"On the Electrodynamics of Moving Bodies" - the Factual Analysis of the Article

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Abstract. This article reveals the essence of the special theory of relativity. There are no scientific arguments against the evidence presented in this article while it was uploaded for discussion as a preprint on the website of ResearchGate (the social networking site for scientists and researchers). The article starts with a general introduction to the problem in modern physics about the constancy of the speed of light for all frames of reference. In the "General Introduction" is presented the fundament of a real solution about all "unexpected" and "inexplicable" results of the experiments related to the measurement of the velocity of light in the time-spatial region "on the Earth surface".
The presented analysis of the article "On the Electrodynamics of Moving Bodies", where Einstein presents the special theory of relativity, is based on the classical mechanics and Galilean relativity which are indisputably valid and lawful in our local time-spatial domain "near the Earth's surface". Before the analysis, the foundations of our perception of the absoluteness of space and time are shown. The presented analysis of the article "On the Electrodynamics of Moving Bodies" shows exactly where and how the erroneous claim that "the speed of light is the same in all inertial reference frames" is applied. Einstein's conclusion that *"We cannot give any absolute meaning to the concept of simultaneous"* was revealed to be based solely on this erroneous claim. This claim, however, has been experimentally proven to be false. Only the experiments, that use Michelson's idea of two-way interferometers cannot fix the difference in the measured speed of light in different directions, because the difference in the speed of the two light beams in the direct and opposite directions is completely and exactly compensated". The undoubted conclusion is that the special theory of relativity is the biggest delusion in physics of the 20th century.

KEY WORDS: special theory of relativity; speed of light postulate; Michelson-Morley experiment; æther; speed of light invariance, On the Electrodynamics of Moving Bodies.

1 General Introduction – Used Terms and Definitions

Vectors, scalars, vector projection, and scalar projection.

***Vector (Euclidean vector)**, in physics, is a quantity that has both magnitude (size, length) and direction. It is represented as an arrow whose length is proportional to the quantity's magnitude. However, the vector has no position. This means that the vector is not altered if it moves parallel to itself.*

Scalar *is a quantity that has a magnitude but not a direction – as the "speed of light in vacuum".*

For example, velocity and acceleration (with magnitude and direction) are vector quantities, while speed (the magnitude of velocity), time, temperature, length, and mass are scalars. In English, in physics, the term "velocity" often is used when we mean the vector $\vec{\boldsymbol{V}}$ with its direction; and the term "speed" is used when we mean only the scalar magnitude $\left|\vec{\boldsymbol{V}}\right|$ of the vector.

Vector projection *of a vector "A" on (or onto) a coordinate axis, or on a nonzero vector "B" (also known as the vector component or vector resolution of "A" in the direction of "B") is the orthogonal projection of "A" on a straight line parallel to "B". It is a vector parallel to "B".*

Scalar projection *of a vector on a coordinate axis (with direction), or on another nonzero vector, is a scalar equal to the length of the orthogonal projection of the vector on the axis and with a negative sign if the projection has an opposite direction with respect to the axis (or to the vector) direction. In Cartesian coordinates, the components of the vector are the scalar projections on the coordinate axes.*

In this way, the scalar projection of the vector $\vec{\mathbf{V}}$ on another vector can be recorded as $\left(\left|\overrightarrow{\boldsymbol{V_0}}\right| \boldsymbol{\cos\theta}\right)$, where $\boldsymbol{\theta}$ is the angle between the two vectors. In other words, some of the scalars in physics have two directions that correspond to the signs "plus" and "minus", while a vector can have infinite directions.

1.1 Concerning the used frames of reference and the speed of light

1.1.1 Frames of reference

The reference system (frame of reference) is a concept in physics (usually associated with the movement) to denote the point of view of the observer.

When we talk about a frame of reference (reference system), we usually imagine it as a coordinate system and we talk about an observer or an experimenter associated with it. When an observer is attached to a frame of reference, this frame is stationary for the observer.

Coordinate systems.

The reference frames used in dynamics are known as coordinate systems. The most widely used is the Cartesian coordinate system which consists of an origin and three axes. The axes are fixed lines, sized/dimensioned with numbers, corresponding to the same unit of length, perpendicular to one another, and with direction for each axis. The common point where the axes cross is known as the origin of the coordinate system.

Using the Cartesian coordinate system, in a time-spatial region with constant measurement units (a region with a uniform intensity of the gravitational field), the location of any point in the space can be described, as well as the change into the time of the location of any point.

As a consequence, in the experiment, we distinguish two main frames of reference:

1) Reference system related to the Earth's surface. This is the frame of reference we usually use. In this frame of reference (for an observer,

positioned at a point on the Earth's surface) – any object immovably fixed on the Earth's surface is stationary. This frame of reference is fixed to the moving surface of the Earth and it is moving in the stationary space due to the rotating of Earth around its axis in the stationary space.

2) Stationary reference system. Celestial bodies and space. Everything in the Universe possessing mass moves. The gravitation is the driving force. It is caused by the masses of celestial bodies and it sets them into motion. Therefore, a stationary reference system cannot actually exist because we cannot actually connect the "origin" of a stationary coordinate system to a stationary material point. Also, we cannot give exact directions to the axes because we cannot orient them to theoretically non-existing stationary points. However, for most of the cases under consideration we can use the following approximately stationary frames of reference:

• *"Earth-centered inertial (ECI) coordinate system"* which can be considered in our time-spatial region as a stationary coordinate system in relation to the stationary space.

The origin of this coordinate system is at the center of the Earth (which is not stationary) and its *axes* are approximately stationary in the space (aimed at very distant astronomical objects).

In other words, we can say that the "Earth-centered inertial (ECI) coordinate system" is related to the space itself where the Earth rotates…, where the photons are born and propagate. If an observer is positioned at a point in this coordinate system, he/she will be stationary in relation to the space near the Earth's surface and will see that the Earth's surface moves (as a result of the Earth's rotation around its axis) in the stationary space with a certain linear velocity (the velocity of a point of the Earth's surface in the stationary space, at the respective latitude). Every point of the Earth's surface always moves in the eastern direction. The magnitude of the linear velocity (i.e., the speed) of a particular point of the Earth's surface, depends on the latitude and is the speed at which the point is moving along its path in the stationary space. It is approximately 0.46 km/s for any point on the equatorial line and is zero at the points of intersection of the axis of rotation of the Earth with the Earth's surface, which points coincide with the north and south poles.

