The inconsistent Equivalence Principle

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Abstract

The equivalence principle between the gravitational motion and the inertial motion is false because a particle or body successively in two any contiguous points while in a gravitational frame they have different kinetic energy, instead they always have equal kinetic energy in an inertial frame.

1 Introduction

The branch of the physics that study the motion is the mechanic, subdivided mainly into:

- Kinematics on the geometric motion, in abstract, as points according position in a mathematical as Galilean, Minkowskian or Semi-Riemannian (Lorentzian) spacetime no defined in physics and in philosophy in controversies between relationism and substantivalism. Velocity as rate of change of position in a determined direction, whereas speed as only the magnitude and acceleration as rate of change of velocity.

Spacetime to substantivalism is absolute and to relationism is relative, as space is space measured relative to perceptible bodies and relative time is time measured relative to some perceptible motion. Space and time, to Galilei-Newton are absolute and independent geometrized through Cartesian coordinates and since Minkowski, a mathematical model that combined space and time. In any case spacetime in philosophy, science and physics it is still an enigma [1] because "We really do not know what spacetime" [2]. "The proponents of general relativity believe space is non-physical and describe the dynamic activity of space by employing the term geometro-dynamics, thereby underscoring the fact that Einstein's space is a mathematical construct, four-dimensional geometrized spacetime.

The philosophical theories supported by the mathematical model, $G_{\mu\nu} = kT_{\mu\nu}$, of the General Relativity are strictly restricted to:

- To dualistic idealist substantivalism, spacetime is a metaphysical fundamental entity, i.e., an entity immaterial whose curvature is the static gravitational field, i.e., a geometric property of spacetime; therefore spacetime and gravitational field are nothing.
- To idealist relationalism, spacetime is a thinking category that expresses metric relations codified in the static gravitational static field, which is a geometric field; therefore they are nothing.

The other theories that endow of materiality to spacetime or to gravitational field require of a mathematical model of the form $G_{\mu\nu} = k(T_{\mu\nu} + t_{\mu\nu})$, of the Entwurf theory abandoned in the general relativity.

- Dynamics on the material motion, modeling it physically through of mathematic as the motion of material particles and bodies with the physical properties of the mass, momentum, energy and force.

The main law of physics of the motion is the inertia elaborated only from kinematics. Its discoverer, Galileo Galilei postulated that a body in the absence of forces shall maintain its state of rest or rectilinear uniform motion, valid only into a flat spacetime. The universe is view flat in two cases: as a theoretical abstraction, for an absolutely empty space, corresponding to the model of special relativity which physically does not exist, since the void is always full of fields free of their sources. The real universe presents quasi flat regions, existing physically, within a local region at solar system and to great scale, where matter and velocity tend to zero. Einstein generalized inertia to any curved spacetime as the geodesic motion explaining apparently the general case of the gravitational motion due to that in the flat spacetime the homogeneous gravitational field (uniform gravitational field) would exists with the hypothetic property of the rectilinear gravitational motion, of course, the special case of the gravitational motion.

Derived of the principle of relativity of Galilei the relativity theories are based in the principle introduced by Poincare of that the physical laws are equal in any inertial frame, i.e, no subject to the action of forces.

In Galilei-Newton and in Einstein the motion is relative; therefore, they arise from kinematics and are relativity theories. Whereas in Galilei-Newton the inertial motion is an effect of coordinates, in Einstein the inertial motion, accelerated motion and gravitational motion are relative states. So, in the particular case, of special relativity, any motion is considered only as a relative motion, i.e. simple effect of change of coordinates, which Einstein erected to his equivalence principle. In the general case, of general relativity, the effect of change of coordinates occurs with change of geometry when it passes between the flat Minkowskian spacetime of special relativity and the curved Lorentzian spacetime of general relativity or vice versa. So, the geometric motion is illusory resulting equivalent to no motion. “A conviction, on grounds of epistemology or metaphysics or both, that motion is can be nothing but the observable changes of relations among bodies” [3].

