ISSN: 2639-0108

Research Article

Advances in Theoretical & Computational Physics

New Physical Meaning and Principle of Determining the Speed of Light Constant

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Submitted: 2024, Apr 02; **Accepted:** 2024, May 06; **Published:** 2024, May 15

Citation: Nastasenko, V. (2024). New Physical Meaning and Principle of Determining the Speed of Light Constant. *Adv Theo Comp Phy, 7*(2), 01-11.

Abstract

The work applies to all areas of physics where the speed constant is used - the speed of light in a vacuum c, in particular - to quantum physics, solid state physics, optical physics, physics of electromagnetic fields and waves and provides for clarification of the true physical meaning of this fundamental physical constant. At this time, it is defined as the path length of the light flux per unit time, which in SI is 1 s. The work shows the main methods for determining the speed of light and increasing its accuracy in their historical development to the modern level. At the same time, the shortcomings of the modern interpretation and measurement of the speed of light, which depend on the influence of the external environment, are indicated. This detracts from the level of c as a constant compared to other fundamental physical constants. Elimination of this shortcoming and a new interpretation of the speed of light c, and the principle of its determination as a fundamental physical constant, is the ***main goal*** *of the work being performed. Its* ***scientific*** *novelty is the substantiation of a new interpretation and principle for determining the speed of light c on the basis of strict and reliable physical laws of the material world.*

Research methods: *The work performed has the level of scientific discovery, for the creation of which there are still no strict methods. Therefore, it used general methods and principles of scientific research – deduction and induction, based on the application of the laws of dialectics, reliable laws of physics and general ways of developing the theory of knowledge. The author's method of transition to the initial level of the material world, justified, was also used.*

New results of work and their discussion: *The necessity of the action of the speed of light constant at all levels of the material world is shown and their features are substantiated. The preference for its definition as the ratio of the wavelengths of physical fields and radiation to their period is shown. In this case, an absolutely exact ratio can be obtained at the quantum level of the material world, since quanta are immutable quantities. The implementation of this principle is possible at the 4th (atomic) level of the material world, since such devices for determining length and time have already been created and are highly accurate. But this possibility is true for all 12 levels of the material world. This allows us to formulate and define a new true physical meaning of the speed of light - as the ratio of the wavelengths of the physical fields associated with any objects and the period of their radiation, in particular the electromagnetic field.*

Conclusions: *The new definition of the true physical speed of light excludes the influence of the environment under normal measurement conditions. It is necessary to distinguish in terminology and use the true speed of light c and the speed of light fluxes, which should also be taken into account in the partial and general theories of relativity.*

Keywords: Speed of Light in a Vacuum, Wave Characteristics of Light Flows, Levels of the Material World

1. Introduction. Connection of the problem with the main scientific directions

The work applies to all areas of physics where the speed constant is used - the speed of light in a vacuum c, in particular - to quantum physics, solid state physics, optical physics, physics of electromagnetic fields and waves and provides for clarification of the true physical meaning of this fundamental physical constant. Its value in the system of the universe is adequate to such fundamental physical constants as Planck's constant h and gravitational constant G, which, in turn, determines the scope of its practical application. However, the speed of light depends on the propagation medium, which distinguishes it from other

constants and requires a more accurate understanding of its physical meaning. The solution to this problem corresponds to the scientific interests of all leading organizations and scientists from many countries of the world conducting research in the field of theoretical and applied physics. It influences the understanding of the fundamentals of the universe and the elucidation of the resulting laws, effects and phenomena in many known natural and technical systems. Analysis of the physical meaning of the rate constant and its refinement constitutes the main content of the work performed.

Considering the areas of application of the constant c, the solution to this problem is relevant and has great scientific and practical importance.

1.1. Analysis of the state of the problem and setting tasks

The work being performed is based on: 1) the currently established definition of the physical meaning of the speed constant as the speed c of light in a vacuum [1]; 2) the reality of the Planck quantities of length l_p, time t_p and mass m_p, substantiated in [2, 3]; 3) the possibility of expressing the fundamental physical constants c, h, G through its own dimension and Planck parameters l_p, l_p, m_p, found in [4]; 4) quantum mechanical principles of the structure of the material world [1]; 5) new definitions of the physical meaning of Planck's constant h [5].

Since light has a wave structure, therefore the speed of light is actually the speed of propagation of electromagnetic waves [1]. Currently, the fundamental physical constant is considered to be the speed of light in vacuum $c = 0.299792458 \cdot 10^9$ m/s, which is regulated by SI [6] and CODATA [7].

