„THE HYPOTHESIS OF THE UNIFIED FIELD AND THE PRINCIPLE OF ITS DUAL INTERPRETATION

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ABSTRACT

The hypothesis of the unified field leads to the principle of its dual interpretation according to which "Any physical magnitude can be expressed, in a coordinate system of a Euclidean space, both as a spacetime and as a quantum magnitude". On the basis of this principle a particle field can be described through the whole of its extent with spacetime wave functions, and it is proved that the product of an eigenvalue of the energy of a particle field by the mean value of the volume which contains that energy is a constant. That constant is verified for the energy levels of a proton and for the rest energy of an electron.

I. INTRODUCTION

The concept of the unified field is not new [1], [2]. However the studies of the black holes and the Big Bang theory revealed the necessity for the unification of the general theory of relativity (GRT) with the quantum mechanics (QM) [3], [4]. As is known the gauge principle interprets the QED [5] but not gravitation; Attempts have been made using supersymmetry, to construct gauge theories but they cannot overcome the requirement for renormalization [6].The superstring theory [6] is expected to give finite amplitudes without any need for renormalization; a rigorous proof of this claim is as yet lacking. However the problem of the unified field is not only mathematical; it is a problem which relates to the substance of the reality; possibly it is also a philosophical problem. Therefore new principles for the unified field could be useful. The principles of this paper are based on the consequences derived from the hypothesis of the unified field according to which the nature of the Universe is everywhere the same.

II. METHODOLOGY-PRINCIPLES

The methodology that is used to derive the consequences of the hypothesis of the unified field is reductio ad absurdum. First it is assumed that the hypothesis of the unified field, the GRT, and the QM are all valid. That assumption leads to certain contradictions. These contradictions lead to the necessary modification of and correlation between the GRT and the QM in order that the hypothesis of the unified field be valid. These modifications and correlations are mentioned in this paper as consequences of the present hypothesis. **As long as the hypothesis is valid, these consequences can be regarded as principles of the unified field.** The hypothesis of the unified field implies a unified nature of the Universe, which means that there does not exist any difference between matter and field. The latter is satisfied by the QM but not by the GRT, according to which any field is a spacetime continuum created by some matter. Thus if we were to unify the QM with the GRT we could state the following consequence-principle of the unified field:

Principle I. In the whole extent of a particle field there does not exist any privileged area, and any spacetime of it contains energy due to the spacetime itself, which is matter.

More specifically, and according to the experience gained hitherto, that principle suggests that every spacetime can be regarded as a particle wave and vice versa, a fact which is valid under the following **principles of the dual interpretation of the unified field:**

Principle II. A particle field can be described, in a coordinate system of a Euclidean space, through a spacetime wave function which is identical with the particle wave function of the field.

Principle III. Any physical magnitude can be expressed, in a coordinate system of a Euclidean space, both as a spacetime magnitude and as a quantum magnitude.

According to this hypothesis the GRT must be compatible with principles I, II, III. Thus we can state the following principle :

Principle IV. In the whole extent of a particle field are valid only those consequences of the GRT which are compatible with principles I, II, III.

Principles II, III include principle I because they hold that any spacetime can be regarded as a particle wave which contains energy and which by its nature excludes the existence of any privileged area. If we were to extend the physical magnitudes to the non comprehensible part of reality, principle III would include principle II. However all principles are mentioned in this paper because they are helpful for better understanding. According to what was mentioned the existence of a spacetime implies the existence of energy. Conversely we arrive at the following corollary I:

Corollary I. The existence or the non existence of energy implies the existence or the non existence of spacetime- and consequently of any geometry.

This hypothesis facilitates the statistical interpretation of space and time and the extension of the relativistic QM (RQM) to spacetime magnitudes; it must be noted that the conventional RQM [7], [8], [9], is based on the relativistic behaviour of energy but ignores the relativistic behaviour of space and time.

However the issue of what the difference is between the gravitational (g) and the electromagnetic (em) space arises, since according to this hypothesis they are both described in spacetime terms. The answer to that question can be given on the supposition that real space has not only our known dimensions but also dimensions that correspond to electromagnetism and to antimatter. Thus, every phenomenon can be described, under the same principles, in spacetime terms but through its relevant domain. In this paper the consequences of the hypothesis of the unified field are investigated for the case of a gravitational space, but according to what has been mentioned they can apply to every space.

