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The Spatial Substrate

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ABSTRACT: This article aims to show that it has been experimentally proven that there is a non-stationary spatial substrate where the electromagnetic and mechanical waves travel in. It will be mathematically demonstrated that the vacuum is not an empty space and, on the contrary, it is a space of high density energy that was called Luminiferous Æther[2]. The possibility of matter being created within pure vacuum (here called koilon[3]) by the agglomeration of tiny voids will be investigated, so matter is the absence of this dense substrate.

KEYWORDS: luminiferous æther, pure vacuum, ætheric wind, speed of light, electromagnetic waves, mechanical waves, waves in solids, solid medium, spatial substrate.

Contents

1 Symbology

In this text we will use the following symbols with its abbreviated units of measure:

N = Newton, kg = kilogram, m = meter, s = second, V = Volt, C = Coulomb, A = Ampère, Wb = Weber, rad = radian.

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2 The word Æther is used here to distinguish it from the commonly used chemical fluid ether and from the etheric elements of the fourth dimension, and Luminiferous because this specific type of æther is the medium for the propagation of light.
3 Greek word meaning “hollow”.

E = Electric field intensity [$N\ C^{-1}$] [$V\ m^{-1}$];
ε_0 = Electric permittivity of vacuum [$C^2\ N^{-1}\ m^{-2}$] [$C\ V^{-1}\ m^{-1}$];
$\varepsilon = \varepsilon_r\varepsilon_0$ = Electric permittivity of the dielectric material [$C^2\ N^{-1}\ m^{-2}$] [$C\ V^{-1}\ m^{-1}$];
H = Magnetic field intensity [$N\ Wb^{-1}$] [$A\ m^{-1}$];
B = Surface density of magnetic charge [$Wb\ m^{-2}$];
μ_0 = Magnetic permeability of vacuum [$Wb^2\ N^{-1}\ m^{-2}$] [$Wb\ A^{-1}\ m^{-1}$];
$\mu = \mu_r\mu_0$ = Magnetic permeability of the material [$Wb^2\ N^{-1}\ m^{-2}$] [$Wb\ A^{-1}\ m^{-1}$];
G = Gravitational field intensity [$N\ kg^{-1}$] [$m\ s^{-2}$];
V_G = Gravitational potential [$N\ m\ kg^{-1}$] [$m^2\ s^{-2}$];
q_G = Gravitational charge [kg];
ρ_G = Volumetric density of gravitational charge [$kg\ m^{-3}$];
α_G = Linear density of gravitational charge [$kg\ m^{-1}$];
γ_0 = Gravitational permeability of vacuum [$kg^2\ N^{-1}\ m^{-2}$] [$kg\ s^2\ m^{-3}$];
k_G = Gravitostatic constant = $6.6739*10^{-11}$ [$N\ m^2\ kg^{-2}$] [$m^3\ kg^{-1}\ s^{-2}$];
I = Inertial field intensity [$N\ s\ m^{-2}$] [$kg\ m^{-1}\ s^{-1}$];
O = Surface density of inertial charge [s^{-1}];
q_I = Inertial charge [$m^2\ s^{-1}$];
I_I = Inertial current [$m^2\ s^{-2}$];
υ_0 = Inertial permeability of vacuum [$(m^2\ s^{-1})^2\ N^{-1}\ m^{-2}$] [$m^2\ N^{-1}\ s^{-2}$] [$m\ kg^{-1}$];
F = Force [N] [$kg\ m\ s^{-2}$];
v = Velocity [$m\ s^{-1}$];
c = Speed of light in vacuum = $2.9979*10^8\ m\ s^{-1}$;
f = Frequency [Hz];
$\omega = 2\pi f$ = Angular frequency [$rad\ s^{-1}$];
r = Radial length (radius) [m];
l = Length [m];
S = Area [m^2].

2 Introduction

The vacuum of space is composed of a vast spectrum of radiations: Cosmic Background Radiation (CBR) whose Cosmic Microwave Background (CMB) spectrum was mapped by COBE space satellite from NASA, sparse light particles like hydrogen and helium, cosmic rays with high energy particles, Cosmic Background Radiation (CBR) that are beyond our technical capacities and so on. Below these, like a substrate, there are what was called Luminiferous Æther, the carrier of light, the medium where radiations or electromagnetic waves travel in. The concept behind the Luminiferous Æther was that waves need a medium or a substratum to propagate.

In the chapter IV of the Einstein's Theory of Relativity book by Max Born [1] we read: "The fact that certain physical events propagate themselves through astronomic space led long ago to the hypothesis that space is not empty but filled with an extremely fine imponderable substance, the æther, which is the carrier or medium of these phenomena. So far as this conception of the æther is still used nowadays it is taken to mean nothing more than empty space associated with certain physical states or 'fields'".

This was an abstract conception that failed to explain the majority of the problems related with æther. The text continues and gives a rough outline about two theories on the propagation of light through space:

1. "The corpuscular theory asserts that luminescent bodies send out fine particles that move in accordance with the laws of mechanics and that produce the sensation of light when they strike the eye."
2. "The undulatory theory assumes the existence of a medium that permeates all transparent bodies and that can execute vibrations; this is the luminiferous æther. In this process of

vibration the individual particles of this substance move only with a pendular-like motion about their positions of equilibrium. That which moves on as the light-wave is the state of motion of the particles and not the particles themselves."

In the chapter 1.1 of An Introduction to Relativity, by Jayant Narlikar [2], we read: "Although Newton had (wrongly) resisted the notion that light travels as a wave, during the nineteenth century the concept of light traveling as a wave had become experimentally established through such phenomena as interference, diffraction and polarization. However, this understanding raised the next question: in what medium do these waves travel? For, conditioned by the mechanistic thinking of the Newtonian paradigm, physicists needed a medium whose disturbance would lead to the wave phenomenon. Water waves travel in water, sound waves propagate in a fluid, elastic waves move through an elastic substance... so light waves also need a medium called æther in which to travel."

There was, however, a need to imagine a special environment where the electromagnetic waves propagated due to the transversality of these waves, which require a medium with a particular type of elasticity that gases and liquids do not have. Air or water may transmit longitudinal waves, but not transverse waves, so the electromagnetic waves transmitted in these media must be transported by another elastic medium that permeates these materials, which is the universally present æther, both in vacuum and in all matter, and which has properties similar to those of a solid.

But the reason for admitting the universality of the æther presence already existed before the demonstration of the transversality of the electromagnetic waves and was related to the planetary orbits:

- In their orbital motion, the planets do not suffer friction with the æter, so there is no drag or turbulence when crossing the æther.
- The absence of turbulence has been verified in practice: when a star (planet or distant star) is hidden by the Moon, immediately before or after concealment there is no disturbance in the image of the hidden star. If the Moon caused some drag or turbulence in the medium in which the light propagates, the image of the hidden star would be distorted.
- Conclusion: the Moon, in its movement, crosses the æther without affecting it, so that the Moon is extremely permeable to the æther. Therefore, the stars are permeated by the æther.

3 The Non-Stationary Spatial Substrate

Many experiments have been performed to detect this medium which should be extremely non-intrusive and therefore difficult to detect. The first of these experiments was conducted by Albert Michelson and Edward Williams Morley, who designed an instrument called an optical interferometer. This device was used to divide a ray of light into two distinct beams, leading each one of them in perpendicular directions and reuniting them again. If the two beams traveled precisely the same distance at the same speed, they would still join the same phase. But if the distance traveled or the speed changed, even slightly, the assembled beams would be out of phase and the apparatus would register interference in the form of a fringe pattern similar to that obtained by Young eighty years earlier.

