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RESEARCH ARTICLE

A String Theory of Quantum Gravity and Inertial Fields for the Description of Reality

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Abstract:

String theory is one of the most promissory standpoint who aims to conjugate quantum mechanics with the Einstein General Relativity theory, a required assignment for theoretical reasons. We face this task from a model not invariant under diffeomorphism and anon perturbation method. The justification of this assumption can be found in [1], [2] where posit a model of vacuum in which decompose the continuous spatial geometry into 3-dimensional cells and put an oscillator on each one.

These oscillators couple in a way that build a large set of one dimension

fibers that group in strings. Because these strings have no null section, it can be interpreted as an extra dimension.

We will show that this cells model can explain gravity and inertial forces in algebraic terms avoiding divergences of perturbation quantization scheme.

Keywords: Quantum Gravity, Bohm, strings, Kaluza Klein

Introduction

Relativity of space time neglects uncertainty principle while Quantum Mechanics takes into account the uncertainty principle but neglects space time structure.

We put here both principles together and find one expression for the interval to the type of Kaluza Klein where this term is not one extra dimension but a quantum state of space.

In §1 bring together Special Relativity with Quantum Mechanics and get a model where space is quantified in cubic cells.

In §1.1 we use it to write the interval in mathematics terms at ultramicroscopic scale in $\mathbb{R}^{1+1}$. Then find one expression where these quanta get a term similar to Kaluza Klein in $\mathbb{R}^{1+1+1}$ but with different significance.

In §2 write the tensor and putting aside this quanta find the form of the interval that describe the topology of space time in $\mathbb{R}^{1+3}$.

In §2.1 sketch the dynamics of a fermionic matter.

In §3 we use this discreteness of cubic cells to develop a quantum gravity model in a Schwarzchild metric where cells stretch truncate the geometry of space-time in a way that it create curvature.

In §4 sketch how this vacuum can store energy not only as gravitational field but also inertial.

In §5 discuss these results.

1. Fundamentals of a discrete and substrate dependent model

The failure of previous attempts to write a quantum theory of gravity was that space-time was treated as continuous, instead of being quantified itself, even at the very short scale of Planck length.

Studies in large particle accelerators suggest that empty vacuum of space had spectroscopic structure similar to that of ordinary quantum solids and suggest that space is more like a crystal [3].

Strings theory is the most promising candidate for a unified quantum theory of all four fundamental interactions.

General Relativity show up geometrical structure or geodesics that are isomorphic with cosmic strings.

Bohm theory of movement also use wave guides isomorphic with strings [4].

No one of this theories show up a convincing model for reality to describe the Physical Space structure of vacuum in a framework that let include the four fundamental interactions.

We analyze the word “vacuum" from the epistemological meaning of emptiness as “nothing", which consists of absolutely nothing, no matter, no light, nothing.

Others are convinced that the vacuum is unthinkable and a space-time should always contain “something", i.e., to be “æther".

In May 1920, in a conference in Leiden Albert Eintein states that "*A more careful reflection teaches us, however, that the theory of special relativity does not compel us to deny the ether. We can suppose the existence of the ether, but we must renounce to attribute to it a definite state of movement*".

In 1955, A. Einstein adds that "*One can give good reasons why reality cannot at all be represented by continuous field. From the quantum phenomena it appears to follow with certainty that a finite system of finite energy can be completely described byfinite set of numbers (quantum numbers). This does not seem to be in accordance with a continuum theory, and must lead to an attempt to find an algebraic theory for the description of reality. But nobody knows how to obtain the basis of such theory.*"

We develop here a method to obtain a set of natural numbers that are the same for all coordinate systems and seriously consider to reintroduce the aether. Also consider the alternative that at ultra microscopic scale space has not more than three spatial dimensions but less.

In accordance with [1] we introduce a model of space based on a media with high rigid structure at rest in a preferred system of reference. Because we quantify this system in cells and label each one, we can distinguish every point and the geometry has not difieomorphism invariance. In that article we introduce some postulates and demonstrate according these postulates that everything is always in a particular place at a corresponding time. But time must be removed as a dimension [5].

We introduce an essential non measurable time and we will question what continuity means from the point of view of uncertainty of Quantum Mechanics.

We use the same model described in [1] where exist a limit in the smallest measurable length and time. That is, a discrete structure where this limit can be assume. Then we replace the continuum for cubic cells of Planck length l_p.

We deal with a fundamental object - an oscillator - that is the constituent of these cells. For a consistent formulation this oscillators have a normal mode of oscillation corresponding to the empty vacuum and couple in a way that build a chain of one dimension fibers. Mathematically these oscillators can be described as bi vectors [6] like spinors. A perturb of this oscillation mode can be described by operators that generate a fermion running over this fibers.

Because we can construct a well defined quantum operator associated with the area of a surface of a region, it is a Hilbert space.