After of the great scientific success of Einstein reached with the formulation, in 1905, of the special relativity explaining from the kinematic and through the Lorentz transformation near any motion, both the mechanic motion and electromagnetic motion only out the gravitational motion, from this theory, between 1907 and 1912, Einstein, chose the most obvious methodological alternative to give an explanation of gravity, by constructing it from the theory of special relativity, which he called the relativistic theory of gravity (TRG) [4], as had previously been attempted by Poincare and Minkowski. Between 1908 and 1909, derived of Erlangen program, the traditional algebraic instrument, i.e. the groups of transformations associated with mechanics, of support of physics were replaced by the geometric instrument due to Minkowski on the transformations of space. Minkowski constructed the geometry associated with the Lorentz transformation applied not the geometry of space, but of a spacetime as a perfunctory by-product of the Erlangen program. But, Einstein found in the invariance of the resting mass of special relativity, the insurmountable obstacle that made him abandon the TRG, within the process of its formation, due to the non-covariant representation of mass according velocity, which he led to the conclusion of the impossibility of describing the potential of gravity by a four-vector.

Between 1913 and 1914, in the Entwurf theory, Einstein maintaining the geometric approach and to instance of Grossmann introduced the absolute differential calculus with the mathematical instrument of the tensors although yet in the Minkowski´s spacetime that permitted him preserve the fundamental law of conservation of energy and momentum of physical process and gravitational field taken together, but failing in obtain in the Newtonian limit the law of gravity of Newton due to the limited covariance of the equations inevitable restriction with the objective of explain gravity as phenomenon of the gravitational energy, that Einstein had elected between the two options of the equations given by Grossmann. In 1918, Emmy Noether showed that the symmetry of Minkowski space tensor is the cause of conservation of energy-momentum of a physical field knowing probably before by Einstein who said so. In the Entwurf theory, Einstein had abandoned his conception initial of gravity as effect of coordinates that he considered now particular case of gravity.

On November of 1915, as consequence of a personal crisis raised of the fortuitous and hard competency with David Hilbert, the best germane mathematician of the epoch, sustained since July, when they worked similar equations, Einstein returned three years before and adopting the other option given by Grossmann of general covariant equations necessarily in a Lorentzian manifold without alternative, since they are impossible in a Minkowskian spacetime, he sacrificed materiality of gravity having that geometrize it, therefore, gravitational field with stress-energy was abandoned. The premium was from Poisson structure reach the law of gravity of Newton taking the Einstein´s equations the now familiar form $G_{\mu\nu}=kT_{\mu\nu}$ where $T_{\mu\nu}$ is the stress-energy tensor and $G_{\mu\nu}$ a gravitation tensor constructed solely from the metric tensor $g_{\mu\nu}$ and their first and second derivatives in absence of the tensor $t_{\mu\nu}$ of the Entwurf theory.

Into previous historic context the Einstein equivalence principle (EEP) is restricted to the particular case of the homogenous gravitational field, therefore, confined to Minkowski spacetime, strictly to linear transformations of Lorentz of the special relativity, adopted as TRG and extended through of general covariance in general relativity. In this work we examine its inconsistence into TRG.

2 The Einstein equivalence principle

The EEP is based in the Galilei equivalence principle now called weak equivalence principle (WEP). The tests of WEP has verified rigorously the equivalence between gravitational mass and inertial mass declared in this principle, using various technologies as the realized by the Washington group (2012), based in “torsion balance”, “with precisions at the part in 10^{13} level” [5].

In 1907, the EEP was originally formulated from special relativity, specifically from TRG, as the equivalence between the gravitational motion into the homogenous gravitational field and the accelerated uniform motion. In 1920, rather puzzling, Einstein said that in 1907 “I got the happiest thought of my life” reformulated EEP as the equivalence between the gravitational and the inertial motions. So, EEP stablishes that the inertial, accelerated and gravitational motion are effect of change of coordinates between frames of reference.

In 1916, in the general relativity, Einstein extended to arbitrary gravitational fields in lorentzian manifold through the general covariance, shared by many other theories include Newton gravitation, his equivalence principle of inertial and uniformly accelerated frames originated in the limiting case of special relativity, in his static homogenous gravitational field, existing free of their sources, similar to the electromagnetic fields which full the Minkowskian spacetime, although the gravitational fields are a phenomenon of spacetime but they are generated for its metric structure responsible for inertial and gravitational effects, no of the spacetime manifold that itself has no properties that can determine such effects associated with any word line is a straight line in Minkowskian metric, and therefore a geodesic, with an arbitrary choice of coordinates in Lorentzian metric. [6].

In general relativity the inertial frames are accelerated with respect to each other whereas in special relativity inertial frames move with constant velocity with respect to each other. Therefore, the laws of physics are the same relative to all frames, not just relative to the inertial frames. This is accomplished by formulating all physical laws in a tensorial form. The equivalence of all observers with respect to physical laws is called the principle of general covariance [7].

