Reasonable Alternatives to the Two Big Problems in 20th-Century Physics

Gocho V. Sharlanov

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(On the Misconceptions of Modern Luminaries in Relativity and Cosmology)

About the author

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Author's Notes:

The content of this book is based on the published articles in the *Journal of Modern and Applied Physics* (https://www.pulsus.com/archive/puljmap-volume-7-issue-1-year-2024.html):

1. Sharlanov G. V. (2024). The complete set of proofs for the invalidity of the special theory of relativity. *J Mod Appl Phys*, 7(1):1-29;
2. Sharlanov V. G. (2024). "Dark matter", "Dark energy", and other problems in physics today. *J Mod Appl Phys*, 7(1):1-8.

and the published article in the *Space Science Journal:*

3. Sharlanov, G. V. (2024). Influence of Gravitation on the Origin and Propagation of Electromagnetic Radiation. *Space Sci J*, 1(3), 01-10.

In turn, these three articles are excerpts from the published books (*Amazon Kindle Direct Publishing):*

1. "***The Special Theory of Relativity – the Biggest Blunder in Physics of the 20th Century"*** *©;*

2. "*Accelerating Expansion of the Universe – the Reasonable Alternative"* ©.

Bibliography included.

The book is intended for all thinking readers,
whose thought is not subordinated to the old dogmas,
but are ready to advance a new future of physics!

In memory of

*my wife **Valentina Dimitrova Sharlanova**,*

with love and gratitude

for the understanding and support she gave me,

and in memory of my parents

for the cultivated intransigence in the search for the truth.

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Abstract of the book

"The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks the real advance in science."
("The Evolution of Physics", Einstein & Infeld, 1938).

The root cause of the biggest problem in 20th century physics, the "special theory of relativity", is actually the incorrectly accepted and maintained for more than 100 years "postulate of the constancy of the speed of light for all reference frames". The reason for the emergence of this postulate is the incorrect interpretation of the famous "Michelson-Morley experiment". This experiment was based on the inappropriate conceptual design used in Michelson's "two-way interferometer". All other known experiments: the Sagnac experiment in 1912, the "Michelson-Gale-Pearson" experiment in 1925, and the "One-way measurement of the speed of light" experiments carried out in recent years, indisputably prove that the speed of light is not the same for all frames of reference. The measured speed of light in the frame of reference related to the Earth's surface differs from the "speed of light in vacuum" and this difference varies depending on the latitude (proven by Michelson himself back in 1925). Michelson published the results of the "Michelson-Gale-Pearson" experiment in the articles "The Effect of the Earth's Rotation on the Velocity of Light I and II". Even with the title of these articles, Michelson shows that such an effect exists, i.e., that the speed of light in vacuum differs from the speed of light in the frame of reference related to the Earth's surface. Michelson's "two-way interferometer" uses exactly the same path in two directions for each arm. That is why, the existing difference in the speed of light in both opposite directions in the frame of reference related to the Earth's surface caused by the Earth's rotation around its axis cannot be established. This is because this difference in the speed of light is completely and accurately compensated for each arm and for any direction of the arm.

On the other hand, the speed of light in vacuum depends on the energy density of the "empty of matter space" (the medium of propagation of electromagnetic radiation), which, in turn, depends on the intensity of the gravitational field. This is an experimentally proven fact, published in scientific articles. The intensity of the gravitational field on the Earth's surface remains the same (dominated by the Earth's mass) when the Earth moves around the Sun and together with the solar system in the galaxy. That is why, there is no difference in the speed of light in vacuum caused by the Earth's motion through the "luminiferous ether" in its orbit around the Sun. Therefore, we can conclude that the reason for the emergence of the special theory of relativity is both the inappropriate conceptual design of the interferometer used in the Michelson-Morley experiment and the resulting incorrect interpretation of the experimental results by the scientists. The reason that this false theory still existed, for more than a century now, is that it's been maintained by the mainstream of physics -- maintaining the delusion that "the speed of light is the same for all reference systems", ignoring the results of experiments carried out as early as 1912 and 1925 and presenting them as "paradoxes" (for example, the Sagnac experiment). This support also includes the fabrication of tests to confirm the validity of this theory, which in this book are analyzed and divided into three types.

The reason for the emergence of the other big problem in physics, the "accelerating expansion of the Universe" despite the indisputably proven Newton's law of universal gravitation, is the incorrect assumption of the existence of the "Doppler effect" at electromagnetic radiation. This assumption is actually a consequence of the supposition of Vesto Slipher (the American astronomer who first reported the observed redshift): that the "redshift" in the spectrum of light coming from distant galaxies can be "due to the velocity", i.e., due to the "Doppler effect". The Doppler effect is an effect of mechanical waves, but not of electromagnetic radiation, which is a stream of immaterial small energy packets (quanta) radially propagating from the source into the propagation medium. This medium (the "empty of matter space"), actually turns out to be

compressed energy by the fundamental forces of nature. The real explanation of the incorrectly called "Doppler radar" is explained in the book according to Schrödinger's dynamic interpretation.

To justify the "accelerating recession of galaxies" despite the indisputably proven Newton's law of universal gravitation, the fallacy of the existence of unjustifiably high percentages of "dark matter" in the Universe is introduced, as well as the myth of the existence of "dark energy", the nature of which is inexplicable even to modern cosmologists themselves. The real reason for the "redshift" in the spectrum of light coming from distant galaxies is that it is due to the energy-space relationship presented in Part 2 of this book, which is in full accordance with Newton's law of universal gravity.

The root cause of these two problems lies, on the one hand, in the misunderstanding of the nature of electromagnetic radiation and the nature of the propagation medium (the so-called "empty space"). The other reason is the ignoring and suppression by the mainstream in physics of the theoretical and experimental evidence provided to explain the problems.

In this regard, Professor Karl Popper's conclusion is that in modern physics "a theory must be falsifiable to be scientific"!

Convention: Quotations are as separate paragraphs with dividing lines, and quotations in line are *in wide-spaced, italic font*.

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Part I

THE COMPLETE SET OF PROOFS FOR THE INVALIDITY OF THE SPECIAL THEORY OF RELATIVITY

Abstract

Part I of the book reveals the essence of the special theory of relativity. To date, there have been no scientific arguments against the proofs presented at the 3rd Annual International Conference on Physics in 2015 in Athens, Greece.

The "Introduction" presents the foundation of the real explanation of all "unexpected" and "inexplicable" results of the experiments related to the measurement of the speed of light in our time-spatial region "near the Earth's surface". Subsequent factual analyses of the most famous experiments related to the velocity of light behaviour prove that the speed of light differs in different directions from the local constant "speed of light in vacuum". The exception is only the experiments that use the "Michelson-type" interferometer. These interferometers use perfectly the same paths in two opposite directions for each light beam, which is why the difference between the speeds of light in the two opposite directions of each light beam is completely compensated. The analysis of the article "On the Electrodynamics of Moving Bodies" shows exactly where and how the claim "the speed of light is the same for all inertial frames of reference" is applied. Einstein's conclusion that "we cannot give any absolute meaning to the concept of simultaneous" is unfounded and absurd and is shown to be based solely on this erroneous claim. At the end of the article, the essence of the so-called "fundamental tests" of the special theory of relativity is also presented.

Key Words: Special theory of relativity; Speed of light postulate; Michelson-Morley experiment; Sagnac experiment; Electrodynamics of moving bodies; Fundamental tests of special relativity.

CONTENTS of Part I

1. INTRODUCTION

The medium of propagation of electromagnetic radiation (of the quanta) is the empty of matter space between the celestial bodies and between the atoms and molecules. The supposed hypothetical "luminiferous aether" turns out to be the "empty space" itself (the vacuum). Electromagnetic radiation is the propagation of particles of energy (quanta) in a medium of propagation, which medium turns out to be compressed energy. The evidence that the so-called "empty space" is actually energy compressed by the fundamental forces of nature is presented in [1] and shown in Part II of this book.

1.1 Logical rationale concerning Global Physical Reality

In this subsection are concerned:

1.The delusion that the speed of light in vacuum on the Earth's surface is the limiting speed for the entire Universe.

2.The reason for the constant speed of light in vacuum on the Earth's surface during its motion in its orbit around the Sun.

The "speed of light in the empty space" is the correlation (the product) between the frequency and the wavelength for the whole electromagnetic spectrum and is a local constant for our and for any other local time-spatial domain, where the intensity of the gravitational field is uniform.

"In areas with equal intensity of the gravitational field, with the change in 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 in vacuum) remains the same" [2].

Gravitational forces affect "empty space" by contracting it and increasing the energy density of the "empty space" (the medium of propagation of electromagnetic radiation). The density of the propagation medium determines the propagation and characteristics of electromagnetic radiation (frequency, wavelength, and speed in vacuum). The frequency and wavelength of any electromagnetic radiation are lower in regions with stronger gravitation (according to general relativity). Therefore, the speed of light in vacuum ($c = \nu\lambda$) is lower in regions with stronger gravitation (near the Sun), and this fact was experimentally proven as early as 1964 by the American astronomer Irvin Shapiro [3].

The logic below undeniably shows that if the results of general relativity are true, then the claim that "the speed of light in vacuum is a limit speed for the entire Universe" is not true:

It was experimentally proven that atomic clocks tick faster high in the mountains (i.e., that time runs faster at higher altitudes)– i.e. the frequency of emitted electromagnetic radiation increases in regions of lower gravitational field intensity. It means that in regions with weaker gravity, the time runs faster (the "second" becomes shorter). This is consistent with the general relativity, and if we define the unit of time "second" as defined in the SI system according to the 13th meeting of the CGPM, Resolution 1, 1967/68:

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom, at rest at a thermodynamic temperature of 0^0 K.

Also consistent with the general relativity is that the unit of length "meter" will become longer (lengthened) in regions with lower gravitational field intensity (at higher elevations). This is also consistent with the definition of the unit of length, given by the 11th meeting of the CGPM, Resolution 6, 1960, because the wavelength of any electromagnetic radiation will increase in regions with weaker gravity:

"The metre is the length equal to 1650763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels 2p10 and 5d5 of the krypton 86 atom."

It was proposed that this fact (increasing the frequency and wavelength of any electromagnetic radiation in regions of weaker gravity), which is according, in fact, to general relativity, be experimentally proven on board the International Space Station (ISS) using atomic clocks and a platinum-iridium rod (sized and scaled).

A comparison of the frequency and wavelength of a monochromatic source of electromagnetic radiation onboard the International Space Station (ISS) with those on the Earth's surface will prove that the speed of light in vacuum is changed ($c=\lambda \nu$)! This idea, however, cannot be accepted by the mainstream of Physics (by the luminaries of relativity) even though it would be proof of the results of the general theory of relativity which they support.

The fact that the speed of light in vacuum increases in regions with a weaker intensity of the gravitational field (near the border of the Solar system) is the explanation and proof of the "inexplicable" anomalies in the accelerations of the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which in fact experimentally prove the presented logic:

"the expected travel time of the communicational electromagnetic signals between the spacecraft and the Earth (based on the universal constancy of the speed of electromagnetic radiation in vacuum everywhere in the Universe), turns out to be much greater than the real travel time. Therefore, we register backward attraction (acceleration anomaly) of the space probe to the Sun" [4].

Conversely, the fact that the speed of light in vacuum decreases in regions of stronger gravity (near the Sun) was proven experimentally by the American scientist Irwin Shapiro in 1964 (Shapiro time-delay) [3], and was confirmed again highly accurately, using controlled transponders aboard space probes "Mariner-6" and "Mariner-7" when they were in orbit around the planet Mars.

The conclusion is that the speed of light in vacuum is not constant for all of the Universe; rather, it depends on the intensity of the gravitational field. Similarly, the speed of light in different optical media varies and depends on the strength of the chemical bonds between atoms and molecules. With the propagation of light in the "empty space" between carbon atoms (for example, in diamond), the strength of chemical bonds is extremely strong, and therefore, the speed of propagation of light is very low.

However, the speed of light in vacuum "near the surface of the celestial body" remains practically the same during the travel of the celestial body through space because the intensity of the gravitational field is constant and is determined (dominated) by the mass of the celestial body. The speed of light in vacuum (in stationary "empty space"), in any particular time-spatial domain near a celestial body, remains practically the same (illustrated in Figure 1 below).

All celestial bodies (as well as the Earth) are traveling through the space-time of the Universe **together with the distortion of the stationary space**, warped by the body itself.

The speed of light in vacuum (in the reference system related to the space itself) depends on the intensity of the gravitational field.

That is why, **the speed of light in vacuum on the surface of the celestial body remains always the** same (constant) during the travel, because the intensity of the gravitational field on the surface of the celestial body remains the same, dominated by the mass of the celestial body.

Figure 1. The motion of the celestial bodies together with the distortion of their "own time-spatial domain"

Therefore, that is the reason why there is no variation in *"the speed of light in vacuum"* when the Earth moves in orbit around the Sun and together with the Solar System in the Galaxy.

All of this undisputable logic shows that if the results of general relativity are true, then *"the speed of light in vacuum"* is different in regions with different gravitation. Conversely, if *"the speed of light in vacuum"* is a fundamental constant for the entire Universe, then General relativity is wrong!

1.2 Logical rationale concerning local physical reality

Newton's law of universal gravitation states that in the Universe, any particle or body with a mass m_1 attracts any other particle or body (with a mass m_2) with a force that is directly proportional to the product of their masses (m_1 and m_2), and inversely proportional to the square of the distance between their centers (r), where G is the gravitational constant:

$$F = G \frac{m_1 m_2}{r^2} \qquad (1)$$

The "empty space" does not have mass. Therefore, from Newton's law of universal gravitation, it becomes clear that the "empty space" is stationary – that the vacuum is stationary. This is undeniable because the "empty space" is without mass and therefore gravitational forces do not attract it (the space does not rotate together with the Earth's surface - only material bodies and molecules in the atmosphere are involved in the rotation)

Actually, there are no "unexpected" or "inexplicable" results from the experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface of the Earth". Moreover, the analyses of the "One-way Measurement of the Speed of Light" and "Michelson-Gale-Pearson" experiments (explained below), indisputably prove that the speed of light in the frame of reference, related to the moving Earth's surface, differs from the speed of light in vacuum (related practically in this case to the Earth-Centered Inertial (ECI) coordinate system). The undeniable fact that the measured speed of light is not the same for all inertial frames of reference was proven as early as 1912 by the Sagnac experiment [5] (see the analysis of Sagnac experiment in section 4 of Part I of the current book).

The Michelson-Morley experiment is an exception because of the inappropriate conceptual design embedded in the construction of the Michelson interferometer. A real explanation of the Michelson-Morley experiment is presented below.

2. ANALYSIS OF THE EXPERIMENTS "ONE-WAY MEASUREMENT OF THE SPEED OF LIGHT"

In regions of equal gravitational field intensity (such as in the "near the Earth's surface" region), experiments prove different speeds of light in the frame of reference related to the moving surface of the Earth (rotating in the stationary space). In the stationary empty space (in relation to the ECI frame of reference in this case), the speed of light (the speed of light in vacuum) is constant because the intensity of the gravitational field near the surface of the Earth is constant (dominated by the mass and proximity of the Earth).

However, the speed of light in the frame of reference related to the Earth's surface, that moves in the stationary space, differs and depends on the linear speed of the Earth's surface (depending on the geographical latitude) and on the direction of the emitted light beam (from "west to east" or from "east to west"). This reality is confirmed by the "Mickelson-Gale-Pearson experiment" (1925) and currently by the "One-way measurements of the speed of light" experiments (Marmet [6] and Kelly), [7]. In these experiments, the difference in the speed of light in different directions is ascertained in the frame of reference related to the moving Earth's surface.

2.1 Initial conditions for the experiments

1.The experiments are carried out in our local physical reality– i.e. in the time-spatial region "in the vicinity of the Earth's surface", where the intensity of the gravitational field is uniform (the same) and where our primary physical constants – the base units for the measurement of time and length are constant.

2.The two frames of reference for examining the experiments are:

4. The *"frame of reference related to the moving Earth's surface"*, where the measured speed of light turns out to be different in different directions.
5. The *"Earth-Centered Inertial (ECI) coordinate system"*, which in most of the considered cases is actually a *"frame of reference related to the stationary space itself"*. The origin of this coordinate system is in the center of the Earth, and its axes are practically stationary – aimed at very distant astronomical objects. In the "frame of reference related to the stationary space itself", the speed of light is the same in all directions.

3. In the local time-spatial region *"near the Earth's surface"*, electromagnetic radiation propagates in vacuum (in the "frame of reference related to the stationary space itself") at a constant speed (scalar) equal to c. This means that in the "Earth-Centered Inertial (ECI) coordinate system", the speed of light in vacuum is constant and equal to 299,792,458 m/s. This numeric value was accepted by the General Conference on Weights and Measures (Resolution of the 15th CGPM, 1975.

We must emphasize again, that in our local physical region "near the Earth's surface", every mechanical or optical experiment actually takes place in the common stationary space of the two above-mentioned frames of reference.

2.2 Some of the experiments performed

The Global Positioning System (GPS) is a satellite-based radio navigation system that provides high-precision geolocation and temporal information (and synchronization) about objects anywhere on or near the Earth's surface, where there is an unobstructed line of sight to four or more GPS satellites.

Based on the GPS, Marmet made measurements and reports in "GPS and the Constant Velocity of Light" that an electromagnetic signal takes approximately 28 nanoseconds longer when traveling eastward from San Francisco to New York than when traveling westward from New York to San Francisco [6]. Using GPS, Kelly also determined that an electromagnetic signal takes 414.8 nanoseconds more time to circumnavigate the Earth eastward near the equator than when travelling westward around the same path [7].

Both researchers concluded that the observed travel-time differences in different directions arise, because electromagnetic radiation (light) travels relative to the surface of the Earth at a speed $(c-V)$ eastward, and at a speed $(c+V)$ westward, where V is the linear speed of the Earth's surface at the respective latitude, and c is the speed of light in vacuum.

Now we will analyze both cases in the two aforementioned reference systems – the case "Eastward Transmission" and the case "Westward Transmission". In both cases, the transmitter and the receiver are fixed on the Earth's surface and are stationary in the reference system related to the Earth's surface.

What the observers will see (located in the two aforementioned frames of reference)?

For the observer, situated within the frame of reference related to the Earth's surface, the transmitting and receiving stations, fixed on the Earth's surface, are stationary.

However, an observer situated in the stationary in relation to the space "ECI coordinate system", will observe how the Earth is rotating and how every point on the Earth's surface is moving. The observer will see that the transmitting and receiving stations, fixed on the ground surface, move eastward (with the ground surface), at the linear speed V for the respective latitude.

2.3 The case "Eastward Transmission". Analysis of the results of the measurement of the speed of an electromagnetic signal by observers located in the two frames of reference

A receiving station B is located precisely east of station A. Let the fixed position of station A and the fixed position of station B on the Earth's surface at moment t be $X_A(t)$ and $X_B(t)$, respectively. The ground distance between Station A and Station B is equal to D (Figure 2).
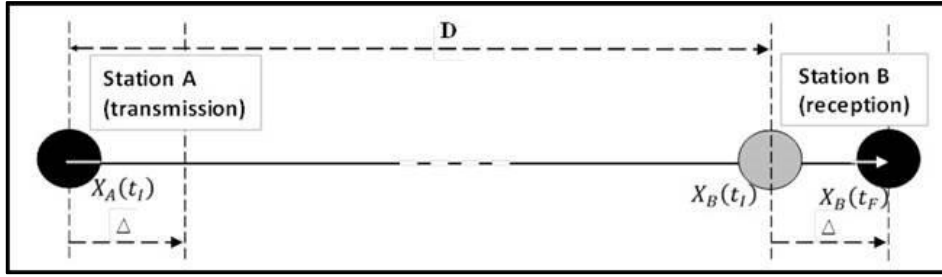
Figure 2. One-way measurement of the speed of light – eastward transmission

Station A transmits an electromagnetic signal (light beam) eastward at time t_I to station B, which receives it at time t_F. The time interval of the light beam travel is $(t_F - t_I)$. During this time interval, each point on the Earth's surface has moved in the stationary space at a distance $\Delta = V(t_F - t_I)$,, where V is the linear speed of movement of the Earth's surface in the stationary space for the corresponding latitude.

2.3.1 Analysis of the results of the measurement of the speed of the electromagnetic signal (of the light beam) by observer-1 located in the stationary in relation to the space "Earth-centered inertial coordinate system" (the ECI frame of reference)

Observer-1, located in the frame of reference "stationary empty space", will see how the fixed-on-the-ground transmission and reception stations are moving eastward in the stationary space with the linear speed V of the Earth's surface for the respective latitude. Observer-1 will find that the electromagnetic signal passes in the stationary "empty space" a definite distance – from position $X_A(t_I)$ of station A at the moment of transmission t_I to position $X_B(t_F)$ of station B at the moment of receiving t_F (see Figure 2). They will measure that the distance travelled by the electromagnetic signal is equal to the distance between the two stations D on the ground, plus the distance $\Delta = V(t_F - t_I)$, which station B passes during the travel-time of the electromagnetic signal $(t_F - t_I)$ with the speed V (the linear speed of the Earth's surface in the stationary space at the respective latitude).

Therefore, observer-1 (located in the stationary in relation to the spaceframe of reference), measures the speed of the electromagnetic signal (which can be a light beam) and confirms that it is equal to c (the speed of light in vacuum):

$$c_{ECI} = c_1 = \frac{D + \Delta}{(t_F - t_I)} = c_{vacuum} \qquad (2)$$

2.3.2 Analysis of the results of the measurement of the speed of the electromagnetic signal (of the light beam) by observer-2 located in the frame of reference, related to the Earth's surface

Observer-2, positioned on the Earth's surface, will see that the electromagnetic signal passes for the same interval of time $(t_F - t_I)$, exactly the distance D (the distance between the fixed on the ground transmission and reception stations). Therefore, observer-2 (located in the frame of reference, related to the Earth's surface), will measure the speed of the electromagnetic signal (or of the light beam) and obtain:

$$c_2 = \frac{D}{(t_F - t_I)} \qquad (3)$$

Obviously, the measured speed by observer-2 is lower than that measured by observer-1 ([equation 2](#)), and the difference is equal to the linear speed of the Earth's surface in the stationary space at the respective latitude:

$$c_1 - c_2 = \frac{D + \Delta}{(t_F - t_I)} - \frac{D}{(t_F - t_I)} = \frac{\Delta}{(t_F - t_I)} = \frac{V(t_F - t_I)}{(t_F - t_I)} = V \tag{4}$$

This theoretical result corresponds exactly to the results of the abovementioned experiments performed by Marmet [6], and Kelly [7], using GPS.

The measured speed of the electromagnetic signals in the reference system related to the Earth's surface in the direction "from west to east" is equal to $C_2 = (C_{vacuum} - V)$, where C_{vacuum} is the speed of light in vacuum, and V is the linear speed of the Earth's surface in the stationary space at the respective latitude.

2.4 The case "westward transmission". Analysis of the results of the measurement of the speed of an electromagnetic signal by observers located in the two frames of reference

The scenario in the case of "Westward Transmission" is the same:

Station A transmits an electromagnetic signal (light beam) at time t_I, but now westward to station B, which receives it at time t_F. During this time interval, each point on the Earth's surface promotes in stationary space at a distance $\Delta = V(t_F - t_I)$, where V is the linear speed for the corresponding latitude. The travel time interval of the signal is $(t_F - t_I)$, but it is smaller than the travel time interval $(t_F - t_I)$ of the electromagnetic signal in the case of "Eastward Transmission". This is because, in this case, the receiving station approaches the transmitting station (not moves away from it) ([Figure 3](#)).
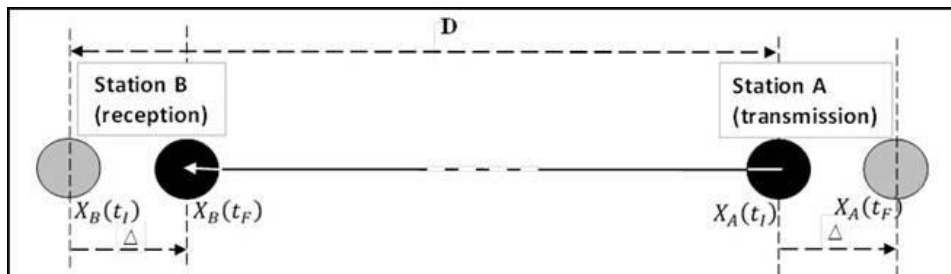
Figure 3. One-way measurement of the speed of light – westward transmission

2.4.1 Analysis of the results of the measurement of the speed of the electromagnetic signal (or of the light beam) by observer-1 located in the stationary in relation to the space "Earth-centered inertial coordinate system" (the ECI frame of reference)

Observer-1, situated in the stationary in relation to the space frame of reference, will see again that the fixed on the ground transmission and reception stations are moving eastward in the stationary space at the linear speed V of the surface of the Earth for the corresponding latitude. However, in this case, they will find that the distance, traveled by the electromagnetic signal, will be equal to the distance D between the two stations on the ground, minus the distance $\Delta = V(t_F - t_I)$. Here, Δ is the distance that station B passes during the travel-time of the electromagnetic signal $(t_F - t_I)$ with the linear speed V of the Earth's surface in the stationary space at the respective latitude.

Therefore, observer-1, situated in the stationary (in relation to the surrounding space) frame of reference, will measure the speed of the electromagnetic signal (the light beam) and will confirm again that it is equal to c_{vacuum} (the speed of light in vacuum)::

$$c_{ECI} = c_1 = \frac{D - \Delta}{(t_F - t_I)} = c_{vacuum} \qquad (5)$$

2.4.2 Analysis of the results of the measurement of the speed of the electromagnetic signal (or of the light beam) by observer-2 located in the frame of reference, related to the Earth's surface

Observer-2, positioned on the Earth's surface, will see again that the electromagnetic signal will pass for the same interval of time $(t_F - t_I)$ exactly the distance D (the distance between the fixed on the ground transmission and reception stations). Therefore, observer-2 (located in the *frame of reference, related to the Earth's surface*), will measure a higher speed of the electromagnetic signal (or of the light beam):

$$c_2 = \frac{D}{(t_F - t_I)} \qquad (6)$$

Obviously, the speed measured by observer-2 (equation 6) is greater than that measured by observer-1 (equation 5), and the difference with the speed of light in vacuum is again equal to the linear speed of the Earth's surface in the stationary space at the respective latitude:

$$c_2 - c_1 = \frac{D}{(t_F - t_I)} - \frac{D - \Delta}{(t_F - t_I)} = \frac{\Delta}{(t_F - t_I)} = \frac{V(t_F - t_I)}{(t_F - t_I)} = V \qquad (7)$$

This theoretical result again accurately corresponds to the results of the above-mentioned experiments performed by Marmet and Kelly, using GPS data, which revealed the following:

The measured speed of the electromagnetic signals in the reference system related to the Earth's surface in the direction "from east to west" is equal to $c_2 = (c_{vacuum} + V)$,

where c_{vacuum} is the speed of light in vacuum, and V is the linear speed of the Earth's surface in the stationary space at the respective latitude.

2.5 Conclusion

The experiments "One-way measurement of the speed of light" are actually irrefutable proof that the measured speed of light in a local time-spatial region with a uniform intensity of the gravitational field is not the same for all inertial frames of reference.

On the experiments "One-way measurement of the speed of light":

Modern physics is trying to accept the unacceptable "logical circular reference" – claiming that the "one-way" measurement of the speed of light from source to detector cannot be measured independently of a convention on how to synchronize the clocks of the source and detector! Here it is essential to realize that if we choose a suitable convention for synchronizing the source clock and the detector clock (which, of course, will not correspond to physical reality), it can be "mathematically proven" not only that the measured speed of light in the east-west and west-east direction is the same, but also anything we would want!

Many scientists have given evidence that the "Light Speed Invariance is a Remarkable Illusion" [8]. However, this is avoided from being formally discussed by physical society.

3. THE ANALYSIS OF THE MICHELSON-GALE-PEARSON EXPERIMENT

The idea for this test was originally proposed by Michelson [9]. According to Michelson, the experiment was undertaken at the urgent instance of Dr. L. Silberstein. In the first part of the article titled *"The Effect of the Earth's Rotation on the Velocity of Light, I."*, we can read:

> *In the Philosophical Magazine, (6) 8, 716, 1904, a plan was proposed for testing the effect of the earth's rotation on the velocity of light. [10].*

3.1 Description of the experiment. Results presented to the scientific community

The "Michelson-Gale-Pearson experiment" (see below Figure 4) uses a very large rectangular ring interferometer (a perimeter of 1.9 kilometers – 612.648 m × 339.24 m).

