Unification in the Frame of Rotational Ether Elasticity Theory

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ABSTRACT

In 1920 Einstein wrote (Cf. Sec. I.1):

> *space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time.*

A very important deduction that we can make from this quotation is that **the existence of the ether permits us to precisely define the notions of time and of space.** These notions are developed further below.

As shown in our previous publications and in the following, a homogeneous elastic medium is generally governed by the Navier-Stokes-Durand equation. E. Durand completed this theory by introducing the concept of **densities of couples of force**s applied to a specific elastic medium, denoted the "ether". This medium and these densities of couples of forces had not been taken into account by them, nor, more generally, by other authors before this time. Indeed, they tended to consider only the linear forces applied to this medium. It is important to state that this concept did not permit any unification of physics, however, the Durand completion, presented in my previous publications and here, is of fundamental importance regarding this unification.

In general, our publications lead to the idea that the theory of elasticity, in which the medium is shown to be an elastic medium governed by the "appropriated Navier-Stokes-Durand equation" (ANSDE), unifies a number of theories in physics. By the word "appropriated" I mean that the ANSDE, being a general equation of elasticity, is restricted to those cases containing the fundamental elements that unify the different domains of physics. That is, the ANSDE ensues from the general theory of elasticity, with the difference that I consider that the points of this medium do not move linearly, one relative to the other, but can only rotate on themselves. Furthermore, I propose that these rotations have their origin in the point couples of forces, denoted C, applied to this medium, where this medium is also not subject to any linear force. These point rotations are then transmitted point-to-point by the fact that each rotating medium point induces rotations in its neighboring points, and this results in the propagation of fields and particles. That these elastic medium points do not

move linearly is due to the fact that, if there were such linear motion, then space would be linearly deformed. For example, drawing near to what is called the "Schwarzschild horizon", the spatial contraction would be infinite and, in this case, there would be no order in space. As such, it follows that **the only changes that the points of the medium can undergo are rotations of linearly immobile points in a medium that is called the "ether".** I denote $Par(m,e)$ any particle of mass, m, and electric charge, e.

The general lines of the unification demonstrated here include the following. The fact that the only changes that points in the ether can undergo are rotations of linearly-immobile points permits us to define, contrary to some other opinions, the fundamental notions of the **dimensions**, **time**, **velocity**, and **motion**. Thus, we may unify the fundamental notions of physics as changes in the ether. For example, time can be defined as proportional to the distance travelled by light in the free ether.

As such, I prove that electromagnetism is the case in which the ether is subject only to the densities $\boldsymbol{C}$ of couples of forces that create the field $\boldsymbol{\xi}$, associated with $Par(0,0)s$, i.e. to photons, of the rotations of the points of the ether and from which one can deduce the Maxwell equations and electromagnetic forces.

Electromagnetism is then generalized to the case where $\boldsymbol{\xi}$ is associated with $Par(m,e)s$, subject to incident fields by the fact that the Lagrange-Einstein function L_G of such a $Par(m,e)$ yields not only the equation of motion, but also ϕ_P, defined by $\hbar d\phi_P/dt = L_G$, which is the phase of a wave $\boldsymbol{\xi}$, associated with $Par(m,e)s$ and also ϕ related to ϕ_P, they are defined by

$$\phi = -t + \int d\ell/V$$

and

$$\phi_P = \omega(-t + \int d\ell/V_P)$$

where V denotes the group velocity, that is, the particle velocity and V_P is the phase velocity, as defined precisely in the following.

The wave $\boldsymbol{\xi}$ is a solution of a generalized ANSDE. A specific sum $R(\phi_P,\phi)$ of waves $\boldsymbol{\xi}$ forms "rotating ether trajectory segments" that move like $Par(m,e)$, containing all of its parameters. In fact, $Par(m,e)$ is $R(\phi_P,\phi)$. It appears that the fields are also elastic changes in the ether.

In the Newton-Maxwell theory, electrical repulsion between two massive electrically charged particles of the same sign is always greater than their Newtonian attraction. However, by taking into account general relativity and the ether theory, I show that their mutual gravitational attraction *surpasses* their electrical repulsion when they are *sufficiently close, one to the other*. This phenomenon plays the role of "strong nuclear interaction".

The Schrodinger equation ensues from axioms inspired from the de Broglie plane wave. As such, this equation is axiomatic, *even though it yields very important results.* Therefore, one may think that quantum mechanics may be generalized by a theory based on physical parameters and on general relativity, not just on axioms. Indeed, I show, in particular, that **Schrodinger's equation is a particular case of the ether elasticity** theory that is compatible with the general relativity, in particular the quantum states are shown to be due to interferences of the waves $\boldsymbol{\xi}$ that compose a $R(\phi_P, \phi)$ in an atom, i.e., where $R(\phi_P, \phi)$ describes a closed trajectory.

