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Unified 4-dimensional Equilibrium within Confined Electromagnetic Radiation

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ABSTRACT

The light emitted from a laser is a simple example of a 2-dimensional confinement of electromagnetic radiation. In this article, the force densities within electromagnetic radiation have been discussed as well within 2-dimensional and 3-dimensional confinements. The interaction has been described by a set of 4-electromagnetic equations. In which the equilibrium equation in the Energy-Time dimension (4th dimension) equals the well-known quantum mechanical Dirac Equation. In this way unifying electromagnetic fields with quantum fields. A new equation has been introduced which describes the interaction between electromagnetic radiation and a gravitational field.

Keywords: Dirac equation, Relativity, Gravity, Electromagnetic interaction, Electromagnetic gravitational interaction, General relativity, Optical confinement.

UNIFIED 4-DIMENSIONAL HYPERSPACE EQUILIBRIUM" BEYOND EINSTEIN 4-DIMENSIONAL, KALUZA-KLEIN 5-DIMENSIONAL AND SUPERSTRING 10- AND 11 DIMENSIONAL CURVED HYPERSPACES

Albert Einstein, Lorentz, and Minkowski published in 1905, the theory of special relativity and Einstein published in 1915 his field theory of general relativity based on a curved 4-dimensional space-time continuum to integrate the gravitational field and the electromagnetic field in one unified field. Since then the method of Einstein's unifying field theory has been developed by many others in more than 4 dimensions resulting finally in the well-known 10-dimensional and 11-dimensional "string theory".

String theory is an outgrowth of S-matrix theory, a research program begun by Werner Heisenberg in 1943 (following John Archibald Wheeler's 1937 introduction of the S-matrix), picked up and advocated by many prominent theorists starting in the late 1950s [1].

Theodor Franz Eduard Kaluza (1885-1954), was a German mathematician and physicist well-known for the Kaluza-Klein theory involving field equations in curved five-dimensional space. His idea that fundamental forces can be unified by introducing additional dimensions re-emerged much later in the "String Theory".

The original Kaluza-Klein theory was one of the first attempts to create a unified field theory i.e. the theory, which would unify all the forces under one fundamental law. It was published in 1921 by Theodor Kaluza and extended in 1926 by Oskar Klein. The basic idea of this theory was to postulate one extra compactified space dimension and introduce nothing but pure gravity in a new (1+4)-dimensional space-time. Klein suggested that the fifth dimension would be rolled up into a tiny, compact loop on the order of 10^{-35} (m) [2].

In classical unified field theory, the electromagnetic and gravitational interactions are defined by the field equations e.g.:

$$\partial_a F^{ab} - \xi R_a^b A^a = -4\pi J^b \text{ with } \xi = -2 \quad (1a) \qquad (1)$$

F^{ab} is the antisymmetric electromagnetic field tensor defined by the potential vector A^a, R_a^b is the Ricci curvature tensor of the hypersurface, and J^b is the electric current density vector. The electromagnetic field equation differs from the Einstein-Maxwell equation by a curvature-coupled term $\xi R_a^b A^a$ [3].

Till now the continuing of the method of Einstein's unifying field theory in a 4-dimensional curved space-time continuum in curved multi-dimensional hyperspaces has not resulted in a successful Grand Unified Field Theory which explains the discrete values for electric charge, magnetic spin and the mass of all known elementary particles. The fundamental question is: Is a hyperspace curved multi-dimensional approach like the 11-dimensional Superstring theory the only way to combine fundamentally different fields into one Grand Unifying Theory or is there a different way?

In this new theory, a fundamentally different path has been chosen. In the basic theory of the "Lorentz-Einstein-Minkovski" transformations (1905) two fundamentally different fields, the electric field and the magnetic field have been integrated into one 4-dimensional theory expressed by the electromagnetic potential 4-vector A^a .

Instead of defining the electric field and the magnetic field separately in a curved 6- or 7-dimensional hyperspace, both fields are integrated by the common fundamental effect of the force density f^a. The electric field and the magnetic field are fundamentally different but have "the same origin" A^a and "the same effect" of a force density f^a acting on an arbitrary electromagnetic field configuration (particle or field).

Instead of focusing on the differences in the separate fields and putting the differences in the separate fields in separate dimensions, this theory focusses on that what is in common. The "Origin" and the "Effect".

There is only one Origin for all the different fields (gravitational field, electromagnetic field etc.). There is only one single common effect, the force density f^a acting on a field configuration (elementary particle or field).

This theory focusses on that what is in common. The resulting force densities f^a which has to equal zero at any time at any place in any direction to realize a Universe in Harmony and Equilibrium integrating in this way the very different fields in a Unified 4-dimensional Space-Time continuum.

In this new fundamentally different approach the different interactions (gravity, electromagnetic interaction etc.) has not been interpreted as a curvature of a hyperspace in a 5-, 10- or 11-dimensional space (string theory).

The new theory has been based on the single concept of "Fundamental Harmony within the Universe". A Unified Field Theory which results in the confinements of electromagnetic radiation (light) within dimensions smaller than 10^{-85} (m), carrying discrete values (positive or negative) for electric charge in monopole, dipole or multi-pole configurations, carrying discrete values (positive or negative) for magnetic string in monopole, dipole or multi-pole configurations and carrying (electromagnetic) mass with the property of inertia according Newton's second law of motion.

The Unified Field Theory has been based on the fundamental question for the existence of light (electromagnetic radiation). What are the fundamental boundaries which are required for a stable electromagnetic field configuration in which light can exist?

There is only one boundary condition. "The electromagnetic field has to be in a perfect equilibrium (balance) with itself and its surrounding." And when an electromagnetic field interacts with a gravitational field, weak interaction or strong interaction exactly the same boundary condition is required. That is the single and only requirement.

From this single requirement follows one single equation. Equation (5) (gravity excluded) and Equation (5a) (gravity included) in this manuscript.

