SPACETIME GEOMETRIC STRUCTURAL PROPERTY OF THE MATTER IN MOTION

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"The form gives the structure to the content"

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GOAL

According to the General Relativity the spacetime is bent due to its content of matter and energy, which produces gravity, causing that the particles and the bodies move freely within causal geodesics. The gravity is not a force but an aspect of the geometry of the spacetime. The interruption of the geodesic motion causes a fictitious force of geometric origin.

However, ”In Quantum Mechanics, the gravitational force is attributed to the exchange of gravitons between the particles of the bodies ... ” (Hawking, 1988).

The contradiction between the gravitational field as a geometric field and the gravitational field as a material force, is examined in this work, down the perspective of the General Relativity, to overcome it.

VISION

Originally, in the thinking of the ancients, the space and the time were united with the material form (described by geometry) of the bodies, but when the geometry becomes a formal science, the space and the time were separated from the material form and they are governed by laws of the geometrical and mathematical sciences. The space and the time acquire an independent and abstract existence by many centuries. In the General Relativity, again the space-time were connected with the material existence: the matter curves the space-time and the space-time determines the motion of the bodies, but the space-time maintains their own ontological entity as a substance or as a relational category.

Problem

- In theoretical physics:
  - The spacetime is any mathematical model that, of a physical dynamic system, combines space and time into a manifold of four dimensions.
  - The space is the three dimensional continuum, that determines the place occupied by the material events (Substantivalist model) or constructed by universal set of relations between material events (Relationist model) (in geometric terms, relative position, direction and sense).
  - The time is the one dimension, that determines the moment in that the events occur, placed in time as order of succession (Substantivalist model) or non distinct of things existing in time (Relationist model) (in geometric terms, relative order of past, present and future)
- But, physically, what is the space, the time, the spacetime?

1 Substantialism and Relationalism

- The presocratics questioned: What contain the Universe and its evolution? Are the space and the time?. Centuries after, questions, about of local motion, led: The space and the time are relations?.

- Democritus, Plato and Aristotle responded that space (time) is container of universe and its evolution. To Democritus the vacuum is space. To Plato space is a physical entity containing all others entities. To Aristotle, body and place –space- are two different things; space is something, it is not a body, but there is no space void, concept known as mono Substancialism.

- To Heraclitus is impossible that space can exist as an entity separate from invisible unity of stuff. Space has to be one quality of the stuff. Therefore Heraclitus is an precursor of Relationalism

- Heraclitus, Democritus and Aristotle built the dynamic image of the universe. To Heraclitus everything is permanently in state of flux. To Democritus exist infinite space in which moved an infinite numbers of atoms that made up being. To Aristotle the bodies are in rest or in motion with a determined speed, but he did not defined speed as relation between space and time. They made possible that the space (time) arises of the relations exist between the bodies in motion.

- Centuries after, Newton said that the space-time are relations between points in which the events occur (Substancialism) and Leibniz that are relations between the event selves (Relationalism).

. Relationalism and Substantialism are identified in that the space-time is a geometric object. They differ in that:

- In the Relationalism the space-time is an geometric ideal object referred to the material existence, exactly to relations between material objects.

- While for the Substantialism the space-time is a geometric real object. In its orthodox version, its substantial nature is understood as real presence, existing by itself, although, is not material presence. But, in other versions, the space-time is also material presence, in such case is a special material substance.

- Leibniz refuted the persistence of the spatial points in the time, saying that if the world was somewhere else, inverted or moving it would have ontological redundancy, while the spatial relationships among its components not would be altered, because would be different representations of one same physical reality and no of different worlds. This Leibniz's equivalence (LE) is the fundament of the solution of the Relationalism of the hole argument of Einstein and later of Earman, Norton and Stachel.

