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Influence of Gravitation on the Origin and Propagation of Electromagnetic Radiation

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Abstract

Impressively, against the background of extraordinary advances in physics and technology, the mainstream continues to support the two most obvious delusions in 20th-century physics: "special relativity" and "the accelerating expansion of the universe". Both of these problems are based on a lack of understanding of the nature and behavior of electromagnetic radiation in the gravitational field. In this paper, an attempt is made to present a new approach to this problem. To understand the real fabric of the Universe, to understand the influence of gravitation on the characteristics of light (frequency, wavelength, speed of light in vacuum), we must first be aware of the nature of electromagnetic radiation and the nature of the medium of propagation of electromagnetic radiation. In this respect, as discussed at the 3rd Annual International Conference on Physics, 20 – 23 July 2015, in Athens, Greece, the characteristics of electromagnetic radiation must be considered in two aspects:

• In the "local time-spatial domains in any place of the Universe" (the regions with a uniform intensity of the gravitational field), and
• In the "global physical reality of the Universe" (related to the regions with different intensities of the gravitational field as an infinite set of local time-space domains).

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

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

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

1.1 On the Nature of the Propagation Medium of Electromagnetic Radiation

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

The supposed hypothetical "luminiferous aether" turns out to be the "warped space-time of the Universe itself" [1].

The logical rationale presented in the article ""Dark Matter", "Dark Energy", and Other Problems in Physics Today" substantiates the reality that the "space empty of matter" (the vacuum) is compressed energy by the fundamental forces of nature (such as gravitational force) [2]. The "space empty of matter" is actually the medium of propagation of electromagnetic radiation (and maybe a medium of propagation of other unknown types of energy).

"*Electromagnetic radiation is a radial propagation of energy packets (quanta) in the stationary space (in the medium of propagation, which actually turns out to be an "energy soup" compressed by the fundamental forces of nature)"* [2].

1.2 On the Nature of Electromagnetic Radiation

Electromagnetic radiation has no material character. Classically, electromagnetic radiation (EMR) consists of electromagnetic

waves, which are synchronized oscillations of electric and magnetic fields. In vacuum, electromagnetic waves travel at the speed of light, commonly denoted c. In homogeneous, isotropic media, the oscillations of the two fields are on average perpendicular to each other and perpendicular to the direction of wave and energy propagation, forming a transverse wave.

• **Duality:** Atoms have different energy levels, and electron states in an atom are associated with different energy levels. In quantum mechanics, an alternative way of viewing EMR is that it consists of quanta, which are responsible for all electromagnetic interactions. The transition of electrons to lower energy levels in an atom provides quanta emission. Quantum electrodynamics is the theory of how EMR interacts with matter at the atomic level. The energy of an individual quantum emitted or absorbed by a particular atom is quantized and is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom. The energy of a quantum is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom and is proportional to the frequency of the electromagnetic radiation *(Equantum = Ei – Ej = ħv)*, where *v* is the frequency, *ħ* is Plank's constant, and *Equantum* is the energy of the quantum. The energy of each quantum of energy emitted or absorbed by a particular atom is given by Planck's correlation between energy and frequency of EMR (*E = ħv*). Thus, a higher frequency corresponds to more energy of the quanta.

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

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

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

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

Electromagnetic radiation, however, is a stream of energy packets (quanta) propagating radially, rather than propagating vibrations of matter particles. The observed change in the frequency (of the energy of a quantum) at the collision with the material body, moving at a certain speed, has a real explanation in accordance with quantum electrodynamics (which is the theory of how EMR interacts with matter at the atomic level). When a moving material body reflects the quanta, the energy of the quanta (frequency) changes when the energy (frequency) of the electromagnetic quantum is comparable to the momentum of the moving object. Each atom of the moving body has a quantity of motion (momentum). Thus, at the collision of the quantum (photon) with the moving atom of the object, there is an energy exchange. The energy of the reflected quantum changes, depending on the momentum of the atom (depending on the velocity vectors of the quantum and the material body). This means that the frequency of the reflected quantum is changed, because ($\Delta E = \hbar.\Delta\nu$), where ν is the frequency, and ħ is the Planck constant.

