ON THE POSSIBILITY OF A UNIQUE AXIOM IN PHYSICS

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ABSTRACT

The purpose of this paper is to show that the main principles which physics has been based on can be regarded as possible consequences of a unique axiom. This leads to a Space -Time QM which obeys the same principles with the ones of "The hypothesis of the Quantum Space Time-Aether"; this hypothesis is based on the unification of the physical meaning of the notions which derive either from the GRT or the QM.

I. INTRODUCTION

The analysis following is, in a first stage, based on the aspect we have for the notions, space, time, exist, matter, energy. In a second stage, these notions are extended - not arbitrarily - and regarded as stochastic. Time implies the existence of earlier and of posterior; space does so, too. If I say 10 cm I mean the existence of 1,2,...,9,10 i.e. the existence of earlier and of posterior. Therefore, the existence of earlier and posterior is the condition for space and time to exist and vice - versa. When we say that matter exists, we mean that every part of it exists in space and it is measurable. Therefore, in order that matter can exist, it must have everywhere the property of earlier - posterior. Thus, we can state the following axiom I:

Axiom I: "In any area of a matter system there is earlier and posterior".

According to what was mentioned, matter can be described in space-time terms. Thus, we can state the following statement I.

Statement I: "Any matter system can be expressed in space-time terms".

A matter system, in general, has differences within its various areas. This means, according to statement I, that a matter system in general is characterised by different rates of earlier - posterior within its various points. More practically, it means that, with respect to an observer, a clock has different rates of its successive hits at various points. Since space is also locally affected by the local rate of earlier - posterior, it is expected to be deformed due to different rates of earlier -posterior. For the purposes of this paper, the following definitions are necessary [1].

i. *As reference space-time we define a Euclidean space-time to which, through transformations of deformity, any field can correspond.* This reference spacetime is not only a geometrical notion because, according to the present hypothesis, it is

also matter. Any magnitude of it will be denoted by the subscript $_0$. A point A_0 of the reference space-time occupies, by the action of the field, a position $A \neq A_0$

ii. *As Hypothetical Measuring Field (HMF)* is defined *a hypothetical field, which consists of the reference space-time, in which at every point* A_0 *the real characteristics of the corresponding point.* A *of the real field exist.* [1]

iii. *In a HMF, we define as relative space-time magnitude* sr *the ratio of a real infinitesimal space-time magnitude* ds *to the corresponding magnitude* ds_0 *of the reference space-time*: i.e. $sr = ds / ds_0$.

The energy of a matter system measures its ability to exist. If a system starts to degenerate, its ability to exist is getting lower until it disappears. According to this paper, an infinitesimal space-time element dU itself is matter and its energy dE, i.e. its ability to exist, is the ability of an interval between two successive hits of a clock connected to the element to exist. This ability can be measured by an observer who can measure the duration dt between two successive hits at various points. With respect to the observer, in a matter system, some intervals between two successive hits "live" more than other intervals. Thus, we can state that the ability of dU to exist is expressed equivalently by its energy dE and by its duration dt. Thus, taking into account the definition ii, we can state the following statement II.

Statement II: *"In the HMF, the energy of an infinitesimal space-time element is equivalent to its internal time. "*

where as internal time we define an infinitesimal time of a phenomenon of comparison. An immediate consequence of statement II is that:

$$dE / dE_0 = dt / dt_0 \qquad (1)$$

The purpose of this paper is to show that the Plank law, the relativity theory and De Broglie's principles can be regarded as possible consequences of statements I,II. Thus, a matter space-time system can be simulated by a particle wave which, as it is known, is interpreted statistically. It is noted that statement II does not imply any stochastic behaviour in space-time. However, by the aid of Goedel's[2] and Rosser Barkley[3] work, it derives, in a mentally consistent way, that space-time can be regarded as a stochastic magnitude(see discussion). This verifies the statistical interpretation of the QM and it leads to the modification of statement II and equation (1) to non relativistic forms [1]. The final consequences of this statement II are the same as the ones of the hypothesis of the Quantum Space-time - Aether [1] (see chapter IV). Many physical phenomena and laws, which have not been explained according to what until now has been accepted, can be explained on the basis of this hypothesis (see chapter IV).