- In Einstein, in the hole argument, a space-time (M) that contains a material field (T), it submits to an active diffeomorphism, that displaces totally to the space-time, even through of an interior hole, empty of matter (H, with T=0). Within of the Hole the transformation of the coordinates of M occurs together with the deformation of the geometric tensor (G) causing, for example, that the point q, in the entry to the hole, corresponds to the point r, in the exit of hole. But the tensor T is invariant in any spacetime.

- Einstein used the hole argument to show that the consequences of the general covariance are: the unity between the spacetime and the gravitational field, since “it cannot consider two gravitational fields on the same spacetime” and “spacetime only has sense with matter or material fields”, since the positions in themselves do not permit measure distances. The positions in themselves do not have sense in the General Relativity. Einstein overcomes the hole argument through of fix restrictions to the general covariance in their equations. Thus, in 1915, for some authors, Einstein adopted the Relationalism in the General Relativity.

Indeed, Einstein between 1913-1915 developed the Entwurf theory with the objectives of Machianization of inertia, in the sense that inertial forces of all kinds, on a mass, are produced by interaction with other masses and hence unify them with equivalence principle, since inertial forces are just gravitational forces. But as Minkowski spacetime is the most clearly anti-Machian spacetime possible and this a solution of the Entwurf equations such objectives Einstein had to leave. However the extension, in 1916, in the general relativity theory, of the validity of the equations to all reference frames is just achieved by general covariance although is purely formal requirement of this, unrelated to the equivalence principle (Carl Hoefer, 1994).

- Truly the solution of the gravity of Einstein using Leibnitz-Mach itself is not a relational philosophical theory on spacetime. Einstein is not a philosopher of the physics but whether a physic that geometrized the physic. Only on the tensor G Einstein established that is determined by the tensor T. But Einstein did not say whether G is a geometric real object or is a geometric relational object. Either the simple failed purpose of the use of Leibnitz equivalence and Mach principle cause that necessary G is a geometric real object or is a geometric relational object, fundamental question to considering G as a own object of the Substantialism or Relationalism.

- The true purpose of Einstein in using Leibnitz-Mach is build a coherent relativistic geometric general theory on gravity unified with the relativistic theory on the inertial systems, applying the principles of Mach (eliminating absolute motion and chained with the equivalence between inertia and gravitation that is obtained of the inertia as an gravitational effect), strong equivalence (gravity and acceleration are equivalents, and also inertia and gravity due to equivalence between inertial and gravitational masses) and general covariance (laws of the nature are valid in any reference system: inertial, accelerated or gravitatory, supported in a property of the tensors).

- The true purpose of Einstein with use of the that he called Mach's principle was clearly a scientific purpose: obtain a scientific theory on gravity.

- However, General Relativity is originally a relational geometric theory, in philosophical terms a relational theory, since G (functions $g_{\mu\nu}$) expresses metric relations between material events. But, the solutions to vacuum of the Einstein´s equations support that G describe spacetime as a geometric real structure that exists itself. Metric relations are geometric and causal relations as such distance, area, volume, angle, curvature, present, past, future, i.e. definitely geometric relations of spacetime. That is, the mathematical formulation of general relativity in Einstein's equations paradoxically destroyed the scientific purpose that Einstein want reach. Grossmann who had driven to Einstein, possibly in 1912, to the geometric view on the gravity and developed primarily the Entwurf equations, in 1913, previous to Einstein´s equations, was the intellectual author of the scientific fall of Einstein as author of the geometrization of the physics.

But Minkowski (1908, 1909) truly was responsible for introducing geometric methods and thinking into relativity theory when, at Special Relativity, Einstein transformed space and time coordinates, according to algebraic formulas of Lorentz transformation. In effect, whereas Einstein had restored the principle of relativity of inertial motion to electrodynamics using that all natural laws must be so conditioned that they are covariant with respect to Lorentz transformations, Minkowski proceeded to treat the groups of transformation of mechanics, that connected various inertial states of motion, in exactly the same way as the geometric groups. In particular, Minkowski constructed the geometry associated with the Lorentz transformation. To begin, it was not he geometry of a space, but of a spacetime, and the notion of spacetime was introduced into physics almost as a perfunctory by-product of the Erlangen geometric program of his colleague at Gottingen, Klein. According to Minkowski, as is well known, one can formulate the content of the principle of relativity as: only spacetime vectors may appear in physical equations. (Norton, 1993). Thus the physical principle of relativity was replaced by the symmetries of spacetime. Of course, Groosmann continued work of Minkowski.

