# Logunov and Mestvirishvil disprove "general relativity"

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**Abstract.**

Based on the various documents, 1989-2002, through the original texts, in addition to the author's contributions, this paper presents the refutation of the mathematicians and physicists A. Logunov and M. Mestvirishvil of A. Einstein's "general relativity", from the relativistic theory of gravitation of these authors, who applying the fundamental principle of the science of physics of the conservation of the energy-momentum and using absolute differential calculus they rigorously perform their mathematical tests. It is conclusively shown that, from the Einstein-Grossman-Hilbert equations, gravity is absurdly a metric field devoid of physical reality unlike all other fields in nature that are material fields, interrupting the chain of transformations between the different existing fields. Also, in Einstein's theory the proved

"inertial mass" equal to gravitational mass has no physical meaning. Therefore, "general relativity" does not obey the correspondence principle with Newton's gravity.

## 1. Introduction.

What was once called the general theory of relativity, GTR, from which only the Einstein-Grossmann-Hilbert equations are preserved today, because the principles that were used as guidelines for its structuring were negated over time, as great philosophers of science like Norton Earman and Glymour among others [1] have presented it, since the general relativity of the movement not is valid in extended gravity and the covariance general is a property of the tensors in the space-time universal of Riemann, apart that Einstein abandoned early the Mach´s principle. Although its equations were obtained in November of 1915, GTR comes from 1907, when from the perspective of restricted relativity, on the basis of equivalence between inertial and gravitational masses and in that the laws of nature are independent of the state of motion, Albert Einstein formulated the equivalence between all kinds of movements, that is, those not subject to forces and those, that according to Newton, if they are, like the accelerated and the gravitational movements, although, limited to the homogeneous gravitational frames. So, first of all, these are equations about the geodetic motion of bodies and particles. And, secondly, of the general relativity of movement, although paradoxically restricted to a spacetime empty of matter.

Let us remember that according to Galilei's principle of relativity, valid in inertial frames, and adopted in special relativity, movement is a coordinate´s effect, since from mechanics, there is no kinematic way between two frames of reference, to establish which one is at rest. It will be in relative motion the one that according to the other changes its coordinates with respect to its frame, both being able to affirm it.

The generalization of relativity made by Einstein to all movements: inertial, accelerated and gravitational, is that any accelerated frame can be considered as an inertial frame although under the action of a local homogeneous gravitational field and this frame in free fall as an inertial one. Therefore, the movements inertial, accelerated and ¡¡gravitational homogeneous¡¡ are relative states, simple effect of change of coordinates as if they really did not exist.

Furthermore, spacetime, the scenery of such coordinate´s changes between frames, in 1908, was introduced by the mathematician Hermann Minkowski, through a mathematical model, uniting space and time on a four-dimensional continuum. This model was adopted by the science of physics, although only operationally defined not thus physically, constituting an unfortunate failure of a science of nature, which studies matter, but lacks the definition of one of its fundamental categories, so that philosophy, supplements it. The substantialism, according to the equations Einstein-Grossmann-Hilbert, defines it as a geometric entity, although existing in itself, which it serves of container of what exists materially; “All things are stored in time as an order of succession; and in space as order of situation” (Newton). On other hand, the relationism define it as a category of thought, which expresses geometric relationships between dynamic bodies and dynamic material particles; "Space is something merely relative, as time is. Space is an order of coexistence, just as time is an order of succession” (Leibniz and Clarke).

Consequence is that the movement is illusory, always subjective effect of the observers in their frames of reference regarding their perception of the space-temporal change of the other frames. Thus, Newton's and Maxwell's laws of physics are the same in all frames of reference regardless of their apparent state of motion as if such preservation were a geometric property of spacetime.

Einstein was a failed relativist absolute unlike Newton and Galileo defenders of the absolute movement whose existence they could not prove, by what they accepted the principle of relativity although only valid in inertial frames.

Since antiquity, two currents of thought have disputed the conception of movement, being in one absolute and in the other relative. Among others the most notable, in the group of absolutists were Aristotle and Newton while in the group of relativists were Descartes, Leibniz and Mach.

The gravitation homogeneous explains the acceleration that bodies and particles undergo in a gravitational field, but not their attraction. In September 1913, Einstein had to introduce the concept of extended gravity in front of the homogeneous one, which he called from then on, point gravitation. "A physicist sharing our point of view can characterize the gravitational field as apparent because by a suitable choice of a state of acceleration, he can achieve that at a given point in spacetime a gravitational field is not present. But it is obvious that for extended gravitational fields this fading of the gravitational field cannot, in general, be achieved by a transformation. For example, it is not possible to fade the gravitational field of the Earth by choosing an appropriate reference system" [2], [3]. The extended gravity is a permanent gravitational field that is not equivalent to a uniformly accelerated frame of reference. The extended gravitational field comprises both acceleration and attraction. Einstein wrote that "The theory of relativity (in the point sense) has to be replaced by a more general theory that contains the former as a limited case" [2]. In 1969, the author warned, from the structuralism approach, to clean the "general relativity" of Einstein's prejudices from his culture, ideology and psychology: "In his famous abstraction of the elevator that rises animated by a uniformly accelerated movement it turns out that a Such a system may or may not be a gravitational field; it all depends on whether the observer is outside or inside the elevator. The person inside the elevator cannot determine if the elevator is hanging from the cable, in the gravitational field, or if it experiences an acceleration directed upwards. Indeed, in both cases the objects will fall in the same way to the elevator floor. But, the truth is that the gravitation fields are neither created nor destroyed by the transformation of the reference system, they exist objectively regardless of our consciousness and prior to it. The empirical-criticist Einstein rejects objective truth and its knowability, that is to say, if the thing in itself exists as something different than a mere complex of sensations, what rebels to knowledge is "the thing for us"; Einstein was a philosophical idealist ”[4].

Albert Einstein, physicist, and Marcel Grossman, mathematician, section VI A undergraduates, specializing in mathematics, physics, and astronomy in department VI, School for Teachers of Mathematics and Science, Zurich Polytechnic School; former colleagues during the first two basic years, of the four years in total; Both Ph.D from the University of Zurich worked together in Zurich between August 1912 and March 1914, producing the best scientific result achieved by Einstein: the Entwurf theory, which was presented in June 1913.

Between, 1908-1909, Minkowski, former professor of Einstein, introduced in special relativity the geometric method and geometric thought [5], who, inspired by Felix Klein's work on new non-Euclidean geometries, in his Erlangen program the traditional algebraic instruments supporting physics were replaced by geometric ones. "Minkowski indicated that the geometers have focused on the transformation of space. But they have ignored the transformation groups associated with mechanics, those that connect various inertial states of motion. Minkowski proceeded to treat those groups in exactly the same way as the geometric groups. In particular he constructed the geometry associated with the Lorentz transformation. To begin with it was not the geometry of space, but of spacetime, and the notion of spacetime was introduced into physics almost as a product of the Erlangen program. He further found that spacetime has the hyperbolic structure now associated with Minkowski's spacetime. From this geometric perspective the formulation of a theory that satisfies the principle of relativity in inertial systems becomes trivial. It is only required to formulate the theory in terms of the geometric entities of the spacetime, effect of the various types of spacetime vectors by Minkowski defined and the theory will be Lorentz covariant, automatically” [5]. Later, in 1915, with the formulation of general relativity, Einstein adopted spacetime with Riemann geometry geometrizing gravity.

The bridge between special and general relativity was the Entwurf theory. Between 1905 and 1907, Einstein like Poincare and Minkowski failed to obtain a relativistic theory of gravitation, RTG, from special relativity due to the impossibility of describing the gravitational potential using a 4-vector. At this point Einstein was unaware of the tensors.

In 1912, Grossmann, who had served as a professor of descriptive geometry since absolute differential calculus, introduced in 1901 by Gregorio Ricci-Curbastro and Tullio Levi-Civitta, introduced Einstein to tensioners, a powerful new mathematical tool, with the power of being able to integrate the principles of equivalence and relativity at the same time, given its covariance property, which could be applied in the Riemann spacetime or in the Minkowski spacetime, a special case of the first when the curvature tensor $R^i_{jkl} = 0$.

Absolute differential calculus represents quantities as geometric objects in that sense it is complementary to the Erlangen program, "allowing the relationships between such quantities to be valid in any frame of reference" [6], that is, the property of covariance.

Einstein chose the tensors applied to Minkowski's spacetime since he, as a physicist, at that point understood that extended gravity was a phenomenon of energy similar to electromagnetic and it was essential to him “that the laws of conservation be satisfied by material processes and the gravitational field taken together. So we demand the existence of the expression $t_{\mu\nu}$ for the impulse and energy flows of the gravitational field, together with the corresponding amounts $T_{\mu\nu}$ of the material processes ”[7]. Furthermore, Einstein devised the argument of the hole to justify the limited covariance, which occurs when the tensors are applied to the Minkowsky spacetime, due to its lack of universality that possesses the Riemann spacetime, avoiding the indeterminism that would result from a general covariance. But, the equations of the Entwurf theory failed in give in limit of the weak gravity the equations of Newton and, on the other hand, in astronomy the trajectory of Mercury.

General relativity arose not as the further development of Entwurf theory but from Einstein's deep personal crisis, in stiff competition with the best German mathematician of the time, David Hilbert, begun in July 1915, and ended in November 1915, when Hilbert first and 5 days later Einstein delivered the equations giving the results, that the equations of the Entwurf theory could not. Einstein was forced to apply the tensors to Riemann's spacetime, the other alternative that Grossmann had given Einstein, at the cost of renouncing the materiality of the gravitational field, which became a field of geometric nature, devoid of physical reality. So Einstein had to give up to the hole argument, for which, with the help of the philosopher Moritz Schlick, he elaborated "the point coincidence argument" with which the indeterminism of the general covariance was overcome. Einstein presented the general covariance as the realization of the general principle of relativity. And without know Einstein how the equations work.

"As noted 90 years ago by Hilbert (1917), Einstein (1918), Schrodinger (1918) and Bauer (1918) within the approach of geometric gravity (general relativity) there are no tensor characteristics of impulse-energy for the field of gravity ”[8].

