

**Athens Institute for Education and Research
ATINER**



**ATINER's Conference Paper Series
PHY2015-1895**

**The Speed of Light Postulate and Uncertainty
Principle of the Macro-world in the General
Relativity**

**Gocho V. Sharlanov
Independent Researcher
Bulgaria**

An Introduction to
ATINER's Conference Paper Series

ATINER started to publish this conference papers series in 2012. It includes only the papers submitted for publication after they were presented at one of the conferences organized by our Institute every year. This paper has been peer reviewed by at least two academic members of ATINER.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

Sharlanov, V. G. (2016). "The Speed of Light Postulate and Uncertainty Principle of the Macro-world in the General Relativity", Athens: ATINER'S Conference Paper Series, No: PHY2015-1895.

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL:
www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm
Printed in Athens, Greece by the Athens Institute for Education and Research. All rights reserved. Reproduction is allowed for non-commercial purposes if the source is fully acknowledged.
ISSN: 2241-2891
26/05/2016

The Speed of Light Postulate and Uncertainty Principle of the Macro-world in the General Relativity

Gocho V. Sharlanov

Abstract

A thorough analysis of the Theory of Relativity started with the publications of the articles “The Speed of Light and Uncertainty Principle of the Macro-world”, and “Awareness of Special and General Relativity and Local and General Physical Reality”. These articles actually give a new model of uncertainty of the Universe, which is shown in the present article. We can communicate in the scope of the Universe only by means of electromagnetic signals. However, we have to be aware of the meaning of the fact that the electromagnetic field exists on the gravitational field. The different intensity of the gravitational field means different characteristics of the electromagnetic field; which means different characteristics of the electromagnetic waves. Therefore, it means and different units of time and space (length), if they are defined by means of the characteristics of the electromagnetic waves. The awareness of all the facts gives answers to a lot of problems in physics today, such as (“the accelerated expansion of the Universe”; “the dark matter and the dark energy in the Universe”, etc.), which have been under research for a long time. The formulated in the present article “Thesis about the behavior of the electromagnetic radiation in gravitational field” actually replaces the postulate of invariance of the speed of light by Albert Einstein. On the base of this thesis, all the “unexpected” and “inexplicable” results of the famous experiments related to the measurement of the speed of light obtain its genuine explanations. The conclusion about the essence of the theory of relativity is given actually as a result of the awareness of the physical reality (based as well and on a quotation of Einstein about the validity of the theory of relativity).

Keywords: General Relativity, Michelson-Morley experiment, Sagnac effect, Special Relativity, Speed of light postulate, Uncertainty principle.

Introduction

Physics today is the basis of the greatest achievements in the field of the technologies in the “time spatial domain” of our existence. In the macro-world however, the important problems, which have been under research for a long time, such as: “the accelerated expansion of the Universe”; “the dark matter and the dark energy in the Universe” etc., are not solved yet.. The maintaining of delusions and misconceptions by the orthodox part of the Physical Society, such as “the speed of light is the same in all frames of reference”, do not give a chance to the theoretical physics to solve problems in the field of the macro-world. Lorentz’s transformations are a perfect solution of the pure mathematical task “How the speed of an object (no matter a ball or a photon) in the moving frame could be measured the same by the stationary observer”. Actually, this is only an imaginary mathematical task, which does not correspond to the physical reality. “Sagnac’s Experiment” (Sagnac, 1913), “Michelson-Gale-Pearson Experiment” (Michelson and Gale, 1925), and all the “One-way speed of light measurements”, which are demonstrated repeatedly and by using GPS ... prove that in physical reality “the speed of light is not the same in all frames of reference”.

The use of Lorentz’s transformations demonstrates that Einstein adopted and applied in the special theory of relativity the wrong statement that the speed of light is constant in all the inertial frames of reference. This primary significance is confirmed by Einstein himself in “My theory and Miller's experiments”, after the widely discussed Dayton Miller publication “The Ether-Drift Experiment and the Determination of the Absolute Motion the Earth” (Miller, 1926). There Einstein wrote:

“If the results of the Miller experiments were to be confirmed, then the relativity theory could not be maintained, since the experiments would then prove, relative to the coordinate systems of the appropriate state of motion (the Earth), the velocity of light in a vacuum would depend upon the direction of motion. With this, the principle of the constancy of the velocity of light, which forms one of the two foundation pillars on which the theory is based, would be refuted.”(Einstein, 1926)

In fact, Sagnac’s experiment (Sagnac, 1913) shows that the speed of light is different in the frame related to the spinning disk and this difference depends on the rotation speed of the disk. Too many unreal, imaginary (deformed in order to be in conformity with the Special theory of relativity) explanations of the Sagnac’s experiment, have been published. A good example of a deformed explanation (Malykin, 2000), where the distorted explanation is called “the correct explanation”. However, the proponents of the special theory of relativity still cannot find a “convenient” explanation of another very important fact:

“Why in case of “one-way measurement” (in the frame of reference related to the Earth’s surface), the measured speed of light in the direction of “East-to-West” is higher than the measured speed of light in the direction “West-to-East”?”