In 1887, in the main building of Adelbert College of Cleveland, with the interferometer mounted on a stone base that floated on liquid mercury in a circular iron tank, to avoid vibration distortions, two beams of light were projected in perpendicular paths. The one that followed in the direction of the translation movement of the Earth through the æther should have a velocity of 30 km/s in relation to the æther. As the expected composition of velocities (of light relative to Earth and Earth in relation to æther) would be different for the different beams, the apparatus should have an interference with the arrival of the waves. The recorded interference accounted for a wind speed of 8.8 km/s in the mid-day observations and 8.0 km/s in the afternoon observations. [3]

In 1902 Dayton Miller and Edward Morley performed experiments with an optical interferometer three times more sensitive than the one used by Michelson-Morley (M-M) in 1887. The equipment had a pine wood base to test the FitzGerald-Lorentz effect whose hypothesis resulted in contraction of the body in the direction of movement and which would result in a null drag measure of the æther in the M-M experiment. The measured æther drag was 10 km/s. In 1904 the interferometer was mounted on a steel base and a drag speed of 7.5 km/s was measured and in 1905 the equipment recorded 8.7 km/s.

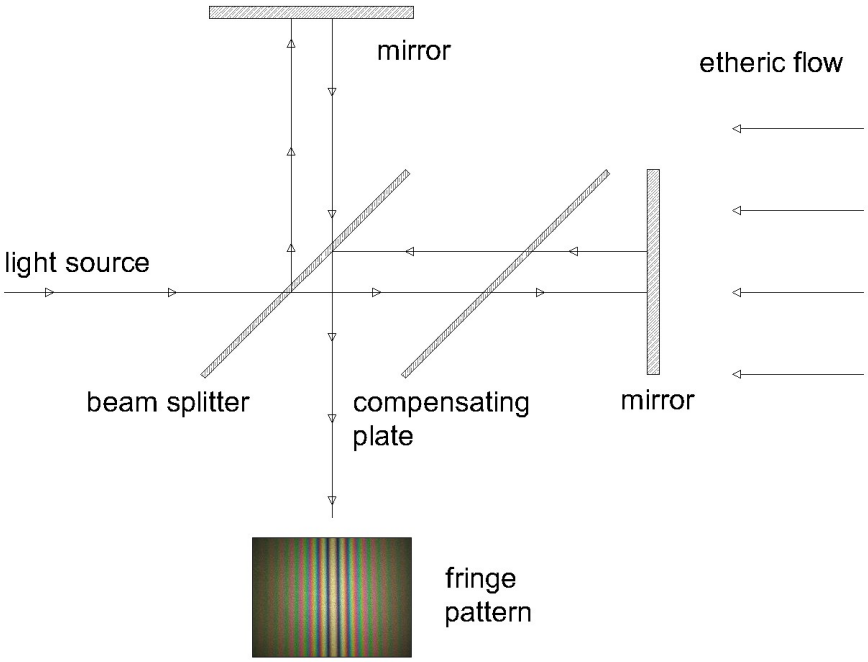

Figure 1: M-M interferometer.

These measures were considered anomalous and, over the years, discarded as null results. Historically, the only argument against the existence of æther came from Einstein, when he formulated his theory of relativity in 1905. He was intrigued by the fact that the mathematical laws governing electromagnetism and light (Maxwell's equations) implicitly define a privileged referential substrate in which the propagation velocity of light is the same in any direction, while the laws of motion and gravitation do not (Newton's laws). Einstein was faced with a critical choice: why do electromagnetic phenomena require a special reference substrate and dynamic phenomena do not? The choice was to admit a preferential substrate that would also regulate movement and gravitation or remove the referential substrate from Maxwell's laws. He chose the second option and the tests of his theory made in the solar eclipse of 1919 were widely accepted as confirmation of his theory of relativity.

In 1913, Georges Sagnac tested the absolute rotation motion with emission of two beams of monochromatic light that run along identical paths in opposite directions around a rotating platform. The circular path of light was created by the positioning of mirrors along the curvature of the platform. The return of the combined rays formed a pattern of fringes that varied when the rotation was altered, that is, the time difference in the trajectories of the beams changed the pattern of fringes. If the speed of light were locally invariant, increasing or decreasing the speed of the platform rotation should not change the fringe pattern. The Abraham Zelmanov Journal published the English translation of Georges Sagnac's paper which contained the following conclusion: "The observed interference effect is very much the effect of optical rotation due to the motion of the system relative to the ether, and directly shows the existence of the ether, a necessary condition for the luminiferous waves proposed by Huygens and Fresnel." [4]

In April of 1921, Miller's equipment was tested on steel and in December with concrete base on Mount Wilson, California (lat. 34°13' N and alt. 1,750 m) and the drag measurements were 10 km/s. From 1922 to 1924 in Cleveland, various changes and improvements in equipment and test procedures were performed, including deliberate temperature changes that proved that the measurements could not be produced by temperature effects, as was then acclaimed. The interferometer has never failed to produce consistently positive results. [5]

In the years 1925 and 1926 Miller conducted experiments on Mount Wilson, California to measure the movement direction of the æther relative to the Earth. Readings were made throughout the 24 hour period confirming that with each rotation of the planet around its axis occurred two instances in which the distances of the fringes became maximum, which indicated the approximate drag direction of the æther. The 24 hours tests were repeated in different seasons of the year to establish if the main component of the ætheric wind is of local or cosmic origin and, due to its constant direction, proved to be of cosmic origin. [6]

In 1933, Miller published in Reviews of Modern Physics journal a history of the various experiments conducted over the years to detect æther and a re-evaluation of the collected data, and with some uncertainty if the direction is diametrically opposed, he concluded that the Earth and the Solar System possess a cosmic movement towards the Dorado constellation in the southern hemisphere [α = 4h56min and δ = 70°30' South][4] with a velocity of 208 km/s. [7] This lecture is highly recommended because he evaluates many historical æther-drift experiments, analyzes the difficulties and presents data and graphics of the measures. In other article [8] he presents approximately the same data and points that: “The ether-drift effect in the interferometer, as is wheel known, is a second-order effect, and the observations correctly define the line in which the absolute motion takes place, but they do not determine whether the motion in this line is positive or negative.”

In 1991, Roland De Witte conducted experiments with radio-frequency signals that traveled back and forth on a 1.5 km long coaxial cable aligned in the north-south magnetic direction of Earth. The objective was to measure the propagation time difference between rounds of the signal as the Earth rotates: the sidereal time of the maximum effect occurred at 5h and 17h corroborating the direction found by Miller and also the speed. It was 178 days of experiments that confirmed that the effect was periodic with sidereal time, not solar, that is, the æther's motion is extra solar or galactic. The figure bellow shows data over 3 sidereal days for the ± difference of the travel time for NS and SN propagation and the maximum effect is indicated with vertical lines. [9]

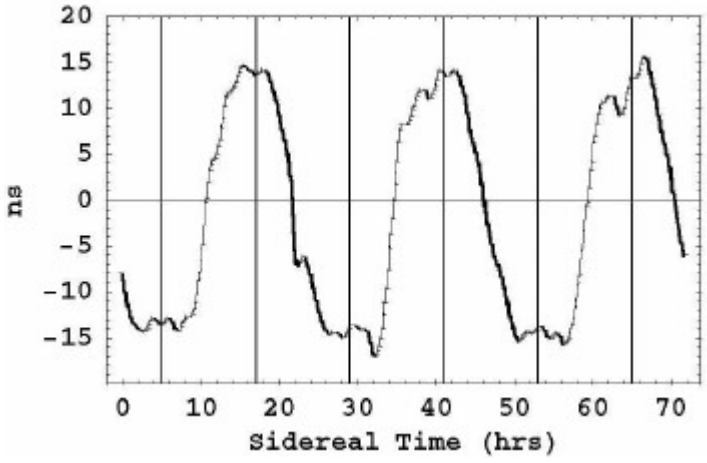

Figure 2: Time difference for NS and SN propagation.

4 The directions are in celestial coordinates: right ascension (α) is the horizontal angle in hours (from 0 to 24h) from the vernal equinox; declination (δ) is the vertical angle in degrees (from 0 to 90°), positive (North) and negative (South), from the celestial equator, that is the extension of the Earth’s equator.

