

MATHEMATICAL SCIENCES

PROVING PHYSICAL REALITY AND EXPLAINING THE PHYSICAL ESSENCE OF IMAGINARY NUMBERS

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Abstract

In the article it is shown that the version of the special theory of relativity (STR), stated in all textbooks of physics, is wrong as the relativistic formulas received in it are wrong, they are incorrectly with use of wrong principle of non-exceeding of speed of light are explained and from them wrong conclusions about physical unreality of imaginary numbers and also about existence in the nature of our only visible universe are made. This generally recognized version of STR is refuted experimentally proved as a result of research of transient processes in linear electric circuits by the general scientific principle of physical reality of imaginary numbers discovered 500 years ago.

It is explained that imaginary numbers in astrophysics correspond to the world of invisible parallel universes in other dimensions. Its cognition is the task of future science. However, the neighbouring universes can be seen on the starry sky in portals now. The corrected relativistic formulas are obtained and the corrected version of STR corresponding to them is created.

Keywords: imaginary numbers, special theory of relativity, invisible universes, hidden Multiverse, invisible Hyperverse

1. Introduction

Imaginary numbers were discovered 500 years ago by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Raphael Bombelli [1]. And perhaps even earlier than them such a scientific discovery was made by Paolo Valmes [2], who was burned alive at the stake for this by the verdict of the Spanish inquisitor Thomas de Torquemada. Even Sir Isaac Newton⁷ was forced to take into account the opinion of the Inquisition about imaginary numbers, who therefore preferred not to use them in his works.

However, their physical significance remains unknown in science to this day. Indeed, everyone knows what 7 seconds, 12 meters, or 19 grams are, but no one knows what $7i$ seconds, $12i$ meters and $19i$ grams,

where $i = \sqrt{-1}$, are. We all know that 7, 12 and 19 are simply numbers having no physical significance outside of their context. However, this knowledge was not enough to understand the STR.

2. The Problem of Understanding Imaginary Numbers

Works of famous mathematicians 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 others contributed to creation of a perfect theory of functions of a complex variable. However, the theory neither proves physical reality of imaginary numbers nor explains their physical significance⁸.

Imaginary numbers are now widely used in all exact sciences, including radio engineering, electrical engineering, optics, mechanics, acoustics, etc. But in them also the physical reality of imaginary numbers is not proved and their physical meaning is not explained⁹.

But in the generally accepted version of the special theory of relativity (STR) [3]-[5], which is rightly considered one of the most outstanding theories created in the 20th century and is therefore currently studied in all physics textbooks, it is even denied, since its creators were unable to explain the relativistic formulas obtained therein.

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

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

$$l = l_0 \sqrt{1 - (v/c)^2} \quad (3)$$

⁷ In the atmosphere of the omnipotence of the Inquisition and intolerance of dissent that existed at that time, Newton's friend William Whiston was stripped of his professorship in 1710 for some of his careless statements and expelled from Cambridge University.

⁸ Naturally, about physical reality and physical essence of imaginary numbers, as well as real numbers, we can speak only

in relation to named numbers, equipped with indications on the used units of measurement of corresponding parameters of physical objects and processes.

⁹ More precisely, in radio engineering and electrical engineering it is actually revealed in the process of their practical use, but nothing is written about this in textbooks, so as not to refute physics.

where m_0 is the rest mass of a moving physical body;

m is the relativistic mass of a moving physical body;

Δt_0 is the rest time of a moving physical body;

Δt is the relativistic time of a moving physical body;

l_0 is the rest length of a moving physical body;

l is the relativistic length of a moving physical body;

V is the velocity of a moving physical body;

C is the speed of light;

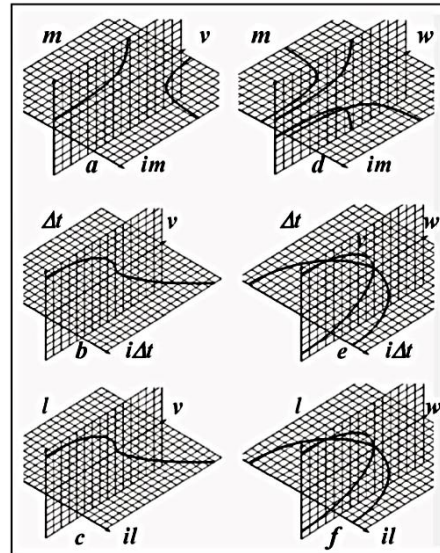


Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $V < C$ and superluminal $V > C$ ranges

