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Origin of the Inertia (Mass) of "Quantum Mechanical Probability Waves" ("De Broglie Waves"/ "Material Waves"). A Mathematical Framework in Quantum Physics for the Quantization Of Mass, Electric Charge And Magnetic Spin

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Abstract

This article will prove and supply the mathematical evidence that "Quantum Mechanical Probability Waves" (De Broglie waves / Material Waves) do have mass. "De Broglie Waves" contain all the mass of all the matter in our universe. What we do measure in our complex experiments are only "De Broglie Waves" and never the illusionary elementary particles. "De Broglie Waves" are the only carrier of the Physical Observable (Measurable) world. Elementary particles are the worldwide accepted physical concept during the last 2400 years since Democritus, a Greek philosopher (460 - 370 BC) had introduced the fundamental concept of the atom (atomos). The "New Theory" presents a "New Equation" describing the electromagnetic field configurations which are also solutions of the Schrodinger's wave equation and the relativistic quantum mechanical Dirac Equation and carry mass, electric charge and magnetic spin at discrete values.

Keywords: General Relativity; Quantum Physics; Dirac Equation; Gravitational-Electromagnetic Interaction; Black Holes; Gravitational-Electromagnetic Confinement; Electromagnetism; Quantum Optics

Introduction

To change the nowadays popular concept of "Problem Solving Physics" into "Fundamental Physics" we have to go back in time for over 300 years. Back to the time when the vast areas of Science, Religion and Magic met each other and often collided towards each other in an unknown challenging world.

Back to the time of Isaac Newton who published in 1687 in the "Philosophiae Naturalis Principia Mathematica" a Universal Fundamental Principle in Physics in Harmony with Religion. The Universal path, the Leitmotiv, the Universal concept in physics which was fundamental in science and not in conflict with the Catholic Church. Newton found the concept of "Universal Equilibrium" which he formulated in his famous third equation Action = - Reaction. In nowadays math the concept of "Universal Equilibrium" has been formulated as:

$$\sum_{i=0}^{i=n} \overline{\mathbf{F}_i} = 0 \qquad (1)$$

Because the Inertia Force is a Reaction Force, the Inertia Force appears in the equation with a minus sign.

$$\sum_{i=0}^{i=n} \overline{\mathbf{F}_i} - m\,\bar{a} = 0 \qquad (2)$$

Equation (2) is a general presentation of Newton's famous second law of motion. In a fundamental way, Newton's second law of motion describes the required electromagnetic equation for the Gravitational-Electromagnetic Interaction in general terms, including Maxwell's theory of Electrodynamics published in 1865 in the article: "A Dynamic Theory of the Electromagnetic Field" and Einstein's theory of General Relativity published in 1911 the article: "On the Influence of Gravitation on the Propagation of Light".

Because Maxwell's 4 equations are not part of one whole uniform understanding of the universe like the fundamental equation of Newton's second law of motion represents, Maxwell's theory is missing a fundamental foundation [1].

Newton's second law of motion has been based on a profound understanding of the universe which is based on the fundamental principle of Harmony and Equilibrium, expressed in equation (2).

To describe the interaction between light and gravity and to understand electromagnetic waves and their interaction and to understand the concept of "photons" it is important to define the fundamental equation for the electromagnetic field based on the fundamental principle of Harmony and Equilibrium formulated by Newton in 1687 and published in his famous work: "Philosophiae Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy)".

To realize this, Newton's second law of motion will be the Ground, the Leitmotiv, the Universal Concept in Physics on which the New Theory will be built. The fundamental Electromagnetic force density equation has been based integral on Newton's second law of motion and has been divided into 5 separate terms (B-1 – B-5), each one describing a part of the electromagnetic and inertia force densities.

$$\sum_{i=0}^{i=5} \mathbf{B}_i = 0 \qquad (3)$$

The first term B-1 represents the inertia of the mass density of light (Electromagnetic Radiation). The terms B-2 and B-3 represent the electric force densities within the Electromagnetic Radiation (Beam of Light) and the terms B-4 and B-5 represent the magnetic force densities within the Electromagnetic Radiation (Beam of Light).

Fundamental in the New Theory is the outcome of (3) which always has to be zero according Newton's fundamental principle of "Universal Equilibrium" [2].

To apply the concept of "Universal Equilibrium" within an electromagnetic field, the electric forces FElectric, the magnetic forces the magnetic forces FMagnetic and the inertia forces will be presented separately in equation (3):

$$\sum_{i=0,\, j=0}^{I=n,\, j=m} \left(\overline{F_{\text{Electric-i}}} + \overline{F_{Magnetic-j}} - m\,a \right) = 0 \qquad (4)$$

The Inertia of Light (Term B-1)

Reducing Equation (2) to one single Force, equation (2) will be written in the well-known presentation:

$$\bar{F} = m\,\bar{a} \qquad (5)$$

The right and the left term of Newton's law of motion in equation (5) has to be divided by the Volume "V" to find an equation for the force density f related to the mass density "ρ".

$$\begin{aligned} \bar{F} &= m\,\bar{a} \\ \left(\frac{F}{V}\right) &= \left(\frac{m}{V}\right)\bar{a} \\ \bar{f} &= \rho\,\bar{a} \end{aligned} \qquad (6)$$

$$\overline{F_{\text{Inertia}}}$$

The Inertia Force for Electromagnetic Radiation will be derived from Newton's second law of motion, using the relationship between the momentum vectors for radiation expressed by the Poynting vector:

$$\overline{F_{Inertia}} = -m\bar{a} = -m\frac{\Delta\bar{v}}{\Delta t} = -\frac{\Delta(m\bar{v})}{\Delta t} = -\frac{\Delta\bar{p}}{\Delta t} = -\left\{\frac{V}{2}\right\}\frac{\Delta\bar{S}}{\Delta tc} \qquad (7)$$