EEP presents the root problem of the absent physical reality of the homogenous gravitational field due to the fictitious free fall of the bodies occurring unrealistically on vertical trajectories in a flat spacetime. However, Einstein had as real the homogenous gravitational field since in “1911 paper on the bending of light, where he talks again about a homogeneous gravitational field, and of course he immediately applies this principle to the gravitational field of the Sun, so there can be no doubt that he had in mind “real” gravitational fields produced by masses” [8].

The naive rhetoric arguments of Einstein used in different scenery, over the years, of such assumed unnatural field, truly creation of the free imagination of Einstein, permitted him declare that the equivalence principle between gravitational and inertial motions is applied, in 1920, “for an observer in free-fall from the roof of a house there is during the fall – at least in his immediate vicinity – no gravitational field”, and, 1921, Princeton lectures (published in book form as “The Meaning of Relativity”) “In the immediate neighborhood of an observer, falling freely in a gravitational field, there exists no gravitational field. We can therefore always regard an infinitesimally small region of the space-time continuum as Galilean" or a homogeneous gravitational field would exist, in 1949, “In a gravitational field (of small spatial extension) things behave as they do in a space free of gravitation, if one introduces into it, in place of an “inertial system”, a frame of reference accelerated relative to the former”. So, the expressions used by Einstein of immediate vicinity, immediate neighborhood, and infinitesimally small region had caused on EEP controversies giving unsatisfactory solutions.

In reality, the equivalence between accelerated and gravitational motions is strictly limited to that gravitational motion is a particular case of accelerated motion, i.e, always that the acceleration results of the gravitational interaction between masses. Too, the equivalence between inertial and gravitational motions is restricted only to that inertial motion would a particular case of punctual gravitational motion unacceptable proposition.

EEP in its modern statement appearing compound of the three elements: WEP, local Lorentz invariance (LLI) now called EEP and local position invariance (LPI) called strong equivalence principle. LLI used by equivalence between accelerated and gravitational motions, means that “the outcome of any local non-gravitational experiment is independent of the velocity of the freely-falling reference frame in which it is performed” [9]. And LPI used by equivalence between inertial and gravitational motions, means that “the outcome of any local non-gravitational experiment is independent of where and when in the universe it is performed” [9] and is not affected by the presence of a gravitational field [7]. So, the original EEP is now any of the various versions dealing with WEP. But, it is not saved in all due to that continue the problem with what is local? Of course, where gravitational field is not exists.

In addition, in 1986, Anatoli Logunov and M. Mestvirishvili showed that WEP does not apply in the general relativity. In 1918, Einstein wrote: "the amount which has been interpreted as energy has, according to special relativity, the role of the inertial mass…. The energy of the body at rest equal to mass multiplied by c^2 ". Anatoly Logunov and M. Mestvirishvili proved that "the system power and, therefore, the inertial mass of the same system have no physical significance, because its magnitude depends on the choice of the coordinate system of three dimensions. Indeed, a basic requirement of any definition of the inertial mass is that it must satisfy the independence of this amount from the choice of the three dimensional coordinate system, which is valid for any physical theory. But in general relativity the definition of inertial mass does not meet this requirement" that the definition of gravitational mass whether meets. "Since the inertial mass and gravitational mass are due to different transformation laws, the transition to other three dimensional systems of coordinates results violates the equality between the two masses". "The claim that the inertial mass equal the gravitational mass in General Relativity has no physical meaning" [11].

3 Controversies on Einstein equivalence principle

Two are the main weaknesses of the EEP. The first the lapse of spacetime where is valid and the second as is extended from special relativity to general relativity.

Historically the Einstein principle of relativity was formulated in the TRG. During the Entwurf theory it suffered collapse due to the limited covariance of the equations since it is not hold in coordinate systems adapted to uniformly accelerating frames of reference in Minkowski spacetime, even allowing restrictions to infinitely lapses of spacetime [6] and in general relativity it is extended through general covariance so, Einstein wrote, in 1916, “The requirement of general covariance of equations embraces the principle of equivalence as a quite special case” and, in 1954, “All Gaussian coordinate systems are essentially equivalent for the formulation of the general laws of the nature” always if its laws were written in a general covariant form. “Einstein has taken the principle of equivalence to assert the equivalence of inertial and accelerated relative spaces an assertion that is subsumed by the extended general principle of relativity” [6].