Therefore, when we are located in our local region "near the Earth's surface" and talk about the speed of light "in vacuum" or "in the empty space" – this will mean that the speed of light is measured in relation to the "Earth-centered inertial (ECI) coordinate system".

• *"Heliocentric Inertial (HCI) coordinate system"*, also can be considered in certain cases as stationary in relation to the space. *The origin* of this coordinate system is at the center of the Sun (which is not stationary) and its *axes* are approximately stationary in the space (aimed at very distant astronomical objects). An observer positioned stationary in the HCI frame will see how the planets orbit around the Sun (how the Earth moves in its orbit around the Sun at approximately 30 km/s); how the plasma of the Sun rotates (at the equator the solar plasma rotation period is about 24.5 days and is almost 38 days at the poles).

> ***Note**: In this paper, the designation "frame of reference related to the space itself" is used as a generalized designation of "stationary in relation to the space coordinate system". For the sake of precision, the term "velocity" is*

used when referring to the vector $\vec{V}$ (with its magnitude and direction); and the term "speed" is used when referring to only the scalar magnitude $|\vec{V}|$ of the vector.

Difference between the mechanical and the optical experiments carried out on the surface of the Earth

• In the mechanical experiments, due to the force of gravity, the material bodies in the atmosphere are involved in the rotation of the Earth around its axis.

• In the optical experiments, however, the photons are not involved in the Earth's rotation around its axis because they do not have a mass and the gravitational force of attraction for the photons is equal to zero – (see Newton's law of universal gravitation). Therefore, the speed of the photons is constant in empty space (in vacuum, in the frame of reference related to the space itself /in ECI frame of reference). The measured speed of light in the reference system related to the moving surface of the Earth in the stationary space, however, is not equal to the speed of light in the empty space, and this was proven by the experiments. The stationary space is actually the medium of the electromagnetic and gravitational fields.

1.1.2 On the speed of light in different frames of reference

The two major frames of reference, where we will consider the measurement of the speed of light (of the electromagnetic radiation), are "the frame of reference related to the Earth's surface" and the "Earth-centered inertial (ECI) frame of reference" – the system that, in the considered case, is stationary relative to the space itself.

For the contemporary physics, there is no difference between "the speed of light in the frame of reference related to the Earth's surface" and "the speed of light in the Earth-centered inertial (ECI) frame of reference, which is the speed of light in vacuum". This is because the modern physics wrongly has accepted that the speed of light is the same in all inertial frames of reference. The factual analyses of all experiments will convince anyone that this claim is a big blunder.

Anyone would ascertain the following fact – that all experiments undoubtedly prove that there is a difference between the measured velocity of light in the "frame of reference related to the Earth's surface" and the speed of light "in the empty space" (in the "Earth-centered inertial (ECI) frame of reference"). The only exception is the conceptually incorrectly designed Michelson-Morley experiment, in which, due to the inappropriate idea (the two-way measurement of the speed of light), used in the Michelson's interferometer, this difference is completely compensated, which fact is presented in a separate manuscript.

1.1.3 Two important statements as a consequence of Newton's law of universal gravitation

The electromagnetic field exists on the space. The hypothetical "luminiferous aether" (the medium for the propagation of the electromagnetic radiation), turns out to be the warped space-time by the celestial bodies themselves.

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:

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

We have to be aware that space cannot be affected by the gravitational forces (cannot be attracted), because space has no mass. Therefore, Newton's law of universal gravitation has another important meaning:

First statement:

From this law, it becomes clear that the space is stationary – that means "the vacuum is stationary". This is undeniable, because space has no mass, and the gravitational forces do not attract it (the space does not rotate along with the Earth, but only the material bodies and the molecules in the atmosphere).

Second Statement:

The gravitational force affects the space by contracting it.

Experiments show that the propagation of the electromagnetic radiation and the electromagnetic properties of the atoms depend on the intensity of the gravitational field (on the density of this medium/on the contraction of the space/).

• In the regions with weaker gravitation, the energy density of the medium of the propagation of the photons (the vacuum) is lower. This means that the wavelength and frequency of any electromagnetic radiation are higher (photons will jump easier – farther and faster). This means that the "meter" becomes longer, and the "second" is shortened. Therefore, the speed of propagation of the photons (of the electromagnetic quanta) is higher $(c=\lambda v)$. And vice-versa:

• In the regions with stronger gravitation, the energy density of the medium of the propagation of the photons (the vacuum) is higher. This means that the wavelength and frequency of any electromagnetic radiation are lower (which means that the "meter" becomes shorter, and the "second" becomes longer). Therefore, the speed of propagation of the photons (of the electromagnetic quanta) is lower $(c=\lambda v)$.

In his article *"On the Influence of Gravitation on the Propagation of Light"* (see the reference number [1]), Einstein discussed the change of the speed of light in vacuum (proposing a formula without deriving it), when the light enters the regions with a different gravitational potential which actually are regions with different intensity of the gravitational field:

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

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

The principle of the constancy of the speed of light holds good according to this theory in a different form from the one that usually underlies the ordinary theory of relativity." [1]

In the same article Einstein also points out that the frequency of any electromagnetic radiation changes depending on the gravitational potential:

$$\nu = \nu_0 \left(1 + \frac{\Phi}{c^2}\right) \qquad (3)$$

This equation, however, was deduced on the basis of the acceptance that the photons (quanta) have mass and consequently the conclusions are wrong. For example, if the photon is losing energy when overcoming the star's gravity (as Einstein "proves"), then the photon will lose a different amount of energy depending on the mass of the star – i. e. the "redshift" will be different and the spectral series of the emission spectrum of the hydrogen atom will be shifted depending on the mass of the star! But there is no such dependence… and no astronomer has observed it!

The frequency of certain electromagnetic radiation defines the base unit of time "second". Therefore, the base unit of time "second" also changes in places with different gravitation potential (with different intensity of the gravitational field), because the duration of the same number 9,192,631,770 time-periods of the used particular electromagnetic radiation will change (see the definition of the "second" since 1967, Ref. [2]). This means that in regions with weaker gravitation (where the frequency increases) the base unit of time "second" becomes shorter (with shorter duration). In this paper, Einstein does not discuss the change in the wavelength of electromagnetic radiation. However, in other articles related to the general theory of relativity it is discussed that in regions with higher gravitation the base unit of length "metre" is contracted (the wavelength of any electromagnetic radiation is shortened) – see the definition of the "metre" in SI accepted in 1960, Ref. [3].

