REFUTATION OF THE SPECIAL THEORY OF RELATIVITY

Alexander A. Antonov*

Abstract

Investigation of oscillation processes offers theoretical and experimental evidence of the general scientific principle of physical reality of complex numbers. Thus, irrespective of results of the OPERA and ICARUS experiments, we disprove the current interpretation of the special theory of relativity (the STR), which denies the physical reality of imaginary and complex numbers. A hypothesis of the Multiverse based on the principle of physical reality of complex numbers is suggested. It is demonstrated that, contrary to other hypotheses of the Multiverse, the suggested hypothesis can be experimentally verified already at the present time by people visiting other parallel Universes through portals.

Key-Words: Complex Frequencies, Resonance, Transient Processes, Special Theory of Relativity, Universe's Hidden Extra Dimensions, Parallel Universes, the Multiverse.

* *Research Center of Information Technologies "TELAN Electronics", P.O. Box 73, Kiev, 03142, UKRAINE*

1. Introduction

On 23 Sept 2011, a sensational report on the OPERA experiment [1] was published, which alleged to have received a statistically valid result of a neutrino reaching superluminal speed. Since this result did not fit into the framework of the generally accepted interpretation of the special theory of relativity (STR), physicists had to admit that either the result of the experiment or the current interpretation of the STR is erroneous. On 16 Mar 2012, it was reported that the ICARUS experiment [2] yielded results disproving the results of the OPERA experiment.

Seemingly, the question on the validity or falsity of the STR was thus closed.

However, this is not so. The STR considers it impossible for any physical object to exceed the velocity of light, just because otherwise, in formulae describing relativistic effects, the corresponding quantities may take values measured with imaginary numbers, the physical meaning of which seemed impossible to explain.

Nevertheless, besides OPERA and ICARUS, there are other experiments described below, which irrefutably prove the physical reality of imaginary and complex numbers. Consequently, these experiments do disprove the generally accepted interpretation of the STR.

2. Proof of the principle of physical reality of complex numbers

2.1. Using resonant processes to prove the principle of physical reality of complex numbers

2.1.1. Analytical evidence.

It is most convenient to study resonant processes in electric LCR-circuits, since the latter allow for the simplest experimental implementation of any particular case, as well as for the reason that the experiments described below can be easily verified in any university laboratory.

It is noteworthy that resonance in linear electric circuits was discovered back in 1826 [3] by Felix Savary (1797 – 1841), however, a consistent theory of resonance has not been developed until very recent time. Contemporary textbooks on the theory of electric circuits explain resonance the same way as 100 years ago, using the same approximate formulae which disguise the inconsistency of the explanation [4].

Inconsistency of the current interpretation of resonance manifests itself during investigation even of the simplest electric LCR-circuits. Let us give an example of such investigation of an electric circuit given in Figure 1.

Its complex conductance found using the symbolic method is

$$Y(j\omega) = C\frac{(\frac{1}{LC} - \omega^2) + j\omega\frac{R}{L}}{\frac{R}{L} + j\omega} = C\frac{(\omega_0^2 - \omega^2) + j\omega 2\sigma_0}{2\sigma_0 + j\omega} \quad (1)$$

where $2\sigma_0 = R/L$; $\omega_0 = 1/\sqrt{LC}$; $j = \sqrt{-1}$.

An imaginary component of this conductance is

$$ImY(j\omega) = C\frac{\omega(\omega^2 - \omega_0^2 + 4\sigma_0^2)}{\omega^2 + 4\sigma_0^2} \quad (2)$$

Its graph, referred to as the phase-frequency characteristic, is plotted in Figure 2a.

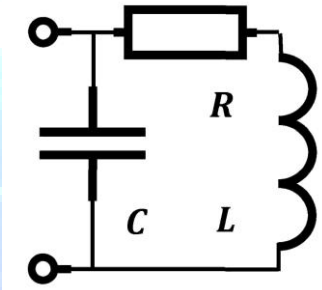

FIGURE 1. Electric LCR-circuit under investigation.

Modulus of this complex conductance is

$$|Y(j\omega)| = C\sqrt{\frac{4\sigma_0^2\omega^2 + (\omega^2 - \omega_0^2)^2}{\omega^2 + 4\sigma_0^2}} \quad (3)$$

Its graph, referred to as the amplitude-frequency characteristic, is plotted in Figure 2b.

Therefore, equating the imaginary component of complex conductance to zero (2), we find two resonance frequencies of the electric circuit under investigation.

$$\begin{cases} \omega'_{res1} = 0 \\ \omega''_{res1} = \sqrt{\omega_0^2 - 4\sigma_0^2} = \omega_0\frac{\sqrt{Q^2 - 1}}{Q} \neq \omega_0 \end{cases} \quad (4)$$

where $Q = \frac{\omega_0}{2\sigma_0} = \frac{1}{R}\sqrt{\frac{L}{C}}$.

