Equivalent photon model of matter

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Abstract: An unpublished observation made in the theory of relativity, reveals a reality of higher spatial dimensions which implies a new model of matter, called equivalent photon model of matter, which displays every particle with rest mass greater than zero, as a photon in a four-dimensional space (without referring to the space-time). This gives an alternative derivation of quantum physics, also can observe the reality behind special relativity, arise physical predictions that not are covered by the existing physical theory and spontaneously arises the concept of five-dimensional space-time, with its fourth spatial axis of compact type.
Keywords: Relativity, photons, elementary particles, four-vectors, mass-energy equivalence, space-time, quantum physics.

1. INTRODUCTION

The argument of this paper is supported by an observation made in the theory of special relativity and quantum mechanics. An unprecedented analysis was performed to a certain theme for each one of them and it was observed that both theories suggest considering the existence of a new physical reality.

1.1 Observation made in the theory of special relativity.

The identity of mass and energy, for the special case where the velocity v is zero, is given by

$$E_0 = m_0 c^2 \quad \textbf{(1)}$$

Where E_0, m_0 is the rest energy and rest mass of matter respectively and c is the speed of light in the empty space.

And the expression for kinetic energy is given by

$$K = \Delta m c^2 \quad \textbf{(2)}$$

Where K is the kinetic energy of matter and $\Delta m = m - m_0$, where $m = m_0 / (1 - v^2 / c^2)^{1/2}$.

Regarding equation (1), has often been misinterpreted its meaning, and then details the two concepts popularly given to this equivalence and the explanation of error:
(1) It is incorrect to say that *mass is a form of energy.* If so, then in the equation (2) any increase / decrease of kinetic energy K, then it should decrease / increase the size of m. This would correspond to compliance with the law of conservation of energy in the event that the mass is a form of energy. However, the opposite happens.
(2) It is wrong to say that *the rest mass contains a kind of potential energy given by equation (1).* If this were so, then in the processes of conversion of mass into energy, the mass should not disappear. But obviously this is not true.
Now, the meaning of this equivalence is exactly what Einstein said: "This equation states that mass and energy are different expressions of the same entity'' (REF 1). Here begins the observation. This entity, referred by Einstein, in physical reality is expressed simultaneously in the two forms in equation (2). This is already known, perhaps what no one had noticed earlier is that, unlike the expression (2), in reference to equation (1) only manifest one of the two aspects: energy or mass, but not both at the same time. That is, physically, in the ordinary three-dimensional space, the

expression like energy can only be manifested when the mass m_0 are annihilated, and vice versa. To explain this, it is proposed to consider the next theorem of tensor theory: "The first three components of a vector ($u_{1,} u_{2,} u_{3,} u_{4)}$ of a four-dimensional space, are components of a vector of the space of three dimensions, the fourth component is a scalar of a three dimensional space"(REF 2). First, if this applies to a four-vector relativistic of the momentum and considering the matter at rest, in corresponding to equation (1), then we have:

$$(0, 0, 0, im_0c)$$

Where $i = (-1)^{1/2.}$

Latter agrees with the previous theorem, because when ignoring it i and adding a factor c, the fourth component is the rest energy, a scalar in ordinary space. However, this not explain the proposed problem because as the fourth component is the measure of temporary nature of the momentum of matter, this only indicates that the rest mass has been linked with a energy that exists in the positive direction of time. Obviously, this last argument is the same case announced by equation (1). On the other hand, if under the same state at rest is considered the following impulse vector of a hypothetical four-dimensional space, whose fourth component is a measure of the spatial property:

$$(0, 0, 0, m_0 c) \quad \textbf{(3)}$$

Then this expression (3) agrees with theorem, but additionally is have an explanation to the problem proposed. Such an explanation is the limitation of the perception to a three-dimensional space confined in a space of four dimensions, in fact the energy of the equation (1) it is expressed in the fourth spatial axis (not referring to the time axis).

1.2 Observation made in the hypothesis of De Broglie wave-particle duality.

The following is the wavelength of De Broglie for the wave-particles:

$$\lambda_{DB} = h / p \quad \textbf{(4)}$$

Where h is the Planck's constant and p is the magnitude of the momentum of the particle.