During TRG, in 1911, Max von Laue observed to Einstein that this type of homogenous gravitational field cannot real since it has not source masses. Einstein responded that homogenous gravitational field, phenomenon of the spacetime, as existing independently of their sources assimilating it arbitrarily to the material electromagnetic field.

During the general post-relativity period, the EEP has been criticized by many authors as imprecise and Einstein or his followers have given answers not free to be controverted although in a few authors the criticism was due to the confusion that origin the applicability of the principle. Onwards we will include the most talked.

The first group is those who consider that the equivalence principle concerns to the infinitesimal lapses of the spacetime.

- In 1917, Moritz Schlick, who helped to Einstein to exit of his hole argument and adopt the general covariance in his equations, interpreting wrongly the lapse of local valid of EEP he introduced the Minkowskian metric declaring that are straights the infinitesimal lapses of the Lorentzian spacetime.

- In 1983, Roberto Torretti resumed that “every curve is straight in the infinitesimal”, based in the false argument that “lines of constant latitude on the Earth’s surface are generally not geodesics, even though they may be considered (by local townspeople) to be “approximately straight” in a small region” when they are not really straight [8].

- In 1920, the critic of Ernst Reichenbacher that the equivalence principle is trivial because it applies in general only over infinitesimal regions since for finite spacetime lapses cannot be transformed away, Einstein responded “that this is of no importance whatsoever. What is important is only that one is justified at any instant and at will (depending upon the choice of a system of reference) to explain the mechanical behavior of a material point either by gravitation or by inertia. More is not needed; to achieve the essential equivalence of inertia and gravitation it is not necessary that the mechanical behavior of two or more masses must be explainable by the mere effect of inertia by the same choice of coordinates” [8]. However, where is possible to explain the mechanical behavior of a material point either by gravitation or by inertia? Will be it perhaps, at a point or in an infinitesimal lapse?

- In 1921, Pauli declared that the principle asserts that one can always transform away an arbitrary gravitational field in an infinitesimal lapse of spacetime, by transforming to an appropriate coordinate system basically well, but he was unauthorized, in 1985, by John Norton [6] who wrote that Einstein after of adopt the covariance general, in 1915, the restriction of his principle of equivalence to infinitesimal regions of space disappeared of his writings as Kevin Brown refuted this was not true [8].

The other relevant group is that of those who consider that EEP is not possible extend to general relativity since the curvature of its metric does not allow it.

- In 1960, John Synge proposed that gravity must be identified with curvature contrary to the conception of general relativity with its homogenous gravitational field equivalent to the inertial motion of accelerating bodies. “The equivalence principle signifies that there is no gravitational force, per se. In a region of spacetime where gravity exists, there is nothing "there" other than spacetime, and the inertial motion of mass-energy. Gravitation is an attribute of spacetime, rather than something that exists within spacetime” [10]. However, the modern interpretation of gravity from general relativity is that of Synge.

- In 1976, Hans Ohanian objected EEP through the fact of the tidal distortion of a water drop in free fall in an infinitesimal lapse of spacetime. The argument in favor of EEP is that when “water droplet enters this region, the molecules are already configured with the tidal bulge, and when those molecules depart the region they are in the very same configuration” [8]. Therefore, there would be no effect of tidal distortion. Nevertheless, many authors claim as, in 1986, Anatoly Logunov and M. Mestvirishvili, writing that "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 nonzero) by selecting an appropriate reference frame, even with in a give accuracy" [11].

According the previous scenery building from both groups the conclusion is that persists EEP in where is valid? And how is it validly extended?

Modernly from the vision of Einstein in his theories of relativity on gravity as the non-curvature of spacetime, two great scholars, John Norton and Kevin Brown, coincide in that Einstein EEP is valid basically because inertia and gravitation effects are caused by the metric structure of the manifold that itself lack of properties, therefore, there is not difference between inertia and gravitation but they differ in relation to the validity of EEP in the infinitesimal lapses of the manifold interpreting wrongly Norton to Einstein.

- John Norton affirm that “for Einstein there is no essential difference between inertia and gravity since the metric structure governs the motion of a body in free falls in the gravitation free case of special relativity or in free falls in a classically recognizable gravitational field…Einstein´s equivalence principle asserted that the properties of space that manifest themselves in inertial effects are really the properties of a field structure in space: moreover this same structure also governs gravitational effects. As a result, the privileged inertial states of motion defined by inertial effects are not properties of space but of this structure and the various possible dispositions of inertial motions in space are determined completely by it….This principle guided Einstein to seek his general theory of relativity as a gravitation theory of which special relativity was a special case” [6]. .