In linear motion, a $Par(m, e)$, i.e. a $R(\phi_P, \phi)$, creates a Lienard-Wiechert covariant potential tensor that yields the magnetic field $\boldsymbol{H}$, which, in *the ether elasticity theory, is the rotation velocity* $\partial_t \boldsymbol{\xi}$ *of the ether points*. It appears that, at a fixed observation point and at a given instant near to the moving electron, i.e., to the moving $R(\phi', \phi)$, the velocity in the ether is of the same form as the velocity of a point of a rotating solid, where the axis of such a rotation is parallel to the electron's trajectory. This phenomenon is electron spin, which, as I show, in the quantum state of an atom can take only quantized values.

Einstein's tensor $g_{\mu\nu}$ is usually considered to only represent the gravitational field. However, the Einstein equations that define $g_{\mu\nu}$ are pure mathematical reasoning, related only to covariant derivatives. Therefore, one can suppose that this tensor is more general in nature than only defining the gravitational field and thus can define other fields also, such as the EM field. I show that the fact that the electrostatic potential of force $A_{4,s}$ (S = static), created by an immobile electric charge e_0, is of the same form as the Newtonian potential of force $G_{4,s}$, created by an immobile $Par(m, e)$, which implies that $A_{4,s}$ is a particular $G_{4,s}$. This is generalized by the fact that the electromagnetic Lienard-Wiechert potential tensor A_μ, created at a point by a *moving* e, is of the same form as the Newtonian approximation (NA) G_μ of $g_{\mu\nu}$, created by a *moving* m.

I generalize the Schwarzschild horizon radius by considering a spherical immobile mass m_0 of radius R_0 with a center located at a fixed ether point $\boldsymbol{O}$, and consider a particle of mass m_1, of velocity $\boldsymbol{V_1}$ due to the interaction of the fields created by m_0 and by m_1.

I prove how a mass is related to a field and what the constitution of that field is. The lines of this proof are based on the fact that, even when it is immobile, a mass m is related to a frequency ν_m by the relation $m = h\nu_m/c^2$. This shows that a mass m creates a field of frequency ν_m propagated in the ether. The nature of such a field is that it is an ensemble of points in the ether only rotating on themselves such that the axes of these rotations are situated on any line passing through the center of this mass.

I prove that on an axis joining two masses, m_1 and m_2, the fields of the rotation of the ether points due to m_1 and m_2 are of inverse senses. This means that they partially destroy themselves, i.e., the fields are smaller than those that are not between m_1 and m_2 and situated on this axis. It follows that m_1 and m_2 have the tendency to draw closer, that is, they are subjected to a force that tends to bring them closer together, finally forming only a single mass. This force is gravitational attraction.

Here, the "chemical" and "nuclear" reactions and the stability or instability of the atom are analyzed. In a chemical reaction involving several atoms, the number of atoms does not change, but they become connected, forming a unique molecule. Thus, a chemical reaction is an electronic reaction after such a reaction, the number of atoms remains the same, that is, all the nuclei involved in this reaction remain separated.

In contrast, a nuclear reaction, also occurring between several atoms, results in a "unique" atom such that all the nuclei of these atoms are fused into one nucleus. For example, one atom of helium H_e^2 results from two H atoms, the nucleus of this atom being constituted by the two H nuclei and neutrons. As such, in a nuclear reaction, protons are attracted to each other and form a new nucleus. More precisely, as has been shown to be due to the Schwarzschild attraction, in so-called "strong gravitation", two protons are attracted to each other when they are sufficiently close together, but repulse one another when their distance is greater than the threshold.

CHAPTER I

INTRODUCTION

I.1 On the Specific Elastic Medium Proposed by Maxwell, About Which Einstein Changed his Opinion and Finally Admitted its Existence, Calling it the "Ether"

In his treatise (Cf. Ref. 1, Art. 866), Maxwell explicitly presumed, although without developing the idea, the existence of a specific elastic medium in which electrodynamics is an ensemble of specific changes that express, in particular, the elastic nature of electrodynamics. Here is the relevant quotation (denoted Quot. 1).

> *Hence all these theories lead to the conception of a medium in which the propagation takes place, and if we admit this medium as a hypothesis, I think it ought to occupy a prominent place in our investigations, and that we ought to endeavor to construct a mental representation of all the details of its action, and this has been my constant aim in this treatise.*

In his 1905 paper (Cf. Ref. 2), Einstein refers to the *luminiferous aether* and **rejects the idea that such a medium can exist**. Indeed, here is the relevant quotation, denoted Quot. 2, with its first argumentation.

> *The introduction of a "luminiferous aether" (Lichtäther) will prove to be superfluous inasmuch as the view here to be developed will not require an "absolutely stationary space" provided with special properties, nor assign a velocity vector to a point of empty space in which electromagnetic processes take place.*

However, in 1920 Einstein completely changed his opinion about the possibility of the ether. Here is the relevant quotation, denoted Quot. 3, in its **second argumentation** as written in Ref. 3.