They could not explain physical significance of these formulas for the superluminal velocity range, where, according to these formulas, mass, time, and distance were measured in imaginary numbers (see Fig. 1a, b, c). However, since a theory that could not be explained even by its creators would be useless to anyone, in the STR had to introduce a postulate¹⁰, known as the principle of light speed non-exceedance, the meaning of which is clear from its name.

In relation, for example, to the Lorentz-Einstein formula (1), it was explained as follows. The postulate asserted that since the situation at $V > C$ never occurred anywhere in the early 20th century, it did not need any explanation. Thus, imaginary numbers were unnecessary. i.e. non-existent. Moreover, they were even called imaginary

However, since the existing version of the STR was based solely on a postulate, that is, an unproven assumption, there was no complete certainty that it was correct. Actually, it turned out to be incorrect, since in 2008-2010 (i.e., even before publication of results of the unsuccessful OPERA experiment¹¹ conducted at the Large Hadron Collider in 2011), it was experimentally

proven [6]-[10] that imaginary numbers are physically real.

3. Proof of Physical Reality of Imaginary Numbers

Thus, in the 21st century, a Hamlet's question has arisen in physics – is the generally accepted version of the STR correct or not correct? Consequently, does it require correction or not? To address this, it was necessary to answer another question – whether imaginary numbers discovered 500 years ago are physically real or not. And the response to this question required experimental confirmation, even though this issue falls within the realm of mathematics. However, Oliver Heaviside asserted on a similar issue, “*Mathematics is an experimental science.*”

Let us further examine electromagnetic transient processes in linear electrical circuits¹² [10]-[15], which allow us to answer this question conclusively using simple experiments¹³. These experiments can be carried out by any engineer in less than a day in any radio engineering laboratory. Such processes in linear electrical LCR circuits are described by linear differential equations (or systems of such equations)

¹⁰ Since it has never been proven theoretically or confirmed experimentally by anyone.

¹¹ Which was no longer needed

¹² Unlike the extremely complex and expensive MINOS, OPERA and ICARUS physics experiments, which were no longer needed

¹³ In contrast to the extremely expensive physics experiments MINOS, OPERA and ICARUS, which were no longer needed

$$a_n \frac{d^n y}{dt^n} + a_{n-1} \frac{d^{n-1} y}{dt^{n-1}} + \dots + a_0 y = b_m \frac{d^m x}{dt^m} + b_{m-1} \frac{d^{m-1} x}{dt^{m-1}} + \dots + b_0 x \quad (4)$$

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

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

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

A solution to the equation (5) is known to equal the sum of two components

$$y(t) = y(t)_{forc} + y(t)_{free} \quad (5)$$

where $y(t)_{free}$ is the free component of response, corresponding to the transient process;

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

They are found in different ways. We are only interested in the free component of response.

Finding a specific type of a free component of response begins with writing and solving the so-called characteristic algebraic equation (usually of the second order) corresponding to the original differential equation (4)

$$a_n p^n + a_{n-1} p^{n-1} + \dots + a_0 = 0 \quad (6)$$

where $a_n, a_{n-1}, \dots, a_0$ are the constant coefficients same as in the equation (4);

$n, n-1, n-2, \dots, 1, 0$ are the degree indices, the magnitude of which is equal to the order of the corresponding derivatives in differential equation (4);

p is the variable, which is often called a complex frequency, when it takes values in the form of complex numbers.

Currently, two algorithms for solving algebraic equations (4) are used in mathematics. According to the first algorithm, solutions are found in the form of real numbers known to everyone. The second algorithm finds solutions to complex numbers that no one understands.