Testing for extremum the radicand of the complex conductance modulus, i.e., solving the equation

$$\frac{d}{d\omega}\left[\frac{(\omega^2-\omega_0^2)^2+4\sigma_0^2\omega^2}{\omega^2+4\sigma_0^2}\right]=\frac{2\omega[\omega^4+8\sigma_0^2\omega^2+(16\sigma_0^4-8\sigma_0^2\omega_0^2-\omega_0^4)]}{(\omega^2+4\sigma_0^2)^2}=0 \quad (5)$$

we find two other resonance frequencies

$$\begin{cases}\omega'_{res2}=0\\ \omega''_{res2}=\sqrt{\omega_0\sqrt{\omega_0^2+8\sigma_0^2}-4\sigma_0^2}=\omega_0\dfrac{\sqrt{Q\sqrt{Q^2+2}-1}}{Q}\neq\omega_0\end{cases} \quad (6)$$

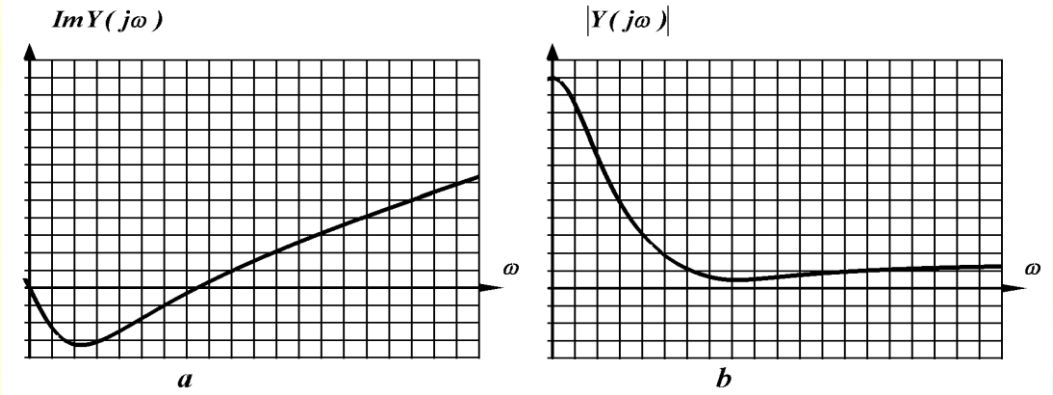

FIGURE 2. Frequency characteristics of the parallel oscillation LCR-circuit presented in Figure 1

Furthermore, the resonance frequencies (4), (6) are not equal to the frequency of free oscillations

$$\omega_{free}=\sqrt{\omega_0^2-\sigma_0^2}=\omega_0\sqrt{\frac{4Q^2-1}{4Q^2}}\neq\omega_0 \quad (7)$$

Russian academician L. I. Mandelstam (1879 – 1944) attempted to explain the latter circumstance in the second half of the 20th century, but failed [5].

TABLE 1. Resonance frequencies and frequencies of free oscillations.

Q	ω''_{res1}/ω_0 (4)	ω''_{res2}/ω_0 (6)	ω_{free}/ω_0 (7)
2	0.8660254	0.9872917	0.9682458
5	0.9797959	0.9996152	0.9949874
10	0.9949874	0.9999752	0.9987492
20	0.9987492	0.9999984	0.9996875

50	0.9998000	1,0000000	0.9999500
100	0.9999500	1,0000000	0.9999875

However, differences between frequencies ω''_{res1}, ω''_{res2} and ω_{free}, as can be seen from the table, are relatively small, and usually do not exceed the experimental error. However, these differences do exist, and they greatly exceed the relative difference between the velocity of light and neutrino in the OPERA and ICARUS experiments. Thus, they cannot be ignored, and prove the inconsistency of the current interpretation of resonance at real frequencies.

Similar results are obtained during investigation of other LCR-circuits.

All of the above certainly contradicts the common sense.

However, if for the same electric LCR-circuit (Figure 1) an expression of complex conductance as a function of complex frequency is used

$$Y(p) = C\frac{p^2 + p\frac{R}{L} + \frac{1}{LC}}{p + \frac{R}{L}} = C\frac{p^2 + p2\sigma_0 + \omega_0^2}{p + 2\sigma_0} \qquad (8)$$

where $p = -\sigma \pm j\omega$ are complex impact frequencies, it will turn out that the roots of the algebraic equation in the numerator $p_{1,2} = -\sigma_0 \pm j\sqrt{\omega_0^2 - \sigma_0^2}$ are the only resonance complex frequencies $p_{res1} = p_{res2} = -\sigma_0 \pm j\sqrt{\omega_0^2 - \sigma_0^2}$ which correspond to impact by exponential radio-pulses, irrespective of the resonance characteristics under consideration. Furthermore, these complex-conjugate resonance frequencies turn out to be equal complex-conjugate frequencies $p_{free} = -\sigma_0 \pm j\sqrt{\omega_0^2 - \sigma_0^2}$ of free damped oscillations. Consequently, interpretation of resonance at complex frequencies, contrary to its interpretation at real frequencies, is consistent.

2.1.2. Experimental evidence

All these statements may seem very strange for those who have studied the interpretation of resonance only at real frequencies. Nevertheless, all of them are correct and can be experimentally verified.