III. THE ENERGY OF SPACETIME

As spacetime of reference of a particle field we define a Euclidean spacetime to which through a coordinate transformation the field corresponds. This spacetime of reference is not only a geometrical notion, since according to the present hypothesis it is matter and any magnitude of it in the following will be denoted by the subscript $_0$.

A point A_0 of the spacetime of reference by the action of the field occupies a position $A \neq A_0$. Thus we have the transformation $A_0 \rightarrow A$ through the transformations $\chi^i \rightarrow \chi^{D^i} = f(\chi^i)$ and $dx_{Ao}{}^i \rightarrow dx_A{}^{Di}$ which are not simply coordinate transformations but transformations of deformity denoted by the superscript ^{D}. According to the GRT in the area of point A these transformations can be regarded as Lorentz transformations [1], [10] denoted by the superscript '. Thus for the invariant magnitude $ds_A{}^2$ we have:

$$ds_A{}^2 = g_{ij}{}^D \ dx_A{}^{Di} dx_A{}^{Dj} = \delta_{ij} dx_A{}^{'i} dx_A{}^{'j} = \delta_{ij} dx_A{}^i dx_A{}^j$$

where $g_{ij}{}^D$ the metric tensor which corresponds to the transformations of deformity when these are regarded as a coordinate system and δ_{ij} Kronecker's symbol. Since the spacetime event which is defined by the quantities $dx_A{}^{Di}$ cannot correspond to two different spacetime events of the spacetime of reference we have: $dx_A{}^i = dx_{Ao}{}^i$.Thus we obtain:

$$ds_A^2 = g_{ij}{}^D dx_A{}^{Di} dx_A{}^{Dj} = \delta_{ij} dx'_A{}^i \, dx'_A{}^j = \delta_{ij} dx_A{}^i dx_A{}^j = \delta_{ij} dx_{A0}{}^i dx_{A0}{}^j = ds_{A0}{}^2$$

Thus the infinitesimal spacetime $d\Omega$ in the area A of the field results from a spacetime $d\Omega_0$ of the area of the point A_0 or of the point A of the spacetime of reference by way of a Lorentz transformation. The same holds true for the infinitesimal spacetimes adjacent to $d\Omega$ and $d\Omega_0$ (of the point A_0) respectively since they correspond through transformations of deformity. According to principles I, IV, $d\Omega_0$ and $d\Omega$ contain energy dE_0 and dE which obey the GRT, according to which the laws of Physics are expressed equivalently in all systems of coordinates and, of course, in systems defined by a Lorentz transformation. Thus it holds that the spacetime $d\Omega$ has energy dE such that we have [11]:

$$\frac{dE}{dE_0} = \gamma = \frac{\tau}{\tau_0} = tr = \frac{dV_0}{dV} = \frac{1}{v_r} \qquad (1)$$

and $dE = \frac{dE_0}{dV_0}.dV_0.tr = DE_0.dV_0.tr$ (2)

where by τ is denoted the time interval, by tr the relative time, by v_r the relative volume and by DE_0 the energy density of the spacetime of reference.

As has been mentioned, to infinitesimal neighboring spacetimes of a field correspond infinitesimal neighboring spacetimes of the space time of reference, by way of a Lorentz transformation. Therefore eqn (2) can be integrated. Thus we have:

$$E = \int dE_0 tr = DE_0 \int tr dV_0 = DE_0 \int_{\Omega_0} tr dr^3 \quad (3)$$

where Ω_0 is the space in the Euclidean spacetime of reference to which the field, through the transformations of deformity corresponds.

On the basis of the above mentioned we may notice that a field can be described through a coordinate system of a euclidean spacetime of reference by the aid of the transformations of deformity with respect to the spacetime of reference.

Elucidation

In this paper when we say description through a coordinate system of a euclidean spacetime of reference we mean the description through the transformations of deformity which apply on the euclidean spacetime of reference which has not been deformed by the action of the field. Any magnitude of the field eg. relative time or relative length in a direction $\vec{n}$, is described through a coordinate system of the spacetime of reference but corresponds to that point of the field which is defined through the transformations of deformity. Thus the principles II, III do apply, since the description of a particle field according to the QM is achieved by the aid of a Ψ wave function through a coordinate system of a euclidean space which has not been deformed by the action of the field.