The first measurement of the speed of light is associated with Olaus Roemer's observations of eclipses of Jupiter's moon Io from different sides of the Earth's orbit. It showed a difference in the time of Io's exit from the shadows of 1000 s. From this, in 1676, he obtained the speed of light as 214,000 km/s, which is approximately 29% less than the true value of 299,792 km/s [8]. The measurement scheme is illustrated in Figure 1 [9].

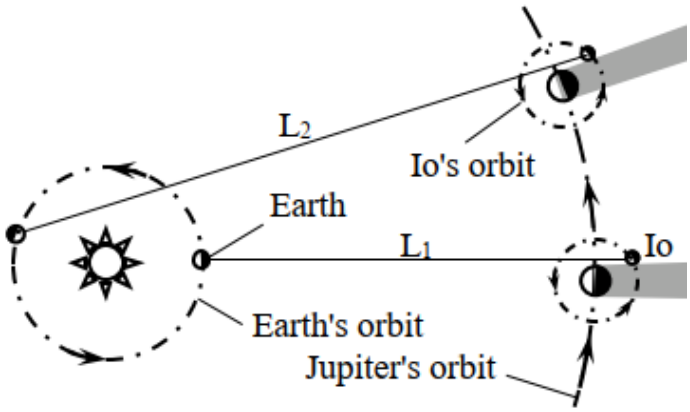

Figure 1: Scheme of observations of eclipses of Jupiter's satellite Io in Roemer's studies.

Further research was carried out by Per Wilhelm Wargentin (1717 – 1783), Giovanni Domenico Maraldi (1709 – 1788), Joseph Louis Lagrange (1736 – 1813) and Pierre-Simon Laplace (1749 – 1827) [10]. In 1809, using observations of Io, Jean-Baptiste Joseph Delembert (1749 – 1822) determined the speed of light to be slightly more than 300,000 km/s. [11].

In 1728 James Bradley (1692 – 1762) determined the speed of light being the apparent displacement of stars due to Earth's motion around the Sun (aberration). He measured the angle of deflection of light rays as the Earth moved around the Sun, and knowing their speed, he found the value of the speed of light c = 301000 km/s [12]. The measurement circuit is shown in Figure 2 [9].

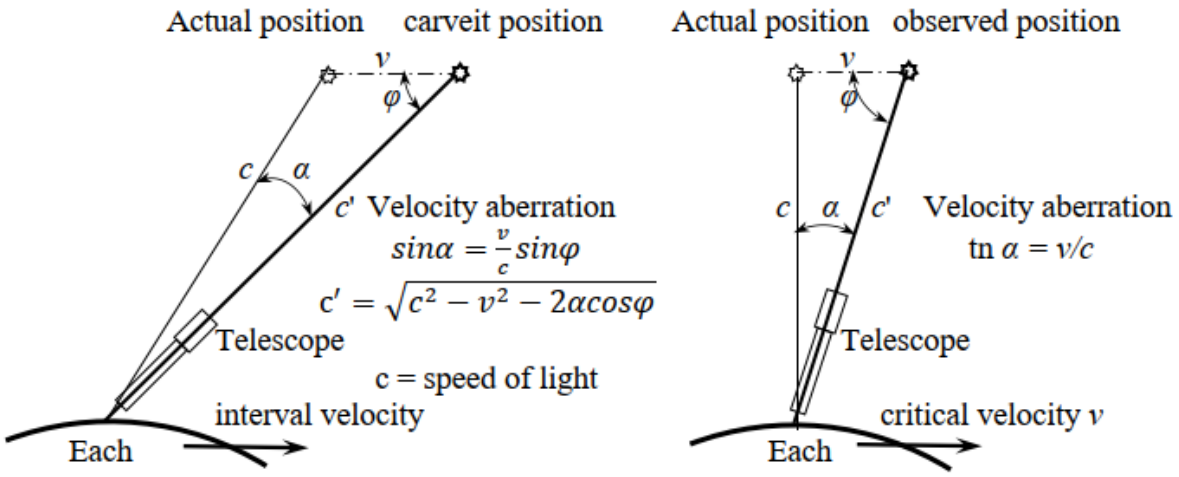

Figure 2: Scheme of changes in the angle of inclination of light during aberration in Bradley studies.