> *.... recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is*

> *unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense.......*

A very important deduction from Quot. 3 is that Einstein found that ***the existence of the ether permits us to precisely define the notions of time and space.*** *This fact is developed in Sec. I.2 and in Sec. II.1, below.*

In the past, numerous efforts were made to develop an elastic interpretation of physical phenomena and, in particular, of electrodynamic phenomena. Among these efforts, I can quote the works of Stokes, Navier, Cauchy, and Poisson, as well as many others. A review of these efforts is given by Sommerfeld (in Ref. 4; Cf. Ref. 5, pp. 106-113), in which an elastic model of the free Maxwell equations has been elaborated with only the electric field and the magnetic field being defined, but where the electric charges, the electric currents, the electromagnetic forces, and the electromagnetic energy have not been defined as elastic quantities. Furthermore, although a tentative elastic interpretation of Maxwell's equations of free electromagnetism was given, there was no attempt to give a tentative elastic interpretation to other physical phenomena. Such phenomena include, for example, the physical interpretation of particles; that of the fields applied to particles or created by them; that of the spin of the electron; that of the phenomena of quantum mechanics; and that of the strong nuclear interaction. Furthermore, there were no responses offered to some questions, including whether a relation exists between Maxwell's theory of electromagnetism and Einstein's theory of gravitation. This question can be asked since the electrostatic Coulomb field created by an immobile electrical charge is of the same form as Newton's approximation of the Schwarzschild field. Within the frame of these remarks and of this question, I show that these physical phenomena are due to the field of rotations, $\boldsymbol{\xi}$, of the point elements of an elastic medium, the ether, the points of which are always linearly immobile, but can rotate on themselves. Indeed, if there were ether points that were moving and had been translated, then, for example in the Schwarzschild case, there would be infinite translations of the ether points near the Schwarzschild horizon, as demonstrated in the following.

> *This confirms the fact that the ether points are linearly immobile, but can rotate on themselves. For example, an ether point that was at rest, begins to rotate due to an external cause and induces rotations on its linearly immobile neighboring points. These then rotate and induce rotations on their linearly immobile neighboring points, and so on.*

This elastic medium cannot be other than the ether introduced by Maxwell and Einstein, as described in the above citations (quots. 1, 2, and 3) and confirmed above and in the following.

This field $\boldsymbol{\xi}$, defined above, is shown to be caused by densities of couples $\boldsymbol{C}$ of forces applied to the ether and also by other parameters. In particular, as I have shown in previous publications and do so again below, electromagnetism is related to $\boldsymbol{\xi}$, to $\boldsymbol{C}$, and to other parameters defined in the following, by the fact that $\boldsymbol{C}$ generates electrical charges and currents, also creating a specific field $\boldsymbol{\xi}$ from which one can deduce the electromagnetic field. We will see in the following that the elastic interpretation of electromagnetism gives a physical explanation of the electromagnetic action at distance and contributes to the completion of Maxwell's theory of electromagnetism and eliminates the inconsistency mentioned by Einstein in Ref. 6, of which I present below a relevant quotation, denoted Quot. 4.

> *The introduction of the field as an elementary concept gave rise to an inconsistency of the theory as a whole. Maxwell's theory, although adequately describing the behavior of electrically charged particles in their interaction with one another, does not explain the behavior of electrical densities, that is, it does not provide a theory of the particles themselves. They must therefore be treated as mass points on the basis of the old theory. The* combination of the idea of a continuous field with the conception of material points discontinuous in space appears inconsistent. *A consistent field theory requires continuity of all elements of the theory, not only in time, but also in space and in all points of space. Hence, the* material particle has no place as a fundamental concept in field theory. ***The particle can only appear as a limited region in space in which the field strength of the energy density is particularly high.*** *Thus, even apart from the fact that gravitation is not included, Maxwell's electrodynamics cannot be considered a complete theory.*

This elastic interpretation of electromagnetism constitutes a departure of the general elastic interpretation of other domains in physics and thus the ether elasticity theory, can be generalized to unify the diverse theories of physics by the fact that they will be shown to be particular cases of the ether elasticity theory.

Many physicists, particularly Einstein, have tried to unify the theories of physics, for example, seeking to unify electromagnetism and general relativity, but without success. In my opinion, this is due to the fact that these eminent physicists did not hypothesize any unique physical cause that connects these different domains of physics. That is to say, they did not see that electromagnetism, the constitution of particles, the constitution of fields, the nature and causes of electron spin, the nature and causes of the strong nuclear interaction, the nature of quantum mechanics, and the relation connecting general relativity and electromagnetism are all particular cases of a unique physical phenomenon. Therefore, I present here the unique physical phenomenon that connects these domains of physics.

In fact, these domains of physics are particular cases of ether point rotations. They are all particular states of ether point rotations, showing that these domains of physics are particular cases of the theory of ether elasticity. The ether is shown to be a specific elastic medium within which points can only rotate on themselves, but not move linearly, one relative to the other.

I present now the general and fundamental concepts of the ether, unifying the theories of physics. Among these concepts, **the theory of ether elasticity is an indispensable element**.