IV. THE UNCERTAINTY OF SPACETIME

The hypothesis of the unified field, by definition, includes the quantum theory. According to the uncertainty principle, no energy of a particle field capable of being measured accurately in a given time exists [7], [9], and it holds that:

$$\delta E . \delta t \geq \hbar \quad (4)$$

where t refers to the spacetime of reference. The hypothesis of the unified field leads to the idea that a particle field can also be regarded as a spacetime field. Thus according to principle III eqn(3) is valid. Due to (3) and (4) it holds that:

$$\delta \int_{\Omega_0} tr dr^3 . \delta t \geq \hbar / DE_0 \quad (5)$$

Relation (5) shows that no unique tr corresponds to every point of a particle field at every instant t, for if this were the case it would not be possible for (9) to hold. **According to the GRT, tr is described by a continuous function. According to the present hypothesis which leads to inequality (5), tr is discontinuous.** As long as this hypothesis is valid the GRT is modified, and it is valid that a particle field can be described with spacetime terms, i.e. its energy can be written in the form of eqns, (1), (2), but it obeys inequalities (4), (5).

V. SPACETIME OPERATORS AND WAVE FUNCTION

According to principle III and to corollary I any spacetime magnitude can be expressed as a quantum-statistical- magnitude. Thus using capital letters to denote the quantum - statistical - magnitudes, the superscript $\bar{}$ to denote a local mean value and the symbol $\langle\ \rangle$ to denote a space mean value , then for the case of the relative time of a particle field in an energy state E, we have :

$$\hat{TR}\,\Psi_E = \langle TR_E \rangle \Psi_E \tag{6}$$

According to principle III it is valid that:

$$\langle \overline{tr_E} \rangle = \langle TR_E \rangle \tag{7}$$

Eqn(3), because of the uncertainty principle, is valid for any t; therefore it holds that:

$$E = DE_0 \int_{\Omega_0} \overline{tr_E}(r)dr^3 \tag{8}$$

and $E = DE_0 \dfrac{V_0}{V_0} \int_{\Omega_0} \overline{tr_E}(r)dr^3 = E_0 \langle \overline{tr_E} \rangle$ (9)

Therefore we have:

$$\langle \overline{tr_E} \rangle = \frac{E}{E_0} \tag{10}$$

and because of eqn(7):

$$\langle TR_E \rangle = \langle \overline{tr_E} \rangle = \frac{E}{E_0} \tag{11}$$

Thus because of eqn(6,11) we have:

$$\hat{TR} = \frac{\hat{E}}{E_0} \tag{12}$$

and $\hat{TR} = \dfrac{\hat{E}}{E_0} = \dfrac{i\hbar}{E_0}\dfrac{\partial}{\partial t}$ (13)

TR is a particle magnitude and it expresses the relative time of an observer moving on a particle of energy E with respect to the spacetime of reference. If VR is the relative volume of this observer according to the SRT it holds:

$$VR = \frac{1}{TR} = \frac{E_0}{E} \tag{14}$$

Thus VR is a particle magnitude with operator:

$$\hat{VR} = E_0 / \hat{E} = -\frac{iE_0}{\hbar}\frac{1}{\partial / \partial t} \tag{15}$$

For $E_0=mc^2$, eqn (14), expresses the formula known from the SRT. However that eqn ,according to this hypothesis, has sense only on condition that it is valid with respect to a matter spacetime of reference with energy $E_0=mc^2$ and not with respect to a Euclidean coordinate system which is simply a geometrical notion.

Due to eqn (15) we have:

$$\hat{VR}\,\hat{E}\,\psi_E = E_0\psi_E \quad \text{and} \quad \hat{VR}\,\psi_E = \langle VR_E\rangle\psi_E = \frac{E_0}{E}\psi_E \tag{16}$$

For a relative length in a direction $\vec{n}$ from the SRT it is known that:

$$LR_n{}^2 = 1-\frac{v_n{}^2}{c^2} = 1-c^2\frac{P_n{}^2}{E^2} \tag{17}$$

In the form of operators eqn(17) takes the following form:

$$(\hat{LR}_n)^2 = 1-c^2\frac{\partial^2/\partial x_n{}^2}{\partial^2/\partial t^2} \tag{18}$$

By the aid of this operator and the ψ wave function possibly we can define the geometry of a particle field; however that is beyond the purposes of this paper. Eqn (18) expresses the (relative length)^2 operator with respect to a spacetime of reference of energy $E_0=mc^2$.

