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Towards a New Physics

(based on the decaying speed of light on quantum level)

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"Our first endeavors are purely instinctive prompting of an imagination vivid and undisciplined. As we grow older reason asserts it and we become more and more systematic and designing. However, those early impulses, though not immediately productive, are of the greatest moment and may shape our very destinies. Indeed, I feel now that had I understood and cultivated instead of suppressing them, I would have added substantial value to my bequest to the world. But not until I had attained manhood did I realize that I was an inventor."- *Nikola Tesla*

Abstract: The Author presents an alternative interpretation to Quantum phenomena based on a non-constant speed of light concept with fundamental consequences on quantum level. Besides its enormous significance about the interaction between charged particles, it leads ultimately to the complete description and unification of all fundamental forces as to the development of a new Mass-Energy equivalence that supplements Einstein's original one. The technological implications of this discovery may actually open the "doors" for real gravito-inertial control (e.g. invisibility, antigravity, teleportation) through electromagnetic means.

Keywords: Mass-Energy Equivalence, Rotating Vacuum (Archimedes Principle in Vacuum), Casimir Force, Uncertainty Principle, Electromagnetic Force, Gravitoinertial Force, Gravitoelectric and Gravitomagnetic flux, E/M Inertial Warp Drive

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1. Introduction

The most commonly taught interpretation of Quantum Theory is the *Copenhagen Interpretation* stating the description of an objective reality is unattainable due to the act of measurement. The idea of it is the collapse of the wave function (due to the act of measurement) of particle that gives essentially a *probabilistic description of nature*. The present work is an attempt to share *an alternative view* related to the cause behind the Quantum phenomena, putting logical consistency ahead of any derived mathematical expression.

Starting from Author's discovery upon a "paradox" found in a thought experiment, it gives us the ability to reveal fundamental weaknesses (lack of logical consistency) of today's Quantum Theory. This involves a charged particle with a nearly zero momentum (at rest) trapped between two photons (i.e. standing wave) of the same Energy but opposite momentums.

The mentioned "paradox" is associated with the cause of why an electron cannot absorb the total Energy of a single or a pair of photons. In order to demonstrate this, the investigation will address first the trivial case where an electron being at rest interacts with a single photon. Thus, the initial linear momentum of the system is just photon's momentum (since the electron is at rest):

$$p = \frac{h}{\lambda} = \frac{E_\lambda}{c}$$

$$E = E_\lambda + mc^2$$

E: initial Energy of the system
p: initial momentum of the system

After the absorption, the total Energy and momentum will be:

$$E' = \left((p_e c)^2 + (mc^2)^2\right)^{1/2}$$

$$p' = p = \frac{E_\lambda}{c} = p_e$$

E': final Energy of the system
p', p_e: final momentum of the system and electron's momentum

Then:

$$E \Rightarrow E^2 \Rightarrow$$

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The square of the total Energy gives:

$$(E_\lambda + mc^2)^2 \Rightarrow$$

$$(E_\lambda)^2 + (mc^2)^2 + 2E_\lambda mc^2 \neq E^2{}' \Rightarrow$$

Hence:

$$2E_\lambda mc^2 = 0 \Rightarrow E_\lambda = 0 \Rightarrow E = E' \quad (1)$$

The condition (1) reveals that in order to hold the Energy conservation, the photon Energy must be null. This is interpreted as the *unattainability* of a single photon to be entirely absorbed by a free electron.

Let us now repeat the previous exercise using two photons of the same Energy but with opposite momentums that strike electron's surface, simultaneously:

$$\lambda_1 = \lambda_2 = \lambda \Rightarrow$$

$$p = \frac{h}{\lambda_1} - \frac{h}{\lambda_2} = \frac{E_{\lambda_1}}{c} - \frac{E_{\lambda_2}}{c} = 0$$

$$E = E_{\lambda_1} + E_{\lambda_2} + mc^2 = 2E_\lambda + mc^2 \quad (1.1)$$

After the absorption, for once more the total Energy and momentum will be:

$$E' = \left((p_e c)^2 + (mc^2)^2\right)^{1/2}$$

$$p' = p = 0 = p_e$$

Then:

$$E \Rightarrow E^2 \Rightarrow (2E_\lambda + mc^2)^2 \Rightarrow$$

$$(2E_\lambda)^2 + (mc^2)^2 + 4E_\lambda mc^2 \neq E^2{}' \quad (1.2)$$

and

$$p_e = 0 \Rightarrow E^2{}' = (mc^2)^2 \quad (1.3)$$

The Energy conservation requires:

$$\left.\begin{aligned} 4E^2{}_\lambda &= 0 \\ 4E_\lambda mc^2 &= 0 \end{aligned}\right\} \Rightarrow E = E' \quad (2)$$

An interesting question arises from the fact that since the electron prior and post interaction is at rest, then why it should not absorb entirely both photons. An equivalent formulation to the violation of the Energy conservation (see (1.2)) is:

$$E' \neq 2E_\lambda + mc^2 \quad (3)$$

The expression (1) holds because of two reasons: a) a free electron may just partially absorb the Energy of a photon over the known *scattering processes*, b) the rest mass or the speed of light are considered invariable. On the other hand, (2) holds just because of the *invariable rest mass or speed of light*.

Furthermore, (3) is interpreted as the raise of electron's total Energy without changing its momentum that leads to violation of the Energy conservation based on *absence* of an expected kinetic Energy. However, one could propose a different but a *falsifiable* outcome (*variable speed of light*). Thus, in order to hold the Energy conservation, the amount of Energy that appeared to be added on (3) must be subtracted:

$$E' \neq 2E_{\lambda} + mc^2 \Rightarrow E' = mc^2 - 2E_{\lambda} \quad (4)$$

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An attempt to conduct a mirrored Compton Effect would result to the cancellation (it will not take place) of the effect itself. In this case the momentum conservation as projected on X and Y-Axis is:

$$X - Axis: p_x = p'_x$$

$$p_e = 0 \Rightarrow$$
$$p_x = \frac{(hf_1 \cos\theta_1 + hf_2 \cos\theta_2)}{c} + p_e$$
$$and$$
$$p'_e = \gamma m u_e \cos\theta_e$$
$$p'_x = \frac{(hf'_1 \cos\theta'_1 + hf'_2 \cos\theta'_2)}{c} + p'_e$$

$$Y - Axis: p_y = p'_y$$

$$p_e = 0 \Rightarrow$$
$$p_y = \frac{(hf_1 \sin\theta_1 + hf_2 \sin\theta_2)}{c} + p_e$$
$$and$$
$$p'_e = \gamma m u_e \sin\theta_e$$
$$p'_y = \frac{(hf'_1 \sin\theta'_1 + hf'_2 \sin\theta'_2)}{c} + p'_e$$

θ_1, θ_2: angle of the incoming photons
θ'_1, θ'_2: angle of the scattered photons
θ_e, u_e: angle and speed of the deflected electron
f'_1, f'_2: frequency of the scattered photons
γ: Lorentz factor

Due to the mirrored interactions (Photons having the same Energy but opposite momentums), the electron will remain at rest.

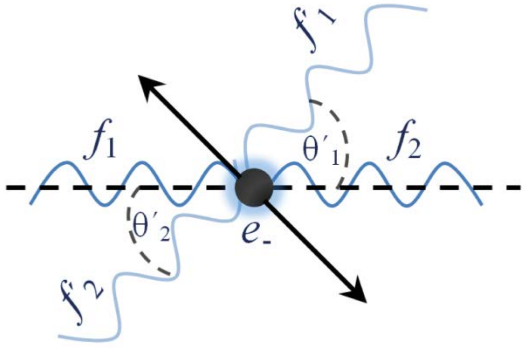

Fig.1 – Mirrored Compton Effect

$$X - Axis: p_x = p'_x$$

$$f_1 = f_2 = f \; and \; \theta_2 = \pi + \theta_1 \Rightarrow p_x = 0 \Rightarrow$$
$$p'_x = \frac{(hf'_1 \cos\theta'_1 + hf'_2 \cos\theta'_2)}{c} + p'_e = 0$$

$$u_e = 0 \Rightarrow p'_e = 0 \; and \; \theta'_2 = \pi + \theta'_1 \Rightarrow$$
$$\frac{(hf'_1 \cos\theta'_1 + hf'_2 \cos\theta'_2)}{c} = 0 \Rightarrow f'_1 = f'_2$$

$$Y - Axis: p_y = p'_y$$

$$f_1 = f_2 = f \; and \; \theta_2 = \pi + \theta_1 \Rightarrow p_y = 0 \Rightarrow$$
$$p'_y = \frac{(hf'_1 \sin\theta'_1 + hf'_2 \sin\theta'_2)}{c} + p'_e = 0$$

$$u_e = 0 \Rightarrow p'_e = 0 \; and \; \theta'_2 = \pi + \theta'_1 \Rightarrow$$
$$\frac{(hf'_1 \sin\theta'_1 + hf'_2 \sin\theta'_2)}{c} = 0 \Rightarrow 0 = 0$$

From the conservation of Energy:

$$mc^2 + hf_1 + hf_2 = E_{rel} + hf'_1 + hf'_2$$
$$but$$
$$f_1 = f_2 = f \; and \; f'_1 = f'_2 \; and \; u_e = 0$$
$$and$$
$$E_{rel} = mc^2\left(1 - \frac{u_e^2}{c^2}\right)^{-1} \Rightarrow$$
$$mc^2 + 2hf = mc^2 + 2hf'_1 = mc^2 + 2hf'_2 \Rightarrow$$
$$f = f'_1 = f'_2 \quad (5)$$

The conclusion of (5) is the photons will be totally reflected. Then by setting the following, it gives:

$$f'_1 = f'_2 = 0 \Rightarrow f = 0 \; (?) \quad (6)$$

Based again on the established Physics (6) leads to absurd, because in that case the incoming photons would be entirely absorbed (frequency decays down to zero).

Consequently, based on (4) and (6), the Energy conservation for the mirrored Compton Effect turns to:

$$mc^2 + hf_1 + hf_2 = E_{rel} + hf'_1 + hf'_2$$
$$E' = E_{rel} \text{ and } f'_1 = f'_2 = 0 \Rightarrow$$
$$E' \neq mc^2 + hf_1 + hf_2 = mc^2 + 2hf$$

Proportional to (4), this leads to:

$$E' = mc^2 - 2hf = mc^2 - 2\mathrm{E}_\lambda \quad (7)$$

Even though (4) and (7) may suggest reasonable alternatives, it is quite hard or even impossible to be experimentally verified. The idea of replacing photons with electrostatic potentials would result of gaining a one-way interpretation.

Then, (4) turns to:

$$\mathrm{E}_\lambda = \left|qV_P\right| \Rightarrow$$
$$E' = mc^2 - 2\mathrm{E}_\lambda = mc^2 - 2\left|qV_P\right| \quad (8)$$

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The conclusion that comes from (8) is a strong indication about the possibility of a variable rest mass of a charge particle or local speed of light on quantum level.

Now when two Electromagnetic waves of the same amplitude travelling in opposite directions and combine with each other, it results a standing EM Wave formation (standing Electric and Magnetic Wave):

$$\mathrm{E}_{F_y}(x,t) = 2E_{F_o}\cos(k\cdot x)\cdot\cos(\omega\cdot t) \quad (9)$$

and

$$B_{F_Z}(x,t) = 2B_{F_o}\sin(k\cdot x)\cdot\sin(\omega\cdot t) \quad (10)$$

E_{Fy}: standing electric field wave equation
B_{Fz}: standing magnetic field induction wave equation

The electric field though is proportional to the electric potential:

$$\mathrm{E}_{F_y}(x,t) \propto V_{F_y}(x,t) \Rightarrow$$
$$V_{F_y}(x,t) = 2V_{F_o}\cos(k\cdot x)\cdot\cos(\omega\cdot t) \quad (11)$$

V_{Fy}: standing electric potential wave equation

Just by placing the amplitude of the standing electric potential wave into (8), it gives a further support to the assumption about the two photons to be entirely absorbed by an electron at rest:

$$E' = mc^2 - 2\mathrm{E}_\lambda = mc^2 - 2\left|qV_{F_o}\right| \quad (12)$$

An equivalent expression to (12) that will help to develop and expose the standing wave mechanism in all kind of interactions is derived over the (4):

$$E' \neq 2E_\lambda + mc^2 \Rightarrow E' = mc^2 - 2E_\lambda \Rightarrow$$
$$\left.\begin{aligned} U_i = U_L \neq E_\lambda + mc^2 \\ U_i = U_R \neq E_\lambda + mc^2 \end{aligned}\right\} + \Rightarrow$$
$$2U_i \neq 2E_\lambda + 2mc^2 \text{ and } U_{EMR} = 2E_\lambda \Rightarrow$$
$$U_i \neq \frac{U_{EMR}}{2} + mc^2 \Rightarrow$$
$$U_i = mc^2 - \frac{U_{EMR}}{2} \quad (13)$$

or

$$U_i = mcu \text{ and } u = c\left(1 - \frac{U_{EMR}}{2mc^2}\right) \quad (14)$$

Decaying speed of light
Stationary conditions

$$u = c\left(1 - \frac{U_{EMR}}{2mc^2}\right) \quad (15)$$
$$U_{EMR} = 2hf = qV_{EP}$$

u: local speed of light (two photons Energy)
m: charged particle's rest mass
U_{EMR}: two photons Energy (standing wave)
U_{EMR}: electrostatic potential Energy

The derivation of the Eq. (15) and Eq. (17), urges us to claim the theoretical discovery of new postulates in Quantum Physics.

Postulate (1): *In order to hold the Energy and momentum conservation for a trapped charged particle (trapped within a standing wave), its rest Energy must be reduced.*

Postulate (2): *The speed of light varies proportional to local electrostatic potential OR inverse proportional to the separation distance (r) between two arbitrary charged particles or from the center of each one separately.*

Eq. (14) may take a more general form:

$$qV_{EP} = \frac{q_1 q_2}{4\pi\varepsilon_o r} \quad and\ \lambda = \frac{\lambda_c}{2} = \frac{h}{2mc} \Rightarrow$$

$$\lambda = \frac{h}{2mc} \Rightarrow \lambda = \frac{h}{\left(m_{q_1} + m_{q_2}\right)c} \qquad (16)$$

Decaying speed of light
Stationary conditions

$$u = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c} = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{\lambda}{h} \qquad (17)$$

Eq. (17) applies for like and opposite charges as follow:

$$q_1 q_2 > 0 \Rightarrow \lambda = \frac{h}{\left(m_{q_1} + m_{q_2}\right)c} \Rightarrow$$

$$u = c - \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c} = c - \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{\lambda}{h} \qquad (18)$$

$$q_1 q_2 < 0 \Rightarrow$$

$$u = c + \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c} = c + \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{\lambda}{h} \qquad (19)$$

As with the effective inertial Energy of the charged particle (Eq. (15)), the electrostatic potential Energy of a “point” charge will be also under the influence of a decaying speed of light:

$$\frac{1}{4\pi\varepsilon_0} = \frac{c^2\mu_o}{4\pi} \Rightarrow c^2 = \frac{1}{\varepsilon_0\mu_o} \Rightarrow$$

$$u = c \Rightarrow U_{s(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r} \qquad (20)$$

$$\left.\begin{matrix} c \Rightarrow U_{s(r)} \\ u \Rightarrow U_{E(r)} \end{matrix}\right\} \Rightarrow U_{E(r)} = U_{s(r)}\frac{u}{c} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{u}{c} \qquad (21)$$

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Electrostatic potential Energy of charge q_1 in the presence of q_2 (Stationary conditions)

$$U_{E(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\left(1 \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c^2}\right) \qquad (22)$$

$$q_1 q_2 > 0 \Rightarrow$$

$$U_{E(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\left(1 - \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c^2}\right)$$

$$q_1 q_2 < 0 \Rightarrow$$

$$U_{E(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\left(1 + \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c^2}\right)$$

Setting Eq. (17) equals to zero, it is revealed another interesting equation:

$$u = 0 \Rightarrow$$

$$u = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r_c\left(m_{q_1} + m_{q_2}\right)c} = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r_c}\frac{\lambda}{h} = 0 \Rightarrow$$

$$c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r_c\left(m_{q_1} + m_{q_2}\right)c} = 0 \Rightarrow$$

$$r_c = \pm\frac{q_1 q_2}{4\pi\varepsilon_o\left(m_{q_1} + m_{q_2}\right)c^2} > 0 \qquad (23)$$

or

$$\frac{r_c}{\lambda} = \pm\frac{q_1 q_2}{4\pi\varepsilon_o hc} > 0 \qquad (24)$$

Eq. (24) gives the separation distance of two charges or the distance from the center of a stationary charge where the *speed of light* goes to zero. The same expression may actually represent a general form of the fine structure constant.