John Archibald Wheeler introduced in 1953 the concept of GEONS (Gravitational ElectrO-magnetic eNtities) in which electromagnetic radiation has been confined by its own gravitational field [1]. To calculate the dimensions of these gravitational-electromagnetic confinements Wheeler based his calculations on the Einstein-Maxwell equations, the mathematical ground on which the Theory of General Relativity has been built and found electromagnetic-gravitational confinements with a diameter of several lightyears and a lifetime of several milliseconds. The results were very disappointing because an elementary particle with a diameter of several lightyears and a lifetime of a few milliseconds can hardly be considered as an elementary particle.

In a way, comparable to the way that GEONS (Gravitational ElectrO-magnetic eNtities) are described by J. Wheeler in General Relativity by the Gravitational-Electromagnetic Equilibrium Equation [3-9] (the Einstein-Maxwell Equations), Electromagnetic Confinements are described by the Dynamic Equilibrium Equation (5).

Newton's Third law has been generalized in all layers of Physics. There is no reason not to generalize Newton's third law also within electromagnetic fields. To generalize Newton's third law within Electromagnetic Field Configurations, the Divergence has been taken of the Stress-Energy Tensor [1], which results in Equation (4) to calculate the force densities f within the Electromagnetic Field Configuration [10,11].

The Energy-Momentum Tensor equals [12]:

$$T^{ab} = \frac{1}{\mu_0}\left[F_{ac}F^{cb} + \frac{1}{4}\delta_{ab}F_{cd}F^{cd}\right] \tag{1}$$

In which F_{ab} are the elements of the Maxwell Tensor defined by:

$$F_{ab} = \partial_b\varphi_a - \partial_a\varphi_b \tag{2}$$

The four-vector potential φ_a is defined by: $\varphi_a = \left\{i\varphi / c, \overline{A}\right\}$

where φ is the electric scalar potential, c the speed of light in vacuum and $\overline{A}$ is the magnetic vector potential [1-3].

Substituting Eqn (2) in (1) results in the Stress-Energy Tensor [3,13-15]:

$$f^b = \partial_{ba}T^{ab} \tag{3}$$

In the absence of any Gravity, the 4-Dimensional force density f^b in the 4 directions of the 4 coordinates of the

the chosen 4-coordinate system follows from the (4- Dimensional) Divergence of the (4-Dimensional) Stress-Energy Tensor [5,12].

The Divergence of a Vector equals a Scalar. The Divergence of a Tensor equals a Vector. The 4-dimensional Divergence of the 4-dimensional Stress-Energy Tensor equals the 4-dimensional force-density vector f^b [16].

The first 3 terms of the 4-dimensional force-density vector f^b equal the force densities in the corresponding 3

dimensions of the chosen Coordinate System. The 4th component equals the Electromagnetic Poynting's Theorhem (Continuity Equation) (4a).

To calculate the equilibrium conditions to present the force densities in the Electromagnetic Field Configuration, the first 3 terms of the 4-dimensional Force-density vector are being used.

By re-arranging the first 3 terms of the (4-dimensional Divergence) of the (4-dimensional) Stress-Energy Tensor [3] an equation for the 3-dimensional force density f^b within the Electromagnetic Field Configuration has been created. This Equation (4b) represents the 3-dimensional force density f^b in a coordinate-free vector equation in the absence of any Gravity:

$$\left(x_4\right)\ \nabla.\left(\overline{E}\times\overline{H}\right) + \frac{1}{2}\frac{\partial\left(\varepsilon_0\left(\overline{E}.\overline{E}\right) + \mu_0\left(\overline{H}.\overline{H}\right)\right)}{\partial t} \tag{4a}$$

(4)

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix}\ -\frac{1}{c^2}\frac{\partial\left(\overline{E}\times\overline{H}\right)}{\partial t} + \varepsilon_0\overline{E}\left(\nabla.\overline{E}\right) - \varepsilon_0\overline{E}\times\left(\nabla\times\overline{E}\right) + \mu_0\overline{H}\left(\nabla.\overline{H}\right) - \mu_0\overline{H}\times\left(\nabla\times\overline{H}\right) = \overline{f} \tag{4b}$$

In which w_{cd} represents the creation or destruction of the energy density. Within a conservative field $w_{cd} = 0$.

According to the fundamental requirement of a perfect equilibrium at any place at any time in any direction, the

the algebraic sum of all the different force densities f^b has to equal zero for any physical possible electromagnetic field configuration (particles and fields).

It is fundamental to realize that 3 different kinds of separate interactions of the force densities in (4b) are being involved within this resulting equilibrium. Magnetic- Magnetic interaction (4th and 5th term in 4b), Electric- Electric interaction (2nd and 3rd term in 4b), Electric-Magnetic interaction and reverse (1st term in 4b) which is time-dependent according to the theory of special relativity.

An electromagnetic field which is in a perfect equilibrium with itself and its surrounding at any space and time in any direction fulfills the necessary requirements for the physical possibility of the existence of this field. Under that condition Equation (4) transforms into the “Unified 4- Dimensional Hyperspace Equilibrium Equation” (5)

$$-\frac{1}{c^2}\frac{\partial\left(\overline{E}\times\overline{H}\right)}{\partial t}+\varepsilon_0\overline{E}\left(\nabla.\overline{E}\right)-\varepsilon_0\overline{E}\times\left(\nabla\times\overline{E}\right)+\mu_0\overline{H}\left(\nabla.\overline{H}\right)-\mu_0\overline{H}\times\left(\nabla\times\overline{H}\right)=\overline{0} \tag{5}$$