Dividing the right and the left term in equation (7) by the volume V results in the inertia force density :

$$\begin{aligned} \overline{F_{\text{INERTIA}}} &= -m\,\bar{a} = -m\frac{\Delta\bar{v}}{\Delta t} = -\frac{\Delta(m\bar{v})}{\Delta t} = -\frac{\Delta\bar{p}}{\Delta t} = -\left(\frac{V}{c^2}\right)\frac{\Delta\bar{S}}{\Delta t} \\ \frac{\overline{F_{\text{INERTIA}}}}{V} &= -\frac{m}{V}\bar{a} = -\frac{m}{V}\frac{\Delta\bar{v}}{\Delta t} = -\frac{1}{V}\frac{\Delta\bar{p}}{\Delta t} = -\left(\frac{1}{c^2}\right)\frac{\Delta\bar{S}}{\Delta t} \\ \overline{f_{INERTIA}} &= -\rho\,\bar{a} = -\left(\frac{1}{c^2}\right)\frac{\Delta\bar{S}}{\Delta t} \left[N/m^3\right] \end{aligned} \qquad (8)$$

The Poynting vector represents the total energy transport of the electromagnetic radiation per unit surface per unit time (J/m^2s). Which can be written as the cross product of the Electric Field intensity and the magnetic Field intensity.

$$\begin{aligned} \overline{f_{INERTIA}} &= -\rho a = -\left(\frac{1}{c^2}\right)\frac{\Delta S}{\Delta t} = -\left(\frac{1}{c^2}\right)\frac{\Delta\left(\bar{E}\times\bar{H}\right)}{\Delta t}\left[N/m^3\right] \\ \overline{f_{INERTIA}} &= -\left(\frac{1}{c^2}\right)\frac{\partial\left(\bar{E}\times\bar{H}\right)}{\partial t}\left[N/m^3\right] \end{aligned} \qquad (9)$$

Coulomb's Law (Coulomb Force) for Electromagnetic Radiation (Term B-2 and B-4)

An example of the Coulomb Force is the Electric Force FCoulomb acting on an electric charge Q placed in an electric field E. The equation for the Coulomb Force equals:

$$\overline{F_{\text{Coulomb}}} = \bar{E}\,Q \;\; [N] \qquad (10)$$

Dividing the right and the left term in equation (10) by the volume V results in the Electric force density:

$$\begin{aligned} \bar{F}_{\text{COULOMB}} &= \bar{E}\,Q \;\; [N] \\ \frac{\bar{F}_{\text{COULOMB}}}{V} &= \bar{E}\,\frac{Q}{V}\left[N/m^3\right] \\ \bar{f}_{\text{COULOMB}} &= \bar{E}\,\rho_E \left[N/m^3\right] \end{aligned} \qquad (11)$$

Substituting Gauss's law in differential form in (11) results in Coulombs Law for Electromagnetic Radiation for the Electric force density:

$$\begin{aligned} \bar{f}_{COULOMB} &= \bar{E}\,\rho_E \\ \bar{f}_{COULOMB} &= \bar{E}\,\rho_E = \bar{E}\left(\nabla \cdot D\right) \\ \bar{f}_{COULOMB} &= \bar{E}\left(\nabla \cdot D\right) = \varepsilon\,\bar{E}\left(\nabla \cdot \bar{E}\right)\left[N/m^3\right] \end{aligned} \tag{12}$$

In Electromagnetic Field Configurations, there is in general no preference for the electric force densities or the magnetic force densities. In general the equations for the electric field densities are universally exchangeable with the magnetic field densities.

For the magnetic field densities, equation (12) can be written as:

$$\begin{aligned} \bar{f}_{Coulomb-Electric} &= \bar{E}\left(\nabla \cdot \bar{D}\right) = \varepsilon\,\bar{E}\left(\nabla \cdot \bar{E}\right)\left[N/m^3\right] \text{ (Term B-2)} \\ \bar{f}_{Coulomb-Magnetic} &= \bar{H}\left(\nabla \cdot \bar{B}\right) = \mu\,\bar{H}\left(\nabla \cdot \bar{H}\right)\left[N/m^3\right] \text{ (Term B-4)} \end{aligned} \tag{13}$$

Lorentz's Law (Lorentz Force) for Electromagnetic Radiation (Term B-3 and B-5)

An example of the Lorentz Force is the Magnetic Force acting on an electric charge Q moving with a velocity v within a magnetic field with magnetic field intensity B (magnetic induction).

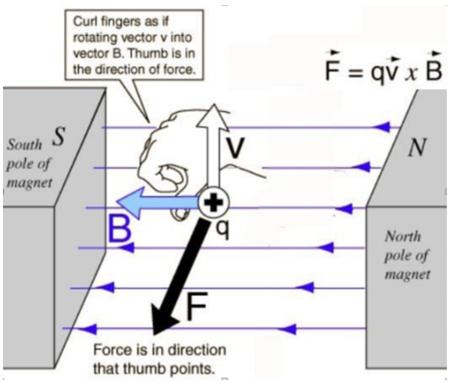

Figure 1: The Lorentz Force equals the cross product of the Magnetic Induction B and the velocity v of the charge q moving within the magnetic field times the value of the electric charge.