General form of the fine structure constant

$$\lambda_{sw} = \lambda = \frac{h}{\left(m_{q_1} + m_{q_2}\right)c}$$

$$\frac{2\pi r_c}{\lambda_{sw}} = \pm\frac{q_1 q_2}{4\pi\varepsilon_o\hbar c} = \pm\frac{q_1 q_2}{2\varepsilon_o hc} = \alpha \qquad (25)$$

or

$$\frac{2\pi r_c}{\lambda_{sw}} = \frac{2\pi r_c}{h}\left(m_{q_1} + m_{q_2}\right)c = \alpha$$

$$\alpha = \frac{1}{137.036}$$

λ_{sw}: standing wave wavelength (two photons)
r_c: critical distance (speed of light goes to zero)

Postulate (3): *The derivation of the fine structure constant over a trapped charged particle within a standing wave points to three important facts: i)at a critical distance the speed of light goes to zero, ii) charged particles possess well-defined geometric/electromagnetic dimensions and iii) an electrostatic potential Energy is equivalent to a two photons Energy (standing wave Energy).*

2. Decaying Speed of Light

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The decaying speed of light appears so far under stationary conditions (the charge or charges possess a nearly zero momentum) where a charged particle is bounded either by photons (standing wave) or by electrostatic potentials:

$$u = c - \frac{U_{EMR}}{2mc} = c\left(1 - \frac{U_{EMR}}{2mc^2}\right)$$

and

$$u = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c} = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{\lambda}{h}$$

Considering photons as electromagnetic waves, Eq. (14) should normally apply for pure standing waves, i.e. in absence of charged particles. The only difficulty is the mass factor that can be overcome using the E/M *Energy Density* or *Power Density* that combines spatial dimensions (volume) with Energy:

$$\frac{U_{EMR}}{V} = \frac{2hf}{V} = 2\varepsilon_o E^2 = 2\frac{B^2}{\mu_o} = \frac{D}{c}$$

$$and\ U_{EMR} \rightarrow U$$

$$\frac{U}{2mc^2} \Rightarrow \frac{U}{2mc^2}\frac{V}{V} = \frac{E^2}{E^2{}_c} = \frac{B^2}{B^2{}_c} = \frac{D}{D_c}$$

V: equivalent E/M *Volume of the trapped particle or Energy*

Decaying speed of light
Pure standing wave in absence of charges

$$u = c\left(1 - \frac{E^2}{E^2{}_c}\right) = c\left(1 - \frac{B^2}{B^2{}_c}\right) \quad (26)$$

E_c: required Electric field intensity to nullify the speed of light
B_c: required Magnetic Induction to nullify the speed of light

Decaying speed of light
Pure standing wave in absence of charges

$$u = c\left(1 - \frac{D}{D_c}\right) \quad (27)$$

$$D = \frac{P}{S} = 2c\varepsilon_o E^2\ and\ D_c = \frac{P_c}{S_c} = 2c\varepsilon_o E_c{}^2$$

D_c: required Power Density to nullify the speed of light

A He-Ne Laser has the following technical characteristics:

$$P = 5mW\ and\ \lambda = 632.8nm$$

$$d = 0.81mm\ \text{(Beam diameter)}$$

A beam with a Gaussian profile has an approximate Power Density given by the following expression:

$$D = \frac{255}{d^2}P \Rightarrow D \cong 19.4\cdot 10^3 W\cdot m^{-2}$$

The calculations of the critical values for Laser applications (using the cross section surface) are:

$r = \lambda$ *(found in various published papers)*

$$r = \lambda \Rightarrow S_A = \pi(\lambda)^2 \cong 1.26\cdot 10^{-12} m^2$$

$$P_c = h\left(\frac{2c}{\lambda}\right)^2 \cong 5.96\cdot 10^{-4} W$$

$$D_c = \frac{P_c}{S_A} \cong 4.74\cdot 10^8 W\cdot m^{-2}$$

or

$2\pi r = \lambda$ *(wavelength definition)*

$$r = \frac{\lambda}{2\pi} \Rightarrow S_B = \pi\left(\frac{\lambda}{2\pi}\right)^2 \cong 3.18\cdot 10^{-14} m^2$$

$$P_c = h\left(\frac{2c}{\lambda}\right)^2 \cong 5.96\cdot 10^{-4} W$$

$$D_c = \frac{P_c}{S_B} \cong 1.87\cdot 10^{10} W\cdot m^{-2}$$

S_A, S_B: critical cross section surfaces

A 5mW Laser beam output used in a *Michelson interferometer* topology will practically display a constant speed (speed of light) at the interference region:

$$D \cong 1.94 W\cdot cm^{-2} \cong 19.4\cdot 10^3 W\cdot m^{-2}$$

$$D_c = \frac{P_c}{S_A} \cong 4.74\cdot 10^8 W\cdot m^{-2}$$

$$u = c\left(1 - \frac{D}{D_c}\right) \cong 0.99959c$$

or

$$D \cong 1.94 W\cdot cm^{-2} \cong 19.4\cdot 10^3 W\cdot m^{-2}$$

$$D_c = \frac{P_c}{S_B} \cong 1.87\cdot 10^{10} W\cdot m^{-2}$$

$$u = c\left(1 - \frac{D}{D_c}\right) \cong 0.999989c$$

Postulate (4): *The speed of light varies proportional to the opposed Power Density (interference) consisted of photons of the same wavelength.*

Standing waves are waves having on average no net propagation of Energy. Could a standing wave suddenly acquire a momentum? According to *Ivanov's Rhythmodynamics*, a standing wave could start moving in space just by creating the necessary shift in phase on both photons (standing wave) simultaneously:

Velocity of a moving standing wave

Yuri N. Ivanov's Rhythmodynamics

$$u_{sw} = c\frac{\phi_{sw}}{\pi}$$

φ_{sw}: standing wave phase shift

Then, Eq. (27) becomes:

$$u = c\left(1 - \frac{D}{D_c}\right) = c\left(1 - \frac{P}{S}\frac{S_c}{P_c}\right)$$

Using the 1m^2 as effective surface, it results an expression having as ratio Powers instead of Power Densities:

$$S = S_c = 1m^2 \Rightarrow$$

$$P \to P_{sw} \Rightarrow P_{sw} = (1m^2)D_{sw} \Rightarrow$$

$$P_c = (1m^2)D_c \ \ but$$

$$P_{sw} = h(f_{sw})^2 \ \ and \ \ P_c = h\left(\frac{2c}{\lambda}\right)^2 = h(2f)^2$$

$$u = c\left(1 - \frac{P_{sw}}{P_c}\frac{c^2}{c^2}\right) \Rightarrow$$

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Decaying speed of light

Moving standing wave with local decaying speed of light

(Pure moving standing wave in absence of charges)

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) \ \ and \ \ u_{sw} = c\frac{f_{sw}}{2f} \qquad (28)$$

f_{sw}: standing wave frequency shift

The same expression (Eq. (28)) can be easily derived through Eq. (14):

$$u = c\left(1 - \frac{U_{EMR}}{2mc^2}\right) \Rightarrow \frac{U_{EMR}}{2m} = u^2{}_{sw} \Rightarrow$$

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) \qquad (29)$$

The speed of a moving standing wave can be expressed by its either phase (Rhythmodynamics) or frequency shift:

$$\left.\begin{array}{l} 2f \to \pi \\ f_{sw} \to \phi_{sw} \end{array}\right\} \Rightarrow \frac{f_{sw}}{2f} = \frac{\phi_{sw}}{\pi} \qquad (30)$$

Postulate (5): *The speed of a photon that participates in a standing wave formation; varies proportional to the standing wave phase or frequency shift squared. Eventually (post shift), the photon acquires a new but reduced momentum and a speed the known constant speed of light c (in the vacuum).*

Photon's momentum

Based on phase or frequency shift during the interaction

$$u = c\left(1 - \frac{D}{D_c}\right) = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right)$$

$$0 \le u_{sw} < +\infty$$

$$u = c\left(1 - \left(\frac{f_{sw}}{2f}\right)^2\right) = c\left(1 - \left(\frac{\phi_{sw}}{\pi}\right)^2\right)$$

$$-\infty < u \le c$$

$$p = \frac{h}{\lambda}\frac{u}{c} \qquad (31)$$

f_{sw}: standing wave frequency shift
φ_{sw}: standing wave phase shift
u: photon's speed
p: photon's momentum

Postulate (4) presents a clear way of constructing a relative easy experiment that may demonstrate an indirect decay of the speed of light occurring at the interference region.

The proposed experiment (see Fig. 2) is consisted of a *Michelson interferometer* setup placed inside a *vacuum chamber* with controllable temperature conditions. The critical components are an adjustable and *extremely stable monochromatic Laser output* together with a high-resolution digital wavelength meter, which the latter is able to distinguish small ($\Delta\lambda < 0.001\lambda$) wavelength variations.

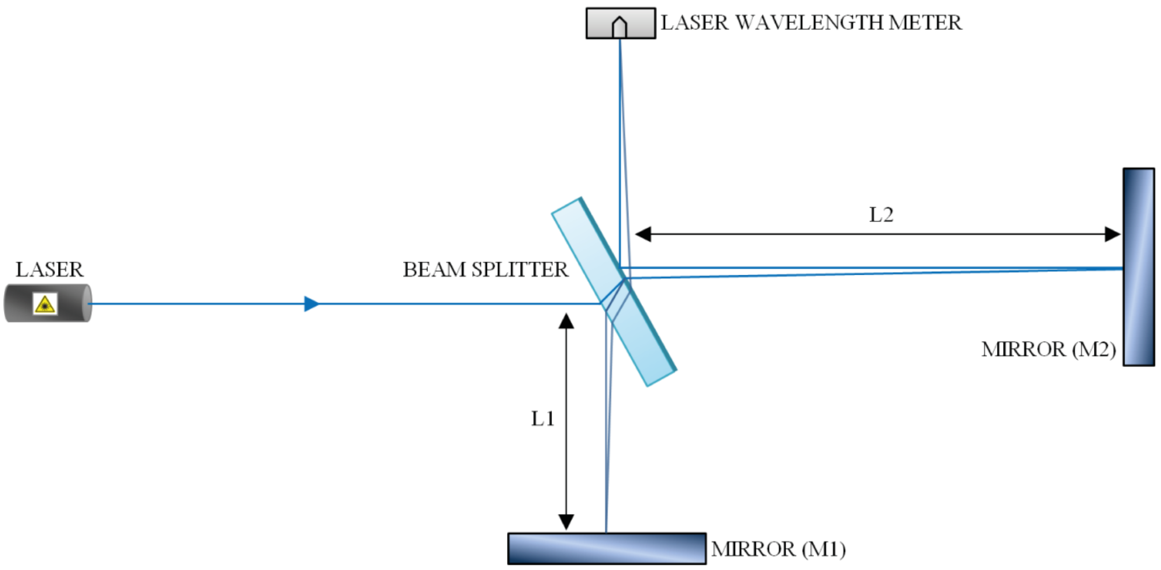

Fig.2 – Experiment: Michelson Interferometer inside a vacuum chamber. Red shift proportional to the opposed Power Density.

The total phase shift between the Laser beams as seen in Fig. 2 is:

$$\phi_{total} = \phi + \frac{4\pi}{\lambda}(L_1 - L_2)$$

ϕ : *phase shift due to the beam splitter glass*

$\phi_{total} = m_{in} 2\pi$ *(Constructive interference m_{in}=0, 1, 2…)*

When L1 distance varies by keeping L2 fixed, one may observe the changes of the constructive and destructive interference patterns. The number of changes in a manually made wavelength measurement is given by:

$$\Delta m_{in} \frac{\lambda}{2} = |L_1 - L_2| \Rightarrow \lambda = \frac{2|L_1 - L_2|}{\Delta m_{in}}$$

Δm_{in}: *number of changes*
λ: *Laser wavelength*

Let us now consider the following Laser beam characteristics (Fig. 2) with the aim to demonstrate the frequency shift (i.e. red shift) effect:

$\lambda = 473nm$

$d = 0.7mm$ *(Beam cross-section diameter)*

$P = 1mW..300mW$ *(Adjustable Laser output power)*

The critical power density for the blue (473nm) Laser beam is:

$2\pi r = \lambda$ *(wavelength definition)*

$$r_c = \frac{\lambda}{2\pi} \Rightarrow S_c = \pi\left(\frac{\lambda}{2\pi}\right)^2 \cong 1.78\cdot 10^{-14} m^2$$

$$P_c = h\left(\frac{2c}{\lambda}\right)^2 \cong 1.03\cdot 10^{-3} W$$

$$D_c = \frac{P_c}{S_c} \cong 5.99\cdot 10^{10} W\cdot m^{-2}$$

The approximate delivered power density of the Laser source (473nm) is:

$P = 1mW \text{ and } d = 0.7mm$

$$D_A = \frac{255}{d^2} P \Rightarrow D \cong 5.20\cdot 10^{5} W\cdot m^{-2}$$

and

$P = 300mW \text{ and } d = 0.7mm$

$$D_B = \frac{255}{d^2} P \Rightarrow D \cong 1.56\cdot 10^{8} W\cdot m^{-2}$$

Then, the corresponding speed at the interference region for the above power density values is:

$P = 1mW \text{ and } d = 0.7mm$

$$u = c\left(1 - \frac{D_A}{D_c}\right) \cong 0.99991c \Rightarrow$$

$$\lambda_u = \frac{c}{u}\lambda = 1.00009\lambda \text{ or } f_u = 0.99991f$$

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$P = 300mW \text{ and } d = 0.7mm$

$$u = c\left(1 - \frac{D_B}{D_c}\right) \cong 0.99739c \Rightarrow$$

$$\lambda_u = \frac{c}{u}\lambda = 1.00261\lambda \text{ or } f_u = 0.99739f$$

Conclusively, the digital wavelength meter (Fig. 2) must provide an accuracy of ±0.0002 nm and an output resolution of 0.0001 nm in order to make a reliable and successful measurement.