We have considered strings made of a wider handful of one dimension fibers. It saves to the string the capability to hold fermions inside.

1.1. The quantification of the interval

Our notion of continuous space-time in R^{1+3} turn out into precedents such that other quantities that we considered continuous, like electric charge or action, also have a discrete character. In particular, action cannot be represented as a continuous process, but there is a quantum of the form

$\Delta T.\Delta E \geq ½\,\hbar$

The conservation of the energy-impulse quadrivector and the interval quadrivector relates ΔR with ΔT and ΔP with ΔE. It implies that this expression must give rise to

$\Delta R.\Delta P \geq ½\,\hbar$

We now postulate that an observable, such that position, energy, charges, etc. cannot be measured in a null time interval, but a minimum interval $\Delta T \geq \tau_0$ is required.

This lead that the position cannot be either determined with infinite precision but there must be a physical limit

$$\Delta R \geq R_0 \quad (1)$$

With R_0 to the order of the radius of the electron.

If we wish to quantify the space time, have to observe that these quanta must take in account the Planck length, that is much smaller than R_0. Also because the relativity, it must be combined by a factor who take in account that the inertial system affect its value. We can then express time and distances by a smaller quanta l_0=c.t_0 to the order of Planck length and time[1] in a coordinate reference system (t,x) and a set of natural numbers (*n, m*);

$$\Delta T = m.t_0 + \delta t \quad (2)$$

$$\Delta R = n.l_0 + \delta x \quad (3)$$

[1]For reasons developed in [1] we set this limit to the Planck time and length plus a less factor

We can express this smaller indeterminacy algebraically by means of a single parameter and an oscillation of the type;

$$\delta t = \frac{t_0}{2}.\cos(\pm\omega_0.\tau + \varphi) \quad (4)$$

$$\delta x = \frac{l_0}{2}.\sin(\pm\omega_0.\tau + \varphi) \quad (5)$$

where τ is an essential non-measurable time, inherent to all observers, $\omega_0 = \frac{2\pi}{t_0}$ [7] and φ unknown phase factor that depends only on m,n: $\varphi = \varphi(m,n)$

We will look next for the expression of this small interval ds from the finite set of natural numbers.

In algebra of physical space [8] (APS), the uncertainty in the interval is expressed as a quadrivector

$\Delta S = c.\ \Delta T.\hat{e}_0 + \Delta x.\hat{e}_1. + \Delta y.\hat{e}_2 + \Delta z.\hat{e}_3$

In Clifford's algebra [9], we replace $\hat{e}_0 \rightarrow 1$, $\hat{e}_1 \rightarrow \mathbf{i}$, $\hat{e}_2 \rightarrow \mathbf{j}$, $\hat{e}_3 \rightarrow \mathbf{k}$, and express

$\Delta S = c.\ \Delta T + \mathbf{i}.\Delta x + \mathbf{j}.\Delta y + \mathbf{k}.\Delta z$

As in relativity like in the quantum theory of movement, the only direction that have physical meaning is the displacement one. Then we can always choose x coordinate in the displacement direction making y = z = 0 and express this quaternion in $\mathbb{R}^{1+1}$ as

$$\Delta S = c.\ \Delta T + \mathbf{i}.\Delta R \quad (6)$$

where i can be also j or k.

Applying Eq. (2) to (5) in (6), we label the smaller quanta δS in the coordinate system (t,x) using charts $s_{n,m}$ of the form;

$$s_{n,m} = c.t_m + i.x_n \quad (7)$$

with

$$t_m = \frac{t_0}{2}.\cos(\pm\omega_0.\tau + \varphi_m) \quad (8)$$

$$x_n = \frac{l_0}{2}.\sin(\pm\omega_0.\tau + \varphi_n) \quad (9)$$

Quantification of the interval implies that the most exact theoretical expression of an event is represented by ultramicroscopic charts $s_{n,m}$.

Every event contains a non measurable uncertainty in the interval of the order of l_0, and the most exact description of one event must be express algebraically in a coordinate system (t, x) by (7).

A smaller indeterminacy on (6) is contained in the ultramicroscopic quaternion δs:

$\delta s = c.\delta t + i.\delta x$ with $|\delta s| \geq l_0$.

It is important to note that despite in a small one dimension zone where this charts $s_{n,m}$ was defined as a closed set, in the ordinary 3D space the direction of this position quaternion is a priori undetermined and can have an arbitrary address on each chart, so that i can be either j or k or any other direction.

Continuity of space time means not only to express the interval like (7) but also some restriction to φ_m that let us glue charts.