In a euclidean reference space-time, on the basis of elucidation I, for a relative spacetime magnitude $\overline{sr}$ by definition it is valid that:

$$\langle\overline{sr}\rangle = \frac{1}{V_0}\int\overline{sr}\ (r,t)dr^3$$

where V_0 is the volume of the reference spacetime. For the probability density it is valid that $\int P(r,t)dr^3=1$. Thus we will have that:

$$\int P(r,t)\langle\overline{sr}\rangle dr^3 = \frac{1}{V_0}\int\overline{sr}\ (r,t)dr^3 \quad \text{and} \quad \overline{sr}(r,t) = \langle\overline{sr}\rangle V_0 P(r,t) \tag{19}$$

In order for principle II to be valid, the spacetime function that describes the spacetime magnitudes of a particle field must be identical with the Ψ wave function of the particle field.

Thus we must have:

$$\tau r(r,t) = c_{tr}\psi \tag{20}$$

where $\tau r(r,t)$ the complex relative time and c_{tr} a quantity which can be calculated. Eqn (19) is compatible with principle III on condition that:

$$P(r,t) = \psi^*\psi \tag{21}$$

In fact in that case because of eqn(19) and principle III it is valid:

$$\overline{tr}(r,t) = \langle\overline{tr}\rangle V_0 P(r,t) = \langle TR\rangle V_0 P(r,t) = V_0\langle TR\rangle\psi^*\psi = |\tau r(r,t)|^2$$

and $\tau r(r,t) = (V_0\langle TR\rangle)^{1/2}\psi$ (22)

According to the RQM in general we have:

$$P(r,t) \neq \psi^*\psi \tag{23}$$

and therefore it seems to be valid that:

$$\overline{tr}(r,t) \neq |\tau r(r,t)|^2 \tag{24}$$

However we may notice the following:
We write the function Ψ in the form: Ψ= Ψ_R+ Ψ_I where Ψ_R, Ψ_I are the real and the imaginary components of Ψ. In the case in which the imaginary axis is perpendicular to the real one we have that:

$$\psi^2 = (\psi_R{}^2 + \psi_I{}^2)^{1/2} = \psi^*\psi \tag{25}$$

In the case in which the imaginary axis is not perpendicular to the real one we can have:

$$P(r,t) = |\psi|^2 = (\psi_R{}^2 + \psi_I{}^2 + 2\psi_R\psi_I\cos\theta)^{1/2} \neq \psi^*\psi \tag{26}$$

$$\text{and} \qquad \overline{\text{tr}}(r,t) = |\tau r(r,t)|^2$$

where θ the angle between the real and the imaginary axis. **Of course, nothing compels us to accept that the axis of an incomprehensible magnitude (imaginary axis) should be perpendicular to the axis of the real magnitudes . On the contrary the physical sense of various magnitudes gives sense to the complex representation.** Thus we can state that the spacetime wave function of a particle field, expressed in coordinate system of a Euclidean space, is identical with the particle wave function and it is valid that P(r,t)= $|\psi|^2$; that eqn implies that the complex representation of the ψ function is a variable complex representation in which the angle θ is a function of (r,t) defined by that equation.

VI. QUANTIZATION OF SPACE

Because of eqn(16) and according to principle III we have:

$$\left\langle \overline{vr_E} \right\rangle = \left\langle VR_E \right\rangle = \frac{E_0}{E} \tag{27}$$

The magnitude $V_0\langle VR_E\rangle$ equals the mean value of the particle volume $\langle V_E\rangle$ for particle energy state E. Thus because of eqn(27) we have:

$$\left\langle V_E \right\rangle E = V_0 E_0$$

The only real Euclidean space is the one for which $E_0 \to 0$. Therefore:

$$\left\langle V_E \right\rangle E = c_{VEg} = \lim_{E_0 \to 0, V_0 \to \infty} E_0.V_0 \tag{28}$$

where c_{VEg} constant for all states of all gravitational particle fields, since it refers to a common state. In practice V_0, E_0 can be finite. However, for an isolated particle field the spacetime of reference-since it is matter and not only a geometrical notion- must ensue from the field itself; that is possible in the case in which its characteristics correspond to the mean values of an energy state of the field. Thus if the values V_0, E_0 are finite, they correspond to an energy state of the field. From eqn(28) we have:

$$\left\langle V_E \right\rangle = \frac{c_{VEg}}{E} \tag{29}$$

Eqn (29) expresses the quantization of space provided that for distinguished values of energy E_1, E_2, …, correspond distinguished values of volume $\langle V_{E1}\rangle$, $\langle V_{E2}\rangle$, …. For f=(length unit)^2 and L equal to the wavelength of a particle whose energy $E_0 \to 0$, according to the present hypothesis, the volume $V_0 = 1\cdot\lambda$ is possible to represent the volume of a particle field which contains energy E_0; the latter, according to the QM, has the form $E_0 = h\nu$. $E_0 \to 0$, $V_0 \to \infty \Rightarrow \nu \to 0$, $\lambda \to \infty$ and $\nu\lambda \to c$ since c is the only velocity in order for a particle to be compatible, according to this hypothesis, with the zero energy spacetime of reference ($E_0/0=\infty=TR$ which holds on condition that v=c). Thus we have :