- Of other hand, the inertial structure subjacent of the motion defies the fundament of the Relationalism which could explain the inertial effects through of the distribution of all matter in the Universe (Mach´s principle subjacent in the tensor of the matter-energy), but not the existence of the inertial structure itself. Neither, the gravitational waves free of its sources. Thus, General Relativity aims to Substantialism. Much more due to the symmetric effects between spacetime and matter. Spacetime acts on matter giving it form, causing it moves within geodesics and producing the effects of the gravitational lenses, the gravitational redshift, the Shapiro time delay and the geodetic precession. Matter acts on spacetime, curving it, twisting it, dragging it and dynamically wavy its curvature. This internal contradiction of General Relativity is derived that spacetime originally a thinking category has physical effects.

- Surely, due to that General Relativity does not define physically spacetime, nature of spacetime is a problem that must resolve the philosophy of the science, therefore, problem that transcend to General Relativity (Guillén, 2014) .

The attempts of Einstein, using Leibnitz-Mach, does not correspond to the solutions of the equations of Einstein: First by Schwarzchild, with the spacetime of Minkowski as limit in the infinite (1916), obligating to Einstein close the Universe to avoid it; with the introduction of positive cosmological constant, and generating the cylinder Universe (spatially closed, and temporally open), filled with a uniform static mass distribution (1916). Later by De-Sitter, with his Universe completely empty in expansion (1917), that results of his solution for an Universe with positive cosmological constant, in opposition to the cylinder Universe.

The Schwarzschild solution caused that Einstein added initial conditions at his equations. And with his cylinder Universe, Einstein treated first, that the Universe is static; and second, that its metric structure is fully determined by matter—in other words, that its metric field satisfies what, in 1918, he called "Mach's principle." De Sitter's vacuum solution of Einstein's field equations with cosmological term is a counterexample to this principle, and, for this reason, Einstein tried to discard it on various grounds. Two main lines of attack can be discerned: one was to argue that the De Sitter solution is not static; the other was to argue that it has what today would be called an intrinsic singularity, which in turn was used to argue that it is not matter-free (Michel Janssen). This was the Einstein-De Sitter debate, realized between 1916-1918, that Einstein believed had gained in the beginning of 1918.

But, due to the papers of Weyl and Klein on the paper De Sitter, in the end, Einstein had to acknowledge that the solution is fully regular and matter-free and hence indeed a counterexample to Mach’s principle (Michel Janssen). Thus, Einstein had accept the inertial structure, and after of the mid of 1918, when Einstein renounced finally to Mach, the Substantialism it became the main philosophical theory about of the spacetime. This is a philosophical result independent of the scientific thought of Einstein.

- In the 1980s, Earman, Norton and Stachel supposed that within of the hole, M is chopped into slices (hypersurfaces) spacelike, along a curve timelike in the direction of the future. The consequence of put the hole in the future is that is not uniquely determined by the past. Hence, necessarily it must apply the Leibnitz's equivalence, since of the contrary it breaks the causality law and definitely it establishes that the action of an active diffeomorphism on the spacetime, must result in the same solution to the motion´s equations of the General Relativity. Therefore, the original identity of the points of Newton, it loses in any covariant theory of the space time.

- The hole argument for the Substantialism produces two different spacetimes. The M of entry to the hole causes a new spacetime of exit, without identity. While, out of the hole, the M displaced produces a spacetime, with identity. Thus, the theory it becomes indeterminist.