The equation for the Lorentz Force equals:

$$\bar{F}_{LORENTZ} = Q\,\bar{v} \times \bar{B}\quad [N] \tag{14}$$

Dividing the right and the left term in equation (14) by the volume V results in the Lorentz force density:

$$\begin{aligned} \bar{F}_{LORENTZ} &= Q\,\bar{v} \times \bar{B}\quad [N] \\ \frac{\bar{F}_{LORENTZ}}{V} &= -\,\bar{B} \times \frac{Q\,\bar{v}}{V}\left[N/m^3\right] \\ \bar{f}_{LORENTZ} &= -\,\bar{B} \times \frac{Q\,\bar{v}}{V} = -\,\bar{B} \times \bar{j} = -\,\mu\,\bar{H} \times \bar{j}\left[N/m^3\right] \end{aligned} \tag{15}$$

In which q is the electric charge, v the velocity of the electric charge, B the magnetic induction and j the electric current density [3]. Substituting Ampère's law in differential form in (15) results in Lorentz's Law for Electromagnetic Radiation for the Electric force density :

$$\begin{aligned} \bar{f}_{LORENTZ} &= -\,\mu\,\bar{H} \times \left(\bar{j}\right) \\ \bar{f}_{LORENTZ} &= -\,\mu\,\bar{H} \times \left(\bar{j}\right) = -\,\mu\,\bar{H} \times \left(\nabla \times \bar{H}\right)\left[N/m^3\right] \end{aligned} \tag{16}$$

In Electromagnetic Field Configurations, there is in general no preference for the electric force densities or the magnetic force densities. In general the equations for the electric field densities are universally exchangeable with the magnetic field densities. For the electric field densities, equation (16) can be written as:

$$\begin{aligned} \bar{f}_{Coulomb-Electric} &= -\,\varepsilon\,\bar{E} \times \left(\nabla \times \bar{E}\right)\left[N/m^3\right] \text{ (Term B-3)} \\ \bar{f}_{Coulomb-Magnetic} &= -\,\mu\,\bar{H} \times \left(\nabla \times \bar{H}\right)\left[N/m^3\right] \text{ (Term B-5)} \end{aligned} \tag{17}$$

The Fundamental Universal Equation for the Electromagnetic field (Term B-1 + Term B-2 + Term B-3 + Term B-4 + Term B-5)

Newton's second law of motion applied within any arbitrary electromagnetic field configuration results in the fundamental equation (23) for any arbitrary electromagnetic field configuration (a beam of light):

$$\text{NEWTON: } F_{TOTAAL} = m\,a \text{ represents: } f_{TOTAAL} = \rho\,a$$

$$\begin{aligned} -\rho\,a &+ f_{TOTAAL} = 0 \\ -\rho\,a &+ f_{ELEKTRISCH} + f_{MAGNETISCH} = 0 \\ -\rho\,a &+ F_{COULOMB} + F_{LORENTZ} + F_{COULOMB} + F_{LORENTZ} = 0 \\ -\frac{1}{c^2}\frac{\partial\left(\bar{E} \times \bar{H}\right)}{\partial t} &+ \varepsilon_0\,\bar{E}\left(\nabla \cdot \bar{E}\right) - \varepsilon_0\,\bar{E} \times \left(\nabla \times \bar{E}\right) + \mu_0\,\bar{H}\left(\nabla \cdot \bar{H}\right) - \mu_0\,\bar{H} \times \left(\nabla \times \bar{H}\right) = 0 \end{aligned} \tag{18}$$

B-1 B-2 B-3 B-4 B-5

Term B-4 is the magnetic equivalent of the (electric) Coulomb's law B-2 and Term B-3 is the electric equivalent of the (magnetic) Lorentz's law B-5.

The universal equation for the electromagnetic field (free electromagnetic waves and confined electromagnetic fields) has been presented in (24) and expresses the perfect equilibrium between the inertia forces (B-1), the electric forces (B-2 and B-3) and the magnetic forces (B-4 and B-5) in any arbitrary electromagnetic field configuration [4].

$$-\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}+\varepsilon_0\bar{E}(\nabla.\bar{E})-\varepsilon_0\bar{E}\times(\nabla\times\bar{E})+\mu_0\bar{H}(\nabla.\bar{H})-\mu_0\bar{H}\times(\nabla\times\bar{H})=0 \qquad (19)$$

B-1 B-2 B-3 B-4 B-5

The Universal Integration of Maxwell's Theory of Electrodynamics:

The universal equation (19) for any arbitrary electromagnetic field configuration can be written in the form:

$$-\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}+\varepsilon_0\bar{E}(\nabla.\bar{E})-\varepsilon_0\bar{E}\times(\nabla\times\bar{E})+\mu_0\bar{H}(\nabla.\bar{H})-\mu_0\bar{H}\times(\nabla\times\bar{H})=0$$

$$-\varepsilon_0\mu_0\left(\bar{E}\times\frac{\partial(\bar{H})}{\partial t}+\bar{H}\times\frac{\partial(\bar{E})}{\partial t}\right)+\varepsilon_0\bar{E}(\nabla.\bar{E})-\varepsilon_0\bar{E}\times(\nabla\times\bar{E})+\mu_0\bar{H}(\nabla.\bar{H})-\mu_0\bar{H}\times(\nabla\times\bar{H})=0 \qquad (20)$$

$$-\left(\varepsilon_0\bar{E}\times\frac{\partial(\bar{B})}{\partial t}+\mu_0\bar{H}\times\frac{\partial(\bar{D})}{\partial t}\right)+\bar{E}(\nabla.\bar{D})-\varepsilon_0\bar{E}\times(\nabla\times\bar{E})+\bar{H}(\nabla.\bar{B})-\mu_0\bar{H}\times(\nabla\times\bar{H})=0$$

M-3 M-4 M-1 M-3 M-2 M-4

The Maxwell Equations are presented in (21):

$$\nabla.\bar{D}=\rho \quad \text{(M-1)} \qquad \nabla\times\bar{E}=-\frac{\partial B}{\partial t} \quad \text{(M-3)}$$

$$\nabla.\bar{B}=0 \quad \text{(M-2)} \qquad \nabla\times\bar{H}=\frac{\partial D}{\partial t} \quad \text{(M-4)} \qquad (21)$$

In vacuum in the absence of any charge density, it follows from (26) that all the solutions for the Maxwell's Equations are also solutions for the separate parts of the Universal Equation (25) for the Electromagnetic field.

