A new Approach to Particles Interactions With Bosons Through Thermodynamics and Mechanics Arguments; Explanation of the Law of Lenz

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Abstract
After a brief criticism of the paper of A. EINSTEIN on the special theory of Relativity of 1905, we try to found this Theory on the smallest scale that can be studied through the use of the Equation of Continuity of Time. We set down the idea of continuity of time at the level of an elementary particle of matter related to an equation that is the basis of our work. We propose a new way to describe interactions between particles of matter and bosons of interaction, and we represent the four dimensional space-time of the particle in a simple way which logic is open to criticism, as all theory is restrained. We elaborate a two orders perturbation theory from which we deduce the mechanisms of the law of Lenz at the smallest scale. This deduction enables us to confirm the existence of the graviton as a boson of spin 2 responsible for the stability of charge of an elementary particle.
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1 Introduction

In his first paper on the Special Theory of Relativity [1], Albert EINSTEIN gives definitions of the notions of simultaneity, synchronization of events and synchronous clocks (in the first two paragraphs of the kinematics part before tackling the Lorentz Transformation). As it has been built, the Special Theory of Relativity is exact, not only physically but also mathematically and what has been done based on and since this early paper proves it.

Nevertheless the gap that still exists between the works of A. EINSTEIN and quantum physics commits critical research to be done to give new sights on Einstein's approach to the Theories of Relativity.

In the third paragraph of his paper [1], A. EINSTEIN introduces two inertial systems: K (x, y, z, t) and k (ξ, η, ζ, τ), the last system moving at the velocity v in comparison with K (with strict and usual conditions of movement of the axis of k in relation to the axis of K…). A. EINSTEIN clarifies the way he measures space and reminds us of how time is specified in each system. He then sets down $x' = x - vt$, what enables him to say that it is obvious that determined values x', y, z, which do not depend on time (that might be a first source of criticisms considering his change of variable), correspond to a point at rest in the system k. At that point of his reasoning, his aim is to express τ as the whole indications given by the clocks at rest in the system k, synchronized as specified previously.

A. EINSTEIN, to establish the equations of the Lorentz Transformation, considers a light ray which is emitted from the origin point of k along the X axis towards x' where it is reflected towards the origin of the coordinates of k.

In the framework of today's physics, this reasoning is valid in accordance with a very low probability: the light ray is composed of vast amounts of photons and statistically we are supposed to find a sufficiently great number of those photons for A. EINSTEIN's reasoning to be right. But within the frame of a modern theory of elementary particles, in which the Special Theory of Relativity is abundantly used, especially for high energies, it seems that the reasoning of A.EINSTEIN is not valid: the photons may be absorbed instead of being reflected, the ray may not be coherent... So a very weak probability for a single photon to do what expected A. EINSTEIN. At the smallest scale, physicists do not consider actually classical rays (as known before A. EINSTEIN demonstrated the existence of the photon) anymore, but they would deal with photons (bosons) beams with probabilities of interaction characterized by cross sections, and probabilities of perfect reflection of a photon by a particle of matter to the point from where the photon has been emitted... Close to zero.

A perfect reflection would be a reflection that allows the preserving of a temporal coherence from the emission to the reception (after reflection) of the photon by the point, which emitted it. In this hypothesis, the photon carries temporal information without any discontinuity (this justifies the name of the main equation of the theory presented here) in order to work on a same "clock" – this idea is suggested by the work of A. EINSTEIN who used light to explain what synchronization is - to reproduce at another level the reasoning of A. EINSTEIN to set up the Special Theory of Relativity.

In accordance with his famous reasoning, A. EINSTEIN sets down (for x' infinitely small, by what he passes from a macroscopic scale to the quantum scale):

$$\frac{\partial \tau}{\partial x'} + \frac{v}{c^2 - v^2} \frac{\partial \tau}{\partial t} = 0 \qquad (1)$$

Where c is the velocity of light in the vacuum. This first equation enables A. EINSTEIN to calculate τ, which is linear because of the properties of homogeneity of space and of time and which does not depend either on y or on z. (according to the special geometric relations between K and k). Other arguments lead to the complete Lorentz Transformation.