Possibly not a fact well known as the hypothesis, but historically the equation (4) was the product of a theory in which Louis de Broglie speculated that the speed of light is less than c, this meant that the photons have rest mass different from zero (REF 3) and thus assumed the existence of systems of reference at rest relative to the photons, which together with the Einstein-Planck equation of the energy of a photon and the equations of Lorentz, make this argument implies the equation (4). That theory was discarded retained as valid only the resulting hypothesis that implies the wavelength of matter. The observation is that for the photons the expression (4) is a consistent deduction as a result of relating the following Einstein-Planck equation for the photon energy:

$$E = hf$$

Where f is the frequency of the photon

With the expression for the relativistic energy in terms of momentum:

$$E = (p^2 c^2 + m_0^2 c^4)^{1/2}$$

And considering that for the particle $m_0 = 0$. However for particles with rest mass greater than zero, this procedure is not consistent. Therefore there must be reasoning that leads from the hypothesis of wave-particle duality for particles with $m_0 > 0$, to the expression (4), but without evaluating the rest mass as null. We find that this reasoning is the introduction of the factor:1/(v/c).

This is that:

$$\frac{h}{\left(p^2 + (m_0c)^2\right)^{1/2} (v/c)} = h / p = \lambda_{DB}$$

Now, in analyzing the factor v/c in the denominator is important highlight the following two observations:

(1) v/c only takes values ranging from -1 to 1.

(2) In the remainder of the terms in the denominator shows that:

$$\left(p^2 + (m_0c)^2\right)^{1/2} (v/c) = p$$

And that:

$$\left(p^2 + (m_0c)^2\right)^{1/2} (1-(v/c)^2)^{1/2} = m_0c$$

This leads to the conclusion that v/c is equivalent to the cosine of an angle which will be called β. That is:

$$v/c = \cos\beta$$

And where

$$\sin\beta = (1-\cos^2\beta)^{1/2} = (1 - (v / c)^2)^{1/2}$$

Considering this, then we can say that:

$$\lambda_{DB} = \frac{h}{\left((p^2 + (m_0c)^2\right)^{1/2} \cos\beta} = h / p$$

In other words, the wavelength De Broglie for every particle with $m_0>0$, is a function of the projection, in the three-dimensional ordinary space, of the momentum vector (**P_4**) which belongs to a four-dimensional space (no refer to space-time), this projection turns out to be exactly: p = mv. Note that the expression:

$$\frac{h}{\left(p^2 + (m_0c)^2\right)^{1/2}}$$

Is a wavelength of a wave-particle manifested in the space of four dimensions and the wavelength De Broglie is like a special case when considering only the three-dimensional ordinary space and not all four dimensional suggested. To express graphically this, is have the following Figure 1:

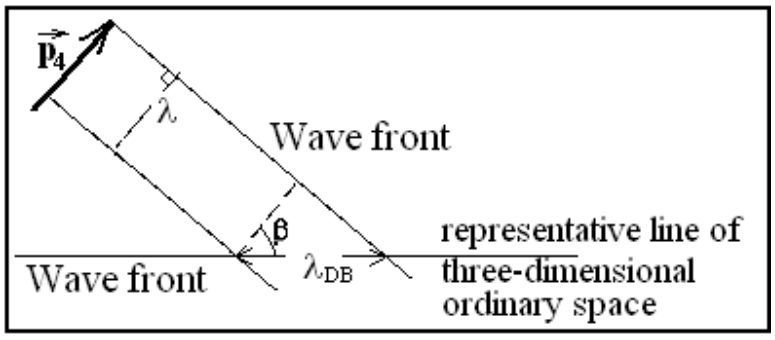

FIGURE 1

The three-dimensional ordinary space is represented by the horizontal line; the momentum ***p*** *4 is orthogonal to the wave fronts, which coincides with the plane wave condition. The subscript 4 of the moment depicted, means that it is expressed in a four-dimensional space.*