It is clear, however, that the space is stationary but the contraction of the space (changed density of the medium of propagation of the electromagnetic radiation) is moving along with the celestial bodies. All celestial bodies (as well as the Earth) are traveling through the space-time of the Universe along with the distortion (contraction) of the contiguous, warped by the bodies themselves (and belonging to them) time-spatial domains, which we can name *"near the surface of the celestial bodies"*.

The misunderstanding of the dominant part of the physical society consists in the fact that the contraction of space moves along with the celestial bodies, but the space remains stationary!

The intensity of the gravitational field *"near the surface of the celestial body"* remains practically the same during the travel of the celestial body through the space, because the intensity of the gravitational field is determined (dominated) by the mass of the celestial body. The speed of light in vacuum (in the stationary empty space), in any particular time-spatial domain, corresponds to the intensity of the gravitational field in this time-spatial domain.

Therefore, during the travel of the celestial body through the space, the constant intensity of the gravitational field "near the surface of the celestial body" determines the constant "speed of light in vacuum" there.

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

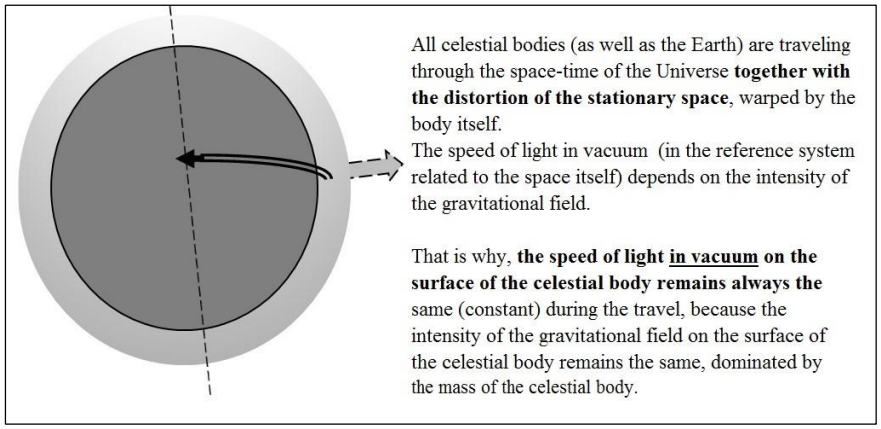

Figure 1. Movement of the celestial bodies together with the distortion of their "own time-spatial domain"

As a consequence, we have to be aware that the behavior of the electromagnetic radiation in vacuum must be considered in two aspects:

- in regions with different intensity of the gravitational field.
- in regions (local time-spatial domains) with a uniform intensity of the gravitational field;

The local physical reality is a "local time-spatial domain". It is any time-spatial domain with a practically uniform (the same) intensity of the gravitational field in the vicinity of any celestial body which remains constant in the general motion of the celestial bodies in the Universe and where the base units of time and of space (length) can be considered to be constant. Our local physical reality can be named "near the Earth's surface".

1.2 The speed of light in regions with different intensity of the gravitational field

The speed of light in vacuum depends on the intensity of the gravitational field. In regions with different intensity of the gravitational field, the speed of light in vacuum (in relation to the stationary space) is different and this has been proven by experiments:

1) The speed of light in vacuum is higher in regions with weaker gravitation.

In regions with a weaker intensity of the gravitational field, the electromagnetic waves will not be so suppressed by the gravity – they will oscillate more freely (easier). This means that they will oscillate with a higher frequency v – the "time period" of the electromagnetic oscillations will be of shorter duration. This means that the "spatial period" (the wavelength λ) of the electromagnetic oscillations will also be greater (they will "jump" with larger wavelength). Therefore, the increased frequency and the increased wavelength of each electromagnetic radiation determine not only the shortening of the

"second" and the lengthening of the "meter" but also increase in the speed of light in vacuum $(c=\nu\lambda)$. That was proven by the registered anomalies in the accelerations of the space-probes "Pioneer 10", "Pioneer 11", "Galileo", "Ulysses"…

"The expected travel time of the communicational electromagnetic signals (based on the constancy of the speed of electromagnetic radiation) between the spacecraft and the Earth turns out to be much more than the real travel time. So we register backward attraction (acceleration) of the ship to the Sun." [4].

The new higher speed will be valid again for the entire electromagnetic spectrum – it will be again a local physical constant. This logic coincides with the idea of the general theory of relativity.

2) The speed of light in vacuum is lower in regions with stronger gravitation.

Experimentally, using the units of measurement defined on the Earth's surface, a slower speed of radar electromagnetic signals has been experimentally measured in the region with strong gravitation (near the Sun) by the American astrophysicist Dr. Irwin I. Shapiro (Shapiro time delay effect), reported in 1964 (see Ref. [5]). The result of this experiment was confirmed later much more precisely using controlled transponders aboard the "Mariner-6" and "Mariner-7" spacecrafts as they orbited the planet Mars.

1.3 The speed of light in regions with a uniform intensity of the gravitational field

In regions with a uniform intensity of the gravitational field, the speed of light in vacuum (in relation to the stationary space) is a local constant in any local time-spatial domain with a uniform intensity of the gravitational field, and this concerns the whole spectrum of electromagnetic radiation.

"The "speed of light in empty space" is the correlation between the frequency and the wavelength for the whole electromagnetic spectrum, which is a local constant for our and for any other local time-spatial domain, where the intensity of the gravitational field is uniform." [6].

However, in regions with a uniform intensity of the gravitational field (as in the region "near the Earth' surface"), the experiments register different velocity of light in relation to the moving frames of reference in the stationary space. This reality is confirmed by:

• the experiments "One-way measurement of the speed of light", (see Ref. [7] and Ref. [8]);

• the "Sagnac experiment" (Ref. [9];

• the experiment "Michelson-Gale-Pearson" (Ref. [10, 11].