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

"dark energy" (whose nature is inexplicable even for the modern cosmologists themselves).

"*The claim of the existence of the "Doppler effect" at electromagnetic radiation (that the motion of the source of electromagnetic radiation causes a "redshift" or "blueshift" of the frequency of the electromagnetic radiation), is actually a big delusion in modern physics*" [2].

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

2. Fundamentals Related to the Behavior of Electromagnetic Radiation in a Gravitational Field

In 1911 Einstein published the second version of the article "On the Influence of Gravitation on the Propagation of Light" (Einstein, 1911) [3]. The ambiguities and inconsistencies that led to the incorrectness of the formulas in the article "On the Influence of Gravitation on the Propagation of Light" are shown in analysis [4]. Some of them are:

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

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

As presented at the 3rd Annual International Conference on Physics in 2015 in Athens, Greece, the speed of light must be considered in two aspects:
1) in the "local time-spatial domains" (the regions with an equal and uniform intensity of the gravitational field), and
2) in the "global physical reality of the Universe" (related to the regions with different intensities of the gravitational field as an infinite set of local time-space domains) [5].

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

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

2.1.1 Logical Rationale Concerning the "Emission of the Quanta and Quanta Absorption"

In time-spatial domains with a uniform intensity of the gravitational field, the energy of the emitted quanta is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom, which is the same everywhere in the time-spatial domain.

Conclusion 1: *The energy of the emitted quanta, corresponding to the transition between two identical superfine levels of the ground state of any atom, is the same everywhere in a time-spatial domain of equal gravitational field intensity, and this energy is independent of the velocity of the emitting atom. It is because the emission is at a quantum level.*
Conclusion 2: *Concerning "Quanta absorption": When the quanta arrive at the place of the observer in the same region with the same gravitational field intensity, the discrete energy of the quantum will be the same – it corresponds to the transition between the same two hyperfine levels of the atom.*

2.1.2 Logical Rationale Concerning "Quanta Propagation" in a "Local Time-Spatial Domain" where the Intensity of the Gravitational Field is the Same

The propagation of electromagnetic radiation in any time-spatial domain with uniform gravitational field intensity occurs in a medium with equal density.

Conclusion 3: *The speed of electromagnetic radiation in the "space empty of matter" (in vacuum), is constant in any region with equal and uniform gravitational field intensity. The energy of the quanta remains the same at propagation, meaning that the frequency and wavelength of any electromagnetic radiation do not change during propagation in a region with uniform density of the propagation medium ($c=\lambda\nu$).*

2.1.3 A Consequence of Newton's Law of Universal Gravitation Concerning the "Empty Space"

Newton's law of universal gravitation states that in the Universe, any particle or body with a mass m_1 attracts any other particle or body (with a mass m_2) with a force that is directly proportional to the product of their masses (m_1 and m_2), and inversely proportional

to the square of the distance between their centers (r), where G is the gravitational constant:

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

Therefore, Newton's law of universal gravitation applies only to objects that possess mass and is the law of the universal power of gravity, bringing all the celestial bodies in the Universe (all the objects that possess mass) into motion.

The "space empty of matter" does not have mass. Therefore, it is undeniable that the "empty space" cannot be affected by the gravitational forces to move (the "empty space" cannot be attracted) – only the material bodies and the molecules in the atmosphere are involved in the Earth's rotation.