Due to restrictions of space, let us discuss only one experiment [6], which, however, is extraordinary enough to give convincing evidence of the foregoing (if you do not agree, try to explain the experiment in a different way). Figure 3 presents two circuits; one of them illustrates

the well-known resonance in an electric LC-circuit under the influence of sustained sinusoidal oscillations, the other one demonstrates the unknown resonance in an electric RL-circuit under the influence of exponential video-pulses.

As can be seen (Figure 3a), in accordance with the formula for resistance of the LC-circuit under investigation at complex frequency $p = j\omega$

$$Z(p) = Z(0,\omega) = j\omega L + \frac{1}{j\omega C} \qquad (9)$$

the corresponding graph crosses the imaginary component axis ω of complex frequency p at the point $\omega_0 = 1/\sqrt{LC}$.

Similarly, the graph (Figure 3b) of resistance of the RL-circuit under investigation at complex frequency $p = \sigma$ in accordance with formula

$$Z(p) = Z(\sigma,0) = R + \sigma L \qquad (10)$$

crosses the real component axis σ of complex frequency p at the point $\sigma_0 = -R/L$.

Since at the points ω_0 and σ_0 complex resistances $Z(p)$ of both circuits under investigation become zero, these points similarly correspond to their resonances.

However, let us reiterate, since resonance in an LC-circuit under the influence of sustained sinusoidal oscillations is well known, and resonance in an RL-circuit under the influence of exponential video-pulses is unknown, the latter needs additional clarifications. The matter is that action on any electric circuit almost always causes not only the forced component of response, but the free component, as well (it will be discussed below). In stable electric circuits the free component of response (also referred to as a transient process) decays relatively fast. However, at the initial time, since $U_{OUT} = U_{OUTforc} + U_{OUTfree}$, it prevents us from observing the forced component of response $U_{OUTforc}$ and, consequently, interferes into investigation of the resonant process. This is why resonance is easy to study by applying sustained oscillations U_{INP} to the LC-circuit, because the duration of forced oscillations $U_{OUTforc}$ (Figure 3a) significantly exceeds that of the transient process $U_{OUTfree}$. Exponential video-pulses $U_{OUTforc}$ (Figure 3b) are possible to observe in a resonant RL-circuit only in the case when their duration significantly exceeds the duration of the transient process $U_{OUTfree}$. For reason of clarity, Figure 3 shows input oscillations

U_{INP}, forced voltage oscillations at inductance U_{Lforc}, at capacitance U_{Cforc}, at resistor U_{Rforc}, their sums $U_{OUTforc} = U_{Lforc} + U_{Cforc}$ and $U_{OUTforc} = U_{Lforc} + U_{Rforc}$, as well as transient processes $U_{OUTfree}$ on separate graphs. It can be seen that at resonance, when $p_{res} = j\omega_0$ or $p_{res} = -\sigma_0$, in both electric circuits, $U_{Cforc} \neq 0$, $U_{Rforc} \neq 0$ at that, in the electric LC-circuit $U_{OUTforc} = U_{Lforc} + U_{Cforc} = 0$, and in the electric RL-circuit $U_{OUTforc} = U_{Lforc} + U_{Rforc} = 0$. This is why, in the output of both the LC-circuit and the RL-circuit, only the free component of response $U_{OUT} = U_{OUTfree}$ can be observed, which actually proves the existence of resonance in both circuits.