$$c_{VEg} = \lim_{E_0 \to 0, V_0 \to \infty} E_0 . V_0 = h \cdot \lim_{\nu \to 0, ‘ \to \infty} \nu\lambda = hc \tag{30}$$

Thus for a spacetime of reference with finite E_0 we have finite V_0=hc/ E_0

VII. GRAVITATION

According to principle III the energy of a field which corresponds to a cube dxdydz of the spacetime of reference, can be expressed both with quantum-statistical- and spacetime terms. Thus we have:

$$DE_0 \overline{tr}(r,t)dr^3 = \langle E \rangle P(r,t)dr^3$$

and $$\overline{tr}(r,t) = \frac{\langle E \rangle}{DE_0} P(r,t) \tag{31}$$

Eqn(31) can be generalized for a many bodies system and in that case P(r,t) represents the **matter** position probability density. In the case of a particle field P(r,t) can result from the Schroedinger [9] relativistic equation. The energy $\langle E \rangle P(r,t)dr^3$ corresponds to a mass:

$$\overline{dm} = \frac{\langle E \rangle}{c^2} P(r,t)dr^3 .$$

In order for that mass to move in a direction x_i from the energy level $\langle E \rangle P(r,t)dr^3$ to the energy level

$$\langle E \rangle (P(r,t) + \frac{\partial P(r,t)}{\partial x_i} dx_i)dr^3$$

a force $\overline{dF} = \overline{dm} g_{xi}$ is needed so that $\overline{dF} dx_i$ equals the difference of the mentioned energy. g_{xi} can be interpreted as the component, in the direction x_i, of the mean value of the gravitational acceleration of the field. Thus in general we have:

$$\vec{g}(r,t) = \frac{c^2}{P(r,t)} \nabla P(r,t) = \frac{c^2}{\overline{tr}(r,t)} \nabla \overline{tr}(r,t) \tag{32}$$

For a body -corresponding to a volume $(x_2\text{-}x_1)$dydz in the spacetime of reference-in a field with **matter** position probability density P(r, t) which takes the existence of the body into account, on the direction x a force ΔF_x acts so that:

$$\Delta F_x = \int_{x_1}^{x_2} \langle E \rangle \frac{\partial P}{\partial x} dxdydz = \langle E \rangle (P(r,t)\big|_{x_2} - P(r,t)\big|_{x_1})dydz = DE_0 (\overline{tr}(r,t)\big|_{x_2} - \overline{tr}(r,t)\big|_{x_1})dydz$$

The same is valid for any other direction. Thus we can say that the space with greater $\overline{tr}$ attracts the body more than the space with lower $\overline{tr}$. Since space is matter we may assume that it can be split with a result the lowering of its relative time. If this takes place in the space under the body so that $\overline{tr_2}' < \overline{tr_1}$ then we will have an upward movement of the body .

VIII. VERIFICATION

1. The behaviour of the proton and of the electron.

From classical mechanics - through which the Bohr's second condition holds for the hydrogen atom - we have:

$$E = \frac{e^2}{2r} = \int dE = \int_r^{\infty} \frac{e^2 dr}{2r^2} = -\frac{e^2}{2}\left(\frac{1}{r_\infty} - \frac{1}{r}\right) \qquad (33)$$

Where E is the absolute value of the total electron energy at radius r.

From eqn (33) we may notice that the same energy E holds on condition that the space defined by r=r and $r \to \infty$ contains energy; the latter is valid on the present hypothesis. Eqn (33) is also valid for the permitted energy levels E_1, E_2, … [7], [8], [9]. The permitted values of energy E_1, E_2, … are precise for the case of a proton. The values of r are not real because they correspond to a space which is defined without taking into account the deformation of space. To every permitted value of E corresponds a permitted mean value $\langle V_E \rangle = V_0 \langle VR_E \rangle$. $\langle V_E \rangle$ behaves as a volume which belongs to a space with constant relative volume or constant energy density; but we can notice that the energy density $dE/dV_E = e^2/8\pi r^4$ is not constant for various r. For this reason in order to calculate $\langle V_E \rangle$ as a function of r we must find a proper transformation f(r) so that:

$$d\left\langle V_{E(r)} \right\rangle = 4\pi f(r) dr \quad \text{and} \quad \left\langle V_{E(r)} \right\rangle = 4\pi \int f(r) dr \qquad (34)$$

where $\langle V_{E(r)} \rangle$ contains energy E(r). For a space with constant energy density it is valid that:

$$dE(r) = -\frac{E(r)}{\left\langle V_{E(r)} \right\rangle} d\left\langle V_{E(r)} \right\rangle \qquad (35)$$

