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# The Astrophysical Phenomenon of Dark Matter and Dark Energy Proves the Existence of the Hidden Multiverse

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**Abstract:** A hypothesis of the hidden Multiverse is suggested. The Multiverse is referred to as hidden, since all parallel universes forming it are invisible to the inhabitants of other parallel universes, except for their own. The nature of mutual invisibility of parallel Universes is explained. It is argued that the structure of the Multiverse proposed herein explains the dark matter /dark energy phenomena, which, in turn, confirm the existence of the hidden Multiverse. The validity of the suggested hypothesis is verified by the data obtained by the WMAP and Planck spacecraft. The hypothesis can also be supported by investigation of portals found on the planet Earth and by people visiting trans-portal areas.

**Keywords:** Dark Matter, Dark Energy, Multiverse, Parallel Universes, Imaginary Numbers, Special Theory of Relativity

## 1. Introduction

In the process of development of mathematics, the notion of a number has continually become more complicated and more appropriate understanding thereof has come, and, as a result, in addition to real numbers, also imaginary and complex numbers have been discovered. However, understanding of their physical meaning has not come, since they turned out to be much more complex objects of study than other numbers.

An imaginary unit $i = \sqrt{-1}$ was discovered over 500 years ago by Scipione del Ferro, Niccolò Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli [1]. Although due to [2], it has been argued that it had been found even earlier by Paolo Valmes, who was sentenced to death at the stake by Spanish inquisitor Tomás de Torquemada for this discovery.

Although by now the works of prominent mathematicians, such as 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, have developed a comprehensive theory of functions of a complex variable, it has not contributed to better understanding of the physical nature of imaginary and complex numbers.

In 1826, Felix Savary [3] discovered alternating electric current, and Charles Proteus Steinmetz [4] suggested using a symbolic method to describe it. This method has introduced into the electric circuit theory the concept of complex frequency, the physical meaning of which, however, has not yet been revealed in textbooks and monographs [5-7]. Imaginary and complex numbers are currently widely used in other exact sciences, such as optics, mechanics, hydraulics, acoustics and so on. However, these sciences have not provided clarification of physical meaning of imaginary and complex numbers.

In the early 20th century Joseph Larmor [8], Nobel Prize winner Hendrik Antoon Lorentz [9], Jules Henri Poincaré [10], Nobel Prize winner Albert Einstein [11] and other prominent scientists developed the special theory of relativity (STR). Its formulae describing relativistic effects at superluminal speeds also had imaginary numbers which again have not been explained. Besides, in order to avoid the necessity to explain it, the absence of physical reality of imaginary numbers in STR has even been postulated: The second postulate to the original statement [11] on the constancy of the speed of light – *"the speed of light is independent of motion of the source"* – has since been extended by the statements on non-exceedance light speed and absence of physical meaning in imaginary numbers [12].

However, such incorrect solution to a complex century-old problem has failed to satisfy everyone. In the early 21st century MINOS and OPERA experiments were conducted first at the American Tevatron Collider and then at the European Large Hadron Collider. Through such experiments,

experimental physicists tried to prove the possibility of neutrinos moving at superluminal speed and, therefore, to prove physical reality of imaginary numbers. However, theoretical physicists considered these experiments not convincing enough.

It is natural in science. In this regard, Karl Raimund Popper, the author of the concept of the 'open society', wrote [13] that conflict of opinions is inevitable in scientific theories and is a prerequisite for the development of science. However, we should add that such a conflict must meet criteria of scientific ethics. It should take into account only theoretical evidence and its proving experiments. And the experiments should serve as basic arguments determining the fate of a particular scientific theory. These should certainly be true physical experiments, rather than so-called 'mental experiments', which are nothing but human implications and therefore may turn to be wrong.

# 2. Physical Reality of Imaginary and Complex Numbers

Apparently, a lot of evidence of the physical reality of imaginary and complex numbers, including experimental, will subsequently be suggested by scientists engaged in various scientific fields.

This paper offers two proofs resulting from investigation of oscillation processes in linear electric circuits. Any experiment referred to below can be verified in any radio electronic laboratory. Theoretical and experimental studies described below have, therefore, more significant evidential value than MINOS, OPERA, and ICARUS experiments, which have neither disproved nor confirmed the principle of non-exceedance light speed.