To extend Field Equation (5) into equilibrium within a multi-dimensional curved Space-Time continuum unifying different fields like gravity and electromagnetism, the transformation has been realized by the transformation of the resulting force-densities within the 4-Dimensional Space-Time continuum. The Unification of the Electromagnetic Fields with the Gravitational fields results in the Relativistic Gravitational Electro Magnetic Equilibrium (RGEE) equation within a gravitational field g in the 3-dimensional (spatial) representation:

$$\begin{aligned}&-\frac{1}{c^2}\frac{\partial\left(\overline{E}\times\overline{H}\right)}{\partial t}+\varepsilon_0\overline{E}\left(\nabla.\overline{E}\right)-\varepsilon_0\overline{E}\times\left(\nabla\times\overline{E}\right)+\mu_0\overline{H}\left(\nabla.\overline{H}\right)-\mu_0\overline{H}\times\left(\nabla\times\overline{H}\right)\\&-\frac{1}{2}\varepsilon_0^2\mu_0\left(\overline{E}.\overline{E}\right)\overline{g}-\frac{1}{2}\varepsilon_0\mu_0^2\left(\overline{H}.\overline{H}\right)\overline{g}=\overline{0}\end{aligned} \tag{5a}$$

It is fundamental to realize that Equation (5) is only a part of the 4-Dimensional Time-Space Continuum Equation. The Divergence of the 4-Dimensional Stress-Energy Tensor $\partial_{ba}\ T^{ab}$ results in the 4-Dimensional Vector Equation $f^b=0^b$. The first 3 terms of the vector Equation have been presented in Equation 5. The 4th term presents the Continuum Equation. By introducing the complex field notations for the electric field and the magnetic field in Equation (39) the 4th term transforms into the well-known relativistic quantum mechanical Dirac Equation and at low velocities into the quantum mechanical Schrödinger Wave Equation [17-20].

The 4 Equations together (3 Equations for the separate space coordinates) and the Dirac/Schrödinger Equation describes the Unification in a perfect Equilibrium of the different Fields.

THE 4TH TERM IN THE UNIFIED 4-DIMENSIONAL HYPERSPACE EQUILIBRIUM EQUATION

The 4-Dimensional Hyperspace Equilibrium Dirac Equation in the absence of gravity equals:

$$\left(x_4\right)\ \nabla.\left(\overline{E}\times\overline{H}\right)=-\frac{1}{2}\frac{\partial\left(\varepsilon_0\left(\overline{E}.\overline{E}\right)+\mu_0\left(\overline{H}.\overline{H}\right)\right)}{\partial t} \tag{5.P}$$

(5)

$$\begin{pmatrix}x_3\\x_2\\x_1\end{pmatrix}\ -\frac{1}{c^2}\frac{\partial\left(\overline{E}\times\overline{H}\right)}{\partial t}+\varepsilon_0\overline{E}\left(\nabla.\overline{E}\right)-\varepsilon_0\overline{E}\times\left(\nabla\times\overline{E}\right)+\mu_0\overline{H}\left(\nabla.\overline{H}\right)-\mu_0\overline{H}\times\left(\nabla\times\overline{H}\right)=\overline{0} \tag{5.F}$$

The Poynting Theorem (5.P) can be rewritten by introducing the vector functions $\overline{\phi}$ and the complex conjugated vector function $\overline{\phi}^*$ in which:

$$\overline{\phi}=\frac{1}{\sqrt{2\mu}}\left(\overline{B}+i\frac{\overline{E}}{c}\right) \tag{5.P.1}$$

$\overline{E}$ equals the magnetic induction, $\overline{E}$ the electric field intensity and c the speed of light. The complex conjugated vector function equals:

$$\overline{\phi^*} = \frac{1}{\sqrt{2\mu}}\left(\overline{B} - i\frac{E}{c}\right) \tag{5.P.2}$$

The dot product equals the electromagnetic energy density w:

$$\overline{\phi}.\overline{\phi^*} = \frac{1}{2\mu}\left(\overline{B} + i\frac{\overline{E}}{c}\right).\left(\overline{B} - i\frac{E}{c}\right) = \frac{1}{2}\mu H^2 + \frac{1}{2}\varepsilon E^2 = w \tag{5.P.3}$$

The cross product is proportional to the Poynting vector

$$\overline{\phi} \times \overline{\phi^*} = \frac{1}{2\mu}\left(\overline{B} + i\frac{\overline{E}}{c}\right).\left(\overline{B} - i\frac{E}{c}\right) = i\sqrt{\varepsilon\mu}\,\overline{E} \times \overline{H} = i\sqrt{\varepsilon\mu}\,\overline{S} \tag{5.P.4}$$

Substituting (5.P.3) and (5.P.4) in Equation (5) results in the 4-Dimensional Hyperspace Equilibrium Equation:

$$(x_4) \quad -\frac{i}{\sqrt{\varepsilon_0\mu_0}}\nabla.\left(\overline{\phi} \times \overline{\phi}\right) = -\frac{\partial \overline{\phi}.\overline{\phi^*}}{\partial t} \tag{5.P.5}$$

(5.5)

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial\left(\overline{E} \times \overline{H}\right)}{\partial t} + \varepsilon_0 \overline{E}\left(\nabla.\overline{E}\right) - \varepsilon_0 \overline{E} \times \left(\nabla \times \overline{E}\right) + \mu_0 \overline{H}\left(\nabla.\overline{H}\right) - \mu_0 \overline{H} \times \left(\nabla \times \overline{H}\right) = \overline{0} \tag{5.F.5}$$

To transform the electromagnetic vector wave function $\overline{\phi}$ into a scalar (spinor or one-dimensional matrix representation), the Pauli spin matrices σ and the following matrices are introduced [15]:

$$\overline{\alpha} = \begin{bmatrix} 0 & \sigma \\ \sigma & 0 \end{bmatrix} \text{ and } \overline{\beta} = \begin{bmatrix} \delta_{ab} & 0 \\ 0 & -\delta_{ab} \end{bmatrix} \tag{5.P.6}$$