All of the experiments related to the speed of light measurement have their real explanation (see Ref. [12]) in accordance with the classical mechanics and

the Galilean relativity (which are indisputably valid and lawful in our local time-spatial domain "on the Earth's surface").

The exception is only the Michelson-Morley experiment… The analysis of the Michelson-Morley experiment shows (see Ref. [12]) that the inappropriate conceptual design, used in the construction of the Michelson interferometer (the advanced version of which is used in the famous Michelson-Morley experiment, held in 1887), is actually the primary root cause for 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. The difference in the velocity of light (in the frame of reference related to the moving Earth's surface in the stationary space) between the two light beams, traveling in two opposite directions on the same arm, is completely compensated if the "two-way light beam interferometer" is used.

"Actually, if even the "ether wind" exists (caused by the Earth's motion through the stationary luminiferous ether) – the difference in the speed of light between the two light beams, traveling in two opposite directions on the same arm, is completely compensated. It is true for any arm in any direction! In other words, if the projection of the velocity of the "ether wind" on the direction of one of the light beams is (+V), then the projection of the velocity of the "ether wind" on the direction of the reflected light beam (traveling in opposite), will be exactly (-V)." [6].

The "unexplained anisotropy of the light velocity", depending on the direction of the light beam in the "one-way measurement of the speed of light" experiments performed using the GPS system, has its explanation that corresponds to the physical reality. The results of the experiments "One-way measurement of the speed of light", of the "Sagnac experiment", of the "Michelson-Gale-Pearson experiment", of the "Michelson-Morley experiment" and of the Fizeau experiment are analyzed in detail in the monograph [Ref. 12]. Moreover, the essence of the so-called "fundamental tests of the special theory of relativity", which have been considered as three major types, are revealed there. This monograph includes the analysis of the article *"On the Electrodynamics of Moving Bodies"* (see Ref. [13]) presenting the special theory of relativity; and **shows exactly where and how** the claim *"the speed of light is the same in all inertial frames of reference"* was applied. It is also presented in *"Thesis on the behavior of the electromagnetic radiation in the gravitational field of the Universe"* (in 10 Statements), which actually rejects the postulate of the constancy of the speed of light for all frames of reference, and shows a solution of other big problems in physics today, such as: *"the accelerated expansion of the Universe"* and *"the dark matter and the dark energy in the Universe"*.

2 Absoluteness of Time and Space. Measurement and Units of Measurement

We can examine our perception of the absoluteness of time and space in our physical reality (in our time-spatial region with a uniform intensity of the gravitational field – "in the vicinity of the Earth's surface". Actually, in our

physical reality, the illusions of "reducing the size of the object" and for the "difference of simultaneity of events" occurs only as a result of the retrieval of the information as a result of the remoteness of the object to the Observer, which in most cases is by means of some electromagnetic signal (electromagnetic radiation).

Before we begin analyzing the article, let us consider in more detail our perception of absoluteness of the space and time in our local time-spatial region "near the surface of the Earth". Our perception of the absoluteness is due to the approximately equal intensity of the gravitational field in this region. If we need to be more precise, the intensity of the gravitational field is exactly the same only at the sea level.

About the "absoluteness" of the space in our local time-spatial region

Obtaining information about an object as part of the overall perception is essential to us. If we move away from an object, it will look smaller, but if we go back to it, we see that its dimensions have not changed. In other words, the *remoteness* of the object to the observer ***creates an illusion*** of *"reducing the size of the object"*. This is an illusion because, in fact, the dimensions of the object have not changed.

An illusion of *"reducing the size in direction of movement"* also exists when observing a *moving object*. Even using a high-quality device, the moving object may not even be registered, if its dimensions are small enough and the speed is high enough. But this is also an illusion ***caused by the way of getting the information***, because if the observer moves along with the object, then this illusion will not exist!

> *We make these reflections so that we can distinguish the reality from the illusions and that* ***the scientific theories must correspond to the reality rather than illusions.***

But let us go back to the "absoluteness" of the space. The space has no mass and according to *Newton's law of universal gravitation*, the gravitational forces cannot bring the space into motion – i.e. that the space is stationary. Therefore, the space does not revolve with the Earth. The influence of gravitational forces on the space is that they "bend" and "contract" the space ("space contraction"). In our local spatial region, the intensity of the gravitational field is the same and unchanging. Therefore, the "contraction" of the space is the same and unchangeable, too. This is a reason we percept the space as "absolute".

Therefore, we can take any point in the local stationary space for an origin of a "stationary coordinate system", and the axes to be dimensioned with a selected measuring unit – for example, the "meter" in the SI system. Thus, each stationary material point in a "stationary coordinate system" has fixed (unchangeable) coordinates respective to its location in the space.

Any change in the position of a material point in a "stationary coordinate system" is a function of the scalar quantity "time". This change, we call "motion of the material point" in a stationary coordinate system. In our local time-spatial region, "the motion" is described by Newton's laws of motion (the foundation for the classical mechanics).

About the "absoluteness" of time in our local time-spatial region.

"Time", as a physics term, is related to events – at any moment of time, different events start or end. "Time" in physics is a scalar magnitude, but it has one direction and always flows in the direction of "the future" without having anything to influence on it. Two are the basic concepts related to the physical magnitude "time" – these are *"moment in the time"*, and *"time interval"*.

• The term *"moment" inside the time* is inextricably linked to the concept of "simultaneity of events". We cannot determine a given moment (point) of the time, without associating it with a time-recording device (e.g. clock). For example, we usually associate a certain moment of starting of some event with the event "a specific position of the clock arrows" – i.e. we are actually talking about the *simultaneous occurrence of two events*.

• We associate the *"time interval"* with the duration of time between two events. *The standardized measuring unit of time* is associated with a precisely accepted *time interval* – for example, this is the *"second"* in the SI system.

So, if we obey the obligatory logical sequence, it follows that *if there is no simultaneity of events* (e.g. the correspondence with the clock's arrows), *then we cannot talk about a moment (a point) inside the time*. And if we cannot talk about a moment of occurrence (beginning) or end of an event – *we cannot talk about "time interval" and about the unit of measurement of time (as a duration between two moments*: between the "beginning" and the "end" of one second). Moreover, if there is no "simultaneity of events", the "end" of each preceding second and the "beginning" of each subsequent second will not be "simultaneous events". Therefore, we cannot measure the time. **Therefore, we cannot have any physical equation where "time" appears… Then, let us realize the absurdity of the facts:**

In the special theory of relativity, Einstein proves the lack of simultaneity of events using physical equations which, in fact, are always based on the presence of simultaneity of events!