Universal Equation for the Electromagnetic Field.

$$-\left(\varepsilon_0\bar{E}\times\frac{\partial(\bar{B})}{\partial t}+\mu_0\bar{H}\times\frac{\partial(\bar{D})}{\partial t}\right)+\bar{E}(\nabla.\bar{D})-\varepsilon_0\bar{E}\times(\nabla\times\bar{E})+\bar{H}(\nabla.\bar{B})-\mu_0\bar{H}\times(\nabla\times\bar{H})=0$$

M-3 M-4 M-1 M-3 M-2 M-4

4 Maxwell's Equations

$$\nabla.\bar{D}=\rho \quad \text{(M-1)} \qquad \nabla\times\bar{E}=-\frac{\partial B}{\partial t} \quad \text{(M-3)}$$

$$\nabla.\bar{B}=0 \quad \text{(M-2)} \qquad \nabla\times\bar{H}=\frac{\partial D}{\partial t} \quad \text{(M-4)} \qquad (22)$$

Comparing the 4 Maxwell Equations (26) with the Universal Equation (24) we conclude that the 4 Maxwell equations show only the 4 parts of the Universal Dynamic Equilibrium in 4 separate terms and the 4 Maxwell equations are missing the fundamental term for inertia. For that reason it is impossible to calculate the interaction between light and gravity with the 4 Maxwell equations. To find the interaction terms between light and gravity the inertia term (B-1 in 24) is necessary.

The Interaction between Gravity and Light (Electromagnetic Radiation)

To define the Fundamental Equation for the Interaction between Gravity and Light, an extra term (B-6) has been introduced in equation (24). The term B-6 represents the force density of the gravitational field acting on the electromagnetic mass density [5].

$$F_{GRAVITY}=m\,\bar{g}\ \ [N]$$

Dividing both terms by the Volume V:

$$\frac{F_{GRAVITY}}{V}=\frac{m}{V}\,\bar{g}\ \ [N/m^3] \qquad (23)$$

Results in the force density:

$$f_{GRAVITY}=\rho\,\bar{g}\ \ [N/m^3]$$

The specific mass "ρ" of a beam of light follows from Einstein's equation:

$W = m\,c^2$

Dividing both terms by the Volume V results in:

$$\frac{W}{V}=\frac{m}{V}c^2 \qquad (24)$$

which represents the energy density "w" and the specific mass "□" of the electromagnetic radiation:

$$w=\rho c^2$$

which results for an expression of the specific mass □:

$$\rho=\frac{1}{C^2}w=\varepsilon\mu w$$

The energy density "w" follows from the electric and the magnetic field intensities:

$$w=\frac{1}{2}\varepsilon E^2+\frac{1}{2}\mu H^2$$

$$w=\frac{1}{2}\left(\varepsilon E^2+\mu H^2\right)=\frac{1}{2}\left(\varepsilon\left(\bar{E}.\bar{E}\right)+\mu\left(\bar{H}.\bar{H}\right)\right) \qquad (25)$$

Substituting equation (25) in equation (24) results in the gravitational force density acting on an arbitrary electromagnetic field configuration (a beam of light) with mass density.

$$f_{GRAVITY} = \rho \, \bar{g}$$
$$f_{GRAVITY} = \rho \, \bar{g} = \varepsilon \, \mu \, w \, \bar{g} = \frac{1}{2}\left(\varepsilon^2 \mu \left(\bar{E} . \bar{E}\right) + \varepsilon \, \mu^2 \left(\bar{H} . \bar{H}\right)\right)\bar{g} \qquad (26)$$

Substituting equation (31) in equation (24) results in the fundamental equation describing the Electromagnetic- Gravitational interaction for any arbitrary electromagnetic field configuration (a beam of light):

$$\text{NEWTON: } \bar{F}_{TOTAAL} = m \, \bar{a} \, [N]$$
$$\text{NEWTON: Expressed in force densities: } \bar{f}_{TOTAAL} = \rho \, \bar{a} \, [N/m^3]$$

$$\begin{array}{l} -\rho \, \bar{a} + \bar{f}_{TOTAAL} = \bar{0} \\ -\rho \, \bar{a} + \bar{f}_{ELEKTRISCH} + \bar{f}_{MAGNETISCH} + \bar{f}_{GRAVITY} = \bar{0} \\ \bar{f}_{INERTIA} + \bar{f}_{COULOMB} + \bar{f}_{LORENTZ} + \bar{f}_{COULOMB} + \bar{f}_{LORENTZ} + \bar{f}_{GRAVITY} = \bar{0} \\ -\frac{1}{c^2}\frac{\partial(\bar{E} \times \bar{H})}{\partial t} + \varepsilon_0 \bar{E}(\nabla . \bar{E}) - \varepsilon_0 \bar{E} \times (\nabla \times \bar{E}) + \mu_0 \bar{H}(\nabla . \bar{H}) - \mu_0 \bar{H} \times (\nabla \times \bar{H}) + \frac{1}{2}\left(\varepsilon^2 \mu (\bar{E} . \bar{E}) + \varepsilon \, \mu^2 (\bar{H} . \bar{H})\right)\bar{g} = \bar{0} \end{array} \qquad (27)$$

B-1 B-2 B-3 B-4 B-5 B-6

Term B-1 represents the inertia term of the electromagnetic radiation. Term B-4 is the magnetic representation of the (electric) Coulomb's Force B-2 and Term B-3 is the electric representation of the (magnetic) Lorentz Force B-5. Term B- 6 represents the Electromagnetic-Gravitational interaction of a gravitational field with field acceleration acting on an arbitrary electromagnetic field configuration (a beam of light) with specific mass.

