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Hidden Multiverse

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Abstract: *Parallel universes that form the actually existing 'Multiverse' received their designation for the reason that, despite their boundlessness, they never intersect. However, they float in the extra spatial dimensions and sometimes partially touch each other, forming portals. These portals enable mutual visits of inhabitants from one parallel universe to another. However, some of these inhabitants (for example, the earthlings at present) may not even suspect the Multiverse exists. This is accounted for by the circumstance that all the parallel universes forming the Multiverse are observable only for their inhabitants, and are invisible for the inhabitants of other parallel universes in any reflection, absorption or radiation range of any physical nature. Therefore, this Multiverse is referred to as hidden. The existence of the hidden Multiverse is confirmed by the dark matter / dark energy phenomenon, which, in turn, is accounted for by certain peculiarities of the hidden Multiverse structure.*

Keywords: *Multiverse, parallel universes, imaginary numbers, special theory of relativity, dark matter, dark energy.*

1. INTRODUCTION

The term 'Multiverse' was coined in 1895 by philosopher and psychologist William James. The term means a hypothetical set of all parallel universes. Various hypotheses regarding the Multiverse have been suggested by astronomers, physicists, philosophers and fiction writers. Long before that, the concept of the Multiverse was mentioned in various world religions. Some hypotheses of the Multiverse can be found in [1–11].

However, it is stated in [12,13] that all the hypotheses of other universes forming the Multiverse suggested so far, except for the one presented herein, will never be experimentally verified, and, therefore, are non-existent for us.

Refs. [14–18] suggest a different concept of the Multiverse, according to which, it actually exists and consists of a set of parallel universes that are not observable from other parallel universes and comply with the similarity principle. That is, the laws of nature governing these parallel universes are assumed to have much in common. Therefore, other parallel universes are accessible for their inhabitants to visit. These mutual visits can prove the reality of this Multiverse, which will be referred to as the hidden Multiverse for the reasons discussed above.

2. HISTORY OF THE HIDDEN MULTIVERSE CONCEPT

The hidden Multiverse, contrary to all other hypothetical Multiverses, is based on the principle of the physical reality of imaginary and complex numbers proven by the author.

Therefore, the history of the Multiverse concept discussed herein starts with the discovery of the imaginary unit $\boldsymbol{i = \sqrt{-1}}$ by Scipione del Ferro (1465 – 1525), Niccolò Fontana Tartaglia (1499 – 1557), Gerolamo Cardano (1501 – 1576), Lodovico Ferrari (1522 – 1565) and Rafael Bombelli (1526 – 1572) [19]. It may have been discovered even earlier by Paolo Valmes, who was sentenced to death at the stake by Spanish inquisitor Tomás de Torquemada (1420 – 1498) for making this discovery [20].

By now, due to the works of prominent mathematicians, such as Abraham de Moivre (1667 – 1754), Leonhard Euler (1707 – 1783), Jean Le Rond D'Alembert (1717 – 1783), Caspar Wessel (1745 – 1818), Pierre-Simon de Laplace (1749 – 1827), Jean-Robert Argand (1768 – 1822), Johann Carl Friedrich Gauss (1777 – 1856), Augustin Louis Cauchy (1789 – 1857), Karl Theodor

Wilhelm Weierstrass (1815 – 1897), William Rowan Hamilton (1805 – 1865), Pierre Alphonse Laurent (1813 – 1854), Georg Friedrich Bernhard Riemann (1826 – 1866), Oliver Heaviside (1850 – 1925), Jan Mikusiński (1913 – 1987) and many others, a consistent theory of functions of a complex variable has been developed [19]. However, it has not revealed the physical meaning of imaginary and complex numbers.

In 1826, during an investigation of electric circuits, Félix Savary (1797 – 1841) discovered the alternating electric current [21], and Charles Proteus Steinmetz (1865 – 1923) suggested using the symbolic method [22] to describe it, thus introducing the concept of complex frequency into the electric circuit theory. However, the physical meaning of complex frequency has not yet been explained in either textbooks or monographs.

Imaginary and complex numbers are currently used in other exact sciences – optics, hydraulics, mechanics, acoustics and so on – however, these sciences have failed to explain the physical meaning of imaginary and complex numbers.