As in the Einstein-Grossmann-Hilbert equations, it is impossible to obtain a tensor for the energy and momentum of the gravitational field that satisfies the conditions:

1. When added to other forms of energy, the sum is preserved.

2. It is independent of coordinate systems.

In exchange Einstein built his pseudotensor that satisfies only the condition that the sum be preserved; Other physicists have obtained similar pseudo-tensors, the Landau-Lifshitz being notable, but the problem is that the pseudo-tensors only behave as tensors with respect to linear transformations of reference frames, that is, the pseudo-tensors are not general covariates and they are consequently confined to Minkowski's spacetime.

The non-localization of the energy of gravity is today the standard solution used by those who still cling to "general relativity" but which causes gravity cannot be treated quantum, while all the other fields are localizable, that is, detectable.

Therefore, in "general relativity", the geometrization of gravity was not due to Einstein using absolute differential calculus, the principle of geometrization or Riemann geometry, nor because the metric tensor encodes or allows obtaining all the data set related to the casual geometric structure of space-time. Gravity was geometrized because the metric tensor, as a metric field, is also the same gravitational field, devoid of impulse-energy because the corresponding tensor of impulse-energy generator $t_{\mu\nu}$, does not exist, violating the conservation law of energy impulse of matter and the gravitational field, taken together. The metric field is just geometric objects, in itself without any physical content, in particular, as in modern general relativity, the gravitational field is the curvature on a Lorentzian manifold (Riemann spacetime of positive curvature), which Wheeler called geometrodynamic, or rather in Einstein the gravitational potentials: “$g_k = -(\text{grad}\ \Theta)_k$, $k = x_1,\dots x_4$ that is to say, $g_{\mu\nu} \leftrightarrow \Theta\ \ \Gamma^k_{\alpha\beta} \leftrightarrow g_k$” [9].

Paradoxically, "general relativity" is restricted to extended gravity that does not obey Einstein's principle of equivalence, a matter recognized by himself in 1913, and what is even more serious, violates the existing experimental equality between inertial and gravitational masses, since that the inertial mass depends on the spatial coordinates, lacking of physical meaning, as in 1986 was demonstrated by Logunov and Mestvirishvili.

In 1986, just over six decades after Einstein, Poincare and Minkowski's early failure to generalize restricted relativity, the group of the Soviets Anatoli Logunov and M. Mestvirishvili resumed the Entwurf theory, that confronting it with "general relativity" they found the great Einstein's error of the geometrization of gravity, which returned them to restricted relativity, and from Poincare's approach they formulated RTG, its true generalization, by using a dualistic structure of space-time: Minkowski - Lorentzian manifold. Of course, without Einstein's inconsistent principle of equivalence, keeping Minkowski's space-time primary, thereby preserving the law of conservation of energy and momentum of matter and gravity taken both, and materializing the static gravitational field, compound of virtual gravitons, generated from the tensor of matter, $T^{\mu\nu}$, plus the tensor of the gravitational field, $t^{\mu\nu}$. Through the superposition of the secondary Lorentzian manifold, due to the presence of the gravitational field in the Minkowski space, the curved space-time is conserved, consequently the general covariant equations, necessary to give in the limit of weak gravity, the Newton's equations and in their astronomical application the correct orbit of Mercury, that is, a wonderful result of ingenuity and mathematical technique based on absolute differential calculus, variational calculus, and gauge formalisms. In 2004, with the additional collaboration of S.S. Gershtein and N.P. Tkachenko, RTG was revised to explain the accelerated expansion of the Universe.

In this work we present, according to their original texts, Logunov and Mestvirishvili's critique of "general relativity", first the critique of Einstein's principle of equivalence, then the critique of the violation of inertial and gravitational mass equality and hereinafter the critique of the geometrization of gravity. This block of conclusive criticism has not been answered by any of Einstein's renowned scientific representatives. The relativistic theory of gravitation that Logunov and Mestvirishvili offer as a replacement for "general relativity”, it is accepted as an alternative theory.

## 2. Einstein's equivalence principle.

Although the equivalence principle was formulated with the aim of serving as a guide for the generalization of the relativity of movement, it is only applicable in the absence of matter, therefore devoid of gravity, that is, of extended gravity, precisely the phenomenon that it intended explain general relativity. However, it is even more dramatic since a vacuum at rest, in Einstein's elevator, produces electromagnetic waves that break the equivalence between a uniform accelerated frame and a gravitational frame. Of course, the alleged law of equivalence between the different types of movements existing in nature that makes movement illusory as a simple effect of changes in coordinates between frames of reference is mere speculation.

"In the first stage of creating his theory, Einstein used the formal analogy between an inertial force field and a gravitational field as his main idea. In fact, these fields have a lot in common in their action on the mechanical movement of objects; the movement of objects under the action of a gravitational field is indistinguishable from their movement in an appropriately chosen non-inertial frame of reference; In both fields, the acceleration of objects does not depend on their mass or composition. This gave Einstein the basis for claiming that the gravitational mass of an object must be exactly equal to the inertial mass of the object and led him to the formulation of the equivalence principle (Einstein and Grossmann, 1913).

> The theory described here stems from the conviction that the proportionality between the inertial and gravitational mass of a body is an exact law of nature that must be expressed as a fundamental principle of theoretical physics. We tried to reflect this conviction in a series of previous documents, in which an attempt was made to reduce the gravitational mass to the inertial mass; This aspiration led us to the hypothesis that physically a gravitational field (homogeneous in an infinitely small volume) can be completely replaced by an accelerated frame of reference. Graphically, this hypothesis can be formulated as follows: an observer locked in an elevator has no way of deciding whether the elevator is at rest in a static gravitational field or if the elevator is located in a gravitational free space in accelerated motion that it is maintained by forces acting on the elevator (equivalence hypothesis).

From Einstein's point of view, the only difference between inertial force fields and gravitational fields consists of the different external sources that these fields generate: the first is due to the non-inertia of the frame of reference used by the observer and the second is generated by material objects. However, as Einstein believed, these fields have an equivalent effect on all physical processes and are therefore indistinguishable in other respects. This statement created the illusion of the possibility of excluding the effect of the gravitational field on all physical phenomena through an appropriate transformation of the space-time coordinates, by the analogy of the destruction of inertial force fields.

However, inertial forces and gravitational forces are completely different in origin, since for the former the curvature tensor is identically zero, while for the latter it is not zero. Consequently, the effect of the former on all physical phenomena can be nullified throughout space (globally) by transferring to an inertial frame of reference, while the effect of gravitational forces can be destroyed only in the local regions of space and not for all physical processes, but only for the simplest ones, those in which the space-time curvature is not present.

Therefore, on the one hand, the equivalence principle is invalid for processes involving particles with higher spins because the equations for the particles explicitly contain the curvature tensor, on the other hand, the principle cannot be applied to extended objects, since that in this case the deviation of the geodesics corresponding to the edge points of the object are manifested. Since the curvature tensor enters the deviation equation, inertial forces and gravitational forces are not equivalent for the mechanical movements of an extended object.

Therefore, the equivalence principle, understood as the possibility of excluding the gravitational field in an infinitesimal region is not correct, since, there is no way in which we can exclude the curvature of space (if it is not zero) selecting an appropriate frame of reference, even within a given precision. Furthermore, gravitational fields and inertial force fields do not have similar effects on all physical processes.

It is true to note that Einstein subsequently reconsidered his view of the equivalence principle and did not insist on complete equivalence of inertial force fields and gravitational fields, noting that the former (non-inertial frames of reference) constitute a particular case of gravitational fields satisfying the Riemann $R^i_{nml} = 0$ condition. Einstein wrote (1949):

> There is a special type of space whose physical structure (field) can be presumed to be precisely known on the basis of the special theory of relativity. This is an empty space without electromagnetic field and without matter. It is completely determined by its metric property: Let $dx_0$, $dy_0$, $dz_0$, and $dt_0$ be the coordinate differences of two infinitesimally close points (events); so
>
> (1) $ds^2 = dx_0^2 + dy_0^2 + dz_0^2 - c^2dt^2$
>
> it is a measurable quantity that is independent of the special choice of the inertial system. If the new coordinates $x_1$, $x_2$, $x_3$ and $x_4$, are entered in this space, through a general coordinate transformation, then the quantity $ds^2$ for the same pair of points has the form
>
> (2) $ds^2 = \sum g_{ik}dx^idx^k$
>
> (sum for i and k from 1 to 4), where $g_{ik} = g_{ki}$. The $g_{ik}$ that form a symmetric tensor and are continuous functions of $x_1$,… $x_4$, then describe according to the equivalence principle a gravitational field of a special class, namely one that can be transformed back into the form (1).
>
> From Riemann's research on metric spaces, the mathematical properties of this $g_{ik}$ field can be given exactly (Riemann condition). However, what you are looking for are the equations satisfied by the general gravitational fields. It is natural to suppose that they can also be described as tensor fields of the $g_{ik}$ type that, in general, do not admit the transformation to the form (1), that is, they do not satisfy the Riemann condition, but they are weaker conditions, which, only in the Riemann condition, they are independent of the choice of coordinates (that is, they are generally invariant). A simple formal consideration leads to weaker conditions that are closely related to the Riemann condition. These conditions are the same equations of the pure gravitational field (out of matter and in the absence of an electromagnetic field).

Therefore, Einstein altered the physical meaning of the equivalence principle, although this fact apparently went unnoticed by many.

In creating the general theory of relativity, Einstein was fully guided by the equivalence principle in his initial wording, which therefore played a heuristic role in constructing the theory (Einstein and Grossmann, 1914):

> The whole theory originated from the conviction that in a gravitational field all physical processes occur in the same way as in the absence of a gravitational field but in an appropriate accelerated (three-dimensional) coordinate system (equivalence hypothesis).

As in those days, thanks to Minkowski's discovery, it was known that different reference frames correspond to different metrics (generally outside the diagonal) of space-time, Einstein and Grossmann, 1913, concluded that the metric space-time tensor of Riemann must be taken as the field variable for the gravitational field and that this tensor is determined by the distribution and motion of matter. In this way the idea of a link between matter and the geometry of space-time arose.