Because of eqns(33), (34), (35), we have:

$$\frac{1}{r} = \frac{f(r)}{\int f(r) dr}$$

which leads to:

$$\left\langle V_{E(r)} \right\rangle = 4\pi K r \quad \text{and} \quad d\left\langle V_{E(r)} \right\rangle = 4\pi K dr \qquad (36)$$

For r=1, $dV = 4\pi 1^2 dr = 4\pi dr$. Thus for r=1, dV corresponds to a space which satisfies eqn (36). Therefore for r=1, $dV = d\langle V_{E(r)} \rangle$ and k=1 . Due to eqn (36), k has units of $(\text{Length})^2$. If, according to eqn(33), to $r = r_{in}$ corresponds a discrete permitted value of energy , then by definition it is valid that $\langle V_{E(rin)} \rangle = \langle V_E \rangle$ and because of (34), (36), we have:

$$4\pi r_{in} = \left\langle V_E \right\rangle = \int_{r_{in}}^{r_{out}} d\left\langle V_E \right\rangle = 4\pi (r_{out} - r_{in}) \qquad (37)$$

where r_{out} the external radius in order for (37) to hold.

Thus we have:

$$r_{out} = 2r_{in} \tag{38}$$

Because of eqns (33), (37) it is valid:

$$c_{VE} = \langle V_E \rangle E = 4\pi r_{in} \frac{e^2}{2r_{in}} = 2\pi e^2 = 2\pi\alpha\hbar c = \alpha hc \tag{39}$$

Eqn (39) can be compared with eqn (30) . If an electric field were regarded as gravitational then we should have c_{VEg}=hc. However, we find that $c_{VEg}=\alpha hc$ because we do not regard the electric charge as a mass and therefore we must use a coefficient for this constant if it is to refer to an electric field .

For a proton eqn (39) verifies that the product $\langle V_E \rangle E$ is constant for every energy state a fact which is in agreement with eqn(28) and consequently with the present hypothesis.

For the case of an electron and for energy level $E=m_0c^2$ we should expect that:

$$\langle V_E \rangle E = 2\pi r_{out} mc^2 = \alpha hc \quad \text{and} \quad mc^2 = \frac{\alpha\hbar c}{r_{out}} = \frac{e^2}{r_{out}} \tag{40}$$

In fact eqn (40) is valid because of the Coulomb potential of an electron on its external radius [7], [9]. **This means that an electron at the energy level $E=m_0c^2$ behaves as a quantum spacetime energy level, a fact which also verifies the present hypothesis.**

2. Black holes

The black holes are so small that Q phenomena cannot be ignored [4]. Thus a black hole should be regarded as a particle field. According to the hypothesis of the unified field a black hole is regarded as a particle field which radiates when it expands. In fact according to eqn(28) we have: $\langle V_E \rangle = c_{VE}/E$. This eqn implies that when E decreases, $\langle V_E \rangle$ increases, and radiation is emitted in order for the energy balance to be kept. The concept that black holes expand is compatible with the expansion of the Universe. If we compare a gravitational particle field with the electrical field which has been mentioned we notice that the product GMm corresponds to $e^2 = \alpha\hbar c$. For that reason, that product should be constant for any pair M,m of any black hole. In the case that M=m=Mp (Plank mass) we have a black hole for which is valid that :

$$M_P{}^2 = \frac{\hbar c}{G} \quad [13] \tag{41}$$

and therefore:

$$GmM = GM_P{}^2 = \hbar c \tag{42}$$

Replacing the factor e^2 by GMm in eqn(39) we have that for a gravitational field it is valid:

$$c_{VEg} = \langle V_E \rangle E = 2\pi GMm = hc \tag{43}$$

Eqn (43) verifies eqn(30) completely and consequently the present hypothesis.