Further measurements moved from the sphere of astronomy to the conditions of the Earth and light-mechanical systems for measuring the speed of light began to be used. The first such measurement was made by Armand Fizeau in 1849. He directed a beam of light through the cavities of the teeth of a rapidly rotating gear wheel to a mirror, which was located at a distance of 8633 m. The speed of rotation of the wheel was increased until the reflected beam was completely blocked by the tooth that occupied when turning place socket of tooth. Knowing the speed of rotation of the wheel, he determined the time it took light to travel 2×8633 = 17266 m and calculated the speed of light c = 315000 km/s [13]. The measurement diagram is shown in Figure 3 [9].

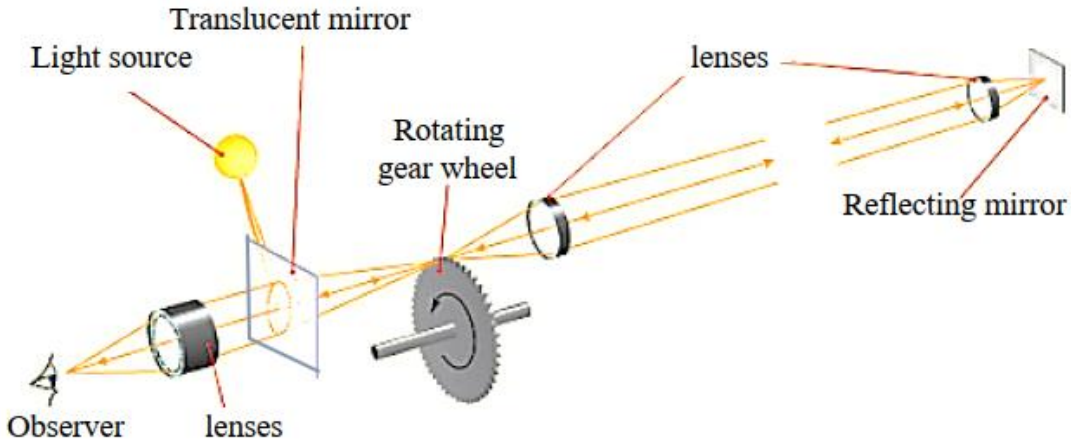

Figure 3: Scheme of the experiment of Armand Fizeau to determine the speed of light.

A year later, Leon Foucault improved this result using a mirror rotating at high speed (512 rps) and obtained a much more accurate value of c = 298,000 km/s, although the reflecting mirror was located only 20 m away [14]. This accuracy made it possible to confirm that light travels slower in water than in air. (transparent containers with water were placed in the path of the light rays). The experimental scheme is shown in Figure 4 [9].

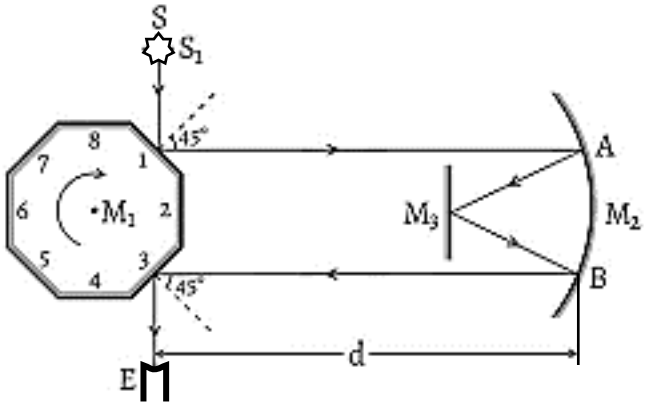

Figure 4: Scheme of the experiment of Leon Foucault to determine the speed of light.

From that time on, they began to take into account that the true speed of light must be measured in a vacuum. It should be taken into account that in modern research conditions and environments were created in which the speed of light slowed down, almost to 0 [15].

Further increase in measurement accuracy was associated with Michelson's experiments. He applied the Foucault method with a mirror rotating at 512 rps and improved it with five intermediate mirrors, which doubled the number of passages of the light beam, as shown by the arrows in the diagram of Figure 5 [9]. He also increased the distance to the reflecting mirror to 35373.21 m [16]. Ultimately, in 1926, he obtained the speed of light as 299 796 km/s.