In the years 2001 and 2002 Yuri Galaev used an optical interferometer that measured the 1st-order effect of the two-way velocity difference and determined the kinematic viscosity of the æther. He also confirmed that the propagation velocity of the optical wave depends on the direction of the radiation and changes its value in the period of a sidereal day, agreeing with Miller. It was determined that the apex motion of the Solar System is toward the celestial coordinates [α = 17.5 h; δ = 65° N], which is equivalent to saying that the æther is flowing in the opposite direction or 180° [α = 5.5 h; δ = 65° S]. This movement is almost perpendicular to the Ecliptic Plane[5], whose North Pole is in the celestial coordinates [α = 18 h; δ = 66° S]. He concluded that the æther is consistent with a medium composed of discrete particles and is responsible for the propagation of electromagnetic waves. [10]

In 2002, Reginald Cahill, based on the work of Héctor Múnera [11] for reanalysis of the original data of the various optical interference experiments carried out over the years, which even showed systematic errors in the original analyzes, understood that the absolute movement through the æther of the space is the cause of several well-known relativistic effects. It applied new correction factors to those measurements and discovered three components that contribute to the æther drag: [12]

1. Tangential velocity of 30 km/s due to the Earth's translation movement in the Solar System;
2. Ætheric wind speed of 42 km/s converging to the Sun (solar centric);
3. Cosmic component velocity of 420±30 km/s in the southern hemisphere direction [α = 5.2 h; δ = 67° S], which represents the æther flow through the Solar System.

It is important to note that this velocity is different from that measured by the dipole of NASA's COBE satellite, which measured the background radiation velocity in relation to the Solar System of 369 km/s in the direction [α = 11.20 h; δ = 7.22° S].

Cahill also exposed the reason why certain experiments report zero or near zero measurement on æther detection: evidence shows that only an optical interferometer operating in gas mode detects a path difference in the light beam; when the interferometer is tested in vacuum, the ætheric wind can not be detected. [13] He also predicted that new experiments with an interferometer operating in dielectric mode will reveal an ætheric flow of 11.2 km/s into the Earth and identified the causal principle of gravity as being the inomogeneous flow of æther into matter.

However, despite the efforts of some physicists to experimentally prove the existence of the luminiferous substratum that supports the propagation of electromagnetic waves, the scientific community seems to be inert in this respect, perhaps because mathematically there is no need for a physical æther. Physicists consider that the velocity $c = 1/\sqrt{\varepsilon_0 \mu_0}$ of the electromagnetic waves through the space is finite and constant, without considering that ε_0 and μ_0 are justly the electromagnetic characteristics of the spatial medium that determines this speed, that is, of the luminiferous æther.

4 The Spacial Substrate (Luminiferous Æther) Properties

By the beginning of the XIX century, Fresnel and Arago made a decisive experiment that drew the inference that light vibrations must be transverse. From the text of Max Born [1]: "The vibrations of the æther particles do not occur in the direction of propagation, but perpendicularly to it, that is, in the plane of the wave. … After the transversality of light had been proved by numerous experiments, there arose in Fresnel's mind the vision of a future dynamical theory of light, which was to derive optical phenomena from the properties of the æther and the forces acting in it, in conformity with the method of mechanics. The æther was necessarily a kind of elastic solid, for it is only in such a substance that mechanical transverse waves can occur. So, Fresnel's results appeared to confirm the analogy of light waves with elastic waves."

5 Ecliptic Plane is the plane of the Earth's orbit around the Sun.

With elastic waves on a one-dimensional medium, like a chord or string, a mechanical force perturbs this medium and produces a mechanical wave that propagates one-dimensionally, following only the chord/string direction. If there is not the chord/string, there would be no way for this mechanical wave to propagate. This is what occurs in the other directions where there are not medium, so a mechanical wave do not propagate without an adequate medium that transports the stress energy that deformed it. Because the medium has mechanical elasticity, it is possible to cause a stress on it and create the perturbation that is propagated on it.

The analogy of light waves with mechanical waves lead physicists to think that electric and magnetic fields produce a stress in the æther and there is a deformation in this medium proportional to the amplitude of the original fields. The electric and magnetic fields of the electromagnetic wave are not the cause of the wave, but the amplitude of the stress caused in the medium at the point where the disturbance occurs. We do not create waves; the wave is the medium propagating the perturbation thanks to its elasticity, that is its capacity to deform with a stress caused by certain type of disturbance. Without an adequate medium or without an adequate disturbance, there is no wave.

The consequence of this analogy is that the cause of the wave is not the fields associated with it, but the stress suffered by the medium. The energy that causes this stress must interact with the medium to produce a deformation that we call field, and it is this perturbation or deformation that is propagated thanks to the elasticity of the medium. What we call fields are the amplitude of the deformation energy being transported by the medium. Without medium, no fields and no waves.

And this leads us to question whether this medium has electromagnetic properties and transports electromagnetic waves, or the electromagnetism appears only when the æther wave interacts with matter. Experience shows that mechanical disturbances only propagate in media possessing mechanical properties, so electromagnetic disturbances must propagate in media possessing electromagnetic properties, and the propagation velocity of the disturbance is determined solely by the characteristics of the medium. So, it will be calculated some ætheric mechanical and electromagnetic characteristics using the gravitational permeability γ_0, inertial permeability ι_0, electric permittivity ε_0 and magnetic permeability μ_0 of the vacuum.

In previous articles[6] it was introduced a form of presentation for the gravitational and inertial equations that is similar to its electromagnetic counterparts. This new presentation form for the gravitoinertial fields permits us to make analogies between electromagnetic and mechanical waves and deduce mechanical properties for the vacuum. In calculating these mechanical properties it was found that the old concept of a substrate, a medium or, more specifically, a luminiferous æther is logical and theoretically correct.

4.1 Mechanical Characteristics of Vacuum

The mechanical characteristics of vacuum may be confirmed by the analogy between the equation of motion of electromagnetic and mechanical waves. This analogy considers that the electromagnetic characteristics ε_0 and μ_0 of the medium (vacuum) determines the velocity of the electromagnetic waves and the mechanical characteristics γ_0 and ι_0 of the medium (vacuum) determines the speed of the mechanical waves, and both are the speed of light in vacuum, as we already have calculated in the Gravitoinertial Fields [14] article.

The propagation velocity of a mechanical one-dimensional traveling wave may be deduced studying the equation of motion for a vibrating string of finite length displaced on the x-coordinate, stretched horizontally and fastened at each end, and set into vibration. For small amplitudes of vibration on the y-coordinate, the tension T [N] constant and density of gravitational charge (mass) of the string per unit length α_G [kg m^{-1}], the equation of motion is: [15]

6 See Gravitational Charge, Inertial Field and Gravitoinertial Fields articles in the bibliography.

$$\frac{\partial^2 y}{\partial x^2}-\frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}=0 \quad \text{with} \quad v=\sqrt{\frac{T}{\alpha_G}} \quad \text{or} \quad v^2=\frac{T}{\alpha_G}$$

This equation is the same as the propagation velocity of a one-dimensional electromagnetic wave, substituting the y-coordinate by the electric field E_y or magnetic field H_z, that are transverse to the x-direction of propagation. Here $v=\sqrt{T/\alpha_G}$ is the motion velocity of the mechanical wave on the string in the x-direction. This equation is analogous to the motion velocity of mechanical waves in solids, liquids and gases:

- For elastic solids: $v=\sqrt{\frac{E}{\rho_G}}$ or $v^2=\frac{E}{\rho_G}$.
- For liquids and gases: $v=\sqrt{\frac{B}{\rho_G}}$ or $v^2=\frac{B}{\rho_G}$.

For these equations, ρ_G [kg m^{-3}] is the volumetric density of gravitational charge (mass) of the medium. For solids, E [N m^{-2}] is the elastic or Yang modulus (elasticity or rigidity); for liquids, B [N m^{-2}] is the bulk modulus; for gases, B [N m^{-2}] is the adiabatic bulk modulus. These equations are for volumetric or three-dimensional mediums.

In the linear or one-dimensional string case, both the tension T (stretching or traction force) and the density of the string per unit length α_G are defined in the same area (the transverse section of the string), so both areas cancel in the velocity equation. Then, the same equation for propagation velocity for elastic solids could be used for the string.