Based on these assumptions, Einstein and Grossmann intuitively attempted to establish the form of the equations linking the components of Riemann's metric tensor of space-time with the impulse-energy tensor for matter. After numerous failed attempts, Einstein found such equations in late 1915. A little earlier, Hilbert, 1915, came up with the same equations (his reasoning was based on variational principles), we will call these equations the Hilbert-Einstein equations.

It should be noted that the Riemann space-time metric tensor cannot serve as a characteristic of the gravitational field because its asymptotic behavior depends on the choice of the three-dimensional (spatial) coordinate system" [10].

## 3. The inertial mass in "general relativity".

The Einstein-Grossmann-Hilbert equations violate the equivalence between inertial and gravitational masses, established experimentally, with great precision, in repeated experiments, and on which the Einstein equivalence principle is precisely based, because according to these equations the inertial mass is the effect of the choice of the three-dimensional coordinate system, on the Lorentzian variety, therefore, without physical meaning.

> "Einstein considered the equality of the inertial and gravitational mass of an object as an exact law of nature, a law that must be reflected in his theory. Today, it is assumed in "general relativity" that the gravitational mass of a system consisting of matter and gravitational field is equal to the inertial mass of the system. Such statements are contained in the works of Einstein, 1918, Tolman, 1934, and Weyl, 1923. Subsequently, the "test" of this statement with various alterations was made by other authors (see Landau and Lifshitz, 1975, Misner, Thorne, and Wheeler, 1973, and Metier, 1952). However, the statement is wrong. Following Denisov and Logunov, 1982, we will now demonstrate this.

Einstein, 1918, defined the gravitational mass M of an arbitrary physical system that is at rest with respect to a Galilean-Schwarzschild-coordinate system (at infinity), as the quantity that is the factor of the term - $2G / c^2r$ in the asymptotic expression (when $r \to \infty$) for the $g_{00}$ component of the Riemann space-time metric tensor:

$$g_{00} = 1 - 2G/c^2r\ M$$

Tolman, 1934, gave a somewhat different definition:

$$M = c^2/4\pi G \int R^0_0 \sqrt{-g}dV \quad (3.1)$$

These definitions directly imply that the gravitational mass is invariant under three-dimensional coordinate transformations, since both the Ricci $R_{00}$ tensor component and the $g_{00}$ metric tensor component are transformed as a scalar.

In the case of a spherically symmetric static source, these definitions are equivalent.

$$R^0_0 = g^{0i} \ |\partial/x^l\ \Gamma^l_{0i} - \partial/\partial x^0\ \Gamma^p_{pl} + \Gamma^n_{0i}\Gamma^p_{np} - \Gamma^n_{pl}\Gamma^p_{n0}|$$

Identity transformations produce

$$R^0_0 = 1/\sqrt{-g}\ \ \partial/x^\alpha\ (\sqrt{-g}\ g^{0n}\Gamma^\alpha_{0n}) - g^{0i}\ \ \partial/x^0\ \Gamma^n_{ni}$$

$$-½\ \Gamma^0_{ni}\ \ \partial g^{ni}/\partial x^0\ + 1/\sqrt{-g}\ \ \partial/x^0\ (\sqrt{-g}\ g^{0n}\Gamma^0_{0n}) \qquad (3.2)$$

Since for static systems the last three terms can be ignored on the right hand side of (3.2), (3.1) produces

$$M = c^2/4\pi G\ § \ dS_\alpha\sqrt{-g}\ g^{0n}\Gamma^\alpha_{0n} \quad (3.3)$$

Since far from the static system, its metric can be described, with a given precision, by the Schwarzschild metric, (3.3) assumes the form

$$M = -\ c^2/8\pi G\ \lim r\to\infty\ §\ dS_\alpha g^{00}\sqrt{-g}\ \partial/x^\alpha\ \ g_{00} \qquad (3.4)$$

The integrand in (3.1) is a scalar for all transformations of the three-dimensional coordinate system, which means that the gravitational mass M is independent of the choice of coordinates. In the Schwarzschild coordinates, (3.4) assumes the form

$$M = c^2/2G\ \lim r\to\infty\ (r^2\partial g_{00}/r) = c^2/2G\ \lim r\to\infty\ |r^2\ \partial/\partial r\ (1 - 2G/c^2r\ M)|$$

Therefore, the gravitational mass of any static system, according to Tolman's definition, is the factor - $2G/c^2r$ in the asymptotic expression for the $g_{00}$ component substance of the Riemann space-time metric tensor. Therefore, for static systems, the definitions of gravitational mass given by Einstein and Tolman coincide.

Einstein closely related the concept of the inertial mass of a physical system in "general relativity" with the idea of the energy of the system (Einstein, 1918):

> ... the quantity that we have interpreted as energy plays the role of inertial mass, according to the special theory of relativity.

Since Einstein suggested calculating the energy of a system within the framework of "general relativity" with the help of pseudo-impulse-energy tensors, the inertial mass is calculated on the basis of (2.11).

$$m_i = 1/c\ P^0 = 1/c^2 \int (-g)(T^{00} - t^{00})\ dV = 1/c^2\ \S\ h^{00a}\ dS_a \qquad (2.11)$$

Now we define according to (2.11) the inertial mass of a symmetric spherical gravitational field source and study how the inertial mass is transformed under coordinate transformations. In isotropic Cartesian coordinates, the Riemann space-time metric has the form

$$g_{00} = (1 - r_g / 4r)^2 / (1 + r_g / 4r)^2 \qquad g_{\alpha\beta} = \gamma_{\alpha\beta}\ (1 + r_g / 4r)^4 \qquad (3.5)$$

where $r_g$ - $2GM/c^2$. These coordinates are asymptotically Galilean, since the following estimates are true when $r \to \infty$:

$$g_{00} = 1 + O\ (1/r) \qquad g_{\alpha\beta} = \gamma_{\alpha\beta}\ |1 + O\ (1 /r)| \qquad (3.6)$$

If we use the covariant components of the metric (3.5), then (2.12)

$$h^{ikl} = c^4 g_{km}/16\pi G\ \partial/\partial x^m\ |-g(g^{ik}g^{ml} - g^{il}g^{mk})|$$

produces

$$h^{oo\alpha} = - c^4/16\pi g\ \ \partial/\partial x^\beta\ |g_{11}g_{22}g_{33}g^{\alpha\beta}|$$

Substituting this in (2.10),

$$P^i = 1/c\ \S\ h^{0ia}\ dS_a = \text{const} \qquad (2.10)$$

considering the fact that

$$dS_\alpha - x_\alpha /r\ r^2\ \text{sen}\theta\ d\theta\ d\varphi \qquad (3.7)$$

and integrating on an infinitely distant surface, we obtain

$$P^0 = c^3/16\pi G\ \text{limite}_{\ r \to \infty}\ r^2 \int x_\alpha/r\ |\partial/\partial x^\beta - g_{11}g_{22}g_{33}g^{\alpha\beta}|\ \text{sen}\theta\ d\theta\ d\varphi \qquad (3.8)$$

Therefore, the $P^0$ component is independent of the $g_{00}$ component of the Riemann space-time metric tensor. Combining (3.5), (3.8) and

$$\partial/\partial x^\beta\ f(r) = x^\beta\ /r\ \ \partial/r\ f(r) \qquad (3.9)$$

where $r^2 = - x_\alpha x^\alpha$, we arrive at the following expression for the impulse-energy component $P^0$:

$$P^0 = c^3 rg / 2G = Mc \qquad (3.10)$$

the fact is that inertial mass "coincides with the gravitational mass that gave grounds for claiming that they are also equal in "general relativity" Landau and Lifshitz, 1975 (p. 334), wrote:

.... $p^\alpha = 0$, $P^0 = Mc$, a result that was naturally to be expected. It is an expression of the equality of "gravitational" and "inertial" mass ("gravitational" mass is the mass that determines the gravitational field produced by the body, the same mass that appears in the metric tensor in a gravitational field, or in particular, in Newton's law, the "inertial" mass is the mass that determines the energy and impulse relation of the body, in particular, the rest energy of the body is equal to this mass multiplied by $c^2$).

However, this statement and similar statements made by Einstein, 1918, and other authors (see Eddington, 1923, Misner, Thorne, and Wheeler, 1973, Mailer, 1952, and Tolman, 1934) are erroneous. As can be easily demonstrated, the "energy" of a system and, therefore, the "inertial mass" of the same system, (2.11), do not have a physical meaning because their magnitude depends on the choice of the three-dimensional coordinate system. In fact, a basic requirement that any definition of inertial mass must satisfy is the independence of this quantity from the choice of the three-dimensional coordinate system; this is valid for any physical theory. But in "general relativity" the definition (2.11) of "inertial mass" does not meet this requirement.

We will demonstrate, for example, that in the case of a Schwarzschild solution, the "inertial mass" (2.11) assumes an arbitrary value depending on the choice of the three-dimensional coordinate system. To this end, we transfer from the three-dimensional Cartesian coordinates $x^\alpha c$ other $x^\alpha_N$ coordinates linked to the previous coordinates using the following formula:

$$x^\alpha c = x^\alpha_N \,|1 + f(r_N)\,| \qquad (3.11)$$

where $r_N = (x^2_N + y^2_N + Z^2_N)^{1/2}$, $f(r_N)$ is an arbitrary non-singular function that obeys the conditions

$$f(r_N) \geq 0,\ \lim_{rN\to\infty} f(r_N) = 0,\ \lim_{rN\to\infty} r_N\ \partial/\partial r_N\, f(r_N) = 0 \qquad (3.12)$$

It is easy to see that the transformation (3.11) corresponds to a change in the arithmetic of the points of the three-dimensional space along the radius, $r_c = r_N\, l1 + f(r_N) l$. For the transformation (3.11) to have an inverse and be one by one, it is necessary and sufficient that

$$\partial r_c/\partial r_N = 1 + f + r_N f' > 0.$$

Where

$$f' = \partial/\partial r_N\, f(r_N)$$

Then the Jacobian of this transformation will also be non-zero:

$$J = \det l\partial x_c/\partial x_N l = (1 + f)^2\, \partial r_c/\partial r_N \neq 0$$

specifically the function

$$f(r_N) = \alpha^2 (8GM/c^2 r_N)^{1/2}\, l\, 1 - \exp(-\varepsilon r_N)\, l \qquad (3.13)$$

with arbitrary numbers $\alpha$ and $\varepsilon$ not equal to zero, satisfy each of the above requirements. If we allow (3.13), we get

$$\partial r_c/\partial r_N = 1 + \alpha^2 (8GM/c^2 r_N)^{1/2} \mid ½ + (\varepsilon^2 r_N - ½) \exp(-\varepsilon^2 r_N) \mid > 0$$

showing that $r_c$ is a monotonous function of $r_N$. It is easy to verify that $f(r_N)$ is a non-negative non-singular function in all space. The Jacobian of the transformation in this case is strictly greater than unity:

$$J = (1 + f)^2 \, \partial r_c/\partial r_N > 1$$

Therefore, the transformation (3.11) with the function $f(r_N)$ defined through (3.13) has an inverse transformation and is one to one.