2 The equation of continuity of time

In order to avoid the supposed "old-fashioned" reasoning and to characterize the continuity of temporal information carried by photons and finally to obtain another approach to the Lorentz Transformation, we set down the equation of continuity of time (ECT):

$$\frac{\partial \tau}{\partial t} + div\left(\tau \frac{1}{n} \vec{c} \right) = 0 \qquad (2)$$

Where n = v/c is the special refractive index of the (particle of) matter which velocity is v (supposed to be different from zero), where v is the apparent velocity of emission of the photon by the matter in the vacuum and c is the (phase) velocity of the photon in the vacuum. τ is then considered as a density of time and $\tau\frac{1}{n}\vec{c}$ as a vector density of time where $\frac{1}{n}\vec{c}$ is the velocity of the time density carrier ($|\vec{c}|$ = c). When the apparent velocity of emission of the photon is c, the velocity of the carrier is $|\vec{c}|$ as well which is compatible with the idea of our introduction that the photon could be the carrier of temporal information. For an apparent velocity of emission (from a particle of matter) lower than c, the density of time would be carried faster than c. So it could mean that global time coherence of a piece of matter or of a star seems higher than the one of the vacuum: particles of matter exchange photons which apparent speed v of emission is lower than c so the time density is exchanged at a speed much higher than c which ensures that the temporal information is exchanged faster than light signals between particles: time coherence is so established globally in matter and perception by light, which is not as fast, gives a sight of a global time coherence. This conjecture formalizes the anticipatory nature of the ECT and of the all perceived matter. Its application to the Lorentz Transformation already exists: Daniel Dubois' work on the foundation of anticipation in Electromagnetism [2] showed the anticipatory effect in an electrical field produced by a moving charged particle.

2.1 The path towards the Lorentz transformation

Considering our single photon moving along the X-axis at the velocity c and so that:

$$\frac{\partial \tau}{\partial y}=0,\ \frac{\partial \tau}{\partial z}=0,\ \frac{\partial v}{\partial x}=0, \qquad (3), (4), (5)$$

eq. 2 becomes:

$$\frac{\partial \tau}{\partial t}+\frac{c^2}{v}\frac{\partial \tau}{\partial x}=0 \qquad (6)$$

Which is equivalent to:

$$\frac{\partial \tau}{\partial x}+\frac{v}{c^2}\frac{\partial \tau}{\partial t}=0 \qquad (7)$$

As τ is linear (for the same reason as quoted in our introduction), it comes from eqs. 3, 4, 5 and 7:

$$\tau=a\left(t-\frac{v}{c^2}x\right) \qquad (8)$$

Where a is a function of v and we choose that at the origin of k t = 0 if τ = 0.
As we set down the equation of continuity of time, we do it for the continuity of space coordinates and we get:

$$\frac{\partial \xi}{\partial t} + v\frac{\partial \xi}{\partial x} = 0 \tag{9}$$

Where v is the velocity of the carrier of "ξ *density*". After *integration* (ξ is linear), we get:

$$\xi = b(x - vt) \tag{10}$$

Where b is a function of v and we choose t = 0 if x = 0.

A further argument would lead to a first kind of homogeneous transformations of K into k with conditions like a = b.

At this stage we do not have any information on y, z, η, ζ, because we considered a single photon with no other rays of light in K or k than a "spark" along the X-axis. We are on the smallest physics scale.

What we have to consider now is the space-time distortion due to the emission of the photon. As a matter of fact, this distortion necessitates the application of a correction, which is:

$$\sqrt{\frac{P_{final}}{P_{initial}}} = \sqrt{\frac{c^2}{c^2 - v^2}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \beta \tag{11}$$

Where P is the differential radiation pressure of the photon.

Then we can write the law of transformation of time and of one space dimension from K to k:

$$\tau = a\beta\left(t - \frac{v}{c^2}x\right) \tag{12}$$

$$\xi = a\beta(x - vt) \tag{13}$$

So, while studying the Special Theory of Relativity through a single photon, it appears that at the smallest scale we lack information to light up the whole set of relations which A. EINSTEIN established as the Lorentz transformation, using abundantly continuity (of light, time, inertial systems, etc), isotropy, sometimes a kind of additive law of velocities mixing up the velocity of a material system and the velocity of light ("forgetting" that the velocity of light is the same in all inertial systems)...