3. Extended Einstein's Relativity

A variable speed of light concept does not oppose to the already experimentally confirmed Theory of Relativity. On the contrary, the new findings play the role of a supplement, a missing part of Relativity that addresses *particle's behavior during electromagnetic interactions*.

The derivation of the new relativistic Energy (momentum and speed of light depended) requires starting from the relativistic momentum. Thus:

$$p = mu_p\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \Rightarrow$$

u_p: particle's speed
m: charged particle's rest mass
U_r, p: Einstein's Relativistic Energy and Momentum
U_i, p_u: Xydous Extended Relativistic Energy and Momentum

$$\left.\begin{aligned} c &\Rightarrow p \\ u &\Rightarrow p_u \end{aligned}\right\} \Rightarrow p_u = mu_p\frac{u}{c}\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2}$$

$$\left.\begin{aligned} c &\Rightarrow U_r \\ u &\Rightarrow U_i \end{aligned}\right\} \Rightarrow U_i = (mcu)\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2}$$

The rest Energy of the charged particle can be blended with the new relativistic momentum as follow:

$$p = mu_p\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \Rightarrow$$

$$pu = umu_p\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \Rightarrow$$

$$(pu)^2 = (umu_p)^2\left(1-\frac{u^2{}_p}{c^2}\right)^{-1} \Rightarrow$$

$$(pu)^2 = \left(muu_p\frac{c}{c}\right)^2\left(1-\frac{u^2{}_p}{c^2}\right)^{-1} \Rightarrow$$

$$(pu)^2 = m^2u^2u^2{}_p\frac{c^2}{c^2}\left(1-\frac{u^2{}_p}{c^2}\right)^{-1} \Rightarrow$$

$$\frac{\left(m^2c^2u^2\dfrac{u^2{}_p}{c^2}+m^2c^2u^2-m^2c^2u^2\right)}{\left(1-\dfrac{u^2{}_p}{c^2}\right)} \Rightarrow$$

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Then:

$$\frac{(m^2c^2u^2)\left(\dfrac{u^2{}_p}{c^2}-1\right)+m^2c^2u^2}{\left(1-\dfrac{u^2{}_p}{c^2}\right)} \Rightarrow$$

$$(pu)^2 = -m^2c^2u^2+m^2c^2u^2\left(1-\frac{u^2{}_p}{c^2}\right)^{-1} \Rightarrow$$

Xydous extended
Relativistic Energy and Momentum
(Based on the decaying speed of light)

$$U_i = m_ic^2 = \frac{u}{c}\left((pc)^2+(mc^2)^2\right)^{1/2} \quad (32)$$

or

$$U_i = m_ic^2 = (mcu)\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \quad (33)$$

$$p_u = mu_p\frac{u}{c}\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \quad (34)$$

and

$$u = c\left(1-\frac{u^2{}_{sw}}{c^2}\right) \text{ or } u = c\left(1-\frac{D}{D_c}\right)$$

$$u_{sw} = c\frac{f_{sw}}{2f}$$

u_p: particle's speed
p_u: particle's extended relativistic momentum
u: decaying speed of light
m: charged particle's rest mass
m_i: charged particle's effective inertial (extended rel.) mass

Assuming a charged particle with nearly zero initial momentum is trapped between two Laser beams (standing wave) and having additionally the technical means to create a frequency shift on both beams, simultaneously.

Then, from Eq. (28):

$$u = c\left(1-\frac{u^2{}_{sw}}{c^2}\right) \text{ and } u_{sw} = c\frac{f_{sw}}{2f} \Rightarrow$$

$$U_i = (mcu)\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \Rightarrow$$

$$U_i = mc^2\left(1-\frac{u^2{}_{sw}}{c^2}\right)\left(1-\frac{u^2{}_p}{c^2}\right)^{-1/2} \Rightarrow$$

A frequency shift upon the beams makes the charge and the standing wave (moving nodes) to start (see *Rhythmodynamics*) moving rapidly on the same direction as a system (wave-particle).

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Consequently, the speed of the standing wave is equal to that of the particle:

$$u_{sw} = u_p = c\frac{f_{sw}}{2f} \Rightarrow \quad (35)$$

Eq. (35) finally leads to an expression discovered first by *Ricardo L. Carezani* in his work called *Autodynamics*, although he never mentioned moving standing waves and variable speed of light.

Carezani
Relativistic Energy and Momentum
(Based on a single reference frame)

$$U_{Carezani} = mc^2\left(1 - \frac{u^2{}_p}{c^2}\right)^{1/2} \quad (36)$$

$$u_p = u_{sw}$$

$$p_{Carezani} = mu_p\left(1 - \frac{u^2{}_p}{c^2}\right)^{1/2} \quad (37)$$

Xydous extended
Relativistic Energy and Momentum
(Based on the standing wave frequency shift)

$$U_i = mc^2\left(1 - \frac{u^2{}_{sw}}{c^2}\right)^{1/2} = \frac{mc^2}{\gamma} \quad (38)$$

or

$$U_i = mc^2\left(1 - \left(\frac{f_{sw}}{2f}\right)^2\right)^{1/2} = \frac{mc^2}{\gamma} \quad (39)$$

$$u_{sw} = c\frac{f_{sw}}{2f} = u_p$$

$$\gamma = \left(1 - \frac{u^2{}_{sw}}{c^2}\right)^{-1/2} \quad \textit{(Lorentz factor)}$$

$$p_u = mu_{sw}\left(1 - \frac{u^2{}_{sw}}{c^2}\right)^{1/2} = \frac{mu_{sw}}{\gamma} \quad (40)$$

or

$$p_u = mc\frac{f_{sw}}{2f}\left(1 - \left(\frac{f_{sw}}{2f}\right)^2\right)^{1/2} = \frac{mu_{sw}}{\gamma} \quad (41)$$

Obviously, Eq. (36) is a subset of the general case (see Eq. (33)) that applies for a particle with a nearly zero initial speed or when the moving standing wave has the same speed with the charged particle. The electrostatic deflection experiment (Fig. 3) is another proposal that could verify besides the decaying speed of light, Carezani's relativistic equation.

The trajectory of the electron inside a homogenous electrostatic field is given by the expressions of Electrodynamics:

$$q_e V_1 = \frac{1}{2} m_e u^2{}_{p_x} \Rightarrow u_{p_x} = \left(\frac{2q_e V_1}{m_e}\right)^{1/2}$$

$$t_{total} = \frac{l_c}{u_{p_x}} \Rightarrow x = u_{p_x} t \Rightarrow t = \frac{x}{u_{p_x}}$$

$$a = \frac{F_E}{m_i} = \frac{q_e E_2}{m_i} = \frac{q_e}{m_i}\frac{V_2}{d_c} \quad and \quad y = \frac{at^2}{2} \Rightarrow$$

$$y = \frac{at^2}{2} = \frac{m_e}{4m_i}\frac{V_2}{V_1}\frac{x^2}{d_c} \quad (42)$$

u_{px}: electron's non-Relativistic speed ($q_eV_1 << m_ec^2$) on x-Axis
u_{py}: electron's speed depended by V_2 on y-Axis
t_{total}: spend time under E_2
a: acceleration under the influence of E_2 (y-Axis)
x: position on x-Axis under E_2 versus time (t)
y: electron's trajectory under E_2

Classical Electrodynamics

$$q_e V_2 << m_e c^2 \Rightarrow u_{p_y} << c \Rightarrow m_i \approx m_e$$

$$y = \frac{at^2}{2} = \frac{V_2}{V_1}\frac{x^2}{4d_c} \quad (43)$$

When the value of V_2 is high enough, the electron acquires a relativistic Energy due to the electric field E_2:

$$m_i c^2 = m_e c^2 + U_k = m_e c^2 + q_e V_2 \quad (43.1)$$

Relativistic Electrodynamics

$$q_e V_2 > 0.01 m_e c^2 \Rightarrow m_i > m_e$$

$$q_e V_2 = m_i c^2 - m_e c^2 \Rightarrow m_i = m_e\left(1 + \frac{q_e V_2}{m_e c^2}\right)$$

$$y = \frac{at^2}{2} = \frac{V_2}{V_1}\frac{x^2}{4d_c\left(1 + \frac{q_e V_2}{m_e c^2}\right)} \quad (44)$$

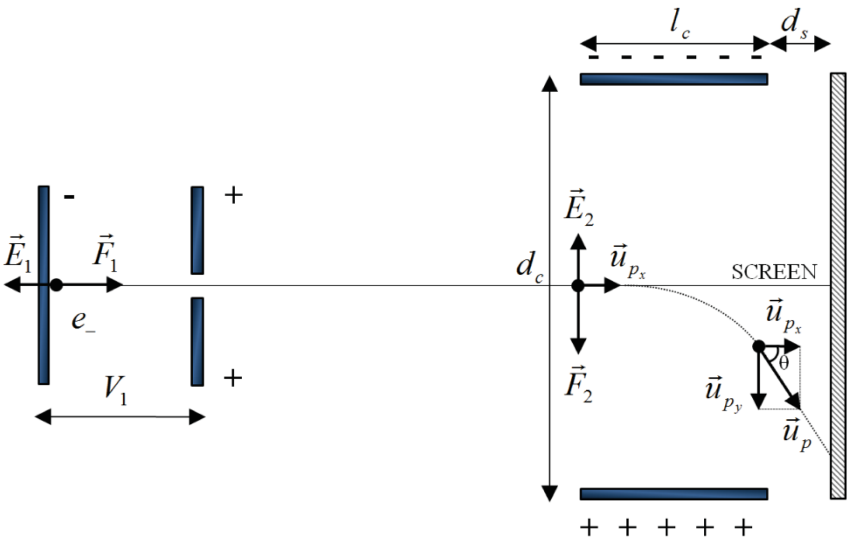

Fig.3 – Experiment: Electron's electrostatic deflection. Deviation from the expected relativistic deflection.

The extended version of Electrodynamics requires starting from Eq. (17), Eq. (29):

$$u = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c} = c \mp \frac{q_1 q_2}{4\pi\varepsilon_o r}\frac{\lambda}{h} \Rightarrow$$

A theoretically unlimited amount of electrostatic charge located at one plate of a capacitor simplifies the previous equation as follow:

$$q_1 = q_2 = q \ and \ m_{q_1} = m_{q_2} = m \Rightarrow$$

$$\frac{q \cdot nq}{4\pi\varepsilon_o r(m + nm)c} \Rightarrow$$

$$\lim_{n\to+\infty} \frac{n}{n+1}\left(\frac{q^2}{4\pi\varepsilon_o rmc}\right) = \frac{q^2}{4\pi\varepsilon_o rmc} = \frac{qV_{sw}}{mc} \Rightarrow$$

$$u = c\left(1 - \frac{qV_{sw}}{mc^2}\right) = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) \quad (45)$$

V_{sw}: equivalent standing wave potential (instant local potential)

In order to derive the general (common) expression of the total Energy that will apply during (Extended Relativity) and post acceleration (Relativity), it is required knowledge of the speed of the particle at any instance.

Based on Eq. (33) and Eq. (43.1), the total Energy of a charged particle is:

$$U_i = m_i c^2 = (mcu)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2}$$

$$U_i = m_i c^2 = \frac{u}{c}\left(qV + mc^2\right) \Rightarrow$$

Xydous extended
Relativistic Electrodynamics
(General expression)

$$(mcu)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2} = \frac{u}{c}\left(qV + mc^2\right) \quad (45.1)$$

LHS RHS

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) = c\left(1 - \frac{qV_{sw}}{mc^2}\right)$$

$$U_i = mc^2\left(1 - \frac{u^2{}_{sw}}{c^2}\right)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2} \quad (45.2)$$

$$U_i = mc^2\left(1 - \frac{qV_{sw}}{mc^2}\right)\left(1 + \frac{qV}{mc^2}\right) \quad (45.3)$$

Fig. (3) illustrates the case of a non-relativistic charged particle entering an electrostatic field. As long as the potential increases, the speed of the charge particle increases, too.

Then from Eq. (45.2) and Eq. (45.3), the speed inside the field becomes:

$$u_{sw} = u_p \ and \ V_{sw} = V \Rightarrow$$

$$mc^2\left(1 - \frac{u^2{}_p}{c^2}\right)^{1/2} = mc^2\left(1 - \frac{qV}{mc^2}\right)\left(1 + \frac{qV}{mc^2}\right) \Rightarrow$$

$$mc^2\left(1 - \frac{u^2{}_p}{c^2}\right)^{1/2} = mc^2\left(1 - \left(\frac{qV}{mc^2}\right)^2\right) \Rightarrow$$

$$\left(1 - \frac{u^2{}_p}{c^2}\right) = \left(1 - \left(\frac{qV}{mc^2}\right)^2\right)^2 \Rightarrow$$

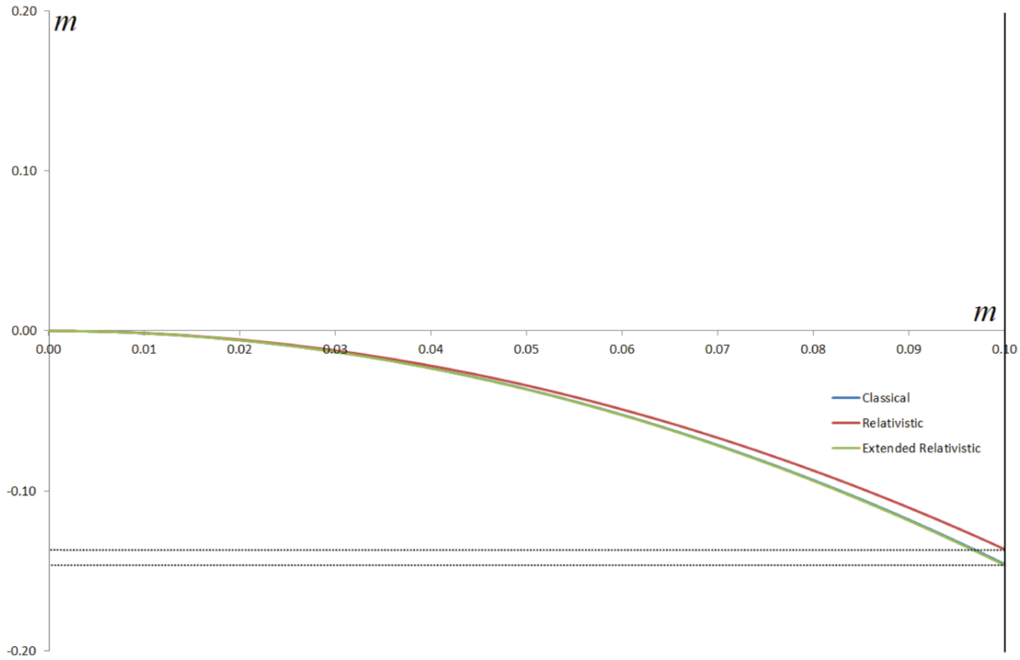

Fig.4 – Calculated electron's trajectory.