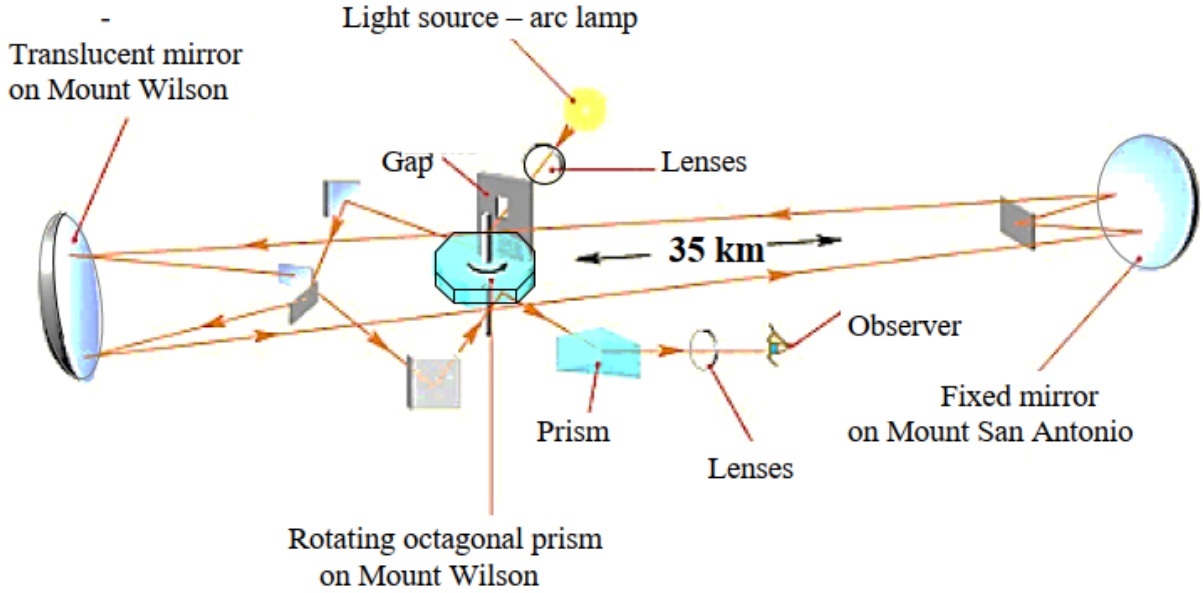

Figure 5: Scheme for measuring the speed of light in the experiment of Albert Michelson.

In modern research methods, lasers have begun to be used. In 1972, Evenson et al. determined the speed of light with an accuracy of c = 2997924574 m/s [17]. The deviation from the modern value c = 299 792458 m/s accepted in 1983 under contractual conditions is only 0.0000002% [18]. In this case, the true speed of light is determined in a vacuum.

The analysis performed shows that in the above experiments, the speed of light c was defined as the speed of light flows.

However, after the development of After Maxwell his theory of electromagnetism, it became possible to calculate the speed of light indirectly by instead measuring the magnetic permeability and electric permittivity of free space. This was first done by Weber and Kohlrausch in 1857 [19]. In 1907 Rosa and Dorsey obtained 299 788 km/s in this way [20]. It was the most accurate value at that time. In this case, a calculation method was used within the framework of the dependence (1) [1]:

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \frac{1}{\sqrt{\left[4\pi \cdot 10^{-7}\left(\frac{N}{A^2}\right)\right]\left[8.851 \cdot 10^{-12}\left(\frac{F}{m}\right)\right]}} = 0.299788 \cdot 10^9 \frac{m}{s}, \quad (1)$$

where μ_0 is the magnetic constant [6, 7];
ε_0 – electrical constant [6, 7].

Thus, the accuracy of determining the speed of light was ensured by the accuracy of determining the value of the electrical constant ε_0.

Many other methods were subsequently employed to further improve the accuracy of the measurement of c, so that it soon became necessary to correct for the refractive index of air since c is light's speed in a vacuum. In 1947 Essen, Gorden-Smith using of Cavity Resonator and obtained a value of 299792 km/s. In 1958 K. D. Froome obtained a value of 299792.5 km/s using a microwave interferometer and a Kerr cell shutter [19].

After 1970 the development of lasers with very high spectral stability and accurate caesium clocks made even better measurements possible. By 1970 the point had been reached where the speed of light c = 299 792 458 m/s was known to within an error of plus or minus 1 m/s [19]. A diagram of the device at the base of the Michelson interferometer to perform this measurement is shown in Figure 6 [9].

Figure 6: Modern laser interferometer for measuring the speed of light.

However, the changing definition of accuracy of the meter had always stayed ahead of the accuracy in measurements of the speed of light. It became more practical to fix the value of c in the definition of the metre and use atomic clocks and lasers to measure accurate distances instead. Nowadays, the speed of light in vacuum is defined to have an exact fixed value when given in standard units [6]. Since 1983 the metre has been defined by international agreement as the distance travelled by light in vacuum during a time interval of 1/299,792,458 of a second [21]. This makes the speed of light c=0.299792458·10^9 ("exactly") *m/s* [18].