The first restriction to the generic expression of interval (7)

$$s_{a,b}(\tau) = c.t_0.a + c\,\frac{t_0}{2}.\cos(\pm\omega_0.\tau + \varphi_a) + \boldsymbol{i}.l_0.b + c\,\frac{l_0}{2}.\sin(\pm\omega_0.\tau + \varphi_b)$$

is to postulate that the modulus of δs is a conserved magnitude, $\delta s = l_0$, so we take

$\varphi_m = \varphi_n$, and we can shortly express the interval as

$$s_{n,m}(\tau) = c.t_0.m + i.l_n.n + \frac{l_0}{2}.e^{i(\pm\omega_0.\tau + \varphi_m)} \quad (10)$$

To calculate $\Delta s(m,n,\tau) = s_{n,m}(\tau+\delta\tau) - s_{a,b}(\tau)$ we separate the difference in 2 terms, a discrete part;

$$\delta s(m,n) = s_{n,m} - s_{a,b} = c.t_0.(m-a) + i.\ l_0.(n-b) + + \frac{l_0}{2}.\{e^{i(\pm\omega_0.\tau+\varphi_m)} - e^{i(\pm\omega_0.\tau+\varphi_b)}\} \quad (11)$$

and another continuous;

$$\delta s(\tau) = s_{n,m}(\tau+\delta\tau) - s_{n,m}(\tau) \quad (12)$$

To calculate (12) we multiply and divide by $\delta\tau$

$$\delta s(\tau) = \frac{s_{n,m}(\tau+\delta\tau) - s_{n,m}(\tau)}{\delta\tau}.\ \delta\tau \quad (13)$$

Since τ is a continuous quantity, this is the partial derivative;

$$\delta s(\tau) = \partial_\tau s.\ \delta\tau = \pm\ \mathbf{i}.\frac{l_0}{2}\,\omega_0.e^{i(\pm\omega_0.\tau+\varphi_m)}.\delta\tau \quad (14)$$

$$\delta s(\tau) = \pm\mathbf{i}.\pi.e^{i(\pm\omega_0.\tau+\varphi_m)}.c.\delta\tau \quad (15)$$

To calculate (11) we make the change of variables;

$$\varphi_+ = ½\ (\varphi_m + \varphi_b) \quad (16)$$

$$\varphi_- = ½\ (\varphi_m - \varphi_b) \quad (17)$$

We recognize in (11) $t_0(m-a)=\delta t$, $l_0(n-b)=\delta x$ and express it as

$$\delta s(m,n) = c.\Delta t + i.\Delta x + i.l_0.\sin(\varphi_-).e^{i(\pm\omega_0.\tau+\varphi_+)} \quad (18)$$

An interval δs will be the sum of the terms discrete and continuous:

$$\delta s(m,n,\tau) = \delta s(m,n) + \delta s(\tau)$$

Doing a change of variables:

$$\delta Q = l_0.\sin(\varphi_-) + \pi.c.\delta\tau \quad (19)$$

$$\theta = \omega_0.\tau + \varphi_+ \quad (20)$$

and taken the limit $\delta x \to dx$, $\delta t \to dt$, $\delta Q \to dQ$, we finally get δs in a differential form:

$$ds(t,x,Q) = c.dt + i.dx \pm i.e^{\pm i\theta}.dQ \quad (21)$$

We use s to indicate that this interval is much smaller than the ordinary S.

These are ultramicroscopic zones of space time in $\mathbb{R}^{1+1+1}$

We will show next that Q give us connections that let us recover the Ordinary Space Time.

2. The interval of classic flat space time.

We find in eq. (21) one metric similar to Kaluza-Klein. But where the term in Q is not one extra dimension but the compaction of $(y,z)^2$ [10]

To recover the interval in $\mathbb{R}^{1+3}$ we go back to the uncertainty of eq. (1).

Squaring (21) in generalized coordinates (x_0, x_1, x_2)

$$ds^2 = c^2.(dx_0)^2 - (dx_1)^2 - e^{\pm i.2.\theta}.(dx_2)^2 + 2.i.c.dx_0.dx_1 \pm 2.e^{\pm i.\theta}.(c.dx_0 + i.dx_1).dx_2 \quad (22)$$

we get the metric tensor $\Omega_{\mu\nu}$ with $\mu,\nu=0,1,2$

[2] The uncertainty in R_0 defined in (1) makes **i** can be both **j** or **k** or any other direction

$$\Omega_{\mu\nu}=\begin{pmatrix} c^2 & i.c & \pm i.c.e^{\pm i\theta} \\ i.c & -1 & \mp i.e^{\pm i\theta} \\ \pm i.c.e^{\pm i\theta} & \mp e^{\pm i\theta} & -e^{\pm 2.i\theta} \end{pmatrix} \qquad (23)$$

where the double-valuedness of the sign involve $\Omega_{\mu\nu}$ and $\bar{\Omega}_{\mu\nu}$.

