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The Complete Set of Proofs for the Invalidity of the Special Theory of Relativity

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Abstract

This article 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 the time-spatial region "near the Earth's surface". Subsequent analyses of the most famous experiments related to the velocity of light behavior 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 greatest delusion in Physics of the 20th century "the special theory of relativity" is presented too.

Keywords: Special theory of relativity; Speed of light postulate; Michelson-Morley experiment; Sagnac experiment; On the Electrodynamics of Moving Bodies; Fundamental tests of special relativity

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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].

Note: *In fact, the **"speed of light"** is the magnitude (the scalar quantity) of the vector **"velocity of light"**, which also has a direction.*

Therefore, the false statement *"the speed of light is the same in all inertial frames of reference"* means that the vector *"velocity of light"* must have the same magnitude in any direction in all inertial frames of reference, which contradicts the experiments carried out (shown below).

1.1 Logical rationale concerning "Global Physical Reality"

In this subsection are concerned:

• The delusion that the *speed of light in vacuum* on the Earth's surface is the limiting speed for the entire Universe;

• 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 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 "second" becomes shorter). This is consistent with 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 (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 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).

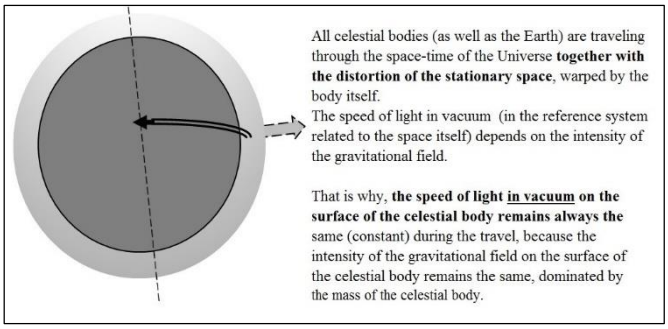

Figure 1. The motion of the celestial bodies together with the distortion of their "own time-spatial domain"

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!

General relativity is wrong1.2 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 (section 2 and section 3 of this paper), 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 in section 4 of the current article).

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 in section 5.

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:

• 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.

• 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 2 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"* [6] 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. 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).

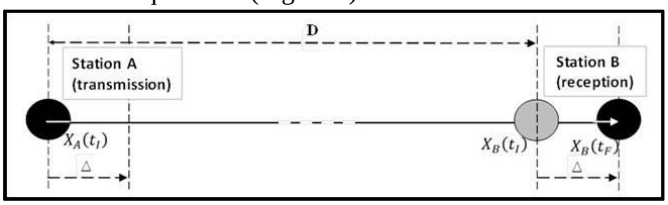

Figure 2. One-way measurement of the speed of light – eastward transmission

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 space frame of reference), measures the speed of the electromagnetic signal (which can be a light beam) and confirms that it is equal to $\boldsymbol{c}$ *(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:

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

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* near the Earth's surface, 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).

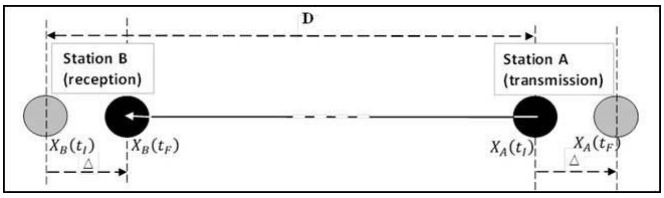

Figure 3. One-way measurement of the speed of light – westward transmission

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 $\boldsymbol{V}$ 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 $\boldsymbol{c_{vacuum}}$ (*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 [6] and Kelly [7], 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 x 339.24 m).

The experiment was carried out in the Northern Hemisphere at a latitude (41° 46').

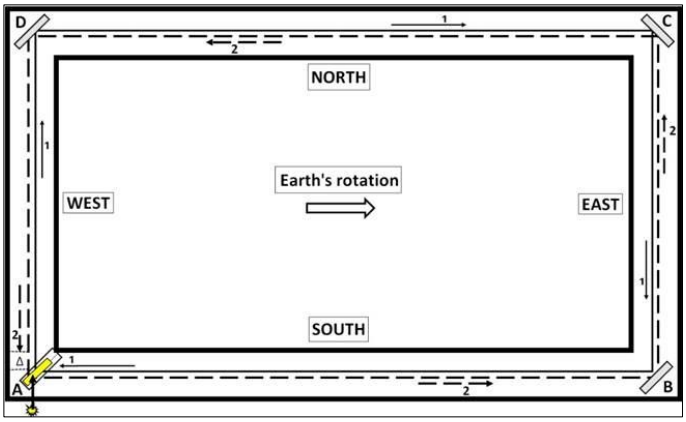

Figure 4. Scheme of the Michelson-Gale-Pearson experiment

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 $\Phi 1$ 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:

$$T = \frac{2l_2v_2}{V^2 - v_2^2} - \frac{2l_1v_1}{V^2 - v_1^2} \qquad (8)$$

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

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

The task that Michelson actually defines, is to experimentally verify the validity of formula (9), where Δ is the displacement of the fringes, lh 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 section 4). 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 sometimes on the right and sometimes on the left of the transmitted image, and by different observers [11].