In fact each of us plays the role of a coherence operator, giving mind to signals and links between events, which are mostly discontinuous at a scale we are not supposed to be aware of without specialized pieces of apparatus. And in spite of our criticisms, A. EINSTEIN was a great operator.

As it appears clearly in this paragraph, we are not able to found the special theory of Relativity but we would do so if we considered the systems K and k at the scales of the classical mechanics or of A. EINSTEIN's physics reached through principles of "decoherence". Our aim is then to exploit the equation of continuity of time locally and at a very small scale (within distances of the order of 10^{-33} m and times of the order of 10^{-43} s).

3 The reciprocity principle of interactions

For the reception of the photon by the particle of matter, we can write the space-time distortion in reception:

$$R = \frac{v^2 - c^2}{c^2} = (\pm i)^2 \frac{c^2 - v^2}{c^2} = \frac{(\pm i)^2}{\beta^2} \tag{14}$$

Where $(\pm i)^2 = -1$; and the space-time distortion in emission:

$$E = \frac{c^2}{c^2 - v^2} = \beta^2 \tag{15}$$

The reciprocity principle, which maintains the matter stability, then involves:

$$E = R \tag{16}$$

And so from eqs. 14, 15 and 16 we get:

$$\beta^2 = \pm i \tag{17}$$

4 Calculation of the ECT in spherical coordinates

We choose to write the ECT in spherical coordinates.

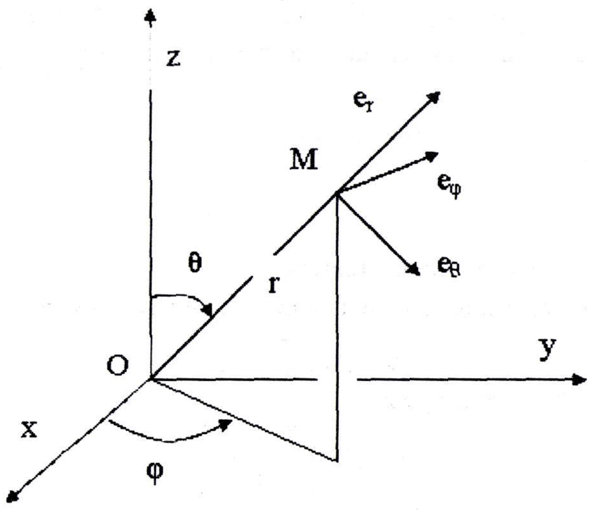

Figure 1: M (O, x, y, z) → M (O, r, θ, φ)

We consider that $r \cong r_0$ with $\frac{\partial r_0}{\partial r} = 0$ but $\frac{\partial r}{\partial t} \neq 0$; $\theta \approx \frac{\pi}{2}$; τ is isotropic; and we use the formulas $\frac{\partial}{\partial \theta} = \frac{\partial t}{\partial \theta}\frac{\partial}{\partial t}$ and $\frac{\partial}{\partial \varphi} = \frac{\partial t}{\partial \varphi}\frac{\partial}{\partial t}$.

We then obtain:

$$\frac{\partial\tau}{\partial t}\left(1+\frac{c^2}{vr_0\dot{\theta}}+\frac{c^2}{vr_0\dot{\varphi}}\right)+\frac{c^2}{v}\frac{\partial\tau}{\partial r}=0 \tag{18}$$

$$\frac{\partial r}{\partial\tau}\frac{\partial\tau}{\partial t}A=-\frac{c^2}{v}\ ;\ A=1+\frac{c^2}{vr_0\dot{\theta}}+\frac{c^2}{vr_0\dot{\varphi}} \qquad (19),\ (20)$$

Where A characterizes the spin asymmetry of the particle of matter. A can be considered as a generalization of what is called the anomalous momentum of the electron.