The universal equation for the electromagnetic field (free electromagnetic waves and confined electromagnetic fields) within a gravitational field with gravity field intensityhas been presented in (33) and expresses the perfect equilibrium between the inertia forces (B-1), the electric forces (B-2 and B-3), the magnetic forces (B-4 and B-5) and the gravitational force (B-6) in any arbitrary electromagnetic field configuration.

$$-\frac{1}{c^2}\frac{\partial(\bar{E} \times \bar{H})}{\partial t} + \varepsilon_0 \bar{E}(\nabla . \bar{E}) - \varepsilon_0 \bar{E} \times (\nabla \times \bar{E}) + \mu_0 \bar{H}(\nabla . \bar{H}) -$$

B-1 B-2 B-3 B-4

$$-\mu_0 \bar{H} \times (\nabla \times \bar{H}) + \frac{1}{2}\left(\varepsilon^2 \mu (\bar{E} . \bar{E}) + \varepsilon \, \mu^2 (\bar{H} . \bar{H})\right)\bar{g} = \bar{0} \qquad (28)$$

B-5 B-6

The Confinement of Light (Electromagnetic Radiation)

When a beam of light is approaching a strong gravitational field in the direction of the gravitational field, generated by a Black Hole, the confinement has been called a Longitudinal Black Hole. The direction of propagation of the beam of light is in the same direction (or in the opposite direction) of the gravitational field. According the first term in (33), the beam of light will be accelerated or decelerated. However, the speed of light is a universal constant and for that reason the speed of light cannot increase or decrease. Instead the intensity of the electromagnetic radiation will increase when the beam of light approaches (propagates in the opposite direction as the direction of the gravitational field) the Black Hole. And the intensity of the electromagnetic radiation will decrease when the beam of light leaves (propagates in the same direction as the direction of the gravitational field) the Black Hole.

The Gravitational-Electromagnetic Confinement for the elementary structure beyond the "superstring"/"Black Hole" is presented in equation (34).

3-Dimensional Space Domain

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad \begin{array}{l} -\frac{1}{c^2}\frac{\partial(\bar{E} \times \bar{H})}{\partial t} + \varepsilon_0 \bar{E}(\nabla . \bar{E}) - \varepsilon_0 \bar{E} \times (\nabla \times \bar{E}) + \\ + \mu_0 \bar{H}(\nabla . \bar{H}) - \mu_0 \bar{H} \times (\nabla \times \bar{H}) + \frac{1}{2}\left(\varepsilon^2 \mu (\bar{E} \bullet \bar{E}) + \varepsilon \, \mu^2 (\bar{H} \bullet \bar{H})\right)\bar{g} = \bar{0} \end{array} \qquad (29)$$

In which represents the gravitational acceleration acting on the electromagnetic mass density of the confined electromagnetic radiation.

A possible solution for equation (34) describing an Electromagnetic-Gravitational confinement within a radial gravitational field with accelerationhas been represented in (35).

$$\begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ f(r)\,\mathrm{Sin}(\omega\, t) \\ -f(r)\,\mathrm{Cos}(\omega\, t) \end{pmatrix} \quad \begin{pmatrix} m_r \\ m_\theta \\ m_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ f(r)\,\mathrm{Cos}(\omega\, t) \\ f(r)\,\mathrm{Sin}(\omega\, t) \end{pmatrix} \quad \bar{g} = \begin{pmatrix} \frac{G_1}{4\,\pi\, r^2} \\ 0 \\ 0 \end{pmatrix} \qquad (30)$$

$$w_{em} = \left(\frac{\mu_0}{2}\left(\bar{m} . \bar{m}\right) + \frac{\varepsilon_0}{2}\left(\bar{e} . \bar{e}\right)\right) = \varepsilon_0 \, f(r)^2$$

In which the radial function f(r) equals:

$$f[r] = K \, e^{-\frac{-\frac{G1\, \varepsilon_0\, \mu_0}{r} + 8\,\pi \log[r]}{8\,\pi}} \qquad (31)$$

The solution has been calculated according Newton's Shell Theorem.

Confinement of Light (Electromagnetic Radiation) in the region smaller than "Super Strings" with an electromagnetic mass of emm = 1.6726 x 10^{-27} (kg) and the radius = 3 x 10^{-58} (m)

For an electromagnetic mass of the confinement: emm = 1.6726 x10-27 (kg) (mass of proton), the radius of the confinement equals approximately 3 x 10-58 (m). This is far beyond the order of Planck's Length.

The Plot graph of the Electric Field Intensity f(r) of the confinement has been presented as a function of the radius in figure (2) and figure (3):

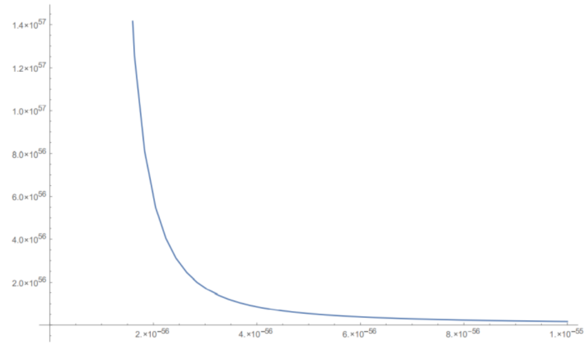

Figure 2: Plot Graph of the Electric Field Intensity f(r) [V/m] for the region 10^{-59}<r<10^{-55} (m) in which the gravitational field acceleration has been chosen accordingly an electromagnetic mass of 1.6 726 x 10^{-27} (kg) located at the center of the confinement, according Newton's Shell Theorem.

$$Plot\left[e^{-\frac{-\frac{G1\,\varepsilon_0\,\mu_0}{r}+8\,\pi\,\log[r]}{8\,\pi}},\{r,10^{-59},10^{-57}\}\right]$$