But let us go back to the "absoluteness" of the time in our local time-spatial region "near the Earth's surface", where the intensity of the gravitational field is the same – meaning that the measurement unit of time, we have defined, is constant. There is no doubt about the simultaneity of events and the constancy of the time interval between every two events – which again means the constancy of the chosen measurement unit of time. Therefore, from the point of view of the physical reality **in our local time-spatial region – "the time is absolute"**

Therefore, any "special relativity" about the time due to motion in our local time-spatial region is a FALLACY!

Indeed, in determining the simultaneity of events in our local time-spatial region, there are also ***illusions*** caused by the way of obtaining the information. Two clocks can be synchronized (to show exactly the same time). If an observer with one clock is distant from the other, however, then the indication of the remote clock will be observed differently – the information will arrive with a delay. This difference does not mean that there is no simultaneity of the events *"corresponding readings of the two clocks"*. This difference is not real, as is unreal the *"reduced size of an observed remote object"*, too. These differences are the result of the process of reaching the information to the observer, rather than "lack of simultaneity" or any real "size reduction". The observer will make sure that the difference in readings is an illusion if they go back to the remote clock with their own clock. Then they will make sure that

there is no difference in either the dimensions or the clock readings of the remote clock.

Therefore, if we have two synchronized super-accurate "atomic" clocks at sea level (where the intensity of the gravity field is definitely the same) – wherever one of them goes, *with whatever velocity moves* ***near the surface of the ocean*** – upon its return, the clocks will show exactly the same time, will show exactly the same parts of seconds (even if a complete tour of the Earth is made and the date is different). But if one of the watches is transported to a space station and then returned to Earth, it will be found that this clock is in a hurry.

3 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 scientific journal Annalen der Physik [**13**].

Remark: In order for a theory to have scientific value (this applies not only to physics) it must also meet the physical reality. That is why, 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:

- the intensity of the gravitational field is approximately the same;
- the defined by us measurement units of length and of time do not change – these are the primary constants that we have chosen to be constants and which we have defined so that we can use mathematics in physics;
- the speed of electromagnetic radiation (of light) in vacuum is constant, as are constant and all physical constants in a region with a uniform intensity of the gravitational field.

As mentioned, the Earth is rotating 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.

In the beginning, Einstein refers to Maxwell's Theory of Electrodynamics, and then gives an initial formulation of the two postulates on the basis of which the special theory of relativity is created.

The formulation of the first postulate, which Einstein calls the "principle of relativity", refers to the natural laws – 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:

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 with the equations of mechanics? On the basis of 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. The equations of mechanics refer to the motion of material bodies in the stationary space. For the equations describing the motion of material bodies in moving systems at different speeds in a stationary space, Galilean transformations are in effect. 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 fixed space.

This means that there is no dependence of the velocity of a body with mass **m** on the direction of motion of the body in the inertial reference system (i.e. there is no anisotropy of the velocity)! However, if the system moves at a constant velocity but not rectilinearly it can be ascertained by a mechanical experiment (Foucault's pendulum). In other words, this assertion 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 relativity theory (see Chapter 18 of the book [**12**]), which fact is an unacceptable logical circular reference.

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 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.

Yes, the speed of light in vacuum is independent of the state of motion of the emitting body, because the emission becomes at a 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's why Einstein had never discussed the experiment performed in 1912 by the French physicist Georges Sagnac because this experiment

confirms the validity of the Galilean relativity in a local time-spatial region with a uniform intensity of the gravitational field. Furthermore, the following important difference is not taken into account – that while the motion of the material bodies is in the stationary space, the electromagnetic waves are like vibrations of the stationary space itself and their velocity of propagation is always the same in a time-spatial region with a uniform gravitational field intensity. So, while it is impossible through some mechanical experiment carried out in an inertial frame of reference to determine whether the given system is at rest or moving uniformly and rectilinearly in the stationary space – by means of measuring the velocity of light in a moving inertial frame of reference, the task "to determine the velocity of the inertial frame of reference in the "empty space" is elementary (see section 21.1 in the monograph [12]). We must elucidate that we are talking about the local stationary "empty space" in a region with a uniform gravitational field intensity – as the region "near the surface of the Earth". This task has been demonstrated with the "Michelson-Gale-Pearson experiment", but can also be demonstrated with experiments at different latitudes where the linear velocity of the Earth's surface is different!. All these experiments will once again prove that *"the speed of light is not the same for all inertial reference systems"*.

Follows: examining of the first part "I. KINEMATICAL PART" and then – of the second part of the article "II. ELECTRODYNAMICAL PART". 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 this paper it is shown exactly where and how this false statement was used!

3.1. 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 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.
- Obviously, the so-called "stationary system" is a frame of reference related to the stationary space itself (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 "stationary system" in question has the defining characteristics of our physical reality: The measurement units are non-variable (rigid standards of measurement). Einstein's chosen unit of length is "a rigid rod" as a standard of measurement – (in the International System of Units (abbreviated as SI); we have chosen this to be the unit of length "metre"). For time measurement, Einstein uses the same clocks ("in all respects resembling each other") that

measure the same time intervals – (in the SI-system 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 relatively to this (actually stationary 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 of 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."

Einstein logically shows us that the concept "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".

That is why, regarding the definition of the term "time". Einstein suggests 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.""

But this is acceptable, Einstein continues, 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) of 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 of receiving the information.

Actually, Einstein considers a stationary system where the time is the same and calls it "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 time in all other points to be 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. It 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). I.e., in the considered stationary coordinate system – the measurement unit of length and the measurement unit of time are constant. Another condition is that the clocks in point A and point B are synchronized (the readings are the same) but with denotations "A time" and "B time" respectively.