5 The state equation of an interacting particle

Using thermodynamic relations (tricks), we get from eq. 19:

$$\left(\frac{\partial r}{\partial t}\right)_\tau A=\frac{c^2}{v} \tag{21}$$

$$\left(\frac{\partial r}{\partial t}\right)_v A=(\pm i)^2\frac{c^2}{v} \tag{22}$$

$$(21)\Rightarrow\frac{v}{A}\left(\frac{\partial t}{\partial r}\right)_\tau=\frac{v^2}{c^2}\Rightarrow\frac{1}{\beta^2}=1-\frac{v^2}{c^2}=1-\frac{v}{A}\left(\frac{\partial t}{\partial r}\right)_\tau \tag{23}$$

From eqs. 17 and 23, we then get the state equation of an interacting particle (SEIP):

$$\beta^2=\pm i=\frac{1}{1-\frac{v}{A}\left(\frac{\partial t}{\partial r}\right)_\tau} \tag{24}$$

5.1 Imaginary use of the state equation

We can notice that the interaction imposes stresses on v. So eqs. 15 and 17 give:

$$\mathrm{v}=\pm\sqrt{\sqrt{2}}\,e^{\pm i\frac{\pi}{8}}c \tag{25}$$

The same way, eq. 24 gives:

$$\mathrm{v}=\sqrt{2}A\left(\frac{\partial r}{\partial t}\right)_\tau e^{\pm i\frac{\pi}{4}} \tag{26}$$

Eqs. 25 and 26 then lead to:

$$\left(\frac{\partial r}{\partial t}\right)_\tau=\frac{1}{\sqrt{\sqrt{2}}\,A}e^{i(2p+1)\frac{\pi}{8}}c\ ,\ p=0,1,2,3,4,5,6,7 \tag{27}$$

According to our approach, the interaction is a kind of perturbation, so we must present our results in accordance with this fact.

5.2 The perturbation theory

A piece of algebra from the § 5.1 and a physical reasoning allow us to set v as composed of a main solution:

$$v = \pm\sqrt{2}\, e^{\pm i\frac{\pi}{4}}\, c \tag{28}$$

Perturbed by:

$$\Pi = \frac{1}{\sqrt{\sqrt{2}}} e^{\pm i\frac{\pi}{8}} \tag{29}$$

Where the perturbation Π is applied to the main solution that is represented by two "axis" in the next paragraph. So Π appears as fluctuations from these axis. In this way, we find all the representations of the eight states found in the equation eq. 27.

6 Graphic representation

The four main solutions given by eq. 28 give a clear description of the light cone according to our approach which take into consideration the whole set of variables (through the radius r and the time t) of the four dimensional space-time (other representations give an erroneous sight of this cone with only two space variables and sometimes with only one space axis which emphasizes the too important role played by the common axis of the two inertial systems studied through the Special Theory of Relativity...).

Half of the states of the particle of interacting matter are in space-like regions (dotted lines in hachured region) and the other half are in time-like regions.

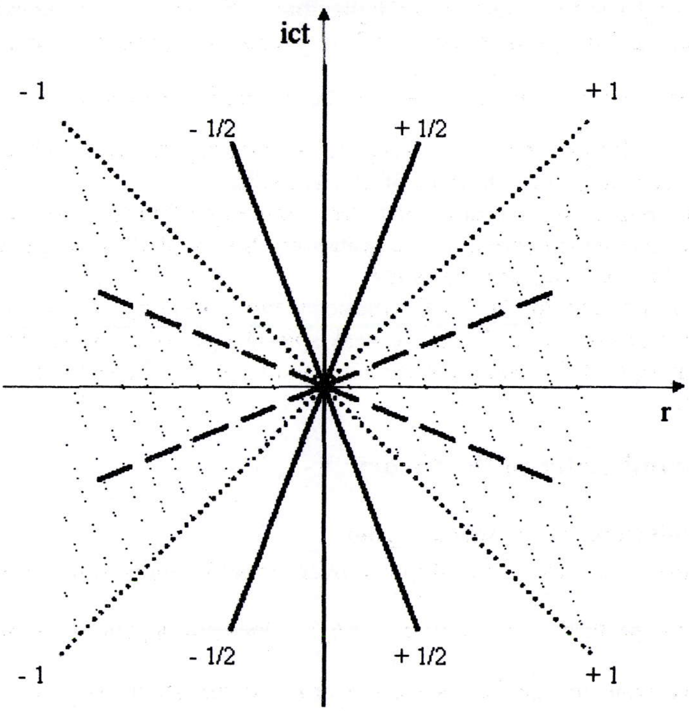

Figure 2: The eight states of the matter interacting with a photon

It appears on this drawing that the spin number, at least in time-like regions, can be explained in our theory. As we began on old electrodynamics, we restrain our reasoning to electrons and photons.