II. RELATIVITY THEORY

The purpose of this chapter is to show that the relativity theory can be regarded as a possible consequence of statements I, II, *on condition that any space-time is considered as a continuum.* An infinitesimal area of a space-time continuum can be regarded as an area with constant rate of earlier - posterior and therefore it has no space-time deformity. Time is independent of space in this infinitesimal area and, since its rate is different in various points of the field, it can be regarded as a 4th dimension. Thus, in Riemans's 4 -dimensional space with $x_4 = kt$, where k is a constant with units of velocity so that x_4 will have units of length, we can write[4]:

$$dS^2 = dx_1'^2 + dx_2'^2 + dx_3'^2 + k^2 dt'^2 = dx_1^2 + dx_2^2 + dx_3^2 + k^2 dt^2 \qquad (2)$$

For $dS = 0$ we have that $k = \pm i\left|\vec{dr}'/dt'\right| = \pm i\left|\vec{dr}/dt\right|$

For $k = \pm ic$, where c is the speed of light, eqn (2) implies the Lorentz transformations, which are the basis of the GRT. An immediate consequence of Lorentz transformations is that:

$$dt/dt_0 = (1 - v^2/c^2)^{-1/2} = \gamma \qquad (3)$$

where v the velocity of a space-time element with time of a phenomenon of comparison dt with respect to a space-time element with time of the same phenomenon of comparison dto. Because of statement II and eqn (3), we obtain:

$$dE/dE_0 = dt/dt_0 = \gamma \qquad (4)$$

We consider a flat matter space-time whose all space-time magnitudes equal the mean - values of the same magnitudes of the field under study. For this flat matter space-time it will be valid that:

$$E/E_0 = dE_i/dE_0 = \gamma_i = const. \qquad (5)$$

where i indicates a point of the HMF. Because of eqns (3,4,5) we will have:

$$E^2 = c^2(E/c^2)^2 v^2 + E_0^2 \qquad (6)$$

Considering the following:

$$E/c^2 = m \text{ (mass)}, \quad E_0/c^2 = m_0 \qquad (7)$$

$$(E/c^2)v = mv = P \text{ (momentum)} \qquad (8)$$

we obtain: $E^2 = c^2P^2 + m_0^2c^4$ (9)

Eqn (9) is compatible with the SRT which, therefore, can be regarded as possible consequence of statement II. Thus, a space-time system can be simulated, in some of its properties, by a relativistic point mass.

For the purposes of this paper the following elucidation is useful.

Elucidation: *Eqns (8,9) are valid for any flat matter space-time; therefore, they are valid also for a flat space-time whose all space-time magnitudes have values equal to the mean - values of these magnitudes of a stochastic matter space-time system.*

III. QUANTUM MECHANICS

1. General

A particle according to this paper can be regarded as a space-time formation, which changes in time. This change must be an oscillation and not a non-periodic process because of the property of particles to be in general stable. For the simple case of one dimension this oscillation can be analysed according to Fourier analysis in harmonic oscillations. The wave function $\Psi = \Psi(x,t)$ can be written in the form $\Psi = \Psi(x',t)$ where $x' = x'(x,t)$. For a given t, according to Fourier analysis, the space-time function $\Psi(x',t)$ can take the form:

$$\Psi = \sum_n (A_n \cos(2\pi nx'/L) + B_n \sin(2\pi nx'/L)) \qquad (10)$$

where L is a proper interval which will be defined in the later and n=1,2,....

The same form is valid for any t but with different $A_1, A_2, ...A_n, B_1, B_2, ...B_n$. Thus, in general we may assume that Ψ has the form of eqn (10) on condition that $A_1, A_2, ...A_n, B_1, B_2, ...B_n$ are functions of t. It is noted that Ψ of eqn (10) can be extended to complex forms when $A_1, A_2, ...A_n, B_1, B_2, ...B_n$ are complex. By using the exponential form of cos and sin, eqn(10) can be written:

$$\Psi = \sum_n (C_{1n} e^{i(2\pi nx'/L)} + C_{2n} e^{-i(2\pi nx'/L)}) \qquad (11)$$

If $x' = x - c_{nx}t = x - \lambda_n(\omega_n/2\pi)t = (\lambda_n/2\pi)(x(2\pi/\lambda_n) - \omega_n t)$

where $c_{nx}, \lambda_n, \omega_n/2\pi$ are the velocity the wave length and the frequency of the n^{th} harmonic wave, we will have that:

$2\pi nx'/L = (2\pi n/L)(\lambda_n/2\pi)(x(2\pi/\lambda_n) - \omega_n t)$

It is noted that for the same (x,t), the variable x' has different values for n=1,2,3,4… since eqn(11) is a general form for any Ψ function and nothing compel us to accept that $c_{nx} = const$ for any n. Therefore, Ψ is meaningless in the form of eqn(11). However, Ψ in the form of eqn (11) can be regarded as a stochastic, statistically interpreted, function i.e. as a function which has a probability to exist for any variable x'=x'(x,t, c_{nx}) for any n=1,2,3,……

Thus, eqn(11) can take the form :

$$\Psi = \sum_m A_m e^{-i((2\pi/\lambda_m)x - \omega_m t)} \qquad (12)$$

only on condition that:

1. $\lambda_m = L/m$ *, i.e. that L is the wave length of the first harmonic*

2.both $\lambda_m = L/n$ *and* $\omega_m = 2\pi c_{mx}/\lambda_m$ *can take values with both signs* $\pm$ *so that all terms of eqn (11) can be included.* (For the possibility of having negative values of λ_m and ω_m see in section 2 of this chapter and in the discussion).

3.the space-time function Ψ *is a stochastic function which can be only statistically interpreted.*

In the general case of waves which are transmitted to various directions we can write:

$$\Psi = \sum_m A_m e^{-i((2\pi/\lambda_m)\vec{e}_w\vec{r}-\omega_m t)} \qquad (13)$$

where $\vec{e}_w$ is a unit vector which has the direction of wave velocity. This wave function is valid on condition that space-time has not any deformation. When the vibrating medium is space-time itself, we may assume that this wave function describes the HMF in which, by definition, there exist only local deformations. Thus, Ψ describes the changes of relative space-time magnitudes i.e. the changes of the rates of earlier-posterior at various points (r,t) of the HMF (see definitions ii, iii).

2. De Broglie's principles

Eqn (1) can be viewed in two ways:

a. When dto is a unit of time, eqn (1) describes the duration dt, with respect to an observer and, as was mentioned, it leads to the relativity theory.

b. When dt is a constant period of time in the HMF, then eqn (1) can be written in the form: $dE/dE_0 = dt/dt_0 = (f/\nu)/(f/\nu_0) = \nu_0/\nu$ (14)

where ν is the frequency of a periodical phenomenon of comparison and f an arbitrarily constant factor through which we can change the scale of ν, ν_0. If $\nu = 1$, ν_0 must be different in various points of the HMF. If this is the case, ν_0 represents the number of hits of a clock connected with the space-time element dU in the unit of time which is observed in the reference space-time and eqn (14) can be written in the form:

$$dE/dE_{i0} = \nu_{i0} \qquad (15)$$

where $dE_{jo} = dE_{i0}$ and $\nu_{i0} \neq \nu_{j0}$ for $i \neq j$ and where i, j indicate points of the HMF. Since, according to this paper energy-matter is nothing else than a system with different and changing rate of earlier - posterior, eqn (15) shows the way through which a field exists and acts at various points.

Thus, for the same equation we have the following correspondences:

$dE/dE_0 = dt/dt_0 \rightarrow$ observation (relativity theory)

$dE/dE_{i0} = \nu_{i0} \rightarrow$ action (QM as it will be shown later)

From eqn(15) we obtain:

$$E = \int dE = \int dE_{i0}\nu_{i0} = \int (dE_{i0}/dV_0)\nu_{i0}dV_0 = (E_0/V_0)\int \nu_{i0}dV_0 = E_0\langle\nu\rangle_E \qquad (16)$$

where $\langle\nu\rangle_E$ the mean value of frequency in the HMF for an energy state E.

Eo is the energy of a field with $\langle\nu\rangle_E = 1$. Thus, Eo can be regarded as a constant since eqn(16) is valid for any level of energy.