Conclusion 4: *From Newton's law of universal gravitation, it follows that "empty space" is motionless, i.e., the "vacuum is stationary".*

Therefore, Newton's law of universal gravitation does not explain how gravity affects space. The "empty space" does not rotate together with the Earth's surface – only the molecules and the material bodies in the atmosphere are involved in the Earth's rotation

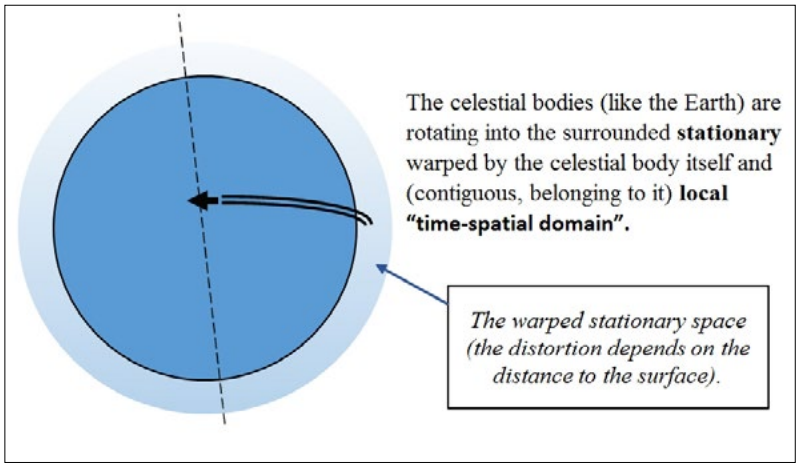

Figure 1: The Rotation of a Celestial Body in Stationary "Empty Space"

2.1.4 Logical Rationale Concerning the Postulate that "The Speed of Light is the Same for all the Inertial Frame of Reference"

The celestial bodies rotate in stationary space. The speed of light in vacuum (in the "medium of propagation") is constant in any time-spatial domain with a uniform gravitational field intensity, such as the time-spatial domain "near the Earth's surface". However, "One-way Measurement of the Speed of Light" experiments, and Kelly, 2005)), indisputably prove that the measured speed of light in the frame of reference, related to the moving Earth's surface, differs from the speed of light in vacuum (related practically in this case to the "Earth-Centered Inertial (ECI) coordinate system") [6,7]. This difference is equal to the linear speed of the Earth's surface at the latitude of the experiment. Well before, the results of the "Michelson-Gale-Pearson" experiment were published by Michelson in the papers "The Effect of the Earth's Rotation on the Velocity of Light I and II" [8,9]. Even with the title of this article, Michelson shows that there is such an effect, i.e., that the speed of light in vacuum differs from the speed of light in the frame of reference connected to the Earth's surface! The undeniable fact that the speed of light is not the same for all inertial frames of reference was proven as early as 1912 by the Sagnac experiment [10]. However, the Sagnac experiment is considered a paradox, because it proves that the speed of light is not the same for all frames of reference.

There are no "unexpected" or "inexplicable" results from the experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface of the Earth". Only the Michelson-Morley experiment cannot prove the undeniable fact that "the speed of light is not the same for all the inertial frame of reference". This experiment is an exception because of the inappropriate conceptual design embedded in the construction of the Michelson interferometer. Unfortunately, this very experiment turns out to be the basis for the fallacy that "the speed of light is the same for all the inertial frames of reference" and for the existence of the biggest blunder in the physics of the 20th century (the special theory of relativity). The difference in the speed of light in relation to the Earth's surface caused by the Earth's rotation around its axis cannot be ascertained if the Michelson interferometer is used because:

"*Actually, if the "ether wind" even exists (caused by the Earth's motion through the stationary luminiferous ether), then the difference in the speed of light between the two light beams, traveling in two opposite directions on the same arm, is completely compensated. This is true for any arm in any direction! In other words, if the projection of the velocity of the "ether wind" in the direction of one of the light beams is (+V), then the projection of the velocity of the "ether wind" in the direction of the reflected light beam (traveling in opposite), will be exactly (-V)" [5].*

A real explanation of the Michelson–Morley experiment and all the above-mentioned experiments can be found in a published paper *"The Complete Set of Proofs for the Invalidity of the Special Theory of Relativity"* [11]. Therefore, all the proper experiments performed in the local time–spatial domain "near the Earth's surface" undeniably prove that the measured speed of electromagnetic radiation is not the same for inertial frames of reference.