However, until this time, the measurement of the meter was carried out between the lines of a platinum-iridium standard, and since 1960 - in the wavelengths of atomic radiation [22]. In 1960, at the XI General Conference on Weights and Measures, the following definition of the meter was adopted: meter is a length equal to 1650763.73 wavelengths in vacuum of the orange line (6056 Å) of the radiation spectrum corresponding to the transition between the $2P_{10}$ and $5d_5$ levels of the krypton atom-86 [23].

Atomic standards continue to be used in SI. Currently, in atomic units of radiation waves, a time of 1 second is defined as the duration of 9,192,631,770 periods of radiation corresponding to the transition between two hyperfine levels of the unperturbed ground state of the cesium 133 atom [24].

The speed of light c is the first fundamental physical constant that is formed in the material world at the moment of the birth of the Unified (magnetic, electric and gravitational) fields of the Universe [25]. This indicates its importance. In addition, within the framework of Einstein's special (STR) and general (GTR) theory of relativity [26], this value limits the speed of all physical interactions that are considered real.

The physical meaning of this constant is one of the simplest to understand - this is the distance that light travels in a vacuum in 1 second [1]. This is where the positive differences between this constant and other fundamental physical constants, in particular h and G, end, since the values h = 6.62607015·10^{-34} J/s and G = 6.67430·10^{-11} m^3/(kg c^2), remain constant, regardless of the medium of their propagation, but the speed of light depends on it. In addition, having encountered a light-proof obstacle on the way, it actually ceases to act, whereas h and G act everywhere and all the time, incl. at the internal levels of matter. If for the Planck constant there were previously restrictions associated with the "specifics of the interactions of the microworld" [1], then these restrictions were removed in [5], since physical systems were justified, where h acts to distances numerically equal to the speed of light c = 0, 299792458·10^9 m/s. This value is very different from the level of parameters of the microcosm (10^{-8} – 10^{-6} m), since it is ¾ of the radius of the Moon's orbit.

The combination of the above restrictions c, within the framework of the general principles of the development of science, detracts from the fundamental nature of the modern physical constant of the speed of light, which is its significant drawback.

Therefore, it is necessary to eliminate all identified deficiencies. Based on this, the **main goal** of the work being performed is a new interpretation and principle for determining the speed of light c, as a fundamental physical constant. Its **scientific novelty** is the substantiation of a new interpretation and principle for

determining the speed of light c on the basis of strict and reliable physical laws of the material world.

1.2. Research methods

The work performed has the level of scientific discovery, for the creation of which there are still no strict methods [27]. Therefore, it used general methods and principles of scientific research – deduction and induction, based on the application of the laws of dialectics, reliable laws of physics and general ways of developing the theory of knowledge [1, 28, 29]. The author's method of transition to the initial level of the material world, justified in [30 – 32], was also used.

2. New results of work and their discussion

It is indicated in [33] that "Despite the fact that definition for the metre refers to light travelling in vacuum, in most cases the realization of the length unit is performed under atmospheric pressure. Then the exact value of the influence of the air on the speed of light is of major importance. Therefore, a distinction has to be made between c, the speed of light in vacuum and c', the speed of light in general.

Under atmospheric pressure, the air refractive index reduces the speed of light ($c' = c/n$) with a relative effect of the order of 3×10^{-4} corresponding to 300 µm per metre of measured length. Moreover, in the case of modulated light it is important to consider the group refractive index of air n_g instead of the (phase-) refractive index, n. For example, for green light ($\lambda = 520$ nm) $n_g - n$ is approximately 10^{-5}, i.e., considering n instead of ng causes an additional error of 10 µm per metre. This difference is significant and comparable in size to the variation of the phase refractive index of air over the entire range of visible light: n(380 nm) – n(780 nm) = 9×10^{-6}. Thus, determination of the exact speed of light to use in equation (1) is a significant consideration in realizing the metre through primary.

This definition only makes sense because the speed of light in vacuum is measured to have the same value by all observers; a fact which is subject to experimental verification. Therefore, experiments are still needed to measure the speed of light in media such as air and water." (End of quotation).

