# DISCUSSING PHYSICS BY MEANS OF AN OLD CONCEPT: THE AETHER NET

# DISCUTIENDO FÍSICA EN BASE A UN ANTIGUO CONCEPTO: LA RED ETÉREA

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***ABSTRAC***

*We present a elementary description of physical facts arising from the point of view, our world is surrounded from a medium: The Aether net.*

Key words: *Relativity, gravitation, nuclear force, unification theory, Ether*

***RESUMEN***

*Presentamos una descripción elemental de los factores físicos presentado desde un punto de vista, nuestro mundo esta rodeado de un medio: La red Etérea.*

Palabras clave: *Relatividad, gravitación, fuerza nuclear, teoría unificatoria, Éter*

## INTRODUCTION

The Question of the existence of a medium which fills space (Aether) is maybe so old as physics self, and some great men such as Lorentz, Maxwell, Dirac were followers of this point of view. Nowadays, there are also efforts to defend this concept, mostly sporadic and with no concrete physical arguments at all, making a poor presentation of the Idea.

The purpose of this paper is to present argumentations (for and against) the conception of an Aether net, making use of simple physical concepts. In doing this, we will arrive indeed (fast in an inspected way) to different topics of physics like: Light and matter, nuclear force, gravitational force, relativity) giving us the opportunity of confronting our actual knowledge. This mental exercise will lead us to a surprising conclusion: Many physical facts (indeed some laws) of our world could be good explained and even derived from an Aether Model of our space. In order to be concise and clear, I put on my departure points:

- A vacuum consists of a Sea of electrons in negative energy levels (Paul Dirac) [1].
- If there is a Medium, that fills space, this must have a solid structure, in order to allow transverse EM waves to travel along [2].

Hence, the space model (Aether) is a 3D Lattice of particles (A Crystal of electrons?).

The conventionally crystals, as we know, are 3D Lattices of Atoms, separated by periodic distances of the order of 5, whose proper vibrations are called Phonons.

For our Aether crystal model, we will consider only the one-dimensional lattice model. Even with this rough approach, we are able to show the strong connection between this lattice properties and conventionally independent theories of physics.

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## Proper waves of an aether net

The solution to the proper waves of a one-dimensional lattice of identical particles (mass m), separated a distance **a**, is the well known [3] dispersion relation:

$$\omega^2 = \left(\frac{4U''}{m}\right) sen^2(ka/2) \quad \text{or} \quad \omega = \left(\frac{4U''}{m}\right)^{1/2} |sen(ka/2)| \qquad (1)$$

Where, as usually: ω is the angular frequency of the lattice wave, **k** is the propagation constant ($k = 2\pi/\lambda$) and

$$U'' = \left.\frac{\partial^2 U}{\partial r^2}\right|_{r=a}$$

For what follows, we will use the abbreviation $\omega=\omega_0 sen\,(ka/2)$ taking in count, that ω can assume also negative values.

From ω(k), we can derive other wave parameters, like the phase velocity $\mathbf{V}_p$ and the group velocity $\mathbf{V}_g$ of the proper waves:

$$V_p = \frac{\omega}{k} = \omega_0 \frac{sen(ka/2)}{k} = C\frac{sen(ka/2)}{ka/2} \qquad (2)$$

$$V_g = \frac{\partial\omega}{\partial k} = \omega_0\left(\frac{a}{2}\right)\cos(ka/2) = C\cos(ka/2) \qquad (3)$$

where: $C = w_0 a/2$, a constant

From this relations, we can see that if: $\lambda = 2\pi/k >> a$, we would obtain: $V_p \cong V_g \cong C$

So, if we admit the existence of an Aether, the maximal velocity allowed by the Medium must be the light velocity; also $C = 3 \times 10^8$ m/s.