Then equation (5) can be written as the 4-Dimensional Hyperspace Equilibrium Dirac Equation:

$$(x_4) \quad \left(\frac{imc}{h}\overline{\beta} + \overline{\alpha}.\nabla\right)\psi = -\frac{1}{c}\frac{\partial\psi}{\partial t} \tag{5.P.7}$$

(5.7)

$$\begin{pmatrix} x_3 \\ x_2 \\ x_1 \end{pmatrix} \quad -\frac{1}{c^2}\frac{\partial\left(\overline{E} \times \overline{H}\right)}{\partial t} + \varepsilon_0 \overline{E}\left(\nabla.\overline{E}\right) - \varepsilon_0 \overline{E} \times \left(\nabla \times \overline{E}\right) + \mu_0 \overline{H}\left(\nabla.\overline{H}\right) - \mu_0 \overline{H} \times \left(\nabla \times \overline{H}\right) = \overline{0} \tag{5.F.7}$$

The fourth term (x_4) equals the relativistic Dirac equation (5.P.7).

THE REAL LIGHT INTENSITY OF THE SUN, MEASURED IN OUR SOLAR SYSTEM, INCLUDING ELECTROMAGNETIC GRAVITATIONAL CONVERSION (EMGC)

When a beam of light leaves the surface of the sun, the light will travel in the radial direction of the radial gravitational field caused by the sun. The required Electromagnetic Field Configuration for a perfect Equilibrium in Space and Time for a Radial Gravitational Field (The Light propagates in the same radial direction as the radial direction of the Gravitational Field) follows from the Dynamic Equilibrium Equation (5) and equals in Spherical Coordinates $\{r,\theta,\varphi,t\}$ for a gravitational field "g (r)" for the Electric Field Components $e(r,\theta,\varphi,t)$:

$$\begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \begin{pmatrix} \frac{1}{r} e^{\frac{Gm_1\varepsilon_0\mu_0}{2r}} & K1g\left(t - r\sqrt{\varepsilon_0\mu_0}\right) \\ & 0 \\ & 0 \end{pmatrix} \tag{6b}$$

The required Electromagnetic Field Configuration for a perfect Equilibrium in Space and Time for a Radial Gravitational Field (The Light propagates in the same radial direction as the radial direction of the Gravitational Field) follows from the Dynamic Equilibrium Equation (5) and equals in Spherical Coordinates $\{r,\theta,\varphi,t\}$ for a gravitational field "g(r)" for the Magnetic Field Components (r,θ,φ,t):

$$\begin{pmatrix} m_x \\ m_y \\ m_z \end{pmatrix} = \sqrt{\frac{\varepsilon_0}{\mu_0}} \begin{pmatrix} & 0 \\ \frac{1}{r} e^{\frac{Gm_1\varepsilon_0\mu_0}{2r}} & K1g\left(t - r\sqrt{\varepsilon_0\mu_0}\right) \\ & 0 \end{pmatrix} \tag{7b}$$

Equation (6b) and (7b) are solutions of (5a) under the influence of a Radial Gravitational field with the field a gravitational field intensity "g(r)" that acts along the radial-direction while the electromagnetic wave is also propagating in the radial direction.

When a light beam leaves the surface of the sun, the intensity will decrease according (6b). At earth, the measured intensity will be according (5a) and (6b):

$$I = \frac{I_0 e^{\frac{Gm_1\varepsilon_0\mu_0}{r}}}{4\pi r^2} \tag{6c}$$

A beam of light represents an amount of electromagnetic energy. Which equals an amount of electromagnetic mass? This amount of electromagnetic mass is moving with the speed of light in the opposite direction of a (radial) gravitational field and gains potential energy. Because the law of conservation of energy, a part of the electromagnetic energy of the light beam has to be converted into potential energy according to equation (6c) (Figure 1).

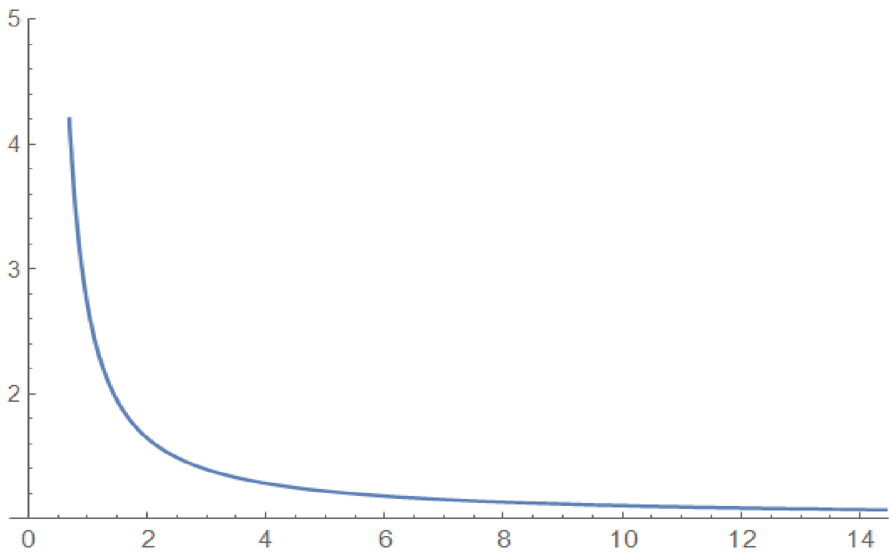

Figure 1: Electromagnetic Gravitational Conversion term $e^{\frac{Gm_1\varepsilon_0\mu_0}{r}}$.

For a radius of the sun equals 695,508 (km) and a distance from the sun to the earth of 149,600,000 (km), the Electromagnetic Gravitational Conversion (EMGC) term equals:

$$C_{EMGC} = \frac{e^{\frac{Gm_1\varepsilon_0\mu_0}{r_1}}}{e^{\frac{Gm_1\varepsilon_0\mu_0}{r_2}}} = \frac{e^{\frac{1}{r_1}}}{e^{\frac{1}{r_2}}} = 4.1877534 \tag{6d}$$

This means that the real intensity of the light at the surface of the sun is about 4 times higher than the intensity which would have been calculated in a classical way from the sunlight intensity measured on earth, due to Electromagnetic Gravitational Conversion.