Xydous extended Relativistic Electrodynamics

(Speed of the charged particle inside the field)
Entering the field with a zero initial speed

$$u_{sw} = u_p \text{ and } V_{sw} = V$$

$$u_p = c\left(1-\left(1-\left(\frac{qV}{mc^2}\right)^2\right)^2\right)^{1/2} \quad (46)$$

$$U_i = mc^2\left(1-\left(\frac{qV}{mc^2}\right)^2\right) \quad (47)$$

(Speed of the charged particle on field's exit)
Relativistic speed

$$u_{sw} = 0 \neq u_p \text{ and } V_{sw} = 0 \neq V$$

$$u_p = c\left(1-\left(1+\frac{qV}{mc^2}\right)^{-2}\right)^{1/2} \quad (48)$$

$$U_i = mc^2\left(1+\frac{qV}{mc^2}\right) \quad (48.1)$$

In case, the electrostatic potential Energy is comparable to electron's rest Energy:

$$q_e V_2 > 0.01 m_e c^2 \text{ and } V_{sw} = V_2$$

Xydous extended Relativistic Electrodynamics

$$y = \frac{at^2}{2} = \frac{V_2}{V_1}\frac{x^2}{4d_c\left(1-\left(\frac{qV_2}{m_e c^2}\right)^2\right)} \quad (49)$$

The maximum expected vertical deflection inside the field, is:

$V_1 = 2000V$ *and* $V_2 = 35KV$

$d_c = 0.3m$ *and* $l_c = 0.1m$

$d_s = 0m$

$y_{ER} = 14.65cm$ *(Xydous extended Relativity)*

$y_R = 13.65cm$ *(Einstein's Relativity)*

$\Delta y = y_{ER} - y_R = 1.00cm$

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4. Archimedes Principle in Vacuum

In the introductory chapter, it was derived Eq. (15) where a trapped charged particle within a standing wave may reduce its total inertial Energy or effective inertial mass under certain conditions:

$$U_i = mc^2 - \frac{U_{EMR}}{2} = mc^2\left(1 - \frac{U_{EMR}}{2mc^2}\right) \Rightarrow$$

$$m_i = m\left(1 - \frac{U_{EMR}}{2mc^2}\right) \text{ or } m_i = m - \frac{U_{EMR}}{2c^2} \quad (50)$$

The correspondence between the above expression and *Archimedes principle* is evident:

Archimedes principle

$$F_{net} = F_i - F_g + F_b = 0$$

$$m_i = m - m_d \text{ and } m_d = \rho_f V_d \quad (51)$$

F_b: buoyancy force
F_g: gravitational force
V_d: displaced fluid (f) volume
ρ_f: fluid (f) density
F_i: support force

In order Eq. (50) be fundamentally justified and true, vacuum should exhibit buoyant effects. Archimedes principle could really work on quantum level just by "inventing" a force that plays the role of gravity (centrifugal force) and being the cause behind the appearance of pressure in fluids and in our case in *vacuum*.

Archimedes principle
(Rotating mechanism in outer space)

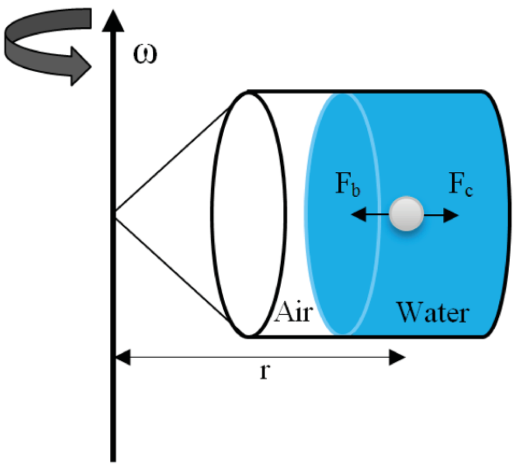

Fig. 5 – Archimedes principle in outer space in absence of gravity.

F_b: buoyancy force
F_c: centrifugal force
m: sphere mass
ω: angular speed
r: distance of the spherical mass from the rotation Axis
F_i: support force (cylinder is suspended from two strings)

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Assuming no frictional forces between the spherical body and the fluid, a constant rotational speed is required in order to set the system at equilibrium:

Archimedes principle
(Rotating mechanism in outer space)

$$F_{net} = F_i - F_c + F_b = 0$$

$$F_i = F_c - F_b$$

$$F_c = m\frac{u^2}{r} = m\omega_d^{\,2} r \text{ and } F_b = m_d \omega_d^{\,2} r$$

$$m_i = m - m_d \text{ and } m_d = \rho_w V_d \quad (52)$$

ρ_w, ρ: water and sphere mass density
ω_d, ω_c: actual (water displacement) and critical angular speed
V_d: displaced water volume
V: sphere total volume

Then for a fully submerged object, it holds:

$$V_d = V \Rightarrow \left.\begin{matrix} m_d = \rho_w V_d \\ m = \rho V \end{matrix}\right\} \Rightarrow m_d = m\frac{\rho_w}{\rho} \quad (53)$$

$$m_i = m - m\frac{\rho_w}{\rho} = m\left(1 - \frac{\rho_w}{\rho}\right) \quad (54)$$

The ratio inside the brackets could be equivalent to a ratio between the local and critical vacuum electromagnetic Energy density (see next page) on quantum level.

Archimedes principle
(Rotating (Hyperbolic Spiral) vacuum)

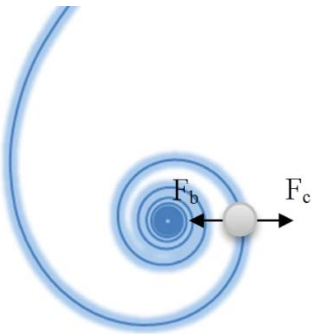

Fig. 6 – Archimedes principle in rotating vacuum.

F_b: buoyancy force (exerted by the vacuum upon the particle)
F_c: centrifugal force (due to the rotation of the vacuum)
m: charged particle rest mass (particle is at rest in vacuum)
ω: angular speed
r: distance of particle from the center of the Universe
F_i: support force (virtual)

Eq. (54) expressed as the ratio of the electromagnetic Energy density of vacuum (applicable on quantum level) and in absence of matter, becomes:

$$\left.\begin{array}{l}\rho_v = \dfrac{m_v}{V_v} \Rightarrow \rho_v c^2 = \dfrac{m_v c^2}{V_v} = \dfrac{U_v}{V_v} \\ \rho = \dfrac{m}{V} \Rightarrow \rho c^2 = \dfrac{mc^2}{V} = \dfrac{U}{V} \; and \; V = V_v\end{array}\right\} \Rightarrow$$

$$\frac{\rho_v c^2}{\rho c^2} = \frac{U_v}{U} \Rightarrow$$

$$\frac{\rho_v c^2}{\rho c^2} = \frac{U_v}{U} = \frac{\rho}{\rho}\frac{u_v^{\,2}}{c^2} \Rightarrow U_v = U\frac{u_v^{\,2}}{c^2} \Rightarrow$$

$$\frac{U_v}{U} = \frac{\rho_v}{\rho} = \frac{u_v^{\,2}}{c^2} \quad (55)$$

ρ_v: local vacuum E/M Energy density
ρ: critical vacuum E/M Energy density (zero inertial effect)

Proportionally to Fig. 5, a charged particle is located at rest to a defined point in vacuum (Fig. 6) under the influence of the local angular speed:

Archimedes principle (Rotating vacuum)
Inertial mass as influenced by the Rotating vacuum
Fundamental law of Physics

$$u = c\left(1 - \frac{u^2{}_v}{c^2}\right) = c\left(1 - \frac{\omega_d^{\,2}}{\omega_c^{\,2}}\right) = c\left(1 - \frac{\rho_v}{\rho}\right) \quad (56)$$

$$u_c = c \; and \; u_v = \omega_v r << c$$

$$u_v = \omega_v r << c \Rightarrow m_i = m\frac{u}{c} \quad (57)$$

$$m_i = m\left(1 - \frac{u^2{}_v}{u_c^{\,2}}\right) = m\left(1 - \frac{\omega_v^{\,2}}{\omega_c^{\,2}}\right) \quad (58)$$

u_v: local tangential speed of the vacuum
u_c: critical tangential speed of the vacuum (zero inertial effect)
m: fully submerged mass in rotating vacuum
r: distance from the center of the rotating vacuum

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Decaying speed of light
(Rotating vacuum)
Fundamental law of Physics

$$u = c\left(1 - \frac{u^2{}_v}{c^2}\right) = c\left(1 - \frac{\omega_v^{\,2}}{\omega_c^{\,2}}\right) \quad (59)$$

u: local speed of light
ω_v: local angular speed of the vacuum
ω_c: critical angular speed of the vacuum (zero inertial effect)

Eq. (58) tells us that our material Universe exists because the (except at the region of *Big Bang*) local tangential speed of vacuum (space) is several orders of magnitude less than the speed of light:

$$u_v = \omega_v r << c \Rightarrow r << c\omega^{-1}{}_v$$

$$1 - \frac{u^2{}_v}{c^2} \approx 1 \Rightarrow u = c\left(1 - \frac{u^2{}_v}{c^2}\right) \approx c$$

<u>Postulate (6)</u>: *The vacuum is expected to be an invisible massless fluid consisted of electromagnetic standing waves (pair of photons) that are able to interact with the centrifugal force. The rotation of the vacuum is responsible for the creation of two opposing forces, the centrifugal (exerts pressure upon the vacuum fluid) and the buoyant force (vacuum fluid exerts an opposite pressure upon objects). A single fully submerged object (charged particle or photon) in the vacuum experiences the effect of quantum vacuum buoyancy.*

<u>Postulate (6.1)</u>: *The speed of light varies proportional to the local vacuum (E/M standing waves) OR local field tangential or angular speed squared.*

<u>Postulate (6.2)</u>: *Local vacuum and local electromagnetic field based buoyancy are the cause behind the quantum tunneling effect.*

<u>Postulate (7)</u>: *The rotating vacuum justifies the existence of the definitions like angular speed, tangential speed, time, space and frequency on the most fundamental level of Nature and in absence of the material Universe. Consequently, the rotating vacuum should pre-exist the Big Bang.*

The discovery of postulate (6) reveals the answer upon some very crucial subjects: i) vacuum appears a hyperbolic spiral like rotation. ii) Quantum tunneling without a rotating vacuum is simply impossible. iii) The construction of a real Warp-Drive based on the decaying speed of light is more feasible than ever before.

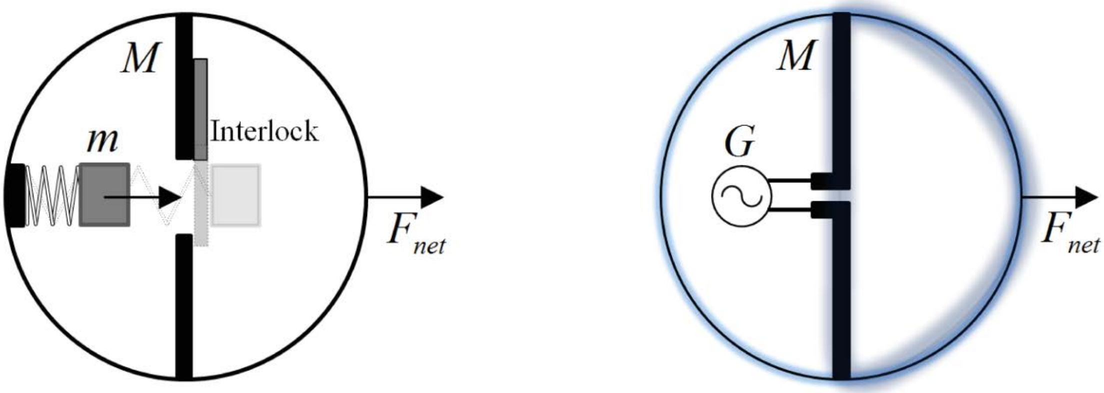

Fig.7 – Mechanical (Left) equivalent of the E/M (Right) Inertial Warp Drive based on the extended Law of motion.

The Warp Drive concept could be realized not by bending space-time but through "bending" the inertia or speed of light on quantum level. On Fig. 7, the proposed *Electromagnetic Inertial Warp Drive* can be explained over an extended version (proposal) of Newtonian Mechanics.

In this construction (Fig. 7) the thrust is given by the inertial forces imbalance inside the body (M), therefore Newton's 2nd Law of motion cannot apply as is:

$$F_{net} = u_c \frac{\Delta M}{\Delta t} = F_H = -k \cdot r \Rightarrow \Delta t = \frac{r}{u_c} \Rightarrow$$

$$F_{net} = u^2{}_c \frac{\Delta M}{r} = -k \cdot r \quad (60)$$

$$F_{net} = u^2{}_c \Delta M = -k \cdot r^2 \Rightarrow \Delta M = M_i - M \Rightarrow$$

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Inertial Warp Drive Equation (Mechanical)

$$M_i = M\left(1 - \frac{k \cdot r^2}{Mu^2{}_c}\right) \Rightarrow \frac{k \cdot r^2}{M} = u^2{}_M$$

$$M_i = M\left(1 - \frac{u^2{}_M}{u^2{}_c}\right) \quad (61)$$

u_M: actual speed of the body (M)
u_c: critical speed of the body (M)
M_i, M: effective inertial (M_i) and rest mass (M) of the body

Xydous extended 2nd Law of motion

$$\sum F_{external} \neq 0 \text{ and } \sum F_{inertial} = 0$$

$$F_{net} = \frac{\Delta p}{\Delta t} = M \frac{\Delta u_M}{\Delta t} = Ma$$

and

$$\sum F_{external} = 0 \text{ and } \sum F_{inertial} \neq 0$$

$$F_{net} = \frac{\Delta p}{\Delta t} = u_c \frac{\Delta M}{\Delta t} \quad (62)$$

The equation for the E/M Inertial Warp Drive is already available (see previous chapter) and very similar to the mechanical version.