The experiment was carried out in the Northern Hemisphere at a latitude (41° 46').
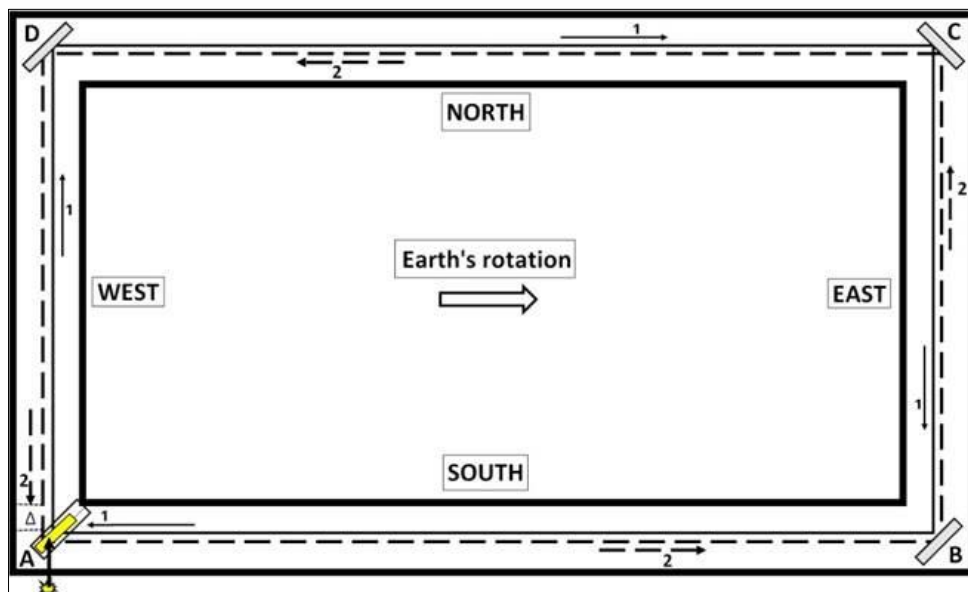
Figure 4. Scheme of the Michelson-Gale-Pearson experiment

A beam of light was split in half and the two beams were sent in opposite directions in an evacuated tube (vacuum conditions). Mirrors located in each corner of the rectangle reflected the two beams. When the two beams were reunited, they were out of phase. This means that the two beams did not arrive at the same time, although they passed exactly the same path in the frame of reference related to the Earth's surface. Therefore, the light beams travel at different speeds in the frame of reference related to the Earth's surface, and as we will see, the interference fringes displacement corresponds to the calculated theoretical value depending on

the linear speed of the Earth's surface at the latitude of the northern and southern sides of the rectangular contour... i.e., this displacement corresponds to the theoretical value calculated according to classical mechanics and Galilean relativity.

The theoretical rationale and the description of the experiment were presented by Michelson and Gale in two articles titled *"The Effect of the Earth's Rotation on the Velocity of Light"* *(part I and part II)*, published in 1925 in the Astrophysical Journal [10, 11].

"The expression for the difference in path between two interfering pencils, one of which travels in a clockwise, and other in a counterclockwise direction, may be deduced on the hypothesis of a fixed ether as follows:

If l_1 is the length of path at latitude Φ_1 and l_2 that at latitude Φ_2, v_1 and v_2 the corresponding linear velocities of the earth's rotation, and V the velocity of light, the difference in time required for the two pencils to return to the starting-point will be:

$$T = \frac{2l_2 v_2}{V^2 - v_2^2} - \frac{2l_1 v_1}{V^2 - v_1^2} \qquad (8) \qquad "[10].$$

In the same article, from formula (8), Michelson deduced formula (9) for the difference in phase of the two light beams, when returning to the starting point:

$$\Delta = \frac{4lh}{V\lambda} \omega \sin \phi \qquad\qquad (9)$$

The task that Michelson actually defines, is to experimentally verify the validity of formula (9), where Δ is the displacement of the fringes, l_h is the area of the rectangle around which the light travels, ω is the Earth's angular velocity, λ is the effective wavelength of the light employed, and *V* is *the speed of light in vacuum*.

Results of the experiment. As reported by Michelson:

"Air was exhausted from a twelve-inch pipe line laid on the surface of the ground in the form of a rectangle 2010x1113 feet. Light from a carbon arc was divided at one corner by a thinly coated mirror into direct and reflected beams, which were reflected around the rectangle by mirrors and corners. The two beams returning to the original mirror produced interference fringes" [11].

The experiment is similar to that of Georges Sagnac (see the analysis in in section 4 of Part I of the current book). The difference is that the moving frame of reference is not the spinning disk in the stationary space, but is the moving Earth's surface in the stationary space. The source of light, the detector, and the mirrors move eastward in stationary space with linear speed at the respective local latitudes for the northern and southern sides of the rectangular contour.

The "Michelson-Gale-Pearson experiment" was carried out accurately – the precision of the experiment is undeniable:

The displacement of the fringes due to the earth's rotation was measured on many different days, with complete readjustments of the mirrors, with the reflected image

The experiment, as reported by Michelson in the second part of the article, was successful; the obtained equation (10) as a result of the experiment coincides with the theoretically deduced equation (9) in the first part of the article:

The calculated value of the displacement on the assumption of a stationary ether, as well as in accordance with relativity (actually Galilean) is:

$$\Delta = \frac{4lh}{V\lambda}\,\omega\,\sin\phi \qquad\qquad (10)$$

The immediate result of the experiment was that the effect of the Earth's rotation around its axis on the speed of light was confirmed!

We can see that the reported conclusion – that the established by the experiment "calculated value" is in accordance with "the displacement on the assumption of a stationary ether". However, this does not correspond to the conclusion of Michelson in 1881 (44 years earlier), that *"the result of the hypothesis of a stationary ether is thus shown to be incorrect and the necessary conclusion follows that the hypothesis is erroneous"* [12].

As we know, in 1881 and in 1887, Michelson attempted to determine the change in the speed of light due to the motion of the Earth in its orbit around the Sun through the "stationary ether" [12, 13]. These experiments are discussed in detail in the analysis in in section 5 of Part I of the current book).

But now let us consider the explanation of the "Michelson-Gale-Pearson experiment", which is based on classical mechanics and Galilean relativity.

3.2 Explanation of the results of the experiment conforming to classical mechanics and Galilean relativity

This subsection presents a theoretical explanation of the experimental results in accordance with classical mechanics and Galilean relativity, which are in force, (valid) in the time-spatial domain with a uniform intensity of the gravitational field ("on the surface of the Earth").

Let us examine in detail the movement of the two light beams (Figure 4), taking into account that the two sides of the rectangular ring interferometer (AB and CD) are parallel to the equator. All the parts of the pipeline (with mirrors) move at linear speed corresponding to the corresponding latitudes (of the southern pipeline and northern pipeline) according to their location. Since the experiment was carried out in the Northern Hemisphere, the linear speed in the stationary space of mirrors A and B (located on the southern side of the rectangle) is greater than the linear speed in the stationary space of mirrors C and D (located on the northern side).

We will perform the experiment with respect to the two reference systems: within the frame of reference related to the space itself (Earth-Centered Inertial (ECI) coordinate system) and within the frame of reference related to the Earth's surface. As shown in Figure 4, beam "1" travels in a clockwise direction, and beam "2" travels in a counterclockwise direction.

3.2.1 Examination of the experiment in the reference system related to the stationary space (in the stationary "Earth-centered inertial system")

For an observer positioned in the stationary space (in the "Earth-Centered Inertial (ECI) frame of reference"), each point on the Earth's surface moves at the linear speed corresponding to the latitude where the point is located (for a point closer to the equator, its linear speed is higher). In the "ECI-frame of reference", the measured speed of light in all directions is equal to the *"speed of light in vacuum"* and is a constant because the gravitational field intensity in the local region "in the vicinity of the Earth's surface" is constant. However, in this frame of reference, the paths that the two beams pass (in the stationary space), are different. This is because the path in the stationary space that the two beams pass between the mirrors will be different because the mirror to which the two beams travel will move away (or approach) during the time of travel of the respective beam between the mirrors that are parallel to the equator. Moreover, the movement of the mirrors in the stationary space, which are located in the southern and northern pipes, occurs at different linear speeds.

As mentioned, the linear speed of mirrors A and B in the southern pipe (closer to the equator), is greater than the linear speed of mirrors C and D in the northern pipe. This means that the path in the stationary space of light beam 2, propagating to the east in the southern pipe, will be longer than the path of light beam 1, propagating to the east in the northern pipe (mirror B moves faster than mirror C). Respectively, the path of light beam 1 in the stationary space propagating to the west in the southern pipe will be shorter than the path of light beam 2 propagating to the west in the northern pipe (mirror A moves faster than does mirror D).

Let us denote the path lengths of the beam paths "1" and "2" in the stationary space (in the ECI-frame of reference). According to Figure 4, (and in accordance with the direction of propagation), the path lengths of beams "1" and "2" on side AB are $|BA|_1$ and $|AB|_2$ respectively, and the path lengths of beams "1" and "2" on side CD are $|DC|_1$ and $|CD|_2$ respectively. Therefore, due to the difference in latitude between sides AB and CD (the linear speed of mirror A and mirror B located on the south side are greater than the linear speed of mirror C and mirror D located on the north side), for the path of the two light beams in the stationary space (in the ECI-frame of reference) in the direction west to east, we can write:

$$|AB|_2 > |DC|_1 \qquad\qquad (11)$$

, and for the westward travel-path of the light beams, we can write:

$$|BA|_1 < |CD|_2 \qquad\qquad (12)$$

Therefore, the path traveled in the stationary space by light beam "2" (which travels in a counterclockwise direction) is longer than the traveled path covered by light beam "1" (which travels in a clockwise direction):

$$(|AB|_2 + |CD|_2) > (|BA|_1 + |DC|_1) \qquad\qquad (13)$$

As a result, the two light beams are out of phase when they return to point A. The resulting phase difference will be greater, not only when the sides AB and CD are longer. When the sides AD and BC are longer, the difference between the linear speeds is greater due to the greater latitudinal difference. Therefore, the phase difference will increase when the area of the rectangle is large (such as in Sagnac ring interferometer).

3.2.2. Examination of the experiment in the frame of reference related to the Earth's surface that moves/rotates in the surrounding stationary space

Michelson (the observer/experimenter), actually made his measurement in the frame of reference related to the Earth's surface. The two light beams are moving in opposite directions but travel the same total travel-path in this frame of reference. This is because the pipelines and the mirrors are stationary in this frame of reference (they are fixed on the Earth's surface); therefore, the distances between them do not change.

However, if the observer measures the speed of light in the frame of reference related to the Earth's surface, they will register different speeds of the light beams in the directions "from east to west" and "from west to east" (as in the experiments titled "One-way measurement of the speed of light"). Moreover, the difference in the speeds of the light beams will be greater on the southern side in comparison with this difference on the northern side due to the greater linear speed of the Earth's surface on the southern side. As a result, the two light beams are out of phase when they return to point A.

Let us, according to the abovementioned reasoning, make a calculation (according to classical mechanics) for the difference between the travel times of the two beams in the frame of reference related to the surface of the Earth:

If c is the *speed of light in vacuum* (the local physical constant in our local time-spatial domain); l_1 is the northern pipeline length (latitude $\emptyset_1$), where the linear speed of the Earth's surface is v_1; and l_2 is the southern pipeline length (latitude $\emptyset 2$), where the linear speed of the Earth's surface is v_2, then, in the frame of reference related to Earth's surface:

1) According to Galilean relativity: the measured speed of light in the northern pipe in the "east to west" direction will be $(c+v_1)$, and that in the "west to east" direction will be $(c-v_1)$;

2) According to Galilean relativity: the measured speed of light in the southern pipe in the "east to west" direction will be $(c+v_2)$, and that in the "west to east" direction will be $(c-v_2)$;

Therefore, the time necessary for light beam "1" (moving in the clockwise direction) to travel through the northern pipe is $l_1/(c-v_1)$; on the southern side, it is $l_2/(c+v_2)$; and the total time for the two sides is

$$T_1 = \frac{l_1}{c - v_1} + \frac{l_2}{c + v_2} \qquad (14)$$

The time necessary for the "2" light beam (moving in the counterclockwise direction) to travel through the northern pipe is $l_1/(c+v_1)$; the time needed for the "2" light beam to travel through the southern pipe is $l_2/(c-v_2)$, and the total time for the two sides is:

$$T_2 = \frac{l_2}{c - v_2} + \frac{l_1}{c + v_1} \qquad (15)$$

If we ignore the small difference between the travel-times of the two beams on side BC and on side AD (in the directions "South to Nord" and "Nord to South"), the total time-difference between the two light beams will be:

$$T_2 - T_1 = \frac{2l_2 v_2}{c^2 - v_2^2} - \frac{2l_1 v_1}{c^2 - v_1^2} \qquad (16)$$

i.e., in the frame of reference related to the Earth's surface (where the experiment was carried out):

The equation (16), obtained from the given real explanation of the experiment (based on classical mechanics and the relativity of Galileo) is the same as equation (8) from the article by Michelson, which, according to him is "deduced on the hypothesis of a fixed ether" [10].

3.3 Conclusion

We can conclude from equation (8), mentioned in the first Michelson's article, which, according to his words, is "deduced on the hypothesis of a fixed ether" [10]:

1.That equation (8) was derived on the basis of classical mechanics and Galilean Relativity.

2.That the equation (8) is derived in the frame of reference related to the Earth's surface (where the experimenter was located and the experiment was carried out);

3.That in our time-spatial region of constant gravity, "the speed of the light in vacuum is constant" is used, which is actually the speed of the light in the reference system related to the stationary space (in this case – related to the "Earth-Centered Inertial (ECI) coordinate system").

Let us track the chronology:

1. In his first article "The Effect of the Earth's Rotation on the Velocity of Light, I", Michelson showed that equation (9) follows directly from equation (8) [10]. However, Michelson did not show that equation (8) is deduced on the basis of classical mechanics and Galilean relativity. He only mentions "the expression for the difference in the pathbetween two interfering pencils", which is the equation (8), "may be deduced on the hypothesis of a fixed ether".

2. In the second article, it was reported that equation (10) is confirmed by the experiment. This means that the theoretically derived equation (9) is confirmed because it is actually the same as equation (10).

3. The equation (16) that was derived in this analysis, is the time difference for reaching the starting point of the two light beams (see equation 14 and equation 15). We have seen that equation (16), which was derived in previous subsection 3.2, based on classical mechanics and Galilean relativity, is exactly the same as equation (8), whose derivation Michelson does not show but mentions that "may be deduced on the hypothesis of a fixed ether".

==*Therefore, the "Michelson-Gale-Pearson experiment" proves the validity of our theoretical explanation, which was done on the basis of classical mechanics and Galilean relativity!*==

In fact, if we look at formulas (14) and (15), they show that, in the frame of reference related to the Earth's surface, the speed of light in different directions is different (as in the "one-way determination of the speed of light" experiments). Therefore, the question can be asked:

Why does Michelson not mention that when deriving the theoretical formulas (8) and (9), he used the fact that, in relation to the Earth's surface (in the frame of reference related to the Earth's surface) – the measured speed of light in "West to East" direction is (V-v), and in "East to West" direction is (V+v), where V is the speed of light in vacuum, and v is the linear speed of the Earth's surface? This would mean that:

The speed of light is not the same for all inertial frames of reference!

In fact, the result of the "Michelson-Gale-Pearson experiment" undeniably proves this fact!

The reason for this "failure to mention" by Michelson in 1925, is (perhaps) that he did not want to enter into conflict with the proponents of the special theory of relativity and because:

The Nobel Prize in Physics 1907 was awarded to Albert A. Michelson:

"For his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid". (Nobelprize.org)

In fact, Michelson has earned this award for his great contribution to science. Actually, it is not his conclusion that *"the speed of light is the same in all inertial frames of reference"*.

4. ANALYSIS OF THE "SAGNAC EXPERIMENT"

4.1 The idea and the description of the experiment

Georges Sagnac, a French physicist, constructed a device "ring interferometer" (rotating interferometer with two light beams on a closed loop), also called the "Sagnac interferometer". The interferometer consists of a light source, collimator (transforming light or other radiation from a point source into a parallel beam), beam-splitter (splitting the beam in two directions), photographic plate, and 4 mirrors of the interferometer, which are all mounted on a spinning disc (0.5m in diameter). In this way, they are all stationary with respect to the disc, but they are actually spinning in the stationary empty space –in the reference system related to the space itself (Figure 5).
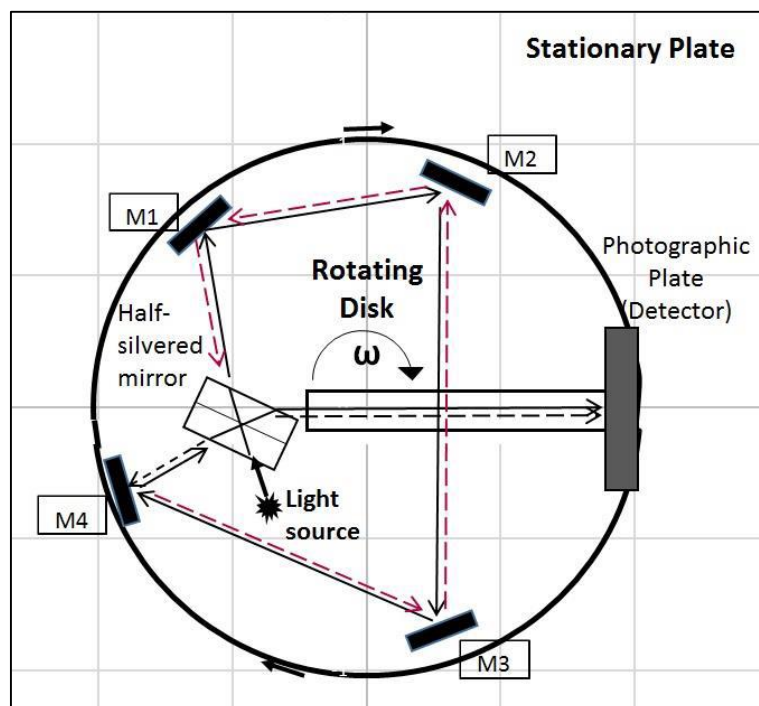
Figure 5. Schematic representation of Sagnac interferometer

Description of the experiment: A monochromatic light beam is split and the resulting two beams follow (reflected by the four mirrors) exactly the same path in the reference system related to the spinning disk. The trajectories of the two beams, however, are in opposite directions, which is actually the brilliant idea of the experiment of Georges Sagnac. The two recombined light beams (unified again after one full cycle), are then focused on a photographic plate, creating a fringe pattern (a series of bright and dark bands caused by light beams that are either in phase or out of phase relative to each other), permitting high-accuracy measurement of the interference fringe displacement, as Georges Sagnac described in his article titled *"On the proof of the reality of the luminiferous aether by the experiment with a rotating interferometer"* [5].

The idea is to demonstrate the different speeds of the two light beams in the frame of reference related to the spinning disk. In this frame of reference, the speed of the beam, moving in the direction of rotation of the disk decreases, and the speed of the other beam, moving in the opposite direction of rotation of the disk increases when the speed of the disk rotation increases. The experiment demonstrated that the picture of the interference fringes (the bright or dark bands caused by the beams of light that are in phase or out of phase relative to each other) changes when the speed of rotation of the disk changes.

The results of the experiment are precisely fixed.

The observed effect: is that the displacement of the interference fringes (the bright and dark bands), changes with the change in the speed of the disk rotation.

The reported result by Georges Sagnac is as follows:

> *"The result of these measurements shows that, in ambient space, light propagates with a velocity V_0, independent of the collective motion of the source of light O and the optical system. This property of space experimentally characterizes the luminiferous aether. The interferometer measures, according to the expression (according to the presented equation), the relative circulation of the luminiferous aether in the closed circuit"* [5].

It is understandable that the result of the experiment was explained a century ago by the relative circulation of the luminiferous aether in a closed circuit. According to the supposition of Christiaan Huygens (Dutch physicist), light travels in a hypothetical medium called "luminiferous aether", a space-filling substance, thought to be necessary as a transmission medium for the propagation of electromagnetic radiation.

In fact, the conclusion is not that the space has a property that characterizes the "luminiferous aether", but rather that: the "ether" is considered to be the "warped space-time of the Universe" itself:

> *the "ether" is considered to be the "warped space-time of the Universe" itself [4].*

4.2 Explanation of the experiment in accordance with classical mechanics and Galilean relativity

The Earth rotates in the surrounding stationary space with a constant angular velocity. The linear speed of the Earth's surface, at the latitude where the experiment was carried out, is

constant. The plate (the table on which the rotating disk is mounted), is fixed stationary on the Earth's surface. Therefore, the influence of the Earth's rotation on the speeds of the two light beams (the displacement of the interference fringes due to the Earth's rotation), is constant.

Note: The displacement of interference fringes due to the Earth's rotation around its axis is discussed in the analysis of the "Michelson–Gale–Pearson experiment".

According to the experiment, however, the light source, the collimator (transforming the light beam from a point source into a parallel beam), the beam-splitter (splitting the beam in two opposite directions), the photographic plate, and the four mirrors mounted on the disk rotate all together in the stationary space at the speed of the disk. As a result, the different rotational velocities of the disc create different displacements of the interference fringes due to the influence of the disc velocity on the speeds of light beams in the frame of reference related to the spinning disk.

The two frames of reference, which we are considering in the theoretical explanation of the experiment, are:

1.The first one is *related to the rotating disk*, where the light source, the collimator, the beam-splitter, the photographic plate, and the four mirrors are mounted. When the observer is on the disk, all devices (the collimator, the beam splitter, the photographic plate, and the four mirrors) mounted on the disk are stationary for the observer (regardless of whether the disc is spinning or not).

2.The second one is *related to the stationary space itself*. Appropriate for the explanation of the experiment is, to consider it in a *"Disk-Centered Inertial coordinate system"* (DCI frame).

The description of this frame of reference is as follows:

> 1. The origin of the *"DCI coordinate system"* is the center of the disk. If we ignore the displacement of the interference fringes due to the Earth's rotation (which is constant, regardless of the disk rotation), we actually accept that the origin of the "DCI coordinate system" (the center of the disk, which is a fixed point on the Earth's surface), is stationary in relation to the surrounding space. Similarly, the North and South poles are stationary in the stationary space when the Earth rotates around its axis.

> 2. The plane of the disk represents the (x, y) plane, and the axes of the "DCI coordinate system" are stationary in relation to the surrounding stationary space.

This means that the "Disk-Centered Inertial coordinate system" (DCI frame), for the present case, can be considered as a stationary frame of reference in relation to the surrounding stationary space. In other words, the observer situated in the DCI frame will see how the light source, the collimator, the beam splitter, the photographic plate, and the four mirrors of the interferometer rotate together with the disc.

Before the examination of the experiment, we can recall that every mechanical or optical experiment actually takes place in the common stationary space of the considered frames of reference.

4.2.1 Examination of Sagnac experiment in the reference system related to the surrounding stationary space – in the "disk-centered inertial coordinate system" (DCI frame of reference)

In our time-spatial region "in the vicinity of the Earth's surface", the intensity of the gravitational field is uniform (the same). According to the abovementioned initial conditions

of the experiments (which do not contradict the standpoint of contemporary physics): electromagnetic radiation propagates in vacuum (i.e. in the stationary space), at a constant speed equal to c. This speed is actually the speed of light in the stationary in relation to the space "DCI frame of reference".

However, everything mounted on the spinning disc rotates (moves) in the stationary space (which means: in relation to the "DCI frame of reference"). Therefore, in this frame of reference, the length of the path that the two light beams actually travel in space is different.

This is due to the movement of each mirror in the stationary space (at the rotation of the disk) during the travel of the light beams toward the mirrors.

The two light beams travel in opposite directions. Thus, the path length in the stationary space of one of the light beams (which travels in the opposite direction of the disk rotation) is shortened, and the path length in the stationary space of the other light beam (which travels in the direction of the disk rotation) is extended. As a result of the change in the path lengths of the two light beams (due to different velocities of the disk rotation), different displacements of the interference fringes are created.

Therefore, the conclusion of the observer, located in the stationary in relation to the space "DCI coordinate system" (where the speed of light is constant and equal to c), is that the displacement of the interference fringes is due to the change in the path lengths traveled by the two light beams, which in turn depends on the velocity of the disk rotation.

4.2.2 Examination of the Sagnac experiment in the frame of reference related to the spinning disk

Positioned on the spinning disk, the observer will see that all devices (the collimator, the beam splitter, the photographic plate, and the four mirrors) mounted on the disk do not move – that they are stationary. Therefore, the path lengths of the two beams (the distances between the mirrors) also do not change when the disk spins. As a result, the speeds of the two light beams in the frame of reference related to the spinning disk are different. This difference depends on the velocity of the disk rotation: the speed of the beam that travels in the direction of the disk rotation decreases to $(c-V)$, where V is the linear speeds of the mirrors, while the speed of the other light beam, which travels opposite to the direction of the disk rotation, increases to $(c+V)$. In fact, the "light speed anisotropy" observed in the Sagnac experiment is similar to the "light speed anisotropy" in the "One-way determination of the speed light" experiments.

Therefore, the conclusion made by the observer positioned in the frame of reference related to the spinning disk is that the displacement of the interference fringes is due to the difference in the speeds between the two light beams. In turn, that difference (respectively the displacement of the interference fringes) changes with the change in the velocity of the disk rotation.

Finally, we can underline that as early as 1913, the Sagnac experiment actually proved that *"the speed of light is not the same in relation to all frames of reference"*. This was even before the publication of the general theory of relativity. Is it not surprising that Einstein never commented on this experiment, although certainly knew about its existence?

The Sagnac experiment is unofficially considered mystical because thus far, none of its explanations have been officially accepted. Although the Sagnac experiment proves that the speed of light is not the same in all inertial reference frames, many modern physics journals publish "scientific" explanations based on the special theory of relativity... which is based on

the false claim that "the speed of light is the same in all inertial frames of reference". In other words, this is a classical "circular reference"! An example of a published "scientific" comparison of different explanations is that of Malykin, G.B. *"The Sagnac effect: correct and incorrect explanations"* [14]. There are other such examples in the scientific literature. Despite all of these mystifications, although there is currently no valid scientific explanation for this phenomenon, the results of these experiments have many significant practical applications. A wide range of applications is found in space navigation, aviation (optical gyroscope), and daily Earth positioning needs, where no one has observed any "anisotropy" of the "meter" as a unit of measurement (which is a claim of the special theory of relativity).

Additional proof of the credibility of the abovementioned explanation of the Sagnac experiment is given in the next subsection 4.3. This theoretical explanation demonstrates the derivation and origin of the most commonly used equation in rotational analyses.

4.3 Derivation of the equation, which is often used in rotation analyses

The Sagnac effect manifests itself in a setup called a ring interferometer. It is the basis of the widely used high-sensitivity fiber-optic gyroscope that fixes changes in the spatial orientation of an object (airplane, satellite).

In general, a fiber-optic gyroscope consists of a rotating coil with a number of optical fiber turns. Optical fibers are flexible, transparent fibers made of glass (silica) or plastic. It consists of two separate parts. The middle part of the fiber is called the core and is the fiber optic medium through which the light travels. Another layer of glass called the cladding wraps around the outside of the core. The cladding's task is to keep the light beams inside the core. This can be done because the cladding is made of a different type of glass relative to the core; the cladding has a lower refractive index and acts as a countless small mirror. Each tiny particle of light (photon) propagates down the optical fiber by bouncing repeatedly off the cladding, as though the cladding is truly a mirror (the photon reflects in repeatedly). This phenomenon is called total internal reflection, which causes the fiber to act as a waveguide.

We will examine a simple ring interferometer (a coil with only one fiberoptic turn) mounted on a rotating disk with an angular velocity ω radian/sec (see Figure 6).
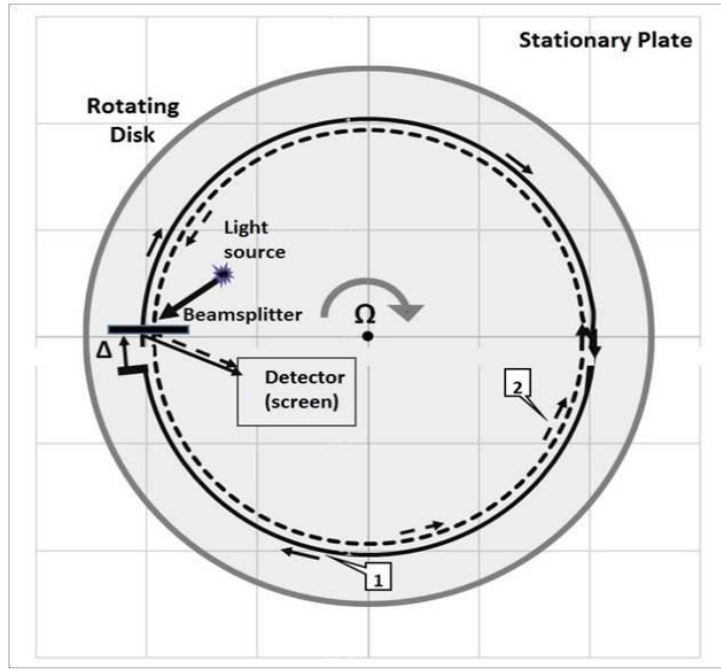
Figure 6. Schematic presentation of a circular interferometer with one optical coil

Two laser beams propagate in the rotating coil: one in the direction of the coil rotation, and the other in the opposite direction of the coil rotation. When the angular velocity of the rotating coil changes at the turning of the object where it is mounted, the displacement of the interference fringes also changes.

The effect (the displacement of the fringes) is dependent on the effective area of the closed optical path. However, this is not simply the geometric area of the loop, but is enhanced by the number of turns in the coil. The equation that we derive on the basis of the aforementioned theoretical explanation of the Sagnac experiment is often used in analyses of rotation:

$$\left(\Delta t = \frac{4A\omega}{c_0^2} \right) \qquad\qquad (17)$$

, where A is the area of the circle bounded by the fiber-optic coil. The optical circuit (the "fiber-optic medium"), mounted on the rotating disc rotates along with the rotation of the disc at a linear speed equal to $R\omega$, where R is the radius of the optical circuit and ω is the angular velocity of the rotating disk. The speed of light in the stationary "empty space" between the atoms is c_0 (inside the "fiber-optic medium" where the speed of light is constant for the homogeneous optical medium).