Obviously, the transformation (3.11) does not change the value of the gravitational mass (3.1). Now we will calculate the value of the "inertial mass" (2.11) in terms of the new $x_\alpha^N$ coordinates. Applying the tensor transformation law to the metric tensor, $f(r_N)$

$$g^N_{ni} = \partial x^l_c/\partial x^n_N \;\; \partial x^m_c/\partial x^i_N \, g^c_{ml} \mid x_c(x_N) \mid \qquad (3.14)$$

we can find the components of the Schwarzschild metric (3.5) in terms of new coordinates. The result is

$$g_{00} = \mid 1 - r_g/4r_N(1+f) \mid^2 \mid 1 + r_g/4r_N(1+f) \mid^{-2} \qquad (3.15)$$

$$g_{\alpha\beta} = \mid 1 + r_g/4r_N(1+f) \mid^4 \{ \gamma_{\alpha\beta} (1 + f)^2 - x^N_\alpha x^N_\beta \mid (f')^2 + 2/r_N f' (1 + f) \mid \}$$

The determinant of the metric tensor (3.15) is

$$g = g_{00} \mid 1 + r_g/4r_N(1+f) \;{}^{12} \; (1 + f)^4 \mid (1 + f)^2 + r^2_N (f')^2 + 2r_N f'(1 + f) \mid \qquad (3.16)$$

It should be especially noted that the metric (3.15) is asymptotically Galilean:

$$\lim_{rN \to \infty} g_{00} = 1 \; \lim_{rN \to \infty} g_{\alpha\beta} = \gamma_{\alpha\beta}$$

In the particular case where the function f is specified by (3.13) and $r_N$ is sent to infinity, the Riemann space-time metric has the following asymptotic behavior:

$$g_{00} \approx 1 + 0\,(1/r_N), \; g_{\alpha\beta} = \gamma_{\alpha\beta} (1 + 0\,(1 / r_N^{1/2}) \qquad (3.17)$$

For the covariant components of the metric (3.15) we have

$$g_{00} = g_{00}^{-i}, \; g_{\alpha\beta} = \gamma_{\alpha\beta} A + x_N^\alpha x_N^\beta B \qquad (3.18)$$

where we have entered the notation:

$$A = (1 + f)^{-2} \mid 1 + r_g / ar_N (1 + f) \mid^{-4}$$

$$B = r_N (f')^2 + 2f' (1 + f) / \{ r_N \mid 1 + r_g / ar_N (1 + f) \mid^{-4} (1 + f)^2 \mid (1 + f)^2 + r^2_N (f')^2 + 2r_N f'(1 + f) \mid \}$$

Substituting (3.16) and (3.18), we obtain:

$$P^0 = c^3/16\pi G \lim r^2_N\, N\to\infty\, J\, x^N{}_\alpha/r_N\ \ \partial/\partial x^\beta{}_N \{ \gamma_{\alpha\beta}(1+f)^2\ \ l\, 1 + r_g/4r_N(1+f)l^8$$

$$X\ \ l\,(1+f^2) + r^2_N\,(f')^2 + 2r_N f'\,(1+f)\, l$$

$$+\ \ x^N{}_\alpha\, x^\beta{}_N / r^2_N\ \ (1+f)^2\ \ l1 + r_g/4r_N(1+f)l^8$$

$$X\ \ lr^2_N\,(f')2 + 2\, r_N\, f'\,(1+f)\, l\}\, dV$$

In view of the validity of (3.9) this produces

$$P^0 = c^3/2G \lim r_{N\to}\infty\, J\, r^3{}_N\,(f')^2\,(1+f)^2\ \ l\, 1 + r_g/4r_N(1+f)l^8$$

$$+\, r_g\,(1+f)^2\ \ (1+f+r_N f')\, l\, 1 + r_g/4r_N(1+f)l^7 \} \qquad (3.19)$$

Taking into account the asymptotic expression (3.12) for f, we finally obtain (see Moller, 1965):

$$P_0 = c^3 / 2G \lim_{rN\to\infty}\ \{ r_g\ + r^3 N\,(f'^2) \} \qquad (3.20)$$

Therefore, the "inertial mass" depends essentially on the speed at which $f'$ tends to zero as $r_N \to \infty$. Specifically, if we take the function $f(r_N)$ in the form (3.13), from (3.20) we obtain

$$m_1 = M\,(1 + \alpha^4) \qquad (3.21)$$

Therefore, for the "inertial mass" (2.11) of a system consisting of matter and gravitational field, we can obtain in "general relativity" any fixed number $m_1 \geq M$ depending on the choice of the spatial coordinate system due to arbitrariness of $\alpha$, while the gravitational mass M (3.1) of this system and, consequently, the three effects of "general relativity" remain unchanged. Also note that in the case of more complex transformations of the spatial coordinates that leave the Galilean asymptotically metric, the "inertial mass" (2.11) of the system can assume any fixed value, both positive and negative.

Therefore, we see that in "general relativity" the value of "inertial mass", a concept introduced by Einstein and later used by many authors (for example, see Eddington, 1923, Landau and Lifshltz, 1975, Misner, Thorne and Wheeler, 1973, Mailer, 1952, and Tolman, 1934), depends on the choice of the three-dimensional coordinate system, and therefore has no physical meaning. Therefore, the claim that "inertial mass" is equal to the gravitational mass in Einstein's theory also has no physical meaning.

Equality occurs in a narrow class of three-dimensional coordinate systems, and since "inertial mass" (2.11) and gravitational mass (3.1) obey different transformation laws, a transition to other three-dimensional coordinate systems results in a violation of this equality.

More than that, such a definition of "inertial mass" in "general relativity" does not obey the correspondence principle with Newton's theory. In fact, since the "inertial mass" $m_1$ in Einstein's theory depends on the choice of the three-dimensional coordinate system, its expression in the general case of an arbitrary three-dimensional coordinate system does not become the appropriate expression in the theory of Newton, in which the "inertial mass" does not depend on such a choice. Therefore, "general relativity" contains no classical Newtonian boundary and therefore does not satisfy the correspondence principle. This implies that "general relativity" is not only logically contradictory from the point of view of physics but also directly contradicts the experimental data on the equality of inertial mass and active gravitational mass.

So why weren't the above mentioned conclusions and the necessary conclusions reached? Apparently, the answer is that Einstein focused on the impulse-energy problem in "general relativity" and after studying it assumed that he had managed to find a solution that was definitive to the same extent as in classical mechanics. Somewhat later, Klein, 1918, mathematically confirmed Einstein's ideas. Einstein's conclusions about the impulse-energy of a system are repeated almost without variation to this day (for example, see Landau and Lifshitz, 1975). The studies of these outstanding scientists created the belief that in "general relativity" the impulse-energy problem had been solved. All this, of course, made it difficult to carry out a detailed analysis and reach basic conclusions. But our findings are completely at odds with those of Einstein and Klein. Why? Because Einstein and Klein's work contains an error. The two did not notice that the amount $J_\sigma$ they operated with is simply an identical zero. This simple error is very important, because it completely destroys Einstein's conclusions.

Let's take a closer look at this question. To this end, we present Einstein's reasoning and analyze its essence. Einstein, 1918, wrote:

> ... I want to show here that with the help of the equation. (1) The concepts of energy and momentum can be established as clearly as in classical mechanics. The energy and momentum of the closed system are completely defined independently of the choice of a coordinate system, provided that the motion of the system (as a whole) with respect to the coordinate system is fixed: for example, "energy at rest" of any closed system does not depend on the choice of the coordinate system.
>
> ... Let's select a coordinate system so that all linear elements (0, 0, 0, $dx_4$) have a time shape and all linear elements ($dx_1$, $dx_2$, $dx_3$, 0) are spatial; then the fourth coordinate can be called in some sense "time".
>
> In order for us to talk about the energy and momentum of a system, the energy and impulse densities must disappear outside a defined region B. This will only happen if outside of B the $g_{uv}$ components are constant, that is, when the system in question it is, so to speak, immersed in a "Galilean space", and we use "Galilean coordinates" to describe the surroundings of the system. Region B has infinite dimensions in the direction of the time axis, that is, it intersects any hyperplane $x_4$ = constant. The section of B by a hyperplane $x_4$ = constant is bounded on all sides. Within B there can be no "Galilean coordinate system"; the choice of coordinates within B is limited by a natural condition, namely that the coordinates must continually pass to the coordinates outside

of B. Let us now consider some such coordinate systems, that is, systems that coincide outside B.

The integral laws of conservation of energy and momentum can be obtained from the equation. (1) by integration with respect to $x_1$, $x_2$, $x_3$, over region B. Since at the limits of this region all $U^v_\sigma$ vanishes, we have

$$(3) \quad d/dx_4 \mid \int U^4_\sigma dx_1 dx_2 dx_3 \mid = 0$$

These four equations express, I believe, the laws of conservation of momentum ($\sigma$ = 1, 2, 3) and energy ($\sigma$ = 4). Let us denote the integral in the equation. (3) by $J_\sigma$. Now, I indicate that $J_\sigma$ does not depend on the choice of coordinates for any coordinate system that outside B coincides with one and the same Galilean system.

He also noted:

Therefore, despite the free choice of coordinates within B, the resting energy or mass of the system constitutes a precisely defined quantity that does not depend on the choice of the coordinate system. This is even more remarkable because thanks to the non-tensor nature of $U^v_\sigma$ an invariable interpretation of the components of the energy density cannot be given.