In this figure is can display two consecutive fronts of a plane wave associated to a particle with momentum $\mathbf{p_4}$ moving in the space of four dimensions, the separation between their fronts is equal to the wavelength λ, however, limited to the ordinary three-dimensional space represented by the horizontal line and analyzing the right triangle formed by λ, λ_{DB} and the flat wave front and using the relation $\lambda = h/p$, then the separation between the wave fronts would be given by:

$$\lambda_{DB} = h/(p_4 \cos\beta) = h/p_{n=3}$$

Where $p_{n=3}$ refers to the projected momentum in ordinary space three-dimensional and β is the angle between $\mathbf{p_4}$ and the line representing the ordinary three-dimensional space.

That is precisely the wavelength de Broglie. In conclusion, this reality suggested by the study made in the hypothesis of De Broglie, actually coincides with the inter-dimensional reality suggested by the earlier observation made in the theory of special relativity. It is proposed by this paper to expose some of the consequences of this explanation of non-simultaneous physical manifestation in the ordinary three-dimensional space, of the mass and energy for the material particle at rest. This development shall not consider the complicated metrics of general relativity, to work within the context that is more simplified of the special relativity. Which is not to take away the validity of the nature of the case, since the essence of the concept of equivalence of mass and energy (which resulted in this analysis) was unchanged with the development of general relativity. That said, an immediate consequence of the proposal of this paper is that it introduces a model of particles with nonzero rest mass, which are equivalent to photons when included a space of fourth dimension, where all axes are spatial. From now on referred to equivalent photon model of matter. On this model is build a new metric of five-dimensional space-time, whose time axis is values in the set of real numbers (and not related to the imaginary unit i, as relativity) and where it adds a fourth spatial axis of compact type, to the ordinary three-dimensional space. Another feature of this theoretical construct is that the fundamental laws of quantum physics arise spontaneously from this analysis to the theory of relativity. To be concise, in this article was omitted full development of deductions, but the reader can play using simple vector algebra and basic math.

2. ANALYSIS, DISCUSSIONS AND RESULTS.

2.1- Four-vector momentum, four-vector displacement vector and four-vector current density for the proposed equivalent photon model of matter.

Although this was never noticed, the expressions for the magnitudes of the relativistic four-vector for the momentum, displacement and current density provide a spontaneous rearrangement of terms that suggests the existence of a four-dimensional space, without reference to relativistic space-time. Indeed, given the following expressions:

$$P^2 = -(m_0c)^2 = (m_0v_1\gamma)^2+(m_0v_2\gamma)^2+(m_0v_3\gamma)^2-(m_0c\gamma)^2 \quad \mathbf{(5)}$$

$$S^2 = -(c\Delta\tau)^2 = \Delta x_1^2+\Delta x_2^2+\Delta x_3^2-(c\Delta t)^2 \quad \mathbf{(6)}$$

$$-c^2\rho_0^2 = j_1^2+j_2^2+j_3^2- c^2\rho^2 \quad \mathbf{(7)}$$

Where v_1, v_2 and v_3 are the velocities of the object in the three axes of ordinary space; $\gamma = 1/(1-v^2/c^{2)\,1/2}$; Δx_1, Δx_2

and Δx_3 are the coordinate differences between two points on the axes 1,2 and 3 of ordinary space, $\Delta\tau$ is the proper time of the particle and $c\Delta t$ is the coordinate difference between two points in the time axis, for an inertial reference frame j_1, j_2 and j_3 (in this case should not be confused with the unit vector **j**) are the components on the axes x_1, x_2 and x_3 respectively of the ordinary three-dimensional space, $c\rho$ and $c\rho_0$ are the total current densities and when the particle is at rest.