As shown, the two light beams (beam 1 and beam 2) travel in opposite directions in the same fiber optic circle. Let us analyze one cycle of each of the two beams (from the moment of splitting to the moment of directing them to the screen-detector).

Here, two factors must be considered:

   1. The first is that the "empty space" inside the optical fiber (the optical medium) is stationary, although each atom of the optical fiber moves during rotation. Since the "empty space" has no mass, no force can accelerate the space (to set it in motion). This is a consequence of Newton's second law of motion (*F=ma*). Neither the strength of the chemical bonds between atoms (in the micro-world) nor the gravitational forces

(according to Newton's law of universal gravitation in the macro-world) can force the space to move, because the space has no mass.

2. The second is that at the microscopic level, the cladding of the optical fiber can be seen as a continuous series of millions of miniature mirrors in which the photons are reflected as they propagate (in the case of Sagnac's experiment, there are only four mirrors).

Like in Sagnac's interferometer, each of these "elementary mirrors" shifts at a definite angle from the previous photon reflection when the optical coil is rotated – (the mirrors are moved at a certain distance during the propagation time of the photons in the stationary "micro-space" of the optical medium). Thus, in the stationary space, the path of the photons (of the light beam), moving in the direction of rotation of the optical coil is extended, and the path of the light beam, moving opposite to the rotation of the optical coil, is shortened.

4.3.1 Analysis of one rotation cycle of the light beam "1" that travels in the direction of the disc rotation

A) In the stationary (in relation to the surrounding space) Disk-Centered Inertial (DCI):

After splitting, light beam "1" makes one full cycle in the direction of disk rotation, and reaches the beam-splitter again after time interval t_1 to redirect to the display (screen). For the stationary in the space observer (located in the DCI-coordinate system), the distance traveled by beam "1" in the stationary space inside the optical medium is longer than the fiber optic coil circumference $(2\pi R)$ with $\Delta = R\omega t_1$. This is because, during the beam travel, the point of redirection to the detector (screen), as well as the entire optical loop, moves at a distance Δ, due to disk rotation.

Therefore, the distance traveled by light beam "1" in the stationary surrounding space is $(2\pi R + R\omega t_1)$; thus for the time interval t_1 (the time for one turn of light beam "1"), the observer in the "DCI frame of reference") records the following

$$t_1 = \frac{2\pi R + R\omega t_1}{c_0} \qquad (18)$$

, where c_0 is the speed of light inside the "fiber-optic medium" (where the speed of light is constant for the homogeneous optical medium).

B) In the frame of reference related to the rotating disk, where the fiber-optic coil is mounted:

For the observer, positioned in this frame of reference (on the rotating disk), the distance traveled by the light beam "1" is $2\pi R$, because the fiber-optic coil does not move in this frame of reference (in relation to the rotating disc). For the same time interval t_1, the speed of light beam "1" is equal to $(c_0 - R\omega)$, and for time interval t_1 (the time for one turn of the light beam "1"), the observer (in the frame of reference related to the rotating disk) will register:

$$t_1 = \frac{2\pi R}{c_0 - R\omega} \qquad (19)$$

, which is actually equal to t_1 from the expression (18) after its transformation for deriving t_1, *i.e., there is no "relativistic difference in time"!*

A) In the stationary (in relation to the surrounding space) Disk-Centered Inertial (DCI) coordinate frame:

After splitting, the light beam "2" makes one full cycle in the opposite direction to the disk rotation and reaches the beam splitter again after the time interval t_2, to be redirected to the display (screen). Actually, the distance, traveled by beam"2" in the stationary space inside the optical fiber, is shorter than the fiber optic coil circumference *(2πR) with Δ = Rωt₂*. This is because, for the travel time of the beam for one cycle, the redirection point to the detector (as well as the whole optical coil) has approached, due to the rotation of the disk against the direction of movement of the beam. Therefore, the distance traveled by the light beam "2" in the stationary space (in the "DCI coordinate frame"), is *(2πR − Rωt₂)*. The Observer, in the stationary in relation to the surrounding stationary space "Disk-Centered Inertial (DCI) coordinate frame", will register for the travel time t2 (for one turn of the light beam "2"):

$$t_2 = \frac{2\pi R - R\omega t_2}{c_0} \qquad (20)$$

where c_0 is the speed of light in the "fiber optic medium" (where the speed of light for the homogeneous optical medium is constant).

B) In the frame of reference related to the rotating disk

For the observer, positioned in this frame of reference (on the rotating disk), the distance traveled by the light beam "2" is exactly $2\pi R$ because the fiber-optic coil does not move in relation to the rotating disc (in the observer's frame of reference). For the same time interval t_2, the speed of light beam "2" is equal to *(c₀ +Rω)*; for the travel time for one cycle of light beam "2", the observer in the frame of reference related to the rotating disk will register:

$$t_2 = \frac{2\pi R}{c_0 + R\omega} \qquad (21)$$

which is actually equal to t_2 from the expression (20) after its transformation for deriving t_2, i.e., *there is no "relativistic difference in time"*.

4.3.3 The results

On the basis of the analysis, it was found that:

1.The time t_2 for one complete tour of light beam "2" is the same for both frames of reference;

2.The time t_1 for one complete tour of light beam "1" is the same for both frames of reference.

3.However, the time for one complete tour of light beam "1" (which moves in the direction of the rotation of the optical coil) is more than the time for one complete tour of light beam "2" (which moves in the opposite direction of the rotation of the optical coil).

The difference between the travel times of the two beams "1" and "2" actually determines the displacement of the interference fringes, which changes with the change in the velocity of the disk rotation.

For the difference between the time for one tour of light beam "1" and the time for one tour of light beam "2", we obtain (after subtracting equation (21) from 19):

$$\Delta t = t_1 - t_2 = \frac{4\pi R^2 \omega}{c_0^2 - (R\omega)^2} \cong \frac{4A\omega}{c_0^2} \qquad (22)$$

because

$$c_0^2 \gg (R\omega)^2 \qquad\qquad (23)$$

Equation (22) is actually the equation (17) we had to derive.

Therefore, the demonstrated derivation of the equation, which is often used in rotation analyses, verifies the validity of the theoretical explanation of the Sagnac experiment (in accordance with classical mechanics and Galilean relativity!

4.4 Conclusion

The moving reference system in the stationary space in the Sagnac experiment is the "spinning disc". The moving reference system in the stationary space in "One-way measurement of the speed of light" and "Michelson-Gale-Pearson" experiments is the "rotating Earth's surface".

The observed effects of displacement of the interference fringes in the case of "Sagnac's ring interferometer", the "Michelson–Gale–Pearson experiment", and "light speed anisotropy" (the difference in the speed depending on the direction of the light beam in the case of "One-way determination of the speed of light") clearly demonstrated the following:

The speed of light is not the same for all inertial frames of reference. The speed of light in vacuum is constant in our time-spatial domain "near the Earth's surface", where the gravitational field intensity is constant. The speed of light is different, however, in a frame of reference that moves in the stationary space. The measured speed of the light in a moving frame of reference differs depending on the speed and the direction of motion of the frame of reference in the stationary space!

The main reason, for the accepted by modern physics false claim, that "the speed of light is the same for all inertial frames of reference" turns out to be the *"Michelson-Morley experiment"*, which "results" are a consequence only of the inappropriate conceptual design of the two-way-interferometer of Michelson.

The delusion, that *"the speed of light is the same for all inertial frames of reference"*, is the fundament of the special theory of relativity. The analysis of the article *"On the Electrodynamics of Moving Bodies"* shows exactly where and how the claim "the speed of light is the same for all inertial frames of reference" illogically was applied – and actually reveals the essence of the special theory of relativity!

5. ANALYSIS OF THE MICHELSON-MORLEY EXPERIMENT

For electromagnetic radiation, the quantum theory put forward by Max Planck in 1900 combined the wave theory and the particle theory. In fact, electromagnetic radiation is a stream of energy packets (like particles) propagating radially from the source, but sometimes it can behave like a stream of particles and sometimes like a wave.

After the development of Maxwell's theory of electromagnetism, questions about the speed of light and what medium supports the transmission of electromagnetic radiation arose. For James Clerk Maxwell and other scientists at that time, the answer was based on the supposition of Christiaan Huygens that light travels in a hypothetical medium called the "luminiferous aether". According to the hypothesis of the existence of a "stationary luminiferous aether", there is an invisible "substance" filling the space, which was thought to be the necessary medium for the propagation of electromagnetic radiation (of the light).

Even today, many scientists believe that light travels in a hypothetical "luminiferous aether" and look for evidence of its existence.

5.1 The expectations of scientists at the end of the 19ᵗʰ century

The Earth rotates around its axis, moves in its orbit around the Sun, and together with the Solar System moves around the center of our Milky Way galaxy.

The expectations of scientists have been that if the hypothesis of the "stationary ether" is correct, the velocity vector of the created "ether wind" at Earth's motion, at any time, must be equal to the sum (vector addition) but in the opposite direction of the following three vectors:

1. The velocity vector of motion of the entire Solar System as it whirls around the center of our Galaxy at approximately 220 km/s (if we measure the speed by means of the units of time and length defined on the Earth's surface); plus

2. The velocity vector of the Earth's motion in orbit around the Sun (which is approximately 30 km/s); plus

3. The vector of the linear velocity of the Earth's surface at the location of the experiment (due to the Earth's rotation around its axis). The linear speed of the Earth's surface at any point on the equatorial line is approximately 0.46 km/s, but it is equal to zero at the points at the intersection of the axis of rotation with the Earth's surface, which coincide with the northern and southern geographic poles.

Figure 7 below is an illustration of the expected "ether wind" that occurs during the motion of the Earth through a hypothetical medium called luminiferous ether. The figure depicts the Sun, the Earth, and the Earth's orbit. The three types of dotted lines depict the three components of the supposed "ether wind", which have opposite directions to the aforementioned three vectors. The figure does not correspond to the scale (the radius of the Sun is approximately 109 times larger than the radius of the Earth, and the difference between the velocities of movement of the Earth and of the Solar System is much greater).
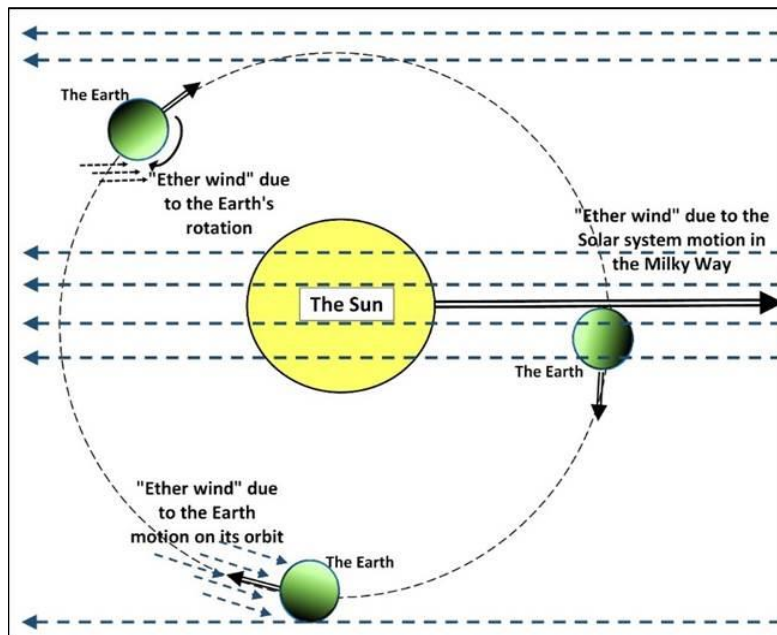
Figure 7. The Earth's motion around the Sun and the alleged "ether wind"

The expectations of scientists have been that the "ether wind" will affect the velocity of a light beam (increase or decrease the speed of light).

1.On the one hand, if the experiment is carried out at a fixed location on the surface of the rotating Earth, then the part of the vector "ether wind" created by the motion of the Earth in its orbit around the Sun should have to vary in magnitude and direction over time (e.g. at night and during the day).

2.On the other hand, the experimenter can point the light beam in different directions. Thus, the effect of the generalized ether wind vector (vector addition) on the speed of the light beam was expected to be different. In this way, the "ether wind" will have a different effect on the speed of the light beam since the scalar projection of the generalized vector "ether wind" on the trajectory of the light beam will be different.

We can call the vector projection of the velocity vector "ether wind" onto the vector of the light beam velocity – "ether headwind" (see Figure 8 below).
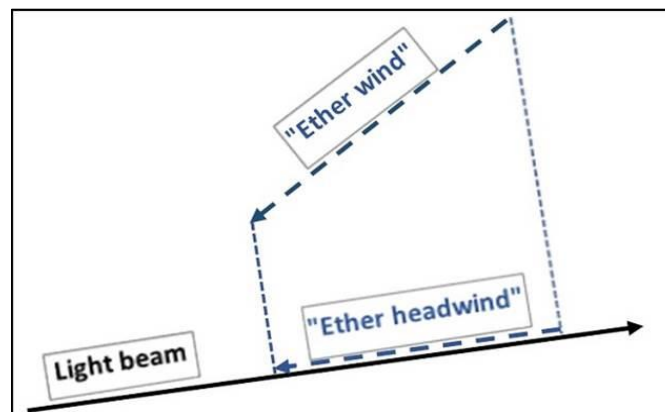
Figure 8. The expected influence of the "ether headwind" on the speed of a light beam in vacuum

Therefore, according to expectations, the resulting speed of light would be different, depending on the direction of the light beam, and would be different at night and during the day when the direction of the "ether headwind", caused by the movement of the Earth in its

orbit around the Sun, is opposite. The difference in the speed of light for different seasons of the year (at various points of the trajectory of the Earth in its orbit around the Sun), was expected to be an indication of the velocity of motion of the Solar System in the stationary luminiferous ether.

Therefore, if the hypothesis of the existence of the "stationary ether" is true, the "ether wind" created by the Earth's motion through the stationary ether should increase or decrease the speed of the light beam (depending on the direction and magnitude of the "ether headwind").

5.2 First Michelson's Experiment

Albert Michelson designed an experimental construction, later known as the Michelson interferometer, (see Figure 9 below), and made his first experiment in 1881 in order to determine the change in the speed of light due to the motion of the Earth in its orbit around the Sun through the "stationary luminiferous ether".

The experimental construction of the interferometer designed by Michelson, illustrated below in Figure 9, uses two-way light beam propagation (in the straight direction and in the opposite direction/the reflected beam) in exactly the same path.

The interferometer consists of a monochromatic light source (with an accurate frequency), a semi-silvered mirror separating the monochromatic light beam from the source along the two mutually perpendicular arms, two mirrors (A and B) reflecting the coherent light beams in opposite directions, and a detector depicting the interference fringes after reuniting the two light beams. All apparatuses are horizontal (i.e. at the same gravitational potential.
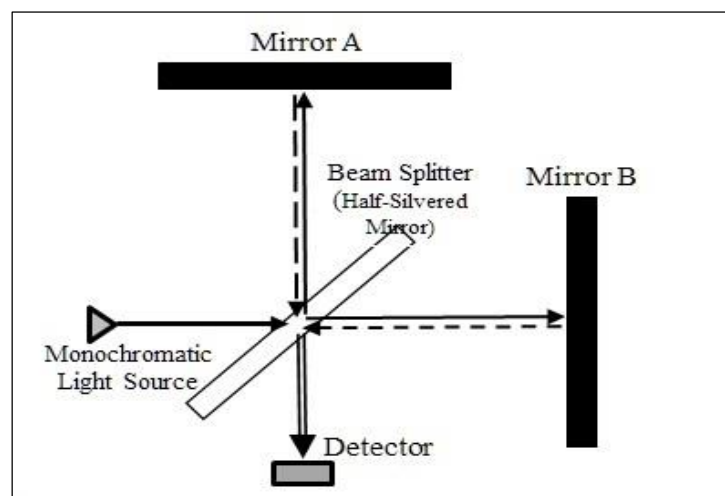
Figure 9. Scheme of the Michelson interferometer

Michelson's expectations:

According to Michelson, if the "stationary luminiferous ether" exists, the motion of the Earth through the ether would result in an effect of the "ether wind" on the speed of the light beam. Above, we have called the projection of the three-component vector sum "ether wind" on the direction of the light beam "ether headwind" (see Figure 8).

In other words, Michelson expected the speed of the light beam to be different:

1.First, depending on the direction of the arms on which the light beams spread.

2.Second, the speed of the light beam (in the case of a fixed direction in relation to the Earth's surface) was expected to be different at night and during the day when the direction of the

"ether headwind" caused by the Earth's motion in its orbit around the Sun was opposite to the direction of the fixed light beam (see below Figure 10).
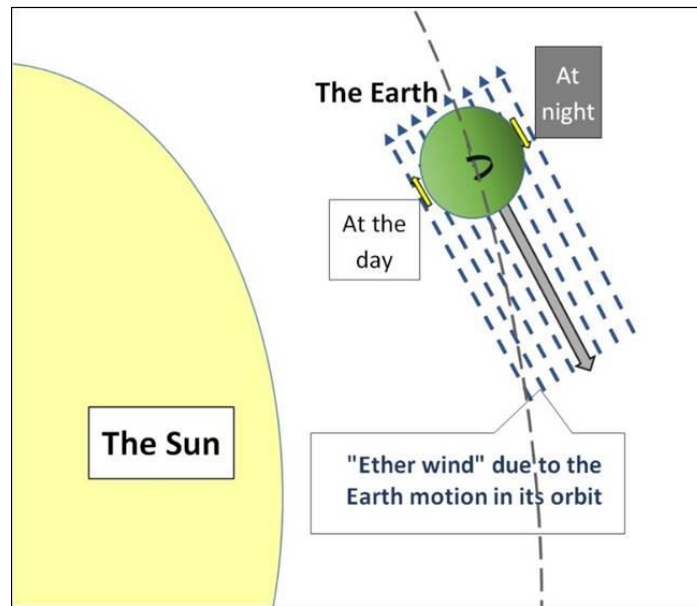
Figure 10. Schematic representation of the opposite directions of the expected "ether wind" at night and during the day due to the motion of the Earth along its trajectory around the Sun.

On this basis, Michelson performed his first experiment in 1881 with an interferometer constructed by him (Figure 9). Michelson used a monochromatic light beam split (for the two coherent light beams to be perfectly the same) on two arms in two mutually perpendicular directions. The two light beams propagate along two mutually perpendicular arms, and each beam is reflected in the opposite direction by a mirror. After reuniting the two reflected beams at the place of splitting, Michelson expected to ascertain the following:

The displacement of interference lines which is consistent with the expected difference in the speeds of the two light beams, caused by the "ether wind" due to the movement of the Earth in its orbit around the Sun.

Subsequently, the construction of the "Michelson-Morley" experiment was improved; the light beams are reflected repeatedly, but the same idea is used again – the usage of two coherent light beams in two directions, from the splitter of the monochromatic beam to the mirrors and backward. The fact that the same beam is used in opposite directions (one reflected) on the same arm, means that each of them travels exactly the same distance – from the monochromatic beam splitter to the mirror (the straight beam), and back (the reflected beam). This, however, means that if the speeds of the two opposite light beams, moving in opposite directions is changed by the "ether wind", the change will be opposite, and the difference will be completely compensated because the paths of the two beams (the straight and the reflected) are perfectly the same! This is the reason why the difference in the speeds of the light beams on each of the arms caused by the rotation of the Earth on its axis cannot be observed!

Thus, on the basis of the speed of the Earth in its orbit around the Sun, which is approximately 30 km/s, the expectation of Michelson was that the displacement of the interference fringes (the bright or dark bands caused by beams of light that are in phase or out of phase relative to each other) will be different at night and during the day and will correspond to the calculations made. However, the speed of light in vacuum (the speed of light in the frame of reference related to the stationary space) always remains unchanged

(constant) because the intensity of the gravitational field on the Earth's surface remains constant during the travel of the Earth in its orbit around the Sun and during the travel of the Solar System in the Galaxy! That is the reason that the difference in the speed of light that can be registered is only that, which is caused by the rotation of the Earth around its axis (as a consequence of the linear velocity of the movement of the surface of the Earth in the stationary space).

The yellow arrows show (see Figure 10) the direction of motion of the Earth's surface, where the interferometer is located. According to the presented image, the direction of motion of the Earth's surface during the day is in the direction of the hypothetical "ether wind", and at night - opposite to the "ether wind" direction. The figure depicts a glimpse of the trajectory at which the Earth moves clockwise.

Note: The experiments were carried out at short intervals of time (the "Michelson-Morley experiment" was carried out from July 8 to July 12). This means that the Earth was located approximately in the same place on its trajectory around the Sun. That is why the difference in the speed of light due to the "ether wind" at different points in the Earth's trajectory around the Sun (which is an indication of the velocity of motion of the Solar System in the Milky Way with approximately 220 km/s – see Figure 7), was not calculated by Michelson.

As stated, the predicted change in the direction of the "ether wind" during the day and at night in relation to the fixed arms of the interferometer to the Earth's surface, should have led to different changes in the speeds of the two light beams, which should have been registered as different displacements of the interference fringes. Using a wavelength of approximately 600 nm, Michelson expected that there would have been a displacement of the interfering fringes, for which he made accurate calculations. The expected difference in the displacement of interference fringes during the day and at night was sought in different directions between the two perpendicular arms of the interferometer.

However, the expected displacement of the interference bands was not ascertained.

The results reported by Michelson:

"The small displacements -0.004 and -0.015 are simply errors of experiment" [12].

Michelson's conclusion was as follows:

"The interpretation of these results is that there is no displacement of the interference bands… The result of the hypothesis of a stationary ether is thus shown to be incorrect, and the necessary conclusion follows that the hypothesis is erroneous" [12].

5.3 The well-known "renowned" Michelson-Morley experiment

The famous Michelson–Morley experiment was performed in 1887. In collaboration with Edward Morley, Albert Michelson, constructed a new improved interferometer. As in the first experiment, the improved interferometer used two-way paths of two light beams on two perpendicular arms. However, by using multiple mirrors, the light path length of the two light beams was approximately 10 times longer. The light was repeatedly reflected back and forth along the arms of the interferometer, increasing the total light path length of each beam to 11

m. Thus, according to the intention, there was more than enough accuracy to detect the ether-hypothetical effect of the Earth's motion. At a path length of 11 m, the expected displacement should have been approximately 0.4 of the distance between the fringes. To eliminate thermal and vibration effects, Michelson and Morley's interferometric apparatus was assembled on the top of a large block of sandstone, approximately a foot thick, which was then floated in a pool of mercury.

The results: The results of the experiment were entirely unexpected and inexplicable; again, the effect of the motion of the Earth around the Sun through the hypothetical ether on the speed of light was practically zero at any time of day or night at all times of the year at different points in the Earth's orbit. The reported results were given by Michelson:

"It seems fair to conclude that if there is any displacement due to the relative motion of the earth and the luminiferous ether, this cannot be much greater than 0.01 of the distance between the fringes" [13].

Although the experiments were repeated many times with even greater precision, they produced the same negative results.

5.4 Conclusion

As grounded above, the speed of light in vacuum is a local constant and depends on the intensity of the gravitational field in any time-spatial domain. The speed of light in vacuum "on the surface of the Earth" is determined by the Earth's gravity and remains constant in the motion of the Earth in its orbit around the Sun and with the Solar system in the galaxy, because the intensity of the gravitational field near the Earth's surface is constant and is determined above all by the mass of the Earth.

However, the measured speed of light in different frames of reference is different in the local region "near the Earth's surface". In the one-way measurement of the speed of light between two points at the same latitude:

    1. The measured speed of light in the "west to east" direction in the reference system related to the Earth's surface is *(c-V)*;

    2. The measured speed of light in the "east to west" direction in the reference system related to the Earth's surface is *(c+V)*;

where c is the local constant *"speed of light in vacuum"*, and *V* is the linear speed of the Earth's surface at the respective latitude. The proofs presented above in the analyses of the *"One-way measurement of the speed of light"* and *"Michelson-Gale-Pearson"* experiments clearly ascertain the effect of the Earth's rotation around its axis on the speed of light, measured on the Earth's surface. The measurements of Marmet in 2000 and of Kelly in 2005 also indisputably ascertained the difference in the measured speed of light in the frame of reference related to the moving Earth's surface in the stationary space. These examples demonstrate the validity of the Galilean transformation (which is an undisputable fact in our local physical reality).

However, in the "Michelson–Morley" experiment, no effect on the speed of light was found as a result of the Earth's rotation around its axis. The reason lies in the inappropriate conceptual design embedded in the construction of the interferometer. When the *"two-way measurement of the speed of light"* is used, the average speed of the two light beams is

measured, propagating in two exactly opposite directions on exactly the same path. Therefore, the change in the speeds of the two light beams in the two opposite directions, for each arm of the interferometer is completely compensated! *If the resultant speed of the light beam in the direction "from the semi-silvered mirror to the reflecting mirror (either mirror A or mirror B)" is (c+V), then the speed of the light beam in the opposite direction will be exactly (c-V)*, where c is the speed of light in vacuum and V is the scalar projection of the linear velocity of Earth's surface on the arm of the interferometer (i.e. on the direction of light beam propagation).

The path of the light beam in both directions for each arm is absolutely equal and the direction and the length of the arm are irrelevant, because, at any value of V, the differences in the speeds will be completely compensated for each other. Thus, the resulting average speed (measured for the two directions of the light beam in any arm) will always be equal to the constant speed of light in vacuum on the Earth's surface: *[(c+V)+(c-V)]/2=c!* This means that the interference fringes will never be displaced, because the average speed of each light beam in both directions of any arm will always be exactly equal to c (the speed of light in vacuum) – regardless of the length of the arm, regardless of the arm's direction!

Therefore, in the "one-way measurement of light speed experiments" and the "Michelson-Gail-Pearson experiment", the change in the speed of light as a result of the Earth's rotation in the reference system related to the surface of the Earth can be registered. However, when Michelson's type interferometer is used ("interferometer using two-way propagation of light beams on exactly the same path") – this is impossible!

The above mentioned conclusion is given in the article [2]:

> *"Actually, if the "ether wind" even exists (caused by the Earth's movement through the stationary luminiferous ether), then the difference in the speed of light between the two light beams, traveling in two opposite directions on the same arm, is completely compensated. This is true for any arm in any direction! In other words, if the projection of the velocity of the "ether wind" in the direction of one of the light beams is (+V), then the projection of the velocity of the "ether wind" in the direction of the reflected light beam (traveling in opposite), will be exactly (-V)" [2].*

Therefore, the poorly designed "Michelson–Morley experiment" can be classified as an enormous fallacy, given what it means to physics "more than a hundred years of delusion".

Over the past 100 years, many variants of the Michelson-Morley experiment have been carried out by many scientists from different famous universities and institutes of relativity and cosmology, with increasing sophistication and increasing accuracy. However, the result cannot be other – the difference in the speeds of light between the two light beams, traveling in two opposite directions on the same arm, is completely compensated if the construction of an "interferometer using two-way propagation of light beams" is used.

An example of this continuing and nowadays delusion is also a publication in *"Physical Review Letters"* and reported in "Physics World" (the membership magazine of the Institute of Physics, one of the largest physical societies in the world) – "Michelson-Morley experiment is best yet" accessed in September 2009 (https://physicsworld.com/a/michelson-morley-experiment-is-best-yet/).

In summary: *The "Michelson-Morley experiment" is actually the primary root cause of the great delusion that "the speed of light is the same in all inertial frames of reference", which is the core of the special theory of relativity published in 1905 by Albert Einstein.*

The analysis of the article *"On the Electrodynamics of Moving Bodies"* in the next section 6 shows exactly where and how the claim "the speed of light is the same for all inertial frames of reference" was applied and actually reveals the essence of the special theory of relativity! Moreover, to be complete the set of proofs of the invalidity of the special theory of relativity, the factual analyses of the three types of so-called *"fundamental tests of the special theory of relativity"* are presented in the following Section 8.

6. ANALYSIS OF THE ARTICLE "ON THE ELECTRODYNAMICS OF MOVING BODIES", PRESENTING THE SPECIAL THEORY OF RELATIVITY

The special theory of relativity was published in the article "On the Electrodynamics of Moving Bodies" in the journal *Annalen der Physik* [15].

Remark: For a theory to have scientific value, it must also meet the physical reality. Therefore, when analyzing the article, we will show to what extent, the used thought experiments and the conclusions made correspond to our physical reality.

The three outlining characteristics of our time-spatial region "near the Earth's surface" relevant to the topic under discussion are as follows:

1. The intensity of the gravitational field is approximately the same;

2. The units of length and time we have defined do not change; these are the primary constants that we have chosen to be constants and that we have determined in order to be able to use Mathematics in Physics;

3. The speed of electromagnetic radiation (of light) in vacuum is constant, as are all physical constants in a region with a uniform intensity of the gravitational field.

As mentioned, the Earth rotates in the stationary space, and only the deformation (the "contraction" itself) of the space moves along with the Earth around the Sun and along with the Solar System in the Milky Way and along with our Galaxy in the Universe.

At the beginning of the article, Einstein referred to Maxwell's theory of electrodynamics and then provided an initial formulation of the two postulates on the basis of which the special theory of relativity was created.

The formulation of the first postulate, which Einstein calls the "principle of relativity", refers to the natural law that the laws of electrodynamics and optics are valid in all inertial frames of reference, where the laws of mechanics are valid.

> *"The same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold well".*

The second postulate, *"which is only apparently irreconcilable with the former"*, is formulated as follows:

> *"that light is always propagated in empty space with a definite velocity c, which is independent of the state of motion of the emitting body."*

By applying the "scientific method", each scientist can analyze the following:

Does this formulation correspond to our physical reality?