I.2 On the Concepts of Distance, Time, Mass, Phase Velocity, and Group Velocity in the Frame of the Ether

In free space, there is no vacuum, but there is a specific medium called the "ether". Numerous authors have predicted the existence of the ether, in particular, Maxwell and Einstein (Cf. the citations in quotations 1, 2, 3, and 4). This confirms the fact that the fundamental characteristic of space is that it is not a void, but constituted by the specific elastic medium called ether. The concept of the ether, as envisaged by Maxwell and Einstein (Cf. refs. 7-9), and developed further by the author (Cf. refs. 10-11), is presented here in detail. The ether appears to be an elastic medium within which its points can **only rotate elastically on themselves**, that is, points within the ether cannot move linearly one relative to the others. By the term "elastically", I mean that when the cause of this rotation no longer exists, then it disappears and this ether point returns to its free state. It appears that, contrary to some opinions, this concept of the ether permits us:

a) To define the fundamental notions of dimensions, time, and velocity.
b) To unify the fundamental notions of physics.

Indeed, the ether is a specific elastic isotropic medium with constant properties within which one can define the positions of points and the "distance" between any two fixed points. This important fact, namely where one can define the positions of points and their distances from each other, is analyzed below, since, in this case, the medium of the ether has to be induced with specific characteristics. I call **light** the effects of a perturbation created in a given domain of the ether and propagated out of this perturbed region. If the ether is not perturbed by another cause, then light always propagates in the same manner. The fact that the ether is an elastic isotropic medium with constant properties allows us firstly to define the fact that light always propagates in non-perturbed ether in the same manner and, as I go on to show, *specific rotational ether segments* can be formed in the ether.

In free space, light is always propagated in the same manner, i.e., propagated *independently from the motion of its emitter*, and this allows us to define the concepts of the ether and of other physical notions presented in the following. Firstly, I am going to define the notions of distance and of "time duration".

A unity δt of **time duration** can be defined as being **proportional to a given length** $\delta\ell$ travelled by a free photon in the ether, that is, by "free" light. For example:

> *One second will be proportional to the distance of value* c*, travelled by the photon in the free ether.*

As such, if for any arbitrary time duration Δt, during which a photon has travelled the distance $\Delta\ell$, which can be different from $\delta\ell$, then Δt and $\Delta\ell$ are related by the relation

$$\Delta t \equiv \Delta\ell/c \tag{1.1}$$

where c is a constant called free light velocity. Having considered the notion of time duration Δt and length $\Delta\ell$, we can define the notion of velocity, **temporarily**, and generally, denoted, **W**.

Definition: ***W*** *denotes the quotient of the length* ΔL *travelled through propagation and of time duration* Δt *during which this propagation was performed, that is*

$$W \equiv \Delta L/\Delta t \equiv c\Delta L/\Delta\ell \tag{1.2}$$

we can see, for example, that

$$[\Delta L \neq \Delta\ell\,] \Leftrightarrow \ [W \neq c] \tag{1.3}$$

However, since there are cases where the velocity $\boldsymbol{W}$ of a perturbation propagating in the free ether is different to c, we have to conceive of the existence of an entity called "mass". This mass causes such a perturbation to propagate at a velocity denoted $\boldsymbol{V}$, (instead of the general notation W), with an amplitude strictly smaller than c, even when it moves in the free ether. In fact, the unique reason why a free particle moves in the free ether at a velocity V strictly smaller than c, is that, this particle possesses a mass denoted generally m. Having conceived of the fact that the mass of a particle modifies its velocity, we now have to generalize and analyze the notion of velocity.

As shown in our previous publications and demonstrated here, in fact, **two different kinds of velocities** are associated with the **massive** particle, that is, $\boldsymbol{V}$ is associated with another velocity denoted $\boldsymbol{V_P}$. This is the reason why I have generally denoted velocity as W. However, we should note that for the massless particle, i.e., for the photon, these two kinds of velocity are identical.

These two different kinds of velocities associated with a massive particle are: the "group velocity", generally denoted $\boldsymbol{V}$; and the "phase velocity", generally denoted $\boldsymbol{V_P}$. As proven in our previous publications and below, V_P and V are not independent, but are connected by the relation

$$\frac{\partial}{\partial E_T}\frac{E_T}{V_p} = \frac{1}{V} \tag{1.4}$$

where E_T denotes the total particle energy defined by

$$E_T = mc^2 + h\nu \tag{1.5}$$

where ν denotes a frequency, and h, the Planck constant.

Let us consider now the case where the particle is a photon, that is, of zero mass, for which the velocity denoted V_{phot} does not depend on E_T. This fact implies that the left-hand member of Eq. (1.4) does not depend on E_T and therefore $V_{p.phot}$ does not depend on E_T, that is, for the photon, Eq. (1.4) becomes simply

$$V_{p.phot} = V_{phot} \tag{1.6}$$

In this case, where Eq. (1.6) is verified, then $V_{p.phot}$ and V_{phot} are generally denoted c_p (the index "p" in c_p is for "perturbed ether"), but are denoted simply c in the free ether. That is, for the photon, the phase and the group velocity are identical and denoted c_p or c. Furthermore, the expression for the photon energy denoted $E_{T,phot}$, considering (1.5) for $m = 0$, is

$$E_{T,phot} = h\nu \qquad (1.7)$$

That is, by saying that a particle is different from a photon, I mean that this particle possesses a mass. As shown here, a photon is a particle of zero mass that moves at the velocity c_p or c, independently of its frequency ν, that is, independently of its energy $E_{T,phot}$. A massive particle moves at the group velocity V, which depends on its energy E_T. Another velocity, called the **phase velocity** and denoted V_P, is associated by the relation (1.4) with V, the function of which is defined in the following.