- The Sophisticated Substantialism resolved the problem linking the manifold of events to the metrical structure (M,g). Thus, the spacetime is equipped of metric, that permits measure distances and the points, initially without identity, are individualized. Therefore, this Substantialism adopted the Leibnitz´s equivalence, eliminating the indeterminism although no definitely, because sometimes, it reaches succeeds and other do not.

- Currently, although the majority favors the interpretation of the Substantialism of the spacetime, the debate with the Relationalism is not over.

2 The space and the time, the containers of matter and its motions according to the Classical Physics

- According to Newton the space-time is the container of the matter-field and their motions. They are absolutes and are independents.
- The matter is aggregations of particles arranged in elements or substances. Each particle may act instantaneously to distance, in the vacuum, and exert the electromagnetic and gravitational forces (fields) on other particles.
- The space and the time are non-material substances.
- The space and the time exist empties (space and time nudes).

- With Faraday and Maxwell was assumed that the space contains the ether, medium to transport electromagnetic waves. Due to the lack of interaction between ether and matter, in the neonewtonian´s revision, the ether is defined as structural property of the space-time.

- The space and the time are defined according to Newton´s continuum (R^3, t), Euclid’s metric (η_{ij} , t). R^3 and isotropic space and t the uniform time. This is the homogeneous s continuum are points and topology equipped with the two Euclid’s metrics: η_{ij} of the three-dimensional space and t of the one-dimensional time. Like such is the inertial structure and the absolute causality.

- Therefore, the Newton´s space and time only has one Euclidean geometry that allows infinite speeds.

- The space and the time have an existence independent of its contents.

- The space and the time is an inertial system in which the objects in motion, free of forces, will maintain their relative state of rest or rectilinear motion uniform with respect to other inertial systems.

- Between inertial systems, the coordinates are transformed according to the Galilee's group which does not apply for the electromagnetic field, out of the scope of the Newtonian´s mechanics.

- Although the motion of the bodies is a absolute motion, because it is always referred to its container: the space and the time. However, the motion it can only know as relative motion.

- The Euclidean's space and time of the classical physics, in the post Newton physics is unified in the Hilbert's space-time (R^4) Euclid's metric (η_{ij}), of fundamental importance in the mathematical formulation of the quantum mechanics, that uses an Euclidean´s space in all law.
- But, in 2009, Petr Horava, proposed a new quantum gravity theory: "going back to ideas of Newton that time and space is not equivalent“, due that “in quantum mechanics, time retains its Newtonian aloofness, providing the stage against which matter dances but never being affected by its presence".

3 The space-time fixed background

3A Special Relativity

- The Einstein's relativity it divides in the Special Relativity of the space-time flat, and in the General relativity of the space-time curved.

- The space-time flat is a continuum (R^4), Minkowski´s metric (η_{uv})*. It is* absolute and independent frame of the physical events, of four (three-dimensions of an homogeneous and isotropic space and one-dimension of an uniform time) interchangeable dimensions, according to different inertial moving observers, that is in contradiction with the Leibniz's relationism, because is based on relative simultaneity. This four dimensions are interrelated by c, upper limit speed. This space-time has an only metric pseudo-Euclidean (η_{uv}).

- "The special theory of relativity is the pseudo-Euclidean geometry of space-time. All physical processes take place just in such a space-time. The consequences of this postulate are energy-momentum and angular momentum conservation laws, the existence of inertial reference systems, the relativity principle for all physical phenomena, Lorentz transformation, the constancy of the speed of the light in Galilean coordinates of the inertial frame, the retardation of time, the Lorentz contraction, the possibility to exploit non-inertial systems, the clock paradox, the Thomas precession, the Sagnac effect, and so on." (Logunov, 2004).

- All inertial systems are absolutely equivalents, it is not possible determine which is stationary or moving, therefore, all phenomenon occurs equal and the motion is always relative.
- Space-time tells to matter how it moves ”but matter does not affect the space-time”.
- Space-time communicates the inertial motion, to the bodies.
- Between inertial systems is applied Lorentz´s transformation.