Any real Lorentz transformation $\mathfrak{D}$ can be decomposed uniquely into two special Lorentz transformations $\mathfrak{B}$ and $\mathfrak{C}$, whose transformation coefficients b_k^i and c_k^i are complex conjugate to each other, where the transformations $\mathfrak{B}$ and $\mathfrak{C}$ define groups that are isomorphic to the group ($\mathfrak{D}$)of Lorentz transformations.

Moreover, we will see in §2.1 that fermions and all matter are made of loop that need two strands X_{adv} and its complex conjugate, X_{ret}; so both sign take place to describe any elementary particle using semi vectors like Dirac spinors running at speed c over both strands $r_{n,m}$ of fibers.

Aside from this double-valuedness of the sign, the association if $\mathfrak{B}$ ($\mathfrak{C}$, resp.) with the $\mathfrak{D}$ is unique: The decomposition of the Lorentz rotation that was performed is true only for pure rotations $|\, a_k^i \,| = +1$, so it is not true for reflection; therefore, only pure rotations may be composed from infinitesimal ones. The elements $\mathfrak{B}$ ($\mathfrak{C}$resp.) are likewise pure rotations.

$$a_k^i = b_k^j \Omega_{ij} + c_k^j.\bar{\Omega}_{ij} \qquad (24)$$

If we define a fermion as a loop that involve both direction whose coefficients b_k^i and c_k^i are complex conjugate, since and are themselves Lorentz transformations, the metric tensor of eq. (23) is a semi-tensor of the second kind with transformation-invariant components [11]. We can thus also employ it for the measurement of semi-vectors, as well as the raising and lowering of indices for semi (and mixed) tensors to obtain a tensor that allows us to measure distances in tree dimension.

To get from $\Omega_{\mu\nu}$ a differentiable manifold who describe the structure of space in $\mathbb{R}^{1+3}$, the uncertainty (1) makes no longer possible to define the distance between two points $p = (p_0; p_1; p_2; p_3)$ and $q = (q_0; q_1; q_2; q_3)$ belonging to two fibers of strings that build a fermion as a straight line between them.

The expression of the interval in 1 + 3 + 1 between p and q is of the form;

$$\delta S = c.t_0(p_0 - q_0) + i.l_0(p_1 - q_1) + j.l_0(p_1 - q_1) + k.l_0(p_1 - q_1) \pm e^{\pm i\theta}.\delta Q \qquad (25)$$

The uncertainty (1) of space have been contain in δQ. It represent a quantum field that let connections between strings arranged on a larger scale generating true directions allowed and prohibited for the displacement in tree spatial dimension [19].

As David Bohm suggest, the movement must then be restricted to the string field topology.

In classical mechanics we can neglect the term in Q and assume a classic trajectory over a line of cubes of Planck length l_p.

Since we can glue cells it define a Atlas of charts; a topological space that let us map the string. Making in (25) $(p_i - q_i)=1$ and replacing: [12]

$$t_0 \leftrightarrow dt$$
$$l_0 \leftrightarrow dx, dy, dz \qquad (26)$$

we can express (25) in a differential form:

$$dS = c.dt + i.dx + j.dy + k.dz \qquad (27)$$

Because all the terms of the form $i.j.dx \wedge dy + j.i.dy \wedge dx$ are null, the quadratic form of dS is;

$$dS^2 = c.dt^2 - dx^2 - dy^2 - dz^2 + 2.c.dt.(dx.i + dy.j + dz.k)$$

where the scalar is the interval.

The signature + - - - arise from the quaternions algebra $i^2 = j^2 = k^2 = -1$ and represents a complex space-time structure that we can fill with fibers arranged in strings of no null section.

The opposite signature arise from Minkowskian model of space-time where the fourth coordinate *i.c.t* can be seen as a bivector.

The fact that imaginary numbers appear always when compute space-time intervals implies that time is different in nature than space. Space and time are separated and, if combine, it does at the speed of light [15]. The coordinate system (ct,x,y,z) fixed to particle is an inertial coordinate system that moves at a speed of light.

The abstract nature of Minkowski diagram in a not Euclidean plane does not show the reality of events involving particles moving in zig-zag at speed c.[3]

We had seen that this set of charts are not always connected. The idea that a line joining two point of $\mathbb{R}^{1+3+1}$ posited by Hausdorff do not apply. Moreover, the borders of these charts play a fundamental role, and continuity and difierentiation must be replaced by algebraic operations with a quanta of space and time.

It is suggestive that both the interval and the wave function of quantum mechanics require imaginary numbers.

2.1 Fermionic matter

We will mention briefly some conclusion finding in other works [1],[2], [17] where one electron were defined as loops where movements take place in zig-zag at speed of light.

For a detailed description refer to a previous paper cited above [1] where we posit the existence of preferred reference system we call S_0. Metric (22) can be use to describe a movement in zig-zag inside *s* string made of fibers carrying spin pulses +½ running at speed +c we will call s_U and fibers carrying spin pulses -½ running at speed -c we will call s_D.