According to eqn(37) we have:

$$\langle V_E \rangle = 4\pi r_{in} \tag{44}$$

For $E=mc^2$ because of (43) we have:

$$4\pi r_{in} mc^2 = hc = 2\pi GMm$$

and $c^2 = \frac{GM}{2r_{in}}$ (45)

Thus because of eqns (43), (45) we have:

$$E = \frac{hc}{4\pi r_{in}} = \frac{\hbar c^3}{GM} \quad (46)$$

The quantizized area of energy E can be regarded as a radiating area due to the expansion of the black hole and corresponds to what is considered as the horizon of the black hole. Thus we can write: $E = kT$, and because of eqn (46) we have:

$$T = \frac{\hbar c^3}{kGM} \quad (47)$$

where k is the Boltzmann constant. The temperature T, which has been calculated by Hawking, is:

$$T = \frac{\hbar c^3}{8\pi kGM} = \frac{1}{8\pi}\frac{\hbar c^3}{kGM} \quad (48)$$

As we can notice, eqn(47), which is derived from the hypothesis of the unified field, and Hawking's eqn(48), almost coincide. Of course it is important to investigate whether or not the factor $1/8\pi$ exists. Eqn(48) is derived by the aid of the GRT and the QM when those are used separately and not as a unified whole. It must be noted that Hawking's radiation is accepted as existing (e.g radiation coming from Cygnus X-1) but eqn(48) has not been experimentally verified [3], [13].

According to eqn(32) for a constant in time symmetric spherical particle field we have:

$$\vec{g} = \frac{c^2}{P(r)}\frac{\partial P(r)}{\partial r} \quad \text{and} \quad P(r) = P(E)P(d\langle V_E \rangle)/d\langle V_E \rangle$$

where P(E) is the probability that the field has energy E, $P(d\langle V_E \rangle)$ is the probability that the particle exists in the area of volume $d\langle V_E \rangle$ on condition that its energy is E, and P(r) is the matter position probability density in the area of volume $d\langle V_E \rangle$. Thus because of eqns (36), (45) we have:

$$\hat{TR} = \frac{i\hbar}{E_0}\frac{\partial}{\partial t}, \quad \hat{VR} = -\frac{iE_0}{\hbar}\frac{1}{\partial/\partial t} \quad \text{and} \quad (\hat{LR}_n)^2 = 1 - c^2 \frac{\partial^2/\partial x_n^2}{\partial^2/\partial t^2}$$

and for

$$\overline{tr}(r,t) = |\tau r(r,t)|^2 = V_0 \langle TR \rangle |\psi|^2 = \frac{\langle E \rangle}{DE_0} P(r,t)$$

which expresses a Newtonian law.

Thus eqn(32) is verified in the case of black holes, a fact which verifies the present hypothesis. However a black hole is regarded approximately as a point mass; therefore eqn(32) is compatible with the gravitational law of any system which is simulated by point masses i.e. with Newton's law in general. It must be noted that eqn(32) expresses the acceleration of gravity with respect to a coordinate system of a Euclidean space; therefore r_{out} does not represents a real distance.

3. The "Locally Dominant Field"

According to P. Beckmann [14], the speed of light is not constant with respect to the observer, but rather, with respect to the locally dominant field, a fact which contradicts the SRT. It must be noted that the SRT has recently been experimentally refuted [15], [16]. **On this hypothesis every space and therefore every "locally dominant field" is matter i.e. a kind of "ether" the existence of which is incompatible with the SRT**

IX. DISCUSSION

1. With the present hypothesis the interpretation of the duality of matter is facilitated
As has been mentioned $\langle Vreal\rangle_E=c_{VEg}/E$. Thus for large values of E we have small values of the real volume of the particle field and vice versa; a particle field can have a large real volume, i.e. it may be extensive, which corresponds to the concept of a wave, or a small real volume, i.e., it may be limited, which corresponds to the idea of a particle. **Thus the duality of matter does not constitute a view that admits solely of a statistical interpretation [7], [9].** According to this hypothesis there is indeed something that is vibrating and this is the quantum spacetime.

2. According to the Schroendinger relativistic equation for an eigenvalue E we have that:
$-\hbar^2c^2\nabla^2\psi + m^2c^4\psi = \Box^2\psi$.
For $E^2=A>0$ we have $E=\pm A^{1/2}$ and, because of eqn (30), $\langle V_E\rangle=\pm hc/A^{1/2}$.The negative values of $\langle V_E\rangle$ can be regarded as corresponding to antimatter. For $E^2=-B<0$ we have $E=\pm iB^{1/2}$ and $\langle V_E\rangle=\pm ihc/B^{1/2}$. This case has sense when it refers to the charge space whose dimensions, and therefore its volume, are incomprehensible.