- Kevin Brown considers “the idea that we arrive at geodesic motion by combining Galileo’s law of inertia with the equivalence principle is basically valid… Einstein did not regard “flat” Minkowski spacetime as being free of a gravitational field. He regarded the inertial field and the gravitational field as identical, represented by the metric tensor…. The equivalence principle signifies that there is no gravitational force, per se. In a region of spacetime where gravity exists, there is nothing "there" other than spacetime, and the inertial motion of mass-energy. Gravitation is an attribute of spacetime, rather than something that exists within spacetime." [8], as an attribute of spacetime, gravitation is really provided by the metric tensor.

4 The Riemannian spacetime

In Cartesian coordinates in the representation of a curve, the deviation from straightness is calculated by the rate at which the tangent direction changes per unit distance along the curve. This rate does not go to zero in the infinitesimal limit. But, in Riemannian geometry the curvature in the Riemann normal coordinates, which can be defined at any point of the curved manifold, vanishes Christoffel symbols, i.e. the curvature, "such manner that the finite distance of the coordinates of any other given point in its vicinity they are well-defined being dependent on the amount of curvature... Beyond that distance the coordinates overlaps and hence are no longer well-defined…In a flat manifold such coordinates can be extended indefinitely….It can be shown that the geodesic curves of the manifold are precisely the curves that are unaccelerated in terms of the Riemann normal coordinates at every point along the curve" [8]. Thus, due to the property of the Riemann normal coordinates, the geodesics through a point are transformed into straight lines that give sense in any infinitesimal lapse to the existence of an inertial system associated with a particle in free fall and, therefore, physical reality to EEP, other "magic" property of the tensors in the manifold of Riemann as that of the covariance general.

In general relativity the totality of the spacetime in the universe is a manifold of Riemann, i.e. a mathematical abstract spacetime, unlike some scientists, who mix the metrics of Minkowski and Riemann in finite or infinitesimal regions as the case of Schlick. Paradoxically, the vanishing of the Christoffel symbols that give straight lines is different from the Minkowski metric, although the equation, $dx_1^2 + dx_2^2 + dx_3^3 + dx_4^4 = ds^2$ that expresses the sum of the squares of the coordinates equal to the square of the extreme trajectory distance from the origin is the same in both metrics, since in the manifold of Riemann the vanishing of the Christoffel symbols give the particular case of special relativity, i.e., the pass from $g_{\mu\nu}$ to $\eta_{\alpha\beta}$ metrics.

In 1913, in the Entwurf theory, Einstein and Grossmann emphasized, that the gravitational field should have an energy-momentum tensor as any physical field [14]. However, in November of 1915, Einstein renounced to this requirement due to the general covariance of the equations of general relativity, so he had to abandon the Minkowski metric [15]. In 1918, as Emmy Noether showed that the symmetry of Minkowski space tensor is the cause of conservation of energy-momentum of a physical field then Einstein had no other recourse than say: "The gravitational field works very well without stress and energy density " [16]. Remember us that Einstein in the general relativity had that abandon the model $G_{\mu\nu} = k(T_{\mu\nu} + t_{\mu\nu})$ of the Entwurf theory, therefore, "the fact that Einstein identified the Riemann's metric of the spacetime with the gravitational field, deprives it of all the properties that a Faraday Maxwell field has". "The gravitational field is not a physical field that has an energy-momentum density." "The fundamental law of conservation of energy-momentum of matter and the gravitational field as a whole does not exist" [11]. Of course, in 1916, Einstein wrote: "We denote everything but the gravitational field as matter. Our use of the word therefore includes not only matter in the ordinary sense, but the electromagnetic field as well" [17].

In 1952, Einstein ratified the geometric character of the gravitational field defined by the $g_{\mu\nu}$, its identity with the inertial field and its complete extension in the spacetime as quality structural of the gravitational field since he wrote: “In order to be able to describe at all that which fills up space and is dependent on the co-ordinates, spacetime or the inertial system with its metrical properties must be thought of at once as existing, for otherwise the description of "that which fills up space" would have no meaning. On the basis of the general theory of relativity, on the other hand, space as opposed to "what fills space", which is dependent on the co-ordinates, has no separate existence. Thus a pure gravitational field might have been described in terms of the $g_{\mu\nu}$ (as functions of the co-ordinates), by solution of the gravitational equations. If we imagine the gravitational field, i.e. the functions $g_{\mu\nu}$, to be removed, there does not remain a space of the type (1), but absolutely nothing, and also no "topological space". For the functions $g_{\mu\nu}$ describe not only the field, but at the same time also the topological and metrical structural properties of the manifold.