Here is the thought experiment:

"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 definition, the two clocks synchronize if

$$t_B - t_A = t'_A - t_B \qquad (4)$$

, where t_A and t'_A are the readings of the clock in point A and t_B is the reading of the clock in point B. The formula (4) 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 (4) *"criterion for the synchronization of two clocks"*. However, we must emphasize again that Einstein had accepted these clocks to be at rest in a stationary system. If we refer to the (see Remark above):

> ***The formula is true for <u>the physical reality</u>:*** *on the condition that the considered stationary system corresponds to the reference system <u>related to the ECI frame of references/ to the stationary space itself</u> (where the speed of light is constant and where the Earth's surface moves).*

In other words, this formula as *"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 the 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) that moves in the stationary space.*** When the circumstances under consideration are not juxtaposed with the physical reality, **a contradiction can be created** – such as the equation (5):

"In agreement with experience we further assume the quantity

$$\frac{2AB}{t'_A - t_A} = c \qquad (5)$$

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

This equation is true because it involves the traveled path in both directions – and therefore, the resulting speed of light is average for both directions and will always be equal to c (as is in the "two-way light speed measurement" – *the case of the Michelson-Morley experiment*)! However, this equation is misleading because it is true not only for the reference system related to the stationary "empty space", but it is also true for the frame of reference related to the moving Earth's surface. In the physical reality, (*this time really in agreement with experience*), is that if the referenced system is related to the moving Earth's surface (point A and B are fixed to the ground) and point B is located east of point A, then:

$$t_B - t_A > t'_A - t_B \qquad (6)$$

As was analyzed in chapter 4 *(the experiments "One-way measurement of the speed of light")* of the book [**12**], when the frame of reference is related to the Earth's surface – the difference (6) in the different directions will depend on the linear velocity of the Earth's surface of 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 (5) 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 the article: *It is a fact that the correspondence of the considered "stationary system" with our physical reality is not indicated. 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 section.*

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

At the beginning of this paragraph Einstein 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:

$$velocity = \frac{light\ path}{time\ interval} \qquad (7)$$

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

We can compare this definition of the "speed of light postulate", with the definition given at the beginning of the article:

"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."*

In fact, living in the time-spatial region "on the surface of the Earth", let us summarize: ***to what extent should the reader agree to these definitions of the postulates?***

• Indeed, in the inertial frames of reference: the physical laws are the same (because, in fact, the processes are carried out in the stationary space that is common for all frames of reference).

• Indeed, in regions with a uniform intensity of the gravitational field the speed of light is constant in "empty space" (i.e. in vacuum) – i.e. in the frame of reference related to the stationary space.

• Indeed, it does not matter whether the photons are emitted from a stationary or moving body – their speed in vacuum is the same because the photon emission happens on a quantum level.

• But nowhere Einstein discusses the fact that *the measured speed of light depends on the motion of the observer in relation to the stationary system of the empty space* – that would mean that the measured speed of light depends on the motion of the observer's frame of reference in the stationary space. Actually, it would mean that the statement *"the measured speed of light is the same for all inertial reference systems"* – is not true! Einstein does not postulate this statement directly, but as we shall see below, it is used to obtain the results of the special theory of relativity. The phrase *"for all frames of reference"* exists only in one place in the article and it is:

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

But let us continue with the line of thought of Einstein – with the examination of a stationary rigid rod (with a constant invariable length):

"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 – the following two methods (operations) are specified, by which the length of the rod can be determined:

(**a**) The observer moves together with the given measuring-rod and the rod to be measured and measures the length of the rod directly by superposing the measuring-rod, in just the same way as if all three were at rest. The measured in this way length of the rod AB Einstein calls *"the length of the rod in the moving system"* and that – *"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 synchronizing 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 a length that may be designated *"the length of the rod"*.

Here we must emphasize that the used measurement unit of length *"measuring-rod"* is the same for the stationary and for the moving system. 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***. According to Einstein, the measured length of the rod in the moving system (*by the method (**a**)*) will differ from the measured length of the rod in the stationary system (*by the 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 but firstly let's answer the 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 analogue of the considered "stationary system" is the Earth-centered inertial coordinate system (the ECI frame of reference), which is the considered stationary in relation to the surrounding space – *a frame of reference related to the stationary space itself;*
- the analogue of the moving frame of reference, *"the moving rigid rod"*, is a rod (oriented and moving in "West-East" direction) – firmly fixed on the moving in the stationary space Earth's surface.
- 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."

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."

Let us analyze how Einstein presented the case under consideration:

• We have synchronized clocks in the "stationary system" – i.e. their readings are the same.

Let us remember that we have established that the *"synchronization criterion"* (see equation (4)) is valid for a system connected to the stationary empty space, where the 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. However, these clocks in the stationary system are synchronized, which means that the clocks in the "moving system" are synchronized too!

*It means, in fact, that Einstein assumed a**s* ***an initial condition of the thought experiment*** *that both in the "stationary system" and in the frame of reference "moving system"* ***the clocks are synchronized*** *– i.e. the clocks' readings are the same and the time goes in the same way!*

In other words, it is set as an initial condition that at any time the readings for the time of the two clocks in the moving system (the rod), and at each point of the stationary system through which the clocks pass, are the same.

This Einstein once again explicitly emphasized in a footnote:

"Time" here denotes "time of the stationary system" and also "position of hands of the moving clock situated at the place under discussion."

As we will see, the adopted initial condition for the synchronicity of all clocks is then turning out to be false due to the unannounced direct acceptance that *"the speed of light is the same for both the systems considered"!*

The subject 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 observers located in the moving system, Einstein asserts:

"Taking into consideration the principle of the constancy of the velocity of light we find that

$$t_B - t_A = \frac{r_{AB}}{c - v} \qquad (8)$$

, and

$$t'_A - t_B = \frac{r_{AB}}{c + v} \qquad (9)$$

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 relative speed of the rod in relation to the stationary space.

Let us go back to the definition of the principle of the constancy of the speed of light, where the following is written – see (7):

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

i.e.:

$$time\ interval = \frac{light\ path}{velocity} \qquad (10)$$

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. It follows that the speed of the light in the moving system in one direction is ***(c-v)***, and in the other direction is ***(c+v),*** where ***v*** is the speed of the moving system in the stationary space (as in the cases "One-way measurement of the speed of light" and the "Michelson-Gale-Pearson experiment" – see Ref. [12]). I.e., for the observers in the moving system, the speed of the light for the two directions **is different from *c!*** Moreover, in fact, the observers in the moving system have no reason to think that their watches are not synchronized – they are synchronized as initial condition according to Einstein!

But 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 mention this!