To account for the constancy observed for this velocity, we must demand that the a value be small enough. In order to estimate the a value, we appeal to dirac's asseveration about the "Sea of electrons". If we suppose, theaether particles are of the same order of magnitude as an electron, than, our aether crystal must have a lattice constant (a value) of the order of the electron radius ($r_e \approx 10^{-15}$ m). So let us assume by now $a = 10^{-15}$ m, from what follows we will decide, if this choice hat or no physical sense

## Mass of a nucleon and its relativity behavior

From the dispersion relation ω=ω(k), we can obtain also the effective mass (m·) associated to the Lattice proper wave, by the well known relation [4]:

$$m\cdot = \frac{\hbar}{\partial^2\omega/\partial k^2} \qquad (4)$$

Inserting the dependence $\omega=\omega_0 sen\,(ka/2)$, we obtain:

$$m\cdot = \frac{-\hbar\left(2/a\right)^2}{\omega_0 sen\left(ka/2\right)} \qquad (5)$$

This relation is valid throughout the k-space, particularly when ω attains its maximal value ($\omega_0$), when $k = \pi/a$ (Border of the first Brilloin zone), where it takes the value $m\cdot_0$:

$$m\cdot_0 = -\frac{\hbar\left(2/a\right)^2}{\omega_0} = -\frac{2\eta}{aC} \qquad (6)$$

It is clear, that at k = p/a, the group velocity of the wave $V_g$ is zero ($V_g$=0), but $V_p$ hat a non zero value ($V_p = [2/\pi]C$), which means, that in this case, there exist a Wave, that do not propagate: a stationary wave, and $m\cdot_0$ is the effective mass of this wave.

If we introduce now the a value proposed initially ($a = 10^{-15}$ m), we obtain:
$m\cdot_0 \approx 10^{-27}$ kg (The Mass of a nucleon).

This conclusion enable us to define a concrete value for the lattice constant a, if we assume, $m\cdot_0$ correspond effectively to the (negative) mass of a proton ($-m\cdot_0 = M_0 = 1.672 \times 10^{-27}$ kg), obtaining:

$$a = \frac{2\hbar}{M_o C} = 0.4206F \qquad (7)$$

where: $F = 1$ Fermi $= 10^{-15}$ m

So, as a first statement, the Aether Model tells us that Matter is solely a stationary EM Wave

Moreover, If we rearrange the last derived relation, in terms of the energy (E) associated with the Wave ($h\omega_0$), we obtain:

$$E = \hbar\omega_o = \frac{2\hbar C}{a} = M_o C^2 \qquad (8)$$

Relation (8), is the well known rest mass energy formula, postulated by Einstein, obtained in this case from a simple derivation of the theory, confirming our supposition of matter building (Proton).

Even more, If we ask, what happens with the Proton mass ($M_o$), when the group velocity takes a value different from zero ($V_g \neq 0$), we must again recur to the general relation (5), substituting, $M_o = 2\hbar/ac$, and M for (-m·), obtaining:

$$M = \frac{M_o}{sen\left(\frac{ka}{2}\right)} \qquad (9)$$

Taking into account, that $V_g = C\cos(ka/2)$, than: $sen(ka/2) = (1 - V_g^2/C^2)^{1/2}$, M takes the form:

$$M = \frac{M_o}{\sqrt{\left(1 - \frac{V_g^2}{C^2}\right)}} \qquad (10)$$

Which is the well known relativistic mass relation, relation (10) can be expressed in energetic terms as.

$$E_m = MC^2 = \sqrt{\left(M_o C^2\right)^2 + \left(M^2 V_g^2 C^2\right)} \qquad (11)$$

Which is identical to the Total energy relation for a particle of rest mas $M_o$ (derived from Dirac for the electron), if we admit, that the product $MV_g = p$, where p is the momentum of the particle $M_0$. This remark is done, because we will use it in other derivation to be discussed next.

**Nuclear magneton**

In the previous topic, we have made use of the fact, that when $k=\pi/a$, $V_g=0$, and consequently we interpreted this, with the occurrence of a standing wave. But, at this point we have also a certain value for the phase velocity ($V_p=2C/\pi$). So the question now is to interpret the meaning of $V_p$.

If we rewrite relation (6) in the form: $\hbar = M(a/2)^2\omega$, this relation resembles the well known Formula of conservation of angular momentum, used by Bohr to explain the hydrogen atom ($L=n\hbar = m\,r\,v = m\,r^2\omega$).