A space of the type (1), judged from the standpoint of the general theory of relativity, is not a space without field, but a special case of the $g_{\mu\nu}$ field, for which – for the co-ordinate system used, which in itself has no objective significance – the functions $g_{\mu\nu}$ have values that do not depend on the co-ordinates. There is no such thing as an empty space, i.e. a space without field.

Spacetime does not claim existence on its own, but only as a structural quality of the field” [12]. A space of the type (1) is a Minkowskian spacetime therefore metric $\eta_{\alpha\beta}$.

In the general relativity, the gravitational field is a geometric field without stress and energy and the spacetime the quality structural of the gravitational field, of course, they are nothing. Thus, the EEP is referred to the entities of space-time and gravitational field abstracts and lacking of materiality.

In 1938, free of the pressures that Lorentz exercised personally and through of others as sir Eddington since he had passed away in the previous decade; Einstein had finished with any attribute that could identify the gravitational field as material, writing that it was no longer necessary to talk about the relativistic ether or gravitational waves, both of which did not exist. However, in “The Evolution of the Physics”, Einstein and his assistant Leopold Infeld, considered the possibility, certainly not within the framework of general relativity, but of the emergence in the future of a unifying theory of gravity as an energy field and others material fields such as electromagnetics, after all, he had worked gravity under this conception during his Entwurf theory. In 1986, six decades later Logunov and Mestvirishvili made it possible in their "Relativistic Theory of Gravitation" although without further use. Einstein and Infeld wrote: “We have two realities: matter and field. There is no doubt that we cannot at present imagine the whole of physics built upon the concept of matter as the physicists of the early nineteenth century did. For the moment we accept both the concepts. Can we think of matter and field as two distinct and different realities? Given a small particle of matter, we could picture in a naive way that there is a definite surface of the particle where it ceases to exist and its gravitational field appears. In our picture, the region in which the laws of field are valid is abruptly separated from the region in which matter is present. But what are the physical criterions distinguishing matter and field? Before we learned about the relativity theory we could have tried to answer this question in the following way: matter has mass, whereas field has not. Field represents energy, matter represents mass. But we already know that such an answer is insufficient in view of the further knowledge gained. From the relativity theory we know that matter represents vast stores of energy and that energy represents matter. We cannot, in this way, distinguish qualitatively between matter and field, since the distinction between mass and energy is not a qualitative one. By far the greatest part of energy is concentrated in matter; but the field surrounding the particle also represents energy, though in an incomparably smaller quantity. We could therefore say: Matter is where the concentration of energy is great, field where the concentration of energy is small. But if this is the case, then the difference between matter and field is a quantitative rather than a qualitative one. There is no sense in regarding matter and field as two qualities quite different from each other. We cannot imagine a definite surface separating distinctly field and matter.

The same difficulty arises for the charge and its field. It seems impossible to give an obvious qualitative criterion for distinguishing between matter and field or charge and field.

Our structure laws, that is, Maxwell's laws and the gravitational laws, break down for very great concentrations of energy or, as we may say, where sources of the field, that is electric charges or matter, are present. But could we not slightly modify our equations so that they would be valid everywhere, even in regions where energy is enormously concentrated?

We cannot build physics on the basis of the matter concept alone. But the division into matter and field is, after the recognition of the equivalence of mass and energy, something artificial and not clearly defined. Could we not reject the concept of matter and build pure field physics? What impresses our senses as matter is really a great concentration of energy into a comparatively small space. We could regard matter as the regions in space where the field is extremely strong. In this way a new philosophical background could be created. Its final aim would be the explanation of all events in nature by structure laws valid always and everywhere. A thrown stone is, from this point of view, a changing field, where the states of greatest field intensity travel through space with the velocity of the stone. There would be no place, in our new physics, for both field and matter, field being the only reality. This new view is suggested by the great achievements of field physics, by our success in expressing the laws of electricity, magnetism, gravitation in the form of structure laws, and finally by the equivalence of mass and energy. Our ultimate problem would be to modify our field laws in such a way that they would not break down for regions in which the energy is enormously concentrated.