Conclusion 5: *The speed of light is not the same for all the inertial frame of reference.*

The undeniable fact that the *"speed of light is not the same for all the inertial frame of reference"* is not convenient for the mainstream in the field of relativity because *the special theory of relativity is created on the basis of this false claim*. The analyses of well-known experiments, the analysis of the article "On the Electrodynamics of Moving Bodies", and the analyses of all so-called "fundamental tests of the special theory of relativity are shown in the abovementioned published paper [11].

Despite the appeal made on social media, however, to date, there is not a single scientific argument given by mainstream physics against the presented proofs for the invalidity of the special theory of relativity!

2.2 Logical Rationale Concerning the "Global Physical Reality"

The "Global Physical reality" can be considered a set of all "local time–spatial domains" on the surface of the celestial bodies with different but uniform intensities of the gravitational field (depending on the mass of the celestial body), plus regions with uneven (changing) intensities of the gravitational field depending on the distance to the surrounding celestial bodies.

In this subsection, the following is discussed:

• The reason for the constant *speed of light in vacuum* on the Earth's surface (on the surface of the moving celestial bodies), during its motion in orbit around the Sun;

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

The gravitational force does not affect the space to move it; however, the gravitational force affects the stationary space around the celestial body by warping it (contracting it), increasing the energy density of the medium of propagation of electromagnetic radiation. The space is stationary; however, the distortion (warping) of the space moves along with the celestial body. The speed of light in vacuum depends on the density of the propagation medium (which depends on the intensity of the gravitational field). For this reason, the "speed of light in vacuum" in the local time-spatial domain "near the surface of the celestial body" remains unchanged during the travel of the celestial body in the Universe, because the intensity of the gravitational field remains the same during the travel of the celestial body dominated by the mass of the celestial body.

2.2.1 Logical Rationale Concerning the "Emission of the Quanta and Quanta Absorption" in the Regions with Different Gravitational Field Intensity

Atoms have different energy levels. The electron states in an atom are associated with different energy levels. The energy spectrum of a system with such discrete energy levels is said to be quantized. In quantum mechanics, an alternate way of viewing EMR is that it consists of quanta, which are responsible for all electromagnetic interactions. Quantum electrodynamics is the theory of how EMR interacts with matter at the atomic level. Quantum effects provide sources of EMR, such as the transition of electrons to lower energy levels in an atom. The energy of an individual photon is quantized and proportional to frequency according to Planck's equation $E = \hbar v$, where E is the energy per quantum, f is the frequency of EMR, and $\hbar$ is the Planck constant. Thus, higher-frequency photons have more energy.

It was experimentally proven that atomic clocks tick faster high in mountains (that time runs faster at higher altitudes). This fact shows that the energy $(E = \hbar v)$ that corresponds to the same transitions between the same two hyperfine levels of any atom located in a region of lower gravitational field intensity is greater than that at sea level (if we can measure this energy with the measurement units defined at sea level). These experiments show that Einstein's conclusion in his paper "On the Influence of Gravitation on the Propagation of Light" [3] that photons lose their energy when leaving the stars is wrong. However, if a photon loses energy when overcoming a star's gravity (as Einstein "proves"), then the photon will lose a different amount of energy depending on the mass of the star. I.e., the "redshift" will be different and for example, the spectral series of the emission spectrum of the hydrogen atom will shift differently depending on the mass of the star. However, there is no such dependence… and no astronomer has observed it.

In fact, these experiments prove that the energy of the emitted quanta, which corresponds to the transition between the same two hyperfine levels of the same atom, has a higher energy at a higher altitude in mountains. Therefore, the energy of the emitted quantum depends on the energy density in the location of the atom. This means that the energy states of the atoms depend on the energy density of the "empty of matter space" in the location of the emitting atoms.

Conclusion 6: *The energy states of any atom depend on the density of the "empty of matter space" in the region where the atom is located, i.e., the energy states of the atom depend on the gravitational field intensity. That is why, the energy (frequency of electromagnetic radiation) of the emitted quanta, which is equal to the difference in energy between the participating pair of quantum energy states of the emitting atom, is different in regions with different gravitational field intensities.*

Therefore, it is clear that at the location of the observer (at the location of absorption), the energy states of the atoms correspond to the density of the "empty of matter space" (corresponding to the gravitational field intensity). That is why the absorption of

the quanta corresponds to the same transition between the same hyperfine levels of the same atom. This is why astronomers expect the hydrogen spectral series to not be shifted. The energy of the arriving quanta at the location of the observer (which is of different intensity of the gravitational field than the intensity of the gravitational field at the location of emission) is such as if the quanta were emitted at the location of the observer.