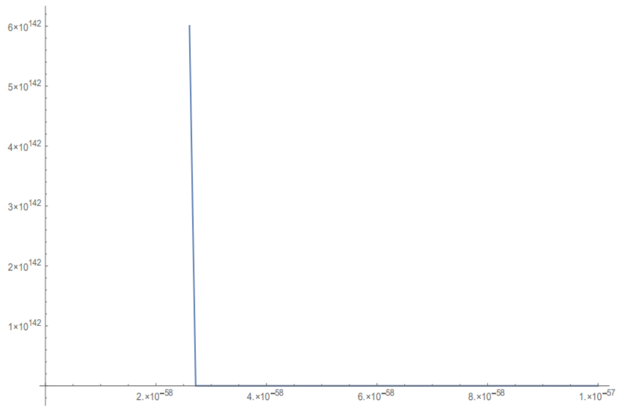

Figure 3: Plot Graph of the Electric Field Intensity f(r) (V/m) for the region 10-59<r<10-57 (m) in which the gravitational field acceleration has been chosen accordingly an electromagnetic mass of 1.6726x10-27 (kg) located at the center of the confinement, according Newton's Shell Theorem.

The fundamental question is: How it is possible to create confinements from "visible light" (with a wave length between 3.9x10^{-7} (m) until 7x10^{-7} (m)) within dimensions smaller than Planck's Length?

This is only possible when the wave length of the confined radiation is smaller than de dimensions of the confinement. This requires extreme high frequencies. The transformation in frequency from visible light into the extreme high frequency of the confinement is possible because of the Lorentz/Doppler transformation during the collapse of the radiation when the confinement has been formed (implosion of visible light).

The Illusion of Quantum Mechanical Probability Waves

The physical concept of quantum mechanical probability waves has been created during the famous 1927 5th Solvay Conference. During that period there were several circumstances which came just together and made it possible to create a unique idea of material waves being complex (partly real and partly imaginary) and describing the probability of the appearance of a physical object (elementary particle).

The idea of complex (probability) waves is directly related to the concept of confined (standing) waves. Characteristic for any standing wave is the fact that the velocity and the pressure (electric field and magnetic field) are always shifted over 90 degrees. The same principle does exist for the standing (confined) electromagnetic waves.

For that reason every confined (standing) Electromagnetic wave can be described by a complex sum vector of the Electric Field Vector and the Magnetic Field Vector (has 90 degrees phase shift compared to).

The vector functions and the complex conjugated vector function will be written as:

$$\bar{\phi} = \frac{1}{\sqrt{2\,\mu}}\left(\bar{B} + i\,\frac{\bar{E}}{c}\right) \tag{32}$$

equals the magnetic induction,the electric field intensity (has +90 degrees phase shift compared to and c the speed of light.

The complex conjugated vector function equals:

$$\overline{\phi^*} = \frac{1}{\sqrt{2\,\mu}}\left(\bar{B} - i\,\frac{\bar{E}}{c}\right) \tag{33}$$

The dot product equals the electromagnetic energy density w:

$$\bar{\phi}\,.\,\overline{\phi^*} = \frac{1}{2\,\mu}\left(\bar{B} + i\frac{\bar{E}}{c}\right).\left(\bar{B} - i\frac{\bar{E}}{c}\right) = \frac{1}{2}\,\mu\,H^2 + \frac{1}{2}\,\varepsilon\,E^2 = w \tag{34}$$

Using Einstein's equation W=mc^2, the dot product equals the electromagnetic mass density w

$$\bar{\phi}\,.\,\overline{\phi^*}\frac{1}{c^2} = \frac{\varepsilon}{2}\left(\bar{B} + i\frac{\bar{E}}{c}\right).\left(\bar{B} - i\frac{\bar{E}}{c}\right) = \frac{1}{2}\varepsilon\,\mu^2H^2 + \frac{1}{2}\varepsilon^2E^2 = \rho\ [kg/m^3] \tag{35}$$

The cross product is proportional to the Poynting vector (3) (equation 15).

$$\bar{\phi} \times \bar{\phi}^* = \frac{1}{2\mu}\left(\bar{B} + i\frac{\bar{E}}{c}\right) \times \left(\bar{B} - i\frac{\bar{E}}{c}\right) = i\sqrt{\varepsilon\mu}\ \bar{E} \times \bar{H} = i\sqrt{\varepsilon\mu}\ \bar{S} \qquad (36)$$

Newton's second law of motion has been described in 3 spatial dimensions, resulting in the fundamental equation for the electromagnetic field.

3-Dimensional Space Domain

B-1 B-2 B-3 B-4 B-5 B-6

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t} + \varepsilon_0\,\bar{E}\,(\nabla\cdot\bar{E}) - \varepsilon_0\,\bar{E}\times(\nabla\times\bar{E}) + \mu_0\,\bar{H}\,(\nabla\cdot\bar{H}) - \mu_0\,\bar{H}\times(\nabla\times\bar{H}) + \frac{1}{2}\left(\varepsilon^2\mu(\bar{E}\bullet\bar{E}) + \varepsilon\mu^2(\bar{H}\bullet\bar{H})\right)\bar{g} = \bar{0} \qquad (37)$$

The formal mathematical way to describe the force density results from the 4-dimensional divergence of the 4- dimensional energy momentum tensor, resulting in a 4- dimensional Force vector. Dividing the 4-dimensional Force vector by the Volume results in the 4-dimensional force density vector.

The 4-dimensional Electromagnetic Vector Potential has been defined by:

$$\bar{\varphi}^4 = \begin{pmatrix} \varphi_4 \\ \varphi_3 \\ \varphi_2 \\ \varphi_1 \end{pmatrix} \xrightarrow{\text{CartesianCoordinateSystem}} \begin{pmatrix} \varphi_t \\ \varphi_z \\ \varphi_y \\ \varphi_x \end{pmatrix} \qquad (38)$$

In which the term represents the 4-dimensional electromagnetic vector potential in the "a" direction while the indice "a" varies from 1 to 4. In a cartesian coordinate system the indices are chosen varying from the x,y,z and t direction. In which the indice "t" represents the time direction which has been considered to be the 4th dimension. The 4- dimensional Electromagnetic "Maxwell Tensor" has been defined by:

$$F_{ab} = \partial_b\,\varphi_a - \partial_a\,\varphi_b \qquad (39)$$

Where the indices "a" and "b" vary from 1 to 4.