Oscillation processes in linear electric circuits (as well as in linear oscillation systems of any other physical nature) are described with a differential equation

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

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

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

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

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

Solution of the differential equation (1) contains two summands

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

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

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

Investigation of each component of response allows getting a proof of the physical reality of imaginary and complex numbers.

## 2.1. Evidence of the Physical Reality of Imaginary and Complex Numbers Using Transient Oscillation Processes

Let us start with the simplest evidence based on investigation of transient component of response $y_{free}(t)$ [14].

In order to determine the particular type of a free component of response, the initial differential equation (1) are substituted for the so-called characteristic algebraic equation

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

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

$n, n-1, ... 0$ are exponents with value equal to the order of the corresponding derivatives in 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 a complex frequency; and solved. And then, a corresponding transient process is determined using the solutions obtained.

However, engineers and mathematicians solve algebraic equations (3) in different ways, since they use these solutions differently.

In mathematics, algebraic equations are solved over the set of both real and complex numbers, whereas in engineering sciences characteristic algebraic equations are solved only over the set of complex numbers.

Why is it so?

A specific nature of the algorithms for solving algebraic equations over the set of complex numbers consists in the fact that the number of their roots turns out to be equal to the degree of the equations, i.e. these solutions always exist for any combination of coefficients $a_n, a_{n-1}, ... a_0$. However, a specific nature of the algorithms for solving algebraic equations over the set of real numbers consists in the fact that in each particular case for different combination of coefficients $a_n, a_{n-1}, ... a_0$, they allows obtaining different number of roots – from zero to the value equal to the degree of the algebraic equation. That is to say, solutions of algebraic equations over the set of real numbers do not always exist. Hence, these solutions, if we're going to give things their proper name, are mutually exclusive. And only one is correct. In the laws of formal logic, the statement 'tertium non datur' (Lat.), i.e, there is no in-between, corresponds to this situation. It is, therefore, necessary to choose a single solution, as the only correct.

But which one?

Mathematicians have not made their choice. However, engineers have made and use the solutions of the characteristic equation only over the set of complex numbers, because they know that real physical transient processes always exist. Otherwise, the engineers would have to argue that, against their life experience, oscillation transient processes are nonexistent in nature, because there are no corresponding solutions of characteristic equations in the form of real numbers.

But oscillation transient processes do exist!

They can be seen on the oscilloscope screen. As well it will be no trouble to observe them in nature. These may be tsunamis, sound of a tuning fork and even a kid's swing being pushed by parents to get a swinging motion.

Therefore, the conclusion should be unambiguous: only those solutions of algebraic equations are true, i.e. corresponding to processes taking place in our physical world, which are found exclusively over the set of complex numbers. Besides, these are solutions of any equations, not only of characteristic ones. It means that both imaginary and complex numbers are physically real.

However, solutions of algebraic equations in the form of real numbers are merely isolated cases corresponding to restrictions (by way of requirement to use only real numbers) imposed by people on the solution sought.

### 2.2. Evidence of the Physical Reality of Imaginary and Complex Numbers Using Resonant Oscillation Processes

The second evidence is more complex. Therefore, let us present it in a simplified form.

This evidence analyzes a very important physical phenomenon, discovered by Galileo di Vincento Bonaiuti de'Galilei in 1602, which determines a parameter value of the forced oscillations $y_{forc}(t)$. This phenomenon is called resonance. Resonance phenomenon reveals itself, when the external oscillation frequency approaches the resonance frequency of the oscillatory system, as follows:

- at resonant frequency the amplitude of the forced oscillations takes on an extreme value;
- at resonant frequency the forced oscillation phase coincides with the external oscillation phase;
- resonance frequency equals to the frequency of the so-called free oscillations, otherwise called an oscillation transient process.

However, the existing theory of resonance on real frequencies, studied by students of all technical professions, turned out to be false [15-18], or rather, approximate. A detailed mathematical analysis showed that resonance, described by this theory, takes place only in the electric LC-circuits. However, in electric LCR-circuits it has many unexplained features and, in particular:

- different resonance frequencies correspond to different attributes of resonance;
- these resonance frequencies are determined for different, even the simplest, electric circuits using different formulae;
- almost in any electric oscillatory circuit several resonance frequencies may correspond to one and the same attribute of resonance;
- attempts to explain, why frequency of free oscillations does not equal to resonance frequency, proved unsuccessful [19].