This view conforms to general relativity:
• The fact, that the frequency of emitted electromagnetic radiation is higher in regions with lower gravitational field intensity means that in regions with weaker gravity, the time runs faster (the "second" becomes shorter). This is also the case according to the definition of the base unit of time "second" using the characteristics of electromagnetic radiation, as defined in the SI system according to the 13th meeting of the CGPM (General Conference on Weights and Measures), Resolution 1, 1967/68:

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom, at rest at a thermodynamic temperature of 00K.

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

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

Conclusion 7: *All of this indisputable logic shows that if the results of general relativity are true, then the speed of light in vacuum is different in regions with different gravitation. Conversely, if the speed of light in vacuum is a fundamental constant for the entire Universe, then general relativity is wrong!*

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

A comparison of the frequency and wavelength of a monochromatic source of electromagnetic radiation onboard the International Space Station (ISS) with those on the Earth's surface will prove that the speed of light in vacuum (in the medium of propagation) is increased. This is because the wavelength and frequency of the electromagnetic radiation are increased ($c=\lambda\nu$) in regions with weaker gravitational field intensities. This idea, however, cannot be accepted by the mainstream of physics (by the luminaries of relativity) even though it corresponds to the results of the general theory of relativity that they support.

The fact that the speed of light in vacuum increases in regions with a weaker intensity of the gravitational field (near the border of the Solar system) is the explanation and proof of the "inexplicable" anomalies in the accelerations of the space probes "Pioneer 10", "Pioneer 11", "Galileo", and "Ulysses", which, in fact, experimentally prove the presented logic:
The expected travel time of the communicational electromagnetic signals between the spacecraft and the Earth (based on the universal constancy of the speed of electromagnetic radiation in vacuum everywhere in the Universe), turns out to be much greater than the real travel time. Therefore, we register backward attraction (acceleration anomaly) of the space probe to the Sun [1].

Conversely, the fact that the speed of light in vacuum decreases in regions of stronger gravity (near the Sun) was experimentally proven as early as 1964 by the American astronomer Irvin Shapiro (Shapiro time-delay) 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 [12].

Conclusion 8: *The indisputable conclusion is that the speed of light in vacuum in our time-spatial domain "on the Earth's surface" is not a constant for all of the Universe – the speed of light in vacuum is only a local constant that depends on the intensity of the gravitational field. Furthermore, this local constant cannot be the limit speed for the entire Universe.*

The speed of light in vacuum depends on the strength of the gravitational force. Similarly, the speed of light in different optical media varies and depends on the strength of the chemical bonds between atoms and molecules. For example, the speed of propagation of light is very low in the "empty of matter space" between carbon atoms (for example, in diamonds), where the strength of chemical bonds is extremely strong.

The fact is, that the speed of light in vacuum (in the stationary "empty space" near the surface of the celestial body") remains practically the same throughout the travel of the celestial body through space because the intensity of the gravitational field there is constant and is determined (dominated) by the mass of the celestial body.

Conclusion 9: *Therefore, the constant gravitational field intensity at the Earth's surface is the reason why there is no variation in "the speed of light in vacuum" when the Earth moves in its orbit around the Sun and together with the Solar System in the Galaxy.*