The first postulate is formulated so generally that it cannot be accepted without detailed analysis!

First, on what basis is the dependence and the analogy between the laws of electrodynamics and optics, and the equations of mechanics? Based on such an unreasonable assertion of analogy (between electromagnetic waves and mechanical waves), the second big blunder in Physics of the 20th Century on *"the accelerating expansion of the Universe"* is due [16]. The mechanics equations refer to the motion of material bodies in stationary space. For the equations describing the motion of material bodies in moving systems at different velocities in a stationary space, the Galilean transformations are in effect. The Galilean principle of relativity states that the laws of motion (Newton's laws of motion) are the same for the material bodies in all inertial frames of reference and therefore:

> *"It is impossible to determine by any mechanical experiment carried out in any inertial system whether this inertial system is at rest or moving uniformly and rectilinearly in the stationary space."*

This means that there is no dependence of the speed of a body with mass m on the direction of motion of the body in the moving inertial reference system (i.e., there is no anisotropy in the measured body's speed in the moving inertial frame of reference)! However, if the system moves at a constant velocity but not rectilinearly it can be ascertained by a mechanical experiment (Foucault's pendulum). Electromagnetic radiation, however, is a stream of immaterial small energy packets (quanta), propagating radially from the source in a stationary space distorted by gravitational forces. Electromagnetic radiation can be thought of as a stream of energy packets in the "empty space", which turns out to be "compressed" energy[1].

In other words, the first postulate cannot be accepted without analyzing in detail the results of the experiments and without discussing the differences. Many of the experiments, however, are explained by modern physics on the basis of the unrealistic results of the special theory of relativity, which can be found in the following Section 8.

The second postulate, which, according to Einstein's words, is:

> *"only apparently irreconcilable with the former", is "that light is always propagated in empty space with a definite velocity c, which is independent of the state of motion of the emitting body".*

Yes, the light propagates in the stationary "empty space" (in vacuum) at a constant speed but in regions of the same (uniform) gravitational field intensity, such as the region "near the Earth's surface". However, the speed of light in vacuum is not the same in all regions of the

Universe; the speed of light in vacuum (in the frame of reference related to the space itself), depends on the intensity of the gravitational field in the regions through which the light passes and this was proven experimentally [3, 4].

Yes, the speed of light in vacuum is independent of the state of motion of the emitting body, because the quantum emission becomes at the quantum level.

However, Einstein does not claim or mention in his article *"On the Electrodynamics of Moving Bodies"* that the speed of light is the same for all inertial reference systems (though, as we will see, he used it in the article). Perhaps, that is why Einstein had never discussed the experiment performed in 1912 by the French physicist Georges Sagnac because this experiment confirms the validity of Galilean relativity in a local time-spatial region with a uniform gravitational field intensity. The "Michelson-Gale-Pearson experiment" also demonstrated the different speeds of light in the frame of reference related to the moving surface of the Earth's registering *"The Effect of the Earth's Rotation on the Velocity of Light"* [10, 11]. These experiments undoubtedly prove that "the speed of light is not the same for all inertial reference systems". Although the expression "speed of light is the same for all inertial reference systems" is not mentioned in the article "On the Electrodynamics of Moving Bodies", in the present analysis it is shown exactly where and how this false statement was illogically used!

Follows: Examination of the first part "I. KINEMATICAL PART" and then – of the second part of PART I of Einstein's article "II. ELECTRODYNAMICAL PART".

6.1 Analysis of "I. KINEMATICAL PART. § 1. Definition of Simultaneity"

Einstein starts exposing his logic by presenting a stationary coordinate system:

> *"a system of co-ordinates in which the equations of Newtonian mechanics hold good. In order to render our presentation more precise and to distinguish this system of co-ordinates verbally from others which will be introduced hereafter, we call it the "stationary system".*

Let us ask the aforementioned question (see the Remark concerning the scientific value of the article). Therefore, the question arises:

What is the correspondence of the considered *"stationary system"* with our physical reality?

The answer is:

1. Yes, the equations of Newtonian mechanics are inforce (valid) in our physical reality, which is related to the moving surface of the Earth in the stationary space.

2. Obviously, the so-called "stationary system" must be a frame of reference related to the stationary space itself, such as the ECI coordinate system (not related to the moving Earth's surface). This is clear from the "synchronization criterion" for two clocks in the stationary system defined below.

3. The defined by Einstein "stationary system", however, has the defining characteristics of our physical reality:

The measurement units are non-variable (rigid standards of measurement).

1.Einstein's chosen unit of length is "a rigid rod" as a standard of measurement (in the International System of Units we have chosen this to be the unit of length "metre").

2.For time measurement, Einstein uses the same clocks ("in all respects resembling each other") that measure the same time intervals – (in the SI we have defined the unit of time "second" by means of the frequency of a specific electromagnetic radiation).

Thus, the position of a material point at rest relative to this (actually Descartes coordinate system) is defined "by the employment of rigid standards of measurement and the methods of Euclidean geometry", and can be expressed in Cartesian co-ordinates. (Renatus Cartesius is the Latin name for René Descartes). In fact, the concept of "space" refers to the concept "position of a stationary material point".

However, if we talk about "motion", the quantity "time" should also be included:

"If we wish to describe the motion of a material point, we give the values of its co-ordinates as functions of the time".

On the "simultaneity". Einstein logically shows us that the concept of "time" is inextricably bound up with the concept of "simultaneity". Indeed, when we talk about the "time-point" – we mean the simultaneity of at least two events: "the moment of any certain event" and "the certain position of the clock's arrows".

For this reason, regarding the definition of the term "time", Einstein suggested that it be replaced with the "position of the arrows of the clock".

"It might appear possible to overcome all the difficulties attending the definition of "time" by substituting "the position of the small hand of my watch" for "time"". However, this is acceptable; Einstein continues: to do so only if the observer is in the place where the clock is located. If the observer is distant from the clock, an additional time interval is required for the transmission of the information (the indication) from the remote clock to the observer. In the case under consideration, we must imagine an observer with a clock positioned at the beginning (at the origin) of the coordinate system, which determines the time of occurrence of events at different points of the system by receiving light signals from the point of occurrence of the relevant event. Einstein talks about the disadvantages of such coordination: "But this co-ordination has the disadvantage that it is not independent of the standpoint of the observer with the watch or clock, as we know from experience".

In fact, the disadvantage is that the synchronization of clocks located in different locations requires a different correction for the time at which the information is received.

Actually, Einstein considers a stationary system where the time is the same and calls this *"the time of the stationary system"*. Of course, we have to accept some initial event to start measuring the time and a point, from which the times at all the other points are synchronized...

The definition of the *"synchronization criterion for two clocks"* in the considered stationary system follows in the article. For this purpose, Einstein examines two points (point A and point B) in the stationary coordinate system where identical clocks are located: "another clock (at B) in all respects resembling the one at A" is positioned. As mentioned, the clocks in every respect "resembling" each other. This actually means that the two clocks measure the same time intervals equally (i.e., the duration of the "seconds" is the same for the two clocks). In the considered stationary coordinate system, the measurement unit of length and the

measurement unit of time are constant. In addition, the clocks at point A and point B are synchronized (the readings are the same for the observers at these points) but with the denotations "A time" and "B time" respectively.

The thought experiment is presented in the following way:

"Let a ray of light start at the "A time" t_A from A towards B, let it at the "B time" t_B be reflected at B in the direction of A, and arrive again at A at the "A time" t'_A".

The given criterion, according to which two stationary clocks are synchronized in the stationary coordinate system under consideration (where the light is propagating in the space at a constant speed), is:

"In accordance with the definition, the two clocks synchronize if:

$$t_B - t_A = t'_A - t_B \qquad ". \qquad (24)$$

, where t_A and t'_A are the readings of the clock at point A and t_B is the reading of the clock at point B. Formula (24) shows that two remote stationary clocks in a stationary system are synchronized when the readings of the clocks for the time intervals in both directions of the light's travel are equal.

Einstein calls this formula (24) the *"criterion for the synchronization of two clocks"*. However, the experiments show that the given synchronization criterion is true only when the reference system is not moving in relation to the stationary space, where the speed of light in vacuum is constant in all directions!

If we refer to (see Remark above): The formula holds true for physical reality: on the condition that the considered stationary system corresponds to the reference system related to the ECI coordinate system, or to the stationary space itself (where the speed of light in vacuum is constant and where the Earth's surface moves).

In other words, this formula, as a "criterion for the synchronization of two clocks", is true when points A and B are stationary in relation to the "empty space", where the speed of light in the "empty space" (in vacuum) is a constant. However, the formula is not correct for an observer in the frame of reference related to the Earth's surface, (when point A and point B are fixed to the Earth's surface) which moves in the stationary space. When the circumstances under consideration are not juxtaposed with the physical reality, a delusion can be created, as shown in equation (25):

"In agreement with experience, we further assume the quantity

$$\frac{2AB}{t'_A - t_A} = c \qquad (25)$$

to be a universal constant – the velocity of light in empty space".

This equation is misleading because it is true not only for the reference system related to the stationary "empty space". This equation is also true for the frame of reference related to the moving eastward Earth's surface, because it involves the travel path in both directions;

therefore, the resulting speed of light is average for both directions and will always be equal to c (the constant speed of light in the stationary space/in vacuum), as is the case for the "two-way light speed measurement" (the case of the Michelson-Morley experiment)! In the physical reality (this time really in agreement with experience), if the frame of reference is related to the moving eastward Earth's surface (points A and B are fixed to the ground) and point B is located east of point A, then:

$$t_B - t_A > t_A' - t_B \qquad (26)$$

As shown in section 2 and section 3, when the frame of reference is related to the Earth's surface, the difference (26) in the different directions will depend on the linear speed of the Earth's surface at the respective latitude. However, the total sum of the light beam travel time in both directions will always be constant $(t'_A - t_A) = const)$ (as in the case of the Michelson interferometers) – and the equation (25) will also be true for the frame of reference related to the Earth's surface. That is why this equation is misleading!

***Summary of section** § 1 of Einstein's article: "It is a fact that the correspondence of the considered "stationary system" with our physical reality Einstein did not specify. This system was called "stationary" only "to distinguish verbally this system of co-ordinates from others which will be introduced hereafter". This creates conditions for contradiction, which is actually evolved in the next subsection".*

6.2 Analysis of "I. KINEMATICAL PART. § 2. On the Relativity of Lengths and Times"

At the beginning of this paragraph, Einstein again defines the two postulates on which the special theory of relativity is based in the following way:

The following reflections are based on the principle of relativity and on the principle of the constancy of the velocity of light. These two principles we define as follows":

1."The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of co-ordinates in uniform translatory motion".

2.Any ray of light moves in the "stationary" system of co-ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body. Hence:

$$velocity = \frac{light\ path}{time\ interval} \qquad (27)$$

, where time interval is to be taken in the sense of the definition in § 1".

Following a thought experiment by which Einstein, using the statement that "the speed of light is the same for all inertial reference frames" and incorrectly applying the *"synchronization criterion"* for a stationary system to a moving system, concludes that *"we cannot attach any absolute significance to the concept of simultaneity"*:

"Let there be given a stationary rigid rod; and let its length be l as measured by a measuring-rod which is also stationary. We now imagine the axis of the rod lying along

Concerning the length of the moving rod, Einstein suggested that the following two methods (operations) be used to specify the length of the rod:

1. The observer moves together with the given measuring rod and the rod to be measured, and the length of the rod is measured directly by superposing the measuring rod in the same way as if all three were at rest. Einstein calls the length of the rod AB, measured in this way, *"the length of the rod in the moving system",* and the length *"must be equal to the length l of the stationary rod".*

2. The observer ascertains at what points of the stationary system the two ends (A and B) of the rod to be measured are located at a certain time by means of stationary clocks situated in the stationary system and synchronized in "accordance with § 1". The distance between these two points (measured by the measuring rod already employed, which in this case is at rest) is also the length. Einstein designated this length *"the length of the (moving) rod in the stationary system".*

Here we must emphasize that the used measurement unit of length *"measuring-rod"* is the same for the stationary and for the moving frames of reference.

About the measurement unit of time:

We must clarify what "synchronized clocks" means. In effect, this means that the readings of the clocks are the same for observers located next to the clocks. The clocks used in the moving reference system are synchronized with stationary clocks and measure the same time intervals; therefore, the same measurement unit of time is used for the two frames of reference.

According to Einstein, the measured length of the rod in the moving system (by method 1) will differ from the measured length of the rod in the stationary system (by method 2):

"The length to be discovered by the operation (2) we will call "the length of the (moving) rod in the stationary system." This we shall determine on the basis of our two principles, and we shall find that it differs from l".

Obviously, this is not true. First, let us answer the following question again:

What is the correspondence of the experiment under consideration with our physical reality?

In our real time-spatial region "near the surface of the Earth":

1. The analog of the considered "stationary system" is the Earth-centered inertial coordinate system (the ECI frame of reference), which is considered stationary in relation to the surrounding space – a frame of reference related to the stationary space itself;

2. The analog of the moving frame of reference, "the moving rigid rod", is a rod (oriented and moving in a "west-to-east" direction) that is firmly fixed on the moving Earth's surface in the stationary space.

3. In this (our) real region, the units for measuring the length and time are constant, the time flows in the same way, and the speed of light is constant in the stationary vacuum, i.e., in the "ECI coordinate system".

Let us proceed with the description of the measurement of the length of the rod using method (2):

> *"We imagine further that at the two ends A and B of the rod, clocks are placed which synchronize with the clocks of the stationary system, that is to say that their indications correspond at any instant to the "time of the stationary system" at the places where they happen to be. These clocks are therefore "synchronous in the stationary system".*

However, it follows something incorrect: *"We imagine further that with each clock there is a moving observer, and that these observers apply to both clocks the criterion established in § 1 for the synchronization of two clocks".*

Incorrectness is clear: for the moving frame of reference, the criterion of synchronization is applied for the stationary system (equation 24)! That is why, for the observers near the moving clocks, the readings cannot be the same, and the conclusion that *"we cannot attach any absolute signification to the concept of simultaneity"* is, therefore, fabricated!

Let us analyze how Einstein contradictorily presents the case under consideration:

1. We have synchronized clocks in the "stationary system" –i.e., their indications (readings) are the same for the observers near the clocks. We remember that we have established that the "synchronization criterion" (see equation 24) is valid for a system related to the stationary empty space, where the measured speed of light is constant in all directions.

2. The readings of the clocks in the "moving system" (the clocks at both ends A and B of the rod) correspond at every moment to the readings of clocks in the corresponding location in the "stationary system", along which the rod passes. The clocks in the stationary system are synchronized. However, the readings of the clocks in the moving system cannot be the same as the corresponding clocks in the stationary system, if they are synchronized using the *"criterion for the synchronization of two clocks for the stationary system"* – using "the criterion established in § 1" –see equation (24)!

The description of the experiment

> *"Let at time t_A (which is actually the time in both the stationary system and the moving system), a light beam is emitted from A, then is reflected in B at a time t_B, and reaches again A at a time t'_A.".*

For the observers located next to the clocks in the moving system, the following conclusions are drawn:

> *"Taking into consideration the principle of the constancy of the velocity of light we find that*
>
> $$t_B - t_A = \frac{r_{AB}}{c - v} \qquad (28)$$
>
> *, and*
>
> $$t'_A - t_B = \frac{r_{AB}}{c + v} \qquad (29)$$
>
> *where r_{AB} denotes the length of the moving rod measured in the stationary system.*

In these equations, c is the speed of light in the "empty space" (the common space for the stationary reference system and for the reference system of the moving rod), and v is the speed of the rod (the speed of the rod in relation to the stationary space. The presented "thought experiment" is actually "a rod on the moving Earth's surface oriented "west-to-east", and is fully analogous to the analyzed experiments in section 2 and section 3 (the experiments "One-way measurement of the speed of light" and the "Michelson-Gale-Pearson experiment"). The analyses indisputably prove that the measured speed of light in the "west-to-east" direction is *(c-v)*, and that in the "east-to-west" direction is *(c+v)* (see equations (14 and 15).

Let us return to the definition of the principle of the constancy of the speed of light, where the following is written – see (27):

$$(velocity = \frac{light\ path}{time\ interval})$$

i.e.:

$$time\ interval = \frac{light\ path}{velocity} \qquad (30)$$

Therefore, if for observers in the moving system, the lengths of the path of the light beam in both directions are the same and equal to the length of the rod r_{AB} *("light path"* $= r_{AB}$), but the time intervals $(t_B - t_A)$ and $(t`_A - t_B)$ are different, ***then***, the speed of the light in the moving system in one direction is *(c-v)*, and in the other direction is *(c+v)*, where *v* is the speed of the moving system in the stationary space. That is, for observers in a moving system, the measured speed of the light in the two directions is different from *c* (different from the *speed of light in vacuum*)!

However, that is the essence of the matter:

It is obvious that here is the key moment in the article presenting the special theory of relativity! It is here that the claim "the speed of light is the same for all inertial frames of reference" is applied - however, without mentioning this!

I.e., for the condition "the speed of light is the same for all inertial systems" to be valid, we must accept that equations (28) and (29) prove that the clocks are not synchronized! Moreover, according to the initial conditions of the thought experiment – they are synchronized. **Is not that an unacceptable contradiction?**

The synchronized clocks show the following:

$$(t_B - t_A) \neq (t'_A - t_B) \qquad (31)$$

Instead of the reality that the measured speed of light in the moving frame of reference is not the same in both directions (equations (28) and 29), Einstein claims that the clocks are not synchronized:

Observers moving with the moving rod would thus find that the two clocks were not synchronous and, as a consequence of this unreasonableness, we can say nothing about the "simultaneity of events" for the two reference systems.

> *"So, we see that we cannot attach any absolute signification to the concept of simultaneity, but that two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relatively to that system".*

 i.e., there is no simultaneity of events (because Einstein assumed that the speed of light in both directions in the moving frame of reference should be the same!!!

As a consequence of this conclusion, it is normal to ask the following question:

"If there is no simultaneity of events (for example, "start of any event" and the respective event "movement the clock's hands") –

is it possible to determine a "time interval" like the "second" (the unit of time, which Einstein uses in the equations for the two frames of reference)?

Therefore, all equations for the two frames of reference in which the physical magnitude "time" participates (including the equations on the basis of which it is concluded that there is no simultaneity of events). ARE THEY EQUATIONS?

In fact, this is the absurd logic applied in Einstein's paper!

In fact, equations (28) and (29) can be called the "criteria for synchronization of two clocks, moving in the stationary space with a fixed spacing between them".

Obviously, if (v=0), then we have the equation (24), i.e., "the criterion for the synchronization of two clocks", which are stationary in the "stationary system".

The reader, however, can conclude to what extent the genius logical consistency presented in the article is acceptable.

6.2.1 Proof of the existence of "simultaneity of events" for the two frames of reference in Einstein's thought experiment

> *"We imagine further that at the two ends A and B of the rod, clocks are placed which synchronize with the clocks of the stationary system, that is to say that their indications correspond at any instant to the "time of the stationary system" at the places where they happen to be. These clocks are therefore "synchronous in the stationary system".*

In this way, the readings of any clock in the experiment are the same for all the observers near the clocks. However, after one paragraph, Einstein contradicts himself in that:

> *"Observers moving with the moving rod would thus find that the two clocks were not synchronous, while observers in the stationary system would declare the clocks to be synchronous".*

This is only based on the acceptance that the speed of light in the moving system is the same in both directions. However, this claim was proven to be wrong by the "Michelson-Gale-Pearson experiment", and by the "One-way Measurement of the Speed of Light" experiments (see section 2 and section 3 of Part I of the current book).

Let us analyze the thought experiment. There are three events in the thought experiment:

"Event 1": "The light beam starts from point A",

"Event 2": "The light beam is reflected in point B",

"Event 3": "The reflected beam arrives back at point A".

Let us accept as an initial moment the event, when *"a uniform motion is imparted to the rod"* that coincides with ***"Event 1"*** (the light beam starts from point A).

The proof that there is "simultaneity of events" for the two frames of reference is as follows:

The time intervals between the three events in the given Einstein's thought experiment are respectively equal for both frames of reference!

The time intervals between the three events in the moving frame of reference.

The time intervals for the observers in the moving reference system are illustrated by equations (28) and (29), as shown by Einstein as follows:

$$t_B - t_A = \frac{r_{AB}}{c - v} \qquad (28)$$

and

$$t'_A - t_B = \frac{r_{AB}}{c + v} \qquad (29)$$

The time intervals between the three events in the stationary frame of reference.

For an observer in the stationary frame of reference, points A and B (the beginning and the end of the rod, respectively) move at the speed v of the rod; the speed of the light beam in the stationary system is c; but the distance that the light beams travel differs in both directions. If point A of the rod is closer to the origin of the coordinate system, and the rod moves along the x-axis towards an increase in x, then the light beam that starts from point A to point B will pass a longer distance *($r_{AB} + \Delta_{AB}$)* than r_{AB} (the length of the rod). This is because, during the travel of the light beam toward point B, point B has moved away. Conversely, the reflected light beam from point B back to point A will pass a shorter path *($r_{AB} - \Delta_{BA}$)* than r_{AB} (the length of the rod), because, during the travel of the light beam, point A approaches point B. Therefore, in the stationary reference system, the measured time intervals between the events are respectively:

$$(t_B - t_A)^{st} = \frac{r_{AB} + \Delta_{AB}}{c} \qquad (32)$$

, and

$$(t'_A - t_B)^{st} = \frac{r_{AB} - \Delta_{BA}}{c} \qquad (33)$$

where Δ_{AB} is the distance that point B passes during the time interval *(t_B-t_A)st* at the speed of rod ***v***; Δ_{BA} is the distance that point A passes during the time interval *(t'_A-t_B)st* at the speed of rod ***v***.

The proof follows:

1. Let us examine, in the two frames of reference, the time intervals between the two events "Event 1" and "Event 2", i.e., whether *(t_B-t_A)=(t_B-t_A)st*:

Since, in the stationary frame of reference, Δ_{AB} in equation (32) is the distance by which point B has moved away during the travel of the light beam from point A to point B, if we replace Δ_{AB} with $(v(t_B\text{-}t_A)^{st})$, we obtain:

$$(t_B - t_A)^{st} = \frac{r_{AB} + \Delta_{AB}}{c} = \frac{r_{AB} + v(t_B - t_A)^{st}}{c} \quad (34)$$

and, as follows from (34), we see that it is the same time interval $(t_B \text{-} t_A)$, as in equation (28) for *the moving frame of reference*:

$$(t_B - t_A)^{st} = \frac{r_{AB}}{c - v} = (t_B - t_A) \quad (35)$$

Therefore, the time intervals between "Event 1" and "Event 2" in the given Einstein's thought experiment for the two reference systems are the same.

2. Let us now examine the time intervals between the two events "Event 2" and "Event 3" in the two frames of reference – i.e., whether $(t'_A\text{-}t_B)=(t'_A\text{-}t_B)^{st}$:

For the stationary reference system, Δ_{BA} in equation (33) is the distance by which point A has come closer to point B during the travel of the light beam from point B to point A.

Therefore, if we replace Δ_{BA} in equation (33) with $(v(t'_A\text{-}t_B)^{st})$, we likewise receive the same time interval for the moving frame of reference – equal to $r_{AB}/(c+v)$, for the moving frame of reference from equation (29):

$$(t'_A - t_B)^{st} = (t'_A - t_B) \quad (36)$$

In other words, the time intervals between "Event 2" and "Event 3" in both frames of reference are also the same.

==***Therefore, the time intervals between the three events in the given Einstein's thought experiment are respectively equal for both frames of reference!***==

Summary for section § 2 of Einstein's article: *Einstein's conclusion that "we cannot attach any absolute signification to the concept of simultaneity" is based on the erroneous statement that **"the measured speed of light is the same in all inertial reference systems"**. This statement has been proven to be inconsistent with the physical reality –not only nowadays through modern technologies, but since the time of the "Sagnac experiment" (1913) and the "Michelson-Gale-Pearson experiment" (1925).*

THE FALSE CONCLUSION, that there is no simultaneity of events, serves as the basis of the next step of the theory, i.e., it deepens in the next subsection of Einstein's article.

6.3 Analysis of "I. kinematical part. § 3. Theory of the transformation of coordinates and times from a stationary system to another system in uniform motion of translation relatively to the former"

In the previous section of his article, Einstein examined a stationary coordinate system and a moving rod (moving reference system) along the x-axis in the stationary system. It was analyzed how the wrong conclusion was made that in the common space *"two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relative to that system"*.

In this section of Einstein's article, the presented *"thought experiment"* is a modification of the experiment that was considered in the previous section – two coordinate systems are

considered in the space that Einstein calls the "stationary" space. One of the coordinate systems is called "stationary" (which means "stationary to the stationary space", and is denoted the "K" system, and another system, called the "moving" coordinate system, is denoted the "k" system. Each coordinate system is Cartesian, with three rigid material lines (axes), perpendicular to each other and intersecting at one point (the origin of each coordinate system). The symbols used for co-ordinates, and time-symbols in the two systems are different. The spatial coordinates and the time in the stationary system "K" are denoted with *[(x, y, z); t]*, in the moving system "k" – *[(ξ, η, ς); τ]*.

> *"Let each system be provided with a rigid measuring-rod and a number of clocks, and let the two measuring-rods, and likewise all the clocks of the two systems, be in all respects alike".*

This means that the measuring units in the two systems are the same. It must be underlined, that the applied "logic" will prove that the measuring units in the two systems will change depending on the speed between the systems.

The axes x and $ξ$ of the two systems coincide, and the movement of the "k" system is at a constant speed of v in the direction of an increase in x of the stationary system. The axes $η$ and $ς$ of the moving system are parallel to the axes y and z of the stationary system, respectively, and remain parallel when the system moves.

The aim is to derive the desired relationship (transformation) of the spatial coordinates and the time between them (which accidentally turns out to be the Lorentz transformation), based on the assertion that *"the speed of light is the same for all inertial frames of reference"*.

6.3.1 Concerning the description of the accepted measurement units of length and time

As an initial condition of the thought experiment (as we saw above), it is assumed that the accepted measurement unit of length is a *"rigid measuring-rod"*, and the accepted unit of time is measured by the same clocks – *"in all respects alike"*. Thus, as we read, the units of measurement are the same in both systems.

This insertion is very important for the validity of the used units of measurement in all the following equations and the validity of the equations themselves *(we all know that for an equation of theoretical physics to be valid, the units of the used units of measurement must be the same and constant in the scope of the equation).* Otherwise, we must be aware that it is manipulation!

From the presented initial conditions for the units of measurement, it is obvious that they are defined when the moving system "k" is at rest because the final result of the special theory of relativity is that the units of both time and length change *(only in the direction of the movement…)* when one inertial system moves relative to the other. This result will be derived based on the unproven statement that *"the speed of light is the same for all inertial frames of reference"*.

In Galilean transformations the units of time and length do not change –there is only a transformation (recalculation) of the spatial coordinates. Time goes in the same way – the clock readings for both systems are the same. Therefore, the Galilean transformations are consistent with our physical reality. An observer, located at the origin of the stationary system, can determine the local moment of occurrence of an event at a particular point in the

moving system. For this purpose, the observer must adjust (correct) his clock, with the time interval for which he receives the information about that event.

6.3.2 About the applied scheme of the thought experiment in this paragraph of the article

The applied scheme of the thought experiment is the same as that in the previous paragraph of the article. At the starting position, it is:

1. The measurement units in both reference systems are the

same and are defined when the moving system is at rest.

2. The same measurement units determine the spatial coordinates and moments in time of the events – [(x, y, z); t] and [(ξ, η, ς); τ], relative to the two frames of reference.

However, let us follow the thought experiment:

If we place (x′ = x – vt), it is clear that a point at rest in the system "k" must have a system of values [x′, y, z], independent of time.

As a point at rest in the system "k" has coordinates (ξ, η, ς), then the aforementioned values *(x′=x-vt; y; z)* are actually the applied Galilean transformations between the two systems *(ξ=x-vt; η=y; ς=z)*.

To find the desired relationship (transformation) between the spatial coordinates and the time of the two systems, Einstein presents the time τ in the moving system as a function of the spatial coordinates and time in the stationary system *(x′, y, z; t)*. Einstein did this in the following unacceptable way:

"From the origin of system k let a ray be emitted at the time τ_0 along the X-axis to x', and at the time τ_0 be reflected thence to the origin of the coordinates, arriving there at the time τ_2; we then must have:

$$\frac{1}{2}(\tau_0 + \tau_2) = \tau_1 \qquad (37),$$

or, by inserting the arguments of the function τ and applying the principle of the constancy of the velocity of light in the stationary system:

$$\frac{1}{2}\left[\tau(0,0,0,t) + \tau\left(0,0,0,t + \frac{x'}{c-v} + \frac{x'}{c+v}\right)\right] = \tau\left(x',0,0,t + \frac{x'}{c-v}\right) \text{"} \qquad (38)$$

In the case under consideration, the designations τ_0, τ_1, and τ_2 are for the moving system, and for this frame of reference $(\tau_1 - \tau_0) > \tau_2 - \tau_1$), equation (37) is not true (see equation (26)! Second, what does mean *"the principle of the constancy of the velocity of light in the stationary system"*? This means that Einstein realized that the speed of light is not constant for a moving system. This means that Einstein deliberately manipulated so that he could prove the preliminary goal – the Lorentz transformations!

Here, we must emphasize that equation ([37](#)) would be true, if the speed of light is the same in both directions in the moving system – in fact, if "the speed of light is the same in all inertial frames of reference".