All these differences are indeed quite insignificance and do not usually exceed the value of permissible experimental error. Therefore, today, like 100 years ago, the resonance theory is always outlined to students using approximate formulae,

masking the existence of this problem. That is why some engineers even don't know anything about it. Nevertheless, this problem does exist and requires a solution.

Let us recall in this regard, that after publication of the results of the OPERA experiment (in which difference between the speed of neutrino and the speed of light was also quite insignificant and comparable to an experimental error), aimed to prove the existence of neutrinos moving at superluminal speeds, over the next few months dozens of scientific publications were devoted to the search of opportunities to disprove this experiment, which later on resulted in the ICARUS experiment. However, both cases – experiments aimed at precise determination of neutrino speed in the STR and experiments aimed at precise determination of resonance frequencies in the electrical circuit theory – refer, in fact, to the solution of one and the same problem, i.e. the problem consisting in disproof or confirmation of the physical reality of imaginary and complex numbers.

Thus, what failed to be proved in the MINOS and OPERA experiments was proved in the radio-electronic experiments, described in [15-18]. These experiments have demonstrated that resonance actually exists on complex frequencies, rather than on real ones. And this conclusion, unlike conclusions of the MINOS and OPERA experiments, turned out to be irrefutable.

The adjusted resonance theory turned out to be completely clear of all the above mentioned aspects of interpretation of resonance on real frequencies, contradicting common sense, and gave explanations to all of those aspects.

Therefore, resonance on complex frequencies, as well as complex frequencies themselves and its derivative quantities – complex impedance and admittance, complex voltage and electric current, complex power and energy – should be recognized as physically existing in nature. And since resonance can as well take place in oscillating systems of other physical nature, other complex parameters of such systems will be also recognized as physically existing.

Thus, on the basis of evidence provided, the principle of the physical reality of imaginary and complex numbers should be recognized definitely proven. The third statement of the extending interpretation of the second STR postulate denying this principle should as well be recognized definitely proven.

## 3. Physical Nature of Imaginary and Complex Numbers: Structure of the Hidden Multiverse

However, proving physical reality of imaginary and complex numbers might not be enough to understand their meaning. It should be also explained what physical entity they present, or to put it simply, how they can be seen, touched or otherwise felt.

Unfortunately, it is impossible at present. Firstly, humans do not actually have such senses. And secondly, people have not yet developed technical devices for registering imaginary physical entities, as far as they had not realized these physical entities.

However, let us remind that humans also do not feel magnetic field and X-rays, do not hear infra and ultrasounds, do not see atoms and molecules and cannot touch black holes and dark matter. And special devices for registering these phenomena have been just recently developed. Only thereafter people realized their existence. Therefore, it is probable that devices for registration of physical entities being just yet incomprehensible at present, which parameters are measured with imaginary numbers, will also be developed, but a little later.

At present, imaginary and complex numbers are widely used in all exact sciences. And as mathematics is a single and universal language of science, mathematical principle of the physical reality of imaginary and complex numbers proven above should be used in all those sciences, which actually exist severally because of limited intellectual capabilities of people. In fact, since the Nature is one whole, the Science, explaining it, should also be consistent and non-contradictory. Therefore, all theories and hypotheses in all sciences (especially different theories within one science, e.g. special theory of relativity and quantum mechanics in physics) should be mutually agreed and adjusted in accordance with the principle of the physical reality of imaginary and complex numbers.

At last, it appears obvious that the use of the principle of the physical reality of imaginary and complex numbers in various disciplines will make it possible to find different physical correspondences to this principle and, thus, numerous scientific discoveries will be made.

Next, we show how the principle of the physical reality of imaginary and complex numbers can be used, for example, in STR. To this end, the STR must show how this principle denies the principle of non-exceedance light speed, which is now generally regarded as a second statement of the extending interpretation of the second STR postulate [12].

Therefore, let us explain how relativistic formulae should be understood in relation to the superluminal velocity of moving physical entities. For example, the formula of the Lorentz-Einstein

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

where $m_0$ is the rest mass of a moving entity (e.g. elementary particle);

$m$ is the relativistic mass of a moving entity;

$v$ is the velocity of a moving physical entity;

$c$ is the speed of light.

The following explanation is suggested. As can be seen from the formula (4), at subluminal speeds, where $v < c$, the mass of elementary particles referred to as tardyons (or bradyons) is measured with real numbers, and at superluminal speeds, where $v > c$, the mass of elementary particles referred to as tachyons is measured with imaginary numbers (and is, therefore, invisible). It is notably that tachyons cannot be registered from our universe (let us call it a tardyon universe), because they are found in some other place, which cannot be registered by scientists' devices available. Thus, this other place that exists physically, but is invisible (since all

measurements in tachyon parallel universe is made using imaginary numbers) can be called a tachyon universe.