At first, we can define h (the Planck constant) in a heuristic way as the circulation of a photon on the "circle" of unit radius on the light cone around the time axis. In a system of units such as c = 1 (according to the drawing the circulation happens for the time unit) calculations should give $h = 2\pi$ (so $\hbar = 1$), both conditions specified to get the Klein-Gordon equation which solution is the wave function of de Broglie. This circulation for the unit positive radius corresponds to a spin 1 (the spin of a photon, specified on the drawing). The helicity -1 of the photon corresponds to a negative radius (the sign depends on the system of reference).

For the fluctuation that gives a state at "half" a causality field (we call "causality field" the "half" of a time-like region) for a positive r, the spin is ½. The state at "half" a causality field for negative r corresponds to a spin -½ (specified on Fig.2).

Our main hypothesis is then that to cross a space-like region (from one light barrier to the other), the particle has to interact with a boson of spin 2, a graviton.

If we consider K as the "eigen" inertial system of the particle of matter, we can suppose that k is also an "eigen" inertial system but of the interacting particle (we then "see" the spin of the particle of matter in K, from k).

As we can check it (see § 2), the time density can be carried by a carrier which velocity may exceed the velocity of light: this is the case if we consider that v is the consequence, at the particle level, of its interaction (emission and reception of a photon). v may be very small so $\frac{c^2}{v}$ may be much higher than c, what suggests that we could receive information (at least temporal one) from particles which are out of regions of "classic" causality, through links of new causalities.

In this paper, we consider that the symmetry of time corresponds also to the symmetry of charge (Feynman's interpretation). So the states that appear for negative t are supposed to fit to negative particles.

We would add to the CPT symmetry the symmetry of spin (at least for the electron/positron) that would imply a weak spin-charge coupling. According to what we study in our paper, this coupling does not resist to parity: the space symmetry implies a shift of spin.

7 The second order of the theory

7.1 The limitations of the second order

For the first order, we skipped over possible indeterminate values of A or $\left(\frac{\partial r}{\partial t}\right)_\tau$ and the perturbation theory of the § 5.2 does not depend on those functions. But now that we want to calculate a second order perturbation, we have to set down the following hypothesis:

$$\left(\frac{\partial A}{\partial t}\right)_\tau = 0 \quad (30)$$

What could be interpreted as connected to magnetic properties of the particle (or a gauge condition). Then we derive eq. 21:

$$-\frac{A}{\alpha}\left(\frac{\partial^2 r}{\partial t^2}\right)_\tau = \frac{c^2}{v^2};\ \alpha = \left(\frac{\partial v}{\partial t}\right)_\tau \quad (31)$$

And we get a second order state equation that gives:

$$\alpha = -\sqrt{2}A\left(\frac{\partial^2 r}{\partial t^2}\right)_\tau e^{\pm i\frac{\pi}{4}} \quad (32)$$

According to A. EINSTEIN, the velocity of light in k measured in K appears to be:

$$c_K = c - v \quad (33)$$

While in k c_k would be the well-known constant. Even if this reasoning is not really valid, it points out that the velocity of light may increase (here from c_K to c_k), especially in our theory:

$$\left(\frac{\partial c}{\partial t}\right)_\tau \geq 0 \quad (34)$$

We then derive eq. 25 and get:

$$\alpha = \pm\sqrt{\sqrt{2}}\ e^{\pm i\frac{\pi}{8}}\left(\frac{\partial c}{\partial t}\right)_\tau \quad (35)$$

From eq. 32 and 35 we get:

$$\left(\frac{\partial^2 r}{\partial t^2}\right)_\tau = -\frac{1}{\sqrt{\sqrt{2}}\ A} e^{i(2p+1)\frac{\pi}{8}}\left(\frac{\partial c}{\partial t}\right)_\tau,\ p = 0,1,2,3,4,5,6,7 \quad (36)$$

Where we keep track of the minus sign in eq. 32 that implies a shift of phase (of π) between v in eq. 28 and α in eq. 37.