Einstein defines the speed of light postulate: *"that light is always propagated in empty space (in vacuum) with a definite velocity c"*. This is, in fact, true in the frame of reference related to the space itself (such as the ECI frame of reference). This is true in our time-spatial domain (our reality), where the intensity of the gravitational field is the same. However, the claim *"the speed of light is the same in all inertial reference systems"* means something completely different.

The physical reality, however, is as follows: the stationary system "K" is stationary in the "stationary space", and the moving system "k" moves in relation to the stationary system "K" (i.e., moves in relation to the stationary space) in the direction of increase in the x-axis. Therefore:

$$\frac{1}{2}(\tau_0 + \tau_2) < \tau_1 \qquad\qquad (39)$$

, because *in the moving reference system*: the interval of time necessary for the light beam to travel the distance at the constant speed of light in vacuum in the direction of movement of the reference system $(\tau_1 - \tau_0)$ is greater than the necessary time interval $(\tau_2 - \tau_1)$ for the light beam to pass the same distance in the opposite direction of the movement of the moving reference system.

As we have shown in [subsection 6.2.1](#), according to equations ([28](#)) and ([29](#)) for the moving system:

$$(t'_A - t_B) < (t_B - t_A) \qquad\qquad (40)$$

This is the same, but written with the new denotation of time for the moving system (k):

$$(\tau_2 - \tau_1) < (\tau_1 - \tau_0) \qquad\qquad (41)$$

which is:

$$(\tau_0 + \tau_2) < 2\tau_1 \qquad\qquad (42)$$

which means that equation ([37](#)) does not correspond to physical reality, as does the claim that "the speed of light is the same in all inertial reference systems".

Thus, based on equations ([37](#)) and ([38](#)), which are inconsistent with physical reality, the Lorentz transformations are derived.

The Lorentz transformations themselves are not incorrect – they have their mathematical value.

In fact, the Lorentz transformations give a solution to the following mathematical task:

How should the units of length and of time be changing in a moving system (depending on its speed) relative to the units in the stationary system, so that the result obtained (the numeric value) when measuring the speed of light in both frames of reference to be the same?

Besides the Lorentz transformations, there are other solutions to this task. One such solution is given in Chapter 20 of the monograph [[17](#)]. Although these solutions have a mathematical value, they cannot be applied in our physical reality to transform the coordinates between two inertial reference systems moving at constant velocity relative to each other, because they are based on a non-existent claim in the physical reality that "the speed of light is the same in all inertial frames of reference"!

Consequently, inconsistency with physical reality also applies to all the results of the special theory of relativity because they are the consequence of, and result from the consecutive incorrect steps outlined here.

As Einstein himself stated, if it is proven that only one step of the logical structure of the theory is not true, then the whole theory of relativity is not correct. This is exactly what Einstein said when he explained the theory of relativity to the readers of the *"London Times"*:

"The chief attraction of the theory lies in its logical completeness. If a single one of the conclusions drawn from it proves wrong, it must be given up; to modify it without destroying the whole structure seems to be impossible".

So, with this statement, Einstein himself actually declares the invalidity of the special theory of relativity.

Other statements by Einstein may also be mentioned that state the invalidity of the theory of relativity. Such a statement was published in *"My Theory and Miller's Experiments"* [18] after the widely discussed publication by Dayton Miller *"Significance of Ether-Experiments of 1925 at Mount Wilson"* [19].

"If the results of the Miller experiments were to be confirmed, then relativity theory could not be maintained, since the experiments would then prove that, relative to the coordinate systems of the appropriate state of motion (the Earth), the velocity of light in 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" [18].

In this statement, however, Einstein mixes the focus! Actually, the speed of light *in vacuum* is the same, but the measured speed of light in the moving system is not the same (i.e., *the speed of light is not the same for all frames of reference)!*

This finding confirms the view, which was presented at the 3rd Annual International Conference on Physics, 20-23 July 2015, Athens, Greece that the speed of light must be considered in two aspects:

1. In the "Global Physical Reality of the Universe" (related to the regions with different intensities of the gravitational field), and

2. In the "Local Time-Spatial Domains" - in regions with a uniform intensity of the gravitational field.

In our "Local Time-Spatial Domain": It has been experimentally demonstrated that in the coordinate system (in the frame of reference), related to the moving Earth's surface, the measured speed of light depends on the direction of its propagation, and on the corresponding latitude (although the speed of light is constant in vacuum).

6.4 Analysis of "II. ELECTROMAGNETIC PART"

This part of the analyzed paper contains sections: "§ 6. Transformation of the Maxwell-Hertz Equations for Empty Space"; "§7. Theory of Doppler's Principle and of Aberration"; "§8. Transformation of the Energy of Light Rays"; "§9. Transformation of the Maxwell-Hertz

Equations when Convection-Currents Are Taken into Account"; "§10. Dynamics of the Slowly Accelerated Electron". The reasoning and all the conclusions in these sections are based on the erroneous results of the previous parts of Einstein's article, which in turn, were obtained based on the statement that *the speed of light is the same in all inertial frames of reference*.

Here the reader will understand that there is no point in further detailed analysis of the article *"On the Electrodynamics of Moving Bodies"*!

As we noted, in this article, Einstein does not mention anywhere that he refers to the statement that "the speed of light is the same in all inertial frames of reference". However, in the article *"Does the Inertia of a Body Depend upon its Energy Content?"*, published three months later (where the mass-energy equivalence formula $E=mc^2$ is derived), Einstein refers to the postulate of the constancy of the speed of light, as well as to the results he deduced (inter alia) in the section *"§8. Transformation of the Energy of Light Rays"* of the currently viewed article.

The equation $E=mc^2$ was proposed in 1903 by the Italian scientist Olinto de Pretto in his paper *"Ipotesi dell'etere nella vita dell'universo (Hypothesis of Aether in the Life of the Universe)"*[20], who studies radioactive decay. The equation refers to the correspondence between the energy released during decay and the difference in the masses of the elements involved before and after the decay. The explanation, however, Olinto de Pretto gives with the existence of the "ether", which actually turns out to be the "empty space" itself.

The formula $E=mc^2$ is not deduced or discussed in Einstein's article *"On the Electrodynamics of Moving Bodies"* [15]. However, this equation is generally attributed to Albert Einstein, although with this derivation of the formula by Einstein in the article *"Does the inertia of a body depend upon its energy-content?"* [21], most scientists do not agree – it is problematic because it suffers from the error of circular reasoning (circular reference), it is problematic because of using the wrong results of the article *"On the Electrodynamics of Moving Bodies"* shown above. This shortcoming was pointed out by many scientists and writers, including Max Planck, Herbert Ives, Max Jammer, and biographers of Einstein including Gerald Holton and Arthur I. Miller. The list of authoritative scientists associated with objections to Einstein's 1905 paper started with Max Planck, the father of quantum theory. His criticism of Einstein's 1905 work was included in an important 1907 article, which is considered to contain the first generally valid and correct derivation of $E=mc^2$.

We also have to mention the fact that neither the article *"On the Electrodynamics of Moving Bodies"* [15] nor the article *"Does the Inertia of a Body Depend upon Its Energy-Content?"*[21] contain the words "gravitational mass" or "inertia mass". However, at the beginning of section *"§ 2. On the Gravitation of Energy"* of Einstein's article *"On the Influence of Gravitation on the Propagation of Light"*, we read [22]:

> *"The theory of relativity shows that the inertial mass of a body increases with the energy it contains; if the increase of energy amounts to E, the increase in inertial mass is equal to E/c², where c denotes the velocity of light"* [22].

As mentioned above, the difference in mass ascertained in the radioactive decay of uranium and thorium is at the base of the mass-energy equivalence formula $E=mc^2$.proposed by Olinto De Pretto for the transformation of the "mass-energy" transformation. Actually, this is the energy that would be released during radioactive decay in a time-spatial region where the speed of light in vacuum is equal to c (the speed of light in vacuum corresponding to the

intensity of the gravitational field inside the time-spatial region where the radioactive decay occurs). Therefore, the released energy will be different in regions with different gravitational field intensities. The difference in the mass of the atoms before the radioactive decay and the mass of the atoms after the decay is equal to the energy released at the radioactive decay according to the formula $E=\Delta mc^2$. Therefore, the law of conservation of mass is not valid when considering the masses of atoms actively involved in nuclear reactors, particle accelerators, or in the thermonuclear reactions in the Sun and stars.

This logic leads us to come to the hypothesis that matter is actually compressed energy (compressed "empty space") by the fundamental forces of nature. Of course, this hypothesis will be classified as "crazy"! However, this has nothing to do with the movement of the inertial reference systems that the special theory of relativity considers – the "*longitudinal mass*" and the "*transverse mass*" do not exist in physical reality. The mass of an object is a measure of the amount of matter in a body. If there is a dependence of the mass (for example, of the mass of our planet) on the planet's speed, then the Earth must have simultaneously different masses (different amounts of matter) as its relative velocity is different in relation to any other celestial bodies in the Universe.

7. CONCLUSION ON THE SPECIAL THEORY OFRELATIVITY

The presented experimental and logical proofs reveal the essence of the special theory of relativity:

The special theory of relativity turns out to be only one hypothesis that can exist only in the field of Mathematics. This theory is based on the statement that "the speed of light is the same in all inertial reference frames", which is experimentally proved to be inconsistent with physical reality – i.e., that is not true! This is why the special theory of Relativity is a delusion in the field of Physics.

Considering what for Physics means *"more than a hundred years of delusion"*, the special theory of relativity can be classified as ***"the biggest blunder in Physics of the 20th century"***. The main reasons for this delusion are as follows.

1. *The "Michelson-Morley experiment"*, rather the inappropriate conceptual design of Michelson's interferometer, is actually the primary cause of the delusion that *"the speed of light is the same for all inertial frames of reference"* which is the core of the special theory of relativity.

2. Sometimes, a persuasion that has survived for many years is surrounded by the halo of absolute truth. However, with the development of new technologies, scientists see undoubtedly the truth about the existing physical reality. The "*one-way measurement of the speed of light*" experiments, performed using GPS, are an example of this. The existing "paradoxes" proved to be actually impossibilities of a correct explanation on the basis of the accepted delusions.

As incredible as it may sound, the Michelson-Morley experiment (albeit mistakenly constructed interferometer), and the invalidity of the special theory of relativity (although it does not correspond to the physical reality) – have played a positive role in the progress of

Physics! Although they are wrong steps, they played a role as a springboard for the giant leap for mankind – to be broken the perception of the absoluteness of time and space!

Here is the place to pay tribute to the genius of Albert Einstein.

Although the special theory of relativity does not correspond to physical reality; although the field equations of Einstein's general theory of relativity are not correct from the point of view of theoretical physics:

Einstein's brilliant ideas changed our perception of the absoluteness of time and space!

8. ANALYSES OF THE THREE TYPES OF SO-CALLED "FUNDAMENTAL TESTS" OF THE SPECIAL THEORY OF RELATIVITY

The purpose of this section is to reveal the essence of all the "tests of the special theory of relativity", which are considered to be of three major types.

All the "unexpected" and "inexplicable" results of the famous experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface of the Earth" have their scientific explanation based on classical mechanics and Galilean relativity, which are proven to be valid in our time-spatial region with a uniform gravitational field intensity. All the evidence shows the validity of the "Thesis on the Behavior of Electromagnetic Radiation in the Gravitational Field of the Universe" presented in chapter 10 of the monograph *"The Special Theory of Relativity - the Biggest Blunder in Physics of the 20th Century"*© [17], and in section 3 of Part III of the current book. In turn, the thesis is based on the "Model of Uncertainty of the Universe" presented in chapter 9 of the same monograph [17].

However, there is a range of various experiments that contemporary physics defines as "tests of the special theory of relativity". The aim is to interpret their results as "consistent" with the results of the special theory of relativity and to prove its validity.

What is the true essence of the most famous "tests of the special theory of relativity"?

All the experiments accepted as tests of the special theory of relativity can be divided into three main types.

8.1 The first type of tests: Based on the wrong "logical circular reference"

The first type of tests uses the trick *"liar paradox"*. They interpret the experiments by referring to the false results of the special theory of relativity, but this is, in fact, a "logical circular reference". However, we all know that the *"circular reference"* is inadmissible – both in Mathematics (e.g. in spreadsheets) and in logic.

According to Robertson, the following experiments are *fundamental tests of the special theory of relativity* [23]. The first two of the experiments refer to the first type of tests:

8.1.1 Michelson-Morley experiment

The analysis of the Michelson-Morley experiment in section 5 showed the inability of the Michelson interferometer to ascertain the difference in the speed of light in different directions in reference to the Earth's surface – the case of so-called "anisotropy of the speed of light". It was also shown that the *speed of light in vacuum* in our local space-time domain "near the surface of the Earth" remains constant as the Earth moves in its orbit around the Sun due to the constant intensity of the gravitational field dominated by the mass of the Earth. However, the measured speed of light in the frame of reference related to the rotating in the stationary space Earth's surface is different in different directions ("anisotropy of the speed of light").

As a result, based on the experiment of Michelson-Morley, the claim *"the speed of light is the same in all inertial frames of reference"* was imposed. From the analysis of the article *"On the Electrodynamics of Moving Bodies"* in section 6, it can be seen that the special theory of relativity was created on the basis of this erroneous claim. In other words, it turns out that the results of the special relativity are a consequence of the inappropriate conceptual design used in Michelson's interferometer, the advanced version of which was used in the famous Michelson-Morley experiment.

However, for modern physics, there is no problem with overturning causal relationships! For modern physics, *the Michelson–Morley experiment is a fundamental experiment that proves the results of the special theory of relativity!* This is nothing other than a classic example of a "logical circular reference", of a classical use of the trick "liar paradox", in which the "truth" value of a statement is evaluated by reference to a previously accepted value of the statement itself (self-referring). Moreover, *"the experiment established a relationship between the longitudinal and transverse lengths of the moving bodies"!*

8.1.2 Kennedy–Thorndike experiment

The speed of light in vacuum (in relation to the stationary space) depends on the intensity of the gravitational field. This is why the speed of light in vacuum does not change when the Earth travels in its orbit around the Sun and along with the Solar System in the Galaxy, because, during the motion of the Earth, the intensity of the gravitational field on its surface remains the same – dominated by the mass of the Earth.

The *"speed of light anisotropy"* in the frame of reference related to the Earth's surface, however, is a fact that cannot be fixed by Michelson's type interferometers. The Kennedy-Thorndike experiment does not principally differ from the Michelson-Morley experiment. The interferometer is actually a modified Michelson interferometer. The modification is that one arm of the interferometer used in the Kennedy-Thorndike experiment is shorter than the other one. As was substantiated:

> *"the interference fringes (the bright or dark bands caused by beams of light that are in phase or out of phase relative to each other) will never be displaced, because the difference in the speeds of each light beam in both directions of each of the arms will be fully compensated – regardless of the length of the arm, regardless of the direction of the arm!" [2].*

Therefore, the results of the Kennedy-Thorndike experiment cannot be different: no phase displacements are detected as a result of the rotation of the Earth around its axis, which was ascertained in the *"One-way measurement of the speed of light" experiments* and "*Michelson-Gale-Pearson experiment".*

According to modern physics, however, the negative result of the Michelson-Morley experiment is explained by *length contraction* (which is the result of the special theory of relativity). In fact, this is a *"logical circular reference".* In the same way – the negative result of the Kennedy-Thorndike experiment is explained by *time dilation* (the other result of the special theory of relativity). In addition to the *length cont*raction. From the report of the experiment:

> *"Using this null result and that of the Michelson-Morley experiment we derive the Lorentz-Einstein transformations, which are tantamount to the relativity principle"* [24].

We see that neither of the two experiments can provide any proof of the special theory of relativity **because the "truth" value of a statement cannot be evaluated by reference to a previously accepted value of the statement itself (self-referring).**

Therefore, the main question that needs to be put forth about the reliability of any experiment with a claim to prove the validity of a theory is as follows:

"Whether the evaluation of the results of the tests are based on the results of the theory the validity of which has to be proven?"

It turns out that most of the tests on the validity of the special theory of relativity use the trick of *"logical circular reference".* Therefore, such "tests" cannot serve as proof of the truth of any theory (in this case the special theory of relativity).

8.1.3 Sagnac experiment

The factual analysis of the Sagnac experiment, based on classical mechanics and Galilean relativity, is presented in section 4 in Part I of the current book.

The "logical circular reference" in modern physics is indiscriminately used. It is not serious for a scholar, maybe a doctor of Physics (not serious also for Wikipedia), to write on the Internet – (retrieved on April 20, 2013, from the site: https://en.wikipedia.org/wiki/Tests_of_special_relativity):

> *"Special relativity also predicts that two light rays traveling in opposite directions around a spinning closed path (e.g. a loop) require different "Special relativity also predicts that two light rays traveling in opposite directions around a spinning closed path (e.g. a loop) require different flight times to come back to the moving emitter/receiver (this is a consequence of the independence of the speed of light from the velocity of the source, see above). This effect was actually observed and is called the Sagnac effect".*

This is absurd, even humiliating for modern physics, that the Sagnac effect, which proves the invalidity of the special theory of relativity, is presented as proof of its validity in such a way!!!! It is interesting in this aspect, the book *"Relativity in Rotating Frames: Relativistic Physics in Rotating Reference Frames"* to be read, too [25].

8.1.4 Michelson-Gale-Pearson experiment

Concerning the "Michelson-Gale-Pearson" experiment – the factual analysis of the Michelson-Gale-Pearson experiment, which is based on classical mechanics and Galilean relativity, is presented in section 3. The conclusions of "modern physics" are the same as those of the *"Sagnac experiment"*, even though even the title of Michelson's article is *"The Effect of the Earth's Rotation on the Velocity of Light"*, which actually shows that the speed of light changes because of the rotation of the Earth!

8.1.5 Experiments "One-way Measurement of the Speed of Light"

Concerning the "one-way measurement of the speed of light" experiments: the "logical circular reference" is applied by modern physics – claiming that the "one-way measurement of the speed of light" from a source to a detector cannot be made independently of a convention as to how to synchronize the clocks at the source and the detector!

Here, as mentioned above, it is understood that if a ***"suitable convention"*** is chosen to synchronize the clock of the source and the detector's clock (what, of course, will not correspond to the physical reality), but it can be "mathematically proven" that the speeds of the light in the "east-west" and "west-east" directions are the same.

However, let us go to the second type of "fundamental tests" of the special theory of relativity. Apart from the "logical circular reference", which can prove whatever theory (because it is based on a reference to the theory itself), there are other ways of "proving" false theories.

8.2 Second type of tests: Based on inadmissible analogy

These are "tests" that use references to unsubstantiated statements that are believed to be correct only because of a non-existing analogy with truly proven correct statements. This is the case with the second type of "fundamental tests" of the special theory of relativity:

8.2.1 Ives–Stilwell experiment

According to contemporary physics, the Ives-Stilwell experiment tested the contribution of relativistic time dilation to the Doppler shift of the frequency of electromagnetic radiation (the light) [26].

In the experiment, a tube for "canal (channel) rays" (a mixture of hydrogen ions) is used; this tube is actually a gas discharge tube in which the cathode is made of perforated plates. An AC rectifier, capable of delivering up to 30,000 volts, has been used to maintain a high negative potential applied to the accelerating electrode, through the openings (channels) through which the accelerated ions that emit photons pass. The beam of emitted photons and its reflected image are observed simultaneously with the help of a concave mirror, which is shifted to 7° from the beam. A measuring microscope was used to fix the displacement of the *H_β spectral line of the Balmer spectral series* of the hydrogen atom emission spectrum. This displacement was claimed to be due to the Doppler Effect.

The Ives-Stilwell experiment, performed in 1938, and follow-up experiment, performed in 1941 [27], however, have several unsatisfactory aspects. Their experimental results are

deemed inconclusive not only in the comprehensive review by Wallace Kantor, a seasoned experimenter in this field [28].

The correct explanation of the results of the experiment is that the frequency (the energy) of the emitted quantum (photon) is always the same, regardless of the direction of movement and the velocity of the hydrogen ion that emitted it. In our case, the frequency of the quantum emitted by the hydrogen atom corresponds only and precisely to the difference in the energy states of the atom corresponding to the Hβ spectral line of the Balmer spectral series – $(E_{photon} = E_2 - E_1 = \hbar v)$, where $\hbar$ is Planck's constant, v is the frequency, and E_{photon} is the energy of the quantum (photon). The energy of the emitted quantum (which means its frequency), however, changes at the collision with the moving hydrogen ion which belongs to the moving oncoming beam.

In fact, the Ives-Stilwell experiment (as well as the incorrectly called "Doppler radar", or "Doppler gun"), obeys Schrodinger's dynamic treatment. According to Schrodinger, the so-called *"Doppler effect for photons"* is simply a consequence of the energy exchange in the case of collision between atoms (in our case hydrogen ions) and quanta (photons). This energy exchange depends on the velocity (momentum) of the hydrogen ion, and on the angle between the trajectories of the colliding hydrogen ion and the photon. After the collision, the speed of the photon in vacuum remains the same, however, its energy (frequency) changes – $(\Delta E = \hbar \, \Delta v)$.

Therefore, the explanation that the observed change in the frequency of electromagnetic radiation is due to the "Doppler effect" is not true.

> *1. If the "Doppler effect" is valid for electromagnetic waves, then the frequency of the photons emitted in the "east direction" (by a stationary source in relation to the moving ground surface), will be different from the frequency of the emitted photons in the "west direction"!*

> *2. If the "Doppler effect" is valid for electromagnetic waves, why are the electromagnetic signals from the space-probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which are moving away from the Sun (respectively of the Earth) are, blueshifted (instead of to be redshifted)?*

Obviously, the existing misconceptions in contemporary physics must be rejected. The Doppler Effect is an effect of mechanical waves, which are vibrations of matter particles. Electromagnetic radiation, however, is a stream of energy packets (quanta), rather than vibrations of matter particles. The explanation of the redshift with the Doppler Effect is the reason for another delusion in Physics of the 20th century – *the "accelerating expansion of the Universe"*. In the article *""Dark Matter", "Dark Energy", and Other Problems in Physics Today"*, the genuine explanation is presented - *"the other cause"* for the redshift – as expressed by Vesto Melvin Slipher, who is the first who observed the redshift of spectral lines of the electromagnetic radiation (of the light) coming from distant galaxies [33]. According to the assistant and successor of Hubble, Allan Sandage, Hubble believed that the redshift *"represents a hitherto unrecognized principle of nature"*. The explanation given in the abovementioned paper is based on the deduced *"energy-spatial relationship"*, which is actually "the unrecognized principle of nature".

The Universe does not expand – actually, the Universe is in a stage of contraction…, which logically follows from the analyses presented in this article. Modern physics tries to explain the delusion of the *"accelerating expansion of the Universe"* by the inexplicable myth of "dark energy" (whose nature is inexplicable even for the modern cosmologists themselves), as

well as by the presence of an illogically high percentage of an unknown kind of "dark matter" in the Universe.

Therefore, maintaining "by analogy" (the presence of the Doppler Effect at electromagnetic waves), without real arguments [1], is not admissible in science. In the same way, the delusion that the speed of light is the same for all frames of reference, is no longer serious to maintain!

8.2.2 Mössbauer rotor experiments

Concerning Mössbauer rotor experiments are also **considered** *"confirmation of the relativistic Doppler effect"*. The experiments are based on the Mössbauer effect. The Mössbauer effect, also called recoil-free gamma-ray resonance absorption, is a nuclear process permitting the resonance absorption of gamma rays. The physical phenomenon was discovered by Rudolf Mössbauer in 1958. The absorption occurs at exactly the same energy of the quanta, resulting in strong resonant absorption of the gamma quanta by the atomic nuclei in the lattice of the solid, so the energy is not lost during the recoil.

Mössbauer rotor experiments usually use a source of gamma rays located in the center of a rotating disk. The gamma rays are sent to the resonance absorber located on the rim of the rotating disk. A stationary counter, measuring the number of unabsorbed quanta, is placed outside the rotating resonance absorber. When the disk with the absorber rotates, the number of unabsorbed quanta, measured by the stationary counter outside the rotation disk, increases.

According to the explanation, given under the accepted explanation with *"Doppler effect for photons"*, the characteristic resonance absorption frequency of the moving absorber at the rim of the rotating disk should decrease due to relativistic time dilation, so the passage of the gamma-rays through the absorber increases, which is subsequently measured by the stationary counter outside the absorber.

In fact, the result of the *Mössbauer rotor-experiments* also obey Schrödinger's dynamical treatment. They are also explained as a consequence of the energy exchange (on the collision) between an atom (in that case the atom in the lattice of the solid) and a gamma-quantum. Actually, the process of absorption is a momentary energy exchange at the impact between the gamma-quanta (with precisely certain energy) and resonant nuclei in the rotating absorber on the rim of the rotating disk. When the absorber rotates, the momentum of the atoms in the absorber changes, and the energy of the atoms becomes different from the necessary exact "resonance" energy at the absorption of the gamma-quantum.

Therefore, this is the reason why the passage of gamma-quantum rays through the absorber increases in the rotation of the disc and is subsequently reported by the stationary counter outside the absorber.

8.2.3 Kündig's experiment

Concerning Kündig's experiment *on the so-called "transverse Doppler shift"*, there are different doubts about the given explanation of the experiment [29]. For example, in the article titled *"Kündig's experiment on the transverse Doppler shift re-analyzed"* [30] we can read the conclusion:

> *"We are inclined to think that the revealed deviation of ΔE/E from relativistic prediction cannot be explained by any instrumental error and thus represents a physical effect. In*

particular, we assume that the energy shift of the absorption resonant line is induced not only by the standard time dilation effect, but also by some additional effect missed at the moment, and related perhaps to the fact that resonant nuclei in the rotating absorber represent a macroscopic quantum system and cannot be considered as freely moving particles" [30].

Actually, the real explanation of Kündig's experiment is the same as that given for the Mössbauer rotor experiments.

8.3 Third type of tests: Completely contrived (fabricated) tests

These types of tests are fully fabricated tests. A brilliant example of a fabricated test is the *Hafele-Keating experiment* (supported by mathematical equations based on the "famous" results of the special theory of relativity).

During October 1971, Joseph C. Hafele, a physicist *(Department of Physics, Washington University)*, and Richard E. Keating, an astronomer *(Time Service Division, U.S. Naval Observatory)*, took cesium-beam atomic clocks aboard commercial airliners. These clocks flew twice around the world in opposite directions near the equator (first eastward, then westward with different sets of clocks), and were compared the clocks with reference clocks at the United States Naval Observatory. The reported result of the experiment was that time dilation was registered as a differences between the three sets of clocks - that their differences were consistent with the predictions of Special and General relativity.

According to contemporary physics, "the reported results provide an unambiguous empirical resolution of the famous relativistic "clock-paradox" with macroscopic clocks".

The theoretical staging of the experiment is presented in the paper *"Around-the-World Atomic Clocks: Predicted Relativistic Time Gains"* as follows:

"Special relativity predicts that a moving standard clock will record less time compared with (real or hypothetical) coordinate clocks distributed at rest in an inertial reference space" [31].

This assertion is inaccurate, because of the perhaps inaccurate definition of the frames of reference used in the article *"On the Electrodynamics of Moving Bodies"*, where the special theory of relativity was published [15]. In fact, in the section *"Definition of Simultaneity"* of his article, Einstein argued for the use of the term *"stationary system"* in the following way:

"In order to render our presentation more precise and to distinguish this system of co-ordinates verbally from others which will be introduced hereafter, we call it the "stationary system" [15].

The lack of an exact definition of the frames of reference by Joseph Hafele and Richard Keating also leads to their mixing, and this is very misleading. However, let us distinguish the truly existing reference systems as they are in this report:

1. Moving frame of reference – related to the surface of the Earth, which moves in the "reference space" (the stationary space), with the respective linear speed of the Earth's surface at the equator. *(The linear speed is the speed of motion of a point on the Earth's*

surface in the stationary space for the respective latitude). Actually, the origin of this coordinate system is the starting point of travel with the airplanes (on the equator), and the x-axis is directed to the east. In this frame of reference (as accepted in this report), the airplane speed in the east direction is $+v$ (for an eastward circumnavigation of the Earth *(v>0)*), and the airplane speed in the west direction is $-v$ (for a westward circumnavigation of the Earth *(v<0)*.

2. "Stationary" reference system – related to the stationary "non-rotating stationary space". The ECI frame of reference can be considered stationary in relation to the surrounding Earth space in such specific cases of experiments carried out on the Earth's surface. ***The origin*** of this coordinate system is in the center of the Earth, and ***its axes*** are practically stationary – aimed at very distant astronomical objects.

In the given report, the origin of the coordinate system is the North Pole:

"For this purpose, consider a view of the (rotating) earth as it would be perceived by an inertial observer looking down on the North Pole from a great distance" [31].

In this stationary reference system (for the "inertial" observer from the North Pole):

"A clock that is stationary on the surface at the equator has a speed Rω relative to nonrotating space, and hence runs slow relative to hypothetical coordinate clocks of this space in the ratio $(1-R^2\Omega^2/2c^2)$, where R is the earth's radius and Ω its angular speed. On the other hand, a flying clock circumnavigating the Earth near the surface in the equatorial plane with a ground speed v has a coordinate speed RΩ+v, and hence runs slow with a corresponding time ratio $1-(R\Omega+v)^2/2c^2$" [31].

Let us make the following clarifications:

1. First, that the North Pole observer is actually stationary in the non-rotating stationary space (not only because they are located on the axis of rotation of the Earth); and

2. Second, for the observer (in this frame of reference related to the stationary space): the ground linear speed at the equator is $R\Omega$; the speed of the airplane flying eastward (in the direction of rotation of the Earth) is $(R\Omega+v)$; and the speed of the airplane flying westward (against the Earth's rotation) is $(R\Omega-v)$.