We also will define a string $\bar{s}$ made of a handful of fibers $\bar{s}_U$ and $\bar{s}_D$ where spin pulses run in opposite direction.

A fermion is a loop crossed by spin pulses running up and down at speed c inside this strings.

Besides, bosons are confined over s_U and $\bar{s}_D$ fibers to lead a photon moving to the right, or over s_D and $\bar{s}_U$ fibers to lead a photon moving to the left.

Be this loop inside a s string a fermion of Compton length λ moving at speed u.

It involve two strands of fibers we will call X_{adv}, X_{ret}. This strands keep the relation

$$X_{adv} = \lambda + u.\Delta T_{adv}$$
$$X_{ret} = \lambda - u.\Delta T_{ret} \quad (28)$$

where u is the speed of this fermion respect to S_0, $X_{adv} = c.\Delta T_{adv}$, $X_{ret} = c.\Delta T_{ret}$.

This length must be consider as the average of both travels of spin pulses;

$\lambda = ½ (X_{adv}+X_{ret})$,

and the usual expression of this mass $\mu = \hbar / \lambda.c$ must be written as

[3] We treat deeply this aspect of space and time in [1]

$$\mu = \frac{2\hbar}{(X_{adv}+X_{ret}).c} \tag{29}$$

We will see next how gravitational potentials achieve from the gap between cells.

And will see in §4 that also a free mass can store energy as a shrinking of cells, and a inertial field arise. When a string hold a fermion, the gap between cells does not keep the gap of vacuum but a lightly stretch[4] and in (26) l_0; t_0 must have a different value.

3. Quantum Gravity in Schwarzchild geometry

As seen in §1, the most exact expression of the distance between two points inside each string must be expressed in a algebraic terms of units of the order of Planck length.

Choosing a coordinate system with j=k=0, making in (25) $(p_1\text{-}q_1) = n$, and using 26) the distance to the origin is[5].

$$r = n.l_0 \tag{30}$$

It means space is flat, and the discreetness of Planck length is insignificant.

Cells build a manifold in which the physical meaning of these cosmic strings are none other than the geodesic of the GR that we describe using the metric tensor $g_{\mu\nu}$.

It is clear that in this case the classic movement must take the direction of these strings, and also that it must be restricted to the string field topology.

But restricting the measurements to integers of this smallest l_0 proper unit of measurement does not necessarily imply that l_0 must remain invariant when we are in presence of a strong gravitational field. In fact, since a cube length also varies with speed respect to the S_0 system [1] we will see in § 4.1 that l_0 is also not invariant when changing the inertial system. In the same sense, the quantification of at space time can be generalized for a space with curvature simply by postulating that Planck's length and frequency modify its values in the presence of strong gravitational field. A curved space can be seen like strings were the length of each cell varies with the radius to the center of mass.

3.1 The principle of equivalence

The generalization of the equivalence principle for this field model is straight; for an observer in free fall to a black hole the space is flat, and the cells are all of equal length of eq. (30). But in a variety with a strong gravitational field, each cell can have a different size, and the distance must be defined as

$$r = l_1 + l_2 + l_3 + \ldots\ldots\ldots\ldots + l_n = \sum_{i=1}^{n} l_i \tag{31}$$

where l_n is the length of the cells for an observer at a distance r from the center of mass of the system with a gravitational field.

For a local observer in a rest system S´;

$$r' = n.l_n \tag{32}$$

For an observer in S in free fall towards a black hole that starts from infinity, all pulses of the mobile system last t_0 and are equidistant in l_0 but;

How far does this observer fall? On the Swarzchild metric in 2 dimensions;

[4]This stretch is so small that if you collapse all the mass of the earth, it makes a hole of 9 millimeters.

[5] We will call this kind of coordinates as *natural coordinates.*

$ds^2 = (1- \frac{2GM}{c^2.r})c^2.dt^2 - (1- \frac{2GM}{c^2.r})^{-1}.dr^2$

For a far enough observer in S, $r = n.l_0$.

Using (26) we must to replace $dt \to t_0$, $dr \to r_0$, $dS \to \delta s$, and obtain the expression:

$\delta S^2 = (1- \frac{2GM}{c^2.n.l_0})c^2.t_0^2 - (1- \frac{2GM}{c^2.n.l_0})^{-1}.l_0^2$

But if we want to measure the distance between two points in the discrete for an observer in S´ which is left freely fall, $\delta s^2 = c^2.t_n^2 - l_n^2$ and we obtain the relations;

$$t_n = \sqrt{1 - \frac{2.G.M}{n.c^2.l_0}}.t_0$$

$$l_n = \frac{l_0}{\sqrt{1 - \frac{2.G.M}{n.c^2.l_0}}}$$

In weak fields we can approximate $\frac{l_0}{\sqrt{1 - \frac{2.G.M}{n.c^2.l_0}}} \approx 1 + \frac{G.M}{n.c^2.l_0}$ and we found that;

$$l_n = l_0 + \frac{G.M}{n.c^2} \quad (33)$$

Since all known particles have a mass μ much less than Planck's mass, point particle

modify his cell length as;

$$l_1 = l_0 + \frac{G.\mu}{c^2} \quad (34)$$

and gravity cannot be responsible for the glue between nucleons at the subatomic scale for n low.