3. A question arises as to the meaning of the phrase "space contains energy". A first answer could relate to the spacetime compatibility. The motion -including acceleration - of a spacetime with respect to an other implies the existence of a relative time; conversely the existence of a relative time of one spacetime with respect to another should imply a motion in order for those spacetimes to be compatible. If we regard an atom as a spacetime system then the splitting of the atom corresponds to an abrupt exposition of the split parts to the surrounding space i.e. to the abrupt appearance of a high relative time which creates all spacetime compatible kinds of motion, such as radiation and/or particle emission.

4. If this hypothesis is valid then a wider, philosophical, view of spacetime is needed for its better understanding. That could possibly have even a practical significance.

X. CONCLUSIONS

From this paper the following conclusions can be drawn:

1. The main consequences of the present hypothesis - which can be regarded as principles of the unified field as long as the hypothesis is valid - are:

Principle I. In the whole extent of a particle field there does not exist any privileged area, and any spacetime of it contains energy due to the spacetime itself, which is matter.

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Principle II. A particle field can be described through a spacetime wave function which is identical with the particle wave function of the field.

Principle III. Any physical magnitude can be expressed, in a coordinate system of a Euclidean space, both as a spacetime magnitude and as a quantum magnitude.

Principle IV. In the whole extent of a particle field are valid only those consequences of the GRT which are compatible with principles I, II, III.

2. In a particle field, relative time ,relative volume and the square of the relative length (in a direction $\vec{n}$ with respect to the spacetime of reference with energy $E_0=m_0c^2$) have operators:

$$\hat{TR}=\frac{i\hbar}{E_0}\frac{\partial}{\partial t},\quad \hat{VR}=-\frac{iE_0}{\hbar}\frac{1}{\partial/\partial t}\quad \text{and}\quad (\hat{LR}_n)^2=1-c^2\frac{\partial^2/\partial x_n{}^2}{\partial^2/\partial t^2}$$

respectively.

3. a. The complex relative time is: $\tau r(r,t)=(V_0\langle TR\rangle)^{1/2}\psi$.

b. It is valid that:

$$\overline{tr}(r,t)=|\tau r(r,t)|^2=V_0\langle TR\rangle|\psi|^2=\frac{\langle E\rangle}{DE_0}P(r,t)\,.$$

c. $P(r,t)=|\psi|^2$ on condition that the complex representation of ψ is a variable complex representation in which the angle between the real and the imaginary axis is a function of (r,t) defined by that equation.

4. The acceleration of gravity in a matter spacetime system is:

$$\vec{g}(r,t)=\frac{c^2}{P(r,t)}\nabla P(r,t)=\frac{c^2}{\overline{tr}(r,t)}\nabla\overline{tr}(r,t)$$

where P(r,t) is the matter position probability density of the system.

5. The product of an energy eigenvalue of gravitational particle field by the mean value of the volume which contains this energy, measured in the image of the field, is the constant $c_{VEg}=hc$. This is verified

in the case of the energy levels of a proton, in the case of the rest energy of an electron, and in the case of black holes when the latter are viewed as particle fields.

6. Hawking's radiation can be interpreted as result of the black holes' expansion when the latter are viewed as particle fields.

7. Any space is matter i.e. a kind of "ether" which is incompatible with the SRT; the latter has recently been experimentally refuted.

XI. KEY TO SYMBOLS

α	Fine structure constant = 1/137
c	Speed of light
c_{VEg}	Particle constant
DE_0	Energy density of the space time of reference
e	Electron charge
E	Energy
$\vec{g}$	Acceleration of gravity
E_0	Energy level of spacetime of reference
h	Plank's constant
$\hbar$	$h/2\pi$
m	Mass
LR	Quantum- statistical- relative length
P_n	Particle momentum in a direction $\vec{n}$
P(r,t)	Position probability density
P_E (r)	Position probability density for energy state E
r	Position
t	Time in the spacetime of reference
tr	Relative time
TR	Quantum -statistical-relative time
τ	Time interval
τr	Complex relative time
v	Speed

V	Volume
v_r	Relative volume
Vr	Quantum - statistical-relative volume
Ψ	Wave function
Ω	Spacetime
$\langle\ \rangle$	Space mean value

Subscripts:

$_0$	Space time of reference

Superscripts:

$\bar{}$	Local mean value
^	Operator

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