It turns out that the authors of this paper made a mistake about the considered frames of reference – which they completely mixed up.

That is why the conclusion that the authors give certainly provokes perplexity even for the supporters of the special theory of relativity:

"Consequently, a circumnavigation in the direction of the earth's rotation (eastward, v>0) should produce a time loss, while one against the earth's rotation (westward, v<0) should produce a time gain for the flying clock if $|v|\sim R\Omega$" [31].

According to special relativity, the observer's clock in the inertial reference system, called a "stationary system" by Einstein *"to distinguish this system of co-ordinates verbally from others"* [15], should be faster than the clocks that move in relation to the "stationary system" ***(regardless of the direction of motion)***. In other words, the clocks on the flying airplanes

must lag (the time must go slower) in relation to the clocks in the U.S. Naval Observatory, *regardless of the flight direction of the airplanes*. <u>Therefore, the experimenters are not familiar with the results of the special theory of relativity, i.e., with the results, whose validity they want to prove!</u>

However, it is not just this inaccuracy that indicates clearly that the experiment was fabricated (see the two presented results):

The reported results of the experiment presented in the article *"Around-the-World Atomic Clocks: Observed Relativistic Time Gains"*, published in the journal *"Science"* (the peer-reviewed academic journal of the *American Association for the Advancement of Science (AAAS)*, with the 2022-2023 impact factor equal to 63.83), are as follows [32]:

1. The clock on the airplane, flying to the east (in the direction of rotation of the Earth), runs slower than the clock located in the U.S. Naval Observatory (latitude: 38° 55' 16.5403", which is far from the North Pole, the point where the experimenters have indicated that is in the "nonrotating space":

   a. According to the theoretical formulas presented in the article → with (-40+/-23 ns), and according to the clock readings → with (-59+/-10ns).

2. The clock in the airplane, flying to the west (contrary to the direction of rotation of the Earth), runs faster (is not funny?) than the clock located in the U.S. Naval Observatory (Latitude: 38° 55' 16.5403"):

3. According to the theoretical formulas presented in the article – with (+ 275 +/-21 ns), and according to the clock readings – with (+ 273 +/-7 ns)

The final conclusions of the experts (and approved by the journal *"Science"*) are as follows:

"These results provide an unambiguous empirical resolution of the famous clock "paradox" with macroscopic clocks" [32].

However, some of the questions that readers of this article may ask are:

First, the *reference clocks*, as indicated, (in relation to which the experimenters measure the differences with the *"flying clocks"*), are located at the US Naval Observatory (latitude 38° 55' 16.5403"), which is far from the North or the South Pole where they are initially accepted to be stationary.

Second, as already mentioned, according to the results of the special theory of relativity *there is no assertion that the time will decrease or increase depending on the direction of motion of the inertial system!*

Third, according to the special theory of relativity, time runs more slowly (time slows down) at a higher speed of movement. Consequently, (if the special theory of relativity is true), the clock of an observer located on the equator will run permanently slower in than the clock of an "inertial" observer located on the North or South Pole (the intersection of the axis of rotation of the Earth with the Earth's surface), because the linear speed of the surface in the stationary space at the equator is approximately *$R\Omega$ = 0.46 km/s (1,656 km/h)*, and because the speed of the Earth's surface on the poles is zero. In other words, an atomic clock in Sweden will be constantly faster than an identical atomic clock located near the Amazon River in Brazil... *and that fabricated experiment would not be necessary!*

Therefore, if the special theory of relativity is true, why do we not adjust clocks according to latitude?

The answer may be only one: *The "experiment Hafele-Keating" is a brilliant example of a fabricated experiment and a brilliant example of the extent to which the "internationally recognized Physics journals" are scientific!*

The truth is that the atomic clock will run faster in regions with a weaker gravitational field intensity. The development of technology and the accuracy of the measurements make it possible to determine the changes in the electromagnetic properties of atoms when changing their location to regions with different gravitational field intensities. For example, many experiments confirm that atomic clocks run faster at higher altitudes (in the mountains). This is a prediction of the general theory of relativity and, in fact, proves that the characteristics of the electromagnetic radiation emitted by the atoms change depending on the intensity of the gravitational field.

An increase in the frequency and wavelength of a same electromagnetic radiation emitted by a same atom can be performed on a space station, such as "the International Space Station (ISS)". This would also unambiguously show that the speed of light in vacuum increases in regions with a weaker gravitational field. This will launch a new realistic concept of the physical reality of the Universe.

8.4 Conclusion on the "fundamental tests" of the special theory of relativity

All the "scientific" explanations of the so-called "fundamental tests of the special theory of relativity", given by its supporters, do not meet the requirements of science to provide a real explanation of the physical world. All of them support the delusion "special theory of relativity" and are contrived in one or another sense. The presented analyses of the "fundamental tests" in this article reveal their essence.

Important: If the special theory of relativity is valid for the physical reality, the atomic clocks in Sweden, at sea level, will be constantly faster than identical atomic clocks located near the Amazon River in Brazil (near the equator at sea level) ... and all these "fundamental tests of the special theory of relativity" would not be necessary!

The given real explanations of all "unexpected" and "inexplicable" results of the most famous experiments related to the behavior and measurement of the speed of light in our local time-spatial region "near the surface of the Earth"; the factual analysis of Einstein's article "On the Electrodynamics of Moving Bodies"; and analyses of the so-called "fundamental tests of special relativity" in the present article indisputably prove that **the special theory of relativity is the biggest blunder in Physics of the 20th Century!**

Part II

"DARK MATTER", "DARK ENERGY", AND OTHER PROBLEMS IN PHYSICS TODAY

ABSTRACT

The cause of the hypotheses of the existence of "dark matter" and "dark energy" is a consequence of the second biggest blunder in physics of the 20th century: "the accelerating expansion of the Universe". This is undoubtedly a big problem in physics because it is illogical for the Universe to expand, despite the existing and undeniably proven universal attraction (Newton's law of universal gravitation). Modern physics tries to explain this delusion by the existence of an illogically high percentage of some unknown type of "dark matter" in the Universe (which, if it existed, should have been discovered by now), as well as by the inexplicable myth of "dark energy" (the nature of which is inexplicable even to modern cosmologists themselves)!

The root cause of this delusion is based mainly on the unproven claim that the redshift of the spectral lines of the emitted electromagnetic radiation from remote galaxies is due to the Doppler Effect. Throughout his life, Hubble did not support Vesto Slipher's supposition that the "redshift" is a "velocity-like displacement" (as a result of the Doppler Effect). The Doppler effect is an effect of mechanical waves, but not of electromagnetic radiation, which is a stream of immaterial small energy packets (quanta) radially propagating from the source into the propagation medium. This medium (the "empty of matter space"), actually turns out to be compressed energy by the fundamental forces of nature. The real explanation of the incorrectly called "Doppler radar" is explained in the book according to Schrödinger's dynamic interpretation.

According to the assistant and successor of Hubble, Allan Sandage, Hubble believed that the redshift "represents a hitherto unrecognized principle of nature". The main scientific contribution is the presentation of this "unrecognized principle of nature"– that is the "energy-spatial relationship" existing in the energy-space-time continuum of the Universe, that the so-called "empty space" between the celestial bodies and between the particles of matter is actually a "soup" of energy.

Key Words: Dark matter; Dark energy; Accelerating expansion of the Universe; Redshift

1. INTRODUCTION

The claim that all the atoms and light in the universe together make up less than five percent of the total contents of the cosmos is based on the delusion that the Universe is expanding, which in turn is based on the assumption that the observed redshift of the electromagnetic radiation coming from distant galaxies is due to the Doppler effect. However, the Doppler Effect is an effect that is observed only with mechanical waves, which are vibrations of matter.

The introduction of this article presents the history of rising the problems of "dark matter" and "dark energy". The laws "redshift-distance" and "velocity-distance" are also discussed, which modern cosmologists indiscriminately call "Hubble's law". A real explanation of the incorrectly called "Doppler radar" with Schrödinger's dynamic interpretation is also presented. Irrefutable counterarguments for the existence of the Doppler Effect in the case of electromagnetic waves are also presented.

Vesto Melvin Slipher was the American astronomer who carried out the first observations of the shifting of spectral lines of electromagnetic radiation (of light) coming from distant galaxies. Slipher used spectroscopy to investigate the rotation periods of planets and the composition of planetary atmospheres. In 1912, he was the first to observe and discover that the spectral lines of hydrogen absorption in the spectrum of distant galaxies redshifted to the low-frequency spectrum. He was also the first to suppose that this redshift was related to velocity (with the unproven existence of the Doppler Effect at electromagnetic waves), thus providing the first empirical basis for the expansion of the Universe.

In September 1912, in "The Radial Velocity of the Andromeda Nebula" in the inaugural volume of the Lowell Observatory Bulletin, Slipher reported:

> *"The magnitude of this velocity, which is the greatest hitherto observed, raises the question whether the velocity like displacement might not be due to some other cause, but I believe we have at the present no other interpretation for it"* [33].

By combining the distances with measurements of galaxy redshifts from the Vesto Slipher, Hubble and his assistant Milton L. Humason found a linear relationship between the galaxy distances and measured redshifts. In 1929 Hubble published the results of the work in his first paper [34]. There, he indicatively concludes that there is a linear relationship between redshift and distance; that is, if one galaxy is twice as far away from another, its redshift is twice as large. This discovery later became known as Hubble's law. Hubble's law "redshift-distance" is represented as $\Delta\lambda/\lambda = constant*D$, where $z = \Delta\lambda/\lambda$ is the redshift and D is the distance to the galaxy.

Two years later, in 1931, in "*The Velocity-Distance Relation among Extra-Galactic Nebulae*", Hubble and Humson presented what astronomers and cosmologists widely regarded as very convincing evidence that the relationship is indeed linear; therefore, the redshift of the spectrum of electromagnetic radiation from a remote galaxy is directly proportional to the distance to the galaxy [35]. The linear relationship is expressed by the equation $z = \Delta\lambda/\lambda = H.D$, where H is the constant of proportionality, D is the "true distance" to the galaxy, and z is the redshift.

The theoretical basis of the delusion of "expansion of the Universe" was given by the Russian and Soviet physicist and mathematician Alexander Friedman [36], and the Belgian astronomer, cosmologist, and mathematician Georges Lemaître. Practice in theoretical physics shows that even if the applied mathematics is perfect, but based on the wrong fundamental concept, the result is wrong. Georges Lemaître, the Belgian Catholic priest and physicist, predicted the "velocity-distance" relation and published observational support for it two years before the discovery of Hubble's law (which is actually different from the real Hubble's law "redshift-distance" relation) [37].

Hubble estimates the distances to 24 extragalactic nebulae using a variety of methods. The established distances turn out to be more or less proportional to the true distances. Yet, the reason for the redshift remained unclear. However, many cosmologists and astronomers (including Hubble himself) failed to recognize the work of Lemaître. Hubble remained doubtful for his entire life about Lemaître's interpretation. Although Hubble used the term "velocities" in his paper (and "apparent radial velocities" in the introduction), he later expressed doubt about interpreting these as real velocities. In 1931 he wrote a letter to the Dutch cosmologist Willem de Sitter expressing his opinion on the theoretical interpretation of the "redshift-distance" relation:

> *"Mr. Humason and I are both deeply sensible of your gracious appreciation of the papers on velocities and distances of nebulae. We use the term "apparent" velocities to emphasize the empirical features of the correlation. The interpretation, we feel, should be left to you and the very few others who are competent to discuss the matter with authority".*

In the 1930s, Hubble was involved in determining the distribution of galaxies and spatial curvature. These data seemed to indicate that the universe was flat and homogeneous, but there was a deviation from flatness at large redshifts. According to Allan Sandage:

> *"Hubble believed that his count data gave a more reasonable result concerning spatial curvature if the redshift correction was made assuming no recession. To the very end of his writings, he maintained this position, favouring (or at the very least keeping open)*

In December 1941, Hubble reported to the American Association for the Advancement of Science that the results from a six-year survey with the Mount Wilson telescope did not support the expanding Universe theory. According to a Los Angeles Times article reporting on Hubble's remarks:

"The nebulae could not be uniformly distributed, as the telescope shows they are, and still fit the explosion idea. Explanations which try to get around what the great telescope sees, he said, fail to stand up. The explosion, for example, would have had to start long after the Earth was created, and possibly even after the first life appeared here".

If, according to modern physics, the Hubble constant represents the "velocity-distance" relationship, then it would tell us the velocity of an object at any distance. Since the distance between all objects in the Universe before the "Big Bang" should have been zero, the time in this equation should be the age of the Universe. (Therefore, Hubble's estimate of what we now call the Hubble constant would put the Big Bang only 2 billion years ago).

1.1 The Doppler Effect at mechanical waves and accepted illogical analogy in the case of electromagnetic waves

The Doppler Effect (or Doppler shift) occurs in mechanical waves; these waves are vibrations of matter particles belonging to a material propagation medium—vibrations (oscillations) of any material particle of the propagation medium around a stationary point in the frame of reference related to the propagation medium of the mechanical wave. This is the change in the measured frequency and length of a mechanical wave ascertained by an observer who moves in the medium of propagation relative to the source of the wave. The effect was named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842 on the basis of his research with sound waves. Known mechanical waves propagate through a material medium (solid, liquid, or gaseous) with a wave velocity that depends on the elastic and inertial properties of this medium. There are two main types of mechanical waves depending on wave motion: "transverse waves" and "longitudinal waves".

We know that the sound waves in the atmosphere are mechanical longitudinal waves - they are oscillations of matter in which material particles (molecules) vibrate parallel to the direction of propagation. In mechanical waves, only the vibrations of the material particles are transmitted in space from particle to particle: any material particle oscillates around a stationary point in the reference frame related to the propagation medium (which medium can be stationary with respect to the stationary space or can move, e.g. running water). The particles themselves are not transported from the source to the receiver in the reference frame related to the propagation medium; only the vibration itself is transported transmitting in this way energy. In the case of mechanical waves, the Doppler Effect is observed if the source or receiver moves within the frame of reference relative to the propagation medium; this effect can also occur with respect to the stationary space since the medium is material.

For Huygens, light is a longitudinal wave (like the sound waves in the air) that propagates through a medium called "ether", or "aether" at that time. The "ether" must fill all the space and be weightless and invisible. The reality is that electromagnetic radiation has no material character:

Electromagnetic radiation is a stream of immaterial small energy packets (quanta), propagating radially from the source in a stationary space distorted by gravitational forces.

This flow of quanta under certain circumstances manifests itself as a wave. For this reason, we agree that electromagnetic radiation has a dual nature – it has a wave-corpuscular character. However, in the case of electromagnetic waves, it is not permissible to draw an analogy with mechanical waves (i.e., if a "redshift" is observed, this does not mean that it is due to the "Doppler effect").

The energy of each emitted or absorbed quantum from a particular atom is given by the Max Planck ratio, which is equal to the difference between the energy levels of the participating pairs of quantum energy states of a given atom *(Equantum = Ei - Ej = ℏv)*, where v is the frequency, $\hbar$ is the Planck constant and *Equantum* is the energy of the quantum. In other words, the "quantum energy states" of an atom are fixed, therefore the energy (frequency) of the emitted quanta (photons) has discrete values that cannot be arbitrary. They are strictly defined and represent the difference between two adjacent energy levels of the atom. Therefore, the frequency, wavelength, and speed in vacuum of the emitted quantum (the properties of atoms) do not depend on the speed of motion of the atom; however, as proven, they depend on the intensity of the gravitational field in the local time-spatial domain, where the atom is located. The assertions of the *"Thesis on the Behavior of Electromagnetic Radiation in the Gravitational Field of the Universe"* are published in the monograph [17] and shown in Part III of the current book.

The frequency, wavelength, and speed in vacuum of the emitted quanta (photons) do not change when they propagate in a region with a uniform intensity of the gravitational field (as in the region "close to the Earth's surface"). Quanta can pass through a substance if their energy is high enough (if the electromagnetic waves are at a high frequency); can be absorbed by the substance, but they can also be reflected.

Let us look at the case of the incorrectly called "Doppler radar" or "Doppler laser gun" according to Schrödinger's interpretation (Schrödinger's dynamic interpretation). When the quanta are reflected by a moving material body, their energy (frequency) changes if the energy (frequency) of the electromagnetic quantum is comparable to the momentum of the moving object. Each atom of the moving body has a quantity of motion (momentum). Thus, at the collision of the quantum (photon) with the moving atom, there is an energy exchange. The energy of the reflected quantum changes, depending on the momentum of the atom (depending on the velocity vectors of the quantum and the material body). This means that the frequency of the reflected quantum changes, because *(ΔE = ℏ.Δv)*, where v is the frequency, and $\hbar$ is the Planck constant. In fact, the speed of the quantum remains the same *(c=λv)*, since the speed of light in vacuum is a local constant for all frequencies of the electromagnetic spectrum in any time-spatial region with uniform gravitational field intensity. However, its frequency v, and therefore its wavelength λ, changes. This is the case with the incorrectly-called "Doppler radar", or "Doppler gun", because the result is not due to the "Doppler Effect", which is an effect only at mechanical waves!

Conclusion:

The claim of the existence of the "Doppler effect" in electromagnetic radiation (that the motion of the source of electromagnetic radiation causes a "redshift" or "blueshift" of the frequency of the electromagnetic radiation), is actually a big delusion in modern physics. This claim is the root cause of the delusion of the "accelerating expansion of the Universe", and hence of the emergence of the superfluous make-believes "dark matter" and "dark energy".

1.2 The laws "redshift-distance" and "velocity-distance"

As mentioned above, Vesto Slipher was the American astronomer who first reported an observed redshift. His assumption is that the observed shift in the spectral lines of the emitted electromagnetic radiation (of the light) from distant galaxies is caused by the velocity "velocity-like displacement" (which means due to the Doppler Effect). This is a brilliant example of how an assumption is perceived as scientific truth by the mainstream of physics without any experimental evidence!

Cosmologists generally fail to distinguish the linear dependence $z=\Delta\lambda/\lambda=H.D, \ z(D)$ "redshift-distance" proposed by Hubble [35] from the law $V(D)$ "velocity-distance". As noted, in contrast to Hubble's law, the origin of the law of velocity-distance $(V=H_0*D)$ actually remains unclear, where V is the recessional velocity, D is the distance to the galaxy, and H_0 is the Hubble constant.

Modern cosmologists ignore this difference, and the two laws are indiscriminately called "Hubble's law". As mentioned, the change in wavelength (displacement) is usually attributed to the Doppler effect, which is observed when the source of mechanical waves (such as sound waves) or the observer are moving at a velocity relative to each other in the material medium of propagation of a mechanical wave. However, thus far, there is no experimental evidence proving that the Doppler effect is valid for electromagnetic waves; i.e., there is no evidence that the two laws are equivalent. Counterarguments refuting the existence of the Doppler Effect at hand the electromagnetic waves are presented below.

With his works in 1922 and 1924, Friedman became the pioneer of "non-stationary" open and closed homogeneous and isotropic cosmological models, and over the next decade, these expanding models were further developed by Lemaître [37], and other cosmologists, e.g., Eddington [38], Robertson, and Tolman. During the formative stages of the expanding cosmic paradigm in the early 1930s, it became clear that expansion must be linear if the universe is homogeneous. However, with the 2011 Nobel Prize in Physics:

> *"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae", modern physics actually accepts that the law "redshift-distance" z(L) is not linear, and is time-dependent, which means that Hubble's constant is not a time-independent constant, and that modern cosmologists do not distinguish the law of "redshift- distance" from the contrived law "velocity-distance".*

Therefore, Vesto Slipher's supposition:

> *"The magnitude of this velocity, which is the greatest hitherto observed, raises the question whether the velocity like displacement might not be due to some other cause, but I believe we have at the present no other interpretation for it" [33].*

 It remains valid for modern physics, although, according to Edwin Hubble, the redshift "represents a hitherto unrecognized principle of nature".

1.3 Counterarguments refuting the existence of the Doppler Effect at electromagnetic waves

In fact, no "redshift" or "blueshift" was observed at the electromagnetic waves, as a result of the "Doppler effect", at a relative velocity between the transmitting and receiving objects. The case of the so-called "Doppler radar", as was discussed above, is due to the collision of the quantum (photon) with the moving atom, where the case is an energy exchange. Here is some of this evidence for the non-existence of the "Doppler effect" in the case of electromagnetic waves:

1. To date, no deviation of the frequency of the electromagnetic signals, emitted by hypersonic airplanes when flying low over a point on the Earth's surface, has been observed (although modern technology makes it possible);

2. If the "Doppler effect" is valid for electromagnetic waves, then the frequency emitted by a suitable laser in "east-west" and "west-east" directions (from a stationary source relative to the moving Earth's surface) will be different due to the linear velocity of the Earth's surface, which, for example, is approximately equal to 0.465 km/s for any point on the equatorial line! The effect should be superimposed when receiving an emitted electromagnetic signal from a hypersonic airplane flying at a low altitude above the receiver, especially if it is close to the equator;

3. If the "Doppler effect" is valid for electromagnetic waves, then the frequency emitted by a space probe will change every half circumference when a space probe orbits a planet in the Solar system in the ecliptic plane (the plane in which the Earth and the other planets orbit around the Sun). However, such an effect is not observed.

4. Moreover: If the "Doppler effect" exists in the case of electromagnetic waves, then when observing the redshift of galaxies of suitable remoteness (in the Earth's orbital plane), the observed redshift of the incoming light from these galaxies should differ significantly in opposite positions of the Earth in its orbit around the Sun (in cases such as "January-July", "March-September", and "June-December").Such a difference should obviously be observed because the speed of revolution of the Earth around the Sun is approximately 30 km/sec, and the Hubble constant is approximately 70 (km/s)/Mpc. Thus, a change from "redshift" to "blueshift" and vice versa during the different seasons should be easily observed if a galaxy is not too remote

5. If the "Doppler effect" is valid for electromagnetic waves, then the electromagnetic signals from the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", when moving away from the Sun (and therefore from the Earth) must be redshifted, and the shift must change in different seasons because the speed of revolution of the Earth around the Sun is approximately 30 km/sec. However, the electromagnetic signals from these space probes (moving away from the Earth) shift toward the blue spectrum and the shift does not change from season to season.

It is obvious that the Doppler Effect is valid only for mechanical waves, which are vibrations of matter – of vibrating particles of matter in a material medium of propagation.

The electromagnetic field, together with the gravitational field, exists on the space, and the gravitational and electromagnetic forces themselves distort (contract) the space at the micro- and macro-levels. Unlike mechanical waves, electromagnetic radiation is a radially propagating stream of quanta of energy in the stationary space (which is actually an "energy soup"); therefore, the "Doppler effect" is not applicable to a nonexistent analogy with mechanical waves.

Moreover, modern physics silently avoids explaining many facts, such as the following:

1. What causes "the redshift" of the frequency of electromagnetic signals from a space probe which reduces its speed before landing on the surface of a planet in the solar system (for example, when a space probe is landing on the surface of Mars)? Obviously, if this is due to the Doppler effect, then we would observe a "blueshift";

2. What is the reason for the "blueshift" of the frequency of electromagnetic signals from the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which actually move away from the Sun (from the Earth);

3. If the Doppler Effect is proving that the Universe is expanding, then why is the Andromeda galaxy approaching our Milky Way galaxy?

Obviously, many paradoxes (such as Olbers' paradox – the "dark night sky paradox") remain, for which modern physics admits that scientific explanations cannot be provided (based on perceived delusions). In fact, the relationship between the "contraction of the space" and the "accumulation of the energy in the space" presented below not only provides a logical explanation for the observed "redshift" of the spectral lines of emitted electromagnetic radiation from the distant galaxies (explanation of the facts cited above) but also provides a reasoned explanation for the "Olbers' paradox".

2. DISCUSSION ON THE REAL CAUSE OF THE REDSHIFT OF THE ELECTROMAGNETIC RADIATION COMING FROM DISTANT GALAXIES

2.1 Logical rationale

Facts:

1. Atomic clocks tick faster high in the mountains. That is, the frequency of emitted electromagnetic radiation increases in regions with lower gravitational field intensities.

2. The shift in the hydrogen spectral series in the spectrum of electromagnetic radiation emitted on the surface of nearby stars is the same, regardless of the size (mass) of the star. Although the frequency of the emitted electromagnetic radiation differs due to the different strengths of gravity on the surface of different stars, it always arrives at the surface of the Earth at a frequency as if it had been emitted at the surface of the Earth.

Conclusion 1 (the case of a static universe) [39]:

1. The frequency of the emitted electromagnetic radiation is in full synchrony with the intensity of the gravitational field at the location of the radiation. This means that the "quantum energy states" of the emitting atom (and therefore the energy (frequency) of the emitted quanta) depend on the intensity of the gravitational field in the location at the atom.

2. The frequency of the propagating electromagnetic radiation changes in full synchrony with the intensity of the gravitational field in the regions through which it passes.

3. Thus the frequency of electromagnetic radiation arriving at the Earth's surface is as if it had been emitted here at the Earth's surface. The interpretation of the astronomical spectroscopy results is based on this logic.

Conclusion 2:

The frequency of electromagnetic radiation is actually the energy of the quanta *(E = ℏ.v)*. Therefore, the energy of the quanta changes as the quanta pass through regions with different gravitational field intensities. Actually, the quanta give out part of their energy to the "energy soup" (the empty space/vacuum) when entering regions of stronger gravity, and some energy is returned back to them when the quanta enter regions of weaker gravity.

Conclusion 3:

It turns out, that the vacuum (the so-called "empty space", which is the medium for propagation of the electromagnetic quanta), is compressed energy from the fundamental forces of nature!

Conclusion 4 (the case of an expanding or contracting universe):

1. If the Universe is expanding during the propagation of the quanta through space, then the quanta arriving at the surface of the Earth from distant galaxies will be of greater energy (blueshifted)! This is because the quanta arrive with additional energy upon arrival at the Earth's surface, which is received from the "empty space" that expands during travel.

2. If during the propagation of the quanta through the "empty space" of the Universe, the "empty space" is contracting, then the quanta arriving at the surface of the Earth from distant galaxies will be of lower energy (redshifted). This is because a part of their energy remains accumulated (stored)in the "empty space" contracting during propagation and will remain absorbed by the contracting space upon arrival at the Earth's surface. The longer they travel (from more distant galaxies), the greater part of their energy will be absorbed by the contracting space during the time of propagation and the greater the redshift will be. This is the real explanation of the law "redshift-distance" discovered by Edwin Hubble!

2.2 Experimental proof

The American astronomer Sandra Faber is known for her research on the formation and evolution of galaxies and the structure of the Universe. She has made significant scientific contributions to the structure and formation of galaxies and the motion of the stars in the galaxies related to their age; she maps the universe in three dimensions and analyses the flow patterns of a large number of galaxies. Her mapping techniques change the way we look at the Universe and contemplate its future.

The fact that the Universe is contracting is confirmed by the discovery of the team of Sandra Faber:

While mapping a vast region of the Universe, including our galaxy, they found that all the galaxies are moving roughly parallel, like a great river of galaxies, at approximately 600 kilometers per second, heading towards a very, very large supercluster, super-supercluster of galaxies– a supercluster of real matter. They called this super-supercluster of galaxies the "Great Attractor".

This is the undeniable argument that the 2011 Nobel Prize in Physics should have been awarded to Professor Sandra Faber and her colleagues:

> *"for the discoveries proving that the Universe is at a contracting state toward a region of global attraction of the Universe, and that this contraction is accelerating due to the increase in the incoming matter in the region of the "Great Attractor" (the region of the global attraction), and due to the decrease in the distance of the moving galaxies toward this region".*

This is the explanation for why, from our galaxy, we are observing an increasing redshift of electromagnetic radiation coming from all other galaxies (which is wrongly accepted as the "recede of galaxies"). This is not only because of the greater travel time of electromagnetic radiation but also because the galaxies closer to the "Great Attractor" have greater attraction (Newton's Law of Universal Gravitation) and consequently greater acceleration, and those farther away have a smaller acceleration than the Milky Way. Exceptions are nearby galaxies with the same distance to the "Great Attractor" (to the center of the contraction), such as Andromeda.

2.3 For a bit of open-mindedness

This subsection provides further evidence that the Universe is contracting (for those who even accept that there is a Doppler effect in the case of electromagnetic radiation).

This discovery by Sandra Faber's team is extremely important because even if cosmologists have accepted that the redshift is due to the Doppler Effect and observe that the galaxies are running away from each other, this actually means that the Universe is contracting. Moreover, this is consistent with Newton's law of universal gravitation (it is illustrated in Figure 1 in Part II of the current book).