- Although the spacetime is made of material events, Einstein did not end with the abstract points of Newton. The space-time empty of matter, electromagnetism and gravity (space-time naked), in itself constitutes the substratum of the inertial structure and like in Newton the spacetime is a substance no material which serves of continent of the matter-fields.

- The physical problems of the motion are treated as geometric problems.

- In the spacetime flat all the laws of the physics (except the gravity) are the same for all the inertial observers.

- The gravity has no geometric character and is a force with no instant action. But, the Special relativity can not assume the presence of gravitational fields and it is not possible to introduce the Newton's equations of the gravity due to its action instantaneous remote. However, it was changed the gravitational potential to a scalar, after to a vector, and finally a to symmetric tensor. But the results are not consistent with the experimental observations.

3B Relativistic Theory of Gravitation

- In 1986, Anatoli Logunov and M. Mestvirishvili formally introduced the Relativistic Theory of Gravitation (RTG), developed between 1984-1986 also with Vlasov, 1984. Last review to explain the accelerated expansion of the Universe (S.S. Gershtein, A.A. Logunov, M.A. Mestvirishvili, N.P. Tkachenko, 2004).

- The RTG is the true generalization of the Special Relativity to the gravity. Truly, there is no Special but whether Relativity, because General Relativity is only on the gravity.

- The principles of the RTG are the relativity, the gauge and the geometrization (Logunov 1986).

- The Poincare-Minkowski´s relativity principle is applied for inertial systems and no inertial systems (all the systems).

- The Lorentz transformation it generalizes for all the systems: the inertial systems or no. Surely the RTG equations are general-covariant and depend explicitly of the metric tensor of the Minkowski space-time.
- “Like the energy-momentum tensor is chosen to be the source of the gravitational field, the gravitational field itself should be described by symmetrical tensor of the second rank, φ_{uv}. Further this gives rise to a “geometrization” of the theory” (Logunov, 2004).
- The gravitational field is constructed as a physical field, in the sense of classical gravitational field, on the Minkowski space-time.

"The gravitational field, as any other fields, develops in the Minkowski space and that the tensor of the energy-momentum of every matter fields, including the gravitational field, is the source of this field" (Logunov, 2004) .

- This field cannot destroy by the coordinates change. It is integrated consistently with the laws of the electromagnetism of Faraday and Maxwell and is "concordant with modern gauge theories of the electroweak interactions and QCD" (Logunov, 2004).

- Therefore all the field variables in the RTG equations are functions of the coordinates of the Minkowski space-time. But is unambiguously separated the forces of inertia from the gravitational field and not present the problems of unification between gravity and electromagnetism of the General Relativity due that in RTG both are physical fields with a material substratum.

- The RTG has manifold (M^4), pseudo Euclidean metric (γ_{ik} (x) g_{uv}) where γ_{ik} (x) is Minkowski´s primary metric and g_{uv} is Riemann' secondary metric.

- Minkowski space-time it curves due to the matter. Locally it becomes a pseudo Riemann spacetime, in function on density of the gravitational field and Minkowski space-time.

The gravitational field has energy-momentum density and two bosons of spins 2 and 0. The TRG need a little mass of the graviton that Logunov esteems ≤ 1,6 * 10^{-66} grams.

- Indeed in the RTG, the gravitational field and the matter, taken together, obey rigorously the laws of conservation of the energy-momentum and the angular momentum.
- Therefore, the RTG has various geometries like the General Relativity: pseudo Euclidean for empty regions and curved (pseudo Riemannian manifold with metric tensor g_{uv} and curvature no null determined by the energy-momentum tensor T_{uv}, equipped with a subjacent real Minkowski´s spacetime) in presence of a gravity field.
- But, absolutely the Minkowski space-time is the container of the matter and the fields.

C- Superluminary Relativity

- In 1998, Petar Anastasovski formulated its theory on Superluminary Relativity, based in that the vacuum has properties which are connected with the mass of the particles. "Besides the vacuum properties covered by the Special Relativity and corresponding observed phenomena, there is some other vacuum properties as well, which are additional to first ones, but witch allow the possibility for $v>c$".