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:

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

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 [12] and in 1887 [13], 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". These experiments are discussed in detail in the analysis in section 5 of the present article.

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:

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

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

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

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):

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

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 $l1/(c-v_1)$; on the southern side, it is $l2/(c+v_2)$; 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 $l1/(c+v_1)$, the time needed for the "2" light beam to travel through the southern pipe is $l2/(c-v_2)$, 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:

$$T_2 - T_1 = \frac{2l_2v_2}{c^2 - v_2^2} - \frac{2l_1v_1}{c^2 - v_1^2} \qquad (16)$$

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 [10], which, according to his words, is "deduced on the hypothesis of a fixed ether":

- that equation (8) was derived on the basis of classical mechanics and Galilean Relativity.
- 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);
- 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"* [10], Michelson showed that equation (9) follows directly from equation (8). 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 path between 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).

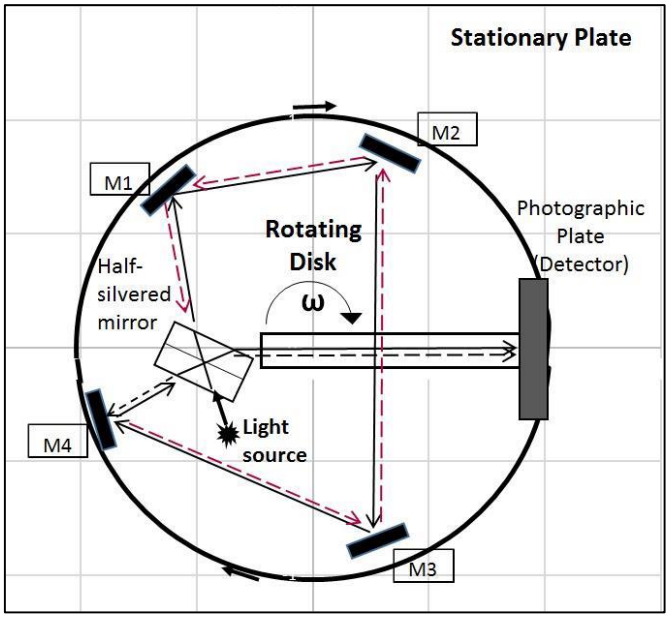

Figure 5. Schematic representation of Sagnac interferometer

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 [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 was discussed in the analysis of the "Michelson–Gale–Pearson experiment" (section 3).*

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:

• **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.

• 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 (see section 2 of the present article).

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 [5] 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"*. 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. 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).

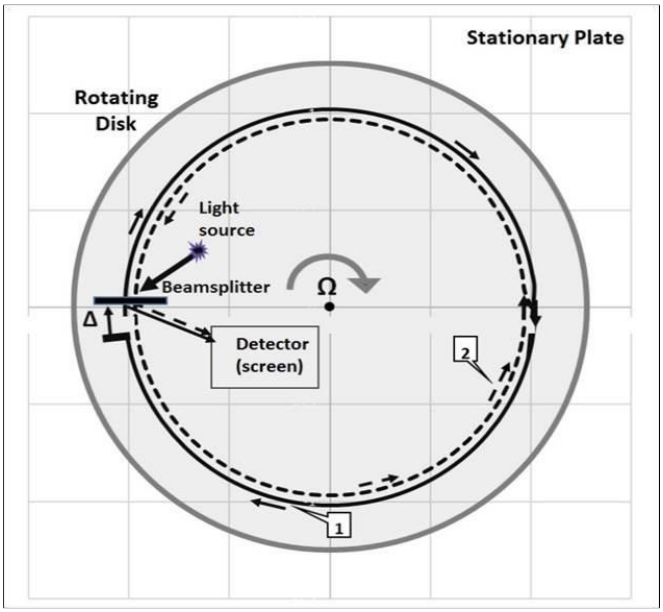

Figure 6. Schematic presentation of a circular interferometer with one optical coil

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:

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

, 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:

• **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.

• **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

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

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 $\boldsymbol{c_0}$ is the speed of light inside the "fiber-optic medium" (where the speed of light is constant for the homogeneous optical medium).