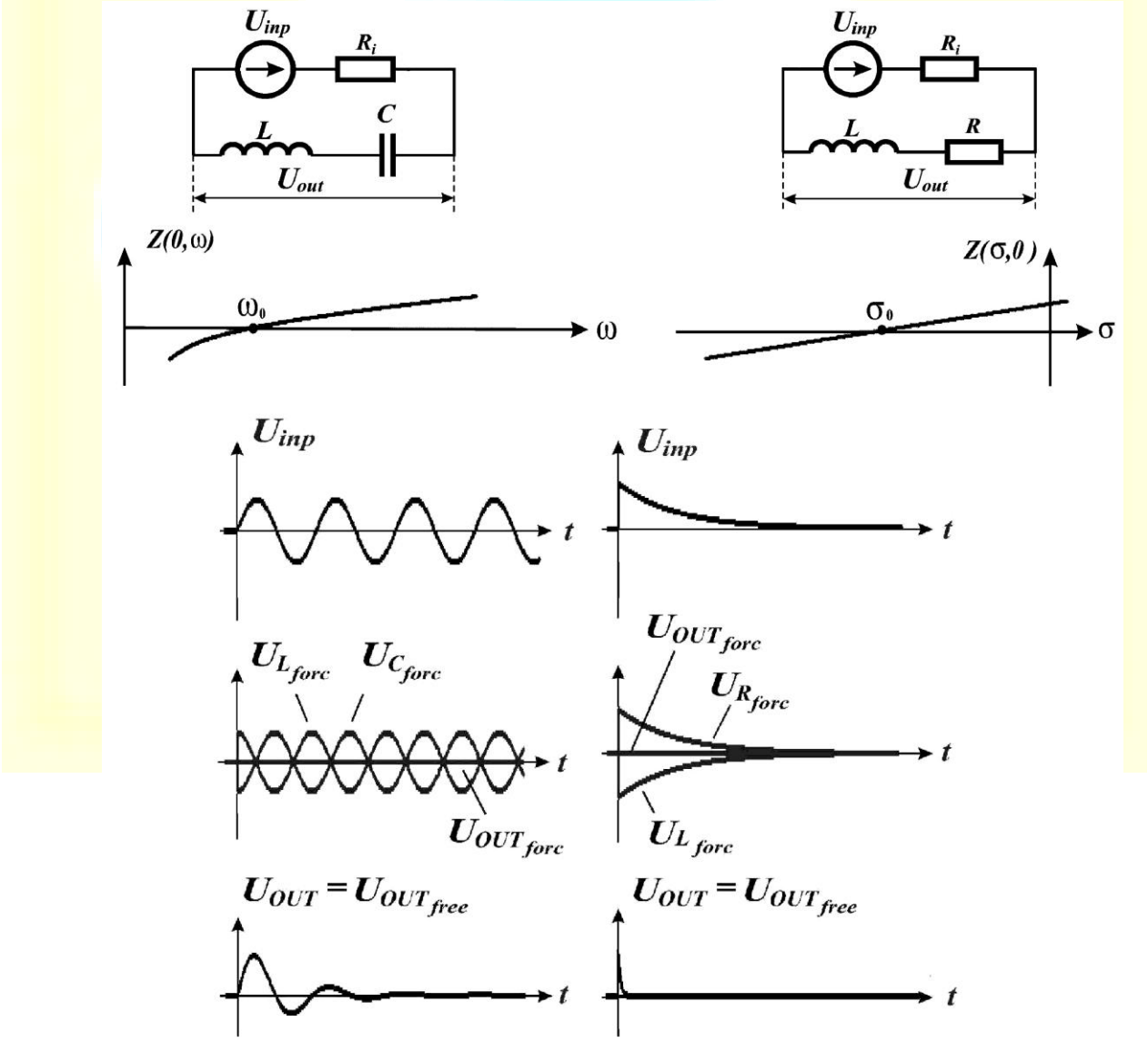

FIGURE 3. Resonant processes in electric LC- and RL-circuits.

In [7] – [9] descriptions of other experiments confirming the physical reality of resonance at complex frequencies can be found. In [10] there is an example of practical implementation of resonance at complex frequencies.

2.2. Using transient processes to prove the principle of physical reality of complex numbers

Physical reality of imaginary and complex numbers can also be proved through investigation of transient processes [11].

Transient processes in linear systems occur because the forced component of response to an external impact at the initial impact moment may require the system's energy state to change instantly, which is physically impossible. Therefore, the emergence of an additional transient component at the initial impact moment provides for a smoother energy process.

Oscillation transient processes are found in linear systems described with differential equations of at least the second degree

$$a_n \frac{d^n y}{dt^n} + a_{n-1} \frac{d^{n-1} y}{dt^{n-1}} + ... + a_0 y = b_m \frac{d^m x}{dt^m} + b_{m-1} \frac{d^{m-1} x}{dt^{m-1}} + ... + b_0 x \qquad (11)$$

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

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

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

n is the degree of the differential equation.

In order to determine the transient process, an algebraic equation, the so-called characteristic equation, which corresponds to differential equation (11), is usually solved for the system

$$a_n p^n + a_{n-1} p^{n-1} + ... + a_0 = 0 \qquad (12)$$

where p is a variable, which, for the case it takes values in the form of complex numbers $p = -\sigma \pm i\omega$ (in mathematics, contrary to the electric circuits theory, and imaginary unit is denoted by i), is often referred to as complex frequency;

n is the degree of the algebraic equation.

In the simplest case, when algebraic equation (30) is a quadratic one, i.e., $n=2$, oscillation transient process will have the form

$$y(t)_{free} = e^{-\sigma t}(A\cos\omega t \pm B\sin\omega t) \quad (13)$$

where $p=-\sigma\pm i\omega$ is complex frequency.

If the solutions of quadratic equation (12) are two real different roots or one real double root, the transient process is, respectively, aperiodic or critical.

In mathematics, solutions of algebraic equations both on the set of real and on the set of complex numbers are used; however, in theory of differential equations characteristic algebraic equations are always solved only on the set of complex numbers.

This is an extremely important circumstance, since it allows answering the question on which of the two solutions of algebraic equations is correct.

The matter is that at negative discriminant a quadratic equation has no solutions on the set of real numbers, but does have a solution on the set of complex numbers. It is easy to see that these two statements are mutually exclusive, since only one of them can be true. "Tertium non datur".

However, algebra does not answer which one is true, because it has no convincing arguments in favour of either choice.

This is why we will take a different approach to finding the truth. First of all, let us answer the following question: How do we understand the expressions "the solution exists" or "the solution does not exist"? Where does it exist? On paper? In a computer? On a blackboard in a university classroom?

In this respect, let us recollect that characteristic algebraic equations are solved only on the set of complex numbers, because with a negative discriminant a transient process still exists and is an oscillation one. If characteristic equations were solved on the set of real numbers, they would not have a solution with a negative discriminant. Consequently, oscillation transient processes in nature are not supposed to exist.