Therefore, the existence of tachyons and tachyon universe confirms the existence of the Multiverse. But which one?

Quite a large number of different hypotheses of Multiverse have been proposed by now. [20-30] should be mentioned as one of the latest. And what is remarkable is that structures of Multiverse suggested by scientists are even more unusual, than those described by fiction writers. Besides, they are so much unusual that, as noted in [31, 32], even in the distant future, these hypotheses will not receive experimental confirmation. Consequently, a Multiverse corresponding to these hypotheses is actually nonexistent.

However, the adjusted STR [33] describes quite a different Multiverse [34-38], the one, humans even have no idea of, because it is invisible for them in all ranges of electromagnetic radiation, reflection and absorption. That is why the author called it a hidden Multiverse.

Another feature of the hidden Multiverse, which distinguishes it from other Multiverses, consists in its compliance with the principle of similarity, under which physical, chemical, biological and other laws of parallel universes are so much identical or similar that allow for mutual transitions from one parallel universe to another of not only elementary particles, but also inhabitants of these parallel universes. So, in this Multiverse, traveling of inhabitants to parallel universes is possible through labyrinths of portals between them, which can significantly reduce the distance between distant astronomical objects in our universe.

However, it can be easily observed (see Fig.1a) that Lorentz-Einstein formula (4) does not comply with the principle of similarity, since its graph is significantly different at subluminal and superluminal speeds.

Therefore, the formula should be adjusted as follows:

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

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 (see Fig.1b), which can take values only in the range $0 \le w < c$;

$v$ is the velocity measured from our universe, which, therefore, can be called a tardyon velocity;
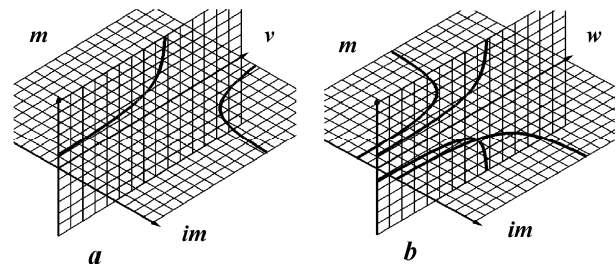
$c$ is the speed of light.



***Figure 1.** Graphs of functions (4) and (5).*

Fig. 1b suggests that the hidden Multiverse concerned should contain at least four, rather than two parallel universes i.e. in addition to tardyon and tachyon universes corresponding to $q = 0$ and $q = 1$, it should also include tardyon and tachyon antiverses corresponding to $q = 2$ and $q = 3$, in which mass, time and other relativistic values have an opposite sign. Besides, these four parallel universes alternate with each other (see. Fig. 1b) in such a way, that the corresponding universes and antiverses cannot annihilate.
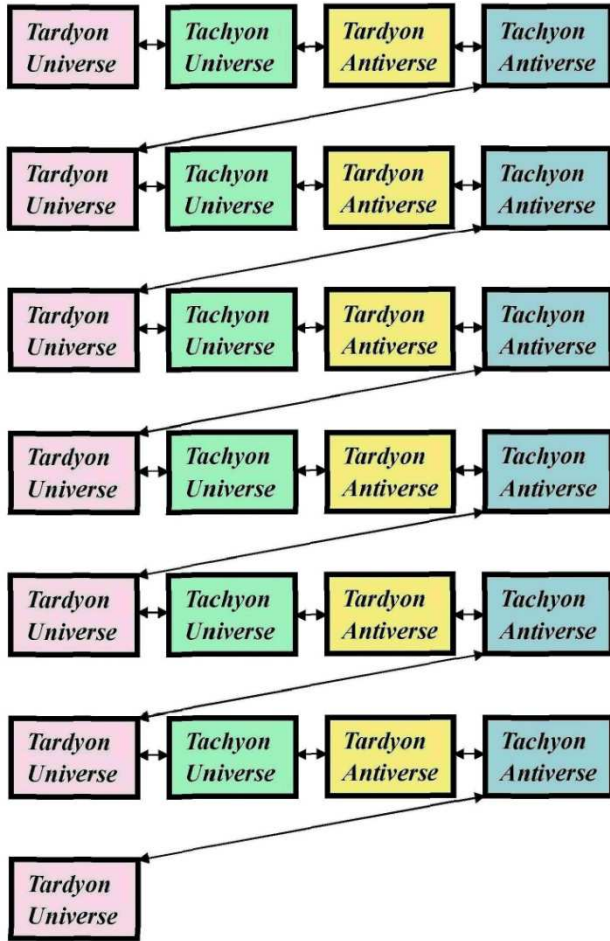