E/M Inertial Warp Drive Equation

$$U_i = Mcu\left(1 - \frac{u^2{}_M}{c^2}\right)^{-1/2} \text{ and}$$

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right)$$

$$U_i = Mc^2\left(1 - \frac{u^2{}_{sw}}{c^2}\right)\left(1 - \frac{u^2{}_M}{c^2}\right)^{-1/2} \quad (63)$$

$$u_{sw} = u_M = c\frac{f_{sw}}{2f}$$

$$f_{sw} = 2f_M$$

(Non-Relativistic)

$$u_{sw} = u_M << c \Rightarrow 1 - \frac{u^2{}_M}{c^2} \approx 1$$

$$M_i = M\left(1 - \frac{u^2{}_{sw}}{c^2}\right) \quad (64)$$

(Wave-Particle Relativistic Energy)

$$0 < u_{sw} = u_p < +\infty \Rightarrow$$

$$U_i = mc^2\left(1 - \frac{u^2{}_{sw}}{c^2}\right)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2}$$

$$\gamma = \left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2}$$

$$m_i = m\left(1 - \frac{u^2{}_{sw}}{c^2}\right)^{1/2} = \frac{m}{\gamma} \quad (65)$$

Faster than Light

$$u_{sw} > c \Rightarrow m_i \rightarrow imaginary$$

5. Extended Relativistic Hamiltonian

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The *relativistic Hamiltonian* of a charged particle as influenced by an electrostatic potential (constant potential), is:

$$H = \sqrt{(pc)^2 + (mc^2)^2} + qV_{EP} \quad (66)$$

p: charged particle's momentum
V_{EP}: electrostatic potential

The chapter of Extended Relativity revealed some new effects that may take place during electromagnetic interactions that are also expected to apply for the Hamiltonian of a charged particle. Based on Eq. (45), which presupposes an almost unlimited stationary potential source, Eq. (66) turns to:

Extended Relativistic Hamiltonian

$$H_i = \frac{u}{c} H$$

$$u = c\left(1 - \frac{qV_{sw}}{mc^2}\right) = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right)$$

$$H_i = \frac{u}{c}\left(\sqrt{(pc)^2 + (mc^2)^2} + qV_{EP}\right) \quad (67)$$

$$qV_{EP} << mc^2 \Rightarrow u \approx c \Rightarrow H_i = H$$

Electric Force upon a single charge
Partial Hamiltonian Derivative

$$V_{sw} = V_{EP} = \frac{q_{EP}}{4\pi\varepsilon_o r}$$

$$\frac{dp}{dt} = -\frac{\partial H_i}{\partial r} = F_E$$

$$F_E = \frac{qq_{EP}}{4\pi\varepsilon_o r^2}\left(1 - \frac{qq_{EP}}{2\pi\varepsilon_o rmc^2}\right) \quad (68)$$

$$qV_{EP} << mc^2 \Rightarrow u \approx c \Rightarrow F_E = \frac{qq_{EP}}{4\pi\varepsilon_o r^2}$$

or

$$r >> \frac{qq_{EP}}{2\pi\varepsilon_o mc^2} \Rightarrow u \approx c \Rightarrow F_E = \frac{qq_{EP}}{4\pi\varepsilon_o r^2}$$

The local speed of light in terms of the standing wave momentum can be written as follow:

$$\frac{u^2{}_{sw}}{c^2} = \frac{qV_{sw}}{mc^2} = \left(\frac{p_{sw}}{mc}\right)^2 \Rightarrow$$

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) = c\left(1 - \left(\frac{p_{sw}}{mc}\right)^2\right) \quad (69)$$

Particle's speed assumes the existence of a similar expression to Eq. (45.2) involving the momentum of the charged particle:

Xydous extended
Relativistic Electrodynamics
(General expression)

$$(70)$$

$$(mcu)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2} = \frac{u}{c}\left(\sqrt{(pc)^2 + (mc^2)^2}\right)$$

LHS RHS

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) = c\left(1 - \left(\frac{p_{sw}}{mc}\right)^2\right)$$

Velocity (speed) of a single charge
Partial Hamiltonian Derivative

$$\frac{dr}{dt} = \frac{\partial H_i}{\partial p} = u_p$$

(During the interaction)

$$V_{sw} = V_{EP} \Rightarrow u_{sw} = u_p \Rightarrow p_{sw} = p$$

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) = c\left(1 - \left(\frac{p_{sw}}{mc}\right)^2\right)$$

$$(70.1)$$

$$u_p = c\left(1 - \left(1 - \left(\frac{p}{mc}\right)^2\right)^2\left(1 + \left(\frac{p}{mc}\right)^2\right)\right)^{1/2}$$

u_{sw}: standing wave speed
p_{sw}: standing wave momentum

(Post interaction)

$$V_{sw} = 0 \neq V_{EP} \Rightarrow u_{sw} = 0 \neq u_p \Rightarrow p_{sw} = 0 \neq p$$

$$u \approx c$$

$$(70.2)$$

$$u_p = \frac{p/m}{\sqrt{1 + (p/mc)^2}}$$

u_p: charged particle's speed
p: charged particle's momentum

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6. Fundamental Uncertainty Principle

Heisenberg's *Uncertainty* principle can be expressed in its simplest form as the difficulty to determine accurately both the position and the speed of a particle at the same instant. The cause of such uncertainty is primarily based on the measurement problem:

$$\Delta p \Delta x \geq \frac{\hbar}{2} \; and \; \Delta E \Delta t \geq \frac{\hbar}{2} \quad (70.3)$$

The theoretical discovery of the decaying of the speed of light reveals an additional factor close to the charged particle, making the whole proceedings by nature uncertain. Thus, from Eq. (14), Eq. (15) and Eq. (25):

$$m_i c^2 = mc^2\left(1 - \frac{U_{EMR}}{2mc^2}\right) \Rightarrow$$

$$\frac{2\pi r}{\lambda} = \alpha \Rightarrow \lambda = \frac{2\pi r}{\alpha} \Rightarrow \frac{\lambda}{hc} = \frac{2\pi r}{hc\alpha} \Rightarrow$$

$$U_{EMR} = \frac{hc}{\lambda} = \frac{hc\alpha}{2\pi r} \Rightarrow$$

Fundamental Uncertainty Principle
Based on the decaying speed of light
(Towards the center of a charged particle)

$$\Delta E = m_i c^2 - mc^2 \; and \; \Delta t = \frac{r}{\alpha \cdot c} \Rightarrow$$

$$\Delta E \Delta t = -\frac{h}{4\pi} = -\frac{\hbar}{2} \quad (71)$$

and

$$\Delta t \geq \frac{r_c}{\alpha \cdot c} = \frac{\lambda_c}{2\pi \cdot c} \Rightarrow$$

$$\Delta E \Delta t \geq -\frac{\hbar}{2} \quad (72)$$

r_c: geometric radius of the particle
λ_c: Compton wavelength

Heisenberg's uncertainty expression Eq. (70.3) is a mathematical construct that associates just the measurement problem and not a by nature limitation, therefore it should not be confused with the result of Eq. (72).

Postulate (8): *The fundamental (by nature) cause behind the uncertainty principle is the decaying speed of light that is responsible for the existence of a wave-particle duality upon charged particles and photons on quantum level.*

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The kinetic Energy of a charged particle trapped within a standing wave moving together as a system (wave-particle), is:

$$m_i c^2 = mc^2\left(1 - \frac{u^2_{sw}}{c^2}\right)\left(1 - \frac{u^2_{p}}{c^2}\right)^{-1/2} \Rightarrow$$

$u_{sw} = u_p \Rightarrow$ *(Wave-particle)*

$$m_i c^2 = mc^2\left(1 - \frac{u^2_{sw}}{c^2}\right)^{1/2} = mc^2\left(1 - \frac{u^2_{p}}{c^2}\right)^{1/2}$$

$$\Delta E = m_i c^2 - mc^2 = U_k \quad (73)$$

U_k: charged particle's kinetic Energy

But:

$$\Delta t \geq \frac{r_c}{\alpha \cdot c} = \frac{\lambda_c}{2\pi \cdot c} \Rightarrow$$

$$\Delta E \Delta t \geq -\frac{\hbar}{2} \Rightarrow \Delta E \geq -\frac{\hbar}{2\Delta t} = -\frac{h \cdot c}{2\lambda_c} \Rightarrow$$

$$\Delta E \geq -\frac{h \cdot c}{2\lambda_c} = \frac{-mc^2}{2} \quad (74)$$

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Detection and minimum uncertainty
(Local speed of light is almost c)

$$\Delta E = m_i c^2 - mc^2 \geq \frac{-mc^2}{2}$$

$$\frac{mc^2}{2} \leq m_i c^2 \leq mc^2$$

$$-\frac{mc^2}{2} \leq U_k \leq 0$$

$$0.866c \geq u_{sw} = u_p \geq 0$$

Non-Detection and maximum uncertainty
(Local speed of light is less than c)

$$\Delta E = m_i c^2 - mc^2 < \frac{-mc^2}{2}$$

$$0 < m_i c^2 < \frac{mc^2}{2}$$

$$-mc^2 < U_k < -\frac{mc^2}{2}$$

$$c > u_{sw} = u_p > 0.866c$$

Non-Detection and maximum uncertainty
(Wave-particle (electron))

$$\Delta E = m_i c^2 - m_e c^2 < \frac{-m_e c^2}{2}$$

$$0 < m_i c^2 < 255.5keV$$

$$-511keV < U_k < -255.5keV$$

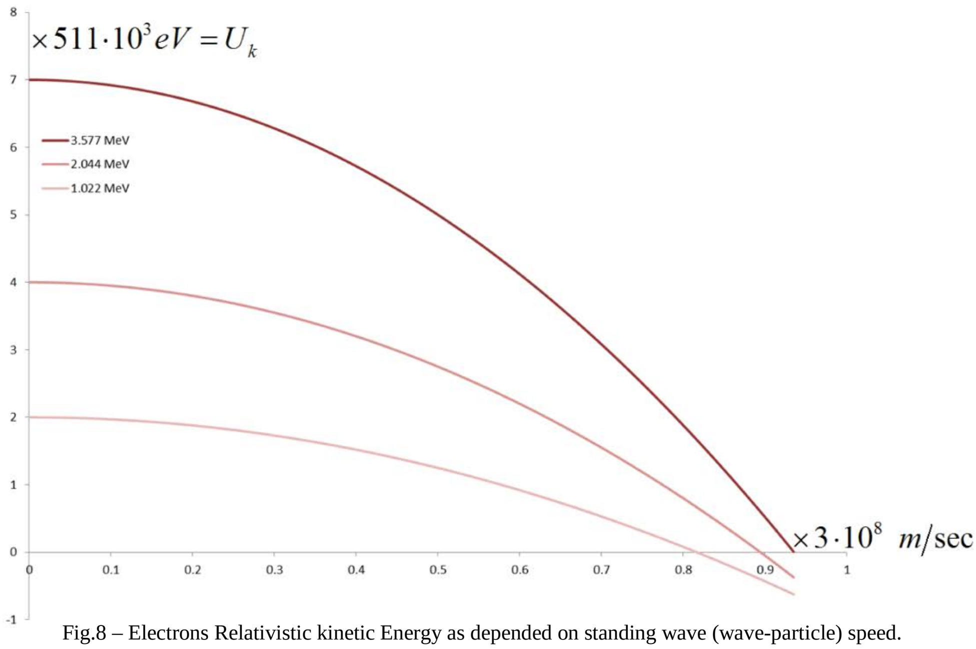

Fig.8 – Electrons Relativistic kinetic Energy as depended on standing wave (wave-particle) speed.

During *solar storms*, relativistic electrons have been known suddenly to vanish from the radiation belt. The strange phenomenon was discovered back in 1960s and it has puzzled scientists ever since. Some latest reports appear to have indications through satellite probes where the phenomenon is most probably associated to ULF and VLF wave-particle interaction.

Based on those reports it will be attempted to explain the phenomenon using the findings of this work. The calculations will apply for a 0.1 mHz ULF standing wave and relativistic kinetic Energies of 3.577MeV, 2.044MeV and 1.022 MeV accordingly.

Relativistic electrons suddenly vanish

(Quantum tunneling through the vacuum)

Entrapment within a standing wave in the outer radiation belt
A burst of Energy (Sun) sets the standing wave in motion OR amplifies its amplitude

$$a = 10^{-4}c = 3 \cdot 10^4 \, m/\sec^2$$

$$u_{sw} = a \cdot t = c\frac{f_{sw}}{2f} = c\left(\frac{D_{sw}}{D_c}\right)^{1/2}$$

$$t \to 0..10000 \ \sec$$

$2f = 0.1mHz$ *(ULF standing wave frequency)*

$$u = c\left(1 - \frac{u^2{}_{sw}}{c^2}\right) = c\left(1 - \frac{D_{sw}}{D_c}\right)$$

D_{sw}: standing wave Power Density
D_c: standing wave critical Power Density
a: moving standing wave acceleration

Relativistic electrons suddenly vanish

(Quantum tunneling through the vacuum)

Kinetic Energy of the Relativistic electrons based on moving standing wave concept

$$U_k = m_e c^2\left(\left(1 - \frac{(a \cdot t)^2}{c^2}\right)\left(1 - \frac{u^2{}_p}{c^2}\right)^{-1/2} - 1\right) \quad (75)$$

or

$$U_k = m_e c^2\left(\left(1 - \frac{(a \cdot t)^2}{c^2}\right)\gamma - 1\right) \quad (76)$$

Kinetic Energy of the Relativistic electrons based on standing wave amplitude concept

$$U_k = m_e c^2\left(\left(1 - \frac{D_{sw}}{D_c}\right)\gamma - 1\right) \quad (76.1)$$

γ: Lorentz factor

Conclusively and under certain conditions (wave-particle interaction), the relativistic electrons may suddenly vanish in the outer radiation belt due to *quantum tunneling* through the *vacuum*.

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7. Electric Force

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The electric force between two arbitrary charged particles is the derivative of the electrostatic potential Energy.
Then from Eq. (22) results:

$$U_{E(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\left(1 \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1}+m_{q_2}\right)c^2}\right) \Rightarrow$$

$$F_E = -\frac{dU_{E(r)}}{dr} \Rightarrow$$

Electric force
between two arbitrary stationary charges
(Magnitude and Vector form)

$$q_1 q_2 < 0 \Rightarrow$$

$$F_E = \frac{q_1 q_2}{4\pi\varepsilon_o r^2}\left(1 + \frac{q_1 q_2}{2\pi\varepsilon_o\left(m_{q_1}+m_{q_2}\right)c^2 r}\right) \quad (77)$$

$$\vec{F}_E = \frac{q_1 q_2}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} + \frac{q^2{}_1 q^2{}_2}{8\pi^2\varepsilon^2{}_o\left(m_{q_1}+m_{q_2}\right)c^2}\frac{\vec{r}}{|\vec{r}|^4} \quad (78)$$

and

$$q_1 q_2 > 0 \Rightarrow$$

$$F_E = \frac{q_1 q_2}{4\pi\varepsilon_o r^2}\left(1 - \frac{q_1 q_2}{2\pi\varepsilon_o\left(m_{q_1}+m_{q_2}\right)c^2 r}\right) \quad (79)$$

$$\vec{F}_E = \frac{q_1 q_2}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q^2{}_1 q^2{}_2}{8\pi^2\varepsilon^2{}_o\left(m_{q_1}+m_{q_2}\right)c^2}\frac{\vec{r}}{|\vec{r}|^4} \quad (80)$$

The electric force (Eq. (80)) is consisted of two parts, an attractive and a repulsive one. On the next page, it is shown a diagram of the electric force and electrostatic potential Energy between two electrons. The Coulomb force is the repulsive part where below the distance of 1 *pm* (10^{-12}m) starts to make its presence the attractive force.