But they do exist! In the form of a tsunami. In the form of a pendulum in a clock. In a piano. In many other cases. I.e., a physical experiment we need has been performed repeatedly by people and nature.

Consequently, we have to admit that the only true and existing in nature solutions of algebraic equations (not only characteristic ones) are those on the set of complex numbers. This means that complex numbers themselves are physically real.

2.3. Using the principle of physical reality of complex numbers to prove the existence of Universe's hidden extra dimensions

The results obtained are quite convincing, however, they require additional clarifications, because complex numbers include not only the real, but imaginary component, as well. If concrete (i.e., having a reference to a unit of measurement) real numbers – e.g., 3 meters, 2 kilos, $100, 1 car – can be somehow registered by human senses, how can we register the result of measurement with imaginary numbers?

Unfortunately, we cannot. People do not have such senses. However, first of all, this situation is not unique, because human senses cannot directly register either the magnetic field, or the electron charge, or detect black holes, or determine the chemical formula of water, and many other things. For purposes of cognition, as in various other activities, people have been using different tools.

Such a mathematical tool in this case may be the Euler formula

$$e^{ix} = \cos x + i \sin x \qquad (14)$$

which obviously can be easily transformed into

$$e^{(-\sigma \pm i\omega)t} = e^{-\sigma t}(\cos \omega t \pm i \sin \omega t) \qquad (15)$$

According to this formula, as can be seen, any oscillation process contains (as shown below, not only mathematically, but physically, as well) both a real and an imaginary component. At that, the real component of an oscillation process is quite possible to register. For instance, it is possible to see oscillations in the form of waves in the sea, or to hear sounds of a piano. This is why it is always possible to confirm the existence of the imaginary component of an oscillation process, as well, as a necessary satellite of its real component.

Similarly, for instance, someone's shadow can tell us that the person is actually nearby, even if they are hiding. However, if the light source is infrared, the shadow becomes invisible, however, it still exists. As any analogy, this comparison to hidden dimensions (see below) is not perfect, but it gives an understanding of the situation.

Furthermore, in the left-hand part of formula (15) the exponent, as is seen, contains the quantity $-\sigma \pm i\omega$, which is complex frequency, and which is, as discussed above, a physically real complex number. Therefore, the left-hand part of formula (15) as a whole is also a physically real complex number. Consequently, the right-hand part of formula (15) is also a physically real complex number, i.e., both its real and its imaginary components. This statement holds true even for the case $\sigma = 0$, i.e., with regard to sustained oscillations. Consequently, this statement holds true for to electron revolution around the atomic nucleus, revolution of planets about their stars, as well as for many other natural processes.

Finally, since concrete imaginary numbers are physically real, they can measure something. In other words, they must correspond to certain dimensions which, according to the Euler formula, are extra to the dimensions with the help of real numbers. However, since we do not see or otherwise feel these dimensions, they are, in fact, hidden extra dimensions [12] – [15]. In this respect, they are similar to the hidden extra dimensions which are described in [16].

3. Structure of the Multiverse in accordance with the principle of physical reality of complex numbers

Multiverse is usually understood as a set of Universes, the number of which most often is taken for infinitely large. The most substantial hypotheses are discussed in [17] – [22]. However, the general fundamental drawback of all these and other hypotheses of the Multiverse structure suggested so far is complete impossibility of their experimental verification even in the very distant future through discovering other Universes [23].

The hypothesis discussed in the manuscript is very likely to describe a really existing Multiverse, because it is based on the theoretically and experimentally established presumption – the existence of hidden extra dimensions of the Universe (of our Universe).This is why the existence of parallel Universes which are part of this Multiverse can be confirmed by people visiting them already at the present time. These expeditions can possibly travel not only in space, but in time, as well (see below).

What are parallel Universes like? In order to answer this question, let us resort, for example, to the Lorentz-Einstein formula

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \qquad (16)$$

where m_0 is rest mass;

m is relativistic mass of a moving body;

v is the velocity of the body (e.g., a neutrino);

c is the velocity of light.

It follows from the formula that relativistic mass m of a physical object having rest mass m_0 and moving at velocity v, which exceeds the velocity of light c, is measured with an imaginary number. Being unable to explain the result, the current interpretation of the STR thus denies this possibility and alleges that imaginary quantities do not exist in nature. However, the principle of physical reality of complex numbers disproves this allegation of the STR. Consequently, it is necessary to suggest an explanation of the situation described, i.e., to show how imaginary mass, time and other imaginary physical quantities in formulae describing relativistic effects can be understood.

The following explanation is suggested [24] – [27]. In physics, elementary particles moving at superluminal speeds are commonly referred to as tachyons, contrary to the particles moving at subluminal speeds, which are usually referred to as tardyons (or bradyons). At that, tachyons cannot be registered from our tardyon Universe. This is why it is possible to assume that imaginary values of mass, time and other quantities refer to physical objects existing in a parallel tachyon Universe (or parallel tachyon Antiverse – see below).