Equations (6b) and (7b) are solutions of (5a) under the influence of a Radial Gravitational field with field intensity "g (r)" that acts along the radial direction while the electromagnetic wave is also propagating in the same radial direction. The electromagnetic wave is propagating with the unaltered speed of light $c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}$, independently of the strength g(r) of the gravitational field in the radial direction. However, the amplitude of the electromagnetic wave becomes dependently of the gravitational intensity "g (r)" and the distance "r" and changes along the radial direction due to the Electromagnetic-Gravitational Conversion term

$$C_{EMGC} = e^{\frac{Gm_1\varepsilon_0\mu_0}{r}}$$

Because of the law of conservation of Energy, the electromagnetic energy of the light emitted by the sun is decreasing over a distance "r" proportional with the same amount $EMGC = e^{\frac{Gm_1\varepsilon_0\mu_0}{r}}$ as the potential energy of the electromagnetic mass of the light emitted by the sun is increasing.

THE ORIGIN OF DARK MATTER

The Cosmic Microwave Background Radiation (CMBR) is the dominant radiation field in the Universe, and one of the most powerful cosmological tools that have yet been found, 25 years after its discovery by Penzias and Wilson (1965).

Within a few years of the discovery of the CMBR, it was established the radiation field is close to isotropic, with a spectrum characterized by a single temperature, $T_{rad} \approx 2.7$ K [21-23]. The specific intensity of the radiation is therefore close to:

$$I_f = \frac{2hf^3}{c^2}\left(e^{hf/k_B T_{rad}} - 1\right)^{-1} \tag{6e}$$

which corresponds to a peak brightness $I_{max} \sim 3.7 \times 10^{-18}$ Wm^{-2} Hz^{-1} sr^{-1} at f_{max}~160 GHz and an energy density $i_f \sim 4 \times 10^{-14}$ J m^{-3}, which can also be expressed as a mass density $\varrho_{em} \sim 5 \times 10^{-31}$ kg m^{-3}.

When from the earth an Electromagnetic Mass Density has been measured which equals $\rho_{em} = 5 \times 10^{-36}$ kg/m^3, the Total Mass of the Universe can be roughly calculated without and with regarding the effect of Electromagnetic Gravitational Conversion.

At the Origin of the Universe, at the start of the Big Bang, a large amount of electromagnetic radiation has been blown into the universe, which has been measured on earth as the well-known CMBR. The radiation, traveling for billions of years against the gravitational field of the origin of the universe and has gained during that time an enormous amount of potential energy. Because of the conversation of energy and the transfer of electromagnetic energy into potential energy, the intensity of the CMBR, measured on earth, has been much lower than the real intensity has been at the origin.

As an example, a visible universe like a sphere has been chosen with a radius of 4.4×10^{26} (m) and the earth located in the middle between the origin of the Big Bang and the outer boundaries of the visible Universe. As an example, two basic calculations have been done. The first one, calculating the total electromagnetic mass in the universe without taking into account the Electromagnetic-Gravitational Interaction.

$$M_{UNIVERSE} = \int_{R_1}^{R_2} \rho_{EM} 4\pi r^2 dr = \int_{0.0113}^{4.4\times10^{26}} \frac{5\times10^{-36}}{\left(\frac{r}{2.2\times10^{26}}\right)^2} 4\pi r^2 dr = 1.338\times10^{45}\,(\mathrm{kg}) \tag{6f}$$

The second calculation has been done by taking into account the Electromagnetic-Gravitational Interaction, including the Electromagnetic-Gravitational Conversion $C_{EMGC} = e^{\frac{Gm_1\varepsilon_0\mu_0}{r}}$.

$$M_{UNIVERSE} = \int_{R_1}^{R_2} \rho_{EM} e^{\frac{1}{r}} 4\pi r^2 dr = \int_{0.0113}^{4.4\times10^{24}} \frac{5\times10^{-36}}{\left(\frac{r}{2.2\times10^{26}}\right)^2} \frac{e^{\frac{1}{r}}}{e^{\frac{1}{2.2\times10^{24}}}} 4\pi r^2 dr = 1.077\times10^{53}\,(\mathrm{kg}) \tag{6g}$$

Including the effect of Electromagnetic-Gravitational Conversion changes an almost negligible effect of the CMBR on the total mass of the Universe into an effect that can easily explain the total mass of the Universe while neglecting the influences of the mass of the galaxies and makes the Theory of Dark Matter avoidable.

A GRAVITATIONAL-ELECTROMAGNETIC MODEL BEYOND THE SUPERSTRING THEORY

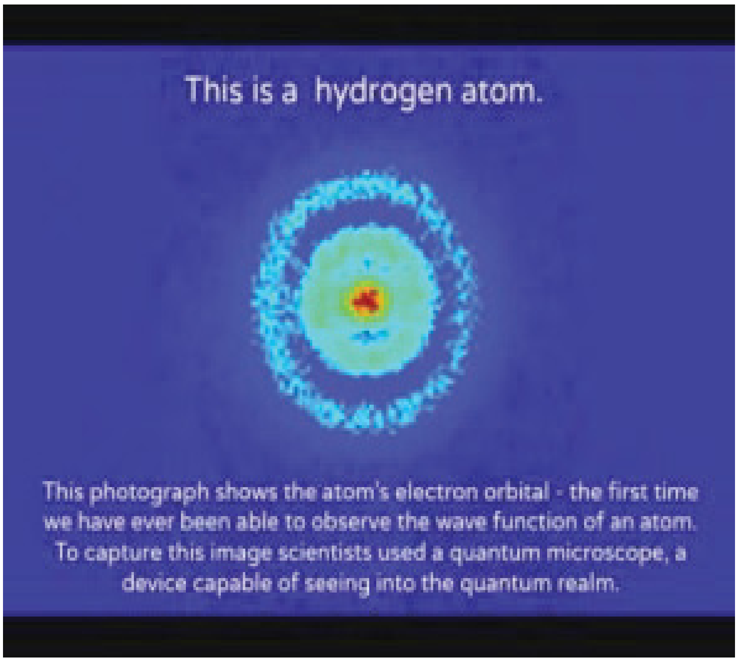

Figure 2: First image of the hydrogen atom's orbital structure.