Note: In this paper it is accepted that the “empty space” or “vacuum”, corresponds to the “reference system related to the space itself”, as well as the “Earth-centered inertial (ECI) coordinate frame” which has its origin at the center of the Earth and is stationary in the space.

Experiments “One-way Light Speed Determination” and the Special Theory of Relativity

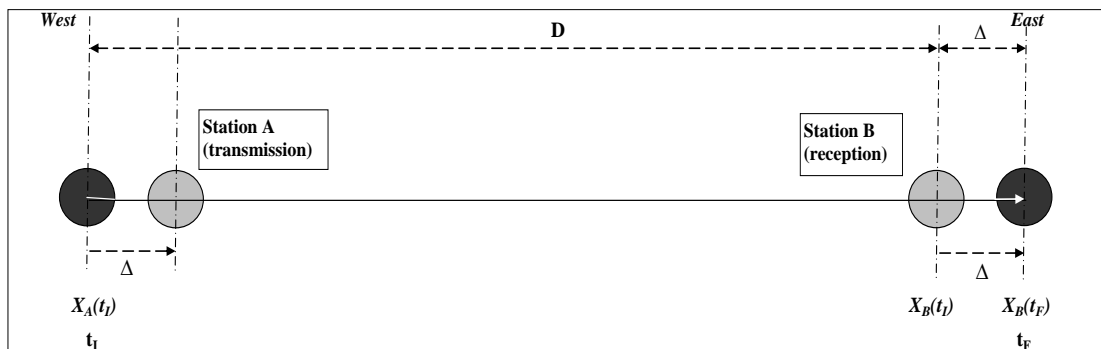
Based on GPS timing, Marmet (Marmet, 2000) observed that a light signal takes traveling eastward from San Francisco to New York about 28 nanoseconds longer than traveling westward from New York to San Francisco. Using a GPS, Kelly (Kelly, 2005) shows that the light signal takes 414.8 nanoseconds longer to circumnavigate the Earth eastward at the equator than the light travelling westward around the same path. Both researchers concluded that these observed travel time differences in each direction arise because light travels at speed $(c-V)$ eastward and at speed $(c+V)$ westward, where V is the linear speed of the Earth’s surface at the corresponding latitude.

Here, we will examine both cases - the case of “Eastward Transmission” and the case of “Westward Transmission”. The transmitter, the receiver and the propagation path (the path of light) are located in a time-spatial domain with equal intensity of the gravitational field (on the surface of the Earth). In the “ECI coordinate frame”, the transmitting and receiving stations are moving towards East (together with the Earth’s surface) at the speed V for the corresponding latitude. The position of station A in the ECI coordinate frame at time t is $X_A(t)$ and the position of the reception station B is $X_B(t)$. The distance between station A and station B is equal to D .

The Case “Eastward Transmission”

Station A transmits a signal eastward at time t_I to station B, which receives it at time t_F .

Figure 1. One-way Light Speed Determination – Eastward Transmission



Explanation of the experiment in conformity with the physical reality:

- In the Earth-centered inertial system (ECI):

The light passes a certain distance in the “empty space” - from the position $X_A(t_I)$ of station A at the moment of transmission t_I , to the position $X_B(t_F)$ of station B at the moment of receiving t_F (Figure 1). This distance is equal to the distance between the two stations D plus the distance Δ , which station B passes during the time interval of $(t_F - t_I)$ with the speed V of movement of the station B (as the surface of the Earth). The time interval between transmitting and receiving is:

$$(t_F - t_I) = \frac{Path}{c} = \frac{D + \Delta}{c} \quad (1)$$

where c is the local constant “speed of light” in “empty space” in our local physical reality “on the Earth’s surface”.

- However, in the reference system related to the Earth’s surface, the obtained result is:

The light passes the exact distance equal to D for the time interval $(t_F - t_I)$ and the measured speed of light in the case “Eastward transmission” is equal to $(c - V)$:

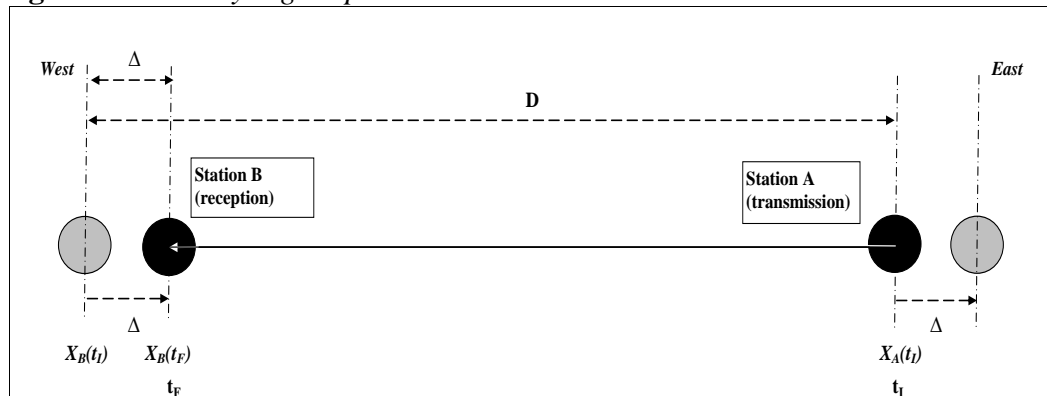
$$(t_F - t_I) = \frac{D}{c - V} \quad (2)$$

As the reader can see, the expression (2) is the same as (1), but Δ is replaced with $(V(t_F - t_I))$.

The Case “Westward Transmission”

Station A transmits a signal at time t_I to station B, but westward, and station B receives electromagnetic signal at time t_F .

Figure 2. *One-way Light Speed Determination – Westward Transmission*



- In the Earth-centered inertial system (ECI):

The light passes a certain distance in the “empty space” - from the position $X_A(t_I)$ of station A at the moment of transmission t_I , to the position $X_B(t_F)$ of station B at the moment of receiving t_F (Figure 2). However, this distance is equal to the distance between the two stations D minus the distance Δ , which the station B passes during the time interval of $(t_F - t_I)$ with the speed V of

movement of the station B (as the surface of the Earth). The time interval between transmitting and receiving is:

$$(t_F - t_I) = \frac{Path}{c} = \frac{D - \Delta}{c} \quad (3)$$

- Respectively, in the reference system related to the Earth's surface, the obtained result is:

The light passes the exact distance equal to D for the time interval $(t_F - t_I)$ and the measured speed of light in the case "Westward transmission" is equal to $(c + V)$:

$$(t_F - t_I) = \frac{D}{c + V} \quad (4)$$

Again, the expression (4) is the same as (3), but Δ is replaced with $(V(t_F - t_I))$.

The results of the both cases "Eastward Transmission" and "Westward Transmission", fully corresponds to the presented thesis about the behavior of the electromagnetic radiation in areas with equal intensity of the gravitational field [subsection: *In Areas with Equal Intensity of the Gravitational Field (the Local Physical Reality)*], which actually explains the existing physical reality.

Conclusion Related to the Experiments "One-Way Light Speed Determination"

This genuine explanation, as well as the explanations of all the "unexpected" and "inexplicable" results of the most famous experiments related to the measurement of the speed of light, are given in (Sharlanov, 2015). The conclusion is the same:

The speed of light is the same in "empty space" (in ECI reference system) in local time-spatial domain with equal intensity of the gravitational field, but it is not the same in all frames of reference.

In fact, it is irrefutable evidence about the invalidity of the special theory of relativity.

"Ether-wind" caused by the movement of the Earth in its orbit around the Sun, as well as "ether-wind" caused by the movement of the Solar system in the Galaxy (and in the Universe at all) does not exist. Awareness of this reality lies in the proposed model of uncertainty (indeterminateness) in the Universe (see the next section).

However, what is the answer to the question "Why Michelson-Morley interferometer cannot register different speed of light in different directions (in the frame of reference related to the Earth's surface)?" - see (Michelson and Morley, 1887). The answer is that Michelson interferometer uses two-way of a light ray traveling on a same path. It means that even if the "ether wind" exists (caused by Earth's movement in its orbit through the stationary luminiferous ether) - the difference in the speed of light of the two rays, traveling in two opposite directions on the same arm, is completely compensated. It is true for any arm in any direction! In other words, if the projection of the velocity of the "ether wind" on the direction of one of the light rays is $(+V)$, then the

projection of the velocity of the “ether wind” on the direction of the other light ray (traveling in opposite), will be exactly $(-V)$. This is actually the reason that the different speed of light in directions “East-to-West” and “West-to-East” cannot be determined by the Michelson-Morley experiment. Therefore, the Michelson interferometer turns out to be conceptually wrongly developed.

In fact, the Michelson–Gale–Pearson experiment exactly fixes the “Effect of the Earth’s Rotation on the Velocity of Light” (Michelson and Gale, 1925).