However, it is impossible for the physical objects mentioned above to get from the tardyon Universe into the tachyon one by overcoming, in accordance with formulae describing relativistic effects, the light barrier, because they must have infinitely large energy to do this. Nevertheless, transitions from one parallel Universe into another are quite possible, but in a different way – through portals, in accordance with the Euler formula.

Right now, let us note that, similarly, it is impossible to move from one room of our home into another through the wall separating them, but it is quite possible to go through the door.

According to another formula describing relativistic effect

$$\Delta t = \Delta t_0 \sqrt{1-(v/c)^2} \qquad (17)$$

relativistic time Δt of moving physical body compared to its rest time Δt_0 slows down as its velocity v increases, and at $v = c$ it stops completely. And at $v > c$ relativistic time Δt even becomes imaginary. This result can also be accounted for by the corresponding physical object

disappearing in the tardyon Universe and emerging in the tachyon Universe. Therefore, for this physical body, time Δt does not exist in the tardyon Universe.

Similarly, for $v > c$ it is possible to explain and correct all other formulae of the STR describing relativistic effect.

3.1. Parallel Universes

Naturally, having no factual data about the tachyon Universe, we can describe its structure only hypothetically. But it is almost safe to suppose that it is inhabited, moreover, its rational beings are able to visit our tardyon Universe. This seemingly simple supposition allows receiving quite a lot of information about the tachyon Universe. First of all, it allows supposing that tachyon Universe is very similar to our tardyon Universe, i.e., it is governed (although in a slightly different way) by the same physical laws, it consists of the same chemical elements, it contains the same elementary particles, atoms and molecules, it has its own planets, stars galaxies and other astrophysical bodies, and, finally, it is inhabited by living beings, which are most likely to have already found ways of visiting the Earth. Then, consequently, people can also visit these Universes. Tardyon, tachyon and other Universes, which, based on this, shall be considered parallel, in aggregate form the Multiverse.

If other principles of explaining the behaviour of the tachyon Universe are used, it will not correspond to the notion of a parallel Universe, and will turn to be completely inaccessible for people to visit and explore.

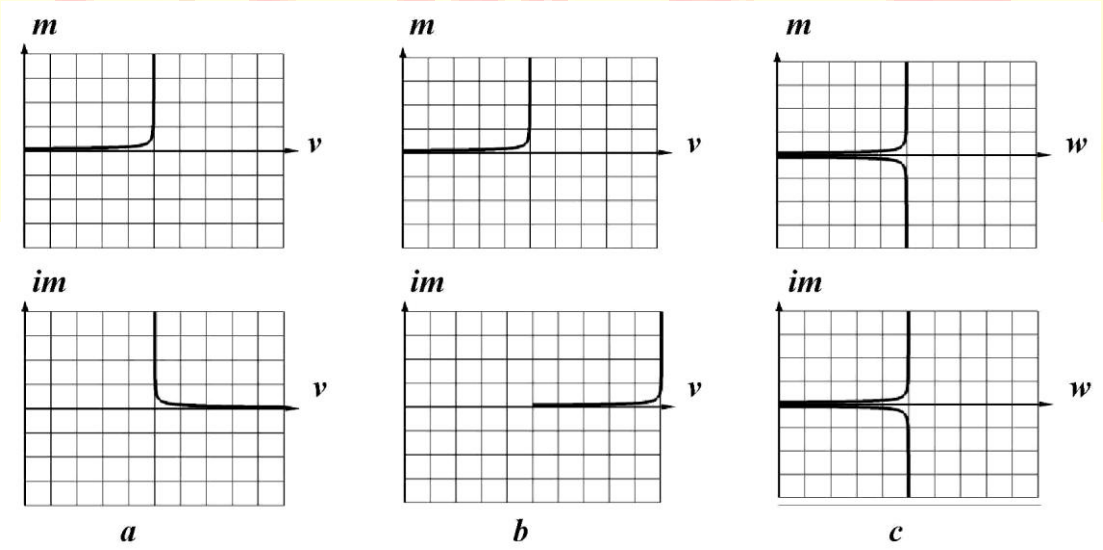

FIGURE 4. Graphs of relativistic mass.

However, relativistic formulae of the STR do not correspond to the similarity principle of Universes formulated above. Indeed, graphs of, for instance, the Lorentz-Einstein formula (16) in the tardyon Universe, when $0 \le v < c$, and in the tachyon Universe, when $c < v < 2c$, look completely different (see Figure 4a) and, therefore, these Universes have different characteristics.

The similarity principle of Universes formulated above, with regard to the tachyon universe, corresponds to the formula (see Figure 4b)

$$m = \frac{im_0}{\sqrt{1-(v/c)^2}} \tag{18}$$

Formulae (16) and (18) can be combined as follows

$$m = \frac{(i)^k m_0}{\sqrt{1-(v/c-k)^2}} = \frac{(i)^k m_0}{\sqrt{1-(w/c)^2}} \tag{19}$$

where $k = \lfloor v/c \rfloor$ is the discrete function «floor» of argument v/c;

$w = v - kc$ is local speed for each Universe, which can take values in the range $0 \le w < c$;

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

As can be seen, at $k = 0$ formula (19) corresponds to the tardyon Universe, and at $k = 1$ – to the tachyon Universe.