The electric force between two electrons is given by Eq. (79) due to like charges interaction:

$$q_1 = q_2 = q_e \ and\ m_{q_1} = m_{q_2} = m_e$$

$$F_E = \frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{2\pi\varepsilon_o\left(m_e+m_e\right)c^2 r}\right) \Rightarrow$$

$$F_E = \frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r}\right) \quad (81)$$

Eq. (81) becomes practically the known Coulomb force when:

$$\frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r} \approx 0 \Rightarrow$$

$$r >> 100\frac{\lambda_{ce}}{4\pi} \approx 1.92\cdot 10^{-11} m$$

$$r = 100\frac{\lambda_{ce}}{4\pi} \Rightarrow 1 - \frac{q^2{}_e}{100\cdot\varepsilon_o m_e c^2 \lambda_{ce}} \approx 0.99985 \Rightarrow$$

$$F_E = \frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r}\right) \approx \frac{q^2{}_e}{4\pi\varepsilon_o r^2}$$

The local maximum of the electric force occurs when:

$$\frac{dF_E}{dr} = \frac{d}{dr}\left(\frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r}\right)\right) = 0 \Rightarrow$$

$$r = \frac{3}{2}\frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2} = \frac{3}{2} r_e \approx 4.22\cdot 10^{-15} m \Rightarrow$$

$$F_E \approx 4.32N$$

$$F_{Coulomb} \approx 12.95N \ and\ F_{Attractive} \approx -8.63N$$

The electric force appears to be zero when:

$$F_E = \frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r}\right) = 0 \Rightarrow$$

$$r \to +\infty \ or\ r = \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2} \approx 2.817\cdot 10^{-15} m$$

$$F_E \approx 0.00N$$

$$F_{Coulomb} \approx 29.10N \ and\ F_{Attractive} \approx -29.10N$$

The electric force appears a maximum when the electrostatic potential Energy becomes zero:

$$r = \frac{q^2{}_e}{8\pi\varepsilon_o m_e c^2} = \frac{r_e}{2} \approx 1.40855\cdot 10^{-15} m \Rightarrow$$

$$F_E \approx -118N$$

$$F_{Coulomb} \approx 117N \ and\ F_{Attractive} \approx -235N$$

As with the electric force, the electric field appears local maximum and zero values, too. The derivation of the electric field of a single charge requires knowing the expression of the electrostatic potential:

$$q_1 = q_2 = q \ and\ m_{q_1} = m_{q_2} = m_q \Rightarrow$$

$$V_{EP} = \frac{U_{E(r)}}{q} \Rightarrow$$

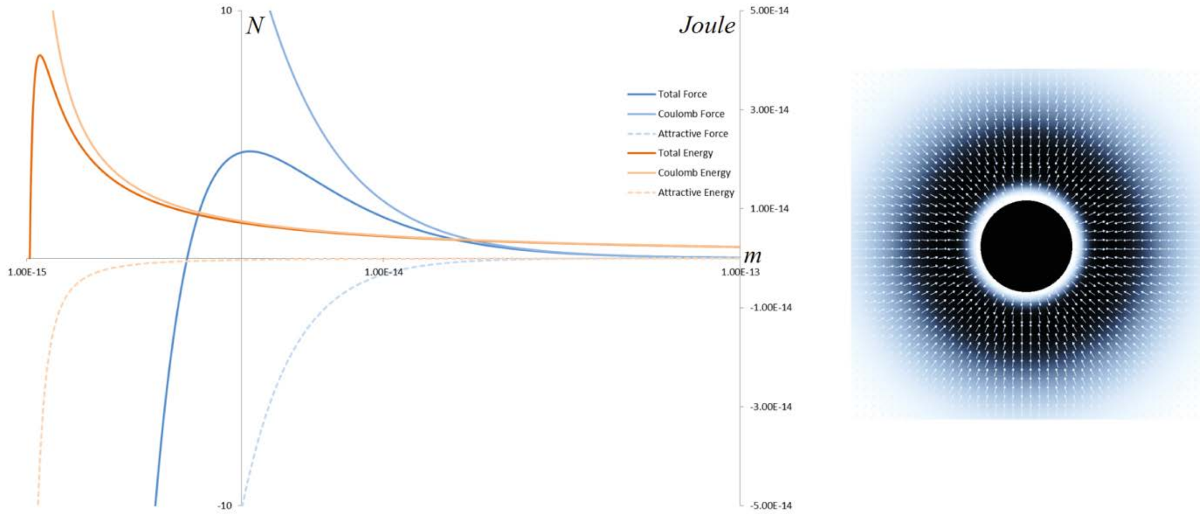

Fig.9 – Left: Electric force (two electrons) and electrostatic potential Energy diagrams. Right: Electron's electric field.

Electrostatic potential at a distance from an arbitrary charge

$$V_{EP} = \frac{q}{4\pi\varepsilon_o r}\left(1 - \frac{q^2}{8\pi\varepsilon_o m_q c^2 r}\right) \quad (82)$$

Electric field of an arbitrary charge

(Magnitude and Vector form)

$$\vec{E} = -\nabla V_{EP}$$

$$E = \frac{q}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2}{4\pi\varepsilon_o m_q c^2 r}\right) \quad (83)$$

$$\vec{E} = \frac{q}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q^3}{16\pi^2\varepsilon^2{}_o m_q c^2}\frac{\vec{r}}{|\vec{r}|^4} \quad (84)$$

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Now going back to the electric force, the existence of a second term could probably be related to the Casimir force. Let us use Eq. (81) as a starting point:

$$F_E = \frac{q^2{}_e}{4\pi\varepsilon_o r^2}\left(1 - \frac{q^2{}_e}{4\pi\varepsilon_o m_e c^2 r}\right) \Rightarrow$$

$$F_E = F_{Coulomb} + F_{Attractive} \Rightarrow$$

$$F_{Attractive} = -\frac{q^4{}_e}{16\pi^2\varepsilon^2{}_o m_e c^2 r^3} \quad (85)$$

Then, from the fine structure constant:

$$\frac{2\pi r_c}{\lambda_{sw}} = \frac{q^2{}_e}{4\pi\varepsilon_o \hbar c} = \alpha \Rightarrow \frac{q^2{}_e}{4\pi\varepsilon_o} = \hbar c\frac{2\pi r_c}{\lambda_{sw}} \Rightarrow$$

$$F_{Attractive} = -\left(\frac{q^2{}_e}{4\pi\varepsilon_o}\right)^2 \frac{1}{m_e c^2 r^3} \Rightarrow$$

$$F_{Attractive} = -\left(\hbar c\frac{2\pi r_c}{\lambda_{sw}}\right)^2 \frac{1}{m_e c^2 r^3} \Rightarrow$$

Then:

$$F_{Attractive} = -\frac{\hbar^2}{\lambda_{sw}}\frac{4\pi r_c{}^2}{r^3}\frac{\pi}{\lambda_{sw}\cdot m_e} \Rightarrow$$

$$r_c = \frac{r_e}{2} \Rightarrow$$

$$F_{Attractive} = -\frac{\hbar^2}{\lambda_{sw}}\frac{4\pi r_e{}^2}{4r^3}\frac{\pi}{\lambda_{sw}\cdot m_e} \Rightarrow$$

$$but\ \lambda_{ce} = \frac{h}{m_e c} = 2\lambda_{sw}$$

$$F_{Attractive} = -4\pi r_e{}^2\frac{\hbar}{4\lambda_{sw}}\frac{c}{r^3} \Rightarrow (86)$$

$$but\ \lambda_{sw} = \frac{2\pi r}{\alpha}\ \ and\ \ A = 4\pi r_e{}^2\alpha \Rightarrow$$

$$F_{Attractive} = -A\frac{\hbar c}{4\cdot 2\pi r\cdot r^3}\frac{\pi^2}{\pi^2} \Rightarrow$$

Second term of the electric force

(Second term turns to Casimir force at critical distance)

$$F_{Attractive} = -A\frac{\pi^2\hbar c}{8\pi^3 r^4} \approx -A\frac{\pi^2\hbar c}{248.05 r^4} \quad (87)$$

$$r = r_c = r_e/2 \Rightarrow$$

$$F_{Attractive} = -A\frac{\pi^2\hbar c}{248.05 r_c{}^4} = -\frac{q^4{}_e}{16\pi^2\varepsilon^2{}_o m_e c^2 r_c{}^3}$$

$$r >> r_c = \frac{r_e}{2} \Rightarrow \lambda >> \frac{\lambda_{ce}}{2} \Rightarrow A >> 4\pi r^2{}_e\alpha \Rightarrow$$

$$F_{Attractive} = -A\frac{\hbar}{4\lambda}\frac{c}{r^3} \approx -A\frac{\pi^2\hbar c}{248.05 r^4} \quad (88)$$

$$1 - \frac{|F_{Attractive}|}{|F_{Casimir}|} \approx +3.24\%$$

8. Universe Properties

Newton's Universal gravitational constant (G) belongs to the group of cosmological constants and applies particularly for large objects in an attractive manner. In the previous chapter, Eq. (86) revealed another attractive force when the distance becomes smaller between two electrons.

Suppose the attractive gravitational force is made equal to the non-Coulomb attractive force that appears between two electrons and setting the gravitational constant to be unknown then, an interesting relation emerges:

$$F_G = -G_r \frac{m_e \cdot m_e}{r^2} \Rightarrow m_e = \frac{h}{\lambda_{ce} c} \Rightarrow$$

$$F_G = -G_r \frac{h^2}{\lambda^2_{ce} \cdot c^2 r^2} \quad (89)$$

Then from Eq. (86):

$$\lambda = \lambda_{ce}/2 \Rightarrow$$

$$F_{Attractive} = -4\pi r_e^2 \frac{\hbar}{4\lambda} \frac{c}{r^3} = -\frac{q^4{}_e}{16\pi^2 \varepsilon^2{}_o m_e c^2 r^3}$$

When both forces become equal:

$$F_G = F_{Attractive} \quad (90)$$

$$-G_r \frac{h^2}{\lambda^2_{ce} \cdot c^2 r^2} = -A \frac{\hbar}{4\lambda} \frac{c}{r^3} \Rightarrow$$

$$G_r \frac{h^2}{\lambda^2_{ce} \cdot c^2 r^2} = r_e^2 \frac{h}{\lambda_{ce}} \frac{c}{r^3} \Rightarrow$$

Decaying Gravitational constant

$$G_r = \frac{\lambda_{ce} c^3}{h} \frac{r_e^2}{r} \quad (91)$$

r: distance between a stationary and a moving electron
r: equivalent radius of the Universe

Setting Eq. (91) equals to Newton's (universal) gravitational constant, results:

Universe Properties

$$G = 6.67384 \cdot 10^{-11} N \frac{m^2}{Kgr^2}$$

$$G_r = G$$

$$r_u = r = r_e^2 \frac{\lambda_{ce} c^3}{hG} \approx 1.1763 \cdot 10^{28} m \quad (92)$$

r_u: todays universe radius

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Universe Properties

$$t_u = \frac{r_u}{c} = r_e^2 \frac{\lambda_{ce} c^2}{hG} \approx 3.9211 \cdot 10^{19} \sec \quad (93)$$

or

$$t_u = \frac{r_u}{c} \approx 1243.3 \cdot 10^9 \, yr \quad (94)$$

t_u: universe age

$$f_{\min} = \frac{1}{2\pi \cdot t_u} = 4.0589 \cdot 10^{-21} Hz$$

f_{min}: universe minimum frequency

$$a_u = \frac{c^2}{r_u} = \frac{hG}{r_e^2 \lambda_{ce} c} \approx 7.6509 \cdot 10^{-12} m/\sec^2 \quad (95)$$

a_u: universe deceleration

$$M_u = \frac{a_u r_u^2}{G} \approx 1.5863 \cdot 10^{55} Kgr \quad (95.1)$$

M_u: universe Mass

$$E_u = M_u c^2 = 1.4277 \cdot 10^{72} \, Joule$$

E_u: universe equivalent Energy

$$\sigma = 5.6704 \cdot 10^{-8} \frac{Joule}{\sec^2 \cdot m^2 \cdot K^4}$$

$$D_u = \frac{E_u f_{\min}}{S_u} = \sigma T^4 \; and \; S_u = 4\pi r^2{}_u$$

$$T = \sqrt[4]{\frac{E_u f_{\min}}{\sigma \cdot S_u}} \approx 2.768 Kelvin$$

T: todays universe thermodynamic Temperature

A dimensional analysis of Eq. (92) or by setting:

$$r_q = r_u = r_e \rightarrow \textit{minimum possible distance}$$

Quantum length and time

$$r_q = \frac{hG}{\lambda_{ce} c^3} = 6.7502 \cdot 10^{-58} m \quad (96)$$

[Quantum Graininess (Science Daily Link)](#)

$$t_q = \frac{r_q}{c} = \frac{hG}{\lambda_{ce} c^4} = 2.2501 \cdot 10^{-66} \sec \quad (97)$$

r_q: quantum length
t_q: quantum time

Fine structure constant
(association with the dimensions of the Universe)

$$r_u r_q = r_e^2 \quad (98)$$

$$\alpha = \frac{2\pi r_e}{\lambda_{ce}} = \frac{q^2{}_e}{4\pi \varepsilon_o \hbar c} = \frac{2\pi \sqrt{r_u r_q}}{\lambda_{ce}} \quad (99)$$

9. Electromagnetic Force

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The electric field of a charged particle is more than just a Coulomb field and is given by Eq. (84):

$$\vec{E} = \frac{q}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q^3}{16\pi^2\varepsilon^2{}_o m_q c^2}\frac{\vec{r}}{|\vec{r}|^4}$$

The second term is actually a *non-Coulomb* field since its decay is inverse proportional to distance cubed:

$$\varepsilon_o\mu_o = \frac{1}{c^2} \Rightarrow$$

$$\frac{q^3}{16\pi^2\varepsilon^2{}_o m_q c^2 r^3} = \mu_o\frac{q}{4\pi}\cdot\frac{q^2}{4\pi\varepsilon_o r}\frac{1}{m_q r^2} \quad (100)$$

The ratio of Energy to inverse moment of Inertia gives:

$$U_{rotational} = \frac{I\omega^2}{2} \Rightarrow \omega^2 = \frac{2U_{rotational}}{I} \Rightarrow$$

$$U_{rot} = \frac{q^2}{4\pi\varepsilon_o r} \; and \; I_q = m_q r^2 \Rightarrow$$

$$\omega^2 = \frac{U_{rot}}{I_q} = \frac{q^2}{4\pi\varepsilon_o r}\frac{1}{m_q r^2} \quad (101)$$

Then Eq. (100) becomes:

$$\frac{q^3}{16\pi^2\varepsilon^2{}_o m_q c^2 r^3} = \mu_o\frac{q}{4\pi}\cdot\omega^2 \Rightarrow$$

Electromagnetic field of an arbitrary charge
(Vector form and rotation on z-Axis)

$$\omega^2 = \frac{q^2}{4\pi\varepsilon_o|\vec{r}|}\cdot\frac{1}{m_q|\vec{r}|^2}$$

$$\vec{E} = \frac{q}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \mu_o\frac{q\omega^2}{4\pi}\frac{\vec{r}}{|\vec{r}|} \quad (102)$$

or

$$\theta = \omega\cdot t \; and \; \vec{A}_{(r)} = \mu_o\frac{q\omega}{4\pi}\sin(\theta)\hat{\phi}$$

$$\vec{E} = -\nabla V_{Cb} - \frac{\partial(\vec{A}_{(r)})}{\partial t} \quad (103)$$

I_q: charge's moment of Inertia
ω: local field angular velocity
V_{Cb}: classical Coulomb potential
A_r: dipolar magnetic vector potential
θ, φ: azimuthal and polar angle

Eq. (103) tells us that charges have a distinguishable electromagnetic nature, revealing additionally the existence of symmetry between "static fields" and *Maxwell's equations*.