**Figure 2.** *The simplest structure of the hidden Multiverse.*

Finally, tardyon universe would once again correspond to $q = 4$, however it could be quite another parallel universe. As well as another tachyon universe would correspond to $q = 5$, etc. Therefore, a hidden Multiverse has a helical structure shown in Fig. 2. And its parallel universes follow each other in the order mentioned above (or in reverse order), i.e. first comes our tardyon universe, then tachyon universe, then tardyon antiverse, then tachyon antiverse, etc.

Presently we don't know how a mutual fixation of such different parallel universes is achieved with respect to each other. However, it is obvious that this process is somehow automatically adjusted. Thus, in the course of this automatic adjustment, parallel universes in some dimensions can approach each other, move away from each other and sometimes even partially interpenetrate. And then a sort of

numerous transition zones or portals emerge in the point of its interpenetration. In these transition zones and portals, $q$ parameter in the modified relativistic formulae of STR gradually changes its magnitude from one integer value to another integer value corresponding to the adjacent parallel universes. This circumstance makes it possible for inhabitants and elementary particles to transit from one parallel universe into another without overcoming the light speed barrier.
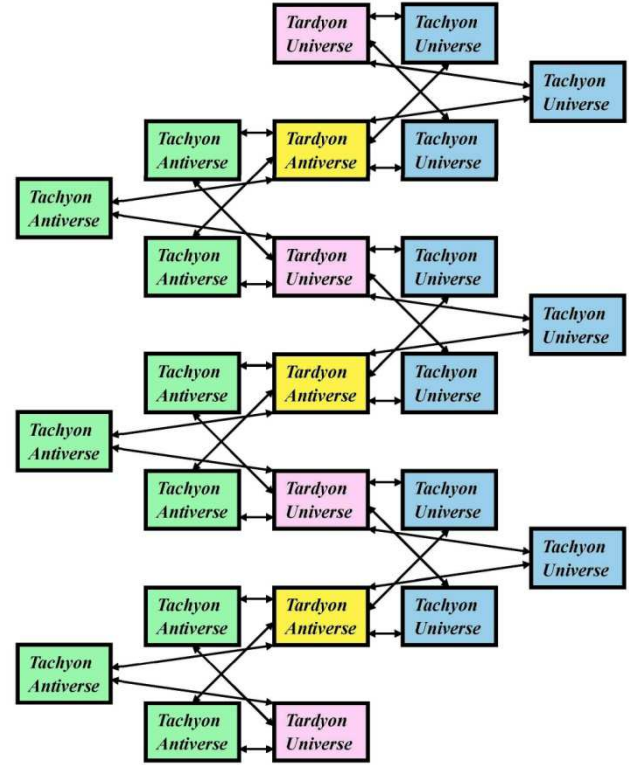


**Figure 3.** *Another structure of the hidden Multiverse.*

However, as the above-mentioned automatic adjustment of the mutual spatial position of parallel universes works extremely reliably and efficiently – otherwise our hidden Multiverse would not exist – the dimensions of portals (in Fig. 2 conventionally designated as bi-directional arrows) are relatively small. And therefore, not only elementary particles can penetrate through these portals from one parallel universe into another, but also inhabitants of these parallel universes and even their relatively large vehicles, though it cannot be done by planets, stars and still less galaxies.

Finally, it should be noted that the other relativistic formulae of STR have actually the same disadvantage as the Lorentz-Einstein formula, and therefore can be adjusted in a similar way. In particular, it follows from the relativistic formulae adjusted in a similar way that in different parallel universes, which correspond to different value $q$, time flows in different directions in relation to the time in our universe: in the opposite direction, perpendicularly etc. It also follows from (5) that the laws of physics are the same in all parallel universes, because they involve its local velocity $w$, rather than tardyon velocity $v$.