This Einstein reasoning contains a simple but fundamental error. To verify this, we write the Hilbert-Einstein equation in the form

$$U^v_\tau = T^v_\tau + t^v_\tau = \partial_u \sigma^u{}_\tau{}^v \qquad (3.22)$$

where $\sigma^u{}_\tau{}^v = - \sigma^v{}_\tau{}^u$ is the density of an antisymmetric pseudotensor. Substituting Eq. (3.22) in the expression for the 4-impulse of an isolated system, we obtain

$$J_\tau = \int dV\, U^4_\tau = \int dV \partial_u \sigma^u{}_\tau{}^4 = \int dS_k\, \sigma^k{}_\tau{}^4 \qquad (3.23)$$

Formula (1) in Einstein's article corresponds to the equation. (2.5) here.

$$\partial/\partial x^k \mid -g(T^{ik} - \tau^{ik}) \mid = 0 \qquad (2.5)$$

Since the integration surface S lies outside B, that is, in a region where all the components of the tensor $g_{uv}$ are constant, $\sigma^u{}_\tau{}^4$ disappears everywhere in S. This follows directly from expression (2.14) for $\sigma^u{}_\tau{}^4$. Therefore (3.23) implies that $J_\tau = 0$. This is what neither Einstein nor Klein (or others) noticed.

They also did not understand Hilbert's, 1917, correct and profound idea (see Introduction) that in "general relativity" there are simply no ordinary conservation laws for energy and momentum. Everything that followed was completed with the dogmatism and faith that for more than half a century canonized general relativity, elevating it to an indisputable truth.

$$\sigma^{ni}{}_k = c^4 g_{km}/6\pi G\sqrt{-g}\; \partial/\partial x^l \mid -g(g^{mi}g^{nl} - g^{mn}g^{il} \mid \qquad (2.14)$$

Lately Faddeev, 1982, has declared that in "general relativity" the Hamiltonian formalism allows solving the problem of the impulse-energy of the gravitational field. But Denisov and Logunov, 1982, and Denisov and Solov'ev, 1983, have shown that this statement is wrong and indicates that the author does not understand the essence of the problem.

It is sometimes said that within the framework of "general relativity" the tensor of the impulse-energy gravitational field can be constructed by replacing the ordinary derivatives in the expression for the pseudotensor with covariant derivatives with respect to "the Minkowski metric". These statements, however, are wrong. In "general relativity", in contrast to RTG, where Minkowski's space-time occupies the center of the stage, there can be no global Cartesian coordinates and, therefore, in principle we cannot say what shape the Minkowski $y^{ik}$ metric has in "General relativity" for a given solution to the Hilbert-Einstein equations. Two solutions of the Hilbert-Einstein equations, say, (3.5) and (3.15), where one is obtained from the other by transforming only the spatial coordinates, have the same state and may, at our option, refer to one and the same $y^{ik}$ metric. But this directly suggests that for each of these solutions we will have different values of the energy of the system. This means that the energy of a system depends on the selection of the spatial coordinates, which makes no physical sense. Such erroneous statements can still be found in the literature (for example, see Ponomarev, 1985)" [10].

## 4. Gravity devoid of physical reality.

The most universal phenomenon in nature, since it affects everything that exists in the Universe, lacks physical reality because it is a simple metric field in the GTR.

### 4.1 The gravitational field described by the metric tensor lacks the impulse-energy tensor

In the absence of the impulse-energy tensor of the gravitational field, the fundamental physical laws of the conservation of momentum-energy and angular momentum are violated.

"Einstein's Theory of General Relativity (GTR), whose basic equations were constructed by Hilbert and Einstein in 1915, opened a new stage in the investigation of gravitational phenomena. But although quite successful, this theory from the first impulse of its existence encountered major difficulties in determining the physical characteristics of the gravitational field and, consequently, in formulating impulse-energy conservation laws.

Einstein clearly understood the fundamental importance of the conservation laws of impulse-energy, in addition, he considered that a total tensor of matter and gravitational field as a whole should be the source of the gravitational field. Therefore, in 1913, he wrote that

"The gravitational field tensor $t_{uv}$ is a source of the field together with the tensor of material systems $T_{uv}$. An exclusive position of gravitational field energy compared to other forms of energy must lead to unacceptable consequences."

In the same work, Einstein concluded that

> "in a general case, the gravitational field is characterized by ten spatio-temporal functions",

components of the metric tensor of the riemannian space $g_{uv}$. However, clinging to building the theory, Einstein failed to make the matter tensor and gravitational field the source of the field, since instead of the gravitational field tensor in the GTR a pseudo-tensor emerged in Riemannian space.

In 1918 Schrodinger demonstrated that, under proper choice of the coordinate system, all components of the gravitational field impulse-energy pseudotensor outside the spherically symmetric source can be converted to zero. In this regard, Einstein wrote:

> "As for Schrodinger's considerations, they are very compelling because of their analogy with electrodynamics where the voltages and the energy density of any field are different from zero. However, I cannot find the reason why we should have the same state of affairs for gravitational fields. Gravitational fields can occur without introducing stress and energy density. "

As we see, Einstein abandoned the concept of the classical Faraday-Maxwell type field, which had an impulse-energy density in relation to the gravitational field, although he took an important step in relating the gravitational field to a tensor quantity. Einstein took a metric tensor of the Riemann $g_{uv}$ space as such a quantity. This tendency of thought seemed quite natural to Einstein, since his point of view on the gravitational field was formed under the influence of the equivalence principle for inertia and gravitation forces, introduced by himself:

> "... for an infinitesimal domain you can always choose the coordinates in such a way that the gravitational field would be absent from it."

He emphasized this idea several times, for example, in 1923, he wrote:

> "For any infinitesimal neighborhood of a point in an arbitrary gravitational field, we can always point to a local coordinate system in such a state of motion, that there would be no gravitational field in this local system (local inertial system)."

In this way a notion arose that the gravitational field could not be located. The presence of the impulse-energy pseudotensor is, in Einstein's opinion, in complete correspondence with the equivalence principle.

However, Einstein's earlier statement is not, in fact, true in GTR, since the Riemannian space curvature tensor must be considered here as a physical characteristic of the field.

Therefore, according to GTR, matter (all substance except gravitational fields) is characterized by the impulse-energy tensor, and the gravitational field is characterized by Riemann's curvature tensor. In this case, if the first has the second rank, the second has the fourth rank, that is, in fact, a main difference appears between the characteristics of matter and the gravitational field in the GTR.

The introduction of the pseudo impulse-energy tensor of the gravitational field did not help Einstein preserve the impulse-energy conservation laws in his theory. This fact was clearly understood by Hilbert. In connection with this, he wrote in 1917:

> "I affirm that for the theory of general relativity, that is, in the case of the general invariance of the Hamiltonian function, there are no energy equations, which ... correspond to the energy equations in the orthogonal-invariant theories, also I could underline this circumstance as a characteristic feature of GTR ".

By virtue of the absence of a group of ten motion space-time parameters in GTR, one cannot in principle introduce into it the conservation laws of momentum-energy and angular momentum like those that occur in any other physical theory. These laws are fundamental in nature, since they simply introduce the universal physical characteristics for all forms of matter that allow us to consider quantitatively the transformation of one form of matter into others." [11].

**4.2 Impulse-energy conservation in GTR**

In the GTR, the impulse-energy of the total system made up of the gravitational field and the material fields existing in nature is not conserved.

> "In all the physical theories describing the various forms of matter, one of the most important field characteristics is the impulse-energy tensor density, which is generally obtained by varying the density of the Lagrangian $L_g$ field over the $g_{mn}$ components of the metric tensor of space-time.
>
> This characteristic reflects the existence of the field: a physical field exists in a certain region of space-time if and only if the density of the impulse-energy tensor is not zero in the region. The impulse-energy of any physical field contributes to the total impulse-energy tensor of the system and does not completely fade away from the source of the field. This allows considering the transport of energy in the form of waves in the direction of Faraday and Maxwell, that is, we can study the distribution of the force of the field in space, determine the energy flows through the surfaces, calculate the change in impulse-energy in emission and absorption processes, and perform other energy calculations.
>
> In GTR, however, the gravitational field does not possess the properties inherent in other physical fields since it lacks such a characteristic. In fact, in Einstein's theory, the Lagrangian density consists of two parts: the Lagrangian gravitational field density $L_g = \sqrt{-g}\, R$. which depends only on the metric tensor $g_{mn}$, and the material Lagrangian density $L_m = L_m\ (g_{mn}, \Phi_A\ )$, which depends on the $g_{mn}$ metric tensor and the other material fields $\Phi_A$. Therefore, in Einstein's general theory of relativity, the $g_{mn}$ has a double meaning: they are field variables and at the same time components of the metric tensor of space-time.

As a result of this physical-geometric dualism, the density of the total symmetric impulse-energy tensor (the variation of the Lagrangian density on the components of the metric tensor) proves to coincide with the field variables (the variation of the Lagrangian density on the components of the gravitational field). The result is that the density of the system's total symmetric impulse-energy tensor (field plus matter) is exactly zero:

$$T^{ni} + T^{ni}_{g} = 0 \qquad (4.0)$$

where $T^{ni} = - 2\partial L_M/\partial g_{ni}$ is the density of the symmetric impulse-energy tensor of the matter (here by matter we mean all the material fields except the gravitational), and

$$T^{ni}_{g} = - 2\partial L_g/\partial g_{ni} = -c^4 \sqrt{-g} / 8\pi \{R^{ni} - ½ g^{ni} R\}$$

Equation (4.0) also implies that all the components of the density of the symmetric impulse-energy tensor of the gravitational field $T^{ni}_{g}$, vanish everywhere outside of matter.

Therefore, these results alone imply that the gravitational field in Einstein's general theory of relativity does not possess the properties inherent in other physical fields, since outside its source the gravitational field lacks the main physical characteristic, the impulse-energy tensor.