Model of Uncertainty of the Universe

A General Definition of the Universe

On the basis of the awareness of the physical reality, the following general definition of the Universe can be given:

“The Universe is warped by a matter time-spatial gravitational force-field, on which other fields exist (such as the electromagnetic field), and where the energy accumulates and transforms.”
(Sharlanov, 2014)

Time and space are mutually connected. The electromagnetic field exists on the gravitational field. The characteristics of the electromagnetic field μ_0 (permeability of free space) and ϵ_0 (permittivity of free space) are only local constants, and they change together with the change of the gravitational field intensity. In fact, the wavelength and the frequency of electromagnetic radiation are its spatial- and time- characteristics respectively. Space-time itself is often called “vacuum” or “empty space” and it actually exists on many levels. It lays among the elementary particles of matter, among all the planets, stars and galaxies. All these levels are interconnected, depending on each other, and changing in perfect, but not yet discovered synchrony.

Any time-spatial domain of “empty space” in the Universe has a certain intensity of gravitational field. Clearly, an “absolute” intensity of the gravitational field does not exist, but we can compare the intensity of a gravitational field among time-spatial domains or to a certain reference. Different local areas in the Universe can be characterized by their GRULW (Global Relative Universe Level of Warping), which is actually a “relative local space-time level of expansion/contraction”.

The Model of the Physical Reality in the Universe is based on the nature of existence of the electromagnetic field on a gravitational field.

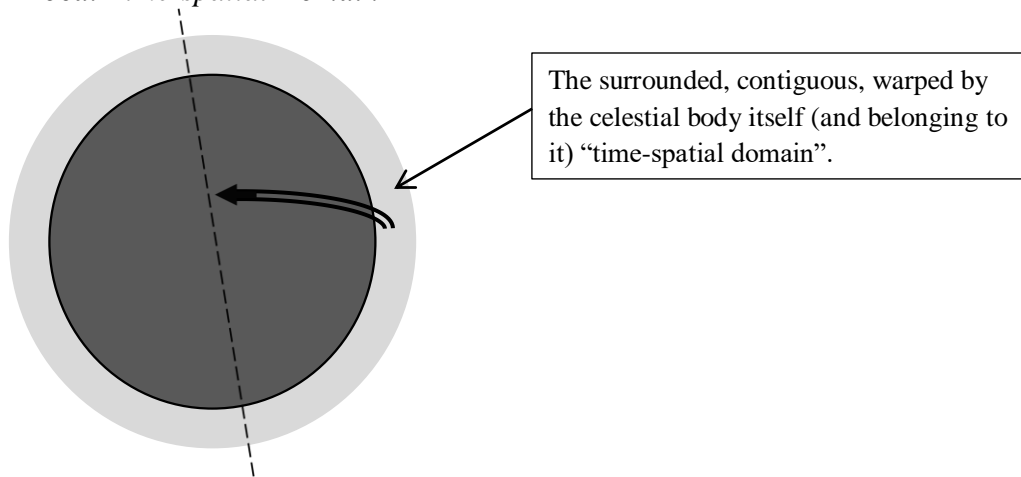
Behavior of the Electromagnetic Radiation in Local Time-spatial Domain

The celestial bodies (like the Earth) are rotating into the stationary (surrounded, contiguous, warped by the celestial body itself and belonging to it) local “time-spatial domain”. Figure 3 bellow illustrates this local reality.

In the local time-spatial domain “on the Earth’s surface”, the speed of light in the ECI reference frame (in the “empty space”) is a constant, that

corresponds to the local intensity of the gravitational field. In fact, in the frame of reference related to the Earth's surface, "light speed anisotropy" is a real fact due to the rotation of the celestial body in the stationary "empty space".

Figure 3. *Rotation of the Celestial Bodies in the Stationary Space of the "Local Time-spatial Domain"*



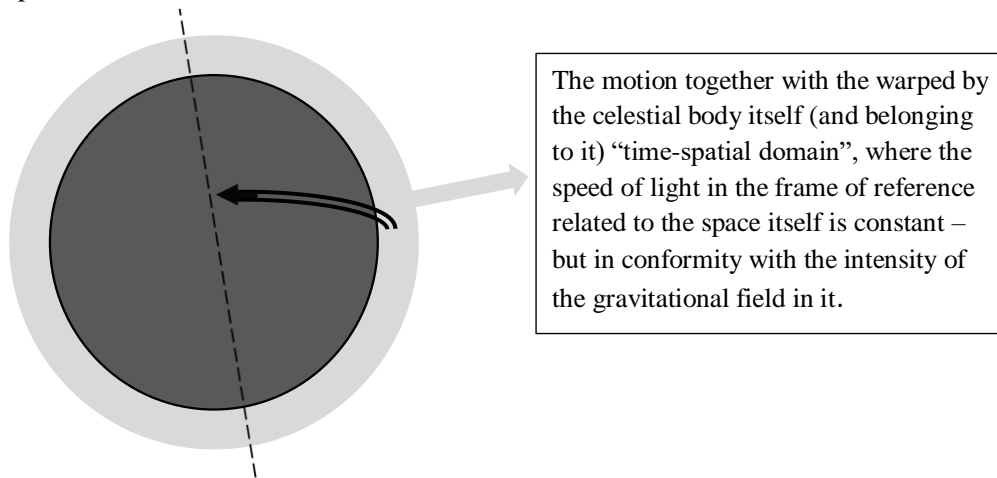
Confirmation: In the case of "One-Way Light Speed Determination" in the reference system related to the Earth's surface – the measured speed of light in direction "East-to-West" is higher than the measured speed of light in direction "West-to-East". This difference corresponds to the linear speed of the Earth's surface at this latitude [see section "Experiments "One-way Light Speed Determination" and the Special Theory of Relativity"]].