The 4-dimensional Electromagnetic "Energy Momentum Tensor" has been defined by:

$$T^{ab} = \frac{1}{\mu_0}\left[F_{ac}\,F^{cb} + \frac{1}{4}\delta_{ab}\,F_{cd}\,F^{cd}\right] \qquad (40)$$

The 4-dimensional divergence of the 4-dimensional Energy Momentum Tensor equals the 4-dimensional Force Density 4-vector:

$$f^a = \partial_b\ T^{ab} \qquad (41)$$

Substituting the electromagnetic values for the electric field intensity "E" and the magnetic field intensity "H" in (71) results in the 4-dimensional representation of Newton's second law of motion:

Energy-Time Domain

B-7

$$(f_4) \quad \nabla\cdot(\bar{E}\times\bar{H}) + \frac{1}{2}\frac{\partial\left(\varepsilon_0(\bar{E}\cdot\bar{E}) + \mu_0(\bar{H}\cdot\bar{H})\right)}{\partial t} = 0 \qquad (42)$$

3-Dimensional Space Domain

B-1 B-2 B-3 B-4 B-5

$$\begin{pmatrix} f_3 \\ f_2 \\ f_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t} + \varepsilon_0\,\bar{E}\,(\nabla\cdot\bar{E}) - \varepsilon_0\,\bar{E}\times(\nabla\times\bar{E}) + \mu_0\,\bar{H}\,(\nabla\cdot\bar{H}) - \mu_0\,\bar{H}\times(\nabla\times\bar{H}) = \bar{0}$$

In which f1, f2, f3, represent the force densities in the 3 spatial dimensions and f4 represent the force density (energy flow) in the time dimension (4th dimension).

The 4th term in equation (72) can be written in the terms of the Poynting vector "S" and the energy density "w" representing the electromagnetic law for the conservation of energy.

Energy-Time Domain

Inner Energy

B-7

$$(f_4) \quad \nabla\cdot\bar{S} + \frac{\partial w}{\partial t} = 0 \qquad (43.1)$$

3-Dimensional Space Domain

B-1 B-2 B-3 B-4 B-5

$$\begin{pmatrix} f_3 \\ f_2 \\ f_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t} + \varepsilon_0\,\bar{E}\,(\nabla\cdot\bar{E}) - \varepsilon_0\,\bar{E}\times(\nabla\times\bar{E}) + \mu_0\,\bar{H}\,(\nabla\cdot\bar{H}) - \mu_0\,\bar{H}\times(\nabla\times\bar{H}) = \bar{0} \qquad (43.2)$$

(43)

The 4-Dimensional Dirac Equation

Substituting (64) and (66) in Equation (73) results in the 4-Dimensional Equilibrium Equation (74):

$$(x_4) \quad -\frac{i}{\sqrt{\varepsilon_0\,\mu_0}}\nabla\cdot(\bar{\phi}\times\bar{\phi}) = -\frac{\partial\bar{\phi}\cdot\bar{\phi}^*}{\partial t} \qquad (44.1)$$

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t} + \varepsilon_0\,\bar{E}\,(\nabla\cdot\bar{E}) - \varepsilon_0\,\bar{E}\times(\nabla\times\bar{E}) + \mu_0\,\bar{H}\,(\nabla\cdot\bar{H}) - \mu_0\,\bar{H}\times(\nabla\times\bar{H}) = \bar{0} \qquad (44.2)$$

(44)

To transform the electromagnetic vector wave function into a scalar (spinor or one-dimensional matrix representation), the Pauli spin matrices and the following matrices (3) (equation 99) are introduced:

$$\bar{\alpha} = \begin{bmatrix} 0 & \sigma \\ \sigma & 0 \end{bmatrix} \quad \text{and} \quad \bar{\beta} = \begin{bmatrix} \delta_{ab} & 0 \\ 0 & -\delta_{ab} \end{bmatrix} \qquad (45)$$

Then equation (44) can be written as the 4-Dimensional Hyperspace Equilibrium Dirac Equation:

$$(x_4) \quad \left(\frac{i\,m\,c}{h}\bar{\beta} + \bar{\alpha}\cdot\nabla\right)\psi = -\frac{1}{c}\frac{\partial\psi}{\partial t} \qquad (46.1)$$

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t} + \varepsilon_0\,\bar{E}\,(\nabla\cdot\bar{E}) - \varepsilon_0\,\bar{E}\times(\nabla\times\bar{E}) + \mu_0\,\bar{H}\,(\nabla\cdot\bar{H}) - \mu_0\,\bar{H}\times(\nabla\times\bar{H}) = \bar{0} \qquad (46.2)$$

(46)

The fourth term (x4) equals the relativistic Dirac equation (46.1) which equals equation (102) page 213 in (3).

Equation (46.1) represents the relativistic quantum mechanical Dirac Equation where ψ represents the quantum mechanical probability wave functions. The mathematical evidence for the equivalent for (46.1) has been published in 1995 in the article: "A Continuous Model of Matter based on AEONs". The Electromagnetic Law for the conservation of Energy (43.1) and the Relativistic Dirac Equation (46.1) are identical but written in a different form.