All galaxies are heading headlong into the Universe's region – the super-supercluster region of galaxies that Professor Sandra Faber calls the "Great Attractor". The gravitational attraction of each galaxy (i.e., its acceleration) to the region "Great Attractor" is inversely proportional to the square of the distance to this region: $F = G\ (m\_1\ m\_2)/r^2$
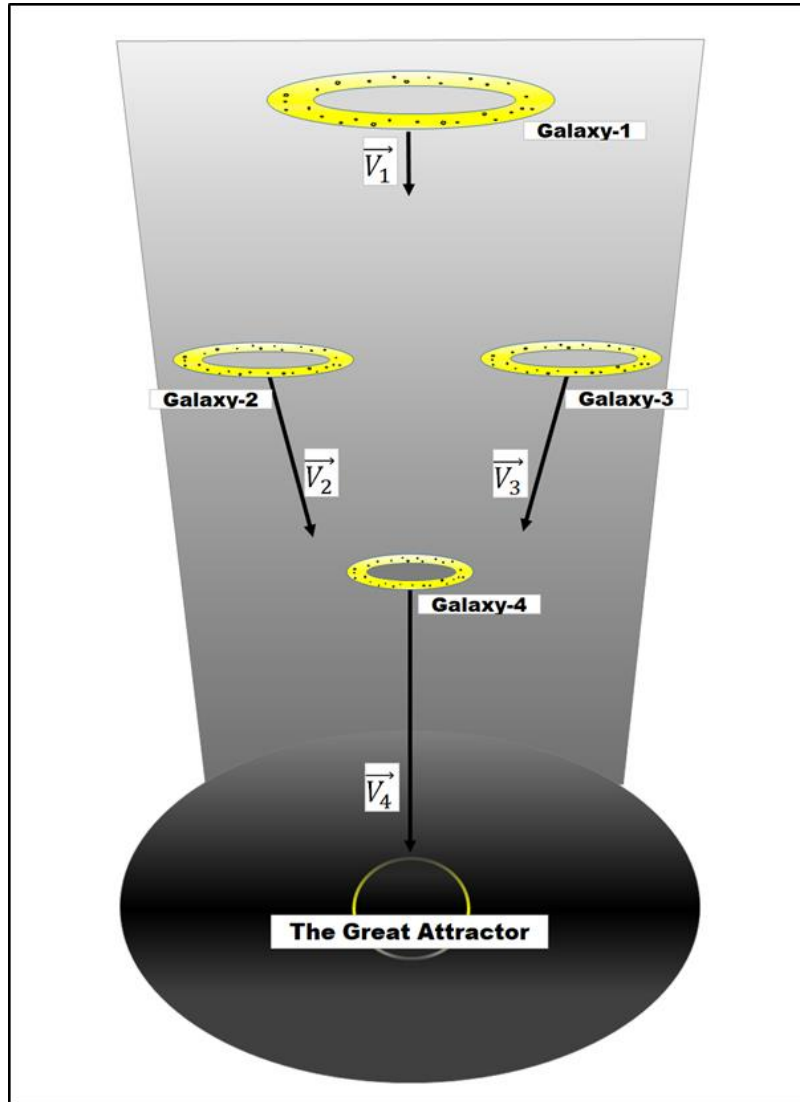
Figure 1. Illustration of a segment of the contracting universe

This means that the accelerations and velocities of the more distant galaxies to the Great Attractor, compared to those of our galaxy, are smaller, and the accelerations and velocities of the galaxies that are closer to the "Great Attractor", compared to those of our galaxy, are greater than the velocities of the Milky Way (from where we make the observations). In this sense, if:

- "Galaxy-2" is our Milky Way galaxy, and its velocity and acceleration are $\vec{V_2}$ and $\vec{a_2}$, respectively;

- Galaxy-1" is more distant from the "Great Attractor" than our Milky Way galaxy is, and its velocity and acceleration are $\vec{V_1}$ and $\vec{a_1}$, respectively;

- "Galaxy-4" is a galaxy closer to the "Great Attractor" than our Milky Way galaxy is, and its velocity and acceleration are $\vec{V_4}$ and $\vec{a_4}$, respectively.

According to Newton's law of universal gravitation $F = G\frac{m_1 m_2}{r^2}$, we can write:

1. $((\vec{a_1} < \vec{a_2})$ and $(\vec{V_1} < \vec{V_2})$, which means that for an observer located in our galaxy: "Galaxy-1" will be moving away from us at a velocity of $(\vec{V_2} - \vec{V_1})$, and with acceleration $(\vec{a_2} - \vec{a_1})$.

2. $(\overrightarrow{a_2} < \overrightarrow{a_4})$ and $(\overrightarrow{V_2} < \overrightarrow{V_4})$, which means that for anobserver located in our galaxy: "Galaxy-4" will be movingaway from us at a velocity of $(\overrightarrow{V_4} - \overrightarrow{V_2})$, and withacceleration $(\overrightarrow{a_4} - \overrightarrow{a_2})$.

Therefore, although the Universe is contracting, from our Galaxy we observe that all galaxies are moving away!

However, not all of them! When two galaxies are equidistant to the Great Attractor and close to each other (such as our Milky Way Galaxy ("Galaxy-2") and the Andromeda Galaxy ("Galaxy-3")), we see a decrease in the distance between them because their velocity and acceleration towards the Great Attractor are the same.

Therefore, according to Newton's law of universal gravitation, when the universe contracts toward that high-gravity region:

From any point outside this region (see), "moving away" (recession) of the galaxies will be observed, and their recessional velocities will increase when the distance from the point of observation to them increases.

3. CONCLUSION

The main conclusion related to the essence of the topic of this article is that the Universe is in a state of accelerating contraction.

Yes, the Universe is in a state of contracting – and no need for myths such as "dark matter" and "dark energy".

The presented explanation of the observed redshift of the electromagnetic radiation coming from distant galaxies, the "energy-spatial relationship", is in full accordance with Newton's law of universal gravitation.

Because of the lack of conformity of the expansion of the Universe with Newton's law of universal gravitation, modern physics has tried to explain the delusion of the "accelerating expansion of the Universe" by the inexplicable myths of "dark energy" (whose nature is inexplicable even for the modern cosmologists themselves), as well as by the presence of an illogically high percentage of some unknown kind of "dark matter" in the Universe.

Throughout his life, Hubble did not support Vesto Melvin Slipher's assumption that the "redshift" is a "velocity-like displacement" (as a result of the Doppler Effect)!

The real cause for the observed redshift of electromagnetic radiation coming from distant galaxies is the "energy-spatial relationship" existing in the energy-space-time continuum of the Universe – that is the "unrecognized principle of nature", as was the belief of Edwin Hubble!

However, this conclusion is not suitable for the common cosmological community because they would lose not only their social status, but their whole life work would be meaningless! In relation to this, the conclusion of Professor Karl Popper states that in modern physics "a theory must be falsifiable to be scientific"!

4. SOME OTHER IMPORTANT CONCLUSIONS THAT CAN CHANGE OTHER "BELIEFS" OF MODERN PHYSICS

4.1 Concerning the dependence of the characteristics of electromagnetic radiation on the gravitational field intensity

The units of measurement are the primary, the most basic physical constants, which we have defined and chosen to be constants. With the help of these primary physical constants, we have the opportunity to create equations, to use mathematics in the field of physics.

As mentioned above, it has been experimentally proven that atomic clocks tick faster high in the mountains (that time runs faster at higher altitudes); i.e., the frequency of emitted electromagnetic radiation increases in regions with lower gravitational field intensity. This means that in regions with weaker gravity, the time runs faster (the unit of time is shorter). This is consistent with the general theory of relativity, and if we define the unit of time "second" as defined in the SI system according to the 13th meeting of the CGPM, Resolution 1, 1967/68:

> *"The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom, at rest at a thermodynamic temperature of 0^0 K".*

According to the general theory of relativity, the unit of length "meter" will become longer (lengthened) in regions with lower gravitational field intensity (at higher elevations). This is also in accordance with the definition of the unit of length given by the 11th meeting of the CGPM, Resolution 6, 1960, because the wavelength of any electromagnetic radiation will increase in regions with weaker gravity:

> *"The metre is the length equal to 1650763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels 2p10 and 5d5 of the krypton 86 atom".*

It was proposed that this fact (increasing the frequency and wavelength of any electromagnetic radiation) be experimentally proven onboard the International Space Station (ISS) by means of atomic clocks and a platinum-iridium rod (sized and scaled) for the purpose of comparison with the wavelength of a suitably chosen monochromatic source of electromagnetic radiation. This idea was not accepted because the increase in the wavelength and frequency of any electromagnetic radiation in regions with lower gravitational field intensities will prove that the speed of light in vacuum will increase *(c=λv).*

The fact that *the speed of light in vacuum* increases in regions with a weaker intensity of the gravitational field (near the border of the Solar system) is the explanation and proof of the "inexplicable" anomalies in the accelerations of the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which in fact experimentally proves the presented logic:

> *"the expected travel time of the communicational electromagnetic signals between the spacecraft and the Earth (based on the universal constancy of the speed of electromagnetic radiation everywhere in the Universe), turns out to be much greater than the real travel time. So we register backward attraction (acceleration anomaly) of the space probe to the Sun"* [4].

Conversely, the fact that the speed of light in vacuum decreases in regions of stronger gravity was proved experimentally by the American scientist Irwin Shapiro in 1964 (Shapiro time-delay) [3], and was confirmed again highly accurately, using controlled transponders aboard space probes "Mariner-6" and "Mariner-7" when they were in orbit around the planet Mars.

The conclusion is that the speed of light in vacuum is not constant for the whole Universe, and the unit of length "light year" should not be used.

This conclusion *actually means that if the results of the general theory of relativity are true (length contraction and time dilation in regions with stronger gravitation), then the speed of light in vacuum is different in regions with different gravitation. Conversely, if the speed of light in vacuum is a fundamental constant for the entire Universe, then the results of the general theory of relativity are wrong.*

However, the characteristics of any electromagnetic radiation from the electromagnetic spectrum (frequency, wavelength, and speed of light in vacuum) do not change during propagation near the surface of the celestial body (such as the Earth). This occurs because the intensity of the gravitational field on the surface of the celestial body remains constant (dominated by the mass of the celestial body) during the motion of the planet Earth around the Sun and during the motion of the solar system in the galaxy. This is the reason why there are no experiments on the surface of Earth that can determine any changes in the speed of light in vacuum.

However, all the experiments, in our local time-spatial domain "near the Earth's surface" prove that the measured speed of light is not the same in all inertial frames of reference.

The only exception is the Michelson-Morley experiment because of the inappropriate conceptual design, embedded in the construction of the Michelson interferometer (see the analysis of the Michelson-Morley experiment in section 5 of Part I of the current book. This type of interferometer uses perfectly the same paths in two-way opposite directions for each light beam, and that is why, the difference between the velocity of light in the two opposite directions of each light beam is completely compensated [2].

4.2 Concerning the measurement units, as defined in the SI system

1. For an equation of theoretical physics to be true, the units of measurement used must be constants within the scope of the equation. Otherwise, this "equation" is just a string of symbols and its solution is meaningless! Let us assume that the results of the general theory of relativity are true and that the unit of time "second" and the unit of length "meter" (defined by the characteristics of electromagnetic radiation) are different in regions of different gravity (for example, onboard the International Space Station). This cannot mean that the rotation period of the Earth and the meridian distance between the pole and the equator have changed (as the units of time and length were defined in the past).

However, this means that: *The units of measurement in the SI system thus defined, based on the characteristics of electromagnetic radiation, are applicable and useful only for the local time-spatial domain "near the surface of the Earth".* Therefore, the units of measurement defined by means of characteristics of electromagnetic radiation should not be used in equations of theoretical physics, which concern the outside of our local time-spatial domain where the units are changing and are different. This concerns all equations in the field of cosmology in whose scope the units of measurement are not constants.

2. Another fundamental problem is the failure to understand the difference between the mathematical equations and the equations of theoretical physics.

a) We work only with numbers in the mathematical equations. Actually, the mathematical equation is an assertion of the equality of two purely numeric expressions.

b) In Physics, however, the use of Mathematics (writing/creation of an equation of theoretical physics), is possible only with the help of the measurement units of the physical quantities involved in the equation. Each equation of theoretical physics is written on the basis of a certain system of units of measurement – for example, the International System of Units (SI), and the used units must not change in the scope of the equation.

That's why the units of measurement are of paramount importance to Theoretical Physics.

So, we can highlight: The units of measurement are the primary, the most basic physical constants, which we have defined and chosen to be constants!

With the help of these primary physical constants, we have the opportunity to use Mathematics in the field of Physics!

In this way, the sign of equality between the physical expressions in the equations of theoretical physics (formed using units of measurement), represents, in fact, the relationships between the physical quantities in nature. On the basis of the equations of theoretical physics, we have discovered the physical laws and have determined the physical constants (like the speed of light in vacuum c, the gravitational constant G, the electric constant ε_0 (vacuum permittivity), the magnetic constant μ_0 (vacuum permeability), the Planck's constant, the Boltzmann constant, etc. All these physical constants are actually secondary constants, because they are obtained on the basis of the defined (and accepted) primary physical constants – the measurement units. That is why we have different numerical values for physical constants when we use units of measurement of other measurement systems.

For many scientists in the field of relativity and cosmology, it is a mistake that they (it seems unconsciously and unintentionally) overlook the following fundamental fact:

The equations of theoretical physics can exist only if the units of measurement are constant and do not change inside the scope of the given equation. Only then, the use of the "equality sign" between the expressions on both sides of the equations is correct!

In this regard, let us consider **a simple example** that shows the importance of the above-mentioned fact:

Let us compose a physical equation for the average speed of a seagoing ship traveling between two ports A and B. Obviously, it is equal to $V = S/t,$ where S is a real number showing how many times the used unit of length (meter) is applied to the distance between points A and B; t is the real number showing the number of elapsed seconds (the used unit of time), for which the ship passes the distance between the two points. The result obtained for the average speed is again an exact real number, but with a certain dimension (m/s), which

shows the units of measurement, used to obtain the resulting number. This example undoubtedly shows that everything is accurate and true…, but remember that *the base units of length and time do not change within the scope of the equation – they are constant, defined at sea level!*

Important question: *"Will the equation V=S/t for the average speed be valid if during the trip the measurement units of time and of length do not stay the same (if they change for any reason)? For example, if the units of measurement depend on the changing unknown distance to the bottom of the sea (on the unknown relief of the bottom of the sea) over which the ship passes?"*
Simply, it won't be an equation at all - it will just be a string of symbols! Furthermore, it will not be serious, if we try to look for a solution to this "equation".

It is the same if point A is our Earth, and point B is another planet or a star on the opposite side of our Galaxy. In this case, during the voyage, the spacecraft will pass through areas with different and unknown strengths of the gravitational field, where the unit of length (meter) and the unit of time (second) will be indeterminately different if they are defined by means of the characteristics of electromagnetic radiation. Defined on the Earth *"meter"* can contract to a millimeter in a strong gravitational field, and the *"second"* there will be equal to minutes or hours on the Earth. Obviously, if we write the equation for the average speed of the spacecraft between points A and B: *(V = S/t),* on the basis of the defined units of length and time on the surface of the Earth by means of the characteristics of the electromagnetic radiation, then this equation in terms of physics would not be true. In fact, we cannot determine either the number of miles (the length of the unit "meter" has changed) or the duration of the voyage (the duration of the unit "second" has changed) in the scope of this equation. **Therefore, the average speed of the ship will be indeterminable – in fact, this equation has simply become a "symbol string".** This concerns Einstein's Field Equations of General relativity too!

In this sense, it appears that:

"in addition to the uncertainty principle in quantum mechanics, it turns out that we have actually uncertainty in the "macro-world" (in the Universe) too" [40].

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Let us return to *Einstein's Field Equations* (**EFE**) – the set of nonlinear partial differential equations in Albert Einstein's *General Theory of Relativity*. Let us make a brief analysis (description) of the modified form of Einstein's field equations (tensor record of these equations):

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu} \qquad (43)$$

The expression **on the left side** of this equation represents the 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). Newton's universal gravitational constant G and the speed of light *c* appear as accepted physical constants for the entire Universe, and π is a numeric constant. Therefore, the EFE are interpreted as a set of equations representing *how matter and energy (on the right side) determine the warping of space-time (on the left side)* in the Universe. They express the warping of the structure of

space-time, and HOW THE UNITS OF MEASUREMENT ARE CHANGING IN THE UNIVERSE BY MATTER AND ENERGY!

However, the scope of Einstein's Field Equations is the entire Universe. The Universe consists of planets, stars, and galaxies, and the intensity of the gravitational field is different in different regions of the space-time of the Universe – and therefore, the units of measurement are different at any point, depending on the intensity of the gravitational field.

The accepted base units of length and time in the EFE, however, are the units defined on the surface of a small planet in the Solar System, and we use these units for the entire Universe!

It is not funny, is it? The funny thing is when some physicists look for solutions to Einstein's Field Equations. Usually, they demonstrate excellent mathematical skills and interpret (physically) irreproachably accurate mathematical "proofs". As a result, they make wrong conclusions and then say:

"It is true, because it is mathematically proven!"

Therefore, our conclusion about Einstein's field equations is that they express only a great, genius "idea"! However, the reader will agree that the use of "the equation sign" here is not correct… and the search for mathematical solutions to Einstein's field equations is only a demonstration of mathematical skills, but they have no physical interpretation.

About tensors: We know that tensors are mathematical objects but are designed for engineering applications – for example, when calculating tensile and bending tensions in heterogeneous materials. One correct example in the engineering field:

If we calculate tensile and bending stress in a piece of heterogeneous material caused by external forces, we use units of a certain measurement system (like the SI system), which are defined in the time-spatial domain <u>outside the material body</u>. In our case, it is our time-spatial domain *"near the Earth's surface"*, where the intensity of the gravitational field is uniform and the defined with great accuracy physical units, are constant. The applied forces on the material body, as well as the calculated tension at any point of the piece of material, are in the *"out of the body" coordinate system* – the same system, where we have defined the units of measurement and where they are constant. Therefore, we can say that in this example, the physical equations are exact and mathematically and physically correct (the use of the equality sign is correct).

The reader sees, however, that the case "Einstein's field equations" is not analogous.

Therefore, Einstein's field equations are not correct regarding the unchangeability of the units of measurement within the scope of the equations.

Part III

INFLUENCE OF GRAVITATION ON THE ORIGIN AND PROPAGATION OF ELECTROMAGNETIC RADIATION

ABSTRACT

Impressively, against the background of extraordinary advances in physics and technology, the mainstream continues to support the two most obvious delusions in 20th-century physics: "special theory of relativity" and "the accelerating expansion of the universe".

Both of these problems are based on a lack of understanding of the nature and behavior of electromagnetic radiation in the gravitational field and of the nature of the medium of the propagation of electromagnetic radiation. Part 2 of the book presents a new approach to this problem. To understand the real fabric of the Universe, to understand the influence of gravitation on the characteristics of light (frequency, wavelength, speed of light in vacuum), we must first be aware of the nature of electromagnetic radiation and the nature of the medium of propagation of electromagnetic radiation. In this respect, as discussed at the 3rd Annual International Conference on Physics, 20 – 23 July 2015, in Athens, Greece, the characteristics of electromagnetic radiation must be considered in two aspects:

• In the "local time-spatial domains in any place of the Universe" (the regions with a uniform intensity of the gravitational field), and

• In the "global physical reality of the Universe" (related to the regions with different intensities of the gravitational field as an infinite set of local time-space domains).

Based on the modern achievements of science and the analysis of the behavior of electromagnetic radiation in the local and global physical reality of the Universe, this article contains the following scientific contribution: "Thesis On the Behavior of Electromagnetic Radiation in the Gravitational Field of the Universe", which should replace the erroneous "postulate of the constancy of the speed of light for all inertial frames of reference". This thesis also ends the delusion that the speed of light in vacuum measured on the Earth's surface is the limit speed for the entire Universe.

Keywords: Speed of Light Postulate, Propagation of Light, Speed of Light Limit, Electromagnetic Radiation, Medium for the Propagation of Light

CONTENTS of Part III

1. INTRODUCTION: Awareness of the Nature of Electromagnetic Radiation and the Propagation Medium of Electromagnetic Radiation

1.1 On the Nature of the Propagation Medium of Electromagnetic Radiation

The medium of propagation of electromagnetic radiation is the space empty of matter between the celestial bodies and between the atoms and molecules of the substances.

> *"The supposed hypothetical "luminiferous aether" turns out to be the "warped space-time of the Universe itself" [4].*

The logical rationale presented in the article *""Dark Matter", "Dark Energy", and Other Problems in Physics Today"* substantiates the reality that the "space empty of matter" (the vacuum) is compressed energy by the fundamental forces of nature (such as gravitational force) [1]. The "space empty of matter" is actually the medium of propagation of electromagnetic radiation (and maybe a medium of propagation of other unknown types of energy).

> *"Electromagnetic radiation is a radial propagation of energy packets (quanta) in the stationary space (in the medium of propagation, which actually turns out to be an "energy soup" compressed by the fundamental forces of nature)" [1].*

1.2 On the Nature of Electromagnetic Radiation

Electromagnetic radiation has no material character. Classically, electromagnetic radiation (EMR) consists of electromagnetic waves, which are synchronized oscillations of electric and magnetic fields. In vacuum, electromagnetic waves travel at the speed of light, commonly denoted c. In homogeneous, isotropic media, the oscillations of the two fields are on average perpendicular to each other and perpendicular to the direction of wave and energy propagation, forming a transverse wave.

• **Duality:** Atoms have different energy levels, and electron states in an atom are associated with different energy levels. In quantum mechanics, an alternative way of viewing EMR is that it consists of quanta, which are responsible for all electromagnetic interactions.

The transition of electrons to lower energy levels in an atom provides quanta emission. Quantum electrodynamics is the theory of how EMR interacts with matter at the atomic level. The energy of an individual quantum emitted or absorbed by a particular atom is quantized and is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom. The energy of a quantum is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom and is proportional to the frequency of the electromagnetic radiation *($E_{quantum} = E_i – E_j = \hbar v$)*, where v is the frequency, $\hbar$ is Plank's constant, and *$E_{quantum}$* is the energy of the quantum. The energy of each quantum of energy emitted or absorbed by a particular atom is given by Planck's correlation between energy and frequency of EMR *($E = \hbar v$)*. Thus, a higher frequency corresponds to more energy of the quanta.

In fact, Planck's correlation represents the wave-particle duality of electromagnetic radiation.

 The similarity between the energy nature of the quanta and the energy nature of the propagation medium is the reason why the electromagnetic radiation (the quanta) manifests itself as a wave with a wavelength and frequency depending on its energy. The discrete differences between the pairs of quantum energy states of the atom exactly determine the energy of the emitted (or absorbed) photons. This determines the specific atomic spectral lines for a particular atom. For example, the emission spectrum of a hydrogen atom can be divided into several spectral series corresponding to the specific transitions between the energy levels of the hydrogen atom (hydrogen spectral series). The spectral series are important in astronomical spectroscopy for detecting not only the presence of hydrogen.

• **Speed:** The electromagnetic quantum is emitting at a transition between two hyperfine discrete energy levels of an atom. The "quantum energy states" of any atom are fixed. Therefore, the transition between two specific hyperfine energy levels of a particular atom (the energy of the emitted quantum) is fixed. *This means that the energy of the quanta cannot depend on the speed of the emitting atom – the quanta arise at the quantum level.* Therefore, the speed of the quanta in the "space empty of matter" also does not depend on the speed of the emitted atom and is a limit speed for a certain time-spatial domain with equal gravitational field intensity. The speed of the emitted quanta in the "space empty of matter" is a local constant for the whole spectrum of electromagnetic radiation in any time-spatial region, where the density of the propagation medium is the same (the intensity of the gravitational field is the same). In terms of the duality of electromagnetic radiation, the local constant "speed of light in vacuum", or "speed of electromagnetic radiation in vacuum" is the correlation between the frequency and wavelength of each electromagnetic radiation for the whole electromagnetic spectrum. This local constant, however, depends on the energy density of the propagation medium, which in turn depends on the gravitational field intensity in the local time-spatial domain, as proven by the experiments shown below. The gravitational field intensity in the time-spatial domain "near the Earth's surface" is constant (dominated by the Earth's mass) and remains constant when the Earth orbits around the Sun and when traveling with the Solar system in our galaxy. For this reason, no change in the speed of light in vacuum can be ascertained as a consequence of the motion of the Earth around the Sun and with the Solar System in the galaxy.

The Doppler effect (or Doppler shift) occurs at the mechanical waves. The mechanical waves represent the propagation of vibrations of matter particles belonging to the material propagation medium. Any material particle vibrates around a stationary point in the frame of reference related to the propagation medium of the mechanical wave. The propagation of a mechanical wave is the propagation of vibrations (oscillations) of any particle of the propagation medium to the adjacent material particle. The frequency of the vibrations perceived by an observer changes depending on the relative speed between the observer and the source of the vibrations in the propagation medium. At a constant speed of the mechanical wave in the propagation medium, a change in frequency means a change in wavelength. The Austrian scientist Christian Doppler discovered this effect.

Electromagnetic radiation, however, is a stream of energy packets (quanta) propagating radially, rather than propagating vibrations of matter particles. The observed change in the frequency (of the energy of a quantum) at the collision with the material body, moving at a certain speed, has a real explanation in accordance with quantum electrodynamics (which is the theory of how EMR interacts with matter at the atomic level). When a moving material body reflects the quanta, the energy of the quanta (frequency) changes when the energy

(frequency) of the electromagnetic quantum is comparable to the momentum of the moving object. Each atom of the moving body has a quantity of motion (momentum). Thus, at the collision of the quantum (photon) with the moving atom of the object, there is an energy exchange. The energy of the reflected quantum changes, depending on the momentum of the atom (depending on the velocity vectors of the quantum and the material body). This means that the frequency of the reflected quantum is changed, because $(\Delta E = \hbar.\Delta v)$, where v is the frequency, and $\hbar$ is the Planck constant.

The misunderstanding that the "Doppler effect" exists at electromagnetic radiation has led to the second biggest blunder in physics of the 20th century – *"the accelerating expansion of the Universe"*. This delusion in turn has led to the hypothesis of the existence of a vast amount of some unknown type of "dark matter" in the Universe and the existence of the inexplicable fiction of "dark energy" (whose nature is inexplicable even for the modern cosmologists themselves).

> *"The claim of the existence of the "Doppler effect" at electromagnetic radiation (that the motion of the source of electromagnetic radiation causes a "redshift" or "blueshift" of the frequency of the electromagnetic radiation), is actually a big delusion in modern physics"* [1].

The main contribution of the published paper ""Dark Matter", "Dark Energy", and Other Problems in Physics Today" is that it presents the "other cause" for the observed "redshift" of the frequency of the electromagnetic radiation coming from distant galaxies – that is "the energy-spatial relationship". The discovery of the "other cause" of the observed "redshift", which "represents, may be, an unknown principle of nature", as Hubble believed, reveals not only the dependence of the characteristics of electromagnetic radiation (frequency, wavelength, and speed of light in vacuum) on the gravitational field intensity. This "unknown principle of nature" actually reveals the nature of "the empty of matter space": The so-called "empty space" actually is a storage of energy – it is a "compressed" energy.

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2. FUNDAMENTALS RELATED TO THE BEHAVIOR OF ELECTROMAGNETIC RADIATION IN A GRAVITATIONAL FIELD

In 1911 Einstein published the second version of the article *"On the Influence of Gravitation on the Propagation of Light"* [22]. The ambiguities and inconsistencies that led to the incorrectness of the formulas in the article *"On the Influence of Gravitation on the Propagation of Light"* are shown in the analysis of this article [41].

Some of them are:

"On the Influence of Gravity on the Propagation of Light" Einstein deduced the dependence of the propagation of light on the intensity of the gravitational field using the gravitational potential between two material systems located in a gravitational field, accepting that quanta (photons) have mass..., which is not true!

The consequence of this, as well as of the other abovementioned scientific inconsistencies, is that the deduced formulas and conclusions contradict both the idea of the general theory of relativity for changing time and space depending on the force of gravity and that they are not confirmed by astronomer observations. For example, if a photon loses energy when overcoming a star's gravity (as Einstein "proves"), then the photon will lose a different amount of energy depending on the mass of the star; i.e., the "redshift" will be different and the spectral series of the emission spectrum of the hydrogen atom will be shifted differently depending on the mass of the star. However, there is no such dependence… and no astronomer has observed it!

As presented at the 3rd Annual International Conference on Physics in 2015 in Athens, Greece, the speed of light must be considered in two aspects:

1) in the "local time-spatial domains" (the regions with an equal and uniform intensity of the gravitational field), and

2) in the "global physical reality of the Universe" (related to *the regions with different intensities of the gravitational field as an infinite sets of local time-space domains*) [2].

2.1 Logical Rationale Concerning "Local Physical Reality" – The "Small Local Time-Spatial Domains" Where the Intensity of the Gravitational Field is Equal (Like the Time-Spatial Domain "Near the Earth's Surface")

Our time-spatial domain "in the vicinity of the Earth's surface" is where humankind is an "inhabitant". This domain is our "reference time-spatial domain" for physical reality. This region has approximately the same gravitational field intensity. The energy (frequency) of the quantum emitted at the transition between fixed quantum energy levels of an atom at sea level is always the same.

2.1.1 Logical Rationale Concerning the "Emission of the Quanta and Quanta Absorption"

In time-spatial domains with a uniform intensity of the gravitational field, the energy of the emitted quanta is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom, which is the same everywhere in the time-spatial domain.

Conclusion 1: The energy of the emitted quanta, corresponding to the transition between two identical superfine levels of the ground state of any atom, is the same everywhere in a time-spatial domain of equal gravitational field intensity, and this energy is independent of the velocity of the emitting atom. It is because the emission is at a quantum level.

Conclusion 2: Concerning "Quanta absorption": When the quanta arrive at the place of the observer in the same region with the same gravitational field intensity, the discrete energy of the quantum will be the same – it corresponds to the transition between the same two hyperfine levels of the atom.

The propagation of electromagnetic radiation in any time-spatial domain with uniform gravitational field intensity occurs in a medium with equal density.