That are the expressions of the magnitudes of the relativistic four-vector of the moment, displacement and current density respectively, is can reorder as follows:

$$(m_0c\gamma)^2 =(m_0v_1\gamma)^2+(m_0v_2\gamma)^2+(m_0v_3\gamma)^2+(m_0c)^2 \quad \textbf{(8)}$$

$$(c\Delta t)^2 = \Delta x_1^2+\Delta x_2^2+\Delta x_3^2+(c\Delta\tau)^2 \quad \textbf{(9)}$$

$$c^2\rho^2 = j_1^2 + j_2^2 + j_3^2 + c^2\rho_0^2 \quad \textbf{(10)}$$

Algebraically, these expressions (8), (9) and (10) represent a simple rearrangement of terms for the (5), (6) and (7) correspondingly, but metric and physically have a very important meaning. The (8), (9) and (10) are the magnitudes of the following four-vector for the momentum, displacement and current density, respectively, for the equivalent photon model of the matter:

$$\mathbf{P} =(m_0 v_1 \gamma, m_0 v_2 \gamma, m_0 v_3 \gamma, m_0 c) \quad \textbf{(11)}$$

$$\mathbf{C\Delta T} = (\Delta x_1, \Delta x_2, \Delta x_3, (\Delta x_4=c\Delta\tau)) \quad \textbf{(12)}$$

$$\mathbf{j} = (j_1, j_2, j_3, c\rho_0) \quad \textbf{(13)}$$

The magnitudes of **P, CΔT** and **j** must be invariant with respect to the rotation of coordinate axes of a four-dimensional space that physical science had not considered. This space is suggested by the comments made in special relativity and de Broglie's hypothesis at the beginning of this article. Of an analysis of these expressions is derived the following observations and results:

(A) The expression (11) is the same four-vector of the expression (3) when v=0, see remark made to special relativity.

(B) Of the expression (8) follows that $m_0 v \gamma = m_0 c \gamma \cos\beta$, where β is the angle between **P** and the momentum vector **p** of the ordinary three-dimensional space. It is easy to see that the above expression leads to:

$$v = c\cos\beta$$

This leads to the conclusion that the velocity v of any particle with rest mass is the projection in three-dimensional ordinary space of the light speed which expresses in the proposed four-dimensional space. It is proposed that all the wave-particles with $m_0 > 0$ are actually electromagnetic waves-photons moving in a four-dimensional space, because of this, the proposed model is called the equivalent photon model. These are the waves which are known to wavelength within the ordinary three-dimensional space, as the wavelength de Broglie, see section on the observation made in the de Broglie hypothesis.

(C) In applying common sense to the new approach for the collision between two electrons, using the equivalent photon model, it follows that the equivalent photon of the electron and therefore all types of electromagnetic wave, have characteristics of corpuscle.

(D) will appreciate in equation (12), when $c\Delta\tau = 0$ then there is the movement of a photon in the ordinary three-dimensional space, which agrees with the null value of its proper time. With this condition must also be:

$$p = E/c \qquad \textbf{(14)}$$

(E) Considering the relativistic Doppler effect and Lorentz transformations for momentum, given by the following expressions:

$$f' / f = (c-u)^{1/2} / (c+u)^{1/2}$$

$$E' = (E-up)/(1-u^2/c^2)^{1/2}$$

$$E=(E'+up')/(1-u^2/c^2)^{1/2}$$

Where f 'and f is the frequency of the electromagnetic wave observed from a frame of reference S' and S respectively. S 'moves relative to S at a speed u. Moreover, E ', p', E and p are the energy and momentum of an object measured from the frame S 'and S respectively.

Then it can be observed that by combining these expressions and substituting p and p' by the identity (14) and to develop reason E' / E and simplify, then obtained:

$$E'/f' = E/f = \text{Constant}$$

This is that the proportion between the energy of a photon and its frequency should be a universal constant, Planck's constant, conventionally symbolized by h.

(E) From here is can obtain the following expression for the wavelength of an equivalent photon for an elementary particle:

$$\lambda = h (1-v^2/c^2)^{1/2}/m_0c \qquad \textbf{(15)}$$

2.2 Compton effect deduced by the equivalent photon model.

When considering the same initial conditions in the collision between an electron at rest and an incident photon used by the method of modern physics, it is possible to deduce the same result of Compton effect when it is assumed that the electron is equivalent to a photon and is used the proposed four-dimensional space.