*I.e., the condition **"the speed of light is the same for all inertial systems"** to be valid, it must be accepted that the clocks are not synchronized. However,*

according to the initial condition of the thought experiment – they are synchronized. This is ***obviously an unacceptable contradiction!***

Actually, the real fact is that *"the speed of light* ***is different*** *for both directions in the moving reference system"*, which is not accepted by modern physics although this is experimentally proven (see analyses of the experiments in Ref. [12]). **Instead**, it is assumed that ***the speed of light in both directions is equal to the speed of light in vacuum "c"***. The fact that in the moving frame of reference the speed in one direction is *(c+v)*, and in the opposite direction is *(c-v)*, is imputed to the clocks … However, this is contrary to the factual initial accepting (*that they are synchronized* - see (4)) and it is concluded *that they are not synchronized* as a consequence of the equations (8) and (9), and this actually wrongly approves that *the speed of light is the same in different directions* in the moving frame of reference**:**

"Observers moving with the moving rod would thus find that the two clocks were not synchronous."

The synchronized clocks show that:

$$(t_B - t_A) \neq (t'_A - t_B) \qquad (11)$$

The consequence of this unfounded *"lack of synchronization"* is the wrong conclusion about the absurd lack of simultaneousness of events – that there is *no simultaneity of events*:

"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 a "second")?"

Therefore, all equations 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 an absurd logical circular reference!

But if we go back to reality, in the reference system related to the moving Earth's surface (as we have seen in chapter 4 of the book [12]*) – the measured speed of the electromagnetic signals* in the direction of movement of the

ground "from West to East" is *(c-v)*, and in the direction "from East to West" is *(c+v)*! This fact nowadays is experimentally established using synchronized GPS satellite clocks.

> *In fact, the equations (8) and (9) can be called "criterion 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 (4) – i.e. "the criterion for the synchronization of two clocks", which are stationary in the "stationary system".*

In fact, it can be concluded – to what extent in the logical consistency, presented in the article, concerning the *"lack of synchronization of the clocks in the moving frame of reference"* there is no contradiction…

3.2.1 Analysis of the "simultaneity of events" for the two reference systems in the thought experiment

It can very easily be proved, based on the physical reality, that the simultaneity of the events is present. Here is the reality:

The events in the thought experiment are three:

> ***"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 systems of reference is that:
The time intervals between the three events are respectively equal for both frames of reference.

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

As we have seen, the time intervals for the observers *in the moving reference system* are (illustrated by) the equations (8) and (9), as shown:

$$t_B - t_A = \frac{r_{AB}}{c-v} \qquad (8) \qquad \text{, and} \qquad t'_A - t_B = \frac{r_{AB}}{c+v} \qquad (9)$$

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) 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 of ***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 $(r_{AB}\text{-}\Delta_{BA})$ than $\boldsymbol{r_{AB}}$ (the length of the rod), because, during the travel of the light beam, point A approaches the point B. Therefore, in the stationary reference system, the measured time intervals between the events are respectively:

$$(t_B - t_A)^{st} = \frac{r_{AB} + \Delta_{AB}}{c} \qquad (12)$$

, and

$$(t'_A - t_B)^{st} = \frac{r_{AB} - \Delta_{BA}}{c} \qquad (13)$$

, where Δ_{AB} is the distance that point B passes during the time interval $(t_B\text{-}t_A)^{st}$ at the speed of the rod $\boldsymbol{v}$;

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

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 (12) is the distance by which point B has moved away during the travel of the light beam from point A to point B, so, if we replace Δ_{AB} with $(v(t_B\text{-}t_A)^{st})$, we get:

$$(t_B - t_A)^{st} = \frac{r_{AB} + \Delta_{AB}}{c} = \frac{r_{AB} + v(t_B - t_A)^{st}}{c} \qquad (14)$$

, and, as follows from (14), we see that it is the same time interval $(t_B - t_A)$, as in the equation (8) for the *moving frame of reference*:

$$(t_B - t_A)^{st} = \frac{r_{AB}}{c - v} = (t_B - t_A) \qquad (15)$$

Therefore, the time intervals between the two events "Event 1" and "Event 2" 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 (13) 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 the equation (13) 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 the equation (9):

$$(t'_A - t_B)^{st} = (t'_A - t_B) \qquad (16)$$

In other words, the time interval between "Event 2" and "Event 3" in both frames of reference turns out to be the same.

Therefore, the simultaneity of the events for the two frames of reference is undeniably proven!

> ***Summary for section § 2 of the 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's experiment" (1913) and the "Michelson-Gale-Pearson experiment" (1925).*

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

3.3. 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 examines *a stationary coordinate system* and a moving rod *(moving reference system)* along the *x-axis*. It should be recalled that in both systems it was accepted that "the time" is the same. 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 relatively to that system."*.

In this section, 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 *"stationary space"*. One of the coordinate systems is called "stationary" and is denoted "K" system, and the other system, called "moving" coordinate system, is denoted "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 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" – $[(\xi, \eta, \varsigma); \tau]$.

The *axes* ***x*** *and* $\boldsymbol{\xi}$ 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 of ***x*** of the stationary system. The axis $\boldsymbol{\eta}$ and ς of the moving system are respectively parallel to the axes ***y*** and ***z*** of the stationary system 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 turns out to be Lorentz transformation), but based on the assertion that *"the speed of light is the same for all inertial frames of reference"*.

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

As an initial condition of the thought experiment, 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:

"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."

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 (in the direction of the movement) change when one inertial system moves relative to the other.

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, 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.

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 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 measuring 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.

But 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 resting point for 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 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)*:

"From the origin of system k let a ray be emitted at the time τ0 along the X-axis to x', and at the time τ1 be reflected thence to the origin of the coordinates, arriving there at the time τ2; we then must have:

$$\frac{1}{2}(\tau_0 + \tau_2) = \tau_1 \qquad (17),$$

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:

$$\frac{1}{2}\left[\tau(0,0,0,t) + \tau\left(0,0,0,t + \frac{x'}{c-v} + \frac{x'}{c+v}\right)\right] = \tau\left(x',0,0,t + \frac{x'}{c-v}\right) \qquad (18)$$

However, the equation (17) is a consequence of the equation (4): (t_B - t_A = t'_A - t_B), which is true, but for the case where the reference system is "stationary" (not "moving") in relation to the empty space (where the light propagates at a constant speed). But in this case, the observer is in the "moving system". The difference with the equation (4) is only in the denotation – the time is written with $\boldsymbol{\tau}$.