A physical characteristic of a gravitational field in Einstein's theory is the Riemann $R^{i}_{klm}$ curvature tensor. That we have a clear understanding of this we owe to Synge, 1960:

> If we accept the idea that space-time is a Riemannian four-space (and if we are relativists we must do so), then surely our first task is to feel it as the first navigators had to feel a spherical ocean. And the first thing we have to feel is the Riemann tensor, since it is the gravitational field, if it disappears, and only then, there is no field. However, strange as it may seem, this most important element has been put in the background.

And also points out:

> In Einstein's theory, either there is a gravitational field or there is none, according to the Riemann tensor it does not disappear or it disappears. This is an absolute property; it has nothing to do with any observer's world line.

The absence of such understanding leads to misunderstanding of the essence of Einstein's theory.

Therefore, since the gravitational field is characterized only by the curvature tensor, we cannot introduce into GTR a simpler physical characteristic of this field, let's say, the impulse-energy pseudotensor with the result that in Einstein's theory Pseudo-impulse-energy tensors are not, in principle, related to the existence of a gravitational field. This statement has the state of a theorem, whose corollary is the possibility of such situations in GTR when the curvature tensor is not zero, that is, there is a field and, nevertheless, the pseudo impulse-energy tensor disappears, and vice versa, the curvature tensor disappears but the pseudo impulse-energy tensor is not zero. Therefore, calculations involving an impulse-energy pseudo tensor are meaningless.

Einstein's general theory of relativity links matter and the gravitational field into a single entity; while the first is characterized, as in other theories, by a momentum-energy tensor, that is, a second rank tensor, the second is characterized by the curvature tensor, which is a fourth rank tensor. Due to the different dimensions of the physical characteristics of the gravitational field and matter in Einstein's theory, it follows directly that there cannot be (in GTR) any conservation law linking matter and gravitational field. This fundamental fact, established in Denisov and Logunov, 1980, and Hilbert, 1917, means that Einstein's theory was built at the expense of repudiating the laws of conservation of matter and the gravitational field taken together.

Another physical characteristic of a gravitational field in GTR, the Ricci tensor, reflects more the capacity of a gravitational field to change the impulse-energy of matter, that is, it reflects the action that a gravitational field has on matter, but does not provide information about the fluid energy carried by a wave. As a result, there is no possibility in Einstein's theory to study the distribution of the force of a gravitational field in space, to determine the energy flows carried by gravitational waves through a surface, etc. That scientists operating within the GTR framework can, by employing the idea of pseudo-tensors, find conserved quantities for matter and the gravitational field as a whole is a profound delusion.

In fact, in GTR the initial relationship to obtain conservation laws is identity

$$\partial_n (T^i_n + t^i_n) = 0. \qquad (4.1)$$

If matter is concentrated only in a volume V, the equation. (4.1) implies that

$$d/dx^0 = \int(T^0_i + t^0_i)\, dV = -\S t^a_i\, dS_a \qquad (4.2)$$

There is now a complete series of exact vacuum solutions of the Hilbert-Einstein equations for which the stresses $t^a_0$ are nil everywhere (see Brdicka, 1951, Rudakova, 1971, Shirokov, 1970, and Shirokov and Budko, 1967). Consequently, for exact wave solutions to the Hilbert-Einstein equations that nullify the components of the pseudo-impulse-energy tensor, the equation. (4.2) produces

$$d/dx^0 \int(T^0_0 + t^0_0)\, dV = 0$$

that is, the energy of matter and the gravitational field within V is conserved. This means that there is no flow of energy from V outward, and therefore there can be no action on the test bodies located outside V. This conclusion follows from Einstein's theory.

However, the exact wave solutions to the Hilbert-Einstein equations that nullify the components of the pseudo impulse-energy tensor result in a non-zero curvature tensor $R^i_{klm}$, therefore, in view of the equation

$$\partial^2 n^i/\partial s^2 + R^i_{klm} u^k u^l n^m = 0 \quad (4.3)$$

where $n_i$ is an infinitesimal geodetic deviation vector, and $u_i = dx_i /ds$ is the velocity 4-vector, the waves of curvature act on the test bodies outside V and change the energy of these bodies. Thus, starting from two different but exact relationships from Einstein's general theory of relativity, we reach mutually exclusive physical conclusions.

To understand the reason for these contradictory conclusions, let's take a closer look at the formalism of pseudo-impulse-energy tensors in Einstein's theory.

Since $t^{ni}$ is a pseudo tensor, by selecting an appropriate coordinate system we can override all the components of $t^{ni}$ at each point in space. This fact only raises doubts about the interpretation of $t^{ni}$ as tensions and impulse-energy density of the gravitational field.

In general, it is said in this regard (see Mailer, 1952) that the energy of the gravitational field in GTR cannot in principle be localized, that is, that a local distribution of the energy of a gravitational field has no physical meaning since that it depends on the choice of the coordinate system and that only the total energy of the closed systems can be well defined. But such a statement does not resist criticism either.

In fact, a local distribution of the "energy" of the gravitational field defined through any impulse-energy pseudotensor depends on the choice of the coordinate system and can be canceled at any point in space, which is generally interpreted as the absence of a gravitational field "energy density" at this point. But a gravitational field described by the curvature tensor cannot be overridden by passing to any admissible coordinate system. Therefore, due to the fact that the curvature waves act on physical processes, we cannot affirm that in a certain coordinate system the gravitational field is null.

This is most clearly seen if we take the example of the exact wave solutions for which the components of the impulse-energy pseudo tensor disappear everywhere, whereas the curvature waves do not. And vice versa, in the case of flat space-time, when the Riemann space-time $g_{ni}$ metric tensor is equal to the $y_{ni}$ metric tensor of the pseudo-Euclidean spacetime, the components of the pseudo-tensors may not disappear although there is no gravitational field and all the components of the curvature tensor are zero in any coordinate system.

For example, in the spherical coordinate system in pseudo Euclidean space-time where

$$R^i_{klm} = 0,\ g_{00} = 1,\ g_{tt} = -1,\ g_{\theta\theta} = -r^2,\ g_{\varphi\varphi} = -r^2 \text{ seno}^2\theta$$

We have the following formula for the component of Einstein's pseudo tensor (see Bauer, 1918):

$$t^0_0 = -1/8\pi \text{ seno } \theta$$

It is clear that $t^0_0 < 0$ and that the total gravitational field "energy" in this coordinate system is infinite.

The Landau-Lifshitz pseudotensor in this case demonstrates a different distribution of "energy" in space:

$$(-g)\, t^0_0 = -r^2/8\pi\,(1 + 4\,\text{seno}^2\theta).$$

The examples just discussed show that the pseudo-impulse-energy tensors in Einstein's theory do not serve as physical characteristics of the gravitational field and therefore have no physical meaning" [10].

**4.3 The pseudo impulse-energy tensors of the gravitational field in the GTR**

In exchange for the impulse-energy tensor $t_{uv}$ for the gravitational field of Entwurf theory, in the GTR, Einstein introduced his pseudo-tensor, which can be obtained from the Landau-Lifshitz pseudo-tensor, and that it has given rise to other alternative pseudo tensors such as those of Lorentz and others.

> "Einstein believed that in GTR the gravitational field along with matter must obey a conservation law of some kind (Einstein, 1914):
>
> > ... it goes without saying that we must demand that matter and the gravitational field taken together satisfy the laws of conservation of energy and momentum.
>
> In his opinion, this problem had been completely solved on the basis of "conservation laws" that used the impulse-energy pseudotensor as the impulse-energy characteristic of the gravitational field. The common line of reasoning leading to such "conservation laws" is as follows (Landau and Lifshitz, 1975). If the Hilbert-Einstein equations are written as
>
> $$(-c^4 / 8\pi G)\, g\, \{R^{ik} - \tfrac{1}{2} g^{ik} R\} = -gT^{ik} \qquad (2.1)$$
>
> where $g = \det g^{ik}$, $R^{ik}$ is the Ricci tensor and $T^{ik}$ the impulse-energy tensor for matter, then the left side can be represented as the sum of two non-covariant quantities:
>
> $$(-c^4 / 8\pi G)\, g\, \{R^{ik} - \tfrac{1}{2} g^{ik} R\} = \partial/\partial x^l\; h^{ikl} + gt^{ik} \qquad (2.2)$$
>
> where $t^{ik} = t^{ki}$ is the gravitational field energy-impulse pseudotensor, and $h^{ikl} = h^{ilk}$ is the spin pseudotensor. This transforms the Hilbert-Einstein equations (2.1) into an equivalent form
>
> $$-g(T^{ik} - t^{ik}) = \partial/\partial x^l\; h^{ikl} \qquad (2.3)$$
>
> In view of the obvious fact that
>
> $$\partial^2/\partial x^k \partial x^l\; h^{ikl} = 0 \qquad (2.4)$$
>
> The Hilbert-Einstein equations (2.3) produce the following differential conservation law:

$$\partial/\partial x^k \, |{-g}(T^{ik} - \tau^{ik})| = 0 \qquad (2.5)$$

Which is formally similar to the conservation law for momentum-energy in electrodynamics. According to GTR, this law is valid for any choice of $x^k$ coordinates, for one thing, spherical coordinates (t, r, θ, φ). But in the latter case (2.5) it will always lead to physically meaningless results. Hence, the equations. (2.1) in arbitrary coordinates always lead to (2.5), which has no physical meaning.