Supposing $V_p$ corresponds to the velocity of a particle of mass $M_{eff}$, orbiting with a radius r (around a Hole?), we must clear, what are this values in order that: $\hbar = M_{eff}\, r^2\,\omega = M_{eff}\, r\, V_p$, (equation (6) holds).

We must point out, that in a orbital motion $V_p = r\,\omega$, but at the same time we have already a relation (2) for $V_p$: $V_p = \omega / k$, which means that the product: **k r = 1**, resulting $r = a/\pi$, for the point we are evaluating ($k = \pi/a$)

If we insist with the Bohr Model, we notice that an alternative explanation of the building of orbitals, takes in count also the formation of standing waves, where: $2\pi r = n\lambda$, or $(2\pi r/\lambda) = kr = n$, which in the case of the ground state (n=1), takes also the form kr = 1

With this observation, relation (6) takes the general form: $\hbar = M_{eff}\, r\, V_p$, which for our specific case ($k = \pi/a$) takes the form

$$\hbar = [(\pi/2)^2 M_o]\ (a/\pi)\ \ (2C/\pi). \qquad (12)$$

The classical meaning of this relation is: a particle of mass $M_{eff}=[(\pi/2)^2M_o]$ is orbiting with radius ($a/\pi$) and velocity ($2C/\pi$) around a point in space. In order to account for the observed spin of a proton: $L_S=\frac{1}{2}\hbar$, we are tempted to express relation (12) as: $\frac{1}{2}\hbar=[(\pi^2/8)M_o]$ $(a/\pi)$ $(2C/\pi)$.

In concordance with the above interpretation (12), the stationary wave corresponds to a mass of charge e orbiting with angular frequency $\omega_o$ and radius ($a/\pi$). This concept enable us to evaluate the corresponding magnetic moment: $\mu^o = I\,A$, taking in count that: $I = e/\tau = e\omega_o/2\pi$, and $A = \pi r^2 = \pi (a/\pi)^2$

$$\mu^o = (e\omega_o/2\pi)\,(a^2/\pi) = 2\,e\,\hbar/ M_o\,\pi^2 = e\,\hbar/2\,M_{eff} = (4/\pi^2)\,(e\hbar/ 2M_o) \qquad (13)$$

The obtained value $\mu^o$ differs from the conventionally assumed Nuclear Magneton $\mu_N = (e\hbar/\ 2M_o)$ by a factor $(4/\pi^2) = 0.4$ , evidencing a limitation of the theory. Even more the observed value of the proton magnetic moment: 2.793 $\mu_N$ underlines the complexity involving the nuclear structure, not to be solved by a simple model.

**Coulomb force**

In the previous treatment, we arrived to a general relation between the propagation constant (k) and the radius (r) of the associated orbit: **k r = 1.**

With this remark, the momentum of the oscillating wave takes the form $P = \hbar k = \hbar/r$ , so if we ask now for the effective force acting upon the orbiting particle, we must evaluate $F_{eff} = \partial P/\partial t$ :

$$F_{eff} = \partial P/\partial t = \partial/\partial t(\hbar/r) = -(\hbar/r^2)\ \partial r/\partial t = -(\hbar/r^2)V_p \tag{14}$$

In order to prove the validity of this relation, we applied it to the case of Bohr's hydrogen atom, where we know that for the ground state (n=1): $V_p = \alpha\ C$, with $\alpha = 1/137.036$ (the fine-structure constant), replacing $\alpha$'s explicit recurrence formula ($\alpha = e^2/4\pi\varepsilon_o\hbar C$), we obtain finally:

$$F_{eff} = -(\hbar/r^2)V_p = -\ e^2/4\pi\varepsilon_o r^2 \tag{15}$$

Assuming also, the effective force expression $F_{eff}$ exact the (MKS) Coulomb force formula as is awaited for the hydrogen atom.

**Nuclear force**

The effective Force relation (14), can also be expressed as function of $\omega$ and k:

$$F_{eff} = (\hbar/r^2)V_p = \hbar k\omega \tag{16}$$

This formula enable us to see the explicit dependence of $F_{eff}$ with $\omega$. So, for k-values in-between the range 0 to $\pi/a$, $F_{eff}$ grows up and remain attractive (for opposite charges), but for for k-values in the range $\pi/a$ to $2\pi/a$, $F_{eff}$ decrease and change of sign at $k = 2\pi/a$, which would mean that for k values greater than $2\pi/a$, the effective Force $F_{eff}$ begins to be repulsive for opposite charges and attractive for equivalent charges.