Hence, the total magnetic field intensity is given by the rotation of the magnetic potential:

Magnetic field of an arbitrary charge
(Vector form and rotation on z-Axis)

$$\omega^2 = \frac{q^2}{4\pi\varepsilon_o|\vec{r}|}\cdot\frac{1}{m_q|\vec{r}|^2}$$

$$\vec{B} = \nabla\times\vec{A}_{(r)} = \mu_o\frac{q\omega}{4\pi|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} \quad (104)$$

Eq. (100) can be also written as the product between the velocity and the magnetic field intensity:

$$\mu_o\frac{q\omega^2}{4\pi}\frac{\vec{r}}{|\vec{r}|} \Rightarrow \mu_o\frac{q\omega^2}{4\pi}\frac{|\vec{r}|}{|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} \Rightarrow$$

$$\omega|\vec{r}|\mu_o\frac{q\omega}{4\pi|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} \Rightarrow u_{\tan} = \omega|\vec{r}| \Rightarrow$$

$$\omega|\vec{r}|\mu_o\frac{q\omega}{4\pi|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} = u_{\tan}\frac{\mu_o q\omega}{4\pi|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} \Rightarrow$$

Electromagnetic field of an arbitrary charge
(Vector form and rotation on z-Axis)

$$\omega^2 = \frac{q^2}{4\pi\varepsilon_o|\vec{r}|}\cdot\frac{1}{m_q|\vec{r}|^2}$$

$$\vec{u}_{\tan}\times\vec{B} = \omega|\vec{r}|\frac{\mu_o q\omega}{4\pi|\vec{r}|}\frac{\vec{r}}{|\vec{r}|} \quad (105)$$

$$\vec{E} = -\nabla V_{Cb} - (\vec{u}_{\tan}\times\vec{B}) \quad (106)$$

u_{tan}: local field tangential velocity
V_{Cb}: classical Coulomb potential
B: dipolar magnetic field intensity

An electric field requires normally the presence of an electric charge. Is there a magnetic charge associated with the magnetic field? There must be just two of them due to its dipolar nature.

The elementary electric charge is the fundamental quantity of electricity, equals:

$$q = \pm 1.60217662 \cdot 10^{-19} Cb$$

$$[q] = [I] \cdot [t] = A \cdot \sec = \frac{[U_E]}{[V_{EP}]} = \frac{Joule}{Volt}$$

The magnitude of Eq. (105) gives:

$$\omega^2 = \frac{q^2}{4\pi\varepsilon_o |\vec{r}|} \cdot \frac{1}{m_q |\vec{r}|^2} \Rightarrow$$

$$\omega^2 = \frac{q^2}{4\pi\varepsilon_o r} \cdot \frac{1}{m_q r^2} \Rightarrow$$

and

$$u_{\tan} \cdot B = \omega \cdot r \frac{\mu_o q \omega}{4\pi \cdot r} = \frac{\mu_o q \omega^2}{4\pi} \Rightarrow$$

$$u_{\tan} \cdot B = \frac{\mu_o q}{4\pi} \frac{q^2}{4\pi\varepsilon_o r} \cdot \frac{1}{m_q r^2} \Rightarrow$$

$$u_{\tan} \cdot B = \frac{q^2}{4\pi\varepsilon_o r \cdot m_q} \frac{\mu_o q}{4\pi \cdot r^2} \Rightarrow$$

$$u_{\tan} \cdot B = \frac{q^2}{4\pi\varepsilon_o r \cdot m_q} \frac{\mu_o q}{4\pi \cdot r^2} \frac{c}{c} \Rightarrow$$

$$u_{\tan} \cdot B = \frac{q^2}{4\pi\varepsilon_o r \cdot m_q c} \frac{\mu_o q c}{4\pi \cdot r^2} \Rightarrow$$

Finally:

$$u_{\tan} = \frac{q^2}{4\pi\varepsilon_o r \cdot m_q c}$$

and

$$B = \mu_o \frac{qc}{4\pi \cdot r^2} \Rightarrow H = \frac{B}{\mu_o} = \frac{qc}{4\pi \cdot r^2} \Rightarrow$$

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The product q·c represents the fundamental quantity of dipolar magnetism:

$$q_{m_d} = 2q_{m_q} = qc \Rightarrow q_{m_q} = \pm \frac{qc}{2} \quad (107)$$

and

$$[q_{m_q}] = [q][c] = Cb \cdot m/\sec = A \cdot m$$

$$[q_{m_q}] = [q][c] = Watt \cdot m/Volt = A \cdot m$$

Proportionally to dipolar magnetic charge, the known electric charge is consisted of two hemispheres (half the total charge):

$$q = 2q_{e_q} \Rightarrow q_{e_q} = \pm \frac{q}{2} \quad (108)$$

Quantum Electric and Magnetic charge

$$q_{e_q} = \pm \frac{q}{2} \quad (109)$$

$$q_{e_q} = \pm 0.80108831 \cdot 10^{-19} Cb$$

and

$$q_{m_q} = \pm \frac{qc}{2} \quad (110)$$

$$c = 3 \cdot 10^8 \, m/\sec$$

$$q_{m_q} = \pm 2.40326493 \cdot 10^{-11} A \cdot m$$

Electric and Magnetic fields
(Hemispherical/monopolar fields)

$$\sigma_H = \frac{\sigma}{2} = \frac{q}{2 \cdot 4\pi \cdot r^2} = \frac{q_{e_q}}{4\pi \cdot r^2}$$

$$q_{e_q} = \pm \frac{q}{2} = \pm 0.80108831 \cdot 10^{-19} Cb$$

$$\vec{E}_H = \frac{\sigma_H}{\varepsilon_o} = \frac{q}{8\pi\varepsilon_o} \frac{\vec{r}}{|\vec{r}|^3} = \frac{q_{e_q}}{4\pi\varepsilon_o} \frac{\vec{r}}{|\vec{r}|^3} \quad (111)$$

σ_H: hemisphere (half-sphere) electric charge density
E_H: hemisphere Electric field
q: total electric charge (two hemispheres)
q_{eq}: quantum electric charge (half the total electric charge)

$$\sigma_{H_m} = \frac{\sigma_m}{2} = \frac{qc}{2 \cdot 4\pi \cdot r^2} = \frac{q_{m_q}}{4\pi \cdot r^2}$$

$$q_{m_q} = \pm \frac{qc}{2} = \pm 2.40326493 \cdot 10^{-11} A \cdot m$$

$$\vec{H}_H = \sigma_{H_m} = \frac{qc}{8\pi} \frac{\vec{r}}{|\vec{r}|^3} = \frac{q_{m_q}}{4\pi} \frac{\vec{r}}{|\vec{r}|^3} \quad (112)$$

σ_{Hm}: hemisphere (half-sphere) magnetic charge density
H_H: hemisphere Magnetic field
q_{md}: total magnetic charge (two hemispheres)
q_{mq}: quantum magnetic charge (half the total magnetic charge)

Total field of an arbitrary charge
(Vector form and rotation on z-Axis)
Based on monopoles concept

$$\vec{E} = -\nabla V_{Cb} - (\vec{u}_{\tan} \times \vec{B})$$

$$-\nabla V_{Cb} = 2 \frac{q_{e_q}}{4\pi\varepsilon_o} \frac{\vec{r}}{|\vec{r}|^3} \quad (113)$$

and

$$-(\vec{u}_{\tan} \times \vec{B}) = \frac{4q^2{}_{e_q}}{4\pi\varepsilon_o |\vec{r}| \cdot m_q c} 2\mu_o \frac{q_{m_q}}{4\pi} \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{B} = 2\mu_o \frac{q_{m_q}}{4\pi} \frac{\vec{r}}{|\vec{r}|^3} \quad (114)$$

Total field of an arbitrary charge
(Vector form and rotation on z-Axis)
Based on monopoles concept

$$q_{m_q} = \pm\frac{qc}{2} = \pm q_{e_q} c$$

$$\vec{u}_{\tan} = \frac{q^2}{4\pi\varepsilon_o|\vec{r}|\cdot m_q c} = \frac{q^2{}_{e_q}}{\pi\varepsilon_o|\vec{r}|\cdot m_q c}$$

$$\vec{u}_{\tan} = \frac{q^2}{4\pi\varepsilon_o|\vec{r}|\cdot m_q c} = \mu_o\frac{q^2{}_{m_q}}{\pi|\vec{r}|\cdot m_q c}$$

$$\vec{E} = \frac{q_{e_q}}{2\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q^2{}_{e_q}}{\pi\varepsilon_o|\vec{r}|\cdot m_q c}\mu_o\frac{q_{m_q}}{2\pi}\frac{\vec{r}}{|\vec{r}|^3} \quad (115)$$

or

$$\vec{E} = \frac{q_{e_q}}{2\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \mu_o\frac{q^2{}_{m_q}}{\pi|\vec{r}|\cdot m_q c}\mu_o\frac{q_{m_q}}{2\pi}\frac{\vec{r}}{|\vec{r}|^3} \quad (116)$$

m_q: charged particle total mass

Postulate (9): *An electric charge is consisted of two unipolar like electric and two unipolar opposite (dipole) magnetic charges.*

The ratio between the electric and the magnetic field intensity gives the speed of light:

$$|\vec{u}_{\tan}| < 0.01c \Rightarrow \frac{q^2{}_{e_q}}{\pi\varepsilon_o|\vec{r}|\cdot m_q c} < 0.01c \Rightarrow$$

$$|\vec{r}| > 100\frac{q^2{}_{e_q}}{\pi\varepsilon_o\cdot m_q c^2} \Rightarrow$$

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Ratio between Electric and Magnetic field

$$|\vec{E}| = \frac{q_{e_q}}{2\pi\varepsilon_o r^2} \text{ and } |\vec{H}| = \frac{q_{m_q}}{2\pi r^2}$$

$$\frac{|\vec{E}|}{|\vec{H}|} = \frac{q_{e_q}}{\varepsilon_o q_{m_q}} = \mu_o c \approx 377 \text{ Ohm} \quad (117)$$

and

$$\frac{|\vec{E}|}{|\vec{B}|} = \frac{q_{e_q}}{\varepsilon_o\mu_o q_{m_q}} = c = 3\cdot10^8 \, m/\sec \quad (118)$$

The theoretical discovery of magnetic charges (magnetic monopoles) eventually leads to a re-definition of particle interactions. When a charged particle moves inside a magnetic field with its velocity perpendicular to the magnetic field lines, a force starts to be exerted upon it, namely the *Lorentz* force.

Apparently, on the assumption the charged particles are not consisted of magnetic monopoles, the existence of the Magnetic force cannot be justified on quantum level.

The electric force between two charged particles is given by Eq. (78):

$$\vec{F}_E = \frac{q_1q_2}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} \mp \frac{q^2{}_1q^2{}_2}{8\pi^2\varepsilon^2{}_o(m_{q_1}+m_{q_2})c^2}\frac{\vec{r}}{|\vec{r}|^4} \Rightarrow$$

Proportionally to Eq. (116):

$$m_{q_1} = m_q \text{ and } m_{q_2} = m_{q'}$$

$$q_1 = 2q_{e_q} \text{ and } q_2 = 2q'_{e_q} \Rightarrow$$

$$\frac{q_1q_2}{4\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} = \frac{q_{e_q}q'_{e_q}}{\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} \quad (119)$$

and

$$q_{m_q} = q_{e_q}c \text{ and } q'_{m_q} = q'_{e_q}c \Rightarrow$$

$$\frac{q^2{}_1q^2{}_2}{8\pi^2\varepsilon^2{}_o(m_{q_1}+m_{q_2})c^2} = \frac{2q_{m_q}{}^2q'_{m_q}{}^2\mu^2{}_o}{\pi^2(m_q+m_{q'})c^2} \Rightarrow$$

$$\frac{u_{\tan}}{c} = 2\mu_o\frac{q_{m_q}q'_{m_q}}{\pi|\vec{r}|(m_q+m_{q'})c^2} \quad (120)$$

and

$$\vec{F}_M = \mu_o\frac{q_{m_q}q'_{m_q}}{\pi}\frac{\vec{r}}{|\vec{r}|^3} \quad (121)$$

Then from Eq. (119), Eq. (120) and Eq. (121):

Quantum Electromagnetic force
between two arbitrary stationary charges
(Vector form with monopole charges)

$$\vec{F}_{EM} = \frac{q_{e_q}q'_{e_q}}{\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} \mp \frac{u_{\tan}}{c}\mu_o\frac{q_{m_q}q'_{m_q}}{\pi}\frac{\vec{r}}{|\vec{r}|^3} \quad (122)$$

or

Quantum static like Lorentz force
between two arbitrary stationary charges
(Vector form with monopole charges)

$$\vec{F}_{Cb} = \frac{q_{e_q}q'_{e_q}}{\pi\varepsilon_o}\frac{\vec{r}}{|\vec{r}|^3} = q_{e_q}\vec{E}'_{e_q}$$

and

$$q_{m_q}(\vec{u}_{\tan}\times\vec{B}'_{m_q}) = \frac{u_{\tan}}{c}\mu_o\frac{q_{m_q}q'_{m_q}}{\pi}\frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{F}_{L_q} = q_{e_q}\vec{E}'_{e_q} \mp q_{m_q}(\vec{u}_{\tan}\times\vec{B}'_{m_q}) \quad (123)$$

F_{Lq}: quantum Lorentz force
F_M: quantum Magnetic force

10. Gravitoinertial Force

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The *intrinsic-angular velocity (ω)* of a charged particle gave rise to a dipolar magnetic field; otherwise, it would have just electric properties. Now from the moment a charged particle has a mass, it should also possess its own *gravitational* and *inertial* field. In other words, there are yet two other types of monopoles, the gravitational and the inertial one.
Obviously, the electric charge must correspond to a *gravitational charge* and its angular velocity to an inertial just as the magnetic charge. Starting from Eq. (110):

$$q_{m_q} = \pm\frac{qc}{2} = \pm q_{e_q} c \Rightarrow q^2{}_{m_q} = q^2{}_{e_q} c^2 \Rightarrow$$

$$\varepsilon_o \mu_o = \frac{1}{c^2} \Rightarrow q^2{}_{m_q} = \frac{q^2{}_{e_q}}{\varepsilon_o \mu_o} \Rightarrow$$

$$\frac{q^2{}_{e_q}}{\varepsilon_o} = \mu_o q^2{}_{m_q} \quad (124)$$

Proportionally to Eq. (124), it should be also possible to have a similar expression for the gravito-inertial charges:

$$\frac{q^2{}_{g_q}}{\varepsilon_{g_o}} = \mu_{i_o} q^2{}_{i_q} \ and\ \varepsilon_{g_o} \mu_{i_o} = \frac{1}{c^2} \quad (125)$$

Setting:

$$\varepsilon_{g_o} = G \Rightarrow \mu_{i_o} = \frac{1}{c^2 G} \quad (126)$$

A new postulate is necessary to be developed in order to allow the description of gravitoinertial forces.