Here we must emphasize that the equation (17) 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"*. It 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. In fact, the conditions under which this statement is true in the presented "thought experiment" are not consistent:

- on the one hand, the "empty space" itself must be stationary for "the stationary system (K)", and
- on the other hand, the "empty space" should move along with *"the moving system (k)"* – (i.e. the "empty space" is not to be stationary)!

It is not anything else except *a logical contradiction*...

The physical reality, however, is the following: 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. in the stationary space) in the direction of increase of the *x-axis*, and therefore:

$$\frac{1}{2}(\tau_0 + \tau_2) < \tau_1 \qquad (19)$$

, because ***in the moving reference system*:** the interval of time necessary for the light beam to travel the distance in the direction of movement of the reference system (in the case is (τ_1 - τ_0), is greater than the necessary time

interval $(\tau_2 - \tau_1)$ for the light beam to pass the same distance back in the opposite direction of the movement of the moving reference system...

As we have seen in the previous section – according to equations (8) and (9) for the moving system:

$$(t'_A - t_B) < (t_B - t_A) \qquad (20)$$

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

$$(\tau_2 - \tau_1) < (\tau_1 - \tau_0) \qquad (21)$$

, which is:

$$(\tau_0 + \tau_2) < 2\tau_1 \qquad (22)$$

, which means that equation (17) does not correspond to physical reality, as well as the claim that "the speed of light is the same in all inertial reference systems".

Thus, on the basis of equations (17) and (18), which are inconsistent with the physical reality, the Lorentz transformations are derived. The Lorentz transformations themselves are not incorrect – they have their mathematical value. The Lorenz transformations show how the time and spatial coordinates between two inertial frames of reference (moving relatively to each other) must be transformed *so that the measured value for the speed of light in the two frames to be the same*.

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 velocity) 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 this book [**12**]. 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 speed 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 that if it is proved that a step in the logical structure of the theory is not true, then the whole theory of relativity is not correct. That is exactly what Einstein said when he explained the theory of relativity for 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"* [16] after the widely discussed publication by Dayton Miller *"Significance of Ether- Experiments of 1925 at Mount Wilson"*[17]:

> *"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 a vacuum would depend upon the direction of motion. With this, the principle of the constancy of the velocity of light, which forms one of the two foundation pillars on which the theory is based, would be refuted."* [16].

In this statement, however, Einstein has changed the focus! The speed of light *in a vacuum* is the same, but the measured speed of light in a moving system is not the same! This actually means that *the speed of light is not the same for all reference systems*!

As we have seen in Chapter 4 and Chapter 6 of the book [12]:

> *It has been experimentally demonstrated that in the coordinate system (in the frame of reference), related to the moving Earth's surface, the speed of light depends on the direction of its propagation (although the speed of light is constant in a vacuum).*

I.e., and according to this statement by Einstein, *"the relativity theory could not be maintained"* …

3.4. 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 II of Einstein's article, which in turn were obtained on the basis of the allegation that the ***speed of light is the same in all inertial frames of reference***. Not in vain in the article *"Does the Inertia of a Body Depend upon its Energy Content?"*, 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 the results he deduced *(inter alia)* in

section *§ 8. Transformation of the Energy of Light Rays* of the currently viewed article.

It is known that the famous equation $\boldsymbol{E=mc^2}$ was previously proposed by **Olinto De Pretto**, an Italian industrialist and scientist. He suggested that the radioactive decay of uranium and thorium was an example of mass transforming into energy.

However, this equation is generally attributed to Albert Einstein. It is well-known that Einstein's first paper on $\boldsymbol{E=mc^2}$, as published in the *Annalen der Physik* in 1905 [18], is problematic in that it suffers from the error of circular reasoning (*circular reference*).

This shortcoming of the paper was pointed out by many scientists and writers including Max Planck, Herbert Ives, Max Jammer, and also 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 $\boldsymbol{E=mc^2}$.

We also have to mention the fact that neither the article *"On the Electrodynamics of Moving Bodies"* [13] nor the article *"Does the Inertia of a Body Depend Upon Its Energy-Content?"* [18] contain the words *"gravitational mass"* or *"inertia mass*". However, at the beginning of section ***"§ 2. On the gravitation of Energy"*** of the article *"On the Influence of Gravitation on the Propagation of Light"* [1], 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/c^2, where* **c** *denotes the velocity of light."* [1].

As was mention 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 at radioactive decay in a time-spatial region where the speed of light in vacuum (the speed of any electromagnetic radiation in vacuum) is equal to *c* (speed respective to the intensity of the gravitational field inside this time-spatial domain). Therefore, the released energy will be different in regions with different intensity of the gravitational field. The difference in mass of the atoms before the radioactive decay and mass of the atoms after the decay is equal to the energy released at the radioactive decay according to the formula $E=\Delta m.c^2$. That is why, the law of conservation of mass is not valid when considering the masses of atoms actively involved in nuclear reactors, in particle accelerators, and in the thermonuclear reactions in the Sun and stars. 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"* which in the physical reality cannot exist. 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 mass as

its relative speed is different in relation to any other celestial bodies in the Universe.

4. Conclusion on the Special Theory of Relativity

The experimental and logical evidence presented reveals the essence of the special theory of relativity that:

The special theory of relativity **turns out to be only one hypothesis that can exist only in the field of mathematics. It is based on the claim that** *"the speed of light is the same in all inertial reference frames",* **which is experimentally proved to be inconsistent with the physical reality** – i.e., that is not true! That is why it 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:

- The "Michelson-Morley experiment", rather the inappropriate conceptual design of the Michelson's interferometer, is actually the primary cause for 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 that the existing physical reality is different. The "one-way light speed measurement" experiments, performed using GPS, are an example of this. The existing "paradoxes" proved to be actually an attempt at an incorrect explanation of the physical reality.

> *As incredible as it may sound, the Michelson-Morley experiment (albeit mistakenly constructed interferometer), and 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 – t****o 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 relativity theory does not correspond to physical reality, although the field equations of Einstein are not correct from the point of view of physics:

The general theory of relativity is a genius's brilliant idea that violates our perception of the absoluteness of time and space!

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