Liquids and gases do not propagate transverse waves inside of it, only longitudinal ones; but on the surface that limits two mediums with different densities it is possible to propagate transverse waves, like the water waves produced between water and air. Transverse waves, like electromagnetic, need a solid medium to propagate inside of it, so we will use the analogy between mechanical waves in solids considering that the vacuum is like an elastic solid medium. Liquid media composed of particles that have angular momentum also propagate transverse waves, so we will make a rough approximation considering this possibility.

In the Inertial Field [16] article, we have defined the gravitational potential by $V_G=v^2=I_I$, so, the gravitational potential of the string/elastic solid is given by the propagation velocity squared, and this is the inertial current of the string/elastic solid. In each point of the string/elastic solid, the gravitational potential is constant and depends only on the mechanical characteristics of the string like tension T and linear density α_G, or the mechanical characteristics of the elastic solid like elastic modulus (Yang modulus) E and volumetric density of gravitational charge ρ_G.

In vacuum, considering that gravitation is a central force, the gravitational potential at a distance r from a gravitational charge q_G is given by:

$$V_G=G\,r=\frac{1}{4\pi\gamma_0}\frac{q_G}{r}=k_G\frac{q_G}{r} \quad .$$

The distance r limits a spherical shell centered in q_G. The division by solid angle 4π is needed because the gravitational potential is calculated only in one point of the spherical shell, that has the same gravitational potential all over its surface. So, substituting the linear density of gravitational charge $\alpha_{G0}=q_G/(4\pi r)=1/\iota_0$, as we have calculated in the Gravitoinertial Fields [14] article, we have:

$$V_G=\frac{\alpha_{G0}}{\gamma_0}=\frac{1}{\iota_0\gamma_0}=c^2=I_I \quad .$$

4.1.1 Mechanical Waves in a String

For a string, that is a one-dimensional medium, there is no need for a division by 4π. This way, for the string, $\alpha_G = q_G / r$ corresponds to the linear density of gravitational charge, and the inertial permeability ι of the string may be calculated by the inverse of this quantity:

$$\iota = \frac{1}{\alpha_G} = \frac{r}{q_G} [m\,kg^{-1}]$$

The gravitational potential of the string may be calculated by:

$$V_G = G\,r = \frac{1}{\gamma}\frac{q_G}{r} = \frac{\alpha_G}{\gamma} \quad \text{, and} \quad V_G = v^2 = \frac{T}{\alpha_G} = \frac{\alpha_G}{\gamma}$$

The gravitational permeability of the string and the gravitational field produced by the tension T may be calculated by:

$$\gamma = \frac{\alpha_G^2}{T} = \frac{\alpha_G}{v^2} \quad \text{and} \quad G = \frac{V_G}{r} = \frac{T}{\alpha_G r} = \frac{T}{q_G}$$

And the tension T, that is a traction force that stretch the string, is equivalent to a gravitational force similar to the gravitational force between two equal gravitational charges. So, the string is a continuous distribution of punctual gravitational charges. Both equations are given here for comparison:

$$T = \frac{\alpha_G^2}{\gamma} = \frac{1}{\gamma}\frac{q_G^2}{r^2} \quad \text{and} \quad F = \frac{1}{4\pi\gamma_0}\frac{q_G^2}{r^2} = q_G G$$

Substituting the linear density of gravitational charge $\alpha_G = 1/\iota$ in the gravitational potential equation obtained above, we have the gravitational potential of the chord/string defined in the same way as the vacuum:

$$V_G = \frac{\alpha_G}{\gamma} = \frac{1}{\gamma\iota} = v^2 = I_I$$

4.1.2 Mechanical Waves in Solids

For an elastic solid, that is a three-dimensional medium, we must deal with the volumetric density of gravitational charge ρ_G [kg m^{-3}], and the inertial permeability ι of the solid may not be calculated by the inverse of this quantity because its unit of measure is [m kg^{-1}]. Because the area is the same for the numerator and denominator, we may note that the relation $v^2 = E/\rho_G$ is the same as $v^2 = T/\alpha_G$. So, we may calculate the tension T and the linear density of gravitational charge α_G of the elastic solid and evaluate its volumetric density of gravitational charge and elastic modulus E.

The gravitational potential of the elastic solid may be calculated considering that the linear density is $\alpha_G = q_G / 4\pi r = 1/\iota$, as we have calculated in the Gravitoinertial Field [14] article:

$$V_G = \frac{1}{4\pi\gamma}\frac{q_G}{r} = \frac{\alpha_G}{\gamma} \quad \text{, and} \quad V_G = v^2 = \frac{T}{\alpha_G} = \frac{\alpha_G}{\gamma}$$

The gravitational permeability of the solid and the gravitational field produced by the tension T may be calculated by:

$$\gamma = \frac{\alpha_G^2}{T} = \frac{\alpha_G}{v^2} \quad \text{and} \quad G = \frac{V_G}{r} = \frac{T}{\alpha_G r} = \frac{T}{q_G}$$

And the tension T, that is a traction force that stretch the solid, is equivalent to a gravitational force similar to the gravitational force between two equal gravitational charges. So, the solid is a continuous distribution of punctual gravitational charges. Substituting the linear density of gravitational charge $\alpha_G = 1/\iota$ in the gravitational potential equation obtained above, we have:

$$V_G = v^2 = \frac{1}{\gamma\iota} = I_I$$

And now we have to consider the Gravitational Poisson's equation $\rho_G = -\gamma \nabla^2 V_G$ that we have exposed in the Gravitational Charge [17] article to deduce that the volumetric density is the laplacian of the linear density:

$$\rho_G = -\gamma \nabla^2 V_G = -\gamma \nabla^2 \left(\frac{q_G}{4\pi\gamma r} \right) = -\nabla^2 \left(\frac{q_G}{4\pi r} \right) = -\nabla^2 \alpha_G$$

Mathematically this makes sense. For a solid material, the relation between the linear density and volumetric density comes from:

$$\alpha_G = \frac{q_G}{4\pi r} \quad \text{and} \quad \rho_G = \frac{q_G}{4/3\pi r^3} = \frac{3q_G}{4\pi r^3}$$

Considering that both density equations are by unity of length (r = 1), we have $\rho_G = 3\alpha_G$. We may calculate the elastic modulus E by the $v^2 = E/\rho_G$ relation:

$$E = \rho_G v^2 = 3\alpha_G v^2 = 3T$$

4.1.3 Mechanical Waves in Vacuum

The gravitational potential equation for the string relates the propagation velocity of the mechanical wave with the gravitational permeability and inertial permeability of the string $\gamma\iota = 1/v^2$ in similar way that the propagation speed of electromagnetic waves (speed of light) is related with the gravitational and inertial permeabilities of vacuum $\gamma_0\iota_0 = 1/c^2$. This lead us to conclude that the vacuum is a mechanical medium too and the speed of light is the velocity for mechanical waves (like the gravitational ones) in this medium.

Considering that the linear density of gravitational charge (mass) is given by $\alpha_G = q_G/(4\pi r)$, the gravitational potential of the vacuum may be related with the linear density of gravitational charge (mass) of vacuum:

$$V_G = \frac{1}{4\pi\gamma_0} \frac{q_G}{r} = \frac{\alpha_{G0}}{\gamma_0}$$

We may relate the speed of light c with the equation of the propagation velocity of mechanical waves $c^2=T_0/\alpha_{G0}$ like if the vacuum would be a mechanical medium whose propagation velocity for mechanical waves is c:

$$V_G=c^2=\frac{1}{\gamma_0\iota_0}=\frac{\alpha_{G0}}{\gamma_0}=\frac{T_0}{\alpha_{G0}}$$

This is a gravitational potential $V_G=T_0/\alpha_{G0}$ produced by a linear density of gravitational charge stretched by a tension. The inertial permeability of vacuum and the linear density of gravitational charge was calculated in the Gravitoinertial Fields [14] article, and this vacuum tension (mechanical force) may be calculated using the last equation:

$$T_0=\frac{\alpha_{G0}^2}{\gamma_{G0}}=\alpha_{G0}c^2=\frac{c^2}{\iota_0}=\frac{1}{\iota_0\varepsilon_0\mu_0}=9.6257*10^{42}N$$

The vacuum elastic modulus (mechanical pressure that determines the elasticity or rigidity) may be calculated using the relation between the linear density and volumetric density:

$$E_0=3T_0=3*9.6257*10^{42}=2.8877*10^{43}Nm^{-2}$$

This is the traction pressure that maintains the (volumetric density of gravitational charge of the) vacuum stretched and is the cause that defines the propagation velocity $c\approx3*10^8ms^{-1}$ for electromagnetic transverse waves, like the velocity of mechanical transverse waves is determined by the elastic modulus in solids or the tension on the chord/string.