Indeed, let $P_{ei} = h/\lambda_{ei}$ and $P_{ef} = h/\lambda_1 - h/\lambda_2 + h/\lambda_{ei}$ the momentum before and after the collision, of the equivalent

photon of the electron; $P_{fi}=h/\lambda_1$ and $P_{ff}=h/\lambda_2$ the momentum of the incident photon (of the ordinary three-dimensional space) and when is dispersed, respectively, θ the angle between the initial and final direction of the incident photon; ϕ_1 and ϕ_2 are the direction angles of the momentum for the photon which equivalent for the electron, with respect to axes 1 and 2 of the ordinary space and ϕ_4 for the fourth spatial axis and assuming that the electron is initially at rest and the collision is elastic, then we have the following system of equations for the momentum before and after the collision:

Momentum in x_1: $h/\lambda_1 = h/\lambda_2 \cos\theta + (h/\lambda_1 - h/\lambda_2 + h/\lambda_{ei})\cos\phi_1$

Momentum in x_2: $0 = h/\lambda_2 \operatorname{sen}\theta + (h/\lambda_1 - h/\lambda_2 + h/\lambda_{ei})\cos\phi_2$

Momentum in x_4: $h/\lambda_{ei} = (h/\lambda_1 - h/\lambda_2 + h/\lambda_{ei})\cos\phi_4$

In developing these equations, then is can reach the following equation:

$$\lambda_2-\lambda_1 = \lambda_{ei}\ (1- \cos\theta)$$

This finally can be rewritten as:

$$\lambda_2-\lambda_1 = (h/m_0c)\ (1- \cos\theta)$$

This is the familiar expression for the displacement of the Compton wavelength of the incident photon.

2.3 Matter-antimatter annihilation explained by the equivalent photon model of matter.

When analyzing the meaning of the sign of the electric charge of an elementary particle, on this model proposed, then is gives a new explanation for the reaction of annihilation of a particle with its antiparticle. Indeed, when they express the ratio between the fourth component and the magnitude for each four-vector related with each of the expressions (8), (9) and (10) and assume that $\rho_0 < 0$, that is to say the electric charge of the particle has a negative value, then is have:

$$-m_0c/(E/c) = (-c\Delta\tau = -\Delta x_4) / c\Delta t = -c\rho_0 /c\rho = -\text{sen}\beta$$

This suggests that the sign change in the electric charge, implies changing the sense of component-vector of the fourth axis of momentum and also involves a direction opposite to the displacement of the photon along the fourth spatial axis. Considering this and if there is to check what happens when an electron (e^-) and an positron (e^+) collide, these being of opposite electrical charges, and assume the motion of photons equivalent only in the x_4 and x_1 axis and opposite (in the x_4-axis because are opposite charges) then is can obtain the following system of equations of momentum and energy before and after the collision:

x_1 axis: $$P_{e^-i1} - P_{e^+i1} = P_{e^-f1} - P_{e^+f1} = 0$$

x_4 axis: $$P_{e^-i4} - P_{e^+i4} = P_{e^-f4} - P_{e^+f4} = 0$$

Energy: $$\left((P_{e^-i1})^2+(P_{e^-i4})^2\right)^{1/2}c + \left((P_{e^+i1})^2+(P_{e^+i4})^2\right)^{1/2}c = \left((P_{e^-f1})^2+(P_{e^-f4})^2\right)^{1/2}c + \left((P_{e^+f1})^2+(P_{e^+f4})^2\right)^{1/2}c$$

Where P_{e^-i1}, $P_{e^+\mathbf{i1}}$, P_{e^-f1} and $P_{e^+\mathbf{f1}}$ are the components in the x_1 axis of initial and final momentum of the equivalent photons of the positron and electron respectively; P_{e^-i4}, $P_{e^+\mathbf{i4}}$, P_{e^-f4} and $P_{e^+\mathbf{f4}}$ are the initial and final momentum four-vector in the x4 axis of the equivalent photons of the electron and positron respectively

It is noted that the system allows the following solution:

$$P_{e^-f4} = P_{e^+f4} = 0$$

This implies the following reaction:

$$e^- + e^+ \rightarrow \gamma + \gamma$$

Which expressing that the result of the collision is two photons that is contained in ordinary three-dimensional space and keeping all the initial energy, which is experimentally found by the official physical.