Conclusion 3: *The speed of electromagnetic radiation in the "space empty of matter" (in vacuum), is constant in any region with equal and uniform gravitational field intensity. The energy of the quanta remains the same at propagation, meaning that the frequency and wavelength of any electromagnetic radiation do not change during propagation in a region with uniform density of the propagation medium (c=λv).*

2.1.3 A Consequence of Newton's Law of Universal Gravitation Concerning the "Empty Space"

Newton's law of universal gravitation states that in the Universe, any particle or body with a mass m_1 attracts any other particle or body (with a mass m_2) with a force that is directly proportional to the product of their masses (m_1 and m_2), and inversely proportional to the square of the distance between their centers *(r)*, where *G* is the gravitational constant:

$$F = G\frac{m_1 m_2}{r^2} \qquad (44)$$

Therefore, Newton's law of universal gravitation applies only to objects that possess mass and is the law of the universal power of gravity, bringing all the celestial bodies in the Universe (all the objects that possess mass) into motion.

The "space empty of matter" does not have mass. Therefore, it is undeniable that the "empty space" cannot be affected by the gravitational forces to move (the "empty space" cannot be attracted) – only the material bodies and the molecules in the atmosphere are involved in the Earth's rotation.

Conclusion 4: *From Newton's law of universal gravitation, it follows that "empty space" is motionless, i.e., the "vacuum is stationary".*

Therefore, Newton's law of universal gravitation does not explain how gravity affects space. The "empty space" does not rotate together with the Earth's surface – only the molecules and the material bodies in the atmosphere are involved in the Earth's rotation

The celestial bodies (like the Earth) are rotating into the surrounded **stationary** warped by the celestial body itself and (contiguous, belonging to it) **local "time-spatial domain"**.

The warped stationary space (the distortion depends on the distance to the surface).
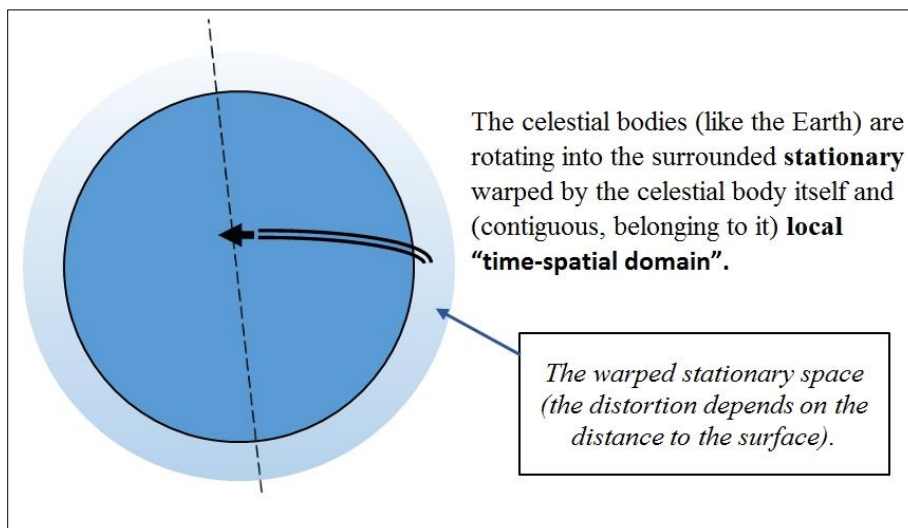
Figure 1. The Rotation of a Celestial Body in Stationary "empty space"

2.1.4 Logical Rationale Concerning the Postulate that "The Speed of Light is the Same for all Inertial Frames of Reference"

The celestial bodies rotate in stationary space. The speed of light in vacuum (in the "medium of propagation") is constant in any time-spatial domain with a uniform gravitational field intensity, such as the time-spatial domain "near the Earth's surface". However, *"One-way Measurement of the Speed of Light"* experiments, like these of Marmet and Kelly [6, 7], indisputably prove that the measured speed of light in the frame of reference, related to the moving Earth's surface, differs from the speed of light in vacuum (related practically in this case to the "Earth-Centered Inertial (ECI) coordinate system"). This difference is equal to the linear speed of the Earth's surface at the latitude of the experiment. Well before, the results of the "Michelson-Gale-Pearson" experiment were published by Michelson in the papers *"The Effect of the Earth's Rotation on the Velocity of Light I and II"* [10, 11]. Even with the title of this article, Michelson shows that there is such an effect, i.e., that the speed of light in vacuum differs from the speed of light in the frame of reference connected to the Earth's surface! The undeniable fact that the speed of light is not the same for all inertial frames of reference was proven as early as 1912 by the Sagnac experiment [5]. However, the Sagnac experiment is considered a paradox, because it proves that the speed of light is not the same for all frames of reference.

There are no "unexpected" or "inexplicable" results from the experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface of the Earth". Only the Michelson-Morley experiment cannot prove the undeniable fact that "the speed of light is not the same for all inertial frames of reference". This experiment is an exception because of the inappropriate conceptual design embedded in the construction of the Michelson interferometer. Unfortunately, this very experiment turns out to be the basis for the fallacy that *"the speed of light is the same for all inertial frames of reference"* and for the existence of the biggest blunder in the physics of the 20th century (the special theory of relativity). A real explanation of the Michelson-Morley experiment and all the above-mentioned experiments can be found in the published paper *"The Complete Set of Proofs for the Invalidity of the Special Theory of Relativity"* [42]. The difference in the speed of light in relation to the Earth's surface caused by the Earth's rotation around its axis cannot be ascertained if the Michelson interferometer is used because:

> *"Actually, if the "ether wind" even exists (caused by the Earth's motion through the stationary luminiferous ether), then the difference in the speed of light between the two light beams, traveling in two opposite directions on the same arm, is completely compensated. This is true for any arm in any direction! In other words, if the projection of the velocity of the "ether wind" in the direction of one of the light beams is (+V), then the projection of the velocity of the "ether wind" in the direction of the reflected light beam (traveling in opposite), will be exactly (-V)"* [2].

Therefore, all the proper experiments performed in the local time–spatial domain "near the Earth's surface" undeniably prove that the measured speed of electromagnetic radiation is not the same for all inertial frames of reference.

Conclusion 5: *The speed of light is not the same for all inertial frames of reference.*

The undeniable fact that the *"speed of light is not the same for all inertial frames of reference"* is not convenient for the mainstream in the field of relativity *because the special theory of relativity is created on the basis of this false claim.* The analyses of well-known experiments, the analysis of the article *"On the Electrodynamics of Moving Bodies"*, and the analyses of all so-called *"fundamental tests of the special theory of relativity"* are shown in the abovementioned published paper [42].

Despite the appeal made on social media, however, to date, there is not a single scientific argument given by mainstream physics against the presented proofs for the invalidity of the special theory of relativity!

2.2 Logical Rationale Concerning the "Global Physical Reality"

The "Global Physical reality" can be considered a set of all "local time–spatial domains" on the surface of the celestial bodies with different but uniform intensities of the gravitational field (depending on the mass of the celestial body), plus regions with uneven (changing) intensities of the gravitational field depending on the distance to the surrounding celestial bodies.

In this subsection, the following is discussed:

• The reason for the constant *speed of light in vacuum* on the Earth's surface (on the surface of the moving celestial bodies), during its motion in orbit around the Sun;

• The delusion that the *speed of light in vacuum* on the Earth's surface is the limit speed for the entire Universe.

The gravitational force does not affect the space to move it; however, the gravitational force affects the stationary space around the celestial body by warping it (contracting it), increasing the energy density of the medium of propagation of electromagnetic radiation. The space is stationary; however, the distortion (warping) of the space moves along with the celestial body. The speed of light in vacuum depends on the density of the propagation medium (which depends on the intensity of the gravitational field). For this reason, the "speed of light in vacuum" in the local time-spatial domain "near the surface of the celestial body" remains unchanged during the travel of the celestial body in the Universe, because the intensity of the gravitational field remains the same during the travel of the celestial body dominated by the mass of the celestial body.

2.2.1 Logical Rationale Concerning the "Emission of the Quanta and Quanta Absorption" in the Regions with Different Gravitational Field Intensity

Atoms have different energy levels. The electron states in an atom are associated with different energy levels. The energy spectrum of a system with such discrete energy levels is said to be quantized. In quantum mechanics, an alternate way of viewing EMR is that it consists of quanta, which are responsible for all electromagnetic interactions. Quantum electrodynamics is the theory of how EMR interacts with matter at the atomic level. Quantum effects provide sources of EMR, such as the transition of electrons to lower energy levels in an atom. The energy of an individual photon is quantized and proportional to frequency according to Planck's equation $E=\hbar v,$ where E is the energy per quantum, f is the frequency of EMR, and $\hbar$ is the Planck constant. Thus, higher-frequency photons have more energy.

It was experimentally proven that atomic clocks tick faster high in mountains (that time runs faster at higher altitudes). This fact shows that the energy $(E = \hbar v)$ that corresponds to the same transitions between the same two hyperfine levels of any atom located in a region of lower gravitational field intensity is greater than that at sea level (if we can measure this energy with the measurement units defined at sea level). These experiments show that Einstein's conclusion in his paper "On the Influence of Gravitation on the Propagation of Light" [22] that photons lose their energy when leaving the stars is wrong. However, if a photon loses energy when overcoming a star's gravity (as Einstein "proves"), then the photon will lose a different amount of energy depending on the mass of the star. I.e., the "redshift" will be different and for example, the spectral series of the emission spectrum of the hydrogen atom will shift differently depending on the mass of the star. However, there is no such dependence… and no astronomer has observed it.

In fact, these experiments prove that the energy of the emitted quanta, which corresponds to the transition between the same two hyperfine levels of the same atom, has a higher energy at a higher altitude in mountains. Therefore, the energy of the emitted quantum depends on the energy density in the location of the atom. This means that the energy states of the atoms depend on the energy density of the "empty of matter space" in the location of the emitting atoms.

Conclusion 6: *The energy states of any atom depend on the density of the "empty of matter space" in the region where the atom is located, i.e., the energy states of the atom depend on the gravitational field intensity. That is why, the energy (frequency of electromagnetic radiation) of the emitted quanta, which is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom, is different in regions with*

different gravitational field intensities.

Therefore, it is clear that at the location of the observer (at the location of absorption), the energy states of the atoms correspond to the density of the "empty of matter space" (corresponding to the gravitational field intensity). That is why the absorption of the quanta corresponds to the same transition between the same hyperfine levels of the same atom. This is why astronomers expect the hydrogen spectral series to not be shifted. The energy of the arriving quanta at the location of the observer (which is of different intensity of the gravitational field than the intensity of the gravitational field at the location of emission) is such as if the quanta were emitted at the location of the observer.

This view conforms to general relativity:

• The fact, that the frequency of emitted electromagnetic radiation is higher in regions with lower gravitational field intensity means that in regions with weaker gravity, the time runs faster (the "second" becomes shorter). This is also the case according to the definition of the base unit of time "second" using the characteristics of electromagnetic radiation, as defined in the SI system according to the 13th meeting of the CGPM (General Conference on Weights and Measures), Resolution 1, 1967/68:

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom, at rest at a thermodynamic temperature of 0^0K.

• In addition, consistent with general relativity, the unit of length "meter" becomes longer (lengthened) in regions with lower gravitational field intensity (at higher elevations). This is also consistent with the definition of the unit of length, given by the 11th meeting of the

CGPM, Resolution 6, 1960, because the wavelength of any electromagnetic radiation will increase in regions with weaker gravity:

The metre is the length equal to 1650763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels 2p10 and 5d5 of the krypton 86 atom.

Conclusion 7: *All of this indisputable logic shows that if the results of general relativity are true, then the speed of light in vacuum is different in regions with different gravitation. Conversely, if the speed of light in vacuum is a fundamental constant for the entire Universe, then general relativity is wrong!*

It was offered that this fact (increasing the frequency and wavelength of any electromagnetic radiation in regions of weaker gravity), which is according to general relativity, can be experimentally proven on board the International Space Station (ISS) using atomic clocks and a platinum-iridium rod (sized and scaled).

A comparison of the frequency and wavelength of a monochromatic source of electromagnetic radiation onboard the International Space Station (ISS) with those on the Earth's surface will prove that the speed of light in vacuum (in the medium of propagation) is increased. This is because the wavelength and frequency of the electromagnetic radiation are increased (c=λv) in regions with weaker gravitational field intensities. This idea, however, cannot be accepted by the mainstream of physics (by the luminaries of relativity) even though it corresponds to the results of the general theory of relativity that they support.

The fact that the speed of light in vacuum increases in regions with a weaker intensity of the gravitational field (near the border of the Solar system) is the explanation and proof of the "inexplicable" anomalies in the accelerations of the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which, in fact, experimentally prove the presented logic:

The expected travel time of the communicational electromagnetic signals between the spacecraft and the Earth (based on the universal constancy of the speed of electromagnetic radiation in vacuum everywhere in the Universe), turns out to be much greater than the real travel time. Therefore, we register backward attraction (acceleration anomaly) of the space probe to the Sun [4].

Conversely, the fact that the speed of light in vacuum decreases in regions of stronger gravity (near the Sun) was experimentally proven as early as 1964 by the American astronomer Irvin Shapiro (Shapiro time-delay) [3], and was confirmed again highly accurately, using controlled transponders aboard space probes "Mariner-6" and "Mariner-7" when they were in orbit around the planet Mars.

Conclusion 8: *The indisputable conclusion is that the speed of light in vacuum in our time-spatial domain "on the Earth's surface" is not a constant for all of the Universe – the speed of light in vacuum is only a local constant that depends on the intensity of the gravitational field. Furthermore, this local constant cannot be the limit speed for the entire Universe.*

The speed of light in vacuum depends on the strength of the gravitational force. Similarly, the speed of light in different optical media varies and depends on the strength of the chemical bonds between atoms and molecules. For example, the speed of propagation of light is very low in the "empty of matter space" between carbon atoms (for example, in diamonds), where the strength of chemical bonds is extremely strong.

The fact is, that the speed of light in vacuum (in the stationary empty space "near the surface of the celestial body") remains practically the same throughout the travel of the celestial body through space because the intensity of the gravitational field there is constant and is determined (dominated) by the mass of the celestial body.

Conclusion 9: *Therefore, the constant gravitational field intensity at the Earth's surface is the reason why there is no variation in "the speed of light in vacuum" when the Earth moves in its orbit around the Sun and together with the Solar System in the Galaxy.*
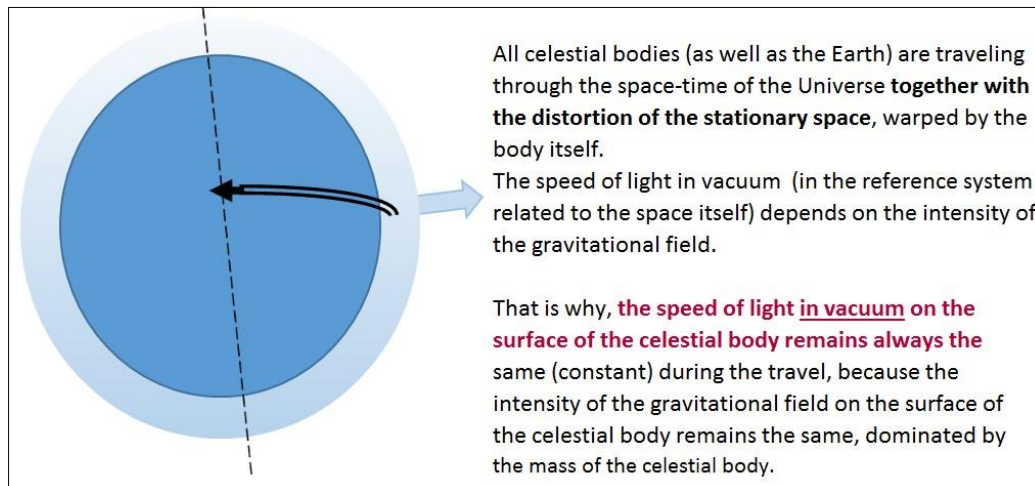

All celestial bodies (as well as the Earth) are traveling through the space-time of the Universe **together with the distortion of the stationary space**, warped by the body itself.
The speed of light in vacuum (in the reference system related to the space itself) depends on the intensity of the gravitational field.

That is why, **the speed of light in vacuum on the surface of the celestial body remains always the** same (constant) during the travel, because the intensity of the gravitational field on the surface of the celestial body remains the same, dominated by the mass of the celestial body.

Figure 2. The Motion of the Celestial Bodies Together with the Distortion of their "own time-spatial domain"

2.2.2 Logical Rationale Concerning "Quanta Propagation" in Regions where the Intensity of the Gravitational Field is Uneven (Changing) Depending on the Distance to the Surrounding Celestial Bodies

As established above, the energy of the emitted quanta ($E = \hbar v$) that corresponds to the same transitions between the same two hyperfine levels of an atom depends on the intensity of the gravitational field where the atom is located, i.e., this energy is different depending on the mass of the star where the emitting atom is located. This means that the spectral series corresponding to the specific transitions between the energy levels of the hydrogen atom are also different. However, astronomers see that the hydrogen spectral series are not shifted when they arrive at the Earth's surface from the stars of our galaxy with different masses. Therefore, quanta change their energy as they pass through regions of varying gravitational field intensity. The quanta change their energy in synchrony with the gravitational field intensity (in synchrony with the density of the propagation medium), and arrive at the Earth's surface with energy that corresponds to the gravitational field intensity in the time-spatial domain "on the Earth's surface".

Conclusion 10: *The quanta give part of their energy to the "empty of matter space" (to the "energy soup"), when entering a region with stronger gravity, and obtain energy back from the "energy soup" when entering a region with weaker gravity (in sync with the different gravitational field intensity in that region).*

This logic fully corresponds to the astronomers' expectations (fully corresponds to the essence of astronomical spectroscopy) and grounds the astronomers for conclusions related to analyses of the electromagnetic spectrum of the coming light from the billions of stars in our

galaxy. For this reason, astronomers expect the hydrogen spectral series to not shift. As a logical consequence of this change of the energy (frequency) of the propagating quanta in synchrony with the density of the medium of propagation, follows that the Universe is in the stage of contraction. Really, If the "empty of matter space" is contracting during the travel of the quanta, a part of the quanta's energy (which corresponds to the contraction of the space during the travel from the distant galaxies) will remain in the "energy soup", i.e., the arrived quanta is redshifted, with a lower frequency (with lower energy). Furthermore, the arrived quanta on the Earth's surface will be more redshifted if they travel more – when they arrive from more distant galaxies (Hubble's law). This logic provides a solution to the second biggest blunder in physics of the 20th century "the accelerating expansion of the Universe". This is undoubtedly a big problem in physics because it is illogical for the Universe to expand, despite the existing and undeniably proven universal attraction (Newton's law of universal gravitation). The observed redshift is not due to a "Doppler effect" but rather to an "energy-spatial relationship": the "*unrecognized principle of nature*" that Hubble believes in. The real explanation of the observed "redshift" is as follows:

> *"If during the propagation of the quanta through the "empty space" of the Universe, the "empty space" is contracting, then the quanta arriving at the surface of the Earth from distant galaxies will be of lower energy (redshifted). This is because a part of their energy remains accumulated (stored) in the "empty space" contracting during propagation, and will remain absorbed by the contracting space upon arrival at the Earth's surface. The longer they travel (from more distant galaxies), the greater part of their energy will remain absorbed upon arrival on the Earth's surface by the contracting space during the time of propagation and the greater the redshift will be. This is the real explanation of the law "redshift-distance" discovered by Edwin Hubble!" [1]*.

Modern physics tries to explain this delusion by the existence of an illogically high percentage of some unknown type of "dark matter" in the Universe (which, if it existed, should have been discovered by now), as well as by the inexplicable myth of "dark energy" (the nature of which is inexplicable even to modern cosmologists themselves)!

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3. THESIS ON THE BEHAVIOR OF ELECTROMAGNETIC RADIATION IN THE GRAVITATIONAL FIELD OF THE UNIVERSE

The above conclusions can be summarized in "Thesis on the behavior of electromagnetic radiation in the gravitational field of the Universe". This thesis represents a step forward in understanding the nature and behavior of electromagnetic radiation. The thesis rejects the postulate of the constancy of the speed of light for all inertial reference frames, which has been proven invalid for more than 100 years (from the Sagnac experiment, Michelson-Gale-Pearson experiment, to today's experiments using modern technologies such as GPS.

This thesis consistent with the astronomical observations and provides scientific explanations of the "unexpected" and "inexplicable" results of famous experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface

of the Earth". However, the author realizes that this thesis will need further corrections which will be in accordance with the further development of science.

The thesis consists of five assertions that concern the behavior of electromagnetic radiation in local regions with equal and uniform gravitational field intensities, and six assertions that concern the behavior of electromagnetic radiation at the transition between regions with different gravitational field intensities (concern the Global Physical Reality in the Universe). The presented assertions concern not only special and general relativity. The assertions on the Global Physical Reality in the Universe have also related to other problems in physics today, such as "the accelerating expansion of the Universe".

3.1 Assertions Concerning the Behavior of Electromagnetic Radiation in Regions with a Uniform Intensity of the Gravitational Field (in the "Local Physical Reality")

• **Assertion 1:** The speed of electromagnetic radiation in vacuum (in the "empty of matter space"), is a local constant.

In a "time-spatial domain" (region), where the intensity of the gravitational field is equal (the same) and uniform, the speed of the electromagnetic radiation in vacuum is a local constant. This local constant, however, depends on the gravitational field intensity in this local "time-spatial domain" and is different in regions with different gravitational field intensities.

• **Assertion 2:** The speed of electromagnetic radiation in vacuum does not depend on the velocity of the source of electromagnetic radiation in the stationary space of the local time-spatial domain. It is the limit speed for the local time-spatial domain but is different for the local time-spatial domains with different gravitational field intensities.

This is because electromagnetic radiation is an emission of quanta, which occurs at a quantum level at the transitions between the fixed quantum energy levels of the atoms. The frequencies (energies) of the quanta are different (depending on the respective transition of the respective atom). However, the velocity of the emitted quanta in a vacuum is the same for the entire spectrum of electromagnetic radiation and does not depend on the velocity of the atom in "empty space" in the local time-spatial domain.

• **Assertion 3:** The measured velocity of electromagnetic radiation in a local time-spatial region with a uniform (the same) intensity of the gravitational field is not the same for all inertial frames of reference.

Mathematically in regions with an equal and uniform intensity of the gravitational field, the relationship between coordinates (between the readings) in the different inertial reference systems is expressed through Galilean transformations; this relationship is subject to Newtonian mechanics. This fact is proven by the experiments "One-way light speed determination", "Sagnac's experiment" and "Michelson-Gale-Pearson experiment" [42].

• **Assertion 4:** The frequency of electromagnetic radiation does not change when it is propagated in vacuum in a local time-spatial region with an equal and uniform gravitational field intensity.

This is valid for the entire electromagnetic spectrum and means that at the propagation of the electromagnetic radiation in the vacuum of the local time-spatial region, the electromagnetic

quanta do not give to (and do not take from) energy that is compressed in the "empty of matter space" (in the medium of electromagnetic radiation propagation).

• **Assertion 5:** The frequency (energy) of electromagnetic radiation changes when it is reflected from a moving object in a local time-spatial region. The frequency change is a consequence of the energy interaction during the collision between the electromagnetic quantum and the moving object *(ΔE=h.Δv)*.

This change in frequency is not due to the Doppler effect (as is incorrectly explained by modern physics), and has its explanation with quantum electrodynamics (the theory of how EMR interacts with matter at the atomic level). This change in frequency has practical application (in radar) when the energy (frequency) of the electromagnetic quantum is comparable to the momentum of the moving object.

3.2 Assertions Concerning the Behavior of Electromagnetic Radiation at Transitions between Regions with Different Gravitational Field Intensities (the Global Physical Reality in the Universe)

• **Assertion 6:** The speed of electromagnetic radiation in vacuum (in the reference system related to the stationary space itself) depends on the intensity of the gravitational field and is different in local time-spatial domains with different gravitational field intensities.

In fact, the speed of electromagnetic radiation in vacuum is only a local constant for each region with a uniform intensity of the gravitational field (as the time-spatial domain "near the Earth's surface").

• **Assertion 7:** The frequency, wavelength, and speed of electromagnetic radiation in vacuum change according to the intensity of the gravitational field when the electromagnetic radiation propagates through regions with different gravitational field intensities.

In fact, the frequency, wavelength, and speed of electromagnetic radiation increase in regions with a weaker gravitational field and decrease in regions with a stronger gravitational field. This fact was incorrectly discussed by Einstein in the article "On the Influence of Gravitation on the Propagation of Light" (see the analysis of the article [41]), and was proven by the "Shapiro time-delay effect" [3], and the anomalies in the accelerations of the space-probes "Pioneer 10" and "Pioneer 11" [4].

• **Assertion 8:** The electromagnetic properties of the atoms change (they are different) in regions with different gravitational field intensities. The energy of the emitted and absorbed photons (the frequency of electromagnetic radiation) at the transition between the same superfine energy levels of an atom corresponds to the gravitational field intensity in the region where the atom is located.

This means that 1) the frequency of the electromagnetic radiation (the energy of the emitted quantum) from an atom located in a local region with a certain intensity of the gravitational field is consistent with the gravitational field intensity where the atom is located. This is why the atomic clocks run faster at higher altitudes (in the mountains). 2) During propagation, the characteristics (frequency, wavelength, and speed) of the emitted quantum (the electromagnetic signal) change in synchrony with the intensity of the gravitational field in the regions through which it passes. 3) In the receiving time-spatial region of the observer "on the surface of the Earth" (the region of absorption of the quanta), the energy of the arriving quantum is again in full agreement with the energy of the transition between the same superfine levels of the same atom located in the emitting region (again in full conformity with

the intensity of the gravitational field) … as if the quanta had been emitted in the receiving time-spatial region. This approach is used in the analysis of the spectra of the energy-emitting celestial bodies (stars), which is the main method used in astrophysical research.

• **Assertion 9:** If a source of electromagnetic radiation moves in a remote local region of an invariable (uniform, equal) intensity of the gravitational field, the frequency of the emitted electromagnetic radiation does not depend on the velocity of the source movement (the gravitational field intensity in the regions of the source and the observer can differ). As was substantiated above, this is because the emission of the quanta occurs at the quantum level. In other words, the Doppler effect does not occur in the case of electromagnetic waves.

The frequency of the electromagnetic signal emitted from a space probe moving in a circular equipotential orbit (equal gravitational potential) around a remote planet does not change when the space probe changes its direction of motion in relation to the Earth.

• **Assertion 10**: If a moving source of electromagnetic radiation passes (at the time of emission) through regions where the gradient of gravitational field intensity is changing, then the received frequency of electromagnetic radiation emitted from the remote object is shifted. The frequency shift will be greater at a higher gradient of difference in the gravitational field intensity.

Depending on the direction of change in the gravitational field intensity through which the source of electromagnetic radiation passes, the frequency shifts to the red end of the electromagnetic spectrum (frequency decreasing) or to the blue end (frequency increasing). Thus, when a space probe moves down to the surface of a planet (in the direction of increasing gravitational field intensity), we observe a "redshift" in the received frequency; a "blueshift" in the received frequency is observed when the space probe is leaving the boundaries of the Solar system (in the case of the observed anomalies in the acceleration of the space probes "Pioneer-10" and "Pioneer-11").

• **Assertion 11:** The energy of the electromagnetic quanta changes (the frequency of electromagnetic radiation shifts) when the quanta pass through regions that are expanding or contracting during the travel of the electromagnetic quanta.

The energy of electromagnetic quanta (frequency of electromagnetic radiation) shifts in synchrony with the change in gravitational field intensity when it passes through regions with different gravitational field intensities. Electromagnetic quanta give part of their energy upon entering a region with stronger gravity and obtain energy back from the "empty space" (from the "energy soup") when entering a region with weaker gravitation. However:

"If during the propagation of the quanta through the "empty space" of the Universe, the "empty space" is contracting, then the quanta arriving at the surface of the Earth from distant galaxies will be of lower energy (redshifted). This is because a part of their energy (upon arrival at the Earth) will remain accumulated (stored) in the contracting "empty space" during propagation. The longer they travel (from more distant galaxies), the greater part of quanta's energy will remain absorbed by the contracting space during propagation, and the greater the redshift will be. This is the real explanation of the law "redshift-distance" discovered by Edwin Hubble!" [1].

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AFTERWORD

This book presents a different concept of the fabric of the Universe, as unity and interconnectedness between matter, space, force fields, and energy.

The book suggests rejecting many misconceptions in modern physics that will open the doors to a new future of theoretical physics and cosmology.

Honesty requires moving to the side of truth because progress in science cannot be stopped!

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p.s.: There is nothing in this book that is incomprehensible or unacceptable to you, but only if you read it with an open mind …

Thank you that you are a person who is looking for the truth, who wants an answer to the question "What is truth and evidence in science" …. and certainly, looking for the truth in life as a worthy person!

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Thank you for reading this book!

About the author

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Gocho V. Sharlanov is the author of the site **https://physics.bg**, as well as the following books in the series **"On the True Nature of Things in Physics"**:

1. *"Theory of Relativity - the Classical Review" ,*
   ASIN: B084QKKHCH ; **ISBN:** 9798610296555 ;

2. "*The Special Theory of Relativity - the Biggest Blunder in Physics of the 20th Century*",
   ASIN: B07DZGCFDC; **ISBN-10:** 1701145154; **ISBN**: 9781701145153 ;

3. *"Accelerating Expansion of the Universe – the Reasonable Alternative"*,
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Connect with the author

I would be grateful if a reader sent me scientific arguments from his lecturer in physics against the evidence presented in this and in the abovementioned books to:

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Preface

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