The variation of cell length for a nucleus of a atom with 200 nucleons considered as a “point” is

$$\frac{l_1}{l_0} = \left(1 + \frac{G.\mu}{l_0.c^2}\right) = 1 + 10^{-17} \approx 1$$

and the gravitational interaction is not applicable to hadrons.[6]

Eq. (33) express a minimal correction for fields involving particles but important for a very large set of them condensed enough.

We postulate that equation (34) is valid everywhere: In the form of weak gravitational fields, the large masses M are the result of many particles of mass μ. If we express (33) as a function of the Schwarzchild length;[7]

$$l_S = \frac{G.M}{c^2} \quad (35)$$

it can be written as

$$l_n = l_0 + {}^{l_S}\!/_n \quad (36)$$

and for n large enough we can replace in eq. (31)

$$\sum_{i=1}^{n} \frac{1}{i} = \int_1^n \frac{1}{x}.dx = \log n$$

and we must to replace the distance from the center of mass (31) for:

$$r = n.l_0 + l_S.\log n \quad (37)$$

Then for weak fields and n large space is almost flat and Quantum Gravity (QG) don't take place.

But a direct consequence for $l_S \gg l_0$ and n low is that because for an observer in free fall towards a black hole, braking does not modify the structure of the field, l_1 is the minimum achievable distance, and the collapse of matter involves treating a black hole as a big cell occupied by a “point mass" at r = 0.[18]

[6] Further, we will see that nuclear forces comes from the transverse components of this wide strings and are responsible for the strong and electroweak forces.

[7] Note that l_S is not the Schwarzchild radius but a half.

3.2. The absence of small black holes

But since no particle neither a black hole can be described by a single cell hole, the zone near a small black hole with M a few orders of magnitude of Planck mass should be a giant fermion; an extremely quantum object with n a high number, and most likely highly unstable. The Planck length must also be very high.

Name with m_r the mass ratio

$$m_r = \frac{G.M}{c^2.l_0} \qquad (38)$$

the law (33) of variation of the cells with the center of mass is;

$$l_n = l_0(1 + \frac{m_r}{n}) \qquad (39)$$

We thus find that there are two perfectly differentiated zones of vacuum:

Those in which $m_r \ll 1$, and those in which $m_r \gg 1$.

Particles with $\mu \approx \frac{c^2.l_0}{G}$ are highly unstable.

That is; at low energies space time is flat. QG is a high energy theory. Collapse of matter to a black hole means there is no smooth transition from GR to QG. Our existence take place in a space of weak gravitational fields where this discreetness is unnoticeable and General Relativity Theory is full valid.

4. Inertial and gravitational potentials

Eq. (36) shows that at weak gravitational fields change in cell's length is very small.

But the rigidity of this network is so great that this minimal difference in the distance between nodes create a significant potential.

The earth is a system with $l_S = 9.10^{-13}$ mts, and its surface corresponds to n = 10^{42}. In eq. (36)

$\frac{l_S}{n} = 10^{-45}$ mts, while $l_0 = 10^{-35}$ mts.

We will show that this little difference in l_n over l_0 can gather energy that pay a role not only in gravitational but also in inertial forces.

To find the total energy of one testing particle in a field of both gravitational and inertial field we put a prove mass μ_0 in a zone of a weak gravitational field and speed +v at radial direction r.

Classic gravitational energy $E_g = -\frac{G.M.\mu_0}{r}$ in term of Schwarzchild length (35) and natural coordinates (30) is $E_g = -\frac{\mu_0.c^2 l_S}{n.l_0}$. Then we can express energy as

$$E_g = \mu_0.c^2 \,(1 - \frac{l_n}{l_0}) \qquad (40)$$

That is a bound state of energy lower than rest mass.

Using the expression developed in [1], in one inertial system S joint to a mass prove who move at speed v respect to S_0 cells are all of equal lengths l_v where

$$l_v = l_0.\sqrt{1 - (\frac{v}{c})^2} \qquad (41)$$

and the kinetic energy:

$$E_k = \frac{\mu_0.c^2}{\sqrt{1-(\frac{v}{c})^2}} \qquad (42)$$

must be written as

$E_k = \mu_0 . c^2 \frac{l_0}{l_v}$ (43)

The total energy for this testing particle is $E = E_k + E_g$:

$E = \mu_0 . c^2 . (1 - \frac{l_n}{l_0} + \frac{l_0}{l_v})$ (44)

And there is only one type of mass that transform one in another.