In the early 20th century Joseph Larmor (1857 – 1842) [23], Nobel Prize winner Hendrik Antoon Lorentz (1853 – 1928) [24], Jules Henri Poincaré (1854 – 1912) [25], Nobel Prize winner Albert Einstein (1879 – 1955) [26] and other prominent scientists developed the special theory of relativity (STR). Its formulae describing relativistic effects at superluminal speeds had imaginary numbers. None of the physicists were able to explain their physical meaning, either at that time or at present.

However, contrary to mathematics and electric circuit theory, as well as other engineering sciences, where scientists, being unable to explain the physical meaning of imaginary numbers, left the question unsettled, the STR postulated the statement of imaginary numbers having no physical meaning.

Nevertheless, the validity of the current interpretation of the second STR postulate was questioned further [27], and in the 21st century, the MINOS and OPERA experiments were conducted; they attempted to refute the fundamental principle of the STR – the principle of non-exceedance light speed – and, thus, to offer experimental evidence of the physical reality of imaginary numbers. However, the physical community considered the MINOS experiment not reliable enough and ignored it, and the results of the OPERA experiment were refuted by the ICARUS experiment.

3. PROOF OF THE PHYSICAL REALITY OF IMAGINARY AND COMPLEX NUMBERS

However, Refs. [28–32] provide the descriptions and results of other experiments that, nevertheless, prove the physical reality of imaginary and complex numbers (thus refuting the corresponding dogma of the STR). These experiments do not involve elementary particle physics, which requires unique and extremely expensive equipment; they deal with the oscillation process physics in electric circuits that can be conducted using the equipment available in any radio electronic laboratory. Any engineer would be able to reproduce these experiments. Therefore, they are absolutely convincing

Let us briefly describe these two experiments.

It is well known that processes in linear electric circuits are described with a differential equation (or a system of these equations)

$$a_n \frac{d^n y}{dt^n} + a_{n-1} \frac{d^{n-1} y}{dt^{n-1}} + ... + a_0 y = \tag{1}$$
$$= b_m \frac{d^m x}{dt^m} + b_{m-1} \frac{d^{m-1} x}{dt^{m-1}} + ... + b_0 x$$

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

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

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

$n, n-1, .. 0, m, m-1, .. 0$ is order of derivatives.

The solution of equation (1) is a sum of two components

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

Where $y(t)_{forc}$ is the forced component of response;

$y(t)_{free}$ is the free (or transient) component of response.

Investigation of both components allows the proof of the physical reality of imaginary numbers, but in a different way.

Thus, in terms of the forced component of response $y(t)_{forc}$, Refs. [28–31] demonstrate that the current interpretation of resonance at real frequencies is confusing and inconsistent, and, therefore, incorrect. Indeed, according to the current interpretation of resonance, almost every simple oscillation circuit turns out to have not one, but several real resonance frequencies, and none of these resonance frequencies are equal to the frequency of free oscillations. In the early 20th century, Leonid Isaakovich Mandelstam (1879 – 1944) tried to explain this circumstance, but failed [33].

Therefore, in all textbooks on electric circuit theory, approximate formulae are still used – thus, the problem is disguised from the students. However, the difference in calculations using approximate and precise formulae for resonance frequencies and frequencies of free oscillations is quite insignificant and usually does not exceed the experimental error; but it does exist, and, thus, requires an explanation. Let us recall in this respect, that the difference between the speed of light and a neutrino in the OPERA experiment was also quite small and comparable to an experimental error. At the same time, several dozen scientific works were devoted to proving the invalidity of the OPERA experiment in less than six months, which resulted in the ICARUS experiment.

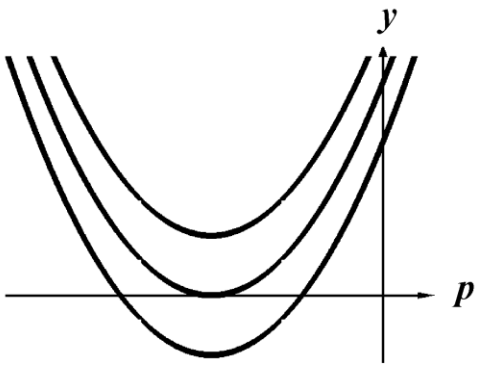

Fig1. *Graphic solution of the quadratic equation on the set of real numbers*

As for resonance, the above-mentioned publications give theoretical and experimental evidence of the fact that resonance is actually observed not at real, but at complex, frequencies. Thus, it was proven that complex frequencies themselves, as well as other complex numbers, are physically real.