According to this analogy, the "flux" of gravitational energy through the elemental surface area $dS_a$ is defined in GTR as:

$$dI = c\,(-g)\, t^{0a}\, dS_a$$

Taking a sphere of radius r as the integration surface ($dS_a = - r^2 n_a d\Omega$), we arrive at the formula for the "intensity" of gravitational energy per unit of solid angle:

$$dI/d\Omega = -cr2\,(-g)\, t^{0a} n_a \qquad (2.6)$$

Formula (2.5) is also used in GTR to derive "integral conservation laws for the momentum-energy" of matter and the gravitational field taken together. Here generally (see Einstein, 1918b, and Landau and Lifshitz, 1975) (2.5) it is integrated over a defined volume and then it is assumed that the matter flows through the surface that limits the integration volume is zero. The result is

$$d/dt \int (-g)(T^{0i} - t^{0i})\, dV = -\S\, (-g) t^{ai} dS_a \qquad (2.7)$$

Einstein, 1918b, assumed that the right side of (2.7) at i = 0 is "surely the loss of energy by the material system" and, therefore,

$$-dE/dt = -\S\, (-g) t^{ai} dS_a \qquad (2.8)$$

In the absence of gravitational field "energy momentum flows" through the surface that limits the integration volume, Eq. (2.7) produces the following conservation law of "momentum-energy" in the system:

$$P^i = 1/c \int (-g)(T^{0i} - t^{0i})\, dV = \text{const} \qquad (2.9)$$

Using the Hilbert-Einstein equations (2.3), the law (2.9) can be rewritten as follows:

$$P^i = 1/c\, \S\, h^{0ia}\, dS_a = \text{const} \qquad (2.10)$$

Einstein, 1918, believed that the four quantities $P^i$ constitute the energy (i = 0) and momentum (f = 1, 2, 3) of a physical system. It is generally stated in this regard (see Landau and Lifshitz, 1975) that

> The quantities $P^i$ (the four field moments plus matter) have a fully defined meaning and are independent of the choice of the reference system for only insofar as necessary on the basis of physical considerations.

However, this statement is erroneous as it was demonstrated in numeral 3.

Based on such a definition of the "energy moment" of a system consisting of matter and gravitational field, the following concept of inertial mass $m_i$ of the system is introduced in GTR:

$$m_i = 1/c\, P^0 = 1/c^2 \int (-g)(T^{00} - t^{00})\, dV = 1/c^2 \S\, h^{00a}\, dS_a \qquad (2.11)$$

Expressions similar to (2.5) - (2.11) can also be obtained if the Hilbert-Einstein equations are written in terms of mixed components:

$$\sqrt{-g}\,(T^n_i - t^n_i) = \partial_m \sigma^{mn}{}_i$$

The choice of gravitational field energy-impulse pseudo-tensors largely depended on the preference of different authors and, as a general rule, was made on the basis of secondary properties. For example, if we take the form

$$h^{ikl} = (c^4/16\,\pi G)\,(\partial/\partial x^m)\,|-g(g^{ih}g^{ml} - g^{il}g^{mk})| \qquad (2.12)$$

the Landau-Lifshitz pseudo symmetric tensor is obtained, which contains only the first derivatives of the metric tensor

$$\begin{aligned}\tau^{ik} = c^4/16\pi G\, \{&(2\Gamma^n{}_{ml}\Gamma^p{}_{np} - \Gamma^n{}_{ml}\Gamma^p{}_{mn} - \Gamma^n{}_{nl}\Gamma^p{}_{mp})\,(g^{il}g^{mk} - g^{ik}g^{ml}) \\ &+ g^{il}g^{mn}(\Gamma^k{}_{lp}\Gamma^p{}_{mn} - \Gamma^k{}_{mn}\Gamma^p{}_{lp} - \Gamma^k{}_{np}\Gamma^p{}_{ml} - \Gamma^k{}_{ml}\Gamma^p{}_{np}) \\ &+ g^{kl}g^{mn}(\Gamma^i{}_{pl}\Gamma^p{}_{mn} - \Gamma^i{}_{mn}\Gamma^p{}_{lp} - \Gamma^k{}_{np}\Gamma^p{}_{ml} - \Gamma^i{}_{ml}\Gamma^p{}_{np}) \\ &+ g^{ml}g^{np}(\Gamma^i{}_{nl}\Gamma^k{}_{mp} - \Gamma^i{}_{ml}\Gamma^k{}_{np})\} \qquad (2.13)\end{aligned}$$

If it is assumed that

$$\sigma^{ni}{}_k = c^4 g_{km}/6\pi G\sqrt{-g}\; \partial/\partial x^l\; |-g(g^{mi}g^{nl} - g^{mn}g^{il}| \qquad (2.14)$$

Einstein's pseudo tensor is obtained

$$\begin{aligned}\tau^i{}_k = c^4\sqrt{-g}\,/16\pi G\;\; \{&-2\Gamma^i{}_{ml}\,\Gamma^l{}_{kp}\, g^{mp} + \Gamma^l{}_{ml}\Gamma^m{}_{kp}g^{ip} + \Gamma^l{}_{ml}\Gamma^i{}_{kp}g^{mp} + \Gamma^l{}_{kl}\Gamma^i{}_{mp}g^{mp} \\ &- \Gamma^l{}_{kl}\Gamma^p{}_{mp}g^{mi} - \sigma^i{}_k\, |g^{mp}\Gamma^l{}_{mp}\Gamma^n{}_{nl} - g^{nl}\Gamma^p{}_{ml}\Gamma^m{}_{pn}|\} \qquad (2.15)\end{aligned}$$

which coincides with the canonical impulse-energy pseudo tensor obtained from the non-covariant Lagrangian gravitational field density

$$L_g = \sqrt{-g}\, g^{li}\;\; |\Gamma^n{}_{pi}\Gamma^p{}_{nl} - \Gamma^n{}_{li}\Gamma^p{}_{np}|$$

in

$$\sigma^{ni}{}_k = c^4\sqrt{-g}\,/16\pi G\; g^{mi}g^{nl}\; |\partial_i\, g_{km} - \partial_m\, g_{ki}| \qquad (2.16)$$

from which we obtain the Lorentz pseudotensor

$$\tau^i{}_k = c^4\sqrt{-g}\,/16\pi G\; |\partial_k\Gamma^l{}_{pl}g^{pi} - \partial_k\Gamma^i{}_{mp}\, g^{mp} - \sigma^i{}_k\;\; R| \qquad (2.17)$$

that coincides with the canonical impulse-energy pseudo-tensor obtained by the non-covariant infinitesimal displacement method from the co-variant Lagrangian density of the gravitational field $L_g = \sqrt{-g}R$" [10].

**4.4 The gravitational field devoid of physical reality**

Because the gravitational field is a metric field, it has no physical reality, interrupting the chain of transformations that exist in nature among all the physical fields.

> "From our point of view, it is not allowed to consider a metric field as the gravitational field, since this contradicts the very essence of the concept of field as physical reality. Therefore, it is impossible to agree with the following reasoning by A. Einstein:
>
> > "The gravitational field" exists "with respect to system K' in the same sense as any other physical quantity that can be defined in a given frame of reference, even though it does not exist in system K. There is nothing strange here, and it can be easily demonstrated with the following example taken from classical mechanics. No one doubts the "reality" of kinetic energy, since otherwise it would be necessary to give up energy in general. However, it is clear that the kinetic energy of the bodies depends on the state of movement of the reference system: by an appropriate choice of the latter it is obviously possible to provide the kinetic energy of the uniform movement of a given body to assume, at a certain moment, a positive value or zero. In the special case, when all masses have equal value and equally oriented speeds, it is possible, by appropriate choice of the reference system, to make the total kinetic energy equal to zero. In my opinion the analogy is complete".
>
> As we see, Einstein gave up the concept of the classical field, like the Faraday-Maxwell field that has an impulse-energy density, in relation to the gravitational field. Precisely this path led him to the construction of GTR, and that gravitational energy is not localizable, with the introduction of the pseudotensor of the gravitational field.
>
> If the gravitational field is considered a physical field, then, like all other physical fields, it is characterized by the impulse-energy tensor $t_{\mu\nu}$. If in some frame of reference, for example, K', there is a gravitational field, this means that certain components (or all of them) of the tensor $t_{\mu\nu}$ differ from zero. The tensor $t_{\mu\nu}$ cannot be reduced to zero by a coordinate transformation, that is, if a gravitational field exists, then it represents a physical reality, and cannot be annihilated by a choice of reference system. It is not correct to compare such a gravitational field with kinetic energy, since the latter is not characterized by a covariant quantity. It should be noted that such a comparison is not admissible, also, in GTR, since the gravitational field in this theory is characterized by the Riemann curvature tensor. If it differs from zero, then the gravitational field exists, and cannot be annihilated by a reference system choice, even locally.
>
> Accelerated reference systems have played an important heuristic role in A. Einstein's creative work, although they have nothing to do with the essence of GTR. By identifying accelerated reference systems with the gravitational field, A. Einstein came

to perceive the metric space-time tensor as the main feature of the gravitational field. But the metric tensor reflects both the natural properties of geometry and the choice of reference system. In this way the possibility arises of explaining the force of gravity in a kinematic way, reducing it to the inertial force. But in this case it is necessary to renounce the gravitational field as a physical field. Gravitational fields (as A. Einstein wrote in 1918) can be established without introducing stress and energy density. "But that is a serious loss, and one cannot consent to it.

Surprisingly, even in 1933 A. Einstein wrote:

> "In the theory of special relativity, as H. Minkowski shows, this metric was quasi-Euclidean, that is, the" length"$ds^2$ of a linear element represented a certain quadratic function of the differential coordinate. If, on the other hand, new coordinates are introduced with the help of a linear transformation, then $ds^2$ remains a homogeneous function of the coordinate differentials, but the coefficients of this function ($g_{\mu\nu}$) will no longer be constant. From a mathematical point of view, this means that physical space (fourth-dimensional) has a Riemannian metric".

This is certainly incorrect, since a pseudo-Euclidean metric cannot be transformed into a Riemannian metric by coordinate transformation. But the main point here is something else, namely, that way, thanks to his deep intuition, A. Einstein came to the need to introduce precisely the Riemannian space, since he considered the metric tensor $g_{\mu\nu}$ of this space to describe gravity. This was essentially how the tensor nature of gravity was revealed. The unity of Riemannian metrics and gravity is the fundamental principle underlying the theory of general relativity. V.A.Fock wrote about this principle:

> "... precisely this principle represents the essence of Einstein's theory of gravity."

However, from a general point of view, the answer to the following question is still not clear: why is it necessary to relate gravity precisely to Riemannian space, and not to any other? The introduction of the Riemannian space allowed the scalar curvature R to be used as a function of the Lagrangian and, with the help of the principle of least action, to obtain the Hilbert-Einstein equation. Thus the construction of Einstein's theory of general relativity was completed.