Behavior of the Electromagnetic Radiation in the Global Physical Reality of the Universe

All celestial bodies (as well as the Earth) are traveling through the space-time of the Universe together with the contiguous, warped by the body itself (and belonging to it) "time-spatial domain". Figure 4 bellow illustrates the Global Physical Reality of the Universe.

This is the reason why it is no variation in the speed of light due to the motion of the Earth around the Sun and in the Galaxy. The intensity of the gravitational field in the local time-spatial domain "on the Earth's surface" remains the same when the Earth travels in the Universe. The speed of light on the Earth's surface in the ECI reference frame (in the "empty space") remains always the same and corresponds to the equal intensity of the gravitational field in the local time-spatial domain "on the Earth's surface".

Figure 4. *Moving of the Celestial Bodies Together with their “Own Time-spatial Domain”*



At the entrance toward the increasing intensity of the gravitational field of the time-spatial domain surrounding the Earth, photons are losing energy, which is absorbed by the gravitational field. The frequency and the wavelength of the photons are decreasing, therefore the speed of the photons is decreasing ($c=v\cdot\lambda$) in conformity with the level of the gravitational field intensity. Respectively, with the change of the frequency and the wavelength, the base units of time “second” and of the length “metre” are changing too, because they are defined by means of the frequency and the wavelength of the electromagnetic radiation. The result is that the measured value of the changing speed of light remains always the same, because it is measured with the changing units of time and length (circular reference). In this sense, one can say that the speed of light in “empty space” is constant in all frames of reference... and moreover, that the speed of light is a fundamental constant in the Universe. It is a big delusion, because actually the speed of light in “empty space” is different in areas with different intensity of the gravitational field and it is changing in synchrony with the measurement units of time and length (Sharlanov, 2012a). The accepted in contemporary physics behavior of the photons in the gravitational field is erroneous and does not correspond to the physical reality.

On the base of this “Model of the Physical Reality”, the suggested “Thesis about the Behavior of the Electromagnetic Radiation in Gravitational Field” [section “Thesis about the Behavior of the Electro-magnetic Radiation in a Gravitational Field”] actually replaces the postulate of invariance of the speed of light formulated by Albert Einstein. As a result, all “unexpected” and “inexplicable” results of the famous experiments related to the measurement of the speed of light obtain their genuine explanations.

Some subsequent delusions:

- As a consequence, the reader will logically come to a conclusion that the astronomical unit of length “light year” is a big delusion.

- If someone claims that the age of the Universe is 13 or 15 billion years, he should be asked: “Where in the Universe the used unit of time is defined?” Obviously, the duration /length of a year on Earth can be equal to a “second” in areas with an extremely strong gravitational field. Therefore, such a statement is meaningless ...
- The “red shift” or the “blue shift” of the frequency of the electromagnetic radiation due to the “Doppler effect” is actually another big delusion. Moreover, this delusion has caused other big problems in the physics today to be generated (such as: “the accelerated expansion of the Universe”; “the dark matter and the dark energy in the Universe”, etc.), which have been under research for a long time ...

In areas with equal intensity of the gravitational field: With the change of the energy (frequency) of the electromagnetic radiation, the wavelength is changing too, but in a way that the correlation between them (the speed of light) remains the same. This is the case of the “radar gun”, when the momentum (the energy) of the photon is changing at the contact with a moving object. Therefore, the explanation that the change of frequency of the photons is due to the “Doppler effect” is not the true explanation.

The Uncertainty in the Macro-World

The characteristics of the electromagnetic field are changing together with the change of the gravitational field intensity; the properties of the atoms are also changing; all the measurement units and physical constants are changing... all physical reality is changing in synchrony, but in a still undiscovered way.

We can receive information from the Universe only by means of the electromagnetic radiation. The electromagnetic signals travel to the Earth for an uncertain period of changing time, cover an uncertain distance of warped space at an uncertain speed:

“The uncertainty of the macro-world consists in the fact, that we cannot measure or calculate in our local time-spatial domain (where the units of time and length are defined by means of the characteristics of the electromagnetic radiation), neither the change of the defined by us units, nor the change of all our local constants, because they all change in perfect synchrony with the change of the entire physical reality. Also, we cannot measure or calculate any change in the entire physical reality in another remote time-spatial domain with a different level of contraction/expansion of the space-time, because the units in the remote domain are uncertainly different.” (Sharlanov, 2012a).