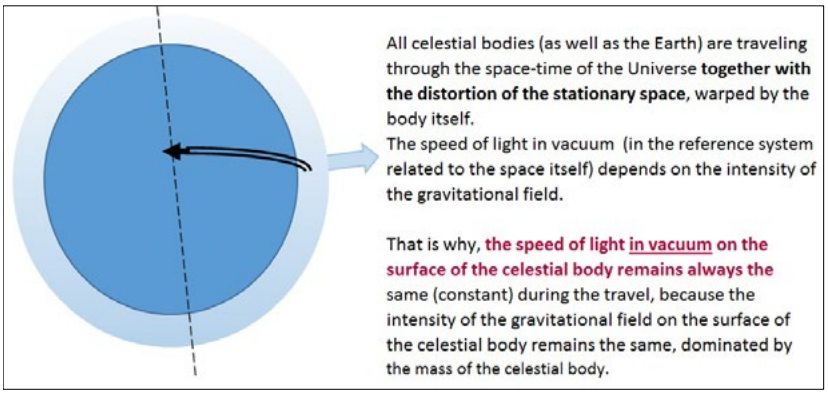

Figure 2: The Motion of the Celestial Bodies Together with the Distortion of their "Own Time Spatial Domain"

2.2.2 Logical Rationale C oncerning "Quanta Propagation" in Regions where the Intensity of the Gravitational Field is Uneven (Changing) Depending on the Distance to the Surrounding Celestial Bodies

As established above, the energy of the emitted quanta ($E = \hbar\nu$) that corresponds to the same transitions between the same two hyperfine levels of an atom depends on the intensity of the gravitational field where the atom is located, i.e., this energy is different depending on the mass of the star where the emitting atom is located. This means that the spectral series corresponding to the specific transitions between the energy levels of the hydrogen atom are also different. However, astronomers see that the hydrogen spectral series are not shifted when they arrive at the Earth's surface from the stars of our galaxy with different masses. Therefore, quanta change their energy as they pass through regions of varying gravitational field intensity. The quanta change their energy in synchrony with the gravitational field intensity (in synchrony with the density of the propagation medium), and arrive at the Earth's surface with energy that corresponds to the gravitational field intensity in the time-spatial domain "on the Earth's surface".

Conclusion 10: *The quanta give part of their energy to the "empty of matter space" (to the "energy soup"), when entering a region with stronger gravity, and obtain energy back from the "energy soup" when entering a region with weaker gravity (in sync with the different gravitational field intensity in that region).*

This logic fully corresponds to the astronomers' expectations (fully corresponds to the essence of astronomical spectroscopy) and grounds the astronomers for conclusions related to analyses of the electromagnetic spectrum of the coming light from the billions of stars in our galaxy. For this reason, astronomers expect the hydrogen spectral series to not shift. As a logical consequence of this change of the energy (frequency) of the propagating quanta in synchrony with the density of the medium of propagation, follows that the Universe is in the stage of contraction. Really, If the "empty of matter space" is contracting during the travel of the quanta, a part of the quanta's energy (which corresponds to the contraction of the space during the travel from the distant galaxies) will remain in the "energy soup", i.e., the arrived quanta is redshifted, with a lower frequency (with lower energy). Furthermore, the arrived quanta on the Earth's surface will be more redshifted if they travel more – when they arrive from more distant galaxies (Hubble's law). This logic provides a solution to the second biggest blunder in physics of the 20th century "the accelerating expansion of the Universe". This is undoubtedly a big problem in physics because it is illogical for the Universe to expand, despite the existing and undeniably proven universal attraction (Newton's law of universal gravitation). The observed redshift is not due to a "Doppler effect" but rather to an "energy-spatial relationship": the "*unrecognized principle of nature"* that Hubble believes in. The real explanation of the observed "redshift" is as follows:

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

Modern physics tries to explain this delusion by the existence of an illogically high percentage of some unknown type of "dark matter" in the Universe (which, if it existed, should have been discovered by now), as well as by the inexplicable myth of "dark energy" (the nature of which is inexplicable even to modern cosmologists themselves)!

3. Thesis on the Behavior of Electromagnetic Radiation in the Gravitational Field of the Universe

The above conclusions can be summarized in "Thesis on the behavior of electromagnetic radiation in the gravitational field of the Universe". This thesis represents a step forward in understanding the nature and behavior of electromagnetic radiation. The thesis rejects the postulate of the constancy of the speed of light for all inertial reference frames, which has been proven invalid for more than 100 years (from the Sagnac experiment, Michelson-

Gale-Pearson experiment, to today's experiments using modern technologies such as GPS.