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 $(c_0\text{-}R\omega)$, 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"!*

4.3.2 Analysis of one rotation cycle of the light beam "2", which travels in the opposite direction to the disk rotation

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 $(2\pi R)$ with $\Delta = R\omega t_2$. 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 $(2\pi R - R\omega t_2)$. The Observer, in the stationary in relation to the surrounding stationary space "Disk-Centered Inertial (DCI) coordinate frame", will register for the travel time t_2 (for one turn of the light beam "2"):

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

where $\boldsymbol{c_0}$ is the speed of light in the "fiber optic medium" (where the speed of light for the homogeneous optical medium is constant).

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 $(c_0 + R\omega)$; 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:

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

• The time t1 for one complete tour of light beam "1" is the same for both frames of reference.

• 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

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

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*** *(see the analysis in the following section 5).*

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"* (section 6) 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).

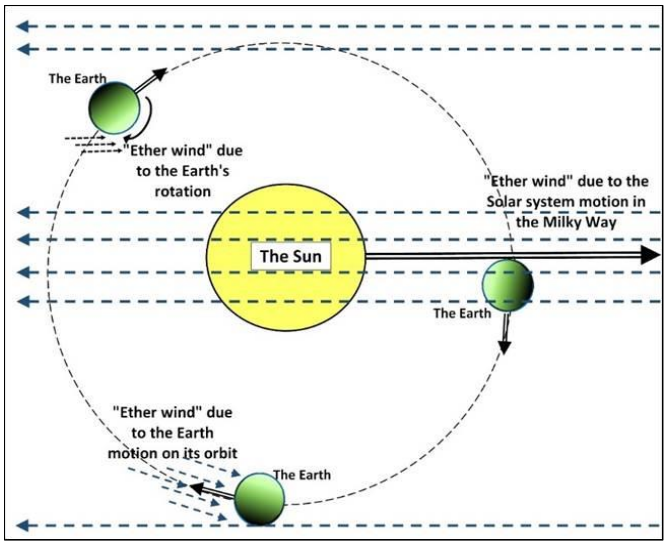

Figure 7. The Earth's motion around the Sun and the alleged "ether wind"

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):

- 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).
- 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).

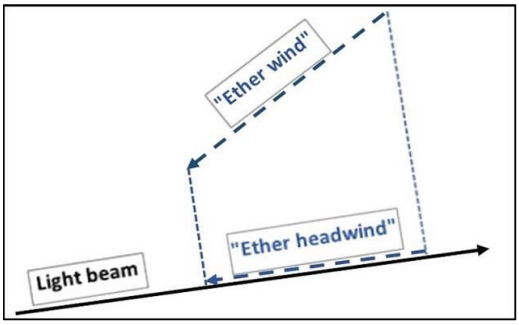

Figure 8. The expected influence of the "ether headwind" on the speed of a light beam in vacuum

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.

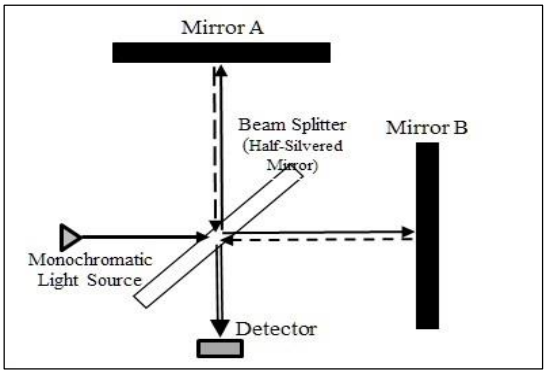

Figure 9. Scheme of the Michelson interferometer Michelson's expectations.

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:

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

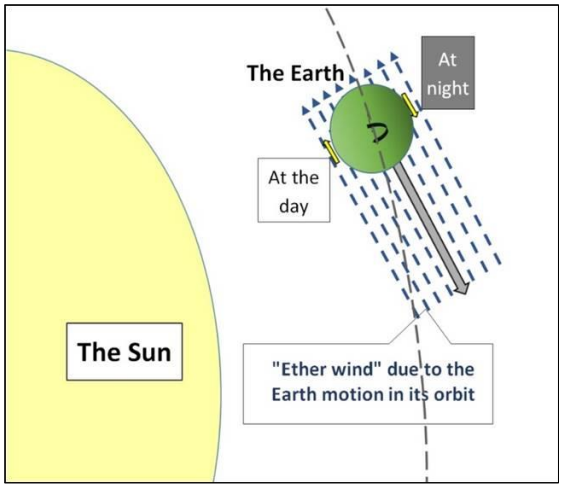

Figure 10. Schematic representation of the opposite directions of the expected "ether wind" at night and during the day due to the motion of the Earth along its trajectory around the Sun.

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 the 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:

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

• 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 [6] and of Kelly in 2005 [7] 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 paper [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 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 Section 8 of the present paper.

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:

- The intensity of the gravitational field is approximately the same;
- 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;
- 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 good.

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 [1]. 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 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].