- The speed c is a constant of the nature but does not the final speed.

- For $v>c$ the fundamental equations of transformation are:

$$x' = \sqrt{(1-c^2/v^2)}(x+vt),\ y' = y,\ z' = z,\ t' = 1/(\sqrt{1-c^2/v^2})\ [t+\sqrt{c^2}(v^2-c^2)/v^4\ x]$$

4 Spacetime structural property of the gravity field

- In the General Relativity (GR) the distribution of mass-energy of the universe determines the geometry of the spacetime, according to Einstein´s manifold (M^4), Lorentz' metric (g_{uv}); intrinsically curved by the tension that exerts mass-energy (T_{uv}) on M.

- The mass-energy (T) determines the curvature, the curvature (g) determines the geometry and the geometry determines the geodesics of the spacetime.

- The metric describes the curvature (gravitational field) of the manifold (spacetime naked). The metric is not unique (No one only geometry).

- The gravitational field is identified with the metric of the spacetime. Therefore this field is of geometric nature.

- In Einstein´s theory of gravitation matter and its dynamical interaction are based on the notion of an intrinsic geometric structure of spacetime continuum.
- A four dimensional continuum endowed with a certain intrinsic geometric structure, a structure that is subject to certain inherent purely geometrical laws.
- Gravitation resides on the geometry of spacetime.
- The pure gravitational interaction is regarded as the energy-momentum (or matter) located in minute specks of matter (the particles or mass-points) and as having a particularly simple form, for example, no charged particles.
- The geometric structure of the spacetime is ruled by the principles of general invariance, an affine connexion and carry a metric.

(Erwin Schrondinger, 1950)

- There is a great number of geometries depending of each exact solution of the ten Einstein's equations. Each solution will depend of the assumptions that are assumed in the solution of the equations. For example, homogeneous and isotropic, to great scale, of the Friedmann-Lemaitre-Robertson-Walker (FLRW) spacetime, homogeneous and anisotropic of the Bianchi spacetime, spherically symmetric completely empty of the Schwarzschild spacetime, maximally symmetric completely empty with a positive cosmological constant of the De Sitter spacetime, maximally symmetric completely empty with a negative cosmological constant of the Anti De Sitter spacetime, etc.

- The equivalence between inertial and gravitational mass implies that gravity is inertial motion in the curved spacetime. The gravitational force is fictitious since is the effect of the curvature of spacetime in itself, in the trajectory of particles when do not follow geodesic lines.

- The motion is always relative to the solutions of the equations of Einstein when ($T>0$) and the laws of physics are covariant in all the reference systems (inertial, accelerated or gravitational).

- The Minkowski´s space-time is the simplest case of the laws of nature since the metric functions (g_{uv}) must satisfy the condition of Riemann. And according to Schwarzchild´s metric must tend in the infinity to the Minkowski´s metric (η_{uv}), which restored the inertial structure of spacetime, beyond the limit in which the matter ceases to act on it. Also on the infinitesimal limit and in all the solutions for a vacuum spacetime ($T_{uv} \approx 0$). Consequently, the geometry of the space time also depends on initial conditions to be established for the Einstein's equations.

- The generalization of the Schwarzschild metric, realized by Roy Kerr, in 1963, describes the geometry of spacetime around an uncharged, axially-symmetric black hole with a spherical event horizon and is known as the Kerr metric (or Kerr vacuum). Therefore, it shows that there is absolute rotational motion. I.e, the general relativity supports Newton's bucket absolute motion.

- The background independence of the General Relativity is not that of Relationism, which denies the existence of a background, but refers to the independence of the geometry of spacetime with respect of one only geometry since is dynamic, due to its interaction with matter, this changes. Also, the General Relativity permits generate, under adequate assumptions, the best geometric model for the best application inside of a determined topic.