Definition

I call a "rotating ether trajectory segment" a segment of a trajectory in the ether that can be very small and where each point of this segment rotates around it, as demonstrated below. The ether points are linearly immobile and can only rotate on themselves, which is to say that only the locations of these rotations can change, but not the ether points. In particular:

> A "rotating ether trajectory segment" moving like light is a photon;
> a "free rotating ether trajectory segment" moving at a velocity smaller than that of the free photon, is a massive particle;
> and the photon is a massless particle.

As shown in our previous publications and developed further here, the ether is a particular elastic medium, the points of which **cannot move linearly** one relative to the other. The only change that a point of the ether can undergo is to rotate on itself. The rotation of a linearly immobile ether point induces rotations or rotational changes in its linearly immobile neighboring points, and these induced rotations or rotational changes induce rotations or rotational changes in other new linearly immobile ether points, and so on. *The propagation of such a field of **first rotations** is in fact the propagation of a particle*. Let us now consider the causes of such rotations, that is, what causes the **first rotations** of the ether points that influence their neighboring points?

> *It appears, as I prove, that these first rotations are fundamentally caused by point couples **C** of forces applied to some ether points that cause the rotations of their neighboring ether points, and so on.*

The rotations of the ether points are elastic, that is, when the causes of these rotations disappear, then they also disappear and the points of the ether return to their free state, that is, at a non-rotating state. As such, the ether is a medium in which each of its points can **only rotate elastically on itself**, but not move spatially relative to its neighbors.

A fundamental property of the ether is that these rotations are created by couples of forces denoted $\boldsymbol{C}$, applied to ether points, or by the ether points influencing other neighboring ether points (it is important not to confound couples of forces $\boldsymbol{C}$ with the light velocity c).

We may recall that, in the *general case*, an elastic medium is such that its points can be subjected to volumetric densities of linear forces $\boldsymbol{f}$ and to volumetric densities of couples of forces $\boldsymbol{C}$. These points in the medium may move linearly, one relative to the other, and also may rotate on themselves. The general equation of elasticity that governs these linear motions of its points and rotations on themselves, that is, the general elasticity equation that governs the field of the relative changes $\boldsymbol{\xi}$ of this general elastic medium ensues from the following **static** elasticity equation

$$\boldsymbol{curlC}/2 + (\sigma + \eta)\boldsymbol{grad}(div\boldsymbol{\xi}) + \eta\nabla^2\boldsymbol{\xi} + \boldsymbol{f} = 0 \tag{1.8}$$

This has to be written as a time-dependent equation, that is, the right-hand member has to contain time derivatives. I call Eq. (1.8) the "static Navier-Stokes-Durand equation of elasticity", in which σ and η denote the two so-called Lamé constants, and in which not only the densities of couples $\boldsymbol{C}$ applied to the elastic medium, but also the densities $\boldsymbol{f}$ of forces applied to it, are taken into account. E. Durand (Cf. Ref. 12) completed the Navier-Stokes equation by including the notion of densities of couples $\boldsymbol{C}$, which appears to be indispensable, i.e., this equation differs from the static Navier-Stokes equation by the term $\boldsymbol{curlC}$, which was not taken into account in the original Navier-Stokes equation of elasticity.

I show now that from Eq. (1.8), we can deduce the Maxwell equations. Indeed, since $\boldsymbol{f}$ is an **arbitrary** general density of linear forces applied to the elastic medium, we can choose the case where the expression for $\boldsymbol{f}$ is such that

$$(\sigma + 2\eta)\boldsymbol{grad}(div\boldsymbol{\xi}) + \boldsymbol{f} = 0 \tag{1.9}$$

In this case, the left-hand member of Eq. (1.8) becomes

$$\boldsymbol{curl}(\boldsymbol{C}/2 - \rho_0 c^2 . \boldsymbol{curl\xi}) \tag{1.10}$$

Since this expression has the dimensions of a density of rotational acceleration that is of $\rho_0 \partial_{tt}\boldsymbol{\xi}$, where

$$c^2 = \eta_0/\rho_0 \tag{1.11}$$

ρ_0 denotes the constant volumetric density of the ether, c, the light velocity, and where, therefore, η_0 is defined by $\eta_0 \equiv c^2\rho_0$, it follows that

$$\boldsymbol{curl}(\boldsymbol{C}/2 - \rho_0 c^2.\boldsymbol{curl\xi}) = \rho_0\partial_{tt}\boldsymbol{\xi} \tag{1.12}$$

This equation is proved by the fact that, as demonstrated in our previous publications and in Sec. IV.1 below, from Eq. (1.12) we can deduce the Maxwell equations of electromagnetism. For example, by changing the variables

$$\boldsymbol{E} \equiv \eta_0\boldsymbol{curl\xi} - \boldsymbol{C}/2 \text{ and } \boldsymbol{B} \equiv \rho_0\partial_t\boldsymbol{\xi} \tag{1.13}$$

Eq. (1.12) becomes

$$\boldsymbol{curlE} + \partial_t\boldsymbol{B} = \boldsymbol{0} \tag{1.14}$$

Eq. (1.14) is one of Maxwell's equations of electromagnetism. Through further variable changes, from Eq. (1.12) we can also obtain **all** of Maxwell's equations.