This thesis consistent with the astronomical observations and provides scientific explanations of the "unexpected" and "inexplicable" results of famous experiments related to the behavior and measurement of the speed of light carried out in the time-spatial region "near the surface of the Earth". However, the author realizes that this thesis will need further corrections which will be in accordance with the further development of science.

The thesis consists of five assertions that concern the behavior of electromagnetic radiation in local regions with equal and uniform gravitational field intensities, and six assertions that concern the behavior of electromagnetic radiation at the transition between regions with different gravitational field intensities (concern the Global Physical Reality in the Universe). The presented assertions concern not only special and general relativity. The assertions on the Global Physical Reality in the Universe have also related to other problems in physics today, such as "the accelerating expansion of the Universe".

3.1 Assertions Concerning the Behavior of Electromagnetic Radiation in Regions with a Uniform Intensity of the Gravitational Field (in the "Local Physical Reality")

• **Assertion 1:** The speed of electromagnetic radiation in vacuum (in the "empty of matter space"), is a local constant.

In a "time-spatial domain" (region), where the intensity of the gravitational field is equal (the same) and uniform, the speed of the electromagnetic radiation in vacuum is a local constant. This local constant, however, depends on the gravitational field intensity in this local "time-spatial domain" and is different in regions with different gravitational field intensities.

• **Assertion 2:** The speed of electromagnetic radiation in vacuum does not depend on the velocity of the source of electromagnetic radiation in the stationary space of the local time-spatial domain. It is the limit speed for the local time-spatial domain but is different for the local time-spatial domains with different gravitational field intensities.

This is because electromagnetic radiation is an emission of quanta, which occurs at a quantum level at the transitions between the fixed quantum energy levels of the atoms. The frequencies (energies) of the quanta are different (depending on the respective transition of the respective atom). However, the velocity of the emitted quanta in a vacuum is the same for the entire spectrum of electromagnetic radiation and does not depend on the velocity of the atom in "empty space" in the local time-spatial domain.

• **Assertion 3:** The measured velocity of electromagnetic radiation in a local time-spatial region with a uniform (the same) intensity of the gravitational field is not the same for all inertial frames of reference.

Mathematically in regions with an equal and uniform intensity of the gravitational field, the relationship between coordinates (between the readings) in the different inertial reference systems is expressed through Galilean transformations; this relationship is subject to Newtonian mechanics. This fact is proven by the experiments "One-way light speed determination", "Sagnac's experiment" and "Michelson-Gale-Pearson experiment" [11].

• **Assertion 4:** The frequency of electromagnetic radiation does not change when it is propagated in vacuum in a local time-spatial region with an equal and uniform gravitational field intensity.

This is valid for the entire electromagnetic spectrum and means that at the propagation of the electromagnetic radiation in the vacuum of the local time-spatial region, the electromagnetic quanta do not give to (and do not take from) energy that is compressed in the "empty of matter space" (in the medium of electromagnetic radiation propagation).

• **Assertion 5:** The frequency (energy) of electromagnetic radiation changes when it is reflected from a moving object in a local time–spatial region. The frequency change is a consequence of the energy interaction during the collision between the electromagnetic quantum and the moving object *($\Delta E=h.\Delta v$)*.

This change in frequency is not due to the Doppler effect (as is incorrectly explained by modern physics), and has its explanation with quantum electrodynamics (the theory of how EMR interacts with matter at the atomic level). This change in frequency has practical application (in radar) when the energy (frequency) of the electromagnetic quantum is comparable to the momentum of the moving object [2].

3.2 Assertions Concerning the Behavior of Electromagnetic Radiation at Transitions between Regions with Different Gravitational Field Intensities (the Global Physical Reality in the Universe)

• **Assertion 6:** The speed of electromagnetic radiation in vacuum (in the reference system related to the stationary space itself) depends on the intensity of the gravitational field and is different in local time-spatial domains with different gravitational field intensities.