- There is not way of introducing the law of conservation of energy-momentum of the matter and the gravitational field taken together.

- The best interpretation of the spacetime is of the Substantialism, but due to Leibniz´s equivalence principle, it produces indeterminism in front of hole argument, direct consequence of the general covariance. The solution is to link the metric with the manifold (thesis of the Sophisticated Substantialism).

5 Space-time a state of the matter

- According to the 'space-time-mass' theory since there is no empty space, then space and mass-energy are the same thing; mass is space, but mass and space are different. How can the mass-space, be same and different thing?. The response is based on another contradiction: empty space as topological space, is container. The geometric curve of spacetime is made of geometric particles that serve as the continent of the particles of energy, forces and matter. Thus, the geometric particles are the lowest state of existence of the particles with mass or energy, these are transformed into geometric particles and vice versa. The space-time is a state of matter.

6 Spacetime and Quantum Gravity

- With the goal of unifying the General Relativity with the Quantum Field theory has been formulated the Quantum Gravity. Their two main theories are: Superstring M (favoring Substancialism) and Loop Quantum Gravity (favoring Relationism).

- In the M theory, the dynamic spacetime (M^4, g_{uv}) is the brane, which is a geometric object continuous. The brane would be incrusted in the bulk in Planck´s scale, which is an extra space of 6 or 7 dimensions. May exist several branes. The particles are open or closed strings of the brane. The strings are under tension and they vibrate in a number infinite ways. The gravitational interaction is caused by the vibration modes of the closed strings that are the virtual gravitons.

- The Standard Model particles are excitations of open strings confined to the surface of branes while the graviton would be the only one that would exist also in the bulk, that would be the cause of the weakness of gravity.

- In Loop Quantum Gravity exists only the manifold (M). Quantum spacetime is bare, composed of a network of elements called spins. The connections, between vertices and edges of the spins, generate the graphs, that evolve to new structures.

- The particles are entangled braids differently in spacetime. Because the network changes in every place at every moment, it requires of a structure-mechanism of quantum superposition that gives persistence to the particles. This would be analogous to the qubit, which at each moment can be in various states.

7 The geometric structure of the wave-particle

- The Universe is all the radiation-matter existing contained in the vacuum. Radiation-matter-vacuum exist always in the structure: wave-particle, subject to motion. The vacuum is the energy of the point zero subject to quantum fluctuations.

- The Radiation-matter-vacuum has the geometric property of volume. Its geometric structure has the three dimensions of latitude, wide and length. These dimensions are the geometric property associated to the mere condition of static existence of the radiation-matter-vacuum that has the potentiality to serve as continent of other structures. Due to this potentiality of continent that has the volume, the three dimensions are the geometric spatial property of the radiation-matter-vacuum. Space means continent.

- The motion of translation and/or rotation of the matter, and the variation (radiation) or fluctuation (vacuum) of field, from the geometric point of view, cause that the field-matter leaves its three-dimensional continuous and a fourth dimension is generated. This is a mathematical law of the dimensional geometric spaces N: if N leaves its continuous N, in a direction k contained in the (N+1) continuous then the geometric space of (N+1) dimensions is generated. Thus, the field-matter in motion has four dimensions. The fourth dimension corresponds to the dynamic reality of the existence of the field-matter and is the temporary geometric property of the field-matter. Field is radiation and vacuum. The time means becoming of the existing.

- The wave-particle of the vacuum is compound of virtual particles. The wave-particle of the radiation is compound of real particles. The particles of the vacuum and radiation are without mass according to four vector moment and are subject to the superposition principle. The wave-particle of matter is compound of real particles with mass according to four vector moment and are subject to the exclusion principle. The wave-particle exists in four dimensions, that are their intrinsic geometric property.