The volumetric density of gravitational charge ρ_G may be obtained using the value of the inertial permeability of vacuum or the linear density of gravitational charge calculated in the Gravitoinertial Fields [14] article.

$$\rho_{G0}=3\alpha_{G0}=3*1.0716*10^{26}=3.2148*10^{26}kgm^{-3}$$

With this volumetric density of gravitational charge, the vacuum is a solid with a very high density, it is not an empty space. The electromagnetic waves, by its similarity with the waves in elastic solids or on chords/strings, are perturbations propagated in a medium, the substrate called luminiferous æther, where the light travels with speed c. This medium has mechanical properties determined by its gravitational permeability γ_0 and inertial permeability ι_0..

4.2 Electromagnetic Characteristics of Vacuum

In this article, it is not our intention to define what luminiferous æther is or what composes it, but only to calculate its properties. Perhaps someone may be induced to think that “luminifeours æther” means that this medium is luminous, but in this article it is not the case, it means that it is the medium where light waves travel in. It will be considered that this medium interacts with electromagnetic perturbations through the electric permittivity ε_0 and magnetic permeability μ_0 of the vacuum. So, there are two types of medium that presents electromagnetic properties that may be considered:

1. Solid dielectric
   Because of its high energy density and elastic modulus, this substrate behaves like an electric insulating solid material that has dielectric properties.
2. Ocean of photons

The energy associated with this elastic modulus may be linked to a fluid composed by photons associated with an extremely high frequency. This is not like a background radiation because radiation is composed by waves produced by the motion of these photons.

4.2.1 Solid Dielectric

Any dielectric material submitted to time-varying electric fields looses its electrical isolating property in proportion to the field frequency. Capacitors are made with dielectric materials between two electrically conductive plates. The electric capacitance of a capacitor is calculated by:

$$C_E = \varepsilon \frac{S}{l}$$

With:

C_E = Electric capacitance [$C^2\ N^{-1}\ m^{-1}$] [$C\ V^{-1}$] [F];
S = Area of the electric conducting plates and dielectric material [m^2];
l = Distance of the plates and thickness of the dielectric material [m].

This equation is similar to the electric conductance S_E of an electric conductor, and this lead us to conclude that the capacitance C_E is like a conductance and the permittivity ε is a conductivity measure for time-varying electric fields. The conductance equation is:

$$S_E = \sigma_E \frac{S}{l}$$

With:

S_E = Electric conductance [Ω^{-1}];
σ_E = Electric conductivity [$\Omega^{-1}\ m^{-1}$];
S = Area of the electric conducting material [m^2];
l = Length of the conducting material [m].

The electric resistance presented by a capacitor to the flowing of electrical current when it is submitted to a time-varying electric field is called capacitive reactance X_E. This equation is similar to the equation for the resistance of electric conductive materials. With these, we may obtain the electric reactive resistivity ρ_{XE} and the electric reactive conductivity σ_{XE}:

$$R_E = \rho_E \frac{l}{S} \qquad X_E = \frac{1}{2\pi f C_E} = \frac{1}{\omega C_E} = \frac{1}{\omega \varepsilon} \frac{l}{S} = \rho_{XE} \frac{l}{S} \quad \text{and} \quad \rho_{XE} = \frac{1}{\omega \varepsilon} \qquad \sigma_{XE} = \frac{1}{\rho_{XE}} = \omega \varepsilon$$

With:

R_E = Electric resistance [Ω];
ρ_E = Electric resistivity [Ω m];
X_E = Electric capacitive reactance [Ω];
ρ_{XE} = Electric reactive resistivity [Ω m];
σ_{XE} = Electric reactive conductivity [$\Omega^{-1}\ m^{-1}$];
ω = Angular frequency of electric field [rad s^{-1}];
f = Frequency of electric field [cycles s^{-1}] [Hz].

The same can be done for the magnetic reactive resistivity ρ_{XM} and get the magnetic reactive conductivity σ_{XM}:

$$C_M = \mu \frac{S}{l} \qquad X_M = \frac{1}{2\pi f C_M} = \frac{1}{\omega C_M} = \frac{1}{\omega \mu} \frac{l}{S} = \rho_{XM} \frac{l}{S} \quad \text{and} \quad \rho_{XM} = \frac{1}{\omega \mu} \qquad \sigma_{XM} = \frac{1}{\rho_{XM}} = \omega \mu$$

With:

C_M = Magnetic capacitance [$Wb^2\ N^{-1}\ m^{-1}$] [$Wb\ A^{-1}$] [H];
X_M = Magnetic capacitive reactance [Ω^{-1}];
ρ_{XM} = Magnetic reactive resistivity [$\Omega^{-1}\ m$];
σ_{XM} = Magnetic reactive conductivity [$\Omega\ m^{-1}$].

Now, we need to establish some parameters to get the real electric and magnetic reactances:

1. The electric and magnetic reactances calculated above use the angular frequency ω [rad s^{-1}] in the denominator, so we really have a reactance by radians unit of measure.
2. In a wave, the wavelength is the distance in which the magnetic or electric fields complete the perimeter of a circle, that is 2π radians.
3. So, to get the reactance of the vacuum for waves we have to divide the reactive resistivity by the wavelength and multiply by 2π radians.

Considering that $\omega = 2\pi f$, $\lambda = c/f$ and $c = 1/\sqrt{\varepsilon_0 \mu_0}$, we have the electric and magnetic reactances of the vacuum for electromagnetic waves:

$$X_E = \frac{2\pi}{\lambda}\rho_{XE} = \frac{\omega}{c}\rho_{XE} = \frac{1}{\varepsilon_0 c} = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 376.7303\ Wb\,C^{-1}[\Omega]$$

$$X_M = \frac{2\pi}{\lambda}\rho_{XM} = \frac{\omega}{c}\rho_{XM} = \frac{1}{\mu_0 c} = \sqrt{\frac{\varepsilon_0}{\mu_0}} = \frac{1}{376.7303}\,C\,Wb^{-1}[\Omega^{-1}]$$

We see that:

$$X_E = \frac{1}{X_M} \;\Rightarrow\; \frac{2\pi}{\lambda}\rho_{XE} = \frac{\lambda}{2\pi}\frac{1}{\rho_{XM}} \;\Rightarrow\; \lambda = 2\pi\sqrt{\rho_{XE}\rho_{XE}} = 2\pi\sqrt{\frac{1}{\omega^2\mu_0\varepsilon_0}} = \frac{1}{f\sqrt{\mu_0\varepsilon_0}} = \frac{c}{f}$$

We can confirm what was exposed above considering that $\vec{B} = \mu_0 \vec{H}$ and $\vec{c} = c\,\vec{k}$, with the unitary direction vector $\vec{k}$, in the relation:

$$\vec{E} = \vec{c} \times \vec{B} = \mu_0 c\,\vec{k} \times \vec{H} = \sqrt{\frac{\mu_0}{\varepsilon_0}}\vec{k} \times \vec{H} = X_E\,\vec{k} \times \vec{H} \;\Rightarrow\; X_E = \frac{E}{H}$$

This relation for the electric reactance is equivalent to the resistance for electric conductive materials $R = V/I$, so the electromagnetic wave propagation is equivalent to an electric current, and vice-versa.