"De Broglie Waves" are real and do exist. Schrödinger" and as well Dirac both have written the simple well-known (electromagnetic) Continuity Equation in a complex form (Figure 2). What they have really found are confined monochromatic electromagnetic waves [15,24-26]. The Schrödinger Solution of a Spherical Probability wave around the nucleus has been interpreted wrong [27-29]. It is not a complex probability wave. It is a real electromagnetic wave in which the real part is the solution for the electric part and the imaginary part is the magnetic part, just written with an "i" index before the term [30-32]. The quantum mechanical wave function ψ is, in reality, a vector function $\vec{\phi}$ which equals:

$$\overline{\phi} = \frac{1}{\sqrt{2\mu}}\left(\overline{B} + i\frac{\overline{E}}{c}\right) \tag{8}$$

and the complex conjugated vector function equals:

$$\overline{\phi *} = \frac{1}{\sqrt{2\mu}}\left(\overline{B} - i\frac{\overline{E}}{c}\right) \tag{9}$$

And the dot product equals the electromagnetic energy density *w*:

$$\overline{\phi}.\overline{\phi *} = \frac{1}{2\mu}\left(\overline{B} + i\frac{\overline{E}}{c}\right).\left(\overline{B} - i\frac{\overline{E}}{c}\right) = \frac{1}{2}\mu H^2 + \frac{1}{2}\varepsilon E^2 = w \tag{10}$$

The cross product is proportional to the Poynting vector [29] equation 15.

$$\overline{\phi} \times \overline{\phi *} = \frac{1}{2\mu}\left(\overline{B} + i\frac{\overline{E}}{c}\right) \times \left(\overline{B} - i\frac{\overline{E}}{c}\right) = i\sqrt{\varepsilon\mu}\,\overline{E} \times \overline{H} = i\sqrt{\varepsilon\mu}\,\overline{S} \tag{11}$$

The Gravitational-Electromagnetic Confinement for the elementary structure beyond the "superstring" is presented in equation (5a).

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

$$-\frac{1}{2}\varepsilon_0^2\mu_0\left(\overline{E}.\overline{E}\right)\overline{g} - \frac{1}{2}\varepsilon_0\mu_0^2\left(\overline{H}.\overline{H}\right)\overline{g} = \overline{0} \tag{5a}$$

In which $\overline{g}$ represents the (radial oriented) gravitational acceleration caused by the electromagnetic mass density of the confined electromagnetic radiation [33,34].

The solution for equation (5a) equals:

$$\begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ f(r)Sin(\omega t) \\ -f(r)Cos(\omega t) \end{pmatrix} \begin{pmatrix} m_r \\ m_\theta \\ m_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ f(r)Cos(\omega t) \\ f(r)Sin(\omega t) \end{pmatrix}$$

$$w_{em} = \left(\frac{\mu_0}{2}\left(\overline{m}.\overline{m}\right) + \frac{\varepsilon_0}{2}\left(\overline{e}.\overline{e}\right)\right) = \varepsilon_0 f(r)^2 \tag{12}$$

In which f(r) equals:

$$f[r] = Ke^{\frac{\frac{-G1\varepsilon_0\mu_0}{r} + 8\pi\log[r]}{8r}} \tag{13}$$

SUB MAX PLANCK LENGTH GRAVITATIONAL- ELECTROMAGNETIC CONFINEMENT

The "sub-Max Planck's length" Type II confinement has been described for the electric field intensity:

$$\begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ \dfrac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} h[\theta,\varphi]\sin[\omega t]^2\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^2}{r} \\ -\dfrac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} h[\theta,\varphi]\sqrt{K1-\sin[\omega t]^4\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^4}}{r} \end{pmatrix} \tag{14}$$

The “sub-Max Planck’s length” confinement has been described for the magnetic field intensity:

$$\begin{pmatrix} m_r \\ m_\theta \\ m_\varphi \end{pmatrix} = \begin{pmatrix} 0 \\ \dfrac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} h[\theta,\varphi]\sqrt{K1-\sin[\omega t]^4\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^4}}{r} \\ \dfrac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} h[\theta,\varphi]\sin[\omega t]^2\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^2}{r} \end{pmatrix} \tag{15}$$

The divergence of the electric field intensity (electric charge density) equals:

$$\nabla.\begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \frac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}}\sqrt{K1-\sin[t\omega]^4\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^4}\,h^{(0,1)}[\theta,\varphi]}{r} \tag{16}$$

$$+\frac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}}\sin[t\omega]^2\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^2 h^{(1,0)}[\theta,\varphi]}{r}$$

In which K1 is a positive constant equal to or larger than 1.