If v is the escape speed at r = ∞ speed will be zero and $E = \mu_0 . c^2$. We get:

$\frac{l_n}{l_0} = \frac{l_0}{l_v}$ (45)

and in (44) gravitational mass will cancel with inertial mass.

What we estate is that this vacuum is a kind of ether that store energy, not only as a well known gravitational field but also as a inertial field. Forces comes from local topology. For pure gravitational fields, eq.(44) give raise

$F = \frac{\Delta E_g}{\Delta r} = \frac{\mu_0 . c^2}{l_0} \left(\frac{l_{n-1} - l_{n+1}}{2 . l_0} \right) = \frac{\mu_0 . c^2}{{l_0}^2} \left(\frac{l_S}{n^2 - 1} \right)$ (46)

We recover the classical equation; $F \approx \frac{G.M.\mu_0}{n^2 . l_0^2}$

Equivalence between inertial and gravitational forces implies not only gravity store energy but also the vacuum.

We will show how it works with one example.

4.1 Energy storage of vacuum

1) - Be a Hydrogen molecule at rest in one inertial system S_1 that move with unknown speed u inside a group of strings at rest in S_0 in absence of gravitational fields.

The Compton length of this H_2 molecule is λ and have a mass M

$M = \frac{\hbar}{\lambda . c}$ (47)

Now we add a potential energy of two bosons that gathered energy in a form of two photons of energy $E = 2.\hbar.\nu$ as exited states of this molecule.

In a tree dimensional space this H_2 molecule involve fibers and strings at all directions, but for simplicity we will consider this molecule as in line cells.

As we describe in §2.1 his Compton length can be express as $\lambda = n.\ l_0$.

The total energy of H_2 can be express in S_1 as;

$M_1 . c^2 = \frac{\hbar . c}{n . l_0} + 2 . \hbar . \nu$ (48)

We postulate that this potential energy make cells shrink over one side of cubes, and we can express it as a H_2 molecule that occupy the same amount of cells, but smaller: [8]

$M_1 . c^2 = \frac{\hbar . c}{n . l_1}$ (49)

If the molecule emit one photon, it goes from S_1 to S_2 system and his energy is

$M_2 . c^2 = \frac{\hbar . c}{n . l_2} + \hbar . \nu$ (50)

with $l_1 < l_2 < l_0$

If the molecule emit both photon simultaneously at opposite direction it remain in the S_1 system. But now his total potential energy is null. From (48) and (49):

$l_0 . (M_1 . c^2 - E) = l_1 . M_1 . c^2$ (51)

and we get for the length of each cell:

$l_1 = l_0 . (1 - \frac{E}{M_1 . c^2})$ (52)

Then, this ether can store energy and S_0 is a inertial and gravitational field.

[8] Do not confuse this l_1 with the one used in equation (34) as length of cell number 1 in a gravitational field,

We make in this example several simplification, but we can extend this result to a spaceship with chemical fuel. Nevertheless this shrink of S_0 system cells is so small to be perceive, it can explain the paradox of a navy who spent energy to go back and forth from one inertial system to another [15].

2) - We show with this example how this ether can feed and store energy somehow through the shrink or stretch of cells of rest mass M_0 made of a large amount of cells.

Using (29), we can identify different length cells values for the rest mass:

2-a) Mass without energy at rest in the system S_0;

If u=0 and $X_{adv} = X_{ret}$ his Compton length λ = n. l_0. Equation (29) turn into

$$M_0 = \frac{\hbar}{n.l_0.c} \tag{53}$$

2-b) Rest mass with energy E inside

Eq. (49) give rise to a shorter Compton length, but the same number of cells:

$$M_1 = \frac{\hbar}{n.l_1.c} \tag{54}$$

and because $l_1 < l_0$; $M_1 > M_0$

2-c) Rest mass in a gravitational field

Eq. (36) implies $l_n < l_0$ and then a rest mass M_n slightly light than M_1.

2-d) Mass without internal energy in a inertial field S moving with unknown speed u respect to S_0.

In the system S where this mass is at rest, every fermion can be split up in strands where spin pulses make a loop over both strands X_{adv}, X_{ret} that comply (28).

The loop implies to take the sum of both path. It easy to demonstrate [1] that [9] :

$$X_{adv} + X_{ret} = \left(\frac{n}{\chi} + n.\chi\right).l_u = 2.n.\gamma.l_u = 2.n.l_0 \tag{55}$$

where

$$\chi = \sqrt{\frac{c+u}{c-u}} \tag{56}$$

In this case proper distances in proper units l_u of eq. (41) must be replaced by l_0

and the mass from eq. (29) have a minimum in the system S given by (53) [1].