2.4 Space-time and fourth spatial axis compact for the equivalent photon model.

Physically we live in a universe of events, this is that all physical things have a place in space and a moment in time. The expression:

$$(x_1, x_2, x_3, ict)$$

Is the space of events of special relativity, commonly known as four-dimensional space-time. The reasoning that leads to the formulation of space-time corresponding to the equivalent photon model of matter was made through a thorough analysis (which could be exposed to its proper length in another article), but then presents a very concise summary of this argument:
(A) In the mathematical theory (REF 4) is defined as a type of n-dimensional space to the set of spheres (n-1)-dimensional of the (n-1)-dimensional space, where its coordinates are determined by: The first n-1, are the coordinates that locate in space n-1 to the centers of these spheres (n-1)-dimensional and the last coordinate (the nth) are the values that can take its radius.
(B) The speed in the proposed four-dimensional space, of all photon (both equivalents of matter, like the known in the ordinary space), is defined by:

$$v_1^2 + v_2^2 + v_3^2 + v_4^2 = c^2 \qquad \textbf{(16)}$$

Where $v_4 = c \sin\beta$ and $(v_1^2 + v_2^{\,2} + v_3^{2)\,1/2} = c \cos\beta$.

(C) When included ct (time measured for the displacement) in the last expression, then we have:

$$\Delta x_1^2 + \Delta x_2^2 + \Delta x_3^2 + \Delta x_4^2 = c^2 \Delta t^2 \qquad \textbf{(17)}$$

Whereas all this previous, then one can conclude that:

(1) The expression (17) can be considered as the equation of the hyper-spheres of possible displacements (or simply, all possible displacements) in the space of four dimensions, of the photons in general, both the equivalents of matter as those contained in the ordinary three-dimensional space.
(2) According to the account (a), is defines the space of five dimensions:

$$(x_1, x_2, x_3, x_4, R=c\Delta t) \qquad \textbf{(18)}$$

Where $0 \leq R = c\,\Delta t \leq +\infty$

As the set of these hyper-spheres and where x_1, x_2, x_3 and x_4 are the coordinates of the center of these and $R=c\Delta t$ are the radius that increase according to the time taken by these photonic displacement.
(3) Since in the expression (18) we have that $R \alpha \Delta t$, then it is proposed that this is also the preliminary form of five-dimensional space-time model for the equivalent photon model.
(4) Each point of this space-time involves a displacement, with $\Delta x_1=\Delta x_2=\Delta x_3=0$ in equation (17), of an equivalent photon of a representative elementary particle of a clock. In other words, each point represents a clock at rest, relative to the reference frame, located at spatial coordinates and marking a moment equal to the time coordinate.
(5) Considering the following two observations: (a) The case in which two events A and B (could be sparks, shocks, etc..) physically is happen in the same coordinate of ordinary three-dimensional space and only separated by time and that therefore their representation in the proposed space-time would be a vertical line, this is they represent the temporary record of events by a single clock at rest. (b)We know that matter is ultimately composed of indivisible elementary particles (e.g. electrons) and that although the matter is agglomerated in macroscopic objects, elementary particles identities remain unchanged. Then, after an analysis of these considerations, we have that kind of space allocated to the fourth spatial dimension must be of compact type. Also, the compact X_4 axis should be rolled on the regular three-dimensional space. Therefore, the proposed space-time corresponding to the equivalent photon model of matter, without considering gravitational effects, must be in final form:

$$(x_1, x_2, x_3, x_4, ct) \quad \textbf{(19)}$$

Where $0 \leq x_4 < (\lambda_0 = h/m_0c)$ and $0 \leq ct \leq +\text{Infinity}$

Where the perimeter of the cross section of the plane X_1-X_4 rolled, see figure 2, is equal to the wavelength (λ_0) of the photon that are equivalent to the elementary particle analyzed at rest, that is to say:

$$\text{Perimeter plane } X_1\text{-}X_4 = \lambda_0 = h/(m_0 c) \quad \textbf{(20)}$$