In other words, if all units of the physical quantities are changing in synchrony with the change of the gravitational field intensity, then:

1) in time-spatial domains with different intensity of the gravitational field – all physical equations (representing the physical laws) will be the same. Thus, the values of all the local physical constants will be measured the same too, because the measurement units will differ exactly in correspondence to the intensity of the gravitational field in these time-spatial domains.

2) in time-spatial domain with equal intensity of the gravitational field (equal in every point), but where the intensity of the gravitational field is varying (in the same way in any point)– the laws of physics will remain the same. As a result, all the local physical units and physical constants will vary in synchrony, and we will not be able to register whatever change. Therefore, the perception of “absoluteness” will be perfect, and the delusion will be “irrefutable”.

That is why, the perception of “absoluteness” is complete. Moreover, it is “proven” by the irrefutability of all “mathematical and experimental evidence” in the local time-spatial domain about the constancy of all the local units, and the unchangeability of all the local constants.

Thesis about the Behavior of the Electro-magnetic Radiation in a Gravitational Field

As a logical consequence of the presented “Model of uncertainty of the Universe”, the following “Thesis about the behavior of the electromagnetic radiation in a gravitational field” is formulated. It replaces the postulate of invariance of the speed of light formulated by Albert Einstein.

In Areas with Equal Intensity of the Gravitational Field (the Local Physical Reality)

Statement 1) *The speed of the electromagnetic radiation is a local constant in the “reference system related to the space itself”, (in the “empty space”).*

In a “time-spatial domain” where the intensity of the gravitational field is the same, the speed of the electromagnetic radiation is constant and depends only on the intensity of the gravitational field. Actually, it is only a local constant, because if we measure it using the units of time and length defined in another “time-spatial domain” with a different intensity of the gravitational field – the measured value for the speed of the electromagnetic radiation will be different. (Sharlanov, 2012a).

Statement 2) *The speed of the electromagnetic radiation in the “reference system related to the space itself” does not depend neither on the velocity of the body of the source of electromagnetic*

radiation, nor on the velocity of the body of the detector (the Observer).

This is because the electromagnetic radiation is a vibration, which occurs at a quantum level and does not depend on the speed of the body to which the atom belongs (the atom which emits or absorbs the photons).

Statement 3) The measured velocity of the electromagnetic radiation in areas with an equal gravitational field intensity is not the same in all frames of reference.

Mathematically, in areas with an equal gravitational intensity, the relationship between the readings in the different reference systems is expressed through Galilean transformations - it is a subject of Newtonian mechanics. This fact is actually proved by the experiments "One way light speed determination", "Sagnac's experiment" and "Michelson-Gale-Pearson Experiment".

In Areas with a Different Intensity of the Gravitational Field (the Global Physical Reality in the Universe)

Statement 1) The speed of the electromagnetic radiation in vacuum (in the reference system related to the space itself) depends on the intensity of the gravitational field and it is different in the time-spatial domains with a different intensity of the gravitational field. The speed of the electromagnetic radiation in vacuum changes when it passes through areas with different intensity of the gravitational field.

In more details, the speed of the electromagnetic radiation increases in areas with a weaker gravitational field and decreases in areas with a stronger gravitational field. This fact is actually proved by the Shapiro time-delay effect.

Statement 2) The properties of the atoms (photon emission and absorption) are different in areas with different intensity of the gravitational field. The energy of the emitted and absorbed photons, what means the frequency and wavelength (at a transition between the same hyperfine levels) are in conformity with the intensity of the gravitational field in the area where the atom is located.

This is so, because the electromagnetic field exists on the gravitational field.

About General Theory of Relativity

Awareness: "What Is the Difference between Mathematical and Physical Equation"

- The mathematical equation is actually an assertion for equality of two numeric expressions. The mathematical equation most often expresses the relationship between the given variables, some of them known (a, b, c, d...), and variables that need to be determined - the unknown (x, y, z, w, etc.). The process of expressing the unknown in an equation or a system of equations, in terms of the known ones, is called solving the equation (or the system of equations).
- In physics, however, the equality of the expressions concerns the links between physical quantities, but this relationship is expressed in the equation, which is written on the basis of a certain system of units of measurement (for example, SI-System).

Here, we must realize that physical equations are based on the assumption that the units of the measurement systems are constants. Only in such a way, the use of the equality sign between the two expressions is correct. However, the units of the measurement systems are constants, but only in a local physical area, where the intensity of the gravitational field is constant (in time-spatial domains with equal intensity of the gravitational field).