Conclusions

- The spacetime is objective since exists independent of the consciousness and intrinsically is property of the material existence, which is the necessary condition of its existence. Their separation occurred in the thought during transit from the philosophical of the ancient to the scientist knowledge. They understood the space-time as the condition of the material existence and the motion. Such inversion, was inferred of the Euclid´s geometry become a formal science before that physics. Always the science of the geometry walked ahead of the science of physics, up with General Relativity, physics it became geometry.

- Inside of the Euclid´s geometry framework was founded the physical science of Galilee and Newton; they stablished that the absolute space and time contains Matter (field-matter), acting on the mechanical motion.

- The geometry of Minkowski and the Michelson-Morley´s experiments on the speed of light did possible, that in the Special Relativity, it established the link between the mechanical motion of the matter and the space-time, putting the speed limit c.

- Einstein found the general covariance, according to the geometry of Riemann. Based in the equivalence between inertial and gravitational mass, he formulated the mutual dependence between the spacetime and the material existence, also the spacetime as the structural property of the gravitational field.

The consequences are:

- the rest of the material existence lacks of spacetime in contradiction with all our experience.

- like Logunov showed, it breaks with the principle of conservation of the energy-momentum applied to the matter and gravitational field taken together.

- it geometrized the physics (in 1923, Ortega and Gasset said to Einstein: You geometrized the physics).

- In the mass-spacetime theory, the spacetime would be a geometric state of the material existence.

- In M and Loop Quantum Gravity the spacetime generates totally the material existence. Therefore, the origin of all the material existence is geometric. The replace of the material content, by its form, is consequence of the General Relativity.

- Substantialism and Relationism coincide in consider the gravitational field as being-in-itself. However, they differ with respect to the space-time: while for the Substantialism is the structural geometric property of the gravitational field, en change, for the Relationism the spacetime is a category of the thought, which expresses the being-in-relation-to (Hegel).
- The error of the Relationism is define the space in relation to the motion without respond which is the container of the universe. While the error of the Substantialism is not respond what it’s made spacetime. These problems are resolve with the spacetime structural geometric property of the material existence (thesis of this work).

- The vacuum is the universal container of the material existence and the vacuum contains to self.

- Truly the spacetime is the geometric dimensional property of the material existence in all their forms of existence (vacuum, matter, radiation).

- The spacetime must exist according to the nature, characteristic and the scales of existence of the wave-particle. Therefore, the spacetime must have various structures differenced according to: virtual and real particles, massless and with mass particles, the superposition and exclusion principles, the determinism and uncertainty principles, the microcosm down Planck scale, the microcosm on Planck scale, the macrocosm.

- Truly the gravitational field is a material force of interaction that has physical effects on Matter.

Appendix: The mathematical fundaments

- **CURRENT VISION**

G_{uv} = $(8 Л G/c^2)\ T_{uv}$ →

Spacetime AND Matter as ontologically two beings

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Geometry Physics

- **MY VISION**

M-Metric $= f(T_{Matter})$

Spacetime U Metric Ċ T_{Matter} as ontologically one being

Form Ċ Content

Geometry Physics

Therefore, the mathematical relations of the theory "Spacetime structural property of the matter in motion" are:

T_{Matter} = (vacuum, radiations, matter) or (field, matter)

[1]

Euclidean Metrics (η_{ij}, t) = T_{Matter} down of Planck

[2]

Pseudo Euclidean metric (η_{ik}) = T_{Matter} in Planck

[3]

Pseudo Euclidean metric (γ_{ik} (x) g_{uv}) = T_{Matter} up of Planck

[4]

Assumptions

If $T_{uv} > 0$ then Matter is compound of real particles.

If $T_{uv} \approx 0$ then Matter is compound of virtual particles. Real particles and virtual particles it propagates in x_1, x_2, x_3, ct dimensions.

Conventions

(η_{ij}, t) according to the Horava´s space and time.

η_{ik} according to the Minkowski´s space-time, revised with the Superluminary Relativity.

$(\gamma_{ik}(x)\, g_{uv})$ according to the Logunov´s spacetime.

Ċ is the structural proper subset.

M is the Manifold