The law of conservation of Electromagnetic Energy can be written in an electromagnetic form (44.1) or in an identical way in a quantum mechanical form (46.1):

Energy-Time Domain

Inner Energy

B-7

$$(f_4) \qquad \nabla \cdot (\bar{\phi} \times \bar{\phi}) = -\frac{i}{c}\frac{\partial \bar{\phi} \cdot \bar{\phi}^*}{\partial t} \qquad (44.1)$$

$$(x_4) \qquad \left(\frac{i\,m\,c}{h}\,\bar{\beta} + \bar{\alpha} \cdot \nabla\right)\psi = -\frac{1}{c}\frac{\partial \psi}{\partial t} \qquad (46.1) \qquad (47)$$

The weakness in the Quantum Mechanical Relativistic Dirac Equation (47) is that the Dirac Equation is a 1-dimensional equation which will never be able to describe the 4- dimensional real physical world.

From the equations (42) and (46) follows the 4-Dimensional Vector-Dirac equation. This equation is a 4-dimensional vector equation and is coherent with the 4-dimensional physical reality.

$$(x_4) \qquad \nabla \cdot (\bar{\phi} \times \bar{\phi}) = -\frac{i}{c}\frac{\partial \bar{\phi} \cdot \bar{\phi}^*}{\partial t}$$

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad \frac{i}{c}\frac{\partial (\bar{\phi} \times \bar{\phi}^*)}{\partial t} - \left(\bar{\phi} \times (\nabla \times \overline{\phi^*}) + \overline{\phi^*} \times (\nabla \times \bar{\phi})\right) + \left(\bar{\phi}\,(\nabla \cdot \overline{\phi^*}) + \overline{\phi^*}\,(\nabla \cdot \bar{\phi})\right) = 0 \qquad (48)$$

In which the Quantum Mechanical Complex Probability Vector Function and the complex conjugated vector function equals:

$$\bar{\phi} = \bar{B} + \frac{i}{c}\bar{E} = \mu\bar{H} + \frac{i}{c}\bar{E}$$

$$\overline{\phi^*} = \bar{B} - \frac{i}{c}\bar{E} = \mu\bar{H} - \frac{i}{c}\bar{E} \qquad (49)$$

The 4-Dimensional Dirac equation represents the Newtonian Perfect Equilibrium in the 4-Dimensional Space-Time Continuum en has been represented by 4 separate equations. The first one represents the well-known relativistic quantum mechanical Dirac Equation in the Time-Energy domain x4. The 3 quantum mechanical equations in the space-momentum domain represents the Newtonian Perfect Equilibrium for the force densities in the domains (x1 ,x2 ,x3).

$$(x_4) \qquad \nabla \cdot (\bar{\phi} \times \bar{\phi}) = -\frac{i}{c}\frac{\partial \bar{\phi} \cdot \bar{\phi}^*}{\partial t}$$

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad \frac{i}{c}\frac{\partial (\bar{\phi} \times \bar{\phi}^*)}{\partial t} - \left(\bar{\phi} \times (\nabla \times \overline{\phi^*}) + \overline{\phi^*} \times (\nabla \times \bar{\phi})\right) + \left(\bar{\phi}\,(\nabla \cdot \overline{\phi^*}) + \overline{\phi^*}\,(\nabla \cdot \bar{\phi})\right) = 0 \qquad (50)$$

Newton Lorentz Coulomb

Newtonian Perfect Equilibrium

$$\frac{1}{c^2}\,\bar{\phi} \cdot \overline{\phi^*} = \rho\ [\mathrm{kg/m^3}]$$

These results lead to the conclusion that a new Copenhagen Interpretation has been needed.

Copenhagen Interpretation	New Theory
The Universe has been built out of elementary particles	The Universe has been built out of Confined Electromagnetic Field Configurations
Elementary Particles are the fundamental building elements in the Universe	Confined Electromagnetic Field Configurations are the fundamental building elements in the Universe
Fundamental properties of matter like mass, charge and spin are carried by elementary particles	Fundamental properties of matter like mass, charge and spin are carried by Confined Electromagnetic Field Configurations
Probability waves describe the location of particles	Probability Waves do not exist. Confined electromagnetic radiation carries electric charge and magnetic spin.
Probability waves are complex waves	Confined Electromagnetic waves are not complex. The phase shift of 90 degrees between the electric standing wave and the magnetic standing wave can be written in a complex function describing simultaneously the electric field and the magnetic field.
The product of the probability function □ and the complex conjugated function ψ* equals the probability	The dot product.= □ in which □ equals the mass density of the confined electromagnetic radiation

Table 1: New theory of Copenhagen interpretation.

Conclusions

The generally accepted idea of the Physical World existing of elementary particles which location in time and space has been described by a non-real (complex) quantum mechanical probability wave function is the inversion of the "Real Physical World". The "Real Physical World" in which elementary particles are only the illusionary effect to locate mass, electric charge and magnetic spin while the quantum mechanical probability waves are representing the Real Physical World.

Quantum mechanical probability waves are not complex (a mathematical name for the combination of a real part and an imaginary part). The complexity has been introduced by the 90 degrees phase shift between the electric and the magnetic components of the standing (confined) electromagnetic waves. The quantum mechanical Probability Waves are not complex and are no probability waves but are "Real Electromagnetic Waves" carrying mass, electric charge and magnetic spin. The discrete values for mass, electric charge and magnetic spin are controlled by the boundary conditions for the electromagnetic confinements.

Confined Light (Confined Electromagnetic Radiation) is the Inception of the Modern Physics in which the ancient concept of Elementary Particles, like the Concept of the Atom introduced by the Greek Philosopher Democritus in 427 B.C., has been left behind and be replaced by the New Physics. The New Physics in which Confined Light (Confined Electromagnetic Radiation) is the Medium for the Physical Reality and represents the be carrier for mass (inertia) electric charge and magnetic spin.

It is coherent with the fact that the introduction of new modern and highly advanced measuring techniques results only in the measurement (perception) of waves and never in the measurement (perception) of elementary particles.

Data Availability

All the Data and all the Calculations to provide evidence to this 'New Theory about Light' have been published in the 'Open Source Framework (OSF)' [6].

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