Alternative structures of the Multiverse, other than the one

shown in Fig. 2, containing several sets of in-parallel tachyon (or tardyon) Universes are also possible. Obviously, these structures can be quite numerous. Therefore, for simplicity, only one of the possible alternative structures is shown in Fig. 3.

As can be seen, once again, similar to Fig. 2, tachyon and tardyon universes alternate to avoid annihilating each other. Besides, tardyon and tachyon universes and antiverses are likely of the same type and differ from each other only by their spatial location as related to other parallel universes.

# 4. Experimental Evidence of Multiverse's Existence

Visiting by humans one of the universes adjacent to our parallel universe would certainly be the strongest evidence of existence of the hidden Multiverse. Consequently, this is the most convincing evidence confirming that the problem of explaining the dark matter and dark energy phenomena was solved correctly. This, evidently, requires that portals (apparently, they are the so-called 'anomalous zones') on Earth should be detected and their geophysical, medical and biological, as well as other research be organized, so that fist existing robotic tools, and afterwards humans can penetrate through these portals into the area beyond the portals; if, only, the inhabitants of the adjacent parallel universes allow us to do it.

## 4.1. Dark Matter / Dark Energy Phenomenon

However, modern astrophysics has some other reliable information, which can be regarded as evidence of existence of the hidden Multiverse. Information on the existence of the dark matter and dark energy in the outer space could be such evidence. Let us check it.

The concept of the 'dark matter' appeared in astrophysics after investigations carried out in 1932-33 by Jan Hendrik Oort and Fritz Zwikky, and the concept of the 'dark energy' appeared after investigations carried out in 1998-99 by Nobel Prize winners Saul Perlmutter, Brian P. Schmidt and Adam G. Riess. A new astrophysical entity corresponding to these concepts was called 'dark', because, firstly, it is invisible and neither emits, nor absorbs, nor reflects light, and, secondly, its nature is unknown. In particular, no chemical elements existing in our universe have been found in the structure of the new astrophysical entity.

Nevertheless, this physical entity has been registered by indirect manifestations of gravity. And according to the latest published observations [39] of the Planck Space Observatory, the total mass-energy of the universe consists of 4.9% ordinary (baryonic) matter (earlier estimate WMAP - 4,6%), 26.8% dark matter (according to WMAP - 22,4%) and 68.3% dark energy (according to WMAP - 73%).

However, the dark matter / dark energy phenomena seem inexplicable solely due to wrong statement of a problem, which follows from the intention to explain the nature of the phenomena in exact compliance with the hypothesis of the Monoverse, corresponding to the older version of the STR. The past decades of unsuccessful attempts of such explanations have convincingly shown that the dark matter and dark energy do not fit into the Procrustean bed of an outdated interpretation of STR.

Though data, which are inexplicable in terms of the conventional hypothesis of Monoverse, are quite explicable in terms of the above-considered hypothesis of the hidden Multiverse [40-44], corresponding to the adjusted version of the STR. Anyway, only the two main above-mentioned features of the dark matter / dark energy phenomena – its invisibility and the inability to detect its structure – are quite explicable:

- the dark matter / dark energy is invisible from our universe due to the main above-mentioned feature of the hidden Multiverse, i.e. invisibility from our universe of other parallel universes forming the Multiverse;
- for the same reason, the structure of the matter in other parallel universes cannot be determined from our universe, because the content of these universes are beyond the reach of our research tools.

Moreover, the results of Multiverse research conducted by the Planck Space Observatory allow us to clarify the structure of the hidden Multiverse.

Thus, considering the ratio of mass-energy of our universe and the whole hidden Multiverse, we can calculate the approximate number of parallel universes forming the Multiverse, as a value approximately equal to $100\%/4,9\% = 20,4$, for example, $20 \div 24$.

Further, assuming that the dark matter corresponds to parallel universes adjacent to ours, and the dark energy corresponds to other parallel universes more distant from ours and, therefore, even less accessible for our research tools, we could clarify which of the above-considered structures (Fig. 2 and 3) of the hidden Multiverse most closely corresponds to the results received from the Planck Space Observatory.