Eq. (1.12) is generalized below to the general case in which the particle is massive and subject to any field of forces. Before this, let us consider the solution to Eq. (1.12). We may recall that a photon is a "rotating ether trajectory segment" moving at the velocity of light. I demonstrate in the following the expression for this "free photon rotating ether trajectory segment", denoted $\boldsymbol{R}(\phi_P,\phi)$

$$\boldsymbol{R}(\phi_P,\phi) \equiv \xi_0\, SINC[(\Delta\omega/2)\phi]\cdot\left[\mathbf{e}_y\cos(\phi_P) + \mathbf{e}_z\sin(\phi_P)\right] \tag{1.15}$$

where, for the free photon, ϕ and ϕ_P are defined by

$$\phi \equiv -t + x/c, \quad \phi_P \equiv \omega(-t + x/c) \tag{1.16}$$

and where $SINC(\Psi)$ is defined by

$$SINC(\Psi) \equiv (sin\Psi)/\Psi \tag{1.17}$$

for any Ψ.

As such, the free photon $\boldsymbol{R}(\phi_P, \phi)$, as generalized in the following, can be written $\boldsymbol{R}(\omega\phi, \phi)$. We can see that $\boldsymbol{R}(\phi_P, \phi)$ is a function of x at a fixed instant t_0 and is a function of t at a fixed location x_0.

As demonstrated in our previous publications and here, I have adapted Eq. (1.8) to the time-dependent case in which the elastic medium is subject to point couples of forces $\boldsymbol{C}$. In this case, Eq. (1.8) becomes Eq. (1.12) and this elastic medium is called the ether. The reason why the linear forces $\boldsymbol{f}$ verify Eq. (1.9) is the fact that we can deduce the Maxwell equations from Eq. (1.12). Equation (1.12), from which we have obtained the Maxwell equations, is then generalized in the frame of the ether. I now present the fundamental ideas concerning this and mathematically develop them in the following.

We should note that for $\Delta\omega = 0$, that is, for

$$SINC[(\Delta\omega/2)\phi] = 1$$

Eq. (15) becomes

$$\boldsymbol{\xi} \equiv \xi_0 \left[\mathbf{e}_y \cos(\phi_P) + \mathbf{e}_z \sin(\phi_P)\right] \quad (1.18)$$

This equation represents a wave of ether point rotations from which we can deduce other electromagnetic quantities.

I.3 Two Examples: Group Velocity and Phase Velocity

Here we offer two examples: the first one deals with group velocity and the second one is for phase velocity. In the first example, I discuss the influence of the immobile particle on its environment. In the second, I consider the free massive or massless particle and its influence on its environment.

First example

We consider the case of a massive or massless particle subject to a field created by a point particle of mass m_0, immobile at the origin of the coordinates. This field, created by m_0, is a Schwarzschild field (Cf. Sec. V.8.2). We denote k as the constant of gravitation and α as the Schwarzschild constant, defined by

$$\alpha \equiv 2m_0 k/c^2 \quad (1.19)$$

where $\boldsymbol{r}$ is the radius vector; $\widehat{\mathbf{Vr}}$ is the angle made by $\boldsymbol{r}$ and the velocity $\boldsymbol{V}$ of a particle in this field created by m_0; and γ^2, $\hat{\gamma}^2$, B are the quantities defined by

$$\gamma^2 = 1 - \alpha/r, \hat{\gamma}^2 = 1 + \alpha(cos^2\widehat{\mathrm{Vr}})/(r\gamma^2) \qquad (1.20)$$

$$B = \sqrt{1 - (\gamma\, mc^2/E_T)^2} \qquad (1.21)$$

As demonstrated in our previous publications and below, the expressions for the particle velocity V and the phase velocity V_P of the wave associated with this particle in the field created by the immobile m_0 are

$$V = cB\gamma/\hat{\gamma} \qquad (1.22)$$

$$V_P = c\gamma/(\hat{\gamma}B) \qquad (1.23)$$

We can see that, for the photon, i.e., for $m = 0$, then the right-hand members of eqs. (1.22) and (1.23) are identical, since $B = 1$. As such, in this case V and V_P are identical, generally denoted c_p, for which the expression in this field is

$$c_p = c\gamma/\hat{\gamma} \qquad (1.24)$$

Having defined the phase velocity, we can deduce the density of the **phase** kinetic energy, denoted η, for which the expression is

$$\eta = \rho_0 {V_P}^2 \ . \qquad (1.25)$$

For example, the expression for the photon energy in a Schwarzschild field, which is simply its kinetic energy, since, for the photon, the phase and group velocities are identical, considering (1.24), is

$$\eta = \rho_0(c\gamma/\hat{\gamma})^2 \equiv \rho_0 {c_p}^2 \qquad (1.26)$$

In this case, Eq. (1.12) is partially generalized by the fact that c^2 has to be partially generalized by ${c_p}^2$, as defined in (1.26). Therefore, on the *Schwarzschild horizon*, i.e. for $r = \alpha$, then $c_P = 0$. It follows that the density of the **phase** kinetic energy η *is null*, and Eq. (1.12) becomes

$$\boldsymbol{curl}(\boldsymbol{C}/2) = -\rho_0\omega^2\boldsymbol{\xi} \equiv \rho_0\partial_{tt}\boldsymbol{\xi} \ . \qquad (1.27)$$