Then, one might assume that no one needs complex numbers because of their incomprehensibility. But, actually, the use of complex numbers greatly simplifies mathematical reasoning and many engineering calculations. Thus, when solving algebraic equations of power n according to the first algorithm, we would

receive either n roots or $n-1$ roots or $n-2$ roots ... or even no roots, depending on the value of coefficients. $a_n, a_{n-1}, \dots, a_0$. And when using the second algorithm to solve the same algebraic equations of power n , we would always receive n roots. Therefore, for some combinations of coefficients $a_n, a_{n-1}, \dots, a_0$, the algebraic equation (6) might not have any solution within the first algorithm, and would always have n solutions within the second algorithm.

This definitely contradicts common sense and requires an answer to the question – which of the algorithms mentioned above provides the only correct solution in a particular situation? After all, two mutually exclusive statements cannot be simultaneously true. In the formal logics, the Latin aphorism ‘*Tertium non datur*’, i.e. there is no gap between them that corresponds to this situation.

However, the question is uneasy, otherwise, the answer thereto would have been received long ago. Since humans have a visual thinking, graphical solutions to algebraic equations would be the most helpful in explaining the situation.

For this purpose, we shall convert, for example, the algebraic quadratic equation

$$a_2 p^2 + a_1 p + a_0 = 0 \text{ as follows}$$

$$\begin{cases} y = a_2 p^2 + a_1 p + a_0 \\ y = 0 \end{cases} \quad (7)$$

Then its solution (see Fig. 2) would correspond to the intersection of the parabola $y = a_2 p^2 + a_1 p + a_0$ and the line $y = 0$, i.e. the abscissa axis p .

As can be seen depending on the parabola position relative to the axis p , which is determined by

values of coefficients a_2, a_1, a_0 , the parabola

$$y = a_2 p^2 + a_1 p + a_0 \text{ can cut the axis } p \text{ either at two or one or none of the points.}$$

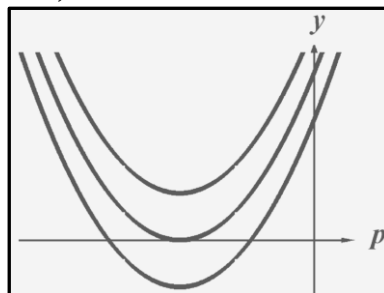


Fig. 2. Graphical solution to the quadratic equation in the set of real numbers, explaining that the equation can have either or two or one or no solutions

The result obtained is consistent with the corresponding analytical solution to the quadratic equation. Actually, if a discriminant of the equation $a_2 p^2 + a_1 p + a_0 = 0$ is positive, the equation has two different real roots $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$. If a discriminant is equal to zero, i.e. $a_1^2 - 4a_2 a_0 = 0$, the equation has one real root $p = -\sigma_0$. And if a discriminant is negative, i.e. $a_1^2 - 4a_2 a_0 < 0$, the equation does not have any real root.

The result is so simple and obvious that it would seem to even serve as a proof of existence of the only right solution according to the first algorithm using real numbers. But this is not the case, since a no less clear graphical solution to the quadratic equation can also be obtained within the second algorithm. It looks to be impossible at first sight, since the graph of function , where and are the complex quantities, should be four-dimensional. Humans can neither imagine nor depict four-dimensional graphs. Really, try to imagine and draw, for example, a four-dimensional cube (also referred to as a tesseract or octachoron). But mathematicians can do this.

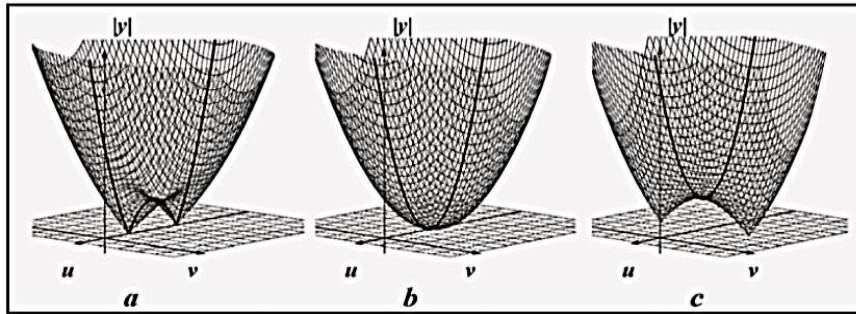


Fig. 3. Graphical solution to the quadratic equation in the set of complex numbers, explaining that the equation can have two solutions or one double solution