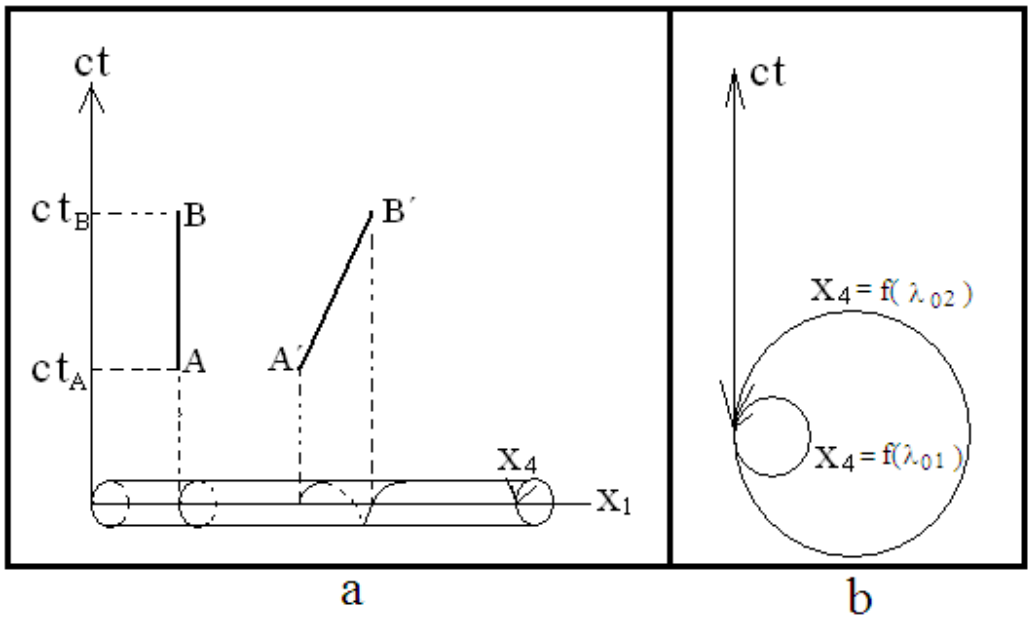

FIGURE 2

(a) *From left to right, is represents the spatial-temporal displacement of a particle at rest and a moving particle, note that in X1-X4 plane this means a displacement, of the equivalent photon, on the fourth axis and which takes the form of a ring in the first case and the form of a spiral of constant diameter in the second.*
(b) Axes X1, X4 and ct of space-time, side view, where the x1 axis is orthogonal to the plane of the page. Note that the length of the compact axis X4 depends on the wavelength of the photon equivalent of the elementary particle being analyzed.

The photon that is equivalent to an elementary particle, periodically intercepts dimensional ordinary space, so orthogonal if the particle is at rest and at an angle β=v/c if the particle is moving at a certain speed, see figure 2-a .
(6) When is ignore the fifth axis (corresponding to time), the crosses periodic in three-dimensional ordinary space of the equivalent photons of matter, amount to a permanent and continuous emission of photons equivalent of a single elementary particle (in its wave aspect, a train of electromagnetic waves emitted continuously and permanently) in the plane X 1-X 4, an illustration of this is Figure 1. And when in these conditions, we calculate the equivalent photon energy of elementary particles in motion, is can get the relativistic energy.
This is that the analysis of the geometry involved in the representation of a continuous emission of equivalent photons, calculate that $\lambda = \lambda_0 (1\text{-}v^2/c^2)^{1/2}$ and therefore the energy of these particles is:

$$E = m_0 c^2 / (1\text{-}v^2/c^2)^{1/2}$$

This is the relativistic total energy.

(7) The Lorentz transformations do not correspond to a reference frame rotation in this space time, if not that these are due to a calibration of units due to the state of motion non-accelerated in three-dimensional ordinary space.