The question is thus: what happens when c_p is zero? Particularly considering that ρ_0 is a constant. The answer is determined by Eq. (1.26), which shows that when c_p is zero, then η is also zero, i.e., the rotations of the ether points do not move; this happens particularly on the Schwarzschild horizon.

Remark

This confirms the fact that ether points are linearly immobile and the movement is the **rotations** of the points. This is because if the ether points were moving and had translated their position, then, for example in the Schwarzschild case, there would be relative infinite translations of the ether points near the Schwarzschild horizon.

Second example

We consider now the case in which the massive or massless particle is free. Here, in eqs. (1.22) and (1.23) $\hat{\gamma}$ and γ take the value 1 and $m_0 = 0$, that is, these equations become

$$V = c\sqrt{1 - (mc^2/E_T)^2} \qquad (1.28)$$

$$V_P = c/\sqrt{1 - (mc^2/E_T)^2}) \ . \qquad (1.29)$$

We can see that a very small V, i.e., a very large mc^2 in front of $h\nu$, causes V_P to be very large, that V is always smaller or equal to c, and that $V = c$ implies $V_P = c$. The particle is then a free photon.

I.4 Preliminary Remarks on the Constitution of the Particle in the Frame of the Ether

As shown here, what I call a particle is, in fact, a rotating ether trajectory segment, generally denoted $\boldsymbol{R}(\phi_P, \phi)$, where ϕ_P denotes the phase of $\boldsymbol{\xi}$, as defined in the following

$$\phi_P = \frac{1}{\hbar}\left(-\int E_T dt + \int \frac{E_T}{V_P} d\ell\right)$$

and where ϕ is defined by

$$\phi = -t + \int d\ell/V \ .$$

$\boldsymbol{R}(\phi_P, \phi)$ is formed by the sum of waves of close phase velocities, of which, for example, the expression for the free photon is given in Eq. (1.15) and that for the **free massive** particle is also given by $\boldsymbol{R}(\phi_P, \phi)$. However, in the case of the free massive particle, the expressions for ϕ_P and ϕ are now given by

$$\phi = -t + x/V \tag{1.30}$$

$$\phi_P = \omega(-t + x/V_P) \tag{1.31}$$

which becomes Eq. (1.16) for the free photon.

This sum of phase velocities V_P moves at the group velocity V, which, in fact, is the particle velocity. This rotating ether trajectory segment $\boldsymbol{R}(\phi_P, \phi)$ moves at the group velocity V, propagating a wave called a "central phase wave", which propagates at the velocity V_P on this axis. The expression for $\boldsymbol{R}(\phi_P, \phi)$, which defines the particle, is defined by eqs. (1.15) and (1.16) for the free massless particle, i.e., a photon, and by the equations (1.15), (1.30), and (1.31) for the free massive particle. We can see that, in these cases, $\boldsymbol{R}(\phi_P, \phi)$ is a function of x at a fixed instant t_0 and is a function of t at a fixed point x_0, since, in these free cases, c, V, and V_P are constant. As demonstrated in the following, $\boldsymbol{R}(\phi_P, \phi)$ is the solution to an equation that generalizes Eq. (1.12) in a domain where $C = 0$. We can see that, for $m = 0$, **i.e., for the photon**, the two quantities ϕ_P/ω and ϕ, defined in eqs. (1.30) and (1.31), are identical. However, they are not identical for the massive particle.

I.5 The Elastic Nature of Mass and Gravitation

I.5.1 Generalities and introduction

Let us consider the case where, on the left-hand side of an ether point denoted P, there is an ether rotation, in one sense of rotation, and on the other side of P, i.e., on its right, there is the opposite rotation, but of similar amplitude. In this case, P, near to which are applied these two opposite rotations, remains immobile (cf. Fig. 1). However, if the left and right rotations are not of the same amplitude, P would not remain immobile. In this case, the question is: how does it happen that at the two sides of P, along the xaxis for example, the **amplitudes** of these ether point rotations are not equal? The answer to this question is that there is a supplementary effect that causes this non-equilibrium situation. This supplementary effect is because there is a supplementary point P_1, also with two rotations on the sides of the ether points such that between P and P_1 the total ether rotations are smaller than those that are outside this interval on the line that joins them. This fact, i.e., that between these two points the ether rotations are smaller, is due to the interference of the two rotations of inverse senses that exist between these two sources of rotation, which interfere and cause the forces that bring these two points closer together.