Einstein's Field Equations (EFE)

One correct example in engineering: If we calculate tension in a piece of material caused by a force, we use units of a measurement system, which are defined in the time-spatial domain outside the material body. In our case it is our time-spatial domain "on the Earth's surface", where the intensity of the gravitational field is equal and therefore the defined physical units are permanent. As a result, we can say that the physical equations for the tension calculation are correct (the use of the equality sign is correct).

In the scope of Einstein's field equations, however, we must realize that we use physical units of length and time defined inside a "material" named "Universe". This "material" consists of planets, stars and galaxies (instead of atoms and molecules). The intensity of the gravitational field is different in different areas of the space-time of the Universe, therefore the physical units of length and time are different too. The EFE themselves express the change of the units of time and length. The used units are not permanent in the scope of the equations, and the use of the "equality" sign is not correct. Therefore, Einstein's field equations express only a "brilliant idea"! That is why, the equations cannot be subjected to mathematical solving directly.

Brief analysis of the Einstein's modified field equation:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu} \quad (5)$$

Note 1 (Concerns the Measurement Units)

The expression on the left side of the equation represents unknown warping of the structure of space-time: ($R_{\mu\nu}$ is the Ricci curvature tensor, R is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, and Λ is the cosmological constant. The expression on the right side represents the known matter and energy ($T_{\mu\nu}$ is the stress-energy tensor). The gravitational constant G and the speed of light c appear as physical constants and π is a numeric constant.

Therefore the EFE can then be interpreted as a set of equations representing how the matter and energy determine the curvature of space-time, or how the units in particular time-spatial domain are changing by the matter and energy. But as any physical equation, the expressions on both sides of the equation have to be written on the base of the same, unchangeable measurement units. If this equation is not written on the basis of unchangeable units of measurement – the equation simply ceases to be an equation in terms of math and the use of the sign “equality” is not correct.

Note 2 (Concerns the Physical Constants)

There was other experimental evidence after Shapiro's experiment, that the speed of light in “empty space” changes depending on the intensity of the gravitational field (for example, by means of controlled transponders aboard Mariner-6 and Mariner-7 space crafts as they orbited the planet Mars).

After the offer of his idea in 1962, Dr. Irvin Shapiro from Lincoln Labs of Massachusetts Institute of Technology, reported:

“...according to the general theory, the speed of a light wave depends on the strength of the gravitational potential along its path.” (Shapiro, 1964).

Clearly, Dr. Shapiro has had in mind the discussed by Einstein the change of the speed of light in his article “On the Influence of Gravitation on the Propagation of Light“. In this article, Einstein asserts:

“If we call the speed of light at the origin of co-ordinates c_0 , then the speed of light c at a place with the gravitation potential Φ will be given by the relation:

$$c = c_0 \left(1 + \frac{\Phi}{c^2} \right)$$

The principle of the constancy of the speed of light holds good according to this theory in a different form from the one that usually underlies the ordinary theory of relativity.”(Einstein, 1911)

Actually, not only the speed of light but - all physical constants change depending on the intensity of the gravitational field.

Unfortunately, our vision of the physical reality in the Universe is based on our local perception of “absoluteness”. The perception of “absoluteness” (not only of time and space) is a result of irrefutability of all the “mathematical and experimental evidence” about the constancy of all local physical constants in our local time-spatial domain, what in turn is based on the perception of unchangeability (constancy) of all local units of measurement. So, we are misled to adopt that the local physical constants are fundamental, universal and unchangeable (like the speed of light). However, all local units change with the change of the intensity of the gravitational field.

For example, this also applies to Maxwell's equations, which are irrefutably true in our (and in any other) local physical area with equal intensity of the gravitational field where the units of measurement are defined... and where we have a perception of full certainty. Thus, ϵ_0 – “the permittivity of the free space” (also called the electric constant), μ_0 – “the permeability of the free space” (also called the magnetic constant) and “the speed of light” in Maxwell’s equations are perceived and adopted as constants, but they are only local constants. In Maxwell's equations, the relation between electricity, magnetism, and the speed of light can be summarized by the equation:

$$c = \frac{1}{\sqrt{\mu_0 \cdot \epsilon_0}} \quad (6)$$

Actually, ϵ_0 , μ_0 and c are not universal constants – they are changing with the change of the intensity of the gravitational field. But:

“In the local “time-spatial domain”, where physical units are defined, it is not possible to prove by measurement the change of the value of any physical constant (the speed of light, Planck’s constant, etc.)” (Sharlanov, 2012a).

In fact, the physical reality in the Universe turns out to be:

“perception of local absoluteness, against the background of global relativity in the Universe”,

In other words:

“perception of complete local certainty against the background of overall uncertainty in the Universe.” (Sharlanov, 2012b).

Conclusions

- About the Special theory of relativity.