<u>Postulate (10)</u>: *There is only one force in Nature, the electric force. The magnetic, gravitational and inertial forces are derivatives of the same force (electric).*

Charge type Unification

$$\frac{q^2{}_{e_q}}{\varepsilon_o} = \frac{q^2{}_{g_q}}{\varepsilon_{g_o}} = \mu_o q^2{}_{m_q} = \mu_{i_o} q^2{}_{i_q}$$

$$\varepsilon_{g_o} = G = 6.67384 \cdot 10^{-11} N \frac{m^2}{Kgr^2}$$

$$\mu_{i_o} = \frac{1}{c^2 \varepsilon_{g_o}} = 1.664875 \cdot 10^{-7} \frac{Kgr^2 \cdot \sec^2}{N \cdot m^4}$$

ε_o: vacuum electric permittivity
ε_{go}: vacuum gravitational permittivity
μ_o: vacuum magnetic permeability
μ_{go}: vacuum inertial permeability

Quantum Gravitational and Inertial
Gravitational charge

$$q_{g_q} = \pm q_{e_q} \sqrt{G/\varepsilon_o} \quad (127)$$

$$q_{g_q} = \pm 2.199348 \cdot 10^{-19} \frac{Joule}{Kgr \cdot m^{-1}}$$

Gravito-electric coupling constant

$$g_e = \sqrt{\varepsilon_{g_o}/\varepsilon_o} = 2.74545 \frac{Volt}{Kgr \cdot m^{-1}}$$

Inertial charge

$$q_{i_q} = \pm q_{g_q} c = \pm q_{m_q} g_e \quad (128)$$

$$q_{i_q} = \pm 6.598044 \cdot 10^{-11} \frac{Joule}{Kgr \cdot m^{-1}} \frac{m}{\sec}$$

Inertio-magnetic coupling constant

$$g_m = \sqrt{\mu_o/\mu_{i_o}} = 2.74545 \frac{Volt}{Kgr \cdot m^{-1}}$$

The equivalent gravito-inertial expressions based on the findings of the electric force and quantum charges can be now easily derived, starting from Eq. (22):

$$U_{E(r)} = \frac{q_1 q_2}{4\pi\varepsilon_o r}\left(1 \mp \frac{q_1 q_2}{4\pi\varepsilon_o r\left(m_{q_1} + m_{q_2}\right)c^2}\right) \Rightarrow$$

$$U_{E(r)} = \frac{q_{e_q} q'_{e_q}}{\pi\varepsilon_o r}\left(1 \mp \frac{q_{e_q} q'_{e_q}}{\pi\varepsilon_o r\left(m_q + m_{q'}\right)c^2}\right) \Rightarrow$$

Quantum Gravitational Potential Energy
of charge q_{gq} in the presence of q'_{gq} (Stationary conditions)

$$(129)$$

$$U_{G(r)} = \frac{q_{g_q} q'_{g_q}}{\pi\varepsilon_{g_o} r}\left(1 \mp \frac{q_{g_q} q'_{g_q}}{\pi\varepsilon_{g_o} r\left(m_q + m_{q'}\right)c^2}\right)$$

or

$$U_{G(r)} = \frac{q_{g_q} q'_{g_q}}{\pi G \cdot r}\left(1 \mp \frac{q_{g_q} q'_{g_q}}{\pi G \cdot r\left(m_q + m_{q'}\right)c^2}\right)$$

Quantum Total Gravitational Force
(Magnitude and Vector form with monopole charges)

$$F_{GI} = -\frac{dU_{G(r)}}{dr} \quad (130)$$

$$F_{GI} = \frac{q_{g_q} q'_{g_q}}{\pi G \cdot r^2}\left(1 \mp \frac{2 q_{g_q} q'_{g_q}}{\pi G\left(m_q + m_{q'}\right)c^2 r}\right)$$

$$\vec{F}_{GI} = \frac{q_{g_q} q'_{g_q}}{\pi G}\frac{\vec{r}}{|\vec{r}|^3} \mp \frac{2q^2{}_{g_q} q^{2\prime}{}_{g_q}}{\pi^2 G^2\left(m_q + m_{q'}\right)c^2}\frac{\vec{r}}{|\vec{r}|^4}$$

Quantum Gravitoinertial force

between two arbitrary stationary charges

(Vector form with monopole charges)

$$\frac{u_{\tan}}{c} = 2\mu_{i_o} \frac{q_{i_q} q'_{i_q}}{\pi|\vec{r}|(m_q + m_{q'})c^2} \quad (131)$$

$$\mu_{i_o} = \frac{1}{c^2 \varepsilon_{g_o}} = \frac{1}{c^2 G}$$

$$\vec{F}_I = \frac{q_{m_q} q'_{m_q}}{c^2 \pi G} \frac{\vec{r}}{|\vec{r}|^3} \quad (132)$$

$$\vec{F}_{GI} = \frac{q_{g_q} q'_{g_q}}{\pi G} \frac{\vec{r}}{|\vec{r}|^3} \mp \frac{u_{\tan}}{c} \frac{q_{i_q} q'_{i_q}}{c^2 \pi G} \frac{\vec{r}}{|\vec{r}|^3} \quad (133)$$

m_q: mass of the first charge (e.g. electron mass)
$m_{q'}$: mass of the second charge (e.g. electron mass)

Quantum static like Lorentz force

between two arbitrary stationary charges

(Vector form with monopole charges)

$$\vec{F}_G = \frac{q_{g_q} q'_{g_q}}{\pi G} \frac{\vec{r}}{|\vec{r}|^3} = q_{g_q} \vec{E}'_{g_q} \quad (134)$$

and

$$q_{i_q}\left(\vec{u}_{\tan} \times \vec{B}'_{i_q}\right) = \frac{u_{\tan}}{c} \frac{q_{i_q} q'_{i_q}}{c^2 \pi G} \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{F}_{L_{gi}} = q_{g_q} \vec{E}'_{g_q} \mp q_{i_q}\left(\vec{u}_{\tan} \times \vec{B}'_{i_q}\right) \quad (135)$$

F_{Lgi}: quantum Gravitoinertial Lorentz like force
F_{GI}: quantum Gravitoinertial (total) force
F_G: quantum Gravitational force
F_I: quantum inertial force

The derivation of the total gravitational field of a charge requires the expression of the total gravitational potential:

$$q_{g_q} = q'_{g_q} \ \ and \ \ m_q = m_{q'} \Rightarrow$$

$$V_{GI} = \frac{U_{G(r)}}{q_{g_q}} \Rightarrow$$

V_{GI}: gravitoinertial (total) potential

Total GI Potential

At a distance from an arbitrary charge

$$V_{GI} = \frac{q_{g_q}}{2\pi\varepsilon_{g_o} \cdot r}\left(1 - \frac{q^2_{g_q}}{2\pi\varepsilon_{g_o} m_q c^2 r}\right) \quad (136)$$

$$\varepsilon_{g_o} = G$$

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Total field of an arbitrary charge

(Magnitude form)

$$E_{gi} = \frac{q_{g_q}}{2\pi\varepsilon_{g_o} r^2}\left(1 - \frac{q^2_{g_q}}{\pi\varepsilon_{g_o} m_q c^2 r}\right) \quad (137)$$

Total field of an arbitrary charge

(Vector form with monopole charges)

Gravitoinertial field

$$\vec{E}_{gi} = -\nabla V_{GP}$$

$$\varepsilon_{g_o} = G$$

$$\mu_{i_o} = \frac{1}{c^2 \varepsilon_{g_o}} = \frac{1}{c^2 G}$$

$$\vec{E}_{gi} = \frac{q_{g_q}}{2\pi\varepsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3} - \frac{q^3_{g_q}}{2\pi^2 \varepsilon^2_{g_o} m_q c^2} \frac{\vec{r}}{|\vec{r}|^4} \quad (138)$$

Total field of an arbitrary charge

(Vector form with monopole charges)

Gravitational field

$$\vec{E}_g = 2\frac{q_{g_q}}{4\pi\varepsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3} \quad (139)$$

Inertial field

$$\vec{H}_i = 2\frac{q_{i_q}}{4\pi} \frac{\vec{r}}{|\vec{r}|^3} \quad (140)$$

Inertial field induction

$$\vec{B}_i = 2\mu_{i_o} \frac{q_{i_q}}{4\pi} \frac{\vec{r}}{|\vec{r}|^3} \quad (141)$$

Local field tangential velocity

$$\vec{u}_{\tan} = \mu_{i_o} \frac{q^2_{i_q}}{\pi|\vec{r}| \cdot m_q c} \quad (142)$$

or

Gravitoinertial field

$$\vec{E}_{gi} = -\nabla V_g - \left(\vec{u}_{\tan} \times \vec{B}_i\right)$$

$$-\nabla V_g = \frac{q_{g_q}}{2\pi\varepsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3}$$

$$-\left(\vec{u}_{\tan} \times \vec{B}_i\right) = -\mu_{i_o} \frac{q^2_{i_q}}{\pi|\vec{r}| \cdot m_q c} \mu_{i_o} \frac{q_{i_q}}{2\pi} \frac{\vec{r}}{|\vec{r}|^3}$$

Gravitoinertial field

$$\vec{E}_{gi} = \frac{q_{g_q}}{2\pi\varepsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3} - \mu_{i_o} \frac{q^2_{i_q}}{\pi|\vec{r}| \cdot m_q c} \mu_{i_o} \frac{q_{i_q}}{2\pi} \frac{\vec{r}}{|\vec{r}|^3} \quad (143)$$

Gravitational flux

(Magnitude and Vector form with monopole charges)

$$D_g = \varepsilon_{g_o} E_g = G \cdot E_g$$

$$\vec{D}_g = G \cdot \vec{E}_g \quad (144)$$

$$[D_g] = [\varepsilon_{g_o}] \cdot [E_g] = \frac{N}{Kgr} = \frac{m}{\sec^2}$$

Measurement Units

(Electromagnetic Field)

$[E]=\frac{V}{m}$ $[H]=\frac{A}{m}=\frac{Joule}{V\cdot m\cdot \sec}$

$[D=\varepsilon_o E]=\frac{Cb}{m^2}$ $[B=\mu_o H]=\frac{V\cdot \sec}{m^2}$

$[\varepsilon_o]=\frac{F}{m}=\frac{Joule}{V^2 m}$ $[\mu_o]=\frac{H}{m}=\frac{Joule}{A^2 m}$

$[q_{e_q}]=Cb=\frac{Joule}{Volt}$ $[q_{m_q}]=\frac{Joule}{Volt}\cdot\frac{m}{\sec}$

Measurement Units

(Gravitoinertial Field)

$[E_g]=\frac{Kgr\cdot m^{-1}}{m}$ $[H_i]=\frac{Joule}{Kgr\cdot m^{-1}\cdot m\cdot \sec}$

$[D_g=\varepsilon_{g_o}E_g]=\frac{m}{\sec^2}$ $[B_i=\mu_{i_o}H_i]=\frac{Kgr\cdot m^{-1}\sec}{m^2}$

$[\varepsilon_{g_o}]=\frac{Joule}{(Kgr\cdot m^{-1})^2\cdot m}$ $[\mu_{i_o}]=\frac{(Kgr\cdot m^{-1}\cdot \sec)^2}{Joule^2}\frac{Joule}{m}$

$[q_{g_q}]=\frac{Joule}{Kgr\cdot m^{-1}}$ $[q_{i_q}]=\frac{Joule}{Kgr\cdot m^{-1}}\frac{m}{\sec}$

Eq. (144) is actually equivalent to quantum gravitational acceleration, where:

$$D_g=\varepsilon_{g_o}E_g=G\cdot E_g=a_g\Rightarrow$$

$$a_g=\frac{q_{g_q}}{2\pi r^2}=\frac{q_{e_q}\sqrt{G/\varepsilon_o}}{2\pi r^2}=\varepsilon_o E_e\sqrt{G/\varepsilon_o}\Rightarrow$$

$$a_g=\sqrt{\varepsilon_o G}\cdot E_e\Rightarrow$$

Electrogravity

$$\varepsilon=\varepsilon_o\varepsilon_r$$

$$G\cdot E_g=a_g=\sqrt{\varepsilon\cdot G}\cdot E_e \quad (145)$$

$$[D_g=G\cdot E_g]=\frac{m}{\sec^2}$$

E_e: electric (Coulomb) field
E_g: gravitational field
a_g: gravitational acceleration (or gravitational flux)

Musha Electrogravity equation derived from the weak field approximation of Einstein's General Relativity and gives:

$$E_g=\sqrt{4\pi\varepsilon\cdot G}\cdot E_e\Rightarrow[E_g]=m/\sec^2$$

The measurement unit of the above expression relates to a gravitational flux and not to a field since the framework of *General Relativity* addresses just large-scale like gravitational fields and not quantum. However, the similarity with Eq. (145) is evident.

An equivalent to Earth's gravitational flux (acceleration) over electromagnetic means requires:

$$a_{g_E}=9.81\ \ m/\sec^2$$

$$a_{g_E}=\sqrt{\varepsilon_o G}\cdot E_e\Rightarrow E_e=\frac{a_{g_E}}{\sqrt{\varepsilon_o G}}\Rightarrow$$

$$E_e\approx 4.0355\cdot 10^{11}V/m$$

$$D_e=\varepsilon_o E_e\approx 3.57\ \ Cb/m^2$$

or

$$a_{g_E}=9.81\ \ m/\sec^2$$

$$E_e=cB=c\mu_o H\Rightarrow H=\frac{E_e}{c\mu_o}\Rightarrow$$

$$H\approx 1.07\cdot 10^9\ A/m$$

$$B=\mu_o H\approx 1.35\cdot 10^3 Tesla$$

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Conclusion

The theoretical discovery of a decaying speed of light on quantum level may explain or reveal the cause behind the quantum phenomena (quantum tunneling, Coulomb barrier between electrons or protons, magnetic monopoles, gravitoinertial effects of charged matter and more) where today's Physics is not able to address or justify over a single and consisted Quantum Theory.

ΠΥΘΑΓΟΡΑΣ
"..ΠΑΝΤΑ ΚΑΤ'ΑΡΙΘΜΟΝ ΓΙΓΝΟΝΤΑΙ…" 579-490 π.Χ

ΠΛΑΤΩΝ
"..ΨΥΧΗ ΠΑΣΑ ΑΘΑΝΑΤΟΣ ΤΟ ΓΑΡ ΑΕΙΚΙΝΗΤΟΝ ΑΘΑΝΑΤΟΝ…" 428-348 π.Χ

ΑΝΑΧΑΡΣΙΣ
"..ΨΥΧΗΣ ΜΕΝ ΟΡΓΑΝΟΝ ΣΩΜΑ, ΘΕΟΥ Δ'Η ΨΥΧΗ…" 589 π.Χ

ΘΑΛΗΣ
"..ΣΟΦΩΤΑΤΟΝ ΧΡΟΝΟΣ· ΑΝΕΥΡΙΣΚΕΙ ΓΑΡ ΠΑΝΤΑ…" 600 π.Χ

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