In order that formula (13) is valid, harmonic oscillations are needed which will not take into account the space-time deformation i.e. oscillations which describe

the HMF. In such an oscillation frequency $\langle \nu \rangle_E$ which is valid in general will be the frequency ν of this oscillation. Thus, we will have:

$$E = E_0 \langle \nu \rangle_E = E_0 \nu \qquad (17)$$

Eqn (17) is compatible with Plank's empirical law and its extension i.e. De Broglie's principle for energy when $E_0 = h$. Thus, De Broglie's principle for energy can be regarded as a possible consequence of statement II.

Taking into account the way through which eqns(15,16,17) are obtained, we conclude that they are valid in general i.e. for any matter space-time system and therefore for a photon or for a particle in general.

In the case of a photon which is described by eqn(9) for $m_0 = 0$ we have

$$E = \pm\sqrt{c^2 P^2} = \pm c|P| \qquad (18)$$

As was mentioned, in order that formula (13) is valid, harmonic oscillations are needed which will not take into account the space-time deformation i.e. oscillations which describe the HMF. In such an oscillation and more specifically in the case of a photon for the wave length we will have:

$$E = h\nu = \pm c|P|, \quad \nu\lambda = c, \quad \omega = 2\pi\nu \quad and \quad \lambda = \pm h/|P| \qquad (19)$$

According to the present paper, the wave length has sense since it refers to something that can vibrate and this is the matter space-time system. Thus, for a photon because of eqns(18,19) we have, relations which are compatible with De Broglie's principles. Therefore, those principles can be regarded as possible consequences of principle-statement II.

In the case of a particle in general, from eqn(9) we obtain:

$$E_{eq} = \pm\sqrt{E^2 - {m_0}^2 c^4} = \pm c|P| \qquad (20)$$

where E_{eq} is the energy of an equivalent photon. Since the rest energy $m_0 c^2$ does not change, we may assume that only the equivalent energy E_{eq} participates in the creation of a space-time wave. Thus, we can write:

$$E_{eq} = h\nu_{eq} = hc/\lambda_{eq} = \pm c|P|, and \lambda_{eq} = \pm h/|P| \qquad (21)$$

For energy the general formula of eqn (17) is valid i.e.

$$E = h\nu\ ,\ \omega = 2\pi\nu\ ,\ \nu = c_w/\lambda_{eq} \neq c/\lambda_{eq} = \nu_{eq} \qquad (22)$$

where c_w is the speed of a hypothetical wave in the HMF. Both ν and λ_{eq} relate to reality but a part of ν, i.e. $\nu - \nu_{eq}$, does not "create" wave length because of the rest energy. $\nu - \nu_{eq}$ behaves as a frequency of a wave with zero speed and length ($0 = (\nu - \nu_{eq})0$). However, for reasons imposed by the Fourier analysis, eqns(22) must be applied. For a particle in general, because of eqns(21,22), we have relations which are compatible with the De Broglie principles and, therefore, those principles can be regarded as possible consequences of statement

II. For the same reasons as was mentioned for a photon the wave length which corresponds to a particle in general has sense since it refers to something that can vibrate and this is the matter space-time system.

3.Equivalent Particle Wave.

Taking into account eqns (13,19,21,22) and considering that $\vec{P} = \vec{e}_w h / \lambda$,

we have: $\Psi = \sum_m A_m e^{-i(\vec{P}_m \vec{r} - E_m t)/\hbar}$ (23)

As it is known according to the QM, this equation describes a De Broglie particle wave which can be statistically interpreted.

Because of eqn(9) E_m, P_m can take values with both signs $\pm$. Thus, because of eqns(21.22) ω_m, λ_m can also take values with both signs $\pm$.

Therefore the conditions required for eqns(12,13) to be valid are satisfied.

Thus, according to eqns (9,19,21,22,23) we may draw the following conclusion I:

Conclusion I: "A particle-space-time system can be simulated by an equivalent particle (De Broglie) wave" or equivalently "Any infinitesimal space-time can be regarded as a particle (De Broglie) wave".

Taking into account the way through which eqns(9,19,21,22,23) have been derived and the elucidation of chapter II, we notice that conclusion I is valid regardless of the matter space-time being stochastic or not. In fact, for a stochastic space-time from eqn(14) we obtain:

$d\bar{E} / dE_0 = d\bar{t} / dt_0 = (f / \bar{\nu}_{eq}) / (f / \nu_0) = \nu_0 / \bar{\nu}_{eq}$ (24)

where $\bar{\nu}_{eq}$ is a frequency which corresponds to $d\bar{t}$. For $\bar{\nu}_{eq} = 1$ we obtain $d\bar{E} / dE_{i0} = \nu_{i0}$ and so on.