2.5 Uncertainty principle deduced by the equivalent photon model of matter.

Consider the following points:
(A) Because all elementary particle representative of any clock at rest is associated with a wave period (T_0) derived from the expression (20), then we have that:

$$T_0 = h/(m_0c^2)$$

Is the sensitivity or the minimum uncertainty in the measurement of time, since in that period the matter of watch ´´is not recording events´´ in the ordinary three-dimensional space.
(B) According to quantum physics, all energy measurement can be reduced finally to the measurement of the frequency of waves associated with the quantum system (REF 5).
In considering the above and if proceed to calculate the energy that is measured, from a reference frame tied to a
clock at rest, for a wave that intersects the location of this clock, then is have the following results:

(1) The time (t) that is taken to measure the frequency of the wave, is given by $t = nT_0$.
Where n is a positive integer.
(2) The frequency (f_{wave}) of the wave under study is:

$$f_{wave} = (s/n)\, m_0\, c^2 /h$$

Where m_0 is the rest mass of representative elementary particle of the clock and s refers to the number of cycles or waves recorded during the time t.
(3) It follows that the wave energy is given by:

$$E_{wave} = (s / n)\, E_0$$

This can be rewritten as:

$$E_{wave}\, E = E_0/n + E_0/n + E_0/n + ... + E_0 / n$$

That is, the sum of s times E_0 / n.
(4) The previous series means that E_0/n is the sensitivity or uncertainty in the measurement of energy of any wave, over a time $t = n\, T_0$.
(5) If this uncertainty in the measurement of energy is called $\Delta E_m = E_0/n$ and identities is replaced conveniently, then we have:

$$\Delta E_m\, t = h$$

Is the minimum uncertainty in the measurement of the energy of a wave and therefore any energy uncertainty (ΔE) is : $\Delta E\, t \geq h$

This is the same uncertainty principle for the measurement of the energy used by quantum physics. Note that if $T_0 = 0$, that is to say if the time registration was not discreet, this is continuous, then there would not be a minimum uncertainty in the measurement of the energy of any system.

3. CONCLUSIONS

(A) The equivalent photon model, predicts that the movement within the ordinary three-dimensional space of an elementary particle with rest mass greater than zero, is given by "leaps" (as a result of the equivalent photon travel in space n=4), so that the length between these leaps is given by:

$$d = \frac{h\,v}{m_0\,c^2\,(1-v^2/c^2)^{1/2}}$$

This is that for one electron each of these spatial intervals is 1(nm) when is hold a speed corresponding to 99.99970611% of the light and which is related to the injection of a kinetic energy of 3.374x10 -11 joules. At this time there is enough technology to access to an experimental realization of this scale, however, must be fine-tuned the means used to show the traces of the electron with the intention that the diameter of these traces are not precisely equal or exceeds the length of the respective area of the period of absence of such a particle, which is exactly what you seek verification.

(2) The principles of quantum physics can be deducted by the equivalent photon model of matter as opposed to simple relativity that must be merged with those principles, independent of it, to produce new predictions.

(3) This analysis of the equivalent photon model of matter has been made, mostly, on its particle aspect. An later analysis on its wave aspect (in which a particle with rest mass are treat as an equivalent electromagnetic wave in the space of four dimensions) can lead to others verified results by experiment or new predictions

(4) The equivalent photon model of matter must also be implicit in general relativity. As mentioned above, this corresponds to the fact that mass-energy equivalence is maintained in the general theory. However, due that the general relativity is extended to all frameworks (and not just inertial) the invariance of physical laws, then, with this generalization must be come changes in the model and these new predictions.

(5) It is interesting that there is a similarity between this model and string theory. Both suggest a fifth dimension of compact type. However, string theory adds this extra dimension to the already developed space-time, while the equivalent photon model adds this before developing the space-time.

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5. REFERENCES

(REF 1) Einstein A., The meaning of relativity (Spanish translation), third edition, page 60.

(REF2) Santalo LA, Vectores y tensores, Twelfth Edition, page 285.

(REF 3) French A. P, Taylor E, Introduction to quantum physics (Spanish translation), Editorial Reverte SA, 1982, page 52.

(REF 4) Santalo LA, Vectores y tensores, Twelfth Edition, page 231.

(REF 5) Serway R., Physics -Vol. 2 (Spanish translation)), third edition, McGraw-Hill.