Then we demonstrate that cells are the constituent of a network that play a active roll not only as a gravitational field but also inertial. Mass at rest in S are made of strands at rest in S_0 that comply the equations (28) and eq. (29) reduce to (53).

4.2 The hidden variables of the vacuum

This model introduce cosmological strings who accommodate space topology where the existence of a hidden parameter $\varphi(\tau,x)$ defined in eq. (4), (5) carried by one dimension fibers, or more general, parameter Q; θ form eq. (19), (20) in tree dimension space of eq. (25) means strings contain an instruction that determine the dynamic of the system. Alter the measurement instrument alter φ, and the outcome.

A hidden variables can control the measurement outcome.

[9] For more details go to ref §2.3 in [1] (Proper units)

The Everett interpretation [20] is deterministic in a way that the violation of Bell inequality have been assume by it[1], and the assumption of a definite outcome lay of the collapse of Copenhague interpretation. The explanation it provide for the Bell inequality and EPR is that when Alice and Bob make their measurements, the trajectory split into many pathways. From the point of view of Alice, there are multiple strings to Bob experiences different results, so Bob cannot have a definite result until both future light cones overlap. And the same is true from the point of view of Bob.

5. Discussion and conclusion

We started introducing uncertainty of quantum mechanics to the interval and find a metric tensor in $\mathbb{R}^{1+1}$ that explain QG as a field.

Restricting the movement to one dimension string we can restrict the uncertainty.

But still remain an algebraic, pure mathematical limit to space and time, and the most exact characterization of the position that we can get comes from (2), (3):

$t = a.t_0$

$x = b.l_0$

with a, b very high natural numbers.

If we speculate on how to map the interval with a parameter τ, universal for all observers that evolves monotonously, the expression (21) is somewhat similar to Kaluza Klein in a very small zone of space $\mathbb{R}^{1+1}$ in which Q is not a fifth dimension but a quantum field we represent as a kind of Lorentz boost. But still taking in §2 apart this quantum field it differ from Ordinary Space Time in many senses.

One is that this algebraic expression (2), (3) of space time implies it is not always continuous, neither isotropic in tree dimension.

Other is that removing two spatial dimension allow the existence of other dimensions not belonging to space.

We build $\mathbb{R}^{3+1}$ from (21) using a closed set of charts where the borders glue building a non Hausdorff space at a scale some orders of magnitude above the Planck scale.

Further we can develop a model in which we use the remaining extra dimension of strings introducing a element belonging Maxwell group that forms planes (branes) [2].

This model fits well in strings theories, and also let merge electromagnetism in a Great Unification Theory (GUT) [2].

We can also start postulating the existence of a preferred reference system as a network of cubic cells holding some oscillatory elements we attribute to some fermionic dark matter that are the basic constituent not for the matter and antimatter but also the vacuum. [1]

We have proved that quantifying space time at scale of Planck length we can explain gravity. But gravity affect its value. It give raise a model of Quantum Gravity (QG) where the collapse of matter makes classic General Relativity (GR) drastically change to QG.

We conclude that a black hole is a real hole on it, and that all mater must end in holes on this network, but the distances between nodes have two sharp geometries:

- One where ordinary quantum solids in weak gravitational fields are cubes of similar lengths. In this case the discreetness in Planck lengths can be neglected and vacuum can be treated as a continuum where the $G_{\mu\nu}$ tensor is given by the stress tensor.

- The other one is near strong gravitational fields that make this cells differ in length so much that it cannot be treated as a continuum, and QG must be take in account.

This theory constrict QG to the collapse of matter and postulate that quantum effects near a black hole must be very strong.

In relation to the connection to this theory with others, this model can be regarded as a superstring theory which requires the presence of this fermionic dark matter field whose quantum effects cancel the ultraviolet divergences of the graviton field. But because this one dimension strings are embedded in a higher dimensional space, superstrings put branes in a equal footing of strings.

The chirality of the oscillators of the classical solution for the closed fiber show a duality between left and right moving leading the concept of T-duality, which is the natural way to introduce the concept of D-branes.

It follow that this network could be the framework for all kind of fields, and merge electromagnetism and quantum mechanics in a GUT.

These topology reintroduce the ether as a quantum field that is nothing other than Bohm's interpretation of pilot waveguides [19] where the ignorance of the phases provides us with a deterministic QM theory with non local hidden variables. A particle constructed as disturbances of the lattice propagates information using the wave function as a guide.

This privilege system is the reviled of the ether we call S_0, but as Einstein state where the rest can not be defined.

This model can explain “spooky action at a distance" by introducing a lattice whose structure can fast propagate pathways that can be described by the wave function of the particles.

Perhaps this string model where the fundamental object is a dark fermionic matter with a current of spin ½ running over the fibers at speed ±c helps us to explain the anomalies that dark matter is intended to account for.

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