However, the problem becomes quite solvable if a four-dimensional graph of the function of complex variable $y = f(x)$ is replaced by a three-dimensional graph of function $|y| = |f(x)| = |f(\sigma + i\omega)|$. Thus, within the second solution algorithm, the quadratic equation can be converted into a system of equations, corresponding to the Fig. 3.

$$\begin{cases} |y| = |a_2(\sigma + i\omega)^2 + a_1(\sigma + i\omega) + a_0| \\ |y| = 0 \end{cases} \quad (8)$$

Herewith, Fig. 3a would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 > 0$ has two real roots of different values $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at two different points $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$ on the axis of real numbers σ .

Fig. 3b would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 = 0$

has one double¹⁴ real root $p_{1,2} = -\sigma_0$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at one point $p_{1,2} = -\sigma_0$ on the axis of real numbers σ .

Fig. 3c would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 < 0$ has two complex conjugate roots $p_{1,2} = -\sigma \pm i\omega$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at two points that are not on the axis of real numbers σ .

Algebraic equations of the third and higher degrees can be solved graphically in a similar way. Fig. 4 gives an example of a graphical solution to the algebraic cubic equation $a_3 p^3 + a_2 p^2 + a_1 p + a_0 = 0$, which in the set of real numbers is converted as follows

$$\begin{cases} y = a_3 p^3 + a_2 p^2 + a_1 p + a_0 \\ y = 0 \end{cases} \quad (9)$$

¹⁴ For example, for the equation $(x + \sigma_0)^2 = 0$

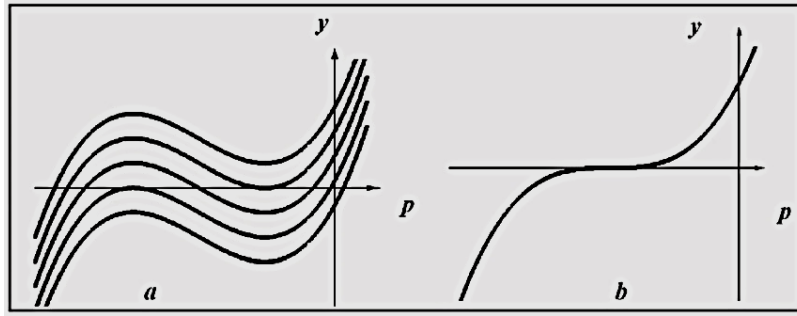


Fig.4. Graphical solution to the cubic equation in the set of real numbers, explaining that this equation can have either one or two or three solutions

Apparently, depending on the position of the curve $y = f(x)$ relative to the abscissa axis (i.e. depending on the value of coefficients a_3, a_2, a_1, a_0), the cubic equation can have either one or two or three real solutions within the first algorithm (see Fig. 4a,b). Fig.

5a,b,c,d,e shows graphical solutions to the cubic equation $a_3(\sigma + i\omega)^3 + a_2(\sigma + i\omega)^2 + a_1(\sigma + i\omega) + a_0 = 0$ in the set of complex numbers for the same combinations of coefficients a_3, a_2, a_1, a_0 , as in Fig. 4, equivalent to the system of equations

$$\begin{cases} |y| = |a_3(\sigma + i\omega)^3 + a_2(\sigma + i\omega)^2 + a_1(\sigma + i\omega) + a_0| \\ |y| = 0 \end{cases} \quad (10)$$

As can be seen, a solution to the equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ has always three roots when using the second algorithm. But some roots can be double as in Fig. 4a, 5b, 5d, and even triple¹⁵ as in Fig. 4b and 5f. In the latter case, in Fig. 3b, the graph is somewhat different, looking like a tangentoid (or cotangentoid).

And while the points of intersection of the curve $y = a_3p^3 + a_2p^2 + a_1p + a_0$ and the abscissa axis p correspond to solutions to the equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ in Fig. 4, the points of contact of the surface $|y| = |a_3(\sigma + i\omega)^3 +$

$a_2(\sigma + i\omega)^2 + a_1(\sigma + i\omega) + a_0|$ of the complex plane $x = \sigma + i\omega$ correspond to solutions to the same equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ in Fig. 5. Moreover, both figures show the same particular cases of the situations mentioned. Consequently, equally convincing graphical solutions can also be proposed to the cubic equations (and equations of higher degrees) in the set of both real (Fig. 4) and complex (Fig. 5) numbers.