It is even easier to prove the physical reality of imaginary and complex numbers during investigation of the transient component of response $y(t)_{free}$ [31]. To find it, engineers substitute the differential equation (1) for the so-called characteristic algebraic equation

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

Where $a_n, a_{n-1}, ...a_0$ are the same constant coefficients as in equation (1);

$n, n-1, n-2, ...1, 0$ are the exponents that equal the order of respective derivatives in the differential equation (1);

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

$i = \sqrt{-1}$ is the imaginary unit; and solve it.

It is very important that engineers always solve characteristic algebraic equations only on the set of complex numbers, contrary to mathematicians who solve their equations on the set of both real and complex numbers, even though these solutions are mutually exclusive.

Why is this so?

The matter is that the final product of engineers, contrary to mathematicians and physicists, are not formulae, theorems or theories, but something tangible that people need and can use – cars, refrigerators, TV sets, buildings, and so on. Any processes or products that cannot be implemented and used by people are of no interest to engineers.

This is why engineers solve characteristic equations only on the set of complex numbers, because these solutions always exist, i.e. for any combination of values of the coefficients $a_n, a_{n-1}, ...a_0$ in algebraic equation (3). It is well known to engineers that transient processes always exist, as well, i.e. forany combination of values of the coefficients $a_n, a_{n-1}, ...a_0$ in the differential equation (1). Therefore, this mathematical approach fully agrees with the experimental results known to engineers.

If engineers solved characteristic algebraic equations on the set of real numbers, these solutions would not always exist. For example, the characteristic quadratic equation that corresponds to the simplest electric oscillation circuit could have, depending on the particular combination of coefficients a_2, a_1, a_0 (see Fig. 1), two real solutions: one real solution or no real solutions. Therefore, the characteristic algebraic equation would not always have a solution on the set of real numbers, contrary to the solution on the set of complex numbers. Therefore, engineers would have to conclude that the mathematical situation where the characteristic equation has no solutions corresponds to the physical situation where the actually existing oscillation transient processes do not exist.

However, these oscillation transient processes always exist! They exist not only in laboratories where electric, mechanical, hydraulic or other oscillation transient processes are studied, but also in nature in the form of tsunamis, church bells tolling, a kid's swing swinging after it is pushed, and so on. Everyone, not only scientists and engineers, knows these processes.

These processes also prove the physical reality of imaginary and complex numbers.

4. THE CONCEPT OF THE HIDDEN MULTIVERSE

Thus, we can assert that the physical reality of imaginary and complex numbers has been proven indisputably.

However, since nature is consistent, sciences that try to understand and explain its regularities must also be consistent. The theories and hypotheses of separate scientific disciplines – physics, mathematics, radio electronics, optics, and so on – that exist only because of the limited intellectual potential of people, must be harmonised. Consequently, the principle of physical reality of imaginary and complex numbers, regardless of the branch of science that has proven it, must be recognised as the general scientific principle, mandatory not only in electric circuit theory [28–32], but also in the STR [14–18, 34],quantum mechanics [35, 36] and other sciences.

Therefore, the theories developed based on the above-mentioned dogma of the STR, which denies the physical reality of imaginary numbers, must be adjusted accordingly.

Let us discuss how this can be done, for example, in the STR.

In the STR, in order to solve this problem, it is necessary to explain the meaning of the relativistic formulae at superluminal speeds. It is enough to consider just one of them, for example, the Lorentz–Einstein formula

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \tag{4}$$

Where m_0 is rest mass of a moving body (e.g. an elementary particle);

m is relativistic mass of a moving body;

v is the velocity of the body;

c is light speed.

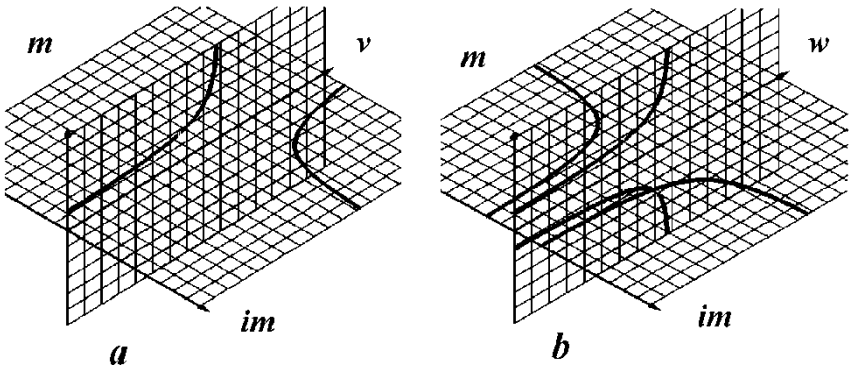

Fig2. *Graphs of functions (4) and (5)*

As can be seen, according to formula (4), at subluminal speeds the mass of elementary particles referred to as tardyons (or bradyons) is measured with real numbers, and at superluminal speeds the mass of elementary particles referred to as tachyons is measured with imaginary numbers. At the same time, tachyons cannot be detected in our universe (let us call it the tardyon universe), because they are located elsewhere: this other place can be referred to as the tachyon universe.