Considering that $c = 1/\sqrt{\gamma_0 \iota_0}$, we have the gravitational and inertial reactances of the vacuum for gravitoinertial waves:

$$X_G = \sqrt{\frac{\iota_0}{\gamma_0}} = 2.79765 * 10^{-18}\ m^2 s^{-1} kg^{-1} \quad , \quad X_I = \sqrt{\frac{\gamma_0}{\iota_0}} = 3.55443 * 10^{18}\ kg\,m^{-2} s \quad \text{and} \quad X_G = \frac{1}{X_I}$$

With:

X_G = Gravitational capacitive reactance [$m^2\ s^{-1}\ kg^{-1}$];
X_I = Inertial capacitive reactance [$kg\ m^{-2}\ s$].

For gravitoinertial waves traveling in vacuum, we can have a relation between gravitational and inertial fields that is similar to that between electric and magnetic fields in electromagnetic waves. Considering that $\vec{O} = \iota_0 \vec{I}$ and $\vec{c} = c\,\vec{k}$, with the unitary direction vector $\vec{k}$, we have:

$$\vec{G}=\vec{c}\times\vec{O}=\iota_0 c\,\vec{k}\times\vec{I}=\sqrt{\frac{\iota_0}{\gamma_0}}\vec{k}\times\vec{I}=X_G\vec{k}\times\vec{I} \;\Rightarrow\; X_G=\frac{G}{I}$$

4.2.2 Ocean of Photons

The medium that has so high volumetric density of gravitational charge may not have material but energy nature, or maybe even another unknown type of nature. In this section, it will be considered that this medium is composed by photons with or without linear momentum, so it behaves like an ocean of particles that must have angular momentum to propagate transverse waves.

The volumetric density of energy of this medium u_0 [J m^{-3}] is exactly its elastic modulus E_0 [N m^{-2}], because pressure in a fluid or solid is its measure of volumetric density of energy. So, with the equation developed we have:

$$V_G=c^2=\frac{T_0}{\alpha_{G0}}=\frac{E_0}{\rho_{G0}} \quad \text{and} \quad E_0=\rho_{G0}c^2=u_0$$

The elastic modulus E_0 [N m^{-2}] of the vacuum, that is like a pressure (force by area), is the volumetric density of energy u_0 [J m^{-3}] of the elastic solid. The equation $u_0=\rho_{G0}c^2$ for a known volume gives us the energy liberated when the matter of this volume is disintegrated through the equation $U=c^2\int\rho_{G0}dV=q_Gc^2=mc^2$, so this is the energy that maintains the matter aggregated. The equation of the propagation velocity of a wave in a solid medium is the same equation of mass-energy conversion:

$$c^2=\frac{E_0}{\rho_0}=\frac{u_0}{\rho_0}=\frac{U}{q_G}=\frac{U}{m}$$

To have an idea of the radiation parameters of this medium, let's consider that this vacuum energy can be compared to a black body radiation, so it obeys the Plank's distribution and the absolute temperature associated with it may be calculated by the relation:

$$\frac{c}{4}u(T)=\frac{\pi^2k_B^4}{60c^2\hbar^3}T^4=\sigma T^4$$

With:

u(T) = Volumetric density of energy [J m^{-3}];
k_B = Boltzmann's constant = 1.381*10^{-23} J K^{-1};
h = Planck's constant = 6.6256*10^{-34} J s; $\hbar=h/2\pi$;
σ = Stefan-Boltzmann's constant = 5.6704*10^{-8} J m^{-2} s^{-1} T^{-4};
T = Temperature [K];

With $u_0=E_0=2.8877*10^{43}\,J\,m^{-3}[N\,m^{-2}]$, the absolute temperature T associated with this radiation is:

$$T=\left(\frac{u(T)c}{4\sigma}\right)^{1/4}=\left(\frac{2.8877*10^{43}*2.998*10^8}{4*5.6704*10^{-8}}\right)^{1/4}=4.420*10^{14}\,K$$

The frequency f_{max} of greater intensity is calculated by the Wien's Law:

$$f_{max} = 2.822 \frac{k_B T}{h} = 2.822 \frac{1.381 * 10^{-23} * 4.420 * 10^{14}}{6.6256 * 10^{-34}} = 2.600 * 10^{25} Hz$$

The wavelength λ_{max} of greater intensity of this frequency is:

$$\lambda_{max} = \frac{c}{f_{max}} = \frac{2.998 * 10^{8}}{2.600 * 10^{25}} = 1.153 * 10^{-17} m = 0.01153 Fermi$$

With these considerations, the volumetric density of energy of the vacuum has electromagnetic properties and its elastic modulus $E_0 = 2.8877 * 10^{43} N m^{-2}$ may be understood like a pressure caused by the presence of photons associated with a frequency of 2.600*10^{25} Hz. Here we have two interpretations:

1. These photons emit radiation and this elastic modulus is radiation pressure;
2. These photons are submitted to a, until now, not defined force that is the cause of this elastic modulus. An example of this phenomenon is the atmospheric pressure caused by the presence of gaseous molecules of the air submitted to the gravitational force of the planet.

Considering that the luminiferous æther is like an ocean of photons and that the electromagnetic waves are produced by the motion of these photons is coherent with mechanical waves. Sound waves are produced by the motion of the molecules that compose the air, water waves are produced by the motion of molecules of water, mechanical waves in solids are produced by the motion or vibration of the atoms that compose the solid. All these mediums must have elasticity to permit the motion of its constituents and propagate waves.

This is a rough approximation because this medium may not be radiation itself, but a fluid of another type of particles until now unknown that makes it behave like a superfluid.

5 The Spatial Substrate and Matter Creation

Data patterns experimentally collected with different interferometry techniques over the decades after the Mikelson-Morley experiment, being studied in detail by various physicists, show that luminiferous æter exists as a non-stationary substrate that permeates all space and also the interior of matter.

The hypothesis of an inhomogeneous æter flow into matter is based on the identification of a center-solar æter flow in our Solar System, this is, large masses are æter sinks. Fluid mechanics teaches us, through Bernoulli's principle, that the flow velocity of a fluid between two points is a consequence of the pressure difference applied at these points, that is, the flow occurs in the direction of the highest to the lowest pressure. In the case of matter, the flow of æter into it occurs because matter is a place of lower Yang or elastic modulus, which indicates that matter is a place of lower ætheric density. We can understand that $U = q_G c^2 = m c^2$ is the energy required to create matter by attenuation, as if the matter were composed of voids within this high density substrate. In this case, the more energy used to attenuate this substrate, the greater the amount of matter created; the higher the density of the energy used, the greater the density of the created matter.

Currently, our knowledge about matter is restricted to solid, liquid, gaseous and plasma substances, but the density levels of the substances are greater in number. The text below, taken from the chapter Details of the Ancient Investigations in the book Occult Chemistry[7], reveals four classes of ethereal matters. [18]

7 The book referred here is the spanish edition Química Oculta published in Barcelona in 1920. It is recommended the study of this work of meta-chemistry which, unlike atomic chemistry that presents theoretical models, is the result of clairvoyant observations of the chemical elements, and clarify about the vacuum or spatial substrate.

> Close examination shows that the ether is not homogeneous, but consists of numerous classes of different molecules, by the way their component atoms are grouped; and upon closer examination it reveals four distinct degrees of ether which, with solids, liquids and gases, constitute the seven states of matter in the physical world.
>
> We will better understand the idea of these four etheric states, if we explain the method followed to study them, which consisted of taking a gaseous atom, dividing and subdividing it until it reached the last physical particle, whose disintegration resulted astral matter and no longer more physical matter.

As we see, based in these declarations, in Nature there are seven classes of matter, which can be listed in descending order of density:

1. Solid;
2. Liquid;
3. Gaseous;
4. Ethereal or ether 4;
5. Hiperethereal or ether 3;
6. Infra-atomic or ether 2;
7. Atomic or ether 1.

What distinguishes one level of density from another is the amount of energy (heat, fire, or light) contained in the substance. Any substance can be brought into any of 7 states by absorbing or exhaling energy. If a substance absorbs energy it becomes lighter (like water that evaporates as it heats up) and when it exhales energy it becomes heavier (like water vapor that condenses when it cools). But how can a substance contain more energy and at the same time be lighter or contain less energy and be heavier if, by the formula $E = mc^2$, an absorbed energy represents an additional mass? We must analyze this question with some notion of the nature of the ether.

