters-antimatters, and that their annihilation is prevented;
- it has been shown that tachyons locate in tachyon universes and antiverses of six different types;
- and, finally, it has been shown how the outlined hypothesis of the hidden Multiverse can be subjected to review for compliance with Popper's falsification criterion.

Acknowledgements

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