Graph of function (19) is presented in Figure 4c. As can be seen, for the image of the Multiverse structure in the graph to be complete, it turned out necessary to plot two more particular cases corresponding to $k = 2$ and $k = 3$. They are described with formulae

$$m = \frac{-m_0}{\sqrt{1-(w/c)^2}} \tag{20}$$

$$m = \frac{-im_0}{\sqrt{1-(w/c)^2}} \tag{21}$$

Then, from (19) at $k = 4$ once again we receive the law (16), which corresponds to a tardyon Universe, and at $k = 5$ we receive the law (18), which corresponds to a tachyon Universe, and so on.

Consequently, the Multiverse includes only four main types of parallel Universes:

- our tardyon Universe, which corresponds, according to formula (16), to physically existent real numbers;
- the tachyon Universe, which corresponds, in accordance with formula (18), to physically real imaginary numbers;
- the tardyon Antiverse (or the anti-tardyon Universe), which corresponds, according to formula (20), to physically existent negative real numbers;
- the tachyon Antiverse (or the anti-tachyon Universe), which corresponds, in accordance with formula (21), to physically real negative imaginary numbers.

It is also noteworthy that not only real or imaginary numbers can be physically real, but complex numbers, as well. Therefore, we can state that, apart from the four major types of parallel Universes, there are many intermediate types of parallel Universes: tardyon-tachyon, tardyon-anti-tachyon, anti-tardyon-tachyon, and anti-tardyon-anti-tachyon. For this reason, in accordance with the Euler formula (see below), it is possible for people, without breaching the physical, physiological and other principles of their vital activity, to make a smooth transition from one parallel Universe into another (similar, for instance, to a smooth transition from air into water and backwards during sea bathing).

Let us furthermore note that formula (17) does not agree with the similarity principle of Universes, either. Thus it can be corrected by analogy to formula (19)

$$\Delta t = (i)^n \Delta t_0 \sqrt{1-(w/c)^2} \qquad (22)$$

where local velocity w has the meaning explained above. In accordance with this formula, in pairs 'tardyon Universe/tardyon Antiverse' and 'tachyon Universe/tachyon Antiverse' the respective relativistic times Δt will be opposite in sign (just like relativistic masses are also opposite in sign). This is why, for an outside observer, these times flow in opposite directions to each other. However, for an insider in each of the parallel Universes, time flows from the past to the future.

3.2. Portals. Space and Time Travels.

As mentioned above, transitions of physical objects with non-zero rest mass m_0, according to formulae (19), (22) and others taking into account relativistic effect, from one parallel Universe into another at singularity points $v = (k+1)c$ are physically impossible, because they will need infinitely large energy to reach the velocity of light c.

But there is another way to make the transition. To this end, we can avail ourselves of the circumstance that borders of parallel Universes, for the reasons still unknown, do not hold still. This is why parallel Universes sometimes partially penetrate into each other, which results in the emergence of certain transition areas, which are more often referred to as portals and which allow mutual penetration from one adjacent parallel Universe into the other. Principle of portals operation can be explained with the Euler formula, which has:

- for the tardyon Universe – the form (14),
- for the tachyon Universe – the form $e^{i(x+\pi/2)} = -\sin x + i\cos x$ (23)
- for the tardyon Antiverse – the form $e^{i(x+\pi)} = -\cos x - i\sin x$ (24)
- for the tachyon Antiverse – the form $e^{i(x+3\pi/2)x} = \sin x - i\cos x$ (25)

As can be seen, in accordance with these formulae, oscillations in adjacent major parallel Universes are in quadrature to each other.

But what oscillations define the types of parallel Universes, and the transition from one parallel Universe into others? How and why do they play such an important part in the behaviour of the Multiverse? There is no answer to this question yet. We can only suppose that, since parts of adjacent Universes opening up for people on the surface of Earth have a relatively large size and exist for quite a long period of time, these are infra-low-frequency spatiotemporal oscillations, most likely, caused by the rotation of the Earth around its axis and revolution of the Moon about the Earth. In other words, these are forced oscillations (confirmed by regular ebbs and tides) of the Earth surface.

Besides, irregular geotectonic dislocations beneath the ground and water surface can cause shock oscillations at frequencies close to that of the Earth's forced oscillations. Moreover, the phase of shock oscillations sometimes may turn out to be significantly different (sometimes even in quadrature) from the phase of forced oscillations, and the amplitude of shock oscillations may be commeasurable and even exceed the amplitude of forced oscillations of the Earth surface. This is why, on relatively small patches of the Earth surface, our tardyon Universe and adjacent tachyon Universe or tachyon Antiverse can mutually penetrate. Borders of these patches on the surface of Earth and beneath it (beneath water, as well) become portals which close after the shock oscillations dampen; as a result, initial fragments of our tardyon Universe recover on these patches.