The divergence of the magnetic field intensity (magnetic monopole) equals:

$$\nabla.\begin{pmatrix} m_r \\ m_\theta \\ m_\varphi \end{pmatrix} = \frac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}}\sqrt{\varepsilon_0}\sin[t\omega]^4\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^2 h^{(0,1)}[\theta,\varphi]}{r\sqrt{\mu_0}} \tag{17}$$

$$+\frac{e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}}\sqrt{\varepsilon_0}\sqrt{K1-\sin[t\omega]^4\sin\left[r\sqrt{\varepsilon_0\mu_0}\,\omega\right]^4}\,h^{(0,1)}[\theta,\varphi]}{r\sqrt{\mu_0}}$$

The function has been chosen:

$$h[\theta,\varphi]=\sin[n\theta]\cos[m\varphi] \tag{18}$$

In which the integers $n=0,\frac{1}{2},1\frac{1}{2},2,2\frac{1}{2},3,3\frac{1}{2},......$ And $m=0,\frac{1}{2},1\frac{1}{2},2,2\frac{1}{2},3,3\frac{1}{2},......$

$$\rho = \varepsilon_0 \nabla . \begin{pmatrix} e_r \\ e_\theta \\ e_\varphi \end{pmatrix} = \frac{n\varepsilon_0 e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} \cos(n\theta)\cos(m\theta)\sin(t\omega)^2 \sin\left(r\sqrt{\varepsilon_0\mu_0}\omega\right)^2}{r} \tag{19}$$

According to Gauss's law, the electric charge density ρ equals for m=0 and n=1 for an electric monopole.

Equation (19) represents a dipole function for the electric charge density (Figures 3 and 4).

For the corresponding magnetic dipole flux density ϕ (spin) equals for n=0 and m=+ ½ (spin up) and m=- ½ (spin down):

$$\phi = \mu_0 \nabla . \begin{pmatrix} m_r \\ m_\theta \\ m_\varphi \end{pmatrix} = \frac{m\sqrt{\varepsilon_0\mu_0} e^{\frac{G1\varepsilon_0\mu_0}{8\pi r}} \cos(n\theta)\cos(m\theta)\sin\left(r\sqrt{\varepsilon_0\mu_0}\omega\right)^2}{r} \tag{20}$$

Equation (20) represents a dipole function for the magnetic flux density (spin).

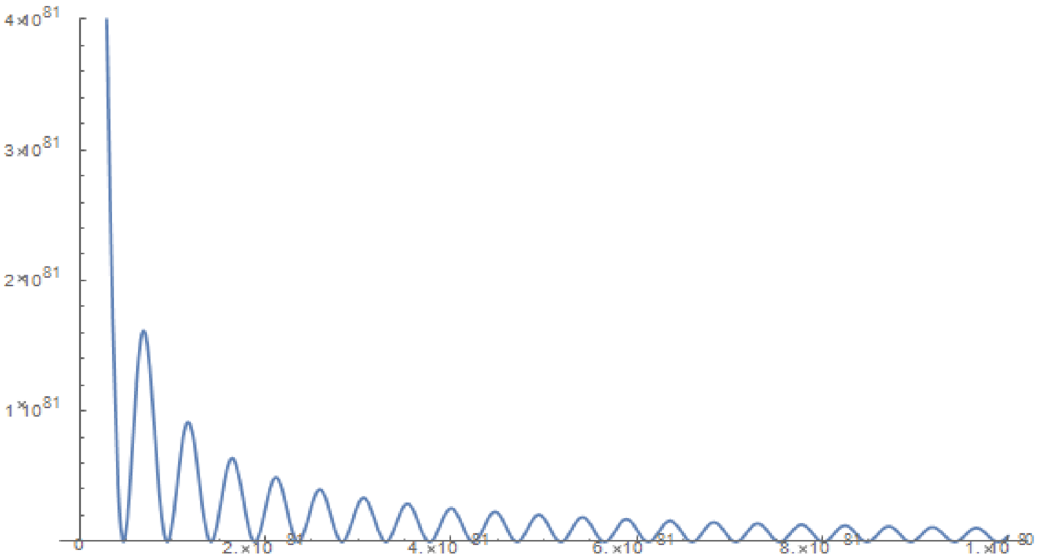

Figure 3: PlotGraph of the Electric Field Intensity f(r) for the region $10^{-85}< r< 10^{-80}$ with a frequency of $\omega=10^{90}$ [s^{-1}] in which the gravitational field acceleration has been chosen accordingly an electromagnetic mass of 1.6726×10^{-27} (kg) located at the center of the confinement, according to Newton's Shell Theorem.

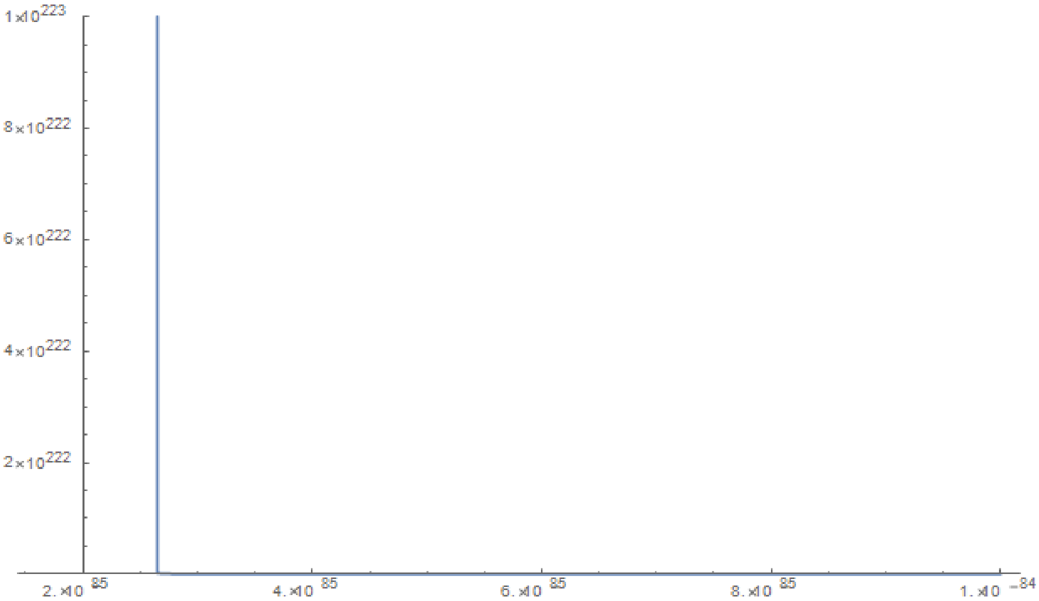

Figure 4: Plot Graph of the Electric Field Intensity f(r) for the region $10^{-85}<r<10^{-84}$ with a frequency of $\omega=10^{90}$ in which the gravitational field acceleration has been chosen accordingly an electromagnetic mass of 1.6726×10^{-27} (kg) located at the center of the confinement, according to Newton's Shell Theorem.