Thus, purely mathematical reasoning above do not allow us to make an indisputable conclusion about the truth of one and the falsity of another algorithm for solving algebraic equations; or, in other words, to draw a conclusion about physical reality or unreality of their solution expressed in the form of complex numbers.

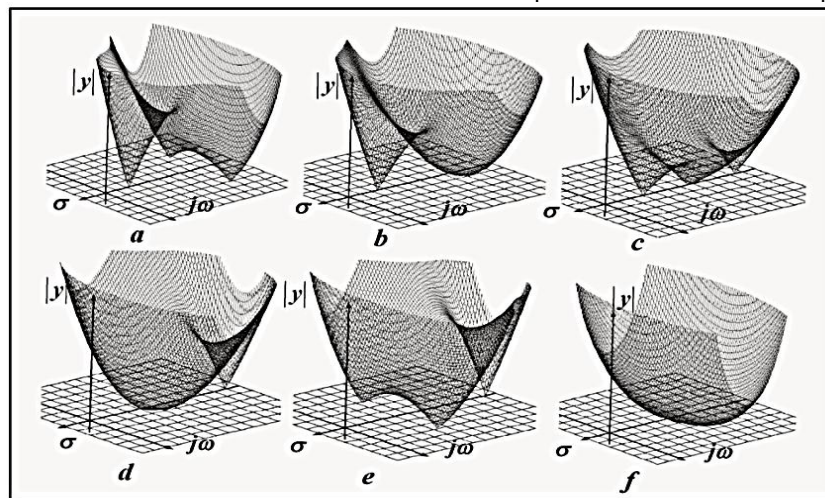


Fig. 5. Graphical solution to the cubic equation in the set of complex numbers, explaining that in this case it has either three solutions or two solutions, one of which is double, or one triple solution, i.e. having always three solutions

¹⁵ For example, for the equation $(x + \sigma_0)^3 = 0$

It is clear that then the choice from the mentioned two algorithms for solving algebraic methods could be made differently - in accordance with the general scientific criterion called "Occam's razor"¹⁶. According to this criterion, the theory that has the simpler explanation¹⁷ must be accepted as true. And in accordance with this criterion, in all likelihood, sooner or later the second recognized algorithm would be true.

But the trouble is that this choice would require explaining physical significance of complex numbers. Physicists do not have an explanation. And, what is worse, instead of admitting this, they state without evidence that imaginary (and, consequently, complex and hyper-complex) numbers have no physical content, referring to the principle of light speed non-exceedance. Authority of the STR actually hinders the study of this important problem. Such a point of view turned out to be even terminologically¹⁸ fixed in science, since one of components of complex numbers is called imaginary, i.e. supposedly non-existent, numbers.

That is why mathematics still uses both algorithms for solving algebraic equations, even despite the fact that

- solutions there to often mutually exclude each other;
- the STR considers one of these solutions (in the form of complex numbers) to be physically non-existent¹⁹.

So what is the answer to the question whether solutions to algebraic equations physically exist in the form of complex numbers? Since, as has just been shown, the use of purely mathematical²⁰ means cannot answer the question, let us try to figure it out relying solely on common sense.

For this purpose we try to understand what meaning the words 'solution exists' or 'solution does not exist' should have. Where does it exist? On paper? In computer? On a blackboard in a university classroom? We could say so, but "in nature, in the physical world we live in" would apparently be more correct answer.

Therefore, we should talk about existence of a solution as a physical reality. And it would be logical to conclude that answering the question requires physical experiments. What kind of experiments are these? And it turns out that such experiments have been done for a long time by both humans and nature. We meet them everywhere. They are well known to everyone. These are shock oscillations. In any form. In the form of sound of a piano or a tuning fork, in the form of tsunami or 'Indian summer', in the form of children's swing²¹ rocking after being pushed by parents, etc.

In this regard, let us recall that only solutions in the form of complex numbers are always used in solving characteristic algebraic equations (6) while studying transient processes (for example, in electrical circuits). The first algorithm for solving algebraic equations using real numbers is never applied in relation to characteristic equations.