Obviously, after studying the mechanism of natural portal formation may create artificial portals, as well. It is quite possible that UFOs are equipped with such means of artificial portal formation. This is why they are able to disappear as a result of transition through these artificially created portals into adjacent parallel Universes. As for the Philadelphia experiment, in view of this, it can be considered as basically the first attempt of scientists to create an artificial portal.

Since portals are an invisible border between parallel Universes, people who get into them (e.g., in a forest) can be unaware of it for quite a long time; and, having realized that the world around them is different from what they are used to, they can believe that they are simply lost in our tardyon Universe. This is why they may, eventually, never find their way back.

4. Summary

The present research, presumably, allows opening up the new era of Great Geographical Discoveries, which will allow discovering not new continents on Earth, but new Universes with their stellar systems, planets, continents and countries.

References

1. Adam T. *et al.*, 2011, Measurement of the neutrino velocity with the OPERA detector in the CNGS beam.
2. Antonello M. e*t al.*, Measurement of the neutrino velocity with the ICARUS detector at the CNGS beam.
3. Blanchard Ju., 1941, The History of Electrical Resonance, *Bell System Technical Journal*, vol. 20, no 4, 415 – 433.
4. Krug K. A., 1946, *Electric Circuits Fundamentals*, 6-th ed., vol. 2, Gosenergoisdat, Moscow.
5. Mandelshtam L.I., 1955, *Lectures on Oscillation*, vol. 4, Academy of Sciences of the USSR, Moscow.
6. Antonov A. A., 2008, Physical Reality of Resonance on Complex Frequencies, *European Journal of Scientific Research*, vol. 21, no 4, pp. 627 – 641.
7. Antonov A. A., 2009, Resonance on Real and Complex Frequencies, *European Journal of Scientific Research*, vol. 28, no 2, pp. 193 – 204,

8. Antonov A. A., 2010, New Interpretation of Resonance. *International Journal of Pure and Applied Sciences and Technology*, vol. 1, no 2, pp. 1 – 12.
9. Antonov A. A., 2010, Oscillation Processes as a Tool of Physics Cognition, *American Journal of Scientific and Industrial Research.*, vol. 1, no 2, pp. 342 – 349.
10. Antonov A. A., Bazhev V. M., 1974, USSR Pat. # 433650.
11. Antonov A. A., 2010, Solution of Algebraic Quadratic Equations Taking into Account Transitional Processes in Oscillation Systems, *General Mathematics Notes*, vol. 1, no 2, pp. 11 – 16.
12. Antonov A. A., 2011, Resonant Processes as a Tool for Revealing the Universe's Hidden Dimensions, *American Journal of Scientific and Industrial Researc*, vol. 2, no 4, pp. 567 – 572.
13. Antonov A. A., 2011, Transitional Processes as a Tool for Revealing Universe's Hidden Dimensions, *International Journal of Emerging Sciences*, vol. 1, no 2, pp. 83 – 94.
14. Antonov A. A., 2011, Extra dimensions in physics have been discovered, *Nauchnaya Perspectiva (Science Perspective)*, no 9, pp. 60 – 64.
15. Antonov A. A., 2011. Evidence of Existence of the Universe's Extra Dimensions, *International Journal of Advanced Science and Technology, Special Issue*, vol. 2, no 6, pp. 1 – 11,
16. Randall L., 2005, *Warped Passages: Unraveling the Mysteries of the Universe's Hidden Dimensions*, Ecco, NY.
17. Lewis D., 1986, *On the Plurality of Worlds*, Basil Blackwell, Oxford.
18. Deutsch D., 2002, The structure of the multiverse. *Proceedings of the Royal Society A*, no. 458, pp. 2911– 2923,
19. Tegmark M., 2002, Parallel Universes, *Scientific American*, vol. 288, no 5, pp. 40 – 51.
20. Ellis G.F.R., Kirchner U., Stoeger W.R., 2004, Multiverses and physical cosmology, *Monthly Notices of the Royal Astronomical Society*, vol. 347, no 3, pp. 921 – 936.
21. Carr B. ed., 2009, *Universe or Multiverse?* Cambridge Univ. Press.
22. Lucash V. N., Mikheyeva E. V., 2010, Physical cosmology, Physmathlit, Moscow.
23. Conley A., Carlberg R. G., Guy J., Howell D. A., Jha S., Riess A. G., Sullivan M., 2007, Is there evidence for a Hubble Dubble? The nature Type 1a supernova colors and dust in external galaxies. *Astrophysical Journal*, vol. 664, no 1, pp. L13 – L16.

24. Antonov A. A., 2011, Structure of the Multiverse, *British Journal of Science,* vol. 2, no 2, pp. 51 – 60.

25. Antonov A. A., 2012, Discovery of the Real Multiuniverse, *Encyclopedia of Russian Thought: Reports to Russian Physical Society,* vol. 16, no. 3, pp. 3 – 20.

26. Antonov A. A., 2012, Multiuniverse. Time Travels, *International Journal of Pure and Applied Sciences and Technology,* vol. 12, no. 2, pp. 43 – 56.

27. Antonov A. A., 2012, Earth. Portals. Parallel Universe, *American Journal of Scientific and Industrial Research,* vol. 3, no. 6, pp. 464-473