IV. CONCLUSIONS

1.General

According to what was mentioned, statements I, II can imply the GRT if space-time is continuum and the QM if it is not; this QM, according to what was mentioned, is a Space-Time QM. Thus, the question whether space-time can be regarded as stochastic or not is raised. A philosophical-mathematical consideration is given in the discussion and shows that space-time can be stochastic and not continuum. It is noted that, according to what was mentioned, both statements I, II can be regarded as possible consequences of a unique axiom i.e. of axiom I.

2. Space -Time QM

According to what was mentioned, this paper leads to a Space -Time QM which obeys principles defined by the conclusion I and by the statement II in its stochastic form. It is noted that “The Hypothesis of the Quantum Space -Time (QST) – Ether” [1] obeys the same principles; many physical phenomena and laws which have not been explained according to what until now has been accepted, can be explained on the basis of this hypothesis. Thus, we can explain

the second thermodynamic law as a result of the Universe expansion, the gravitation and the manner of unification of forces, the Casimir effect, the attraction and repulsion of ions, the property of self similarity in matter systems, the black holes' radiation, the reason why there are limits of an approximate validation of the QM and the GRT and the reason why the Lorentz transformations are non valid in the whole extent of the QST[1,6,7,8]. It is noted that a first approximate interpretation of the cold fusion, according to this hypothesis, has already been given [9]. It is also noted that, according to this hypothesis, the QST is matter and therefore it can be regarded as *ether*.

V. DISCUSSION

The mathematical formula of the probability density P(r,t) implies the existence of a logical structure; however, P(r,t) itself means that something exists and does not exist at the same time. The existence of negative λ_m and ω_m in eqns (12,13) means the existence of negative space and time which is incomprehensible, while the corresponding formulae show the existence of a logical structure. It is noted that negative space-time magnitudes, according to previous works [1,8], can be regarded as anti-matter. Eqn (9) is valid either for real or imaginary values of E, P, m. The notion of an imaginary magnitude is incomprehensible. However, the imaginary values of E, P, m imply the existence of imaginary space-time which, according to previous works [1,8] can be regarded as electromagnetic (em) space. All these are logical and illogical at the same time. Thus, a deeper interpretation is needed.

Our basic communication system comprises of Aristotle logic and of a hidden axiom which postulates the existence of earlier and posterior. In fact, every word or phrase is constructed in such a way that the letters or the words are put the one after the other.

According to the process through which Goedel's theorem is proved [2,3], two contradictory statements are valid at the same time. This leads to the following statement "A": "There exists no system including logic and Peano's arithmetic axioms which will not lead into contradiction." This statement does not constitute expression of any of Goedel's theorems which are based on the hypothesis that all axioms are consistent; this Goedel's hypothesis of course is arbitrary. The basic axiom of Peano's arithmetic declares the existence of earlier and posterior. Because of this axiom, we can have the numbers 1,2,3,4...and, according to what was mentioned, this axiom implies the existence of space and time. Thus, the basic communication system obeys the statement "A". We notice that statement "A" cannot be stated because it is based on the basic communication system which, according to statement "A", is contradictory. Thus, statement "A" imposes the silence. When we communicate, we use another hidden axiom according to which *"what is accepted as truth is what includes the minimum possible contradictions"* since the contradictions cannot be vanished. According to this hidden axiom, which we could name as *"axiom of the minimum contradiction"* [10], we obtain the logical and the illogical dimension that is needed, according

to what was mentioned, in physics. In fact, through this axiom we try to approach logic (minimum possible contradictions) but at the same time we expect something illogical since the contradictions cannot be vanished. The systems of axioms we use include the communication system and therefore their contradictions are minimised when they are reduced to the communication system itself. It is noted that this paper is based only on the communication system itself since the existence of earlier-posterior implies the existence of space-time and vice-versa. Thus, the contradictions of the basic communication system can explain the illogical behaviour of space-time i.e. its stochastic nature as well as the existence of negative and imaginary space-time magnitudes.

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