In order to evaluate the value of the effective force around the critical point $k = 2\pi/a$, we use an approximation for $\omega$: $\omega \cong A + Bk$, resulting, $A = 2\pi C/a$ and $B = -C$. Substituting this result in (16), we obtain:

$$F_{eff} = \hbar k_{eff}\omega = \left(\frac{\hbar}{r}\right)\left(\frac{2\pi C}{a} - \frac{C}{r}\right) = -\left(\frac{\hbar C}{r}\right)\left(-\frac{2\pi}{a} + \frac{1}{r}\right) =$$

$$-\left(\frac{\eta C}{r}\right)\left(-\frac{1}{r_o} + \frac{1}{r}\right) \tag{17}$$

To compare this result with known data, we recall to the Yukawa nuclear potential: $V_Y = -\ g^2(e^{-\mu\ r}/r)$ and evaluate from this relation, the corresponding Yukawa nuclear force:

$$F_Y = -\frac{\partial V_Y}{\partial r} = -\left(\frac{g^2 e^{-\mu r}}{r}\right)\left(\mu + \frac{1}{r}\right) \tag{18}$$

Comparing both expressions, we can observe a good resemblance between them. The greatest difference arise from the analogous constants: $r_o$ and $(1/\mu)$, both differing in magnitude and sign: $r_o = a/2\pi = 0.42/2\pi$ F $= 0.067$ F, and $1/\mu \cong 1.5$ F.

The minus sign of $(1/r_o)$ allows in our case, the change from a repulsive to an attractive force. To explain the magnitude differences, we compare the fundamental dependences of both equivalent constants $(1/\mu)$ and $(r_o)$ :

$$1/\mu = \hbar/m_\pi C \tag{19}$$

where $m_\pi$ is the mass of $\pi$-meson ($m_\pi \cong 100$ MeV/$C^2$)

$$r_o = a/2\pi = \frac{\hbar}{\pi M_o C} \tag{20}$$

where $M_o$ was taken in this work as the proton mass

We observe, that both relations are basically the same and would attain the same value if the mass introduced by Yukawa: $m_\pi \cong 258\ m_e$ and the (in this work assumed) value $\pi M_o = 5768\ m_e$, were the same.

In reference to the Yukawa constant $g^2$, from experimental data results [5] will be assumed: $g^2 \cong 15\,\hbar C$, giving for $g^2(e^{-}\mu^{r}) \cong g^2(e^{-1}) = 5.5\,\hbar C$. The equivalent value found in our case (relation 17) is only $\hbar C$. This last constant can be expressed also as:

$$\hbar C = e^2/4\pi\epsilon_o\,\alpha \qquad (21)$$

Where: $\alpha = 1/137.036$ (the fine-structure constant).

**De Boglie wavelength**

The observation made in section (C), about the product $MV_g = p$, recognized as the effective momentum of the particle of mass M helps us now to make a new interpretation of this result. Namely: at the border of the first Brillouin zone of the net ($k = \pi/a$), the Aether net waves materializes (stationary waves), giving live to the nucleons (basic stone of Matter). This particular point of space $\omega_o\, k_o$ : (2C/a, $\pi$/a) can be considered as the origin of our reference frame, wherefrom we measure all physical parameters of our material world, per example: velocity, energy and momentum.