The ether of scientists is composed of the subtle substances of the four etheric levels already seen above, for it is through the vibrations of these subtle materials that light, heat and electricity propagate.[8] The luminiferous æther – the interetheric composite element – is the substance of which all visible and invisible things are composed. To confirm what has been said, we transcribe an excerpt from the Koilon – The Æther of Space chapter of the book Occult Chemistry: [18]

> The scientific hypothesis is that all space is filled with a substance called aether, as to the constitution of which many apparently contradictory statements are made. It is thought to be infinitely thinner than the thinnest gas, absolutely frictionless and without weight, and yet from another point of view far denser than the densest solid. In this substance the ultimate atoms of matter are thought to float as motes may be seen to float in the air, and light, heat and electricity are supposed to be its vibrations.
>
> Theosophical investigators, using methods not yet at the disposal of physical science, have found that this hypothesis includes under one head two entirely different and widely separated sets of phenomena. They have been able to deal with states of matter higher than the gaseous, and have observed that it is by means of vibrations of this finer matter that light, heat and electricity manifest themselves to us. Seeing that matter in these higher states thus performs the functions attributed to the aether of science, they have (perhaps unadvisedly) called these states etheric, and have thus left themselves without a convenient name for that substance which fulfills the other part

8 We can make an analogy between the four etheric levels, this is, ether 1, 2, 3 and 4, and the four ethers that make up the vital body of the esotericists, namely: chemical ether = ether 4, life ether = ether 3, luminic ether = ether 2, reflective ether = ether 1. The vital body is the life-sustaining body of the material or biological body and is well known in Gnostic esotericism. These ethers are also known as tattwas.

> of the scientific requirements.
>
> Let us for the moment name this substance koilon[9], since it fills what we are in the habit of calling empty space.

The above passage makes it clear that the subtler matter than the gaseous state, which are the four ethereal levels already seen, are very subtle substances that, by their vibrations, produces the various energies we know, namely electricity, magnetism, light, heat, etc. Therefore, early twentieth-century researchers identified the manifestation of electricity and magnetism with the movement or vibrations of subtle gases.[10] When those subtle gases are absorbed by matter, electricity, magnetism, light, and heat manifest themselves as we know them. Moreover, the solid, liquid and gaseous material substances are agglomerations of those very subtle substances. However, the empty space is of another nature, as follows: [18]

> To any power of sight which we can bring to bear upon it this koilon appears homogeneous, though it is not probable that it is so in reality. It answers to scientific demands in so far that it is out of all proportion denser than any substance known to us – quite infinitely denser – belonging to another order and type of density altogether. For the very kernel and nexus of the whole conception is that what we call matter is not koilon, but the absence of koilon. So that to comprehend the real conditions we must modify our ideas of matter and space – modify them almost to the extent of reversing our terminology. Emptiness has become solidity and solidity emptiness.

So the substance that fills in the empty spaces between the planets, which we call the vacuum, and which is also called koilon, is of a very different class from the substances we know, for it is the substance of uncreated matter, undifferentiated space. Matter has nothing to do with this substance because it is its absence and behaves like bubbles of empty spaces within a sponge. Moreover, these empty spaces are very small and their agglomeration is what shapes the atoms of the substances we know. Each atom of any material substance is made up of a large number of minimal atoms called the ultimate physical atoms or ANU. The explanation of what these last physical atoms are follows in The Ultimate Physical Atom or Anu chapter of the same text:

> As we have seen, a chemical atom may be dissociated into less complicated bodies; these, again, into still less complicated; these, again, into yet still less complicated. After the third dissociation but one more is possible; the fourth dissociation gives the ultimate physical atom on the atomic sub-plane, the Anu. This may vanish from the plane, but it can undergo no further dissociation on it. In this ultimate state of physical matter two types of units, or Anu, have been observed; they are alike in everything save the direction of their whorls and of the force which pours through them. In the one case force pours in from the “outside”, from fourth-dimensional space, the Astral plane, and passing through the Anu, pours into the physical world. In the second, it pours in from the physical world, and out through the Anu into the “outside” again, i.e., vanishes from the physical world. The one is like a spring, from which water bubbles out; the other is like a hole, into which water disappears. We call the Anu from which force comes out positive or male; those through which it disappears, negative or female. All Anu, so far as observed, are of one or

9 Greek word meaning “hollow”.

10 Researcher Karl Schappeller, in the first half of the twentieth century, devoted himself to the study of the primary state of matter and concluded that electric and magnetic manifestations, as well as other energies, were a consequence of the motion of immaterial ultra-fine particles. His research aimed to clarify the process of creating energies and material substances from the æter and, therefore, it would be possible to extract various types of energy directly from æter. He called this process Primary Physics, attributing to the current processes of energy production that do not extract energy from the æter, Secondary Physics. The book “The Physics of the Primary State of Matter” describes his studies.

other of these two forms.

It will be seen that the Anu is a sphere, slightly flattened, and there is a depression at the point where the force flows in, causing a heart-like form. Each is surrounded by a field.

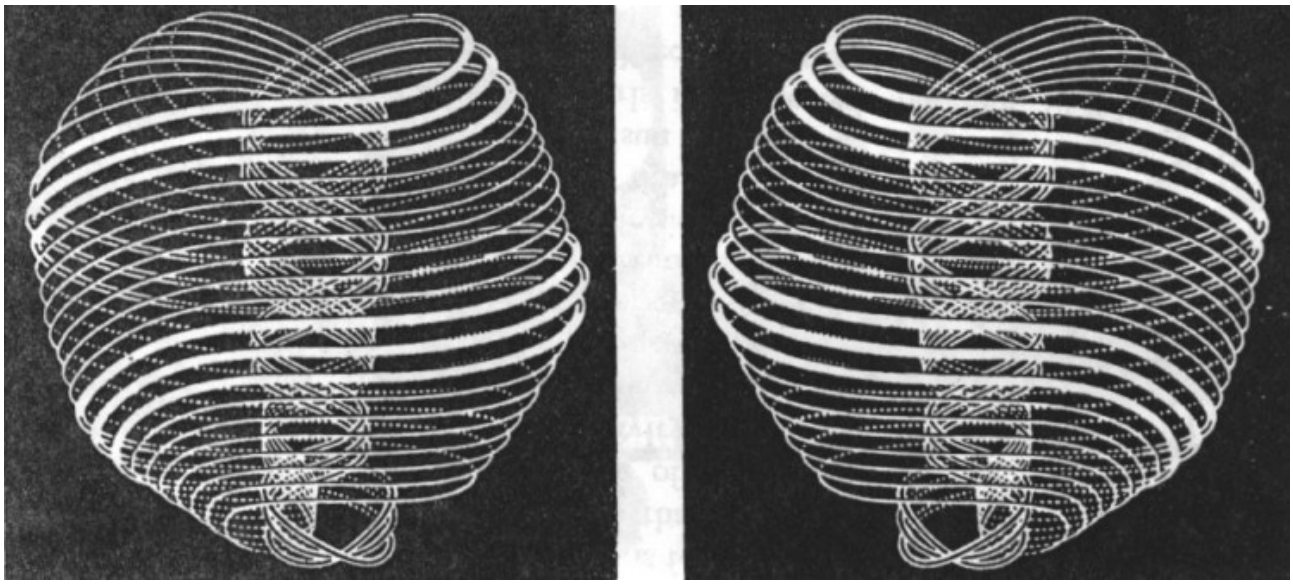

Figure 3: The Anu. Left: positive or male; right: negative or female.

We can see that the Anu that makes up matter is constitued by vortices that create empty spaces within the koilon. The swirling envelope or wall is the undifferentiated space that has been put away or "pushed" backward, so the wall belongs to space, not the Anu. At the atomic level this is where all material substances become similar, for the last atom is the same for all of them. All material substances are composed of different amounts of this last atom. Hydrogen atom contains 18 of them, nitrogen contains 261 and oxygen contains 290 of them.[11]

The contiguous filaments or rings that form the spirals of the Anu are made up of 1,680 even thinner or first-order filament spirals, and these consist of tiny voids or tiny non-material particles called dots. It takes millions of dots to form one last physical atom or Anu. Thus matter is not solidity, but the emptiness of space.[12] We can confirm this statement in the continuation of the same book.