The speed of light is constant in “empty space” (in ECI reference system) in local time-spatial domains where the intensity of the gravitational field is equal. In fact, the speed of light is not the same in all frames of reference. This reality was proven by Sagnac’s experiment (Sagnac, 1913), by Michelson–Gale–Pearson’s experiment (Michelson and Gale, 1925), nowadays by “one-way speed of light measurements” using a GPS system. The wrong design of Michelson’s interferometer turns out to be the primary root cause for the big fallacy that “the speed of light is the same in all inertial frames of reference”, which is the core of the special theory of relativity. Nonetheless, the Nobel Prize in physics 1907 has been awarded to Albert Abraham Michelson “*for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid*”!

According to Einstein, if the velocity of light in a vacuum would depend upon the direction of motion, then “*the principle of the constancy of the velocity of light, which forms one of the two foundation pillars on which the theory is based, would be refuted.*” (Einstein, 1926). The fact is that it is *refuted*. Therefore all famous results of the special theory of relativity are actually *refuted*. The Lorentz transformation is only a mathematical solution of the mathematical task: “How the speed of the light can be measured the same in all frames of reference”. Actually, this mathematical task does not correspond to the physical reality.

- About the General theory of relativity (GTR).

The General theory of relativity is a creative imagination, which marks real advance in the science. The ideas of absolute time and space were superseded by the dynamically curved spacetime in general relativity.

The fact is that within the scope of the Einstein field equations (EFE) the units of measurement and the physical constants are variable. Therefore, the Einstein field equations of the GTR are “brilliant as a general idea”, but the use of the sign “equality” is not correct. It means that the solving the Einstein field equations is only a training of excellent mathematical skills in the field of mathematics, but it has nothing to do with the interpretation of the physical reality in the Universe.

- About a next step of the physical science.

Undoubtedly, the new model of uncertainty of the Universe is a different vision, which not only reveals the essence of Theory of Relativity by Albert Einstein, but also holds explanation of a lot of problems in physics today (such as: “the accelerated expansion of the Universe”, “the dark matter and the dark energy in the Universe”, etc.), which have been under research for a long time.

The big task of the next generation of physicists will certainly be: “How the characteristics of the electromagnetic radiation (and all physical reality) change with the change of the intensity of the gravitational field”. Actually, this task is a subset of the main task: “How the uncertainty in the macro-world (macrocosm) can be more certain for us”...

References

- Einstein, A. 1911. On the Influence of Gravitation on the Propagation of Light. *Annalen der Physik* [35]. Available: <http://bit.ly/25jc3cu>.
- Einstein, A. 19th Jan 1926. My theory and Miller's experiments. *Vossische Zeitung*. Available: <http://bit.ly/22q0z50>.
- Kelly, A. 2005. Challenging Modern Physics. *BrownWalker Press, Florida*.
- Malykin, G. B. 2000. The Sagnac effect: correct and incorrect explanations. *Phys. Usp.* 43 1229. DOI= <http://bit.ly/1XyPsG7>.
- Marmet, P. 2000. The GPS and the Constant Velocity of Light. *Acta Scientiarum*, 22, 1269.
- Michelson, A. A., Morley E.W. 1887. On the Relative Motion of the Earth and the Luminiferous Ether. *American Journal of Science*. 34, 333-345. DOI= <http://bit.ly/25jcB1S>.
- Michelson, A. A., Gale, H. E. 1925. Effect of the Earth's Rotation on the Velocity of Light (PART I and PART II). *Astrophysical J.* 61 137. DOI: 10.1086/142879.
- Miller, D. C. 1926. Significance of Ether-drift Experiments of 1925 at Mount Wilson. *Science*, V63, pp. 433-443. (A.A.A.S Prize paper). DOI= <http://bit.ly/1TY7UCY>.
- Sagnac, M. G. 1913. Sur la preuve de la réalité de l'éther lumineux par l'expérience de l'interférographe tournant. *Comptes Rendus*, 157: 1410-1413. Available Translation: <http://bit.ly/1TBWTwU>.
- Shapiro, I. 1964. Fourth Test of General Relativity. *Physical Review Letters*, vol.13 (26): 789-791. DOI= <http://bit.ly/1qL0ZoL>.
- Sharlanov, G. V. 2012a. The Speed of Light and Uncertainty Principle of the Macro-world. *Applied Physics Research*, Vol.4 No.4: 118-125. DOI= <http://bit.ly/1RsCBhB>.
- Sharlanov, G. V. 2012b. Awareness of Special and General Relativity and Local and General Physical Reality. *Applied Physics Research*, Vol.4 No.4 126-137. DOI= <http://bit.ly/1XUTskL>.
- Sharlanov, G. V. 2014. The New SI – an Alternative Proposal for a Next Generation System of Measurement; DOI= <http://bit.ly/25nmoaA>.
- Sharlanov, G. V. 2015. The Theory of Relativity by Albert Einstein – Awareness of the Physical Reality; DOI= <http://bit.ly/1Z1XBSv>.