In order for inhabitants of different universes to visit the planet Earth, other universes must comply with the 'similarity principle', i.e. the fundamental physical, chemical, biological, and other laws in them must be identical or have much in common.

However, as can be seen (see Fig. 2a), graphs of function (4) at $v < c$ and at $v > c$ look different, i.e. they do not comply with the similarity principle. Therefore, the Lorentz–Einstein formula must be adjusted as follows

$$m = \frac{(i)^q m_0}{\sqrt{1-(v/c-k)^2}} = \frac{(i)^q m_0}{\sqrt{1-(w/c)^2}} \tag{5}$$

where $q = \left\lfloor v/c \right\rfloor$ 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 $0 \le w < c$;

v is the velocity measured from our tardyon universe, which, hence, can be referred to as the tardyon velocity.

Other relativistic formulae of the STR, naturally, have the same shortcoming and can be adjusted in a similar way.

Then the value $q = 0$ in formula (5) corresponds to the tardyon universe, and the value $q = 0$ to the tachyon universe. It can be seen from Fig. 2b that the Multiverse must have at least two more parallel universes that correspond to $q = 2$ and $q = 3$. It is logical to refer to them as the tardyon antiverse and the tachyon antiverse, because they correspond to the values of mass (as well as time and other quantities measured with the relativistic formulae of the STR) measured with negative real numbers and negative imaginary numbers.

Since we have proven the principle of physical reality of complex (and not only imaginary) numbers, there can be other parallel universes as well; they correspond to intermediate values of the parameter q – the tardyon-tachyon, tachyon-anti-tardyon, and so on. They exist in portals discussed below.

Let us note that in the Multiverse structure described herein the tardyon universe and the tardyon antiverse are never adjacent (see Fig. 2c, d, e), but are separated by the tachyon universe and the tachyon antiverse. Similarly, the tachyon universe and the tachyon antiverse are never adjacent, because they are separated by the tardyon universe and the tardyon antiverse. Thus, annihilation of the corresponding universes and antiverses is prevented.

Further, the value $q = 4$ in formula (5) once again corresponds to the tardyon universe. However, this can be either our universe or another tardyon universe. Depending on this, as well as on other yet unknown circumstances, the structure of the Multiverse will have a different form. Further research will reveal what it actually is.

In view of the above, it is appropriate to note that dark matter and dark energy discovered in the 20th century actually confirm the existence of unobservable parallel universes, including those corresponding to $q > 4$. Their existence also explains the phenomenon of dark matter and dark energy.

However, the above-mentioned parallel universes in the Multiverse of any structure are not locked, relative to each other, but sort of float in the extra spatial dimensions. Therefore, they sometimes touch, and in some places even partially penetrate into each other. Then, in points of these mutual penetrations, certain transition zones, or portals, appear (they have nothing to do with the so-called 'wormholes' mentioned in other hypotheses of the Multiverse). These portals enable the inhabitants of adjacent universes to visit each other.

Now it is possible to explain how both elementary particles and living beings, as well as any other physical objects, can make transitions from one parallel universe to another. It turns out that in the Multiverse, portals are used for this purpose. Therefore, there is no need to break the light speed barrier in accordance with the relativistic formulae of the STR. This is similar to the fact that you do not have to break through a wall to move from one room of your apartment to another, because there is an alternative way – through the door.

5. CONCLUSION

The present publication has left many questions unanswered, because there is next to no reliable initial information on parallel universes and portals. It can be obtained only after visiting and exploring parallel universes.

Exploration of the resources of the Multiverse, no doubt, will drastically change human civilization. New knowledge and new material resources will inevitably accelerate the economic and intellectual advancement of humanity [18].

Moreover, the human civilization will be able to escape in the Multiverse in case of an inevitable global disaster – for example, a huge volcano eruption, collision with a large meteorite, and so on.

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