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"* [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 the 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:

- ***Yes***, the equations of Newtonian mechanics are in force (valid) in our physical reality, which is related to the moving surface of the Earth in the stationary space.
- ***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.
- ***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
> $$t_B - t_A = t'_A - t_B \qquad (24)$$

, 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) a *"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 the axis of **x** of the stationary system of co-ordinates, and that a uniform motion of parallel translation with velocity **v** along the axis of **x** in the direction of increasing **x** is then imparted to the rod.

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

(**a**) 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".

(b) 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 (**a**)*) will differ from the measured length of the rod in the stationary system (*by method (**b**)*):

> The length to be discovered by the operation (b) 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"*:

- 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;*
- 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.
- 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 (b):

> 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:

- 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.

- 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 $\mathbf{r_{AB}}$ denotes the length of the moving rod measured in the stationary system. 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.

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 $(c\text{-}v)$, 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 $\boldsymbol{r_{AB}}$ *("light path" =* r_{AB}*)*, but the time intervals $\boldsymbol{(t_B - t_A)}$ and $\boldsymbol{(t`_A - t_B)}$ are different, **then**, the speed of the light in the moving system in one direction is $(c\text{-}v)$, 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 questions:

"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 formula (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).

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 $\boldsymbol{r_{AB}}$ (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 $\boldsymbol{r_{AB}}$ (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 $(t_B\text{-}t_A)^{st}$ at the speed of rod ***v***; Δ_{BA} is the distance that point A passes during the time interval $(t'_A\text{-}t_B)^{st}$ 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 $(t_B\text{-}t_A)=(t_B\text{-}t_A)^{st}$*:*

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:

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

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

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

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.

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):

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

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 section of Einstein's article.

6.3 Analysis of "I. KINEMATICAL PART. § 3. Theory of the Transformation of Co-ordinates 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:

• The measurement units in both reference systems are the same and are defined when the moving system is at rest.

• 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_1 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*:
>
> $$\frac{1}{2}\left[\tau(0,0,0,t) + \tau\left(0,0,0,t + \frac{x'}{c-v} + \frac{x'}{c+v}\right)\right] = \tau\left(x',0,0,t + \frac{x'}{c-v}\right) \qquad (38)$$

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:

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

, 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:

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

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

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

which is:

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

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 [16]. 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"* [17] after the widely discussed publication by Dayton Miller *"Significance of Ether-Experiments of 1925 at Mount Wilson"*[18]:

> 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. [17].

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 [2] 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 Part I 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"*!

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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?"* [19], 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)", 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 [1]. 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 [19], 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?" [19] 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" [20], we read:

> 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. [20].

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 of relativity

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:

- 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.
- 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 chapter 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 About the Behavior of the 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"©. In turn, the thesis is based on the *"Model of Uncertainty of the Universe"* presented in chapter 9 of the same monograph.

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 [21], the following experiments are fundamental tests of the special theory of relativity. 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.. 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 (see the analysis in section 5). 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 contraction…. 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. [22].

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 of the present article.

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 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"* [23] to be read, too.

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 [24], tested the contribution of relativistic time dilation to the Doppler shift of the frequency of electromagnetic radiation (the light).

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 [24], and follow-up experiment, performed in 1941 [25], 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 [26].

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 H_β spectral line of the Balmer spectral series – (E_{photon} =

$E_2 - E_1 = \hbar\nu$), where $\hbar$ is Planck's constant, ν 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 – ($\Delta E = \hbar \Delta\nu$).

Therefore, the explanation that the observed change in the frequency of electromagnetic radiation is due to the "Doppler Effect" **is not true:**

- *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"!*
- *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*" [27], 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. 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, 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! This delusion must be replaced on the basis of the proposed in chapter 10 *"Thesis on the behaviour of the electromagnetic radiation in the gravitational field of the Universe"* of the book ***"The Special Theory of Relativity – the Biggest Blunder in Physics of the 20th Century"***.

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"* [28], there are different doubts about the given explanation of the experiment. For example, in the article titled *"Kündig's experiment on the transverse Doppler shift re-analyzed"* 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. [29].

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. [30].

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"* [15], where the special theory of relativity was published. 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:

- *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 ($v<0$)*).
- *"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. [30]

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 $R\omega$ 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 $R\Omega+v$, and hence runs slow with a corresponding time ratio $1-(R\Omega+v)^2/2c^2$. [30].

Let us make the following clarifications:

• ***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

• ***Second***, for the observer (in this frame of reference related to the stationary space): the ground linear speed at the equator is *RΩ*; the speed of the airplane flying eastward (in the direction of rotation of the Earth) is *(RΩ + v)*; and the speed of the airplane flying westward (against the Earth's rotation) is *(RΩ – 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| ~ RΩ. [30].

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***. 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!

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"* [31], 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:

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"*:

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

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"**):

• 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." [31].

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 *RΩ = 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**!

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