1.5.2 Generalization of the Schwarzschild case

We generalize the Schwarzschild radius $\alpha \equiv 2m_0k/c^2$ (Cf. Eq. (1.19)) by considering a spherical immobile mass m_0 of radius R_0 with its center located at a fixed ether point $\boldsymbol{O}$, and a particle of mass m, of velocity $\boldsymbol{V}$, due to the fact that it is subject to the field created by m_0. The expression for V is then (Cf. Eq. (1.22))

$$V = cB\gamma/\hat{\gamma} \quad (1.32)$$

where

$$\gamma = \sqrt{1 - R_0/r} \quad (1.33)$$

$$\hat{\gamma} = \sqrt{1 + R_0 cos^2(\widehat{\mathrm{Vr}})/(r\gamma^2)}\ . \quad (1.34)$$

In these expressions, $\boldsymbol{r}$ denotes the radius vector originating from the center of m_0 and directed towards the center of m; $\widehat{\mathbf{Vr}}$ denotes the angle made by $\boldsymbol{r}$ and $\boldsymbol{V}$; and B and Ω denote the quantities defined by

$$\Omega = \frac{mc^2}{mc^2 + h\Delta\nu} \quad (1.35)$$

$$B = \sqrt{1 - (1 - R_0/r)\Omega^2}\ . \quad (1.36)$$

In Eq. (1.35), c denotes the free light velocity and ν a frequency. It follows that Eq. (1.32) can then be written as

$$V = \frac{\sqrt{1-R_0/r}}{\sqrt{1+R_0 cos^2(\widehat{\nabla r})/(r\gamma^2)}}\sqrt{1-\left(1-\frac{R_0}{r}\right)\Omega^2}\ . \tag{1.37}$$

For $m = 0$, i.e., for $\Omega = 0$, Eq. (1.37) gives the photon velocity, denoted V_{ph}, defined by

$$V_{ph} = c\frac{\sqrt{1-R_0/r}}{\sqrt{1+R_0 cos^2(\widehat{\nabla r})/(r\gamma^2)}}\ . \tag{1.38}$$

In the free case, that is for $m_0 = 0$ and with $R_0 = 0$, V becomes V_{free}, defined by

$$V_{free} = c\sqrt{1-\Omega^2} \tag{1.39}$$

which, for $m = 0$, i.e., $\Omega = 0$, takes the value c.

1.5.3 The elastic nature of mass

Eq. (1.35) shows that mc^2 has the dimensions $h\nu$, and therefore we have the frequency ν_m, such that

$$mc^2 \equiv h\nu_m \tag{1.40}$$

and so Ω can be written

$$\Omega = \frac{\nu_m}{\nu_m + \Delta\nu}\ . \tag{1.41}$$

Considering eqs. (1.35), (1.39), and (1.41), it appears that:

> a free massive particle of mass m moves at velocity V_{free}, defined in (1.39), (1.35), and (1.41), which depends on the frequency ν_m and causes $\left|V_{free}\right| < c$; while a free massless particle, that is, a free photon, moves at velocity c independently of its frequency.

The explanation for these facts is that the mass modifies the medium in such a way that, for example, a free particle moves at velocity V_{free}, which is different to c. Since a free photon moves independently of its frequency, and V_{free} is defined in eqs. (1.39) and (1.41), it follows that, for the photon,

$\nu_m = 0$, i.e., m = 0. Since a free photon always moves at velocity c, it follows that the free photon moves independently of its frequency.

We consider here the physical constitution of the free mass m that can be immobile, and then consider the constitution of the photon, which moves at velocity c when it is free, but can move at a velocity less than c and can even be immobile, for example, when it is located on the Schwarzschild horizon.

The question remains as to how a mass is related to a field and what is the constitution of this field. The answer is that, even for an immobile mass m, one has (Cf. Eq. (1.40)) $m = h\nu_m/c^2$. This shows that an immobile mass m creates a field of frequency ν_m propagated in the ether. I term this phenomenon

mass wave of frequency $\nu_m = mc^2/h$

(Cf. refs.10, 13 and 14).

This mass wave concept is generalized to electrical charges and fields as specific changes in the medium of the ether such that they influence one another. Regarding, in particular, the field $h\nu_0/c^2$, created by an immobile mass m_0, we find that it **generalizes** the case treated by Einstein and Schwarzschild. Then, conceptually speaking in relation to the first ascertainment of the nature of the mass, we have

$$R_0 \equiv K\nu_0 \qquad (1.42)$$

where K is a constant of dimensions $2hk/c^4$, that is,

$$2m_0k/c^2 = 2hk\nu_0/c^4 \implies m_0c^2 = h\nu_0 \qquad (1.43)$$

As such, γ^2 and $\hat{\gamma}^2$ defined in (1.33) and (1.34) can be written as being the following functions of ν_0

$$\gamma^2 = 1 - K\nu_0/r \qquad (1.44)$$

$$\hat{\gamma}^2 = 1 + K\nu_0(cos^2\widehat{\mathrm{Vr}})/(r - K\nu_0)$$

We can see that, for $\widehat{\mathrm{Vr}} = 0$, i.e., for $\boldsymbol{V}$ directed towards $\boldsymbol{O}$ or its opposite sense, we have

$$\hat{\gamma}^2 = r/(r - K\nu_0)\ . \qquad (1.45)$$