Maintaining the constructed Aether-Net formalism, we can evaluate now if this point of view is valid. We suppose first, that the observed propagation constant $k_{eff}$ of the wave associated with the displacement of M takes the form: $k_{eff} = [(\pi/a) - k]$, where k as usually is the propagation constant of the wave. With this observation, we evaluate p and see its significance:

$$p = \frac{M_o C \cos\left(\frac{ka}{2}\right)}{sen\left(\frac{ka}{2}\right)} = \frac{M_o C sen\left(\frac{\pi}{2} - \frac{ka}{2}\right)}{\cos\left(\frac{\pi}{2} - \frac{ka}{2}\right)} = \frac{M_o C sen\left(\frac{k_{eff}a}{2}\right)}{\cos\left(\frac{k_{eff}a}{2}\right)} \qquad (22)$$

In the ordinary case ($k_{eff}\,a << \pi$), we obtain:

$$p = M_o\, C\, (k_{eff}\; a/2) = \left(\frac{2\hbar}{aC}\right)\left(\frac{Ck_{eff}a}{2}\right) = \hbar k_{eff} \qquad (23)$$

Equation (23) expressed as: $p = h/\lambda$ (where $\lambda = 2\pi/k_{eff}$) is the well known De Broglie relation, postulated for the "Matter waves".

**Matter waves**

Following the idea expressed previously (F), we ask now if the difference of energy $E_{eff}$ measured up from the critical point $\omega_o\, k_o$ : (2C/a, $\pi$/a), can be associated also to the motion of the mass $M_o$.

$$E_{eff}/\hbar = \omega_{eff} = \omega_o - \omega = \omega_o\,[1 - sen(ka/2)] = \omega_o\,[1 - \cos(k_{eff}\,a/2)] \qquad (24)$$

From this $\omega$ value, we evaluate respectively the involved: velocity (group velocity) and effective mass:

$$V_g = \partial\omega_{eff}/\partial k_{eff} = C\ sen\ (k_{eff}\,a/2) \qquad (25)$$

$$M_{eff} = \frac{\hbar}{\partial^2\omega_{eff}/\partial k_{eff}^{\,2}} = \frac{M_o}{\sqrt{1 - \frac{V_g^{\,2}}{C^2}}} \qquad (26)$$

Relation (26), express that the associated mass of the wave is just the Proton mass, including the relativistic behavior.

In order to see the significance of Equation (25), we simplify it, for $k_{eff}$ very small: $V_g \cong C\,(k_{eff}\,a/2)$, or rearranging:

$$\hbar\, k_{ef} = (2\hbar/aC)\, V_g = M_o\, V_g \qquad (27)$$

Which is again the classical de broglie relation.

In view of the certainty of the deduced relations, we follow on making additional deductions from $E_{eff} = \hbar\,\omega_{eff}$. We evaluate next, the $E_{eff}$ dependence, for non-relativistic velocities ($k_{eff}\,a << \pi$).

$$E_{eff} = \hbar\,\omega_o\,[1 - \cos(k_{eff}\,a/2)] \cong \hbar\,\omega_o\,\{1 - [1 - (k_{eff}\,a/2)^2/2]\} = \hbar\,\omega_o\,[(k_{eff}\,a/2)^2/2]$$

$$E_{eff} = \left(\frac{(\hbar k_{eff})^2}{2M_o}\right) = \frac{p^2}{2M_o} \qquad (28)$$

Equation (28) is the classical energy dependence of free particles of mass $M_o$, obtained ordinary as solution of the Schroedinger equation.

In view of the results obtained, we must realize the validity of the stated interpretation, namely to describe the material properties up from the critical point: $\omega_o\, k_o$ : (2C/a, $\pi$/a)

## Gravitational force

In connection with the last derived energy relation (28), this resembles the typical energy solution of free particles in a box of potential (like free electrons in a metal). In order to specify also the possible energy levels, we must define the length L of the "Box".

Since we are treating the proper waves of the Aether-Net, it follows that the magnitude L corresponds to the extension of this net. If we assume, the limits of the Aether-Net is our proper Universe. The magnitude L corresponds then to the diameter of the Universe ($L \cong 10^{26}$ m).