In fact, the speed of electromagnetic radiation in vacuum is only a local constant for each region with a uniform intensity of the gravitational field (as the time-spatial domain "near the Earth's surface").

• **Assertion 7:** The frequency, wavelength, and speed of electromagnetic radiation in vacuum change according to the intensity of the gravitational field when the electromagnetic radiation propagates through regions with different gravitational field intensities.

In fact, the frequency, wavelength, and speed of electromagnetic radiation increase in regions with a weaker gravitational field

and decrease in regions with a stronger gravitational field. This fact was incorrectly discussed by Einstein in the article "On the Influence of Gravitation on the Propagation of Light" (see the analysis of the article), and was proven by the "Shapiro time-delay effect" and the anomalies in the accelerations of the space-probes "Pioneer 10" and "Pioneer 11" [1,3,4,12].

• **Assertion 8:** The electromagnetic properties of the atoms change (they are different) in regions with different gravitational field intensities. The energy of the emitted and absorbed photons (the frequency of electromagnetic radiation) at the transition between the same superfine energy levels of an atom corresponds to the gravitational field intensity in the region where the atom is located.

This means that 1) the frequency of the electromagnetic radiation (the energy of the emitted quantum) from an atom located in a local region with a certain intensity of the gravitational field is consistent with the gravitational field intensity where the atom is located. This is why the atomic clocks run faster at higher altitudes (in the mountains). 2) During propagation, the characteristics (frequency, wavelength, and speed) of the emitted quantum (the electromagnetic signal) change in synchrony with the intensity of the gravitational field in the regions through which it passes. 3) In the receiving time-spatial region of the observer "on the surface of the Earth" (the region of absorption of the quanta), the energy of the arriving quantum is again in full agreement with the energy of the transition between the same superfine levels of the same atom located in the emitting region (again in full conformity with the intensity of the gravitational field) ... as if the quanta had been emitted in the receiving time-spatial region. This approach is used in the analysis of the spectra of the energy-emitting celestial bodies (stars), which is the main method used in astrophysical research.

• **Assertion 9:** If a source of electromagnetic radiation moves in a remote local region of an invariable (uniform, equal) intensity of the gravitational field, the frequency of the emitted electromagnetic radiation does not depend on the velocity of the source movement (the gravitational field intensity in the regions of the source and the observer can differ). As was substantiated above, this is because the emission of the quanta occurs at the quantum level. In other words, the Doppler effect does not occur in the case of electromagnetic waves.

The frequency of the electromagnetic signal emitted from a space probe moving in a circular equipotential orbit (equal gravitational potential) around a remote planet does not change when the space probe changes its direction of motion in relation to the Earth.

• **Assertion 10:** If a moving source of electromagnetic radiation passes (at the time of emission) through regions where the gradient of gravitational field intensity is changing, then the received frequency of electromagnetic radiation emitted from the remote object is shifted. The frequency shift will be greater at a higher gradient of difference in the gravitational field intensity.

Depending on the direction of change in the gravitational field intensity through which the source of electromagnetic radiation passes, the frequency shifts to the red end of the electromagnetic spectrum (frequency decreasing) or to the blue end (frequency increasing). Thus, when a space probe moves down to the surface of a planet (in the direction of increasing gravitational field intensity), we observe a "redshift" in the received frequency; a "blueshift" in the received frequency is observed when the space probe is leaving the boundaries of the Solar system (in the case of the observed anomalies in the acceleration of the space probes "Pioneer-10" and "Pioneer-11").

• **Assertion 11:** The energy of the electromagnetic quanta changes (the frequency of electromagnetic radiation shifts) when the quanta pass through regions that are expanding or contracting during the travel of the electromagnetic quanta.

The energy of electromagnetic quanta (frequency of electromagnetic radiation) shifts in synchrony with the change in gravitational field intensity when it passes through regions with different gravitational field intensities. Electromagnetic quanta give part of their energy upon entering a region with stronger gravity and obtain energy back from the "empty space" (from the "energy soup") when entering a region with weaker gravitation. However:

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

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