Thus, despite achieving high accuracy of the final result, real problems in measuring the speed of light remain, which require solutions. Their search is based on the conclusion of works [31, 32] that a solution to a problem is possible only at the level of the material world to which it relates. In this case, the rate constant c is a global quantity relating to the entire Universe. Therefore, its definition also requires a global scope, from the initial level of the Universe and the material world, to all its other levels [31, 32]. The division into levels is due to the fact that each of them has its own specific physical laws, which differ from other levels and create limitations in their application.

Currently, the main levels of the material world include:

0. Initial level (does not have its own position, since it is common with the global level (the entire Universe), like a plane - in the longitudinal direction it is infinite, and in the transverse direction it tends to zero). In this case, the plane closes into a cylinder (Figure 7).
1. The level of elementary particles, where the laws and regularities of quantum physics and superstrong interaction operate (this option still requires its development, which goes beyond the scope of the work being performed).
2. The level of atomic nuclei, where the laws of strong interaction operate.
3. The level of atoms with the spheres of its electrons, where the laws of weak interaction, as well as the laws and regularities of solid-state physics, operate.
4. Molecular level, where the laws and regularities of physical chemistry operate.
5. Microlevel, where the laws of combining atoms into layers and crystal lattices, and molecules into macromolecules and other group structures operate.
6. Macro level, where the laws and regularities of classical physics and other traditional laws of the material world operate.
7. Planetary level, where special laws and patterns operate that lead to the formation of planets and the stages of their life cycle.
8. Stellar level, where special laws and patterns operate that lead to the formation of stars, their combustion and support of the combustion process, as well as other stages of their life cycle.
9. The star-planetary level, where its own laws and patterns operate, leading to the formation of planetary systems and to the implementation of other stages of their life cycle.
10. The galactic level, where its own laws and patterns operate, leading to the formation of galaxies and other stages of their life cycle;
11. Metagalactic level, where new own laws and patterns operate, leading to the formation of metagalaxies and intergalactic systems and to the formation of other stages of their life cycle;
12. The global level, where new own and rest all known laws and patterns operate, leading to the formation of the Universe and to the implementation of all stages of its life cycle.

The structural diagram of the levels of the material world is shown in Figure 7.

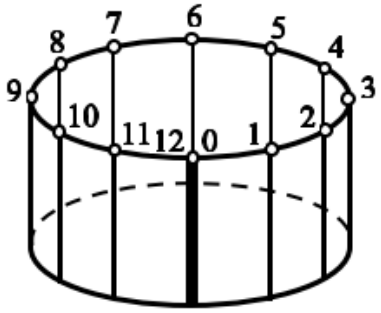

Figure 7: Structural diagram of the 12 levels of the material world of the Universe and their interconnection.

A possible option is to connect the zero 0 and global 12 levels like a Mobius strip, but this requires additional independent research, since it can give rise to fantasies through the looking glass.

A feature of the 0th initial level of the material world is that it is created by 3 physical fields: magnetic, electric and gravitational, which first form the Unified Field of the Universe and then separate as their wavelengths increase [3, 34]. The basis of this level is 7 fundamental physical constants, which are listed in the order of their occurrence in the Universe [25, 31, 32]:

1) the frequency of vibration of the waves of the Unified Field v_U, as the natural vibration of the Universe, which forms them [35];

2) the speed of light in vacuum c, as a connecting element between the oscillation frequency of waves and their length;

3) Planck's constant h, as the energy generated by one frequency pulse of the waves of the Unified Field and its constituent physical fields [5]:

4) gravitational constant G, as the relationship between energy and the speed of light.

5) magnetic constant μ_0, as a transformation of gravitational force;

6) electric constant ε_0, as a counteraction or dialectical negation of gravitational and magnetic forces;

7) the thermodynamic Wien constant β as a particular manifestation of the energy of the Unified Field and its constituent physical fields (the Boltzmann constant does not yet exist at this level, since it refers to the molecular level of the material world).

In this case, the primary values in the Universe are the Planck quantities of length l_P, time t_P, mass m_P and energy E_P [36], which are associated with wave λ_U (2), T_U (3) and mass-energy parameters m_U (4), E_U (5) her Unified Field:

$$\lambda_U = l_p = \sqrt{\frac{hG}{c^3}} = \sqrt{\frac{6.62607015\cdot10^{-34}\left(\frac{kg\cdot m^2}{s}\right)\cdot 6.67430\cdot10^{-11}\left(\frac{m^3}{kg\cdot s^2}\right)}{\left[0.299792458\cdot10^{9}\left(\frac{m}{s}\right)\right]^3}} = 4.05125\cdot10^{-35}(m), \quad (2)$$