Table 1 contains calculation data of mass-energy ratio of our universe, adjacent universes and other universes for the above-considered structures of the Multiverse, given that the masses-energies are the same for all parallel universes. For this purpose, the following situations were compared:

- With regard to the Multiverse corresponding to Fig. 2, it was assumed that our universe was the last in the chain of universes. Then it would be adjacent to only one universe.
- With regard to the Multiverse corresponding to Fig. 2, it was assumed that our universe was somewhere within the chain of universes. Then it would be adjacent to two universes.
- With regard to the situation corresponding to Fig. 3, it was assumed that our universe was tardyon (or anti-tardyon) and was located on the edge of the Multiverse. Then it would be adjacent to three tachyon universes (or antiverses).
- With regard to the situation corresponding to Fig. 3, it was assumed that our universe was tardyon (or anti-tardyon) and was located inside the Multiverse.

Then it would be adjacent to six tachyon universes and antiverses.

- With regard to the situation corresponding to Fig. 3, it was assumed that our universe was tachyon in the Multiverse. Then it would be adjacent to two universes: one tardyon universe and one tardyon antiverse.

*Table 1. Analysis of Multiverse structures against the results of Planck space laboratory observations.*

| If our universe is located in the Multiverse as follows, | | | then its mass-energy and masses-energies of other universes would be distributed in the Multiverse as follows | | |
|---|---|---|---|---|---|
| Type of the Multiverse | Location of our universe in the Multiverse | Number of universes in the Multiverse | Our universe | Adjacent universes, corresponding to the dark matter | Other universes, corresponding to the dark energy |
| Multiverse, corresponding to the fig. 2 | In the tardyon universe on the edge of the Multiverse | 20 | $1/20 = 5,00\%$ | $1/20 = 5,00\%$ | $18/20 = 90,00\%$ |
| | | 21 | $1/21 = 4,76\%$ | $1/21 = 4,76\%$ | $19/21 = 90,48\%$ |
| | | 22 | $1/22 = 4,55\%$ | $1/22 = 4,55\%$ | $20/22 = 90,91\%$ |
| | | 23 | $1/23 = 4,35\%$ | $1/23 = 4,35\%$ | $21/23 = 91,30\%$ |
| | | 24 | $1/24 = 4,17\%$ | $1/24 = 4,17\%$ | $22/24 = 91,67\%$ |
| | In the tardyon universe inside the Multiverse | 20 | $1/20 = 5,00\%$ | $2/20 = 10,00\%$ | $17/20 = 85,00\%$ |
| | | 21 | $1/21 = 4,76\%$ | $2/21 = 9,52\%$ | $18/21 = 85.71\%$ |
| | | 22 | $1/22 = 4,55\%$ | $2/22 = 9,09\%$ | $19/22 = 86,36\%$ |
| | | 23 | $1/23 = 4,35\%$ | $2/23 = 8,70\%$ | $20/23 = 86,96\%$ |
| | | 24 | $1/24 = 4,17\%$ | $2/24 = 8,33\%$ | $21/24 = 87,50\%$ |
| Multiverse, corresponding to the fig. 3 | In the tardyon universe on the edge of the Multiverse | 20 | $1/20 = 5,00\%$ | $3/20 = 15,00\%$ | $16/20 = 80,00\%$ |
| | | 21 | $1/21 = 4,76\%$ | $3/21 = 14,29\%$ | $17/21 = 80,95\%$ |
| | | 22 | $1/22 = 4,55\%$ | $3/22 = 13,64\%$ | $18/22 = 81,82\%$ |
| | | 23 | $1/23 = 4,35\%$ | $3/23 = 13,04\%$ | $19/23 = 82,61\%$ |
| | | 24 | $1/24 = 4,17\%$ | $3/24 = 12,50\%$ | $20/24 = 83,33\%$ |
| | In the tardyon universe inside the Multiverse | 20 | $1/20 = 5,00\%$ | $6/20 = 30,00\%$ | $13/20 = 65,00\%$ |
| | | 21 | $1/21 = 4,76\%$ | $6/21 = 28,57\%$ | $14/21 = 66,67\%$ |
| | | 22 | $1/22 = 4,55\%$ | $6/22 = 27,27\%$ | $15/22 = 68,18\%$ |
| | | 23 | $1/23 = 4,35\%$ | $6/23 = 26,09\%$ | $16/23 = 69,57\%$ |
| | | 24 | $1/24 = 4,17\%$ | $6/24 = 25,00\%$ | $17/24 = 70,83\%$ |

Results of calculations, corresponding to these five cases, are given in Table 1. And, as can be seen, one of the situations considered turned out to be very close to the results of the Planck Space Observatory. Indeed, the Multiverse corresponding to Fig. 2 and including 22 universes consists of 4.55% ordinary (baryonic) matter (according to Planck - 4,9%), 27.27% dark matter (according to Planck - 26,8%) and 68.18% dark energy (according to Planck – 68.3%). The discrepancy between

the results of calculations and the results of observations can be explained by a variety of reasons, including some disparity of parallel universes. Therefore, it can be argued that the hidden Multiverse, described above, actually exists, and has a structure similar to that shown in Fig. 4 (although for 22 universes). And observations of the Planck Space Observatory verify this statement.