But we have not so far succeeded in fulfilling this programme convincingly and consistently. The decision, as to whether it is possible to carry it out, belongs to the future. At present we must still assume in all our actual theoretical constructions two realities: field and matter" [18]. The field referred by Einstein is the gravitational field.

5 Equivalence between inertial and gravitational motions is not exist

In the physical real universe, Misner, Thorne and Wheeler consider that the "curvature of spacetime" is necessary and sufficient for a gravitational field to exist and that all real gravitational fields have tidal effects. In our universe a perfectly uniform gravitational field does not exist. Therefore, any gravitational field can always be distinguished from a system accelerated by tidal forces that are always detectable over any finite distance [13], coinciding in the basic with Logunov. This is the current predominant current known as "Modern general relativity" [10]. Of course, the homogenous gravitational field does not exist physically in the universe; it is an invention of the imagination of Einstein and aberrant case of the science history because Einstein originated it to introduce the EEP.

In addition, the author highlights the conception of the movement from the classic physic and the derivate theories of relativity that they are referred to the kinematic motion, as the geometric description of the motion using the relativity principle derived of the geometric motion, which in Newton applies to the inertial motion while in Einstein to any motion. The relative geometric motion is the change of coordinates of the points in a mathematical spacetime between reference frames; therefore it lacks of physical reality and is illusory.

Of other hand, studied by the dynamic, the true motion embraces mass, momentum, kinetic energy and force of material particles and bodies. It is the real motion. In this context is impossible the equivalence between inertial and gravitational motions since while the inertial motion implies constancy of the kinetic energy and the impulse during full trajectory oppositely the gravitational motion as the accelerated motion imply change in the kinetic energy and impulse between two any points without import its separation. The conservation of energy in inertial motion and the change of energy in gravitational motion is precisely its difference.

Kinetic energy = ½ mass x velocity².

In the gravitational motion

$v_2 = v_1 + g\ t$ where v_2 is final velocity, v_1 is initial velocity, g is the gravity acceleration and t is time

Therefore

½ mass $(v_1 + gt)^2$

While in the inertial motion

$v_2=v_1$

In gravitational motion such change in the kinetic energy between v_1 in time taken as 0 and v_2 in any greater time permits distinguish experimentally a gravitational motion of an inertial motion.

Further, in the imaginary homogenous gravitational field, the author proved which is not valid the equivalence between gravitational and accelerated motions in his work: “The critical failure of the equivalence principle between acceleration and gravity”, since two bodies, aligned according to the perpendicular, under the reciprocal action of their gravity, in free fall, in the vacuum, inside of an accelerated reference frame, they fall with a different acceleration while one augment, the other decreases, according respectively to:

$$a_1 = g + \frac{GM}{r^2}$$

$$a_2 = g - \frac{GM}{r^2}$$

This result invalidates such principle [19]. However, some relativists sustain that the principle is punctually valid, i.e, in an event, of course, where it is not possible make experiments; also it breaks with the interpretation that the scholars make of EEP.

Conclusions

The geometric conception on the motion of the kinematic and the Galilei relativity principle permitted to Einstein search generalize it to any motion, introducing the inexistent homogenous gravitational field where he could formulate EEP. However, it is impossible the “fall free” without a center of masses although Einstein believed that gravity as effect of the metric structure of the spacetime maybe act without masses similarly to the free electromagnetic fields.

During the Erlangen program due to the limited covariance of the equations, Einstein had that abandon EEP although preserving the gravitational field as material that he and Grossmann considered essential in the elaboration of a theory on gravity.

In the general relativity Einstein returned to EEP and he declined his exigencies on preserve the materiality of the gravitational field in front of the power of the general covariant equations applied in the semi Riemann manifold. Their successive success in explain the anomaly of the orbit of Mercury and give in the Newtonian limit the equations of Newton between others, were more important.

Scholars considered basically valid EEP because the same metric structure determines the inertial and gravitational motions. However, yet in the imaginary homogenous gravitational field, the author has proved which EEP is inconsistent because the equivalence between gravitational and inertial motions, likewise between gravitational and accelerated motions, does not exist really. Since, in the gravitational motion, in any two closed points have different kinetic energy, while in the inertial motion they have an only kinetic energy, likewise in the gravitational motion two bodies aligned vertically fall with equal acceleration, while in the accelerated motion they fall with different accelerations.

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