$$T_U = t_p = \sqrt{\frac{hG}{c^5}} = \sqrt{\frac{6.62607015\cdot10^{-34}\left(\frac{kg\cdot m^2}{s}\right)\cdot 6.67430\cdot10^{-11}\left(\frac{m^3}{kg\cdot s^2}\right)}{\left[0.299792458\cdot10^{9}\left(\frac{m}{s}\right)\right]^5}} = 0.135138\cdot10^{-42}(s), \quad (3)$$

$$m_U = m_p = \sqrt{\frac{hc}{G}} = \sqrt{\frac{6.62607015\cdot10^{-34}\left(\frac{kg\cdot m^2}{s}\right)\cdot 0.299792458\cdot10^{9}\left(\frac{m}{s}\right)}{6.67430\cdot10^{-11}\left(\frac{m^3}{kg\cdot s^2}\right)}} = 5.45551\cdot10^{-8}(kg), \quad (4)$$

$$E_U = E_p = \sqrt{\frac{hc^5}{G}} = \sqrt{\frac{6.62607015\cdot10^{-34}\left(\frac{kg\cdot m^2}{s}\right)\cdot\left[0.299792458\cdot10^{9}\left(\frac{m}{s}\right)\right]^5}{6.67430\cdot10^{-11}\left(\frac{m^3}{kg\cdot s^2}\right)}} = 4.90317\cdot10^{9}(J), \quad (5)$$

where h – Planck constant [6, 7]:

$$h = 6.62607015\cdot10^{-34}\,(\text{exactly})\,J\cdot s = 6.62607015\cdot10^{-34}\,(\text{exactly})\,\frac{kg\cdot m^2}{s},$$

G – is gravitational constant [6, 7]: $G = 6.67430(15)\cdot10^{-11}\,\frac{m^3}{kgs^2}$.

Based on the above 7 constants, all currently known derived physical quantities were obtained: mechanical [37], electrical [38], thermophysical [39] and lighting [40].

The use of Planck quantities (2) – (5) as the basic characteristics of the initial level of the Universe is explained by the fact that they are obtained within the framework of strict laws, consisting only

of fundamental physical constants *c, h* and *G*, which makes them secondary physical constants, they cannot be other quantities. At the same time, at the current level of scientific knowledge, there is no level of significance equal to them for strict fundamental physical constants, and values smaller than the Planck length l_P (2) and time t_P (3). News of shorter wavelengths allegedly obtained from X-ray radiation from distant quasars [41] were refuted in [32, 42, 43] within the framework of the strict quantum properties of light radiation waves and electromagnetic waves identical to them.

Thus, until new strict laws and constants of the same fundamental level as *c, h* and *G* are found, giving a shorter length than the Planck value $l_P = 4.05125 \cdot 10^{-35}$ m, it should be considered the minimum possible in the material world or quantum of length. The conclusions are similar for the Planck time, which is also the minimum possible time quantum $t_P = 0.135138 \cdot 10^{-42}$s [32, 42, 43]. For this purpose, the reality of the Planck parameters (2) ... (5) was first substantiated in [2] and confirmed in [3, 32, 34] by their connection with the spheres of quanta of space of the Planck thickness, which cover the entire Universe layer by layer. This reduces the Planck and global levels into a single one, like a plane - along it is "infinite", and across it has "zero" dimensions, which are the Planck length, and the wave parameters of the Unified field associated with it $l_P = \lambda_U$ (3). The Planck time is also related to the wave parameters of the gravitational field $t_P = T_U$ (2) and is a real value, like the time of passage of the Planck layer l_p at the speed of light *c*. Thus, within the framework of the given grounded reality of waves and Planck quantities, their ratio is also a real quantity that represents the speed *c* of light in vacuum (6):

$$c = \frac{l_P}{t_P} = \frac{\lambda_U}{T_U} = \frac{4.05125 \cdot 10^{-35}(m)}{0.135138 \cdot 10^{-42}\ (s)} = 0.299792458 \cdot 10^9 \left(\frac{m}{s}\right) \quad (6)$$

Considering that this is exactly how the speed of light *c* is formed in the material world, therefore, within the framework of the quantum principles of the invariability of the values l_P, t_P, the numerical value of the speed of light (6) is also unchanged and absolutely accurate. Thus, at the initial (zero) quantum level of the material world, the speed of light was found on a strict physical basis. It remains to determine it at other levels of the material world. This is important because obtaining the Planck values l_P, t_P at this level of development of science and technology is not yet possible.