Why? The answer to this question is extremely important. Therefore, let us consider in more detail how this question is covered, for example, in the electrical circuit theory. It states that if a characteristic algebraic equation of the second degree has two different real roots $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$, then an aperiodic transient process exists in an electrical circuit and is described by the time function

$$y(t)_{free} = Ae^{-\sigma_1 t} + Be^{-\sigma_2 t} \quad (8)$$

If roots of a characteristic equation of the second degree are real and multiple of $p_{1,2} = -\sigma_0$, then the so-called critical transient process exists in an electrical circuit and is described by the time function

$$y(t)_{free} = (A + Bt)e^{-\sigma_0 t} \quad (9)$$

And, finally, if roots of a characteristic equation of the second power are complex conjugate numbers $p_{1,2} = -\sigma \pm i\omega$, then an oscillatory transient process corresponding to them exists in an electrical circuit, and the quantities p_1 and p_2 are the complex frequencies of free oscillations. This transient process is described by the time function

$$y(t)_{free} = e^{-\sigma t} [A \cos(\omega t) + B \sin(\omega t)] \quad (10)$$

Herewith, integration constants A and B are determined from the initial conditions $y(0)$ and $y'(0)$ in all particular cases.

Solutions to characteristic algebraic equations of higher powers can include aperiodic, critical and oscillatory components. This is covered in detail in textbooks. However, they neither explain nor substantiate why characteristic equations are solved only using the second algorithm, which allows finding their roots in the form of complex numbers. And, it turns out, because only in such a case the transient can also exist in the form of shock oscillations (10). The use of the first algorithm would necessitate arguing that shock oscillations should not have existed. However, they do exist.

Thus, the point is that oscillatory transition processes exist in nature. And they can exist only if the

¹⁶ 'Occam's Razor' is a principle formulated in the 14th century by the English monk William of Ockham: "More things should not be used than are necessary".

¹⁷ As, for example, in astronomy the Copernican heliocentric system was recognized as true and the Ptolemaic geocentric system was recognized as false.

¹⁸ Actually, long before the STR was created.

¹⁹ Consequently, mathematicians have not recognized the principle of light speed non-exceedance postulated in the STR as scientifically sound.

²⁰ But we must not forget that names such as mathematics, physics, radio electronics, etc. were given by people special-

izing in some narrow research area subject to their limited intellectual capabilities. However, when it comes to Nature, all these names are replaced by the only name of Science.

²¹ It is interesting to note that children's swing, on which children are rocking without the help of their parents, refutes another scientific misconception, which, according to information on the Internet, is shared by many authoritative scientists. The misconception suggests that unsupported motion devices, the so-called inertoids, cannot exist, and their existence is therefore denied by modern science, as it contradicts the law of conservation of momentum.

characteristic algebraic equations corresponding to them have solutions in the form of complex numbers. And only for this reason the unsolvable in pure mathematics question about which of the two mutually exclusive algorithms of solving algebraic equations is correct, turned out to be quite solvable with the help of simple physical experiments. And common sense.

It follows from the above that it is necessary to recognise solutions of algebraic equations²² using complex numbers as the only correct and corresponding to physically real existing processes in the world around us. Therefore, complex frequencies $p_{1,2} = -\sigma \pm i\omega$ of free oscillations are physically real, including their imaginary components. And not only complex frequencies, but also any other imaginary and complex numbers. And as this statement is true for transients not only in the theory of linear electric circuits, but also for transients studied by all other sciences, i.e. it is general scientific, so we will call it the principle of physical reality of imaginary numbers.

And this experimentally provable principle of the physical reality of imaginary numbers naturally refutes the postulated principle of non-exceeding the speed of light, asserting from the unreality,

4. Explanation of Physical Essence of Imaginary Numbers

Hence, for relativistic formulas of STR (1)-(3) the results of calculations on them not only in the form of real, but also in the form of imaginary numbers should be explainable. Nevertheless, these formulas still cannot be explained for one more reason - as can be seen (see Fig. 1a,b,c) their graphs in sublight and hyperlight ranges have essentially different form. Moreover, they correspond to physically unstable processes, which cannot exist in Nature. Therefore relativistic formulas (1)-(3) are still incorrect.