All of the above is explained by the absence in Riemannian space of the group of ten space-time motion parameters, making it essentially impossible to introduce conservation laws of momentum-energy and angular momentum, similar to those considered valid in any other physical theory. Another peculiar feature of GTR, compared to known theories, is the presence of second order derivatives in the Lagrangian R function. About fifty years ago, Nathan Rosen demonstrated that if, along with the Riemannian metric, the $\gamma_{\mu\nu}$ metric is introduced from Minkowski's space, then it is possible to construct the Lagrangian scalar density of the gravitational field, which will not contain derivatives of orders greater than one. Thus, for example, he constructed such a Lagrangian density that it led to the Hilbert-Einstein equations. Thus arose bimetric formalism. However, such an approach immediately complicates the problem of constructing a theory of gravity, since, when using the tensors $g_{\mu\nu}$ and $\gamma_{\mu\nu}$, a large number of scalar densities can be written, and it is not at all clear which scalar density should be chosen like Lagrangian density to build the theory of gravity. Although the mathematical apparatus of GTR allows introduce, instead of ordinary derivatives, covariant derivatives of the Minkowski space, the $\gamma_{\mu\nu}$ metric that is not present in the Hilbert-Einstein equations makes its use in GTR devoid of physical meaning, since the Solutions for the $g_{\mu\nu}$ metric are independent of the choice of $\gamma_{\mu\nu}$. It should be noted that the substitution of covariant derivatives for ordinary derivatives in the Minkowski space leaves the Hilbert-Einstein equations intact. This is explained by the fact that, if in Minkowski space one substitutes covariant derivatives for ordinary ones in the Riemann curvature tensor, it will not change. Such a substitution in the Riemann tensor is nothing, but an identical transformation. Precisely for this reason, such freedom in the writing of the Riemann tensor cannot be taken as an advantage within the GTR framework, since the Minkowski space metric tensor does not fit into the Hilbert-Einstein equations.

At GTR we only treat the Riemannian space metric as the main characteristic of gravity, which reflects both the characteristics of geometry and the choice of the reference frame. When the gravitational interaction is deactivated, that is, when the Riemann curvature tensor is equal to zero, we arrive at the Minkowski space. It is precisely for this reason that the problem of satisfying the equivalence principle arises in GTR, since it is impossible to determine in which frame of reference (inertial or accelerated) we came to be when the gravitational field was annulled.

In 1921, in the article "Geometry and Experiment", A. Einstein wrote:

> "The question of whether this continuum has a Euclidean, Riemannian, or any other structure is a physical problem, which can only be solved by experiment, and not a problem of convention regarding the choice of simple convenience ...".

This is naturally correct. But immediately a question arises: what experiment? There can be many experimental facts. Thus, for example, it is possible, in principle, to study the movement of light and test bodies, to establish unambiguously the geometry of space-time. Should a physical theory be based on it? At first glance, the answer to this question might be positive. And the matter would seem resolved. Precisely that was the path that A. Einstein took to build GTR. The test bodies and light move along the geodetic lines of Riemannian space-time. So he based the theory on Riemannian space. However, the situation is much more complex. All types of matter satisfy the conservation laws of momentum-energy and angular momentum. Precisely these laws, which originated from a generalization of numerous experimental data, characterize the general dynamic properties of all forms of matter by introducing universal characteristics that allow the quantitative description of the transformation of some forms of matter into others. And all this also represents experimental facts, which have become fundamental physical principles. What should be done with them? If one follows A. Einstein and retains Riemannian geometry as a basis, then they must be discarded" [12].

### 4.5 Riemann space is not eligible as primary space

The quantities $g_{\mu\nu}$ of the metric tensor are variables of the gravitational field, on the one hand, and the components of space-time, on the other hand. By virtue of this physical and geometric dualism of $g_{uv}$ and the impossibility of the existence of the $t_{uv}$ tensor for the metric tensor, due to the Riemann space, the "physics" of the gravitational field is geometric, consequence of taking the Riemann manifold as primary space.

> "Poincare and Minkowski's discovery of the fourth-dimensional world provided a fundamental possibility to demonstrate that, in the general case, various frames of reference are assigned a different metric, $\gamma_{\mu\nu}$ (x), of space-time, depending on the $x_\mu$ coordinates of this frame and not necessarily diagonal. For example, in an arbitrary non-inertial frame of reference S', the metric coefficients $\gamma'_{\mu\nu}$ turn out to be functions of the x' coordinates of this system. This finally causes the acceleration of a point of free matter with respect to S' and the inertial forces expressed through the first-order derivatives of the tensor $\gamma'_{\mu\nu}$ with respect to the relevant coordinates. The kinematic nature of inertial forces is reflected in the fact that the accelerations of free material bodies induced by them will be independent of their masses. Gravitational forces, as is known, have the same property because, as seen in the experiment, the gravitational mass of a body is equal to its inertial. Only this circumstance was used by Einstein when he concluded that the gravitational field, similar to that of inertial forces, should be described by the metric tensor $g_{\mu\nu}$, although in Riemannian space-time.
>
> At this primal point, Einstein departed from the concept of the gravitational field as physical reality. This has just led to unmanageable GTR difficulties. One of them that is derived directly from the above is related to the non-location of the gravitational field. It is well known that in all physical theories a primary characteristic of the field has always been the impulse-energy tensor density obtained, following Hilbert, by the variation of the Lagrangian density of the field on the components of the metric tensor of space-time. This characteristic reflects the fact that the field exists: a density of the energy-impulse tensor different from zero in some region of space-time is the necessary and sufficient condition for a physical field to exist in it. In GTR, the gravitational field does not possess such a characteristic and this is explained by the fact that in Einstein's theory the quantities $g_{\mu\nu}$ have a dual interpretation: they are field variables, on the one hand, and the components of the metric space tensor- time, on the other hand. By virtue of this physical and geometric dualism of $g_{uv}$, the expression for the density of the full symmetric impulse-energy tensor must also be the field equation. Apparently, this suggests that this field of a system, as defined above in the agreed manner, must be rigorously equal to zero throughout space-time, while the density of the impulse-energy tensor of the gravitational field must be zero beyond substance. In GTR, the gravitational field beyond the source, therefore, turns out to lack the basic physical characteristic, that is, the impulse-energy tensor and,

consequently, the theory also lacks impulse-energy and angular momentum, that is, the laws of conservation of the substance and gravitational field taken together.

In 1918, Einstein, realizing clearly the need for the "energy and momentum" characteristics of the gravitational field and the laws of conservation, introduced the concept of the impulse-energy pseudotensor $\tau_u^v$ of the gravitational field. However, in the same year, Schrodinger demonstrated that all the components of $\tau_u^v$ can be converted to zero outside of a homogeneous sphere by a special choice of the coordinates of three-dimensional space.

Another fundamental difficulty inherent in the GTR and related to the identification of the gravitational field as a metric tensor of the Riemannian space is the absence not only of local laws, but also integrals of the conservation of energy, momentum and angular momentum. The first person to notice this as a specific feature of GTR was Hilbert. The fundamental fact that the conservation laws of momentum-energy and angular momentum are basically impossible in GTR because the Riemannian space introduced into it does not have the maximum group of space-time motion, was left beyond the attention of contemporaries.

Some of the more unsatisfactory consequences of GTR are the non-uniqueness of its predictions for gravitational effects. This conclusion can be reached from the fact that with the agreed space arithmetic, the Hilbert-Einstein equations do not define the Riemannian space-time metric (in the general case, its solution can contain four arbitrary functions). We have demonstrated the non-singularity of GTR predictions using two examples: the calculation of inertial mass and the effect of the gravitational delay of the radar echo.

Such an analysis shows that the non-singularity of predictions for gravitational effects is an inherent feature of GTR. Therefore, the absence in GTR of the conservation laws of momentum-energy and angular momentum; the rejection of the concepts of the gravitational field as a physical field, as well as the non-singularity of the predictions for the gravitational effects, make this theory unsatisfactory from the point of view of physics and demand that the concepts of gravitation be reviewed cardinally.

In our opinion, in establishing the structure of space-time, one must proceed not from particular (and different for different sources) facts of the nature of the movement of light and test bodies, but of the more general dynamic properties of the matter, that is, its conservation laws are not only fundamentally important, but also verifiable experimentally. Apparently, the existence of ten conservation laws (of energy, momentum and angular momentum) objectively reflects the property of our material world that manifests itself in the homogeneity and isotropy of space-time.

There are three known types of spaces that allow the introduction of ten motion integrals. These are the space of constant negative curvature (Lobachevsky space), the space of zero curvature (Euclidean space) and the space of constant positive curvature (Riemann space). The first two spaces are infinite while the third is closed but without limits. If any theory, including that of the gravitational field, is required to contain the ten laws of conservation, Riemannian geometry of the general form must necessarily be rejected and one of the geometries mentioned above must be chosen as the underlying one. All currently known experimental data on weak and strong electromagnetic interactions unambiguously favor space-time with pseudo-Euclidean geometry (underlying primary field theory) and there are no facts to question it, this geometry should naturally be considered unique for all physical theories without exception for the theory of gravitation. In this case, compliance with the conservation laws for energy momentum and angular momentum, which are taken separately, will be guaranteed" [13].

## 5. Conclusions.

The rigorous conclusive criticism of the "general relativity" of the mathematician-physicists A. Logunov and M. Mestvirishvili, of a primarily mathematical nature, ratify what H. Minkowski has stated: "The gravitational field is, at best, a geometric field, not physical" [14] and by A. Einstein himself:" We denote everything except the gravitational field as matter. Therefore, our use of the word includes not only matter in the ordinary sense, but also the electromagnetic field" [15] because "as 90 years ago by Hilbert (1917), Einstein (1918), Schrodinger ( 1918) and Bauer (1918) within the focus of geometric gravity (general relativity) there are no tensor characteristics of the impulse-energy for the gravity field." [8] The gravitational field is a metric field without physical reality.

On the other hand, Einstein's principle of equivalence is not applicable to extended gravity but to a Universe devoid of it, therefore, of matter (which includes everything except the gravitational field). Furthermore, the equivalence between the inertial and gravitational masses is violated, which constitutes an experimentally established fact. Consequently, also, it is confirmed that the so-called "general relativity" is not a theory because it lacks principles, but the Einstein-Grossmann-Hilbert equations, which work, according to their astronomical predictions, although it is not known why.

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