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REFERENCES

[1] Wheeler, J., 1955. Geons. *Phys Rev*, 97, pp. 511.

[2] Hořava, P., 2009. Spectral dimension of the universe in quantum gravity at a lifshitz point. *Phys Rev Lett*, 102, pp. 161301.

[3] Li, L.X., 2016. A new unified theory of electromagnetic and gravitational interactions. *Front Phys*, 11(6), pp. 110402.

[4] Silva, H.O., et al., 2018. Spontaneous scalarization of black holes and compact stars from a gauss-bonnet coupling. *Phys Rev Lett*, 120, pp. 131104.

[5] Abedi, J, et al., 2017. Echoes from the abyss: Tentative evidence for Planck-scale structure at black hole horizons, *Phys Rev D*, 96, pp. 082004.

[6] Hayashi, K, et al., 1981. Addendum to "New general relativity". *Phys Rev D*, 24. pp. 3312.

[7] Davis, T.M. et al., 1981. Ghost neutrinos in general relativity. *Phys Rev D*, 9, pp. 331.

[8] Whitman, P. G., et al, 1981-82. Charged spheres in general relativity. *Phys Rev D*, 24. pp. 2049.

[9] Jacobson, J., et al., 1995. Photonic de Broglie Waves, *Phys Rev Lett*, 74. pp. 4835.

[10] Costa, L.F.O., et al., 2018. Spinning particles in general relativity: Momentum-velocity relation for the Mathisson-Pirani spin condition. *Phys Rev*, 97, pp. 084023.

[11] Kase, R, et al, 2018. Relativistic stars in vector-tensor theories. *Phys Rev D*, 97, pp. 084009.

[12] Hees, A., et al., 2017. Testing general relativity with stellar orbits around the supermassive black hole in our Galactic center, *Phys Rev Lett*, 118, pp. 211101.

[13] Gwak , et al., 2015. Instability of rotating anti-de Sitter black holes. *Phys Rev D*, 91, pp. 064020.

[14] Bousso, R., et al., 1999. Erratum: Lorentzian condition in quantum gravity. *Phys Rev D*, 59, pp. 109903.

[15] Vegt, J. W., 1995. A continuous model of matter based on AEONs. *Phys Essays*, 8(2), pp. 201-224.

[16] Englund, D, et al., 2012. Ultrafast photon-photon interaction in a strongly coupled quantum dot-cavity system. *Phys Rev Lett*. 108(9), pp. 093604.

[17] Vegt, J. W., 1996. A particle free model of matter based on electromagnetic self-cofinement. *Ann Fond Louis Broglie*, 21(4), pp. 481-506.

[18] Maldacena, J. M., Black holes in string theory, Princeton University.

[19] de Andrade V. C. et al., Gravitational Lorentz force and the description of the gravitational interaction, *Phys Rev D*, 56(8), pp. 4689-4695.

[20] Mohr, P.J., et al., 2006. CODATA recommended values of the fundamental physical constants. *Rev Mod Phys*, 80(2), pp. 633-730.

[21] Cahn, S. B., et al., 1997. Time-domain de broglie wave interferometry. *Phys Rev Lett*, 79, pp. 784.

[22] Synge, J. L., 1953. Primitive quantization in the relativistic two-body problem. *Phys Rev*, 89, pp. 467.

[23] Jehle, H. , 1972. Flux quantization and particle physics. *Phys Rev D*, 6, pp. 441-457.

[24] Steane, A. et al., 1995. Phase modulation of atomic de broglie waves. *Phys Rev Lett*, 74(25), pp. 4972-4975.

[25] Kobe, D. H., 2007. Quantum power in de Broglie-Bohm theory. *J Phys A-Math Theor*, 40(19).

[26] Rodewald, J., et al., 2017. New avenues for matter-wave-enhanced spectroscopy. *Appl Phys B*, 123(3), pp. 21-34.

[27] Kwon, O., et al., 2010. Observing photonic de Broglie waves without the maximally-path-entangled |N,0□+|0,N□ state. *Phys Rev A*, 81, pp. 063801.

[28] Krachmalnicoff, V., et al., 2010. Spontaneous four-wave mixing of de broglie waves: Beyond optics. *Phys Rev Lett*, 104, pp. 150402.

[29] Turlapov, A., et al., 2005. Talbot-Lau effect for atomic de Broglie waves manipulated with light. *Phys Rev A*, 71, pp. 043612.

[30] Petersen, J., et al., 2018. Mutual interactions of phonons, rotons, and gravity. *Phys Rev B*, 97, pp. 134516.

[31] Petersen, J., et al., 2018. Quantum threshold reflection is not a consequence of a region of the long-range attractive potential with rapidly varying de Broglie wavelength. *Phys Rev A*, 97, pp. 042102.

[32]. Jing, H., et al., 2011. Quantum superchemistry of de Broglie waves: New wonderland at ultracold temperature. *Front Phys*, 6(1), pp. 15-45.

[33] Easther, R., et al., 2005. String windings in the early universe. *J Cosmol Astropart Phys*.

[34] Vegt, J. W., 2002. The maxwell-schrödinger-dirac correspondence in auto confined electromagnetic fields. *Ann Fond Louis Broglie*, 27(1).