And so that the same patterns took place in nature in the subluminal $V < C$ and superluminal $V > C$ speed ranges, and, therefore, formulas describing the corresponding processes could be explained, the graphs $m(v)$, $\Delta t(v)$ and $l(v)$ should be as depicted in Fig.

1d,e,f. For this purpose, the function i^q should be introduced into the corrected relativistic formulas of the STR corresponding to them.

$$m(q) = \frac{m_0 i^q}{\sqrt{1 - (v/c - q)^2}} = \frac{m_0 i^q}{\sqrt{1 - (w/c)^2}} \quad (14)$$

$$\Delta t(q) = \Delta t_0 i^q \sqrt{1 - (v/c - q)^2} = \Delta t_0 i^q \sqrt{1 - (w/c)^2} \quad (15)$$

$$l(q) = l_0 i^q \sqrt{1 - (v/c - q)^2} = l_0 i^q \sqrt{1 - (w/c)^2} \quad (16)$$

where $q(v) = \lfloor v/c \rfloor$ is the “floor” discrete function of the argument v/c ;

$w = v - qc$ is the local velocity of each universe.

This is the function convenient for explaining, as for integer values of the argument $0, 1, 2, 3, 4, 5, \dots$ it takes the required alternating values $+1, +i, -1, -i, +1, +i, \dots$ corresponding to four types of universes alternating in space. Herewith local velocity $w = v - qc$ (Fig. 1d,e,f) of each universe takes finite values only in the range $0 \leq w < c$.

But it's not hard to notice that Euler's formula takes the same values $+1, +i, -1, -i, +1, +i, \dots$ corresponding to the integer values $0, 1, 2, 3, 4, 5, \dots$ of the argument q . And the right side of Euler's formula allows determining the values of this function also for non-integer values of the argument q . Therefore, considering this circumstance, we can conclude that the function i^q takes the form

$$i^q = \cos(q\pi/2) + i\sin(q\pi/2) \quad (17) \text{ for both}$$

integer and non-integer values of the argument q .

The new formula thus obtained has an important advantage - it introduces into the mathematics of complex and hyper complex numbers the mathematical operation of raising imaginary numbers to a non-integer degree, which has been absent in it until now. In astrophysics, it therefore allows us to assert that the integer values of the quantity in formula (14) correspond to mutually invisible parallel universes²³, since they are relative to each other beyond the event horizon, and its non-integer values correspond to portals between such neighbouring universes. And the invisible Multiverse containing these parallel universes has a spiral structure.

In other cases, described by other mathematical formulas containing imaginary numbers, other objects of the invisible world will correspond to them, Determining the specific nature of these objects will require further specialized research. The research will significantly define the content of future science.

5. Conclusion

In the article by simple researches of transients in linear electric circuits, carried out before publication of results of extremely difficult and expensive, but unsuccessful experiment OPERA, the physical reality of imaginary numbers is proved and, consequently, the fundamental principle of non-exceeding the speed of light in the generally recognised version of STR is refuted. And therefore it is asserted that the version of STR stated in all physics textbooks used in the educational process of even the most prestigious universities is incorrect [16]-[72].

The existence of physically real imaginary numbers, discovered 500 years ago, shows that besides our visible world there is also a bigger, but invisible and unknown to us world. And cognition of physical essence of this invisible world will become the main

²² And not only characteristic ones.

²³ Since, despite their boundlessness, they do not overlap anywhere, but they do dip slightly into each other in many places, forming portals.

problem of science of the future [73]-[96]. Moreover this problem is now in relativistic physics astrophysics, overcoming the resistance of opponents, is already solved. And that's fine. One of the most authoritative philosophers of science of the 20th century Sir Karl Raimund Popper [97] wrote on this occasion that "*...the struggle of opinions in scientific theories is inevitable and is a necessary condition for the development of science*". I.e., the development of science is possible only as a result of identifying incorrect statements in existing theories and their subsequent refutations [98]-[104].

This article identifies such false statements and **demonstrates how the incorrect (due to the use of the erroneous postulate of light speed non-exceedance) version of the STR can be corrected.**

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