### 4.2. Phenomenon of Dark Dimensions

So, which physical entities do imaginary numbers correspond to? To answer this question more clearly, let us introduce a new term 'dark dimensions'.

With regard to the above mentioned, we would reason in the following way. Complex numbers, which physical reality has been proved, contain a real and an imaginary component. Besides, all the numbers – real, imaginary and complex - are always used for measurement. Therefore, using concrete real numbers we are well aware what is meant by 2 cars, 10 pounds, 20 meters, etc.

Consequently, imaginary numbers are as well used to measure parameters of some physical entities which exist in nature, but are yet unknown. Thus, parameters of these entities shall be referred to as 'dark dimensions'. The term 'dark' is used here in the same sense, as in the 'dark matter / dark energy', i.e. 'transparent', 'invisible', 'unknown'.

In addition to the dark matter / dark energy, that appears to be one more actually existing, though incomprehensible, phenomenon [45-47]. Dark dimensions, as well as the dark matter / dark energy are also invisible. But actually they seem to explain the mechanism of mutual invisibility of parallel universes.

To prove that we live in the world of not only real dimensions comprehensible to everyone, though in the world of incomprehensible dark dimensions, we will use the Euler's formula

$$e^{ix} = \cos x + i \sin x \qquad (6)$$

which can be rewritten as

$$e^{(-\sigma \pm i\omega)t} = e^{-\sigma t}(\cos \omega t \pm i \sin \omega t) \qquad (7)$$

As can be easily seen, the formula (7) describes damped and undamped oscillations which turn out to contain not only real, but also imaginary components. Moreover, as the exponent on the left-hand side of the formula (7) contains the product of

two physically real values: the complex frequency $-\sigma \pm i\omega$ and time $t$, the whole left-hand side of the formula (7) is also a physically real value. Therefore, real and imaginary (corresponding to dark dimensions) components on the right-hand side of the formula are also physically real.

However, it is not clear what these dark dimensions are in terms of physical reality, as far as oscillations (7) can be electromagnetic, mechanical, or any other. Therefore, it is very difficult to explain what the physical nature of imaginary component, corresponding to all those dark dimensions, may be.

We can only make assumptions in this respect. For example, it can be assumed that understanding of the nature of dark additional dimensions enables creating artificial portals and even developing time machines (since, as noted above, in different parallel universes time may flow in different directions with respect to our time) on their basis. Though, to give more substantive answer, we, apparently, need more researches. And the vital importance of such researches cannot be overstated.

## 5. Conclusion

The information provided above leads to the following conclusions. Imaginary and complex numbers appear to be much more difficult physico-mathematical concepts to understand, than other numbers currently used in mathematics, such as integers / fractions, positives / negatives ... and others. The process of their cognition by scientists has been lasted for over 500 years and is still going on.

Nevertheless, as a result we have so far the following important results:

- The physical reality of the imaginary and complex numbers, which was first denied by the Inquisition and then by the second formulation of the second STR postulate in physics, has been proved theoretically and experimentally. Therefore, the interpretation of the second postulate and relativistic formulae had to be adjusted in this theory.
- The adjusted relativistic formulae of STR have led to the conclusion that the hidden Multiverse, in which from any parallel universe other universes are invisible, exists.
- It has been clarified, that the dark matter / dark energy phenomena, discovered over 80 years ago, are explained by the existence of the hidden Multiverse.
- Comparative analysis of the structures of the Multiverse, corresponding to the principle of the physical reality of imaginary and complex numbers, and observations of the Planck Space Observatory has showed that parameters of one of these structures are extremely accurate.

Therefore, the existence of the hidden Multiverse can be acknowledged as proven, The next step is its investigation, which must start with a research of portals and trans-portal areas with the existing robotic tools.

Exploration of resources of the hidden Multiverse will greatly facilitate the development of the human civilization.

What is more, portals will enable the humanity to escape in case of a global threat to its existence.

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