The next levels of the material world are elementary particles and atomic nuclei. For them, the relationship between the wavelengths and periods of their radiation within the speed of light *c* is also satisfied. However, they are unstable physical formations, so their technical use is impractical and is not considered further.

Real and technically accessible are the 4th…6th levels of wave parameters of the material world. However, the atomic level is more stable and resistant to environmental influences, than molecular and higher levels, so it should be given preference. In addition, at this level, devices and instruments have already been developed that provide high-precision (up to 14 digits) determination of wavelengths and periods of their radiation [23, 24]. Their use makes it possible to determine the exact value of the speed of light, simplifying the conditions and eliminating the corrections specified in [33].

At other levels of the material world, there is also a similar connection between the wavelength and the period of natural oscillations for any physical objects, but their identification is beyond the scope of the tasks posed in this work. At the same time, it was taken into account that for the 12th (global) level of the material world - the entire Universe, this ratio is satisfied if we consider its age to be 13.8 billion years old, and its dimensions, within the parameters of visible light from stars, are $13.8 \times c$. Consequently, the value of the speed of light is automatically included and can be obtained in the relationships between these parameters.

Thus, it can be considered proven that the relation $c = \lambda/t$ is satisfied for all 12 levels of the material world. This allows us to formulate and define a new true physical meaning of the speed of light - as the ratio of the wavelengths of the physical fields associated with any objects and the period of their radiation, in particular the electromagnetic field.

In this case, all traditional experiments and actions with the emission of light should be attributed to light fluxes, which do not reflect the true meaning of the speed of light *c*. Therefore, measurements are necessary in terminology with a separation of the concepts of "speed of light" and "speed of light flows," which are influenced by environmental conditions. Consequently, the constancy of the speed of light in STR and GTR takes on a new, more rigorous meaning. In this case, the "speed of light" constant should be abandoned, since it is limited to a narrow range of wave parameters. Only the "fundamental speed constant" is real, which is numerically equal to the speed of light in vacuum: $c = \lambda/T = 0.299792458 \cdot 109$ ("exactly") m/s. This is precisely the true fundamental physical constant, which operates at all levels of the material world and not only outside, but also inside matter. This raises its status to the level of constants h and G. It should also be taken into account that, in contrast to the movement of photons, the energy of which is changed by the medium and their speed (their wavelength) decreases, the ratio of new wavelengths and periods of their emission remains constant. Therefore, the new constant "fundamental constant speed of movement" remains unchanged under her normal conditions and must be accepted as fundamental value in the material world.

The studies carried out do not contradict the known physical laws [1], therefore they are real. Since they are new, they can therefore claim to be at the level of scientific discoveries [44].

General Conclusions

1. he modern definition of the speed of light *c* comes down to the ratio of the path length (metre) that the light flux travels in a unit of time equal to 1 second.

2. The modern interpretation of the physical meaning of the speed of light *c*, as the length of the path of light radiation that it travels in a time of 1 s, does not allow us to strictly reduce *c* to fundamental physical constants, since its value depends on environmental conditions. This does not correspond to the level of other fundamental physical constants, in particular Planck's constant *h* and the gravitational constant *G*, to which it relates.

3. The fundamental speed constant, according to all formal criteria on a strict basis, should be considered the speed of electromagnetic radiation, as the ratio of the length λ of its waves to their period *t*, within the framework of the dependence $c = \lambda/t$, which is numerically equal to the exact value of 299792458 m/s and under normal measurement conditions it does not depend on the influence of the external environment. In this case, there is no need to add the "in a vacuum" attribute.

4. A new interpretation of the physical meaning of the speed of light is carried out at all levels of the material world, from the initial (physical fields) to the global – the entire Universe, and it acts not only outside, but also inside the matter (substance).

5. It is necessary to distinguish in terminology and use between the "speed of light" constant should be abandoned, it is simply a "fundamental speed constant", numerically equal to $c = \lambda/T = 0.299792458 \cdot 10^9$ ("exactly") m/s. These changes must be made to all textbooks and reference books on physics, as well as to encyclopedias, including the British one.

6. The difference between the real speed of light c and the speed of light flows should be taken into account in the partial and general theories of relativity.

Conflict of Interest

This work was carried out by the author alone, on his own initiative, on the basis of personal scientific works: [2-5, 25, 27, 30-32, 34, 35, 37-40, 42, 43]. It uses literature sources from open databases, so permission for their publication is not required.

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