7.2 The second order perturbation equations

From eqs. 32 and 35, the main solution for α appears to be:

$$\alpha = \mp\sqrt{2}\ e^{\pm i\frac{\pi}{4}}\left(\frac{\partial c}{\partial t}\right)_\tau \quad (37)$$

And the perturbation due to the interaction is still Π.

8 The coherence between the first and the second orders

The rules of coherence of our theory are the following:

1. The interaction is characterized "mechanically" (as a fluctuation of the light cone) and is independent of the kind of bosons which interact,
2. The interaction (electromagnetic, weak, strong, gravitation) the boson is for, is characterized by the number of spin of the boson (1 for the photon,

2 for the graviton) and the matter interacting is characterized by its state (which the spin number is a part of),

3. The representation of the state of spin appears in Fig.2 on which one unit of spin corresponds to a rotation of $\pi/4$,
4. In Fig.2, it is possible to turn around O to count the numbers of spin between the different states,
5. We consider that when the second order state coincides with the first order state, a particle characterized by those states exists and is stable.

9 The equivalence between gravitation and acceleration

The difference of phase (of π) between v and α implies the same difference of phase between states of first and second order. This shift of π turns a negative particle of spin ½ into a positive particle of spin -½ and to reach the state of the negative particle of spin ½ back, it has to interact with bosons which sum of spins is four ($4 \times \pi/4 = \pi$). All combinations of bosons totalizing a sum of spins of four and respecting the rules 3 and 4 would suit (according to our tricky theory).

We choose the two following examples:

A. The two orders states coincide after two interactions with two photons and one interaction with a graviton,

B. The two orders states coincide after two interactions with two gravitons.

This last example particularly means that at the smallest scale, the acceleration of a particle changes its charge sign so the particle becomes its anti-particle and needs two gravitons to get back its initial charge. In other terms, the gravitation is responsible for the stability of the negative charge of the electron.

10 An explanation of the law of Lenz

The main result of the previous paragraphs is well known as the "law of Lenz" which can be expressed as follows: the effects induced by a variation in magnetic field (and so the currents which create it) go against the causes which give birth to them (the decreasing or the increase in the magnetic field or in the electrical current which creates it). This law is essentially valid in electric circuits composed of a certain amount of turns.

So for a turn where goes a current I, the increase in I creates effects which go against itself (and against the current represented by I). At the level of the charges carriers, the electrons, our theory brings a description: the charge switch of the carriers creates a current which go against their initial current and its increase, and this would give an explanation of the appearance of an induced ("counter") electromotive force.

As this electromotive force is not created by a generator and as it comes from charge carriers currents, the law of Lenz is simply the switch of charge of the carriers when they are accelerated or slowed down in their own inertial system which can be detected macroscopically within a very short time.

In the case of a decreasing I, the charge carrier seems slowed down, so accelerated in the opposite direction of its initial movement, this acceleration creates the charge switch and then its participation to a positive flux going in the direction of I, tending to stop I from decrease.

Other phenomena are screening by surrounding atoms (which allows the switch of charge to be sufficiently persistent to create the macroscopic effect of the law of Lenz), collisions of electrons and positrons which would create the energy dissipated by the Joules effect (as "friction" is not the appropriate term for the collisions of electrons with other particles or "impurities" supposed to be found in a conducting material)...

11 Conclusion

It is important to specify that to be detected as an element of the electrical current the particle must exchange a boson of electromagnetic interaction with the current detector. The same requirement must be fulfilled to detect the switch of charge of the particle. This is the case for the example A of the § 9.

This requirement is not fulfilled in the case of the example B of the § 9: without the screening by surrounding atoms, the particle exchanges two gravitons in the "continuity" with its acceleration and keeps its charge. It is the reason why beams of accelerated electrons seem stable in charge from a "macroscopic" point of view.

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