… These dots are so inconceivably small that many millions of them are needed to make one ultimate physical atom. They appear to be the basis of all matter of which we at present know anything; astral, mental and buddhic atoms also are built of them, so we may regard them as fundamental units of which all material atoms on any plane yet attainable are composed.

These units are all alike, spherical and absolutely simple in construction. Though they are the basis of all matter, they are not themselves matter; they are not blocks but bubbles. They do not resemble bubbles floating in the air, which consist of a thin film of water separating the air within them from the air outside, so that the film has both an outer and an inner surface. Their analogy is rather with the bubbles that we see rising in water, bubbles which may be said to have only one surface – that of the water which is pushed back by the contained air. Just as the bubbles are not water, but are precisely the spots from which water is absent, so these units are not koilon but the

11 The relation between these numbers, contained in Occult Chemistry book, with atomic numbers and mass may reveal a new chemical atomic model.

12 Walter Russell's book “New Concept of the Universe” reinforces the theory that matter is created by pairs of spiral vortices that alone form the basis of atomic, solar or stellar construction, where the Core is the center point of the gyro wheel. Thus all nuclear mass must first be spiraled in by the centripetal force before it can be spiraled out by the centrifugal force.

absence of koilon – the only spots where it is not – specks of nothingness floating in it, so to speak, for the interior of these space-bubbles is an absolute void to the highest power of vision that we can turn upon them.

Such is the amazing and almost incredible feat. The matter is nothing. It is the space resulting from rejecting an infinitely dense substance by creating infinitesimal holes, and these holes are the thin nothing, the bubbles on which the “solid” universes are built. The text below, taken from chapter XIII of The Secret of the Saucers book, confirms the understanding that matter is emptier than space. [19]

First, it is well to understand that atoms are not in reality whirling particles of energy. They are simply “bubbles” in the ether. Also, light rays are merely portions of these bubbles, but in elongations; thus in reality appearing as darting fissures, or splits in the ether.

There are endless variations of magnetic fields, or fluxes in the entire universe. From the bubbles (atoms) they bounce away in all directions, producing magnetic spheres. From the light rays they proceed away at right angles to the rays so that magnetic vortices accompany the rays. Cosmic rays produce their own magnetic wakes in their paths. Thus the ether is in constant motion at all times in all places.

On the other hand, this kind of substrate that fills the vacuum of space, called koilon, is in fact immateriality, uncreated and undifferentiated space, it is the texture of which space is composed. It is the original support from which all substances are produced by the agglomeration of tiny voids in this koilon. The primary vacuum is the densest filled space we can have.

But how can there be no pressure in the vacuum if it is of an infinitely greater density than any material substance, whereas here on the planet's surface we are under pressure of $1.01*10^5$ N/m^2 (1.033 kgf/cm^2)? What happens is that the difference in density between the vacuum of space or koilon and the material substances is so great that it is possible for each other to move without hindrance, like air or water passing through a tissue. Therefore all subtle or dense matter is completely immersed in this fluid and is filled with it. The fact is that any matter forms from the rarefaction of this substrate, however, it continues to fill the inter-atomic (not) empty spaces.

Now we need to clearly establish the difference between koilon and luminiferous æther because there is no way for light to propagate in koilon without the formation of the last physical atoms or Anu because, as seen, the light waves and energies exist as a result of the vibrations of the very subtle etheric matter. The 7 levels of matter density (solid, liquid, gaseous, ether 4, ether 3, ether 2, ether 1) correspond to the physical (third) and etheric (fourth) dimensions. Therefore light, as well as energies, are phenomena of the fourth dimension, and the modulus of Yang or elastic calculated for the luminiferous æther in the previous section corresponds to the last physical atoms immersed in the koilon, not the pure koilon. Beyond the last physical atoms there is the astral (fifth) dimension.

All energies and material substances, and therefore also beings with their life-conscious material biological bodies, are created from the loss of koilon density, initially by the creation of the dots that form the filaments of the ultimate atoms or Anu, and later by the agglomeration of these, when atoms are formed. They cluster and form the molecules and finally the cells that make up the body tissues. Thus creation in the most material dimensions of nature occurs in proportion to the loss of the original koilon density. The greater the density loss caused to koilon, the more material and solid the created substance will be, so the less dense (energetic) the space that occupies this matter.

6 Conclusion

The data patterns experimentally collected with different techniques of interferometry over the years after the famous M-M experiment, being studied in detail by several physicists, proved that the Luminiferous Æther exists as a non-stationary substrate that permeates all space and matter. Because it is the carrier of electromagnetic waves, it was possible to measure differences in travel time between light beams and RF signals that followed different paths in the period of a sidereal day.

The results showed that the æther has a cosmic component velocity of 420±30 km/s in the southern hemisphere direction [straight ascension 5.2 h; declination 67° S], which represents the difference between the ætheric flow and the drag of the Solar System. Also there is flow of æther into matter, and this tell us that matter is a place of lower ætheric density. We may estimate that $U = q_G c^2 = m c^2$ is the required energy to create matter by attenuation, as if matter were composed of empty spaces inside this substrate.

With the old concept of the light wave analogy with a vibrating chord/string and properties of the capacitor with solid dielectric, the mechanical and electromagnetic properties of the vacuum may be mathematically deduced with the electromagnetic and gravitoinertial equations developed in previous articles. This raises again the concept of a medium or substratum where the waves travel in, the Luminiferous Æther, that has the properties of a solid to propagate transverse waves like electromagnetic.

The Yang or elastic modulus of the vacuum is $E_0 = 2.8877 * 10^{43}\, N\, m^{-2}$, and this is a mechanical pressure that determines the rigidity of the medium, with associated energy density $u_0 = 2.8877 * 10^{43}\, J\, m^{-3}$. The volumetric density of gravitational charge of the vacuum is $\rho_{G0} = 3.2148 * 10^{26}\, kg\, m^{-3}$. These are extremely high values that lead us to think that matter tissue is created producing countless empty little bubbles inside a very dense ocean because there is no matter with a density close to this. In this way, matter is like attenuated Æther Luminiferous, a local where it is rarefied.

The electric and magnetic reactances of the vacuum to electromagnetic waves are $X_E = \sqrt{\mu_0 / \varepsilon_0} = 376.7303\,\Omega$ and $X_M = \sqrt{\varepsilon_0 / \mu_0} = 1/376.7303\,\Omega^{-1}$ confirmed by the relation $E = c\, B = \mu_0\, c\, H = \sqrt{\mu_0 / \varepsilon_0}\, H = X_E H$, so $X_E = E / H$. This relation between electric and magnetic fields in an electromagnetic wave is analogous to the $R = V / I$ for electric circuits and lead us to conclude that the propagation of an electromagnetic wave behaves like an electric current, and vice-versa. In this point of view, the electric current is consequence of electromagnetic wave propagation inside matter, and the low speed of carriers inside conductors is caused by photon collisions.

Theosophists investigations have confirmed that the vacuum is a high density medium and from the pure koilon, that is the pristine or uncreated space, little dots of void are the constituents of all substances in all dimensions. From the agglomeration of these little dots of void into swirling streamer there is the formation of the Anu, the ultimate physical atom. The seven levels of matter, solid, liquid, gaseous, and four etheric (that constitute all substances of the third and fourth dimensions), are agglomeration of millions of ultimate physical atoms. So matter is created inside koilon by the absence of it as the agglomeration of billions of bubbles of void.

The energies that we know, like heat, light, electricity, magnetism etc., are caused by vibrations of etheric substances, so the substrate that propagate light, called luminiferous æther, is constituted by the koilon with these etheric substances. The manifestation of that energies is a fourth dimension phenomenon.

So now, to understand these phenomenon and establish a coherent physical model, it is time to search for a mathematical model for the dimensions of Nature, perhaps including esoteric concepts and/or using unorthodox research methods.

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