Done this remark, we evaluate the corresponding standing waves, obtaining as usually:

$$L = n\,(\lambda/2) \qquad (29)$$

This relation corresponds also to the quantization of the possible $k_{eff}$ values:

$$k_{eff} = n\,(\pi/L) \qquad (30)$$

The possible Energy values are:

$$E_{eff} = \left(\frac{\hbar^2}{2M_o}\right)\left(\frac{\pi}{L}\right)^2 n^2 \qquad (31)$$

As we have seen on other sections, if we have the energy relation $E_{eff}$ (or $\omega_{eff}$), we can estimate the effective force acting upon the particle $M_o$. For this purpose, we use again the relation (14), where we need to specify, what is the value of the corresponding phase velocity $V_p$. In our case:

$$V_p = \omega_{eff}/k_{eff} = E_{eff}/\hbar\, k_{eff} = (\pi aC/4L)n \qquad (32)$$

Limiting us to the ground state level (n = 1), the effective force assumes the value:

$$F_{eff} = -\frac{\hbar V_p}{r^2} = -\left(\frac{1}{r^2}\right)\frac{haC}{8L} \qquad (33)$$

As we are treating with matter waves, the deduced effective force $F_{eff}$ can be associated to a matter force exerted upon $M_o$. Supposing, this force is the gravitational force produced by a unknown mass $\mathbf{m}_x$, we make the equality and deduce the corresponding $\mathbf{m}_x$ value:

$$F_{eff} = -\left(\frac{1}{r^2}\right)\frac{haC}{8L} = -\left(\frac{GM_o m_x}{r^2}\right) \qquad (34)$$

Using: $G = 6.672 \times 10^{-11}$ Jm/Kg$^2$ and all other known Data, we obtain for $m_x$ the value: $9.35 \times 10^{-31}$ kg.

The resulting $m_x$ value coincide extremely good with the electron (positron?) mass $m_e = 9.11 \times 10^{-31}$ kg.

A interpretation of this result is the following: The particle $M_0$, in his ground state, is oscillating around a "hole" in space with phase velocity $V_p$. But a "Hole" in a space filled with electrons is a localized anti-electron, or a localized positron.

Assuming the validity of this interpretation, we state the fundamental relation for **G**: the Gravitational constant, as

$$G = \frac{\pi (aC)^2}{8Lm_e} \qquad (35)$$

where: $L = 1.027 \times 10^{26}$ m is the diameter of our Universe, obtained in this work from the correct numeric equivalence of the G formula (35).

## Magnetic monopole

The effective force relation (14), used throughout this work can also be expressed as a Lorentz force:

$$F_{eff} = -\frac{\hbar V_p}{r^2} = -eV_p\left(\frac{\hbar/e}{r^2}\right) = -eV_p B_o \qquad (36)$$

This last relation indicates that the effective force is basically magnetic, and the magnetic field responsible for this interaction $B_o$ is:

$$B_o = \left(\frac{\hbar/e}{r^2}\right) = \frac{\left(2g/C\right)}{r^2} \qquad (37)$$

where, g is the Dirac magnetic monopole.

Which, lastly means, that the magnetic field $B_o$ is generated by a magnetic monopole of strength: 2g

In connection with this result, we can pay attention again to the nuclear force relation (17), derived in this work, and reformulate it in terms of g (magnetic charge) and e (electronic charge), obtaining:

$$F_{eff} = -\left(\frac{\hbar C}{r}\right)\left(-\frac{1}{r_o}+\frac{1}{r}\right) = -\left(\frac{2ge}{r}\right)\left(-\frac{1}{r_o}+\frac{1}{r}\right) \quad (38)$$

This substitution will indicate us that, the nuclear force arise from the interaction of a magnetic monopole of strength 2g and a electronic charge e.

## CONTRADICTIONS

The principal contradiction to the here proposed Aether theory is the fact, that in no way have been detected until now a dispersion effect, the velocity of EM Waves is a constant ($C = 3 \times 10^8\ ms^{-1}$) no matter what is the frequency. Even though the occurrence of pair-production (Proton-Antiproton) by the collision of two photons of energy $\hbar\omega_0$, can be interpreted as a dispersion effect (Bragg diffraction).

Another point of contradiction is the ordinary result concerning the relativistic addition of velocities. As can be easily deduced from the theory presented here (momentum addition), this result is obtained only if the involving masses are the same.

## CONCLUSIONS

The Aether theory presented in this contribution allowed us to cover different topics of physics, giving us another point of view of our world. It should be noted that the ultimate goal of our exposition is not to convince the reader of the existence of a Aether-Net System but to make him or her aware of the possibility of their existence.

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